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PRATICAL STATIC CALCULATION METHOD FOR ESTIMATING ELASTO-PLASTIC DYNAMIC RESPONSES OF SPACE FRAMES

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1. INTRODUCTION

This study deals with response and damage-controlled structures such as aluminum alloy latticed wall structures induced by the plastic elongation of the steel bolt among the joint connection. The latticed wall structure system as shown in Fig.1 is composed of several elements such as ball joints, strut members and their connections. The lattice structure has two collapse types such as a progressive member buckling due to a compression stress and a yield failure due to a tension stress. In our previous paper, we presented that the progressive member buckling induces the brittle collapse of the structure. This means that the structure looses the horizontal load carrying capacity, soon after the load reaches the maximum capacity. On the other hand, it could be known that an axial plastic elongation ductility of the steel brings about the response control of a structure due to the absorbing energy.

The purpose of this study is to investigate the energy absorbing mechanism within the 'joint connection bolt tension collapse type structure system' caused by the bolt plastic elongation due to an axial tension stress.

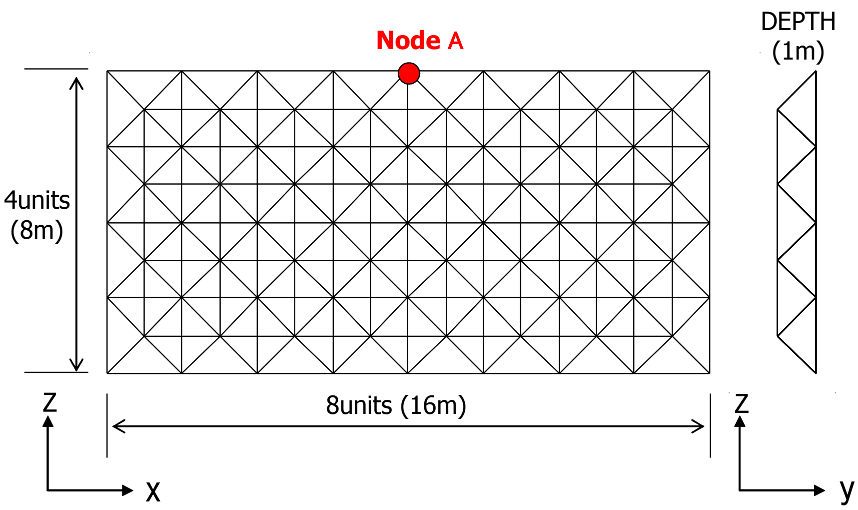

Figure 1. Lattice wall structure: All the top nodes of the wall can move for the horizontal axis (Y axis) and are restrained for the vertical and out of plane axes (Z and X axes).

As far as the one degree of freedom equivalent model is concerned, the modeling procedure of the simplified one degree of freedom vibration system is proposed in order to predict the seismic Elasto-plastic responses of the latticed wall using the seismic response spectrum and the property of the energy conservation. In the modeling, the calculation method of predicting the horizontal resistant capacities such as the horizontal effective stiffness K and the horizontal strength Q_{By} due to the steel connecting bolt yield state is presented. And the first horizontal natural vibration period T can be also calculated by using the proposed equations. The estimation results obtained by using the simplified vibration model are verified to be in close agreement with the Elasto-plastic dynamic analysis results of the full numerical analysis model. Accordingly, structural engineers can understand both the static and the dynamic characteristics of the latticed wall structures using the proposed static calculation procedure.

2. CONCEPT OF EQUIVALENT SINGLE DEGREE OF FREEDOM VIBRATION MODEL AND PROPERTY OF ENERGY CONSERVATION

Fig.2 shows a concept of predicting the maximum horizontal response displacement of the damage-controlled latticed wall induced by the joint connection bolt elongation subjected to earthquake motions by using the equivalent single degree of freedom vibration system and the property of the energy conservation.

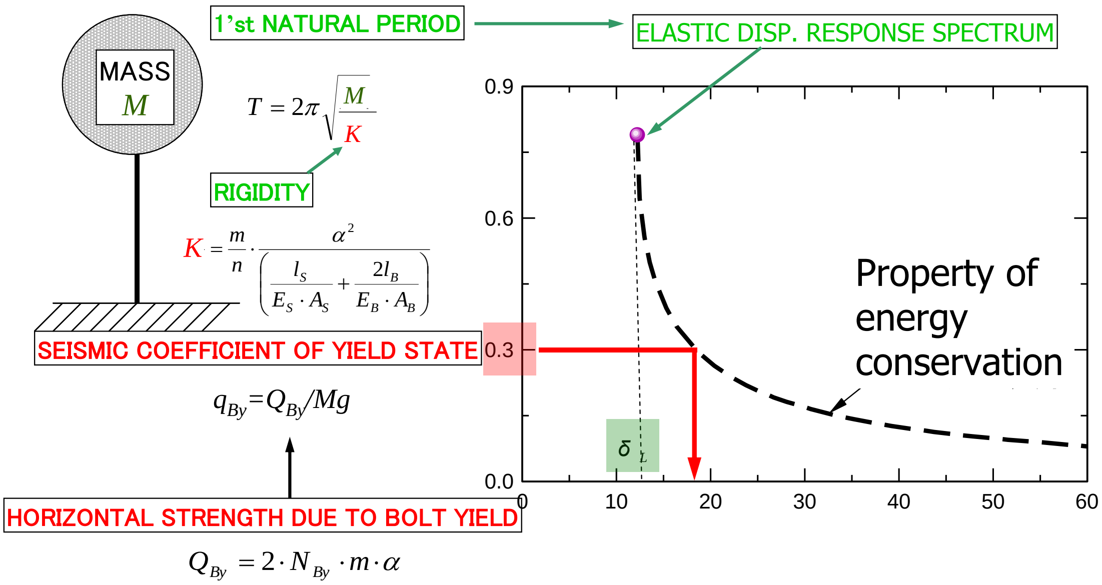

Figure 2. Concept of modeling for predicting the horizontal maximum response displacement

3. CONCLUSION

The presented method using the property of the energy conservation can statically predict the horizontal maximum displacements at the top of the wall.

REFERENCE

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