NATIONAL PROJECTS CONSTRUCTION CORPORATION LIMITED
(A Government Of India Enterprise)
ISO 9001:2008
Regd. Office: 30-31, Raja House, Nehru Place, New Delhi – 110 019
Corp. Office: Plot No. 67-68, Sector-25, Faridabad – 121 004
www.npcc.gov.in

TENDER FOR CONSTRUCTION OF HATHIARI SURFACE POWER HOUSE & SWITCH YARD AT DISTRICT DEHRADUN, UTTRAKHAND.

एन पी सी सी
NPCC
PROJECT EXCELLENCE SINCE 1957

VOLUME: II

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1. Principal Agreement No. - 02/SE/LVCC-II/1987-88. Except Page No. 04 to 17.
2. Supplementary Agreement of Principal Agreement No. 02/SE/LVCC-II/1987-88 Except Page No. S6 to S19.

Issued to :-

M/s ……

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VOLUME - II

Principal Agreement

LAKHWAR VYASI PROJECT
IRRIGATION DEPARTMENT
UTTAR PRADESH

AGREEMENT No. O2/SE LVCC–II / 1987-88

Agreement for Construction of Hathiari Surface Power House alongwith Surge tank, Penstocks, 7 M dia and 1.35 Km. long Head Race Tunnel from Hathiari end and appurtenant works on River Yamuna in District Dehradun, Uttar Pradesh, India.

VOLUME–I

GENERAL CONDITIONS AND TECHNICAL PROVISIONS

SUPERINTENDING ENGINEER,
LAKHWAR VYASI CONSTRUCTION CIRCLE - II
YAMUNA PROJECT I. D., U. P.
DEHRADUN - 248 001

INDEX

AGREEMENT DEED

This agreement made this Fifteenth day of July year 1987 corresponding to Shak Samvat the fifth day of Shravan (श्रावण) 1909 between the Governor of Uttar Pradesh (hereinafter called "the Government") represented by the Superintending Engineer, Lakhwar Vyasi Construction Circle-II, Dehradun of the one part and M/s National Project Construction Corporation Limited a company within the meaning of the Companies Act, 1956, having its registered office at Raja House, 30-31 Nehru Place, New Delhi-110019 (hereinafter called "the Contractor") of the other part.

Whereas the Governor of Uttar Pradesh is undertaking the construction of following works for Power House on river Yamuna in District Dehradun, Uttar Pradesh (hereinafter called "the works").

'Hathiari Surface Power House alongwith Surge Tank, penstocks, 1.35 Kms. long and 7 M. dia. Head Race Tunnel from Hathiari end and Appurtenant works on river Yamuna in District Dehradun, Uttar Pradesh, India'.

AND WHEREAS the Contractor has agreed to undertake the construction and execution of the said works as per conditions of contract, technical provisions and drawings hereinafter.

NOW THEREFORE, it is agreed between the parties hereto as follows :

ARTICLE-I. Scope of works : The contractor shall perform faithfully everything required to be performed and shall furnish all the labour, materials, tools and equipment required to perform and complete in a workman-like manner all the work covered by the contract documents all in strict accordance with the drawings and conditions of contract and technical provisions including annexures and list of corrections and amendments to drawings and conditions of contract which are part of this contract and in strict compliance with the contract documents, shall do everything required by this contract and the other documents constituting a part thereof.

ARTICLE-II. Payments : The Government will have sufficient funds in Indian currency for the execution of the works and will pay the contractor in Indian currency for the satisfactory performance of this contract and in accordance with the provisions embodied in the documents made a part of this contract.

ARTICLE-III. Commencement and Completion: The work to be performed under this contract shall be commenced by the Contractor within 30(thirty)days of the date of receipt of notice to commence with the work and shall be diligently presecuted and completed ready for handing over to the Engineer-in-charge before 54 (fifty four) months from the date of notice to commence the work.

ARTICLE-IV. Component parts of the Contract : This contract consists of the following component parts all of which are as fully a part of this contract as if herein set out verbatim or if not attached as if hereto attached.

Part-I i. Documents of Security Deposit.
ii. Contractor's warranty.
iii. Schedule of Quantities and Bids.

Part-II General conditions of contract.

Part-III Technical specifications.

Part-IV Drawings-As stated in clause 8.02 of conditions of contract.

ARTICLE-V. Service of Notice : Every notice to be given to the Contractor may be served on any of their authorised representative personally or left at their residence or last known place of business or handed over to any of their agents personally, or may be addressed to the Contractor by registered post at their usual or last known place of business and if so addressed and posted shall be deemed to have been served on the Contractor on the date on which in the ordinary course of post, a letter so addressed and posted would reach their place of business.

ARTICLE-VI. Assignment and Subletting:The Contractor shall not assign or make over the contract or the benefits or burdens thereof or any part thereof to any other person or persons or body corporate. The contractor shall not underlet or sublet to any person or persons or body corporate the execution of the contract or any part thereof without the consent in writing, of the Engineer-in-Charge, who shall have absolute power to refuse such consent or rescind such consent (if given) at any time,if he is not satisfied with the manner in which the contract is being executed and no allowance or compensation shall be made to the Contractor or the sub-contractor upon such rescission, provided

always that if such consent be given at any time, the contractors shall not by reason thereof be relieved from any obligation, duty or responsibility under this contract.

ARTICLE-VII. In-solvency or liquidation : In case the Contractor becnmes insolvent or goes into liquidation or makes or proposes to make any assignment for the benefit of their creditors or proposes any composition with their creditors for the settlement of their debts, or carries on their bus ness or the contract under inspection on behalf of their creditors, or in case any receiving order or orders for the administration of their estate are made against them, or in case the contractor shall commit any act of insolvency, or in case in which, under any clause of or clauses of this contract, the contractor shall have rendered himself liable to damages amounting to the whole of their security deposit, the contract shall thereupon after notice is given by the Engineer-in-Charge to the Contractor, be determined and the Engineer-in-Charge may complete the contract in such time and manner and by such person as the Government shall think fit. But such determination of the contract shall be without any prejudice to any right or remedy of the Government against the Contractor or their sureties in respect of any breach of contract comitted by the Contractor.

ARTICLE-VIII. Breach of Contract : If the Contractor commits breach of all or any of the terms or conditions of this contract the Government shall be entitled to recover from the Contractor all damages it might suffer thereby. The amount thus due, could be recovered from the Contractor in any manner the Government may choose including recovery by revenue recovery proceedings.

ARTICLE-IX. Release of Bank Guarantee : The Bank Guarantees furnished by the Contractor under this contract towards performance of the contract will be released only after the Engineer-in-charge, certifies that the contractor has performed the contract in a full, complete and satisfactory manner. If the Bank Guarantee has been cashed, amount thus cashed will be returned to the Contractor upon the Contractor's furnishing a certificate from the Engineer-in-Charge to the afore-said effect subject, however, that the Government will be entitled to deduct therefrom the amount of damages, costs charges and expenses claimed by the Government from the Contractor.

The Contractor hereby agrees to extend the period of validity of bank guarantees furnished by him under this contract as required by Engineer-in-Charge without any demur.

In witness whereof the parties hereto have hereunto set their hands the day and year first above written.

Signed, sealed and delivered by .....Signed, sealed and delivered by

Signatures	Sd/- R. K. Chaturvedi	Signatures	Sd/- Jai Singh
Name	Manager (Contracts) National Project Construction Corporation Limited Raja House,30-31 Nehru Place New Delhi-110019	Name	Superintending Engineer Lakhwar Vyasi Construction Circle-2, Dehradun.
Contractor		For and on behalf of the Governor of Uttar Pradesh.	
In the presence of :		In th presence of :	
1.	Sd/- S. M. Gupta D.G.M. N.P.C.C. Ltd. New Delhi	1.	Sd/- Kamal Kumar Jain Executive Engineer Koti Colony & Commn. Divn. Dakpathar (Dehradun)
2.	Sd/- A. P. Dhamija D.M. (Law) N.P.C.C. Ltd. New Delhi Camp Dehradun.	2.	Sd/- Narendra Kumar Goel Executive Engineer Lakhwar Dam Constn. Dn. 2 Dakpathar (Dehradun)

Providing, fabrication, erection and testing of 2 nos Penstock Liners,

Sub-CONTRACTOR'S WARRANTY

M/s ~~National Project Construction Corporation Limited~~, a Company within the meaning of the Companies Act, 1956 having their registered office at ~~Raja House~~, 30-31 Nehru Place, New ~~Delhi-110019~~ (hereinafter referred to as Sub Contractor') having carefully studied all the documents, specifictions etc., pertaining to the Contract for works required for ~~the construction~~ of ~~Hathiari~~ Surface Power House ~~alongwith Surge Tank~~, penstocks, 1.35 km. long 7 m. dia. Head Race Tunnel ~~and~~ Appurtenant works ~~on river~~ Yamuna in District Dehradun, Uttar Pradesh, India (hereinafter called 'works') and the local and site conditions and having undertaken to execute the said works.

DO HEREBY WARRANT THAT :

1. The Sub Contractor is familiar with all the requirements of cnntract.
2. The Sub Contractor has investigated the site and satisfied himself regarding the character of the work and local conditions, that may affect the work or its performance.
3. The Sub Contractor is satisfied that the work can be performed and completed as required in the Contract.
4. The Sub Contractor accepts all risks, connected with the performance of the contract subject to the limitations stipulated in Clause 1.09 of the conditions of contract.
5. The Sub Contractor has had no collusion with other contractor, with any of the men of the Engineer-in-charge or with any other person in undertaking to execute the said works according to the terms and conditions of the said contract.
6. The Sub Contractor has not been influenced by any statement or promise of the Government or Engineer-in-charge but only by the contract documents.
7. The Sub Contractor is financially solvent.
8. The Sub Contractor is experienced and competent to perform the contract to the satisfaction of the Engineer-in-Charge.
9. The statement submitted by the Contractor are true.
10. The Sub Contractor is familiar with all general and special laws, acts, ordinances, rules and regulations of the Municipal, District, State and Central Government that may affect the work, its performance or personnel employed therein.

FOR AND ON BEHALF OF
(SEAL OF THE COMPANY)
Sd/-
R.K. Chaturvedi
(Manager Contracts)
National Project Construction Corporation Limited, Raja House 30-31, Nehru Place, New Delhi-110019

WITNESSES :

1. Sd/-
S.M. Gupta
D.G.M.
N.P.C.C. Ltd.
New Delhi

2. Sd/-
A.P. Dhamija
D.M. (Law)
N.P.C.C. Ltd.
New Delhi
Camp Dehradun.

CHAPTER—1

DEFINITIONS AND GENERAL CONDITIONS OF CONTRACT

1.01 DEFINITIONS :

For the purpose of this contract specifications comprising condition of contract, technical Provisions and Annexure thereto including list of corrections and amendments and drawings etc., the following words will have the meaning herein assigned to them.

a. 'Governor'	:	Shall mean the Governor / Government of Uttar Pradesh, India.
b. 'Government'	:	Shall mean the Government / Governor of Uttar Pradesh, India.
c. 'Engineer-in-Charge'	:	Shall mean the Superintending Engineer, Lakhwar Vyasi Construction Circle-II Dehradun (Uttar Pradesh) or such other officer as may be authorised by the Chief Engineer (Yamuna Project) Dehradun, Uttar Pradesh to act as the Engineer-in-Charge.
d. 'Contractor'	:	Shall mean the tenderer, whether a firm registered company, partnership or an individual whose tender has been accepted by the Government and shall include such tenderer's heirs, legal representatives, successors and assignees as the case may be.
e. 'Work or Works'	:	Shall be held to comprise not only works of construction but also all accessories thereto, all matters and things pertaining to the work executed or to be carried out under the contract whether such work is permanent or temporary and whether it is original, altered, substituted or additional, including clearance of site after the completion of construction.
f. 'Specifications'	:	Shall mean collectively, all the terms and stipulations contained in the conditions of contract, technical provisions and annexure thereto including list of corrections, amendments and drawings.
g. 'Drawings'	:	Shall mean collectively all accompanying general drawings as well as all detailed drawings. supplemented drawings or reproductions thereof, which show the location, character and details of the work to be done and are issued by the Engineer-in-Charge from time to time during the period of construction.
h. 'Words'	:	Words in the singular number shall include the plural number and vice-versa and the words in the masculine gender shall include the feminine and neutral gender where the context so requires.
i. 'Plant'	:	Shall mean and include plant, epuipment, machinery, tools and other implements of all descriptions necessary in the execution of the work in a workmanlike manner.
j. 'Contract and Contract Documents'	:	Shall mean the agreement and all component parts as defined in Article IV of the Agreement.
k. 'Rates', Tendered/ Contract Rates or 'Unit Prices'	:	Shall mean the unit prices entered in the 'Schedule of Quantities and Bids' and in case of extra items, the rates as given by the Contractor and as accepted by the Govt. or the Engineer-in-charge.
l. 'Work Site'	:	Shall mean the site of proposed works as detailed in the specifications or any other place where works are to be executed under the contract and such land, other than

camp area of the Contractor, in the vicinity of work as may be notified by the Engineer-in-Charge as the work site.

m. 'Month' : A month shall mean calendar month and in the particular context also any period between a date in a particular month and a date previous to the corresponding date in the subsequent month unless specifically stated otherwise.

n. 'Week' : Means seven consequtive days.

o. 'Day' : Shall mean a period of 24 hours from midnight to midnight and shall also mean the calendar days including Sundays and Holidays.

p. 'Department' : Shall mean the Irrigation Department, Government of Uttar Pradesh.

q. 'Writing' : Shall include any manuscripts, type written, cyclostyled or printed statement, under and over signature or seal as the case may be.

r. 'Sub contractor or Piece Worker' : Shall mean the person, named by the Contractor for any part of work or any person to whom any part of the Contract has been sublet by the Contractor, with the consent in writing of the Engineer-in-Charge and the heirs, legal representatives, successors and assignees of such person.

s. 'Labourer' : Shall mean all categories of labour engaged by the Contractor, his sub-contractor including piece workers in connection with the execution of the work covered by the specifications. All such labourers will be deemed to be employed primarily by the Contractor.

t. 'Tests of Equipments' : Shall mean such tests as are required to be carried out either by the Contractor or by the Engineer-in-Charge as detailed in the specifications before the work executed under the contract is taken over by the Engineer-in-Charge.

u. 'Liquidated damages' Shall mean the amount prescribed in the specifications to be paid to the Government or to be deducted from any payments due or to become due to the contractor for any delay in completing the whole or any special portion of the work beyond the time allowed in the specifications.

v. 'Para' or 'Paragraph' : Shall include clause also.

w. 'Clause Headings' : Shall not limit, alter or affect the meaning of the specifications, conditions of tendering or these conditions.

x. 'Tonne' or 'Metric Tonne' : Shall mean 1000 Kg. (One Thousand Kilograms). Metric system shall be followed in all interpretations and execution of works under this contract. Any conversion found necessary shall be in accordance with the figures given in Indian Standard Conversion Table (IS-786-1967) and subsequent revision of this standard.

y. 'Elevation' or 'Reduced Level' : Shall mean the height in 'Metres' above the mean sea level, whenever figures are shown after the words 'Elevation', 'Reduced Level' or any abbreviation thereof or when figures representing 'Elevations' or 'Reduced levels' are given.

z. 'Approved/Approval' : Means approved/approval in writting.

zi. 'Bank' : Shall mean a Scheduled Bank.

1.02 CONTRACTOR'S WARRANTY :

The Contractor shall within 30 days of the receipt of the notice of acceptance of his tender, shall furnish a warranty of his complete understanding of the nature and conditions of work and of the contract on the form prescribed for this purpose.

1.03 CONTRACT :

On receipt of the notice of acceptance of his tender, the Contractor shall furnish security deposit as per clause 1.04, furnish the Contractor's Warranty as per clause 1.02 and also execute the Agreement in the presribed form where upon the contract will become operative.

The Engineer-in-Charge shall operate the Contract and give necessary instructions and orders to the Contractor from time to time. The Engineer-in-Charge may delegate in writing any of his powers to his authorised representatives. The Contractor will correspond only with the Engineer-in-Charge or his authorised representative regarding the execution of the contract. All corresponde-nce by the contractor and the Engineer-in-Charge will be either in Hindi written in Devnagri script or in English.

1.04 SECURITY DEPOSIT :

(i) The Contractor shall wihthin 30 days of the date of receipt of notice of acceptance of his tender for award of contract furnish an initial security of Rs. 8 lakhs (Rupees Eight Lakhs) in the form of Bank Call Deposit receipt, Fixed Deposit receipt, Post Office Saving Account, Bank Guarantee or other approved securities acceptable to the Engineer-in-Charge. In case the contractor fails to furnish the security as aforesaid within the specified time or any extension thereof as granted by the Engineer-in-Charge the Government shall have the right to rescind the contract and forefeit the Earnest Money. This initial security shall remain operative and valid upto six months beyond the date of completion of the work under the contract.

(ii) In addition to the above mentioned initial security deposit the contractor shall also permit the Engineer-in-Charge to deduct the following security deposit from intermediate bills.

A— On first Rs. 1 Crore of work at the rate of 5 percent.

B— On next Rs. 1 Crore of work at the rate of 4 percent.

C— On next Rs. 1 Crore of work at the rate of 3 percent.

D— On balance work at the rate of 2.5 percent.

Provided that the total amount of deductions as aforesaid including the above mentioned initial security shall not exceed Rs. 66,17,000/- (Rs. Sixty six lakh seventeen thousand only).

Whenever the amount deducted from the intermediate bills on account of security deposit accumulate to a sum of Rs. 2.00 lakhs(Rs. two lakhs only), the Contractor will be allowed to replace it at his own cost, by a Bank Call Deposit Receipt, Bank Guarantee or other approved securities, acceptable to the Engineer-in-Charge of equal amount and the same shall remain operative and valid upto the expiry of the guarantee period stipulated in clause 1.22 of the Conditions of Contract. The Contractor shall pay all charges for commission and brokerage incidental to the purchases, safe custody, withdrawal and collection of interest on these securities. No interest shall be payable by Government on any deposit belonging to the Contractor on whatsoever account.

(iii) The order to commence work shall be given only after the contract has become operative as specified in clause 1.03 hereinbefore and if the contractor starts the work or incurs any liabilities prior to this he shall do so at his own responsibility and at his own risk and no payment whatsoever shall be made unless the order to commence work has been given.

(iv) In case of non-performance, in any form or shape, of the covenants, stipulations and conditions of this contract, the Engineer-in-Charge shall have powers to annul, rescind or cancel this contract and upon his notifying in writing to the Contractor that he has done so, this contract shall be absolutely determined and the security deposit mentioned in clause 1.04 (i) and 1.04 (ii) may be forfeited by him and upon his doing so the said security deposit shall become the property of the Government. The Contractor shall, on being required by the Engineer-in Charge from time to time, renew, replenish or increase such security in the event of the same becoming exhausted or in-sufficient. The Engineer-in-Charge shall be at liberty at any time to appropriate any amount of security deposit or part thereof towards payment of any sums of money which shall become due

against the contractor under this contract, provided that the provision in this clause shall not prejudice any other remedy to which the Govenment may be entitled for the recovery of such sums of money.

1.05 TRANSFER OF THE CONTRACT AND SUB-CONTRACT :

This contract has been made in reliance upon the qualifications and responsibility of the Contractor and any advance payments made hereunder are intended to assist him in part in financing of the performance of the work. Therefore, the contractor shall not assign or transfer this contract or any part thereof or any money due under this contract without the written consent of Engineer-in-Charge. However, the Contractor may sublet portions of the work to be performed hereunder to such persons as the Engineer-in-Charge may expressly approve in writing for which purpose the contractor shall inform the Engineer-in-Charge in writing the names of all sub-contractors proposed for the work together with the extent and character of the work to be done by each sub-contractor on this work.

If for any reason, at any time during the progress of the work, the Engineer-in-Charge determines that any Sub-Contractor is incompetent or undesirable, he will notify the Contractor accordingly and immediate steps shall be taken by the Contractor for cancellation of Sub-contract. Subletting by the Contractor shall be subject to the same regulations as the contract but nothing contained in this contract shall create any contractual relation between any sub-contractor and the Government. Disallowing any sub-contract and disapproval of any sub-contractor shall not under any circumstances operate to relieve the contractor and/or his sureties, of any of his or their obligations under the contract, neither shall any sub-contract or approval of any sub-contractor create or be deemed to create any rights in favour of such Sub-contractor against the Government. All Sub-contractors shall be deemed to be the agents of the Contractor. All sub-contracts and all approval of sub-contractors shall be understood to be based upon the requisite performance by the sub-contractor in accordance with this contract and should any sub-contractor fail to perform the work to the satisfaction of the Engineer-in-Charge, the latter shall have the absolute right to rescind his approval atonce and to require the performance of such works by the contractor himself entirely or in part through other approved sub-contractors.

1.06 DEATH, BANKRUPTCY OF CONTRACTOR :

If the Contractor dies or commits any act of bankruptcy or being a corporation commences proceeding to be wound up except for reconstruction purposes or carries on its business under a receiver, the executors, successors or other representatives in law of the estate of the Contractor or any such receiver, liquidator or any person in whom the contract may become vested, shall forthwith give notice thereof in writing to the Engineer-in-Charge and shall for one month during which he shall take all reasonable steps to prevent stoppage of work, have the option of carrying out the contract subject to his or their providing such guarantee as may be required by the Engineer-in-Charge but not exceeding the value of the work remaining unexecuted at the time. In the event of the stoppage of the work, the period of option under this clause shall be fourteen days only, provided that, should the above option not be exercised the contract may be terminated by Government by giving 15 days notice in writing to the Contractor and the Engineer-in-Charge may exercise the same power which he could exercise and will have same right which he would have under clause 5.21 as if the work has been taken out of the contractor's hand under that clause.

1.07 CONTRACT DOCUMENT AND MATTERS TO BE TREATED AS CONFIDENTIAL :

All documents, correspondance, decisions and other matters concerning the contract shall be considered as of confidential and restricted nature by the Contractor and he shall not divulge or allow access thereto to an authorised person of any kind.

1.08 THE CONSTRUCTION OF THE CONTRACT :

The contract shall in all respect be construed and operated as a contract defined in the Indian Contract Act, 1872 as amended from time to time.

1.09 RISKS / ACCIDENTS :

The contractor shall be the insurer of the Government and of the latter's agents and employees against any and all of the following risks within the work area, whether they arise out of

the acts of commission or omission of the contractor or of third persons, excepting only those risks which result from affirmative wilful acts done by the Engineer-in-Charge subsequent to the execution of the contract.

(a) The risk of loss and damage to the work occuring prior to the issue of the certificate of final completion including those arising out of the contractor's faulty workmanship, defective execution of work, inadequate upkeep, operations, negligence or otherwise due to contractor's acts of commission and/or omission. In the event of any such loss or damage the contractor shall promptly repair, replace and make good the work without cost to the Government.

(b) The risk of injuries (including death) and damage and loss to Government, their agents and their employees and to their property arising out of or in connection with the performance of the work.

The Contractor shall indemnify Government and the latter's agents and employees for all such injuries, damages and losses resulting therefrom within the works area (which includes all work sites and roads in project area) arising out of or in connection with the performance of the work.

(c) The risks of claims and demands by third party against the Government, their agents and employees arising or claimed to arise out of the performance of the work. The Contractor shall take insurance for third party risks of all claims of loss to life in the work area, which includes all work sites and roads in the project area.

The Contractor shall indemnify the Government and latter's agents and employees against and from all such claims and demands and for all losses and expenses incurred by Government in the defence, settlement and satisfaction thereof. Neither the certificate of final completion nor any payment to the Contractor shall relieve the Contractor from his obligation in this respect.

(d) Amount of Insurance : The Contractor shall take insurance to cover the following accidents under sub-clause (b) above :

1. Death
2. Loss of two limbs, two eyes or one limb and one eye.
3. Loss of one limb and one eye.
4. Permanent total disablement from injuries other than those named above.
5. Permanent partial disablement (PPD)
6. Temporary total disablement.

The following amount of insurance shall be taken by the contractor for different categories of staff as listed below to cover the accidents as listed hereinabove. The benefits occuring as a result of insurance for accidents (1) to (6) enumerated in para (d) above, shall be as per rules of the Insurance Company providing the cover against such accidents :

Category		Capital sum insured	No. of persons in each category to be insured
I	Consulting Engineers, Ministers, Secretaries to Govt. and Chief Engineer.	Rs. 50,000	6
II	Superintending Engineer, and other officers of equal or higher rank.	Rs. 50,000	5
III	Executive Engineer, Asstt. Engineer, Incharge, Asstt. Engr. or other officers of equal rank.	Rs. 40,000	25
IV	Junior Engineer, Test and Control Supervisor or persons of equal rank.	Rs. 30,000	30
V	Workcharged Supervisors and persons of equal rank.	Rs. 20,000	20
VI	Class IV staff and other workcharged staff.	Rs. 10,000	30

The Contractor shall take additional insurance for Rupees Three lakhs to cover risks under sub-clause (c) above.

(e) Specific Risks : Provisions elsewhere in the contract of specific risks or of particular claims for which the Contractor is to be responsible shall not be deemed to be limited by the effect of the foregoing provisions nor to imply that the contractor is responsible for only risks or claims of the types enumerated in the clause.

(f) The Engineer-in-Charge shall during the progress of the works have powers to order the following in writing from time to time :

(i) The removal from the site within such time or times as may be specified in the order, of any materials which in the opinion of the Engineer-in-Charge are not in accordance with the contract specifications.

(ii) The substitution of specified materials by other suitable materials

(iii) The removal and proper re-execution (notwithstanding any previous test thereof or interim payment therefor) of any work which in respect of materials or workmanship is not in the opinion of the Engineer-in-Charge in accordance with the contract specifications.

In case of default on the part of the Contractor in carrying out such orders the Engineer-in-Charge shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be borne by the Contractor and shall be recoverable from him by the Enginee-in-Charge or may be deducted by the Engineer-in-Charge from any money due or which may become due to the Contractor under this or any other contract with the Government.

1.10 INSTRUCTIONS TO CONTRACTOR :

After the contract agreement has been executed all orders and instructions to the Contractor, shall, except as herein otherwise provided, be given by the Engineer-in-Charge and the same shall be deemed to have been issued on behalf of the Government.

1.11 DEVIATIONS, ALTERATIONS AND ADDITIONS TO THE WORK :

The Contractor shall not in any way alter any of the works without the previous written consent of the Engineer-in-Charge but the Engineer-in-Charge may from time to time and at any time during the progress of the works, by writing, under his hand, direct any deviations, alterations or additions etc., to be made from, in or to the works or any part thereof or may direct the Contractor to curtail or to omit any of the work or to execute any new or substituted work or to commence and execute the works or any part thereof in such order and manner as he shall think fit. Any such directions of the Engineer-in-Charge and any deviations, alterations, additions, curtailments and omissions made in pursuance thereof shall not vitiate this contract or be made the ground for any claim for compensation for alleged loss of profit in respect of curtailed or omitted works or (except as hereinafter provided) for extra payment for additional works (occasioned due to deviations, alterations and additions) and any works so directed to be curtailed or omitted shall be curtailed or omitted and any deviations, alterations or additions as directed to be made shall be made to the satisfaction of the Engineer-tn-Charge in the same manner as if such curtailments, omissions, deviations, alterations and additions had been originally provided for in the specifications except that value of additional works, whether by way of addition or deduction shall be estimated by the Engineer-in-Charge according to the schedule of quantities and bids where applicable or otherwise treated as an extra item under clause 3.10.

The Contractor shall not however on account of such modified new or extra works executed for the Government, be entitled to claim relief from the obligation to execute other works stipulated under the contract, provided that curtailments, omission, deviations alterations and additions to the works aforesaid will be limited to plus/minus 20% (plus or minus twenty per cent) of the total estimated value of the contract as mentioned in the schedule of quantities and bids (hereinafter called the estimated value of the contract) which value for this purpose shall be Rs. 22,05,85,530/- (Rupees Twenty two crore five lakh eighty five thousand five hundred and thirty only). For variations beyond this limit of ± 20% of the total value of this contract, payments for the works beyond this limit of plus/minus 20% of the value of this contract mentioned above, will be varied by the percentages shown hereinafter for the plus or minus variation amount only.

Variation in value of work as per schedule of quantities and bids only	Increase in payment for minus variation.	Decrease in payment for plus variation.
Above 20 per cent upto 25 per cent	2.5 per cent	1.5 per cent
Above 25 per cent upto 30 per cent	5.0 per cent	2.5 per cent
Above 30 per cent upto 35 per cent	6.25 per cent	3.33 per cent
Above 35 per cent upto 60 per cent	8.0 per cent	4.00 per cent
Above 60 per cent upto 100 per cent	10.0 per cent	5.00 per cent

Provided further that if additions/deviations or alterations to the work shall have the effect of increasing the work beyond 100 percent of the estimated valve of the contract, then the rates for the work exceeding 200 per cent of the estimated value of the contract will be settled by agreement between the Contractor and the Government and failing such agreement the same will be determined by the arbitrator under clause 4.01. Pending the determination of rates by the arbitrator the Contractor shall continue to complete all the work demanded and shall be paid for at the rates mentioned in the first proviso hereinbefore as if the variation had not exceeded 100 per cent. If the rates determined by the arbitrator entitle the Contractor to receive money over and above those already paid, the Contractor shall be paid the same upon submission and checking of the bill therefor, and if any money are due to the Government on that account, the same may be recovered as provided in clause 3.14 or in any other lawful manner.

The recovery rates of the materials issued to the Contractor shall remain unchanged both in case of plus or minus variations.

Illustrations :

A. In case of variation in value of work by (plus) 50%, the payment for (50-20) percent i.e, 30 percent of value of work (as per estimated value of contract) shall be decreased 4%.

B. In case of variation in vaiue of work (minus) 50 percent, the payment for (50-20) percent, i.e. 30 percent of value of work (as per estimated value of contract) shall be increased by 8%.

1.12 DAMAGE TO WORKS :

(a) If during the period of work or erection of an equipment the contractor or his workmen or servants shall injure or destroy part of a building or other structure contiguous to the work in progress or if any damage or imperfection shall be caused from any causes whatsoever to any other works (whether in progress or completed) the contractor shall make good such damages and imperfections at his own cost.

(b) The Contractor shall also be liable for, and shall indemnify the Government from, all damages to property resulting from the negligence of the contractor or his workmen or his sub-contractor or from defective work or defective design or defective construction aids.

(c) The Contractor will indemnify and save harmless the Government against all actions, suits, claims, demands relating to injuries (other than such as may be attributable to the Government or their employees) suffered prior to the date when the works shall have been taken over under clause 5.27 hereof by persons employed by the Contractor or his sub-contractor on the works, whether by common law or under the workmen Compensation Act, 1923, or any other statute in force on the date of execution of the contract, relating to the question of the liability of employees for injuries suffered by employees and will, if called upon to do so, take out the necessary or policies of insurance to cover such indemnity.

(d) In the event of any claim being made, or action brought against the Government involving the contractor and arising out of the matters referred to hereinbefore and in respect of which the Contractor is liable under this clause, the Contractor shall be immediately notified thereof and he shall with the assistance, if he so requires, of the Government but at the sole expense of the Contractor, conduct all negotiations for the settlement of the same. In such cases the Government shall. at the expense of the contractor, afford all reasonable and available assistance for any such purposes.

(e) The contractor shall undertake all risks and liabilities of whatever kind arising out of the works including by way of amplification but not by way of limitation, all risks attendent on the nature of the site, the soil, the levels and consistency of strata in or on which the works are to be found or constructed. Also risks of fire, floods, gales of winds, variation of water levels in sub-soil, quantities of water to be pumped, discharge of existing water courses and drains, traffic delays and other causes, whether in or beyond contractor's control, which may affect the work during the construction and all damages which may happen in any way whatsoever to the works during their progress shall be made good by the contractor as his own expense.

(f) The Contractor shall, however, not be liable for any loss or damage caused by or arising from the acts of the Government or its agents and employees or due to circumstances over which the Contractor has no control, provided that all reasonable precautions have been taken and instructions of the Engineer-in-Charge have been complied with by the Contractor, nor shall his total liability for loss or damage under this ciause exceed the total value of the contract.

1.13 USE OF CONSTRUCTION FACILITIES BY OTHER CONTRACTORS AND GOVERNMENT EMPLOYEES :

The Government may undertake or award other contract for additional work at or in the vicinity of the work site and the Contractor shall fully cooperate with such other contractor and Government employees, and carefully fit his own work to such additional work as may be directed by the Engineer-in-Charge. The contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor or by Governmet employees. The Contractor shall, without charge, permit the Government and such other contractor to use the roads, bridges, lighting installations, and any other facilities constructed or acquired by the contractor for use in the performance of the work under these specifications as are available without entailing any material increase in cost to the Contractor for maintenance or operation of such facilities. The Contractor shall not stack any construction materials or dispose off any material in the space fixed for construction of any other work by some other agency in the vicinity of the work under this contract. In case of failure on the part of the Contractor in this regard, the Engineer-in-Charge shall get the space, required for execution of other works, cleared out departmentally or through some other agency and the cost of the same shall be borne by the Contractor.

1.14 SANITATION :

The Engineer-in-Charge may establish sanitary and watch and ward rules and regulations for all forces employed under this contract and if the Contractor fails to enforce these rules and regulations, the Engineer-in-Charge may enforce them at the expense of the Contractor.

1.15 PENALTY FOR OFFERING ILLEGAL GRATIFICATIONS TO GOVERNMENT EMPLOYEES :

If the Contractor or any of his employees or agents directly or indirectly gives promises or offers any gratuity, gift, loan, reward or advantage pecuniary or otherwise, to any public officer or person in the employment of the Government or in any way directly or indirectly tries to influence the action of such an employee in any way relating to his office or employment, the contractor shall be liable to be rescinded. In the event, of the contract being rescinded, the security deposit of the Contractor shall stand forfeited to the Government.

1.16 PATENTS AND/OR COPY RIGHTS :

The Contractor shall hold and save the Government, its officers, agents, servants, and employees harmless from liability of any nature or kind, including costs and expenses, for or on account of any copy right or uncopy-right composition secret process, patented or unpatended invention, articles or appliances manufactured or used in the performance of this contract, including their use by the Government unless otherwise specifically stipulated in this contract. Any patented invention, the use of which by these specifications is required or permitted in the alternative to be used and which the Government of India has the right to use royalty free, shall be available to the Contractor without the payment of royalty,

1,17 TRAINING OF GOVERNMENT PERSONNEL :

The Contractor, if and as directed by the Engineer-in-Charge, shall provide free of any charge adequate facilities to the Government for training of Government Officers, Supervisors,

foremen, skilled workmen etc. not exceeding twenty in number at any one time on the Contractor's works. They will work with Contractor's staff, and remain under his control. Their salaries etc., will be borne by the Government and training scheme will be arranged by the Engineer-in-Charge in consultation with the contractor.

1.18 INSURANCE AND HYPOTHECATION OF CONSTRUCTION PLANT :

The contractor shall, at his cost, insure against theft, damages or destruction by fire or acts of God such as floods, earthquakes etc. with companies dealing with general Insurance to its full insurable value but not less than the amount of outstanding advance, all plants, materials or equipment for which advance is paid by the Government against all insurable risks of loss or damage upto the time of repayment in full to the Government of the advance payment as per clause 3.07. The insurance will be done in the name of the Government and the policies and the premium receipts from time to time shall be deposited with the Engineer-in-Charge who shall, in the event of the failure on the part of the contractor to do so, have unquestioned power to keep the policies alive and recover from the Contractor the expenses therefor. All the construction plant and equipment for which advance payment has been made shall be hypothecated to the Government.

1.19 ACCESS TO THE CONTRACOR'S BOOKS AND COSTING :

The Government may constitute a cost cell for the Power House, Surge Tank, Penstocks, Head race tunnel and appurtenant works for the following purposes :

i) To ascertain the actual cost of execution of any particular item of work or supply of the plant or material or any extra item of work or claims.

ii) To arriye at the cost of production of main items by suitable analysis and classification of all expenditure.

iii) To provide actual figures of cost for comparison with estimates.

iv) To reveal the cost arising from various methods, equipment, designs or outputs and to indicate sources of economy in production.

When directed by the Engineer-in-Charge, the Contractor shall produce the relevant documents such as pay rolls, records of personnel, performance data of machinery, invoice of materials and any or all other data relevant to the item or necessary to determine its cost etc. for the above purposes and the Contractor shall when so required, furnish all information pertaining to the aforesaid items in the mode and manner that may be specified by the Engineer-in-Charge.

1.20 REGULATIONS AND BYE-LAWS OF LOCAL AUTHORITY :

The Contractor will also throughout the continuance of this contract and in respect of all matters arising in the performance thereof, serve all notices and obtain all consents, wayleaves, approvals, permissions required in connection with ordinances, regulations and bye-laws of any local or other authority, if necessary and applicable to the works. The Contractor shall protect and indemnify Government against all claims or liabilities arising from or based on the violation of such laws, ordinances, regulations bye-laws, decrees or attachments by him or by his employees.

1.21 MARGINAL NOTES AND CAPTIONS :

The marginal notes and captions to the clause do not from part of the same and shall not affect their legal construction.

1.22 REFUND OF SECURITY :

If not appropriated by the Government, under the provisions of this contract, the security money or such balance thereof as may be left over after making the deductions will be refunded to the contractor after the Engineer-in-Charge has satisfied himself that all the terms and conditions of this contract have been duly and faithfully carried out by the Contractor, but not before the expiry of the period of six months after the completion of the work.

1.23 JURISDICTION :

The contract shall be governed by the laws of India and of the State of Uttar Pradesh for the time being in force and be subject to the jurisdiction of the High Court of Judicature at Allahabad

1.24 FINDS ON THE WORKS :

Any finds on the site of work such as relics or fossils of antiquity or other value or any

hoards, minerals etc. shall be absolute property of the Government and shall be handed over intact by the Contractor to the Engineer-in-Charge. The Contractor shall take reasonable precautions to prevent his workers or any other person or persons from removing or damaging any such articles or things and shall, immediately thereof and before removal, acquaint the Engineer-in-Charge of such discovery.

1.25 ERRORS, OMISSIONS AND DISCREPANCIES :

(a) If the Contractor discovers any error, omission or discrepancy in the Contract or drawings or technical provisions or in the work undertaken and performed by him, he shall immediately notify the Engineer-in-Charge and the latter shall promtply verify and set right the same. The Contractor shall not take advantage of errors or omissions as full instructions shall be available to the Contractor should any error or omission be discovered. If even after detection of such errors or omissions and prior to the correction thereof the Contractor proceeds with any work affected thereby, he shall do so at his own risk and the work so done shall not be considered as work done under the contract and in performance thereof unless and until approved and accepted by the Engineer-in-Charge.

(b) The drawings and technical provisions are to be considered as explanatory of each other and should any thing appear in the former but is not described in the latter, no advantage shall be taken by the Contractor of any such omissions. In case of disagreement between technical provisions and drawings, the technical provisions shall govern the contract. Should any discrepancies, however, appear or should and mis-understanding as to the meaning and interpretations of the technical provisions or drawings or dimensions or the quality of the materials for the proper execution of the work or as to the measurements or quality and valuation of the works executed arise under this contract or in respect of extra item, the same shall be clarified by the Engineer-in-Charge.

(c) In case of errors, omissions and/or disagreement between the drawings and technical provisions the following order of preference shall apply unless otherwise directed by the Engineer-in-Charge.

(i) Between the written or shown description or dimensions in the drawings and the corresponding one in the technical provisions, the latter shall apply.

(ii) Between the quantities shown in the schedule of quantities and bids and those arrived at from drawings, the latter shall apply.

(iii) Between the written description of the item in schedule of quantities and bids and the detailed description in the technical provisions of the same item, the latter shall be adopted.

(iv) Figured dimensions shall supercede scaled dimensions and drawings to a larger scale shall take p ecedence over those on smaller scale.

Special directton incorporated in the drawings shall be complied with strictly.

1.26 GUARANTEE :

The Contractor hereby guarantees that the materials and workmanship of all the items of works executed under this contract shall be sound and of the best quality.

1.27 PERIOD OF VALIDITY OF THE GUARANTEE :

For a period of six calendar months commencing from the date of issue of the final completion certificate (hereinafter called "the guarantee period") the Contractor shall be liable for the replacement of any part of the works found to be defective from causes arising from faulty materials or workmanship or other causes for which, in the judgment of the Enginder-in-Charge the Contractor is responsible.

1.28 EXTENSION OF PERIOD OF VALIDITY OF GUARANTEE :

If the contractor is required to make replacement and/or to repair defects as provided in clause 1.27 hereinbefore, the guarantee period shall be extended by six months from the date of completion of such replacement and/or repairs and this extension of guarantee will be only in respect of the replacement made and/or repairs done.

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CHAPTER 2

FOREIGN EXCHANGE

2.01 NON INDIAN PERSONNEL, FOREIGN COSTS :

For any foreign exchange required by the Contractor for obtaining the services of foreign technical personnel or paying fees to foreign consultants as approved by the Engineer-in-Charge, assistance to Contractor by the Engineer-in-Charge, will be limited to the recommendations to the Government of India for the release of foreign exchange and no reimbursement shall be made to the contractor on this account.

2.02 CONSTRUCTION TOOLS, PLANT AND EQUIPMENT :

Assistance for foreign exchange required by the Contractor for construction tools, plant and equipment will be provided by way of recommendation by the Engineer-in-Charge to the Government of India only for item to be imported the details of which will be furnished by the contractor in Proforma I and II after execution of agreement deed. This will be scrutinised and approved by the Engineer-in-Charge before forwarding to the Government of India for release of foreign exchange.

The contractor is expected to know the latest rules and regulations of Government of India regarding the release of Foreign Exchange and import licence etc. and the Government does not take any responsibility, whatsoever, regarding the release of Foreign Exchange and import licence for procuring tools and plants etc. from any foreign country.

In bonafide cases the Engineer-in-Charge will assist the contractor in obtaining Foreign Exchange required to import spare parts for the imported equipment aheady with the Contractor or new imported equipment for the project on actual user's Import Licence.

2.03 The Government will however in no case be responsible for not release or short release of Foreign Exchange for items in para 2,01 and 2.02 above.

PROFORMA (I)

LIST OF CONTRACTOR'S TOOLS AND PLANTS/EQUIPMENTS FOR WHICH FOREIGN EXCHAGE WILL BE REQUIRED BY THE CONTRACTOR

This list shall be filled up by the Contractor in full details after execution of the agreement.

Sl. No.	Brief specification of tools and plant equipment required to be imported	Probable F.A.S. cost (Rs.)	Probable C.I.F. Bombay cost (Rs.)	Probable Custom charges (Rs.)
1	2	3	4	5

Probable landing and other charges (Rs.)	Probable total cost of T & P equipment (Rs.)	Foreign Exchange required (Rs.)
6	7	8

Country from where the T & P/equipment is to be imported	Foreign Exchange release required in the exporting country's currency	Exchange rate assumed
9	10	11

DECLARATION

The undersigned hereby declare that the prices noted in the above list are based on quotation invited and received and that he shall produce these quotations in original for verification by the Engineer-in-Charge when demanded. It is also understood that the Engineer-in-Charge's responsibility in the release of foreign exchange is limited to recommending to the concerned authorities, if the Engineer-in-Charge is satisfied that the equipment/tool and plant is required for the bonafied use at site.

Signature of Contractor.

PROFORMA (II)

LIST OF SPARES FOR WHICH FOREIGN EXCHANGE WILL BE REQUIRED BY THE CONTRACTOR :
This list shall be filled up in detail by the Contractor after execution of agreement.

Sl. No.	Equipment for which spares are required	Delails of spares	Probable F.A.S. cost (Rs.)	Probable C.I.F. Bombay cost (Rs.)
1	2	3	4	5

Probable customs (Rs.)	Probable landing and other charges (Rs.)	Probable total cost of spares (Rs.)
6	7	8

Foreign Exchange required (Rs.)	Country from where the spares are to be imported	Foreign exchange release required in exporting country's currency	Exchange rate assumed
9	10	11	12

DECLARATION :

The undersigned hereby declares that the prices noted above are based on quotations invited and received by him and that he shall produce these quotations for verification by the Engineer-in-Charge when demanded. It is also understood that the Engineer-in-Charge's responsibility in the release of foreign exchange is limited to recommending to the concerned authorities. It is certified that the above spares are for bonafide use in the machinery to be used for the work.

Signature of contractor

CHAPTER 3

INSPECTION, MEASUREMENT AND ADVANCE PAYMENTS

3.03 INSPECTION :

(a) The Engineer-in-Charge and/or his duly authorised agent shall have, at all times, the right to inspect the works which are in progress either on the site or on the Contractor's or Sub-contractor's premises where work in connection with the Contract may be in hand. Such inspections will not absolve the Contractor of his contractual obligations to execute the works in accordance with the specifications of the contract.

The Contractor shall, during working hours, maintain supervisors of sufficient calibre to supervise the various items and operations of the work and the said supervisors shall remain present during the inspection by the Engineer-in-Charge. All orders and directions given to such supervisors or other staff of the Contractor shall be deemed to have been given to the Contractor. Further, the Engineer-in-Charge may desire a higher ranking member of the supervisory staff of the contractor to be present on any inspection and the Contractor shall comply with such directions.

(b) Except as otherwise provided in paragraph (e) hereinafter all materials and workmanship shall be subject to inspection, examination and test by the Engineer-in-Charge at any and all times during the manufacture and/or construction and at any or all places where such manufacture and/or construction are carried on. The Engineer-in-Charge shall have the right to reject defective material and workmanship or require its correction. Rejected workmanship shall be satisfactorily corrected and rejected material shall be satisfactorily replaced with the proper material without any charge therefor, and the Contractor shall promptly segregate and remove the rejected material from the premises. If the Contractor fails to proceed with the replacement of rejected material and/or the correction of defective workmanship, the Engineer-in-Charge may by contract or otherwise replace such material and/or correct such workmanship and charge the cost thereof to the Contractor or may terminate the right of the Contractor to proceed with the work as provided in clause 5.21 of this contract, the contractor and his surety being liable for any damages to the same extent as provided in the said clause 5.21 for termination thereunder,

(c) The Contractor shall furnish promptly and without any additional charge all reasonable facilities, labour and materials necessary for the safe and convenient inspection and test that may be required by the Engineer-in-Charge. All inspection and test by the Engineer-in-Charge shall be performed in such a manner as will not unnecessarily delay the work.

(d) Should it be considered necessary or advisable by the Engineer-in-Charge at any time before final acceptance of the entire work to make an examination of work already completed by removing or tearing out that work, the contractor shall on request promptly furnish all necessary facilities of labour and material. If such work is found to be defective or not conforming in any material respect, due to fault of the Contractor or his Sub-contractor, the Contractor shall defray all expenses of such examination and of satisfactory reconstruction. If however such work is found to meet the requirements of the Contract, the actual direct cost of labour and material necessarily involved in the examination plus 10 per cent shall be paid to the Contractor and he shall in addition, be paid for the replacement of work at the contract rates for that particular item or items of work and also if completion of work has been delayed thereby, be granted a suitable extension of time on account of the additional work involved.

(e) Inspection of materials and finished articles to be incorporated in the work at the site shall be made at the place of production, manufacture or despatch whereever the quantity justifies it, unless otherwise stated in the specifications, and such inspection and written or other formal acceptance, shall be final, except as regards latent defects, departure from specific requirements of the contract, damage or loss in transit, fraud or gross mistake, subject to the requirements contained in the preceding sentence, the inspection of materials and workmanship for final acceptance as a whole or in part shall be made at the site. Nothing contained in this paragraph shall, in any way, restrict the right of the Government under any warranty or guarantee.

(f) If the Contractor fails to comply with any of the requirements of the Engineer-in-Charge for inspection under the conditions of the contract or with instructions or decisions of the Engineer-in-Charge issued thereunder, except where otherwise specifically providcd in this contract, the Engineer-in-Charge, may, after giving written notice to the Contractor, take necessary action for the compliance of said conditions, instructions or decisions and the expenditure incurred shall be recoverable from the Contractor.

3.02 COVERING OF WORK :

In order that the work may be measured and the correct dimensions taken thereof, the Contractor shall not cover up any part of the same or otherwise place it beyond the reach of the measurement until he has obtained the consent in writing of the Engineer-in-Charge or until he has given the Engineer-in-Charge at least four days notice in writing that the work is ready for measurement. If the Contractor covers up any work or places it beyond the reach of the measurement without any such notice, the Contractor shall either, as he may select, strip such work at his own expense in order that it be measured or shall forego the cost of such work and the material used in its construction unless otherwise specifically accepted by the Engineer-in-Charge for computing the quantities from drawing or other alternative methods or documents. Judgement of the Engineer-in-Charge in this respect shall be final and binding on the Contractor without prejudice to other works.

3.03 MEASUREMENTS :

Every measurement for intermediate payment on account of work, material or other things shall be regarded as only provisional and approximate and all payments made on such measurements shall be regarded as being advance payments and shall respectively be subject to revision and settlement by the Engineer-in-Charge and in the event of his deciding that under any circumstances the measurements of the works executed, returns of materials provided and used or the estimate of value previously made, did not truely represent the quantity and quality of works executed and materials provided and used, the Engineer-in-Charge shall have the power, from time to time and at any time upto the time of the refund of security deposit to correct the total results by recording measurements afresh or by such other means as, after communications with the Contractor or his duly authorised agent, the Engineer-in-Charge may deem to be just, and such corrections shall be binding on the Contractor.

3.04 PAYMENT OF INTERMEDIATE BILLS :

(a) In the first week of each month, the Contractor may submit a bill for all works executed by him during the preceding calendar month and the Engineer-in-Charge shall take or cause to be taken all measurements necessary for checking the Contractor's bill. If the Contractor does not submit his bill within the time as fixed, the Engineer-in-Charge may after giving the contractor three days notice in writing measure or depute his representative to measure such work in the presence of the Contractor or his authorised agent whose signatures on the list of measurements shall be sufficient authority to the Engineer-in-Charge to draw up a bill based on such measurements and any bill so drawn shall be binding on the Contractor, provided that for concrete placed in the Power House, Head Race Tunnel and Surge Shaft, fortnightly payments shall be made on the basis of quantity recorded at the batching plant subject to adjustment in the monthly bills.

(b) The Contractor shall on submitting the monthly or periodical bills be entitled to receive a monthly or periodical intermediate payment provided the bills are complete, duly supported by details in every respect and are for the actual quantity of the work approved by the Engineer-in-Charge. A deduction at the rate mentioned under clause 1.04 (ii) of the total value of the bill will be made from each intermediate bill towards security deposit. Deduction on account of recovery of advance payment made to the Contractor will also be made from these intermediate bills in accordance with clause 3.08. In case any item of work is not in order in any respect the item will be deleted from the bill or the intermediate payments made at the reduced rates, if in the judgement of the Engineer-in-Charge sufficient justification exists for doing so. The decision of the Engineer-in-Charge in this respect will be final and binding on the Contractor. This however, does not preclude

the inclusion of the item by the Contractor in his next bill or bills, if the item is subsequently made to order to the satisfaction of the Engineer-in Charge,

(c) Intermediate payment against bills will only be made as advance to be credited to the Government in the final settlement of accounts with the contractor and not as payment for work completed and passed and the making of any such payments shall not preclude the Engineer-in-Charge from requiring the Contractor to remove or reconstruct or re-erect any work on the ground that such work is faulty, unsound, imperfect or unskilled or prevent the Government from enforcing any claim against the Contractor on account of any default by him or conclude, determine or effect in any way the powers of the Engineer-in-Charge under these condititions or any af them as to the final settlement and adjustment of the accounts.

(d) 2% of the gross amount of any bill i.e. including cost of material etc. shall be deducted towards income tax under section 194-C of the Income Tax Act 1972, subject to any amendments thereto made in future. No deduction towards income tax shall be made from the Contractor's bill if the Contractor is able to produce a certificate from the Income Tax Department stating that he is exempted from such deductions.

3.05 QUANTITIES, UNIT PRICES, TAXES AND ROYALTY ETC.

(a) Unless otherwise expressly provided in this agreement payment for various items of works shall be made at the rates provided for various items of work in the schedule of quantities and bids included in the contract. Deductions and recoveries will however, be made from the bills as stipulated in the specifications and conditions of contract.

(b) The quantities noted in the schedule of quantities and bids shall be treated as approximate and no claim shall be made against the Government for any variations therein actual or relative except as provided in clause 1.11. The unit prices in the shedule of quantities and bids include the cost of all the labour, material, tools, equipment, accessories and processes and all other expenditure as are required for completion of corresponding items of work in accordance with the technical provisions and conditions of contract.

(c) The unit prices also include Sales Tax, local tax, excise duty, octroi, royalty on quarry rights etc. on boughtout items and materials required for this work. The Contractor shall not request the Engineer-in-Charge for issue of exemption certificate for octroi or any other taxes.

If there be any enhancement in royalty on quarry rights, the extra cost so incurred shall be reimbursed to the Contractor by the Government on production of documentary evidence thereof, on the material actually used on the works under this contract. In case there is decrease in royalty on quarry rights, the Government shall be entitled to a rebate of amount actually saved by the Contractor on this account. The enhancement or decrease in rates of royalty shall be adjusted over the rates applicable on April 1, 1985. The rates of royalty as applicable for different quarry materials on April 1, 1985 are given below :

(i) Sand @ Rs. 2.50 per Cu. m.
(ii) Shingle @ Rs. 5.00 per Cu. m.
(iii) Boulder @ Rs. 2.00 per Cu. m.

This variation shall be applicable only on quantities of various items of concrete, masonry and pitching as actually executed and as provided in the schedule of quantities and bids. For assessing quantities of quarried material used in concrete, 125 m^3 of material shall, for royalty purposes, be deemed to be consumed for every 100 m^3 of concrete and, out of this 125 m^3 quantity, sand, shingle & boulder shall be deemed to be 30 m^3, 55 m^3 and 40 m^3 respectively,

No reimbursement or deduction from Contractor's bill on account of variation in the rates of Sales tax, excise duty, octroi etc. other than royalty on quarry rights shall be made to the Contractor during the operation of contract.

The Contractor shall not, however, quarry any material from the land acquired by the Government or otherwise belonging to it, except with prior permission from the Engineer-in-Charge. If such permission is accorded by the Engineer-in-Charge, the payable royalty, other taxes and

duties etc. shall be borne by the Contractor. In such cases, no reimbursement of royalty so paid by him shall be made.

3.06 FINAL MEASUREMENTS :

Residual final measurements and adjustments of quantities shall be made on completion of the work only when the Engineer-in-Charge has given a certificate of completion of work as per clause 5.26.

3.07 ADVANCE PAYMENT :

A. The following advance payment will be made to the Contractor in accordance with the provisions contained hereinafter in this clause.

(I) (a) 90% (Ninety percent) ex-works cost of new indigenous construction plant and equipment required for the execution of works and which have been procured by the Contractor for the execution of this contract and brought to the site of works.

(b) 90% (Ninety percent) of the cost F.O.B. part of shipment of imported equipment required for the execution of works and which have been procured by the Contractor for the execution of this contract and brought to the site of works.

(II) 70% (Seventy percent) of the depreciated value of the old construction plant and equipment required for the execution of works and which were already with the contractor or have been procured by him for the execution of this contract and have been brought to the site of works.

(III) 80% (Eighty percent) cost of construction of camps, offices, stores and workshop structures at the sites of works after their construction. The total advance under this item shall not exceed 1% of the total value of the contract. The cost of construction material like cement, steel etc., issued to the Contractor from Government stores for construction of camps, offices, stores and workshop structures shall be treated as advance under this clause and shall be included in 1% limit while making advance payment to the Contractor. The cost of construction shall be determined as below :

(i) Offices and quarter for staff at the rate of Rs. 300.00 per Sq.M.

(i i) Labour sheds, stores and workshop at the rate of Rs. 150.00 per Sq. M.

Provided that the contractor shall not dismantle any construction against which an advance as mentioned above had been paid to him without prior written permission of the Engineer-in-Charge.

(IV) 75% (Seventy five percent) of the cost of imperishable construction material under and in accordance with para 456 (a) of the Financial Hand Book Volume VI issued by the authority of Govt. of Uttar Pradesh. The total advance under this item at any time shall not exceed 2% of the total value of contract.

(V) Adhoc advance not exceeding Rs. 44,11,000/- (Rupees forty four lakh eleven thousand only) against Bank guarantee of equivalent amount in five equal instalments, one instalment in each month in the form approved by the Engineer-in-Charge for mobilisation of works after submission of initial security by the Contractor as per clause 1.04 (i) hereinbefore and after the Contractor takes Insurance cover as provided in clause 1.09 (b), (c) and (d).

The advances under items (I), (II), (III) and (V) above shall bear simple interest of 14% per annum on sums upto 10% value of contract, and 19½% per annum on all sums exceeding 10% of the value of the contract. The advance under item (IV) above shall be interest free.

B. The advance payments stipulated at (I) and (II) above shall be made subject to the fulfilment of the following conditions :

(I) No advance payment shall be made against new construction plant and equipment unless the Engineer-in-Charge has been consulted and his written approval has been obtained in writing prior to procurement of such equipment.

(I I) No advance payment shall be made against old construction plant and equipment which is not considered necessary for works by the Engineer-in-Charge or which is not found to be in satisfactory working condition by the Engineer-in-Charge.

(III) The Contractor shall assist the Engineer-in-Charge in assessing the cost/depreciated value of the plant and equipment by producing original bills, certificates of Chartered Accountants and other relevant documents. The cost/depreciated value as determined by the Engineer-in-Charge shall be adopted for calculating the advance payment to be made

In case of new imported equipment the Contractor shall produce evidence to the satisfaction of the Engineer-in-Charge of the cost of the equipment alongwith the invoices, shipping documents etc. The equivalent cost in rupees shall be worked out on the basis of official exchange rate of the Reserve Bank of India at the time of shipment.

(IV) The total advance payment against new and old equipment as stipulated at (I) and (II) above shall not exceed 9% of the total value of contract.

The total advance under para (I), (II), (III) and (V) will not exceed 12% of the total value of the contract i.e. 2,64,70,000/- (Rs. Two crore sixty four lakh seventy thousand only) and will be paid in two years as specified below :

(i) Total advance upto 7% of total advance upto the end of Ist year.

(ii) Balance 5% upto the end of 2nd year.

If due to unforeseen reasons, the phasing for advance payments specified above is modified by the Engineer-in-Charge, the Contractor will not be entitled to any claim, whatsoever, on this account.

(V) The plant and equipment is hypothecated in favour of and to the satisfaction of the Government.

(VI) The plant and equipment is duly insured as provided in clause 1.18 at the Contractor's expense with an Insurance Company of repute against damage, destruction from fire, floods and earthquake and also against such other risks as the Engineer-in-Charge may direct for an amount not less than the cost/depreciated value assessed by the Engineer-in-Charge as provided at (B) (III) above. Such insurance shall continue and remain operative till the full recovery of the advance payments.

(VII) The Contractor shall be solely responsible for the adequacy, efficiency, use, protection, operation, maintenance, repair and preservation to the satisfaction of the Engineer-in-Charge of all plant and equipment against which advance payments have been made to him. The Contractor shall not remove from site of works the plant and equipment without prior written permission of the Engineer-in-Charge and after fully paying back the advance payment received by him for the plant and equipment.

(VIII) No advance shall be granted against any plant and equipment, the value of which is less than Rs. 50,000/- (Rs. Fifty thousand only) and no advance for plant and equipment shall be granted after 24 months from the date of notice to commence the work. If the circumstances are considered reasonable by the Engineer-in-Charge, the period may be extended.

Note : The total value of contract referred to in this clause shall be total value of contract as indicated in the schedule of quantities and bids.

3.08 RECOVERIES :

Recoveries as detailed hereinafter will be made from the intermediate bills of the contractor :

A. FOR ADHOC ADVANCE AND ADVANCE PAYMENTS AGAINST NEW AND OLD PLANT AND EQUIPMENT AND BUILDING MENTIONED AT (I), (II), (III) AND (V) OF CLAUSE 3.07 (A).

(I) Recovery on this account shall be made at the rate of 22% (Twenty two percent) of the difference of the gross amount of any intermediate bill and the gross amount of the immediately preceding intermediate bill, subject to the condition that no such

recoveries will be made from the intermediate bill for the work done during first twelve months from the date of signing the agreement and that the full recoveries are made by the time 80% of work as per schedule of quantities and bids is completed, provided that if the Engineer-in-Charge considers that it will not be possible to recover the whole of advance within the period as stipulated hereinabove at the rate of 22% he may order recovery of the advance at higher percentage.

(II) Any amount recovered under item (I) above shall first be adjusted against interest due and the balance if any, towards the principal and the principal amount recovered shall first be adjusted towards the advance bearing 19½% (per annum) interest and thereafter towards the advance bearing 14% (per annum) interest.

B. FOR ADVANCE PAYMENT AGAINST MATERIALS UNDER CLAUSE 3.07 (A) (IV).

Recovery on this account shall be made as provided in para 456 (A) of the Financial Hand Book Volume VI issued by the Authority of the Government of U.P.

C. FOR COST OF MATERIALS AND EQUIPMENT SUPPLIED BY THE GOVERNMENT.

Recovery of the cost of cement and other materials and equipment issued to the contractor under clause 9.03 will be made from the intermediate payments to the Contractor to the extent of issues upto the month previous to the month in which the bill is prepared subject to the provisions of clause 9.03 (I) A (VIII) (C).

D. FOR HIRE CHARGES OF GOVERNMENT MACHINERY.

Recovery on this account shall be made from intermediate payments to the Contractor to the extent of amount due upto the month previous to the month in which the bill is prepared.

E. FOR SECURITY DEPOSIT.

Deductions on this account shall be made from intermediate payments to the contractor as specified in clause 1.04 (ii) of the contract.

F. FOR OTHER MISCELLANEOUS ACCOUNTS.

Recoveries on account of services such as electricity and water supplies etc., and on account of expenditure, if any, incurred by the Government on contractor's behalf shall be made in full from intermediate payment to the Contractor.

3.09 WORKS SUBJECT TO TECHNICAL EXAMINATION AND AUDIT :

The Government shall have the right to cause technical examination or audit of works, running and/or final bills including supporting vouchers, abstracts etc., to be made before or after the payment of final bill.

If as a result of acceptance of substandard or defective work, audit or technical examination, any sum is found to have been over-paid in respect of any work done by the Contractor under the Contract or in respect of any work claimed to have been executed by him under the contract but found not to have been actually executed, the Contractor shall be liable to refund the amount of over payment and it shall be lawful for the Government to recover the same from him on the certificate of the Engineer-in-Charge which shall be final, conclusive, and binding on the contractor as arrears of land revenue or in any other manner legally permissible, and, if it is found that the contactor was paid less than what was due to him in respect of any work executed by him under the contract, the amount of such under payment may be duly paid by Government to the Contractor.

3.10 EXTRA ITEMS :

The Contractor shall, when ordered in writing by the Engineer-in-Charge perform extra work and/or furnish extra materials, not covered by the specifications or included in the schedule of quantities and bids but forming an inseparable part of the work contracted for. Such extra work and materials will be paid for at such rates as may be approved by the Engineer-in-Charge. The Contractor shall submit his rates with complete analysis for the extra items which he is ordered in writing by the Engineer-in-Charge to execute and the Engineer-in-Charge shall examine the contractor's proposal and take decisions thereon within thirty days of submission of rates by the Contractor. Whenever in the opinion of the Engineer-in-Charge it is impracticable to fix the price because of the nature of work or the like reason, the extra work and material shall be paid for at the actual cost as determined by the Engineer-in-Charge plus 20% (Twenty percent) thereof being

the cost of superintendence, general expenses and profit. The actual cost will included all expenditure for materials, labour and supplies furnished by the Contractor and reasonable allowance for the use of the plant and equipment, where required but will in no case include any allowance for office expenses, general superintendence or other general expenses. For the purpose of determining the actual cost of extra item, the accounts of all labour, materials, plant and equipment etc. which are relevant to the actual cost, shall be kept by the Contractor who will also get them verified from the Engineer-in-Charge. The onus of satisfying the Engineer-in-Charge as to the correctness and genuineness of accounts kept in respect of the extra items shall be on the Contractor.

3.11 LIQUIDATED DAMAGES :

The Contractor shall be liable to pay the Government as fixed and agreed liquidated damages subject to a maximum limit of Rs. 30,00,000.00 (Rupees Thirty Lakhs only) in total on account of any one or all of the following :

(I) An amount equal to Rs. 5000/- (Rupees Five thousand only) for every calendar day after 12th month from the date of order to commence work i.e. the work of construction of portal at junction of H.R.T. with construction adit specified in clause 5.29 (I) remains in-complete.

(II) An amonnt equal to Rs. 10000/- (Rupees Ten thousand) for every calendar day, after 18th month from the date of order to commence work. i. e. the work of excavation of Power House foundation and first bucket of concrete in Power House raft foundation specified in clause 5.29 (II) remains incomplete.

(III) An amount equal to Rs. 15000/- (Rupees Fifteen thousand only) for every calendar day after 48th month from the date of order to commence work i.e. the work of completion of exacavation and lining of the head race tunnel specified in clause 5.29 (III) remains incomplete.

(IV) An amount equal to 25000/- (Rupees Twenty five thousand only) for every calendar day from 54th month from the date of order to commence work i.e. the whole of the work under the contract or any portion thereof including cleaning up of work site as laid down in clause 5.24 remains incomplete.

3.12 FINAL PAYMENT :

Final payment will be made to contractor on the basis of the final measurements taken as per clause 3.06 after adjustment of all outstanding recoveries on account of advance payment made to the Contractor as mentioned in clause 3.08, liquidated damages as mentioned in clause 3.11 hereinbefore and other recoveries or amounts due from the contractor. Full credit shall also be given to the Government for all intermediate payments to the Contractor made in accordance with clause 3.04. The amount withheld as security deposit shall be refunded to the Contractor after he has cleared all campsites as laid down in clause 5.24 and has handed over all Government land as laid down in clause 6.09 or after the expiry of guarantee period whichever is later. The Contractor shall, before the final payments, obtain and furnish to the Engineer-in-Charge satisfactory evidence that the work is fully released from all claims, liens and demands from all other allied Government agencies and secure and furnish his written consent and of his sureties to acceptance of final bill hereunder. The acceptance of final payment by the Contractor shall release the Government from all claims and liabilities to the Contractor for all work done and materials furnished in the execution of the contract. Final payment or any other payment shall, however, not serve to release the Contractor or his sureties from their obligations under or in connection with this contract, particularly with reference to clause 1.04.

3.13 LIEN TO WITHHOLD ANY PAYMENT DUE TO THE CONTRACTOR :

The Government shall have a lien on and over all or any moneys that may become due and payable to the Contractor under these presents and/or also on and over the deposit or security amount or amounts under this contract, which may become payable to the Contractor under the conditions of contract, in respect of any debt or sum that may become due and payable to Govt. by the Contractor either alone or jointly with another or others and either under this or under any other contract or transactions of any nature whatsoever between the Government and the Contractor and

also in respect of any Government tax or taxes or other moneys which may become due and payable to the Government by the Contractor either alone or jointly with another or others under the provisions of the Acts. Ordinances, rules or any other statutory enactment or enactments in force, its modifications and substitutions.

Government shall, at all times, be entitled to deduct the said debt or sum or tax due from the Contractor from the moneys, securities, or depsits which may become payable or returnable to the Contractor under these presents. The provisions of this condition shall also apply and extend to the banker's guarantee given by the Contractor.

3.14 NO CLAIM FOR DELAYED PAYMENT DUE TO DISPUTE ETC·

The Contractor agrees that no claim for interest or damages will be entertained or be payable by the Government in respact of any money or balances which may be lying with the Government owing to any dispute, difference or mis-understanding between the parties or in respect of any delay or omission on the part of the Engineer-in-Charge in making intermediate or final payments or in any other respect whatsoever.

3.15 INTEREST ON MONEY DUE TO THE CONTRACTOR :

No omission on the part of the Engineer-in-Charge to pay the amount due upon measurement or otherwise shall vitiate or make void the contract, nor shall the Contractor be entitled to interest upon any guarantee or payments in arrears nor upon any balance which may on the final settlement of his accounts, be due to him.

3.16 DEDUCTION FOR UNCORRECTED WORKS :

If the Engineer-in-Charge deems it expedient not to get corrected the damaged work or works not done in accordance with the contract, an equitable reduction of the contract rate as provided in the schedule of quantities and bids shall be made from the bills of the Contractor. However, any action by the Engineer-in-Charge under this clause shall not, in any way, absolve the contractor from his responsibilities and liabilities as per terms of the contract. The decision in this regard of the Engineer-in-Charge shall be final, conclussive and binding on the Contractor.

CHAPTER 4

PROTESTS AND CLAIMS

4.01 PROTESTS ·

(a) If the Contractor considers any record or ruling of the Engineer-in-Charge or of his authorised representatives in respect of any of the provisions of this contract to be unfair or considers any work demanded of him by the Engineer-in-Charge to be outside the requirement of the contract, he shall, immediately upon such record or ruling being made or such work being demanded, ask in writing for written instructions or decisions. On receipt of instructions, decision, he shall proceed without delay to conform to the record or ruling or to perform the work demanded, and wtthin twenty (20) days after the date of receipt of the written instructions and decisions he may file a written protest to the Engineer-in-Charge stating clearly and in detail the basis of his objection. Except for such protests or objections as are made on record in the manner herein speceified and within the time limit stated, the records, rulings, instructions or decisions of the Engineer-in-Charge shall be conclusive and binding on the Contractor. Instruction and/or decision of the Engineer-in-Charge contained in letters transmitting drawings to the Contractor shall be considered as written instructions or decisions, subject to protest or objection as herein provided.

(b) If the Contractor is dissatisfied with final decision of the Engineer-in-Charge on the protest or objection made by the Contractor in accordance with the procedure prescribed in clause 4.01 (a) hereinabove, the Contractor may within thirty (30) days after receiving notice of such decision give notice in writing to the Engineer-in-Charge requiring that the matter be submitted to arbitration and furnish detailed particulars of the dispute or difference specifying clearly the points at issue. If this notice from the Contractor is not received in the Office of the Engineer-in-Charge within a period of thirty (30) days as stipulated above, the decision of the Engineer-in-Charge shall be conclusive and binding on the Contractor.

(c) Every dispute, difference or question which may at any time arise between the parties hereto or any person claiming under them, touching or arising out or in respect of this contract or the subject-matter thereof shall be referred to the arbitration of Legal Remembrancer, Government of U. P. or any person nominated by him. There will be no objection to any such appointment that the arbitrator so appointed is a Government servant, that he had to deal with the matters to which the contract relates and that in the course of his duties as Government Servant he had expressed views on all or any of the matters in dispute or difference. In the event of the arbitrator to whom the matter is originally referred being transferred or vacating his office or being unable to act for any reason Legal Remembrancer, Government of U. P. shall either enter upon the reference himself or appoint another person to act as arbitrator. Such person shall be entitled to proceed with the reference from the stage it was left by his predecessor. It is also a term of this contract that no person other than a person appointed as aforesaid should act as arbitrator and if for any reason that is not possible the matter is not to be referred to arbitration at all. In all cases where the amount of the claim in dispute is Rs. 50,000 (Rupees fifty thousand) and above the arbitrator shall give reason for the award.

It is a term of the Contract that the party invoking the arbitration shall specify the dispute or disputes to be referred to arbitration together with the amount or amounts claimed in respect of each such dispute.

Subject to as aforesaid, the provision of the Arbitration Act, 1940 or any statutory modification or re-enactment thereof and the Rules made thereunder and for the time being in force shall apply to the arbitration proceedings.

The arbitrator may from time to time with the consent of the parties enlarge the time for making and publishing the award.

(d) The cost of such arbitration shall be borne by the parties or party as decided by the arbitrator.

(e) If work under the contract has not been completed when a dispute is referred to arbitration, the work shall continue during the arbitration proceedings and no payment due to the Contractor within the provisions of the contract shall be withheld on account of arbitration proceedings unless authorised or required by the arbitrator.

4.02 ENGINEER-IN-CHARGES ORDERS TO BE FINAL AND BINDING IN CERTAIN MATTERS :

In the matter of disputes (either before the commencement, during the progress, or after the completion of the works by the Contractor or after taking possession of the works by the Government rightly or wrongly or after the abandonment of the works by the Contractor) in respect of any or every claim by the Contractor whether arising under or out of the Contractor Contract, from the breach or alleged breach thereof or in any way incidental thereto, or connected therewith or not herein provided for, including (but without limiting the generality of the foregoing provisions) questions as to the quality, quantity and kind of materials, labour, supervision, workmanship' plant and temporary works, the order of works and the several parts thereof, the prescribed or extended time limit (if any) for completion of the works, the measurement of the works and materials and all additional, altered, modified, substituted or omitted works and certificates of completion and of payment and as to all other matters and things in the contract documents left to or dependent on the decision, opinion, order, direction, requisition and/or certificate of the Engineer-in-Charge, his measurement, decision, opinion, order, direction, requisition and/or certificate shall be final and binding upon the Contractor, subject to protest under clause 4.01.

Further the Engineer-in-Charge shall be the sole judge as to which clauses of the technical provisions relate to which particular work and as to the items in the schedule of quantities and bids under which any particular work is to be classed and also whether or not the unit price for any item in the schedule of quantities and bids shall hold good under conditions altered or modified according to the provisions of this contract and opinion of the Engineer-in-Charge in this respect shall be final, conclusive and binding on the Contractor except that the Contractor will have option to refer the matter to arbitration under clause 4.01.

4.03 NON-EXERCISE OF POWERS IN RESPECT OF PENALTY ETC. NOT TO WAIVE THE RIGHT OF THE ENGINEER-IN-CHARGE :

The non-exercise of powers of the Engineer-in-Charge to levy penalty or take any other action as contemplated at the time they should have been exercised, shall not debar the Engineer-in-Charge from exercising such power, levying such penalty or taking any other action against the Contractor to which he become liable at a future date.

4.04 BREACH ON THE PART OF THE GOVERNMENT :

No breach or non-observance on the part of the Government of any thing given in the agreement contained herein shall annul this contract or discharge the contractor from the observance and performance thereof but on application by the Contractor the Engineer-in-Charge may in respect of such breach or non-observance by Government, grant suitable extension of time for the completion of the works.

CHAPTER 5

COMMENCEMENT,EXECUTION AND COMPLETION OF WORK :

5.01 CONTRACT INCLUDES ALL NECESSARY OPERATIONS :

The contract is to inclue the whole of the works whether permanent or temporary which are described in or implied by the contract documents, which may be inferred to be obviously necessary for the efficiency, stability and completion of the permanent works, also the performance of all other operations including clearance of the site, the supplying of all materials and things described in or implied by the contract documents which may be deemed desirable or required for the completion in all respect of the above works to the entire satisfaction of the Engineer-in-Charge and all such matters shall be deemed as included in the contract.

Work shown upon the drawing but not mentioned in the specifications or described in the specifications but not shown on the drawings shall nevertheless be held to be included in this contract, in the same manner as if they had been expressly shown upon the drawings and described in the specifications also.

5.02 EXECUTION OF WORK IN CONFORMITY WITH CONTRACT DOCUMENTS :

The Contractor shall execute the work with faithfullness and in conformity with the contract documents as well as in accordance with such explanatory and detailed drawings and direction as may be furnished from time to time by the Engineer-in-Charge for the guidance of the Contractor.

5.03 WORKS TO BE EXECUTED TO THE SATISFACTION OF ENGINEER IN-CHARGE :

The contractor shall proceed with the works with diligence and expedition and the whole of the works herein specified as well as the mode of execution shall be under the supervision and direction, and carried out to the entire satisfaction of the Engineer-in-Charge who shall have full power to order the Contractor to alter, enlarge or diminish fhe forms, dimensions, positions or quantities of any of the works or to make use of materials and workmanship of different descriptions and qualities from those herein specified.

The whole of the work together with any temporary works associated therewith shall be carried out in the substantial, proper and workmanlike manner with the best materials and workmanship and to the entire satisfaction of the Enginee-in-Charge and in such order of time as he may direct. The Contractor shall attend to and execute without delay, all orders and instructions, which may from time to time, be issued by the Engineer-in-Charge or his authorised representative.

5.04 CONTRACTOR TO BE RESPONSIBLE FOR THE SUFFICIENCY OF MEANS EMPLOYED :

The Contractor shall supply and take upon himself the entire responsibility of the sufficiency of the machinery, tools, implements and generally all the means used for the fulfilment of this contract whether or not of the type enumerated and whether such means may or may not have been approved or recommended by the Engineer-in-Charge and the Contractor must accept all risks and accidents, or damages, from whatever cause they may arise except where otherwise provided in this contract, until the completion of this contract.

The Contractor shall ensure that all such structures shall have adequate strength for the purpose for which they are constructed and the Contractor shall maintain these in a proper condition to the satisfaction of the Engineer-in-Charge. The design of such structures shall be prepared by the Contractor and shall be submitted to the Engineer-in-Charge for his approval before being used. Examination by the Engineer-in-Charge, however, will be in a spirit of helpfulness but shall not relieve the contractor of his responsibility for the design, contsruction and use of such structure and the Contractor shall make good all injuries to persons or things arising on account or in respect thereof.

5.05 ORDER TO COMMENCE THE WORKS :

The order to commence the work shall be obtained in writing from the Engineer-in-Charge by the Contractor. Without the written order, the contractor shall not enter upon or

commence any portion of the work. If he does so, the contractor shall have no claim to ask for measurement of or payment for works until the order to commence work has been given. The Contractor will, however, be responsible for any claims or damages that may arise due to such unauthorised commencement or entry.

5.06 CONDITIONS TO BE FULFILLED BEFORE THE ISSUE OF ORDER TO COMMENCE WORKS :

The order to commence the work shall be given only after the initial security deposit has been furnished by the Contractor as required under clause 1.04 of the contract and the contractor has executed the warranty and the agreement as required under clause 1.03.

5.07 DELAY IN ORDER TO COMMENCE THE WORK :

Any delay on the part of the Engineer-in-Cherge in the issue of the order to commence the work shall not be considered a ground for any claim for compensation by the Contractor nor shall the Contractor be entitled to extension of time if the issue of the order to commence work is delayed due to any of the conditions necessary to be complied with by the Contractor remaining uncomplied or due to any other lapse on the part of the contractor.

5.08 CONSTRUCTION PROGRAMME :

Within thirty (30) calendar days after the date of receipt of notice to commence the work, the Contractor shall furnish to the Engineer-in-Charge a complete construction programme showing in detail his proposed programme of operations including clean up operations which programme shall provide for orderly performance of the work. The construction programme shall be in such form and in such details as to properly show the sequence of the work under each item of the schedule of quantities and bids. Revised construction programme shall be submitted at intervals of not more than three (3) months for the approval of the Engineer-in-Charge and in addition thereto, the Contractor shall immediately advise the Engineer-in-Charge of any proposed change in his construction programme. Such revision shall not, however, affect or supersede the final period of completion of work including the clean up operation as laid in clause 5.29.

5.09 COMMENCEMENT OF WORKS :

The Contractor shall commence the work under this contract within thirty (30) calendar days from the date of receipt of notice to commence the work. Any delay by the Contractor in commencement of the work will render him liable to action under clause 5.21.

5.10 MATERIALS, WORKMANSHIP ETC. :

The work shall be executed in a thorougoly workmanlike manner with materials and workmanship of the required quality and strictly in accordance with the specifications and with the drawing or with such other drawings or written instructions as may from time to time be furnished to the Contractor in accordance with the terms of this contract and shall be completed in every respect with all materials and workmanship implied and necessary according to the fair interpretation and meaning of the same. Should there be any discrepancy between the drawings and spectfications or any difference or dispute as to the dimensions to be worked to or the quality of the material to be used or the mode of doing, or periodical quantity of the work to be executed or with respect to any subject arising out of this contract the decision of the Engineer-in-Charge shall be final and binding on the Contractor. Rejected materials shall be so disposed of as to obviate any possibility of their use on works. The place, method and period of disposal shall be as directed by the Engineer-in-Charge.

5.11 SITE INVESTIGATION :

It shall be understood that the contractor has satisfied himself as to the nature and location of work, the general and local conditions, including those bearing upon transportation, disposal, handling and storage of materials, availability of labour, water etc. or similar physical conditions at the site, the configuration and condition of ground, the character, quality and quantity of the surface and sub-surface materials to be encountered, the character of equipment and facilities needed, preliminary to and during the presecutions of the work and all other matters which can in any way affect the work, or the cost thereof under this contract. Any default or failure

by the Contractor to acquaint himself with all the available information concerning these conditions will not relieve him of his responsibility for the execution of this contract unless the contract expressly provides that the responsibility therefor is assumed by the Government.

5.12 STAKING OUT OF WORK :

The control survey and staking of lines and grades will be carried out by the Engineer-in-Charge but the Contractor shall be required to verify those lines and grades etc. to fully satisfy himself about their accuracy and shall assume entire responsibility for accuracy of lines and grades according to which he would carry out the works.

5.13 BENCH MARKS AND SURVEY STAKES :

Bench marks and survey stakes shall be preserved by the Contractor and in the event of their destruction or removal by him or his employees, those will be replaced by the Engineer-in Charge at the Contractor s expense.

5.14 LINES AND GRADES :

During the execution of works, the Contractor shall lay all lines and grades etc. required for the proper execution of the works. The Engineer-in-Charge may exercise check on such lines and grades for his satisfaction but the responsibility regarding their accuracy will rest entirely with the Contractor. The Contractor shall provide all facilities and assistance as may be required by the Engineer-in-Charge for checking the lines and grades etc. The lines and grades, stakes and bench marks shall be preserved carefully by the Contractor until they have served their purpose. Works shall be suspended at such points and for such reasonable time as may be required for checkihg as above. No compensation or extension of time will be granted to the Contractor for required assistance in checking of lines and grades etc. or for loss of time on account of such suspension of works or otherwise on account of requirement of this clause.

5.15 PERIOD AND HOURS OF WORK :

The Contractor will plan the execution of works and shall inform the Engineer-in-Charge of the number and hours of shift he proposes to work and obtain prior approval of his proposal from the Enginee-in-Charge. He shall work in shifts and hours as may be specified by the Engineer-in-Charge from time to time. The Contractor shall abide without any reservation with the orders of the Engineer-in-Charge in this respect and no claim of any type whatsoever shall be admissible to the Contractor on this account.

5.16 SPEED OF WORK :

The Contractor shall at all times during the continuance of the work prosecute it with such labour force and equipment as in the judgement of the Engineer-in-Charge are sufficient to complete it within the specified period of time, The capacity of the Contractor's construction plant, sequence and methods of operation and the forces employed shall at all times during the continuance of the contract be subject to the approval of the Engineer-in-Charge and shall be such as to ensure the completion of the work, within the specified period of time. The Engineer-in-Charge reserves the right to direct the Contractor to supplement the construction plant capacity in case it is found during operation that the plant capacity provided by the Contractor is not sufficient to achieve the desired target required for completing the Power House Complex in time. The Contractor's plant shall, therefore, be designed for operation for a minimum peak capacity of 500 cubic metres of concrete per day. Nothing contained in this clause will however, affect the responsibility of the contractor to complete the work within the periods or dates for completion of the different stages of work, as laid down in clause 5.29.

The Contractor shall at all time maintain the speed of work to conform to the latest operative construction programme but the Engineer-in-Charge may at any time, with one month's notice in writing direct the Contractor to slow down any part or whole of the work for any reason (which shall not be questioned) whatsoever, and the contractor shall comply with such orders of the Engineer-in-Charge. The compliance of such orders shall not entitle the Contractor to claim for any compensation except that reasonable extension oftime will be granted in case such slowing down results in delay in final completion of work to be determined by the Engineer-in-Charge.

Since for timely completion of work the contractor has to lay about 150 cum. concrete daily, he can carry out the work in a single shift per day. However, in case the progress in this regard is not considered sufficient by the Engineer-in-Charge, the contractor shall have to carry out work in more shifts/round the clock. He will have to make arrangement for labour for all the three shifts separately. In case he employs the labour of one shift in another shift also, he may do so but in that case the contractor will not be entitled for any claim for overtime or any other payment made to the labour (both skilled or unskilled) or members of supervisory staff,

5.17 SUSPENSION OF WORK :

(A) The Engineer-in-Charge may at any time suspend the whole or any portion of the work under this contract. No compensation for loss which may occur due to such suspension shall be admissible to the contractor. The right to suspend the works shall however not be construed as denying the Contractor, reasonable and necessary time extension to be determined by the Engineer-in-Charge. No. time extension will be allowed for such suspension when ordered by the Engineer-in-Charge on account of weather and climatic conditions.

(B) The Contractor shali plan his works taking into account the effect of floods upto 5000 Cumecs during monsoon period (15th June to 15th October). The loss of time or damage to works on account of monsoon floods will be Contractor's own responsibility and shall be made good by him at his own cost.

5.18 POWER TO CLOSE WORK :

If at any time after the acceptance of tender, the Government shall for any reason whatsoever, not require the whole or any part of the work to be carried out, the Engineer-in-Charge shall give notice in writing of the fact to the Contractor who shall have no claim to any payment by way of campensation or otherwise on account of any profit or advantage which he might have derived from the execution of work in full but which he could not derive in consequence of the giving up of the work before completion. He shall only be paid as par clause 1.11 for the work executed, upto the date of receipt of notice as aforesaid after taking into consideration the variation in the work under the relevant clause. No other expenses incurred by him on account of any labour & material collected at site or arrangement made for the execution of the work which could not be utilised either fully or partially on the work on account of giving up of work as aforesaid shall be admissible to nim.

5.19 CONTRACTOR RESPONSIBLE FOR MAINTENANCE OF WORKS DURING CONSTRUCTION :

All the works under this contract, until handed over to the Engineer-in-Charge, shall stand at the risk of the contractor who shall be responsible and make good at his own cost all or damage caused due to any cause whatsoever and the Contractor shall hand over at the time of completion of the Contract, the works in good orders and condition and in conformity, in every respect, with the requirements of the Contract and the instructions of Engineer-in-Charge. Nothing extra will be paid for maintenance of the work during contruction.

6.20 ACTION AND COMPENSATION PAYABLE IN CASE OF BAD WORK :

All material and workmanship shall be subject to inspection, examination and test by the Engineer-tn-Charge at any and all times during manufacture and/or construction and at any and all times during manufacture and/or construction and at any and all places where such manufacture and/or construction are carried out. If the Engineer-in-Charge is satisfied that the construction of any part of the work is faulty or that the material used in the same are inferior to these for which the specifications are provided or that any of the materials or articles provided by the contractor are not in accordance with the contract, he may, not withstanding such work materials or articles, having been passed, certified or paid for, serve the contractor with notice in writing specifying the work, materials or articles of which he complains and require the Contractor to remedy such defects or to replace such materials or articles within a specified period of time.

If the Contractor fails to comply in all respects with the requirement of any notice within ten days after the expiry of the period specified in the notice, the Engineer-in-Charge may himself remedy such defects or replace such materials or articles and the Contractor shall pay all expenses

incurred by the Engineering-in-Charge, whose decision as to the amount of any such expenses shall be final and binding on the Contractor.

5.21. TERMINATION FOR DEFAULT AND DAMAGES FOR DELAY :

(A) (i) If during the progress of work at any stage the Contractor fails or refuses to comply with the conditions of the contract or with the instructions, decision of the Engineer-in Charge or refuses or fails to prosecute the work or part thereof, with such diligence and such number of skilled and unskilled labour, plant and equipment as in the opinion of the Engineer-in-Charge will ensure its completion as per construction programme and within the time specified in this contract or any extension thereof or fails to complete the said work within such time, the Engineer-in-Charge may communicate by written notice to the Contractor his decision to terminate the Contractor's right to proceed with the entire work or such part of the work on which there has been delay. In such event the Engineer-in-Charge, may after the expiry of a period of thirty (30) days from the date of receipt of such notice by the Contractor, take over the work or part of the work and prosecute the same to completion by contract or otherwise and the Contractor shall be liable to pay the Government any excess cost occcasioned to the Government thereby and the same as determined and certified by the Engineer-in-Charge without prejudice to any other remedy in respect thereof belonging to the Government against the Contractor or his surety, may be deducted by the Government from any money due or to become due to the Contractor.

(ii) If the Contractor's right to proceed with the work be so terminated, the Engineer-in-Charge shall have the right to take possession of and to utilise in completing the work all such materials, appliances and plant and equipment as may be on the site of work which, in opinion of the Engineer-in-Charge would be necessary for the completton of works and for which the depreciated value of such materials, appliances and plants & equipment shall be payable to the contractor subject to deduction of any amount due against the contractor under this contract. The decision of Engineer-tn-Charge in regard to the depreciated value to be paid to the Contractor for such material, appliances, plants and equipment as may be taken over by the Engineer-in-Charge shall be final and binding on the Contractor subject to clause 4.01.

(B) If the Government does not terminate the right of the Contractor to proceed with the work as provided in the preceding sub-para (i) thereof, the Contractor shall continue the work, in which event he and his sureties shall be liable to pay the Government fixed and agreed amount of liquidated damages as provided in clause 3.11 for each calendar day of delay until the work is completed and accepted by the Engineer-in-Charge.

(C) Notwithstanding any-thing contained in clause 1.11 hereinbefore, in case of termination of work under this clause, the Contractor shall not be entitled to claim any benefit for minus variation under the said clause 1.11

5.22 TIME EXTENSION :

The right of the Contractor to proceed with the work shall not be terminated as provided in clause 5.21 (A) hereof nor the Contractor charged with liquidated or actual damages as provided in clause 5.21(B) hereinbefore because of any delays in completion of the work due to unforeseeable causes beyond the control and without the fault or negligence of the contractor including but not restricted to acts of God or of the public enemy, act of the Government in either its sovereign or contractual capacity, act of another contractor in the performance of a Contract with the Government, fires, floods, epidemics, quarantine, restrictions, freight embargoes, unusually severe weather or delays of sub-contractor or suppliers due to such causes provided that the contractor shall, within 10 (Ten) days from beginning of any such delay notify the Engineer-in-Charge in writing of the cause of delay who shall ascertain the facts and the extent of delay and suitably extend the time for completing the work or stage of work as stipulated in clause 5.28 and 5.29 when in his judgement the findings of facts justify such an extension. The period of extension of time shall be determined by the Engineer-in-Charge after taking into consideration the nature of the work delayed and the practicability of its execution during the period of extension.

5.23 EMERGENCY :

In an emergency affecting the safety of life or of the works or of adjoining property, the Contractor shall immediately inform the Engineer-in-Charge of such emergency, measures proposed to be taken and the conditions that warrant such action. In case sufficient time is not available to obtain approval of the Engineer-in-Charge of the measures required to be taken to meet the emergency (the opinion of the Engineer-in-Charge in this respect being final and binding), the Contractor is permitted to act in his discretion to prevent such loss or injury. The measures that the Contractor will adcpt to prevent such loss or injury shall however, not cause any damage to any other work.

In case the Contractor takes action to meet an emergency at his own discretion as specified above, without obtaining approval of the Engineer-in-Charge, he shall be bound to justify the soundness of the action taken by him. In case the action taken by the Contractor is not found justifiable, the Contractor shall be entirely responsible for the consequences entailing therefrom and shall make good any damage or loss at his own cost. He shall further be not entitled any compensation from the Government.

Any compensation claimed by the Contractor on account of justifiable emergency work shall be determined by the Engineer-in-Charge.

The provisions of this clause shall not in any way limit the provisions of any other clause nor relieve the Contractor of any responsibility whatsoever under any other clause of the Contract.

5.24 CLEANING UP :

Upon completion of the works, the Contractor shall remove from the work sites all plants, buildings, rubbish, scaffolding, unused materials concrete forms and other like materials belonging to him or used under his directions during constructions and in the event of his failure to do so, the same shall be removed by the Government at the expense of the Contractor and his surety or sureties shall be liable therefor.

5.25 ACTION TO BE TAKEN BY THE CONTRACTOR ON COMPLETION OF WORKS :

On completion of work the contractor shall inform the Engineer-in-Charge in writing about the date of completion and shall request him for certificate of completion. No such certificate shall be given nor shall the work be considered to be complete until the contractor has discharged his contractual obligations including the obligations contained in clause 5.24 and has removed from the work site all scaffolding, surplus material, rubbish and other like materials belonging to him or used under his direction during construction and if the Contractor fails to do so on or before the date fixed for the completion of the work, the Engineer-in-Charge may do so and may sell such scaffolding and materials as have not been removed by the Contractor and the expediture so incurred shall be recovered from the contractor's outstanding dues. He shall have no claim in respect of any sum actually realised by the sale thereof.

5.26 COMPLETION CERTIFICATE :

As and when the whole of the work including the cleaning up of site etc. under clause 5.24 of the conditions of the contract shall have been completed to the satisfaction of the Engineer-in-Charge and in accordance with the contract, the Engineer-in-Charge shall give to the Contractor the "completion certificate" and take over the work, provided always that the Engineer-in-Charge shall at his discretion be at liberty from time to time to certify that a part of the work has been completed to his satisfaction and in accordance with this contract and take over that part of the work included in such certificate, and provided further that the Engineer-in-Charge may in his discretion grant a completion certificate even when minor items not affecting the commissioning of the project remain incomplete subject to condition that the Contractor shall complete such minor items within the period specified by the Engineer-in-Charge. The obligations for completion of the work as laid down in clauses 5.28 and 5.29 shall be deemed to have been fulfilled when the 'certificate of completion' has been granted to the Contractor on his application within the intent of clause 5.25. The validity of the contract shall, however, continue until the final certificate of completion as laid down under clause 5.27 has been granted.

5.27 FINAL CERTIFICATE :

The Contract shall not be considered as completed until, "final certificate of completion" shall have been signed by Engineer-in-Charge to the effect that the Contractor has carried out all the obligations under the contract and in the manner specified in the contract, notwithstanding any previous entry upon the works or taking possession, working or using any part thereof by the Government or grant of completion certificate under clause 5.26.

5.28 COMPLETION OF WORKS :

The contractor shall supply erect, equip or construct the whole of the works and hand them over to the Government on or before the expiry of fifty four (54) months after the date of order to commence work. This time of completion of work shall in no circumstances whatsoever be extended or altered except as stated in clause 5.22.

5.29 DATES OF COMPLETION :

The Contractor shall complete the under mentioned works by the dates specified below against them.

I.	Construction of portal at junction of Head race tunnel with construction adit.	12 months after the date of order to commence works.
II.	Excavation of Power House foundation upto deepest level and laying Ist bucket of concrete in raft-foundation.	18 months after the date of order to commence work
III.	Completion of excavation and lining of Head race tunnel.	48 months after date of order to commence work.
IV.	Completion of all works under this contract including cleaning up of work sites as laid down in clause 5.24.	54 months after the date of the order to commence work.

In addition to the above schedule, the contractor will adhere to the dates fixed from time to time for specific items of work concerning the Power Hose in consultation with the U.P. State Electricity Board. The Contractor shall not be entitled to any compensation or claim on account of any delay or slow downs which may result from such adjustments of construction programme.

5.30 POSSESSION PRIOR TO THE COMPLETION :

The Engineer-in-Charge shall have the right to take possession of or use any completed part of work or works or any part thereof under construction either temporarily or permanently. Such possession or use shall not be deemed as an acceptance of any work either completed or not completed in accordance with the contract, except where expressly otherwise specified by the Engineer-in -Charge within the intent of clause 5.26.

CHAPTER 6

CONTRACTOR'S STAFF, REPRESENTATIVES, LABOUR AND CAMP

6.01 CONTRACTOR'S REPRESENTATIVES, SUPERVISORY STAFF AND LABOUR :

The Contractor shall, at all time, maintain on the works adequate number of qualified Engineers and Supervisors of sufficient experience of similar other jobs to ensure that the quality of work turned out shall be as intended in these specifications.The Contractor shall also maintain at the works, a project manager of sufficient status, experience and office, and duly authorised to deal with all aspects of the day to day work. All communication and commitments by the project manager shall be considered binding on the Contractor.

The Contractor shall at all times, submit details of skilled and unskilled labour and equipment employed to the Engineer-in-Charge in the prescribed proforma as may be required to assess and ensure the proper progress of work.

6.02 RIGHT TO OBJECT ON PERSONNEL EMPLOYED :

The Engineer-in-Charge shall have the right to object to the employment or presence of any representative or other person or labour employed by the Contractor on the works for incompetence, negligence, misconduct or being considered undesireable in the interest of work and on receipt of such objection in writing from the Engineer-in-Charge, the Contractor shall be bound to remove such person or persons as may have been pointed out in the written objection raised by the Engineer-in-Charge provided that if such objection or objections happen to be in respect of the Contractor or his authorised representative himself, the Engineer-in-Charge shall have the right to rescind the contract. The Contractor shall not be entitled for any damage or loss that may be caused by removal of the persons or by rescinding the contract due to such objections as provided herein,

6.03 RATES AND WAGES :

(A) No labour below the age of 14 years shall be employed on the work. Fair wages, not less than minimum wages that may be fixed from time to time in accordance with the law or any Act or Rules thereunder applicable to the area covered by the work, shall be paid by the Contractor to all labour and their wage rates shall be prominently displayed in the labour camp written in Hindi in Devnagri script and English script. The payment of wages to the labourers shall be made at regular and reasonable intervals and shall be governed by the labour laws enforced from time to time. Proper acquittance record for such payments shall be maintained and made available for inspection, in the event of there being any complaint from the labourers.

(B) If after the last date of submission of the tender, the minimum wages of labour as applicable to this work are increased by the Government under any law for the time being in force (for any reason other than increase in the cost of living index) over and above the rates for similar labour paid by the Contractor or the Contractor is required by the Government under any law for the time being in force to make provision of labour amenities and benefits in excess of these customary on similar project in India on the last date of submission of tender which is 30.4. 1985, the contractor shall, during the, period this contract remains in force, be reimbursed for any direct increase in the cost of construction which he may have to incur on this account as determined by the Engineer-in-Charge whose decision shall be final and binding on the Contractor.

Provided that in computing the amount of reimbursement under this clause, the labour component under consideration will not be more than 20% of the value (in rupees) of work done, during the period under review. The above adjustment will be allowed by the Engineer-in-Charge after taking a certificate from the Contractor that these extra wages or amenities have been actually provided to the labourers by the Contractor. It will be open to the Engineer-in-Charge to verify and be satisfied about the correctness thereof.

(C) Variation on cost of living index will be adjusted and payment to the contractor will be calculated on the formula :

$$V = 20\% \text{ of } R \times \frac{I - Io}{Io}$$

Where R = Value of work done in rupees during the year under review.

Io = All India Average Consumer Price Index Number for Industrial Workers (General Index). Base 1960=100) during Jan. 1985.

I = All India Average Consumer Price Index Number for Industrial Workers (General Index) (Base 1960=100) during the year under review.

V = The increase or decrease in the total payment made to the Contractor during the year under review.

New series of All India Average Consumer Price Index Number for Industrial Workers (General Index) on base 1960 as 100 issued by the Labour Bureau Simla and published in the Indian Labour Journal or as published in the Reserve Bank of India Bulletin from time to time shall be accepted for the purpose of calculations under this clause. Adjustment will be made once a year (January Ist to December 31st). The Engineer-in-Charge may, if he deems fit, allow intermediate adjustments during a year. Final adjustment on this account will, however, be made in the final bill by recalculating adjustments for each year's work. Provided always that the Contractor gives a certificate that the aforesaid extra wages have actually been paid to the labourers. This variation shall be adjustable only on the value of work done as per items of the schedule of quantities and bids.

(D) The preceding sub-clause (B) and (C) above shall remain operative only for the contract period as stipulated in clause 5.28 of completion of work or extension thereof. In case the work is delayed due to the fault or negligence of the Contractor, the aforesaid sub-clauses (B) and (C) shall not be operative and the Contractor shall not get any benefit under the said sub-clause for the period of such delays in the completion of work.

(E) The Contractor shall employ labour for three shifts as per the requirement of work. Any payment for overtime work made by the Contractor to the labourers to suit his requirement shall not be reimbursed by the Government.

6.04 LABOUR STATISTICS :

The Contractor shall report monthly and shall cause all sub-contractors to report in the like manner within five days after the close of each calendar month, on forms to be approved by the Engineer-in-Charge, the number of persons on their respective pay rolls and such other additional information as may be required by the Engineer-in-Charge. He shall furnish to the Engineer-in-Charge, if required, the names and addresses of all such persons on the work.

The Contractor shall, as for as possible, employ local labour (skilled and unskilled) and staff if found suitable.

6.05 CONVICT LABOUR :

In connection with the performance of work under this contract, the contractor agrees not to employ any person being tried in the court for criminal offence or any person who has been convicted for criminal offence.

6.06 NON-DISCRIMINATION IN THE EMPLOYMENT :

In connection with the performance of work under this contract, the contractor agrees not to discriminate against any employees or applicant for employment, because of race, caste, creed or colour or national origin and further agrees to insert the foregoing provisions in all sub-contracts, hereunder.

6.07 EMPLOYMENT OF LABOUR OF OTHER CONTRACTORS :

If the Contractor takes away any labour brought and employed by other contractors of the Government working on the same project, he shall be liable to pay compensation equal to the profit the original contractor would have made, if the labour would have continued with him and he will also have to return the labour thus employed. The decision of the Engineer-in-Charge in this regard shall be final and binding on the Contractor.

6.08 RIGHT OF WAY :

The Government will provide the right of way for permanent works. The Contractor will be permitted to use such right of way as well as other available Government land for construction purposes. The Contractor shall supply to the Government within a reasonable time after the award of the contract the details of the land required by him for the purposes of camp, stores and shops at work sites. Should any private land or land belonging to Government which has not been requisitioned be required by the Contractor for the work, the acquisition/requisition proceedings will be carried out if practicable, by the Government and as far as possible the Contractor shall be allowed to use the land free of rent on the completion of the acquisition/requisition proceedings. In case of problem in getting such land by the Government the Contractor shall have to explore alternative possibilities.

The location where land for Contractor s colonies and other works is likely to be available, is shown in Exhibit No. 2. Comparatively flatter areas are generally cultivated and due to scarcity of areas suitable for cultivation it is necessary that the requirement of such land is minimised. In case, however, the contractor takes over any land at site of works by private negotiations, the cost of such land will be reimbursed to him at the rates as may be certified to be reasonable by the District Magistrate and/or his authorised representative or their actual purchase prices whichever is lower and the land so acquired will become the property of Government. Provided that no reimbursement as aforesaid shall be made to the Contractor if he has procured private land by negotiations without obtaining proir written approval of the Engineer-in-Charge.

6.09 SURRENDER OF OCCUPIED LAND :

The lands as hereinbefore mentioned shall be given back to the Engineer-in-Charge within three months after the issue of completion certificate or before issue of final certificate. Also no land shall be held by the Contractor longer than the Engineer-in-Charge shall deem necessary and the Contractor shall, on receipt of notice from the Engineer-in-Charge, vacate and give back the land which the Engineer-in-Charge may certify as no longer required by the Contractor for the purpose of the work. All areas of operation, including those utilised by the Contractor's Staff and colonies, shall be handed back in goood condition to the Engineer-in-Charge.

The Contractor shall make good, to the satisfaction of the Engineer-in-Charge, any damage to the areas which he has to hand over back to Government or to other property or land handed over to him for purpose of this work.

6.10 CAMP SITES :

The Contractor shall provide, maintain and operate under competent direction, camp and facilities convenient to the work and sufficient for housing and accommodating all his employees including labour. He shall also provide facilities for community latrines, bath-rooms, kitchens dining hall and recreation facilities for labourers. The location, operation and maintenance of such camps and facilities shall be subject to the approval of the Engineer-in-Charge. No camp construction of any kind, other than that of the most temporary nature, shall be undertaken until drawings and specifications have been approved by the Engineer-in-Charge. The desion, construction, operation and maintenance of electric and water supplies, sewerage and sanitation will be carried out by the Contractor to the satisfaction of Engineer-in-Charge.

The Government will assume no responsibility for damage to or interference with Contractor's camp due to any operations under the contract or due to any natural calamites.

6.11 CONTRACTOR'S OFFICE :

The Contractor shall have an office near the work site where notices or directions and instructions from the Engineer-in-Charge may be served. The contractor shall have a clerk or some authorised person always present in office who shall receive such notices, directions and instructions on behalf of the Contractor.

6.12 BUILDING AND ROADS :

Expensive or permanent type of construction will not be required but all buildings erected in the Contractor's camp shall be substantial in construction and shall have, reasonably good

appearance. A minimum of 5 (five) Square meties of covered area shall be provided for every employee of the contractor including all workmen. All approach roads and roads inside his camp shall be constructed and maintained by the Contractor at his own cost. The layout, design, construction and maintenance etc. of the roads shall be subject to the approval of the Engineer-in-Charge.

6.13 WATER SUPPLY AND FIRE PROTECTION :

The Contractor shall provide and maintain on all camp and work sites, water system for supplying water for domestic purposes, fire protection and for use in the workshop. The capacity design, construction, operation and maintenance of all water supply and fire protection arrangements shall be subject to the approval of the Engineer-in-Charge.

6.14 SEWERAGE AND SANITATION :

The Contractor's camp site shall be provided with complete sewerage systems and the contractor shall make arrangements for the protection of health and sanitation of his camp on a scale which is not to be less than that specified, in the health and sanitary provisions given in Annexure 6/1. For his camp or camps, the Contractor shall furnish and install sewer pipes, fittings, manholes and all other materials therefor and shall construct, operate and maintain complete sewer systems which shall at least serve community buildings for the labourers within the camp sites. The design, construction, operation and maintenance of the sewer system shall be subject to the approval of the Engineer-in-Charge. The disposal of the sewerage or the discharge of sewerage into streams shall conform to the laws and regulations of the Department of Public Health of the State of Uttar Pradesh. All garbage and refuse shall be collected regularly at such intervals as may be approved by the Engineer-in-Charge and shall be disposed off by burial, incineration or other satisfactory means.

6.15 CAMP REGULATIONS :

The Contractor shall be responsible for maintaining good order in his camps and on the works and shall employ such officers, watchmen or other persons as may be required for this purpose. Unauthorised persons shall be excluded from the camps and from the work areas. If in the opinion of the Engineer-in-Charge, any employee or agent of the Contractor misbehaves or causes obstruction to proper execution of the work or otherwise makes himself undesirable, the Engineer-in-Charge may ask the contractor to remove such employee or agent from his camp at once and the Contractor shall promptly carry out such orders.

6.16 MEDICAL AID AND FAMILY WELFARE :

The camp area shall be provided by the Contractor with adequate medical facilities on scale commensurate with camp requirements. Facilities for first aid shall be arranged by the Contractor at every work site as per health and sanitary provisions given in Annexure 6/1. The Contractor shall maintain an ambulance in the work area.

The Contractor agrees to persuade all his labourers and other employees including casual labour employed by him to adopt voluntarily family welfare techniques (including Vasectomy and Tubectomy) in lines with the policies and programmes announced by the State Government in so far as these may be applicable.

6.17 POST, TELEGRAPHS, TELEPHONE AND WIRELESS OFFICE :

(A) Postal and telegraphs facilities may be available at the offices to be set up by the Post and Telegraphs Deptt. at the various sites. A connection to the trunk telephone system may also be available at the site. These will be at the usual terms and conditions of Post and Telegraph Department.

(B) Arrangements are being negotiated with the Post and Telegraph Department to operate and maintain telephone connection in the different offices and major workshop as may be necessary. If any connections are surplus, these may be alloted to the Contractor on presentation of application. In that case the Contractor shall have to pay the telephone rental and any other charges in this connection as may be fixed by the Post and Telegraph Department for the telephone installed for his office and works.

(C) In case the Contractor desires to have a wireless link from work sites to his Head-quarters, he would arrange it himself. Government will, however, render assistance to the Contractor in obtaining necessary permission and licence from the Government of India if permissible under the law in force.

6.18 REMOVAL OF CAMP :

After completion of the work covered by these specifications and before final completion certificate is issued under the contract, the Contractor shall remove from any camp site located on lands owned or controlled by the Government all buildings and all other construction above the ground surface except buildings not owned by the Contractor. He shall neatly fill with earth all cellars, basements and other excavated areas and shall leave the site in a clear and sightly condition. If the Contractor refuses or fails to remove the buildings and other construction as herein provided within the specific period the building and other improvements shall become the property of the Government free of any cost or compensation and at the option of the Government all or any part thereof may be removed as herein provided and in such event the cost of such removal will be deducted from the amount withheld vide clause 3.13 from the final payment due to the Contractor.

6.19 ACCIDENT PREVENTION :

The Contractor shall at all times exercise reasonable and proper precautions for the safety of the people on the works and shall comply with the provisions of current safety laws and relevant buildings and construction codes of the State Government and the safety manual of C.W.C. as may be applicable. He shall also provide all necessary fencing and lights required to protest public from accidents. All machinery and equipment and other sources of physical hazards shall be guarded in accordance with the regulations or laws of the State Government and the Government of India. The Contractor shall be responsible for all risk to the lives and property of the people from whatsoever cause arising out of or in connection with the execution of the works during their progress although all reasonable and proper precautions may have been taken by the Contractor. The Contractor shall be deemed to have indemnified and undertaken to save harmless the Government against all actions, suits, claims, demands and cost etc. arising in connection with injuries suffered prior to the issue of the final certificate of completion. In case the Government (either alone or jointly with the Contractor) shall be called upon by a court of law to make good any such loss or damages, or to pay compensation (including that payable under the provision of the Workman's Compensation Act) to any person or persons sustaining damages as aforesaid by reason of any act, or any negligence or omission on the part of the Contractor, the amount which the Government may be required to pay in respect thereof and the amount of any costs or charges (including legal costs or charges in connection with legal proceedings) which the Government may incur in reference thereto shall be chargeable from the Contractor.

Furthermore, the Engineer-in-Charge shall in his discretion, if he deems fit, have the right to pay or to defend or to compromise any claim which may be made against the Government or in case of threatened legal proceedings or in anticipation of legal proceedings being instituted in respect of matters for which the contractor is liable, to take such steps as he may consider necessary or desirable to ward off or mitigate the effect of such proceedings and recover from the contractor all sums and expenses the Engineer-in-Charge may incur and pay in this behalf and the propriety of the action taken and the sums and expenses incurred and paid by the Engineer-in-Charge in this behalf shall not be open to question. Provided that Engineer-in-Charge shall, before taking any action, as aforesaid, give to the Contractor notice in writing of the action proposed to be taken by him and in case the Engineer-in-Charge proposes to pay or compromise any claim, no such payment shall be made or compromise affected without the consent of the Contractor except when the claim does not exceed a sum of Rs. 1000/- (Rs. One thousand only) and the payment or the compromise is sanctioned by the Government.

Monthly report of all accidents shall promptly be submitted by the Contractor to the Engineer-in-Charge as required under any Act or law giving such details as may be prescribed under

any law for that purpose. In case of accidents of serious nature the Contractor shall send the report immediately to the Engineer-in-Charge after the accident has taken place.

6.20 PRESERVATION OF EXISTING VEGETATION :

A. The Contractor will preserve and protect all existing vegatation such as trees, on or adjacent to the site which do not unreasonably interfere with the construction. The Contractor will be held responsible for all unauthorised setting fire or cutting of and damage to trees, brush wood or grass by careless operation of equipment, stockpiling of materials etc. Care will be taken by the Contractor in felling trees, authorised for removal, so as not to cause any damage to vegetation or trees or to structures under construction or in existence or injury to workmen.

B. The Contractor shall be charged for all trees standing on the land handed over to him for use for plant storage and other incidental purposes in connection with the prosecution of the work except those trees which may be marked for being preserved by the Engineer-in-Charge, The Contractor will be free to cut any trees for which he has been charged and he will be free to use all the timber and fuel obtainable from such trees.

The Contractor shall pay for such trees at Rupees two thousand per cubic metre of quantities of timber or "ballies" that may be available from the trees according to the estimates of the Engineer-in-Charge. No charge shall be made for fuel content. The recovery of amount on this account shall become due immediately after the land has been taken over by the Contractor and the amount is intimated by the Engineer-in-Charge. The recovery in full shall be made from the intermediate bill that follows.

6.21 COTRACTOR NOT TO DISPOSE OF SOIL ETC.

The Contractor shall not dispose of or remove, except for the purpose of fulfilment of this contract, sand, stone, clay, ballast, earth, trees and shrubs or other materials and equipment, obtained in the excavation made or lying on the site of the work and all such materials and produce shall remain the property of the Government. The Government may upon request from the Contractor if so stipulated in the conditions of the contract, allow the Contractor or to use any of the above materials and produce for the works, either free of cost or after payment, as may be specifically agreed to in writing by the Engineer-in-Charge as considered necessary during the execution of the works.

ANNEXURE 6/1

HEALTH AND SANITARY PROVISIONS

1. APPLICATIONS :

These rules shall apply to all construction works carried out under this contract.

2. DEFINITION :

A- "Work place" shall mean a place at which at an average fifty or more but less than 500 workers are employed in connection with the Construction work.

B- "Large work place" shall mean a place at which at an average 500 or more workers are employed in connection with the construction of work.

3. FIRST AID :

A- At every work place there shall be maintained in a readily accessible place first aid appliance including an adequate supply of sterilized dressings and sterilized cotton wool. The appliance shall be kept in good order and in large work places they shall be placed under the charge of a responsible person who shall be readily available during working hours.

B- At large work places where hospital facilities are not available within easy distance of the work, first aid posts shall be available and run by a trained compounder.

C- Where large work places are situated in cities, town or in their suburbs and no beds are considered necessary owing to proximity of city or town hospitals, no separate regular hospital may be provided and only dispensaries maintained at suitable places, easily accessible to labour, arrangements being made available for removal of urgent cases to those hospitals but for

other large work places hospitals or indoor ward shall be provided with one bed for every 250 employees. At such place some conveyance factlities, such as an ambulance car shall be kept readily available to take injured person or persons suddenly taken seriously ill to the nearest hospital.

4. DRINKING WATER :

A- In every work place there shall be provided and maintained at suitable places easily accessible to labour, a sufficient supply of water fit for drinking.

B- Where drinking water is obtained from an intermittent public water supply, each work, place shall be provided with storage where such drinking water is stored.

C- Every water supply storage shall be at distance of not less than 20 metres from any latrine, drains or other source of pollution. Where water has to be drawn from an existing well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking and all such wells shall be entirely closed in to be provided with a trap door which shall be dust and water proof.

D- A reliable pump shall be fitted to each covered well, the trap doors shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

E- The temperature of drinking water, supplied to workers shall not exceed 32.2°C (90°F).

5. WASHING AND BATHING PLACES :

A- Adequate washing and bathing places shall be provided separately for men and women.

B- Such places shall be kept in clean and drained conditions.

6. LATRINES AND URINALS :

Except in work places provided with water flushed latrines connected with water sewerage system, all latrines shall be cleared at least four times daily and at least twice during working hours and kept in a strictly sanitary condition. The receptacles shall be tarred inside and outside at least once a year. In particular cases the Engineer-in-Charge has power to vary the scale where necessary.

7. SCALE OF ACCOMMODATION IN LATRINES AND URINALS :

There shall be provided within the precincts of every work place, latrines and urinals in an accessible place and the accommodation separately for each of them shall not be less than the following scales :

A- Where the number of persons employed does not exceed 50 — 2 Nos.

B- Where the number of persons employed exceeds 50 but does not exceed 100 — 3 Nos.

C- For every additional 100 persons, 3 Nos. per hundred. In particular cases Engineer-in-Charge shall have the power to vary the scale where necessary.

8. LATRINES AND URINALS FOR WOMEN :

If women are employed, separate latrines and urinals, screened from those for men and marked in the vernacular in conspicuous letters "For Women only" shall be provided on the scale laid in para 7. Those for men shall be similarly marked "For Men Only". A poster showing figure of a man and women shall also be exhibited at the enterance of urinals for each sex. There shall be adequate supply of water close to the urinals and latrines.

9. CONSTRUCTION OF LATRINES :

The inside walls shall be constructed of masonry of some suitable heat resisting and absorbant materials and shall be cement washed inside and outside at least once a year. The dates of cement washing shall be noted in a register maintained for this purpose and kept available for inspection.

10. DISPOSAL OF EXCRETA :

Unless otherwise arranged for by the local sanitary authority, arrangement for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator

approved by the Assistant Director of Public Health or the Municipal Medical Officer of Health as the case may be in whose jurisdiction the work place is situated. Alternatively, excreta may be disposed off by putting a layer of night soil at the bottom of pucca tank, prepared for the purpose, and covering it with a layer of 15 cm waste of refuse and then covering it with a layer of earth for a fortnight (when it will turn into manure).

11. PROVISION OF SHELTER DURING REST :

At every work place there shall be provided free of cost at least two suitable sheds, one for menials and other for the use of labour. The height of the shelter shall not be less than 3.35 M (11 feet) from the floor level to the lowest part of the roof.

12. PROVISION OF HUTS FOR CHILDREN :

At every work place at which 50 or more women workers are ordinarily employed there shall be provided at least two huts for the use of children under the age of 6 years belonging to such women. One hut shall be used for infants games and play and the other as their bed room. The huts shall not be constructed on a lower standard than the following :

1. Thatched roofs
2. Mud floors and walls
3. Planks spread over the mud floor and covered with mattings. The huts shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provisions of sweepers to keep the places clean. There shall be two midwives in attendance. Sanitary utensils shall be provided to the satisfaction of the Health Officer of the area concerned. The use of the huts shall be restricted to children, their attendants and mothers of the children.

13. CANTEENS :

A canteen for cooked food on a moderate scale shall be provided for the benefit of workers wherever it is considered expedient.

CHAPTER 7

DATA ABOUT PROJECT AND LOCAL CONDITIONS

7.01 THE DATA :

The information and data stated herein and incorporated in the contract elsewhere is for information only and the Engineer-in-Charge does not guarantee that the available records show completely the existing conditions. The Contractor shall assume full responsibility for any deductions, interpretations or conclusion drawn therefrom by him.

7.02 LOCATION :

Hathiari Power House site is located on river Yamuna in district Dehradun of Uttar Pradesh about 15 kms from Dakpathar. The Hathiari Power House site is about 65 kms. from Dehradun via Vikasnagar and lies 15 km. downstream of the bridge where Mussoorie-Chakrata Road crosses river Yamuna.

Nearest railhead at present is Dehradun. However, in view of heavy requirement of cement, steel, construction and other equipment which will require a large yard for transit storage, it is proposed to have the Project railhead at Harrawala nearly 8 km. beyond Dehradun where a railway siding of the project already exists and is proposed to be further enlarge and extended by the department at its own cost if deemed necessary by the Engineer-in-Charge for handling the materials and equipments for the works of Lakhwar Vyasi Project.

7.03 EXISTING APPROACH FACILITIES :

The following approach facilities exist or are under construction :

A- Right bank of river Yamuna :

I- There is a metalled P.WD. road from Dehradun to Kalsi. From Kalsi a single lane roadoff takes from main P.W.D. road and runs along the right bank of river Yamuna upto Yamuna bridge on Mussoorie-Chakrata road.

II. A high level double lane project road off-takes from the above mentioned P.W.D. road at Chainage 15.2 Km. and joints the existing Mussoorie-Chakrata road near village Lakhwar.

B- Left bank of river Yamuna :

I- A double lane class A A project road has been constructed along left bank of Yamuna. This offtakes from P.W.D. road at Barwala (about 3 Km. from Dakpathar) and passes via proposed Hathiari Surface Power House.

C- All the roads as stated in clause A and B above pass through slip zones and are likely to get blocked temporarily during winter rains too. The communication on these roads during the period 15th June to 15th October is uncertain. Hence the contractor shall have to make adequate storage arrangements for materials at the work sites to enable prosecution of works during monsoons.

D- Bridge :

A suspension foot bridge across river Yamuna exists at Gaski nala site about 2 Kms. upstream of proposed power house site. A double lane steel bridge at Juddo about 4.7 Kms. upstream of proposed power house site exists and it provides a link between right bank road and left bank double lane road at its chainage 17.0 Km.

E- Temporary link roads and bridges etc. to be constructed by the Contractor.

All temporary approach roads and river crossing as required for proper execution of works in extension of existing roads as detailed hereinabove will be constructed and maintained by the Contractor at his own cost.

F- Diversion of Roads :

I- The department will arrange to provide diversion of main project roads in the work area on either of the banks, required if any. The contractor will be so required to

arrange his programme of works that the main project road is kept open on either of the banks and at no time the access to forward work area is dislocated. No additional payment will be made to him in lieu thereof.

II- The diverted main project roads will be maintained by the department. In case any material slips down from the project roads in the work area inspite of all the reasonable precautions taken by the department, the contractor will be required to remove and dispose it off at his own cost. Neither any additional payment will be made to him on this account nor any claim will be entertained on account of damage, if any to his works & plants etc.

G- All haul roads within and outside the area of excavation as also temporary bridge or bridges if required across river Yamuna in the work area shall be constructed and maintained by the contractor at his own cost. The layout and other details of these roads and bridges will be subject to approval of the Engineer-in-Charge. It is understood, ascertained and agreed that approval of Engineer-in-Charge as to the alignment and details for the haul roads and temporary bridges will not in any way absolve the contractor of his responsibility about the safety and sufficiency of these structures.

7.04 CLIMATIC CONDITIONS :

The work area is situated in medium rain fall zone at elevations varying from 519 metres to 700 metres above mean sea level. The rainy season generally commences from middle of June and lasts upto end of September. There is hardly any rainfall beyond October through a few sporadic showers cannot be ruled out. The average monthly rainfall of the nearby sites are given in the following table :

Average monthly precipitation in millimentres :

Month	Preceipitation	Remarks
January	75	The data of rainfall
February	77	
March	42	has been compiled from
April	45	
May	52	observations recorded
June	185	
July	482	near Lakhwar dam site
August	490	
September	249	from 1974 to 1979.
October	30	
November	8	
December	33	
Average Total :	1768	

Maximum and Minimum Air Temperature and River Water Temperatures at Lakhwar Dam Site are given below :

Month	Average max. temp. of air	Average min. temp. of air	Average mean temp. of air	Average river water temp.
January	18.23	9.20	13.72	10.94
February	21.10	11.12	16.11	12.98
March	23.82	15.58	19.70	15.00
April	28.16	19.49	23.82	18.39
May	31.14	22.83	26.98	20.18
June	33.91	25.50	29.74	22.42
July	30.80	25.02	27.91	20.54
August	29.21	24.50	26.87	21.33
September	27.60	21.49	24.54	20.31
October	27.54	18.48	23.01	19.30
November	24.69	14.72	19.71	14.86
December	21.09	11.25	16.17	11.94

7.05 HYDROLOGICAL DATA :

Maximum monthly discharge of river Yamuna at Lakhwar (about 11 km. upstream) from 1961 to 1980 are given in Chapter 13.

7.06 AVAILABILITY OF LABOUR .

Some unskilled labour may be available locally, but suitable skilled labour is not likely to be available in the project area. The contractor must, however, make his own enquiries.

7.07 ROADS IN WORK AREA :

The kutcha or pucca roads constructed by Government in work area and Colony will be available for use by the Contractor subject to the conditions imposed by the Engineer-in-Charge.

7.08 RAILWAY AND HARBOUR FACILITIES AND STORAGE FACILITIES FOR OILS :

The loading facilities available on Indian Harbour and railways are given in Annexure 7/1. The Laksar-Haridwar Dehradun section passes through hilly terrain and two short tunnels. The Contractor should examine the extent of rail transport carefully. There are no facilities for storage of oils at work sites at present. Government may provide necessary assistance for installation of pumps and depots but does not take any responsibility in this respect.

7.09 ENGINEERING FEATURES OF GEOLOGY OF PROJECT AREA :

The details given in succeeding paragraphs are as per the investigations carried out by Geological Survey of India and other agencies. The observations and references contained herein are for information only and the Enginner-in-Charge does not accept any responsibilities for the observations and inferences contained herein.

I—Power House, Penstocks and Surge Shaft Site : As per G.S.I. report the rocks exposed in the area are the Kalsi lime stones with marble bands quartzites with slates. Nearly 70% area is covered by terrace gravels.

The following investigations have so far been carried out. :

10 No. drill holes with depths varying from 45 m. to 110 m. have been made at power house site and two drifts one 110 m. long & the other 50 m. long have been made at road level, one drift 74.5 m. long with two cross cuts 58 m. & 55 m. long has been made at surge shaft site at El. 635 m. Two drifts, one on right bank 35 m. long and one on left bank 65 m. long have also been made in power house area. Based on the logs of the drift and drill holes so far a geological section for site of power house and appurtenant works has been prepared and supplied by G.S.I. and the same is enclosed in tender drawings as exhibit (5). According to this section the Power house would be located in slaty quartzites, the surge shaft in Kalsi lime stones and the penstocks in both these rocks.

In the Power house area the slaty quartzites become available below at El. 517.4 M. This rock is fine grained, There calcareous Veins (1-2 mm) thick are also present at various levels in this rock. At the surge shaft site the Kalsi Lime stone is inter bedded with thin layer of greenish talcose bands 5-15 cm thick, Hematite lenses and bands and thin telechlorite schist bands are also visible along bedding planes the bedding plane dips at 85° in N and 25° E direction i.e. upstream.

II—Head race tunnel : As per preliminary geological investigation report (P.R. 7 of F.S. 1973-74).

The proposed 2.7 Km. long tunnel between Vyasi and Hathiari would cross only three units of the Mandhali rocks, namely white, grey and purple quartzites with minor slates, slates with minor limestone bends and Kalsi lime stone. The tunnel alignment would make an angle of 15° to 40° with the strike of these formations and may give rise to adverse tunnelling conditions with high overbreaks in certain reaches of thinly bedded slates and Kalsi lime stones.

A tentative geological section along Vyasi Hathiari tunnel Alignment has been prepared in which various rock units likely to be encountered during tunnelling have been depicted and is enclosed as Tender Plan exhibit 17.

MISCELLANEOUS DATA :

The data regarding chemical analysis and bacteriological examination of water samples from Yamuna river at nearby Lakhwar Dam site have been enclosed as annexure 7/2, 7/3 and 7/4.

Gauge	Type of Wagon	Dimension of Indian Railway stock			Actual door opening of covered Wagon			Maximum dimensions of package			
		Length	Breadth	Height above rail level	Height	Width	Height at centre	Height at site	Width	Length	Weight
5'-6"	Low side Wagon bogies	45'-5/8"	9'-6"	2'-0"	—	—	9'-2"	7'-6"	9'-0"	44'-0'	45
5'-6"	Covered Wagon bogies	40'-0"	9'-0"	—	6'-6"	3'-1½"	6'-5"	6'-5"	3'-9"	9'-5"	42
5'-6"	Timber Truck bogies	45'-0"	9'-6"	—	—	—	8'-7"	6'-9"	9'-3"	44'-6"	36-44
5'-6"	Crocodile wagon bogies	56'-0"	9'-0"	—	—	—	10'-9"	9'-3"	10'-0"	29.6"	39
5'-6"	Open wagon 4 wheeled	27'-6"	9'-4"	4'-¾"	—	—	—	—	—	—	22
5'-6"	Well truck bogies	30'-3"	7'-11"	2'-2⅞"	—	—	—	—	—	—	39
5'-6"	Well wagon bogies	31'-6½"	8'-6"	2'-2¼"	—	—	—	—	—	—	40
5'-6"	Well truck bogies	26'-5"	7'-0"	1'-7"	—	—	—	—	—	—	90
5'-6"	Well truck bogies	31'-0"	7'-0"	1'-6¼"	—	—	—	—	—	—	50
5'-6"	Well truck bogies	22'-0"	9'-0"	2'-0"	—	—	—	—	—	—	130

Note : Indian Railways should be referred to for confirmation of above data.

Annexure 7/1 (Contd.)

Maximum dimension of package that can be transported under special arrangement from Calcutta to Mughal Sarai.

Overall height	12'-3"
Overall width	13'-0"
Height at Maximum width	8'-9"
Width at max. height	6'-0"
Length	20'-0"
Weight	130 Tons

Maximum dimension of packages that can be transported on Laksar-Dehradun section.

Overall height	13'-6"
Overall width	10'-6"
Height at Max. width	11'-6"
Width at Max. hight	2'-0"
Weight	34 Tons

MAJOR HARBOUR FACILITIES

Particulars	Calcutta	Bombay	Madras	Vishakhapattnam
Draft Depth	30 Max.	33 Max.	29 Max.	28.5 Min.
Berthing for Vessels	37 Berths			
	18 Jetties	50	7	5
Ware House	65 acres	13 acres	Available	Available
Transit Sheds	94 acres	48 acres	Available	Available
Cranes and loading installations	100 Tons Max.	100 Tons Max.	68 Tons Max.	14 Tons Max.
Transhipment services	Railways	Railways	Railways	Railways

1. The above data is only for Contractor's information and should be ascertained by the Contractor from the authorities concerned.

Note : Max. Length of ship that can enter Harbour is 570 ft. Recent improvements in shipping facilities can be ascertained from respective port authorities.

Annexure 7/2 (A)

Chemical Analysis of Water Samples received from Yamuna river at Lakhwar Dam site.

Sl. No.	Constituents	Sites of taking samples			Remarks
		10 metres D/s of Dam axis	Dam axis	10 metres D/s of Dam axis	
1	2	3	4	5	6
1.	P.H. Value	8.8	8.8	8.8	Water samples were collected at site on 20.2.1973
2.	Electrical conductivity in Millimhos/cm	1.68 x 10	1.68 x 10	1.68 x 10	
3.	Sulphates in p.p.m.	34	37	37	Well within limit of 1000 p.p.m.
4.	Sulphuric anhydrids as So_3 in p.p.m.	29	31	31	Well within limit of 400 p.p.m.

5.	Total solids in p.p.m.	128	154	186	Well within limit of 4600 p.p.m.
6.	Suspended matter in p.p.m.	24	52	81	Well within limit of 2000 p.p.m.
7.	Alkalinity (Volume of n/10 HCl consumed to neutralize 200 ml. of sample	3.2 ml.	3.2 ml.	3.2 ml.	Well within limit of 10 ml. (Max.)
8.	Acidity (volume of n/10 NaoH, consumed to neutralize) 200 ml. of sample.	—	—	—	(Max. limit 8 ml.)
9.	Temporary hardness in p.p.m.	80	80	80	
10.	Permanent hardness in p.p.m.	40	40	40	
11.	Total hardness in p.p.m.	120	120	120	
12.	Percentage of 7 days compressive strength of cement mortar prepared with water sample with that of distilled water.	95.5%	95.5%	95.5%	Well within limit of minimum 90%

Annexure 7/3 (A)

STATE HYGIENE INSTITUTE, U.P. LUCKNOW

Result of Chemical analysis of water, sent by and collected by	Executive Engineer, Test and Control Division, Dakpathar (Dehradun)
Date of collection	9.5.1973
Date of receipt	10.5.1973
Date of analysis	11.5.1973
Source	Water from river Yamuna at Lakhwar Dam site
Physical character	Transparent
Reaction	Slightly Alkaline
Free and saline ammonia in p.p. 1,00,000	0,002
Albuminoid ammonia in p.p. 1,00,000	0.003
Oxygen absorbed in 3 Hrs. at 37°C in p.p. 1,00,000	0.01
Solids in solution total p.p. 1,00,000	15
Solids solution fixed p.p. 1,00,000	10
Solids solution volation p.p. 1,00,000	5
Appearance on ignition	No charring
Total hardness p.p. 1,00,000	8
Permanent p.p. 1,00,000	4
Temporary p.p. 1,00,000	4
Chlorides p.p. 1,00,000	0.5
Nitrates p.p. 1,00,00	Nil
Nitrates p.p. 1,00,000	Nil
Flourine as flourides p.p. 1,00,000	0.016
Remarks	Potable

Annexure 7/3 (B)

स्टेट हैल्थ इंस्टीट्यूट उत्तर प्रदेश लखनऊ

रीवर यमुना में प्राप्त जल के रासायनिक विश्लेषण का परिणाम अधिशासी अभियन्ता टैस्ट एन्ड कन्ट्रोल डिवीजन डाकपत्थर (देहरादून) द्वारा एकत्रित

एकत्र करने का दिनांक	7-4-81
प्राप्त होने का दिनांक	8-4-81
विश्लेषण का दिनांक	8-4-81
जल प्राप्त का स्थान	रीवर यमुना
भौतिक क्षण	ट्रान्सपैरन्ट विद सैडीमैंट
प्रतिक्रिया	स्ता० एल्क्लाइन
असंयोजित एवं लवणीय भाग (फ्री एन्ड सेलाइम इमोनिया) 1,00,000	0.001
37° से० पर 3 घन्टे में अवशैणित जारक भाग (आक्सीजन एब्जार्ब्ड) प्रति 1,00,000	0.01
सांद विलयन में अनुत्पत भाग (सालिड इन सैल्यूशन फिक्सड) प्रति 1,00,000 सांद विलयन में अनुत्पत भाग (सालिड इन सैल्यूशन वोलेशन) प्रति 1,00,000	20
प्रज्वलन पर रूप	नो चारिंग
सम्पूर्ण कठोरता भाग प्रति 1,00,000	110
स्थायी कठोरता भाग प्रति 1,00,000	50
अस्थायी कठोरता भाग प्रति 1,00,000	60
नीरैय भाग (क्लोराइड्स) प्रति 1,00,000	0
भूषित भाग (नाइट्राइट्स) प्रति 1,00,000	निल
भूषीय भाग (नाइट्राइट्स) प्रति 1,00,000	निल
क्लोरिन एज फ्लोराइड प्रति 1,00,000	0.0016
अभ्युक्ति	रा वाटर

संख्या 91 डी लखनऊ दिनांक 15-4-81

सूचनार्थ प्रेषित :

1-अधि० अभि० टैस्ट एन्ड कन्ट्रोल डिवीजन डाकपत्थर, देहरादून (एक बिल 10 का संलग्न है)

2-सी०एम०ओ० देहरादून

Annexure 7/3 (C)

RESULT OF WATER SAMPLE COLLECTED FROM LAKHWAR DAM SITE ON 18.3.1981

Sl. No.	Name of Constituents	Result	Specific limits as per IS : 456-1978 for concrete suitability
1.	Specific conductivity mohs/cm.	1.68×10^{-4}	—
2.	P.H.Value	8.8	6.0
3.	Acidity volume of $\frac{N}{10}$ Na OH Soln consumed to neutralize 200 ml of water sample	Nil	2.0 ml
4.	Alkalinity volume of N HCL soln. consumed to neutralize 200 ml of water sample	3.4 ml.	10.0 ml
5.	Sulphuric anhydride (SO_3)	38	500 p.p.m.

UTTAR PRADESH SWASTHYA MANDIR, LUCKNOW

Results of the Bacteriological Examination on water samples taken from Test & Control Division, Dakpather (Dehradun)

Name and designation of the person collecting the sample. : Executive Engineer Test & Control Division, Dakpather (DEHRADUN)

Sl. No.	Date and time of collection	Date of receipt and inoculation	Source of sample	Colony agar count on per ml. of water		Presumptive Coliform Count					Probable no. of coliform organism in 100 ml of original water	Free residual chlorine p.p.m.	Remarks
				At 37° C in 48 hrs.	At room temperature in 72 hrs.	Quantity of water putup in each tube	50 ml.	10 ml.	1 ml.	0.1 ml.			
81-D	8.5.1973	1.5.1973	Water sample from Lakhwar Dam Site	Innumerable	—	—	1	4	5	—	40	—	Unsatisfactory

CHAPTER—8

SCOPE OF WORKS, CONSTRUCTION EQUIPMENT AND CONSTRUCTION POWER

8.01 SCOPE OF WORKS :

(A) Hathiari Power House works included in the tender comprises the following r

(I) Power House and appurtenant works : The Hathiari Power House will be a surface power house located on the left bank of river Yamuna. As the power house is located just very near the river it will be almost closed on all sides upto H. F. L. except for essential openings like draft tubes and entrance to erection bay which is proposed 1 M.higher than the flood level anticipated for 5000 cumecs (1 in 50 years frequency). The power house structure will be reinforced concrete construction and will accommodate 2 turbines of conventional Francis type of 60 MW each. The total installed capacity of the Power House shall be 60x2 =120 MW. One 100 tonnes and one 20 tonnes overhead travelling Crane will be installed in the power house. Erection bay is proposed to be provided on the left side of the machine hall at RL 529 M. and control room, office block etc. is proposed to be located in between the power house building and the hill slope and transformers are proposed to be placed on the side of the power house at an elevation of 534.0. The switchyard shall be located on the terrace lying on the left hand side of power house. Power plant equipment including control equipment and other miscellaneous equipments, electrical and hydraulic apparatus and steel structures for the switch yard, except as otherwise specified shall be erected by U.P.S.E.B. Sills, guides & other embedments for all the hydro mechanical equipment, will be supplied by the Government but shall be installed by the Contractor.

The total concrete in the power house alone shall be about 25000 m^3. This concreting shall have to be done in 30 months time, concurrently with the installation of turbine parts like draft tube liner, scroll casing etc.

(II) Surge Tank & Penstocks : A restricted orifice type Surge Tank is proposed at the end of H.R.T. The diameter of the Surge tank and riser will be about 18 M. & 10 M. respectively. It shall be about 60 M. high from the top of the tunnel.

Two no. penstocks of 4.00 M. dia would be taken out from the riser at the Surge Shaft beyond its junction with the H. R. T. The length of each of the penstock will be about 200 M. The angle of inclination of the penstock would be about 30^0 to the horizontal. The penstocks would be lined with micro-alloyed steel MA 410 HYB (Manufactured by SAIL) plates of appropriate thickness or any other suitable steel liner as approved by the Engineer-in-Charge.

(III) The Head Race Tunnel : The diameter of the tunnel will be about 7 M. and it will be circular in shape. It will start from Hathiari end with its central line at El. 589. O.M. and will be constructed in almost straight alignment towards Vyasi dam at an upward gradient of 1 in 100 approx. in a total length of 2.7 Km. approximately. Half of the tunnel i. e. 1.35 Km. long approximately is to be constructed from Hathiari end under this contract. A construction adit will have to be made at Hathiari for this purpose. The tunnel would be supported and concrete lined.

(B) Construction of Power House would involve construction of a protection wall along side the river in between the two natural rock spurs available near about for isolating the area of operation. For this purpose approx. 20 M. high protection wall of boulder masonry or concrete etc. with grout curtain uuder-neath will have to be constructed by the contractor. The protection wall should be strong enough to withstand the floods. The monthly maximum observed discharges in river Yamuna at Lakhwar site (gauge site G-2), about 10 Km. upstream and corresponding river gauges at about 135 m. downstream the power house site are shown in exhibit 1 (VOL. III). In year 1978 approximate flood discharge of 3700 cumecs, the maximum so far, has passed at Hathiari Power House site at a river gauge of 526 M. The contractor is advised to make his own assessment of the flood discharge for which to make this protection wall safe and he will stand responsible for safety of works, men, materials and equipments during rainy season or otherwise under all circumstances. Construction of the protection wall has to be so planned as to enable excavation of the power house foundation to the deepest desired level.

8.02 DRAWINGS :

(A) Tender Drawings.

The following drawings are made a part of these specifications :

Exhibit-1 : Index map and discharge data at Lakhwar dam site.
Exhibit-2 : Lakhwar Vyasi Yojna-Access roads and General Layout.
Exhibit-3 : Geological log of Drill Holes at Hathiari Power House site (i to v).
Exhibit-4 : Geological plan of Hathiari Power House site.
Exhibit-5 : Geological Section along Water conductor System of Hathiari Power House.
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Exhibit-21 : Analysis of R. B. M. in pits at proposed quarry site in Yamuna river bed & Naro-ka-khala.

(B) Additional, general, revised & detailed drawings.

The drawings which form a part of these specifications show the work to be done under these specifications as definitely and in as much detail as is possible at the present stage of the development of the design. These drawings will be supplemented and/or superseded as the work progresses by such additional, general, revised and detailed drawings as may be considered necessary or desirable by the Engineer-in-Charge. Such additional, general, revised and detailed drawings will show dimensions and details necessary for construction purpose more completely than are shown on the attached drawings for all features of the work and for the installation of machinery or equipment. In case there is difference in details or in specifications and drawings, the details given in these additional, general, revised and detailed drawings shall prevail. The Contractor shall be required to perform the work on these features and in accordance with the additional, general, revised and detailed drawings mentioned above and all alterations, at the applicable unit prices tendered in the schedule of bids for such work or works as per clause 3.10 as determined by the Engineer-in-Charge. The Contractor shall check all drawings carefully and advise the Engineer-in-Charge of any errors or omissions discovered. The Contractor shall not take advantage of errors or omissions, as full instructions will be furnished to the Contractor, should any errors or omissions be discovered. The Contractor shall on request be furnished with such additional copies of the specifications and drawings as may be required for carrying out the work.

8.03 CONSTRUCTION PLANT AND EQUIPMENT :

(A) The Contractor shall submit a complete plant layout for the work alongwith list of the equipment which they propose to utilise for construction of Power House and appurtenant

works and the source of procurement of the equipment. The basis of arriving at the requirement of the equipment may also be indicated.

The Contractor will be required to submit statement in the prescribed form for the imported equipment for which Government assistance will be required. The Government, however, does not assume any responsibility regarding supplies of the equipments. The entire construction equipment proposed by the Contractor for use on works will be subject to the approval of the Engineer-in-Charge.

(B) The exact amount of foreign exchange required by the Contractor, with details of the cost of equipment and the source of purchase shall be submitted by the Contractor as per clause 2.02. In case there is delay in release of foreign exchange and grant of import license, the date of completion contained in clause 5.29, will be altered suitably and no compensation would be given on account of such delays.

(C) All equiment intended to be paid for or financed in whole or in part with funds to be advanced to the Contractor shall be assigned and hypothecated to the Government until such time as the work under the contract is completed and accepted by the Government. The lien so created shall be paramount to all other liens upon such equipment. All other equiment employed by the contractor in connection with the work under this contract shall remain the property of the Contractor, free of encumbrance subject to the provisions of clause 5.21 of the contract. Upto the completion of whole of the work but not until such completion, all equipment except as may be purchased by Government in pursuance of sub para (I) hereinafter shall become subject to the disposition of the Contractor free or the lien herein provided.

(D) The Contractor shall obtain insurance effective from the date of receipt of the equipment at work site from an Insurance firm of repute to be approved by Government for all construction plant and equipment for which advance payment has been made to him under clause 3.07.

The insurance will be against theft, damage or destruction by fire or acts of God such as floods, earthquake etc. The amount of insurance not at any time be less than the amount of the balance advance outstanding against the Contractor at the time. Such insurance shall continue until the said advance has been fully recovered from the Contractor and the insurance policy shall be pledged to the Government of Uttar Pradesh.

(E) The Contractor shall be solely responsible for adequacy, efficiency, use, protection, operation, maintenance, repair and preservation of all construction plant. The Contractor shall be required to satisfy the Engineer-in-Charge that the machinery is being properly maintained and operated. The Contractor shall employ suitable staff for the satisfactory operation and maintenance of each machine.

(F) For equipment for which advance payment has been made, the Contractor shall maintain a log book of each machine with an initial value of Rs 25,000/- or more containing information about the actual hours of working of machinery, data regarding its performance and replacement of its parts and accessories. Such log book shall be kept at the site of machine to which the log book pertains and shall be available for inspection of the Engineer-in-Charge.

(G) No item of plant and equipment required for the construction of the work and brought to site for this purpose shall be removed by the Contractor prior to the completion of the work without the written permission of the Engineer-in-Charge. In respect of items of plant and equipment belonging to the Contractor, such permission to remove shall not be withheld by the Engineer-in-Charge unless in his opinion such item is required or is likely to be required for the completion of the work.

(H) Should the contract be terminated for any reason, the Government reserves the right, which must be exercised within 90 days from the date of such termination, to purchase the interest of the Contractor in construction plant and equipment by payment of all expenses incurred by the Contractor in the purchase, transport and erection at the site of such plant and equipment

less depreciation calculated in accordance with C.W.C. Depreciation Rules upto the date of termination of the Contract subject to the adjustment of the total advance payment made to the Contractor and total amount of recoveries made from the Contractor in respect of the plant and equipment. In the event of termination of the contract by either party for any reason and the Government not electing to purchase the interest of the Contractor in any plant and equipment as herein provided, it is agreed that the Contractor, if he elects to remove such plant and equipment, will pay to the Government an amount equal to the total advance payment made to the Contractor in respect of such plant and equipment together with interest less recoveries already made from the Contractor.

(I) The Government will also have the right to take over from the Contractor in its existing condition at the time of take over any of all plant and/or equipment which is no longer required for the works, and which is of foreign make (wholly or partially) and in the procurement of which the Engineer-in-Charge had helped the Contractor by way of release of foreign exchange or otherwise and the Contractor shall not dispose off such plant and equipment without obtaining prior permissin of the Engineer-in-Charge in writing. The price to be paid to the Contractor for the plant and/or equipment so taken over shall be 30 percent of the total cost (F.O.R. Dehradun including both the indigenous and imported components) occasioned to the Contractor at time of procurement for the works of this contract. Provided that such right shall be exercised by the Government not later than six months after completion of the work. In case the Government do not exercise the right as aforesaid to take over any of the plant or equipment the Contractor will be free to dispose off such plant and equipment as he choose except that Government shall have the first preference to purchase any item or items of the plant and equipment at the mutually agreed price which shall not be more than 30 percent of the original cost.

8.04 LOAN OF GOVERNMENT TOOLS, PLANTS AND MACHINERY :

The Government tools, plants and machinery, if available, may be loaned on hire to the Contractor from the stores of Engineer-in-Charge. Arrangement for carriage from Government stores to the work site and vice-versa shall be done by the Contractor at his own cost. The hire rates at which machinery will be loaned to the Contractor will be hourly use rates of machinery as fixed by the Engineer-in-Charge plus 10 percent supervision charges thereon.

8.05 CONSTRUCTION POWER :

A. General.

U. P. State Electricity Board (Called UP SEB) shall supply electrical power for the construction of Lakhwar-Vyasi Project. The supply shall be given to the Contractor for the civil and other allied works including Contractor's camp and camp utilities.

The power shall be supplied in bulk to the Contractor at 11000 volts, 3 phase, 50 cycle at one or more points as mutually agreed in the vicinity of work sites. Electricity may also be supplied at 400 volts, 3 phase, 50 cycle at certain points, if feasible and agreed to by the UP SEB.

B. Power Connection.

i) The contractor shall apply to the Engineer-in-Charge for taking connection at least three months in advance with the schedule for such connection required by him at various points and the quantum and other particulars of load. The application on prescribed proforma shall be forwarded by the Engineer-in-Charge duly recommended to the UP SEB. In case the supply of power is delayed the Contractor shall not claim any compensation on this account but suitable extension of time may be allowed by the Engineer-in-Charge on the written request from the Contractor, provided that in the opinion of the Engineer-in-Charge reasonable circumstances exist to justify such extension.

ii) The Contractor shall deposit the required security in cash with UP SEB at the admissible rates depending upon the contracted load which will be refundable after expiry of the agreement for electric connection with UP SEB.

iii) The Contractor shall execute separate agreement for each connection on 'Non judicial stamp paper' at his own cost with the UP SEB on standard agreement form prescribed by the UP SEB.

iv) In order to provide proper voltage regulation the Contractor shall comply with the following conditions :

(a) Motor upto 10 BHP may be of the Squirrel cage type and beyond 10 HP starting device shall be 'Star Delta' type designed to keep the starting current within the limit of thrice the full load current.

(b) Motor from 50 BHP to 100 BHP shall be of slipring type provided with starting device designed to keep the starting current within one and half time the full load current.

(c) The motor above 100 BHP shall be of "Synchronous Induction" type and starting device shall conform to provision as per above para.

v) At every point of supply reliability of supply will be ensured by laying of duplicate lines as far as possible by the UP SEB.

vi) In addition to above, UP SEB shall also make alternative arrangements for feeding the emergency load from diesel power house in case of supply failure from grid. However, the emergency load shall be identified in writing by mutual discussion with the Contractor, Engineer-in-Charge and UP SEB seeing the importance of the work. The Contractor shall lay his separate lines for emergency equipment from the point of supply at his own cost, so that only emergency load is fed from the diesel engines at the time of supply failure from the grid.

C. Maintenance of equipment and Inspection :

i) The Contractor shall provide and maintain in safe and satisfactory condition his own transmission, transformation and distribution system, sub-station and other equipments beyond the point of bulk supply. All such installations upto the end point of use will be such as to satisfy the requirement of 'Indian Electricity Act' and rules made thereunder as amended from time to time and shall be subject to the instructions and acceptance of the Chief Electrical Inspector of Govt. of U. P. or his authorised representative at the Contractor's cost.

ii) In the event of any electrical accident on the line and/or equipment owned by the Contractor, the compensation, if any, shall be payable by the Contractor, and the same shall not be claimed from the Government.

iii) After the points of bulk supply at 11000 volt, the Contractor will make his own arrangement of step down sub-station including transformer, switchgear etc. and shall lay his own distribution lines for distribution purpose. In case of supply at 400 volts the Contractor will make his own distribution system and install switches etc.

D. Metering Arrangement :

i) The supply of power to the Contractor shall be metered by UPSEB at bulk supply at the cost of Contractor for which metering panel complete with meter and other equipment shall be arranged by the Contractor at his own cost. Alternatively, this can be provided by UPSEB if available at the cost of the Contractor or on rental basis.

ii) The site of metering shall be decided by the UPSEB or his authorised representative and in case of any dispute UPSEB shall be the final authority whose decision shall be final and binding upon the Contractor. In case the metering is done at the sub-station of the supplier, the Contractor shall not claim for any line and transmission losses etc. However, the cost of the metering panel and equipment installed at the sub-station of the supplier shall not be charged from the Contractor except meter rent which shall be payable by the Contractor.

E. Rates.

(a) Construction power.

(i) The tendered rates are based on the rates of electricity as described hereinafter. In case there is any enhancement in these rates, the same shall be reimbursed to the Contractor by the Government. In case there is reduction in

the rates, the same shall be recovered from the Contractor.

In case the supply is given on 11000 volts for construction power, the rates of charges will be as below :

Damand charge (All KVA of billable damand for the month)	@ Rs. 30.00 per KVA
PLUS	
Energy charge (All KWH consumed in a moth)	@ Rs. 0.50 per KWH

(ii) Fuel surcharge :- In addition to the above charges, fuel surcharge as applicable from time to time shall also be charged. The present rate of fuel surcharge is Rs. 0.10 per KWH.

(iii) Minimum consumption guarantee charges, if imposed by the UPSEB and as applicable from time to time, shall be borne by the Contractor and the Contractor shall not be entitled for any compensation on this account from the Government.

(iv) In case the Contractor uses power more than the Contracted demand, the Contractor will have to pay charges for such excess to the UPSEB as per applicable tariff schedule of UPSEB and in addition, may have to face any other appropriate action as may be deemed necessary by the UPSEB to restrain the Contractor from excecding his contracted demand. In case the additional charges on account of excess demand are imposed on the Contractor by UPSEB, the same shall be borne by the Contractor and he will not be entitled for any compensation on this account from the Government. Similarly, if any surcharge is imposed by the UPSEB on the Contractor on account of low power factor, the same shall also be borne by the Contractor and in that case also he shall not be entitled for any compensation on this account from the Government.

(v) Area lighting :- The electrical energy supplied for construction work can be utilised for area lighting which shall mean and include all the energy consumed in the offices, the main work area/workshop, dispensaries, staff welfare centre and compound lighting only. For purposes other than the above, separate metering will have to be provided.

(vi) If the supply is given on 400 volts 7.5% extra charges shall be levied on the amount calculated on the rates of 11 KV mentioned above.

(vii) In the event of any bill not being paid by the due date specified therein, the Contractor shall pay charges of Rs. 0.07 per day per Rs. 100/- or part thereof on the unpaid amount of the bill for the period by which the payment is delayed beyond the due date specified in the bill without prejudice to the right of the UPSEB or its authorised representative to disconnect the supply and or to take any legal action to recover the dues as may be deemed fit including deduction of dues from his bills payable to him by the Government for work done by the Contractor against this or any other contract. Such additionol charges shall be borne by the Contractor and he shall not be entitled for any compensation on this account from the Government.

(b) Light and Fan (domestic).

For colony of the Contractor or for domestic purpose, separate connection shall be taken by the Contractor for which UPSEB rate schedule LMV-10 (at present @ Rs. 0.68 per KWH) shall be applicable if the supply is taken on 400 volts. A rebate of 5% will be admissible at the gross rate if supply is taken at voltage higher than 400 volts. However, no hill development rebate as admissible to the general public of the hill area shall be admissible to the Contractor. The above

rates are subject to a rebate of Rs. 0.05 per KWH provided the bill is paid by the due date specified therein.

F. Electricity Duty.

In addition to the charges of electricity consumption as provided under clause 8.05 E (a) and 8.05 E (b) above, electricity duty as applicable from time to time shall be charged. The present rate of electricity duty is Rs. 0.02 per KWH.

G. Protest and Claims.

(i) The Contractor shall not claim any compensation for any failure of supply for any duration at any or all bulk supply points.

(ii) In the event of power shortage due to any unforeseen circumstances, the load can be reduced to any extent for which Contractor shall not be entitled to claim any compensation or loss.

(iii) The Government shall not be responsible for any loss/damage to the works, human being and material due to lock-out, strike by any cadre of the employees of the UPSEB or any other person beyond the control of UPSEB (supplier).

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CHAPTER- 9

MATERIALS

9.01 DEVIATIONS, ALTERATIONS ETC. IN THE MATERIALS :

The Contractor shall not in any way alter any of the materials to be used on the works without the previous consent of the Engineer-in-Charge but the Engineer-in-Charge may from time to time and at any time direct in writing any deviations, alterations, additions or omissions to be made from, in or to the materials, or any part thereof and any deviations, alterations, additions or omissions made in pursuance thereof shall not vitiate this contract and any deviations so directed to be made shall be made to the satisfaction of the Engineer-in-Charge in the same manner as if materials had been originally included in or omitted from the specifiations and schedule of quantities and bids, except that value of the same, whether by way of addition or deduction, shall be estimated by the Engineer-in-Charge according to the schedule of quantities and bids where applicable and worked out as an extra item otherwise.

9.0 SAMPLES AND/OR DESCRIPTIVE DATA :

Samples and/or descriptive data as required shall be submitted by the Contractor to the Engineer-in-Charge in good time before the use of such materials so as to permit inspecion and testing. The samples shall be properly marked to show the name of the material, manufacture, place of origin and the location where it is to be used etc.

Failure of any sample to pass specified tests, will be sufficient cause for refusal to consider any further samples from the same source. Materials will be used only after obtaining approval of the Engineer-in-Charge.

9.03 (I) MATERIALS TO BE FURNISHED BY THE GOVERNMENT :

A. Cement.

(a) For execution of works under this contract as also for construction of camps and other ancillary works, the Government will furnish cement.

(b) The issue of cement for bonafide use in the works shall be subject to the following conditions :

(i) Cement whether supplied in bulk or bags shall be used only for works approved by the Engineer-in-Charge as provided in the contract.

(ii) (a) For main works cement is being arranged in unpacked loose (bulk) condition and will be available direct from wagons and/or factory and/or from departmental storage sites at following places :

(I) U.P. Irrigation Department, Railway Siding, Harrawala near Dehradun.

(II) Rajban Cement Factory near Paonta Sahib (H.P.)

(b) For works where use of cement in loose and unpacked conditions is not required or when supply can not be arranged to be given in bulk, cement will be given to the contractor in bags at U. P. Irrigation Department. Railway Siding Harrawala near Dehradun and/or at Saharanpur Railway Station and/or at Rajban Cement Factory (H.P.)

(c) The tendered rates for concrete are based assuming :

deleted

(I) that 10% of the total cement is to be supplied in bags and the balance 90% in bulk. The Contractor shall be paid at Rs. 3.50 per bag for the cement supplied in bags in excess of 10% or recoveries made from him at the same rate if the cement supplied in bags falls short of 10% of the total supplied at the end of the work. For operation of this clause, one tonne of bulk cement shall be taken equivalent to 20 bags of cement.

Amended

(II) that the cement shall be issued from places and at rates specified in clause 9.03 (I) (A) VIII and 9.03 (I) (A) IX hereinafter. In case the cement is supplied from any place other than those specified in clause 9.03 (I) (A) VIII and 9.03 (I) (A) IX, its issue rate shall be enhanced or reduced over the departmental silos (or godowns) rates at U. P. Irrigation Railway Siding Harrawala at the rate of Rs. 1/km/ tonne (or 20 bags of cement) for the actual kms. travelled in excess or in short of 75 km. which is the distance from the Railway Siding Harrawala to the site of work including plain & hill roads. The distance between the supply point and the site of works shall be decided by the Engineer-in-Charge.

(III) (a) In case of bulk cement, the weight of the cement passing from silos to the bulk carriers of the Contractor shall be recorded by weigh bridge or other device to be furnished by the Government.

(b) In case of cement supplied in bags, no weighment will be made, the cement content shall be taken as fifty kg. per bag.

(IV) The Contractor shall have to transport and carry the cement from the point of delivery at Railway Station or Factory site to the sites of work at his cost and risk and shall provide suitable means for its protection and take all necessary steps to safeguard the cement against deterioration and / or losses and/or pilferage in transit and storage. Such arrangement shall be made to the satisfaction of the Engineer-in-Charge. Any cement found short due to loss or pilferage during transit shall be recovered at penal rate as per clause 9.03 (i) F and in addition legal action can be taken if deemed fit by the Engineer-in - Charge. The responsibility for obtaining permits for plying the vehicles for conveyance of cement on P. W. D. roads shall be that of the Contractor. The Contractor shall pay all the vehicles and road taxes for plying the vehicles as leviable.

(V) (a) Storage silos or godowns with total storage capacity of not less than 1000 tonnes will have to be constructed and erected by the Contractor at or near the batching plant at his own cost. The Contractor shall without any additional cost to the Government, increase the capacity of cement silos or godowns upto 2000 tonnes as soon as he is informed by the Engineer-in-Charge that it is necessary to do so.

(b) Bulk cement shall be transported in double locked bulk cement carriers. The design of the bulk carries and the storage silos and mode of transferring the loose cement from bulk carriers to the silos and arrangement of taking out loose cement from storage silos for use on works shall be subject to approval by the Engineer-in-Charge.

(VI) The Engineer-in-Charge will handover railway receipt/authority to the Contractor duly endorsed in Contractor's favour. The Contractor shall be responsible for taking delivery from railway / factory authorities, promptly unloading of cement and for proper care of cement in these operations and will be held liable for any demurrage and/or wharfage charges incurred due to the Contractor's failure to promptly unload wagons/silos and removing cement from railway/factory premises.

(VII) Cement in bulk/bag will, as far as possible, be booked in wagons at

Railway Risk. In case of deterioration due to any reason or where the bags received are in lesser number than specified in the R.R. for which the railway may be responsible, the Contractor shall intimate the details of such losses and/or deterioration to the Engineer-in-Charge, within 24 hours of taking delivery of the consignment and shall correctly fulfil all the requirement of Railway Authorities in registering such losses at the time of taking delivery from the railways. In case the contractor fails to do so and the claim for the losses/deterioration is thereby not accepted, the Contractor shall bear the cost of such losses/ deterioration.

(VIII) (a) The Contractor shall pay for the cement supplied by the Government at the rates given in clause 9.03 (I) A (VIII) as hereinafter. The cost of unloading, weighing, loading, handling, storing and carting the cement shall be borne by the Contractor and shall be presumed to be included in the unit prices for the items of work in which cement is utilized.

(b) The cost of cement delivered by the Railways in a condition unfit for use shall be refunded to the Contractor provided he has taken action to register the loss at the time of taking the delivery, as stipulated in clause 9.03 A (VII) hereinabove and provided further that he delivers such cement in the stores of Engineer-in-Charge.

(c) The Engineer-in-Charge may direct the Contractor in writing to lift cement for the work from a Railway yard on the basis of Railway Receipt even in excess of his monthly requirements as intimated by him under sub-clause XII hereinafter and the Contractor shall be bound to lift all such cement. However, the cost of such excess cement will be deducted from the intetmediate bills of the Contractor after such excess cement (above the monthly requirements) has actually been used in the works.

The recovery of cost of cement so issued shall be made at the rates specified below :

Place	Issue rate of cement in Rupees			
	Destignation Rly Station/ factory premises		From departmental silos/godown at Rly. Station/factory premises	
	Bulk per M.T.	Per bag (excluding cost of EC bag)	Bulk per M.T.	Per bag (excluding cost of EC bag)
U.P. Irrigation Railway Siding Harrawala near Dehradun	850	45.00	870	46.00
Saharanpur	830	44.00	—	—
Rajban	855	45.75	885	46.75

(IX) In special circumstances, cement, if available in the Government stores at Dehradun or Dakpather or Ambari or Haripur or Hathiari may be issued to the Contractor at his request or at the instance of the Engineer-in-Charge. The recovery of cement so issued shall be made at the following rates.

Dehradun Yamuna Colony Stores	Rs. 46.50
Dakpather/Ambari	Rs. 48.75
Haripur	Rs. 49.25
Hathiari	Rs. 50.00

(X) (a) The Government will not be responsible in any manner if the cement in bags delivered to the Contractor in railway wagon or issued to him from Dehradun/Dakpather/Ambari/Haripur/Hathiari or any other Stores are found to contain less than 50 kgs. of cement per bag. The cost of cement in bags under all circumstances will be charged on the basis of number of bags supplied and at the rates specified hereinabove irrespective of the actual weight of cement contained in bags. For cement supplied in bulk the cost will be charged on basis of the recorded weight as per clause 9.03 (I) A (III) above.

(b) The dispensation of cement shall be by actual weightment both in case of weigh batching for manufacture of concrete & for volume batching. The loss of cement due to handling, transit and storage shall be borne by the Contractor. Wastage of cement upto 1% (One percent) on account of handling, transit & storage shall be treated as bonafide loss and shall be recovered from the contractor at normal issue rates. However any shortage of cement beyond the limits of 1% as specified hereinabove shall be recovered from the Contractor at the penal rates as per clause 9.03 (I) F.

(XI) The Contractor shall arrange to open the cement bags in a manner as to prevent any damage to them so that the same could be used again. Empty cement bags in good and useable condition shall be returned by the Contractor free of charge to the Govt. Stores at site of works within 60 days of use of cement, failing which recovery of cost of empty bags will be made at the rate of rupees two or D.G.S.&D. rate applicable during the month of issue of cement whichever is higher, for each bag not so returned by the Contractor within the stipulated time. The recovery shall be affected from the intermediate bills of the Contractor, provided that recovery of cost of empty cement bags used by the Contractor on works with the specific permission of the Engineer-in-Charge (which shall not exceed 5% (Five percent) of total bags issued) will be made at Rs. 1/- (Rupee One) per empty bag. The bags shall not be put to any other use by the Contractor before returning them to the stores and all empty bags will be carefully stored and transported to prevent damage from weather conditions.

(XII) The Contractor shall within two months from the date of receipt of notice to commence the work submit a quarterly programme of his requirement of cement for the duration of the contract and thereafter by June 30 every year, his monthly requirements for the ensuing year commencing Oct. 1. Modification of the quantity, if any, required subsequently shall be intimated by the Contractor to the Engineer-in-Charge atleast one month before such change is desired. If the Engineer-in-Charge finds that the Contractor has overstated or understated his monthly requirement of cement, he will direct the Contractor to correct the same and the Contractor shall carry out such directions. The decision of the Engineer-in-Charge as regards the quantum of the monthly requirement of cement will be final and binding on the Contractor.

(XIII) The Contractor shall not claim compensation on account of inadequate supply or

any failure in the supply of cement and/or steel provided that the breakdown of the supply of cement and/or steel is not for a period exceeding 15 days at a stretch. Should any one breakdown of supply be for a period of more than 15 days at a stretch and should the contractor be obliged to stop work on this account, he shall be allowed compensation equal to the cost of the supervisory staff that cannot be utilised elsewhere on the job under the contract and thus becomes idle on this account subject to a maximum of Rs. 1000/- (Rupees one thousand) only per working day (excluding Sundays and statutory Holidays) for the period beyond fifteen days till the normal supply is restored. In respect of adequacy and reasonableness of such compensation the judgment of the Engineer-in-Charge shall be final and binding on the Contractor. The Contractor shall also be given extension of time for the completion of work to the extent considered reasonable by the Engineer-in-Charge.

(XIV) The Contractor shall not use or bring in any cement that is not supplied by the Government and shall not take any cement outside the work area or permitted routes. The Contractor shall be held responsible to keep proper account for all the cement entrusted to him. The Engineer-in-Charge reserves the right to take inventory of the Contractors stocks at any time and check the cement stock at any time. Any excess cement noted during the inventory shall be credited to the Government account and for any deficiency the penal recovery will be made at twice the issue rate specified as per clause 9.03 (i) F.

(XV) The Contractor shall provide all facilities to the Engineer-in-Charge to inspect the cement stored in Contractor's godown and to take samples as and when necessary. Such inspection shall not however absolve the Contractor of the responsibility for taking care during storage and all precautions shall be taken by him to maintain the cement in good condition. As far as practicable all cement shall be stored according to batches in which the consignments are received and earlier supplies shall be utilised first.

(XVI) (a) The contractor shall provide and install suitable weigh bridges at his own cost at the work sites and/or at his storage points. These shall be subject to approval of the Engineer-in-Charge.

(b) After installation the Contractor shall get the weigh bridges tested, verified and stamped by the Inspector of Weights and Measures. The stamping fee shall be borne by the Contractor. No weighment shall be permitted until weigh bridge has been so tested, verified and so stamped.

(c) The Contractor shall arrange for regular maintenance and testing of weigh bridge at his own cost. The Engineer-in-Charge may require the weigh bridge to be tested and calibrated at any time and the Contractor shall provide the necessary facilities for checking and calibrating.

B. POZZOLANA, AIR ENTRAINING AGENT AND OTHER MIXTURES :

For items of cement concrete provided in the Technical provisions, pozzolana to the extent of about 25 percent by weight of replacement of cement may be used. Pozzolana shall be made available to the Contractor free of cost within 1.5 km. of the batching and mixing plant. The cost of storing, handling, batching and mixing shall be borne by the Contractor and shall be included by him in unit prices tendered for concrete.

The Government will furnish Air Entraining Agent and Yamuna set etc. if required to be used to the Contractor free of charge at Govt. Stores at Dakpathar. The cost of transport, storing, handling, batching and maxing shall be borne by the Contractor and the same are included in the unit price for concrete in the schedule of quantities and bids. Recovery for Yamuna set and Air Entraining Agent (AEA) not used on the works and not returned to the stores of the Govt. at Dakpather shall be made at Rs. 12.00 per kg. and Rs. 20.00 per kg. respectively.

C. MECHANICAL AND OTHER EQUIPMENT :

The Government will furnish plumbing, electric and test installations and mechanical equipment which are required to be installed by the Contractor in accordance with Chapters 32 and 33 of the Contract. All materials furnished by the Government will be delivered to the Contractor in railway wagons at U. P. Irrigation Department Railway Siding near Harrawala (Dehrdun). The Contractor shall, at his cost, haul all the materials from the point of delivery to the site of work, shall provide suitable storage for materials and also provide suitable means of protection of such materials not stored in the Government stores. Materials and equipments shall be stored in the most suitable manner to protect them from distortion or other damage, to the satisfaction of Engineer-in-Charge and where directed by the Engineer-in-Charge shall be placed on timber blocking to be furnished by the Contractor.

Machined or finished surfaces of all mechanical equipment and other parts subject to damage by weather, water or dust shall be protected by the Contractor from camage in a manner satisfactory to the Engineer-in-Charge. The Contractor shall inform the Engineer-in-Charge about transport of any consignment of machinery to the site within three days of having transported the consigment. The Contractor shall thereafter open the consignment in presence of an authorised representative of the Engineer-in-Charge and take over the contents. Shortage, if any, that may be found at the time of opening of the consignment shall be got duly verified by the authorised representative of the Engineer-in-Charge and reported by the Contractor in writing to the Engineer-in-Charge within 24 hours of opening of the consignment to which such shortage pertains. The Railway Receipt will be handed over to the Contractor who shall be responsible for the prompt unloading of materials delivered in railway wagons and/or proper care for the materials and will be held liable for any demurrage and/or wharfage charges incurred due to his failure to unload wagons promptly, within the stipulated time. The cost of unloading, handling, storing and protection of all the materials furnished by the Government are included in the unit rates of lump sum bid for the installation of such equipment or in the rates of item of work in which such materials are to be used. The Contractor shall return at his cost and expense all unused materials to the Government at the Railway Station, most convenient to the work or at points as directed by the Engineer-in-Charge. The actual cost of the unused materials not returned by the Contractor will be recovered from the Contractor's bill, the actual cost being determined at the point of delivery of such materials to the Contractor. The Contractor shall furnish a programme of requirement of such materials with respect to time schedule within 8 weeks after the date of redeipt of the notice to proceed with the work and thereafter repeat the intimation of requirement according to the latest effective construction programme, three months in advance.

D. STEEL.

I. Government will issue steel to the Contractor for the works as per items of schedule of quantities and bids or items as per clause 3.10 according to the schedule below showing materials, rates and places of delivery. Steel used in the items which are not measured for payment purpose but are embedded permanently in the payable items of concrete and shotcrete etc. like anchors, dowels, chairs etc. shall also be issued at the rates given in the Table below. These however will not be treated as part of reinforcement or supports for purposes of payment. Steel shall be issued to the Contractor by actual weighment but for payment purposes weight of steel shall be calculated on the basis of latest edition of ISI Hand-book for Structural Engineers. For sections not covered by ISI Handbook, supplier's sectional tables shall be used. The Government shall not be responsible in any manner if weight of steel issued to the Contractor is different from that calculated for payment as aforesaid. The Contractor shall, to fulfil the requirement of work, procure steel from Govt. stores in the first instance, if available.

Sl. No.	Material	Rate in Rs./tonne At Dakpather/Ambari store
1.	M. S. Rounds/Tor steel	6000
2.	M. S. Structurals including rails	6000
3.	M. S. Plates	6400
4.	Galvanised corrugated/Plain Sheets.	11500

II. The Contractor shall purchase steel from outside only after he has been denied the issue of steel from Govt. stores in writing and has been allowed to purchase steel from outside in writing by the Engineer-in-Charge. In such event, the difference of cost over or below the issue rates specified above per tonne shall be adjusted by reimbursement to or rebate from the Contractor. The Contractor shall submit documentary proof to the satisfaction of the Engineer-in-Charge regarding the rates at which the steel has been purchased from outside. In case of non-availability of steel from Govt. stores at Dehradun/Dakpather/Ambari, purchase of steel from outside shall be permitted by the Engineer-in-Charge in writing, for the following two cases :

1. In respect of items of schedule of quantities and bids or items covered under clause 3.10 to the fullest extent required.
2. In respect of items for which payment is not being made under items of schedule of quantities and bids or to the extent of difference of quantities mentioned in clause 9.03 D (III) and the quantities actually issued to the Contractor from Govt. stores for such items.

III. Steel which is required by the Contractor for such items of works for which payment is not being made to him by measurement of steel consumed such as steel used in construction utilities, preparation of jigs, centering and shuttering, camp construction, bridges etc. shall be supplied at the rates specified in the sub-clause I above to the limits of quantities mentioned below :

A. Corrugated G. I. Sheets 200 Tonnes
B. Plane G. I. Sheets 50 „
C- Structural steel (R.S. Joists, Channels, angles, flats, M.S. Rounds, tor steel and M.S. Plates) 300 „

This limit shall however not included permanent embedments like chairs, dowels etc. as mentioned in (D) above.

Any quantity in excess of above shall be arranged by the Contractor or issued from the Govt. stores if available at Dakpather/Ambari at stock issue rates prevalent at the time of issue plus 10% supervision charges. Steel as issued above will not be taken back and the Contractor will be permitted to shift the used material and articles fabricated from these materials to other project sites after completion of works.

IV. The maximum allowance made for wastage and scrap for different categories of steel being used in different items of works as per schedule of quantitids and bids shall be limited to the following. These allowances shall be determined as percentage of the total steel consumed in the various items of the schedule of quantities and bids or extra items as per clause 3.10.

	Item	Permissible allowance for wastage	Permissible allowance for scrap over and above the wastage
(i)	Structural steel (R.S. joists, angles, channels, flats, plates, excluding G.C. Sheets and plane sheets)	(2%)	(10%)
(ii)	M.S. Rounds and Tor steel	(1%)	(5%)

(These allowances do not include the steel used in the items which are not measured for payment purposes such as use of steel in dowels, chairs etc. but a record of such steel shall be kept and measured for proper accounting of steel issued from the Government stores),

V. All the steel scrap and steel not utilised or recoverable from the works shall be taken back by the Department at 80% of rate at which these are issued to the Contractor under this contract. Steel covered wholly or partially with concrete shall not be taken back. The decision of Engineer-in-Charge in this respect shall be final and binding on the Contractor. It shall be binding on the Contractor to return the steel scrap and steel not utilised or recoverable from the works at Government stores at Dakpather.

E. MISCELLANEOUS MATERIALS AND EQUIPMENT.

If the Contractor requests the Engineer-in-Charge for issue of such other materials and equipment as may be available in the stores of the Engineer-in-Charge, these materials and

equipment may be issued to him from the stores for the execution of the work, if the Engineer-in-Charge considers it so expedient. The Contractor shall pay for such materials and equipment at the price fixed by the Engineer-in-Charge from time to time and such price will include the cost of procurement, transport to the stores, storage and other incidental expenses whatsoever.

F. No material which may be issued by the Government to the Contractor for use on the work shall be utilised elsewhere or otherwise disposed off by him. If the Engineer-in-Charge is satisfied that the contractor has sold or used the material on the works other than pertinent to this contract, the cost of such material will be recovered from his bills at a penal rate equivalent to twice the rate as provided in clause 9.03 (I) (A) and 9.03 (I) (D) or twice the stock issue rate at departmental stores at Dakpather/Ambari prevailing at the time of effecting the recovery, whichever is higher.

G. No material issued by the Government to the Contractor shall be removed by him from the site of work without prior and written approval of the Engineer-in-Charge.

H. The Contractor will produce satisfactory evidence to the Engineer-in-Charge of having used the cement and other materials issued to him from Government stores bonafide for the execution of the works, payable or nonpayable, under this contract.

9.03 (II) MATERIAL TO BE FURNISHED BY THE CONTRACTOR :

Except the materials which may be issued by the Government under clause 9.03 (I) hereinbefore, all other materials required for the execution of this contract and corresponding to the specifications stipulated either in this chapter or under the technical provisions given for the items of works in this contract will be furnished by the Contractor.

9.04 PRICE VARIATION FOR MATERIALS :

A. IMPORTED MATERIALS.

(a) If the applicable exchange rate of rupee and foreign currency as ascertained by the Engineer-in-Charge from time to time during the period of execution of works are different from the rates applicable on Jan, 1, 1985, compensation will be paid to the Contractor or deduction made from payment due to him to the extent of 100 percent of variation depending upon whether there has been an increase or decrease, over the rates applicable on Jan 1, 1985, provided that the adjustment will apply only to the quantity of materials and equipment imported for the work under this contract after obtaining written approval of the Engineer-in-Charge.

(b) if the applicable rates of Custom and Excise duty of imported equipment and spares as ascertained by Engineer-in-Charge from time to time during the period of execution of work are different from the rates applicable on Jan 1, 1985, compensation will be paid to the Contractor or deductions made from payments due to him to the extent of 100 percent of variation depending upon whether there has been an increase or decrease over the rates applicable on Jan 1, 1985.

(c) Adjustment on account of variations provided for in sub-clause (a) and (b) above will be made quarterly. The Contractor will maintain accounts and details in respect of such items in a manner approved by the Engineer-in-Charge.

B. INDIGENOUS MATERIALS.

(a) The contract is based on the prices including taxes as prevalent on Ist Jan, 1985 of various materials stated below. Any variation in price including any change in rate of taxes, excise duty etc. and including any new taxes and duties imposed on the same shall be adjusted on the following basis. These variations shall be adjustable only on the value of work done as per item of schedule of quantities and bids.

(i) The base price of high speed diesel oil, petrol main lubricants (viz. mobil oil grade 30 and 40) shall be as per Indian Oil Corporation list prices at Saharanpur. These commodities will be treated as representative of all P. O. L. These commodities will be taken together and their value will be treated as equivalent to 5 (five) percent of the total value of work calculated at the

unit price specified in the schedule of quantities and bids. The percentage of these three products which will govern are :

High Speed Diesel Oil	75%
Petrol	10%
Main lubricants	15%

The price variation in any of the above three products will be adjusted on the above basis as illustrated below :

(Plus)	10% variation in price of high speed diesel oil.	7.50%
(Plus)	0% variation in price of petrol	0.0%
(Plus)	15% variation in price of main lubricant of grade 30 and 40	2.25%
		9.75%

Increase in price payable to the Contractor will be 9.75 x 5% i.e. 0.4875 of the value of work done after the date of increase.

(ii) The base price of explosive shall be as per prices of 80% strength special gelatine of Messrs. Indian Explosives Ltd. as applicable in the State of Uttar Pradesh.

Value of explosives will be treated as equivalent to $2\frac{1}{2}\%$ (Two and half percent) of the value of work calculated at the unit prices specified in schedule of quantities and bids. Any price variation in explosives will be adjusted on the same basis as illustrated in (i) above.

Note : Explosives include detonators also.

(iii) Value of tyres and tubes and flaps of all autovehicles, earth moving machinery, mobile cranes and trucks etc. will be taken equivalent to 1% (One) of the value of work calculate at the unit prices specified in the schedule of quantities and bids. Any variation in prices of these shall be paid to the Contractor or recovered from him as the case may be every quarter ending March, June, September and December on the basis of formula given below :

$$A = 1\% \; R \frac{(B-BO)}{BO}$$

A=Amount reimbursable to or recoverable from the Contractor for the quarter under review.

R=Value of work done during the quarter under review.

BO=Index number of wholesale prices in India (New Series) (Base 1970-71=100) Rubber and rubber products) for Jan, 1985.

B=Average Number of wholesale prices in India (New series) (Base 1970-71=100) (Rubber and rubber products) for the quarter under review.

Index number of wholesale prices in India (New series) (base 1970-71=100) (Rubber and rubber products) issued by the Labour Bureau Simla and published by the Ministery of Labour, Govt. of India in the Indian Labour Journal or otherwise shall be accepted for purpose of calculations under this clause.

C. ANCILLIARY COMMODITIES.

The Contract is based on the prices including taxes as prevalent in Jan, 1985 of various ancilliary commodities. in additon to those covered by part (B) of this clause, which shall be required for the execution of works. Any variation in prices of the ancilliary commodities shall be paid to the Contractor or recovered from him, as the case may be, every quarter ending March, June, September and December on the basis of the formula given :

$$A = 10\% \; X \; R \; \frac{(M-MO)}{MO}$$

Where A=Amount reimbursable to or recoverable from the contractor for the quarter under review.

R=The value of the work done during the quarter under review.

MO = Index number of wholesale prices in India (New series) (base 1970-71 = 100) (All commodities) for Jan, 1985.

M = Average Index Number of wholesale prices in India (New series) (base 1970-71 = 100) (All commodities) for the quarter under reveiew.

Index number of wholesale prices in India (New series) (base 1970-71 = 100) (All commodities) issued by the Labour Bureau Simla and published by the Ministry of Labour, Govt. of India in the Indian Labour Journal or otherwise shall be accepted for purpose of calculations under this clause. Variation in prices of ancilliary commodities shall be adjustable only on the value of work done as per items of Schedule of quantities and bids.

The expression ancilliary commodities used hereinbefore means and includes all the materials required, whether directly or indirectly for the execution of work under this contract excluding those covered under part (A) above and those supplied by the Government.

9.05 PERIOD OF PRICE VARIATION FOR MATERIALS :

Clause 9.04 hereinabove shall remain operative only for the contract period as stipulated in clause 5.28 or extension thereof. In case the work is delayed due to the fault or negligence of the Contractor the aforesaid clause 9.04 shall not be operative and the Contractor shall not get any benefit under the said clause for the period of such delay in the completion of work.

9.06 APPROVAL AND STORAGE OF MATERIALS :

A. All materials or articles shall be approved by the Engineer-in-Charge. Samples shall be submitted for approval when so directed and the materials or articles used without such approval shall be at the risk of subsequent rejection. Such approval shall not absolve the Contractor from his responsibility to use materials and articles as per specifications.

B. The Engineer-in-Charge shall during the progress of the work have powers to order the following in writing from time to time.

I. The removal from the site within such time or times as may be specified in the order of any materials which in the opinion of the Engineer-in-Charge are not in accordance with the contract specifications.

II. The substitution of specified materials by other suitable materials.

III. The removal and proper re-execution (notwithstanding any previous test thereof or interim payment therefor) of any work which in respect of materials or workmanship is not in accordance with the contract specifications.

In case of default on the part of the Contractor in carrying out such orders the Engineer-in-Charge shall be entitled to employ and pay other persons to carryout the same and all expenses consequent thereon or incidental thereto shall be borne by the Contractor and shall be recoverable from him by the Engineer-in-Charge or may be deducted by the Engineer-in-Charge from any money due or which may become due to the Contractor.

C. The Contractor shall at his own expense, provide and furnish sheds and yards in such situations and in such numbers as in the opinion of the Engineer-in-Charge are required for the storage of materials arranged by him or handed over to him by the Government for execution of the work under this contract. The Contractor shall keep at each of such sheds and yards sufficient quantity of materials and stock so as not to delay carrying out of the works with due expedition.

9.07 INSPECTION OF MATERIALS :

All materials, process of manufacture and methods of construction, shall be subject to the inspection of the Engineer-in-Charge who shall be the sole judge of their quality and suitability for the purpose for which these are to be used. If any of them fails to meet his approval these shall forthwith be replaced and/or corrected and/or otherwise made good, by the Contractor at his own expenses and to the satisfaction of the Engineer-in-Charge. Rejected materials shall be disposed of as the Engineer-in-Charge may direct. Acceptance of any materials and/or workmanship shall not serve to prevent subsequent rejection by the Engineer-in-Charge if he finds either or both to be unsatisfactory. No material shall be transported to the work site from its place of manufacture without approval of the Engineer-in-Charge unless so ordered by him.

CHAPTER—10

QUALITY CONTROL AND INSPECTION

10 01 INSPECTION :

The Engineer-in-Charge shall have the right to inspect all materials and workmanship as specified in clause 9.07 and to control the quality of the same. Such inspections, however, will not absolve the Contractor from his responsibilities under the provision of any other clauses in the general condition or technical provisions of the contract.

10.02 TESTS :

The various tests that shall be required to be performed for different jobs and materials are specified in the following clauses. These tests are however only for obtaining information and do not purport to replace, define or explain any of the provisions in other clauses of the contract. The Engineer-in-Charge may also require the use of electric power, compressed air and other general services for the purpose of carrying out in-situ tests of the properties of the rock in adits, underground structures and other locations as specified by the Engineer-in-Charge. The contractor shall provide free of cost such services when required by the Engineer-in-Charge.

10.03 TESTS ON CEMENT :

(a) Cement will be required to be sampled at the work sites or at the stores. The contractor shall provide all facilities for sampling of cement as directed by the Engineer-in-Charge.

(b) The cement shall be tested to conform to the Indian Standard IS : 269-1976, IS : 455-1976 and IS : 1489-1976 and their subsequent amendments for ordinary portland cement portland slag cement and portland pozzolana cement, respectively. The tests shall be conducted according to IS : 4031-1968 and IS : 4032-1968 and their subsequent amendments for physical and chemical properties. These tests shall be done at Government expenses but the Contractor shall provide all sampling facilities at his own cost.

10.04 TESTS ON AGGREGATES :

(a) Tests shall be made for the suitability of coarse and fine aggregates by the Government at their own expense. All facilities shall, however, be provided by the Contractor at his own cost for taking and transporting to test laboratory representative samples of aggregates at various stages of the crushing and processing plant, stock piles, batching and mixing plant as considered necessary by the Engineer-in-Charge.

(b) All sampling of coarse and fine aggregates shall be done in accordance with Indian Standard IS : 2430-1969 and subsequent amendments.

(c) At the processing plant, the aggregates shall be tested in accordance with IS:2386 (Part I to VIII) for each new lot.

(d) At the batching plant, tests on aggregates shall be made for grading, absorption, moisture content and specific gravity. The grading analysis includes determination of oversizes and undersizes. The frequency of these tests shall be sufficient to ensure that aggregates are in accordance with requirement of specifications and shall be as determined by the Engineer-in-Charge.

10.5 TESTS ON CONCRETE AS MIXED :

(a) The following tests will be made on the concrete as mixed at the batching plant.

1. Consistency (Slump)
2. Air content
3. Unit weight
4. Temperature
5. Casting of specimens for compressive strength tests.

(b) Tests for consistency, unit weight and determination of entrained air shall be done as per latest IS : 1199 and the compressive strength test shall be done as per latest IS : 516. The frequency of sampling for casting specimen shall be in accordance with the provisions in IS : 456-1978 or its latest revision and for other tests the frequency shall be as required by the Engineer-in-Charge. The samples shall be taken from the discharge hopper of the batching plant.

(c) The strength and slump of concrete shall be as specified by the Engineer-in-Charge from time to time for various locations. Acceptance criteria for strength requirements shall be as per IS : 456-1978 or its latest revision.

(d) The Contractor shall erect and provide to the Government at his own cost such facilities as may be necessary for collecting and handling representative test samples of concrete at the batching and mixing plants.

(e) These tests shall be carried out at the Government's expense.

10.06 TESTS ON COMPACTED CONCRETE AT SITE :

(a) The Engineer-in-Charge may take out cores of size depending upon the maximum size of aggregate used in concrete after it has been poured and properly cured. The frequency of taking out cores for testing shall be decided by Engineer-in-Charge. The coring shall be done at Government cost.

(b) The contractor shall fill up all holes made in the concrete by coring as described above, with mortar or concrete and cure the mortar or concrete so poured in holes without any extra payment to be made by the government.

(c) The testing of concrete cores shall be done as per IS:516 (latest).

10.07 TESTS FOR WELDING :

Tests as described below shall be performed by the Government to check the adequacy and efficiency of welding for different structures. The particulartests to be performed shall be specified by the Engineer-in-Charge from time to time. The Contractor shall provide free of cost, all facilities for making these tests and shall also furnish test specimens wherever required by the Engineer-in-Charge and in a manner specified by him.

(a) Visual Inspection : Visual inspection shall be made to ensure that :

(i) Size of weld is correct

(ii) Weld deposit is of correct contour.

(iii) Weld is clean and free of slag, excessive oxides and scales.

(iv) Weld edges indicate thorough fusion without undercut and overlap.

(v) Weld bands are free of pin holes and have uniform fine ripples.

(b) Tensile Tests : Tensile tests on welded splices of reinforcement bars shall be taken at random from actually placed reinforcement at the rate of not more than one out of 100 splices. In case the splice is found to be defective, the test shall be repeated on other random splices until three successive tests give satisfactory results.

(c) Radiographic Inspection : Radiographic inspection by X-ray equipment or Gamma Ray equipment depending upon the thickness of materials and nature of work as determined by the Engineer-in-Charge, shall be done in shop and/or at site. The directions of the Engineer-in-Charge with regard to the work where these tests are required to be done shall be final and binding on the contractor. X-ray examination shall be done in shop where the thickness of metal does not exceed 5 cm while beyond this thickness Gamma-Ray Examination shall be done. At the work site either Gamma-Ray Examination or inspection by Ultra Sonic flaw detector shall be done as directed by the Engineer-in-Charge.

All the epuipment, test plates and operational staff etc. for radiographic examination shall be supplied by the Contractor.

The Contractor shall take proper precaution to safeguard against hazards of radiation in such test.

(d) Ultra Sonic Inspection : Where it is impractical or inexpedient to take radiographs of welds, inspection shall be done by Ultra Sonic flaw detector by the Government. This detector shall also be used for difficult locations and also to check defect not discernible in the radiograph.

The Ultra Sonic equipment shall be supplied by the Government.

(e) Hydrostatic pressure tests :

(i) Where required by the specifications for the particular item of work, each

individual pipe section shall be subjected to hydrostatic pressure test. This test shall be done only after all welding has been inspected, radiographed, repaired where required, and finally accepted by the Engineer-in-Charge.

(ii) Unless otherwise called for in the specifications a stress equal to $1\frac{1}{2}$ times the design stress shall be produced in the tests. The pressure shall be held at that value for a sufficient length of time to permit inspection of all plates, welds and connection for leaks or signs of failure.

10.08 TESTS OF WELDERS :

(a) Welding shall be done only by qualified welders. The Contractor shall arrange for quaiification tests on all welders under the direction of the Engineer-in-Charge and shall submit test result to the Engineer-in-Charge for approval. The qualification procedure shall be according to IS:817-1966 "Code of practice for training and testing of metal arc welcers" or its latest revision.

(b) Regular performance tests shall also be required to be done for horizontal, vertical and overhead positions for all welders. The performance test shall be done under the directions of and at intervals approved by the Engineer-in-Charge and all test results shall be submitted to the Engineer-in-Charge for his appproval.

10.09 TEST FOR PAINTING :

(a) The contractor shall submit test certificates, form Government Test House Alipur, Calcutta or other testing centres as approved by the Engineer-in-Charge in respect of the quality of paints and coating materials to be used on works. However, the Engineer-in-Charge shall have the right to perform any other tests to check up the suitability of the particular paint or coating material.

(b) Visual inspection of painted surface shall be made to check cracking, uniformity and finish.

(c) Checking of thickness of paint film shall also be done where necessary and as directed by the Engineer-in-Charge.

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CHAPTER- 11

INFORMATION AND DRAWINGS TO BE FURNISHED BY THE CONTRACTOR

11.01 INFORMATION TO BE FURNISHED BY THE CONTRACTOR :

(a) The Contractor shall furnish within five days after the close of each calendar month on forms to be prescribed by the Engineer-in-Chare the number of persons on his pay rolls and log books for working of the machinery and any other information of similar nature which may be required by the Engineer-in-Charge as per clause Nos. 6.04 and 8.03 respectively.

(b) The Contractor shall submit the following information to the Engineer-in-Charge within the period specified in each case.

(i) In persuance of clause 5.08 of the General condition of contract, the proposed construction programme and time schedule showing sequence of operations, within thirty (30) days after the date of receipt of notice to commence the work and revised construction programme at intervals of not more than 3 months.

(ii) Quarterly and monthly detailed programme by the end of preceding quarter or month.

(iii) Monthly programme of requirement of electric power with respect to the time schedule, within four months of the date of receipt of notice to commence the work.

(iv) In persuance of clause 9.03 (A) XII of the General condition of contract, approximate quarterly requirements of cement for the entire construction period within two months of the date of receipt of notice to commence the work and monthly requirement of the ensu-ing year commencing October 1 by June 30 each year.

(v) In persuance of clause 9.03 (C) of the General conditions of contract, programme of requirement of mechanical and other equipment with respect to the time schedule, within eight week of the date of receipt of notice to commence the work.

(vi) Quarterly and monthly requirement of cement steel, admixtures and other materials.

(vii) Requirement of drawings, embedments of permanent equipment to be installed three months in advance.

(viii) Layout plan and details of construction plant and equipment for the execution of the work including proposed sizes and capacities of principal items which the Contractor proposes to install at the site of work, within three months of the date of receipt of notice to commence the work.

(ix) Layout plan for care and diversion of river required for the construction of the work, within three months of the date of receipt of notice to commence the work.

(x) Prior to the commencement of the work, the Contractor shall submit to the Engineer-in-Charge for approval, drawings or prints on white amonia paper of size 100x70 cm. ; 70x50 cm. or 50x35 cm. as may be suitable, in triplicate showing the locations of major plants, shops and storage buildings, offices, housing facilities, roads, temporary bridges, unloading facilities and storage yards, etc. which he proposes to put up at the site.

Any changes in the approved layout will be subject to further approval of the Engineer-in-Charge.

(xi) An insurance policy for the Government personnel insured by him under clause 1.09 as well as terms of insurance after the award of the Contract but before any adhoc advance is given to him as per clause 3.07 (A) (V).

(xii) Hypothecation and insurance policies for all equipment for which advance has been paid to him as required in clause 3.07 (B).

(xiii) Requirement of land at work site other than Dehradun and Dakpather as early as possible after the award of the Contract.

11.02 DRAWINGS :

The Contractor shall submit to the Engineer-in-Charge for approval three copies of white ammonia paper, of size 100x70 cm; 70x50 cm or 50x35 cm. as may be suitable of all shop drawings, shuttering drawings etc. containing all required detailed information. One copy of the drawings will be returned to the Contractor either approved or with remarks for compliance and repeating the above procedure if and as directed by the Engineer-in-Charge.

The approval by the Engineer-in-Charge of any programme or working drawings (or of any drawings of the Contractor's plant or equipment), shall not in any way be deemed to release the Contractor from full responsibility for errors therein or from responsibility for complete and accurate performance of the work in accordance with Contract drawings and specifications, neither shall such approval relieve the Contractor from any liability placed upon him by any provision in the contract.

CHAPTER 12

SAFETY REQUIREMENTS

12.01 GENERAL :

It shall be the complete responsibility of the Contractor to meet the safety requirements on the works. The provisions detailed hereinunder are supplementary to safety requirements as stipulated in Central, State or local bodies laws, rules, regulations etc., applicable for the time being and as amended from time to time. Where the provisions conflict, with the afore-mentioned laws etc. by reason of amendment or by other cause the stipulations of the afore-mentioned laws etc., shall govern.

12.02 SAFETY ENGINEER :

In order that the accident prevention programme may function properly, the Contractor shall provide a full time Safety Engineer. The Safety Engineer shall report and be responsible to the highest ranking job managerial, executive or his designated representative. The duties of the Safety Engineer include the following :

He shall -

(i) be responsible for co-ordinating the safety programme.

(ii) act in an advisory capacity on all matters pertaining to safety for the management, superintendents, foreman, purchasing department, Engineering Department and sub-contractors.

(iii) (a) make personal investigation of all fatal, serious and unusual accidents.
(b) check corrective action taken by the supervisors to eliminate accident causes.

(iv) make inspections for the purpose of detecting and correcting unsafe conditions and unsafe work practices (Records to be maintained and filled for future reference).

(v) make certain that all Central Government, State Government or local laws and ordinances are complied with.

(vi) initiate activities that will stimulate and maintain the interest of all supervisors and employees in safety.

(vii) prepare in agenda for and attend safety meetings.

(viii) appoint a safety steward for each craft on location.

(ix) confer with the insurance company Engineer on safety problems and accompany him on surveys on the job operation, initiated by him.

12.03 EXPLOSIVES :

All operation involving handling, storage, transportation and use of explosives in surface as well as underground work shall be performed in accordance with all applicable Central, State and Municipal Laws and Ordinance as required by the concerned Chief Inspector of Explosives, Government of India.

12.04 SAFETY TECHNIQUES AND STANDARDS :

The Contractor shall comply with the provisions laid down in the Safety Manual published by Central Water Commission, Government of India and shall also follow the safety rules and regulations as stipulated in the U.S.B.R. Instruction series 520 Safety Techniques and Standards, as well as relevant Indian Standard Specifications in respect of protective devices, construction machinery, transportation of equipment, electrical installation, transportation, storage and handling of materials, open excavation, blasting and drilling operations, scaffolds and ladders and tunnelling work.

12.05 ELECTRICITY LAWS :

The contractor shall comply with the Indian Electricity Act and the Rules made thereunder. He will also comply with the Rules framed by the Government of Uttar Pradesh and enforced by the Chief Electrical Inspector, Uttar Pradesh.

Sd/- R. K. Chaturvedi
Contractor

Sd/- Jai Singh
S.E.L.V.C.C.II
Dehradun

PART-III

TECHNICAL PROVISIONS

CHAPTER 13

CARE AND PROTECTION OF POWER HOUSE AND ITS APPURTENANT WORKS

13.01 GENERAL :

The work will have to be suitably protected against floods in the river Yamuna, the maximum normal monsoon & non-monsoon discharge of which at Lakhwar Dam Site (11 Km upstream) has been estimated to be of the order of 3157 and 352 cumecs respectively. The corresponding maximum discharge at Power House site is estimated to be of the order at 3700 cumecs. For this a protection wall of Boulder masonry or concrete with grout curtain under-neath will have to be constructed by the contractor along the river in between two rock spurs to isolate the working area from river flow alongwith other protection works. The flood levels at a site 130 M downstream of Power House site are estimated as 526 M for a discharge of 3700 cumecs & 528 M for a discharge of 5000 cumecs (1 in 100 year frequency). The contractor will have to provide protection arrangement suitably on basis of this data & as per his own assessment.

The monthly maximum discharge of river Yamuna at Lakhwar Gauge Site (G-2) which is about 10.5 Kms. upstream from the Power House site are given in the table annexed. The river discharge during monsoon period which lasts from 10th June to 15th October each year is to be catered by the protection work. Although the chances of monsoon & nonmonsoon discharge exceeding 3700 & 352 cumecs respectively are remote, the contractor is advised to make protection wall initially upto El. 527 M and raise the height of protection wall to El. 529 M so that the protection works are not over-topped even in case of a discharge of frequency of 1 in 100 years. The contractor shall also have nearby arrangements to shift quickly his men, material and machinery etc. to a safer place, in case any, such eventuality arises. Government shall not be responsible for any such loss of men, material and machinery or equipment etc. It shall be the responsibility of the contractor to safeguard the works from damage due to overtopping of protection work and any damage caused to the works on this account shall be made good by the contractor at his own cost. The protection work shall be designed and constructed in a manner that same are not damaged when monsoon flood passes. These shall be provided adequate protection against scour during floods and will be so planned and constructed so as to provide enough working space for permanent work.

The contractor shall construct protection wall and other protective works, and shall furnish all meterials required therefor. However, he will be allowed to use material from the excavation if the same is found to be suitable for use by the Engineer-in-Charge & no deduction in rates except for royalty charges will be made on this account. The contractor shall also furnish, install, maintain and operate all necessary pumping and other equipments for dewatering the various parts of the work and for maintaining the Power House foundations, pump drainage systems, grouting system and other parts of the work free from water as required for constructing each part of the work and as required after any work is completed for inspecting safety installations by the Govt., or for any reason determined to be necessary by the Engineer-in-Charge. The pumping sites shall be lighted, even though permanent lighting facilities may not be required, and shall be readily accessible at all times. The contractor shall pump all water from the site of the Power House and other appurtenant works, and shall keep the foundations free of water while excavating, preparing the foundation, consolidation grouting, while placing concrete or as otherwise required for completing the work and shall be entitled to no claim for damages or additional payment by reason of any amount of water that may leak through, under or around the protection and all other protective works.

The Contractor shall submit his own layout plan for river protection work after proper study and site conditions and requirements within two (2) months of date of receipt of the notice to proceed with the work and its design prior to starting the construction of diversion works for the approval of Engineer-in-Charge. Such approval shall not relieve the contractor of his responsibility for the adequacy of the protection works or repairing at his own expense any damage caused by failure or partial failure of the protection works. The contractor shall adopt layout and designs so

TABLE SHOWING MONTHLY MAXIMUM OBSERVED DISCHARGES OF RIVER YAMUNA AT LAKHWAR AT GAUGE-2 (ABOUT 10.5 KM. UPSTREAM OF P.H. SITE)

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1968	81.20	96 80	194.40	74.80	66.40	89.10	237.00	226.00	88.80	57.00	51.00	50.00
1969	28.90	21.30	29.20	33.70	42.20	43.50	69.80	188.70	203.10	52.60	46.10	28.60
1970	20.30	22.60	25.70	39.60	25.00	32.80	52.50	214.30	115.60	42.60	39.80	27.20
1971	25.50	22.10	23.20	30.80	55.50	365.80	403.00	514.40	405.80	77.50	46.50	31.10
1972	19.30	45.40	24.20	94.30	48.60	40.40	198.70	270.50	929.40	66.58	30.90	22.30
1973	34.00	29.10	52.20	51 50	146.50	101.80	238.00	493.30	318.90	106.70	37.90	25.40
1974	21.70	26.50	19.30	23.70	25.10	33.70	22.60	428.10	89.00	152.00	28.70	22.70
1975	30.00	74.50	88.80	73.00	52.70	169.90	299.70	503.10	819.24	97.10	43.80	26.00
1976	26.30	51.80	28.63	54.23	48.20	59.90	357.60	668.60	193.00	52.44	29.40	21.56
1977	26.20	16.95	19.20	28.90	49.50	79.80	666.20	365.50	358.00	94.63	43.61	35.00
1978	25.40	43.50	351.90	70.90	73.50	169.60	451.90	615.00	3137.00*	55.70	55.60	33.80
1979	36.80	108.90	63.00	64.40	54.10	96.70	282.00	363.90	54.40	35.65	19.20	48.60
1980	20.60	16.65	20.50	28.70	29.60	93.00	342.10	710.70	129.90	41.90	29.10	48.60
1981	33.30	27.10	44.70	44.60	68.60							

Note : *In the early hours of September 3, 1978 at 2 a.m. the maximum peak discharge estimated as 3157 cumec passed down in Yamuna river at Lakhwar site.

submitted after the approval has been accorded.

Nothing contained in this clause shall relieve the contractor from his full responsibility for the adequacy of the protection of work against the river and protective works connected therefor.

13.02 MAINTENANCE AND REPAIR OF PROTECTION WORKS :

After each monsoon the protection work shall be thoroughly inspected. In case any damage is observed the same shall be repaired by the contractor at his own cost in a manner approved by the Engineer-in-Charge.

13.03 REMOVAL OF PROTECTION WALL & OTHER WORKS :

After having served their purpose the protection wall and other temporary protective works shall be removed to the extent specified hereinafter. Care shall be exercised during removal of protective works to prevent injury to the permanent works and any damage caused thereby shall be repaired as directed by the Engineer-in-Charge by the contractor at his own expenses. Plan of disposal of material shall be subject to prior approval of the Engineer-in-Charge. The material shall be placed in the spoil areas on the downstream of the Power house as directed by the Engineer-in-Charge. Material placed in downstream spoil areas shall be graded so as to present a neat appearance and sloped to facilitate general drainage and shall be subject to the approval of the Engineer-in-Charge.

13.04 MEASUREMENT AND PAYMENT :

(a) The lumpsum rate for the item "Care and Protection by the river during construction" will include all works namely.

(i) Construction of protection wall and other temporary protective works and furnishing all material required therefor.

(ii) Cost of furnishing, installing, maintaining and operating pumps and other equipment for dewatering the various parts of the work as per clause 13.01.

(iii) Removal of protection wall and other work as stipulated in clause 13.03.

(iv) Any other work as stipulated in clause 13.01 to 13.03 or required in connection with the care and protection by the river during construction.

Intermediate payment for item "Care and protection by the river during construction" will be made as hereinafter provided, subject to the condition that the river protection works are constructed and maintained during various years of consrruction in accordance with the proposal approved by the Engineer-in-Charge as required in clause 13.01 to 13.03.

(i) 50 percent of the lumpsum bid for the item after the first year of protection by the river.

(il) Additional 20 percent of the lumpsum bid for the item after the second year of protection by the river.

(iii) Additional 15 percent of the lumpsum bid for the item after the third year of protection by the river.

(iv) The remaining 15 percent after the protection works have been removed in accordance with clause 13.03.

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CHAPTER—14

CLEARING THE SITE

14.01 GENERAL :

The work to be done under this section consists of furnishing all plants, labour and materials, performing all work necessary to perform all clearing and grubbing operations as hereinafter specified and as directed by Engineer-in-Charge. The contractor shall clear the area to be occupied by the Power House, Surge Tank, and/any other works under this contract of all trees, bushes, stumps, roots and other objectionable materials, before starting the excavation. The surface of all aggregate quarries shall also be cleared of all trees, stumps, roots buried logs and other objectionable materials.

14.02 DISPOSALS :

All stumps, roots, bushes, buried logs and other debris within the area required to be cleared and grubbed shall be burnt or otherwise completely removed from the site, to the satisfaction of the Engineer-in-Charge. Disposal in the stream will not be permitted and no material shall be piled where, in the opinion of the Engineer-in-Charge it is liable to cause afflux or flood in the upstream side. Timber and fuel obtained in clearing shall properly stacked at a site approved by the Engineer-in-Charge. Clearing outside the required limits will be permitted when necessary for the contractors operations, subject to the approval of the Engineer-in-Charge. D'sposal by burning shall be done under constant attendance until fires have burned out or have been extinguished to guard against spreading of fire.

14.03 PAYMENT:

No separate payment will be made for the required clearing and grubbing as stipulated above. No separate payment will be made for clearing outside the limits permitted by Engineer-in-Charge. Clearing and grubbing required in the performance of this contract will be considered as incidental to the items of schedule of bids.

If the work contemplated under this section is not carried out to the entire satisfaction of the Engineer-in-Charge. the work will be got completed by the Engineer-in-Charge and recovery will be made from contractor's bills at rates fixed by the Engineer-in-Charge which shall be final and binding on the contractor.

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CHAPTER - 15

EXCAVATION OF FOUNDATIONS AND ITS PREPARATION

15.01 GENERAL :

The work to be done under this section is surface excavation and consists of furnishing all tools, plant, labour and material and performing all works required to do all excavation and maintain the excavated slopes and prepare the foundations as specified in these specifications and as may be directed in the field by the Engineer-in-Charge. The work to be done under this section includes excavation of all types of rock, whether lime stone quartzites, slate, hard or soft, weathered or loose, dry or wet etc., including all over-burden, silt, earth, clay, sand, gravel, soft moorum etc.

15.02 LIMIT OF EXCAVATION :

Excavation for foundation of the Power House, Surge tank and other works, shall be done to sound firm rock free from weathered materials, open seams and crevices, and shall be so shaped, cleaned and roughly stopped, as to produce the desired surface of contact between the concrete and rock as shown on the drawings or as directed by the Engineer-in-Charge. Where not to be covered with concrete, excavations shall be made to the full dimensions required and shall be finished to the prescribed lines and grades in a workman like manner, except that sharp points of undisturbed ledge rock will be permitted to extend upto 15 cm within the prescribed line. The bottom and side slopes of common excavation upon or against which concrete is to be placed shall be finished accurately to the dimensions shown on the drawings or prescribed by the Engineer-in-Charge and the surfaces so prepared shall be moistened with water and tamped or rolled with suitable tools or equipment for the purpose of thoroughly compacting them and forming firm foundations upon or against which to place the concrete structures.

15.03 TREATMENT AND RESPONSIBILITIES FOR OVER-EXCAVATION :

If at any point in foundation excavation, material is excavated beyond the lines required to receive the structure, the same shall be replaced with selected material which shall be thoroughly compacted. Where concrete is to be placed upon or against rock and average and minimum thickness are shown, the excavation shall be sufficcient to provide for the minimum thickness of concrete at all points and the prescribed average thickness shall be exceeded as little as possible. Measurement for payment of such excavation will be limited to the excavation required for the prescribed average thickness of the concrete. Where concrete is to be placed upon or against rock and the thickness of concrete is not indicated on the drawings, the excavation shall be made to the lines and grades prescribed by the Engineer-in-Charge. Measurement for payment of such excavation will be made of the materials actually removed within the lines established by the Engineer-in-Charge.

All necessary precautions shall be taken to preserve the material below and beyond the lines of all excavation in the soundest possible condition. Any and all excess excavation or over-excavation performed by the contractor for any purpose or reason, except as may be ordered in writing by the Engineer-in-Charge and whether or not due to the fault of the contractor shall be at the expense of the contractor. No blasting that might injure the work will be permitted, and any damage done to the work by blasting, including the shattering of the material beyond the required excavation lines, shall be repaired at the expense of and by the contractor in a manner satisfactory to the Engineer-in-Charge. All over excavation and cavities in rock excavation upon or against which concrete is to be placed, caused by careless excavation as determined by the Engineer-in-Charge or by rock removal as directed by the Engineer-in-Charge or other foundation materials needlessly damaged by blasting or other operations of the contractor, shall be filled solidly with concrete of the same mix as the foundation concrete, entirely at the expense of the contractor including the cost of all materials required therefor.

15.04 SLOPES AND DIMENSIONS :

During the progress of work, it may be found necessary or desirable to vary the slopes or the dimensions of the excavations from those shown on the drawings or established by the

Engineer-in-Charge. The contractor shall be entitled to no additional payment above the unit rates in the schedule of bids for excavation by reason of such changes. Shoring or protective arrangement may be used by the contractor to dig to steeper slopes than those shown on the drawings and for maintenace of excavation. Such arrangement shall be the full responsibility of the contractor but the Engineer-in-Charge may direct the contractor to strengthen or extend any such management if he finds the same to be inadequate and contractor shall immediately comply with such instructions.

When the excavation for the foundations of Power House and appurtenant works under this contract has been completed to the approximate grade specified or stacked on the ground, all loose rock and other excavated material shall be removed and the surface shall be cleaned with an air water jet under high pressure for purpose of inspection. This procedure shall be repeated until satisfactory foundation is reached.

Where vertical or inclined plain faces of rock are required as in the sides of the Power House as directed by the Engineer-in-Charge, such faces of excavation shall be formed in such a manner as would least shatter the rock mass. Only light blasting will be allowed in areas adjacent to such faces, provided that where further blasting might injure the rock upon or against which concrete is to be placed, the use of explosives shall be discontinued and excavation completed by line drilling, broaching, wedging, barings of other suitable methods, unless otherwise specified or directed by the Engineer-in-Charge in any specific work or face. All loose or loosened rock in the side shall be removed by baring, wedging etc. The unit rates for open excavation shall include the cost of all these operations also.

In locations where the Engineer-in-Charge specifies excavation to be done to slopes steeper than normally specified fcr any particular class of material, the use of shoring and timbering may be required for maintaining the excavation. The contractor shall provide necessary shoring and timbering as approved by the Engineer-in-Charge.

15.05 STRIPPING BLUFFS AND LOOSE ROCK :

All loose rock, semi-detached rocks (alongwith the earthy stuff therewith) not directed in the excavation but so close to the area to be excavated as to be liable, in the opinion of the Engineer-in-Charge, to fall or otherwise endanger the workmen, equipment or the work, shall be stripped and removed away from the area of excavation. The methods used shall be such as not to shatter or render unstable or unsafe any rock that was originally sound and safe. Any material not requiring removal as contemplated in the work, but which in the opinion of the Engineer-in-Charge is likely later to become loosened or unstable, shall also be promptly and satisfactorily removed, as directed by the Engineer-in-Charge.

The cost of such stripping will be paid for at the unit rates for 'open excavation' provided in the schedule of bids. The mode of measuring the quantity for payment shall be decided by the Engineer-in-Charge whose decision shall be binding on the contractor.

15.06 EXCAVATION IN SURCHARGE SLOPES :

All excavation work will be influenced in general by the nature and structure of materials. The side slopes in excavation shall be as steep as will stand with safety in over-burden, but shall not exceed those shown on the construction drawings without the specific permission of the Engineer-in-Charge.

If during or after excavation it becomes evident in the opinion of the Engineer-in-Charge that the slopes established are too steep for the safety of the work, additional material shall be removed, as directed, to produce a stable slope and/or to widen the existing terraces and/or to introduce fresh terraces. Such additional excavation shall be paid for at the rates in the schedule of bids for the item 'open excavation'.

Every precaution shall be taken to prevent slips. But should slips occur, the slipped material shall be removed to the designed (modified) slopes. Removal of such slipped material shall be paid for at the rate in the scehdule of bids for 'open excavation' as if it were fresh excavation.

No additional allowance above the unit price stated in the schedule of bids for excavation will be made on account of any of the material being wet.

15.07 BLASTING :

While blasting proper precautions shall be taken for the protection of persons, work and property, and damage done to the work or property by blasting shall be repaired by the contractor at the contractor's expense. The contractor shall be liable for all injuries to or deaths of persons or damage to property caused by blast or explosives. Blasting may be done only to depth and extent approved by the Engineer-in-Charge with explosives of only approved type and quality and in such locations as neither crack nor damage the rock outside the prescribed limits of the excavations.

The contractor shall construct storage magazines for explosives at the site approved by the Engineer-in-Charge, at his own expense. Contractor shall himself arrange to obtain licences for the magazines.

Holes shall be drilled not exceeding two-third of the depth of rock to be excavated from the elevation at which the hole is started. The holes shall not be larger than necessary to permit the passage of whole sticks of explosives to the bottom of the holes, and holes shall not be sprung or chambered. As the excavation approaches its final limits, the depths of hole for blasting and the amount of charge per hole shall be reduced progressively. when ever in the opinion of the Engineer-in-Charge, further blasting may injure the rock upon or against which concrete is to be placed, the use of explosive shall be discontinued and the excavation shall be completed by wedging, barings, channelling, drilling and broaching or by other suitable methods.

Wherever required by the Engineer-in-Charge, excavation shall be carried out by line drilling and broaching. For this, cracks for the final contour shall be created by light blasting in closely spaced holes along the perimeter of the rock mass to be removed prior to the drilling of the rest of the holes for the blast pattern. For this a row of holes at a spacing of about 10 to 15 times the diameter of the holes shall be drilled along the perimeter of the section of rock to be removed and blasting performed at about 1/10th of the concentration of the fully loaded hole. By this spliting cracks for the final contour shall be created connecting the holes and separating the mass from the section to be removed. In hard rock the holes for breakage of rock shall be placed rather close to the pre-split row or the pre-split holes shall be charged once more with the bottom charges and ignited in the main round. In cases, where smooth contours are essential one or two uncharged guide holes between the charged ones may be used. The contractor shall take sufficient care in selecting the number and diameter of holes, the charge per hole etc. in order to complete the work in a workman like manner.

Charging, tamping, and firing or drilling holes shall be done by the foreman or by some approved competent person under his personal directions. Proper signals by siren or bugles shall be given before each operation of blasting. In charging a hole, the cartridges shall be inserted one at a time and each squeezed home gently with a wooden rod. Metal or bamboo rods shall not be used for this purpose. The primer cartridges with fuse and detonators shall be lowered gently into the hole and shall not be squeezed home under any circumstances. The fuses shall be cut long enough to give the man igniting them ample time to retire to safe position. The fuses shall be cut in such a way that the firing of the holes can be easily counted. Unless electric firing is used, no more holes shall be fired at any one time than can be easily counted, in order it may be determined definitely whether all the holes fired above discharged properly. If a misfire occurs, no one should approach the misfired hole until a safe time has elapsed. A second hole shall then be charged and fired and then the debris shall be searched thoroughly for unfired detonators and cartridges. Special care shall be taken to keep the fuses dry and the explosives protected from the direct rays of the sun.

The contractor shall make himself fully acquainted with the Government of India Explosives Act and Regulations and amendments pertaining to the said Act and other publications referred to in clause 12.04 in connection with the quarry operations, storing and firing of all explosives and shall strictly abide by them. In case it is decided to use the excavated material in

other works, the contractor's blasting operation shall be such that the material excavated will be suitable for use in the work.

15.08 EXCAVATION IN SHAFTS, IN FOUNDATION FAULTS AND SEAMS :

Where seam and fault are found in the foundation of the Power House and other works under this contract such seams and faults shall in general, be excavated in open trenches. It may be necessary on desirable, as determined by the Engineer-in-Charge, after the excavation, to excavate shafts below the bottom of such excavation for the purpose of sealing the faults and seams. The excavation shall extend into sound rock on each side of the fault or seams to the depth given by the Engineer-in-Charge, and the shafts shall by excavated to such depths as may be directed by the Engineer-in-Charge.

All drilling and blasting shall be performed skilfully and carefully so that the material outside the required lines will not be shattered. Any and all excess excavation or over-excavation performed by the contractor for any purpose or reason except as may be ordered in writing by the Engineer-in-Charge, and whether or not due to the fault of the contractor shall be at the expense of the contractor. No blasting that might injure the work shall be permitted and any damage done to the work by blasting including the shattering of material beyond the required excavation line shall be repaired by and at the expense of the contractor and in a manner approved by the Engineer-in-Charge. All cavities in rock excavation upon or against which concrete is to be placed caused by careless excavation, as determined by the Engineer-in-Charge or removal, as directed by the Engineer-in-Charge of rock, or other foundation material necessarily damaged by blasting or other operations of the contractor shall be filled solidly with concrete at the expense of the contractor. Suitable temporary timbering including lagging shall be used where such temporary timbering is necessary to support the sides of the shafts. All temporary timbering shall be removed by the contractor before the concrete for the cut off is placed in the shafts. All timber for temporary timbering shall be furnished by the contractor. Nothing contained in this paragraph shall prevent the contractor from erecting, at his own expense such amounts of temporary timbering as he may consider necessary nor shall it be construed to release the contractor from his sole responsibility for the safety of shafts or from liability for injuries to or deaths of persons or damage to property. No additional payment above the unit rates for the item in the schedule of bids for open excavation in shafts, in foundation faults and seams will be made on account of the class, nature or on account of any of the material being wet. Payment for excavation of all classes of rocks and soils in shafts, in foundation faults and seams as described in this paragraph will be made at the unit price per cubic metre for the item provided therefor in the schedule of bids, which shall include the cost of all work described in this paragraph. The amount of excavation in shaft, in foundation faults and seems that will be required is uncertain, and the contractor shall be entitled to no additional payment above the unit price for the item in the schedule of bids, by reason of any amount or none of this excavation being required. The excavation having less than 20 sq.m. area and carried more than 2 meteres below the general level surrounding the area shall be termed as excavation in shafts, in foundation faults and seams.

15.09 DISPOSAL :

All suitable material from excavation from the Power House and appurtenant works under this contract including excavation in shafts, in foundation faults and seams shall be used in the rock fill, back fill and riprap so far as practicable and as determined by the Engineer-in-Charge. Materials suitable for the purposes listed above shall be selected separately from the materials to be wasted and suitable materials shall be segregated by loads from excavations and shall be placed in designated final locations directly from the excavations or shall be placed in temporary stock piles and later placed in the designated locations as desired by the Engineer-in-Charge. Such suitable material, obtained from excavation, if used for the purpose listed above, shall be allowed free of cost to the contractor. However the royalty charges shall be paid by the contractor.

No lifts for ascending or descending in excavation work shall be admissible at all. Where

required by the Engineer-in-Charge, the piles of excavated material shall be levelled and trimmed to reasonably regular lines and the contractor shall be entitled to no additional payment on account of this requirement.

All other excavated materials shall be wasted. The disposal of wasted materials shall be subject to the approval of the Engineer-in-Charge. Waste piles of excavated materials from the foundation of Power House shall be located within a radial distance of 1 km. downstream of Power House Waste piles shall not be located where, in the opinion of the Engineer-in-Charge, they will harmfully interfere with the natural flow of the river or with construction work, or will detract from the appearance of the completed structures or interfere with accessibility of the structures for the operation. Where required by the Engineer-in-Charge, waste piles shall be levelled and trimmed to reasonably regular lines and the contractor shall be entitled to no additional payment on account of this requirement. The cost of disposing off all excavated materials that shall be disposed off within 1 km. radius downstream of Power House, shall be included in the unit price per cubic metre of excavation in the shedule of bids.

If the contractor has to carry excavated material through haul roads in more than 1.0 km. road length but if the material is finally disposed off within 1.0 km. radial area (as defined above) then no extra lead over 1.0 Km. shall be admissible. Measurement of distance for measuring lead beyond 1.0 Km. will have no bearing with the distance travelled along the haul roads but will be measured radially taking centre point of Power House on its axis as the centre. But in case the contractor is directed by the Engineer-in-Charge to dispose off the excavation material at radial distance greater than that specified above, the contractor will be allowed extra rates for the same as per applicable item of the shedule of bids.

15.10 FOUNDATION PREPARATION AND DEWATERING :

Just prior to placing concrete a clean up shall be made by baring, wedging and picking or by other approved methods. All loose, shattered or disintegrated materials shall be removed and surface cleaned with jets of air and water under high pressure to the satisfaction of Engineer-in-Charge. Chiselling, however, will not normally be resorted to for such clean up. In case at the some specifled locations, chiselling is specifically required by Engineer-in-Charge, the contractor shall be paid for chiselling at the rate of Rs. 20/- (Twenty) per square metre of rock surface cleaned by chiselling.

The contractors shall pump all water from the site of the Power House and other appurtenant structures and shall keep the foundations free of water while excavating, preparing the foundations or as otherwise required for completing the works. The contractor shall be solely responsible for any damage done to the construction work or any part and any delay or loss the Government may suffer owing to faulty or inadequate dewatering programme and the contractor shall make good all such losses to the Government. The mere fact that the design for dewatering works have been approved will not absolve the contractor of his responsibilities for safety and adequacy of such temporary dewatering arrangements and structures.

15.11 MEASUREMENT AND PAYMENT :

Cross-section of the site of excavation shall be taken just prior to commencement of work under this contract and grades and lines shall be fixed for excavation. The final excavated section shall be taken on completion of excavation and plotted on the initial sections previously taken. For intermediate payments, cross-sections along the established lines and grades will be taken as considered expedient by the Engineer-in-Charge to determine the quantity to be paid for in any running bill. In such cases, it may not be necessary to take cross-sections along every line of original cross-section. However, the judgement of Engineer-in-Charge in such matters will be final and binding on the contractor. All measurements for excavation will be based on this survey subject to the condition that needless excavation shall not be measured. Where excavation is done to steeper slopes than the grades specified by the contractor himself by use of shoring and timbering,

the grades fixed for excavation shall be taken as the basis of measurement, but no payment shall be made for timbering and shoring. However, where use of timbering and shoring is made for excavation at steeper slopes under the specific instructions of the Engineer-in-charge, the payment for excavation shall be made to such steeper slopes as are specified by the Engineer-in-Charge and the payment for timbering and shoring required therefor shall be made at the unit rate for this item in the schedule of bids.

The rate for 'open excavation' shall include removal, handling and disposal of all material wet or dry as stipulated in clause 15.09 encountered within the scope of these specifications and shall further include drilling holes for blasting, shoring, dewatering and diversion of water that may find its way into excavated foundations, fencing, lighting, clearing the site and all other operations necessary for the excavation and protection of works. The rates for excavation for all classes of rocks & soils shall include all lift as well as lead upto 1.0 Km radial distance and shall include all temporary work such as shoring, timbering etc. necessary to maintain the excavation in good order during construction and/or removing such temporary work when required. The unit prices for the item in the schedule of bids for excavation, include the entire cost of transporting the materials directly or indirectly from the excavation to the points of final use, including temporary stock piling and rehandling and of disposing off all excavated materials that are wasted. All excavated material that are actually placed in rockfill, backfill and riprap will again be included for payment under the appropriate items of the schedule of bids for placing the various materials. Payment shall not be made for any and all over excavation made beyond the prescribed grades and lines by contractor whether or not due to his negligence, defect, oversight or for his convenience.

Payment for drilling line holes will be made at the unit price per square metre for the item of 'Line drilling and broaching holes for rock excavation' in the schedule of bids, and only the area derived by length of holes and the depth of holes actually drilled into the rock foundation at the direction of Engineer-in-Charge will be considered in making measurements for payments.

Measurement for preparing and cleaning the surface of foundations as required above will be based on the actual number of square metres of the horizontal projection of foundation prepared and cleaned, and payment thereof will be made at the contract unit price per square metre for item of 'Foundation Preparation' in the schedule of bids.

The rate for shoring and timbering shall include all cost of labour, material and tool and plant required for shoring and timbering in accordance with specifications as per clause. Measurement shall be based on the actual area of the slope supported by shoring and timbering and the payment shall be made at unit price per square metre for the item 'shoring and timbering' in the schedule of bids.

CHAPTER—16

UNDERGROUND EXCAVATION

16.01 GENERAL :

The tunnels, galleries and shafts etc. in the Head race tunnel, Power House, Surge tank, Penstock shall be excavated to the lines and grades shown in the drawing. Tunnel excavation shall also include that portion of excavation for the reinforced concrete portal which is executed by tunnelling method. The general dimensions and arrangements of tentative sections shown on the drawing are indicative only and are subject to modifications and alterations and the contractor shall be entitled to no additional payment above the unit prices specified in the schedule of quantities and bids on account of such modifications and alterations.

16.02 PLAN OF OPERATIONS :

At least 30 days before starting work on underground excavation, the contractor shall submit to the Engineer-in-Charge, if so desired by him for his approval, a detailed and step by step plan of operations and procedure which he proposes to follow for completion of this work. This plan shall Include, but is not limited to the following :

1. Detailed plans of safety precautions to be taken.
2. Detailed plans and procedures for all excavations including temporary supporting of rock, shotcreting first stege concrete, drainage etc.
3. Detailed plans for blasting procedures upto final activity including ventilation.
4. Plans and procedures in as much detail as possible for the final blast.
5. Schedule showing each step of the operations and procedure.

As the work progresses, the planning and execution of works shall be carried out with such changes as may be found necessary and ordered by the Engineering-in-Charge to suit the conditions as may actually be encountered from time to time. The approval of the contractor's plan of operations and procedure shall not relieve him of his contractual obligations in any manner.

16.03 POINT OF COMMENCEMENT :

The point where open excavation shall stop and underground excavation by tunnelling methods shall start shall be decided by the Engineer-in-Charge.

16.04 ALIGNMENT :

The line of tunnels, galleries and shafts etc. shown in the drawings is the probable line that will be adopted subject to lateral or vertical shift that the Engineer-in-Charge may consider necessary. The salient features of these underground structures i.e. X-sections, length etc. are shown on the drawings. These are subject to modifications and the contractor shall not be entitled to any extra payment over the unit rates quoted in the schedule of bids if such modifications are made before the excavation is commenced in the corresponding reach of the work where modification is desired.

16.05 SETTING OUT :

The contractor shall establish at suitable points, to the satisfaction of the Engineer-in-Charge, permanent reference marks along the centre lines of the tunnels' galleries and shafts etc. and their extensions at both the ends as may be necessary and directed. The permanent works shall be inscribed on bronze pegs, set in substantial concrete blocks, where they will be free from any likelihood of disturbances. Suitable permanent bench marks shall also be established near the portals of tunnels, galleries and shaft etc. As the work progresses centre line marks shall be established on pegs inserted at suitable places at convenient intervals to the satisfaction of the Engineer-in-Charge for checking alignment grades, levels etc. as well as the 'minimum excavation lines'. The contractor shall, at all times, remain responsible for the sufficiency and accuracy of all such

bench marks and reference points. The cost of these shall be deemed to have been included in the rates tendered for excavation.

The contractor shall, at all stages, remain fully responsible for carrying out the work to specified alignments, grades and profiles and shall use instruments and methods to ensure the accuracy regarding these according to best tunnelling practices in use for similar works.

16.06 ACCURACY OF ALIGNMENT, GRADES, LEVELS ETC. :

Bench marks and fixed reference points, with the value of the levels and coordinates will be fixed by the Government in the work area. Plans showing the position, coordinates and level of these points will be supplied to the contractor who will fix his permanent points and bench marks in relations to these. He shall take all precautions to see that the points fixed by the Government are not disturbed by the execution of work and shall make good the damage, if any, to such reference points at his own cost.

The contractor shall take the utmost care and precautions to excavate the tunnels, galleries and shafts etc. true to alignment, grades and levels and shall check these at frequent intervals as the work progresses. The contractor shall provide, free of cost, all facilities like labour, instruments etc. and all cooperation to the Engineer-in-Charge for checking the alignment, grades etc. as and when required by the Engineer-in-Charge. Such checking by the Engineer-in-Charge shall not absolve the contractor from his responsibility of maintaining the accuracy of the work. Any discrepancy or error, detected during the course of excavation and/or at the end of the excavation when the faces meet, shall be set right by the contractor at his own cost in a manner satisfactory to the Engineer-in Charge.

Work in tunnels, galleries and shafts etc. may have to be suspended for such reasonable time as the Engineer-in-Charge may require for transference of reference points, for lines and grades. No compensation shall be paid to the contractor for assistance rendered by him in setting lines and grades or for loss of time on account of such necessary suspension of work.

16.07 FACILITIES FOR CHECKING LAYOUT PROFILES ETC.

The contractor shall provide suitable jig and other equipment and make all necessary arrangement to the satisfaction of Engineer-in-Charge for moving the equipment along the alignment and grade of tunnels, galleries and shafts etc. to check the dimensions of the excavation lines and lining etc. as and when required by the Engineer-in-Charge. The cost of all these operations shall be considered as included in the unit rates in the schedule of quantities and bids.

16.08 ROCK MASS TO BE EXCAVATED :

The rock strata through which the tunnels are to be excavated are indicated in clause 7.09 of the contract and the drawings attached. The Government does not, however, guarantee that the strata to be actually encountered will correspond to these indications. The rates quoted in the schedule of quanties and bids, shall hold good for all excavation irrespective of type of rock actually encountered. The material to be excavated may be wet. No compensation shall be paid to the contractor on account of the class, nature or condition of the material to be excavated or on account of its being wet.

16.09 MINIMUM EXCAVATION LINE :

The minimum excavation line designated as 'A' Line herein-after represents the absolute minimum section of excavation of tunnels, galleries and shafts etc. and no projections of unexcavated materials of any kind including timbering and metallic or other supports for sides, roofs or other parts of the tunnel, galleries and shafts etc. shall be permitted within this line.

The minimum excavation line for sections of tunnels, gallery and shafts etc. shall be fixed by the Engineer-in-Charge keeping in view interalia the minimum clearance required for approved construction equipment and technique. The judgement of the Engineer-in-Charge in this respect shall be unquestioned and binding on the contractor for purposes of measurements and payment.

16.10 PAYMENT LINE :

The payment line, designated as 'B' Line hereinafter is a line parallel to the minimum excavation line and fifteen (15) centimetres away from it towards the rock face. The quantity of excavation to be measured and paid for will be laid down in clause 16.21 hereinafter.

16.11 VARIATION OF MINIMUM EXCAVATION LINE :

(a) Prior to excavation :

The nature of the materials being excavated may make it necessary, as determined by the Engineer-in-Charge, to vary the line of minimum excavation in any reach. Should the minimum excavation line be modified in any reach, payment line shall also be simultaneously modified for that reach to the same extent keeping it parallel to and fifteen (15) centimetres away from the modified minimum excavation line. The contractor shall not be entitled to any compensation on this account.

(b) After Excavation :

In some exceptional cases, as determined by the Engineer-in-Charge, the minimum excavation line may be required to be increased necessitating enlargement of the tunnel. The payment line will be simultaneously modified to the same extent keeping it parallel to and fifteen (15) centimetres away from the modified minimum excavation line. If such enlargement is ordered, the contractor shall carry it out. Payment for the final section shall be made in accordance with clause 16.21 on the basis of revised payment line and the contractor shall not be entitled to any compensation on this account.

16.12 METHOD OF EXCAVATION :

The mode and sequence of underground excavation of tunnels, galleries, cavities and shafts etc. will be as is found expedient for the type and response of rock encountered. It will also be governed by their size, shape and layout. If needed the excavation shall be done from both upstream and downstream headings. Sequence and mode of operation of all underground excavation shall be subject to the approval of the Engineer-in-Charge. The contractor shall be paid for the excavation of construction adit or shaft at the applicable unit rate of schedule of bids. The contractor shall be required to plug this adit or shaft as directed by the Engineer-in-Charge.

16.13 DRILLING :

All the drilling for underground excavation shall be done wet with an adequate supply of water to each drill except for trimming and minor work for rectification for which dry drilling would be permissible.

The spacing of the holes shall be as approved by the Engineer-in-Charge and shall be sufficiently close to ensure that the rock will break along the desired line. Whenever the Engineer-in-Charge finds that further blasting might injure the rock, the use of explosives shall be discontinued and the excavation completed by wedging, baring or other suitable methods. The cost of drilling shall be deemed to have been included in the unit rates in schedule of bids applicable to various underground excavations.

16.14 BLASTING :

Blasting shall be permitted only when proper precautions are taken for the protection of persons, work and property. Any damage to the work or property by blasting shall be repaired or compensated by the contractor at his own expenses.

The contractor shall arrange for procurement and storage of all explosives and blasting accessories required for the speedy and efficient execution of the work. He shall submit details and obtain prior approval of the Engineer-in-Charge in respect of the drive per round, drilling patterns, type of explosives, blasting accessories and procedure proposed to be adopted by him. All modification in any of these respects shall be intimated to the Engineer-in-Charge and approval obtained.

The cost of these shall be deemed to have been included in the unit rates in schedule of

bids applicable to various underground excavations.

16.15 TRIMMING OF ROCK :

All excavation shall be so done that the rock around ihe periphery of the excavated final section shall not be shattered, loosened or otherwise weakened. Large overbreaks shall be avoided by suitable means. The last 30 centimetres or so shall be removed by only light charges and rim holes (trimmers).

Where, however, in the opinion of Engineer-in-Charge it is specially necessary to thoroughly protect the rock against any chances of loosening or carcking the last 30 centimetres depth of rock normal to the finished surface of excavation shall be removed by means other than blasting. Such excavation shall be done by line drilling, baring, chiselling or wedging as may be convenient and approved by the Engineer-in-Charge.

16.16 EXCAVATION THROUGH SEAMS AND FAULTS OR POCKETS OF DISINTEGRATED ROCK BEDDED IN GOOD ROCK :

In certain locations layers of soft or dis-integrated rock bedded with good rock or seams and faults may be required to be excavated beyond the payment line to enable such weak zones to be plugged with concrete. Such soft rock shall be removed by hand or by pneumatic or other implements without requiring continuous and systematic blastiug.

16.17 SCALING OF ROCK AND EXCAVATION OF RECESSES AND ENLARGEMENT :

(a) After a face is blasted, gases removed and the face ventilated, all loose or loosened rock from the top and sides shall be removed as quickly as practicable by approved methods to avoid danger to workmen and equipment. Later, if any loose or loosened rock is noticed any where in the excavation it shall be removed expeditiously. The cost of such scaling and removal of loose or loosened rock shall be considered to have been included in the rate applicable for underground excavation.

(b) Where ground water is encountered in sections of underground excavation, the Engineer-in-Charge may require the contractor to make provision in the excavated section for relieving water pressures in the surrounding rock. This will require excavation of recesses at intervals and of dimensions as directed by the Engineer-in-Charge. If, however, drainage holes are required to be drilled, they shall be paid for at the relevant unit rates provided in the Schedule of quantities and bids.

Measurements for excavation of the recesses will be made to the lines and dimensions indicated on construction drawings or as directed by the Engineer-in-Charge. Payment for excavation of such recesses will be made at the unit rate quoted for the item 'Underground excavation' in the Schedule of bids, in which such recesses may be located.

16.18 DRAINAGE OF WATER :

All water from the underground excavation shall be satisfactorily drained away and pumped out, if necessary. In case any underground spring are met with, the water from them shall be drained out so as not to damage or endanger any work. The cost of all draining arrangements shall be considered as included in the unit rate for underground excavation. However, where the dewatering cannot be done by gravity and is done by pumping. as per mode and method approved by the Engineer-in-Charge, the contractor shall be paid at Rs. 1.50(Rupees One & Paise fifty) only per KWH of electricity consumed in pumping for which separate metres shall be installed by the contractor to the satisfaction of the Engineer-in-Charge. This unit rate for dewatering of underground excavation shall include the cost of installation, operation and maintenance of pumps. Pipes lines and fittings, removal and excavation of sumps and refilling them with concrete similar to that used in the invert of the lining to prevent infiow of water form outside.

Any seepage water encountered in the foundation of Power House and Surge tank etc. shall be satisfactorily drained away by gravity or carried to the sump made for the purpose. No separate payment for dewatering shall be made for pumping out water from this sump outside the foundation area as mentioned in chapter 13.

16.19 DISPOSAL OF EXCAVATED MATERIALS :

All excavated materials shall be deposited along the river bank to form a road in filling or in another dump or disposal areas as directed by the Engineer-in-Charge within a radial distance of 1.0 Km from respective portals. The unit rates tendered for excavation shall include all leads, lifts and other relevant works involved in such disposal. The material so excavated and disposed off shall be the property of the Government. In case the contractor desires to use the dumped materials for any particular work, he can obtain the specified material free of cost provided the Engineer-in-Charge considers the materials suitable for use on the particular work and can spare the same. However the royality charges shall be paid by the contractor.

16.20 LIGHTING AND VENTILATION :

All the works shall be acequately lighted with electric lights to the satisfaction of Engineer-in-charge. The cost of all lighting shall be considered as included in the unit rates tendered for different items of works.

All the underground works shall be properly and adequately ventilated by a system of pipes and fans to the satisfaction of Engineer-in-Charge. Positive artificial means of ventilation as required shall be employed. Arrangement of ventilition shall be in effective operation at all times when people are working underground. The ventilation plant and ducts employed shall be of such size and capacity as to be capable of delivering to or exhausting from the vicinity of the working face at least 9 cum of air per min. per person or more as specified by the Engineer-in-Charge in addition to an extra 2 cum per minute per H.P. of the internal combustion engines, if permitted to be used by the Engineer-in-Charge. This is the minimum requirement and may have to be supplemented if the working conditions in the tunnels so warrant for the health and safety of personnel. This supply of fresh air shall be in condition to the compressed air discharged from the pneumatic equipment in operation inside the tunnel.

After blasting, the ventilation plant shall be set to exhaust the gases from the vicinity of the face for adequate length of time which will depend on the number and size of blasts and capacity of the blowers. The workmen shall not be allowed to enter and start work unless and until all objectionable gases are removed to the extent considered satisfactory by the Engineer-in-Charge. The capacity of the ventilation plant shall be adequate to allow removal of gases in as short time as possible to allow starting of mucking operations commensurate with the cycle time of operation to match the scheduled progress of work.

The entire cost of furnishing, installing, maintaining and operating the ventilation system in most satisfactory and efficient manner shall be deemed to have been included in the unit rate quoted for underground excavation in the schedule of quantities of bids. No extra payment shall be admissible on this account.

16.21 MEASUREMENT AND PAYMENT

Cross-sections shall be taken at every metre for computing the quantity of actual excavation. The payment for excavation shall be made for each unit length of one metre as follow :—

(i) If the quantity of actual excavation is equal to or less than the theoretical quantity computed on the basis of payment line, the payment shall be made at the full applicable rate and for the theoretical quantity computed on basis of the payment line.

(ii) If the quantity of actual excavation is more than the theoretical quantity computed on basis of the payment line, the quantity of actual excavation shall be split up in two parts and the payment shall be made as below :—

(a) For the theoretical quantity computed on the basis of the payment line, at full applicable rate.

(b) For the balance quantity at half the applicable rate.

Provided that no payment shall be made for the quantity in excess of the quantity computed on the basis of the payment line, if in the opinion of the Engineer-in-Charge to overbreak resulting in excessive excavation is due to the lack of reasonable care and skill in excavation on the part of the contractor.

Under special circumstances such as high local chimney where it is not possible or convenient to take excavated profile cross sections, the total quantity of excavation shall be taken as 50 percent of the volume of muck as computed from the number of muck car loads taken out. To enable computation of total quantity of excavation by this method the contractor shall remain vigilant and shall notify the Engineer-in-Charge without loss of time as soon as such chimney formation is apprehended and shall keep reliable record of muck car loads taken out in a manner approved by the Engineer-in-Charge.

Intermediate payment will be made on the basis of payments line and adjusted after the cross sectional measurements of actual excavation are taken.

16.22 DEFINITIONS :

(a) The following definitions shall be deemed to hold good for measurements and payments of under ground excavation :

(i) Tunnel : The tunnel will mean the head race tunnel from the junction with Surge Tank at Hathari and in half of the total length.

(ii) Galleries : All works located underground in which the finished cross-sectional area of the cavity is less than 60 square metre but more than 10 square metre shall be designated as galleries.

(iii) Vertical Shafts : All works located underground requiring excavation by shaft method involving systematic blasting in which the centre line of excavation is vertical shall be designated as shafts provided that the depth of excavation is at least three times the minimum dimension of the shaft.

(iv) Penstock tunnels and pressure shafts : Penstock tunnel and pressure shaft shall mean the under ground excavated section for laying the penstocks between surge shaft and power house. All excavation for drainage galleries in Power house and surge shaft etc. in which the finished cross sectional area is less than 10 square metre shall be designated as drainage galleries.

All the excavations within any of the above mentioned categories (i) to (iv), done to accommodate fittings, machine parts, Penstocks etc. shall be considered part of the main category in which such excavation is located. Unless otherwise specified the same condition will apply for classification and payment of any work done therein.

(b) Payment for underground excavation shall be made for the various items of works involved as stipulated herein before in accordance with the relevant clause of these specifications and at the applicable unit rates in the schedule of bids. The dividing lines of different categories of excavation at junctions will be determined by inter-section of corresponding payment lines.

CHAPTER-17

STEEL SUPPORTS IN UNDERGROUND EXCAVATION, SHOTCRETING AND GUNITING

17.01 GENERAL :

Depending upon the nature of rock encountered (along the alignment of the underground works) steel supports, rock bolts perfo anchors or shotcrete or any combination thereof may be necessary. Some of the supports may be temporary and some permanent. Suitable supports, temporary or permanent as hereinafter specified shall be erected and maintained by the contractor. Repa rs and/or replacement of supports if required to be done due to contractors negligence shall be made good by and entirely at the expense of the contractor. Payment for supports shall be made as specified in clause 17.02 (F). Nothing contained in this para shall prevent the contractor from erecting, at his own expense, such amounts of temporary supports as he may consider necessary or using at his own expense permanent supports heavier than approved by the Engineer-in-Charge, not shall it be contrued to relieve the contractor from his sole responsibity for the safety of the excavation or the liability for injuries or deaths of persons or damage to property.

Structural steel in supports in tunnels, galleries and shafts and structural plates etc. shall be of unused stock, clean and straight, free from rust or mill scales without any sharp kinks, bends or other objectionable defects and of tested quality and shall conform to IS : 226 : 1962 or equivalent thereof as approved by the Engineer-in-Charge. All materials used shall be selected, as the best available for the purpose for which used, considering strength, durability and best engineering practice. Full test reports will constitute sufficient record as to the quality of the material used. Other materials like bolts, nuts, washers etc. shall be of high grade commercial quality equal to that covered by Indian standard specification for classifications covering their intended use.

The sequence and method of excavation shall be selected such as to enable the installation of the necessary supports, before the bridge action period of the excavation profile has expired.

17.02 PERMANENT STEEL SUPPORTS :

(A) General : For the purpose of these specifications permanent support are defined as the steel supports, which shall be left in place and be embedded in the concrete lining and shall include the structural steel supports, complete with all nuts. bolts, plates, spikes. drift pins, dowels, wedges, tie rods and other components and accessories required for assembling supports, erecting and holding them in place until the concrete lining is placed, also are included all laggings for the steel supports etc. The quantitv shown in the schedule of bids for this item is likely to very substantially depending upon the geological formations The contractor will not be entitled to any claim or compensation on account of such variations.

The tentative details of permanent supports are indicated in the Tender drawings. The type of supports to be provided shall, in a general way, roughly conform to the disposition as indicated in the drawings. The detailed designs of the permanent supports for various rock types and load conditions as encountered shall be worked out by the Engineer-in-Charge and detailed construction drawings shall be supplied to the contractor who shall furnish and install the supports accordingly.

As the underground excavation proceeds and rock conditions get known, the Engineer-in-Charge will indicate to the contractor the type and spacing of the steel suppors, whenever they are required. If the contractor feels that closer or stronger supports should be provided, he would discuss the same with the Engineer-in-Charge who after considering the same will specify in writing the provision of supports to be made beyond which any further provision of supports will be considered wasteful and will not be paid for.

The steel supports shall be installed in a workmanlike manner, true to the lines and grades and as directed by the Engineer-in-Charge and shall be maintained by the contractor in proper condition and alignment until the concrete lining is placed against them.

Improper installation of supports shall be corrected by the contractor within 48 hours after the improperly installed supports are called to this attention.

In supported sections of the tunnel, gallery and shaft the contractor shall securely brace

the supports with spreaders, blocking and wedges as provided in para 17.02 (C).

Where it is necessary to place structural steel struts across the invert, the struts shall be placed as shown on the drawings or as directed.

In certain rock conditions the load and side pressures may increase due to gradual subsidence of rock and if initially provided supports are founds substantially inadequate due to such increase in load it shall be the responsibility of the contractor to take appropriate and prompt measures to strengthen the supports and pack the cement concrete blocks/stone boulders behind the supports and grout the back packing material later after the lining has been placed or any other measures as approved by the Engineer-in-Charge. The additional steel provided by way of strengthening shall be measured for payment as steel supports. The backing materials shall from pa.t of the 1st stage concrete lining and therefore will not be paid for separately. The payment for furnishing and installing pipes for pack grouting shall be made as specified in clause 20.06 and nothing extra will be paid for drilling holes for pack grouting Cement consumed in pack grouting shall however be paid at Rs. 1000/- per tonne.

In order to limit such subsequent increase of rock loads and side pressures, the contractor, after erection of permanent supports, will take care to do immediate Ist stage concreting i.e. blocking concrete as per directions of the Engineer-in-Charge. All such concrete whether precast pr insitu or for lagging will be paid as the concrete in tunnel lining.

(B) Fabrication :

(i) General : Fabrication of the steel suppports shall be done in accordance with the drawings. Workmanship and finish shall be equal to the best general practice in modern steel fabrication shop. The ribs shall generally be bent cold. For small ribs may be fabricated as polygons but only after the approval of Engineer-in-Charge.

(ii) Butt plates : Butt plates of rib joints shall be 4 mm less in depth than the I beam so that they do not get welded with the splice plates.

(iii) Splice plates The accuracy of bending of splice shall be such that no portion of any splice plate shall depart more than 3 mm. from the surface of its assigned position on the rib segment to which it is to be welded.

(iv) The accuracy of bending shall be such that after bending, each segment shall conform to true template at ends Intermediate portions may depart from true template by not more than $\pm$ 10mm. The web shall be true and wrinkles or buckles shall not exceed 5 mm. when measured from a straight edge held flush against either side of web on radial plate.

(v) Bolt holes : Finished diameters of the holes in the beams, butt plates, splice plates, splice plates of wall plate joints etc. shall not be less than that shown on the drawing which is 3 mm. more than the normal diameter of the bolt. The hole dia shall, however, not be larger by more than 1.5 mm. than shown on the drawing. The holes will be drilled and reamed with the parts to bolted in assembled position.

(vi) Welding :

General : Welding shall be by the electric arc welding process using a method which exclude the atmosphere from the molten metal. Welding shall conform to the applicable provisions of IS : 816-1969 code of practice for use of Metal Arc welding for general construction in mild steel or its subsequent revision.

Surface to be welded shall be free from loose scales, slag, rust, grease, paint and any other foreign material except that mill scale which withstands a vigorous Wire brushing may remain. Joint surfaces shall be free from fins and tears. Preparation of edge by gas cutting shall whenever practicable, be done with a mechanically guided torch.

Welders : All Welding shall be structural. Only qualified welders shall be allowed to weld. For this purpose, the welders shall be periodically tested by the Engineer-in-Charge or his authorised agent; Welder shall be allowed to do fillet weld only on such locations for which he qualifies. For the above test IS : 817-1966 "Code of practice for Trainihg and Testing of metal arc welders" shall be applicable.

Inspection : All welds shall be visually inspected for the following :

(i) Gauging of dimensions and surface contour

(ii) Checking of specified tolerance.

(iii) Examining for under-cutting, overlap slag inclusion, and incipient cracks in weld.

Where so desired by the Engineer-in-Charge or his authorised agent, a test piece shall be tack welded to the job and the welding shall be continued so as to cover the test piece. After the welding has cooled down test piece shall be separated from the job by a hammer b-low and the broken face of the fillet weld shall be inspected for the following :

(i) Cracks

(ii) Incomplete penetration

(iii) Slag inclusion and porosity

(iv) Any other defect like under cutting etc.

(C) Foot blocks, lagging, blocking and spreaders : The dimensions and amount of the foot blocks, lagging, spreaders, wedges and blocking, where not shown on the drawing, shall, in all cases, be as necessary to serve their functions and for safety. The material used for foot blocks, lagging, blocking, and spreaders may be steel or concrete.

Payment for furnishing and placing the steel lagging and blocking placed permanently in the work will be made as laid down in clause 17.02 (F). If the foot blocks are of concrete they shall be treated to be a part of blocking concrete.

The laggings and steel blocking shall be tightly blocked by wooden wedges against the excavated rock surface at intervals as shown on the drawings. The blocking shall be checked frequently to maintain it in secure condition. Steel blocking shall be welded with the top flange of the rib and shall be provided in a radial direction.

In gravelly ground, splicing may be done and solid lagging of steel liner plates provided. The space between the liner plates and excavated rock surface shall be filled as completely and compactly as practicable with gravel blown through hose.

Permanent steel supports shall be braced securely in the lower half section by spreader bars before gravel is placed. The steel sets shall be placed in the plane at right angles to the tunnel, gallery, and shaft axis or in a vertical plane. In order to prevent buckling about the minor axis, and displacement of sets during blasting, wooden collar braces shall be provided between the webs near the spreaders bars. No separate payment will be made for this item.

(D) Erection Tolerances : The steel supports shall be erected at spacing shown in the drawings and kept blocked and wedged tightly until final concreting. They shall be erected either vertical or in a plane at right angles to the slope of the tunnel as may be found practicable. The erection shall be done within the following tolerances :

(a) Spacing of ribs : Average of three measurements taken around periphery shall not differ from the spacings shown on the drawings by more than $\pm$ 3 cm.

(b) Internal Dimension : Dimensions between the inner flanges of ribs shall be checked at 2 or 3 points in the horizontal plane and such dimensions shall not vary from the theoretical dimensions by more than $\pm$ 3 cm.

(c) Level of crown : Level of the crown shall be within —2 cm and +4 cm. of the required level.

(d) Deviation in vertical plane : The deviation from vertical or the required inclination shall not be more than $\pm$ 20 mm when measured at the lowest point.

(e) Spacing between the Tie rods : This shall be as shown on the drawings with a tolerance of $\pm$ 3 cm.

(f) Gap between the joints : The gap between the joints of the butt plates of the ribs shall not be more than 5 mm.

The Engineer-in-Charge may, if he considers necessary due to special circumstances, relax these tolerances.

(E) Joints : Welding of joints plates shall be done soon after installation of steel rib. Welding shall, be as per clause 17.02 (B) (vi). All welding shall however be completed before placement of reinforcement steel of concrete lining.

(F) Measurement and payment for permanent supports : Payment for furnishing and installing permanent steel supports as specified hereinabove, shall be made only for the quantity of steel in the structural sections used in the supports proper, footing, lagging, tie rods and plates used in butt joint and splice plates of joints and wall plates. The weight of the net length, and sizes put in shall be calculated from the unit weights given in latest edition of ISI Handbook for Structural Engineers. For Sections not covered in this Handbook, weights as given in manufacture's catalogue shall govern. No deduction shall be made for any holes for bolts etc. Weight of bolts, nuts used to fabricate the structural supports and bolts and nuts used for tie rods etc. will not be included in calculating the weight of steel to be paid and shall be considered included in the rates for steel supports. No separate payment shall be made for back packing backfill grouting except for cement as per clause 20.20 (viii) which shall be deemed to be included in the items of steel supports.

The classification of permanent supports for purpose of measurement and payment shall be as given below :

(i) Permanent support in tunnel and other underground works : This item of schedule of bids shall include all permanent steel supports installed in tunnels, galleries and shafts. This will also include all structural steel supports installed for the construction of portal.

(ii) Permanent steel supports in underground excavation in drainage galleries in surge shaft and Power House : This item of schedule of bids shall include all permanent steel supports installed in drainage galleries of Power House and Surge shaft etc.

17.03 TEMPORARY SUPPORTS :

By temporary supports is meant supports whether of timber or steel required to support the underground excavated sections during excavation but which can be removed before or during the concrete lining. Temporary supports shall be erected by the contractor, when so desired by the Engineer-in-Charge. It shall be the contractor's responsibility to bring in writing to the notice of the Engineer-in-Charge, location where the contractor considers the provision of temporary supports necessary. Consequences, if any for this failure to do so in good time, shall be the sole responsibility of the contractor.

The methods, the extent of supporting, sizes and spacing of supports etc. shall be approved by the Engineer-in-Charge. The stipulation given in para 17.02 for permanent supports shall apply in the case of temporary supports also. The supports may be of steel or timber and shall be removed before placing, the concrete lining.

Steel used in temporary supports shall be paid at Rs. 1500/- per tonne and timber at Rs. 800/- per cum.

The above rates shall include the cost of furnishing, installing, maintaining and removing the temporary supports including cost of all materials, labour and equipment provided that re-use of timber, steel or other materials, reclaimed from temporary supports will be permitted for the manufacture and installation of fresh temporary supports subject however, to the approval of the Engineer-in-Charge in respect of the condition and suitability of reclaimed timber, steel and other materials for reuse. The rate shall hold good for the first erection as well as subseqent additions, if necessary. The materials will be contractor's property after removal. If, however, some steel supports are allowed to be left embedded in concrete, they will be paid for at the rate applicable for permanent supports instead of temporary supports. Such supports shall not however, be left in place unless on specific direction of the Engineer-in-Charge in writing. In case temporary support of timber or any other material except steel is allowed to be left embedded in concrete, neither extra payment on that account for the same nor deduction in volume of concrete on that account shall be made.

17.04 SHOTCRETING/GUNITTING :

Whenever the Engineer-in-Charge considers that it is necessary to protect weak rock by either guniting or by shotcreting, the contractor shall carry out the same in accordance with the specification given hereinafter.

(a) General : The work of guniting and/or shotcreting to be done under these specifications shall consists of furnishing, scaffolding, plant, labour and materials required preparing the surfaces as directed by the Engineer-in-Charge and all operations covered within the intent and purpose of this item of work. The quantities provided for these items in the schedule of bids are very approximate and are likely to vary substantially, for which no compensation will be payable.

(b) Material :

(i) Guniting : The mortar for guniting shall generally consists of 1 part cement and 3 parts sand by weight. Special additives, supplied free of cost to the contractor, shall be added if so ordered by the Engineer-in-Charge.

Sand used shall be clean, graded and dry. The maximum grain size will not be more than 4.75 mm. The actual grading will be decided at the site after making trial mixes, otherwise it will generally conform to specifications given for sand in clause 20.07.

The proportion of water shall be adjusted to give the best possible adherance and to meet the requirements of additives where ordered to the satisfaction of the Engineer-in-Charge.

(ii) Shotcreting : The shotcrete mix shall generally consist of one part cement, 3 parts sand and one part coarse aggregate of 10 to 4.75 mm size by weight. Special additives, supplied free of cost to the contractor, shall be added if so ordered by the Engineer-in-Charge.

Coarse and fine aggregates for shotcreting shall generally conform to the specifications given under clause 20.06 and 20.07. The exact size and grading of coarse and fine aggregate shall be specified by the Engineer-in-Charge with the mix design during coarse of work. Other materials going into shotcrete including admixtures (additives) shall be governed by applicable specifications given under chapter 20 for Cement Concrete Work.

The water cement ratio shall be controlled at the placement point to give the best possible adherence and to obtain a slightly shiny surface. The water cement ratio will generally be between 0.40 to 0.55.

(c) Placement :

(i) Guniting : The rock or concrete surface to which gunite is to be applied shall be thoroughly cleaned of all dirt and loose material, using water and air under pressure if directed. All smooth surface like concrete shall be thoroughly roughened to ensure proper bond.

Gunite shall be applied in layers normally not less than 2.5 cms in thickness under a pressure of 5.5 to 7 kg per square cm. The total finished average thickness shall be as directed by the Engineer-in-Charge. The guniting gun shall be held normal to the surface being gunited and as close to it as possible. The final cost shall be trewelled to give a smooth surface where so required.

Material which rebounds and drops down shall not be reused and shall be removed and disposed off as approved by the Engineer-in-Charge.

In case of reinforced gunite, the reinforcement shall be laid true to lines and so placed as to give a minimum cover of 2.5 cms of gunite.

(ii) Shotcreting : All surfaces on which shotcrete is to be applied shall be properly hacked to remove all shaled, decayed, loose or dirty surface and have cavitites and cracks opened up and trimmed to square cut edges and shoulders. All old surfaces shall be thoroughly washed down with a high pressure water jet or cleaned with wet sand blasting if directed by the Engineer-in-Charge.

Concrete spraying by shotcreting method shall be done at the locations as directed by the Engineer-in-Charge. The machine shall be fed continuously so that there are no interruptions in spraying. The shotcreting machine shall be located within 60 metres of the surface to be sprayed.

Material shall be fed directly from a ready mix truck from a hopper, or by conveyor belt. Additives of in the powder form shall be added directly at the hopper of the machine. Liquid additives shall be pumped with the water directly into the nozzle.

The water pressure for this shall not be loss than 7 kg per sq. cm.

The nozzle shall be kept about one metre from the surface to be sprayed and the stream shall be directed normal to the surface. The distance of the nozzle shall be so adjusted that there is minimum rebound and shotcreted surface is even. The water shall be adjusted as needed.

Materials which rebounds and drops down shall not be reused and shall be removed and disposed off as approved by the Engineer-in-Charge.

The shotcrete shall be applied in multiple passes as required to build up the total thickness as directed by the Engineer-in-Charge. Each layer shall have a thickness that will ensure complete adherance to the surface or preceding layer and avoidance of sagging.

The period clapsing between successive applications of shotcrete shall not exceed 14 days, unless specifically permitted by the Engineer-in-Charge.

In case of reinforced shotcrete, the reinforcement shall be laid true to line and grade and so placed as to give a minimum cover of 2.5 cm of shotcrete.

The surface to receive shotcrete shall, where practicable, be rid of free water when the shotcrete is applied. Suitable weep holes, relief pipe, or other method of controlling water seepage shall be provided. Where impracticable to control free water, the contractor may apply shotcrete to such surfaces provided the shotcrete adheres readily to the surfaces and prevents the inflows as and use plastic tubes to collect and drain inflows as and when approved by the Engineer-in-Charge. The plastic tubes may be left in place and embeded in the shotcrete.

The cost of all labour and material involved in such draining of the surface will be deemed to be included in the unit rate for shotcrete.

(d) Curing : As soon as the gunite/shotcrete has hardened sufficiently it shall be cured in accordance with clause 20.18 provided that curing will not be required if a relative humidity of 85 percent is maintained in the area of gunite/shotcrete application for atleast 14 days from time of application.

(e) Measurement and payment : Payment for guniting and for shotcreting as per respective item will be made on the basis of 50 kg. of cement consumed for work as recorded at the point of mixing provided that no payment will be made for cement used in mortar or shotcrete rejected for placement. The rate shall be considered to include all equipment. labour, material, wastage of aggregates, curing, finishing, preparation of surface, draining the surface etc. Reinforcement if laid, will be paid for separately at the rate quoted for reinforcement in concrete.

17.05 SUPPORTING BOLTS :

(a) General : While in the opinion of the Engineer-in-Charge, blocks of rock are likely to get loose and fall down, the contractor may be required to furnish and install supporting bolts (rock bolts/perforanchors) upto 5 m. depth. Such supporting bolts in the tunnels shall be installed not later than 24 hours after exposure of the rock surface to be supported and shall be installed prior to blasting the next round. The requirement for furnishing and installing supporting bolts at any location and the total quantity thereof shall be subject to the approval of the Engineer-in-Charge. The quantities shown in the schedule of quantities and bids for these items are likely to vary substantially depending upon the geological formations of the underground works. The contractor will not be entitled to any claim or compensation on account of such variations or if no supporting bolts are required to be provided. Any required repair to or replacement of supporting bolts due to the contractor's operation shall be made at the expense of and by the contractor.

(b) Drilling : The Contractor shall drill holes for supporttng bolts in the roof or the sides (as the case may be) of the excavation at locations and to depth directed or approved by the Engineer-in-Charge. These would vary in different situations and locations.

(c) Rock bott bolts : The contractor shall furnish 25 m.m. diameter bolts of mild steel (conferming to IS : 432) selected at one end and threatcd at the other and shall furnish one 200x 200x 10 m.m. thick mild steel bearing plate and one met for each rock botts. The slots shall be approxmately 3 m.m. wide and 150 m m. long. The contractor shall also furnish the steel wedges approximately 2 cm x 2 cm at head and 14 cm long. The details of the rock bolts are given in the drawing attached. The bolts shall be driven into the holes until the slotted portion of the bolt has expanded sufficiently to provide adequate anchorage of bolts against the sides of the drilled holes.

After the bolt is secured in the hole, the bearing plate shall be placed on the bolt and the nut tightened against the bearing plate so that the plate has a firm bearing against the rock surface. The rock bolts may be grcuted where required by the Engineer-in-Charge.

(d) Perfo bolts : In the location where grouted rock bolts are required perfo bolts of 25 m.m. dia shall be used. For this perfo sleeve of 31 m.m. diameter shall be required with a bore hole of 38 m.m. diameter. The anchors shall be of mild steel conforming to IS : 432 pointed at one end.

The details of the perfo anchors shall be as per drawing attached. The location, depth and their mode of installation shall be as approved by the Engineer-in-Charge.

The anchor bars shall be cleaned thoroughly before being placed. The holes shall be cleaned thoroughly before receiving perfo tubes (sleeve) compactly filled with mortar mixed in the proportions of (1 cement : 3 sand) and to the consistency spocified by the Engineer-in-Charge. The anchor shall than be driven into the tube so as to push out the mortar and compactly fill the hole.

(e) Measurement and payment :

(i) Rock bolts : Measurement for payment furnishing and installing rock bolts shall be made per metre length of the bolt installed at the direction of the Engineer-in-Charge at the rate given on the schedule of bids. The rate includes the cost of the bolts including wedge, nut and the accessories etc. of driving the bolts, and also of the temporary timber supports and all other work in connection therewith. In case the Engineer-in-Charge desires to get the rock bolts to be grouted, the same shall be done by the contractor and in that case the cost of cement thus consumed shall be paid as per item 'Pressure-grouting' provided in the schedule of bids. Measurement and payment for furnishing and installing mild steel bearing plate shall be made seperately as per clause 17.02 (F) under permanent supports payment for drilling the holes shall be made separately under the item "Drilling holes for rock bolts/perfor bolts".

(ii) Perfo bolts : Measurement for payment for furnishing and installing perfo bolts shall be made per metre length of the perfo bolt installed at the dirction of the Engineer-in-Charge at the rate given in the schedule of bids. The rate shall include the cost of the bolt including the perfo tube and accessories etc. driving the bolt, and also of the temporary timber supports and all other work in connection therewith including grouting and cost of grout. Measurement and payment for furnishing and installing M.S. bearing plates if fequired shall be made separately as per clause 17.02 (F) under permanent supports. Payment for drilling the holes shall be made separately under the item "Drilling holes for rock bolt/perfo bolt".

17.06 CHAIN LINK FABRIC

The contractor shall furnish and install chain link fabric of approximately 50 mm mesh and woven from 10 S.W.G. steel wire for roof and side supports. The requirement for furnishing and installing chain link fabric at any location and the amount thereof shall be subject to the approval of the Engieer-in-Charge.

The chain link fabric shall be of approved commercial quality. The fabric may be required to be placed over the previously installed rock bolt and drawn up tight against the rock surface by means of the nuts and bearing plates. In case no rock bolts perfo bolts are provided the contractor shall be required to keep the chain link fabric in position by means of M.S. anchors or other means, the cost of which shall be deemed to be included in the unit rate quoted for this item in the schedule of quantities and bids. The contractor shall lap sections of fabric a minimum of 10 centimeters

provided that at connoctions where it is impracticable to maintain 10 contimeters laps, determined by the Engineer-in-Charge, the contractor will be permitted to extend laps in lieu of cutting along regular lines. Final layout of the fabric and extent of lapping shall be subject to approval of the Engineer-in-Charge,

Measurement for payment of chain link fabric will be made for the area covered by the fabric ignoring the overlaps and payment shall be made at the rate quoted in the schedule of quantities and bids.

17.07 FOREPOLING :

Forepoling may be necessary during underground excavation. For this holes in the top periphery of tunnel or elsewhere outside the minimum excavation line will be required at locations and direction as desired by the Engineer-in-Charge. The reinforcement bars shall be inserted thereafter in these holes and welded to the previously installed steel supports. The payment for the holes drilled shall be made at the unit rate provided for the item "Drilling holes for rock bolts/perfo bolts upto 5 m. depth". The payment for the bars shall be made under the item "Furnishing and Placing reinforcement" in case these remain inside the drill holes. If during blasting the bars come out of the holes, these shall then be paid under "temporary supports" at Rs, 1500/- per tonne as per clause 17.03. In case however steel sructural sections like joists, angles or channels etc., are used for forepoling, these shall be paid under the item "Permanent steel supports".

CHAPTER-18

FILL, BACKFILL, RIPRAP AND PITCHING

18.01 General : The work to be done under this section consists of furnishing all plants, labour and material and performing all works required to place rock fill, uncompacted and compacted backfill, riprap, filter blanket, rock pitching where indicated on the drawings or as directed in the field by the Engineer-in-Charge, all in accordance with provisions hereinafter specified.

18.02 Rockfill : The rock fill, whereever required to be placed, as shown on drawings or as directed in the field by the Engineer-in-Charge, shall consist of a suitable free draining mixture of rock fragements, boulders and cobbles from excavation for the Power House and appurtenant works or any other approved source. The largest rock in the rockfill shall be not more than 1/16 cubic metre in volume. The inclusion of gravel or rock spalls in the mass in an amount not in excess of that required to fill the voids, as determined by the Engineer-in-Charge, will be permissible, successive loads of material shall be dumped so as to secure the best practicable distribution of the material as determined by the Engineer-in-Charge. The rock fill shall be placed in approximately horizontal layers not exceeding 1 metre in thickness. The materials in the rockfill need not be specially compacted but shall be dumped and roughly graded off so as to conform to the established lines. grades and slopes and to ensure that the completed fill will be stable and that there will not be large unfilled spaces within the fill and the fill shall be free-draining.

Where the surface of the rockfill is to be covered with grouted paving, the upper 30 cms. of the rock unless otherwise directed by the Engineer-in-Charge, shall be constructed of selected fine rock material and finished so as to be suitable for sub-grade for the grouted paving as determined by the Engineer-in-Charge.

18.03 UNCOMPACTED & COMPACTEC BACKFILL :

(i) Materials : Uncompacted and compacted backfill shall be placed where indicated on the drawing or as directed by the Engineer-in-Charge. Materials used shall be only those approved by the Engineer-in-Charge and shall be secured from required excavation, or from other sources developed by the contractor as approved or as directed by the Engineer-in-Charge. Material shall be free from shale, bush, roots, sods or other perishable and objectionable materials. Rock may be used in compacted backfill, provided that voids occuring between rocks are filled with earth or other approved material to provide a compact mass and that rock is distributed throughout the course, using no rock that is larger in any of its dimensions than the depth of the course wherein the rock is placed.

(ii) Placement : The contractor will be required to break-up the fill material to such maximum size as is determined necessary by the Engineer-in-Charge to permit satisfactory placement. Compacted backfill shall be placed in layers approximately 15 Cms. in thickness prior to compaction and compacted by mechanical or pneumatic tampers or sheep-foot rollers. The density (dry) of the soil fraction in the compacted material shall be not less than 95 percent of the laboratery maximum soil density (dry) as determined by standard compaction test for the materials being compacted.

The standard compaction test as per IS: 2720 (part-VII) 1974 shall be performed on the soil fraction of the material which has been passed through a screen having 4.75 mm. square mesh opening. The test shall be made by compacting the soil in three layers, each approximately 5 Cms. thick, in a cylindrical container 10 Cms. in diameter and 12.73 Cms. deep equiped with a loose collar at the top. Each layer shall be subjected to 25 blows uniformly distributed over the surface thereof by an 31.0 Cms. drop 2.6 Kg. tamping rod having a striking area 5 Cms. in diameter. The collar shall then by removed and the soil struck off flush with the top of the cylinder. The compacted soil specimen shall be weighed and the wet weight of the compacted soil per cubic foot shall be calculated. A moist sample shall be removed from the soil specimen and even dried to a constant weight and from the wet and dry weights the percentage of moisture with respect to dry weight of soil shall be calculated. The above operation shall be repeated for about five or six different

moisture conditions to obtain a well-shaped dry density moisture curve. The peak point of the dry density moisture curve shall indicate the maximum dry density and the corresponding moisture content shall be referred to as the optimum moisture content.

The moisture content of the compacted backfill at the time of compaction shall be that repuired to give maximum consolidation of the material, when directed by the Engineer-in-Charge, the contractor shall add water by uniform sprinkling in advance of the compaction of each layer. The amount of sprinkling shall be controlled so that no free water will appear on the surface during or subsequent to compaction. Where the material is too wet to permit proper compaction, the contractor shall aerate the material until in the opinion of the Engineer-in-Charge optimum moisture is reached.

18.04 RIPRAP

Material for riprap shall be hard, dense, durable stone and may be obtained from suitable rock excavation or from quarry. It shall be free from cracks, seams or other defects which will tend to increase unduly its deterioration from natural causes, and shall not disintegrate under conditions of handling. It shall be free from earth, clay or other unsuitable material and shall be of a quality to insure permanence in the structure. Riprap wherever required to be placed shall be well graded and of size such that :

Approximately 35 per cent shall weigh from 270 to 450 Kg.
Approximately 30 per cent shall weigh from 135 to 270 Kg.
Approximately 20 percent shall weigh from 34 to 135 Kg.
Approximately 15 per cent shall weigh from 2.25 to 34 Kg.

Riprap stone shall be dumped directly on the filter blanket in such a manner as to ensure that larger stones are well distributed and to produce a reasonable uniform, well graded mass. Bridging will not be permitted and the full course thickness shall be accomplished in one operation. Hand placing and barring will be required only to the extent necessary to secure the results specified above. Due care shall be taken to prevent damage to the finished surface during dumping of the riprap and any damage done shall be repaired before proceeding with the riprap work.

18.05 FILTER BLANKET:

A continuous filter blanket shall be placed where directed by the Engineer-in-Charge. Material for filter shall be crushed stone or gravel composed of hard and durable particles and shall be well graded. The grading of the filter material shall be directed by the Engineer-in-Charge. The filter material shall be reasonably free from thin, flat and elongated pieces and shall contain no organic or other objectionable matter nor soft, friable particles in quantities considered deleterious.

Prior to placing filter blanket material, which shall be placed just ahead of the riprap, the areas on which the filter blankets are to be placed shall be reasonably smooth and free from holes and eroded areas. The material shall be spread uniformly over the area and the method of placing shall be such as to prevent segregation of the Material. No intermixing of materials will be permitted and the required thickness shall be maintained throughout the area covered. No special compaction of the filter blanket will be required.

18.06 BOULDER PITCHING :

Boulder pitching shall be placed on slopes roughly prepared for the purpose in locations and in thichness shown on the drawings or as directed by the Engineer-in-Charge.

Boulder pitching shall be of stone which shall be got approved by the Engineer-in-Charge in lots. The boulders used for such purpose shall be sound, tough and resistant and those which are porous or liable to quick abrasion, chipping or distintegration by water action shall be excluded. Boulders of 0.02 cum. each and of larger size shall constitute atleast 50 percent of the total pitching and the smallest sizee shall not be less than 0.012 cum. When the pitching is more than 0.30 m deep it shall be done in two layers, each layer being one boulder thick, the bottom layer shall be minimum 15 cm thick and shall be laid on rammed shingle or earth. This layer may comprise flat stones with their largest surface laid.

At the bankslope the next layer shall be 22.5 cm or more thick and boulder shall be pitched with its larger size at right angle to the bank slope. Atleast 20 percent of the boulders in this layer shall be more than 25 cm long and these shall be evenly distributed throughout the surface. The pitching shall be carried up regularly and evenly in not more than 60 cm height. When any portion of the pitching has to be extended it shall be stopped at the joints in a slope not exceeding 45° with the horizontal. The top of the pitching shall be finished plane and shall present a neat appearance.

The pitching shall be so laid as not to allow picking out of boulder by hand, the interstices shall be well packed with stone chips or bajri or as directed by the Engineer-in-Charge.

18.07 GRAVEL OR CRUSHED STONE SURFACING :

Gravel or crushed stone surfacing material shall be placed on the sub-grade of the parking areas, and elsewhere as directed by Engineer-in-Charge. The material shall be furnished by the contractor and shall consist of quarry waste, broken stone, crushed gravel or a combination thereof approved by the Engineer-in-Charge. The maximum size of gravel or rock fragments shall not exceed 2 cms. The aggregates shall be free from vegetable matter, loam and other deleterious substances and shall be of such quality that it will compact thoroughly when watered and rolled. The subgrade shall conform to the grade and cross-section prescribed by the Engineer-in-Charge. The material shall be spread on the subgrade in the locations and to the depths prescribed by the Engineer-in-Charge. The contractor shall route his hauling equipment over the materials so as to compact the material thoroughly and the material shall be dragged and bladed to line and grade.

18.08 MEASUREMENT :

Measurement for payment for rockfill, uncompacted and compacted backfill will be made in cubic metres of material placed between the lines and grades as indicated on the drawings or as stacked in the field as per approval of the Engineer-in-Charge.

Measurement for riprap, filter blanket and boulder pitching will be made in cubic metres of material placed to the lines and grades shown on the drawing or as stacked in the field as per approval of the Engineer-in-Charge.

Measurement for gravel or crushed stone surfacing will be made by volume of surfacing in cubic metres. The stack measurements as mentioned above will be resorted to only in case when it is not possible to measure the materials as laid at site and in such case a deduction of 10% for voids will be made from stack measurement.

18.09 PAYMENT :

payment for rockfill, uncompacted back fill and compacted backfill will be made as herein specified at the applicable contract unit prices which includes all cost of furnishing all plant, labour and material and performing all work including loading, hauling, spreading, sprinkling, tamping, compacting, dressing of slopes and other incidentals required for completion in accordance with the details shown on the drawings and as required by the specifications, or as directed by the Engineer-in-Charge. No payment will be made for rockfill replacing material excavated beyond the required lines of excavation or for rockfill in excess of the required limits as shown on the drawings or as staked in the field by the Engineer-in-Charge.

Payment for riprap, filter blanket and boulder pitching will be made as herein specified at the applicable contract unit prices which shall include all cost for furnishing all plant, labour and materials and performing all work required for completion of the work in accordance with the details shown in the drawings and as required by the specifications or as directed by the Engineer-in-Charge. No payment will be made for riprap, filter blanket and rock pitching placed outside the required limits as shown on the drawings, or as staked in the field by the Engineer-in-Charge. Payment for gravel or crushed stone surfacing will be made at the applicable unit price per cubic metre for the item therefor in the schedule of bids of which unit price shall include the cost of furnishing, excavating loading, hauling, placing and spreading the material as described in paragraph 18.07.

CHAPTER—19

EXPLORATORY CORE DRILLING

19.01 GENERAL:

Exploratory core drilling will be required to be done at Hathiari Power House area and elsewhere as directed by the Engineer-in-Charge.

The Contractor shall, where and if directed by the Engineer-in-Charge, perform such core drilling as may be required to determine the condition of the rock or the effectiveness of the grouting operations. The requirement of the core drilling and the amount thereof will be optional with the Engineer-in-Charge, and the contractor shall be entitled to no addttional compensation above the unit price in the Schedule of bids for core drillling NX, BX or AX holes and for core drilling $5\frac{1}{2}$" diameter holes. The NX, BX and AX holes shall not ordinarily be less than $2\frac{1}{16}$", $2\frac{3}{8}$" and $1\frac{7}{8}$" in diameter respectively and shall produce cores ordinarily not less than $2\frac{1}{16}$", $1\frac{5}{8}$" and $1\frac{1}{8}$" in diameter respectively. All core drilling shall be performed with standard core drilling equipment, using NX size bits and double tube core barrels and capable or producing cores of Diameter specified. The NX, BX and AX holes will be required to be drilled to varying depths and at any inclination. The $5\frac{1}{2}$" diameter holes shall produce cores not less than 4" in diameter and will be required to be drilled to a depth of not more than 10 m. All core drilling shall be performed in a workmanlike manner, by competent and experienced workmen and special care shall be exercised to obtain cores in as good condition as possible from all holes in material capable of producing satisfactory cores. The drill bit shall be pulled and the core removed as often as possible to secure the maximum possible amount of core. The contractor shall keep and furnish in the manner prescribed by the Engineer-in-Charge an accurate log of all drill holes, including description of all materials of whatever character encountered in the drilling, their location in the holes and the location of special features such as mud seams, open cracks, soft or broken ground, points where abnormal loss of drill water occured and any other item of interest in connection with the purpose for which the core drilling is required. The contractor shall place accurately the core in suitable boxes in the correct sequence and segregated accurately by labelled wooden block according to the measured distances in the holes. No box shall contain cores from more than one hole. Designating marks, holes numbers and elevations shall be placed on the boxes and along the line of cores as directed by the Engineer-in-Charge. The covers shall be fastened securely to the core boxes and the boxes shall be delivered to the Engineer-in-Charge at a point designated by the Engineer-in-Charge in the vicinity of the work. Water testing shall be done whenever abnormal loss of drill water occures or as directed by the Engineer-in-Charge. Results of water testing done shall be kept accurately.

19.02 MEASUREMENT AND PAYMENT FOR CORE DRILLING :

Core drilling will be measured for payment to the actual depth of drilling or upto the depth directed by the Engineer-in-Charge, whichever is less. Payment for core drillling will be made at the unit rates per linear meter in the schedule of bids for core drilling NX, BX, AX of $5\frac{1}{2}$" diameter holes in stages between depths specified in the schedule of bids. These unit rates will include the cost of furnishing all labour, material, tools and equipment required for drilling the holes, boxing, lebelling and transporting the cores and all incidental works connected there-with but excluding water percolation tests.

Water testing may be required to be done for the holes in various depths and lengths of the holes using suitable packers as directed by the Engineer-in-Charge. The sequence and mode of drilling and water testing shall be as per direction of Engineer-in-Charge. Payment of water testing shall be made as per provision of clause 24.06 and paid as per provisions of clause 24.07.

CHAPTER—20

CEMENT CONCRETE WORK

20.01 GENERAL:

The work covered by this chapter consists of furnishing all labour, material, and equipment with the exception of those to be provided by Government in accordance with the provisions of paragraph 9.03 of the General conditions of contract and performing all work for the manufacture, transporting, placing, finishing and curing of concrete in the structures included in these specifications. The cost of producing aggregates shall be included in the unit prices in the schedule of bids for the items of work in which the aggregates are used of which unit prices shall also include all expenses of the contractor in stripping the quarry and in screening, crushing, washing, classifying, blending, storing, handling and other necessary operations on the aggregates. The rates in the schedule of bids include provision for the use of hammer mill in tertiary crushing only if necessary as well as for wet screening of aggregates. The contractor shall be entitled to no additional payment for materials wasted from a quarry including crusher fines, excess materials of any of the size into which the aggregates are required to be separated by the contractor, and materials which have been discarded by reason of being above the maximum sizes specified for use.

Rock ladder facilities will be provided by the contractor in the storage piles for coarse aggregates without additional cost to Government, if required by the Engineer-in-Charge.

20.02 COMPOSITION :

Concrete shall be composed of portland and/or pozzolana cement, water, fine and coarse aggregates, and if considered necessary by the Engineer-in-Charge, an air entraining admixture, dispersion agent and/or pozzolanic admixture. The design of each concrete mix will be based on the water-cement ratio necessary to secure a plastic workable mix suitable for the specific conditions of placement and when properly cured, a product having durability, impermeability and strength in accordance with all the requirements of the structures covered by these specifications. About 25 percent Fly-ash is likely to be used as replacement of portland cement in mass concreting. The mix will be designed by the Engineer-in-Charge and the test samples of each specified mix shall be prepared and tested in the laboratory.

20.03 QUALITY

Samples for testing concrete, as mixed, will be taken by the Government for all classes of mix (a) when being delivered from the mixer, and (b) when being placed in the forms and tested, in accordance with the relevant I. S. Specifications. The contracter shall provide all facilities to take these concrete samples free of cost to the Government. He will make arrangements for carrying and depositing these samples for testing to Test and Control Laboratory, Dakpather.

Test operations of the concrete plant will be carried out by the Contractor under the supervision of the Engineer-in-Charge from time to time as may be required by the Engineer-in-Charge, to determine the average strength of concrete of each class of mix. The average strength of all test samples of particular mix taken during a day shall not be less than the acceptable strength as notified to the contractor by the Engineer-in-Charge on basis of the test operation.

20.04 CEMENT :

(a) General : Cement will be furnished by the Govt. in accordance with the provisions of clause 9.03 (A) of the general conditions of contract and shall be used for all works.

(b) Portland cement : Cement shall conform to I. S. 269-1970 and its subsequent amendments. Pozzolana cement will conform to I. S. 1489-1976 and its subsequent amendments.

(c) Special test requirements : Cement will be sampled at the stores and/or the site of work. All tests will be made by or under the supervision of the Government and at its expense, No

cement shall be used by the contractor until notice has been given by the Engineer-in-Charge that the test results are satisfactory.

(d) Transportation of cement : The cement shall be transported in accordance to provision of paragraph 9.03 (A) of general condition in trucks/silos/bulk carriers provided with adequate arrangements for prevention of deterioration due to weather conditions.

(e) Storage : Immediately upon receipt, the cement shall be stored in a dry, weather-tight and properly ventilated structure with the adequate provisions for the prevention of absorption of moistura. All storage facilities shall be subject to the approval of the Engineer-in-Charge and shall be such as to permit easy access for inspection and identification. Storage shall be provided at the site near the batching and mixing plant for a minimum of 1000 tons of cement. In order that cement may not become unduly aged after delivery, the contractor shall use any cement which has been stored at the site for 60 days or more before using cement of lesser age. Any cement stored at project site for over four months shall not be used unless retest proves it to be satisfactory.

20.05 ADMIXTURES

(a) Air entraining admixtures : The air entraining admixture, if required, will be furnished by the Government free of cost and will consist of an approved substance or compund which will produce entrained air in the concrete as hereinafter specified. The contractor shall provide facilities satisfactory to the Engineer-in-Charge for adding the admixture at the mixer, when so required. The total calculated air content for that portion of the concrete containing aggregate smaller than that passing through the 40 mm square mesh sieve will be a percentage of the volume of the concrete, as determined by the Engineer-in-Charge. Nothing extra will be paid to the contractor on account of facilities made for adding admixture.

(b) Other admixture (including pozzolana) : Pozzolanic and other admixtures will be used only as and when directed by the Engineer-in-Charge. These admixtures will be supplied by the Government as per clause 9.03 (B) of general conditions. The cost of adding any admixture, including all necessary operations and arrangements necessary to be made, shall be included in the unit rates of concrete and nothing extra shall be paid to the contractor.

(c) Test : Tests of admixtures will be made by the Government in accordance with applicable Indian Standard Specifcations or as otherwise prescribed by the Engineer-in-Charge.

20.06 COARSE AGGREGATE :

The term 'Coarse aggregate' is used to designate aggregate that is reasonably well graded from 4.75 mm. to 150 mm or any size or range of size within such limits. Coarse aggregate for concrete shall be furnished by the Contractor and shall consist of crushed rock or natural gravel or a mixture of crushed rock and natrual gravel blended uniformly and to the satisfaction ot the Engineer-in-Charge.

(a) General : Sufficient quantities of coarse aggregate is available in river bed at Kalsi and Naro-Ka-Khala. The contractor may explore the availability of coarse aggregate at other places also with the permission of the Engineer-in-Charge. Analysis of river bed material from a number of pits excavated in Yamuna river bed & Naro-Ka-Khala bed is given in Exhibit 21 of Valume III. This data is given only for general inrormation of the contractor and the Government does not hold any responsibility in case the analysis of river bed material during processing is found to be different. The contractor is advised to make his own assessment regarding grading and other properties of different fractions of coarse and fine aggregates found in the river bed. The river bed material from proposed quarry site as shown in Exhibit 2 shall be allowed to be used as a whole subject to limitations of deleterious substances and other properties specified in I. S. 383-1970.

In case the coarse aggregate from places nearer or farther from river bed at Kalsi is used after the approval of Engineer-in-Charge, the same rates of concrete as quoted by him shall be applicable.

The contractor should investigate the quantity required by him for the works well in advance. The Government shall not be responsible if the work suffers on this account. The

Contractor shall set up a processing and crushing plant at his own cost for producing aggregates of required sizes and shall make necessary arrangement for its transportation to the batching plant to the full satisfaction of Engineer-in-Charge.

Coarse aggregate shall consist of uncoated hard, strong, dense, and durable pieces and shall be free from injurious amounts of disintegrated stones, soft, flaky or elongated particles, salt, alkali, vegetation and organic matter and other deleterious substances. The percentage of deleterious substances in any size of coarse aggregate as delivered to the mixer shall not exceed the following values.

Sl. No.	Substance	Percentage by weight	
		Uncrushed	Crushed
(i)	Coal and lignite	1.00	1.00
(i i)	Clay lumps	1.00	1.00
(i ii)	Material fine than 75-u IS Sieve.	3.00	3.00
(iv)	Soft fragments	3.00	—

The total of percentage (sl. No. 1 to 4) of all deleterious substance (except mica) in any size as delivered to the mixer, shall not exceed 5 percent by weight both for crushed and uncruched aggregate. However, Engineer-in-Charge at his discretion, may relax some of the limits as a result of some further tests and evidence of satisfactory performance of the aggregate.

Coarse aggregate may be rejected if it does not comply to the following requirements as specified in IS: 383-1970 or its subsequent amendment issued thereafter.

(i) Crushing value : The aggregate crushing value when determined in accordance with IS: 2386 (Part IV) shall not exceed 45 percent for aggregate used for concrete other than for wearing surfaces, and 30 percent for concrete for wearing surfaces such as runways, roads and pavements.

(ii) Impact value : As an alternative to (i) above, the aggregate impact value shall not exceed 45 percent weight for aggregate used for concrete other than for wearing surfaces and 30 percent by weight for concrete for wearing surfaces such as runways, roads and pavements.

(iii) Abrasion value : The aggregate abrasion value when tested in accordance with IS : 2386 (Part IV) shall not exceed the following values :

(a) For aggtegate to be used in concrete for wearing surfaces 30%

(b) For aggregates to be used in other concrete 50%

(iv) Soundness : As a general guide, the average loss of weight after 5 cycles shall not exceed 12 Percent tested with sodium sulphate and 18 percent when tested with magnesium sulphate.

(v) Specific gravity test : The specific gravity computed on saturated surface dry basis should not be less than 2.60.

(vi) Absorption Test : The amount of water absorbed should not exceed 5 Percent.

The Engineer-in-Charge may examine the aggregate in other respects as well, such as the quick chemical reactivity test, assessment of clay, soft and elongated particles etc. and the contractor shall supply free of cost necessary quantities of aggregates to carry out all the tests desired by the Engineer-in-Charge. The source from which concrete aggregates are to be obtained shall be selected by the contractor well in advance of the time when they are required in the work, and shall supply samples to the Engineer-in-Charge at least 60 days before the contemplated use of the aggregate in concrete.

The aggregate shall be resistant to chemical or physical changes such as cracking, swelling, softening, leaching or chemical alternation after its incorporation in concrete.

In case the aggregate is not considered to be free from dust, dirt, etc. by the Engineer-in-charge, the contractor shall get the stone screened, washed and/or treated as directed.

(b) Grading : The coarse aggregate as delivered to the mixer shall be well graded within the limits as may be specified by the Engineer-in-Charge.

Maximum size of aggregate for concrete for some of the more important locations will be as given below except for such portions of the work where the use of smaller or larger maximum size of aggregate is specifically directed by the Engineer-in-Charge.

Location	Maximum size of aggregate
1. Concrete in sub-structure of Power House and its appurtenant works where there is no reinforcement.	80 millimetres
2. (a) Concrete in side walks, curbs and parapets.	
(b) All reinforced concrete of thickness, more than 150 millimetres.	
(c) Pumped concrete in lining of tunnels, galleries, surge tank and other locations.	
(d) Concrete in substructure of Power House and its apppurtenant works in reinforced portions (subject to spacing and cover of reinforcement).	
(e) Concrete in sub-structure of Power House and its appurtenant works where thickness of concrete is more than 150 millimetres.	
(f) Concrete in switch yard, foundation structure (subject to spacing and cover of reinforcement)	
(g) Concrete in penstock	40 millimetres
3. Reinforced concrete in slabs and walls less than 150 millimetres thick.	20 millimetres

(c) Sampling : All sampling of coarse aggregate shall be in accordance with the applicable provisions of I.S. 383-1970 and its subsequent amendments. All tests will be made by and under the supervision of the Government and at its expense. Routine control tests of the coarse aggregate at various stages in aggregate processing plant, storage piles and batching and mixing plant will be made by the Government. The contractor shall provide such facilities as the Engineer-in-Charge may consider necessary for the ready procurement of representative test sample.

(d) Storing and handling of coarse aggregate : The coarse aggregate shall be separated in fair storage piles designated 80 mm to 40 mm; 40 mm to 20 mm; 20 mm to 10 mm and 10 mm to 4.75 mm. The piles shall be so located as to avoid any undesirable material getting mixed up with the aggregate and will be provided with suitable handling equipment such as belt conveyors to deliver the aggregates to the mixing plant. If the piles get mixed up with undesirable materials, the contractor shall remove such undesirable material by washing and other means as directed by the Engineer-in-Charge. The aggregate shall be so deposited in and removed from the storage piles, as not to cause any excessive breakage or change in the uniformity of grading.

The contractor shall keep at all times a live storage of coarse aggregates so as to last for the work without replenishment, for at least 3 days near the batching plant and another 4 days at the quarry site.

20.07 FINE AGGREGATE :

(a) General : The term 'fine aggregate' or 'sand' is used to designate the aggregates in which the maximum size of particles is 4.75 millimetres. It is expected that suitable river sand may be available in the river Yamuna near Dakpathar and Kalsi and in stray reaches in insignificant quantities in the Yamuna Valley. The contractor shall be responsible for the investigation and procurement of sand of the quality specified herein. Depending upon availability and suitability, it may be necessary to supplement the river sand with manufactured sand from quarried rock. Manufactured sand may have to be used entirely, or blended with river sand to obtain a satisfactory grading of the fine aggregate.

In the case of river sand, the source from which it is obtained shall be subject to the approval of the Engineer-in-Charge. The fine aggregate, whether it is Yamuna river sand, crushed sand or a mixture of both in proportions as required by the Engineer-in-Chare, shall comprise of all aggregate particles having a maximum size upto 4.75 mm. The manufactured sand, if used, shall be crushed out of approved stone and the contractor shall take suitable measures to reduce the blowing of dust at each point of handling of this sand.

All fine aggregate obtained from the river bed shall be washed to remove impurities silt and clay. Aggregate manufactured from natural rocks shall be freed from dust by either washing or any other approved process to the satisfaction of the Engineer-in-Charge. The fine aggregate shall be clean, free from excess mica, silt practicle, organic and chemical impurities.

The sand shall consist of hard, dense durable, uncoated rock fragments. The maximum pecentage of deleterious substance in the sand as delivered to the mixer shall not exceed the following values as specified in IS : 383-1970 or as modified in subsequent amendment of the code.

Material	Percentage by weight	
	Uncrushed	Crushed
1. Coal and lignite	1.00	1.00
2. Clay lumps	1.00	1.00
3. Material finer than 75 u IS sieve	3.00	15.00
4. Soft fragments	—	—
5. Shale	1.00	—

The sum of percentage of all deterious substances (except mica) in sand as delivered to the mixer shall not exceed five (sum of Sl. No. 1 to 5) for uncrushed and two (sum of Sl. No. 1 and 2) for crushed. However, Engineer-in-Charge at his discretion may relax some of the limits as a result of some further tests and evidence of satisfactory performances of the aggregate.

Sand may be rejected if it does not conform to the following requirements as specified in IS : 383-1970 and any subsequent amendments issued thereafter :

(i) Test of organic impurities : The sand should not produce a colour darker than the standard in the colorimetric test for organic impurities.

(ii) Soundness test : As a general guide the average loss of weight after 5 cycles should not be more than 10 percent with sodium sulphate solution and 15 percent with magnesium sulphate solution.

(iii) Specific gravity : The specific gravity computed on the saturated surface dry basis should not be less than 2.60.

(b) Grading : The fine aggregate as delivered to the mixer or as incorporated in the mixed concrete shall be well graded within such limits as may be specified by the Engineer-in-Charge. During normal operations, the grading of the fine aggregates shall be controlled so that the fineness modulus of nine samples out of ten of the fine aggregate as delivered to the mixer shall be within the range of 2.3 to 2.7 or as modified by the Engineer-in-Charge. In exceptional cases, the fine aggregate of fineness modulus less than 2.3 may be permitted by the Engineer-in-Charge provided that extra cement consumption on this account shall be at contractor's cost. The recovery of cost of cement for such extra consumption will be made at the issue rates as given in clause 9.03 (A). Any classifying, batching or other operations on the fine aggregate required to meet the gradation shall be done by the contractor and the cost thereof shall be included in the unit prices for the items of work in which the fine aggregate is used.

(c) Sampling : All sampling of fine aggregate shall be in accordance with the applicable provisions IS: 383-1970 and any subseqent amendments. All tests will be made by and under the supervision of the Cavernment and at its expense. Routine control tests of the fine aggregate at

various stages in aggregate processing plant, storage piles, batching and mixing plant will be made by the Government. The contractor shall provide such facilities as the Engineer-in-Charge may consider necessary for the ready procurement of representative test samples.

(d) Storage : The fine aggregates will be stored in separate stock piles within the limits of the areas as approved by the Engineer-in-Charge. The removal of the materials from storage area shall be done in a manner that will result in increasing the uniformity of the grading in so far as is possible. All aggregate shall remain in free draining storage for atleast seventy two hours prior to use. Sufficient live storage so as to last for the work without replenishment for atleast 3 days near the batching plant and another 4 days at the quarry site shall be maintained.

20.08 WATER :

Water used for mixing and curing shall conform to IS: 456-1978 or its subsequent revision. It shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Portable water is generally considered satisfactory for mixing concrete.

20.09 PROPORTIONING OF CONCRETE :

(A) The proportions of all materials entering into the concrete shall be as directed by the Engineer-in-Charge. The contractor shall provide all necessary equipment and plant to determine and control the actual amounts of materials entering each batch. The proportions will be charged, whenever, in the opinion of the Engineer-in-Charge, such change is necessary in order to maintain the uniformity and standard of quality required by these specifications.

(B) Measurement : All materials entering into the concrete shall be mechanically batched and measured by weight at the scales of the batching and mixing plant.

(C) Cement content : The cement content in the various schedule items of concrete will range from an approximate minimum of 115 Kilograms to an approximate maximum of 400 Kilograms each per cubic metre, depending upon the size, type and gradation of aggregate and pozzolana used, and on the structural requirements as determined by the Engineer-in-Charge.

(D) Aggregate Content : Concrete mixes will be designed to use the largest size and the maximum amount of coarse aggregate placeable in the various parts of the structures. Any variation in the quantities of coarse and fine aggregates or other ingredients due to change in the quantity of cement per cubic metre of concrete or on any other account shall be deemed to be included in the unit rates of respective items of concrete as given in the schedule of bids.

(E) Workability : The concrete mixes which have been designed and tested in the Government laboratory will be adjusted in the field from time to time to meet the various conditions encountered during construction as directed by the Engineer-in-Charge. Unless otherwise provided, the concrete shall be so controlled that the slump at all times for works other than lining is, kept between 25 mm and 75 mm and for concrete lining for tunnels, shafts and galleries between 75 mm and 125 mm when tested in accordance with IS: 1199-1959 or its subsequent amendments.

20.10 BATCHING :

(A) Equipment : The contractor will have to procure and install batching plant of adequate capacity at his own cost. The average pouring rate is 150 m^3/day for a peak quantity of approx. 20000m^3 in one working season. All the concreting equipments are to be planned for a peak pouring rate of 300 m^3/day capacity. The equipment shall be capable of determining accurately and of controlling the prescribed amounts of the various materials, including water, cement admixture, pozzolana, sand and each individual size of coarse aggregate entering the concrete and combining them to give a uniform mix within the prescribed time and discharging this mix without segregation. The equipment and its operation shall at all times be subject to approval of the Engineer-in-Charge. Any waste resulting from faulty operation of batching equipment over batching of materials, or other causes will be charged to the contractor. All records and charts of the batching operations shall be prepared as required by the Engineer-in-Charge and shall become the property of the Government. The equipment shall conform to the following detailed requirements.

(I) Batch bins shall be constructed so as to be self-cleaning during draw down and the materials shall be drawn from the bins in such a manner that they are practically empty at least three times per week. Material shall be deposited in the batch bins, directly over the discharge. Equipment for conveying batched materials from the batch hoppers to and into the mixer shall be so constructed, maintained and operated that there will be no spillage of batched materials or overlap of batches.

(II) Each weighing unit shall include a visible springless dial which will register the scale load at any stage of the weighing operation from zero to full capacity. The weighing hoppers shall be so constructed as to permit the convenient removal of over weight materials in excess of the prescribed tolerance.

(III) The weigh batches shall be automatic. these shall be capable of weighing accurately toprescribed limits, with tolerance of not more than $1\frac{1}{4}$ percent for cement Pozzolana and water, 2 percent for crushed and river sand and stone aggregate upto 40 mm size, 3 percent for 40 mm to 80 mm aggregate and 5 percent for air entraining agent.

(IV) Convenient facilities shall be provided for readily obtaining representative samples of each ingredient from the discharge streams between bins and the batch hopper or between the batch hoppers and the mixer.

(V) The water measuring device shall be such that leakage will not occur when the valves are closed and that small increments of water may be discharged, when required. The water measuring devices shall be so constructed that the water will be discharged quickly and freely into the mixer without objectionable dribble from the end of the discharge pipe, and without any spillage.

(VI) The control room shall be so located that the operator can have unobstructed direct visibility into one of the mixer and should have arrangements for viewing the discharge hoppers as well.

(VII) The control panel and weighing dials shall be positioned in the control room away from the weigh hoppers. The panel shall have glass inspection windows and easily removable access panels. The dials shall be of sufficient size so that the operator can read them readily from his normal seat. Provision shall also be made for making changes easily and quickly to any one of the present mixes. The adjustment of the settings shall be such that it could be made by the operator from the front of the panel, without delaying the batching operations.

(VIII) The batching equipment shall include an accurate recorder for making a continuous visible combined record of the measurement of each separate concrete ingredient and of the consistency of the concrete during the mixing process. A portion of the recorder chart equivalent to atleast 30 minutes of plant operation shall be visible after recording. This portion of the charge shall be supported over its entire width on a smooth firm backing so that notes can be made without puncturing the paper. Each unit for recording the weight of a concrete ingredient or for recording the consistency of concrete during the mixing process shall be equipped with a readiiy adjustable guide pen or other equally suitable device for making a continuous visible indication on the chart of the correct weight of the ingredient of the designed consistency of the concrete. Suitable means shall be provided to ensure proper alignment, uniform rate of travel, and tautness of the paper without wrinkling. The recording equipment shall include facilities for automatically registering the time of day at intervals of not more than 15 minutes and shall be designed for simplicity in operation and maintenance.

(IX) The equipment shall be capable of ready adjustment for compensation for the varying weight of any moisture co ntained in the aggregates.

(X) Suitable provisions shall be made to guard against the following :

(A) Batches may not be discharged until all aggregates are correctly weighed.

(B) Batches may not be discharged until the chute is correctly positioned to mixer which is in the charging position. Mixer may not discharge until hopper gate is open.

(XI) Check test of equipment : The contractor shall provide test weights at least equivalent to the maximum working load used on the most heavily loaded scale and any other auxiliary equipment required for checking the operating performance of each scale or other measuring device and shall make periodic tests for accuracy of measurement over the full capacity range of each scale or measuring devise. The test shall be made in the presence of an authorised representative of Engineer-in-Charge and the test procedure shall be subject to his approval. Unless other wise directed, tests of equipment in operation shall be made atleast once every 2 weeks in the case of equipment for measuring water, cement, pozzolana, and admixture and at least once every month in the case of equipment for measuring sand and coarse aggregate. The contractor shall if required, furnish the Engineer-in-Charge with copies of the complete results of all check tests made and make such adjustments, repairs or replacement, as the Engineer-in-Charge may consider necessary. to secure satisfactory performance.

(XII) The plant shall, if possible, include a device suitable for proportioning air entraining admixture. The discharge mechanism of the device shall be interlocked with the batching or discharging operations of the aggregate or the water, so that the batching of the admixture will be automatic. The device shall be capable of ready adjustment to permit varying the quantities of admixture to be batched.

(XIII) The plant shall include a device suitable for proportioning pozzolana admixture.

(XIV) The plant shall include a device for indicating and recording the number of the batch mixed.

(XV) The plant shall include a mix selector to permit simultaneous setting and selection of at least eight different mixes.

(XVI) Facilities for obtaining concrete samples from the discharge stream between the wet hopper and the concrete bucket where the concrete is being delivered into the later shall be provided by the contractor at his own cost in accordance with the design to be supplied by the Engineer-in-Charge. Suitable space, as required by the Engineer-in-Charge shall also be provided in the batching plant free of cost for carrying out tests on concrete samples by representatives of the Engineer-in-Charge.

(XVII) The Engineer-in-Charge may relax any of the conditions mentioned here-in-above if he is satisfied with the results.

20.11 MIXING :

Tilting type mixers shall be used. The arrangements for concreting the tunnels, adits, shaft and Power House shall be got approved by the Engineer-in-Charge. The concrete ingredients shall be mixed thoroughly in batch mixer so as to positively ensure uniform distribution of all the component materials throughout the mass at the end of the mixing period.

The variation within a batch as provided in IS: 4968-1968 appendix A shall be determined. For these specirications the comparison shall be between two samples, representing the first and the last portions of the batch being tested. Test results conforming to the limits of five out of six tests listed in Table below shall be taken as uniform concrete within the limits of these specifications. Analysis of concrete samples shall be made in accordance with the relevant requirements of IS: 1199-1959.

REQUIREMENTS FOR UNIFORMITY OF CONCRETE

Sl. No.	Test	Requirement, Expressed as Maximum Permissible Difference in Results of Tests of samples taken from Two locations in the concrete batch.
i)	Weight per cubic metre calculated to an airfree basis.	16 kg/m^3
ii)	Air content, percent by volume of concrete	1.0

iii)	Slump :	
	(a) If average slump is 10 cm or less	2.5 cm
	(b) If average slump is 10 to 15 cm	3.8 cm
iv)	Coarse aggregate content, percent (Portion by weight of each sample retained on 4,75 mm I.S. Sieve)	6.0
v)	Unit weight of air free mortar, percent based on average for all comparative samples tested	1.6
vi)	Average compressive strength at 7 days for each sample based on average strength of all comparative test specimens, percent	7.5

Unless otherwise determined, the mixing of each batch shall continue for not less than the number of minutes stated below after all materials, except the full amount of water, are in the mixer.

Capacity of mixer	Mixing time
$\frac{1}{2}$ Cubic yard or smaller	$1\frac{1}{4}$ Minutes
$\frac{3}{4}$ to $1\frac{1}{2}$ cubic yard	$1\frac{1}{2}$ Minutes
2 to 3 Cubic yards	2 Minutes
4 Cubic yards	$2\frac{1}{2}$ Minutes

The minimum mixing periods specified are predicted on proper control of the speed of rotation of the mixer and of the introduction of the materials, including water, into the mixer, but may be increased by the Engineer-in-Charge when the charging and mixing operations fail to produce a concrete batch that conforms with the foregoing requirements with respect to adequacy of mixing. The concrete, as discharged from the mixer, shall be uniform in composition and consistency from batch to batch except where changes in composition or consistency are required.

Water shall be admitted throughout the charging operation. Excessive overmixing requiring addition of water to preserve the required concrete consistency will not be permitted. The Engineer-in-Charge may at any time reduce the size of batches, adjust batching sequences mixing time or mixing speed and make such changes as may be deemed necessary to obtain concrete of the quality specified.

20.12 HAND MIXING :

Hand mixing of cement concrete will not be allowed unless the total quantity to be mixed is small i. e. less than 3 cu. metre. Coarse materials shall be measured in a gauge box, on sheets or similar surface. After the removal of the box, the coarse aggregate shall be spread to an even layer. Sand shall similarly be measured in a gauge box and spread evenly over the coarse aggregate. The requisite quantity of cement shall then be spread over the materials. All the ingredients shall then be turned over in the dry state three times or more, until they are thoroughly mixed. A measured quantity of water shall then be added. The mix shall be carefully and sufficiently turned over till a uniformly mixed concrete is obtained.

20.13 FORMS :

(a) General : Forms shall be of wood, steel or other approved material. The type, size, quality and strength of all materials, of which the forms are made shall be subject to the approval of the Engineer-in-Charge. Forms shall be used, wherever necessary, to confine the concrete and shape it to the required lines or to ensure against contamination of the concrete by materials caving or sloughing from adjacent surface left by excavation (Tolerance limits specified are for finished concrete and not for the forms). Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall be maintained rigidly in correct

position. Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Moulding strips shall be placed in the form so as to produce bevelled edges on permanently exposed concrete surfaces. Interior angles on such surface will not require bevelling unless requirement for bevelling is indicated on the drawings. Formed joints in exposed concrete surfaces shall be bevalled, except where such bevelling is specifically eliminated by the direction of the Engineer-in-Charge. Forms for concrete surfaces against which backill or concrete is not to be placed shall be reset and tightened at construction joints, so that they fit snugly and firmly against the hardened concrete. When concrete placement is resumed, additional form ties shall be used as necessary to ensure against spreading of the reset forms under pressure of the subsequently placed concrete and consequent offset from the previously formed face.

(b) Form sheathing and lining : Wood sheathing or lining shall be of such kind and quality or shall be so treated or coated that there will be no chemical deterioiation or discolouration of the formed concrete surfaces. The type and condition of form sheathing and lining, the ability of the forms to withstand distortion caused by placement and vibration of the concrete and the workmanship used in form construction shall be such that the formed surfaces, after being finished, will conform with the applicable requirements of these specifications pertaining to finish of formed surfaces.

(c) Forms for warped surfaces subject to water action : Forms for warped surfaces shall be constructed so as to conform accurately to the required curvatures of the section. Dimensions from the centre lines of the structure to the concrete surfaces will be given at several sections throughout the length of the structure. Where necessary to meet requirement for curvature the form sheathing shall be built up of laminated splines and three ply lining so cut and fitted as to make tight and smooth form surfaces. The form shall be so constructed that the joint marks of the concrete surfaces inside water conduits shall follow the line of waterflow. After the forms have been constructed all surface imperfections shall be corrected, and nails shall be hidden, and any roughness and all angles on the surfaces of the forms caused by matching the form materials shall be dressed to the required curvatures.

(d) Form Ties : Embedded metal rods used for holding forms shall remain embedded and small terminate not less than thirty millimetres in the concrete clear of the formed surfaces where the maximum size of aggregate in the concrete is forty millimetres or less and not less than fifty millimetres in the concrete clear of the formed faces of the concrete where the maximum size of aggregate is eighty millimetres or more. Embedded fasteners on the end of rods shall be such that their removal will leave holes of regular shape. Embedded wire ties for holding forms will not be permitted in concrete walls to be subjected to water pressure, or where the concrete surface through which the ties would extend will be permanently exposed. Wire ties shall be cut off flush with the surface of the concrete after the forms are removed.

(e) Cleaning and oiling of forms : At the time concrete is placed, in the forms the surfaces of the forms shall be free from encrustations of mortar, grout or other foreign materials that would contaminate the concrete or interfere with the fulfilment of the specification requirements relative to the finish of formed surfaces. Before concrete is placed, the surface of the forms shall be oiled with a commercial form oil or treated with other form coating materials that will effectively prevent sticking and will not stain the concrete surfaces. For wood forms, oil shall consist of straight refined, pale, peraffin mineral oil or other form coating material satisfactory to the Engineer-in-Charge. For steel forms. form oil shall consist of refined mineral oil suitably compounded with one or more ingredients which are appropriate for the purpose or other form coating material.

(f) Inspection and approval of forms : After the forms are erected and before any concrete is placed, the forms shall be inspected for line, level and grade, with respect to the structure, adequacy of bracing, freedom from dirt, fixtures, key ways, opening etc. No concrete shall be placed against the forms unless the forms hava been checked and placement of concrete permitted by the Engineer-in-Charge. Such inspection and approval shall, however, not absolve the contractor of his responsibility for the sufficiencies and stability of the forms. The contractor shall, at all times, be solely responsible for its sufficiency and stability.

(g) Cost of formwork included in rates : The contraotor shall have taken into account all the cost of form work in the schedule of bids for the rate of concrete for which the forms are used, and no separate payment shall be due to the contractor for erection etc. of the form work to the specifications herein detailed. Contractor shall submit drawings of all form-work proposed to be used by him for approval of the Engineer-in-Charge.

20.14 PREPARATiON FOR PLACING :

(A) General : No concrete shall be placed until all form-work installation of parts to be embedded, and preparation of surfaces involved in the placing have been approved. No concrete shall be placed in water except with the written permission of the Engineer-in-Charge, and the methed depositing the concrete shall be subject to his approval. Concrete shall not be placed in running water and shall not be subjected to the action of running water until after the concrete has hardened.

(B) Concrete on earth foundations : Unless otherwise authorised, all concrete shall be placed upon clean, damp surfaces free from standing or running water and never upon soft mud, dried, porous earth or upon fills that have not been subjected to approved rolling and tamping until optimum compaction has been obtained. The contractor shall take all measures necessary to accomplish the results contemplated in this paragraph.

(C) Concrete on rock foundations : Rock surfaces upon which concrete is to be placed shall be clean free from oil, standing or running water, mud, drummy rock, objectionable coating debris, loose semi-detached or unsound fragments. Faults or seams shall be cleaned to depth satisfactory to the Engineer-in-Charge and to firm rock on the sides. Immediately before concrete is placed all such rock surfaces shall be cleaned thoroughly by the use of high velocity air and water jets, wet sand-blasting or other means satisfactory to the Engineer-in-Charge. All installations or riser pipes, headers and other installation necessary to produce a foundation free of running or standing water, shall be installed by the contractor and securely fastened in place so as to prevent their being jarred loose by concrete placement. No separate payment will be made for such installations. All work surfaces shall be kept continuosly wet for forty eight hours before concrete is placed upon them, and all approximately horizontal surface shall be covered immediately before the concrete is placed with a layer of mortar of 10 millimetres thickness of the same cement sand ratio as used in the concrete.

(D) Surfaces of construction joint : Concrete surface upon or against which concrete is to be placed and to which new concrete is to adhore, that have become so rigid that the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of construction joints shall be clean and damp when covered with fresh concrete or mortar. Cleaning shall consist of the removal of all laitance, loose or defective concrete, coating, sand and other foreign material. The surfaces of construction joints shall be wet sand blasted and then washed thoroughly. In the process of wet sand blasting construction joints, care shall be taken to prevent over cutting of aggregate in the concrete. The sand blasting and washing shall be performed at the last opportunity prior to placing of concrete. The surface of all construction joints shall be washed thoroughly with air water jets immediately prior to placement of adjoining concrete. All pools of water shall be removed from the surfaces of construction joints before the new concrete is placed. The surfaces of all construction joints shall be cleaned thoroughly of accretions of concrete or other foreign material by scrapping, chipping or other means approved by the Engineer-in-Charge. The surface of the lift when ready shall be covered with an initial mortar coat of 10 millimetre thickness of the same cement sand ratio as used in the concrete just prior to start of concreting opera tions.

(E) Check-up of equipment, communication and lighting : Before starting the placing of concrete, it should be made cortain that the transporting and placing equipment is clean and in proper order and that the equipment alongwith the operating forces is sufficient and properly arranged to deliver the concrete in its final position, without undue delays and objectionable segregation and excessive loss of slumb.

If concrete is to be placed at night, lighting system should be efficient and satisractory. The methods and equipment used for transporting and placing concrete should be such as will permit the delivery of concrete of the required consistency into the work without objectionable delay, segregation, porosity or excessive loss of workability. Continuous adequate telephonic communication shall be provided by the contractor between the concrete mixing plant and the form during the placement of all concrete.

20.15 CONVEYING OF CONCRETE

Concrete shall be conveyed from the mixers to forms as rapidly as practicable, by methods which will prevent segregation, or loss of ingredients. There shall be no vertical drop greater than 2 metres except where suitable equipment is provided to prevent segregation or to remix concrete and where it is specifically authorized by the Engineer-in-Charge. Belt conveyors, chutes, or other similar equipment in which the concrete is delivered to the structure in a thin, continuously exposed flow, will not be permitted except for very limited or isolated sections of the work and only if approved in writing by the Engineer-in-Charge. Such equipment shall be arranged to prevent objectionable segregation.

20.16 PLACING OF CONCRETE

(A) General : The contractor shall keep the Engineer-in-Charge advised as to when placing of concrete will be performed. Unless inspection is waived in each specific case, placing of concrete shall be performed only in the presence of any authorized representative of the Engineer-in-Charge.

(B) Time interval between mixing and placing : Concrete shall be placed before initial set has occured, and before it has contained its water content for more than thirty minutes. This period may however, be increased by the Engineer-in-Charge if the site conditions so warrant.

(C) Retempering of concrete : Retempering of concrete will not be permitted. Any concrete which has become so stiff that proper placing cannot be assured, shall be wasted, and the contractor will be charged for any materials furnished by the Government at the point of delivery to the contractor.

(D) Working in of concrete : Concrete shall be worked readily into the corners and angles of the forms and around all reinforcement and embedded items without permitting the material to segregate. Placing of concrete shall, as far as practicable, be done by means of bottom dump bucket of sufficient size to handle the full capacity of two mixers, but not to exceed six cubic metre capacity. The design of the bucket shall be of the straight side type with full bottom discharge which shall also permit close regulation of the amount of concrete to be deposited in each dumping position. It is contemplated that the full capacity of the bucket may be deposited in one operation, but near forms or embedded items, or elsewhere as directed by the Engineer-in-Charge, the discharge shall be controlled so that the concrete may be effectively compacted into horizental layers not exceeding fifty centimetres in thickness with a minimum of lateral movement and accompanying tendency for segregation. Free water shall be collected in depression away from the forms and removed by bailing prior to placing of fresh concrete. The methods shall be subject to the approval of the Engineer-in-Charge.

(E) Concrete to be deposited to avoid segregation : Concrete shall be deposited in all cases as nearly as practicable directly in its final position and shall not be caused to flow such that the flow within the mass and lateral movement will permit or cause segregation of the coarse aggregate, mortar, or water from the concrete mass. Methods and equipment employed in depositing concrete in forms shall be such as will not result in clusters or group of coarse aggregate being separated from the concrete mass, but if clusters do occur they shall be scattered before the concrete is vibrated.

(F) Lifts in concrete : The contractor shall place concrete in Power House & Surge shaft structures in lifts not exceeding 1.5 m in height. All concrete shall be deposited in appryximately

horizontal layers not to exceed fifty centimetres in thickness unless otherwise specifically authorized or directed by the Engineer-in-Charge. The placement shall be carried on at such a rate that all concrete surfaces not yet to grade shall not have reached their initial set before additional concrete is placed thereon. Slabs shall generally be placed in one layer unless the depth is so great that this procedure will produce objectionable results. In walls, layers including door and window openings shall terminate at the top and bottom of the openings and other layers shall terminate at such levels as will conform to architectural details.

(G) Vibration of concrete : Concrete shall be placed with the aid of mechanical vibrating equipment and supplemented by hand spading and tamping. Concrete shall be consolidated to the maximum practicable density so that it is free from pockets of entrapped air between coarse aggregate and closes snugly again all surfaces of forms and embedded materials. In no case v brators shall be used to transport concrete inside the forms. The vibrating epuipment shall be of the in ernal type and shall at all times be adequate in number of unit, and in power of each unit to properly consolidate all concrete. Form vibrators shall not be used unless specifically approved by the Engineer-in-Charge. Internal vibrators shall maintain a speed of not less than 7,000 impulses per minute, when in oparation and submerged in the concrete. The intensity (amplitude) of vibration shall be sufficient to produce satisfactory consolidation. The duration of vibration shall be limited to that necessary to produce satisfactory consolidation without causing objectionable segregation and shall continue until bubbles of entrapped air have generally ceased to escape. Tendency of bringing excessive amount of water to the surface of lateral flow of concrete by excessive vibration shall be avoided. In consolidating each layer of concrete, the vibrator shall be operated in a near vertical position and the vibrating head shall be allowed to penetrate and revibrate concrete in the upper portions of the underlyihg layer in the same lift. Layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. The disturbance of reinforcement embedded in concrete beginning to set or already set, shall be avoided. Care shall be taken to avoid contact of vibrating head with surfaee of the forms.

(H) Equipment not to be diverted : Once placement of concrete has commenced in a location. it shall not be interrrupted by diverting the placing equipment to other uses.

(I) Finishing of concrete lift surfaces : The manupulation of the concrete adjacent to the surface of the lift in connection with completing lift placement shall be the minimum necessary to produce not only the degree of consolidation desired in the surface layer of concrete, but also a surface with the desired degree of roughness for bond with the next lift. Surface vibration or excessive surface working including screeding of any kind, will not be permi'ted. In placing concrete cobbles and coarse gravel protruding from the surface of the lift shall be worked down into the mass during the initial compacting or vibrating operations. All top surfaces not covered by forms, and which are not to be covered by additional concrete or backfall, shall be carried slightly above grade, as directed by the Engineer-in-Charge and struck off by board finish.

Construction joints shall be approximately horizontal unless otherwise shown on the drawings or prescribed by the Engineer-in-Charge and shall be given in the prescribed shape by the use of forms, where required, or other means that wili ensure suitable jointing with subsequent work, provided that unless otherwise shown on the drawings, keyways will not be required at construction joints.

After the top surface of the lift is finally compacted it shall immediately and carefully be protected from pedestrian tratfic, material being placed thereon, running water, heavy rain, or any activity upon the surface which in any manner will affect the setting of the concrete.

All horizontal construction joints shall be sloped enough to provide for drainage of clean up water. All horizontal joints exposed in showing face shall be sharp, level and in straight line. Each joint shall be prepared to receive the succeeding lift by having all laitance and loose or defective concrete, coating and foreign materials removed by means of a jet or air and water applied at high velocity before the concrete has taken its final set.

(J) Rate of placing : Concreting shall be continued without avoidable interruption until the structure or section is completed or until a satisfactory construction joint can be made. Concrete shall not be placed faster than the placing crew can compact it properly. The rate of deposition shall be such as to have no objectionable effect o the placement of concrete, particularly near the forms and in and around embedded equipment, where the rate shall not exceed the limitations placed by the Engineer-in-Charge.

If concrete is placed monolithically around openings having vertical dimensions greater than 60 centimetres or if concrete is decks, floor slabs, beams, girders, or other similar parts of structures is placed monolithically with supporting concrete, the following instructions shall be strictly observed.

(1) Placing of concrete shall be delayed from 1 to 3 hours at the top of openings and at the bottom of levels under decks, floor slabs, beams, girders, or other similar parts of structures when levels are specified and at the bottom of such structure members when levels are not specified but in no case shall the placing be delayed so long that the vibrating unit will not readily penetrate of its own weight the concrete placed before the delay, when consolidating concrete placed after the delay, the vibrating unit shall penetrate and revibrate the concrete placed before the delay.

(2) The last 60 centimetres or more of concrete placed immediately before the delay shall be placed with as low slump as practicable and special care shall be exercised to effect thorough consolidation of the concrete.

(3) The surfaces of concrete where delays are made shall be clean and free from loose and foreign material when concrete placing is started after the delay.

(4) Concrete placed over openings and in decks, floor beams, girders, and other similar parts of structures shall be placed with as low slump as practicable and special care shall be exercised to effect thorough consolidation of the concrete.

The contractor shall be entitled to no additional payment over the unit prices in the schedule of bids for concrete by reason of any limitations in the placing of concrete required under the provisons of this paragraph.

(K) Placing concrete through reinforcement : In dropping concrete through reinforcement care shall be taken that no segregation of the coarse aggregate occurs.

(L) Adverse weather conditions : No concrete shall be placed during rain, high winds, dust storms, excessive heat, and similar conditions without prior approval of the Engineer-in-Charge. The Engineer-in-Charge shall, further have the right to disallow the placing of concrete during such conditions and the contractor shall comply with such directions. No claim shall lieagainst Government on account of action by the Engineer-in-Charge in this behalf.

(M) Concrete deposited in water : When specifically authorised, concrete may be deposited in water. The method and equipment used shall be subject to the approval of the Engineer-in-Charge, when deposited by the tremie methods, the tremie shall be watertight and sufficiently large to permit a free flow of concrete. The discharge end shall be kept submerged continuously in the concrete and the shaft kept full of concrete to a point well above the water surface. When the bottom dump bucket method is used, the bucket shall not be dumped until after it has come to rest on the surface upon which the conctete is to be deposited. The bucket shall be provided with a suitable cover and the bottom doors, when trippled, shall open freely, The bucket shall be completely filled and slowly lowered in order to avoid back-wash and when tripped it shall be withdrawn slowly until entirely free of the concrete. With either method placement shall proceed without interruption until the top of the concrete has been brought to the required height.

(N) Replacement of rejected concrete : Concrete which is not placed and compacted in accordance with these specifications, and is, in the opinion of the Engineer-in-Charge of inferior

quality shall be removed and replaced by the contractor. The entire cost of removing and replacing such rejected concrete shall be borne by the contractor including the cost of all material required in the replacement.

20.17 REMOVAL OF FORMS :

Removal of forms shall not be started until the concrete is thoroughly set and has aged to give it sufficient strength to carry its own weight and the live load which is likely to come on the work during the course of construction. The length of time, the form should remain in place shall be decided by the Engineer-in-Charge with reference to weather conditions, shape and position of the structure or structural member and the nature and amount of dead and live loads.

The following minimum intervals of time as specified in IS: 456-1978 will generally be allowed between placing concrete and striking moulds if normal portland cement is used but the period shall be increased in case of wet weather and also at the option of the Engineer-in-Charge.

A. Walls, columns and vertical faces of all structural members.	24 to 40 hours as may be decided by the Engineer-in-Charge.
B. Slabs (props left under)	3 days
C. Beam soffits (props left under)	7 days
D. Removal of props under slabs :	
I-Spanning upto 4.5 m	7 days
II-Spanning over 4.5 m	14 days
E. Removal of props under beam and arches:	
I-spanning upto 6 m	14 days
II-spanning over 6 m	21 days

These minimum perieds are expected to be safe and no claim shall be made against Government for damage owing to the periods not being sufficient. The contractor may, where he so desires extend the above to longer interval. This shall not, however, constitute any reason for any claim or extension of time.

In no case should forms be removed until there is assurance that removal can be accomplished without chipping spalling or defacing the concrete surface. Further more, heavy live loads should not be permitted until after the concrete has reached its designed strength. The exact period shall be fixed by the Engineer-in-Charge and shall be binding on the contractor. The forms should be removed with great caution and without jerring the structure or throwing heavy forms upon the fioor. In order to achieve this end, edges and clamps shall be used whenever practicable instead of nails. The work of striking forms shall be carried out under the personal supervision of a competent foreman in the employment of the contractor.

In order to avoid excessive stresses in the concrete that might result from swelling of the form, wood forms for wall openings shall be loosened as soon as this can be accomplished without damage to the concrete. Forms for the openings shall be constructed so as to facilitate such loosenings.

The contractor shall be solely responsible for any damage that may be caused by negligence, lack of proper precautions or hastiness etc. in the matter of removal of forms and shall make the same good at his own cost to the satisfaction of the Engineer-in-Charge.

20.18 CURING AND PROTECTION :

All concrete shall be protected against injury until final acceptance, giving particular attention to permanently exposed corners and edges. Exposed finished surfaces of concrete shall be protected from the direct rays of the sun for atleast 72 hours after placement. Fresh exposed concrete shall also be protected from the action of the rains, flowing water and mechanical injury. No fire or excessive heat shall be permitted in direct contact with concrete at any time. Concrete

should be kept continuously (not periodically) moist for not less than 21 days by covering with water saturated material or by system of perforated pipes, mechanical sprinklers or porous hose, or by any other approved method. All horizontal surfaces shall be continuously kept wet till the time of next pouring, regardless of time. Curing shall be maintained so as to prevent detrimental loss of water from the concrete for the entire curing period. Curing period where special cement may be used, shall be specified by the Engineer-in-Charge,

All galleries, conduit and other formed openings through the concrete shall be closed during the entire curing period and as long thereafter as practicable to prevent circulation of air and the resultant choking and cracking.

Construction joints shall be cured in the same way as the other concrete and shall also, if practicable, be kept moist for at least 72 hours prior to the placing of additional concrete upon the joint. Approximately horizontal surfaces shall be cured by sprinkling or by covering with damp sand or may be cured by the use of wet guilts or mats which will satisfactorily supply the required curing water. If damp sand or quilting is used for curing, it shall, later be completely removed. The time of applying damp sand shall be specified by the Engineer-in-Charge, before which curing will be carried out by other approved methods.

The method of keeping formed concrete surface moist shall be continuous sprinkling or spraying of water as may be necessary to prevent any portion of the surface from drying during the specified curing period.

The water and other material of curing shall be free from excessive amounts of silt, colouring matter and other impurities and shall be so handled as not to stain concrete surface which shall be exposed.

The actual method of curing adopted shall be subject to the approval of the Engineer-in-Charge. The contractor shall have, on hand, and ready to install before actual concrete placement is started, all equipment needed for adequate curing and protection at all locations of concrete placement.

The cost of furnishing and applying all material used for curing concrete shall be included in the unit price in the schedule of bids for the concrete on which the curing materials are used.

In case, the curing operations are inadequate or unsatisfactory the Engineer-in-Charge shall be entitled to take such steps as he may deem necessary to make good the deficiencies and defects at the contractor's risk and cost.

20.19 MEASUREMENT AND PAYMENT :

Measurement of concrete for payment will be made only to the neat lines of the structure as indicated on the drawings or as established by the Engineer-in-Charge. Measurement of concrete placed upon or against rock surfaces will be made to the lines of excavation as specified in Chapter 15. Intermediate payment of conerete shall, however, be made on the basis of concrete recorded at the mixing point subject to final adjustment as aforesaid. In measuring concrete for payment, the volume of all recesses, passage ways, chambers, openings, cavities and depressions, embedded pipes except reinforcement bars, metal work and anchor bolts and bars, will be deducted. In the event of the foundations having been excavated beyond the required limits as per drawings and as directed, the contractor shall fill the same with the similar grade of concrete as in the foundation and no payment shall be made on this account.

The rate in the schedule of bids are based on the use of 150 kilogarammes of cement per cubic metre of finished concrete. If the contractor is required to use any different quantity of cement per cubic metre of cement concrete than 150 kllogrammes of cement, the payment to the contractor shall be adjusted upward or downward on the basis of such variation in cement content @ Rs. 1000/- per tonne.

The cement content of concrete for the purpose of calculating the variation in cement content per cum for purposes of intermediate payments shall be arrived at by dividing total cement

consumption as recorded at the mixing point by the total volume of concrete manufactured and recorded at the mixing point. The variation in cement content shall be payable only on quantity of concrete admissible for payment under this contract. Final adjustment shall be made periodically on the basis of finished concrete actually placed within prescribed lines.

The account of consumption of cement and production of concrete shall be maintained by the contractor for every batch of concrete in forms approved by the Engineer-in-Charge. The account for each shift of work shall be submitted to the Engineer-in-Charge or his representative for acceptance and only quantities thus accepted will be considered for computing payment to be made for variation in cement content of concrete.

20.20 CONCRETE LINING FOR TUNNELS, SHAFTS AND GALLERIES :

(i) The item of concrete lining (covering all the operations within the intent of the work) will include plain or reinforced concrete placed between the prescribed interior surfaces of the concrete lining, and the surfaces of the excavated rock, except as provided in the paras hereinafter, lining shall mainly be of plain concrete though in isolated reaches reinforced lining cannot be ruled out.

The lining may be alongwith steel shell inside and/or permanent supports, and mild steel reinforoements, as directed by the Engineer-in-Charge. The lining shall be placed in conformity with specifications and other conditions as applicable to the items concerned or as modified by the Engineer-in-Charge.

It may be possible that in some tunnels, galleries and shafts only some portions are required to be lined as may in the opinion of the Engineer-in-Charge be necessitated during construction, when the actual stratification will be fully known. The quantities for the concrete lining included in the schedule of bids are, therefore, approximate and are likely to undergo changes after the nature of the sub-strata is known from the excavation. Actual thickness of concrete lining may be different from that shown in the contract drawings depending upon rock strata actually encountered.

(ii) The method of conveying concrete may be mixed concrete in agitator tanks or mixing dry batched constituents in truck mixers during transit or any other method approved by the Engineer-in-Charge.

(iii) The mode of transport shall be subject to approval of Engineer-in-Charge which shall be binding on the contractor.

(iv) The form-work shall be such that internal dimensions of the lining conform to those specified for the various elements of work. The shuttering shall be arranged with joints close together so that the finished surface of the concrete may be free from excrescences and afford smooth surface to the passage of water.

The form work shall be arranged true to line and grade and shall be fixed firmly to prevent movement during or subsequent to the placing of concrete. The forms for tunnel lining shall be provided with sufficient openings along each side of wall and in the arch to permit access to and inspection of concrete being placed behind the forms.

The form work shall be of robust construction capable of easy manupulation and accurate setting and of being removed and re-erected without disturbing concrete lining. The form work shall be of such dimensions that the length of concrete elements as directed by the Engineer-in-Charge is achieved.

In curved lengths of tunnels and where the tunnel sections are to be moulded to special sections such as bellmouth etc., timber forms conforming to the specifications in para 20.13 (C) of these specifications may be allowed to be used by the Engineer-in-Charge.

(v) The concrete in lining shall be placed either by pumping or pneumatic placers. The end of the pipe line shall be sufficiently immersed in freshly laid concrete. The concrete should be

so placed in the forms that there is no segregation. Manual placing can be done with specific approval of Engineer-in-Charge.

(vi) The mode and sequence of placement of lining concrete shall be as directed by Engineer-in-Charge which shall be final and binding on the contractor. If required by the Engineer-in-Charge, the lining may have to be laid in three parts viz. the kerbs, the arch, and the invert. The sequence for laying these components shall be as directed by Engineer-in-Charge and will be binding on the contractor.

(vii) Wherever required by the Engineer-in-Charge blocking concrete will be placed behind steel supports or enveloping steel supports wholly or partially. This can be in the form of precast blocks also if so desired by the Engineer-in-Charge. Blocking concrete shall be classified as concrete in lining of structure where it is laid and paid as such.

(viii) The contractor shall fill with mortar or grout of composition, to be specified by the Engineer-in-Charge, by grouting method all spaces behind the lining in tunnels, galleries, cavities, adits and shafts. Pipes of 75 mm or 50 mm diameter shall be set in concrete lining for drilling holes 300 mm deep in rock and for filling spaces behind lining by grouting method. This grouting will be done at low pressure not exceeding 4 kg/cm^2 and not earlier than 28 days after laying concrete. The size and location of pipes and holes shall be as directed by Engineer-in-Charge. Sand used in mortar shall be clean and of such fineness that 100 percent will pass through No. 30 standard sieve.

Payment for furnishing and installing the pipe and pipe fittings in the lining for grout holes shall be made at the unit rate per kilogram in the schedule of bids for the item 'Furnishing and installing black steel pipes and fittings for grouting and drainage' as provided in the schedule of bids.

No payment will be made to the contractor for drilling holes for grouting for filling spaces behind lining and for grouting the spaces behind the lining. Payment shall however, be made to the contractor for the cement consumed in pack grouting at Rs. 1000/- per tonne. The cost of drilling holes for pack grouting will be deemed to be included in the cost of concrete in lining of the structure where it is done.

(ix) The construction joints for arch, invert and kerbs shall be provided as directed by the Engineer-in-Charge. Bulk headed joints or the circumferential construction joints shall also be provided for stepping of the concrete at the end of the set of forms, the joint being formed by using bulK head of a satisfactory design. Care shall be taken to fill in concrete tightly against the bulk head. Care shall also be taken to pack concrete at the joint while starting the next day operations. The joints shall be finished in a vertical plane at right angles to the axis of the tunnel.

(x) The length of time the forms should remain in place shall be decided by the Engineer-in-Charge depending upon the shape and position of the structure. Tunnel steel lining forms may be removed after 12 hours. The period may however, have to be extended by the Engineer-in-Charge if found necessary. This period is expected to be safe and no claims shall be made against Government for damage owing to the period not being sufficient. The contractor shall be solely responsible for any damage that may be caused by negligence, lack of proper precautions or hastiness etc., in the matter of removal of forms and shall make the same good at his own cost to the satisfaction of the Engineer-in-Charge.

20.21 CURING AND PROTECTION OF CONCRETE LINING :

All concrete lining shall be protected against injury until final acceptance. Fresh exposed lining shall also be protected from the action of flowing water and mechanical injury. No fire shall be permitted in direct contact with concrete at any time. Concrete should be kept continuously (not perdiodically) moist for not less than 21 days by covering with water saturated material or by other approved means.

Where tunnelling operations are in progress, excessive drying of sections already placed and cured should be avoided. If necessary, a form should be placed at a point where tunnelling was commenced and moist air passed over the portions already placed.

20.22 MEASUREMENT AND PAYMENT OF CONCRETE LINING :

Measurement and payment for the concrete in lining shall be made as follows :

(i) If the quantity of actual excavation in 100 metre length is equal to or less than the theoretical quantity computed on the basis of payment line (B-line) the payment for the concrete in lining in that length shall be made for the quantity of concrete which can theoretically be placed between the outer surface of the form work or the steel shell, when used, the payment line of excavation irrespective of the quantity actually placed.

(ii) If the quantity of actual excavation in 100 metre length is more than the theoretical quantities computed on the basis of original payment line, the lesser of the quantities of concrete which can either theoretically be placed between the outer surface of the form work or steel shell when used and actually excavated profile or the concrete as recorded at the mixing point shall be split up into two parts and the payment shall be made as follows :

(a) For the theoretical quantity of concrete computed for that length between the outer surface of the form work or steel shell when used the payment line at full applicable rate of concrete.

(b) for the balance quantity of concrete at a rate equal to 80% (eighty) of the applicable rate of concrete.

Provided that no payment shall be made for concrete placed beyond the payment line as stipulated at (b) above, if, in opinion of the Engineer-in-Charge, the over-break resulting in excess excavation is due to the lack of reasonable care and skill in excavation on the part of the contractor and not due to joints, faults. and other structural defects in rocks.

Intermediate payment of concrete lining or blocking concrete shall be made on the basis of quantity of concrete recorded at mixing point subject to final adjustment as per provisions of clause 20.22 (i) and (ii) hereinbefore.

Initially only 90% payment for concrete including payment for cement variation, if any, will be made to the cotractor. Out of the balance 10% payment, 5% will be paid after pack grouting of spaces behind the concrete lining, repairs, finishing and balance 5% on final cleanup of the concrete surface as per provisions of the clause 20.13; 20.33; 20.24 and 24.15 respectively to the satisfaction of the Engineer-in-Charge. The rate for concrete lining shall be for concrete only, the reinforcement required to be provided, if any, being paid separately on the basis of the actual quantity. No deduction will be made for the volume of reinforcement from that of concrete. Payment for permanent supports left buried in concrete shall be governed by the appropriate paragraphs of the specifications. The volume of permanent steel support shall be deducted from the total volume of concrete lining.

Any material, other than approved embedments such as timber, supports for sides, roofs or other parts of the tunnel, shall not be permitted to remain in the concrete without the written permission of the Engineer-in-Charge.

At the junction of two different types of concrete such as concrete of different classifications or concrete of the same classification but placed at different rates, because of their occurence under different elements of the works, the measurements for the concrete at the junction will be made on the basis of the volume calculated by projecting the inter section planes or the curved-surfaces at the junctions. The junction concrete enclosed in the projected surfaces will be included for payment in the concrete with the higher rates as included in the Schedule of Bids.

In special circumstances where sectional measurements are not practicable, quantity of

concrete to be paid shall be the sum total of the computed absolute volume of each batch.

20.23 REPAIR OF CONCRETE :

Repair of concrete shall be performed by skilled workmen in the presence of an authorized representative of Engineer-in-Charge. The contractor shall correct imperfections on the concrete surfaces as necessary to produce surfaces that conform with the requirements specified in paragraph 20.24. Repairs of imperfections on formed concrete shall be completed as soon as practicable after removal of forms and wherever practicable within 24 hours after removal of form. Fins shall be neatly removed from surfaces. Concrete that is dam ged from any cause and concrete that is honeycombed, fractured or otherwise defective and concrete which because of excessive surface depressions must be excavated and built up to bring the surface to the prescribed lines, shall be removed and replaced by dry pack mortar or concrete, as hereinafter specified. Where buldges and abrupt irregularities protrude outside the limits specified in paragraph 20.24 on formed surface, the protrusions shall be reduced by bush hammering and grinding so that the surfaces are within the specified limits. Off sets and other abrupt surface irregularities on surfaces of transition shall be reduced in accordance with the previous provisions of paragraph 20.24. Dry pack filling shall be used for holes having at least one surface dimension little greater than the hole depth, for holes left by the removal of fasteners from the ends of form tie rods and for narrow slots cut for repair of cracks. Filling of holes left by the removal of fasteners from the ends of the tie rods in surfaces against which backfill or concrete is to be placed will not be required. Dry pack shall not be used for filling behind reinforcement or for filling holes that extend completely through a concrete section. Mortar filling placed under impact by use of mortar gun, shall be used for holes too wide for dry pack filling and too shallow for concrete filling no deeper than the far side of the reinforcement that is nearest the surface. Concrete filling shall be used for holes extending entirely through concrete section for holes which are greater in area than 900 square centimetres and deeper than 10 centimetres; and for holes in reinforced concrete which extend beyond reinforcement. All materials, procedures and operation used in the repair of concrete shall be subject to direction and approval of the Engineer-in-Charge. All filling shall be bonded tightly to the surfaces of the holes and shall be sound and free from shrinkling cracks and drummy areas, after the fillings have been cured and have dried. All fillings in surface prominently exposed to view shall contain sufficient white portland cement to produce the same colour as that of the adjoining concrete. The costs of all materials labour and equipment used in the repair of concrete, which before the final acceptance of the work is found to be damaged, or defective or not within the specified limits, shall be borne by the contractor.

20.24 FINISHES AND FINISHING :

(A) General : Allowable deviations from plumb or level and from the alignment profile grades, and dimensions shown on the drawings as specified in para 20.25 are defined as "Tolerances" and are to be distinguished from finishes as defined herein. The classes of finish and the requirements for finishing of concrete surfaces shall be as specified in this paragraph. The finishes to be given to the various surfaces shall be as hereinafter specified. In the event that finishes are not clearly specified herein, the finish to be used shall be that specified for similar adjacent surface as determined by the Engineer-in-Charge. Finishing of concrete surfaces shall be performed only by skilled workmen and in presence of an authorised representative of Engineer-in Charge. Concrete surface shall be tested by the Engineer-in-Charge where necessary to determine whether surface irregularities are within the limit hereinafter specified. Surface irregularities are classified as 'abrupt' or 'gradual irregularities'. Off sets caused by displaced, or misplaced form sheathing or lining from sections or by loose knots in forms or otherwise defective form lumber, will be considered abrupt irregularities and will be tested by direct measurement. All other irregularities will be considered as gradual irregularities, and will be tested by use of a template consisting of a straight edge of the equivalent thereof for curved surface. The length of the template will be 1.5 metre for testing of formed surfaces and three metres for testing of unformed surfaces.

Before final acceptance of the work, the contractor shall clean all exposed surfaces, except surface for which finish as mentioned in 20 24 (B) (I) is specified of unsightly encrustations and stains.

(B) Formed surfaces : The classes of finish shall apply as follows :

(I) Formed surfaces upon or against which backfill or concreta is to be placed requlre no treatment after form removal except removal and repair of defective concrete and the specified curing. Correction of surface irregularities will be required for depression only, and only for those which, when measured as described in clause 20.24 (A) as hereinbefore exceed 2.5 centimetres.

(II) All permanently exposed surfaces for which the finishes as mentioned in clauses 20.24 (B) (III) and (IV) hereinafter do not apply will need no filling of pits or sack rubbing and no grinding other than that for surface imperfections. Surface irregularities measured as described in ciause 20.24 (A) shall not exceed 6 millimetres for abrupt irregularities and 12 millimetres for gradual irregularities.

(III) Formed surface the appearance of which is considered by the Government to be of special importance such as surfaces of structure prominently exposed to public inspection will not require general stoning or grinding. Surface irregularities, measured as described in clause 20.24 (A) shall not exceed three millimetres for abrupt irregularities and 12 millimetres for gradual irrequlanties.

(IV) Formed surfaces for which accurate alignment and evenness of surfaces are of paramount importance from the stand point of eliminating destructive effects of water.

Aside from any necessary repairs and the speclfied curing no surface treatment will be required for such surfaces, except that irregularities measured as described in clause 20.24 (A) shall be reduced or eliminated in accordace with the following requirements.

(x) Abrupt irregularities on surfaces of transition and within 30 metres of the exit and entry ends of tunnels shall be completely eliminated by grinding.

(y) All abrupt irregularities on other surface shall not exceed 6 millimetres for irregularities parallel to the direction of flow and three millimetres for irregularities not parallel to the direction of flow. For irregularities exceeding these limits, the excess shall be eliminated by grinding.

(z) Gradual irregularities, shall not exceed 12 millimetres. Gradual irregularities greater than the specified 12 millimetres shall be reduced by grinding so that they are within that limit.

(C) Unformed surfaces : Interior surfaces shall be sloped for drainage where directed. Surfaces which will be exposed to the weather and which would normally be level, shall be slooed for drainage. Unless the use of other slopes or level surfaces is directed, narrow surface such as tops of walls and curbs shall be sloped approximately three centimetres per metre of width. Broader surfaces, such as walks, roadways, platforms, and decks shall be sloped approximately two contimetres per metre. The classes of finish shall apply as follows :

(I) Screeded finish : (Unformed surfaces that will be covered by backfill or by concrete and surfaces of sub-floors which will be covered by concrete floor topping). This finishing operation shall consist of levelling and screeding to produce even uniform surfaces. Surface irregularitles measured as described in clause 20.24 (A) shall not exceed 19 millimetres.

(II) Floated finish : Sufficient levelling and screeding shall be done to produce even uniform surface. Flating may be performed by use of hand or power driven equipment. Floating shall be started as soon as screened surface has stiffened sufficiently and shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. If trowelled finish is to be applied, floating shall be continued until a small amount of mortar without excess water is brought to the surface, so as to permit effective trowelling surface irregularities measured as described in clause 20.24 (A) shall not exceed 12 millimetres for gradual irregularities. Joints and edges of gutters, side walks, and entrance slabs and also other joints and edges shall be tooled where directed.

(III) Trowel finish This finish is to be used for unformed surface of tunnels, floors etc. When the floated surface has hardened sufficiently to prevent excess of fine material from being brought to the surface steel trowelling shall be started. Steel trowelling shall be performed with firm pressure, such as will flatten the sandy texture of the floated surface and produce a dense uniform surface, free from blemishes and trowel mark, except the light steel trowelling shall be permitted on surfaces of slabs to be covered with built up roofing or membrane water proofing, in which even light trowel marks will not be considered objectionable. Surface irregularities, measured as described in clause 20.24 (A) shall not exceed 12 millimeteres for gradual irregularities.

20.25 TOLERANCE FOR CONCRETE CONSTRUCTION :

(A) The intent of this paragraph is to establish tolerances that are consistent with modern construction practice yet governed by the effect that permissible deviations may have upon the structural action or operational function of the structure. Deviation from the established lines, grades and dimensions will be permitted to the extent set forth herein, provided that the Govt. reserves the right to diminish the tolerance set forth herein if such tolerances impair the structural action or operational function of a structure. Concrete form shall be set so as to ensure completed work within the tolerance limits specified herein. Where tolerances are not stated in the specifications or drawings for any individual will be interpreted conformably to the provisions of this paragraph. The notation on the construction drawings of specific maximum or minimum tolerance in connection with any dimensions shall be considered as supplemental to the tolerances specified herein. Rejected work shall be remedied or removed and replaced at the expense of and by the contractor.

(B) TOLERANCES IN REINFORCED CONCRETE STRUCTURES VARIATION FROM THE PLUMB :

(I)	In the lines and surface of columns, piers, walls and in arrises.	In 3 metres	6 mm.
		In 6 metres	9 mm.
		In 12 metres or more	12.5 mm.
	For exposed corners, columns and other conspicuous lines	In any bay or 6 metres	6 mm.
		In 12 metres or more	12 mm.
(II)	Variation from the level or from the grades indicated on the drawings :		
	In floors, ceiling, beam soffits and in arrises.	In 3 metres	6 mm.
		In any bay or 6 metres	9 mm.
		In 12 metres or more	19 mm.
	For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines.	In any bay or 6 metres	6 mm.
		In 12 metres or more	12.5 mm.
(III)	Variation of the lineal building lines from established position in plan and related, position of columns, walls and partitions	In any bay or 6 metres	12.5 mm.
		In 12 metres or more	25 mm.
(IV)	Variation in the sizes and location of sleeves, floor openings and wall openings.		6 mm.
(V)	Variation in cross sectional dimensions of columns and beams and in the thickness of slabs and walls	minus	12.5 mm.
		plus	19 mm.
(VI)	Footings :		
	Variation of dimensions in plan	minus	12 5 mm.
		Plus	51 mm.
	Misplacement or eccentricity	2 percent of the footing width in the direction of misplacement but not more than 5 cm.	

	Deduction in thickness		minus 5 percent of specific thickness
(VII)	Variation in steps :		
	In a flight of stairs	Rise and tread	12.5 mm.
	In consecutive steps	Rise and tread	6 mm.

(C) TOLERANCES IN SURGE TANK AND APPURTENANT WORKS, AND TRASH RACK STRUCTURE :

(I)	All structuctures :		
	Variation of the construction line or outline from established position in plan.	In 6 metres	12.5 mm.
		In 12 metres	19 mm.
	Variation of dimensions to individual structure features from established position.	In 24 metres or more (In buried construction twice the above amounts)	32 mm.
(II)	Variation from the plumb specified batter, or curved surfaces of all structures including the lines and surfaces of columns, walls, piers, buttresses, arch section, vertical joint grooves, and visible arrises.	In 3 metres	12.5 mm.
		In 6 metres	19 mm.
		In 12 metres or more (In buried construction twice the above amounts)	32 mm.
	Variation from the level or frnmothe grades indicated on the drawing in slabs, beams, soffits, horizontal joint grooves and visible arrises.	In 3 metres	6 mm.
		In 10 metres or more (In buried construction twice the above amounts)	12.5 mm.
(III)	Variation in cross sectional dimensions of columns, beam, buttresses piers, and similar members.	minus	6 mm.
		plus	19 mm.
	Variation in the thickness of slabs, walls, arch sections and similar members.	minus	6 mm.
		plus	19 mm.
(IV)	Footings for columns, piers, walls, buttresses and similar members.		
	Variation of dimensions in plan	Minus	12.5 mm.
		plus	50 mm.
	Misplacement or eccentricity	2 percent of footing within the direction of misplacement but not more than	50 mm.
	Reduction in thickness	5 percent of specified thickness.	
(V)	Sills and side walls for gates and similar water tight joints.		
	Variation from plumb and level.	Not greater than a rate of 3 mm in 3 meters.	
	Variation from indicated spacing.	minus	6 mm.
		plus	Nil
(VI)	Span of draft tube openings.	Overall minus	6 mm.
(VII)	Shafts for elevators	12.5 mm. In 3 m. but not more than 25 mm. in full height from true vertical.	

(D) TOLERANCES FOR CONCRETE LINING IN TUNNELS AND SHAFTS :

(I)	Departure from established alignment or from established grade.	12.5 mm	
(II)	Variation from inside dimensions	Plus or minus	25 mm.
(III)	Variation in thickness at any point.	minus	NIL

(E) TOLERANCES FOR PLACING REINFORCEMENT STEEL :

(I)	Variation for protective covering or effective depth in bending.	With 5 cms. cover/12.5 mm. with 7.5 cm. Cover/25 mm.
(II)	Variation from indicated spacing.	25 mm.

20.26 REQUIREMENT OF CONCRETE CONSTRUCTION AND THEIR PAYMENTS :

(A) General : All concrete construction shall conform to the requirement of this chapter and to the detailed requirements of the following paragraphs. All structures shall be built in a workmanlike manner and to the lines, grades and dimensions shown on the drawings or prescribed by the Engineer-in-Charge. The dimensions of each structure shown in the drawings will be subject to such changes as may be found necessary by the Engineer-in-Charge to adopt the structures to the conditions disclosed by excavations.

Concreting operations shall proceed in stages where so required to co-ordinate with the erection of power plant, control equipment and accessories. The contractor shall be entitled to no additional payment above the unit prices on account of delay in the installations of the plant which is to be followed by concreting operations.

(B) Items and rates of concrete work : The underground works where the concrete will be required shall be classified for purposes of payment into the categories stipulated in clause 16.22 (a) of these specifications. The rates in schedule of bids shall be deemed to apply to respective types of concrete specified hereinafter and placed in the structures according to the categories mentioned in clause 16.22 (a).

(i) Concrete in shaft, in foundation faults and seams : The item of the schedule of bids for concrete in shafts, in foundation faults and seams includs all concrete in shafts below the bottom of trenches required to be excavated for the correction of foundation defects as provided for in clause 15.08. The sound rock on the sides of the shafts shall be clean solid, free from oil, mud, and other objectionable coatings and shall be sufficiently rough to assure satisfactory bond with the concrete. All temporary timbering shall be removed from the shafts before or during the placing of the concrete in the shafts. The concrate shall be taped and vibrated, and special care shall be taken to fill all irregularities in the surface of the rock excavation. Measurement for payment for concrete in shafts; in foundation fault and seams will be made on the same basis as measurement for payment of excavation in foundation faults and seams.

(ii) Concrete in retaining walls : The item of the schedule of bids for concrete in retaining walls includes all concrete in left and right Tail race channel retaining walls and those of Power house. This will also include concrete in other retaining walls as specified by the Engineer-in-Charge.

(iii) Concrete in side walls, curbs, parapets and lamp posts : The item of the schedule of bids for concrete side walls, curbs, parapets and lamp posts includes all concrete in the side walls, curbs, parapets railing and lamp posts. Payment for furnishing and placing premoulded bituminous joints fillers, in expansion joints, will be made at the unit rate per square metre in the schedule of bids, for furnishing and installing premoulded bituminous fibre joint filler. The cost of constructing open joints and false joints shall be included in the unit rate per cubic metre in the schedule of bids for concrete in side walls, curbs, parapets and lamp posts. Lighting recesses may be constructed in the parapets or lamp posts constructed separately and the cost of constructing lighting recesses shall be included in unit rate in the schedule of bids for concrete in side walks, curbs, parapets and lamp posts. Payment for furnishing and installing metal supports for lighting in

fixtures will be made at the unit price per kilogram in the schedule of bids for installing miscellaneous metal work.

(iv) All concrete placed in head race tunnel will be paid at the rates for this item in the schedule of bids.

(v) Concrete in Power House : All concrete placed in Power house structure will be paid at the rates for this item in the Schedule of bids. This will include the cost of furnishing and installing cork tarmastic around scroll casing as per clause 20.27.

(vi) Concrete in Surge Tank : All concrete in Surge tank will be paid at the rates for this item in the schedule of bids.

(vii) Concrete in Penstocks : All concrete in penstocks will be paid at the rates for this item in the schedule of bids.

(viii) Concrete in Switchyard structure : All concrete in switchyard structure will be paid at the unit rate for the item in the schedule of bids.

(ix) Concrete in blockouts : All concrete required to be placed in blockouts constructed to permit the installation and adjustment of mechanical of other equipment will be paid at the rates for this item in the schedule of bids.

Exceptional care shall be tacken in placing the concrete in blockouts in order to ensure satisfactory bond with the concrete previously placed and to secure complete contact with all metal work in the blockouts.

The roughening of the concrete surface of the blockouts shall be performed by chipping or sand blasting as approved by the Engineer-in-Charge and in such a manner as not to loosen, crack or shatter any part of the concrete beyond the roughened surface. After being roughened, the surface of the concrete shall be cleaned thoroughly of all loose fragments, dirt and other objectionable substances and shall be sound and hard in such conditions as to assure good mechanical bond between the existing and the new concrete. All concrete which is not hard, dense and durable shall be removed to the depth required to assure its surfaces satisfactory to the Engineer-in-Charge. The cost of chipping and roughening concrete surface of blockouts shall be included in the unit price per cubic metre in the schedule of bids for concrete in blockouts.

Mesh of steel bars may be required to be placed in blockouts and welded to reinforcement of previously laid concrete for bonding. Such steel, if placed, will be measured as reinforcement and reinforcement and payment for concrete will be made at the rates in the schedule for concrete in blockouts.

(x) Concrete in plugging of adit to H.R.T. : This item of schedule of bids shall include all concrete required for plugging the adit to the H.R.T.

(xi) Concrete in other structure : This will include all concrete in diversion conduit/ conduits, portals of tunnels, adits. Concrete in location not covered up in clause 20.26 (ix) shall also be paid under this item.

20.27 RESILIENT AND NON EXTRUDING FILLER AROUND SCROLL CASING :

The scroll casing for the turbines will be furnished and installed by Govt. but the Contractor shall furnish and place the cork tarmastic coverning around the scroll casing and its holding down bolts, as directed by the Engineer-in-Charge prior to concreting. The cork tarmastic covering shall be about 30 mm. thick and the cork shall be free from hard particles of dust. The sheet shall be of the best quality and of such character as not be deformed or broken by twisting, bending or other ordinary handling The contractor shall furnish to the Engineer-in-Charge samples of the cork tarmastic free of cost, for recovery, compression and other tests. The material shall be such as will recover to 90% of its thickness after three successive loads have been applied to compress it to 50% of its thickness at the end of each application. The load required to be applied to compress it to 50% of its thickness shall not be less than 7 kgs/cm^2 and not more than 50 kg/cm^2. The cork tarmastic shall be evenly and carefully applied, ensuring that it adheres firmly sungly around the scroll casing without damage or entrapping air pockets.

The cost of furnishing and installing cork tarmastic shall be considered included in the applicable rate for concreting.

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CHAPTER—21

POROUS CONCRETE

21.01 GENERAL :

Porous concrete shall be placed around the spiral casing to form a drain for passage of leakage water from the spiral casings and where necessary as determined by Engineer-in-Charge, but the contractor shall be entitled to no additional payment whatsoever by reason of any amount or none of this work being required.

21.02 PREPARATION :

Porous concrete shall be mixed in the proportion of one part of portland cement to four parts of coarse aggregate, by weight. All of the coarse aggregate shall pass a screen having 20 mm square or equivalent round openings, and shall be retained on a screen having 4.75 mm. square or equivalent round openings. The amount of water used in the concrete shall be such that it will give a water cement ratio of 0.33 by weight and that the resulting cement paste will not fill the voids of the aggregate but will thoroughly coat and bind the aggregate particles. The compressive strength of the porous concrete at 7 days, as determined by tests of 15 cm. cube, shall be less than 100 kilogram per square centimetre. The porosity of the concrete shall be such that water will be pass through a slab of concrete 30 cm. thick at the rate of not less than 460 litres per minute per square metre of the slab, with a constant 10 cm. depth of water on the slab.

21.03 PLACING :

The porous concrete shall be placed to the grades and dimensions established by the Engineer-in-Charge.

21.04 MEASUREMENT AND PAYMENT :

Measurement for payment of porous concrete placed around scroll casing or else where will be made to the actual dimension of the porous concrete in place. Payment for porous concrete will be made at the unit price per cubic metre therefor in the schedule of bids, which unit price shall include the cost of furnishing, hauling and handling the aggregate, furnishing, hauling and handling cement and of mixing and placing the porous concrete as described in the paragraph 21.02 and 21.03 and any other incidental charges. The rate of item "Porous concrete" is based on the use of 150 kg. of cement per cum. of porous concrete and any variation of cement content per cum. of porous concrete shall be adjusted as per provisions of clause 20.19.

CHAPTER—22

COOLING OF CONCRETE

DELETED

CHAPTER—23

REINFORCEMENT

23 01 GENERAL :

The contractor shall furnish, and install steel reinforcement as indicated on the drawings or otherwise required or as directed by the Engineer-in-Charge.

23.02 QUALITY OF REINFORCEMENT :

Reinforcement bars shall be of standard commercial quality steel bars conforming to the I.S. 432-1960 and subsequent amendment. Tor steel reinforcement shall conform to I.S. 1786 and subsequent amendments, if any. All steel used for reinforcement shall be clean, free from oil, grease, paints, dust, mortar, scales of rust, kinks, or any rolling defect or bends other than those required as per drawings. The reinforcement shall be tied in position by welding or by steel wires of 16 BWG or stays as approved by the Engineer-in-Charge. Wire for tying reinforcement shall be of soft and annealed steel and shall have an ultimate strength not less than 5600 kg/cm^2 and an yield point of not less than 3700 kg/cm^2.

The exact position, size, and shape of reinforcement are not shown in all cases on the drawings included in these specifications, and where not shown they shall be in all respects as specified by the Engineer-in-Charge. Detailed drawings for reinforcement will be furnished by the Engineer-in-Charge as soon as practicable and according to construction schedule.

Reinforcement shall not be straightened or bent in a manner that will injure or weaken the materials. Bars shall be bent cold to the shapes and dimensions as per drawings and as directed. Heating of bars for bending shall not be allowed, except where expressly permitted by the Engineer-in-Charge. The radii of all bends should not be less than four times the diameter of the bars or as specified by the Engineer-in-Charge.

23.03 PLACING OF REINFORCEMENT :

(a) Before placing the reinforcement bars in position, rust scales shall be removed and care shall be taken to keep them in this condition until concrete is placed. All bars shall be of size and length as directed and no substitution shall be made unless approved by the Engineer-in-Charge. In slabs, beams and girders, splices of reinforcement shall not be made at points of high bending moments except as specifically approved. Splicing shall be done either by providing lap to transfer stresses by bond or by welding as per standard practice or as approved by the Engineer-in-Charge. Splicing shall not be done without the approval of the Engineer-in-Charge.

(b) Joints in steel bars of 25 mm diameter and above will be required to be welded unless and otherwise directed by the Engineer-in-Charge.

The welded splice may be butt weld or lap weld. In case of lap weld the length of lap to be welded shall be as given in the table below. In case of welding tor steel, special precautions as specified by the Engineer-in-Charge shall have to be taken.

Sl. No.	Size of bar	Length of lap to be welded
1.	25 mm	82 mm
2.	28 mm	91 mm
3.	32 mm	103 mm
4.	36 mm	115 mm
5.	40 mm	128 mm
6.	45 mm	145 mm
7.	50 mm	160 mm

The edge preparation for butt welds shall be single or double V-cut as directed by Engineer-in-Charge. Welding shall be done by electric arc method. The surface to be welded shall be cleaned of all loose scale, rust, grease or other foreign matter before welding. Welding procedure, the number of passes for depositing weld, the size and quality of electrodes shall be as approved by the Engineer-in-Charge. Welding shall be done with proper care to produce welded joints of sufficient strength. Due care as required shall be taken not to damage the parent material in the vicinity of the welded joints.

In case of welding being done to joints bars of different sizes, the length of lap shall be governed by the smaller size of bars, and payment made for the same.

23.04 MEASUREMENT AND PAYMENT :

(a) Measurement for furnishing and placing reinforcement (both mild and tor steel) shall be made for the weight of steel reinforcement (exclusive of weight of weld) actually placed in position and accepted for embedment in concrete. The rate for the item "Furnishing & Placing Reinforcement" shall include all cost of furnishing, hauling, storing, straightening, cutting, bending, cleaning, placing and securing and maintaining in position of all reinforcement bars as shown in the drawings or as directed and also all cost of furnishing binding wires, ties and metal supports, if any, and shall hold good both for mild and tor steel. The rate shall also include for the wastage etc. of the steel bars. The weight as specified in ISI Handbook for Structural Engineers (Latest Edition) shall be taken as standard for purposes of computing the total weight of steel used as reinforcement.

Payment for splicing shall be made as follows :

(i) In case of lap joints, the length of steel reinforcement shall be measured as the part of the reinforcement and paid as such.

(ii) The payment for each weld splice shall be made at the unit rate prescribed below irrespective of the type of weld joint and shall hold good both for mild steel and tor steel

Sl. No.	Diameter of bar in mm.	Rate in Rs. (each splice)
1.	25	10 00
2.	28	15.00
3.	32	20.00
4.	36	25.00
5.	40	30.00
6.	45	35 00
7.	50	40.00

The rate for splicing shall include cost of the materials, plant, labour and any other incidental charges in preparation and cleaning of the surface to be welded and for welding in accordance with the direction of the Engineer-in-Charge.

(b) Before starting concreting, the contractor shall make certain that measurements of the reinforcement placed have been recorded and the Engineer-in-Charge certifies to the correctness of the reinforcement used. Failure to do so might mean no payment or payment at the unquestioned discretion of the Engineer-in-Charge for the reinforcement concerned.

CHAPTER-24

GROUTING

24.01 GENERAL :

The general plan for grouting underneath the power house and around the tunnel, galleries, shafts etc. will be as directed by the Engineer-in-Charge. Holes may be drilled as directed by the Engineer-in-Charge to provide for the grouting of major surface seams, crevices and fractures. The actual number and spacing of the holes and the pressure to be used for grout injection will depend upon the nature of the rock as disclosed by the foundation excavation, the result of water pressure or other tests and the results of the grouting operations.

Grout holes underneath the power house and galleries tunnels and shafts will be drilled either directly into the rock or through concrete lining and then into the rock as may be directed by the Engineer-in-Charge. The holes shall be oridinarily drilled in a direction normal to the surface of the underground excavation or concrete lining as the case may be. In case seams, if any in the rock have to be interected, the holes shall be drilled at inclinations as directed by the Engineer-in-Charge.

The amount of drilling and pressure grouting that will be required is uncertain and the contractor shall be entitled to no additional payment above the unit prices laid in the schedule of bids by reason of increase or decrease of the scheduled quantities.

24.02 DRAINING OF THE ROCK :

When directed by the Engineer-in-Charge, the contractor shall drill holes in and around the area of excavation for draining the rock. The minimum diameter of the holes shall be 40 mm or 75 mm or as per direction of Engineer-in-Charge. Tne location, direction, length and number of holes to be drilled shall be as ordered by the Engineer-In-Charge. Similar holes shall be driven, if so directed after the completion of the work to serve as weep holes and/or grout holes. These will be paid for at the unit rate for drilling grout holes in stages in the schedule of bids.

When so directed by the Engineer-in-Charge, such holes shall be used for grouting the rock to tighten it up and toe stop the leakage of water. The contractor shall, however, take all precautions to avoid any danger of flooding wherever, it can be foreseen or ascertained in advance.

Whereever there is any doubt of underground pockets occuring in any location, the contractor shall immediately notify the Engineer-in-Charge and, unless otherwise directed, proceed to investigate and check the presence of such pockets of water. Deep or long pilot holes shall be drilled ahead or in the side of the excavation to locate the release such water, if any. Payment for such drilling will be made at the unit rate for drilling grout holes in the schedule of bid. Drainage of such water will be paid for as in clause 16.18 of these specifications.

24.03 DRILLING GROUT HOLES :

(a) General : Grout holes shall be drilled into the rock underneath the power house and surrounding shafts, galleries, and tunnels for the treatment of faults and seams. The requirements as to depth, spacing and direction of holes as shown on the drawings are approximate and subject to revision during the work of drilling, testing and grouting. The use of 'Rode dopes' greases, or other lubricants on the drill rods or in the grout holes will not be permitted.

All drilling for grouting shall be by rotary drill of non-coring type. The minimum diameter of hole for grouting shall be 35 mm. Where core is required, drilling for grouting shall be payable under respective items of core drilling.

The depth of holes for grouting, underneath the power house and around, galleries, tunnels and shafts will ordinarily be 5 metres but can be increased upto 8 metres. The drilling of grout holes will normally be with percussion and rotary type drills. In special locations as determined by the Engineer-in-Charge, the contractor may be required to drill grout holes by core drilling. The payment for drilling grout holes by percussion/rotary drilling of noncoring type or if

required by core drilling shall be made at respective applicable rates in the schedule of bids.

As the construction work progresses, the development of leakage or the condition of the surrounding foundations may indicate that part of the foundation already covered with concrete required grouting in which event holes shall be drilled through the concrete and into the underlying or surrounding rock and pipe for grout connection shall be placed as directed by the Engineer-in-Charge. After holes in a region have been drilled and grouted it may be found necessary to drill additional grout holes. No allowance above the unit prices in the schedule of bids will be made for the drilling of such holes or for the expense of moving equipment to other operation and returning to a previously drilled area.

Unless otherwise directed the first holes in the grout cap or in the foundation rock and the first rings of grout holes and the grout holes within each grout ring in the galleries, tunnels and in shafts shall be spaced widely as indicated in the drawings or as directed by the Engineer-in Charge and shall be drilled and grouted before the intermediate holes are grouted. These intermediate holes shall be drilled and grouted before further intermediate holes are drilled and grouted and in this manner the drilling and grouting of all holes and rings and the holes within each ring shall be completed with such final spacing of holes and rings as tne grouting results show to be necessary.

Where necessary, as determined by the Engineer-in-Charge, the drilling and grouting shall be performed in successive operations consisting in each case of drilling the hole to a limited depth, grouting at that depth, cleaning out the grout holes by washing or other suitable means before the grout in the hole has set sufficiently to require redrilling, allowing the grout surrounding the grout hole to attain its initial set, all as determined by the Engineer-in Charge, drilling the hole to an additional depth, and then grouting and then successively drilling and grouting the hole at various depths within the stages until the required depth of hole is completely drilled and grouted. Redrilling required because of the contractor's failure to clean out a hole before the grout has set shall be performed at the contractor's expense but where the grout has been allowed to set by the direction of the Engineer-in-Charge the required redrilling will be paid at the rate 50 percent of the schedule price for drilling the grout holes. The depth of each successive drilling, the grout mix used, the pressure for each stage of the grouting and other details of the grouting procedure shall be directed by the Engineer-in-Charge.

Holes for high pressure grouting below power house foundation shall be drilled through the pipes embedded in concrete of the structure. The diameter of any grout hole shall not be less than 35 mm. Core recovery shall not be required, grout holes shall be drilled at varying depths and at vary inclinations not exceeding 30 degrees from the vertical.

Whenever the drill water is lost or artesian flow encountered, the drilling operations shall be stopped and the hole grouted before drilling operations are resumed. No additional payment above the unit price in the schedule of bids for drilling grout holes will be allowed on account of the requirement for interrupting the drilling of holes or permit grouting, or on account of the requirement for cleaning out holes before further drilling that may be necessary due to the requirement of such grouting.

When the drilling of each hole has been completed it shall be protected from becoming clogged or obstructed by being temporarily capped or otherwise suitably protected until it is grouted and any hole that become clogged or obstructed before it is grouted shall be opened to the satisfaction of the Engineer-in-Charge by and at the expense of the contractor.

(B) Drilling through concrete : As the construction work progresses, the development of leakage, the conditions of the surrounding rock of the results of grouting operations may indicate that the rock already covered or lined with concrete requires grouting in which event holes shall be drilled through the concrete including concrete in grout cap, and into the underlying or surrounding rock and pipes for grout connection shall be placed as directed.

(c) Measurement and payment for drilling grout holes through rock and concrete : Grout

holes driven in rock and concrete will be measured for payment after the holes are drilled and only the holes drilled to full specified depth and at the direction of the Engineer-in-Charge, shall be entitled to measurement and payment; holes drilled deeper than specified shall be paid only upto the specified depth, except as otherwise specifically provided, all holes so measured will be paid for at the unit rate in the schedule of bids for drilling grout holes, which unit rate shall include the cost of labour, material, plant and operations required in drilling the holes, maintaining them free from obstructions until grouted as specified hereinabove and all the necessary operation within the intent and purpose of this item of work.

24.04 DRILLING GROUT HOLES THROUGH PLATE STEEL LINER :

(a) Holes shall also be drilled through penstock plate steel liner, or elsewhere as required by the Engineer-in-Charge. The holes drilled in plate steel liner shall be ordinarily closed by threaded fillets screwed into the holes. The fillets shall have a through slit 3 millimetre wide in their head to facilitate fixing and removing them like screws whenever necessary. When completely closed these fillets shall be flushed with the surface of the pipe shell. Some holes, if so directed, may be closed by plug welding after completion of grouting. The plug weld shall be machined to give a smooth surface flush with the liner surface, the choice of the method for plugging the holes being with the Engineer-in-Charge. While driving such holes, utmost care and precaution shall be taken to ensure that the anchor rods or stiffeners behind the plate steel liner or the reinforcement if any, in the concrete lining shall not be cut through.

(b) Measurement and payment for grout holes drilled through plate steel liner : Grout holes drilled through plate steel liners shall be paid for at the unit rate for the item 'drilling grout holes through plate steel' in the schedule of bids. The cost of providing fillets, threading, plugging, welding, finishing holes through plate steel as specified shall be paid for at the unit rate for the item 'Providing fillets, threading, plugging, welding and finishing holes drilled through plate steel' in the schedule of bids.

24.05 CLEANING HOLES :

Before grouting and when a suitable small group of holes has been drilled, all but three holes (consecutive or as otherwise considered suitable for the purpose of cleaning and more or less than three holes as may be required) shall be closed temporarily at the surface. Water and air shall be pumped under pressure as determined by the Engineer-in-Charge in the two holes and allowed to escape, if it will, from the third until all possible loose material, sand, mud etc. has been washed out of communicating seams or other passage ways, if any. Combination of three holes at a time shall thus be cleaned before applying any grout into the hole. Suitable valves shall be used to permit alternate or continuous injection of air and water and for quickly switching the flow from one hole to the other so as to produce the turbulent action necessary to dislodge the softer material, if any. Water will be connected to one hole and air to the other which shall be an adjoining hole. The water and air connections shall be interchanged at frequent intervals to cause water to flow in every possible direction. The operation should be continued till reasonably clear water emerges out of the holes to the satisfaction of the Engineer-in-Charge. In general the pressure of water and air shall be such as to maintain the maximum possible velocity but sufficiently low to prevent heaving and movement of rock. The normal maximum pressure should be about 2 kg. per square centimetre for cavities, galleries, tunnels and shaft and and about 8 kg per square centimetre for other works. Higher or lower pressure shall be used where so specifically directed by the Engineer-in-Charge. The connected hole shall be blown clean of any detritus that might have settled in the seams therein. Washing shall be so timed as to immediately proceed the grouting. Before the grouting of a hole is taken up, the adjoining hole shall be kept clear so that they are ready for grouting in case they are found connected to the hole under grouting. All this shall be done in the presence of the Engineer-in-Charge or his representative and under his direction.

24.06 WATER PRESSURE TESTING :

Water pressure testing of holes shall be done to determine the pressure and consistency of grout. This shall be done as directed by the Engineer-in-Charge and in his or his representative's

presence. Water shall be forced into the hole at a pressure approved by the Engineer-in-Charge and the loss of water shall be observed and data recorded.

24.07 PAYMENT FOR WATER PRESSURE TESTING OF GROUT/EXPLORATORY HOLES :

Payment for water pressure testing of grout holes and/or exploratory holes shall be made every time the test is performed at the unit rates for 'water testing of grout/exploratory holes' in the schedule of bids which unit rate shall include the cost of making connection for water testing, cleaning hole, supplying all materials, labour and equipment required for performing the test as per direction of the Engineer-in-Charge.

24.08 PIPES AND FITTING :

Black steel pipes for grout connections shall be set in the rock foundation, in the concrete or elsewhere if required, as shown on the drawings or as directed by the Engineer-in-Charge. Grout pipes shall end not less than 25 mm inside of the finished surface of the concrete, and recess shall be provided in the concrete to be filled with dry pack after grouting is completed. The size of the grout pipe for each hole will be as determined by the Engineer-in-Charge to meet the requirment of the drilling and grouting equipment used. The end of the pipe farthest from the finished face shall be cut at about 45^{o} to the central line of the pipe to ensure that the outer end does not butt against rock surface and thus hinder satisfactory grouting.

The depth of hole for setting pipe for grouting shall be as directed by the Engineer-in-Charge. The spaces between grout pipes and the rock or concrete into which they are inserted shall be carefully sealed with oakum grout or other suitable material to prevent entry of concrete or other material prior to grouting. All oakum or other suitable material required for sealing shall be furnished by the contractor. All pipes and fittings to be embedded in concrete shall be cleaned thoroughly of all dirt grease, grout and mortar immediately before being embedded in the concrete. The pipe and fittings shall be carefully assembled and placed and shall be held firmly in position and protected from damage while the concrete is being deposited. All pipes and fittings required for the work described in this clause will be furnished and installed by the contractor. The pipes and pipe fittings shall be standard black steel. The pipe plugs shall be of heavy plastic or bronze. Payment for furnishing and installing the pipes and pipe fittings for grout holes shall be made at the unit rate per kilogramme in the schedule of bids for item 'Furnishing and installing black steel pipe and fittings for grouting and drainage'.

Payment for furnishing and installing heavy plastic and bronze plugs for grout pipes shall be made at the unit rate per kilogramme in the schedule of bids for the respective items of furnishing and installing pipe plugs of heavy plastic or bronze as the case may be.

24.09 GROUTING EQUIPMENT :

The equipment for mixing and grouting shall be capable of effectively mixing in conrete and specified proportions, agitating the grout and pumping it into the hole in an un-interrupted flow at the designed pressure upto a maximum of 40 kg. per sq. cm. There should be satisfactory arrangements for accurately measuring the quantity of water, cement and other ingredients to be used. The agitator shall have pedals of suitable design and shapes, to keep the mix at the proper consistency till it is pumped into the holes. The pump shall be air driven double acting and receiprocating type.

The mixing and conveying system shall be laid out to provide sufficient capacity for a heavy flow of grout. The mixer shall be in two compartments or parts so that grout could be mixed in one while that from the other is pumped. The compartments or parts shall be independently connected to the pump. In general, an uninterrupted flow of grout shall be maintained and the grout conveyed from the pump to the hole through a pipe.

The mixer shall be placed as near to the hole as possible and long pipe lines avoided. A portable unit mounted on a truck or a trolley on pneumatic tyres would be best. The flow of grout into the holes shall be controlled by pressure relief valve by passing and returning to the mixer all grout not accepted by the hole at the desired pressure.

Proper pressure gauges shall be provided to measure the pressure of the grout, being pumped into the hole. They shall be provided with diaphragms to prevent grout from getting into the gauge and clogging them.

The circulating system shall be so provided that the grout shall be kept circulating continuously at sufficient velocity to prevent undue settlement of cement or clogging of pipe line and fittings. The pumps and the pipe lines shall be flushed with clear water at frequent intervals to keep them clear. Deposits of grout in the pump, mixer etc., not removed by flushing shall be removed by scrapping, chipping etc.

A fine screen capable of being readily removed cleaned and replaced would be desirable between the mixer and the pump. Proper arrangements shall be provided with equipment to stock adequate quantity of cement, stone dust etc., likely to be required for the grouting.

24.10 GROUT :

Grout shall consist of cement, water in proportions to be determined in field and approved by the Engineer-in-Charge. Suitable admixture such as clay, bentonite, stone dust etc., may be required to be used if considered desirable by the Engineer-in-Charge. Cement shall conform to requirement of clause 20 04. The water cement ratio by volume, the time of grouting, the pressures for grouting and all other details of the grouting operations shall be as determined by the Engineer-in-Charge. Screening of the grout after mixing to remove lumps and foreign matter may be required to be done if directed by the Engineer-in-Cnarge. In general, if pressure tests indicate a tight hole, grouting shall be started with thin mix. If an open hole condition exists, as determined by loss of drill water or inability to build up pressure during washing operations, the grouting shall be started with a thick mix and with the grout pump operating as nearly as practicable at constant speed at all times. The water cement ratio will be decreased, if necessary until the required pressure has reached. When the pressure tends to rise too high the water cement ratio shall be increased. If necessary to relieve premature stoppage, periodic application of water under pressure shall be made.

24.11 PRESSURE GROUTING :

As many of the drilled grout holes as may be directed by the Engineer-in-Charge shall have grout forced into them under pressure specified for the respective work in general or as specifically directed by the Engineer-in-Charge.

The grout shall be applied at a low pressure (as may be specified by the Engineer-in-Charge) initially and gradually, but within the time as may be specified by the Engineer-in-Charge, increased upto the maximum pressure specified at which maximum pressure it shall be maintained for a period of atleast 10 minutes. Care shall be taken to release the pressure immediately if there are signs of extension or heaving rock,which might amongst other observations, be indicated by sudden or erratic drop in pressure.

No grout hole or grout connection shall be grouted except with the permission of the Engineer-in-Charge until all concrete required within a radius of 60 metres. has been placed, has set and has been properly cured. If during the grouting of any hole, grout is found to flow from adjacent grout holes or a construction joint in the concrete lining in such quantity as to seriously interfere with the grouting operation or to cause appreciable loss of grout, such holes or joints shall be capped over or caulked temporarily. When such capping or caulking is not essential, underground holes, shall be left open to facilitate the escape of air and water from pocket in the space surrounding the lining.

Should at the time when grouting has just been commenced in any hole, it be found that the grout in it has been freely flowing too far from the hole at low pressure, fine stone dust, saw dust or other suitable materials as may be approved by the Engineer-in-Charge shall be immediately added in order to block the leakage at sufficient distance from the hole and thus localise the area to be grouted for any particular hole or set of holes. The grouting of any hole shall be continued until the hole takes grout at the rate of less than 25 litres of the greut mix in 20 minutes if pressure

of 3.5 kg per sq. cm. or less are being used, in 15 minutes if pressure between 3.5 and 7 kg. per sp.m. are being used, in 10 minutes if pressure between 7 and 14 kg. per sq. cm. are being used and 5 minutes if pressure in excess of 14 kg. per sq. cm. are being used. After the grouting of the holes is completed, the pressure shall be maintained by means of stop cocks or other suitable devices until the grout has set sufficiently so that it will be retained in the holes being grouted.

The utmost care and precautions shall be taken to ensure that the concrete or steel plate liner does not get damaged during the grouting. Any damage caused to the concrete or liner shall be made good by the contractor at his own expense and to the satisfaction of the Engineer-in-Charge.

After the grouting operations are completed for the shift or the day. the remaining unused grout mix shall be thrown away. Also a mix not used up complete within one hour after mixing or that which in the opinion of the Engineer-in-Charge has set, settled or clogged shall be thrown away. No payment shall be made for the cement having to be so wasted.

No grouting shall be done unless the Engineer-in-Charge or his authorised representative is present to direct the grouting operations.

24.12 PRESSURE GROUTING WITH PACKERS :

It may be necessary or desirable, as determined by the Engineer-in-Charge to use different grouting pressure for grouting different sections of the grout holes. Where such grouting of a hole is directed by the Engineer-in-Charge, the grouting shall be performed by attaching a packer to the end of grout supply pipe, lowering the grout supply pipe into the hole to the top of the bottom section that is required to be grouted at different pressure, grouting at the required pressure and in accordance with the provisions of clause 24.10 allowing the packer to remain in place until there is no back pressure, withdrawing the grout supply pipe to the top of the next higher section that is required to be grouted at a different pressure and thus successively grouting the hole in section at the specified grouting pressure until the entire hole is completely grouted, except that the grouting of the top section shall be performed in the manner specified in clause 24.10 without the use of packer. The grout supply pipes and packers shall be furnished by the contractor. The packers shall consist of expandible rings of rubber, leather, or other suitable material attached to the ends of the grout supply pipes, The packer shall be designed so that they can be expanded, to seal the holes at the specified elevations and when expanded, shall be capable of withstanding, without leakage for a period of 5 minutes, water pressure to the maximum grout pressures to be used. The amount of packer grouting that will be required will depend upon the conditions disclosed by the drilling of the grout holes.

24.13 CONSOLIDATION GROUTING :

Consolidation grouting may be required to increase the bearing capacity of foundation rock, if so determind by the Engineer-in-Charge. The consolidation will be done at about 4 kg per square centimetres pressure. The holes are spaced at 5 m c/c and shall be 8 m deep. The holes shall be drilled by percussion drills and will not be less than 35 mm in diametre. Payment for drilling these holes shall be made for the item 'Drilling grout holes 0 to 10 m deep'. Payment of consolidation grouting shall be made for the item 'Pressure grouting including cost of cement' in the schedule of bids.

24.14 PACK GROUTING :

Concrete and steel lining of underground works shall be grouted as directed by the Engineer-in-Charge to pack the spaces between the rock and the lining and between the steel lining and concrete lining. Pack grouting shall be done not earlier than 21 days after the concrete lining has been placed. The specifications for grouting in this chapter shall apply in so far as they are relevent, for pack grouting as well. The Engineer-in-Charge shall have the right to specify the number of pattern of additional holes for pack grouting where in his opinion, they are required to fully pack the space between lining and the rock.

In tunnels, invert holes shall be grouted first, then the holes in the sides and finally the crown holes.

The grout mix shall be subject to the approval of the Engineer-in-Charge. The grout shall be forced in at low pressure not exceeding 4 kg per sq. cm. or as directed. Grouting shall continue until refusal.

Some holes may drilled for testing the effectiveness of grouting and if these reveal the grouting to be unsatisfactory, further grouting shall be done to the satisfaction of the Engineer-in-Charge. No payment shall be made for drilling holes for pack grouting as stipulated in clause 20.20 (viii). Payment shall however be made for the cement consumed in pack grouting as stipulated in clause 20.02 (viii) @ Rs. 1000/- per tonne. The cost of pack grouting shall be deemed to have been included in the unit rates including cost of drilling holes for pack grouting shall be deemed to have been included in the unit rates of concrete for respective item of work.

24.15 TEST OF GROUTING WORK :

To test the efficiency and penetration of grouting, fresh holes may be drilled as directed by the Engineer-in-Charge after the grouting operations are completed. These holes shall be tested by the water under pressure equal to the maximum grout pressure adopted at the particular location and the amount and the rate of leakage, if any, measured in each such hole. If the Engineer-in-Charge so directs, such holes shall be grouted at pressure specified by the Engineer-in-Chgrge. If not, they shall be left open. Drilling of such test holes will be paid for at the unit rates for drilling grout holes. If such holes are grouted under direction of the Engineer-in-Charge, such grouting will be paid for as pressure grouting on the basis of the quantity of cement actually forced in.

24.16 FINISHING :

The grout mix that might flow out or otherwise get on the concrete lined surface, shall be removed expeditiously without allowing any time for the grout to set on the concrete surface. After the grout has set the grout holes shall be plugged with cement sand mortar in the proportion of one to two by volume and the surface finished smooth. The cost of finishing will be included in unit rate for pressure grouting.

24.17 KEEPING RECORDS OF DRILLING AND GROUTING OPERATIONS :

Records shall be maintained by the contractor of drilling, grouting, and testing, etc. neatly and systematically in the manner approved by the Engineer-in-Charge. The exact location of all holes in relation to proper reference lines and accurate logs of all operations shall be detailed in the records. Record maps and sections shall be compiled showing all conditions of holes grouted. All information regarding the grouting operations, amount of grout taken, effects observed in the surrounding holes of rock etc. observation about behaviour of holes under air and water pressure, appearance of wash water, quantity and proportion of grout used, time and pressure of grouting application etc., shall be noted for each hole.

A copy of such record shall be submitted to the Engineer-in-Charge daily during the drilling and grouting operation.

24.18 MEASUREMENT AND PAYMENT :

Payment for water pressure testing of grout/exploratory holes shall be made as specified in clause 24.07 and the payment for pipes and pipe fittings as in clause 24.08. Payment for pressure grouting and pressure grouting with packers will be made on the basis of per 50 kg. of cement in grout actually forced into the holes at the unit rates in the schedule of bids which unit rate shall include all cost of making connections for grouting. cleaning holes, supplying all material including cement etc. plants and equipment labour and supervision required for grouting including plugging and caulking of leaks and use of packers as per direction of the Engineer-in-Charge. Stone dust and other additives, if used, will be measured separately in the loose dry state before mixing and shall be measured by boxes of sizes and design approved by the Engineer-in-Charge. The volume of sand, stone, dust etc. that may be used, if and when approved by the Engineer-in-

Charge for blocking the seams, shall be paid for as an extra item as provided in clause 3.10 of general conditions of contract.

No payment shall be made for grout or for cement used in grout lost due to improper anchorage of grout pipes or connections or rejected by the Engineer-in-Charge on account of improper mixing or lost by a leakage due to the failure of the contractor to caulk surface leaks when directed by the Engineer-in-Charge.

CHAPTER—25

MASONRY, CEMENT PLASTER & CEMENT POINTING

25.01 GENERAL :

(A) Masonry : Stone masonry may be used in walls etc. The contractor shall be entitled to no additional payment by reason of none or any amount of such work being required.

25.02 MATERIALS :

(a) Stone : The stone used in the masonry shall be sound, clean, hard, durable and tough. It shall be free from decay, sand holes, veins, flaws, cracks and other defects and shall have, as far as possible, uniform colour and texture.

Each course shall consist of stones of even thickness not less than 15 cms.

No stones shall weigh less than 10 kg. in the hearting and less than 15 kg. in the face work.

No stone in face shall have less breadth than height and no stone shall tail into the wall less than its height and atleast 33% of the face stones shall tail into the wall twice their height.

Engineer-in-Charge may however, direct the use of stones of size 20 cms. x 30 cms. x 40 cms. approximately for face work in important locations without entitling the contractor to any claim on this account. Stones shall be obtained from excavation of foundation of Power House structure and appurtenant works, if found suitable for such use, or from any other quarry if so desired by the contractor but approved by the Engineer-in-Charge in writing. Approval of such quarry site shall not mean an approval of the stone for use on works.

(b) Gravel : Gravel shall include uniformly graded traction of size from 12 mm to 4.75 mm. It shall be hard and free from particles that soften or dissolve in water and be cleaned from earth and other impurity by washing.

(c) The sand shall be well graded and have fineness modulus ranging between 2.1 and 2.7 and shall conform to the other provisions of clause 20 07.

(d) Cement : The cement shall conform to the provisions of clause 20 04.

(e) Water : The water used for motar shall conform to the provisions of clause 20.08.

25.03 CEMENT MORTAR :

Mortar shall consist of cement, sand and gravel in the proportion as specified by the Engineer-in-Charge. Mixing shall be done in mechanical mixers. Cement shall be measured by weight and sand and coarse aggregate in suitable size measuring boxes. A portion of water from 5 percent to 10 percent shall precede and like quantity shall follow the introduction of other materials. The remainder of water and other ingredients shall be fed into the mixer simultaneously.

The thoroughness of mixing and adequacy of mixing time so as to give a unifom water shall be tested at the start of the job and as such intervals as may be considered necessary by the Engineer-in-Charge.

If possible the same mixer shall not be used for different mixes. The first mix mortar at the start of the day's work shall be made richer by addition of 1/2 bag of extra cement over and above that required for the particular mix. For small quantities of mortar, mixing by manual labour may be done. The mortar shall be finally used in place before initial set begins (within 30 minutes)

25.04 COURSED RUBBLE STONE MASONRY :

(i) Course rubble masonry shall be used in face work of the masonry or as directed by the Engineer-in-Charge.

(ii) Stone shall be hammer dressed on bed and top surface unless the nature cleavage of the stone gives paralled faces. Faces shall be squared by hammer dressing and all face joints shall be dressed at right angles to the face for a distance of 50 mm.

(iii) The mortar shall consist of cement concrete (cement, sand and gravel). All stones shall be thoroughly wetted before laying. The masonry shall be carried up regularly and no step shall be allowed more than 600 mm but when masonry of one part has to be delayed the work must be raked back at an angle not exceeding 45°. On non-working days the top of all unfinished masonry shall be kept well watered.

(iv) The wall shall be carried up in plumb. The stone shall be fairly equal in size, every stone shall be fitted to adjacent stones.

(v) Thickness of face joints shall not exceed 10 mm.

When pointing is not provided the joints shall be struck and finished at the time of laying.

(vi) The masonry during construction shall be protected from the effects of sun, frost and rain by suitable covering and the masonry shall be kept moist for a period of at least ten days after completion. The work shall be left fooded at the end of each day's work with 25 mm of water. Watering is to be carefully done so as not to wash any mortar out of the joints.

(vii) Measurement of masonry shall be made of the actual masonry placed between the lines shown on the drawing or as directed in the field by the Engineer-in-Charge and shall be paid at the unit price in the schedule of bids for 'coursed rubble stone masonry'. The unit price shall, include the cost of labour, all materials and equipment required for the work of stone masonry in accordance with the specifications hereinabove. The rate in the schedule of bids is based on use of 65 kilogrammes of cement per cubic metre of masonry. If the contractor is required to use any different cement content per cubic metre of masonry than 5 kilogrammes of cement the payment to the contractor shall be adjusted upward or downward on the basis of such variation in cement content at Rs. 1000/- per tonne.

25.05 RANDOM RUBBLE STONE MASONRY :

(i) Random rubble masonry shall be used in hearting of masonry or as directed by the Engineer-in-Charge.

(ii) The stone shall be hammer dressed on the face also on the side and beds to such an extent that the stones will come into close proximity.

(iii) The other specifications shall be as provided in para (iii), (iv), (v) and (vi) of clause 25.04 except the thickness of joint which will not exceed 25 mm in case of random rubble masonry.

(iv) Measurement of masonry shall be made of the actual masonry placed between the lines shown on the drawings or as directed in the field by the Engineer-in-Charge and shall be paid at the unit price in the schedule of bids for 'Random rubble stone masonry'. The unit price shall include the cost of labour, all material and equipment required for the work of stone masonry in accordance with the specifications hereinabove. The rate in the schedule of bids is based on use of 90 kilogrammes of cement per cubic metre of masonry. If the contractor is required to use any different cement content per cubic metre than 90 kilogrammes of cement, the payment to the contractor shall be adjusted upward or downward on the basis of such variation in cement content at Rs. 1000/- per tonne.

25.06 RANDOM RUBBLE STONE MASONRY (DRY) :

(i) Random rubble masonry (dry) shall be used in retaining or breast walls.

(ii) Stone shall be as described in paragraph 26.05.

(iii) The masonry shall be carried up regularly and no step shall be allowed more than 600 mm but when masonry of one part has to be delayed the work must be raked back at an angle not exceeding 45°.

(iv) The stones shall break joints on the face. Walls shall be carried up to the batter shown on the drawings. The stone shall be fairly equal in size, every stone shall be fitted to adjacent stones.

(v) Filling at the back of the wall shall consist of a mixture of earth and clay and stone as directed, but in no case it shall be earth or clay alone.

(vi) Measurement for the masonry shall be made of the actual masonry placed between the lines shown on the drawings or directed in the field by the Engineer-in-Charge and shall be paid at the unit price in schedule of bids for random rubble stone masonry (dry). The unit price shall include the cost of labour, all material and equipment required for the work of masonry in accordance with the specifications hereinabove.

Concrete shall be required to be placed in the foundation of the wall and its top in capping as shown in drawings or as directed by the Engineer-in-Charge. Measurement and payment of such concrete shall be made as provided in paragraph 20 19 and at the unit price in the schedule of bids for 'concrete in retaining walls'.

25.07 PLASTERING & POINTING :

The work of cement plastering, pointing to be done under these specifications shall consist of furnishing scaffolding, plant, labour and material required, preparing the surfaces as directed by the Engineer-in-Charge and all operations covered within the intent and purpose of this item of work.

25.08 SPECIFICATIONS :

(a) Mortar : The mortar shall consist of portland cement and sand in the proportion as specified by the Engineer-in-Charge.

The water cement ratio by weight shall be maintained between 0.4 to 0.6 or by weight of cement or as may be specified by the Engineer-in-Charge from time to time.

(b) Mixing : The sand and cement shall be separately measured in prepared wooden boxes giving the required quantities. Dry sand shall thereafter be spread out on a clean solid mixing platform and the required quantity of dry cement spread on top of it and the whole mixed dry. The dry mixture shall then be formed roughly into a hollow cone chape and water added by a rosecan and the whole mixed until the colour and consistency of the mixture and uniform and show complete mixing.

The mortar once mixed shall be used preferably within 15 minutes but in no case later than 30 minutes. No mortar which has begun to cake or set shall be used. Such mortar shall be immediately removed from the site of works.

(c) Surface preparations : Masonry surfaces shall be prepared and cleaned by removing loose particles, dust, adhering mortar, grease, oil effloresence and other foreign matters.

Concrete surfaces shall be prepared by hacking and removing all loose material and shall be kept wet for 24 hours before the application of plaster. If tne time between hacking and the application of plaster is excessive. sand blasting may be resorted to as directed by the Engineer-in-Charge.

(d) Plastering : When applied over masonry, the plaster shall be 20 mm thick and shall be applied in two coats or equal thickness. To ensure fairly even thickness and truely plane surface, patches of plaster about 15 cm. x 15 cm. or narrow strips of plaster about 10 cms. wide, shall be first applied about 3 metres apart to act as gauges. The plaster shall then be applied and brought to a true smooth surface by means of proper trowels having a face measuring about 25 cm, x 11 cm. If so specified or if so ordered by the Engineer-in-Charge, the plaster shall be floated with wooden trowel so as to produce a sandy granular surface. In this case, the use of steel or iron trowels shall be prohibited. Corners and junctions must be neat straight lines horizontal, vertical or inclined as in plan.

Where the plaster is to be applied to concrete surface, the thickness of the two coats shall be 20 mm. each coat being 10 mm thick. First coat or the scratch coat shall be applied with sufficient force to form a good key or bond with the surface receiving it. This coat, when allowed

to harden shall be scratched with a suitable tool making V-shaped scratches approximately 3 mm. deep by 3 or 2.5 cm. apart.

The second and final coat or the finish coat shall not be applied until the scratch coat is thoroughly dry. It shall be spread to cover the scratch coat completely and there shall be no noticeable joints or ridges.

1. Trowel finish : The finish coat shall be allowed to dry for a few minutes, then troweled to a smooth hard, even surface.

2. Float finish : The finish coat shall be troweled with a wooden float to an even sandtextured surface. The plaster shall be protected from sun, rain and frost at the contractor's expense and by such means as the Engineer-in-Charge may approve. Ordinarily to protect the plaster from sun, the whole surface shall be covered with wet sacks. The contractor shall keep the plaster continually wetted for a period of 21 days after application.

Any cracks in the plaster, or any parts which sound hollow when tapped or are found to be soft or otherwise defective. shall be cut out and replastered at the contractor's expense.

All moulding shall be worked true to drawings with a properly constructed template and drawn neat, clean and straight. All angles and junctions with door frame shall be carefully finished and the former, if so specified or shown in the drawings shall be rounded with a properly constructed template made to the correct radius.

(e) Pointing : As a rule, whetever specified by the Engineer-in-Charge, pointing shall be done whilst the mortar in the joints is still green and in the case of brick work or masonry in cement or lime mortar, it shall be done by striking off the edge of the original mortar to a slope, recessing it to about 6 mm. or more as may be specified from the upper edge of the horizontal joint and sloping it to meet the joint. The vertical joints shall be struck semi-circular or V-shaped by means of an iron tool. 6 mm. diameter.

Where the mortar in the joints is insufficient to allow of this being done or when it is not sufficiently green, the joints shall be raked about 2 cms. after which the surface of the wall shall be thoroughly cleaned and washed and kept wet for two days after which the joints shall be finished off with fresh mortar as explained above.

In no case shall mortar be spread over the outer faces of the bricks and stones. The bricks and stones shall be kept clean and the edge of the bricks and stones above and below the joints shall be clearly defined. After pointing is complete all motar shall be washed from the face of the wall which shall be kept wet for seven days.

(f) Measurement and Payment :

(i) Plaster shall ordinarily be measured in square metres, no deductions being made for small size openings or additions for returns and soffits, the latter being considered equal to the former. Payment for cement plastering will be made at the rate for this item in the schedule of bids per square metre of plaser. The unit price shall include the cost of labour, all material and equipment required for the work in accordance with the specifications given herein above. The rate in the schedule of bids is based on use of 14 kilogrammes of cement per square metre of plaster. If the contractor is required to use any different cement content per square metre of plaster than 14 kilogrammes of cement, the payment to the contractor shall be adjusted upward or downward on the basis of such variation in cement content at Rs. 1000/- per tonne.

(ii) Pointing shall be measured in square metres, deduction being made for small size opening such as doors, windows, ventilators etc. on one face of the wall only if both faces are pointed, but in case of plaster on the inside and pointing on the outside the area of the opening shall be deducted from pointing only, making no deduction in plaster work. In case of large openings such as in verandahs, the area of the openings will be deducted and the actual pointing done on the pillers and soffits shall be measured. Payment for cement pointing will be made at the rate for

this item in the schedule of bids per square metre of pointing. The unit price shall include the cost of labour, all material and equipment required for the work in accordance with the specifications given hereinabove. The rate in the schedule of bids is based on use of 2.3 kilogrammes of cement per square metre of cement pointing. If the contractor is required to use any different cement content per square metre of pointing than 2.3 kilogrammes of cement, the payment of the contractor shall be adjusted upward or downward on the basis of such variation in cement content at Rs. 1000/- per tonne.

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CHAPTER—26

FLOORS, WALLS AND CEILINGS

26.01 GENERAL :

The details of location of various finishes shall be supplied during construction as and when required. The requirement and quantity of each type of flooring as given in the schedule of bids is, therefore, liable to variation as directed by the Engineer-in-Charge. The contractor shall be entitled to no additional payment, above the unit prices in the schedule of bids, for any quantity or none of the items described hereinafter being required.

26.02 BONDED CONCRETE FLOOR FINISH AND CONCRETE WALL BASE :

(a) General : A bonded concrete finish shall be applied to concrete floors and a concrete wall base shall be applied to the walls, wherever directed. The contractor shall furnish all materials for bonced concrete floor finish and concrete walls base, including cement, coarse aggregate water proof paper covering and metal dividing strips. The floor finish shall be applied before or after the installation of the machinery is completed as directed. The surfaces of the concrete on which such finishes are to be placed shall be left at a sufficient depth below or in back of the finished surface to permit the placing of the required thickness of floor finish or base and proper allowance shall be made for the finish when anchor bolts, pipes and other metal parts are placed. The finished floor surfaces shall be sloped where and as directed, by varying the thickness of the finish. The variation in the thickness of the finish shall not exceed 12.5 mm more or less than the average thickness. The concrete wall base shall have thickness as shown on the drawings. The average thickness of the floor finish shall be approximately 38 mm except where the surface is to be covered with composite flooring, in which case the average thickness of the floor finish shall be approximately 32 mm. Aluminium dividing strips of specified size and gauge shall be placed at abrupt changes in elevation of the finished floor level as directed and at panel joints. The top of strips shall be flush with the finished floor. Where two strips meet, these shall be cut and placed in such a manner that the joint is not visible in finished floor.

(b) Preparation of base : The surface of the concrete base to which the finish is to be bonded shall be clean and rough when the finish course is applied. The surface shall be prepared for the application of the finish course by wet sand blasting and washing with water under pressure so as to produce the specified surface condition. If, in the opinion of the Engineer-in-Charge, wet sand blasting is inadequate to obtain the specified surface condition, the contractor shall prepare the surface by chopping followed by the complete removal of all fractured and semidetached particles of concrete The surface so prepared shall be washed thoroughly with water under pressure.

(c) Concrete mix : Sand or coarse aggregate for the concrete floor finish shall conform to the requirements of chapter 20. The size of aggregates, proportioning of mix, water cement ratio, mixing time and other details of concrete shall be directed by the Engineer-in-Charge.

(d) Proportioning and finishing : The surface of the concrete base shall be kept thoroughly wet for 24 hours prior to placing the floor finish, but no free water shall be applied to or allowed to remain in the surface within 30 minutes of the time when the finish course is to be placed. The floor finish shall not be placed when the temperature of the slab is less than 50° F. Before the finish course is placed a limited area of the base to be covered with concrete shall be treated by thorough scrubbing with just sufficient mortar to cover the area completely with a coating having an average thickness of approximately one and half mm. The mortar shall be mixed in the proportions of one part by weight of cement to one part by weight of sand and a sufficient quantity of water to produce a slump of approximately 20 cms. The scrubhing shall be performed with still bristled brushed. Before the mortar coating has thickened appreciably, the finish course shall be spread, rolled or tamped or both and struck off to the required level. The tampers and rollers used

shall have sufficient weight to assure thorough compaction of the finish course. The finish course shall be compacted further & smoothened with an approved type of mortar driven float so as to bring sufficient mortar to the surface for finishing. The surface shall be tested with a straight edge and any high or low spots shall be eliminated. The floating shall be followed by steel trowelling as soon as the finish course has hardened sufficiently to prevent bringing excess fine material to the surface by the trowelling operation. Dry cement, a mixture of dry cement and sand, or water shall not be sprinkled on the surface of the finish course. The trowelling shall be performed at the proper time and with heavy pressure and shall be such as will result in a smooth dense finish free from defects and blemishes. As the concrete continues to harden, the surface shall be given additional trowellings. The final trowelling shall be performed after the surface has hardened to such an extent that no cement paste will adhere to the edges of the trowel. Excessive trowelling will not be permitted. The number of trowelling, the time at which the trowellings are performed and the quality of the final finished surface shall be subject to the approval of the Engineer-in-Charge.

(e) Curing and protection : The contractor shall protect all bonded concrete floor finish and concrete wall base from damage. As soon as the completed floor finish and wall base have hardened sufficientlv, they shall be moistened by being sprayed lightly with water and shall then be covered completely with an effective air tight, non-staining, watsr proof, covering of paper to prevent loss of moisture from the concrete by evaporation. The edges of the paper shall be lapped and sealed, and the paper shall be left in place for not less than two weeks. If the floor is to be subjected to any usage during the curing period that might rupture or otherwise damage the covering, the covering shall be protected by a suitable layer of sand or other cushioning material satisfactory to the Engineer-in-Charge. After the curing has been accomplished, the covering and all foreign material shall be removed and disposed off as directed.

(f) Measurement and payment : Measurement for payment for bonded concrete floor finish will be made to the lines of the areas required to be covered with bonded concrete floor finish and the areas of all openings and the horizontal area of all concrete wall base to the groove in the floor approximate 25 mm. from the inside face of the base will be deducted. Measurement for payment of concrete wall base will be made to the lineal meter of a wall base actually placed. Payment for bonded concrete finish and concrete wall base will be made at the unit prices for the item in the schedule of bids which price shall include the cost of furnishing all materials, labour, tools and plants. The rate in the schedule of bids is based on use of 13 kilograms of cement per square metre of bonded concrete floor finish and concrete wall base. If the contractor is required to use any different cement content per square metre of concrete than 13 kilograms of cement, the payment to the contractor shall be adjusted upward or downward on the basis of such variation in cement content at Rs. 1000/- per tonne.

26.03 QUARRY TILES, MARBLE TILES, MOSAIC TILES, HARDONATE TILES AND ACID RESISTANT TILES :

(a) Quarry tiles : Quarry tile flooring shall be provided at places as directed. All quarry tiles for floors and bases shall be standard grade vitrified shale, imprevious of water, resistant to the action of acids or alkalies, sound and solid true to shape, and without spalled corners, and of uniform size. The thickness of these tiles will vary from 25 mm to 38 mm and size as per direction of the Engineer-in-Charge. All tiles shall be of uniform colour as directed by the Engineer-in-Charge. Unless otherwise indicated, all necessary trim shape of tile shall be finished to ensure covered and rounded corners that can be easily cleaned. Where standard square tiles are cut as fillers, the cut edges shall be ground to proper dimensions so that edges and corners are not spalled and are true and square.

Concrete floor slabs that are to receive tile shall be carefully cleaned of all loose dirt and other refuse matter and shall be scrubbed with dilute muriatic acid and then flushed with clean water. The slab shall be then soaked with water for 24 hours before placing the mortar bed. The tile shall be set in a mortar bed consisting of one part portland cement and three parts of sand. The

mortar shall be thoroughly mixed and shall be stiff enough to hold up the weight of tile without its working upto into the joints.

The tile shall be laid in true alignment, using block joints systems. Tile nosings, coves: curbings or other moulded or shaped pieces shall be thoroughly backed up with mortar. They shall be rigidly placed, reinforced or otherwise made firm and secure. Setting mortar shall be kept at least 12.5 mm below the top surfaces of the tile. After the mortar is thoroughly set the tile shall be thoroughly scrubbed with clean water and a broom. After the tile has thoroughly dried, they shall be grouted flush with mortar. Mortar grouting between tile shall be jet black in colour, composed of two parts portland cement and one part sand, using enough black iron oxide (Fe3 04) to obtain a jet black mortar without seriously weekening its strength. The joints shall be slicked smooth with a spoon before the mortar sets. After the joints mortar is thoroughly set, the surface of the completed floor shall be cleaned with a solution of acid, care being taken to remove any mortar drippings that may have adhered to the tile. Extreme care shall be exercised to prevent the acid from bleaching the joints. Prior to acceptance of the work the tile floor shall be cleaned and polished with an approved brand of penetrating oil. The unit price shall include the cost of labour, all material and equipment required for the work in accordance with the specifications given hereinabove. The rates in the schedule of bids is based on use of 9 kilograms cement per square metre of quarry tiles. If the contractor is required to use any different cement content per square metre of quarry tile than 9 kilograms of cement, the payment to the contractor shall be adjusted upward or downward on the basis of such variation in cement content at Rs. 1000/- per tonne.

(b) Marble tile : Marble tile shall be used at locations directed by the Engineer-in-Charge. The concrete foundation shall be prepared as for quarry tiles and Mosaic tiles. It shall be well completed to the required levels and of the thickness as directed.

The marble tiles shall be of approved quality, hard, even sound, durable and of equal thickness and similar colour unless otherwise specified. When the specification provides for the use of marble of different colours and kinds, they shall be of equal hardness. The thickness of tiles shall be approved by the Engineer-in-Charge before use. In the case of Makrana marble tiles from 30 cms x 30 cms, to 45 cms x 45 cms, the thickness shall be 20 mm to 25 mm whereas the Italian marble tiles upto 45 cms x 45 cms shall be approximately 20 mm thick.

Marble tiles shall be laid as ordered by the Engineer-in-Charge with practically no joints. They shall be evenly and firmly bedded, flush in mortar on the concrete and no hollow shall be left. The finished surface shall be perfectly true. The greatest care shall be taken to obtain a true surface and during the laying this shall be frequently tested with straight edges atleast 1.8 metres long. The mortar for laying the marble tiles shall consists of 1 cement : 1 white limes : 6 sand (by volume). Three clear days shall be allowed for setting before the flooring is walked over and no weight shall be rested upon the surface until seven clear days after laying. During this period, the floor shall be kept continuously flooded.

All courses shall be paralled and at right angles to the wall in case of tiles laid square and shall break joints, if so directed by the Engineer-in-Charge and in the case of tiles laid diagonally the courses shall be at an angle of 45° with the walls. Unless specially ordered by the Engineer-in-Charge the tiles shall not be less than 30 cms square in this case. All joints shall be true and square for the full thickness of the tiles and on no account shall the edges be wedge shaped.

Unless otherwise specified, marble floors shall be finely polished and their edge truly dressed before laying. When laid the joints shall be polished with stone and then the whole surface shall be polished with polished powder. The rate in the schedule of bids is based on use of 9 kilograms of cement per square metre of marble tiles. If the contractor is required to use any different cement content per square metre of marble tiles than 9 kilograms of cement content the payment to the contractor shall be adjusted upward or downward on the basis of such variation in cement content at Rs 1000/- per tonne.

(c) Mosaic tiles : Mosaic tile flooring shall be provided at all places as shown on the drawing or as otherwise specified. All mosaic tiles for floors, wall and bases shall be of standard

grade, sound and solid, true to shape and without spalled corners and of uniform size and colour as directed by the Engineer-in-Charge. Unless otherwise indicated all necessary trim shapes of the tile shall be furnished to ensure covered and rounded corners that can be easily cleaned. Where standard square tiles are cut as fillers, the cut edges shall be ground to proper dimension so that edges and corners are not spalled and are true and square. Special tiles for corners and for top edge of dado on walls etc. shall be provided where directed by the Engineer-in-Charge. The colour, texture and thickness (about 20 mm) of mosaic tiles shall be got suitably approved by the Engineer-in-Charge.

Concrete floor slabs and walls that are to receive tiles shall be left 38 mm to 50 mm lower. Floors and walls shall be carefully cleaned of all loose dirt and other refuged matter and shall be scrubbed with dilute muriatic acid and then flushed with clean water. The slab and walls shall then be soaked with water for 24 hours before placing the mortar bed. Mosaic tiles shall be laid as ordered by the Engineer-in-Charge and with practically no joints. They shall be evenly and firmly bedded flush in mortar on the concrete and no hollow shall be left. The finished surface shall be perfectly true. The greatest care shall be taken to obtain a true surface and during laying this shall be frequently tested with straight edges at least 1.0 metre long. The mortar for laying the mosaic tiles shall consist of one cement and three sand (by volume). Three clear days shall be allowed for setting before the flooring is walked over and no weight shall be rested upon the surface until seven clear days have elapsed after laying. During this period of seven days the floor and the walls shall be kept continuously wet. After the tiles have thoroughly dried, they shall be grouted flush with mortar. Mortar for grouting the joints shall be coloured cement corresponding to the colour of tiles. The joints shall be slicked smooth before the mortar sets. The floor and the walls shall be kept wet for a period of three days after grouting of the joints. After the joint mortar is thoroughly set the surface of completed floor shall be cleaned with a solution of acid, care being taken to remove any mortar dripping that may have adhered to the tiles. Extreme care shall be exercised to prevent the acid from bleaching the joints. Prior to acceptance of the work the tile floor shall be cleaned and polished with an approval brand of penetrating oil to the satisfaction of the Engineer-in-Charge. Payment for mosaic tiles floor will be made at the unit price for the item in the schedule of bids. The rate in the schedule of bids is based on use of 9 kilograms of cement per square of mosaic tiles. If the contractor is required to use any different cement content per square metre of mosaic tiles than 9 kilograms of cement, content the payment to the contractor shall be adjusted upward or downward on the basis of such variation in cement content at Rs. 1000/- per tonne.

(d) Hardonate tile (Hard mosaic tiles) : Hardonate tile flooring shall be provided at locations directed by the Engineer-in-Charge The tiles shall be of size 300x300x30 mm finished thickness.

(i) Material : Sand and coarse aggregate for these tiles shall conform to the requirement of chapter 20. Marble chips shall be of uniform size of smallest to 12 mm. size as/or desired by the Engineer-in-Charge. These shall be machine crushed of approved quality and of specified colour. The marble chips shall be free from foreign matter. The hardening compound must have a test certificate of any Govt. Test Laboratory. However Ferronite hardner is admissible (N.T.W. Product). The metallic hardening compound to be added to the tiles should consist of uniformly graded iron particles treated with wetting agent and soluble alkaline compound. The top layer of mosaic tiles shall consist of 10 mm. thick layer of mix in ratio of 1 cement and two marble chips by weight. The metallic hardening compound shall be mixed in ratio 1:4 cement by weight. The metallic hardener should be dry mixed with cement and then with colour marble chips. The bottom base of tiles should be 20 mm. thickness and must consist of 1:3 cement and aggregate by weight (6 mm and below aggregate shall be used).

Where colouring material is used in the wearing layer it shall not exceed 10 percent by weight of cement used in the mix. The colour and texture of the wearing layer shall be uniform throughout the thickness. The wearing faces of the tiles shall be mechanically ground and filled and free from projections, depressions and cracks. All angles shall be right angles

all edges shall be straight and true. The tiles shall be manufactured under hydraulic pressure of not less than 150 kg/sq. m. and shall be given the first grinding with machine before delivery at site. The thickness of tile after cutting and polishing at site should not be less than 30 mm. the laying and finishing of tiles shall generally conform in all respect to standards laid down in I.S. 1443 (latest) unless otherwise specified herein.

(ii) Laying : The laying and finishing of tiles shall generally conform in all respect to standard laid down in I.S. 1443 (latest) unless otherwise specified here.

(iii) Subgrade Concrete : The concrete floor shall be left 40 to 50 mm. lower than the required level and be checked by contractor before laying of tiles. This sub-grade concrete shall be cleaned, wetted and mopped before laying tiles.

Concrete floor on which tiles are to be laid shall be flushed with clear water. The slab shall then be soaked with water for 24 hours before placing the tiles on it or as per direction of Engineer-in-Charge.

(iv) Bedding Mortar : The average thickness of the bedding mortar shall be 15 mm. and the thickness at any place shall not be less than 10 mm. The bedding mortar for laying the hardonate tiles shall consist of 1 cement and 3 sand (coarse) by volume.

Over this bedding neat grey cement solution of honey like consistency shall be spread at the rate 4.4 kg. of cement per sq.m. over such an area as would accommodate about twenty tiles. Tiles shall be ashed clean and shall be fixed in this grout, each tile being gently tapped with a wooden mallet, till it is properly bedded and is in level with the adjoing tiles. The joints shall be kept as thin as possible not exceeding 1.5 mm and in straight lines or to suit the required pattern. Where full size tiles can not be fixed these shall be cut (sawn) to the required size and their edges rubbed smooth to ensure a straight true joint.

(v) Curing, Polishing and Finishing : The day after the tiles are laid all joints shall be cleaned of the grey cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with or without pigment to match the shade of the top wearing layer or the tiles. Cutting and final polishing will be done as approved and directed by the Engineer-in-Charge. The finished floor shall not sound hollow when tapped with a wooden mallet. If tiles is disturbed or damaged, it shall be refitted or replaced properly, jointed and pointed. After polishing, the floor, the floor shall very carefully be washed, cleaned and dried, then the floor shall be covered with oil-free dry saw-dust, final polish may be obtained by running the floor machines fitted with hessian bobs or felts until the floor shines. The payment for Hardonate tile (Hard mosaic tile) will be made at the unit price for the item in the schedule of bids.

(e) Acid resistant tiles : Acid resistant tiles shall be provided at places shown on drawings or as otherwise specified. Acid resistant tiles for floors, walls and bases shall be of standard grade, sound and hard, durable, true of shape, without spalled corners, of uniform size, and shall be of approved quality. The thickness of such tiles will be about 12 mm and the size will be as per direction of Engineer-in-Charge. Concrete floor slabs and walls that are to receive acid resistant tiles shall be carefully prepared to the required levels and thickness as directed by the Engineer-in-Charge. Extreme care shall be taken while laying the tiles so as to obtain a true finished surface. All laying of tiles and finishing work shall be done as per directions of the Engineer-in-Charge. Payment for acid resistant tiles floor will be made at the unit rates for the item in the schedule of bids. The unit price shall include the cost of labour, all material and equipment required for the work in accordance with the specifications given hereinabove, the rate in the schedule of bids is based on use of 9 kilograms of cement per square metre of acid resistant tiles. If the contractor is required to use any different cement content per square metre of acid resistant tiles than 9 kilograms of cement content, the payment to the contractor shall be adjusted upward or downward on the basis of such variation in cement content at Rs. 1000/- per tonne.

26.04 TERRAZO FLOORING :

The terrazo flooring wherever required to be provided shall consist of two layers of cement concrete, the lower layer being 20 mm thick plain cement concrete, and the upper layer 6 mm. thick cement concret composed of marble chips and cement.

The concrete for the lower layer shall consist of one part cement, two parts sand and two and half parts of 5 mm. to 12.5 mm. stone ballast by weight.

The concrete for the upper layer shall consist of one part cement, two parts sand and two parts marble chips. The marble chips shall be of quality and colour or colours as directed by the Engineer-in-Charge.

If in accordance with the general specification or the drawing the whole or any portion of the floors is to be coloured, the cement for the upper layer of that portion of the floor shall be a coloured cement as approved by the Engineer-in-Charge. The use of ordinary cement with colouring matter added locally is prohibited.

To ensure uniform colour, cement from one stock shall be used on particular work. The sand shall be well washed, clean and sharp and shall be well graded from 12.5 mm down to dust. It shall be screened into two portions through a screen having 64 meshes to the square inch and the sand used in the lower layer of concrete shall consist of equal parts of these portions. Two coarse aggregate for the lower layer of concrete shall consist of ballast broken from stone of approved quality and shall be well graded from 5 mm to 12.5 mm.

The marble chips shall be machine or hand broken as specified or ordered by the Engineer-in-Charge to such a size that all pass through a 1/8" screen but are retained on a 1/16" screen.

The ingredients, inclusive of water, shall be accurately measured. Cement will be measured by volume, the unit being one bag and volume taken per bag as specified by the manufacturer. The other ingredients shall also be measured by volume.

In order to ensure uniformity of colour it is important to keep the same proportion of cement, sand and stone ballast and the same quantity of water throughout. The proportions must not be changed. It is important that the same brand of cement be used for the whole floor of one room.

The quantity of cement required in one room should be calculated in bag units, counting any portion of a bag as full bag. Then all these bags should be opened and the cement in these should be well mixed together till the whole mass of cement is of uniform colour and this mixed cement should be refilled in bags and stored in a dry place and used as expeditiously as possible.

When laying the floor, the cement and sand in the prescribed proportions will first be mixed dry, being turned over by 'phaoras' several times till the whole mass is well mixed and assumes a uniform colour. This mixture is then added to the prescribed quantity of 'stone ballast' and the whole turned over by 'phaoras' or 'belchas' atleast six times till the pieces of stone ballast are well coated with dry mixed cement and sand.

After the mixture is thus well mixed and dry, water is to be added gently through rose-cans and in quantities only enough to make the mixture of plastic consistency, the entire mix being continuously turned over by 'belchas' or 'phaoras' during this process of sprinkling water by rose-can till it assumes a uniform colour and consistency. The quantity of water to be added shall not exceed 38 litres per 50 kilogramme of cement, the quantity of water per bag being kept constant. For the same room the same quantity of water shall be strictly adhered to. Only that quantity of concrete as can be mixed and laid within the setting time should be wet mixed at one time. No more should be wet mixed. No concrete which has begun to cake or set shall be used even after mixing. Such mortar shall be immediately removed from the site of the work.

The concrete bed over which the flooring is to be laid shall be kept under water for two days and roughened with wire brushes and brushed clean to remove all loose particles. The floor shall next be divided into panel according to the pattern as directed by the Engineer-in-Charge.

The desired level of the floor shall then be marked on the walls all round and on numerous places on the floor close to the intersections of the panel lines.

Teak wood strips 2.5 cm thick and about 5 cm wide shall be fixed around the alternate panels or bays. These strips shall be bedded on lime mortar, with their tops true to the desired level and fixed in position with the holp of wire nails.

Aluminium dividing strips of specified size and gauge shall be placed at panel joints and at abrupt changes in elevation of the finished floor level as directed. They shall be placed in such a manner that the upper edge of the strips is flush with the upper side of the battens. Where two strips meet, they shall be cut and placed in such a way that the joint is invisible in the finished floors.

The lower 20 mm. thick layer of plain cement concrete shall then be laid, starting from the edges and rammed lightly with wooden 'thapis' for five minutes. The surface of the concrete shall then be checked with a rebated straight edge resting on the dividing strips to ensure that the level every where is at least 6 mm below the top of wooden strips.

Within 15 minutes of this, the upper concrete layer consisting of cement and marble chips, shall be spread evenly but slightly higher than the wooden strips and rammed lightly with straight edge and worked flush with the strips with the help of the straight edge. To avoid pockets in the surface, care shall be taken to see that there shall always be sufficient material ahead of the straight edge when working it. The surface shall not be trowelled in any case.

The laying of the first set of panels shall be completed in one day. The laying of the alternate set of panels shall be completed in the same manner by next day. In laying the alternate bays, the wooden strips shall first be removed and care shall be taken to see that the sides of the pannels laid the first day are perfectly clean. The concrete of the second set of panels shall be laid truly abutting the sides of the first set to avoid all appearance of joints. The finished floor surface shall give a uniform appearance free from all signs of joint lines. The fresh concrete shall be covered with wet cloth or gunny bags after about two hours of completion and shall then be left undisturbed for two days.

The floor shall then be allowed to set for atleast two days after which the operations of grinding and polishing will be started. The grinding as well as final polishing may be done manually or by machine. During initial grinding, sand shall be sprinkled and kept wet. This operation shall be carried till all the top cement mortar has been removed. Then the floor shall be left undisturbed for about six days when heavy grinding will be started. This shall be continued until the entire surface shows a uniform granular appearance. The final grinding shall then be done and continued until the floor presents an asbolutely uniform appearance, each marble chip showing clear and clean against the cement back-ground and there shall be no 'cloudiness' in any part of the floor. The floor shall then be washed thoroughly and left for about a week. Finally oxalic acid powder shall be well rubbed on the surface for producing the required gloss on the surface.

Measurement for payment for terrazo flooring will be made to the lines of the areas required to be covered with mosaic finish and the areas of all openings shall be deducted. Payment for terrazo flooring will be made at the unit price for the item in the schedule of bids which shall include the cost of furnishing all materials, labour, tools and plants. The rate in the schedule of bids is based on use of 12 kilograms of cement per square metre of terrazo flooring. If the contractor is required to use any different cement per sqm. of terrazo flooring than 12 kg., the payment to the contractor shall be adjusted upwards or downwards on the basis of such variation in cement content at Rs. 1000/- per tonne.

26.05 ALUMINIUM DOORS, WINDOWS AND PARTITION WALLS :

(1) Aluminium doors and windows, fully glazed or non-glazed in portions thereof shall be provided on different faces of the power house at different elevations and aluminium partitions complete with doors, top fillers and accessories will be provided in control room, office blocks or elsewhere as directed by the Engineer-in-Charge.

(2) Material : Hollow extruded aluminium alloy sections conforming to I. S. HE-9-WP of IS 733-1956 and I. S. H. V./W. P. of I. S. 1285-1958, and I. S. 949-1962 and I. S. 1081-1960 and standard accessories like door closures (Mechanically operated type), handles, bolts and locks as approved by Engineer-in-Charge shall be used, Standard wood screws, bolts and nuts shall only be used. The sheets used shall be of gauge from 18 to 26 BG and the space between two sheets shall be filled with a fire proof hard filler material.

(3) Sizes and Tolerances : The opening for all sashes and doors shall be 12.5 mm greater all around the doors. This shall be packed by 1:3 cement sand mortar after completion of fixing of doors and windows.

Generally an overall tolerance of 1.5 mm shall be allowed in fabrication of doors and windows frames and panels.

(4) Finish of surface : All exposed surfaces in aluminium shall have matt finish.

(5) Fabrication : Fabrication of all frames fixed and openable shall be done conforming to I. S. 1948-1961 (latest version). Compositioning of frames and parts shall be done conforming to the above and I. S. 1091-1960.

(6) (i) Fixing of Doors, Windows and Partitions : It shall include securing aluminium doors, windows and partitions etc. into appropriate openings and fixing of accessories, fittings and glazed panels according to various relevant codes in such a way that any movements into the structure to which securing is done, does not transit strain these frames.

(ii) Fixing of Aluminium items shall be done only in prepared openings and not while construction is going on, to avoid any damage to the unit during construction and ensure clearance between the opening and the units to be installed. The lugs (or plugs) wherever used shall be grouted with cement mortar which will be allowed to set before the screws are put in position and tightened.

(7) Partition Walls : The partition walls shall consist of various units coupled to side heights. These shall be got fabricated from anodized aluminium sheets of 18 to 26 B. G. gauge and installed similar to the aluminium doors and windows except that the vertical and horizontal hollow sections of the frame shall be made to accommodate hidden lightening leads and switch panels etc. over sheets wherever required and so desired by the Engineer-in-Charge concealed wiring etc. shall be accommodated and openings cut for switches etc. The partition shall be rigid and sheets shall be in true plane, suitable stiffeners shall be provided so that the partitions are quite rigid.

(8) Precautions :

(i) Whereever aluminium surface is anchored into or in contact of masonry, alkali resistant bitumen paint in two coats shall be applied to avoid direct chemical attack and any splatters or drops of wet cement mortar over aluminium should be removed immediately.

(ii) All aluminium parts shall be coated with a thick layer of a transparent liquir based upon cellulose butyrate.

(iii) Placing of scaffolding on the frames or glazing panels shall never be allowed.

(iv) Any and all hardwares fixed in position during fabrication and fitting shall be removed before fixing the units into its surrounds. The units shall be fixed just befor finishing in such a manner as may not work loose and screws and pins shall not be marked or multilated by hammers and screw drivers etc.

(v) Moving parts like shutters shall be secured by wire or string during erection to prevent damage to the unit.

(vi) No contact of aluminium parts with wet cement or mortar is allowed even during their storage.

9. Glazing :

(i) Material : 5.5 mm glass sheets shall be used in doors, windows and partitions and

shall be strong enough to withstand vibrations caused by running of plant and machines in the power house. These shall be free from all flows, speeks and bubbles etc. and will conform to I. S. 1761-1960 for fire resistance to I. S. 1942- 1960 and to I. S. 3548-1966 for thermal insulation and expansion and contraction characteristics and to I. S. 1950-1962 for sound insulation.

(ii) Size : Size of glass panels shall be kept so as to provide a min. 2.5 mm clearance on its edges into its aluminium surrounds and min. 1.5 mm cover to the glass on faces.

(iii) Finish : Glass shall either be plain and transparent or finished opaque by grinding wherever so desired by the Engineer-in-Charge.

(iv) Fixing : Before fixing glass panes all opening parts shall be checked to ensure that they are closing correctly and are well bedded and not twisted in any way. These frames and grooves shall be completely cleaned and rebates made completely unobstructed. The glass shall be bedded in putty appropriately as laid in the relevent I.S. Codes.

(10) Rendering : Rendering in clearance between the units and openings and plaster on the jambs tops and sides of the openings shall be done as per specification in clause 28.02.

(11) Scaffolding and Cleaning : All scaffolding, cleaning shall be done by the contractor at his cost. All parts and panes shall be cleaned by the contractor and made free from any dirt, putty, or any adhering materials at his cost.

(12) Payment : Payment for furnishing and installing aluminium door, window and partition walls will be made at the unit price per kilogramme in the Schedule of bids. This will include cost of supply and fixing glass panes and all other fittings and fixtures etc.

26.06 SUSPENDED FALSE CEILING WITH ALUMINIUM FRAME AND ACCOUSTICAL TILES :

(1) Exposed aluminium frame false ceiling with accoustical tiles shall be provided under roof of control room and other block of power house to give a decorative appreance and also to provide special accoustic effects and insulation for air conditioning.

(2) Material : All material shall conform to specifications given hereunder and shall be used after approval of the Engineer-in-Charge.

(3) Steel Frame Work :

(i) 12 mm. dia. M.S. suspenders shall be welded vertically with the steel plates already embedded in the slab and beams of control room block for this purpose and the rate of 1000 mm. c/c in longitudinal and 1500 mm. c/c in transverse direction. M.S.Angle or tee sections of suitable size shall be welded with the 12 mm. dia. M.S. rods and shall run in longitudinal direction to suspend the Aluminium Frame from them.

(ii) Welding shall be done by the Electric arc method in accordance with the applicable I.S. Specifications.

(iii) All metal surface shall be painted after cleaning to the satisfaction of the Engineer-in-Charge. The painting shall comprise of one primer coat and one coat of synthetic enamel paint as approved by the Engineer-in-Charge.

(iv) Payment will be made for the net weight of steel erected and nothing extra shall be paid for any wastage. Payment for steel frame work shall be made at the unit rate per kg. in schedule of bids for term of 'Furnishing and installing miscellaneous embedded metal and metal works (Chapter-31). The rate shall include cost of material, labour and T & P etc. required for fixing. The steel will not be supplied by the Department and the contractor shall have to procure it himself.

(4) Aluminium Frame Casing with accoustical tiles :

(i) Exposed grid system Aluminium suspended ceiling will be provided at different elevations as shown in drawing or as directed by the Engineer-in-Charge.

(ii) 600 x 600 mm. square grid shall be made with the Aluminium anodised bulbed Tee and angle sections extruded from proper aluminium alloy. All the aluminium extruded sections shall be anodised with mett finish conforming to the applicable I.S. Specification.

(iii) The main Tee sections shall be of 37x25x1.8 mm size which shall run in the transverse direction at 600 mm. c/c. The cross Tee and angle section (to be provided on outer edges along the walls) shall be of 25x25x1.5 mm size. The fabrication of the grid i.e. jointing the cross Tee with main Tee shall be rigid enough to withstand the heavy vibrations.

(iv) The aluminium frame shall be hung from steel frame by means of sliding hangers of 6 mm. dia. steel bars and M. S. hanging clips. Suitable arrangement shall be made for adjusting the level of Ceiling by providing threading and nuts in hanger rod. The size of flat, out of which clips are to be made, shall not be less than 40 x 10 mm or as approved by the Engineer-in-Charge. The M. S. hangers and clips shall be painted with one coat of primer and one coat of synthetic enamel paints after proper cleaning. The quantity of the paint shall be got approved by the Engineer-in-Charge.

(v) The accoustical tiles shall be flat pressed particle board processed out of teak wood and bonded with high quality synthetic resin. The particle board accoustic tiles shall have half random perforations in at least 5% area for good accoustic quality. The material will have a sound reduction value of at least 0.70 at 1024 cycles. The Tiles shall be Fire resistant, termite and insect resistant, warp free and heat insulated. The tiles shall be of standard make like Anchor or equivalent as approved by the Engineer-in-Charge. The size of tiles shall be 600x600x12 mm. The tiles shall laid working from the centre of Ceiling outwards outside so that any slight variation can be taken up in the border course. All the joints shall be straight and true. The ceiling shall be finished in a smooth plane and shall present a neat appearance. The Ceiling tiles shall be of correct size, having square sides and be free from cracks, buldging or distortion.

(vi) The installation drawing for suspended Ceiling shall be submitted for approval of Engineer-in-Charge before purchasing material.

(vii) Adequate arrangements for storage of the Ceiling tiles and other stores required for the work shall be made at work site or at convenient place near the work site to be approved by the Engineer-in-Charge. This all shall be at contractor's cost. The Department shall not be responsible for any loss or damage of material during transit.

(5) Openings : Different openings for lighting and air conditioning fixtures as shown in drawing shall be provided in ceiling. Extra frame work of aluminium sections shall have to be provided around these openings for which nothing extra shall be payable to the contractor. However, no deductions for these openings shall be made in measurements and payment.

(6) Finishing and Painting : Exposed surface of accoustical tiles shall be painted with synthetic enamel paint of approved quality and colour. The paint shall be applied after proper cleaning of tiles with sand paper. This shall be included in the unit rate tendered in the schedule of bids.

(7) Measurements and Payments : Measurements for payment for furnishing and installing aluminium suspended Ceiling with M. S. hangers and pressed particles board tiles shall be made on basis of finished area in square metres. Payment for furnishing and installing aluminium frame ceiling with accoustrical tiles at the unit rate per square metre for this item in the schedule of bids. The unit price shall include cost of all material i. e. M. S. hangers, clips with bolts, aluminium frame work, accoustical tiles, painting and labour including T and P and scaffolding required for the completion of the work.

CHAPTER—27

ANCHOR BARS IN ROCK

27.01 DRILLING HOLES FOR ANCHOR BARS :

Wherever directed, holes shall be drilled into the rock to receive anchors for anchoring concrete walls and ground mats to the rock. The dimensions of the anchor bars and the location, diameter and depth of anchor bar holes shall be as directed. The diameter of anchor bar holes shall not be less than $1\frac{1}{2}$ times the diameter or greatest transverse dimension of the anchor bar specified for that hole.

27.02 PLACING ANCHOR BARS AND GROUTING:

Anchor bars shall be cleaned thoroughly before being placed. The holes shall be cleaned thoroughly, kept flagged until placing the bars and shall be filled completely and compactly with grout of mortar mixed in the proportions and to the consistency specified by the Engineer-in-Charge. All water shall be removed from the hole when the anchor grout is placed. The anchor bar shall be forced into place before the grout or mortar has taken its initial set and where practicable, shall be vibrated or tapped until entire surface of the embedded portion of the bar is in intimate contact with the grout. Special care shall be taken to ensure against movement of the bars which have been placed. Anchor bars shall be placed not less than 6 days in advance of concrete operation to allow the grout to become set. Special care shall be taken to prevent movement of the bars after they may have been set. Anchor bars found loose after setting shall be replaced by and at the expense of the contractor.

27.03 MEASUREMENT AND PAYMENT :

Measurement for payment for drilling holes for anchor bars and grouting bars in place will be based upon the length of holes required to be drilled beyond the surface of the excavation of rock surface. Payment for drilling holes for anchor bars and grouting bars in place will be made at the unit price per linear metre therefor in the schedule of bids, which unit price shall include the cost of furnishing grout drilling holes and grouting the anchors in place. Payment for furnishing and placing the anchor bars will be made at the unit price in the schedule of bids for furnishing and placing reinforcement.

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CHAPTER—28

TARFELTING WATER PROOFING AND DAMP PROOFING

28.01 TARFELTING OVER ROOFING :

(a) General : Wherever directed by the Engineer-in-Charge the roof shall be covered with five-ply coaltar saturated felt, built up roofing complete with gravel surfacing. The type and design of roofing, however, may change in the final design. The contractor shall furnish all materials required therefor. The contractor shall be entitled to no additional payment above the unit rate provided in the schedule of bids for any quantity or none of the work being required.

(b) Flashing reglets : Flashing reglets shall be formed in the concrete walls above the roof slabs. The reglets shall be completely fabricated in sections ready for installation. Continuous wood spreaders shall be in place before the reglets are nailed to the forms. All joints between reglet sections shall be tight fitting built joints.

(c) Cants : Recesses shall be provided at all inter-sections of walls and roof slabs to receive cants. The cants shall be constructed of nailing concrete consisting of approximately equal parts by loose volume of standard portland cement, regular concrete sand, and pine of fir saw dust mixed thoroughly with a sufficient quantity of water to produce a mixture having a slump of approximately 5 cm. The saw dust shall be clean, shall be free from chips and lumps, and shall pass a screen having 1/4 inch square opening and shall be retained on a no. 16 screen. The nailing concrete shall be finished smoothly and neatly to the required lines.

After being placed, the nailing concrete shall be kept continuously moist for a period of 3 days and then shall be allowed to dry slowly.

(d) Built up roofing : The built up roofing shall contain not less than the following quantities of material per 10 square metre of roof area.

	Weight per 10 square metre
Coaltar pitch	108 kg.
Five layers of 7.25 kg. coaltar saturated felt	36.25 kg.
Gravel	195 kg.

The surfaces to be covered with roofing shall be smooth dry and free from high spots, depressions and loose or foreign material. The coaltar pitch shall not be heated over 375° F, shall be applied uniformly and shall be hot when the felts are laid. Felts shall be laid free from wrinkles or buckles and shall be rolled closely behind the moppings so that no voids or air pockets will form under the felts. So far as practicable, the felts shall be laid at right angles to the incline of the roof, starting at the low points. The gravel surfacing shall be dry. The roofing shall be applied only during favourable weather conditions, as follows :-

(i) Coat the surfaces to be covered with roofing, except cants, with hot cealtar pitch, using not less than 25 kg. per 10 spuare metre. Coat the surface of the cants with bituminous plastic cement.

(ii) Over the coating of coaltar pitch, while hot, lay five layers of 7 kg. coaltar saturated felt, lapping each sheet 0.65 metre over the preceding sheet if feft 0.8 metrs wide is used, or lapping each sheet 0.8 metre over the preceding sheet if 1 metre wide felt is used. Lap the ends of the sheet 15 cm. Mop each sheet the full width of the lap with hot, coaltar pitch, using not less than 12 kg. per 10 square metre between successive layers so that in no place will felt touch felt. On the cants, however, cement the layers of felt together with bituminous plastic cement. Cut starting and finishing felts to the proper width to provide full thickness of built up roofing over the entire surface of roofs and cants. Carry the finishing felts and the ends of all felts to the top of the cants and cut them off flush with the vertical surface of the wall or take off structure foundation pad.

(iii) After all flashing is placed, mop the surface of the roofs, except cants, with a uniform coating of hot coaltar pitch, using not less than 35 kg. per 10 square metre. While the pitch is still hot, embed 200 kg. of gravel per 10 square metre of roof area.

(e) Flashing at walls : Base flashing shall consist of two layers of coaltar saturated felt covered with a single layer of mineral surfaced, asphalt-saturated felt. The under layer of felt shall extend from the top of the cant out onto the roof not less than 7.5 cm. from the bottom edge of he cant and each succeeding layer of flashing shall extend from the top of the cant onto the roof not less than 7.5 cm beyond the edge of the preceding layer. The layers of felt shall be bonded in place and together with solid coatings of bituminous plastic cement. The bottom layer of base flashing only shall be nailed to the cants with 4 cm barbed, galvanized roofing nails 7.5 cm from the top of the cants at 30 cm centres. After all base flashing has been completed, non-corrosive metal counter-flashing 15 cm wide; shall be placed over the base rlashing, with the upper edge of the counter-flashing extending into the reglet as far as possible. The counter-flashing shall be lapped 7.5 cm at splices and shall be cut and bent at all corners to form neat, water-tight connections. The lapped surfaces of the counter-flashing shall be coated with bituminous plastic cement. The bottom edges of the counter-flashing shall be embedded in bituminous plastic cement and shall adhere firmly to the top layer of the base flashing. Temporary wood wedges shall be inserted in the reglets at appropriate intervals to hold the counter-flashing firmly in place. The reglets shall then be filled completely for their entire length with mortar composed of one part by weight of cement, two parts by weight of regular concrete sand, a small quantity of admixture containing unpolished aluminium powder and some inert powder and approximately 12 per cent of water, based on the total weight of the dry materials used. The wood edges shall be removed as the placing of the mortar progresses. The stated proportions of sand and water are based on dry sand and due allowance shall be made for moisture in the sand in determining batch quantities of sand and water. The mortar shall be just plastic enough to permit thorough consolidation in the reglet by forcible use of a trowel and to permit smooth finishing of the surface to be exposed. The mortar shall not be so wet that it will sag during or after the filling of the reglet. The blended admixtre shall be used in proportions ranging from 125 gm per sack of cement for mortar having a temperature of 70° F or higher to 200 gm per sack of cement for mortar having a temperature of 40° F. The admixture shall be weighed accurately in the amount required for each batch and shall be introduced by scattering over the batch before mixing. The batch shall be mixed immediately until all ingredients are uniformly distributed and the size of the batch shall be such that all of the mortar will be used before it becomes too stiff for proper placement and finishing. Curing of the mortar filling shall be accomplished by keeping it covered with wet burlap or other suitable material for not less than 3 days.

(f) Flashing at roof drains and vent-stock sleeves : The three bottom layers of roofing felt shall be cut off flush with the exterior edge of the body flange of each roof drain and vent-stock sleeve. One layer of non-corrosive metal flashing 60 cm square shall be cut to fit the roof drain. The extent of the cutting shall be determined by the inside dimensions of the clamping surface of the body flange. The metal flashing shall be embedded in place in a layer of bituminous plastic cement. The two top layers of roofing felt shall extend to the inside edge of the clamping surfaces of the body flange with each layer of roofing felt within the clamping surface area embedded in bituminous plastic cement. The clamping surface of the dome section of the roof drain and the clamping ring of the vent-stock sleeve shall be coated with bituminous plastic cement and the dome section and clamping ring shall be fastened in place.

(g) Measurement and payment : Measurement for payment for placing coaltar saturated felt roofing will be made to the neat lines of the areas required to be covered with roofing and no allowance will be made for the sloping surface of cants. Deductions will be made for all opening and for roof areas not covered with roofing. Payment for placing coaltar saturated felt roofing will be made at the unit rate per square metre in the schedule of bids, which unit rate shall include the cost of furnishing wood spreaders for flashing reglets, saw dust, sand, roofing nails and gravel for gravel surfacing.

28 02 MEMBRANE WATER PROOFING AND CONCRETE COVER SLABS :

(a) General : The specifications here-in-below are for 5 ply membrane. The specifications for 4 ply membrane will be similar except that the number of plies will be 4 instead of 5.

A five-ply, bituminous, membrane water prooing shall be placed on the concrete surface of roof slabs as directed by the Engineer-in-Charge. All membrane water proofing shall be protected with a concrete cover slab. The contractor shall furnish all materials, equipment and labour for membrane water proofing and concrete cover siab.

(b) Flashing reglets : Flashing reglets shall be installed in the concrete walls and elsewhere as directed. The reglets will be completely fabricated in sections ready for installation Continuous wood spreaders shall be in place before the reglets are nailed to the forms. All joints between reglet sections shall be tight fitting butt joints.

(c) Cants : R ecesses shall be provided at all inter-sections of walls and roof slab of the high roof and elsewhere as required to receive cants. The cants shell be in accordance with the applicable provisions of sub-paragraph 28.01.

(d) Membrane water-proofing : The membrane water-proofing shall consist of three plies of coaltar saturated felt, plies of coaltar saturated cotton fabric and not less than 100 kg of hot coaltar pitch per 10 square metre Before the membrane water proofing is applied, the concrete slabs to receive the membrane water-proofing shall be thoroughly dry throughout their depths. The surfaces to be covered shall be smooth, dry and free from all loose foreign material. Tne ooaltar pitch shall not be heated over 375° F, shall be applied uniformly, and shall be hot when the plies are laid. Felts shall be applied and fabrics shall be laid free from wrinkles or buckles and shall be rolled closely behind the moppings so that no voids and pockets will form under the felts or fabrics. The ends of sheets shall be lapped 15 cm. Starting and finishing felts and fabrics shall be cut to the required widths and shall be placed to provide the membrane water-proofing as directed. Between stoppages in work, all felts or fabrics which have been laid and have not received a hot mopping of coaltar pitch shall be protected adequately. The membrane water-proofing shall be applied only during favourable weather conditions, as follows :

(i) Coat the concrete surfaces to be covered with membrane water proofing except cants, with hot coaltar pitch, using not less than 20 kg per 10 square metre. Coat the surface of the cants with bituminous plastic cement.

(ii) While this coating of coaltar pitch is still hot, lay two plies of coaltar saturated felt. Lap each felt over the preceding felt 2.5 cm more than one-half of the width of the felt. Mop each felt the full width of the lap with the coaltar pitch, using not less than 12 kg per 10 square metre between successive layers so that in no place will felt touch felt. On the cant, however, cement the layer of felt together with bituminous plastic cement.

(iii) Apply uniform coating of hot coaltar pitch to the surface of the felts, except felts on cants, using not less than 15 kg. per 10 square metre. Coat the surface of the felts on cants with bituminous plastic cement.

(iv) While this coating of coaltar is still hot lay one ply of coaltar saturated cotton fabric, pressing the fabric into the hot coaltar pitch and bituminous plastic cement lapping the edges 7.5 cm. and breaking joints with the preceding layers of felts.

(v) Apply a uniform coating of hot coaltar pitch to the surface of the fabrics. except fabrics on cants, using not less than 15 kg. per 10 square metre. Coat the surface of the fabric on cants with bituminous plastic cement.

(vi) While this coating of coaltar pitch is still hot, lay one ply of coaltar saturated felt, lapping each sheet over the preceding sheet 7 5 cm and breaking joints with the preceding layers. Mop each sheet the full width of the lap with hot coaltar pitch so that in place will felt touch felt. On the cants, however, coat the surface of laps with bituminons plastic cement.

(vii) Apply uniform coating of hot coaltar pitch to the surface of the fetl, except felts on cants, using not less than 15 kg per 10 square metre. Coat the surface of the felts on cants with bituminous plastic cement.

(viii) While this coating of coaltar pitch is still hot, lay one ply of coaltar saturated cotton fabric, pressing the fabric into the hot coaltar pitch and bituminous plastic cement, lapping the edges 125 cm and braking joints with the preceding layer.

(ix) Coat the entire surface of the fabrics except surface of fabrics on cants, with unifrorm coating of hot coaltar pitch, using not less than 18 kg per 10 square metre.

At expansion joints, the edges of the two bottom plies of felt shall be embedded in grooves filled with bituminous plastic cement. The two plies of cotton fabric and the intermediate ply of felt shall be carried across the joint and shaped as directed.

(e) Flashing at walls : Base flashing shall consist of two layers of coaltar saturated felt. The under layer of felt shall extend from the top of the cant out on to the roof not less than 7.5 cm from the bottom edge of the cant and the succeeding layer of flashing shall extend from the top of the cant on to the roof not less than 7.5 cm. beyond the edge of the preceding layer. The layers of felt shall be bonded in placed and together with solid coatings of bituminous plastic cement. The bottom layer of base flashing only shall be nailed to the cants with 4 cm barbed, galvenized roofing nails 7.5 cm from the top of the cants at 30 cm centres. After all base flashing has been completed non-corrosive metal counter-flashing 15 cm wide shall be placed over the base flashing, with the upper edge of the counter-flashing extending into the reglet as far as possible. The counter-flashing shall be lapped 12.5 cm at splices and shall be cut and bent at all corners to form neat water-tight connections,. The lapped surfaces of the counter-flashing shall be coated with bitumineus plastic cement. The bottom edges of the counter-flashing shall be embedded in bituminous plastic cement and shall adhere firmly to the top layer of the base flashing. The entire surface of the base flashing, except on cants, shall be coated with coaltar pitch, using not less than 18 kg per 10 square metre. The entire surface of the base flashing and counter-flashing on cants shall be coated with bituminous plastic cement. Temporary wood wedges shall be inserted in the reglets at appropriate intervals to hold the counter-flashing firmly in place. The reglets shall then be filled completely for their entire lengths with mortar.

(f) Flashing at roof drains : The three bottom layers of the membrane water-proofing shall be cut off flush with the exterior edge of the body flange of each roof drain. One layer of non-corrosive metal flashing, 60 cm square shall be cut to fit the roof drains. The extent of the cutting shall be determined by the inside dimensions of the clamping surface of the body flange. The metal flashing shall be embedded in place in a layer of bituminous plastic cement. The two top layers of the membrane water-proofing shall extend to the inside edge of the clamping surface of the body flange, with each layer of membrane water-proofing within the clamping surface area embedded in bituminous plastic cement. The clamping surface of dome section of the roof drain shall be coated with bituminous plastic cement, and the dome section fastened in place.

(g) Concrete cover slabs : The concrete cover slabs over the membrane water-proofing shall be reinforced with 4 inch by 4 inch mesh of no 4 gauge wire fabric. Intermediate joints of premoulded joint filler shall be placed in the cover slabs to form panels approximately 9 metre inside dimensions. Grooves with neatly tooled edges shall be placed in the top surface of the cover slabs to form panels approximately 9 metre inside dimensions. Before the cover slabs are placed, the metal plates at expansion joints shall be installed in accordance with details indicated on the drawings. Expansion joints in the cover slab and joints between bituminous plastic cement leaving space in expansion joints for rubber joints strips where required. The tooled grooves and the upper 25 mm of the intermediate joints shall be filled with caulking compound. All concrete and wire fabric shall conform to the specifications for concrete and reinforcement.

(h) Measurement and payment : Measurement for payment for furnishing and placing membrane water-proofing (5 ply or 4 ply) will be made to the lines of the areas required to be

covered with membrane water-proofing and no allowance will be made for the sloping surfaces of cants. Deductions will be made for all openings and areas not covered with membrane water proofing. Payment for furnishing and placing membrane water-proofing (5 ply or 4 ply) shall be made at the applicable unit rates in the schedule of bids. The unit rate shall be exclusive only of concrete content in cover slab which shall be paid under the item 'Concrete in other structures'.

Measurement for payment for furnishing and installing flashing reglets and cants for membrane water-proofing will be made at the unit rate per square metre for the item in the schedule of bids.

28 03 DAMP PROOFING :

(a) Asphalt emulsion damp proofing shall ba applied to the surface as directed by the Engineer-in-Charge. The contractor shall furnish all materials, equipment and labour for damp proofing, including asphalt emulsion damp proofing and clear damp proofing compound. The contractor shall not be entitled to any additional payment above the unit price therefor in the schedule of bids by reason of any amounts or none of this work being required.

(b) Damp proofing shall not be applied when the temperature is below 45° F. Surfaces to receive damp proofing shall be dry and free from all loose and foreign materials. Surface to receive damp proofing shall be covered. Each coat of damp proofing shall be uniform in thickness without streaks or runs. Care shall be taken not to puncture or otherwise damage the coating when backfill is placed. Each coat of asphalt emulsion damp proofing shall be applied at the rate of approximately 10 litres to each 15 square metres of area. The second coat of asphalt emulsion damp proofing shall not be applied until after the free water is absent from the surface of first coat. The asphalt emulsion need not be applied by spraying, but the method used shall be subject to the approval of the Engineer-in-Charge. The first coat of damp proofing compound shall be applied at the rate of approximately 10 litres to each 55 square metre of area and each succeeding coat shall be applied at the rate of 10 litres to each 90 square metres of area. Each coat of clear damp proofing compound shall be allowed to dry for 72 hours before the succeeding coat is applied. The damp proofing compound shall be applied by spraying in three coats. The damp proofing surfaces shall be protected from the direct rays of the sun from the time the first coat is applied until 3 days after the last coat is applied.

(c) Material for damp proofing shall conform to the Indian Standard Specifications or as approved by the Engineer-in-Charge.

(d) Measurement and payment : Measurement for payment for furnishing and applying damp proofing will be made to the lines of the areas required to be damp proofed and the areas of all openings will be deducted. Payment for furnishing and applying asphalt emulsion damp proofing will be made at the unit price per square metre for the item in the schedule of bids which unit price shall include all cost of materials, labour and other accessories required for damp proofing in three coats. Payment for furnishing and applying clear damp proofing compound will be made at the unit price per square metre for the item in the schedule of bids, which unit price shall include all cost of material, labour and other accessories required for damp proofing in three coats.

28.04 HEAT INSULATION OF ROOFS OF AIR CONDITIONED ROOMS :

Slabs of foam concrete shall be laid over roofs of control room and other locations where heat insulation is required for air conditioning. The foam concrete slabs shall be arranged over a thin bed of dry sand and the gaps between them thoroughly filled with dry sand. The foam concrete shall bc made by using suitable air entraining admixtures. It shall have a density of about 48 kg. per cubic metre and a maximum thermal conductivity of 0.67 BTU per square foot per hour per degree fahrenheit for a thickness of 1". The method of preparation and the quantity of slabs shall be subject to the approval of the Engineer-in-Chargs. The contractor shall provide slabs free of cost to the Engineer-in-Charge for testing purposes. A 18 mm thick layer of cement plaster 1:3 shall be placed over the foam concrete slabs. While plastering, care shall be taken to prevent water entering into the foam concrete. After the plaster has been cured and the surface has become dry, membrane

water proofing shall be done as per para 28.02 (d) and concrete cover slabs laid in accordance with para 28.02 (g) of these specifications.

Payment for foam concrete will be made at the unit rate per cubic metre for the item in the schedule of bids which unit rate shall include the cost of supplying and actually placing conerete into place including the cost of admixtures used therein. Payment for cement plaster will be made at the unit rate as per para 25.08 (f), (i). Payment for membrane water-proofing and cover slabs will be made at the unit rates as per para 28.02 (h).

28.05 MATERIALS FOR ROOFING, WATER-PROOFING AND DAMP PROOFING :

Material for roofing, water proofing and damp proofing shall conform to the I.S.I. Standard specifications or shall be as approved in writing by the Engineer-in-Charge.

CHAPTER—29

DRAINAGE SYSTEM

29.01 GENERAL :

The Power House, tunnel and appurtenant structures under the contract will be drained by systems of drains, the material and construction details of which will depend on the desired functional performance. Care shall be taken to avoid clogging of the drains during the progress of the work and should any drain become clogged or obstructed from any cause before final acceptance of the work it shall be cleaned out in a manner approved by the Engineer-in-Charge or replaced by and at the expense of the contractor. No compensation will be given to the contractor for any or none of the quantity of any of the following works being required to be performed.

(i) Drilled drains : Drainage in the tunnel, surge shaft and power house and other appurtenances will be provided by a series of holes drilled into the rock as described in clause 29.02 through pipes of such diameter and at spacing given in the drawing or as decided by the Engineer-in-Charge. The pipes through which the holes are to be drilled shall be placed as provided in clause 29.03.

(ii) Sewer pipe drains : Concrete or clay sewer pipe drains 15, 30 and 45 cms. in diameter with uncemented joints and embedded in gravel shall be constructed wherever directed by the Engineer-in-Charge as described in paragraph 29.04. The outlet of the sewer pipe drain systems with uncemented joints embedded in gravel shall be constructed of metal pipe 30 cms and 60 cms in diameter and of concrete or clay sewer pipe 30 cms in diameter with cemented joints. Sewer pipe drains through the retaining walls and elsewhere when directed shall be constructed of concerete or clay sewer pipe 15 cms and 30 cms in diameter with cemented joints as described in paragraph 29.05.

(iii) Half-round pipe drains : Concrete half round pipe drains 20 cms; 30 cms and 45 cms in diameter shall be constructed under retaining walls and elsewhere as described in paragraph 20.06.

(iv) Metal pipe drains · Cast iron pipe drains shall be constructed as cross drains for Power House drainage and elsewhere as shown in the drawings or as directed by the Engineer-in-Charge.

(v) Open drains : Open drains shall be constructed at the bottom of slopes of retaining walls or other places as directed by the Engineer-in-Charge. The drains shall have section as directed by the Engineer-in-Charge. Construction of culverts on such drains shall also be done by the Contractor.

29.02 DRILLING DRAINAGE HOLES :

Drainage holes shall be drilled through pipes placed in the concrete for this purpose on location as shown on the drawing or as directed by the Engineer-in-Charge. The drainage holes shall be drilled at angles of inclination as directed by the Engineer-in-Charge and shall be drilled from the specified locations through 10 cms diameter black steel pipes embedded in the concrete as shown on the drawings and as described in paragraph 29.03. All drainage holes shall be drilled by rotary drilling (non coring) of a tvpe as approved by the Engineer-in-Charge. In general, the elevation of the bottom of the drainage hole shall be higher than the bottoms of the adjacent grout holes and no drainage hole will be permitted to be drilled until all adjacent grout holes within minimum distance of 20 metres hava been drilled and grouted, unless otherwise directed by the Engineeer-in-Charge. The bottom of drainge holes may be drilled upto 10 metres and there shall have nominal diameter or 5 cms. If a given area is grouted and drilled for drainage and it is found desirable to drill and grout additional grout holes, the contractor may be required to open previously drilled drain holes by redrilling to secure satisfactory drainage. Such redrilling of holes and the drilling of any drainage holes required to be drilled to a greater depth than 10 metres in case of

5 cm. dia holes will be ordered by the Engineer-in-Charge in writing and will be paid for as extra item under the provisions of clause 3.10 of general conditions of contract.

29.03 PIPES FOR FOUNDATION DRAINAGE :

The contractor shall furnish and place all black steel pipes and fittings required for the drainage, as, directed by the Engineer-in-Charge. The drainage pipes shall be set and caulked into holes drilled to a depth of not less than 15 cm into the rock foundation and shall be held securely in position while the concrete is placed about them. Payment for drilling holes for setting dralnage pipes will be made at the unit price per linear metre therefor in the schedule of bids for drilling drainage holes. All chaulking material for caulking the drainage pipes into the rock shall be furnished by the contractor. Drainage pipes shall be plagged by removable plugs of heavy plastic/bronze as directed and approved by the Engineer-in-Charae.

29.04 CONSTRUCTING SEWER-PIPE DRAINS WITH UNCEMENTED JOINTS :

Concrete or clay sewer-pipe 15, 30 and 45 cms. in diameter shall be laid with uncemented joint in the lecation described in paragraph 29.01 and elsewhere as directed by the Engineer-in-Charge. All sewer-pipe drains with uncemented joints shall be embedded in gravel. Heavy burlap for covering gravel bedding where required and all gravel for bedding shall be furnished by the contractor. Burlap shall be 1 metre in width and about 300 grams per linear metre. No pipe which has been damaged to such an extent that in the opinion of thc Engineer-in-Charge, it is unfit for use, shall be used in work. For pipe to be embedded in gravel, gravel bedding of the thickness as directed by the Engneer-in-Charge shall be placed in the bottom of the pipe trench. The pipe shall be laid carefully on the gravel bedding with the bellend upgrade and with partially open uncemented joints, in a workmanlike manner and to the lines and grades established by the Engineer-in-Charge. Gravel shall then be placed to provide a minimum thickness of 15 cms. over the top of and at the sides of the pipes. The gravel shall be carefully placed and tamped about the pipe so as not to disturb the pipe after being laid and to hold it securely in position while the fill is being placed. The gravel herein referred to shall consist of natural gravel or crushed rock as approved by the Engineer-in-Charge, shall be clean and reasonably well graded from 20 mm to 40 mm in size and shall be obtained from approved sources of coarse aggregate for concrete. Where concrete is to be placed over or against the gravel bedding, the gravel bedding shall be covered with a layer of heavy burlap before the concrete is placed, to prevent fresh mortar from the concrete from entering the gravel bedding.

29.05 LAYING SEWER-PIPE DRAINS WITH CEMENTED JOINTS :

Concrete or clay sewer-pipes 30 cms. and 45 cms. in diameter shall be laid with cemented joints in locations described in paragraph 29.01 and elsewhere as directed by the Engineer-in-Charge. The pipe will be furnished by the contractor. No pipe which has been damaged to such an extent that, in the opinion of the Engineer-in-Charge, it is unfit for use. shall be used in the work. The pipe shall be laid carefully and true to the lines and grades established by the Engineer-in-Charge. The ends of the pipes shall fit closely and the spigot ends shall be placed concentrically in the bells as to provide uniform space around the pipe for the cement sand mortar. The joints shall be filled fully and neatly with cement-sand mortar mixed in proportions determined by the Engineer-in-Charge and wiped on the inside, all in a workmanlike manner and to the satisfaction of the Engineer-in-Charge. Pipes to be embedded in concrete shall be placed accurately in position and shall be held securely in place while the surrounding concrete is being placed. For pipes to be embedded in embankment material, the pipe shall be laid and sufficient suitable materials shall be tamped under and about the pipe to hold it firmly and accurately in place while the joints are being completed and after mortar in the joints has set to the satisfaction of the Engineer-in-Charge, additional embankment materials shall be placed and thoroughly tamped or otherwise consolidated about the pipes in a manner satisfactory to the Engineer-in-Charge, care being taken not to disturb the pipe.

29.06 HALF ROUND CONCRETE PIPES :

Concrete half round pipes 20 cms 30 cms and 45 cms in diameter shall be laid with cemented joints in locations described in the paragraphs 29.01 and elsewhere as shown on the drawings or as directed by the Engineer-in-Charge. All materials shall be supplied by the contractor. No pipe which has been damaged to such an extent that, in the opinion of the Engineer-in-Charge it is unfit for use, shall be used in the work. The pipe shall be laid carefully and true to the lines and grades established by the Engineer-in-Charge. The half round concrete pipe shall be laid on the excavated rock surface or on porous concrete where required, with mortar placed along the lines of contact uniform bearing and to prevent mortar from the concrete from entering the pipe.

29.07 MEASUREMENT AND PAYMENT :

(a) Drilled drainage holes will be measured for payment including the holes drilled for placing the pipe and only the depth of holes actually drilled as directed by the Engineerin-Charge will be considered in making the measurements. Except as otherwise provided for refilling and drilling to a depth greater than 10 metres in case of 5 cm diameter holes, payment for the drilling described in this paragraph will be at the unit rate per linear metre for the item in the schedule of bids, which unit rate shall include the cost of all labour, materials, plant and all operations required in drilling the hole and maintaining them free from obstructions until the work is completed.

(b) Payment for furnishing and placing black steel pipes and fittings for foundation drainage will be made at the unit rate per kilogramme for the item 'Furnishing and installing black steel pipe and fittings for grouting and drainage' provided in the schedule of bids. Payment will be made only for the pipes and fittings installed and left in place in the completed structure at the direction of the Engineer-in-Charge. Payment for plastic or bronze plugs shall be made at the unit rate per Kilogramme for the respective item of 'Furnishing and installing pipe plugs of heavy plastic or bronze' in the schedule of bids.

(c) Measurement for payment for construction of Sewer-pipe drain with uncemented joints will be made for the length along the centre line of the pipe from end to end of the pipe in place and no allowance will be made for laps and joints. Payment for constructing sewer-pipe drains with uncemented joints will be made at the unit price per linear metre therefor in the schedule of bids, which unit price shall include the cost of furnishing, hauling, storing handling, preparing an even bedding for and placing the pipe and gravel fill around pipe, furnishing and placing burlap for covering, where required and of all other operations except the excavation of the trenches required for completion of the drains. Measurement for payment of excavation for trench for pipe drain will be made only to the lines required to provide for the thickness of gravel fill around the drain pipe as directed by the Engineer-in-Chage and payment for excavation of the trench will be made at the unit price per cubic metre for the item in the schedule of bids for the excavation for the structure for which the pipe drains are constructed.

(d) Measurement for payment for laying sewer-pipe drains with cemented joints will be made for the length along the centre lines of the pipe, from end to end of the pipe in place and no allowance will be made for laps and joints. Payment for laying pipe with cemented joints will be at the unit price per linear metre for the item in the schedule of bids, which unit price shall inclule the cost of furnishing all materials, handling, hauling, storing, preparing an even bedding for and laying the pipe and cementing the joints.

(e) Measurement for payment for laying half-round concrete pipes with cemented joints will be made for the length along the centre lines of the pipes. from end to end of pipe in place and no allowance will be made for laps and joints. Payment for laying half round concrete pipe with cemented joints will be made at the unit rate per linear metre for the item in the schedule of bids which unit rate shall include the cost of furnishing and placing the half round concrete pipe, fitting the joints with cement and mortar and of all other operations required for the completion of the drains.

(f) Payment for installing metal pipe drains not otherwise specifically provided for in sub-paragraph 29.03 above will be made at the unit rate per kilogramme in the schedule of bids for installing metal pipe, fittings and valves less than 15 cm in diameter and for installing metal pipe fittings and valves 15 cm and larger in diameter. Measurement for payment of open drains shall be for the actual quantities of work done in such open drains and shall be paid for as an extra item for which a rate shall be decided upon in writing bofore the start of the particular work as provided in clause 3.10 of general conditions of contract.

(g) No payment will be made for any pipes and formed drains or pipe drains choked during the period of construction before final taking over of the work by the Engineer-in-Charge.

CHAPTER— 30

CONTRACTION JOINTS, WATER SEAL STRIPS, ASPHALT SEALS AND JOINT FILLERS

30.01 CONTRACTION JOINTS :

Contraction joints shall be constructed in power house, other appurtenant works and elsewhere as directed. The joints shall be made by forming the concrete on one side of the joints and allowing it to set before concrete is placed on the other side of the joint. The surface of the concrete first placed at the contraction joints in the Power House shall be coated with approved sealing compound.

The entire cost of furnishing the sealing compound and of constructing contraction joints shall be included in the unit price therefor in the schedule of bids for the concrete in which joints are required.

30.02 METAL SEALING STRIPS :

(a) General : Metal seals or metal sealing strips of copper shall be placed in joints in the Power House and appurtenant structures where shown on the drawings and else-where as directed. The contractor shall furnish all materials for metal sealing strips, materials for brazing metal sealing strips and washers and nails for fastening the sealing strips to the forms. The details of the shape and of the placing of sealing strips will be as shown on the drawings or as directed by the Engineer-in-Charge, the sealing strips shall be jointed carefully together by brazing so as to form continuous water tight diaphragms in the joints. Adequate provision shall be made to support and protect and the sealing strips during the progress of the work. The contractor shall replace or repair to the satisfaction of the Engineer-in-Charge, any metal sealing strips punctured or damaged before final acceptance of the work.

(b) Materials : Materials for metal sealing strips shall conform to the specifications mentioned hereinafter unless otherwise approved in writing by the Engineer-in-Charge.

(i) Metal sealing strips : Metal seals or sealing strips shall be of copper conforming to relevant I. S. specifications or as approved by the Engineer-in-Charge.

(ii) Miscellaneous materials : Miscellaneous materials not covered herein by detailed specifications shall be of best standard commercial quality, of a type and composition approved by the Engineer-in-Charge.

(c) Measurement and payment : Measurement for payment for furnishing and placing metal sealing strips will be made of the weight of sealing strips in place, exclusive of the weight of brazing. Payment for furnishing and placing metal sealing strips in the Power House and appurtenant works will be made at the unit price per kilogramme therefor in the schedule of bids, which unit price shall include the cost of furnishing, storing, handling, cutting, brazing and placing the metal sealing, strips, furnishing all brazing rods, washers and nails and maintaining the metal sealing strips free from damage as described in this clause.

30.03 RUBBER/PVC WATER STOPS :

(a) General : Rubber and P.V.C. water stops should correspond to C.W.C. or applicable Indian Standards and shall be got approved by the Engineer-in-Charge before installation. These will be placed at contraction joints of Power House and elsewhere as directed by the Engineer-in-Charge. The rubber water stops will be of the hollow bulb and flat dumb bell type and shall be 225 mm in width. The P.V.C. water stops shall be of corrugated with centre bulb with end grip type and 305 mm wide. The contractor shall furnish all materials for installing and jointing the water stop including connection plates, gum rubber, rubber cement, bolts, tools etc.

(b) Storage : The water stops shall be stored in as cool a place as practicable, preferably at 70° F or less and in no case shall the rubber be stored in the open or exposed to the direct rays of the sun. All rubber/P.V.C. water stops shall be stored so as to permit free circulation of air round the water stop.

All field connections shall be made as directed. The contractors shall take suitable precautions to support and to protect the water stops during the progress of the work and shall replace or repair at the contractor's expense any water stops which are damaged before final acceptance of the work.

(c) Measurement and payment : Measurement for payment for placing/rubber P V.C. water stops will be made on the basis of linear metre of water stops put in place. Payment for rubber/P.V.C. water stops shall be made at the unit price per linear metre for the item in the schedule of bids which unit price shall include the cost of furnishing all material, tools, equipment and labour.

30.04 RUBBER JOINT STRIPS .

(a) General : Rubber joint strips with or without metal strips may be placed in locations as directed by the Engineer-in-Charge. The contractor will furnish the rubber joint strips, metal strips, expansion anchors, bolts and washers. The metal strips. bolts and washers, shall be of either corrosion resisting steel throughout or nickel copper alloy throughout. Expansion anchors shall consist of lead and iron expansion unit and shall be of such design that when installed properly, they will develop strength not less than the strength of the bolt. All joints in the rubber joint strips shall be close fitting joints and the location of all such joints shall be subject to the approval of the Engineer-in-Charge. The metal strips for the rubber joint strips shall be fastened to the concrete with bolts set in expansion anchors.

(b) Measurement and payment : Measurement and payment for furnishing and installing rubber joint strips will be made of the number of linear metre of rubber joint strips in place. Payment for furnishing and installing rubber joint strips with metal strips will be made at the unit price per linear metre for the item in the schedule of bids, which unit price shall include the cost of furnishing rubber strips, metal strips, expansion anchors, bolts and washers and all other materials, labour and equipment for installing the rubber joint strips and washers, Payment for furnishing and installing rubber strips without metal strips will be made at the unit price per linear metre in the schedule of bids.

30.05 ASPHALT SEALS :

(a) General : The contractor shall construct asphalt seals in contraction joints in the Power House 15 cms. formed square openings as shown in drawing of water stops or elsewhere as directed by the Engineer-in-Charge. The contractor shall furnish all materials for asphalt seals including the metal cover plates and frames for the recesses, the 12.5 mm. standard pipe and 12.5 mm fitting, fastening bars and wire for supporting 12.5 mm. steam pipes and asphalt. Materials shall conform to applicable Indian Standard Specifications.

(b) Placing : The 12.6 mm steam pipes shall be secured rigidly in place as directed by the Engineer-in-Charge and all piping connections shall be made tight. After each lift of concrete has been completed the receeses for the seals shall be filled with hot asphalt. After each seal has been completed to the top of the structure in which it is located, the seal shall be capped as directed. The contractor shall when directed connect the steam piping in the seal to a steam supply and steam shall be passed through the piping until all the asphalt in the seal is liquefied completely. Any spaces in the top of the seals resulting from consolidation if the asphalt upon reliquefying shall be filled immediately with hot asphalt. The plugs shall then be replaced in the caps.

(c) Measurement and payment : Measurement for payment for constructing asphalt seals in the structure will be made of the number of linear metre of asphalt seals in place. Payment for constructing asphalt seals will be made at the unit price per linear metre in the schedule of bids, which unit price shall include the cost of furnishing all required materials, placing and securing the steam pipes in the seals including connecting pipes between seals and bleeder pipes to drainage gallery, filling the spaces in the seals with asphalt, furnishing all steam and reliquefying the asphalt seals and capping the seals, as described in this clause. Payment for furnishing and placing metal

cover plates for recesses will be made at the unit price per kilogramme for the item in the schedule of bids for furnishing and installing miscellaneous embedded metal and metal work.'

30.06 JOINT FILLERS :

(a) General : The joint fillers shall be used at contraction and expansion joints. The joint filler materials and coaltar damp proofing compound for coating the first placed concrete, shall be furnished by the contractor.

(b) Resilient type : A cork board joint filler material or thermocol 25 mm in thickness shall be placed in expansion joints where and as directed. The filler materials shall be furnished by the contractor and shall be non-extruding, resilient type, expansion joint fillers, in accordance with the applicable U. S. Federal specifications or equivalent. The filler material shall be cut by the contractor to cover the entire surface of the concrete of the joints and to fit around all openings, where directed by the Engineer-in-Charge, the exposed edges of the filler material shall be placed at the required distance back from the finished surface of the concrete. The joint filler shall be held securely in place against the completed side of an expansion joint by copper or brass nails precast in the first placed concrete or by a water proof cement applied to the face of each board on a margin strip coating approximately 38 mm wide. Joints in the filler material shall be made tight so that mortar from the concrete will not seep through to the opposite concrete surface.

(c) Bituminous fiber type : A premoulded bituminous fiber type expansion joint material 10 mm in thickness may be placed in contraction and expantion joint in places as directed by the Engineer-in-Charge. The joint filler material shall be non-extruding bituminous fiber type in accordance with the applicable U. S. Federal Specifications or equivalent.

The coltar damp proofing compound shall consist entirely of coaltar pitch and coal-tar solvents, suitable blended to produce a liquid which is smooth and uniform in consistency and which complies with the following detailed requirements.

(i) Distillate to 440° F, 25 to 35 percent.

(ii) Softening point of distillation residue, 140° F to 160° F.

(iii) Water 0.5 per cent, by weight maximum.

(iv) Shall be suitable for any spray application at temperatures above 60° F.

(v) When applied at a coverage rate of 6 square metre per litre on a clean, smooth steel surface and allowed to dry in a ventilated 70° F, 50 per cent relative humidity atmosphere the compound shall dry to a firm dry film in 24 hours.

Methods of testing the coaltar damp proofing compound shall be in accordance with the standard methods of testing. The filler material shall be placed to cover the entire surface of the concrete of the joints. Joints in the filler material shall be made tight so that mortar from the concrete will not seep through to the opposite concrete surface.

(d) Measurement and payment : Measurement for furnishing and placing joint filler will be made to the required neat lines and the areas of all openings will be deducted. Payment for furnishing and placing joint fillers will be made at the unit price per square metre for the item in the schedule of bids, which unit price shall include the cost of all materials, labour and equipment required for construction of the expansion joints as described in this clause.

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CHAPTER—31

MISCELLANEOUS EMBEDDED METAL AND METAL DOORS

31.01 MISCELLANEOUS EMBEDDED METAL AND METAL WORK :

The item of the schedule of bids 'Furnishing and installing miscellaneous embedded metal and metal works will include furnishing and installing embedded steel frames for openings in floors, decks and walls and for trenches etc. The contractor will furnish all metal frames for opening in floors, decks, walls in elsewhere as described in this paragraph. The metal frames shall be set accurately in position when the concrete is placed, or where directed; blockouts shall be left in concrete to provide for the installation of the metal frames and after the metal frames have been placed accurately in position, the blockouts shall be filled with concrete. After being installed, all exposed surface of metal works shall be painted, payment for 'furnishing and installing miscellaneous embedded metal and metal work' will be made at the unit price per kilogramme for the item in the schedule of bids. Payment for concrete in blockouts will be made at the unit price per cubic metre therefor in the schedule of bids.

The item of 'Furnishing and installing miscellaneous embedded metal and metal work' shall also include furnishing and installing miscellaneous steel items in supports for suspended false ceilings, lighting fixtures in parapets recesses, manhole frames and covers for septic tanks, cable tray supports, ladder rungs, power house gallery metal works including steel platform and supports in sump well and gutter cover plates, including floor plates, steel cover plates for asphalt seal recess in pipe sleeves, steel chequered plates and floor gratings, edging of trenches etc. Where and as shown on the drawing and elsewhere as directed by the Engineer-in-Charge. Exposed unfinished surface of metal work shall be painted as directed by the Engineer-in-Charge. Payment for furnishing and installing miscellaneous metal work will be made at the unit price per kilogramme as given for the item 'furnishing and installing miscellaneous embedded metal and metal work'. The cost of furnishing and installing all other minor miscellaneous items of metal work, for which specific unit prices are not provided in the schedule of bids, shall be included in the unit price in the schedule of bids for the work to which they are appurtenant, as determined by the Engineer-in Charge.

31.02 METAL ACCORDION DOORS :

The contractor will furnish and install the metal accordion doors as directed, together with the steel frames, hardware, steel thresholds and all other accessories. The doors, frames and thresholds will be of steel. The frames shall be placed accurately in position before the concrete is placed and shall be held securely in place while the concrete is being placed. Special care will be required in placing the frames to ensure proper operation of the doors. The thresholds shall be fastened to the concrete with unit type lead and iron expansion anchors and bolts, where required and the contractor shall drill holes in concrete required for the anchors. The contractor shall furnish and install all hardware and other accessories. After the doors are hung, the doors and the frames shall be painted. Hardware shall be painted as directed. Before acceptance of the work, the contractor shall test the operation of the doors and shall correct any defects in operation. Measurement for payment for furnishing and installing metal accordion doors will be made for the weight of the doors, inclusive of the frames, fittings and hardware. Payment for furnishing and installing metal accordion doors will be made at the unit price per kilogramme therefor in the schedule of bids, which unit price shall include the cost of furnishing and installing hardware and other accessories.

The metal accordion doors shall be standard manufactured in conformity with Indian Standard Specification and as approved by the Engineer-in-Charge. The method of installation and material shall be subject to the approval of Engineer-in-Charge.

31.03 METAL SWINGING DOORS :

The item of the schedule of bids for furnishing and installing metal swinging doors,

includes the installation of metal swinging doors in the Power House, in the gallery entrance structures etc. but does not include the installation of doors in metal partitions. The contractor will furnish the metal swinging doors, together with metal frames, hardware metal thresholds, glass and glazing material and all other accessories. The metal swinging doors, metal frames and metal thresholds will be of steel or aluminium. The metal frames and thresholds shall be fastened to the concrete with unit type lead and iron expansion anchors and bolts where required and the contractor shall drill all holes in concrete required for anchors. Spaces between the bucks and the concrete shall be filled solidly with cement grout mixed in the proportions prescribed by the Engineer-in-Charge. Space between the trim and the concrete shall be caulked with caulking compound to provide tightly sealed joints. The contractor shall furnish and install all hardware and shall perform all required glazing. After the doors have been hung but before projecting hardware such as door knobs and door closures have been installed, the doors, frames and trim shall be painted. Hardware shall be painted where directed. Before the acceptance of the work, the contractor shall test the operation of all doors, shall correct any defects in operation and shall clean all glass. Measurements for payment for furnishing and installing metal swinging doors will be made of the weight of the doors, inclusive of the frames, fittings, glazing and hardwares. Payment for furnishing and installing metal swinging doors will be made at respective unit price per kilogramme for furnishing and installing doors, sash and louvres of steel or aluminium as the case may be in the schedule of bids which unit price shall include the cost of furnishing cement grout and furnishing and installing hardwares, frames, glazing and other accessories.

The metal swinging doors shall be of standard manufacture in conformity with Indian Standard Specifications and as approved by the Engineer-in-Charge. The method of installation and material etc., shall be subject to the approval of the Engineer-in-Charge.

31.04 METAL FIRE DOORS :

The contractor shall furnish and install the metal fire doors in the Power House as directed together with fusible links, hangers, track. weights, bolts and other accessories. The fire doors will be of steel. The track, brackets and other hardware shall be fastened to the concrete with unit-type lead and iron expansion anchors and bolts, where required and the contractor shall drill all holes in concrete required for the anchors. The contractor shall furnish and install fusible links, closing devices and opetating hardware. After the doors are hung, the doors shall be painted. Hardware and accessories shall be painted where directed. Before the acceptance of the work the contractor shall test the operation of all doors and shall correct any defects in operation. Measurement for payment for furnishing and installing metal fire doors will be made of the weight of the doors inclusive of the frames, fitting and hardware. Payment for furnishing and installing steel fire doors will be made at the unit rate per kilogramme for ihe item 'furnishing and installing steel fire doors provided in schedule of bids which unit rate shall include the cost of furnishing and installing hardware and other accessories.

The metal fire doors shall be of standard manufacture in conformity with Indian Standard Specifications and as approved by the Engineer-in-Charge. The method of installation and material etc shall also be subject to the approval of the Engineer-in-Charge.

31.05 METAL DOORS, SASH AND LOUVERS :

The contractor shall furnish and install all materials for metal doors, sash, louvers and windows in Power House and elsewhere as directed including metal sash, hardware, glass, glazing clips, putty caulking compound, and grouting. Before installing the metal doors, sash louvers and windows, the concrete grooves shall be free from all loose and foreign material. Metal doors, sash louvers and windows shall be installed in vertical planes without warping, shall be braced rigidly and shall be held in position until the grout has set. All spaces between the sash and the concrete shall be filled with cement grout mixed in the proportion prescribed by the Engineer-in-Charge and the sash shall be caulked around the exterior edges with caulking compound. All sash shall be

adjusted before glazing is begun. The contractor shall perform all required glazing. After the installation is completed all sash and putty shall be painted. The hardware shall be painted where directed. The operating gear mechanism for the windows and louvers shall be provided as approved by the Engineer-in-Charge and shall be paid for at the unit rate per kilogramme for the respective item of furnishing and installing steel or aluminium doors, sash and louvers. Measurements for payment for furnishing and installing metal doors, sash louvers and windows will be made of the weight of the doors, windows etc inclusive of the frames, fittings, glazing and hardware. Payment for furnishing and installing steel or aluminium doors, sash, louvers, windows and glazing will be made at the applicable unit rate per kilogramme proivded therefor in the schedule of bids. Before acceptance of the work, the contractor shall test the operation of all doors, sash, louvers and windows, shall correct any defect in operation and shall clean all glasses.

The metal doors, sash, louvres and windows shall be standard manufacture in conformity with Indian Standard Specifications and as approved by the Engineer-in-Charge. The method of installing and material etc. shall also be subject to the approval of the Engineer-in-Charge.

31.06 ROLLING STEEL DOORS :

The work to be done under this section includes the furnishing and complete erection of rolling steel doors as specified, with all the hardware necessary for its installations. The contractor shall make and submit for approval to the Engineer-in-Charge shop drawings of the doors specified herein, or shown on the drawings. Shop drawings shall be approved before any fabrication is started.

The curtain shall be made up of interlocking slats of 16 gauge of open hearth copper bearing steel, hot-dip galvanized. Slats will be held together by means of malleable iron and locks which shall also prevent the slats from coming in contact with grooves.

The shaft shall be commercial black iron of sufficient diameter to carry the load, with a maximum deflection of 2.5 mm. for each metre of span. The shaft shall revolve on bell or roller bearings which shall be arranged for grease gun lubrication. Springs shall be of the helical type, sufficient to counter balance the curtain at any point and with a load factor of safety of 25 percent in excess of the actual weight of the curtain. A suitable self sustaining spring adjustment device shall be furnished for use in conjunction with springs.

The curtain shall travel in channel side grooves built up of structural shapes. Channel grooves shall be secured to the wall by means of back angle tapped to the steel jamb members. The brackets shall be made up of cast iron. These brackets are to support the shaft mechanism.

Manual operation shall be by means of endless chain gearing or removable crank and gearing, electrical operation shall be by means of a 50 cycle, 3 phase, 400 volt motor properly geared to raise or lower the door at a speed of 2 metres per minute. The motor shall be provided with limit switches and shall be operated by an automatic button switch.

Ungalvanized exposed parts shall be given one shop coat of zinc chromate primer. All unexposed parts shall be given one coat of red oxide primer or zinc chromate primer.

Measurement for payment for furuishing and installing rolling steel doors will be made for the weight of the doors inclusive of the frames and payment for furnishing and installing rolling steel doors shall be made at the unit price per kilogramme in the schedule of bids.

31.07 METAL STAIRWAYS AND HANDRAILS :

All metal straight run and spiral stairways and handrails in the Power House or elsewhere as directed, including the ladders will be furnished and installed by the contractor as directed Stairways metal work shall include supporting beams for stairways platforms. The stairway brackets shall be anchored to the concrete with expansion anchors placed in holes drilled in the concrete after the assemble of the steps is completed.

Handrails to be placed in concrete shall either be completely assembled and placed when the concrete is placed or recesses shall be left in the concrete to receive the railing posts, and handrails shall be completely assembled, aligned accurately and grouted in the position at some later time. Where shown on the drawings or as directed by the Engineer-in-Charge expansion anchors and flanges shall be installed for anchoring the handrails in place. After installation, all exposed metal work shall be painted. Payment for furnishing and installing metal stairways and handrails will be made at the applicable unit prices per kilogramme as given for furnishing and installing stairways, stair treads and hand rails of steel or aluminium in the schedule of bids.

CHAPTER 32

PLUMBING, ELECTRICAL INSTALLATION, TEST INSTALLATIONS, PAINTING AND PHOTOGRAPHY

32.01 PLUMBING :

(a) Plumbing fixtures : Plumbing fixtures shall be installed wherever directed by the Engineer-in-Charge. The contractor shall install water closets, urinals, wash hand basins and sinks complete in all respects. All plumbing fixtures shall be tested after installations and any deficiency corrected by the contractor at his own cost.

The plumbing fixtures may either be supplied by Government or the contractor may be required to purchase them as directed by the Engineer-in-Charge In case the fixtures are required to be purchased by the contractor, he will be paid the actual cost of the fixtures F. O. R. Dehradun plus ten percent thereof. Before purchasing the fixtures, the contractor shall submit to the Engineer-in-Charge for his approval the names of the manufacturers, the catalogue designations and the approximate dimensions for the fixtures, he proposes to furnish. The approximate dimensions shall meet the requirement of the detailed drawings furnished by the Government.

Payment for installing water wash, closets, urinals hand basins and service sinks will be made at the applicable unit price per fixture for the item in the schedule of bids.

All pipes required for plumbing shall be of galvanized iron and payment for their furnishing and installations will be made at the unit rate per kilogramme in the schedule of bids for pipes less than 150 mm and 150 mm or more in diameter.

(b) Electric drinking water coolers : Electric drinking water coolers may be required to be installed as directed by the Engineer-in-Charge. The coolers shall be installed and tested in accordance with the standard plumbing practice. Payment for installing electric drinking water coolers will be made at the unit rate per cooler for this item in the schedule of bids.

(c) Other fixtures : Other fittings, such as towel racks, hooks, showers, toilet room accessories, etc. may also be required to be provided. Payment for such items will be made at the rates agreed upon in writing between the Engineer-in-Charge and the contractor, before the work is actually carried out.

(d) Materials for plumbing : Materials for plumbing shall coform to the following specifications unless other-wise approved in writing by the Engineer-in-Charge. All plumbing fixture and toilet accessories shall be of standard specifications as approved by the Engineer-in-Charge. All surfaces of materials to be exposed after installations of fixtures and toilet room accessories shall be chromium plated unless otherwise approved by the Engineer-in-Charge. Bolts for anchoring fixtures to walls shall be of sufficient length as approved by the Engineer-in-Charge Expansion anchors shall be two unit lead and iron anchors.

(i) Water closets : Water closets shall be cabinet type as approved by the Engineer-in-Charge with low or high cistern of 14.5 litres capacity and shall be furnished with the following fittings :

Flush valve for connection to 12.5 mm supply and 32 mm or 38 mm flush pipe.
Back flow preventer.
Lock Shieldangle stop
Floor slange
Flush pipe
Vent pipe
All bolts, nuts, screws, washers etc.

(ii) Urinals : Urinais shall be of pedestal or bowl type as approved by the Engineer-in-Charge and shall be furnished with the following fittings :

Flush valve for connection to 12.5 mm supply and 32 mm or 38 mm flush pipe.
Backflow preventer.
Flush pipe.
Lock shield angle stop.
Floor flange.
All botls, nuts, screws, washers etc.

(iii) Sinks : Sinks shall be of pedestal or mounted type as approved by the Engineer-in-Charge with or without back and shall be furnished with the following fittings :

Metal supports, in case of mounted type.
Stop cocks.
Drain pipe.
Chain and stopper.
All bolts, nuts, screws, washers etc. trap and lead connection.

(iv) Wash hand basins : Wash hand basins shall be of the mounted type as approved by the Engineer-in-Charge and shall be furnished with following fittings :

Metal supports.
Stop cocks.
Drain pipe.
Chain and stopper.
All bolts, nuts, screws, washers etc.
Trap and lead connections.

32.02 ELECTRICAL INSTALLATIONS :

(a) General : The contractor shall furnish and install all embedded electrical conduits, conduit fittings, boxes, cabinets and ground wires and insulators wherever so directed. All work shall be performed in a workmanlike manner and in accordance with the best latest practice. No exposed conduits, electrical apparatus conductors, or run way conductors, will be required to be furnished and installed under these specifications.

(b) Electrical conduits : All embedded electrical conduits, fittings, boxes and cabinets shall be furnished and installed as directed. The contractor shall furnish all materials for sealing joints and embedded non-metallic conduits. The contractor shall furnish all sealing compound for embedded metallic conduit joints and such compound shall be subject to the approval of the Engineer-in-Charge. Conduits, fittings and conduit boxes to be embedded in concrete shall be held securely in position while the concrete is being placed and all concrete shall be removed from the conduit boxes after the forms are removed. The ends of the conduit shall be protected to prevent the entrance of concrete or other foreign materials. All joints in the embedded conduit runs shall be tightened securely. Joints in embedded metallic conduit shall be covered with an approved paint or sealing compound to prevent leakage. Joints in embedded non-metallic conduit shall be wrapped first with one layer of rubber tape half lapped for a distance of 5 cms. beyond each end of the coupling and then with three layers of asphalt saturated cotton fabric, half lapped for a distance of 10 cms. beyond each end of the coupling. A torch shall then be applied until the asphalt runs. All metal conduit bends made in the field shall have standard radii unless otherwise specified and shall be free from kinks, indentations, or flattened surfaces. All metal conduits bend in the field shall be bent cold to prevent damage to the protective coating. Burrs and sharp corners at the end of each piece of metal conduit shall be removed with a taper reamer. All boxes and cabinets, locknuts, and bushings shall be installed to provide a ground circuit and to protect the wires from abrasion. Provision shall be made for draining conduits as directed. All exposed metal surfaces shall be painted. Measurement for payment for furnishing and installing embedded electrical conduit will be made along the centre line of the conduits from centre to centre of conduit fittings, boxes and cabinets. All materials shall conform to applicable Indian Standards. Where there are no Indian Standards, the applicable U. S. Standard shall govern.

Payment for furnishing and installating the various types and sizes of embedded electrical conduits will be made at the applicable unit price per linear metre in the schedule of bids, which unit price shall include the cost of furnishing and installing electrical conduits, fittings boxes, cabinets and sealing for embedded metallic conduit.

(c) Ground wires and ground rods : A net of copper conductors clamped or welded at each intersection and fastened to anchored copper ground rods shall be furnished and installed as directed by the Engineer-in-Charge Bare copper conductors shall be installed leading from the mat into and throughout the Power House and appurtenant works and other works as required by the Engineer-in-Charge. Risers from these conductors and from the mat shall be furnished and installed as directed by the Engineer-in-Charge so that connections may be made for grounding all electrical apparatus. The contractor will be required to make the complete installation of the ground cables. The various parts of the grounding system shall be located in the structures as directed. Payment for furnishing and installing ground wires and ground rods will be made at the unit price per kilogramme for the item in the schedule of bids. Payment for drilling holes for grouting rods to anchor the mats to the rock foundations and grouting the rods into the holes will be made at the unit price per linear metre of the item in the schedule of bid for 'drilling holes for anchor bars and grouting bars in place.'

32.03 TEST INSTALLATIONS :

(a) General : instruments as listed below shall be installed by the contractor as directed by the Engineer-in-Charge. The quantities of these instruments as given in the schedule of bids is only approximate.

(i) Mechanical strain gauges : These may be embedded to determine stress in the steel supports by means of strain measurements.

(ii) Carlson type stress and strain metres : Carlson stress metre may be used to measure deflection by means of an internal diaphram under pressure of a liquid held within a contained chamber.

Carlson strains metres may be used to measure strains and temperatures in the concrete lining and shall be placed in the concrete at various depths in the lining on both sides of the tunnel as directed by the Engineer-in-Charge.

(iii) Piezometer cells : Pore pressures in the clayee soil may be measured by embedding piezometer cells.

(iv) Goldback pressure cells : These may be embedded for direct measurement of stress against concrete lining. Other types of mechanical reading instruments as directed by the Engineer-in-Charge may be required to be installed to measure, as fully as practicable, the movements and deflection of the tunnel, power house and its appurtenant works and the surrounding ground. An adequate number of settlement points may be required to be installed on the ground surface above test section of the tunnels and cavities Standard survey equipment shall be used for level observations and levels shall be referred to permanent bench marks. Ground surface settlements will be observed above the section of the tunnel under test before the reference points are obliterated.

(b) Installation of instruments : No compensation shall be allowed to the contractor for none or all of the equipment being installed. These instruments will consist of small electrical resistance coils sealed in suitable protective casings of metal and rubber tubing and will weigh only a few kilogramme each. The instruments, if required, will be furnished by the Government with the necessary lengths of electrical ends attached for connecting the instruments to terminal boxes located in the galleries. The terminal boxes shall be installed in the side walls of galleries and mounted flush with the walls. The leads will be specially fabricated, rubber insulated, rubber sheathed cable designed to minimize the possibility of mechanical injury and to ensure long life when embedded in concrete. In general splicing will be avoided and will be made only where absolutely necessary as directed by the Engineer-in-Charge. The strain metres will be equipped

with four conductor cable having an approximate over-all diameter of 19/32 of an inch. The contractor shall provide suitable recesses or grooves in the fresh concrete before it has attained final set and the strain metres etc. shall be placed in these recesses and shall be embedded properly in fresh concrete, as directed by the Engineer-in-Charge. The cables from all instruments shall be embedded in concrete in grooves suitably formed in the concrete before final set has been attained and shall be covered with not less than 15 cm of fresh concrete, or placed in coduits embedded in the concrete, as directed by the Engineer-in-Charge.

(c) Payments : Payments for installing electrical cable for strain metre etc. will be made at the unit rate per linear metre of cable provided in the schedule of bids which unit rate shall include the cost of the complete installation of the cable, as described in this paragraph and of installing strain metres etc. terminal boxes, and the connection of the cables from the instruments to the terminal boxes. The unit rate shall also include the cost of transporting, storing and handling the equipment. Electrical conduit installed by direction of the Engineer-in-Charge in connection with the installation of the temperature and strain measuring instruments will be paid for separately at the unit rate per linear metre in the schedule of bids for installing embedded electrical metal conduit 32 mm or less in diameter.

32.04 PAINTING :

The contractor shall furnish all paints, thinners and other ingredients and labour for painting surfaces of concrete and plaster. All paints etc. shall be standard make and shall be got approved by the Engineer-in-Charge before their purchase.

Colours for the finish coats and undercoats shall be as directed or to match samples previously approved.

General and basic component materials entering into the manufacture of paints herein specified shall conform to the applicable IS or ASTM Specifications or equal. Primers, under coats etc. herein specified, may be either mixed on the job or delivered factory mixed. Paste in oil shall be factory ground. Turpentine paint thinner shall be used in thinning lead and oil and enamel materials. Replacement oil or other approved substitutes may be used in lieu of boiled or raw linseed oil.

Painting of interior and exterior surfaces, where indicated on the drawings or as therein specified. shall be as follows.

Lead and oil paints on concrete shall be applied only after the concrete surface has been neutralized by a solution of three kgm. of zink sulphate in ten litres of warm water, applied not less than forty eight hours before the application of the priming coat. One primer coat and two finish coats of lead and oil paint shall follow the application of the neutralizer.

Paint shall not be applied to wet, damp, dirty, rough or unfinished surfaces. No paint or water proof clear sealer shall be applied to concrete or plaster surfaces until at least fourteen days after the concrete or plaster has been placed. Finished surfaces shall be smooth, even and free from all defects. All brush work shall be even coatings free from brush marks. Sand paperihg, where necessary, shall be done after the undercoats are dry. Paint shall be worked thoroughly into all angular joints and open spaces. Tops and bottoms of all shelving and sides of cabinets shall be painted after they are fitted. Measurement for payment of painting will be made of the area actually covered by the paint. Payment will be made at the unit prices in the schedule of bids which unit price shall include all cost of paint, primer, cleaning the surfaces for priming and painting, and other works connected therewith.

32.05 PROGRESS PHOTOGRAPHS & CINE FILM :

The contractor shall supply to the Engineer-in-Charge a negative and four unmounted prints of progress photographs in black and white suitably inscribed, of an approximate size 165 mm x 115 mm., of such portions of the work in progress and completed as the Engineer-in-Charge may

direct. These will be required every month unless otherwise directed by the Engineer-in-Charge. The negative of the photographs shall become the property of the Department and no prints from the negative may be supplied to any person or persons without the authority of the Engineer-in-Charge.

The contractor shall also supply to the Engineer-in-Charge 16 mm colour edited progress Cine film with sound track of such portions of the work in progress and completed as the Engineer-in-Charge may direct so as to have a coherent record of the construction from start to its completion. These will be required every month unless otherwise directed by the Engineer-in-Charge. The contractor shall also arrange for monthly showing of the film at Dakpathar to the Engineer-in-Charge whose directions on any matter related to the preparation of Cine film shall be binding on the contractor. The cost of the monthly exhibition of the film shall be secured to be included in the rate for the items, in the schedule of bids. The film shall be deemed to be the property of the Department at all times.

Measurement and payment for progress photographs and cine film shall be made respectively for each number of photograph including one negative and four prints and in metres of cine film delivered at the unit rates of these items provided in schedule of bids.

CHAPTER—33

HYDROMECHANICAL EQUIPMENT AND METAL WORK

33.01 INSTALLING MACHINERY, EQUIPMENT AND OTHER METAL WORK :

(a) General : Except as otherwise provided, all metal work and machinery required to be installed under these specifications as parts of the completed Head race tunnel, surge tank, power house and appurtenant works will be furnished by the Government. In general, the machinery and equipment furnished by the Government will have been assembled, marked and match marked to facilitate assembly in the field, will have been tested to determine that all parts function properly and will have been dis-assembled as required for shipment. In general, all other metal work will be furnished, fabricated in sections convenient for despatch and marked. The contractor shall install or attach to or build into the structures and shall clean and paint all machinery, eqipment and other metal work in a workmanlike manner as hereinafter specified. Machinery and equipment, including all moving parts, shall be installed carefully and accurately, shall be tested for operation, and shall be adjusted so that all parts will move freely and will function properly to secure satisfactory operation, as determined by the Engineer-inCharge. In the installation of machinery, equipment, and other metal work mechanics skilled in their various trades, shall be employed.

(b) Repair of damaged parts : Damaged or defeetive parts shall not be installed. If any defects, errors and inaccuracies are found in the machinery, equipment and other metal work furnished by the Government, the Engineer-in-Charge will decide whether the parts will be returned to the manufacturer for correction or whether the defects, errors and inaccuracies shall be corrected in the field. The repair of damage which is due to the operations of the contractor and the correction of minor defects, errors and inaccuracies in the machinery, equipment and other metal work furnished by the Government which may be expected to occur in the ordinary commercial grade of shop work and manufacture of such materials as determined by the Engineer-in-Charge shall be made good by and at the expense of the contractor in a manner satisfactory to the Engineer-in-Charge. The repair of damage in the machinery, equipment and other metal work furnished by the Government which is due to no fault of the contractor and the correction of defects, errors and inaccuracies in the machinery, equipment and other metal work furnished by Government which are ordered to be corrected by the Engineer-in-Charge and which are over and above what may be expected to occur in the ordinary commercial grade of shop work and manufacture of such material as determined by the Engineer-in-Charge will be paid for as extra work under the provisions of para 3.10 of the contract.

(c) Installation details : Special care shall be taken to ensure that all frames, guides and other fixed metal work are installed in exact position and alignment, that all machinery is in the proper position relative to the equipment which it will operate and that all parts are in exact alignment. Special care shall be taken in assembling all gearing to ensure that the gears will mesh properly so as to engage evenly over their full face width and will operate freely without binding and without excessive backlash All couplings and flange faces shall be cleaned thoroughly of all dirt and burrs before connection to ensure tight fit and true alignment. The finished surface of all flange joints shall be coated with joint compound furnished by the contractor and satisfactory to the Engineer-in Charge and unless otherwise specified gaskets shall be placed in flange joints. All flange bolts shall be tightened until it is assured positively that there will be no leakage. Metal work to be embedded in concrete shall be placed accurately and shall be supported in correct position of alignment and grade while the concrete is being placed and until it has set. Anchor bolts shall be installed when the concrete is placed unless otherwise directed. Where it is impracticable to place anchor bolts or anchors for the installation of ladders, stairways, or other comparatively light metal work before the concrete is placed, holes shall be drilled in the concrete after the concrete has set thoroughly and compound load and metal alloy expansion anchors and bolts shall be installed as directed. The surfaces of all metal work to be in contact with or embedded in concrete or cement grout shall be cleaned of all rust dirt,

grease, loose scale, and other foreign substance immediately before the concrete or grout is placed; and the cleaning of such metal work shall be in accordance with provisions of paragraph 33.03 (b). Machinery and equipment bases and all machinery and equipment units not mounted on bases shall be levelled carefully and adjusted to correct alignment and grade. Unless otherwise specified, after the machinery and equipment has been located properly, it shall be secured rigidly in place using permanent steel shims; and if required by these specifications, all spaces under machinery and equipment or machinery and equipment bases and supports shall be filled completely with cement grout. All shims shall be furnished by and at the expense of the Contractor.

(d) Grouting : Grout for machinery, equipment and other metal work shall be mixed in the proportions and to the consistency prescribed by the Engineer-in-Charge. The cost of all work and materials in connection with the grouting operations shall be included in the prices in the schedule of bids for concrete in blockouts. Before placing grout the surfaces of existing concrete on which grout willl be placed shall be roughened and shall be cleaned of all laitance, loose or defective concrete, coatings, and other foreign material by effective means followed by thorough washing. Such surfaces shall be kept moist for at least 24 hours immediately prior to the placing of the grout.

(e) Servicing and testing : After each complete unit of machinery has been installed and connected to the equipment that it is to operate, the machinery and equipment shall be serviced and tested. The servicing shall consist of cleaning, lubricating, and adjusting all parts of the machinery and equipment. All parts shall be cleaned thoroughly, bearings shall be lubricated properly; and the gear housings shall be filled with suitable gear oil as directed. If required by the Engineer-in-Charge the contractor shall flush thoroughly all bearings, reservoirs and gear housings with kerosene before the bearings; reservoir and gear housings are filled with oil. All lubricating oil and grease will be furnished by the contractor. Kerosene and other cleaning agents for flushing bearings, reservoirs and gear housings shall also be furnished by the contractor. After each unit of machinery and equipment has been serviced to the satisfaction of the Engineer-in-Charge, it shall be given an operating test and adjustments shall be made until the operation of the unit is satisfactory to the Engineer-in-Charge. All tests shall be witnessed by a representative of the Government.

(f) Payment : Except as otherwise provided in these specifications, payment for furnishing and installing or for installing the various items of machinery including motors and limit switches which are definite parts of the machinery mechanism, equipment and other metal work will be made at the applicable rate in the schedule of bids for furnishing and intalling and for installing the various items of machinery, equipment and other metal work which shall include the cost of transportings, handling, assembling, erecting, servicing, adjusting, cleaning and repair of painting and galvanising of all machinery, equipment and other metal work; of drilling holes of making all connections to machinery, equipment and other metal work of making, required tests; and of maintaining the machinery, equipment and other metal work in position and proper operating condition until final acceptance and taking over by the Government. The weights of machinery, equipment and other metal work as given in the schedule of bids and elsewhere are approximate or estimated weights only. The contractor will be allowed no additional payment above the unit rates in the schedule of bids by reason of any variation between the approximate or estimated weights shown and the actual weights. The unit prices for installing metal work and machinery shall include the cost of making minor changes and the cost of correcting minor errors and inaccuracies in various parts as may be expected to occur in the ordinary commercial grade of shop work and manufacture of such materials and as determined by the Engineer-in-Charge.

33.02 ERECTING STRUCTURAL STEEL :

(a) General : All structural steel work which is furnished by the Government will be completely fabricated in sections convenient for dispatch and with a supply of rivets and permanent bolts for field erection. Erection in the field of all steel shall be by bolting, riveti ıg and arc welding.

or by any combination of these and the contractor shall be prepared to perform all classes of work. Only expert riveters and qualified welding operators shall be employed to perform the riveting and welding and if required by the Engineer-in-Charge, each such riveter or welding operator shall submit satisfactory evidence of his ability or take a qualifying test before being allowed to perform the work.

(b) Assembling : All parts shall be accurately assembled and erected as shown on the drawings. manufacturer's approved erection drawings or as directed by the Engineer-in-Charge and all match marks of the manufacturer or fabricator shall be followed carefully. Members shall not be overstressed during the process of erection and hammering that will injure or distort the members will not be permitted. Bearing surfaces to be in permanent contact shall be carefully cleaned before the members are assembled or erected In bolted connections the bolts shall be drawn tight and where required by the Engineer-in-Charge, the threads shall be burred so that the nuts cannot become loosened. Where fitted bolted connections are shown on the drawings or required by the Engineer-in-Charge. the bolt holes shall be reamed in the field to provide a tight drive fit. Where riveting is required, the field connections and splices of all gates and all members carrying erection stresses shall have not less than 1/2 of the holes fitted with bolts and cylindrical erection pins (half bolts and half pins) before being riveted. The diameter of the fitting-up bolts shall be the same as the nominal diameter of the rivets or field bolts and cylindrical erection plus shall be one millimeter larger in diameter than the nominal diameter of the rivets; provided that cylindrical erection pins used in erecting all structural steel gates and frames shall be of the same diameter as the rivet or bolt holes. Erection bolts and pins shall be furnished by the contractor. Corrections of minor misfits and a reasonable amount of reaming and cutting of excess stock from rivets shall be considered a legitimate part of erection. For the purpose of determining what constitutes a reasonable amount of reaming it shall be considered that where any rivet or bolt hole is not more than three millimetres off in concentricity in the two or more members after the connection is temporarily assembled, the same is a minor error in shop works, any holes more that three millimetres off in concentricity after the connection is temporarily assembled shall be reported immediately to the Engineer-in-Charge and his approval of the method of correction shall be obtained, the contractor will be paid for such required correction of structural steel furnishing by the Government as extra work under the provisions of paragraph 3.10 of these specifications. Cutting of members with a cutting torch will not be permitted, unless approved by the Engineer-in-Charge.

(c) Riveting : Riveting shall be done with pneumatic riveters, and pneumatic buckers shall be used wherever possible. All connections shall be accurately and securely fitted up before the rivets are driven. Drifting done during assembling shall be only such as to bring the parts into position and not sufficient to enlarge the holes or distort the metal. All unfair holes shall be reamed or drilled. An unfair hole will be considered as one in which a cold rivet of the size specified will not enter with light tapping after light drifting has been resorted to. Rivets shall be heated to a light cherry red colour and shall be driven while hot. They shall not be overheated or burned. When driven the rivets shall completely fill the holes and shall firmly grip the connected parts together. The rivet heads shall be of the same shape and size as the heads of shop rivets, full and symmetrical, concentric with the shank and shall have full bearing on the member. Recupping or caulking of rivets will not be permitted. Loose burned or otherwise defective rivets shall be removed. In removing rivets the surrounding metal shall not be injured and if necessary rivets shall be drilled out. Field rivets shall not be painted until they have been inspected and accepted by the Engineer-in-Charge.

(d) Welding : All welding shall be done by the electric arc method, using a process which will exclude the atmosphere from the molten metal, except otherwise where specifically permitted by the Engineer-in-Charge. All welding rods required shall be furnished by the contractor. Welding rods shall be of the heavily coated type designed for all position welding and the size, type and manufacture of the rod shall be subject to the approval of the Engineer-in-Charge. Welds shall

be made as specified on the drawings and in accordance with the welding symbols of the Indian Standard Institution (IS: 813). Welding except for penstock liners and where otherwise specifically stated, shall be done in accordance with the latest applicable code of practice of Indian Standard Institution. All butt welds shall have complete penetration. Peening of multiple layer welds will not be required, except as otherwise noted for penstock liners. Stud anchors and stud bolts shall be end-welded with automatic end-welding guns.

33.03 CLEANING AND PAINTING METAL WORK :

(a) General : The contractor shall furnish and prepare and apply all material for cleaning, painting and coating of metal work as hereinafter specified. All metal surfaces, either unpainted, or shop-painted, shall be cleared, painted, repaired or recoated as hereinafter specified. The cost of furnishing, preparing and applying all material, which are required for the cleaning, painting or coating operations including supply of all labour, tools and equipment shall be included in the prices in the schedule of bids for installing or furnishing and installing the various items of metal work.

(b) Cleaning surfaces : Surfaces shall be cleaned and prepared in accordance with the method to be used for each item of metal work which is indicated in the painting schedule. Weld spatter or any other objectionable surface irregularities shall be removed by any suitable means before cleaning. The following methods shall be applied :

Method A : All oil, grease and dirt shall be removed from the surface by the use of clean mineral spirits, xylol, or white gasoline and the clean wiping material.

Method B : All oil, grease, rust preventive compound and dirt shall be removed from the surface by the use of clean mineral spirits, xylol, or white gasoline and clean wiping material. Following the solvent cleaning, all loose rust, loose mill scale and other foreign substances shall be removed by scrapping, chipping, blasting or other effective means.

Method C : All oil, grease, and dirt shall be removed from the surfaces by the use of clean mineral spirits, xylol or white gasoline and clean wiping material except that for surfaces which requires coaltar coating, the cleaning solvent shall be xylol. Following the solvent cleaning, the surface to be painted shall be cleaned of all rust, mill scale and other tightly adhering objectionable substance by sand blasting or grit blasting as directed by Engineer-in-Charge, to uniform bright base metal. Any grit or dust from the cleaning operation shall be completely removed from surface by brushing, air blowing, suction or other effective means before the surfaces are painted.

In the event that rust forms or the surfaces become otherwise contaminated in the interval between cleaning and painting, recleaning will be required. Surfaces of stainless steel, nickel bronze and machined surfaces adjacent to metal work being cleaned or painted, shall be protected by masking tape or by other suitable means during the cleaning and painting operations.

(c) Repair of shop coat : Metal work which has been shop painted shall be handled with care so as to preserve the shop coat in the best practicable condition. Before proceeding with any painting operation the contractor shall clean the base metal and repaint all areas of shop paint which are defective or damaged. Paint applied to such areas shall be of the same type as used for the original shop coat unless otherwise directed. The cleaning and painting of damaged areas shall be at the contractor's expense, except that if damaged areas on metal work furnished by the Government exceed 20 percent of the total shop painted areas, the contractor will be paid for the clean ing and painting the excess areas as extra work under the provisions of paragraph 3 10.

(d) Application procedures : Paint and coating materials shall be applied in accordance with this sub paragraph and the painting schedule. All paint and coating material shall be in a thoroughly mixed condition at the time of application and shall not be thinned except where hereinafter specifically provided. Any warming of the paint shall be performed by means of a hot water bath and except as specifically provided, the paint shall not be heated to a temperature higher than thirty eight degrees centigrade. Paint shall not be applied when the temperature of the metal or of

the surrounding air is less than 7 degrees centigrade. Surfaces shall be free from moisture at the time of painting. The first coat shall be applied immediately after cleaning. When paint is applied by spraying, suitable means shall be provided to prevent segregation during the painting operations Effective means shall be provided for removing all free oil and moisture from the air supply lines of all spraying and blasting equipment. Each coat of paint shall be done to completion and shall be free from runs and sags. Except, as otherwise specifically provided, each coat shall be allowed to dry or harden before the succeeding coat is applied. Surfaces to be painted that will be inaccessible after installation (except inaccessible surfaces of metal work or machinery which have been shop coated with priming paint) shall be completely painted as scheduled prior to installation. Coverage rates and application procedure for the particular types of materials shall be as follows :

1. Cold applied coaltar paint shall be applied at coverage rate of approximately 2.5 square metre per litre per coat. The combined, coverage for three coats shall be not more than 0.83 square metre per litre. Spraying will be permitted on the last two coats, if the contractor uses the special type of spray equipment designed for spraying heavy bodied materials. Thinning will not be permitted.

2. Coaltar primer and coaltar enamel for the plate steel liners as specified shall be applied in accordance with applicable Indian Standard and the following specifications. Where there is conflict the specifications given below will apply :

(i) The application of coaltar primer and enamel, and related operations shall be performed under experienced supervision by workmen skilled in the trade. The contractor's equipment for blasting and priming and for application of the enamel shall be so designed and manufactured and shall be in such conditions as to enable compliance with the specification requirements.

(ii) The surfaces shall be dry at the time the coaltar primer is applied.

(iii) The primer shall be supplied by hand brushing, air gun spraying of spraying and brushing. Spray gun apparatus, if used, shall include an air separator that will remove all oil and free moisture from the air supply.

(iv) The use of coaltar primer that becomes fouled with foreign substances or has thickened through evaporation of the solvent oil will not be permitted.

(v) After application the coaltar priming coat shall be uniform, free from floods, rains, sags, dips, holidays or bare spots. Any bare spots or holidays shall be recoated with an additional application or primer. All runs, sags, floods or dip shall be removed by scrapping and cleaning and the cleaned area retouched or if considered necessary such defects shall be remedied by reblasting and repriming.

(vi) In cold weather when the temperature of the steel is below seven degrees centigrade or at any time when moisture collects on the steel, the steel shall be warmed to a temperature of approximate thirty degrees to thirty eight degrees centigrade for sufficient time to dry the metel prior to priming. To facilitate spraying and spreading, the primer may be heated and maintained during the application a temperature of not more than thirty eight degrees centigrade.

(vii) The minimum and maximum allowable drying time of the coaltar primer between application of primer and application of coaltar enamel shall be 24 hours and 72 hours. If the enamel is not applied within the maximum time after priming, the surface shall be reprimed with an additional light coat of primer or if considered necessary the entire prime coat shall be removed by reblasting and the surface reprimed.

(viii) At all time during cold weather when liner temperature is below is seven degrees centigrade or during rainy or foggy weather when moisture tends to collect on cold liner, enamelling shall be preceeded by warming the liners.

(ix) Warming shall be done by a method which will heat liner uniformly without injury

to primer. Steel temperature of liner shall not exceed fifty-two degrees centigrade.

(x) The primed surface to be enamelled shall be dry and clean at the time the enamel is applied. No enamel shall be applied during cold weather, rain or fog unless the liners are preheated and from weather.

(xi) All surfaces shall be triple coated by applying the enamel with daubers. The final brush strokes of enamel shall be made in the direction of flow and at the right angles to the previous coat. All brush strokes shall over-lap and from a continuous coating. Twenty four hours drying time shall be allowed between coats.

(xii) Where overhead enamelling is necessary inside of liner or specials, the invert and sides of the liner shall be protected from drippings and splashings of enamel by tarpaulins or heavy tar paper laid in the liner.

(xiii) Hand enamelling daubers shall be of size best adopted for the work. Daubers shall be made of the best grade of fibre set in solid hardwood handles. Mops sweeps or knot daubers shall not be used.

(xiv) The contractor shall at all times use every precaution to prevent damage to protective coating on the liners. Heavy tar paper shall be laid and maintained in the bottom of the liner through its entire length as long as there is need of passage through liners. This shall apply to all surfaces whether bare primed or enamelled. Any damage to the protective coating from any cause during progress of painting shall be repaired by the contractor at his expense.

(xv) The coaltar primer shall be applied at a coverage rate of approximately at 10 square metre per litre and the five coats of coaltar enamel (coal applied) shall be applied at a coverage rate of approximately 9 sq. metre per litre per coat.

3. Special aluminium paint system :

(i) With sand : The painting operations for the special aluminium paint system, with sand shall be performed in the forlowing sequence :

The rust : Inhabitive wash shall be applied by brushing immediately following the cleaning operations and the surfaces shall be thoroughly wetted with the rust inhabitive wash at a coverage rate of approximately 30 sq. metre per litre and allowed to dry. Proper reaction will be evidenced by the appearance, after drying, of a dull grey phosphate coating. Painting shall proceed within one hour after the rust inhabitive wash has dried thoroughly. Two coats of zinc chromate aluminium priming paint shall be applied. The first coat shall be thinned with approximately 125 millimetres of mineral spirits to each litre of priming paint and shall be applied by brushing at a coverage rate of approximately 10 square metre per litre After the first coat has dried, the second priming coat shall be applied without thinning, by brushing or spraying at a coverage rate of approximately 7 square metre per litre. While the second priming coat is still wet (within 5 minutes after application) a heavy uniform coat of the sand (screened in 30 mesh to 50 mesh screens) shall be applied using low air pressure, or other effective means to thoroughly embed a uniform coating of the sand in the paint film. After drying for at least 24 hours, the sanded surface shall be brushed or 'blown down' with compressed air to remove loose sand particles. A coat of aluminium finish paint shall then be applied by spraying without thinning, at coverage rate of approximately 3 square metre per litre respectively. A minimum of 24 hours drying time shall be allowed between applications of the various coats. The final coat shall be dry at least 4 days before the coating is subjected to water immersion. The mixing of about 200 gms. of aluminium paste per litre of zinc-chromate primer and about 200 gms. of aluminium paste per litre of phenolic mixing varnish shall be performed in the field immediately prior to application only enough paint for each day shall be prepared at one time.

(ii) Without sand : The painting operations for the special aluminium paint system without sand shall be as follows :

Immediately following the surface preparation as indicated in the painting schedule and the application of the rust inhabitive wash previously described, one coat of zinc-chromate aluminium priming paint shall be applied by brushing without thinning, at coverage rate of approximately 8.5 square metre per litre. After the priming coat has dried for at least 24 hours, two coats of the special aluminium finish paint shall be applied at coverage rates of approximately 8 square metre per litre per coat.

4. Alkyd priming paint for use under machinery paint, and aluminium paint (except for aluminium finish paint in the special aluminium paint system) shall be applied by brushing at a coverage rate of approximatety 10 square metre per litre. An additional priming coat shall be applied by brushing over all irregularities such as rivets. welds, bolts, seams etc. without thinning before the application of the machinery paint, acid resisting paint or aluminium paint

5. Machinery paint shall be applied by brushing or spraying at a coverage rate of approximately 15 square metre per litre per coat without thinnings.

6. Aluminium paint (except for the aluminium finish in the special aluminium paint system) shall be applied by brushing or spraying at a coverage rate of approximately 8 square metre per litre per coat. The mixing of about 200 gms. of aluminium paste per litre of varnish shall be performed in the field. Only enough paint for each day shall be prepared at one time.

7. Rust-preventive compound shall be applied by any convenient method which will ensure complete coverage with a heavy uniform coating.

(e) Painting Schedule : Cleaning and painting shall be in accordance with the following schedule :

Sl. No.	Item	Method of surface preparation as per para 33.03 (b)	Painting or coating material	No. of coats	Remarks
1	2	3	4	5	6
1.	Penstock liners and valve cashing :				
	(a) Interior surface	C	Epoxy Primer Epoxy Paint	2 3	
	(b) Exterior surface to be exposed in concrete sheltered areas	B	Alkyd priming paint, Aluminium paint or machinery paint which-ever is directed.	2	
	(c) Exterior surface to be encased in concrete	A	No painting or coating required.		
2.	Exterior surface of valves	C (for unpaid surface)	Red lead priming	1	
		B (for damaged areas of shop coated surface)	Red lead priming paint Aluminium paint	1 2	
		A (for undamaged areas of shop coated surface)	Aluminium paint	2	

1	2	3	4	5	6
		B			
3.	Hoist for draft tube & penstock gates, gantry crane for draft tube gates.	(for damaged areas of shop coated surface)	Same as original shop coat or alkyd priming paint whichever is directed.	1	
		A (for undamaged areas of shop coated surface	Machinery paint	2	
4.	(a) Draft tube gates, gate frames and guides	C	-Do-	3	
	(b) Penstocks gates, frames and guides	C	-Do-	3	
5.	Metal work that will be subject to normal interior and exterior atmospheric exposure such as structural steel work, embedded metal frames of doors, metal doors, metal hand rails, metal ladders and ladder rungs etc. but not including items otherwise scheduled.	B	Alkyd priming paint Machinery or aluminium paint whichever is directed.	1 2	
6.	Metal work shop coated with the alkyd priming paint or the manufactures standard shop coat that will be subjected to normal interior and exterior exposure as motors, generators, operating mechanism, hoist, gear boxes, oil tanks etc. but not including items otherwise scheduled.	B (for damaged areas of shop coated surface) A (for undamaged areas of shop coated surfaces)	Same as original shop coat or alkyd priming paint whichever is directed. Machinery paint or aluminium paint whichever is directed.	1 2	
7.	Galvanized surfaces required to be painted for decorative purpose (where and as indicated on the drawings or where directed by the Engineer-in-Charge)	A followed by an etching solution of 5% muriatic or acetic acid or by good quality galvanizing etching solution rinsed thoroughly with clear water and dried.	Alkyd priming paint. Machinery paint or aluminium paint, whichever is directed.	1 2	
8.	Doors, frames and trim in battery room.	3	Alkyd priming paint Acid resisting paint	1 2	

1	2	3	4	5	6
9.	Machinery surfaces exposed which are to be in rolling or sliding contact and which will not be lubricated.	A	Gasoline, solute rust preventive compound.		
10.	Metal surfaces to be embedded in concrete.	A	No painting is required.		

(f) Inspection of material : All paint and coating materials shall be made available for sampling at least 30 days prior to use and no paint or coating materials shall be used until they have been tested or/and approved by the Engineer-in-Charge. In so far as practicable, as detemined by the Engineer-in-Charge, the contractor shall make arrangements with the Government for inspection of paint materials at the despatch point. The contractor shall provide facilities and assistance as required for procuring representative test samples which will be taken by representative of Engineer-in-Charge. Test sample shall be 10 kilogramme of coaltar enamel, one litre each of all liquid materials and a representative sample of all other material proposed to be used. With each set of samples of coaltar enamel and coaltar primer for enamel, the contractor shall furnish the detailed information regarding specifications.

(g) Paint materials : All paints, such as cold-applied coaltar paint, coaltar primer and cold-applied coaltar enamel materials for special aluminium paint, alkyd priming paint, rust preventive compound, machinery paint and aluminium paint shall conform to applicable U.S. Federal Specifications or Indian Standard Specifications and shall be tested in accordance with the applicable A.S.T.M. provisions. If desired by the Engineer-in-Charge, the contractor shall be required to furnish necessary reports from the Government test house for the paint materials submitted for approval of the Engineer-in-Charge.

33.04 REQUISITION OF STORES :

All materials and equipment to be furnished by Government as provided in subsequent paragraph shall be delivered to the contractor in railway wagons at UPID railway siding near Harrawala or Dehradun railway station and the contractor shall transport the materials to site of works. The handling and storing of materials shall be done by the Contractor as per provisions of paragraph 9.06 and as directed by the Engineer-in-Charge. On arrival of each consignment at site of storage these will be checked by the contractor in presence of representative of the Engineer-in-Charge and shortages or damaged, if any, shall be communicated to the Engineer-in-Charge within fifteen days of the arrival of that consignment at destination railway station duly verified by the representative of the Engineer-in-Charge.

33.05 ERECTION SUPERVISION :

The erection of various equipments as detailed in subsequent paragraphs will be carried as per erection drawings of the manufactures or ths Government and as directed by the Engineer-in-Charge. In case of complicated equipment such as cranes, valves, hoists and controls, the Government may also obtain the services of erection engineers of the manufacturers who will advise and supervise the erection works under the direction of the Engineer-in-Charge for :

(i) Handling and transportation of equipment from distination Railway Station to site of works.

(I i) Assembly, erection and installation of equipment.

(iii) Field painting, and

(iv) Testing of equipment.

The contractor shall work in full co-operation and collaboration with such erection engineer provided by the Government.

33.06 General :

(a) Any item of machinery or equipment which is not covered under these specifications and is required to be installed later on, shall be furnished and installed or installed by the contractor as required by the Engineer-in-Charge. The terms of payment for such work shall be determined in accordance with the provisions of paragraph 3.10.

(b) No compensation shall be admissible to the contractor for delay in supply of any item of equipment or machinery to be furnished by the Government other than the time extension commensurate with the consequence of delays as determined by the Engineer-in-Charge.

(c) Contractor shall adhere to the tolerances specified in the maker's drawings or the drawings supplied by the Engineer-in-Charge in respect of each individual part of any assembly.

33.07 PENSTOCK LINERS AND ACCESSORIES :

(a) General : The contractor shall furnish and install steel liners in penstocks and elsewhere as directed by the Engineer-in-Charge complete with all mounting and valves except the main butterfly valves and also including fabricated steel supporting frames, bolts, anchor plates and other items required for the installation works, as shown on the drawings or as directed by the Engineer-in-Charge. The total number of liners may be increased or decreased but the contractor shall be entitled to no additional payment above the unit prices per kg. for the applicable item in schedule of bids for such increase or decrease in the number of liners. The diameter and location of the penstock liners may be changed in the final designs but the contractor shall not be entitled to any additional payment above the unit prices for these items in schedule of bids.

(b) Materials : All materials used in the manufacture and fabrication shall conform to applicable officially recognised standard specification of the country. Such standard specifications shall, however, be approved by the Engineer-in-Charge. Applicable Indian or American Standard Specifications are, however, mentioned for general guidance.

Steel for penstock liners shall be of microalloyed steel MA 410 HYB (Manufactured by SAIL) or any other approved quality and shall be imported by the Department if required. This steel shall be supplied to the contractor @ Rs. 10,000 per tonne at UPID Railway siding near Harrawala or Dehradun Railway Station. Steel liner used elsewhere shall be of high tensile steel according to Indian Standard Specifications IS 961 or weldable quality plates according to IS : 226 which shall be issued @ Rs. 6400/- per tonne at Dakpather stores.

Forged steel shall conform to the A.S.T.M. designation A 105-56 grade-I, shall be suitable for welding and shall not have carbon content in excess of 0.35 per cent.

Cast steel shall be in accordance with Indian Standard specificatian IS : 1030 or Indian Railways Specification M2-48 grade-I. All castings shall be annealed as required therein. Radiographic, Gamma rays, magnaflux or other non-distructive tests shall not be ordinarily required, but for the purpose of examination of repairs to defects, the Government may require the contractor to make such tests to determine the suitability of the repairs.

Flex packing for expansion joints shall conform in all respect to the U. S. Federal specification H.H.P-10-68.

Gasket material shall conform to the requirements of the U. S Federal Specifications H.H.P-151-B.

The contracter shall furnish the Engineer-in-Charge copies of specifications for materials and equipment pruchased by contractor for use in fabrication of liners. All such orders shall quote the requirements of these specifications. Test specimens for physical tests of metal shall be supplied by the contractor, plainly marked to indicate the materials they represent and shall be

properly boxed and shipped at the contractor's expense. The cost of making the tests shall be borne by the contractor. Acceptance of articles, material and supplies shall in no way relieve the contractor of the responsibility for furnishing articles, material and supplies which meet the requirements of these specifications.

(c) Manufacture : Before beginning manufacture of any parts of the liners the contractor shall submit to the Engineer-in-Charge, for approval, four copies of shop drawings showing details of all parts. The shop drawings shall show clearly the layout of the plates and the details of the joints and connections of the plate steel, and liners. Any manufacturing done by the contractor before approval of the drawings shall be at his risk. The Engineer-in-Charge, shall have the right to require the contractor to make the finished articles to conform to the requirements of these specifications, without additional cost to the Government. Approval by the Engineer-in-Charge of the contractor's drawings shall not be held to relieve the contractor of any part of the contractor's responsibility to meet all the requirements of these specifications or of the responsibility for the correctness of the contractor's drawings.

The contractor shall furnish 5 complete sets of all final drawings of details and of erection diagrams showing all changes and revisions upto the time the fabrication is completed.

All work shall be performed and completed in a thorough workmanlike manner according to the best modern practice in the manufacture and fabrication of the types covered by these specifications. Works shall in all cases be of high grade and be carefully performed to the satisfaction of the Engineet-in-Charge. The contractor shall replace, free of cost to the Government. any defective materials or workmanship discovered during erection and shall pay the actual cost to the Government of the correction in the field of any errors for which he is responsible. Where finished surfaces are specified or required for parts shown on the drawings, the type of finish, where not otherwise specified, shall be most suitable for the part to which it applies and shall be smooth or average as defined hereinafter. Smooth surfaces shall be practically free from tool marks, while slight tool marks shall be allowed on average surface. In general a smooth finish shall be required for all surfaces in sliding contact and an average finish for surfaces in permanent contact, where a tight joint is necessary.

The liners shall be welded in accordance with the provisions of paragraph 32 02 (d) subject to the following conditions :

(i) The process and equipment used, the rate of deposit of weld metal and the range of voltage and current shall be subject to the approval of the Engineer-in-Charge. The ends of the liner with the exception of the closing sections will have to be bevelled or grooved to permit depositing the weld metal. Cracked or broken tack welds and those of poor quality shall be chipped out before the final weld is made.

(ii) All welding shall be in accordance with the requirements of Indian Standard Specifications IS: 812 to 819, 1179, 1131-S2, 1261, 1278, 1323, 1395 and 1442. Where the weld metal is deposited in successive layers, each layer shall be thoroughly cleaned before the subsequent layer is deposited. Whenever possible, joints shall be welded in the flat position, unless otherwise directed by the Engineer-in-Charge. Welded beads on the interior surfaces of the liner shall not project more than 3 mm. above the surface of the liner. Welded joints shall be reasonably free from craters, depressions and other irregularities.

After welding is completed all weld spatters shall be removed. Radiographic examination of welds will be required for the longitudinal welds of the liners. Where the requirements of the Standard specifications conflict with these specifications and drawings, the requirements of these specifications and drawings shall govern.

(iii) All welds shall have complete penetration and freedom from imperfections and all defective welds shall be repaired to the satisfaction of Engineer-in-Charge. Defects in the welds

shall be chipped or flame gouged until sound metal is reached on all sides and the resulting cavity shall be filled by the same procedure as the orignal grooves were filled.

(iv) The contractor shall furnish at his own cost for testing, two welded plates 450 mm. wide and 600 mm. long and 13 mm. thick. The process of welding these shall be the same as that to be used on the job. The Government shall prepare test specimens from these test plates and will test the specimens. The Engineer-in-Charge may require the contractor to make changes in his welding progrmme, if found necessary, as a result of these tests.

(d) Radiographic tests of welds : As soon as possible after being welded, all shop welded longitudinal joints in the liners shall be radiographed for the entire length of the joints. The film used in making the radiographs shall be made in strict accordance with the requirements contained herein and the Indian Standard Specification I.S. 1182.

Before making the radiographs of the welds, the contractor shall place suitable identification markers adjacent to the weld, which markers shall be designed and located so that the images will appear on the radiographs. The markers shall be painted, stamped or fastened to the liners, as directed by the Engineer-in-Charge and shall not be removed until all of the welds have been accepted. All radiographs shall be delivered to the Engineer-in-Charge who shall judge the acceptability of all welded joints. Defect in welds, as shown by the radiographs, shall be chipped or flame gouge to sound metal and the resulting cavities shall be rewelded. Welds that have been repaired shall be radiographed. The method of radiographing the welds and the apparatus, equipments and the technique used in making the tests shall be subject to the approval of the Engineer-in-Charge. The contractor shall provide all equipment, apparatus supplies, and labour required for making the radiographic tests. The contractor shall prepare and furnish a marking diagram of the liner sections showing the location of each radiograph for each welded joint. All radiographs shall become the property of the Government.

(e) Fabrication : Fabrication of the penstock liners and accessories shall be in accordance with these specifications and drawings and with the requirements of applicable Indian Standard Specifications and sections of the latest edition of the A.P.I.-A.S.M.E. Code for the "Design", Construction, Inspection and repair of Unifired Pressure Vessels for Petrolium Liquids and Gases, sponsored by the American Petrolium Institute and the American Society of Mechanical Engineers. Where provisions of the Codes conflict with provisions of these Specifications and the drawings, the provision of these specification and the drawings shall govern.

Each liner course unless otherwise shown shall be made from not more than two plates and shall be not less than 1.5 metre in length. The longitudinal seams of adjoining course of the liner section shall be located approximately 45 degrees from the vertical centre line and shall be staggered. Plates for the liners shall be bent or rolled to true required sections. Correction of shape by blows will not be permitted. The liner section shall be completely fabricated and buttwelded. All points on each end of each liner section shall lie in a plane normal to the longitudinal axis of the section within a maximum deviation of one and half millimetre on either side of such plane. The edges of each fabricated liner section shall be prepared for field buttwelded joints where required. Particular care shall be exercised in matching the edges of the adjoining plates and courses to ensure that at all shop, buttwelded, longitudinal and circumferential joints, the inner surface of the plates are in continuity within a maximum offset at any point of one and half millimetre. Bends shall be made with equal deflection angles. Piezometer connections shall be provided for penstock liners. The manholes welding necks and all nozzles shall be good weldable quality steel and forged steel, shall be shaped properly to the slope of the liners where necessary and shall be located and welded to the liners. The stiffener rings shall be fabricated from not more than six circumferential sections. The sections of the stiffeners shall be jointed by buttwelds and the stiffeners shall be attached to the liners so that the plane of the stiffeners will be normal to the liner axis.

(f) Stress relieving : Upon certification that the radiograph inspection and the density, bending and strength tests have shown the welding to be satisfactory, each fabricated section of

the liner will be subjected to thermal treatment in the stress relieving furnace for the elimination of stresses developed during bending and welding. In the stress relieving operations, the liners will be heated uniformly, the temperature being gradually increased to approximately 620° C which will be maintained for one hour per 25 mm of liner shell thickness. The furnace shall then be cooled to 260° C during three hours period, after which liner sections will be removed from the furnace. The holes etc. to be drilled in any liner section shall be drilled after stress relieving.

The stress relieving will only be required if liners are fabricated from mild steel. For liners fabricated from high tensile steel, stress relieving will not be required.

(g) Shop cleaning and painting : Shop painting of liner will not be required, however all metal surface shall be cleaned of weld spatter before transportation. All finished surfaces of ferrous metal work, including screw threads, that will be exposed to the atmosphere during transportation, or while awaiting installation shall be coated with a gasoline soluble rust preventive compound.

(h) Marking : Each completed liner section shall be marked to show its location in the finished assembly. Each section shall be marked to show the vertical centre line, the direction of flow and a serial number with the marks for the vertical centre line placed on the outside on the liner at the top and on the inside at the bottom at each end. The contractor shall indicate the location of each section of liner and appurtenant parts in the completed assembly on the drawings required in paragraph 33.07 (c).

(i) Hydrostatic tests : Some representative lengths of liners to be furnished including bends shall be given hydrostatic pressure tests satisfactory to the Engineer-in-Charge if so directed. Hydrostatic test pressure shall be computed from the following formula :

$$P = \frac{5600 \times t}{D}, \text{ in which}$$

P = test pressure in kgms per square centimetre.

t = minimum thickness, in centimetres of plate in liner length tested.

D = minimum internal diameter, in centimetre of section being tested.

Each liner length shall be filled completely with water, and the pressure slowly and uniformly increased until the required test pressure is reached. The test pressure shall be applied and released three successive times and after each application shall be held at the required pressure until all welded joints and seams can be examined. Any defects in welds or plates disclosed by the hydrostatic pressure test shall be repaired by the contractor to the satisfaction of the Engineer-in-Charge, and all repaired lengths shall be retested hydrostatically after all repairs have been made. The contractor shall furnish all labour, materials, supplies and equipment including test heads, required for making the test. Payment for such tests shall be made as per item 'hydrostatic testing of penstock liners' in the schedule of bids.

(j) Installation : The liners complete with the manhole covers, nozzles piezometres plugs, filling line connections, drains, flanges and stiffeners rings, will be furnished by the contractor in accordance with specifications given above. The contractor shall install all required anchor bolts at the levels established as working bases for the installation of the liners. The liner sections shall be located or placed in position in accordance with the erection diagrams and shall be accurately aligned to grade before the joints are welded and the sections embedded in concrete. The contractor shall provide and attach necessary permanent structural steel supports to the liner sections. The contractor shall, in addition, provide and install all temporary supports, blocking cables, anchors or expansion spiders required to hold the liners in position or to prevent distortion while the liners are being welded or being embedded in concrete. When assembled and ready for welding, the distance between the ends of adjoining sections which are to be connected together with butt-welds shall not be greater than six millimetre and not less than three millimetres unless otherwise directed. Care shall be taken to avoid excessive growth or shrinkage in length. All welding

and repairing of defective welds shall be performed in accordance with the provisions of paragraph 33.02 (d). After the girth joints have been welded and repaired to the satisfaction of the Engineer-in-Charge, the sections shall be cleaned and encased in concrete. Any temporary timber supports used for the liners, shall be removed before the concrete is placed.

(k) Painting : The liners shall be painted as specified in the schedule in paragraph 33.03 (d) (2) and 33.03 (e).

(l) Payment : Payment for furnishing and installing liners will be made at the unit price per Kgm for the item in the schedule of bids, which unit price shall include furnishing, installing and painting liners.

(m) Expansion joint : The expansion joints for the penstocks shall be furnished by the Government complete as shown on the drawings, with bolts, studs, nuts, and packings. The sleeves of expansion joint shall be formed accurately to the required dimension to provide close fitting stuffing boxes for the packing and to ensure water tight joints. The longitudinal welds on the outside of the sleeves, on both sides of the packing glands and on the inside of the outer sleeves shall be ground flush. The stiffeners and the centering rings shall be fitted to the outer sleeves and welded. The ends of the inner sleeves shall be chamferred and bevelled. The large diameters make machining of the completed sleeves impracticable and with the exception of the facing of the end edges of the outer sleeves before rolling and the drilling, spot facing and tapping necessary for the bolts, machining of the completed expansion joint will not be required. The parts, however, shall be carefully fabricated with close clearances between sliding surface. The packing for each expansion joint shall be installed as shown in the drawings or as directed by the Engineer-in-Charge. Before the expansion joints are assembled and packed, they shall be cleaned and painted. All surfaces of the expansion joints that will be inaccessible after assembly including the inner surfaces of the outer sleeves and packing glands, but not including the inner and outer surface of the inner sleeves, shall be cleaned to base metal by sand blasting and shall be given three coats of cold applied coaltar paint.

The expansion sleeves will have stainless steel cladding and it would be necessary to weld the components along the cladding with electrodes suitable for the stainless steel used in cladding. The contractor shall adhere to any other special instructions or requirements of the manufacturers for installing the expansion pieces.

Payment for installing the expansion sleeves shall be made at the unit rate per kg. of the item 'Installing Expansion joints' in the schedule of bids. The unit rate shall include the handling and transport of materials from destination railway station to work-site, storage, cleaning, assembling, painting and testing in accordance with the specifications herein contained.

33.08 BUTTERFLY VALVE AND HOISTS :

(i) General : Butterfly valves shall be installed at the locations shown in the drawings or as directed by the Engineer-in-Charge. The arrangement and number of valves may be changed but the contractor shall not be entitled to any additional payment above the unit rate per kg. for the applicable items in the schedule of bids. The valves shall be operated by electrically operated hydraulic controls and will also have remote control operation from the power-house. Electrically operated overhead cranes will be provided for installation of valves, controls and accessories.

The Government will furnish the valves complete with casings, controls, intermediate shafts and coupling and all required brackets, bolts, anchor bolts and gaskets and also the bye pass lines and control valves on these lines. The contractor will install the equipment as shown on the drawings and as directed by the Engineer-in-Charge. The cranes in the valve chambers will be utilised by the contractor for the installation of the equipment.

(ii) Installation : Field installation will consist of bolting or welding of disassembled parts of each valve together, bolting the valves and castings on the ends of pipes, installing the

anchor adjusting and grouting the valve supports, assembling, setting and anchoring the control units and connecting the units to the valves, installation of bye pass lines and expansion joints. After installation the valves shall be operated several times as directed by the Engineer-in-Charge and necessary adjustment including the adjustment of remote position indicators will be made until the operations are free and smooth and the functioning of all parts is satisfactory to the Engineer-in-Cdarge. After the valves have been installed and tested for satisfactory operation by the Engineer-in-Charge, all exposed surfaces will be painted as provided in the painting schedule and as directed by the Engineer-in-Charge.

(iii) Measurement and Payment : Payment for installing Butterfly valves and hoists will be made at the unit rate per kg. of the respective items of the schedule of bids, which rates will include all work in the transport of materials from UPID railway siding near Harrawala or Dehradun railway station to the site of works, assembly at site and installation. The rate shall also include all painting, testing of operations and all maintenance till the completion of the work and final taking over by the Government.

33.09 GATES, GATE FRAMES AND GUIDES FOR PENSTOCKS AND DRAFT TUBES :

(i) General : The gates, gate frames and guides, anchor bolts, turnbuckles and gate latches etc. for the penstock and draft tube will be furnished by the Government and will be installed by the contractor as directed by the Engineer-in-Charge.

(ii) Installation : The structural steel, and metal work for the frames and guides will be furnished completely fabricated in sections convenient for dispatch and will have been assembled in the shop, and when so assembled, all parts will have been marked and match-marked to facilitate assembly in the field. Field assembly will be by bolting, riveting or welding as shown in the drawings. Suitable recesses or blockouts shall be constructed in the concrete of the structures to provide for the installation of the frames and guides as shown on the drawings or as directed. Anchor bolts shall be located accurately and shall be held rigidly in position, while the concrete in the structures is being placed. Frames and guides shall be placed in position and shall be adjusted accurately to exact position and alignment by means of the adjusting nuts and turn buckles on the anchor bolts or by means of erection beams. Exceptional care shall be taken to ensure that all frames and guides are installed so that the gate sealing surface of each frame is even true and lies in a true plane and that the bearing surfaces of gate guides on each frame lie in the same plane so that, when the gates are installed, gate seats and seals will bear evenly without excessive leakage between the seats, to the satisfaction of the Engineer-in-Charge. After the frames and guides have been placed accurately, adjusted and cleaned thoroughly of all rust dirt and other foreign material the recesses or blockouts shall be filled with concrete. After these recesses or blockouts have been filled with concrete, all exposed unfinished ferrous metal shall be cleaned and painted.

The gates shall be completely assembled in the shop, except for the seals, and shall be marked and match-marked to facilitate field assembly and disassembled for convenient transportation. Assembly of the gates in the field will be by bolting, rivetting or welding or by any combination of these methods. The rubber sealing strips where indicated, shall be cut accurately to length and shall be attached to the gates as shown on the drawing or as directed. The contractor shall locate carefully the holes to be drilled in the sealing strips. The seal clamp bars shall be used for templates for drilling the holes in the rubber seals, using plug drills. At joints, the ends of the seals shall be cut as to butt evenly. The leaf springs shall be bolted to the gate leaves as shown on the drawings. The gates shall be assembled and erected at convenient locations, shall be painted and shall be installed in the gate frames as directed. Each gate shall be raised and lowered in its gate frame several times and all adjustments shall be made to the satisfaction of the Engineer-in-Charge. Particular care shall be taken in assembling and adjusting the gate seats, to ensure that the seals have an even bearing on the seal seats. The gates shall be tested for satisfactory operation.

(iii) Measurement and payment : Payment for installing gates and embedded parts for penstock and draft tubes will be made at the unit price per kg. for the item in the schedule of bids,

which price will include all work in the transport of materials from U. P. I. D. Railway Siding near Harrawala or Dehradun Railway Station to the site of work and installation. The price shall also include all painting of exposed metal work and repair to shop coats, all testing or operations and all maintenance till the equipment is finally taken over by the Government.

33.10 HOIST FOR DRAFT TUBE AND PENSTOCK GATES .

The hoists and fittings and lifting beams required for handling various equipment will be furnished by the Government. The hoists and accessories will be transported in convenient sections. Each hoists shall be assembled and placed in correct position with relation to the gate it will operate and all parts shall be installed in true alignment. The hoists shall then be given an operating test satisfactory to the Engineer-in-Charge and all required operations shall be made until the operation is satisfactory to the Engineer-in-Charge. The contractor shall furnish and install all temporary electrical control equipment and wiring required for making the tests. After the hoists have been installed and tested, these shall be painted as per the painting schedule.

Payment for installing hoists and accessories will be made at the unit prices per kgm. for the respective items in the schedule of bids, which prices will include transport of all material from U. P. I. D. Railway siding near Harrawala or Dehradun Railway Station to the site of the work and installations. The prices shall also include all painting of exposed metal work and repair to shop coats, all testing of operations and maintenance till the completion of the work and final taking over of the hoists by the Government.

33.11 PASSENGER-CUM-FREIGHT ELEVATOR IN POWER HOUSE :

Passenger-cum-freight elevator or separate elevator therefor in the Power House shall be installed by the manufactures. Blockouts for the embedment shall be provided in the elevator shafts concurrently with the Power House concreting as per construction drawings issued by the Engineer-in-Charge.

33.12 DEWATERING PUMPS IN SUMP IN FOUNDATIN AND DRAINAGE GALLERY OF POWER HOUSE AND SURGE SHAFT :

Dewatering pumps shall be installed in the sump in foundation and drainage gallery of Power House and surge shaft or elsewhere as directed by the Engineer-in-Charge. All material to be so installed will be furnished by the Government in components suitable for transport and carriage to the point of installation.

Payment of installation of dewatering pumps shall be made at applicable rates for the respective items in the schedule of bids which prices will include all works in the transport of materials from destination railway station to the site of work and installation etc. The prices shall also include all painting of metal work.

33.13 STRUCTURAL STEEL ROOFING IN POWER HOUSE :

The item of the schedule of bids includes the furnihsing and erection of roof girders, purlins and bracings in the power-house. All structural steel shall be assembled and erected in accordance with the provisions of paragraph 33.02. After erection, all structural steel will be painted. Payment for furnishing and erecting including painting structural steel roof framing will be made at the unit rate per kg. in the schedule of bids. All structural steel furnished by the contractor shall comply with IS: 800 Code of practice for use of structural steel in general building construction' and other applicable Indian Standards or American Institute of steel construction specification for the design fabrication and erection of structural steel in buildings or similar British or officially recognised standard specification of any other country which may be approved by the Engineer-in-Charge.

33.14 CORRUGATED GALVANIZED IRON SHEET ROOFING :

(i) Corrugated galvanized iron sheet of BS 22 gauge shall be used for roofing unless otherwise approved by the Engineer-in-Charge. The zinc covering at the time of fixing shall be in

perfect condition. Any sheet showing rust marks, white powdery deposit on the surface or places rubbed through the zinc covering shall be rejected.

(ii) Laps : Each sheet shall be laid with 150 mm lap at the ends and lap of two corrugations at each side.

(iii) Holes : Holes for nails, screws, rivets etc. shall be made on the ground, the sheet shall be placed on trestles and the holes punched in the ridges of the corrugations with every sharp punches and in such a manner that the axis of the punched hole may come on the top of the sheet when laid.

Sheet torn round the punch holes or wrongly punched shall be rejected where four sheets over at the corners the holes for the nails, screws etc. shall be drilled.

(iv) Laying : The sheet shall be laid on the scantlings as indicated in the plan and to a true flat surface and lines of corrugation shall be, unless otherwise ordered truely parallel to the sides of the area to be covered with the sheets.

The sheet shall be jointed together by galvanized rivets and fixed to the scantlings by standard galvanized screws, nails, or hook bolts with bitumen washer as required and approved by the Engineer-in-Charge.

Unless otherwise specified or ordered by the Engineer-in-Charge, each sheet shall be riveted at the corners and at least once in its breadth also at a distance of from 300 mm to 600 mm intervals along its length.

(v) G P. Sheet ridges : Ridges shall be covered by G.P. sheets of 18 BWG which shall be riveted or clipped to the sheets, with a 300 mm. lap on each side securely fastened down so as to present the rain driving under it.

(vi) Gutters : Gutters shall be made of GP sheets of 18 BWG in rectangular, semi-circular, circular or trapezoidial section as specified by the Engineer-in-Charge. The base width and height of the gutter will be 300 mm each, suitable holes for down pipes will be made in the gutter and down pipe shall be welded to the gutter so as to provide a water tight joint.

(vii) Cast iron down pipes : 100 mm dia superior quality and of thickness not less than 10 mm cast iron down pipe complete with all necessary specials as per direction of Engineer-in-Charge shall be provided to drain water off the gutters.

(viii) Measurement and payment : Measurement for the payment of corrugated galvanized iron sheet roofing shall be for the finished roof surface. No allowance shall be made in measurements for overlaps and corrugations. Payment shall be made at the unit price per square metre of the item in the schedule of bids. The unit rate shall cover the fixing of 22 gauge corrugated galvanized iron sheet on roof trusses, the manufacture and fixing of ridges and hips from 18 gauge of galvanized plain sheets including all materials and accessories such as bolt and nuts and bitumen washers but excluding the cost of corrugated galvanized iron sheet (22 gauge) and galvanized plain sheets' (18 gauge). The galvanized plain sheet gutters shall be measured and pai in Kgm. at the unit rate of item provided in schedule of bids, the unit rate shall cover the manufacture and fixing of galvanized plain sheet gutters from 18 gauge of galvanized plain Sheet including all materials and accessories but excluding the cost of galvanized plain sheet. The cast iron down pipes shall be measured and paid in Kgs. at the unit rate of item provided in schedule of bids.

33.15 METAL PIPES, FITTINGS AND VALVES :

The contractor will furnish all metal pipes, fittings and valves, roof drains, floor drains, area drains, track drains, joint materials and all other accessories and appurtenances required for permanent installation, as parts of permanent piping to be attached to or built in the Power Houre, Surge Tank, Penstock, Head race tunnel, outlet works and other appurtenant works being carried out under this contract and other permanent piping not otherwise specifically provided

for in the schedule of bids and specifications. The pipes, fittings valves and accessories and appurtenance shall be installed and tested by the contractor as directed. All pipes after being cut and before being threaded or fitted to welding fittings shall be reamed and all burrs shall be removed. The thread shall be cut full, shall be free from torn or ragged surfaces and the joints shall be made up so that no threads are exposed on chromium plated pipe and not more than three threads are exposed on other threaded pipe after installation. Screw joints shall be made with lubicant applied on male threads only. Screw joints shall be made metal to metal and caulking of screwed joints to stop or prevent leakage will not be permitted. The pipe ends and all sockets fittings shall be cleaned thoroughly and shall be free of foreign matter before assembly prior to welding operations. Flanged joints shall be made up with undamaged gaskets and all bolts will be drawn tight. Cast iron bell and spigot pipes shall be finished in standard lengths and shall be cut where required by the contractor. The spigot ends of cast iron pipes and fittings shall be placed concentrically on the belts and the joints shall be packed with oakum or similar material and shall be thoroughly caulked with suitable caulking tools so as to leave 50 mm. in the belt of cast iron water pipes and approximately 25 mm in the belt of cast-iron soil pipe for lead or mortar. Joints not to be embedded in concrete shall be poured full of molten lead in one operation. The lead shall be retained in the joints by suitable joints runners and after the lead has cooled sufficiently, it shall be caulked tightly. Joints to be embedded in concrete shall be filled completely with lead if so specified or with mortar from the concrete in which the pipes are placed. Metal pipe and fittings to be embedded in concrete shall be held firmly in position and protected from damage while the concrete is being placed. Care shall be taken to prevent the pipe from becoming clogged during the progress of the work and should any pipe become either partially or wholly clogged before final acceptance of the work, it shall be cleaned out in a manner satisfctory to the Engineer-in-Charge, or shall be replaced by and at the expense of the contractor. Open ends of pipes shall be plugged or otherwise suitably closed where and as directed. All exposed piping from the roughed in piping to the plumbing fixtures shall be installed in accordance with good standard plumbing practice. The metal pipes, fittings and valves shall conform to the following Indian Standard Specifications :

(1) Sheetmetal; rain water pipes, gutters, fittings and accessories IS : 1728
(2) Gate, globe and check valves for water and oil IS : 778
(3) Cast iron rain water pipes, fittings. IS : 780
(4) Sluice valves IS : 1230
(5) Centrifugally-Spun pressure pipes IS : 1536
(6) Vertically-spun cast iron pipes IS : 1537
(7) Cast-iron fittings for pressure pipes IS : 1938
(8) Steel tubes and pipes IS : 1161

All portions of all piping systems which will not be embedded in concrete, except air vent piping not subjected to pressures, all sanitary drains and vent lines, all drain lines which connect to sanitary sewers, all portions of all pressure piping system for oil, air and water supply and all other piping system which will be operated under a pressure exceeding 2 Kg. per spuare cm. as determined by the Engireer-in-Charge shall be tested by the contractor as directed. All sanitary drains and vent lines, all drain lines which connect to sanitary sewers and the portions of drain line which will not be embedded in concrete and which will not be operated under pressure shall be subjected to a test pressure of not less than 1 kg. per square centimetre and not more than 1.5 kg. per square centimetre as directed. Tests of sanitary and drainage system shall be made by hydrostatic pressure or air pressure, as directed. Except as otherwise provided in these specifications, all pressure piping systems for oil, air and water supply shall be tested by the contractor to a hydrostatic pressure of not than 7 kg. per square centimetre and not more than 28 kg. per square centimetre as directed. The methods used shall be satisfactory to the Engineer-in-Charge. The piping for

all oil system shall be thoroughly cleaned by an approved method after testing as directed. The contractor shall furnish all materials, supplies, labour and equipment required for making the tests. All leakage and other defects in the work which may be disclosed by the test or at any time prior to acceptance by the Government shall be corrected by the contractor to the satisfaction of the Engineer-in-Charge. Pipes and fittings to be placed in concrete shall not be painted but shall be thoroughly cleaned of all excessive rust, dirt and grease immediately before being embedded in the concrete. After being installed and tested, if testing is required for exposed piping shall be painted. Except as otherwise provided in these specifications payment for furnishing and installing, including painting metal pipes, fittings and valves, will be made at the unit prices per kg. in the schedule of bids for furnishing and installing metal pipes, fittings and valves, less than 150 mm in diameter and for furnishing and installing metal pipes, fittings and valves 150 mm. and larger in diameter, which unit prices shall include the cost of welding rods and paints. The rates in the schedule of bids are for ferrous pipes, fittings and valves only. If non-ferrous pipes, fittings and valves are required by the Engineer-in-Charge to be furnished and installed by the contractor, terms of payment for such work shall be determined in accordance with the provisions of paragraph 3.10.

Sd/- R.K. Chaturvedi
Contractor

Sd/- Jai Singh
S.E.L.V.C.C. II
Dehradun

ERRATA

Page	Line	For	Read
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3	9	cnntract	contract
4	Sl. 2 Col. 2	HRT : 10000	HRT : 100000
4	Sl. 4 Col. 7	—	Rs. 3150/-
9	Sl. 56 Col. 3	1600	16000
17	Sl. 133 Col. 2	p ees fiting and vaves	pipes fitting and valves
21	46	authorised	unauthorised
26	21	arriye	arrive
27	4	thereof	on discovery thereof
27	32	desc iption	description
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29	20	aheady	already
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110	10	backing	back packing
110	12	20.06	24.08
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114	4	loss	less
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157	Last line	greut	grout
159	6	may drilled	may be drilled
170	22	tiies	tiles
170	27	approval	approved
170	30	square of	square metre of
171	20	adjoing	adjoining
171	29	tiles	tile
173	5	holp	help
179	35	cealtar	coaltar
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