New Form of Base Column Connection in Self-Centering Braced Frames without Post-Tensioned Cable

Zahra Hajimohammadi , Ali Biglari*

Department of Civil Engineering, Faculty of Engineering, Golestan University, Gorgan, Iran

*** biglari.a@gmail.com**

Abstract

In this research, a new type of connection at the steel column bases has been proposed. the main purpose of proposing this connection is to decrease residual displacement and minimize repair time and disruption of the building serviceability after a strong earthquake. The performance of the system with the proposed column base is evaluated using numerical analysis. The results show that the proposed connection satisfies the main purpose of the research well, which is to eliminate residual drifts in the system

Introduction

The results of the recent large earthquakes have shown that the column bases have tolerated significant damages and ruptures due to lateral loads [1]. Therefore, in recent years, researchers have discussed self-centering in structures, in order to minimize the damage at the column bases. Self-centering systems, as systems resistant to lateral load in concrete, steel and even wooden buildings, have significant advantages over conventional structures due to their high capacity to resist lateral loads and the amount of permanent deformation that is almost zero [2-6]. However, due to the uneconomical of the SC-CBF system in our country, in this research, in order to develop and improve the seismic performance of column bases in steel structures, an innovative connection at the column bases has been presented.

Methodology

In this research, in order to provide the possibility of evaluating and comparing the seismic behavior of this connection with the recently developed lateral load resisting resistant systems, first a SC-CBF system from Hassan's research was selected and analyzed and validated. Numerical simulations are performed using OpenSEES software. After that, the results obtained from the numerical analysis of the SC-CBF system are compared with the results obtained from the numerical analysis of the proposed column base in order to improve or not improve the seismic performance of this column base.

Results

The results obtained from the validations in this research are shown in figures 1 and 2.

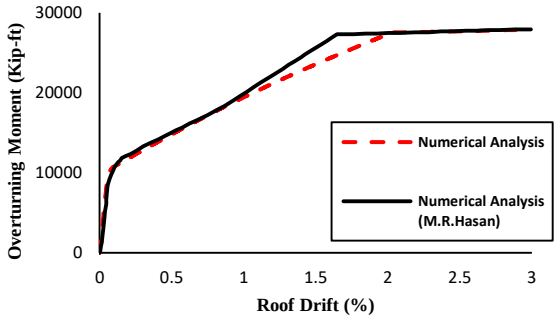

Figure 1: Comparison and validation of pushover analysis results of SC-CBF system

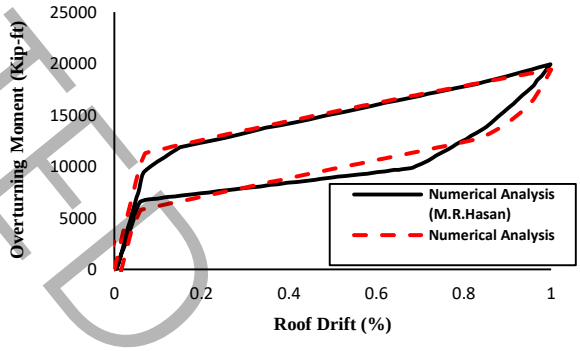

Figure 2: Comparison and validation of cyclic analysis results of SC-CBF system

Also, the results of the evaluation and analysis of the proposed column base in this research are compared with the validation results and are presented in Figure 3.

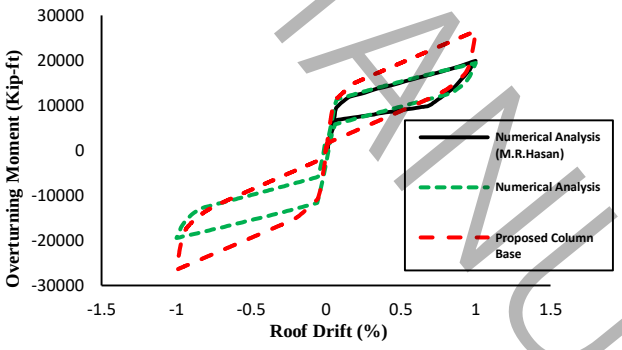

Figure 3: Comparing the hysteresis behavior of SC-CBF system in Hasan's research and the current research and the proposed column bases

In addition, in order to obtain appropriate dimensions for the wires used in the proposed connection, the trial and error method was used and appropriate dimensions were obtained for them. Figures 4 and 5 show the results of the investigation and comparison of different dimensions for these wires.

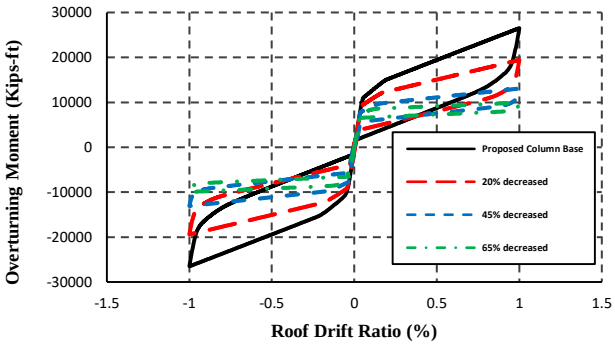

Figure 4: Comparing the hysteresis behavior of the frame in the case of decreasing the diameter of the wires

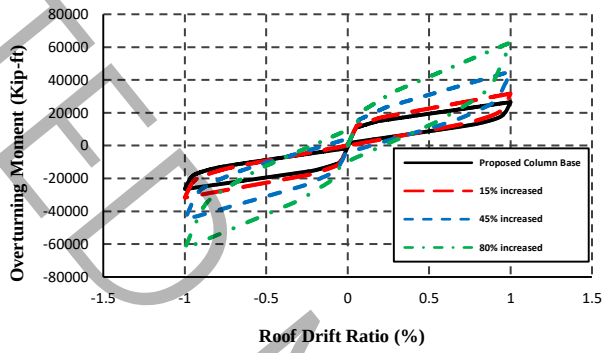

Figure 5: Comparing the hysteresis behavior of the frame in the case of increasing the diameter of the wires

conclusion

- Hysteresis evaluation of the proposed connection at the column bases shows that in the presented system, the permanent drift in the structure is equal to 2.2 x 10-14%. Therefore, it can be concluded, the proposed connection satisfies the main aim of the research, which is to eliminate permanent displacements in the system.
- Investigations show that, in addition to the system with the proposed connection at the column bases, it has the ability to self-centering, it also has more energy dissipation and stiffness than the SC-CBF systems that have been developed so far
- The evaluation of the dimensions of the wires used in the proposed connection shows that by increasing the cross-sectional area of the wires, although the energy dissipation and the stiffness of the system increases, but the system loses self-centering performance and permanent displacements are observed.
- When the cross section of the wires is reduced, the energy dissipation and the stiffness of the system is reduced, but The system still maintains self-centering performance.
- The results show that according to the trial and error in selecting the dimensions, the dimensions considered for the triangular plate and the diameter of the wires are the best possible.

References

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