



# TRAVANCORE TITANIUM PRODUCTS LIMITED

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**Re-Tender No. TTPL/PROJ/ Centrifuge Foundation/RT/20-21**

**Date: 13.10.2020**

## TENDER NOTICE

Sealed tenders are invited from registered/experienced Contractors in prescribed format for the **CIVIL WORKS FOR THE CENTRIFUGE FOUNDATION** as per the schedule attached. The Tender Form can be had from the office of the undersigned between 10:00 a.m and 3.00 p.m on all working days except Saturdays on remitting the Tender Form cost of **Rs.500/- +GST @18% (Total: Rs.590/-)**. Tender document can also be downloaded from our website [www.travancoretitanium.com](http://www.travancoretitanium.com) and shall submit the Tender along with DD against the Tender Form cost & EMD in favour of Travancore Titanium Products Limited payable at Thiruvananthapuram. The bids will be opened at the date and time given below in the presence of the tenderers present at that time.

The tender shall be enclosed in an envelope, sealed and super scribed with "**Tender No.& date, due date and the name of work**". The same shall then be forwarded to the "**General Manager (Tech.) i/c, Travancore Titanium Products Limited, Kochuveli P.O, Thiruvananthapuram, Kerala, Pin.695 021**".

Name of Work: Civil Works for Centrifuge foundation for TTPL

**EMD: Rs.1313/-(refundable)**

Sealed Tenders will be received at our office on all working days and the due date of submitting the same is on 23.10.2020 at 12.00 noon. Tenders received after the due date & time will not be accepted. Fax/email offers also will not be accepted.

The bids will be opened at 2.00 pm on **23.10.2020** in the presence of the Tenderers present at the time.

For TRAVANCORE TITANIUM PRODUCTS LTD.,

  
**General Manager (Tech.) i/c**

Encl: Proforma & Work schedule

Signature of the Tenderer:



**Re-Tender No. TTPL/PROJ/ Centrifuge Foundation/RT/20-21**

**Date: 13.10.2020**

**Name of work: "Civil Works for Centrifuge foundation" for TTPL**

1. **Scope of work:** Casting of a M30 grade concrete foundation with departmentally supplied counter frame attachment, as specified in the given drawings. Sequence of the work should be as listed below:-

Place the foundation plate/frame arrangement in a clean surface, Bottom anchoring bolts, specified in the drawing no DP 932 DRG CL 01 024 has to be installed priorly in the frame arrangements in the specified locations.

Fill the inside space between the ground and the counter frame with hard foam boards.

Cover the surface with a plastic film, and glue the plastic film to the counter frame.

Encase the ground and counter frame to the sides with shutters up to the necessary block height.

Lay the reinforcements as specified in the drawing no DP 932 DRG CL 01 023.

Make the recesses for anchoring of the centrifuge according to drawing no. DP 932 DRG CL 01 024.

Fill the foundation block with concrete of the necessary grade.

The contractor shall provide all necessary labour, materials, equipment and management and supervisory personnel to complete the works provided under this contract in time.

2. **Quantity:** Detailed in Work schedule
3. **Price: Percentage rate** for the entire work shall be quoted.
4. **Period:** The work should be completed within **Two Week** from the date of Work Order.
5. The company is no way responsible for any loss or damage to the materials entered in TTPL campus by the contractor.
6. Quantities considered in the estimate are based on drawings.
7. All the balance materials should be removed and cleared the work site at the end of every day. The work site must be cleaned before submitting the bill.
8. Payment will be made after satisfactory completion of the work with the recommendation of the officer in charge. Contractor shall submit Entry Pass issued from Main Gate along with the bills.
9. It is entirely the contractor's responsibility to provide all safety equipment wherever necessary to their workmen. The Company is in no way responsible for any injury, disability or death of contractor's workmen due to non-compliance of safety regulations.

Signature of the Tenderer:

10. TTPL reserves the right to accept / reject any of the tender after evaluation with or without assigning reason no matter whether a Tenderer has quoted the lowest rate. All questions/disputes arising out of or in connection with this shall be decided by the Managing Director of the company and his decision thereof shall be final and binding to all tenderers.
11. Bids should bear the signature of the bidder in all pages.
- 12. The rate quoted shall be exclusive of GST and the % of GST applicable should be mentioned at the space provided in the price pro forma. If the bidder is below the threshold limit of GST that should be clearly mentioned at the space provided for GST. No subsequent claim will be entertained.**
13. It is no binding on the company to accept the lowest offer. The company reserves the right to cancel/postpone the tender or to reject any or all offers without assigning any reason.
14. The tenderer should remit the Earnest Money Deposit (EMD) mentioned in this document in cash/DD and proof of thereof should be enclosed along with the tender. Other mode of remittance will not be accepted.
15. Before commencing the work, the tenderer shall deposit 5% of the contract value as Security Deposit for the proper fulfillment of the contract within a week of intimation of the acceptance of the tender and if the contract value is more than Rs. One lakh, the tenderer shall execute an agreement in the prescribed form. The security deposit will not carry any interest and will be refunded after the completion of all contractual obligations including guarantee period. On default of the tenderer to remit the Security Deposit and sign the Agreement, the MD withstand forfeited and if any loss or damage is sustained by the company in this regard, the same will also be recovered from him.
16. The tenderer should also provide a guarantee for six months against poor workmanship. 10% of the contract amount will be retained by the company during the guarantee period.
17. If any irregularity or fraudulent behavior is noticed on part of the contractor/ his agents/ representatives or the crew of the vehicle engaged by the contractor for the performance of the contract, the company reserves the right to take all suitable action deemed fit against the contractor and those concerned.
18. The contractor will be responsible for meeting all the requirements of the various labour enactments applicable from time to time and should indemnify and keep indemnified the company against all losses and damages sustained by the company in this regard at all times.
19. Contractor should comply with all relevant formalities under contract labour (Regulation and Abolition) Act 1971, such as display of rate of wages, date, place and time of payment of wages, date of payment of unpaid wages etc. they should also intimate the time, date and place of disbursement of wages to the supervisory Officer nominated under the above act for certification of payment to contract workers.

Signature of the Tenderer:

20. Crawling boards and safety belts are to be provided to contract labourers working at roof top and high elevation. Workmen using such equipment alone will be permitted to work at such elevated position. The contractor should strictly adhere to the Safety Rules prevailing in the company failing which penalty are decided will be imposed. It is entirely the contractor's responsibility to provide all safety equipment wherever necessary to their workmen. The Company is in no way responsible for any injury, disability or death of contractor's workmen due to non-compliance of safety regulations. The Contractor can purchase safety belts from the Company@ Rs.510/- subject to availability.
21. The contractor should fix a display board on the materials of their own kept within the Company premises indicating the names of the Contractor and Work Order No.
22. The Company reserves the right to cancel the work order forfeiting security deposit if the work is not started within 10 days from the date of receipt of work order and also to terminate the contract at any time if the work is not done with proportionate progress to the satisfaction of the company officials and in all such cases the company will be at liberty together work done in any manner that the company thinks fits and all losses and damage sustain by the company in this regard will be recovered from contractor and his assets.
23. The work should be completed within the time limit stipulated in the work schedule. 1% of the contract amount will be levied per week for delay on your part as liquidated damages, subject to a maximum of 10% of the contract value.
24. The Contractor and his crew can avail Company canteen facility by remitting the cost of coupons or the food items at the rate fixed by Canteen Authority from time to time
25. Company reserve the right to accept/reject any of the tender after evaluation with or without assigning reason no matter whether a Tenderer has quoted the lowest rate. All questions/ disputes arising out or in connection with this shall be decided by the Managing Director of the Company and his decision thereof shall be final and binding to all tenderers.
26. Any dispute or questions relating to or arising out of the finalization of this tender, if remains, shall be subject to the executive jurisdiction of the courts at Thiruvananthapuram.
27. All statutory deductions will be made from the contractor's bill as per rules.
28. **Estimate Amount:Rs.52,523/- (Rupees Fifty Two Thousand Five Hundred and Twenty Three Only)**
29. **Tender cost: Rs.500/- plus GST @ 18% (Total: Rs.590/-)**
30. **EMD: Rs.1313/- (Refundable)**
31. **Due Date: 23.10.2020 at 12.00 hrs.**

For TRAVANCORE TITANIUM PRODUCTS LTD



**General Manager (Tech.) i/c**

**PARTICULARS OF THE TENDERER**

1. Name of the Bidder:
2. (a) Registered office address of the Bidder:  
  
(b) Address for correspondence:
3. Mobile Nos.:
4. E-mail address:
5. Status of the tenderer (Individual, Prop. firm, Partnership, Ltd. Company,
6. Registration No.:
7. Year of establishment:
8. Permanent Account No. (PAN issued by Income Tax Dept.):
9. GST Registration No.
10. ESI Registration No.
12. PF Registration No.
13. MSME No. ( if applicable)
13. Name and address of Proprietor/ Partners/ Directors:

**Declaration**

We confirm that we have read and understood all tender conditions and we accept all tender conditions in its entirety.

Date:

Signature:

Name of Person signing:

Tenderer's Name and address with seal:

Signature of the Tenderer:

**PRICE PROFORMA**

Name of work: “Civil Works for Centrifuge foundation” for TTPL

Re-Tender No. TTPL/PROJ/ Centrifuge Foundation/RT/20-21

I have read and understood all the tender conditions and work schedule the tender in its entirety and my lowest offer to carry out the work as per the tender is:

1. At the estimate rate : (in figures) Rs.....+ GST%.....  
(Rs.52,523.00)

: (in words) Rs.....

2. Below estimate rate : (% in figures).....+GST%.....

: (% in words).....

3. Above estimate rate : (% in figures).....+GST%.....

: (% in words).....

**Please mention % of GST at the space provided. If not mentioned, the rate will be considered as Inclusive of GST. Also if the bidder is within the threshold limit of GST the same shall be mentioned at the space.**

**Whether below threshold limit:**

Tender cost remittance details:

EMD remittance details:

Signature of the Bidder:

Name & Address:

Registration Number:

Mobile No:

E Mail:

Signature of the Tenderer:

# TECHNICAL SPECIFICATIONS

## CONCRETE AND ALLIED WORKS

### Applicable Codes

The following codes and standards are made a part of the Specifications. All standards, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall prevail.

### Materials

- 1) IS 269 : Specification for ordinary, rapid hardening and low heat portland cement
- 2) IS 455 : Specification for Portland blast furnace slag.
- 3) IS 1489 :Specification for Portland-pozalana cement
- 4) IS 4031 :Methods of physical tests for hydraulic cement
- 5) IS 650 :Specification for standard sand for testing of cement
- 6) IS 383 :Specification for coarse and fine aggregates from natural sources for concrete
- 7) IS 2386 (Parts I to VIII) : Methods of test for aggregates for concrete
- 8) IS 516 :Methods of test for strength of concrete
- 9) IS 1199 :Methods of sampling and analysis of concrete
- 10) IS 2396 (I) IS 5640 :Flakiness Index of aggregates
- 11) IS 3025 : Methods of sampling and test (physical and chemical water used in industry)
- 12) IS 432(Part I & II) :Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
- 13) IS 1139 : Specification for hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement
- 14) IS 1566 :Specification for plain hard drawn steel wire fabric for concrete reinforcement
- 15) IS 1785 :Specification for plain hard drawn (Part I) steel wire for prestressed concrete
- 16) IS 1786 :Specification for cold twisted steel bars for concrete reinforcement
- 17) IS 2090 :Specification for high tensile steel bars used in prestressed concrete
- 18) IS 4990 :Specification for plywood for concrete shuttering work
- 19) IS 2645 :Specification for integral cement water-proofing compounds

### Equipment

- 1) IS 1791 :Specification for batch type concrete mixers
- 2) IS 2438 :Specification for roller pan mixer
- 3) IS 2505 :Specification for concrete vibrators immersion type
- 4) IS 2506 :Specification for screed board concrete vibrators
- 5) IS 2514 :Specification for concrete vibrating tables
- 6) IS 3366 :Specification for pan vibrators
- 7) IS 4656 :Specification for form vibrators for concrete

- 8) IS 2722 :Specification for portable swing weigh-batchers for concrete (single and double bucket type)
- 9) IS 2750 : Specification for steel scaffoldings

### **Codes of Practice**

- 1) IS 456 : Code of practice for plain and reinforced concrete
- 2) IS 1343 :Code of practice for prestressed concrete
- 3) IS 457 :Code of practice for general construction of plain and reinforced concrete for dams and other massive structures
- 4) IS 3370 (Part I to IV) :Code of practice for concrete structures for storage of liquids.
- 5) IS 3935 :Code of practice for composite construction
- 6) IS 3201 :Criteria for design and construction of precast concrete trusses
- 7) IS 2204 :Code of practice for construction of reinforced concrete shell roof
- 8) IS 2210 : Criteria for the design of RC shell structures and folded plates
- 9) IS 2751 :Code of practice for welding of mild steel bars used for reinforced concrete construction
- 10) IS 2502: Code of practice for bending and fixing of bars for concrete reinforcement
- 11) IS 3558:Code of practice for use of immersion vibrators for consolidating concrete
- 12) IS 3414:Code of practice for design and installation of joints in buildings
- 13) IS 4014 (Part I&II): Code of practice for steel tubular, scaffolding
- 14) IS 2571:Code of practice for laying insitu - cement concrete flooring

### **Construction Safety**

- 1) IS 3696 : Safety code for scaffolds and ladders

### **Measurement**

- 1) IS 1200 :Method of measurement of building works
- IS 3385 :Code of practice for measurement of civil engineering works

### **General**

The quality of materials, method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise shall conform to the applicable portions of this specification.

### **Materials**

The ingredients to be used in the manufacture of standard concrete shall consist solely of standard type portland cement, clean sand, natural coarse aggregate, clean water and admixtures.

### **Cement**

If the Contractor is instructed to supply cement, then the following points shall be applicable:



- a. The cement to be used shall be ordinary Portland/Portland Pozzolana cement conforming to IS: 8112-1989 & IS:1489 part I respectively for 43 Grade OPC/PPC unless otherwise mentioned. The cement procured should be of reputed brands such as Malabar Cements, ACC, L&T, Shankar Cement, etc. and as approved by the Engineer-in-Charge. As far as possible, all the cement shall be obtained from a single source throughout the contract. Cement of different types shall not be mixed together. Different brands of cements or same brand of cement from different sources shall not be used without prior approval of the Engineer-in-Charge.

The cement shall be delivered at site in original sealed bags which shall be labelled with the weight, date of manufacture, brand and type. Cement received in torn or hand-stitched bags shall not be used. For volumetric batching of concrete, cement should be mixed only by box measurement. All cement should be fresh when delivered and shall be stored in an approved manner in stores built by the Contractor at his own cost. Set cement shall not be allowed to be used for any work.

- b. A certified report attesting to the conformance of the cement to IS specifications by the cement manufacturer's chemist shall be furnished to engineer if demanded.
- c. Cement held in storage for a period of sixty (60) days or longer shall be tested. Should at any time Engineer have reasons to consider that any cement is defective, then irrespective of its origin, and/or manufacturers test certificate, such cement shall be tested immediately at contractor's cost at an approved laboratory and until the results of such tests are found satisfactory, it shall not be used in any work. Contractor shall not be entitled to any claim of any nature on this account.
- d. Contractor will have to make his own arrangements for storage of adequate quantity of cement.
- e. The site engineer shall be regularly notified when supplies of cement are made to the site store. Copies of invoices shall be made available to the site engineer and a common cement register shall be kept at his office showing the supply stock and issue on a daily basis.

If the cement is supplied by the Client

- a) Contractor will have to make his own arrangements for the storage of cement. If supplies are arranged by owner, cement will be issued in quantities to cover work requirements of one month or more, as deemed fit by Engineer and it will be the responsibility of contractor to ensure adequate and proper storage. The storage arrangements shall be such that there is no dead storage. The storage arrangement shall be approved by Engineer.

## **Aggregates**

Aggregate in general designates both fine and coarse inert materials used in the manufacture of concrete. Fine aggregate is aggregate all of which passes through 4.75 mm IS sieve. Coarse aggregate is aggregate most of which is retained on 4.75 mm sieve. Specification mentioned against various item of work may also be followed.

All fine and coarse aggregates proposed for use in the work shall be subject to Engineer's approval and after specific materials have been accepted the source of supply of such materials should not be changed without prior approval of Engineer.

Aggregates shall, except as noted above, consist of natural sands, crushed stone and gravel from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard, durable against weathering, of limited porosity and free from deleterious materials that may cause corrosion of the reinforcement or may impair the strength and/or durability of

concrete. The grading of aggregates shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the mix design and preliminary tests on concrete specified later.

#### Sampling and testing

Samples of the aggregates for mix design and determination of suitability shall be taken under the supervision of Engineer and delivered to the laboratory, well in advance of the scheduled placing of concrete. Records of tests which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to Engineer in advance of the work for use in determining aggregate suitability. The costs of all such tests, sampling, etc., shall be borne by contractor.

#### Storage of Aggregates

All coarse and fine aggregates shall be stacked in stock separately in stock piles in the materials yard near the work site or if instructed in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign materials and with earth during storage and while heaping the materials shall be avoided. The aggregate must be of specified quality not only at the time of receiving at site but more so at the time of loading into mixer.

#### Screening and Washing

- a) Sand shall be prepared for use for such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions.
- b) Natural gravel and crushed rock shall be screened and/or washed for the removal of dirt or dust coating, if so demanded by Engineer

### **Water**

Water used for both mixing and curing shall be free from injurious amounts of deleterious materials. Potable waters are generally satisfactory for mixing and curing concrete.

In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in IS-456. The sample of water taken for testing shall be typical of the water proposed to be used for concreting, due account being paid to seasonal variation. The sample shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

### **Brick aggregates**

The brickbats shall be of new bricks well burnt, hard, durable and broken to sizes, well graded. It shall be free from dust, the size shall be of 37 mm and down. It shall be free from earth and other impurities.

### **Mix Design**

#### **Classification**

In case of concrete works, mix design may be necessary as per IS:456 for certain items as directed by Engineer-in-charge. All concrete in the works shall be of design mix as defined in IS 456, unless it is a nominal mix concrete such as 1:3:6, 1:4:8, 1:5:10. Whether reinforced or otherwise, all design mix concrete works to be carried out under this specification shall be divided into the following classifications. (Also refer Clause 1.2.6.3 for testing of concrete).

MINIMUM COMPRESSIVE STRENGTH OF 15 CM CUBES AT 7 AND 28 DAYS AFTER MIXING, CONDUCTED IN ACCORDANCE WITH IS 516

Class	Specified Characteristic Compressive Strength of 15cm Cube at 28 Days in	Assumed Standard Deviation as per table no.8 of IS 456	Max. size of aggregate mm
M 40	40.0	5.0	40 or 20
M 35	35.0	5.0	40 or 20
M 30	30.0	5.0	40 or 20
M 25	25.0	4.0	40 or 20
M 20	20.0	4.0	40 or 20
M 15	15.0	3.5	40 or 20

It shall be very clearly understood that whenever the class of concrete such as M 20 is specified it shall be the Contractor's responsibility to ensure that minimum crushing strength stipulated for the respective class of concrete is obtained at works. The maximum total quantity of aggregate by weight per 50 kg of cement shall not exceed 250 kg except when otherwise specifically permitted by Engineer.

To fix the grading of aggregates, water cement ratio, workability and the quantity of cement required to give preliminary and works cubes of the minimum strength specified, the proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be carried out according to Indian Standard Specifications.

Whenever there is a change either in required strength of concrete or water cement ratio or workability or the source of aggregates and/or cement, preliminary tests shall be repeated to determine the revised proportions, of the mix to suit the altered conditions.

While fixing the value for water cement ratio for preliminary mixes, assistance may be derived from the graph (appendix IS 456) showing the relationship between the 28 day compressive strengths of concrete mixes with different water cement ratios and the 7 days compressive strength of cement tested in accordance with IS 269.

### **Preliminary tests**

Test specimens shall be prepared with at least two different water/cement ratios for each class of concrete, consistent with workability required for the nature of the work. The materials and proportions used in making preliminary tests shall be similar in all respects to those to be actually employed in the works as the object of these tests is to determine the proportions of cement, aggregates and water necessary to produce concrete of required consistency and to give the specified strength. It will be the Contractor's sole responsibility to carry out these tests and he shall therefore furnish to Engineer a statement of proportions proposed to be used for the various concrete mixes.

Materials shall be brought to the room temperature and all materials shall be in a dry condition. The quantities of water, cement and aggregates for each mix shall be determined by weight/volume to an accuracy of 1 part in 1000 parts.

Mixing shall be done by a mixer machine as per IS 516 in such a manner as to avoid loss of water. The cement and fine aggregate shall first be mixed dry until the mixture is uniform in colour. The coarse aggregate shall then be added, mixed and water added and mixed thoroughly for a period of not less than 3 minutes until the resulting concrete is uniform in appearance. Each mix of concrete shall be of such a quantity as to leave about 10% excess concrete after moulding the desired number of test specimens.

The consistency of each mix of concrete shall be measured immediately after mixing, by the slump test in accordance with IS 1199. If in the slump test, care is taken to ensure that no water or other materials is lost, the materials used for the slump test may be remixed with the remainder of the concrete for making the specimen test cubes. The period of remixing shall be as short as possible yet sufficient to produce a homogeneous mass.

Compression tests of concrete cubes shall be made as per IS 516 on 15 cm cubes. Each mould shall be provided with a metal base having a plane surface so as to support the mould during filling without leakage. The base plate shall be preferably attached to the mould by springs or screws. The parts of the mould when assembled shall be positively and rigidly held together. Before placing concrete the mould and base plate shall be cleaned and oiled. The dimensions and internal faces of the mould shall be accurate within the following limits:

Height and distance between the opposite faces of the mould shall be of specified size plus or minus 0.2 mm. The angle between the adjacent internal faces and between internal faces and top and bottom planes of mould shall be 90 Deg. plus or minus 5 Deg. The interior faces of the mould shall be plane surfaces with a permissible variation 0.03 mm.

Concrete test cubes shall be moulded by placing fresh concrete in the mould and compacted as specified in IS 516.

Curing shall be as specified in IS 516. The cubes shall be kept in moist air of at least 90% relative humidity at a temp. of 27 Deg. Cent. plus or minus 2 Deg. Cent. for 24 hours plus or minus half hour from the time of adding water to the dry ingredients. Thereafter they shall be removed from the moulds and kept immersed in clean, fresh water and kept at 27 Deg. Cent. plus or minus 2 Deg. Cent. temp. until required for test. Curing water shall be renewed every seven days. A record of maximum and minimum temperatures at the place of storage of the cubes shall be maintained during the period they remain in storage.

Testing of specimens

The strength shall be determined based on not less than five cubes test specimens for each age and each water cement ratio. All these laboratory test results shall be tabulated and furnished to Engineer. The test result shall be accepted by Engineer if the average compressive strengths of the specimens are tested subject to the condition that only one out of the five consecutive test may give a value less than the specified strength for that age. The Engineer may direct the Contractor to repeat the tests if the results are not satisfactory and also to make such changes as he considers necessary to meet the requirements specified. All these preliminary tests shall be conducted by the Contractor at his own cost in an approved laboratory.

### **Proportioning, consistency, batching and mixing of concrete Aggregate**

The proportions which shall be decided by conducting preliminary test shall be by volume. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete mixing. The supply of properly graded aggregate of uniform quality shall be maintained over the period of work, the grading of aggregates shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different

sizes shall be stocked in separate stock piles. The grading of coarse and fine aggregate shall be checked as frequently as possible as determined by Engineer, to ensure maintaining of grading in accordance with the samples used in preliminary mix design. The material shall be stock piled well in advance of use.

### **Cement**

The cement shall be measured by weight.

### **Water**

Only such quantity of water shall be added to the cement and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete. The water added to the mix shall be such as not to cause segregation of material or the collection of excessive free water on the surface of the concrete.

The water cement (W/C) ratio will be decided by Engineer-in-charge on weight basis and this shall be strictly followed at site.

#### **Proportioning by Water/Cement ratio**

The W/C ratio specified for use by Engineer shall be maintained. The Contractor shall determine the water content of the aggregates as frequently as directed by Engineer as the work progress and as specified in IS 2386 (Part-III) and the amount of water added at the mixer shall be adjusted as directed by Engineer so as to maintain the specified W/C ratio. To allow for the variation in volume of aggregates due to variation in their moisture content suitable adjustments in the volume of aggregates shall also be made.

#### **Consistency and slump**

Concrete shall be of a consistency and workability suitable for the conditions of the job. After the amount of water required is determined, the consistency of the mix shall be maintained throughout the progress of the corresponding parts of the work and approved tests e.g. slump tests, compacting factor tests, in accordance with IS 1199 shall be conducted from time to time to ensure the maintenance of such consistency.

### **Slumps for Various Types of Construction**

Only sufficient quantity of water shall be added to concrete during the mixing to produce a mix of sufficient workability to enable it to be well consolidated, to be worked into the corners of the shuttering and around the reinforcement, to give the specified surface finish, and to have the specified surface strength. The following slumps shall be adopted for different kinds of works:

Placing Conditions	Degree of Workability	Slump (mm)
[1]	[2]	[3]
Blinding concrete: Shallow sections; Pavements using pavers	Very low	
Mass concrete: Lightly reinforced sections in slabs, beams, walls, columns: Floors; Hand placed pavements; Canal lining; Strip footings	Low	25-75
Heavily reinforced sections in slabs, beams, walls, columns; Slipform work; Pumped concrete	Medium	50-100 75-100
Trench fill; <i>In-situ pilling</i>	High	100-150
<i>Tremie concrete</i>	Very high	

### Sampling and testing concrete in the field

Facilities required for sampling materials and concrete in the field shall be provided by the Contractor at no extra cost. The following equipment with operator shall be made available at Engineer's request (all must be in serviceable condition):

- a) One concrete cube testing machine suitable for 15 cm cubes of 100 tonnes capacity with proving calibration ring.
- b) Twelve cast iron cube moulds of 15 cm size
- c) One Lab. balance to weigh upto 5 kg with sensitivity of 10 gm.
- d) One set of sieves for coarse and fine aggregates
- e) One set of slump cone complete with tamping rod
- f) A set of measures from 5 litre to 0.1 litre
- g) One electric oven with thermostat upto 120 Deg. Cent.
- h) One flakiness gauge
- i) One elongation index gauge
- j) One sedimentation pipette
- k) One Pyconometer
- l) Two calibrated glass jar of 1 litre capacity

Arrangement can be made by the contractor to have the cubes tested in an approved laboratory in lieu of a testing machine at site at his expense, with the prior consent of the Engineer.

At least 6 test cubes of each class of concrete shall be made for every 15.0 cu.m. of concrete or part thereof. Such samples shall be drawn on each day for each type of concrete. Of each set of 6 cubes, three shall be tested at 7 days age and three at 28 days age. The laboratory test results

shall be tabulated and furnished to Engineer. Engineer will pass the concrete if average strength of the specimens tested is not less than the strength specified, subject to the condition that only one out of three consecutive tests may give a value less than the specified strength but this shall not be less than 90% of the specified strength. The cubes shall be tested on 7th and 28th day from the day of casting of the cubes.

### **Admixtures**

Admixtures may be used in concrete only with the approval of Engineer based upon evidence that, with the passage of time, neither the compressive strength nor its durability reduced. Calcium chloride shall not be used for accelerating setting of the cement for any concrete containing reinforcement, or embedded steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1.5% of the volume of the cement in concrete. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturer's instructions and in the manner and with the control specified by Engineer-in-charge.

### **Air entraining agents**

Where specified and approved by Engineer, neutralised vinyl resin or any other approved air-entraining agent may be used to produce the specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM standard 6260, air entraining admixtures for concrete. The recommended total air content of the concrete is 4% plus minus 1%. The method of measuring air content shall be as per IS 1199.

### **Water reducing admixtures**

Where specified and approved by Engineer-in-charge water reducing lignosulfonate mixture shall be added in quantities specified by Engineer. The admixtures shall be added in the form of a solution.

### **Retarding admixtures**

Where specified and approved by Engineer-in-charge retarding agents shall be added to the concrete mix in quantities specified by Engineer.

### **Water proofing agent**

Where specified and approved by Engineer-in-charge water proofing agent conforming to IS 2645 shall be added in quantities specified by Engineer.

### **Optional tests**

Engineer-in-charge may order tests to be carried out on cement, sand, coarse aggregate and water in accordance with the relevant Indian Standards. Tests on cement shall include (i) fineness test (ii) test for normal consistency (iii) test for setting time (iv) test for soundness (v) test for tensile strength (vi) test for compressive strength (vii) test for heat of hydration by experiment and by calculations in accordance with IS 269. Tests on sand shall include (i) sieve test (ii) test for organic impurities (iii) decantation test for determining clay and silt content (iv) specific gravity test (v) test for unit weight and bulkage factor. Tests on coarsed aggregate shall include (i) test for sieve analysis (ii) specific gravity and unit weight of dry loose and rodded aggregate (iii) soundness and alkali aggregate reactivity (iv) petrographic examination (v) deleterious materials and organic impurities (vi) test for aggregate crushing value. Any or all these tests would normally be ordered to be carried out only if Engineer feels the materials are not in accordance with the specifications or if the specified concrete strengths are not obtained and shall be performed by contractor at site or at an approved test laboratory.

If the work cubes do not give the stipulated strengths Engineer-in-charge reserves the right to ask contractor to dismantle such portions of the work which in his opinion are unacceptable and re-do the work to the standard stipulated at contractor's cost.

### **Preparation prior to concrete placement**

Before the concrete is actually placed in position, the insides of the form work shall be inspected to see that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottom of columns and walls forms to permit removal of saw dust, wood shavings, binding wire, rubbish dirt, etc. Openings shall be placed or holes drilled so that these materials and water can be removed easily. Such openings/holes shall be later suitably plugged.

The various agencies shall be permitted ample time to install drainage and plumbing lines in floor and trench drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedments to be cast in the concrete as indicated on the drawings or as is necessary for the proper execution of the work. Contractor shall cooperate fully with all such agencies and shall permit the use of scaffolding form work, etc., by other agencies at no extra cost.

All embedded parts, inserts, etc., supplied by Owner or Contractor shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.

Anchor bolts shall be positioned and kept in place with the help of properly manufactured templates. The use of all such templates, fixture, etc., shall be deemed to be included in the rates.

Slots, openings, holes, pockets, etc., shall be provided in the concrete work in the positions indicated in the drawings or as directed by Engineer-in-charge.

Prior to concrete placement all work shall be inspected and approved by Engineer and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected at Contractor's cost. Cat ladders shall be provided on the reinforcement to facilitate labour movement.

Approval by Engineer for all materials and work as required herein shall not relieve contractor from his obligation to produce finished concrete in accordance with the drawings and specifications.

No concrete shall be placed in wet weather or on water covered surface. Any concrete that has been washed by heavy rains, the work shall be entirely removed, if there is any sign of cement and having been washed from the concrete mixture. To guard against damage which may be caused by rains, the works shall be covered with tarpaulins immediately after the concrete has been placed and compacted. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water over/around freshly placed concrete, suitably drains and sumps shall be provided.

Immediately before concrete placement begins, proposed surfaces except framework, which will come in contact with the concrete to be placed, shall be covered with a bonding mortar.

### **Transportation**

All buckets, containers or conveyors used for transporting concrete shall be mortar tight. Irrespective of the method of transportation adopted, concrete shall be delivered with the required consistency and plasticity without segregation or loss of slump. However, chutes shall not be used for transport of concrete without the written permission of Engineer and concrete



shall not be rehandled before placing.

Concrete must be placed in its final position before it becomes too stiff to work. On no account, water shall be added after the initial mixing concrete which has become stiff or has been contaminated with foreign materials shall be rejected and disposed off as directed by Engineer.

All equipment used for mixing, transporting and placing of concrete shall be maintained in clean condition. All pans, buckets, hoppers, chutes, pipelines and other equipment shall be thoroughly cleaned after each period of placement.

### **Procedure for placing of concrete**

Before any concrete is placed, the entire placing programme, consisting of equipment, layout proposed procedures and methods shall be submitted to engineer for approval if so demanded by Engineer and no concrete shall be placed until Engineer's approval has been received. Conveyor for conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete during depositing without segregation of materials, considering the size of the job and placement location.

Concrete shall be placed in its final position before the cement shall normally be compacted in its final position within thirty minutes of leaving the mixer and once compacted it shall not be disturbed.

Concrete, in all cases, be deposited as nearly as practicable directly in its final position, and shall not be rehandled or caused to flow in a manner which will cause segregation, loss of materials, displacement of reinforcement, shuttering or embedded inserts or impair its strength. For locations where direct placement is not possible, and in narrow forms, contractor shall provide suitable drop and elephant trunks to confine the movement of concrete. Special care shall be taken when concrete is dropped from a height especially if reinforcement is in the way, particularly in columns and thin walls.

Except when otherwise approved by Engineer, concrete shall be placed in shovels or other approved implements and shall not be dropped from a height more than 1 M or handled in a manner which will cause segregation.

The following specification shall apply when placing of concrete by use of mechanical equipment is specifically called for while inviting bids or is warranted considering the nature of work involved. The control of placing shall begin at the mixer discharger, concrete shall be discharged by a vertical drop into the middle of the bucket or hopper and this principle of a vertical discharge of concrete shall be adhered to thoroughly all stages of delivery until the concrete comes to rest in its final position.

Central bottom dump buckets of a type that provides for positive regulation of the amount and rate of deposition of concrete in all dumping position, shall be employed.

In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1 M. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any manner which results in separation of ingredients or disturbance of previously placed concrete will not be permitted.

Concrete placed in restricted forms by wheel barrows, buggies, cars, short chutes or hand shovelling shall be subject to the requirement for vertical delivery of limited height to avoid segregation and shall be deposited as nearly as practicable in its final position.

Where it is necessary to use transfer chutes, specific approval of Engineer must be obtained to the type, length, slopes, baffles, vertical terminals and timing of operations, the discharge and without segregation. To allow for the loss of mortar against the sides of the chutes, the first

mix shall have less coarse aggregate. During cleaning of chutes the waste water shall be kept clear of the forms. Concrete shall not be permitted to fall from the end of the chutes by more than 1 M. Chutes when approved for use shall have slopes not flatter than 1:2 chutes shall be of metal or metal lined and of rounded cross section. The slopes of all chutes sections shall be approximately the same. The discharge end of the chutes shall be maintained above the surface of the concrete in the forms.

Concrete may be conveyed and placed by mechanically operated equipment e.g. pumps or pneumatic placers only with the written permission of Engineer. The slump shall be held to the minimum, necessary for conveying concrete by this method.

When pumping is adopted, before pumping of concrete is started, the pipeline shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. The concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

When pneumatic placer is used, the manufacturer's advice on layout of pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to cater for the reaction at this end. Manufacturer's advice shall be followed regarding concrete quality and all other related matters when pumping or pneumatic placing equipment are used.

Concreting, once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 to 90 mm as directed by Engineer. These shall be placed as rapidly practicable to prevent the formation of cold joints or planes of weakness between each succeeding layer within the pour. The thickness of each layer shall be such that it can be deposited before the previous layer has stiffened. The bucket loads or other units of deposit shall be spotted progressively along the face of the layer with such overlap as well facilitate spreading the layer to uniform depth and texture with a minimum of shovelling. Any tendency to segregation shall be corrected by shovelling stones into mortar rather than mortar on to stones. Such a condition shall be corrected by redesign of mix or other means, as directed by Engineer.

The top surface of each pour and bedding planes shall be approximately horizontal unless otherwise instructed.

### **Compaction**

Concrete shall be compacted during placing with approved vibrating equipment until the concrete has been consolidated to the maximum practicable density, is free of pockets of coarse aggregate and fits tightly against all form surfaces, reinforcement and embedded fixtures. Particular care shall be taken to ensure that all concrete placed against the forms faces and into corners of forms or against hardened concrete at joints is free from voids or cavities. The use of vibrators shall be consistent with the concrete mix and caution exercised not to over-vibrate the concrete to the point that segregation results.

Vibrators shall conform to IS specifications. Type of vibrator to be used shall depend on the structure where concrete is to be placed. Shutter vibrators to be effective, shall be firmly secured to the formwork which must be sufficiently rigid to transmit the vibration and strong enough not to be damaged by it. Immersion vibrators shall have no load frequency, amplitude and acceleration as per IS 2505 depending on the size of vibrator. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not be permitted.

The exact manner of application and the most suitable machines for the purpose must be carefully considered and operated by experienced men. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to transport concrete inside the forms. Particular attention shall be paid to vibration at the top of a lift e.g. in a column or wall.

When placing concrete in layers, which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, blending and mixing of the concrete between the succeeding layers.

The immersion vibrator shall penetrate the layer being placed and also penetrate the layer below with the underlayer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

Care shall be taken to prevent contact of immersion vibrators against reinforcement steel. Immersion vibrators shall not be allowed to come in contact with reinforcement steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.

Form attached vibrators shall be used only with specific authorisation of Engineer.

The surface vibrators will not be permitted under normal conditions. However for thin slabs vibration by specially designed vibrators may be permitted upon approval of Engineer.

The formation of stone pockets or mortar bondages in corner and against faces of forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for through bonding, as directed by Engineer.

### **Placement interval**

Except when placing with slip forms each placement of concrete in multiple lift work, shall be allowed to set for atleast 24 hours after the final set of concrete and before the start of a subsequent placement.

### **Special provision in placing**

When placing concrete in walls with openings and in floors of integral slab and beam construction and other similar conditions, the placing shall stop when the concrete reaches the top of the opening in walls and bottom horizontal surface of the slab, as the case may be placing shall be resumed before the concrete in place takes initial set, but not until it has time to settle as determined by Engineer.

### **Placing concrete through reinforcement steel**

When placing concrete through reinforced steel, care shall be taken to prevent segregation of the coarse aggregate. When the congestion of steel makes placing difficult it may be necessary to temporarily move the top steel aside to get proper placement and restore reinforcing steel to design position.

### **Bleeding**

Bleeding of free water, on top of concrete being deposited, in to the forms shall be caused to stop the concrete pour. The conditions causing this defect corrected before any further concreting is resumed.

### **Curing, protecting, repairing and finishing**

#### **Curing**

All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous sprays or ponded water continuously saturated covering of sacks, canvas, hessian,

polythene sheets or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even textured coat. Extra precautions shall be exercised in curing concrete during cold and hot water as outlined hereinafter. The quality of curing water shall be the same as that used for mixing concrete.

Certain types of finish or preparation for overlaying concrete must be done at certain stage of the curing process and special treatment may be required for specific concrete surface finish.

Curing of concrete made of high alumina cement and supersulphated cement shall be carried out as directed by Engineer.

Fresh concrete shall be kept continuously wet for a minimum period of 15 days from the date of placing of concrete following a lapse of 12 to 14 hours after laying of concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately the concrete has hardened. Water shall be applied uniformly to concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of forms. Quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.

Curing shall be assured by use of an ample water supply under pressure in pipes with all necessary appliance of hose, sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used, unless otherwise specified or approved by Engineer.

Whenever, by the judgement of Engineer, it may be necessary to omit the continuous spray method, a covering of clean sand or other approved means such as wet gunny bags which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which would stain or damage the concrete during or after the curing period. Covering shall be kept continuously wet during the curing period.

For curing of concrete in pavements, side-walks floors, flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Engineer. Special attention shall be given to edges and corners of the slabs to ensure proper protection to these area. The ponded area shall be kept continuously filled with water during the curing period.

Surface coating type compounds shall be used only by special permission of Engineer, curing compounds shall be liquid type white pigmented. Other curing compounds shall be used on surfaces where future blending with concrete, water or acid proof membrane or painting is specified.

All equipment and materials required for curing shall be on hand and ready for use before concrete is placed.

### **Protecting fresh concrete**

Fresh concrete shall be protected from defacements and damage due to construction operation by leaving forms in place for an ample period as specified later in this specifications. Newly placed concrete shall be protected by approved means such as tarpaulins from rain, sun and winds. Steps as approved by Engineer shall also be taken to protect immature concrete from damage by debris, excessive loading, vibration, abrasion or contact with other materials, etc., that may impair the strength and/or durability of the concrete. Workmen shall be warned against and prevented from disturbing green concrete during its setting period. If it is necessary that workmen enter the area of freshly placed concrete, Engineer may require that bridges be placed over the area.

## **Repair and replacement of unsatisfactory concrete**

Immediately after the shuttering is removed, the surface of concrete shall be very carefully inspected and all defective areas called to the attention of Engineer who may permit patching of the defective areas or also reject the concrete unit either partially or entirely. Rejected concrete shall be removed and replaced by contractor at no additional expense to owner. Holes left by form bolts, etc., shall be filled up and made good with mortar composed of one part of cement to one and half parts of sand passing 2.36 mm IS sieve after removing any loose stones adhering to the concrete shall be finished as described under the particular items of work.

Superficial honeycombed surfaces and rough patches shall be similarly made good immediately after removal of shuttering in the presence of Engineer and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with a wooden float. Excess water shall be avoided. Unless instructed otherwise by Engineer the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fine or other irregularities and necessary care being taken to avoid damage to the surface. Surface irregularities shall be removed by grinding.

If reinforcement is exposed or the honey combing occurs at vulnerable positions eg. ends of beams or columns it may be necessary to cut out the member completely or in part and reconstruct. The decision of Engineer shall be final in this regard. If only patching is necessary, the defective concrete shall be cut out till solid concrete is reached (or to a minimum depth of 25 mm) the edges being cut perpendicular to the affected surface or with small under cut if possible. Achors, tees or dovetail slots shall be provided whenever necessary to attach the new concrete securely in place an area extending several centimetres beyond the edges and the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.

The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of Engineer. Epoxy shall be applied in strict accordance with the instructions of the manufacturer.

Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of form bottom, grout insert holes and slots cut for repair of cracks shall be repaired as follows. The hole to be patched shall be roughened and thoroughly soaked with clean water until absorption stops.

A 5 mm thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched, followed immediately by the patching concrete which shall be well consolidated with a wooden float. The concrete patch shall be built up in 10 mm thick layers. After an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden float and smooth finish obtained by wiping with hessian, a steel trowel shall be used for this purpose. The mix for patching shall be of same materials and in the same proportions as that used in the concrete being repaired, although some reduction in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible.

Mortar filling by air pressure (guniting) shall be used for repairing of areas too large and/or too shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour and texture of the surrounding concrete. While cement shall be substituted for ordinary cement, if so directed by Engineer, to match the shade of the patch with original concrete.

The patched area shall be covered immediately with an approved non-staining water saturated material such as gunny bag which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by fine spray of sprinkling for not less than 10 days.

All materials, procedures and preparation used in the repairing of concrete and also the finished repair work shall be subject to the approval of Engineer. All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and finished.

## **Finishing**

The type of finish for formed concrete surface shall be as follows, unless, otherwise specified by the Engineer.

For surfaces against which backfill or concrete is to be placed, no treatment is required except repairing of defective area.

For surface below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which would interfere with proper application of the waterproofing material which is specified for use.

Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repairing of damage or defective concrete removal of fins and abrupt irregularities, fillings of holes let by form ties and rods and clean up of loose or adhering debris.

Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Unless the drawing specifies such as stair treads, walls shall be sloped across the width approximately 1 in 30 broader surface such as walkways, roads, parking areas and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete subfloors to be covered either concrete topping, terrazzo or quarry tile and similar surfaces shall be smooth screeded and levelled to produce even surfaces. Surface irregularities shall not exceed 6 mm. Surfaces which will not be covered by backfill, concrete or tile toppings such as outside decks, floors of galleries and sumps, parapets, gutters, sidewall floors and slabs shall be consolidated, screeded and floated. Excess water and laitance shall be removed before finishing. Floating may be done with hand or power tools and started as the screeded surface has attained a stiffness to permit finishing operation and these shall be the minimum required to produce a surface uniform in texture and free from screed marks or other imperfections. Joints edges panels and forms linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothed off and all blemishes, projections etc., removed leaving the surfaces reasonably smooth and unmarked.

### **Integral cement concrete finish**

When specified on the drawings and integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded as specified on the drawing as per IS 2571. The surface shall be compacted and then floated with a wood float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

### **Exposed Concrete finish/Rendering**

A rubbed finish shall be provided only on exposed concrete surfaces as specified on the drawings. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, off-sets levelled and voids and damaged sections be immediately saturated with water and repaired by filling with a concrete or mortar of the same composition as was used in the surface. Then surface shall be thoroughly wetted and rubbed with carborundum or other abrassive. Cement mortar may be used in the rubbing, but the finished surface shall be brush coated with either cement grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

## **Form Work**

The formwork shall consist of shores, bracings, sides of beams and columns, bottom of slabs, etc., including ties anchors, hangers inserts, etc., complete which shall be properly designed and planned for the work. False work shall be so constructed that necessary adjustment can be made to compensate for take up and settlements. Wedge may be used at the top or bottom of timber shores but not at both ends to facilitate vertical adjustment or dismantling of the formwork.

### **Design of formwork**

The design of the formwork as well as its construction shall be the responsibility of Contractor. If so instructed, the drawings and/or calculation for the design for the formwork shall be submitted to Engineer for approval before proceeding with work, at no extra cost. Engineer's approval shall not however relieve Contractor of the full responsibility for the design and construction of the formwork. The design shall take into account all the load vertical and lateral that the forms will be carrying live and vibration loadings.

### **Type of formwork**

Formwork may be of timber, plywood, metal, plastic or concrete. For special finishes the formwork may be lined with plywood, steel, sheets, oil, tempered hard board, etc. Sliding forms and slip forms may be used with the approval of Engineer.

### **Form work requirements**

Forms shall conform to the shapes, lines, grades and dimensions including camber of the concrete as called for on the drawings. Ample studs, braces, ties, straps, etc., shall be used to hold the forms in proper position without any distortion whatsoever until the concrete is set sufficiently to permit removal of forms. Forms shall be strong enough to permit the use of immersion vibrators. In special cases form vibrators may also be used. The shuttering shall be close boarded. Timber shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps or other surface defects in contact with concrete. Faces coming in contact with the concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight splits or other defects. Joints shall be sufficiently tight to prevent loss of water or any fine material from concrete.

Plywood shall be used for exposed concrete surfaces; where called for. Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces which are to be rubbed finished shall be planed to remove irregularities or unevenness in the face. Formwork with linings shall be permitted.

All new and used form timber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness and cleanliness of surfaces. Form timber unsatisfactory in any respect shall not be used and if rejected by Engineer shall be removed from the site.

Shores supporting successive members shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed supports shall be provided for shores that cannot be secured on adequate foundations.

Formwork, during any stage of construction showing signs of distortion or distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be removed completely and the formwork be corrected prior to placing of new concrete.

Excessive construction camber to compensate for shrinkage, settlement may impair the structural strength of members and shall not be permitted.

Forms shall be so designed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conform to the architectural features of the structure as to location of joints and be as directed by engineer.

Where exposed smooth or rendered concrete finishes are required the forms shall be constructed with special care so that the resulting concrete surfaces require a minimum finish.

### **Formwork For Slope Surfaces**

Forms for sloped surfaces shall be built so that the formwork can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration inspection and repair of the concrete.

The formwork shall also be built so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surfaces of construction joints and finished surfaces with slopes steeper than 4 horizontal: 1 vertical shall be formed as required herein.

### **Formwork for Curved Surfaces**

The contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form timber shall be built up of laminated splines cut to make tight, smooth form surfaces.

After the forms have been constructed, all surface imperfections shall be corrected and all surface irregularities at matching faces of form material shall be dressed to the specified curvature.

### **Formwork for Exposed Concrete Surfaces**

Where it is desired, directed or shown on the drawings to have original fair face finish of concrete surface without any rendering or plastering, formwork shall be carried out by using wood planks, plywood or steel plates of approved quality and as per direction of the Engineer.

The contractor shall use one type of material for all such exposed concrete faces and the forms shall be constructed so as to produce uniform and consistent texture and pattern on the face of the concrete. Patches or forms for these surfaces will not be permitted. The formwork shall be placed so that all horizontal formworks are continuous across the entire surface.

To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features, chills, window heads or change in direction of the surface. All joints between shuttering plates or panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be provided between sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.

To achieve a finish which shall give the rough appearance of concrete cast against sawn boards, formwork boards unless otherwise stated shall be of 150 mm wide, securely jointed with tongue and grooved joints if required to prevent grout loss with tie rod positions and direction of boards carefully controlled. Sawn boards shall be set horizontally, vertically or at an inclination shown in the drawings. All bolt holes shall be accurately aligned horizontally and vertically and shall be filled with matching mortar recessed 5 mm back from the surrounding concrete face.

Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicated top of pour) at horizontal construction joints, unless the use of groove strips is specified on the drawings. Such forms shall be removed and reset from lift to lift, they shall not



be continuous from lift to lift. Sheeting of reset forms shall be tightened against the concrete so that the forms will not be spread and permit abrupt irregularities or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.

For fair faced concrete, the position of through bolts will be restricted and generally indicated on the drawings.

Chamfer strips shall be placed in the corners of forms for exposed exterior corners so as to produce 20 mm beveled edges except where otherwise shown in the drawings. Interior corners and edges at formed joints shall not be beveled unless shown on the drgs. Mouldings for grooves, drip courses and bands shall be made in the form itself.

The wood planks, plywood and steel plates used in formwork for obtaining exposed surfaces shall not be used for more than 3 times in case of wood planks, 6 times for plywood and 10 times for steel plates respectively. However, no forms will be allowed for reuse, if in the opinion of the Engineer it is doubtful to produce desired texture of exposed concrete.

In order to obtain exposed concrete work of uniform colour it shall be necessary to ensure that the sand used for all exposed concrete work shall be of approved uniform colour. Moreover the cement used in the concrete for any complete element shall be from single consignment.

No exposed concrete surface shall be rendered or painted with cement or otherwise. Plastering of defective concrete as a means of achieving the required finish shall not be permitted, except in the case of minor porosity on the surface, the Engineer may allow a surface treatment by rubbing down with cement and sand mortar of the same richness and colour as for the concrete. This treatment shall be made immediately after removing the formwork.

The contractor shall also take all precautionary measures to prevent breaking and chipping of corners and edges of completed work until the building is handed over.

### **Bracings struts and props**

Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bearers.

The shuttering for beams and slabs shall be so erected that the shuttering on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Repropping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be generally lowered vertically while striking the shuttering. If the shuttering for a column, is erected for the full height of the column, one side shall be left open and built up in sections as placing of concrete from the sides to limit the drop of concrete to 3 M or as directed by Engineer.

### **Mould Oil**

Care shall be taken to see that the faces of form work coming in contact with concrete are perfectly cleaned and two coats of mould oil or any other approved material applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Reinforcement and/or other items to be cast in the concrete shall not be placed until coating of the forms is complete, adjoining concrete surface shall also be protected against contamination from the coating material.

## Chamfers and fillets

All corners and angles exposed in the finished structure shall be formed with moulding to form chamfers or fillets on the finished concrete. The standard dimension of chamfers and fillers, unless otherwise specified shall be 20 mm x 20 mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the mouldings shall be planned or surfaced to the same texture as the forms to which it is attached.

## Wall ties

Wire ties passing through the walls shall not be allowed. In their place bolts through sleeves be used.

## Reuse of forms

Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer. Warped timber shall be resized. Contractor shall equip himself with enough shuttering material to complete the job in the stipulated time.

## Removal of forms

Contractor shall record on the drawings and in a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed therefrom. The Contractor shall remove the shuttering after obtaining the approval of the Engineer.

In no circumstances shall forms be struck until the concrete reaches a strength of at least twice the stress due to self weight and any construction/erection loading to which the concrete may be subjected at the time of striking formwork.

In normal circumstances (generally where temperatures are above 20 Deg. Cent.) forms may be removed after expiry of the following periods:

		Ordinary Portland cement concrete	Rapid hardening Portland cement
a)	Walls columns and vertical sides of beams	24 to 48 hrs as directed by the Engineer	24 hrs.
b)	Slabs props left under	3 days	2 days
c)	Beam soffits prods left under	7 days	4 days
d)	Removal of props to slabs: i) Spanning upto 4.5m ii) Spanning over 4.5m.	7 days 14 days	4 days 8 days
e)	Removal of props to beams & arches i) Spanning upto 6m ii) Spanning over 6m	14 days 21 days	8 days 12 days

Striking shall be done slowly with utmost care to avoid damage to arises and projections and without shock or vibration, by gently easing the wedges. If after removing the form work, it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.

Reinforced temporary openings shall be provided as directed by Engineer to facilitate removal of formwork which otherwise may be inaccessible.

Tie rods, clamps, form bolts etc., which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours nor later than 40 hrs. after the concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time, Ties, withdrawn from walls and grade beams shall be pulled towards the inside face cutting ties back from the faces of walls and grade beams will not be permitted.

For liquid retaining structures no sleeves for through bolts shall be used nor shall through bolts be removed as indicated above. The bolts, in this case, shall be cut at 25mm depth from the surface and then the hole shall be made good by sand, cement mortar of the same proportions as the concrete just after striking the formwork.

## **Reinforcement Steel**

### **General**

Reinforcement bars, if supplies are arranged by contractor unless otherwise specified, shall be either plain round mild steel bars grade I as per IS 432 (Part I) or medium tensile steel bar as per IS 432 (Part I) or hot rolled mild steel and medium tensile steel deformed bars as per IS 1139 or cold twisted steel bars as per IS 1786, as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with IS 1566. Substitution of reinforcement will not be permitted except upon written approval from Engineer.

Plain round mild steel bars grade II as per IS 432 (Part I) may be used with prior approval of Engineer in writing and with 10% increase in the reinforcement area but its use shall not be permitted in structures located in earthquake zones subjected to severe damage (as per IS 1895) and for structures subject to dynamic loading (other than wind loading), such as frames supporting rotary or reciprocating machinery, etc.

All reinforcement shall be clean, free from grease, oil, paint, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used.

All concrete in the works shall be of design mix as defined in IS 456, unless it is a nominal mix concrete such as 1:3:6, 1:4:8 or 1:5:10. Whether reinforced or otherwise, all design mix concrete works to be carried out under this specification shall be divided into the following classifications:

### **Providing, fabricating and placing in position reinforcement steel**

The quality of the steel shall be as mentioned in the materials section. The bars shall be fabricated as per the drawings and binding with 16 gauge GI binding wire etc. Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be approved by Engineer. The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

### **Bending**

Reinforcing bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done in cold and without damaging the bars. This is considered as a part of reinforcement binding fabricating work.

All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawings/bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and rebent in a manner that will injure the material, bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 32 mm in diameter which may be bent hot if specifically approved by

Engineer. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 845 °C) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and rebending shall not injure the material. No reinforcement shall be bent when in position in the work without approval whether or not it is partially embedded in hardened concrete. Bars having kind orbends other than those required by design shall not be used.

### **Fixing**

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the drawings by the use of block, spacers and chairs as per IS 2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be strongly bound together at all such points with two no. 16 gauge annealed soft iron wire. The vertical distance required between successive layers of bar in beams or other members shall be maintained by providing of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

### **Cover**

Unless indicated otherwise on the drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be as follows:

- a) At each end of reinforcing bar, not less than 25 mm nor less than twice the diameter of the bar whichever is less.
- b) For a longitudinal reinforcing bar in a column, not less than 40 mm, nor less than the diameter of the bar. In case of columns of minimum dimensions of 20 cm or under, with reinforcing bars of 12 mm and less in diameter, a cover of 25 mm may be used.
- c) For longitudinal reinforcing bars in a beam 25 mm nor less than the diameter of the bar.
- d) For tensile, compressive, shear, or other reinforcement in a slab or wall not less than 12 mm nor less than the diameter of such reinforcement.
- e) For any other reinforcement not less than 12 mm nor less than the diameter of such reinforcement.
- f) For footings and other principal structural members in which the concrete is deposited directly against the ground, cover to the bottom reinforcement shall be 75 mm. If concrete is poured on a layer of lean concrete the bottom cover may be reduced to 50 mm.
- g) For concrete surfaces exposed to the weather or the ground after removal of forms, such as retaining walls, footing sides and top, etc., not less than 50 mm for bars larger than 16 mm dia and not less than 40 mm for bars 16 mm dia or smaller.
- h) Increased cover thickness shall be provided, as indicated on the drawings, for surfaces exposed to the action of harmful chemicals (or exposed to earth contaminated by such chemical, acid, alkali, saline atmosphere, sulphurous smoke, etc.
- i) For reinforced concrete members, totally or periodically immersed in sea water or subject to sea water spray, the cover of concrete shall be 50 mm more than those specified in (i) to (v) above.
- j) For liquid retaining structures the minimum cover to all steel shall be 40 mm or the diameter of the main bars, whichever is greater. In the presence of sea water and soils and waters of a corrosive character the cover shall be increased by 10 mm.
- k) Protection to reinforcement in case of concrete exposed to harmful surroundings may also be given by providing a dense impermeable concrete with approved protective coatings, as specified by the Engineer.

- 1) The correct cover shall be maintained by cement mortar cover blocks. Reinforcement for footings, beams and slabs on sub-grade shall be supported on precast concrete blocks as approved by engineer. The use of pebbles or stones shall not be permitted.

### **Inspection**

Erected and secured reinforcement shall be inspected, jointly measured and recorded and approved by Engineer prior to placement of concrete.

### **LIST OF APPROVED MAKE**

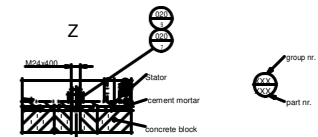
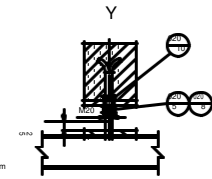
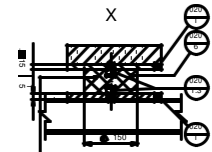
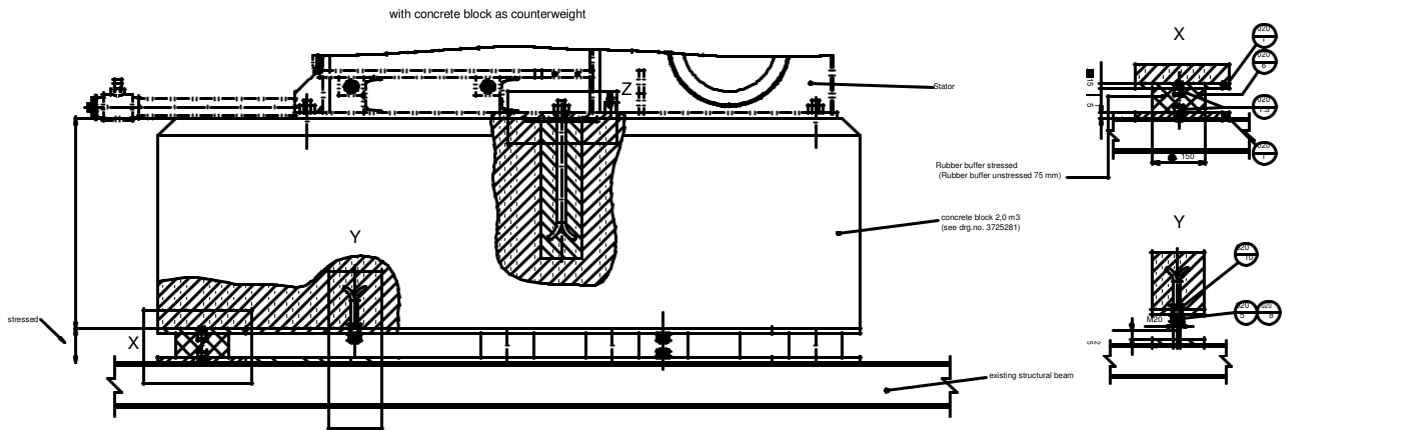
1.	Cement	Malabar, Ultra Tech, Zuari, Ramco, ACC, India Cements, Dalmia, Ambuja, J.P. Rewa, Vikram, Shri Cement, Birla Jute and Cement Corporation of India, Chettinadu, JSW Cement etc. or any other approved brand
2.	Steel (TMT)	Tata, Vizag, SAIL, TISCO, IISCO, RINL, Jindal Steel and Power Ltd, JSW Steel Ltd or equivalent as approved
3.	Admixtures	FOSROC, Polygon, STP, BASF, CERACHEM, Don Chemicals, Sika, Eurobuild Construction Chemicals & Coating, MAPEI, Bostik, MYK Schomburg, SunandaSpeciality Coatings Pvt. Ltd, KunalConchem Private Ltd., The Structural Waterproofing co. Pvt.Ltd. / CHRYSO or equivalent as approved

## SPECIFICATIONS AND SCHEDULE OF QUANTITIES

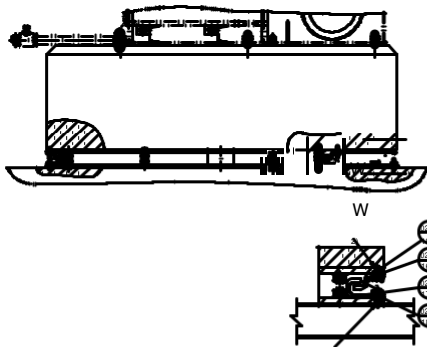
KITCO LTD					
TRAVANCORE TITANIUM PRODUCTS LTD					
CIVIL WORKS FOR THE CENTRIFUGE FOUNDATION.					
SPECIFICATION AND SCHEDULE OF QUANTITIES					
Sl.No	Description of Items	Unit	Qty	Rate(Rs)	Amount(Rs)
	<b>(RCC works)</b>				
1.00	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge.Note :- Cement content considered in this item is @ 330 kg/cum.				
	All works upto plinth level	cum	3.00	8891.59	26674.77
2.00	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding with 16 gauge GI binding wire etc complete including cost, conveyance, lead, lift of all materials for all types of RCC works as per drawing/specification and as directed by Engineer-in-Charge at all levels.				
	Thermo-Mechanically Treated bars of grade Fe-500D or more.	kg	300.00	78.07	23421.00
3.00	Extra for providing richer mixes at all floor levels.Providing M-30 grade concrete instead of M-25 grade BMC/ RMC. (Note:- Cement content considered in M-30 is @ 340 kg/ cum)	cum	3.00	95.86	287.58
4.00	Centering and shuttering including strutting, propping etc. and				
4.01	Foundations, footings, bases of columns etc. for mass concrete.	sqm	8.00	267.52	2140.16
	<b>Grand Total</b>				<b><u>52523.51</u></b>

## DRAWINGS

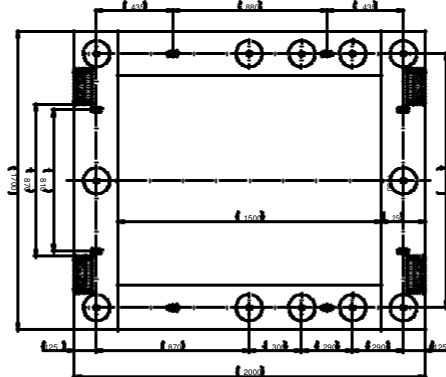





(1 : 10)  
A  
with concrete block as counterweight and earthquake safety  
2) Pay attention while setting the frames, that the threads don't get blocked. (Ideal if there is 2-3 mm free space at the end of the threads)



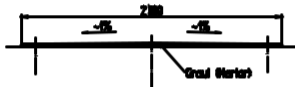
A (1 : 10) View from top without stator, without concrete block



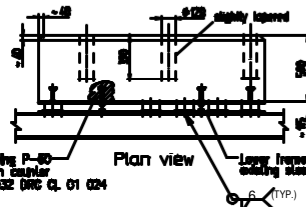
- NOTES:**
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
  2. CONCRETE SHALL BE CONTROLLED QUALITY AS PER IS:456-2000 MIX M30.
  3. REINFORCEMENT SHALL BE HYSD BARS OF GRADE Fe 500D.
  4. BEND HOOK/LAP LENGTH etc. SHOULD BE TAKEN AS PER IS:456-2000.
  5. CLEAR COVER TO OUTER REINFORCEMENT FOR FOUNDATION BLOCK SHALL BE 30mm.
  6. THIS DRAWING IS PREPARED BASED ON THE FERRUM CENTRIFUGAL P-60 VIBRATION ISOLATION WITH COUNTER WEIGHT.  
DRAWING NO: 3723007, H-1 DATED 27.07.2018

 the consultants		<b>KITCO Ltd.</b> (Estd. in 1972 by IDBI & Govt. of Kerala) PUTHIYA ROAD - NH BYPASS, KOCHI - 28		
CLIENT: TRAVANCORE TITANIUM PRODUCTS LIMITED				
PROJECT: COPPERAS RECOVERY PLANT				
TITLE: P-60 FERRUM CENTRIFUGE VIBRATION ISOLATION WITH COUNTER WEIGHT				
DRG NO: DP 932 DRG CL 01 024	SHEET NO: 1 OF 1	REV.	SCALE: NTS	A3
DESIGNED: Tibu Chacko	DRAWN: Sandeep S	CHECKED: Kurichan Simon	APPROVED: Shalimar MS	
ISSUED FOR:			UNIT: mm.	DATE: 12.03.2020
This drawing is the property of KITCO Ltd. and is to be used only for the purpose for which it was made and must not be in any way distributed to the extent of the company and is subject to change or damage.				

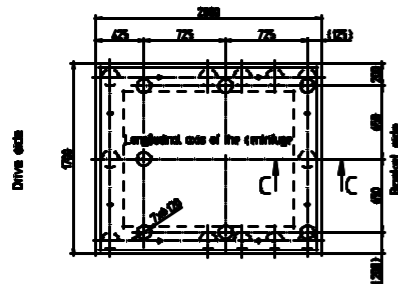
**Figure 3: Grouting inside the base frame**



**Figure 4: Form for the foundation block**

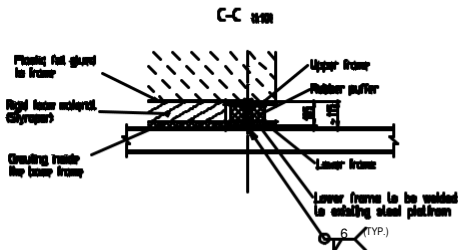


For details refer drawing P-60 vibration isolation with counter weight. dwg No: DP 932 DRG CL 01 024



**Note:**

1. The centre to centre distance of the bolt hole to be confirmed with the actual equipment to be installed.

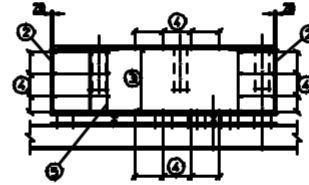


**Figure 5: Reinforcement of the foundation block**

**List of reinforcing bars:**

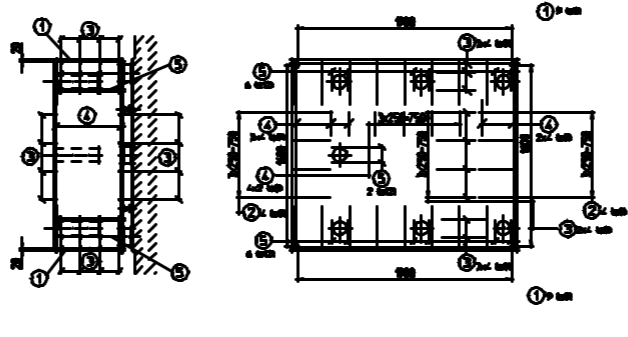
Reinforcing bars ribbed, 1cr steel  
SI 8 (R)  $\geq 486$  N/mm<sup>2</sup>

- ① 10x  $\phi$  8x1900 g.l.
- ② 8x  $\phi$  8x1900 g.l.
- ③ 10x  $\phi$  8x1900
- ④ 20x  $\phi$  8x1400
- ⑤ 14x  $\phi$  12x1450 g.l.



Plan view

**SPECIAL NOTE:**  
1. THE SPACING OF THE REINFORCEMENT IN THE TOP, BOTTOM AND SIDES SHALL NOT BE MORE THAN 200MM IN ANY CASE. THE NUMBER OF REINFORCEMENT SHALL BE VARIED ACCORDINGLY IN THE LIST OF REINFORCEMENT.



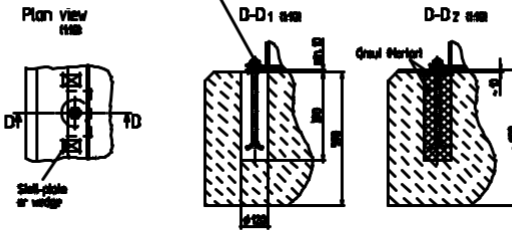
**SPECIAL NOTE:**

1. THE LOWER FRAME WORK OF THE ANTI/VIBRATION SYSTEM TO BE WELDED TO THE EXISTING PLATFORM MEMBERS AT THE RESPECTIVE LEVEL. THE POSITION, LEVEL AND ORIENTATION TO BE CONFIRMED WITH THE MECHANICAL AND PIPING LAYOUT.
2. THE CENTRE TO CENTRE DISTANCE OF THE BOLT HOLE TO BE CONFIRMED WITH THE ACTUAL EQUIPMENT TO BE INSTALLED.
3. ALL THE INSTRUCTIONS GIVEN IN THE INSTALLATION OPERATION AND MAINTENANCE MANUAL WHICH ARE RELEVANT TO THIS KIND OF FOUNDATION SHALL BE STRICTLY FOLLOWED. (DOC.NO: D-11 DATED 25/05/2007)

**NOTES:**

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. CONCRETE SHALL BE CONTROLLED QUALITY AS PER IS:456-2000 MIX M30.
3. REINFORCEMENT SHALL BE HYSD BARS OF GRADE F<sub>y</sub> 500D.
4. BEND/HOOK/LAP LENGTH etc. SHOULD BE TAKEN AS PER IS:456-2000.
5. CLEAR COVER TO OUTER REINFORCEMENT FOR FOUNDATION BLOCK SHALL BE 30mm.
6. THIS DRAWING IS PREPARED BASED ON THE FERRUM CENTRIFUGAL P-60 FOUNDATION BLOCK DRAWING NO: 1-372581, 1-E DATED 20-11-2018

For details refer drawing P-60 vibration isolation with counter weight. dwg No: DP 932 DRG CL 01 024



**Figure 6: Setting-up of centrifuge on foundation block**

**KITCO Ltd.**  
(Estd. in 1972 by IDBI & Govt. of Kerala)  
PUTHIYA ROAD - NH BYPASS, KOCHI - 28

CLIENT: TRAVANCORE TITANIUM PRODUCTS LIMITED				
PROJECT: COPPERAS RECOVERY PLANT				
TITLE: P-60 FERRUM CENTRIFUGE FOUNDATION BLOCK				
DRG NO: DP 932 DRG CL 01 023	SHEET NO: 1 OF 1	REV. NTS	SCALE: A3	
DESIGNED: Tibu Chacko	DRAWN: Sandeep S	CHECKED: Kuriachan Simon	APPROVED: Shalimar MS	
ISSUED FOR:	UNIT: mm.	DATE: 12.03.2020		

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