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Unbonded Composite Steel Tube Concrete Columns

Colonnes en béton moulées dans un tube d'acier non adhérent

Stahlrohrbetonsäulen ohne Verbund

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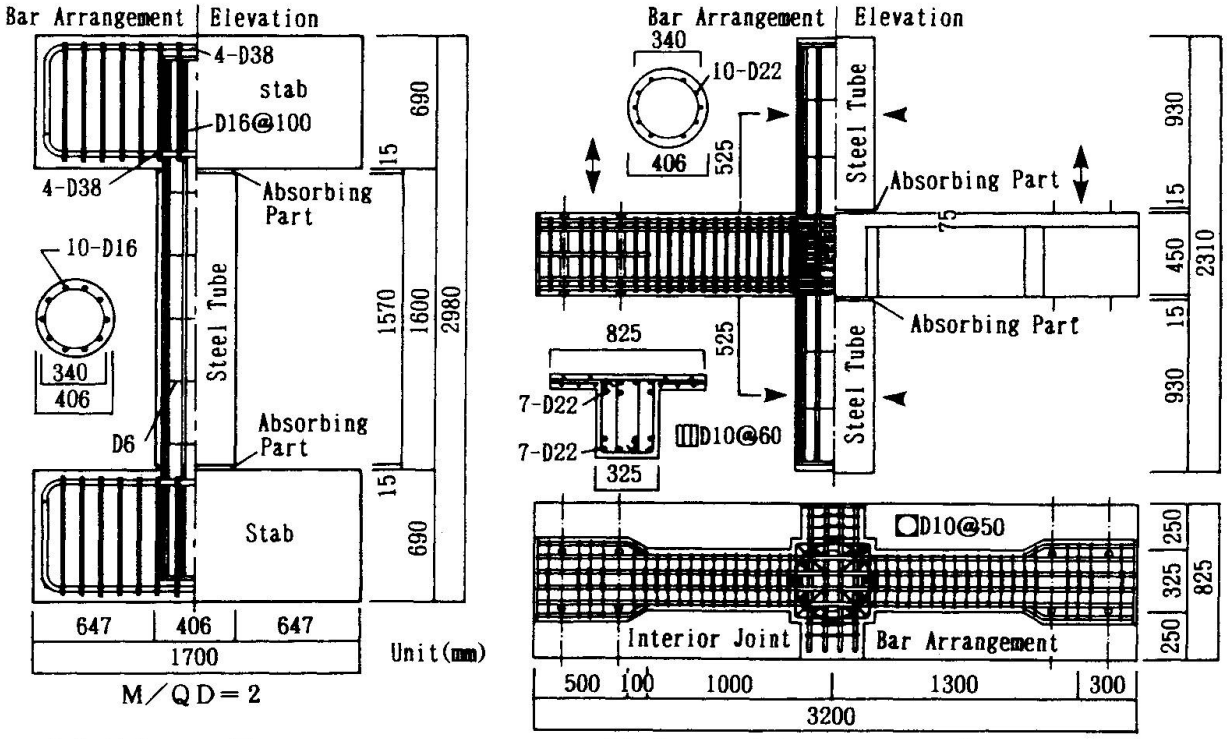
1. Introduction

The UTC (unbonded steel tube concrete) column has a circular RC (reinforced concrete) section encased with a steel tube. The tube is unbonded to maximize its confining effect on inside concrete. A series of column tests and beam-column assemblage tests have been conducted to study the behavior of the UTC columns under severe load conditions and to establish design criteria for RC frame structures using the UTC columns.

2. Test program

The UTC column specimens were designed varying the shear span ratio and the amount of reinforcement.The RC beam-UTC column subassemblages were designed varying the amount of joint confinement, column axial force and joint configurations.



(a) Column Tests (b) Beam-Column Assemblage Tests

Fig. 1 Test Specimens

The test specimens, shown in Figure 1, were half-scale models. The steel tube was unbonded by coating a thin layer of asphalt on the inside surface. The UTC column had a slit of 15 mm at both ends to accommodate column axial deformation. The column specimens with a rigid stub at both ends were loaded to produce a contraflexural moment distribution along the height. The joint specimens were subjected to vertical force at the beam tips and axial force at the column. The joint had a square section and was reinforced with circular and rectangular ties.

3. Test results

Obserbed envelope curves of the load-deflection relations are shown in Figure 2. Major findings from the tests are summarized below:

1) All test specimens showed a ductile and stable behavior until large deformation.

2) The column specimens showed excellent load-carrying capacities becase the steel tube confined inside concrete and enhanced its strength.

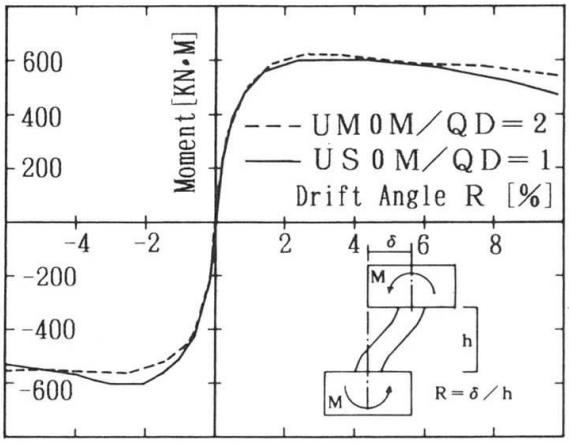
3) The interior joint specimen with a lateral reinforcement ratio of 0.64% showed almost the same ductility and strength as those with 1.27% reinforcement.

4) With regard to the exterior and corner joints, a large amount of lateral reinforcement appeared to be effective in confining the joint concrete and maintaining the integrity of the joint.

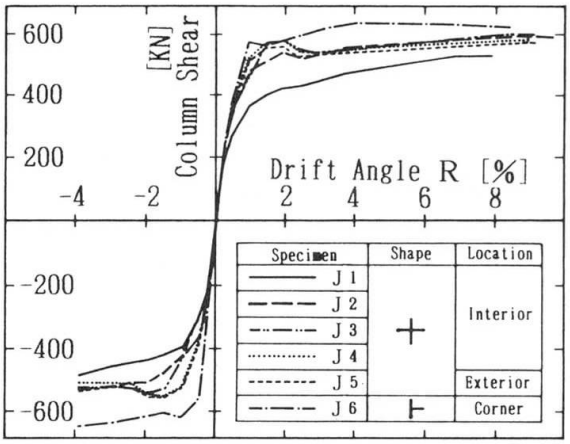
4. Conclusions

A series of seismic tests on columns and joints have verified that the UTC columns have high strength and good ductility. Design of RC frames using the UTC columns has been developed based on the test results.

Figure 3. shows the UTC column in construction of a high-rise building in Tokyo.



(a) Colum Tests



(b) Beam-Column Assemblage Tests

Fig. 2 Envelope Curves

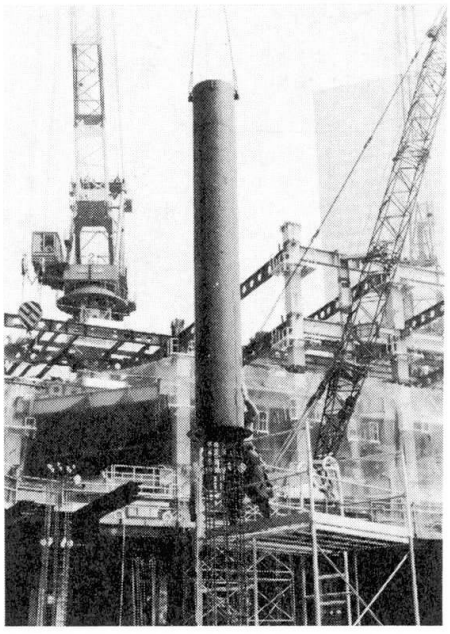


Fig. 3 Construction of UTC Column