SUMMARY

This paper presents selected problems of masts analysis, particularly taking into account the elasto-plastic properties of the guys. The main purpose of the presented analysis was to investigate the differences in the static work of masts with guys made from the cables after prestretching ($E = \text{const}$), in relation to masts supported by cables without prestretching ($E \neq \text{const}$). In the first case, the constant value of elastic modulus E for cables causes that a mast shaft after loading and unloading returns to its original configuration. Whereas the mast shaft with cables with elasto-plastic dependence ($E \neq \text{const}$), after stopping load, does not return to its original vertical position, but remains slightly tilted from the vertical. This behaviour results from permanent strains of the cables after unloading, which leads to a decrease in initial guys forces and the reduction of mast stiffness. Therefore, a periodic rectification and adjustment of initial guys forces, especially in the initial period of service life, is required. Taking into account this type of non-linearity in the static analysis contributes to the increase in the accuracy of the mast calculations. To carry out numerical analysis in the inelastic range, nonlinear $\sigma - \varepsilon$ relations of two cables of different construction, obtained from experimental tests, were used.

Chapter 1 presents the characteristics of guyed masts. The types, applications, principles of construction with examples of solutions and assembly technology were discussed. Information about permanent loads, environmental loads (wind, icing and temperature loads) and special loads such as sudden guy repture or differential settlement of the mast shaft base and guys foundations, and combinations of those loads, were collected and systematized. The current state of knowledge concerning the calculation of guyed masts, including a historical outline of mast construction and the evolution of the applied calculation models of the mast shaft and guys was presented. The most important literature items and standard guidelines are referred to here. The phenomena of geometric non-linearity and physical non-linearity of cables used for guys were also explained. The subject, purpose, scope and thesis of this work are also given.

In chapter 2, the basic technical information concerning the mast guys was collected and described. The types, materials for production, mechanical properties, anti-corrosion protection, applicable standard guidelines for dimensioning and types of cable anchors used for the mast guys are described. Additionally, the statics of a single cable is discussed, taking into account an approximate and accurate solution.

In the next, third chapter, the experimental tests of the 1x37 spiral strand rope and the 6x19 wire rope, carried out by the author at the Faculty of Civil Engineering, Environmental and Geodetic Sciences of the Koszalin University of Technology, are described. The purpose of those

tests was to determine the real properties of the aforementioned ropes such as determination of the $\sigma - \varepsilon$ relationship, finding the constant elastic modulus E of the cable after its initial prestretching, and determination of the real value of the cable breaking force. All experimental tests were carried out on the basis of a static tensile test in the INSPEKT 600 testing machine. The description of the research was preceded by a detailed discussion about the cable sample preparation procedure and the description of the measuring equipment and software used during the tests.

Chapter 4 is devoted to the presentation of the current rules for calculating masts. Computational models of the mast shaft, taking into account a beam-column model and exact models such as truss model and frame-truss model are analysed. Selected methods of solution of cable beam structures in the non-linear range are described. The theoretical basis of FEM application for guyed mast analysis was presented. The SOFiSTiK system environment, used to carry out numerical analysis of guyed mast structures, was characterised.

Chapter 5 concerns selected advanced numerical analysis of guyed masts, carried out in the SOFiSTiK program, using the FEM method. The presented examples have been varied in terms of geometry, location, reliability class of the structure, height, width of the mast shaft side, number of guys attachment levels as well as different constructions and properties of guy cables. The main numerical analysis were preceded by selected test examples of a single cable and a selected mast structure. The results of those analysis were confronted with the results of analytical calculations with the use of the approximate equation of the cable and the results from the MAST program by prof. Szymon Pałkowski.

Final remarks containing summarizing, new elements of the dissertation, as well as proposed directions for further work are included in chapter 6. Supplementary information was attached in the electronic version on the CD. These are, among others two attachments presenting the collection of loads respectively for a 190 m high mast (as a supplement to point 5.5) and a 200 m high mast (point 5.4). The work ends with a list of references, including 259 items, as well as a list of figures and tables.

Renata Pipoń