

6.4 Codal provisions in design of communication towers

The following are the steps involved in design of communication tower.

- a. Selection of configuration of tower
- b. Computation of loads acting on tower
- c. Analysis of tower for above loads
- d. Design of tower members according to codes of practices.

Selection of configuration of a tower involves fixing of top width, bottom width, number of panels and their heights, type of bracing system and slope of tower.

6.4.1 Wind load on tower

The wind load on tower can be calculated using the Indian standards IS: 875(Part 3)-1987[3] and BS: 8100 (Part 1)-1996[4].

The designer should select the basic wind speed depending on the location of tower. The design wind speed is modified to induce the effect of risk factor (k_1), terrain coefficient (k_2) and local topography (k_3) to get the design wind speed V_z . ($V_z = k_1 k_2 k_3 V_b$).

The design wind pressure P_z at any height above mean ground level is $0.6V_z^2$.

The coefficient 0.6 in the above formula depends on a number of factors and mainly on the atmospheric pressure and air temperatures.

Solidity ratio is defined as the ratio of effective area (projected area of all the individual elements) of a frame normal to the wind direction divided by the area enclosed by the boundary of the frame normal to the wind direction.

Force coefficient for lattice towers of square or equilateral triangle section with flat sided members for wind blowing against any face shall be as given in Table 30 of IS:875(Part-3)-1987.

Force coefficients for lattice towers of square section with circular members and equilateral triangle section with circular members are as given in tables 31 and 32 of IS: 875(Part-3)-1987 respectively.

Table 2 of IS:875(Part-3)-1987 gives the factors to obtain design wind speed variation with height in different terrains for different classes of structures such as class A, class B, class C.

The wind load acting on a tower can be computed as $F = C_{dt} A_e P_z k_2$.

For circular sections the force coefficient depends upon the way in which the wind flows around it and is dependent upon the velocity and kinematic viscosity of the wind and diameter of the section. The force coefficient is usually quoted against a non-dimensional parameter, called the Reynolds number, which takes account of the velocity and viscosity of the medium and the member diameter.

6.4.2 Wind load on antennae

Wind load on antennae shall be considered from Andrew's catalogue. In the Andrew's catalogue the wind loads on antennas are given for 200kmph wind speed. The designer has to calculate the antenna loads corresponding to design wind speed.

6.4.3 Design of tower members

According to the clause 5.1 of IS-802(Part-1/sec2)[5] the estimated tensile stresses on the net effective sectional areas in various members shall not exceed minimum guaranteed yield stress of the material. However in case the angle section is connected by one leg only, the estimated tensile stress on the net effective sectional area shall not exceed F_y , where F_y is the minimum guaranteed yield stress of the material. For structural steels conforming to IS-226[6] and IS-2062[7] the yield strength is 250 MPa. Generally yst25 grade tubes conforming IS-1161[8] are used for tower members.

As per IS-802 part1/sec2 estimated compressive stresses in various members shall not exceed the values given by the formulae in clause 5.2.2. of IS-802 code.

6.4.4 Limiting slenderness ratios

a. As per clause 6.3 of IS-802(Part1/sec2)-1992 the limiting values KL / r shall be as follows:

Leg members	120
Redundant members and those carrying nominal stresses	250
Other members carrying computed stresses	200

b. As per clause 6.4 of IS-802(Part1/sec2) Slenderness ratio L / r of a member carrying axial tension only, shall not exceed 400.

c. Similarly for tubular sections as per clause 6.4.2 of IS-806-1968[9] – The ratio of effective length (l) to the appropriate radius of gyration(r) of a compression member shall not exceed the following values.

Type of member	l/r
Carrying loads resulting from dead loads and superimposed loads	180
Carrying loads resulting from wind or seismic forces only provided the deformation of such members does not adversely; affect the stress in any part of the structure.	250
Normally acting as a tie in a roof truss but subject to possible reversal of stress resulting from the action of wind.	350

As per clause 6.4.1 of IS-806-1968 the effective length (l) of a compression member for the purpose of determining allowable axial stresses shall be assumed in accordance with table 7 of IS-806-1968.

As per clause 7.2 of IS-802(Part1/sec2) Gusset plates shall be designed to resist the shear, direct and flexural stresses acting on the weakest or critical section. Re – entrant cuts shall be avoided as far as practical. Minimum thickness of gusset shall be 2mm more than lattice it connects only in case when the lattice is directly connected on the gusset outside the leg member. In no case the gusset shall be less than 5mm in thickness.