UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

MASTER ON NUMERICAL METHODS IN ENGINEERING
OFFICIAL MASTER of UPC Barcelona Tech

Design and analysis of the fuselage of a high-speed prototype applied to Hyperloop concept, using finite elements method.

SUBJECT:

COMUNICATION SKILLS 1

ASSIGNAMENT: Elevator pitch + abstract

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STUDENT: FURIÓ ALARCÓN, NÉSTOR

ABSTRACT

Nowadays High-speed transportation has been developed different technologies, and countries around the world are implementing their own high-speed concept. In Spain, the company Zeleros it's creating their more efficiently design of Hyperloop vehicle. This technology needs a light-weight fuselage with longitudinal rigidity to flexion, having said that, this work investigates the effects of composite materials and non-structural masses on the static and dynamic behaviour of Hyperloop fuselage.

To achieve this goal, it's used the finite element method based on a full nonlinear analysis that use the classical Newton-Raphson technique, however the high computational complexities generated from both the incremental-iterative procedure and the very refined mesh needed for resolve the model, it's translated on a high computational cost. For this reason, in the report, first it's done a qualitative analysis based on a free-free normal mode analysis and a restricted normal mode analysis. This type of analysis is calculated applying the Lanczos method, it's the general method, that not implies the fastest or the most precision form to obtain the natural frequencies but is the better by their stability to converge and implies to waste less time on the mesh. Then we complete the study with Stress and Strain nonlinear analysis, in this analysis it has been modelled the most critical load cases, reducing the number of cases from 14 to 4, one acceleration condition, other on stationary condition and two of brake conditions.

The innovation of this paper is found it in this new type of manufacture concept applied in the vehicle, a carbon fibre tubular mono-body fuselage made by the company MTorres. The concept has been studied to improve the rigidity at high frequency of the vehicle, since the main problem is the excitation frequency introduced by the aircraft compressor of 250 Hz mixed with the little space on the vertical axis.

The results show the capability of the present model to provide a realistic solution with a low computational cost, and validate the methodology followed to get these results. Also, the investigation of this type of fuselage with strict boundary conditions contribute to improve it and motivate other companies to use it.