EARTHQUAKE RESISTANT DESIGN OF STEEL TOWERS OF ELECTRICAL HIGH VOLTAGE TRANSMISSION LINES SUBJECTED TO HORIZONTAL OR VERTICAL GROUND MOTIONS.

by

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The paper deals with the problem of the Earthquake Resistant Design of Steel Towers of an Electrical High Voltage Transmission Line. The main parts of the paper are the computer design of the tower under static loading, the description of the dynamic model of the tower as well as its response under earthquake loading.

During the last twenty years, design and construction of high voltage transmission lines have mushroomed and it seems that they will continue to do so in the future. A considerable effort is under development during the last few years towards the directions of the amelioration of the design concepts or the optimal design of the lines. The paper is a contribution to the problem and refers to the Earthquake Resistant Design of Steel Towers of an Electrical High Voltage Transmission Line.

First the problem of the computer design of the tower under static loading is considered, for the case vertical or horizontal loads.As an application, the stiffness coefficients of the structure are calculated. The deformation of the soil layer on which the tower is erected is taken into account. For these calculations a special computer program was written, using the well known stiffness method of analysis of linear space trusses with pin jointed members, but taking into consideration the special partial restrictions for the relative rotations of the ends of each bar of the truss in the real tower. The description of the dynamic model of the tower is a next step. The space-truss tower is idealized into a twenty lumped mass system, whereas the influence of the conductors as well as the effect of the soil-structure interaction on the dynamic response of the tower is taken into account. For the model of the soil layer, a finite element mesh is used.

Finally, the results for a special case are given for a typical steel tower of an electrical high voltage transmission line, located at a high elevation. The problem is solved for two motions, first for a vertical one and secondly for a horizontal one, and two cases of soil surface conditions, first for towers located on hills (non plane case) and secondly for towers located on level ground (plane case). The possibility of torsional vibrations of the tower due to a broken conductor is also briefly discussed. Two general conclutions may me cited here; a) that the influence of the vertical component of the earthquake is very important for the safetyof the tower (especially for the insulators) and b) that the various soil conditions that can be met along a transmission line give a great variety of ground motion for each case and consequently a variety for the response of the towers.

An extensive bibliography on the subject can be found in previous paper by the author, presented at the 5th symposium on Earthquake Engineering, Roorkee, 1974.

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