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Load Testing of Large Panel System Dwellings

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Summary

This paper describes the programme of full-scale static proof load tests carried out by BRE on a 10-storey block built in the late 1960's using the REEMA Conclad large panel system (LPS) of construction. The load tests were aimed at establishing the performance of selected areas of the building under the currently employed notional loading criterion of 17 kN/sqm. This was taken to be acting as an equivalent static pressure applied simultaneously to the surfaces of all structural elements bounding the enclosed space containing the explosion. The load tests have conclusively shown that the Reema Conclad block tested, and a Bison system built block tested earlier in the year, are able to accommodate the minimum specified notional loading of 17 kN/sqm without gross distortion of the panels and accompanying joints. These were therefore sufficiently strong to resist the accidental loads associated with non-piped gas explosions.

Keywords : Concrete, panel, static loading, explosion, large panel system, LPS

1. Introduction

A Tribunal was set up to investigate the cause and implications of the partial collapse which occurred in 1968 of a 23-storey large concrete panel system (LPS) built tower block built in London. The block was built using the Taylor Woodrow-Anglian system of LPS construction. The Tribunal recommended that system-built blocks of flats over 6-storeys in height should be appraised and, if needed, strengthened. In considering whether strengthening was required engineers were to consider the affects of forces on the structure equivalent to a static pressure of 34 kN/sqm where piped gas was supplied to the building, and 17kN/sqm where it was not.

Unless there are particular problems with the workmanship in a block, the current view held by BRE is that extensive strengthening is unlikely to be necessary for many types of block without a piped gas supply. However, up until now there has been no way of establishing this definitively because of the lack of information on the performance under accidental loads of LPS buildings without a piped gas supply. Consequently, experimental data was required to resolve these issues and to provide engineers with a better basis for undertaking structural appraisals of these buildings.

To meet these needs, the Building Research Establishment Ltd (BRE) obtained temporary possession of a 20-storey BISON and a 10-storey REEMA Conclad LPS block prior to their demolition. A series of load tests were carried out in the two buildings during 1997. Provisional results of the load tests carried out in the Bison LPS block have been reported previously.

The test programme for each block was carried out in two phases. Phase I consisted of structural investigations of the block, with Phase II involving a series of static load tests carried out in selected areas of that block. Those for the Reema block are described below.

2. Phase I - Investigation of the form and quality of construction

The preliminary investigations were aimed at verifying that the design intentions had been complied with and assessing the standard and consistency of workmanship within the building. Consequently, selected joints were opened up within rooms away from the zones in which the main load tests where to be performed.

Fig. 1 External view of a Reema Conclad block

The quality and consistency of workmanship within the building was, in the main, found to be reasonably good in all the areas opened-up, although there was some variation in the detailing of the tying reinforcement.

Therefore, the structural performance of the areas load tested was likely to be representative of similar areas in other nominally identical Reema blocks located elsewhere in the country.

3. Phase II - Static load tests

The load tests were aimed at investigating the ability of structural elements within the block to withstand the notional loads associated with the UK accidental loading criterion of 17 kN/sqm. The maximum mid-span bending moment and maximum shear force at the supports which would result from the uniformly distributed loading induced by such a loading, was applied simultaneously to the wall and floor components using a system of hydraulic jacks, adjustable lightweight loading shores and steel distribution beams.

Several forms of protection were provided to prevent excessive movement of the wall panels and floor slabs in the event of a premature failure of any of the components under test. These consisted of Acrow props, tie rods (loose during the test) fixed between opposing wall panels and steel fixing angles bolted (loose during the test between the floor slabs and top/bottom of the walls.

The physical response of the structure to the applied loads was measured using displacement transducers mounted on an independent instrumentation frame and vibrating wire strain gauges attached at selected positions on the floor slabs.

4. Conclusions

The static load tests have shown that the Reema Conclad block tested by BRE (and the Bison block tested earlier in the year) was able to accommodate the minimum specified notional loading of 17 kN/sqm without gross distortion of the panels and accompanying joints. Accordingly, the Reema (and Bison) buildings tested are judged sufficiently strong to resist the accidental loads associated with non-piped gas explosions.

It has been demonstrated that static load testing might be used to assess the safety of particular designs of LPS buildings where calculations suggest that a structure may have an inadequate margin of safety for the specified notional accidental loading case.