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*Indian Standard*

**SAFETY CODE FOR ERECTION OF  
CONCRETE FRAMED STRUCTURES**

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**BUREAU OF INDIAN STANDARDS**

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# Indian Standard

## SAFETY CODE FOR ERECTION OF CONCRETE FRAMED STRUCTURES

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# *Indian Standard*

## SAFETY CODE FOR ERECTION OF CONCRETE FRAMED STRUCTURES

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 16 November 1978, after the draft finalized by the Safety in Construction Sectional Committee had been approved by the Civil Engineering Division Council.

**0.2** Erection of concrete framed structures is an important operation in the construction industry. The work involved is of specialized and hazardous nature, which sometimes leads to accidents. It is necessary, therefore, that certain rules are laid down for various phases of work involved and that these are meticulously followed by each member of the crew working on the job, not only for his own safety but also for the safety of his fellow workers and onlookers. This standard has, therefore, been formulated to lay down safety requirements during erection of concrete framed structures.

**0.3** In the formulation of this standard due weightage has been given to international coordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

**0.4** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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### 1. SCOPE

**1.1** This standard lays down the safety requirements for erection of concrete framed structures.

**1.2** Safety requirements for erection of structural steel work are covered separately in IS : 7205-1973†.

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\*Rules for rounding off numerical values (*revised*).

†Safety code for erection on structural steel work.

## 2. HANDLING OF MATERIALS

**2.1** Workmen handling cement bags shall wear goggles and durable close fitting clothes. Workmen handling cement, who are continually exposed to it, shall, in addition to the above be equipped with hand gloves and dust mask. All workmen shall wear adequate clothing to protect themselves from direct sun-rays and other irritants.

## 3. HANDLING OF PLANTS

### 3.1 Mixers

**3.1.1** All gears, chains and rollers of mixers shall be properly guarded. If the mixer has a charging skip the operator shall ensure that the workmen are out of danger before the skip is lowered. Railings shall be provided on the ground to prevent anyone walking under the skip while it is being lowered.

**3.1.2** All cables, clamps, hooks, wire ropes, gears and clutches, etc, of the mixer, shall be checked and shall be cleaned, oiled and greased and serviced once a week. A trial run of the mixer shall be made and defects shall be removed before operating a mixer.

**3.1.3** When workmen are cleaning the inside of the drums, the operating power of the mixer shall be locked in the off position and all fuses shall be removed and a suitable notice hung at the place.

### 3.2 Cranes

**3.2.1** Cranes rails, where used, shall be installed on firm ground and shall be properly secured. In case of tower cranes, it shall be ensured that the level difference between the two rails remains within the limits prescribed by the manufacturer to safeguard against toppling of the crane.

**3.2.2** Electrical wiring which can possibly touch the crane or any member being lifted shall be removed, or made dead by removing the controlling fuses and in their absence controlling switches.

**3.2.3** All practical steps shall be taken to prevent the cranes being operated in dangerous proximity to a live overhead power line. In particular, no member of the crane shall be permitted to approach within the following distance of overhead power lines:

11 kV and below	1.40 m
33 kV and below	3.60 m
132 kV and below	4.70 m
275 kV and below	5.70 m
400 kV and below	6.50 m

**3.2.3.1** If it becomes necessary to operate the cranes with clearances less than those specified in 3.2.3, it shall be ensured that the overhead power lines shall invariably be shut off during the period of operation of cranes. Location of any underground power cables in the area of operation shall also be ascertained and necessary safety precautions shall be taken.

**3.2.4** Cranes shall not be used at a speed which causes the boom to swing.

**3.2.5** A crane shall be thoroughly examined at least once in a period of 6 months by a competent person who shall record a certificate of the check. Any defect noticed shall be removed before allowing crane to be used. A crane, including all ropes, clamps and hooks shall be inspected by a responsible person and defective ropes, clamps, hooks, etc, replaced before taken into use every time.

**3.2.6** The operator of the crane shall follow the safe reach of the crane as shown by the manufacturers.

**3.2.7** Unauthorised persons shall not be allowed to move near and around the crane. No person shall be lifted or transported by the crane on its hook or boom.

**3.2.8** Concrete buckets handled by crane or overhead cableway shall be suspended from deep-throated hooks, preferably equipped with a swivel and safety latch. In the concrete buckets, both bottom drop type and side drop type, closing and locking of the exit door of the bucket shall always be checked by the man incharge of loading concrete in the bucket to avoid accidental opening of the exit door and consequent falling of concrete.

**3.2.9** When the bucket or other members being lifted are out of sight of the crane operator, a signaller shall be posted in clear view of the receiving area and the crane operator.

**3.2.10** A standard code of hand signals shall be adopted in controlling the movements of the crane and both the driver and the signaller shall be thoroughly familiar with the signals.

**3.2.10.1** The driver of the crane shall respond to signals only from the appointed signaller but shall obey stop signal at any time no matter who gives it.

**3.2.11** If a travelling gantry crane is operating over casting beds, a warning signal which sounds automatically during travel should be provided to avoid accidents to workmen crossing or standing in the path of the moving loads.

### **3.3 Trucks**

**3.3.1** When trucks are being used on the site, traffic problems shall be taken care of. A reasonably smooth traffic surface shall be provided. If practicable, a loop road shall be provided to permit continuous operation of vehicles and to eliminate their backing. If a continuous loop is not possible, a turnout shall be provided. Backing operations shall be controlled by a signalman positioned so as to have a clear view of the area behind the truck and to be clearly visible to the truck driver. Movement of workmen and plant shall be routed to avoid crossing, as much as possible, the truck lanes.

### **4. FORMWORK**

**4.1** Formwork shall be designed after taking into consideration spans, setting temperature of concrete, dead load and working load to be supported and safety factor for the materials used for formwork.

**4.2** All timber formwork shall be carefully inspected before use and members having cracks and excessive knots shall be discarded.

**4.3** As timber centering usually takes an initial set when vertical load is applied, the design of this centering shall make allowance for this factor.

**4.4** The vertical supports shall be adequately braced or otherwise secured in position so that these do not fall when the load gets released or the supports are accidentally hit.

**4.5** Tubular steel centering shall be used in accordance with the manufacturer's instructions. When tubular steel and timber centering is to be used in combination, necessary precautions shall be taken to avoid any unequal settlement under load.

**4.6** A thorough inspection of tubular steel centering is necessary before its erection and members showing evidence of excessive rusting, kinks, dents or damaged welds shall be discarded. Buckled or broken members shall be replaced. Care shall also be taken that locking devices are in good working order and that coupling pins are effectively aligned to frames.

**4.7** After assembling the basic unit, adjustment screws shall be set to their approximate final adjustment and the unit shall be level and plumb so that when additional frames are installed the tower shall be in level and plumb. The centering frames shall be tied together with sufficient braces to make a rigid and solid unit. It shall be ensured that struts and diagonal braces are in proper position and are secured so that frames develop full load carrying capacity. As erection progresses, all connecting devices shall be in place and shall be fastened for full stability of joints and units.

**4.8** In case of timber posts, vertical joints shall be properly designed. The connections shall normally be with bolts and nuts. Use of rusted or spoiled threaded bolts and nuts shall be avoided.

**4.9** Unless the timber centering is supported by a manufacturer's certificate about the loads it can stand, centering shall be designed by a competent engineer.

**4.10** Centering layout shall be made by a qualified engineer and shall be strictly followed. The bearing capacity of the soil shall be kept in view for every centering job. The effect of weather conditions shall also be taken into consideration as dry clay may become very plastic after a rainfall and show marked decrease in its bearing capacity.

**4.11** Sills under the supports shall be set on firm soil or other suitable material in a pattern which assures adequate stability for all props. Care shall be taken not to disturb the soil under the supports. Adequate drainage shall be provided to drain away water coming due to rains, washing of forms or during the curing of the concrete to avoid softening of the supporting soil strata.

**4.12** All centering shall be finally inspected to ensure that:

- a) footings or sills under every post of the centering are sound.
- b) all lower adjustment screws or wedges are snug against the legs of the panels.
- c) all upper adjustment screws or heads of jacks are in full contact with the formwork.
- d) panels are plumb in both directions.
- e) all cross braces are in place and locking devices are in closed and secure position.
- f) in case of *CHHAJAS* and balconies, the props shall be adequate to transfer the load to the supporting point.

**4.13** During pouring of the concrete, the centering shall be constantly inspected and strengthened, if required, wedges below the vertical supports tightened and adjustment screws properly adjusted as necessary. Adequate protection of centering shall be ensured from moving vehicles or swinging loads.

**4.14** Forms shall not be removed earlier than as laid down in the specifications and until it is certain that the concrete has developed sufficient strength to support itself and all loads that will be imposed on it. Only workmen actually engaged in removing the formwork shall be allowed in the area during these operations. Those engaged in removing the formwork shall wear helmets, gloves and heavy soled shoes and approved safety belts if adequate footing is not provided above 2 m level. While cutting

any tying wires in tension, care shall be taken to prevent back lash which might hit the body.

**4.14.1** The particular order in which the supports are to be dismantled should be followed according to the instructions of the site engineer.

## **5. RAMPS AND GANGWAYS**

**5.1** Ramps and gangways shall be of adequate strength and evenly supported. They shall have railings on the open side(s), high enough to protect workmen and shall either have a sufficiently flat slope or shall have cleats fixed to the surface to obviate slipping of workmen. Ramps and gangways shall be kept free from grease, mud, snow or other slipping hazards or other obstructions leading to striking and accidental fall of the labourer.

**5.1.1** Ramps and gangways meant for transporting materials shall have even surface and be of sufficient width and provided with skirt boards on open sides.

## **6. PRESTRESSED CONCRETE**

**6.1** In pre-stressing operations, operating maintenance and replacement instructions of the supplier of the equipment shall be strictly adhered to.

**6.2** All tools and pre-stressing wires shall be kept clean and in good condition.

**6.3** Extreme caution shall be exercised in all operations involving the use of stressing equipment as wires/strands under high tensile stresses become a lethal weapon.

**6.4** During the jacking operation of any tensioning element(s) the anchor shall be kept turned up close to the anchor plate, wherever possible, to avoid serious damage if a hydraulic line fails.

**6.5** Pulling-headers, bolts and hydraulic jacks/rams shall be inspected for signs of deformation and failure of threads on bolts and nuts should be frequently inspected for diminishing cross section. The pumping and fittings shall be checked periodically. Choked units shall be carefully cleaned.

**6.6** Care shall be taken that no one stands in line with the tensioning elements and jacking equipment during the tensioning operations and that no one is directly over the jacking equipment when deflecting is being done. Signs and barriers shall be provided to prevent workmen from working behind the jacks when the stressing operation is in progress.

**6.7** Necessary shields should be put up immediately behind the prestressing jacks during stressing operations.

**6.8** Wedges and temporary anchoring devices should be inspected before use.

**6.9** The prestressing jacks shall be periodically examined for wear and tear.

## **7. ERECTION OF PREFABRICATED MEMBERS**

**7.1** A spreader beam shall be used wherever possible so that the cable can be as perpendicular to the members being lifted as practical. The angle between the cable and the member to be lifted shall not be less than  $60^\circ$ ; except that where the engineer-in-charge first satisfies himself, by actual calculations, that having a flatted angle between the cable and member shall not produce excessive stresses in the member being lifted or in the cable, such flatted angle, up to  $30^\circ$  minimum, may be allowed.

**7.2** No one shall be allowed under the members while these are being lifted, transported or erected.

**7.3** The lifting wires shall have been tested for double the load to be handled at least once in six months. The guy line shall be of adequate strength to perform their function of controlling the movement of members being lifted.

**7.4** Temporary scaffolding of adequate strength shall be used to support precast and members at predetermined supporting points while lifting and placing them in position and connecting them to other members.

**7.5** After erection of the member, it shall be guyed and braced to prevent it from being tipped or dislodged by accidental impact when setting the next member.

**7.6** Precast concrete units shall be handled at specific picking points and with specific devices designated by the designer. Girders and beams shall be braced during transportation and handled in such a way as to keep the members upright.

**7.7** Method of assembly and erection, specified by the designer, shall be strictly adhered to at site. Immediately on erecting any unit in position, temporary connections or supports as specified shall be provided before releasing the lifting equipment. The permanent structural connections shall be established at the earliest opportunity.

## **8. HEATED CONCRETE**

**8.1** When heaters are being used to heat aggregates and other materials and to maintain proper curing temperatures, the heaters shall be frequently checked for functioning and precautions shall be taken to avoid hazards against using coal, liquid, gas or any other fuel.

## **9. STRUCTURAL CONNECTIONS**

**9.1** When reliance is placed on bond between precast and *in situ* concrete the contact surface of the precast units shall be suitably prepared in accordance with the specifications.

**9.2** The packing of joints shall be carried out in accordance with the assembly instructions.

**9.3** Levelling devices such as wedges, nuts, etc, which have no load bearing function in the completed structure shall be released or removed as necessary prior to integrating the joints.

**9.4** If at any stage of preparation of the joints welding work is involved the precautions inherent in the welding work shall be observed. If it becomes necessary to use electric power for *in situ* work the same should be stepped down to a safe level as far as possible.

## **10. GENERAL**

**10.1** Scaffolding shall be erected wherever it is necessary to enable workmen to work safely [ see IS : 3696 ( Part I )-1966\* ].

**10.2** Workmen working in any position where there is a falling hazard shall wear safety belts or other adequate protection shall be provided.

**10.3** All workmen shall be cautioned to stand clear of moving vehicles and swinging cranes and a load being raised or lowered.

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\*Safety code for scaffolds and ladders: Part I Scaffolds.

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