PAPER REF: 4779

DEVELOP TAILORED MANUFACTURING SAFE METHODS FOR WIND TOWERS ERECTED IN REMOTE AREAS BASED ON AN INTEGRATED TOWER CONCEPT AND OPTIMAL USE OF HIGH STRENGTH STEELS-SAFETOWER

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ABSTRACT

This paper summarizes the work developed under the EU funded project, SAFETOWER demonstrating the possibility to manufacture under a new concept for monolithic Wind Towers with more than 100m height totally welded, partially on site due to dimension constraints related accessibilities and adequate for remote zones. The document describes the availability of having a good compromise between fatigue, buckling and toughness, within other properties, using a High Strength Steel, 460M type.

Keywords: wind towers, high strength steels, fatigue, buckling.

INTRODUCTION

Conventional Towers for Wind Energy Converters, WEC have reached all the transportation the limits in dimension and weight, leading to the need of having several transportation permits to move them in a road and consequently new tower concept is needed to overcome this constraint. The problem is critical if WEC are to be installed in remote areas; for a Power range of 5-6MW the height will be around 120m, and diameters in the range of 4 to 8 meters. Conventional Towers of lower Power, i.e., 2-3MW, are manufactured in sections with top flanges and assembled with bolts. An extensive project is being developed by an EU consortium covering all the steps of the value chain. The solution was to design a monolithic tower totally welded, partially on site, assembling the related cylindrical sections by welding; of course the lower and upper tops will maintain the flanges, to anchor to the basement and in the top to the nacelle. The challenge was to use HSS, High Strength Steels, with good weldability, minimizing possible distortions, with good fatigue, buckling and toughness properties. All the objectives were already achieved and the main results are presented in this paper.

RESULTS AND CONCLUSIONS

The economically most favourable tower design depends on the effort for increasing the fatigue performance. For further investigations there following reference geometry was chosen from the design studies. It has to be noted that the first natural frequency of this tower design is 0.246 Hz and thus slightly underruns the lower bound of 0.25 Hz. This was accepted at a starting stage of SAFETOWER project, because the necessary increase of shell thickness to keep the frequency limit is very small (Table 1).

Table 1 - Reference tower design for investigations

Type	Unstiffened design, constant slope
Tower height	117.85 m (120 m nacelle height)
Top diameter	3.75 m
Base diameter	7.0 m
Detail category	DC 112
Fabrication quality tolerance class	class B
Wall thicknesses	16 - 28 mm
Steel grade	S460 (S355 for reference purpose)

One of the most elementary parameters of the tower design is the base diameter. The parameter study aims on the detection of the lightest tower design by investigating different base diameters in combination with several possible detail categories for the circumferential welds. Furthermore, two different steel grades, S355 and S460, are investigated. Table-1 shows exemplarily the characteristic values of an unreinforced tower variation with 7000 mm base diameter. The results are depicted in Fig.1. Equal detail categories are indicated by identical colours, steel grade S355 is shown in solid lines, while S460 is drawn in dashed lines.

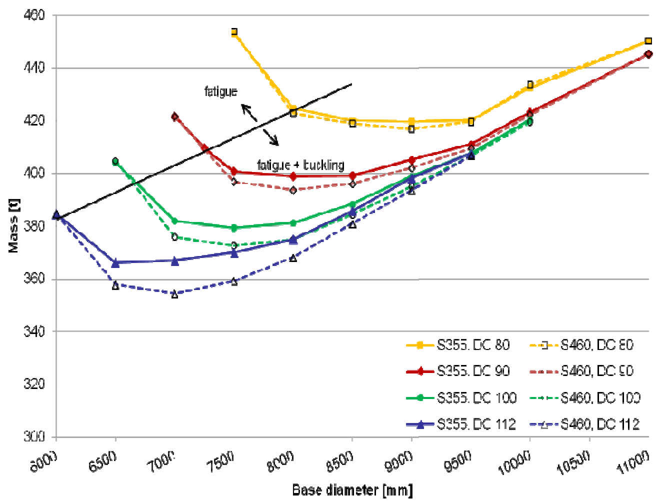

Fig. 1 - Tower mass versus base diameter

ACKNOWLEDGMENTS

The authors gratefully acknowledge Research Programme of the RFCS Research Fund for Coal and Steel, carried out with a financial contribution of SAFETOWER Grant Agreement Nº.RFSR-CT-2010-00028

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