

Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 60 (1990)

Artikel: Experimental behavior of encased steel column-base connections
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DOI: <https://doi.org/10.5169/seals-46494>

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Experimental Behavior of Encased Steel Column-Base Connections

Comportement expérimental du pied de poteau métallique
de type encastré

Experimentales Verhalten von einbetonierten Stahlstützen

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INTRODUCTION

In designing earthquake-resistant steel structures, it is extremely important to clarify the mechanical characteristics of steel column bases. The relative displacement of the 1st story of the structure under lateral forces is remarkably affected by the degree of fixity of the column bases. In Japan, the case often arises where such degree is found insufficient, so the sectional area of the column member must be increased to meet the requirement restricting the story displacement. However, it is difficult to attain an enough degree of fixity for the exposed type of column bases. This is because it is very hard to maintain a high degree of precision in positioning the anchor bolts and in working out the contact surfaces between the base plates and levelling grout under them. To increase the degree of the fixity, therefore, encased column bases, namely, steel column bases enclosed with reinforced concrete are in use in Japan. Also, exposed type steel column bases damaged by lateral loadings are repaired with this constructional method.

EXPERIMENTAL RESULTS AND DISCUSSION

A total of seven specimens, i.e., two exposed type and five encased type column base specimens were tested. As shown in Table 1, the experimental factors were the presence or absence of encasing concrete, height and sectional area of concrete encasement and loading methods. As shown in Fig. 1, the axial load was zero, and at one position which was considered the point of inflection of the column member, the lateral loads were applied monotonously or repeatedly. The relations between the lateral load $[Q]$ and the displacement $[\delta]$ at 1m height above the bottom surface of the base plate are shown in Figs. 2 and 3. In Fig. 2, the envelope curves of the $Q-\delta$ relations under the repeated load are shown, too. As can be seen from this figure, it is clear that the differences between the $Q-\delta$ curves under the monotonic loading and the envelope curves under the repeated loading are relatively small. The solid straight line shown in Fig. 2 represents the calculated stiffness of an ideal steel column perfectly fixed at the base. Although the degree of fixity and strength of exposed type column bases are small, they increase remarkably if the bases are encased in reinforced concrete. When the encasement height is more than about twice the depth of steel section, these column bases may be regarded as perfectly fixed because the stiffness of these columns is larger than that of the steel column ideally fixed at the base. The specimen in which the sectional area of the stub column is enlarged shows a little increase in the stiffness and strength. The relations between the load $[Q]$ and the lateral displacement $[\delta_b]$ of the base plate are shown in Fig. 4. In the encased type specimens, little lateral movement of the

