



Reinforced Concrete Precast Structures with Rigid Connections

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Summary

The solution of rigid joints between columns and beams for precast concrete structures like halls with one level, is presented. The aspects concerning design, tests and application of this solution are analyzed in the paper.

Keywords: RC precast structures; rigid connection; column to beam joint; laboratory model test; on site test; seismic load; precast structure application.

1. Introduction

The paper presents some aspects of RC precast structure. In traditional way the connection between columns and beams is realized by hinged joint. This solution has some advantages and many disadvantages. Taking into account such aspects, an original conception of the rigid connection was designed, tested and used for RC precast structures with one level.

2. Behaviour of a RC Precast Structure with Rigid Joints

The behaviour of a rigid connection between beam and column under vertical and horizontal (seismic) loads was analyzed. The main advantages of a RC precast structure with rigid connections are: the distribution of the efforts (particularly of the bending moments) on the structure is more equilibrated as compared with hinged joints; the effects of seismic actions are more diminished; the horizontal drift of the precast structure with rigid connections is four times smaller than that of the same structure (column stiffness) with hinged joints; the buckling length of a column with rigid connection to beams is approximately half as compared with a column having hinged connection to beams; the actions on the foundations are approximately 60%, as compared with hinged connection for the inside columns; at the structures with different spans, there is the possibility of decreasing the bending moments of the column by executing the rigid connection at different stages (with or without some self weight prefabricated elements). Some disadvantages are: existence of a proper system; supplementary reinforcement at beams end; more complex erection works; durability of the new system is more sophisticated.

3. Tests concerning the rigid connection

The model (at scale 1:1) of the rigid connection was tested in laboratory under static loads. The diagram load-deflection, obtained during the experimental determinations, is plotted in Fig. 1; the values of loads (F_1 and F_2) for the symmetrical test as well as for asymmetrical test (F'_2) and corresponding deflections can be read from the diagram.

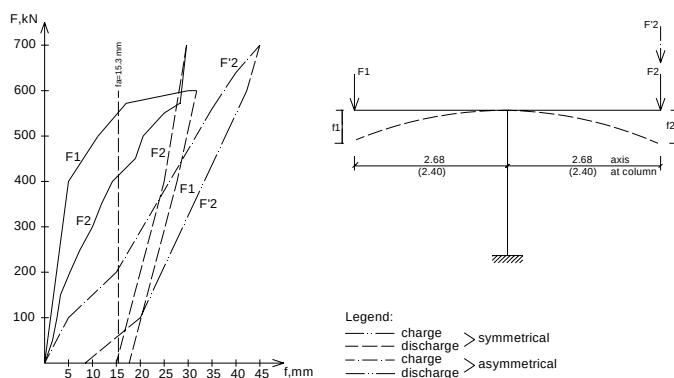


Fig. 1: The phases and results of the laboratory test

Some conclusions can be pointed: allowed deflection is $f_a = 15.3$ mm ($L/175$); due to the column flexibility, the deflections of the two corbels are asymmetrical at symmetrical charge; the average value of F_1 and F_2 at allowed deflection is approximately $F_m = 500$ kN; for asymmetrical charge the experimental deflection will include both deformations: corbel and column; at value of load, $F_1 = 600$ kN, a system slip was observed. From the experimental values of the vertical loads, we could obtain the experimental maximum value of the bending moment: $M_{max} = F_m \times L = 1340$ kNm. The analysis of a RC precast structure with rigid connections gives the design bending moment as $M_d = 1146$ kNm (Shopping Center SELIMBAR Sibiu).

4. Application of solution

The solution of a structure with rigid connection was used, designed and erected at three buildings realized in Romania : Food Factory SCANDIA Sibiu, Shopping Center BUCOVINA Suceava and Shopping Center SELIMBAR Sibiu.

5. Conclusions

From the data presented in the paper some important conclusions can result:

- The technical advantages of prefabricated structures with rigid connections are: a better distribution of stresses on the whole structures, smaller efforts and deflection due to seismic actions, a better behaviour at buckling, a sensitive reduction of the action on the foundation.
- The tests made in the laboratory on a model 1:1 scale and in situ on a main beam with rigid connection demonstrate a very good behaviour at service limit states.
- The procedure of RC precast structure with rigid connections has been applied with beneficent implications at three buildings with different shapes and spans.