# Annexure ‘B’

**PRESTRESSED CEMENT CONCRETE POLES FOR 11KV & LT OH LINES**

PSC Poles

PSC poles shall be of solid rectangular type with an overall length of 9.0 Mts. suitable for use in 11 KV & LT overhead power lines.

Applicable Standards

Except when they conflict with specific requirements in this Specification, the PSC poles shall comply with the relevant provisions made in the following Indian Standards or the latest versions thereof.

1. IS: 1678, Specification for prestressed concrete poles for overhead power, traction and telecommunication lines.
2. IS: 2905, Method of test for concrete poles for overhead power and telecommunication lines.
3. IS: 7321, Code of Practice for selection, handling and erection of concrete poles for overhead power and telecommunication lines.

Terminology

For the purpose of this specification, following definitions shall apply:-6.3.1. Average Permanent Load That fraction of the working load which may be considered of long duration over a period of one year.

Load Factor

The ratio of ultimate transverse load to the transverse load at first crack. Transverse

The direction of the line bisecting the angle contained by the conductor at the pole. In the case of a straight run, this will be normal to the run of the line.

Transverse Load at First Crack

For design, the transverse load at first crack shall be taken as not less than the value of the working load. Working Load

The maximum load in the transverse direction, that is ever likely to occur, including the wind pressure on the pole. This load is assumed to act at a point 600 mm below the top with the butt end of the pole planted to the required depth as intended in the design.

Ultimate Failure

The condition existing when the pole ceases to sustain a load increment owing to either crushing of concrete, or snapping of the prestressing tendon or permanent stretching of the steel in any part of the pole.

Ultimate Transverse Load

The load at which failure occurs, when it is applied at a point 600 mm below the top and perpendicular to the axis of the pole along the transverse direction with the butt end of the pole planted to the required depth as intended in the design.

Application

These poles shall be used for 33 kV overhead power lines. In case, poles of height more than 9 mts. (11m) are considered necessary for road crossing or for any other purpose, rail poles shall be used. Same shall be in the scope of bidder and he shall quote for the same as specified in Bid Price Schedule (BPS). Rail poles shall be as per IS with 105 pound in weight per yard.

Material Cement

The cement used in the manufacture of prestressed concrete poles shall be ordinary or rapid hardening Portland cement conforming to IS: 269 - 1976 (Specification for ordinary and low heat Portland cement) or IS: 8041 E-1978 (Specification for rapid hardening Portland cement).

Aggregates

Aggregates used for the manufacture of pre-stressed concrete poles shall confirm to IS: 383 (Specification for coarse and fine aggregates from natural sources for concrete). The nominal maximum size of aggregates shall in no case exceed 12 mm.

Water

Water should be free from chlorides, sulphates, other salts and organic matter. Potable water will be generally suitable. Admixture

Admixture should not contain Calcium Chloride or other chlorides and salts which are likely to promote corrosion of pre- stressing steel. The admixture shall conform to IS 9103.

Pre-Stressing Steel

The pre-stressing steel wires including those used as untensioned wires should conform to IS: 1785 (Part-!) (Specification for plain hard-drawn steel wire for prestressed concrete, Part-! cold drawn stress relieved wire), IS: 1785 (Part-II) (Specification for plain hard-drawn steel wire) or IS:6003 (Specification for indented wire for prestressed concrete). The type designs given in the annexure are for plain wires of 4 mm diameter with a guaranteed ultimate strength of 175 kg/mm2 and for plain wires of 5 mm diameter with a guaranteed ultimate strength of 160 kg/mm2. All prestressing steel shall be free from splits, harmful scratches, surface flaws, rough, aged and imperfect edges and other defects likely to impair its use in prestressed concrete.

Concrete Mix

The concrete mix shall be designed to the requirements laid down for controlled concrete (also called design mix concrete) in IS: 1343 - 1980 (Code of practice for prestressed concrete) and IS: 456- 1978 (Code of practice for plain and reinforced concrete), subject to the following special conditions;

1. Minimum works cube strength at 28 days should be at least 420 Kg/cm2.
2. The concrete strength at transfer should be at least 210 Kg/cm2.
3. The mix should contain at least 380 Kg. of cement per cubic meter of concrete. d) The mix should contain as low a water content as is consistent with adequate workability. If it becomes necessary to add water to increase the workability,

the cement content also should be raised in such a way that the original value of water cement ratio is maintained. Design Requirements

The poles shall be designed for the following requirements:

1. The poles shall be planted directly in the ground with a planting depth as per IS: 1678. Wherever, planting depth is required to be increased beyond the specified limits or alternative arrangements are required to be made, on

account of ground conditions e.g. water logging etc., the same shall be in the scope of the bidder at no extra cost to owner. The bidder shall furnish necessary design calculations/details of alternative arrangements in this regard.

1. The working load on the poles should correspond to those that are likely to come on the pole during their service life. The working load of PSC poles shall be 400 Kg.
2. The factor of safety for all poles 9.0 Mts. shall not be less than 2.0.
3. The average permanent load shall be 40% of the working load.
4. The F.O.S. against first load shall be 1.0.
5. At average permanent load, permissible tensile stress in concrete shall be 30 kg/cm2.
6. At the design value of first crack load, the modulus of rupture shall not exceed 53.0 kg/cm2 for M-40.
7. The ultimate moment capacity in the longitudinal direction should be at least one fourth of that in the transverse direction.
8. The maximum compressive stress in concrete at the time of transfer of prestress should not exceed 0.8 times the cube strength.
9. The concrete strength at transfer shall not be less than half, the 28 days strength ensured in the design, i.e. 400 x 0.5

= 200kg/cm2.

For model check calculations on the design of poles, referred to in the annexure, a reference may be made to the REC "Manual on Manufacturing of solid PCC poles, Part-!- Design Aspects"

Dimensions and Reinforcements

The cross-sectional dimensions and the details of pre-stressing wires should conform to the particulars given in the annexure. The provisions of holes for fixing cross-arms and other fixtures should conform to the REC specification No. 15/1979.

Manufacture

* All pre-stressing wires and reinforcements shall be accurately fixed as shown in drawings and maintained in position during manufacture. The untensioned reinforcement, as indicated in the drawings, should be held in position by the

use of stirrups which should go round all the wires.• All wires shall be accurately stretched with uniform prestress in each wire. Eachwire or a group of wires shall be anchored positively during casing. Care should be taken to see that the anchorages do not yield before the concrete attains the necessary strength.

Cover

The cover of concrete measured from the outside of pre-stressing tendon shall be normally 20 mm. Welding and Lapping of Steel

The high tensile steel wire shall be continuous over the entire length of the tendon. Welding shall not be allowed in any case. However, jointing or coupling may be permitted provided the strength of the joint or coupling is not less than the strength of each individual wire.

Compacting

Concrete shall be compacted by spinning, vibrating, shocking or other suitable mechanical means. Hand compaction shall not be permitted.

Curing

The concrete shall be covered with a layer of sacking, canvass, hessian or similar absorbent material and kept constantly we up to the time when the strength of concrete is at least equal to the minimum strength of concrete at transfer of

prestress. Thereafter, the pole may be removed from the mould and watered at intervals to prevent surface cracking of the unit, the interval should depend on the atmospheric humidity and temperature. The prestressing wires shall be de-tensioned only after the concrete has attained the specified strength at transfer (i.e. 200 or 210 kg/cm2, as applicable). The

cubes cast for the purpose of determining the strength at transfer should be cured, as far as possible, under conditions similar to those under which the poles are cured. The transfer stage shall be determined based on the daily tests carried out

on concrete cubes till the specified strength indicated above is reached. Thereafter the test on concrete shall be carried out as detailed in IS: 1343 (Code of practice for prestressed concrete). The manufacturer shall supply, when required by the

owner or his representative, result of compressive test conducted in accordance with IS: 456 (Code of practice for plain and reinforced concrete) on concrete cubes made from the concrete used for the poles. If the owner so desired, the manufacturer shall supply cubes for test purposes and such cubes shall be tested in accordance with IS : 456 (Code of practice for plain and reinforced concrete).The detensioning shall be done by slowly releasing the wires, without imparting

shock or sudden load to the poles. The rate of detensioning may be controlled by any suitable means either mechanical (screw type) or hydraulic.The poles shall not be detensioned or released by cutting the prestressing wires using flames or bar croppers while the wires are still under tension.

Lifting Eye-Hooks or Holes

Separate eye-hooks or holes shall be provided for handling the transport, one each at a distance of 0.15 times the overall length, from either end of the pole. Eye- hooks, if provided, should be properly anchored and should be on the face that has the shorter dimension of the cross-section. Holes, if provided for lifting purposes, should be perpendicular to the broad face of the pole.

Holes for Cross Arms etc.

Sufficient number of holes shall be provided in the poles for attachment of cross arms and other equipments. Stacking & Transportation

Stacking should be done in such a manner that the broad side of the pole is vertical. Each tier in the stack should be supported on timber sleeper located as 0.15 times the overall length, measured from the end. The timber supported in the stack should be aligned in a vertical line.

Poles should be transported with their broad faces placed vertically and in such a manner that shocks are avoided. Supports should be so arranged that they are located approximately at a distance equal to 0.15 times the overall length from the

ends. The erection of the pole should be carried out in such a way that the erection loads are applied so as to cause moment with respect to the major axis, i.e. the rope used for hoisting the pole should be parallel to the broader face of the pole.

Earthing

Earthing shall be provided by having length of 8 SWG GIwire embedded in concrete during manufacture and the ends of the wires left projecting from the pole to a length of 100mm at 250 mm from top and 150 mm below ground level.

Earth wire shall not be allowed to come in contract with the prestressing wires.