CHAPTER 5 SUMMARY AND CONCLUSIONS

This study presents the development of an analytical model of KBMFs with PR connections as well as an investigation into the dynamic behavior of the proposed system. PR connections are used in connecting the beams to the columns in this improved version of KBMF system. For this study, bolted top and seat angle connections were used. This type of PR connections is designed based on actual moment-rotation behavior of joints. A mechanical model was employed to model the beam-to-column connections of KBMFs in this study and the accuracy of the model was verified using experimental results. The hysteretic behaviors of the frames using two different types of braces, regular buckling braces and BRBs were studied using the developed model.

In this study, the dynamic behavior of the three-story buildings incorporating KBMFs was investigated. Responses of KBMFs using the two different types of braces were used to evaluate the viability of the system for seismic resistant design. The main findings from this study can be summarized as follows:

1. The component-based mechanical model was employed to predict the moment-rotation relationship under cyclic loads of bolted top and seat angle connections with double web angles. The model considers key deformation components including the nonlinear behavior of the angles, the contact and detachment between the face of the column flange and connecting angles, and the column panel zone. The pinching behavior of the connection is well approximated by using the nonlinear contact element in the mechanical model.

2. An appropriate analytical model for KBMFs with PR connections was developed. Inelastic bar elements with buckling material were used to represent the buckling braces. Inelastic bars in combination with elastic components (called BRB element) were used to represent the yielding and transition zone of BRBs. The beams and columns were modeled using lumped plasticity inelastic beam and column elements.

3. The hysteretic response from the analysis was compared with the experimental results. The comparison indicates that the analytical model can predict the overall hysteretic behavior of KBMFs with PR connections in terms of stiffness, strength, and pinching behavior. However, the pinching was more severe in the experimental hysteretic loops. This highly pinching hysteretic response is due to localized plastic deformations which can not be fully simulated by the model.

4. Two different types of braces, regular buckling braces and BRBs, were evaluated. The hysteretic responses of both frames were studied and compared. The results indicate that regular buckling braces are not suitable for this application. The flexibility of the PR connections in conjunction with buckling of the braces resulted in significantly large axial strain in the braces. The braces would likely to fracture with a small drift value. The KBMFs with BRBs, on the other hand, have very stable hysteretic loops.

5. The results from the nonlinear static and nonlinear dynamic analyses of three-story KBMFs confirm that KBMFs with regular buckling braces would reach the ultimate limit state under a moderate ground motion. For KBMFs with BRBs, even under a severe ground motion, the frames may suffer damage but would not reach the ultimate state.