

# AXIS CONSULTANTS

<b><u>STANDARD CIVIL ENGINEERING SPECIFICATION</u></b>		
<b>ISSUED: 15-09-2012</b>	<b>FORMWORK SPECIFICATION</b>	<b>REV. - 0</b>

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## 1. **SCOPE**

This specification covers type of formwork, moulds and scaffolding required for this job.

## 2. **APPLICABLE CODES**

**Note:** - Wherever reference is made to IS Codes, on any page of this Technical Specification (including annexure), applicable year of publication of IS Code is as stated below.

All work shall be carried out strictly in accordance with the Technical Specifications, unless otherwise approved by the Engineer-in-Charge in writing.

The Indian Standard Codes applicable to this section shall include, but not limited to the following:

IS 1200 (Part 5) – 1982	:	Method of measurement of building and Civil Engineering Works : Part 5 Formwork
IS 2750-1964	:	Steel scaffoldings
IS 3696 (Part 1) -1987	:	Safety code of scaffolds and ladders Part 1 Scaffolds
IS 3696 (Part 2) -1991	:	Safety code of scaffolds and ladders Part 2 Ladders
IS 4014 (Part 1 & 2) -1967	:	Code of practice for steel tubular scaffolding
IS 4990-1993	:	Plywood for concrete shuttering work.
IS 6461 (Part 5) -1972	:	Glossary of terms relating to cement concrete Part 5 Formwork for Concrete.
ACI 347	:	American Institution Standard Guide to Formwork for Concrete

## 3. **PRIORITY OF REQUIREMENTS**

In case of any variation and discrepancy in condition between the special conditions, this specifications and codes, order of priority shall be as under :-

- (1) Special conditions
- (2) This specification
- (3) Codes

## 4. **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.

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## **5. MATERIALS**

- (i) Timber facing formwork in contact with concrete for "Exposed Concrete Surfaces" shall consist of lap jointed or tongue and grooved planks, as directed by the Engineer-in-Charge. No joint shall permit leakage of mortar from cast-in-situ concrete.
- (ii) 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-in-Charge.

## **6. 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. Approval of the proposed formwork by the Engineer-in-Charge shall not diminish the CONTRACTOR's responsibility for the satisfactory performance of the formwork, nor for the safety and co-ordination of all operations.

## **7. FORMWORK FOR EXPOSED CONCRETE SURFACES**

The facing formwork, unless indicated otherwise in drawings, or specifically approved by the Engineer-in-Charge in writing, shall generally be made with materials not less than the thickness mentioned below for different elements of the structure:

- (i) Plain slab soffits, sides of beams, girders, joists, ribs, side of walls, fins, parapets, pardis, sunbreakers, etc. shall be made with:
  - (a) Steel plates not less than 3 mm thick, of specified sizes stiffened with a suitable structural framework, fabricated true to plane with a tolerance of  $\pm 2$  mm within the plate.
  - (b) Timber planks of 20 mm actual thickness and of specified surface finish, width and reasonable length.
  - (c) Plywood plates not less than 12 mm thick or 3 mm thick with a 20 mm timber plank backing, of specified sizes stiffened with a suitable timber framework.
- (ii) Bottoms of beams, girders and ribs, sides of columns shall be made with:
  - (a) Steel plates not less than 5 mm thick, of specified sizes stiffened with a suitable structural framework, fabricated true to plane with a tolerance of  $\pm 2$  mm within the plate.
  - (b) Timber planks of 35 mm actual thickness and of specified surface finish, width and reasonable length.
  - (c) Plywood plates not less than 12 mm thick of specified sizes, stiffened with a suitable timber framework.

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## **8. FORMWORK FOR ORDINARY SURFACES TO BE PLASTERED**

- (i) Plain slab soffits, sides and bottoms of beams, girders, joists, ribs and side formwork for columns, walls, fins, parapets, pardis, sunbreakers, etc. shall be made with:
  - (a) Steel plates not less than 3 mm thick with a suitable structural framework.
  - (b) Plywood plates not less than 10 mm thick or timber planks not less than 25 mm thick with suitable timber framework.

## **9. ERECTION OF FORMWORK**

The following shall apply to all formwork.

- (a) To avoid delay the CONTRACTOR shall obtain the approval of the Engineer-in-Charge for the design of forms and the type of material used before fabricating the forms.  
(Ref. ACI 347 formwork for concrete or equivalent I.S. Code 6461 Part V).
- (b) All shutter planks and plates shall be adequately backed to the satisfaction of the Engineer-in-Charge by a sufficient number and size of walers or framework to ensure rigidity during concreting. All shuttering shall be adequately strutted, braced and propped to the satisfaction of the Engineer-in-Charge, to prevent deflection under deadweight of concrete and superimposed liveload of workmen, materials, plant and to withstand vibration. No joints in props shall be allowed.
- (c) 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 storey shall be placed directly over those in the storey immediately below, and the lowest props shall bear on a sufficiently strong area.
- (d) Care shall be taken that all formwork is set plumb and true to line, level, camber or batter where required and as specified by the Engineer-in-Charge.
- (e) Provision 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.
- (f) If 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-in-Charge 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-in-Charge. Holes left in the concrete by these tie-bolts shall be filled as specified by the Engineer-in-Charge at no extra cost.
- (g) Provision shall be made in the shuttering for beams, columns and walls for a porthole of convenient size, so that all extraneous materials that may be collected could be removed just prior to concreting.

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- (h) Formwork shall be arranged as to permit removal of forms without jarring the concrete. Wedges, clamps and bolts shall be used wherever practicable, instead of nails.
- (i) Surfaces of forms in contact with concrete shall be oiled with mould oil of approved quality or clean diesel oil. If required by the Engineer-in-Charge the CONTRACTOR shall execute different parts of the work with different mould oils to enable the Engineer-in-Charge to select the most suitable. The use of oil, which darkens the surface of the concrete, shall not be allowed. Oiling shall be done 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.
- (j) Immediately before concreting is commenced, the formwork shall be carefully examined to ensure the following:
  - (i) Removal of all dirt, shavings, sawdust and other refuse by brushing and washing.
  - (ii) The tightness of joints between panels of sheathing and between these and any hardened core.
  - (iii) The correct location of tie bars, bracing and spacers, and especially connections of bracing.
  - (iv) That all wedges are secured and firm in position.
  - (v) That provision is made for traffic on formwork, not to bear directly on reinforcing steel.
- (k) The CONTRACTOR shall obtain the Engineer-in-Charge approval for dimensional accuracy of the work and for the general arrangement of propping and bracing. It is imperative that for scaffolding heights of 3.6m and above, timber posts or steel scaffolding be used with adequate bracings in horizontal and vertical planes. When timber posts are used, the bracings shall consist of minimum 25mm thick wooden planks fixed to each post with at least two nails. The CONTRACTOR shall be entirely responsible for the adequacy of propping, and for keeping the wedges and other locking arrangements undisturbed through the decentering period.
- (l) 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 taken.

## **10. EXPOSED CONCRETE WORK**

After removal of formwork, exposed concrete surfaces shall be smooth and even, without any finishing or rendering. Where directed by the Engineer-in-Charge, 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, positions and to produce the surface patterns desired. No honeycombing shall be allowed. The CONTRACTOR as directed by

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the Engineer-in-Charge shall remove honeycombed parts of the concrete and fresh concrete placed without extra cost, as instructed by the Engineer-in-Charge.

All materials, sizes and layouts of formwork including the locations for their joints shall have the prior approval of the Engineer-in-Charge. No extra payment shall be made for grooves, drip courses, bends etc. (IS 1200 - Part 5).

## 11. **CAMBER**

Forms and false work shall be generally cambered as indicated in the drawings or as instructed by the Engineer-in-Charge. However, for beams up to 5m span and slabs up to 4m span, camber is not normally required to be provided.

## 12. **TOLERANCES**

The following tolerances will normally be observed in erection of formwork, but may be varied as directed by the Engineer-in-Charge.

### (a) **Deviations from vertical**

#### (i) Lines and surfaces of columns, piers, walls, etc.

in 3m	6 mm
in any storey or 6m (max)	10 mm
in 12m or more	20 mm

#### (ii) Exposed corner columns

in any bay or 6m max	6 mm
in 12 m or more	10 mm

### (b) **Deviations from level**

#### (i) In Floors, ceilings, beam soffits

in 3m	6 mm
in any bay or 6m max	10 mm
in 12 m or more	15 mm

#### (ii) For exposed lintels, sills, parapets, horizontal grooves

in any bay or 6m max.	6 mm
in 12 m or more	10 mm

### (c) Deviations of lines from established position in plan or related position of columns, walls and partitions.

in any bay or 6 m max	10 mm
in 12 m or more	20 mm

### (d) Deviations in location of embedments 6 mm

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- |     |  |                   |
|-----|--|-------------------|
| (e) | Deviations in cross sectional dimension of beams and columns and in thickness of slabs and walls | - 5 mm / +10mm    |
| (f) | Deviations in dimensions of footings   | - 10 mm / + 50 mm |
| (g) | Deviations in thickness of footings  | - 10 mm / + 20mm  |
| (h) | Deviations in location of footings   |                   |
|     | upto 1.2 m width   | +/- 20 mm         |
|     | above 2.4m width   | +/- 40 mm         |

The tolerances stated shall apply not only to general surfaces and concrete sections, but also to built-in items of plant, or openings formed to accommodate the components of buildings or plant, unless tolerances for these are separately specified. The CONTRACTOR shall be responsible for ensuring that the necessary clearances are maintained for all window and door frames and other components forming part of the structure.

## **13. AGE OF CONCRETE AT REMOVAL OF FORMWORK**

Unless otherwise permitted in writing by the Engineer-in-Charge, the minimum period of keeping formwork in position after concreting the members, shall conform to the Indian Standard Specifications and shall be as follows:

Footings	1 day
Sides of beams, columns, lintels, walls, coping, fins	2 days
Underside of beams spanning less than 6 m	14 days
Underside of beams spanning over 6 m	21 days
Underside of slabs spanning less than 4 m	7 days
Underside of slabs spanning more than 4 m	10 days
Flat Slab bottom	21 days

The Engineer-in-Charge may vary the above period if he considers it necessary. Immediately after the forms are removed, they shall be cleaned with a jet of water and a soft brush.



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## **14. STRIPPING OF FORMWORK**

Formwork shall be removed carefully without jarring the concrete. Rectification of the concrete shall be commenced immediately. Concrete surfaces to be exposed shall, where required by the Engineer-in-Charge, be rubbed down with carborundum stone to obtain a smooth and even finish.

## **15. 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-in-Charge (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 CONTRACTOR's rates.

## **16. 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-in-Charge 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.

## **17. HACKING-OUT**

- (a) Immediately after removal of forms, the concrete surfaces to be plastered shall be roughened with a brush, hammer or with chisel and hammer as directed by the Engineer-in-Charge to make the surfaces sufficiently coarse and rough to provide a key for plaster.

This shall not be paid for separately and shall be deemed to have been included in the CONTRACTOR's rates.

- (b) 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.