

SECTION - IV

FORM WORK

1.0 GENERAL

1.1 Standards

Work shall be carried out to Indian Standards and Code of Practices. In absence International Standards shall be followed. These shall be latest issue. List given hereunder is not to be considered as conclusive and is for reference and guidance only. Any discrepancies/conflict noticed shall be directed to the Architect for his direction/approval. However, as a general rule more stringent specification shall take precedence.

1. IS 303 Specification for plywood for general purpose.
2. IS 456 Code of practice for construction and design of reinforced concrete.
3. IS 2751 Code of practice for welding of M.S bars used for RCC
4. IS 3696 Safety Code of scaffolds and ladders :
Part 1 Scaffolds
Part 2 Ladders
5. IS 4014 Code of practice for steel (part 1 & 2) tubular scaffolding
6. IS 4082 Recommendation on stacking and storage of construction materials
7. IS 8989 Safety code of erection of concrete formed structures

1.2 Quality assurance

Contractor shall assume and take upon himself to

- a) Design, construct, erect, maintain and struck form work proprietary or custom made
- b) Form work shall provide required
 - ☐ Shape, size and finish
 - ☐ Rigidity and durability during placing (live levels)
 - ☐ Rigidity and durability for receiving fresh concrete
 - ☐ Leak proof watertight joints/junctions
 - ☐ Easy removal without disturbing concrete
 - ☐ Provide easy access for handling and placing
- c) Form work shall provide safety and shall have adequate access for concreting

- d) Workers shall work with required safety measures such as safety belts, helmet etc.

1.3 Experience

The contractor shall provide

- a) Site supervisors and foremen qualified and experienced atleast 5(five) years on similar nature of form work.
- b) Semiskilled / skilled labour shall be of minimum experience of 5(five) years in doing similar nature of form work

1.4 Examination of strata

The contractor shall examine and convince himself prior to start of work that strata is firm, rigid and safe to erect scaffold. In absence, same shall be prepared by him and then work shall proceed. If it is not possible due site condition, method of erection support etc. shall be detailed and got approved from Architect prior to start. In any case responsibility of formwork shall be that of the contractor.

2.0 MATERIAL

2.1 Timber

- a) Jungle wood timber in form of planks, battens (runners), ballies, strong durable without cracks, able to sustain warping, twisting and distortion shall be allowed in work for type of requirements.
- b) Teak wood /good quality jungle wood shall be used for special decorative moulds. Moulds may be smooth planed or finished with laminate

2.2 Steel

Standard rolled steel sections shall be used with due fabrication of standard special moulds, unitised form work scaffolds, staging etc.

2.3 System

Patented proprietary designed metal (Steel, aluminium or fiber glass) form work best suited for type of work undertaken and its requirements shall be used.

2.4 Wire nails confirming to IS and mating needs shall be used.

2.5 Bolts / Nuts /Clamps

MS bolts, nuts, clamps standard or purpose made shall be used. Use of these shall not be harmful to concrete and shall be easily removable or if left in concrete shall be inert to concrete in all respect.

2.6 Form release Agents

Emulsion and oil or chemical agent being used shall not react with reinforce concrete at any stage. No chemical reaction shall take place which may be harmful to reinforcement concrete for its durability strength. These shall not produce any stain and shall not stick to concrete surfaces which will reduce further bonding strength of masonry mortar, painting etc.

3.0 SCOPE OF WORK

3.1 Designing

The contractor shall design, draw, prepare and submit method of statement backed by designed calculations, taking into account the points noted in clause 1.2 here above atleast six weeks prior to the starting of activity. Required drawing and sketches shall be enclosed along with statement for the proposed area to be taken up for working. The statement shall give

- ☐ Loadings considered
- ☐ Materials proposed
- ☐ Repetitions expected
- ☐ Staging/supporting arrangement
- ☐ Deployment of proprietary metal form work system.
- ☐ Method of handling

It shall be responsibility of the contractor to get the design approved from Architect atleast four weeks prior to start of formwork.

3.2 Equipments

The contractor shall provide required tools, plants, equipments including its proper maintenance during construction at site.

3.3 Proprietary metal formwork

The contractor shall arrange to provide proprietary system metal formwork applicable/adoptable to various areas of works. He shall be responsible to deploy with required mechanism for handling, shifting, transporting placing in position.

3.4 Supervision

The contractor shall be responsible to provide experienced foremen (atleast Five years) in supporting/executing similar nature and magnitude of work. He shall be able to read drawings and should be capable of guiding and getting work executed to quality.

3.5 Labour

The contractor shall provide experienced skilled carpenters to carryout work with system of formwork deployed and necessary plants and equipment shall be made available at site.

4.0 WORKMANSHIP

4.1 Form work shall be classified namely as follows :

- a) Textured or decorative finish
- b) Fair-faced finish
- c) Rough finish

In BOQ, the contractor shall account for all material and labour etc. to achieve the above finishes to the satisfaction of the Architect in his quoted price.

- 4.2
1. Erection of form work may be from pre-moulded, prefabricated, pre-assembled plates or forms reasonable enough to transport and erect at site to correct line and level as set out at site. Supports shall be firm and maintained in position by nails, cross bracings, tie rods, locking bolts and nuts. It shall be rigid and stiff so as to retain its shape during and after concreting.
 2. Joints shall be watertight, and no cement slurry shall be allowed to slip through. In joints foamed tapes shall be used.
 3. Prefabricated or site forms shall be assembled, so as to deshutter without any jerk to the green concrete. For these double wedges shall be used. Wedges shall be nailed, the heads reasonably left out, allowing easy removal while deshuttering.
 4. Prefabricated or on-site fabricated forms shall be of sufficient thickness and with the required supporting runners in either direction. Supporting runners shall be standardised in size for easy replacement and universal use at site.
 5. Props shall be of steel only. Teak ballies may be permitted with written permission of the Architect for specific use. Size and verticality shall be approved by the Architect. Its spacing shall be as per design. It shall be vertical and plumbed. Base shall be a proper steel plate or timber plank, for equal distribution of load.
 6. In repeated use, panels shall be clearly marked for using at defined locations.
 7. Successive lift shall be tightened with previous lift by fixing foamed strips at joints to avoid grout leakage.
 8. In fill pieces and panels shall be well dressed, leveled and jointed with main formwork so as to achieve smooth, even natural finish.
 9. Props, Soldiers, wallings, Shores, bearers, Clamps, wall & ties etc. shall be at required spacings.
 10. Props, shores shall be securely braced with firm bearing.
 11. Provide and fix or fix only inserts pockets, to correct line and level and with sufficient rigidity to keep in position while concrete placing is in progress along with vibration.
 12. Sloping, brackets, chajjas etc shall be well secured and firmly restrained.
 13. Adequate access and working platform shall be arranged with required safety to avoid reinforcement displacement, damage to shuttering and easy movement of concrete gang.

14. Props and scaffolds are to be erected to correct plumb, line, level and with required tie. Load carrying capacity of props shall be as per table of manufacturer.
15. Props and scaffolds shall not be loaded more than allowed by manufacturer of Props /scaffolds.
16. Heavy, medium and light duty props shall not be mixed up.
17. Beams and slabs shall have camber of 4 mm per metre or as directed by the Architect.
18. All angles and corners shall be sharp and well defined. In places where concrete edges are permanently exposed and require no further treatment, they shall be chamfered in a tringle of 25x25mm.
19. Props of steel or timber (if approved in writing) shall be provided with adequate horizontal and cross - bracing. Steel props shall use steel pipes and steel couplers. If use of timber is permitted, planks of 100 x 25 mm shall be used and shall be secured by nailing them to timber props. No other material shall be permitted.
20. At the design and erection stage, the following additional points shall be considered and incorporated into the shutters.
 - a) Openings for cleaning prior to start of concreting.
 - b) Pouring points shall avoid high drops and provide easy access to vibrator needles.
21. Surfaces shall be treated with mould releasing oil or emulsion as approved by the Architect prior to reinforcement laying.
22. The following point shall be observed very carefully:
 - a) Joints of moulds shall be watertight. It is easy to check from bottom and make sure that no light is visible.
 - b) Props shall be on solid base, plumbed, in one straight line, and braced horizontally and cross.
 - c) Tie bars in beams, walls and columns shall be at the correct place and fully tight.
 - d) Wedges shall be fully secured and nailed with head left out for easy removal.
 - e) All saw dust, dirt, shaving and any other unwanted materials shall be cleaned and hosed out.
 - f) Provision shall be made for watching form work while concreting and any other platform needed for movement of workers without any disturbance to reinforcement.
23. Opening/inserts

All required openings and pockets shall be provided as detailed in the drawing. The contractor shall provide for the required material, labour for fixing and supporting during concreting, in his quoted

price. It is imperative that all openings and pockets shall be deshuttered with care and all corners of openings shall be preserved. All openings/pockets shall be in a correct line and level. After concreting, the openings shall be secured by proper covering against any accident and guard rail and warning notice, if any will be incorporated.

24. In case of multistorey building, any upper floor shall be suitably supported on atleast one floor below the same or as approved by the Architect. The concreting of upper floor shall be done only after lower floors have attained the strength.

4.3. Checking prior to concreting.

1. All props and struts are plumbed at right spacing properly tightened up and locked.
2. Formwork is correctly aligned and leveled.
3. Stop ends are properly secured and sealed.
4. All ties are properly tightened.
5. All inserts, pockets etc are at desired level and secured.
6. Joints are sealed and no possibility of leakage of grouts.
7. Reinforcement has proper covers and required spacers.
8. All forms are cleaned, free from rubbish, tie wires etc.
9. Proper access for concreting and compaction available.
10. Required guard rails, toe boards are provided

4.4 Tolerances

- 4.4.1 Tolerance is a specified permissible variation from lines, grade or dimension given in drawings. No tolerances specified for horizontal or vertical building lines or footings shall be considered to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted.

4.4.2 Tolerances for RCC buildings

1. Variation from the plumb :
 - a) In the lines and surfaces of columns, piers, walls and in arises 3 mm per 2.5 m but not more than 10 mm.
 - b) For exposed corner columns and other conspicuous lines,

In any bay upto 5 m maximum	:	5 mm
In 10 m or more	:	10 mm
2. Variation from the level or from the grades indicated on the drawings,
 - a) In soffits of slab, ceilings, beam and in arises

In 2.5 m	5 mm
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		In any bay upto 5 m maximum	8 mm	
		In 10 m or more	10 mm	
	b)	For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines,		
		In any bay upto 5 m maximum	5 mm	
		In 10 m or more	8 mm	
3.		Variation of the linear building lines from established position in plan and related position of columns, wall and partitions.		
		In any bay upto 5 m maximum	5mm	
		In 10 m or more	10 mm	
4.		Variation in the sizes and location of sleeves, openings in walls and floors 5mm (except in the case of and for anchor bolts).		
5.		Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls - 5 mm + 10 mm		
6.		Footings		
	a)	Variation in dimension in plan - 5 mm + 50 mm		
	b)	Misplacement or eccentricity		
		2% of footing width in the direction of misplacement but not more than 50 mm		
	c)	Reduction in thickness		
		5% of specified thickness subject to a maximum of 50mm		
7.		Variation in steps		
			Riser	Tread
	a)	In a flight of stairs	3 mm	5 mm
	b)	Consecutive steps	1.5 mm	
		3 mm		
4.4.3		Tolerances in other concrete structures.		
1.	a)	Variation of the constructed linear outline from established position in plan		
		In 5 m :	5 mm	
		In 10 m or more :	10 mm	
	b)	Variations of dimensions to individual structure features from established positions		
		In 20 m or more :	25 mm	
		In buried construction :	50 mm	
	c)	Variation from plumb, from specified batter or from curved surfaces of all structures		

Upto 2.5 m	:	3 mm
2.5 m to 5 m	:	8 mm
5 m to 10 m or more	:	12 mm
In buried construction	:	Twice the above

- d) Variation in cross sectional dimensions of columns, beams, buttresses, piers and similar members

(-) 5 mm (+) 10 mm

- e) Variation in the thickness of slabs, walls, arch sections, and similar members.

(-) 5 mm (+) 10 mm

2. Footings for columns, piers, walls, buttresses and similar members.

- a) Variation of dimensions in plan

(-) 10 mm (+) 50 mm

- b) Misplacement or eccentricity

2% of footing width in the direction of misplacement but not more than 50 mm

- c) Reduction in thickness

5% of specified thickness subject to a maximum of 50mm

4.5 Removal of form work

- 4.5.1 1. Forms shall not be struck until the concrete has reached a strength at least twice the stress to which the concrete may be subjected at the time of removal of form work.

Under normal circumstances and where 53/43 grade O.P. Cement is used, forms shall be removed after expiry of the following periods :

- | | | |
|----|-----------------------------------------|--------------|
| a) | Walls, columns and vertical faces | 24 to 48 hrs |
| b) | Slabs (props left under) | 3 days |
| c) | Beam soffits (props left under) | 7 days |
| d) | Removal of props under slabs | |
| | i) Spanning upto 4.5 m | 7 days |
| | ii) Spanning over 4.5 m | 14 days |
| e) | Removal of props under beams and arches | |
| | i) Spanning upto 6 m | 14 days |
| | ii) Spanning over 6 m | 21 days |

For other cements, the stripping time shall be suitably modified in consultation with the Architect.

2. Where the shape of elements is such that the form work has re-entrant angles, the form work shall be removed as soon as possible

after the concrete has set, to avoid shrinkage or cracking that might occur due to the restraint imposed.

3. For precast moulds, the stripping time shall be 24 hours. The mould may be lifted and stored in the yard within 24 hours to 48 hours as approved by the Architect.
4. For PT slab, de-shuttering of slab shall be done as per instructions of Structural Consultant or as per approved vendor's guidelines in a schematic way.

4.6 Maintenance

It shall be responsibility of the contractor to protect, maintain and handover to next contractor / Employer in finished condition. No additional cost due to this shall be paid by the Employer providing and fixing inserts is part of this

- a) On completion of concreting inserts shall be cleaned and required treatment such as oiling, greasing, covering with plastic/plywood boxes, painting etc. shall be carried out by the contractor to approval of the Architect. Inserts and pockets shall be protected from weathering/or damage in course of construction.
- b) Opening and pockets shall be deshuttered with due care not to damage edges, falling of debris within pockets etc. Further all opening and pockets shall be preserved, secured against accident by covering, putting up guard rails, warning notice etc. as approved by the Architect. Guarding and protecting pockets shall be responsibility of the contractor at no extra cost to contract.

4.7 Cleaning / stacking

All formwork deshuttered shall be cleaned with a stiff wire brush to remove dust, grout, concrete etc. and if required maintained/repared prior to being reused. Steel plates, props, frames, proprietary formwork system shall be oiled, greased to protect against rusting, weathering etc.

Plywood and timber form shall also be applied with preservative agent if to be kept for long time without use. It shall be protected against heat, rains etc.

4.8 Measurements

Wherever it is not specifically stated in description of the item that form work shall be paid for separately, the rate of R.C.C. item shall be deemed to be included in the cost of the form work.

1. Form work shall be measured as the area (in square meters) of shuttering in contact with the concrete.
2. It shall be measured to the nearest centimeter and the areas worked out corrected to second decimal places.
3. No deductions shall be made for openings upto 0.4 sq m in the plan.
4. Form work to secondary beams shall be measured upto sides of the main beams but no deduction shall be made from the form work of the main beam.

5. No deduction shall be made from the form work of column at intersection of the beam.
6. The quoted rate shall be applicable for all working conditions and at all heights, depths or lifts specified in the BOQ. The rate shall include the cost of materials and labour for various operations involved, such as,
 - a) Splayed edges, notching, allowance for overlaps and plastering at angles, battens, centering, shuttering, strutting, propping, bolting, nailing, welding, casing, striking and removal.
 - b) Filling to form stop chamfered edges or splayed external angles not exceeding 75 mm to footing and 25 mm to beams, columns and like.
 - c) Temporary openings in the forms for pouring concrete and removing rubbish.
 - d) Dressing with oil/approved emulsion/soap solution to prevent adhesion of concrete with shuttering.
 - e) Racking or cutting
 - f) Fixing inserts and openings at the correct line and level and any required stage to support the same at the directed height and place.
 - g) Platforms, if any, required to keep check on form while the concreting is in progress.
 - h) Filling and making joints water-tight to the satisfaction of the PMC.
 - i) Cleaning the shuttering.
7. Inserts shall be measured by weigh or enumerated as specified in the BOQ.
8. Any work damaged through premature or careless removal of form shall be removed and reconstructed at the contractor's cost.
9. Holes for electrical conduits, hooks for fans and for plumbing are included in the price of items.
10. Precast units shall be measured shall be as detailed in BOQ including
 - a. Casting, lifting, curing and stacking
 - b. Lifting and placing in position at various slab levels including required staging and shuttering, and deshuttering for concreting.

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