DYNAMIC BEHAVIOR OF LARGE PANEL CONNECTIONS

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SUMMARY

This paper deals with the behavior of vertical joints between precast R. C. panels.Experimental data are given and discussed for both static and dynamic loading.The connections dealt with in this paper are of the key-type, trasversally reinforced by means of loops.The findings presented herein underline the relevance of further research correlating static and dynamic behavior of joints,and leading to suggestions and prescriptions for construction in siesmic areas.

INTRODUCTION

The purpose of the research described herein is to investigate dynamic behavior of vertical joints between R.C. precast panels.As it is known, a great number of parameters influence the behavior of joints of precast elements even if they are subjected to static loading.Consequently it appears that the dynamic experimentation with the same joints is conditioned by a series of complex problems and uncertainties.

In the preliminary stage of the research the joints were dynamically subjected to tangential,reversed alternate displacements and their static behavior was investigated.This joice was made in order to estimate the strength and deformability of the chosen joints under dynamic loadings, and compare them with the behavior under static loading.

During testing,information was continuonsly obtained concerning the following points:loadinglevel vs displacements in relation to the number of cycles; stresses on the tying steel bars.

In order to establish analytical formulas for the estimation and the degradation of each one of shear-transfer mechanisms involved under this kind of dynamic loading,shear-transfer mechanisms must be experimentally isolated. Subsequently, superposing them,it is possible to predict their interaction and the overall behavior of the connection.The next stage of this research will consider this last aspect.

DESCRIPTION OF THE SPECIMENS AND LOAD PROGRAM

The experimental program comprises twentyfour joints between complanar panels of two types,shownin Figs.1 and 2. In type 1 specimen there are variations in the following parameters:no. of keys, depth of the joints and quality of the concrete(compression strength and shrinkage).In type 2 specimen there is variations inthe no. of keys, while the total key area remains constant. Only the tests of type 1 specimens have already been conclúded and the optained results have been partially reported [4].

Fig. 3 shows the test setup.Each precast panel was simulated by a strip 47 cm deep, which during the test was bolted to a pair of C-section steel beams. The load was applied by means of a double-effect jack,inserted in a closed-loop preprogrammable hydraulic loading system.In the dynamic tests the specimens were tested under cycles(1 cycle/sec)of symmetrically imposed tangential displacements varying between -g and +g. The value g was kept constant for 10 cycles; then it was increased by approximately 0,1 mm and another 10 cycles applied, and so on.An example record(end of the test no.2) is shown in Fig. 4.

DISCUSSION OF THE EXPERIMENTAL RESULTS

As concerns the static tests, the experimental bearing capacity T_u is in good agreement with the expression proposed [3]: $T_u = 0{,}115\ B_k + 0{,}8\ A_a f_y$, where B_k is the cross-section of keys, f_c the concrete strength, A_a the cross-section of the reinforcement; f_y the steel yield point. In our test G_5 ,for example, $B_k = 540\ cm^2$(3 keys), $f_c = 123\ kg/cm^2$, $f_y = 4100\ kg/cm^2$, $A_a = 2.01\ cm^2$(4 Ø 8); the experimental T_u was 14,9 t, while the calculated T_u was 14,23 t. Note that the formulae proposed by Jensen and by CIB/W23A [5] yield larger values, especially the second one.

The main results of the dynamical tests may be summarized as follows. The behavior of keyed joints differs from that observed in static tests not so much with regard to ultimate strength but mainly with respect to ductility, which shows a considerable decrease (Figs 5 and 7).
The keyed joints have a comparable yield strain under both dynamic and static loading.The ratio between the maximum force T_u for equal joints in dynamic and static tests is of the order of 0,70 for keyed joints and 0,72 for plain joints (made of special no-shrinkage concrete).The maximum force T_u was obtained for static displacements in the range of 2,1- 3,3 mm(for joints made of normal concrete) or for dynamic displacements in the range of 1,4-3,9 mm.This value of T is reached when diagonal crackings between opposite keys are completed (Fig. 6).The cut of the base of the keys follow these diagonal crackings but not necessarilly in each one.
The increase in number of keys caused the ductility to decrease remarkably,as immediatly shown by comparison between diagrams in Fig. 7.
Fig. 8 shows the shear force T and the strain recorded in a tying bar during test G_2 , at different values of the displacement amplitude g.Note that ε corresponding to maximum shear force T_u, coincides with good approximation to the yielding value.

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FOOTNOTES

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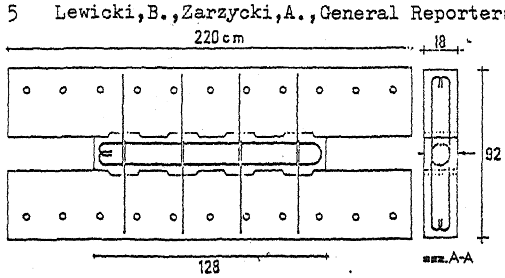

Fig. 1. Specimen type 2.

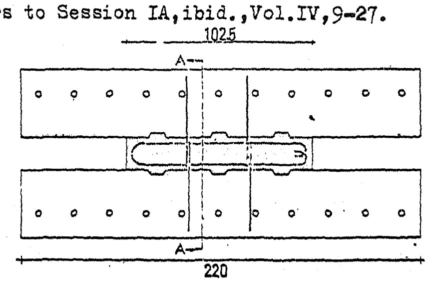

Fig. 2. Specimen type 1.

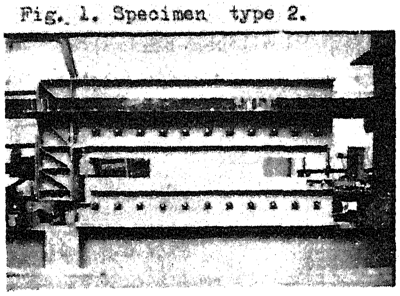

Fig. 3.The test setup.

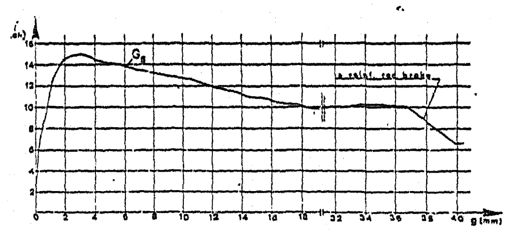

Fig. 5.Static test:Displac.,g.vs.T.

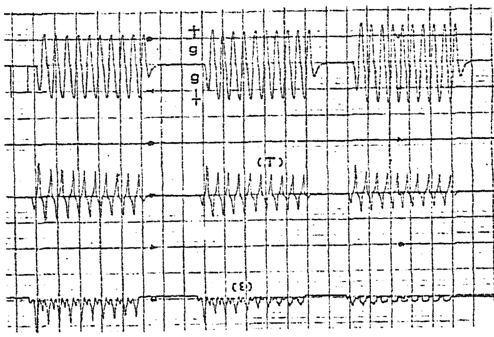

Fig.4 Loading program.

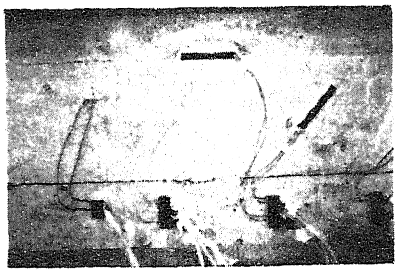

Fig. 6. Photo of dynamic test.

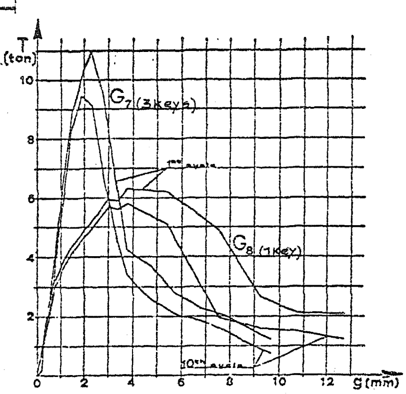

Fig.7.Dynamic tests:Typical plots of shear force T recorder at 1st and 10th cycle vs. g.

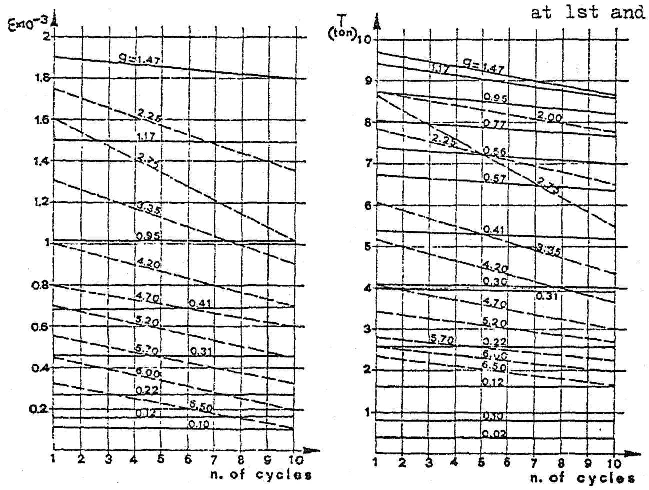

Fig. 8.