ABSTRACT

The dissertation deals with the preliminary study of steel masts and towers with particular reference to their behaviour under conditions of seismic loading.

The first chapter is a general introduction into flexible steel masts. It presents all the categories of steel structures and a short description of each category. It then deals extensively with steel masts describing their characteristics, design processes as well as advantages and disadvantages. It also presents the types of loads that should be taken into account with such structures and the required checking of their resistance and serviceability according to the present regulations and specifications of Eurocode 3 and especially its relevant section on masts and towers. The chapter ends with a schematic presentation of various alternative ways of stabilization of the masts and ways and reduction of their bending length.

Chapters 2, 3 and 4 tackle the analysis of three masts 29, 36.5 and 44.4 metres tall each. For the sake of reliability, the shape of all three masts is the same. The masts are studied in the following way: The sections to be used are first selected and then modeled on the static program SAP2000. We should note here that due to the peculiar nature of their dynamic response and the low limits of slenderness allowed selection is very strict. Then, all possible combinations of loads are presented and the load of snow, wind, technical equipment of masts and working equipment is calculated. The price of a new case of loading in section 3.1 of Eurocode 3 is also calculated, according to which it is possible that the snow on the sections might freeze resulting in an increase in the weight as well as the impact surface of the wind. Besides, for the seismic loading modeling, the design spectrum of national antiseismic regulations is used. Thus, the vertical component is ignored and the factor of behaviour is considered as being equal to one. After the mode analysis of the masts and the required number of eigen frequencies for activating a sufficient percentage of their mass for their oscillation are determined, their static and dynamic analysis on the program SAP2000 takes place. The results of all possible combinations are presented excluding the moments of bending and shear forces considering that the sections used are mainly angles, whose function is axial. This is followed by the checking of the sections selected under conditions of tension and bending as well as the calculation of the maximum displacement of the mast antenna whose size should be very small so that risk of losing the signal re-transmitted is avoided. Finally, an alternative way of mast construction is considered, whereby the stabilization net-like pattern-the diagonals of the first panel is now omitted.

The fifth chapter tackles a parametric study, examining whether the widely held belief that the additional tension on flexible steel structures is caused by the wind, in the form of either static or dynamic loading and not by the earthquake applies in the case when the towers are exposed to the strongest earthquake possible according to the national antiseismic regulations, in other words whether they belong to a dangerous area IV and are located in ground of D category.

Finally, Chapter 6 presents the conclusions that have been drawn and some implications for the study and construction of masts and towers.