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Compression tests of Mi Panels

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Abstract. A number of compression tests of Mi Panels are presented. The use of lightweight Mi Panels as building system allows the reduction of construction time and waste in the building environment. The compression tests are performed to simulate the behaviour of the wall, when subjected to vertical loads from the roof. Two LVDTs were placed at mid-height of the panels during the compression tests, to record the lateral displacement. Mi Panels failed by fracturing into two parts at mid-height. No cracks in the panel were observed before overall flexural buckling failure. The tests showed that the panels are capable of carrying the required loads, and can be used in place of brick walls.

Keywords. Mi Panel, compression, fibre cement, Polystyrene, high strength cement.

Introduction

The increasing housing demand and the increasing costs due to the use of conventional bricks structures has become motivations for the building industry to use alternative building systems that can reduce the construction time and waste in the building environment. This reduction can be achieved by using lightweight materials, such as Mi Panels. Mi Panels are produced locally in South Africa and can offer rapid construction compared to conventional construction. Mi Panels are composed of high strength cement, polystyrene beads that are graphite impregnated, and a special blend of binding agents that allows adhesion between the inner core and the external fibre cement sheets. Since this building system is still new in South Africa and its demand has slowly started increasing, there is a need for a better understanding of their buckling behaviour and strength. The aim of this experimental study is to determine the compressive strength of Mi Panels, and its failure patterns. Preliminary compression tests of these panels have produced good results [1].

1. Experimental programme

The test set-up for the compression tests is shown in Figure 1. The test simulates the behaviour of the wall, when subject to vertical loads from the roof. In the set-up, thick flat plates were placed at the top and bottom ends of the panel so as to distribute the load uniformly along the width of the panel.

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The panels were instrumented so that lateral deflection could be measured. Lateral deflection, at mid height of the panel, was measured by means of a linear variable displacement transducer (LVDT). Two LVDTs were used so that the readings of one LVDT could be checked against the other.

After settings and calibration of all measuring devices have been completed and the load value zeroed, the load was applied using a 500 kN Instron. All measurements (lateral deflection and load) were recorded automatically as the test was performed. Each panel was incrementally loaded at the rate of 1mm/min, so that the behaviour and failure patterns of the panel could be well observed.

Figure 1. Panel specimens

2. Test results

In all the tested panels, it was observed that failure occurred around mid-height, by sudden fracturing. There was no debonding observed of the fibre sheeting from the inner core, after failure. Figures 2(a) and (b) shows a panel deflecting under vertical load before failure and fracture failure of the panels, respectively. This sudden failure is due to the lack of reinforcing steel inside the inner core.

(a) Overall flexural buckling (b) Fracturing failure

Figure 2. Failure mode

The experimental results are summarized in Table 1. These results include the ultimate loads achieved by the panels, the corresponding distributed loads, and the lateral deflection. The failure load value exhibited by the specimen varied from 107.57 kN to 136.28 kN. Notice that Test 5 was removed Table 1 and Figure 3, since it was significantly distorted. The lateral deflection was used to calculate the secondary moment. Values of this second order effect are also given in Table 1. The lateral deflection and subsequent secondary moment are too small to warrant any further consideration.

Table 1. Compression loads

Test	Load (kN)	Distributed load (kN/m)	Lateral deflection (mm)	Secondary moment (kNm)
1	136.28	227.13	7.44	1.01
2	116.05	193.42	7.18	0.83
3	107.57	179.29	7.32	0.78
4	133.42	222.37	6.98	0.93
6	127.16	211.93	6.32	0.80

Figure 3 shows the load-deflection graphs of the tested panels. The load-deflection graphs clearly show that all the tests were initially elastic, but became progressively inelastic as the applied load approached the maximum capacity of the panels.

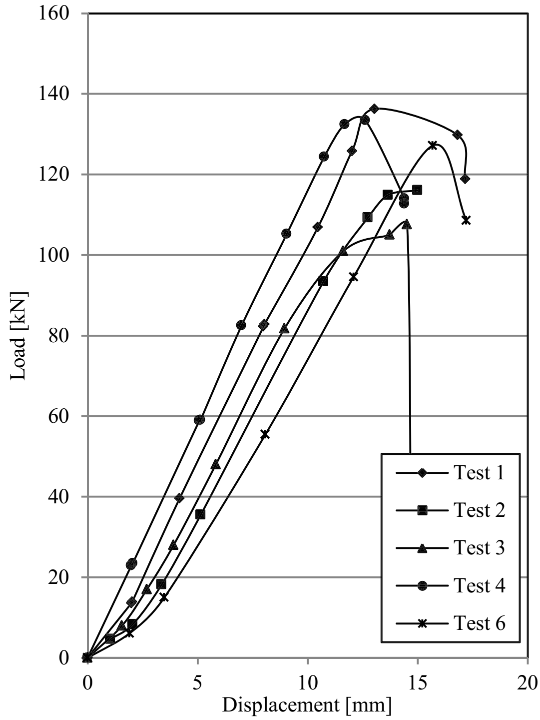

Figure 3. Load-deflections

3. Conclusions

This paper has described experimental studies on the compressive strength and behaviour of Mi-Panels tested in compression. From the tests the following conclusions are made:

- The panels achieved substantially large loads, considering that they are made of very light materials. These loads range from 107.57 kN to 136.28 kN, and far much exceeds the 80 kN load, expected of this type of panels.
- The tested panels achieved all the maximum loads at small lateral deflections. This lack of ductility is due to the absence of steel reinforcements, which can sustain the load before global failure occurs.
- The failure mode observed in all the tested panels was a sudden fracturing failure, which occurred either at mid-height for some panels or close to mid-height for others.

Based on the strengths obtained in these compression tests, it can be concluded that Mi Panels are strong enough in compression, and can meet the requirements required by South African code, SANS 10400 [2].

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References

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