



ZABOL UNIVERSITY

Department of civil engineering, Faculty of technical and  
engineering

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Title:

Numerically investigating the effect of stiffeners on behavior and  
response factor of gate braced steel frames

Supervisor:

Dr.Seyyed Mahmoud Reza Hosseini tabatabai

Dr. Hossein Ali Rahdar

BY:

Mohammad Momeni

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## Abstract

Gate brace is one of the common types of bracing systems in providing adequate stiffness to deal with lateral loads, which is considered in the design or seismic improvement of structures. This type of bracing has an advantage over most bracing systems from an architectural point of view, and on the other hand, it has relatively low lateral stiffness and out-of-plane buckling potential. Therefore, in this study, an attempt has been made to evaluate the performance of steel frames equipped with external gantry braces and compare it with the coaxial gantry bracing system. Accordingly, in this study, the effect of parameters such as the dimensions of the connecting beam, the position of intermediate nodes, the presence of connecting beam stiffeners, etc., on the seismic behavior and behavior coefficients of the steel frame braced with an external pivot gate brace system and comparing it with the performance of steel frames with The braces of the co-axial gate brace are treated. Abaqus software was used to simulate the desired models. According to the results, in both cases of using coaxial and eccentric braces, with the increase of the distance between the two middle nodes, the amount of damage and stress has been created in the structure, and the amount of stress and deformation has also increased in the columns. Also, the comparison of stresses and deformations in the coaxial and eccentric frames of the vestibule and gate shows that in the divergent gate samples, due to the connection beam, less deformations have occurred in the steel frame. The comparison of stresses and deformations in coaxial and eccentric frames showed that in the divergent samples, due to the connection beam, less deformations occurred in the steel frame. And in the sample of the bending frame, failures have occurred at much lower stresses than the bracing samples. According to the results, by increasing the distance of the intermediate nodes in the portal braces, the load capacity decreases. In both coaxial and off-axis samples, with the increase of the distance between the middle nodes, the bearing capacity decreases, but its effect is greater in the coaxial samples compared to the off-axis samples. The results showed that the use of coaxial braces compared to the bending frame has led to an increase in the behavior coefficient and a decrease in the ductility of the structure. It was found that the use of braces has led to an increase in the behavior coefficients, but with the increase in the distance between the intermediate nodes of the gate brace, the amount of the behavior coefficients has also decreased and the frame is moving towards becoming a bending frame.

**Key words: steel frame, gantry brace, coaxial brace, off-axis brace**