SPECIFICATIONS FOR READY MIX CONCRETE

1. **Batching of Concrete ingredients**:
   For all structural concreting, only Ready Mixed Concrete (RMC) manufactured at site is mandatory, weigh batching plant or obtained from approved R.M.C. supplying agencies or produced at site using mechanical mixers and weigh batchers as per item description, will be used. The R.M.C. supplying agency will supply mix design details in advance before start of delivery.

2. **Transporting, placing, compacting, finishing and curing**:
   Transporting, placing, compacting, finishing and curing of concrete shall be in accordance with IS:456-2000.

   2.1 **Transporting**:
   For all RMC concreting, the concrete after discharge from batching plant will be loaded in transit mixers and kept continuously agitated while mix is in transit. At destination the mix will be unloaded in to the hoppers of concrete pump. For site made concrete suitable prescribed methods shall be adopted.

   2.2 **Placing**:
   The concrete produced in RMC plant/batching plant, when discharged from transit mixer in pump hopper shall be kept continuously agitated and pumped to destination placing point. Site made concrete shall be placed by approved method of placing. The height of any single lift of concrete shall not exceed 1.5 m for walls and 2.0 m for columns. For columns where the height of pour is more than 2.0 m, suitable arrangement in formwork should be made.
so that the vertical drop of concrete is restricted to less than 2.0 m. Any such arrangement should be approved from the engineer in advance before execution.

High velocity discharge of concrete causing segregation of mix shall be avoided. The concrete shall be placed in the forms gently and not dropped from the height exceeding 1.5 m except in columns where the maximum allowed will be 2.0 m. Each batch of concrete will be placed in layer. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall be placed and fully compacted before the layer immediately below has taken initial set. The layers should be sufficiently shallow, to permit stitching of two layers together by vibration.

Concreting of any portion or section of the work shall be carried out in one continuous operation and no interruption of concreting work will be allowed without approval of the Engineer.

Plain concrete in foundations shall be placed, in direct contact, with the bottom of excavation, the concrete being deposited in such a manner, as not to get mixed with the earth. The concrete placed below the ground level shall be protected from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be kept free from contact, with such ground and with water draining there from during placing and for a period of 7 days or otherwise instructed there after. Approved means shall be taken to protect immature concrete from damage by debris, excessive loading, abrasion, vibrations, deleterious ground water, mixing with
earth and other materials and other influences, that may impair strength and durability of concrete.

Before starting of work contractor will get the concrete pouring programme and its sequence approved by Engineer to avoid cold joints.

2.3 **Compaction**:

External, Internal (needle) and surface (screed board) vibrators of approved make shall be used for compaction of concrete

a) External/internal vibrators shall be used for compaction of concrete in foundations, columns etc. For sections such as slabs, the concrete shall be compacted by external, internal and surface type vibrators, depending on the thickness of layer to be compacted. 25mm, 40mm and 60mm dia internal vibrators may be used. The concrete shall be compacted by use of appropriate diameter vibrator by holding the vibrator in position until:

i) Air bubbles cease to come to surface

ii) Resumption of steady frequency of vibrator after short period of dropping the frequency, when the vibrator is first inserted.

iii) The tone of the vibrator becomes uniform

iv) Flattened, glistening surface, with coarse aggregates particles blended into it, appears on the surface.
After the compaction is completed, the vibrator should be withdrawn slowly from concrete so that concrete can flow into the space previously occupied by the vibrator. To avoid segregation during vibration, the vibrator shall not be dragged through the concrete nor used to spread the concrete. The vibrator shall be made to penetrate into layer of fresh concrete below if any, for a depth about 150mm. The vibrator shall be made to operate at regular pattern of spacing. The effective radii of action will overlap, approximately half a radius to ensure complete compaction.

v) To secure even and dense surfaces free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic.

vi) A sufficient number of spare vibrators shall be kept readily accessible to the place of deposition of concrete to assure adequate vibration in case of breakdown of those in use.

25mm diameter immersion vibrators shall be used in thin sections upto 125mm, 40mm diameter immersion vibrators in fairly wide sections like beams, slabs, columns etc. and 60mm diameter vibrators in foundations, pilecaps or such large section members. Screed vibrators shall also be used for slab concreting.
vii) Plain concrete also shall be vibrated whenever and wherever directed by EIC to achieve full compaction, using needle and screed vibrators as necessary.

2.4 **Curing**:  
Curing shall be started at the earliest by spreading wet jute cloth (hessian) and cover top with impervious sheet and subsequently cured with spraying water. In inaccessible area to start with, curing be started by spraying curing compound before starting membrane curing.

3. **Placing temperatures**:  
During extreme hot weather, the concreting shall be done as per procedures set out in IS:7861, Parts I & II.

Fine and coarse aggregates for concreting shall be kept shaded and the concrete aggregates sprinkled with water for a sufficient time before concreting, in order to ensure that the temperature of these ingredients is as low as possible prior to batching. The mixer and batching equipment shall be also shaded and if necessary painted white in order to keep their temperatures as low as possible. The placing temperature of concrete shall be as low as possible in warm weather and care shall be taken to protect freshly placed concrete form overheating by sunlight in the first few hours of its laying. The time of day selected for concreting shall also be chosen so as to minimize placing temperatures. In case of concreting in exceptionally hot weather the Engineer may in his discretion specify the use of ice either flaked and used directly in the mix, or blocks,
used for chilling the mixing water. In either case no extra payment shall be made to the contractor on this account.

4. **Construction joints**:  
Construction joints in all concrete work shall be made as directed by the Engineer. Where vertical joints are required, these shall be shuttered as directed and not allowed to take the natural slope of the concrete.

Before fresh concrete is placed against a vertical joint, the old concrete shall be chipped/sand blasted, cleaned and moistened 25 hours before placing the concrete. All standing water should be removed and dried with compressed air. Neat cement slurry shall be applied on the chipped/sand blasted surface and mortar of the same water cement ratio as the concrete and 10mm thick applied. Where required suitable expansion joints shall also be provided as directed by the Engineer.

The time of day selected for concreting shall also be chosen so as to minimize placing temperatures. In case of concreting in exceptionally hot weather the Engineer may in his discretion specify the use of ice either flaked and used directly in the mix or blocks used for chilling the mixing water. In either case the cost of ice either flaked and used directly in the mix or blocks used for chilling the mixing water. In either case the cost of ice and additional labor involved in weighing and mixing etc. shall be borne by the contractor and nothing will be paid on this account.
5. **Defective Concrete:**

Should any concrete be found honeycombed or in any way defective, such concrete shall on the instruction of the Engineer be cut out by the Contractor and made good at his own expenses.

6. **Exposed Faces, Holes and Fixtures:**

On no account shall concrete surfaces be patched or covered up or damaged concrete rectified or replaced until the Engineer or his representative has inspected the works and issued written instructions for rectification. Failure to observe this procedure will render that portion of the works liable to rejection; in which case it will be treated as a work which has failed to meet specified strength requirements and dealt with according to Clause 1.11.

Holes for foundation or other bolts or for any other purposes shall be moulded, and steel angles, holdfasts or other fixtures shall be embedded, according to the drawing or as instructed by the Engineer.

7. **Cracks:**

7.1 If cracks develop in concrete construction which in the opinion of the Engineer may be detrimental to the strength of the construction, the contractor at his own expense shall test the slab or other construction as specified in Special Conditions. If under such test loads the cracks develop further, the Contractor shall dismantle the construction, carry away the debris, replace the construction and carry out all consequential work thereto, without any extra payment.

7.2 If any cracks develop in the concrete construction, which in the opinion of the Engineer, are not detrimental to the strength of the
construction, the contractor at his own expense shall grout the cracks with polymer cement grout of approved quality at his own expense and risk and shall make good to the satisfaction of the Engineer the surface finish which in the opinion of the Engineer has suffered damage either in appearance or stability owing to such cracks. The Engineer’s decision as to the extent of the liability of the Contractor in the above matter shall be final and binding.

8. **Finishes :**

Unless otherwise instructed the face of exposed concrete placed against formwork shall be rubbed down immediately on removal of the formwork to remove irregularities. The face of concrete for which for which formwork is not provided other than slabs shall be smoothed with a float to give a finish equal to that of the rubbed down face, where formwork is provided. The top face of a slab which is not intended to be covered with other materials shall be leveled and floated to a smooth finish at the levels or falls shown on the drawings or as directed. The floating shall be done so as not to bring as excess of mortar to the surface of the concrete. The top face of a slab intended to be surfaced with other materials shall be left with a spaded finish. Face of concrete intended to be plastered shall be roughened by approved means to form a key.

When at site, concrete cube testing machine is used 10% of the cubes should be tested at independent recognized laboratories approved by Engineer at their cost.
9. **Scope of work & item to include:**

1. The item refers to ready mix concrete required for R.C.C./P.C.C. works as mentioned in item description under Schedule-‘A’ procured from reputed manufacturer approved by Engineer. The material shall be conforming to B-7 refer page No.38 for controlled cement concrete. (Standard Specifications of PWD, Vol-I)

   The material requirement shall be completed according to Standard Specifications No.B.7.1 refer Page No.38 for controlled cement concrete.

2. The item include manufacturer with ingredients, control temperature, transportation, pumping, placing, vibration and curing of Ready Mix Concrete and all taxes, excise duty, sales tax, octroi, insurance etc. levied by Govt./Semi-Govt./local authority and cost of ready mix concrete and any penalty, additional charges for controlling temperature up to casting or any other charges levied by the manufacturer.

3. Proportioning of the mix/mix design shall be decided by the contractor/RMC manufacturer to achieve strength specified in item and shall be get approved by Engineer. The proportioning of ingredients, use of ingredients and mix designs parameters for various slumps shall be got approved by Engineer prior to mix design.

4. Scaffolding shall conform to specifications No.B.6.5 (a) and get approved by the Engineer.
5. Forms shall conform to specifications No.B.6.5(b).

6. The concrete shall be pumped to the final positions as quickly as possible by methods which will prevent segregation and loss of ingredients.

7. The concrete shall be placed into its final position, compacted and finished within 30 minutes of mixing the water and before initial setting commences. The method of placing shall be such as to avoid segregation. Placing shall be done in a balanced manner to avoid eccentric loads on the form work.

As far as possible the concreting shall be done continuously and construction joints avoided.

If the area to be concreted is under water, the water shall be removed by bailing out or using pumps and other devices.

8. Compaction shall be done by mechanical vibrators and also by rods so that a dense concrete is obtained.

9. The concrete shall be adequately cured.

10. Immediately after the removal of forms, any undulations, depressions, cavities, honey combing broken edges or corners height spots defects shall be made good and finished with cement mortar 1:2. But necessity of such finishing must be exceptional and the total not exceed 1% on an average.
11. Concrete which is partially hardened shall not be tempered or re-mixed but shall be disposed off as desirable.

12. Sampling and testing shall be done as per I.S.456 (latest version).

13. All labour, materials use of equipment, tools and plant, installing and removal of scaffolding, flase work and forms and branching necessary for the satisfactory completion of item,

14. Compensation for injury to persons and damage to work or property.

15. Establishment of site laboratory.

10. **Testing**:
Cubes of 15 cm x 15 cm x 15 cm size shall be cast on the first day and tested for compression at 7 and 28 days. Later on, if the Engineer so directs, 6 cubes shall be tested for every 50 cubic meters or part thereof of the concrete casted.

11. **Measurement**:
Concrete and reinforcement shall be paid separately unless otherwise specified.

The contract rate shall be for a unit of one cubic meter of concrete. The concrete shall be measured for its length, breadth and depth
limiting dimensions to those specified on the drawings or as ordered by the Engineer.

The volume of concrete measured shall include that occupied by
1) Reinforcement and other metal sections.
2) Cast in components each less than 0.01 M³ in volume.
3) Rivetts, fillets or internal splays each less than 0.005 M² in cross sectional area.
4) Pockets and holes not exceeding 0.01 M³ in volume.
5) Rates for precast concrete shall include demoulding, handling, storing, transporting and erecting at site, including all clamping, bolting, bracing that may be required during erection, including erection equipment.

11.1 In order to exercise the required degree of constant control over the concrete materials and their proportions, the contractor shall set up and maintain at his own expense a testing laboratory at site. He shall provide all apparatus required for sensitive testing of concrete and concrete materials. In particular he must have the following equipment set up in the site laboratory.

i) A set of Standard Sieves.
ii) Sieve shaker
iii) Measuring Cylinders
iv) Slump cones
v) Adequate number of Standard moulds
vi) Weighing balance
vii) Curing tank for cubes
viii) Concrete cube testing machine 200 T. Capacity must be electricity operated.

Any other apparatus deemed necessary by the Engineer for proper control shall be provided by the Contractor at his own expense. The laboratory shall be staffed by qualified technicians.

When at site, concrete cube testing machine is used 10% of the cubes should be tested in CIDCO laboratory or approved by Engineer at contractor’s cost.

12. **Ready-Mixed Concrete and Pumping Concrete**

12.1 Ready-mixed concrete may be manufactured in a central automatic weight Batching plant and transported to the job in agitating transit mixer.

The maximum size of coarse aggregate shall be limited to one-third of the smallest inside diameter of the hose or pipes used for pumping. Provision shall be made for elimination of over-sized particles by screening or by careful selection of aggregates. To obtain proper gradation it may be necessary to combine and blend certain fractional sizes to aggregates. Uniformity of gradation throughout the entire job shall be maintained.

The quantity of coarse aggregate shall be such that the concrete can be pumped, compacted and finished without difficulty.
12.2 Fine aggregates:
The gradation of fine aggregate shall be such that 15 to 30 percent should pass the 0.30 mm screen and 5 to 10 percent should pass 0.15 mm screen so as to obtain a pumpable concrete. Sands that are deficient in either of these two sizes should be blended with selected finer sands to produce these desired percentages. With this gradation, sands having a fineness modulus between 2.4 and 2.8 are generally satisfactory. However, for uniformity, the fineness modulus of the sand should not vary more than 0.2 from the average value used in proportioning.

12.3 Water, Admixtures and slump:
The amount of water required for proper concrete consistency shall take into account the rate of mixing, length of haul, time of unloading and ambient temperature conditions.

Additions of water to compensate for slump loss should not be resorted to nor should the design maximum water-cement ratio be exceeded. Additional dose of retarder/plasticizer/superplasticizer shall be used with prior approval of Engineer to compensate the loss of setting time and slump at contractor’s cost. Retempering water shall not be allowed to be added to mixed batches to obtain desired slump.

12.4 Transportation:
The method of transportation used should efficiently deliver the concrete to the point of placement without significantly altering its desired properties with regard to water-cement ratio, slump, and homogeneity.
The revolving-drum truck bodies of approved make shall be used for transporting the concrete. The number of revolutions at mixing speed, during transportation, and prior to discharge shall be specified and agreed upon. Reliable counters shall be used on revolving-drum truck units. Standard mixer uniformity tests, conforming to ASTM standards C 94-69 “Standard Specifications for Ready Mix Concrete”, shall be carried out if desired by Engineer to determine whether mixing is being accomplished satisfactorily.

12.5 Pumping of concrete:

Only approved pumping equipment, in good working condition, shall be used for pumping of concrete. Concrete shall be pumped through a combination of rigid pipe and heavy-duty flexible hose of approved size and make. The couplings used to connect both rigid and flexible pipe sections shall be adequate in strength to withstand handling loads during erection of pipe system, misalignment, and poor support along the lines. They should be nominally rated for at least 3.5 Mpa pressure and greater for rising runs over 30 m. Couplings should be designed to allow replacement of any section without moving other pipe sections, and should provide full cross section with no construction or crevices to disrupt and smooth flow of concrete.

All necessary accessories such as curved sections of rigid pipe, swivel joins and rotary distributors, pin and gate valves to prevent backflow in the pipe line, switch valves to direct the flow into another pipe line, connection devices to fill forms from the bottom up, extra strong couplings for vertical runs, transitions for connecting different sizes of pipe, air vent for downhill pumping, clean-out
equipment etc. shall be provided as and where required. Suitable power controlled booms or specialized crane shall be used for supporting the pipe line.

12.6 Field control:
Sampling at both truck discharge and point of final placement shall be employed to determine if any changes in the slump and other significant mix characteristics occur. However, for determining strength of concrete, cubes shall be taken from the placement end of line. The RMC supplier should nominate a technically qualified representative at site for sampling, testing and placing of concrete.

13. Planning:
Proper planning of concrete supply, pump locations, line layout, placing sequence and the entire pumping operation shall be made. The concrete production, transportation and placing shall be planned in such a manner that duration between addition of water during mixing and placing of concrete in desired location is well within time limits prescribed by the RMC manufacturer, however, this is subjected to fulfillment of slump and other properties of concrete as specified in tender. On failure to adhere to the time schedule by the supplier the Engineer may reject the concrete.

The pump wherever used should be as near the placing area as practicable, and the entire surrounding area shall have adequate bearing strength to support concrete delivery pipes. Lines from pump to the placing area should be laid out with a minimum of bends. For large placing areas alternate lines should be installed for rapid connection when required. Standby power and pumping
equipment should be provided to replace initial equipment, should breakdown occur.

The placing rate should be estimated so that concrete can be ordered at an appropriate delivery rate.

As a final check, the pump should be started and operated without concrete to be certain that all moving parts are operating properly. A grout mortar should be pumped in to the lines to provide lubrication for the concrete, but this mortar shall not be used in the placement.

When the form is nearly full and there is enough concrete in the line to complete the placement, the pump shall be stopped and a go-devil inserted and shall be forced through the line by water under pressure to clean it out. The go-devil should be stopped at a safe distance from the end of the line so that the water in the line will not spill into the placement area. At the end of placing operation, the line shall be cleaned in the reverse direction.

SUBMISSION OF DOCUMENTS FROM RMC MANUFACTURER

Following document shall be submitted by the RMC manufacturer to CIDCO through the contractor along with checklist for RMC specified in the tender document.

1. Design Mix
2. Manufacturer’s Test Certificate for cement and plasticizer
3. Lab test certificates for all ingredient of concrete
4. Delivery docket sheet mentioning the grade of concrete, quality of ingredient used, slump, transit mixer vehicle no. placement, location, time of concrete production and placing etc.
14. **Reinforcement** :

List of Bureau of Indian Standard Code of Practice (ISI)

- 432 - Mild steel and medium tensile steel bars and hard drawn steel wire for concrete.
- 1786 - Specifications for HYSD bars and wires for concrete reinforcement.
- 250 - Code of practice for bending and fixing of bars for concrete reinforcement.
- 2751 - Recommended practice for welding of mild steel reinforcement.

14.1 **Steel** :

Mild Steel, rounds conforming to IS:432, HYSD bars conforming to IS:1139, Cold twisted bars conforming to IS:1786. Any other steel specified for reinforcement shall conform in every respect to the latest relevant Indian Standard Specifications and shall be of tested quality under the ISI Certification Scheme.

All reinforcing work for concrete work shall be executed in conformity with the drawings supplied and instructions given by the Engineer and shall generally be carried out in accordance with the relevant Indian Standard Specifications (IS:2502)

14.2 **Inspection and Testing** :

Every bar shall be inspected before assembling on the works and any defective, brittle, excessively rusted or burnt bars shall be removed. Cracked ends of bars shall be cut out.
Specimens sufficient for three Tensile Tests per 20 tonnes of bars and for each different size shall be sampled and tested by the Contractor. Batches shall be rejected if the average results of each batch are not in accordance with the specifications.

14.3 **Lapping**:

a) As far as possible bars of the maximum length available shall be used. Laps shown on drawings or otherwise specified by the Engineer will be based on the use by the contractor of bars of maximum length. In case the contractor wishes to use shorter bars, laps shall be provided at the contractors cost in the manner and at the location approved by engineer.

b) As and when necessary welded laps shall be provided as specified by the engineer.

14.4 **Spacing, supporting and Cleaning**:

i) All reinforcement shall be placed and maintained in the position shown on the drawing

ii) The contractor shall provide approved type supports as specified on the drawings for maintaining the top bars of the slab in position during concreting. All cover blocks shall be concrete (not and cement mortar) and of the same strength as that of the surrounding concrete and properly compacted.

iii) 18 SWG PVC coated G.I. wire shall be used as binding wire. All bars crossing one another shall be bound with this wire twisted tight to make the skeleton or network rigid so that the reinforcement is not displaced during placing of concrete.
iv) Bars must be cleaned before concreting commences of all scales, rust or partially set concrete which may have been deposited during placing of concrete in previous lift of concrete.

The bars shall be cleaned with dry gunny bags if they are coated lightly with rust or other impurities. On no account shall the bars be oiled or painted nor shall mould oil used on the framework be allowed to come in contact with the bars. Cement wash to bars shall not be permitted.

14.5 **Welding**:

i) Whenever specified all welding shall be carried in accordance with IS: 2751. Only qualified welders shall be permitted to carry out such welding.

ii) For cold twisted reinforcement, welding operation must be controlled to prevent supply of large amount of heat greater than that can be dissipated. The extreme non twisted end portion shall be cut off before welding. Electrodes with rutile coating should be used.

14.6 **Measurement**:

i) The weight of steel to be paid for at the contract rates shall be the weight of bars as mentioned on the drawing or as instructed by the engineer including stirrups, ties, spacer bars, chairs and any other steel works specified as reinforcements but excluding welding and cover blocks. Laps as specified on the drawing shall be paid for. Laps required because of the contractor’s use of shorter bars will not be paid for.

ii) The weight of any stirrups and tie bar shall be computed from the dimension given on the drawings or bending schedules. The
weight in Kg/ metre shall be taken as 0.785 kg/ metre per 100 mm² of cross section. No allowance in the weight paid for shall be made for the rolling margin.

No rolling margins will be considered for payment.

15. **Formwork**

4990 - Specification for plywood for concrete shuttering work.
3696 - Safety code of scaffolds and ladders
4014 - Steel and tubular scaffoldings.
8989 - Safety code for erection of concrete framed structures.

15.1 **Definition**:

The term “Formwork” or “Shuttering” shall include all forms, moulds, sheeting, shuttering planks, walers, poles, posts, shores, struts and strutting, ties, uprights, wallings, steel rods, bolts, wedges and all other temporary supports to the concrete during the process of setting.

15.2 **Materials**

15.2.1 All facing formwork to come in contact with concrete in different elements of the structure shall be of such material and size as specified on drawings or as instructed by the Engineer.

15.2.2 Timber facing formwork to come in contact with concrete for “Exposed Concrete Surfaces” shall consist of lab-jointed or tongue and grooved planks as directed by the Engineer and no joints shall permit leakage of mortar at all from cast-in-situ concrete.
15.2.3 The materials for other backing and supporting formwork and their sizes shall be selected by the contractor and shall be subject to the approval of the Engineer.

15.3 **Design**:  
The formwork shall be designed and constructed so that the concrete can be properly placed and thoroughly compacted to obtain the required shape, position and level subject to specified tolerances. It is the responsibility of the contractor to obtain the results required by the Engineer, whether or not some of the work is sub-contracted. Approval of the proposed formwork by the Engineer will not diminish the Contractors responsibility for the satisfactory performance of the formwork, nor for the safety and co-ordination of all operations.

15.4 **Formwork for Exposed Concrete Surfaces**:  
The facing formwork, unless indicated otherwise on drawings, or specifically approved by the Engineer in writing, shall generally be made with materials not less than the thickness mentioned below for different elements of the structure.

15.4.1 Plain slab soffits, and sides of beams, girders, joists and ribs and side of walls, fins, parapets, pardis, sub-breakers etc. shall be made with:

a) Steel plates not less than 3mm thick of specified sizes stiffened with a suitable structural frame work, fabricated true to plane with a tolerance of +/- 2mm within the plate.
b) Plywood plates not less than 12mm thick (IS:4990-Specification for plywood for Concrete Shuttering Work) or 3mm thick with a 20mm timber plank backing, of specified sizes stiffened with a suitable timber framework.

15.4.2 Bottom of beams, girders and ribs, sides of columns shall be made with:

a) Steel plates not less than 5mm thick of specified size stiffened with a suitable structural frame, fabricated true to plane with a tolerance of +/- 2 mm within the plate.

b) Timber planks of 35mm actual thickness and of specified surface finish, width and reasonable length.

c) Plywood plates not less than 12mm thick, of specified sizes stiffened with a suitable timber framework.

15.5 Erection of Formwork:
The following shall apply to all formwork:

15.5.1 To avoid delay and possible erection of the formwork, the Contractor shall obtain sufficiently in advance, the approval of the Engineer for the design of forms and the type of materials used before fabricating the forms. (ref ACI 347 Formwork for concrete of equivalent I.S. Code)

15.5.2 All shutter planks and plates shall be adequately backed to the satisfaction of the Engineer by a sufficient number and size of walers
or framework to ensure rigidity during concreting. All shutters shall be adequately strutted, braced and propped to the satisfaction of the Engineer to prevent deflection under deadweight of concrete and superimposed live load of workmen, materials and plant, and to withstand vibration. No joints in proper shall be allowed.

15.6 Vertical props shall be supported on wedges or other measures shall be taken where the props can be gently lowered vertically during removal of the formwork. Props for an upper story shall be placed directly over those in the storey immediately below, and the lower props shall bear on a sufficiently strong area.

1) Care shall be taken that all formwork is set plumb and true to line and level or camber or batter where required and as specified by the Engineer.

2) Provisions shall be made for adjustment of supporting struts where necessary. When reinforcement passes through the formwork care should be taken to ensure close fitting joints against the steel bars so as to avoid loss of fines during the compaction of concrete.

3) If the formwork is held together by bolts or wires, these shall be so fixed that no iron will be exposed on surface against which concrete is to be laid. In any case wires shall not be used with exposed concrete formwork. The Engineer may at his discretion allow the Contractor to use tie-bolts running through the concrete and the Contractor shall decide the location and size of such tie-bolts in consultation with the Engineer. Holes
left in the concrete by these tie-bolts shall be filled as specified by the Engineer at no extra cost.

4) Formwork shall be so arranged as to permit removal of forms without jarring the Concrete. Wedges, clamps and bolts shall be used wherever practicable instead of nails.

The formwork for beams and slabs shall be so erected so that forms on the sides of the beams and the soffit of slabs can be removed without disturbing the beam bottoms or props under beams.

5) Surface of forms in contact with concrete shall be oiled with a mould oil of approved quality or clean diesel oil. If required by the Engineer the contractor shall execute different parts of the work with different mould oils to enable the Engineer to select the most suitable. The use of oil which results in blemishes of the surface of the concrete shall not be allowed. Oil shall be applied before reinforcement has been placed and care shall be taken that no oil comes in contact with the reinforcement while it is being placed in position.

The formwork shall be kept thoroughly wet during concreting and for all the whole time that it is left in place.

6) Immediately before concreting is commenced, the formwork shall be carefully examined to ensure that following:
a) Removal of all dirt, shavings, sawdust and other refuse by brushing and washing
b) The tightness of joints between panels of sheathing and between these and any hardened core.
c) The correct location of tie bars, bracing and spacers, and especially connection or bracing.
d) That all wedges are secured and firm in position.
e) That provision is made for traffic on formwork not to bear directly on reinforcing steel.

7) Formwork shall be continuously watched during the process of concreting. If during concreting any weakness develops and formwork shows any distress the work shall be stopped and remedial action shall be taken.

15.7 Exposed Concrete Work:
Exposed concrete surfaces shall be smooth and even originally as stripped without any finishing or rendering. Where directed by the Engineer, the surface shall be rubbed with carborundum stone immediately on striking the forms. The Contractor shall exercise special care and supervision of formwork and concreting to ensure that the cast members are made true to their sizes, shapes and positions and to produce the surface patterns desired. No honeycombing shall be allowed. Honeycombed parts of the concrete shall be removed by the Contractor as directed by the Engineer and fresh concrete placed without extra cost, as instructed by the Engineer. All materials, sizes and layout of formwork including the locations for their joints shall have prior approval of the Engineer or the Architect.
15.8 **Camber:**
Forms and falsework shall be generally cambered as indicated in the drawings or as instructed by the Engineer. However, for beams up to 5m span and slabs up to 4m span camber is not normally required to be provided.

15.9 **Tolerances**
In accordance with IS:456 2000 and MORT & H section 1500.

15.10 **Age of Concrete at Removal of Formwork:**
In accordance with IS:456 2000 and MORT & H section 1500.

The Engineer may vary the periods specified in IS : 456-2000 if he considers it necessary. Immediately after the forms are removed, they shall be cleaned with a jet of water and a soft brush.

15.11 **Stripping of Formwork**
Formwork shall be removed carefully without jarring the concrete, and curing of the concrete shall be commenced immediately. Concrete surfaces to be exposed shall, where required by the Engineer, be rubbed down with carborundum stone to obtain a smooth and even finish. Where the concrete requires plastering or other finish later the concrete surface shall be immediately hacked lightly all over as directed by the Engineer. No extra charge will be allowed to the Contractor for such work on concrete surfaces after removal of forms.
15.12 **Repropping**

For multistoreyed buildings the floors may need repropping to support the loads of the upper floors under construction. The extent of such repropping shall be as directed by the Engineer (this does not normally exceed one fourth of the props provided above). Such repropping shall not be paid for separately and the cost of such repropping shall be deemed to have been included in the rates.

15.13 **Reuse of Forms**

The Contractor shall not be permitted reuse of timber facing formwork brought new on the works more than 5 times for exposed concrete formwork and 8 times for ordinary formwork. 5 or 8 uses shall be permitted only if forms are properly cared for, stored and repaired after each use. The Engineer may in his absolute discretion order rejection of any forms he considers unfit for use for a particular item, and order removal from the site of any forms he considers unfit for use in the works. Used forms brought on the site will be allowed proportionately fewer uses as decided by the Engineer.

Use of different quality boards or the use of old and new boards in the same formwork shall not be allowed.

15.14 **Hacking-Out**

1. Immediately after removal of forms, the concrete surfaces to be plastered shall be roughened with a bush-hammer or with chisel and hammer as directed by the Engineer to make the surface sufficiently coarse and rough to provide a key for plaster.
2. At all construction joints in the beams, slabs and columns etc. laitance and any other loose concrete shall be chipped off immediately after striking the formwork. The chipped surface shall then be thoroughly cleaned with a jet of water.

15.15 Measurements:

1. Where formwork is paid for separately, measurements shall be of the area of finally exposed surface requiring shuttering including curves, angles, splays, metres, bevels, etc. for which no special rate shall be allowed. The rates shall be inclusive of all work connected with provision of formwork, its erection and removal and treatment of the concrete surface immediately after removal of the formwork.

2. No extra payment shall be made for holes to be made in formwork for inserting electrical conduits, hooks for fans, for plumbing work.

3. Where boxes or pockets are required to be formed in the concrete, they will be paid for separately at the Contract Rates, but in measuring the area of concrete surfaces shuttered, no deduction will be made for openings upto 0.4 m². For voids larger than 0.4 m² the surface of formwork forming the voids shall be paid at rates of formwork set out in the Schedule and the area of voids deducted from the face area of shuttering.

4. No deductions shall be made from formwork of main beams where the secondary beam intersects it. Formwork to secondary beams shall be measured upto sides of the main beams. No deduction shall be made from the formwork to stanchion or column casings at intersections of beam.
5. No payment shall be made for temporary formwork used in concreting, nor for formwork required for joints or bulkheads, in floors, or elsewhere, whether such joints are to be covered later with concrete or mastic or other material.

Signature of Tenderer
Date:

Chief Engineer & General Manager (T)
Date: