Seismic Resistance of Composite Structures

Résistance sismique des constructions mixtes

Erdbebensicherheit von Verbundbauten

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Introduction

Several times each year, earthquakes occur all over the globe, causing incalculable human and material losses. In order to reduce these dammages, a great number of research projects have been realized in the last two decades. Most of these projects were dealing with steel or steel reinforced concrete structures. Unfortunately, the structures combining the advantages of both steel and concrete, namely the composite structures, were analyzed only in some rare cases in relationship with their seismic resistance, leading thus to large gaps in different chapters of EUROCODE 8 project "Seismic Design".

Aim of the research project

The scope of the project was to show that composite structures have besides their good fire resistance properties also an inherent seismic resistance which is due to the combination of

- the steel ductility and
- the damping properties and rigidity of the concrete

This seismic resistance can even be increased by improving the beam-to-column joint design, without loosing the fire resistance.

The project was realized under the leadership of ARBED, in collaboration with the universities of Darmstadt(D), Liège(B), Milan(I) and Wuppertal(D).

Description of the tests

To reach the scope, three test series are performed:

- series 1: 18 tests on Tee-form joints
- series 2: 20 tests on cross-form joints
- series 3: 10 tests on full scale frames

The tests of series 3, which are performed on real size up to two spans and two storey frames with concrete slab, are used for the verification of the numerical code to be developped.

Results

After finishing test series 2, it can be stated that:

- composite structures show an astonishing ductility
- concrete increases the ultimate bearing capacity substantially and
- local instability phenomena are reduced

The 38 tests performed gave important data for the design of composite structures submitted to earthquakes.

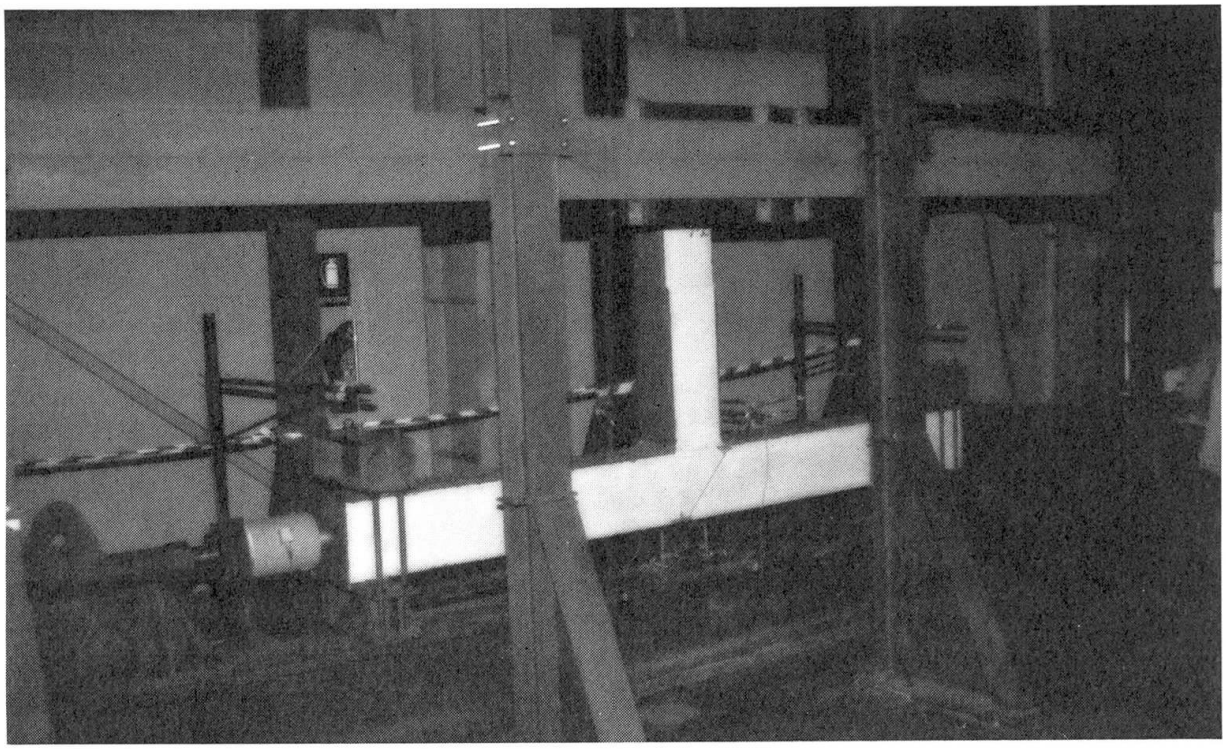

Fig. 1 Testing installation for T-joints in Milan

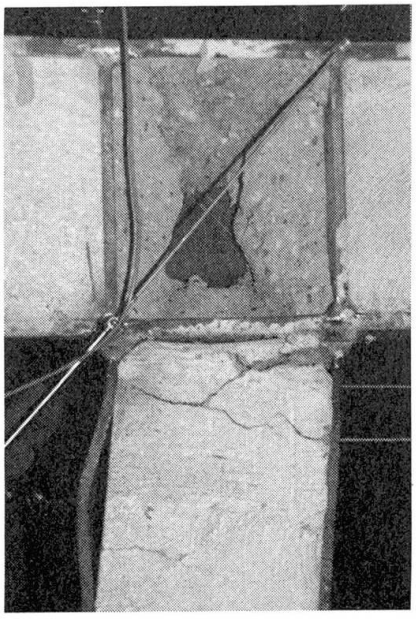

Fig. 2 Welded joint E3 after testing

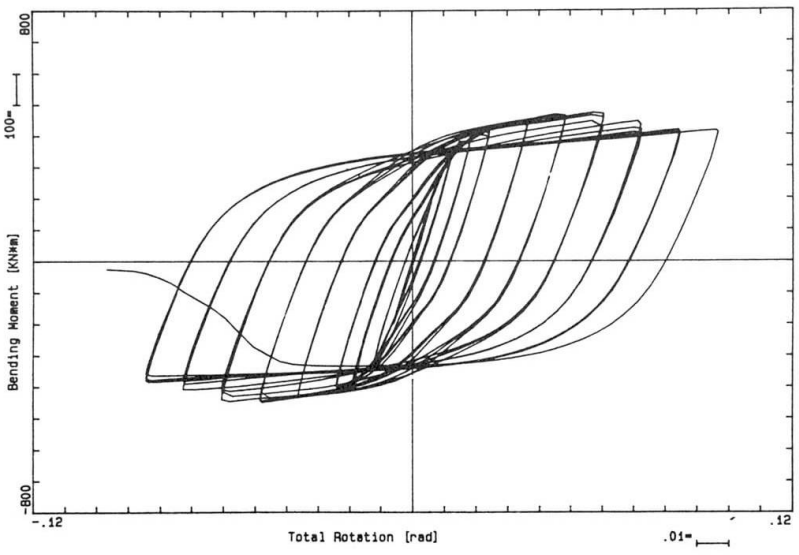

Fig. 3 M-θ hysteresis diagram of E3