Nonlinear effects under compression-flexion combination for sleeveless space frame connection systems and validation of linear superposition for resistance verification

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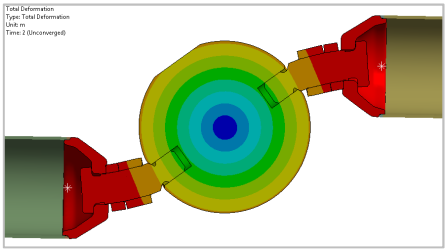
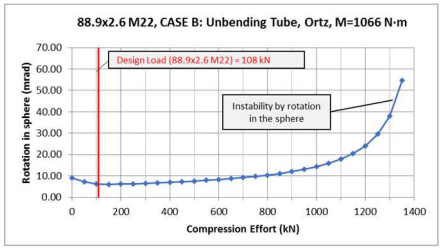
Abstract

In general, it is admitted to consider biarticulated elements when we simulate space frame structures, so elements just transmit axial forces and there is no flexion through the nodes. Of course, for this consideration to be correct, loads and constraints must be applied in the center of the nodes, and this is how the great majority of space frames are calculated. However, this is a simplification of the reality: There can be moments in space frame nodes due to different events (eccentricities, hyperstaticity with substructure) and these moments not always can be considered insignificant. This is the case of Mexico's New International Airport's space frame and many other particular cases.

Focusing on the ORTZ as an example of a sleeveless space frame connection system, the linear superposition of axil and moment efforts when evaluating the resistance of space frame connection bolts can only be admitted if the behavior of the node under combination of compression and flexion is linear until reaching design limits, and this is not something that can be taken for granted. In fact, space frame nodes are traditionally physically tested under full compression to evaluate the stability of the node itself against rotation of the sphere. In those tests, however, the effect of an additional moment which accelerates the buckling failure is not considered, and it is not possible to evaluate where the real stability limit of the node is, because generally the bars are the first suffering from buckling failure.

In this research, FEM has been used to simulate and analyze under different considerations the nonlinear behavior of ORTZ connection system under combination of flexion and compression.





It is concluded that in all cases the instability of the node appears once design loads are largely exceeded, so the linear superposition of axil and flexion for checking a bolt's section can be admitted.

References

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