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Hysteretic behavior of shallow-embedded steel column bases with varying axial force

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1. Introduction

The exposed type of column base is favored for steel structures, because the works on site are simple and the cost is low. However, the exposed type of column base exhibits smaller stiffness and strength than the column base embedded and fixed in the foundation. In addition, the energy dissipation from the yielding anchor bolts is very small, because the hysteretic loop exhibits a pinching behavior.

On the other hand, in most practical design, the column bases are likely covered by a shallow concrete slab to hide the bolted base plate and to level the slab. However, there is no guideline that reflects the influences of the slab on the seismic performance of the column base. Identifying the benefits of the concrete slab will make the design for column bases more reasonable.

The goal of this study is to evaluate the physical behavior of the exterior column base that is embedded in a shallow concrete slab in terms of seismic performance, and to propose a reasonable design method for that type of column base. As part of the shallow-embedded steel column base research, this presentation shows the principle features of the exterior column base from a series of cyclic loading tests. The specimens are comprised of a steel column, a concrete slab, a footing, and grade beams. The thickness of the slab, the shape of the slab, and the axial force of the column were changed as parameters.

(a) (b) (c)

Fig.1 Types of specimens: (a) Exposed type, (b) Flat slab, (c) Elevated grade beam

2. Specimens

Fig.1 shows photographs of the specimen. Reverse cyclic loading was applied slowly at the top of each specimen. A varying axial load was applied for the duration of the test to simulate typical behavior of an exterior column base.

3. Test Results

The hysteretic loop of shallow-embedded column base under varying axial force is shown in Fig. 2. The plot shows the moment-rotation relationship for the unreinforced flat slab specimen. In the positive loading, the axial force and the ultimate strength increased. Oppositely, in the negative loading, the axial force decreased. The effect of the concrete slab is not clear and an increase in ultimate strength is not observed.

In addition, the estimated equation of ultimate strength is proposed in previous research. A comparison of the values to the test result is also undertaken.

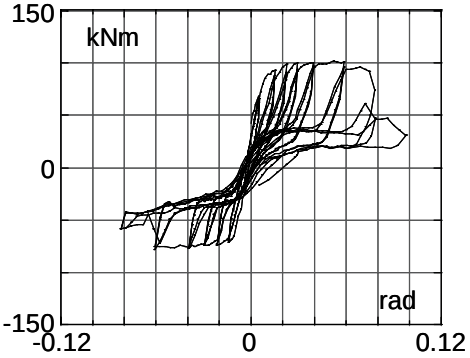

Fig.2 Moment-rotation angle relationship