Fig. 13 Concrete cracking at and between loading points (B1b)

Deflection of the composite beam is presented in Fig. 14 in which plastic deformation of the beam at loading points can also be observed. Although the composite beam experienced large deflection, e.g. up to 120 mm for specimen B1b, the composite slab can still be easily detached after cutting, which can be seen from Fig. 15. This figure also shows intact shear connectors after the test at the one shear span, in contrast to the stud fracture occurred at the other shear span (Fig. 12).

Fig. 14 Deflection of beam and slab and yielding of beam section (B1b)

Fig. 15 Studs at the other shear span (no fracture during testing and dismantling; B1b)

3. REMARKS ON DEMOUNTABILITY AND REUSABILITY

After the first round of tests, the composite beams were easily dismantled with the slabs cut into segments. For specimen B1a, the beam and composite slab segments were reassembled after the first test/use. Segment sizes were planned based on the following concerns: 1) minimum cuts, 2) manageable weight, 3) storage space, and 4) width for future transportation. A total of 4 × 2 cuts was made (10 slab segments) for each specimen. The segment size was approximately 1000 mm × 750 mm for the two mid-span segments, 1210 mm × 750 mm for the four end segments and 1340 mm × 750 mm for the other four segments. The blade of the diamond saw used for cutting was 5 mm in thickness. The gap between adjacent slab segments after cutting was between 5 mm to 7 mm, which is enough for grouting when reconstructed the specimen.

Beam specimen B1a was loaded to serviceability limit and unloaded after 10 cycles between the limit to 5% of failure load. The mid-span deflection of the beam was measured before concreting, and after the slab was cut into segments, and detached from the beam. It was found from the measurements that the beam had no residual deformation, which was align with the stain readings that showed the beam did not yield. The difference in resistance of specimen B1b and reused specimen B1a was approximately 2%, demonstrated a similar composite action between first use and reuse. From the test observations, the grout could transfer in-plane forces and there was no problem to easy separation of the floor units.

For composite structures, it is possible to re-use both the steel section and the composite slabs. The beams could also be re-used individually. For re-use of salvaged composite floor slabs, the slab segments can be cut to the required length and re-used as precast floor elements with similar composite action (2nd use) or with no (3rd use) composite action. Grout will be used to fill the gap between the slab segments.

4. CONCLUSIONS

A series of beam tests were carried out to investigate the behaviour of composite beam with demountable shear connectors. Comparable results were obtained from the first-use beam and the re-use beam. The less than 5% differences in load resistance could due to the effect of cast in-situ vs. precast, further analysis is currently on-going. Testing of the demountability and re-assemblability showed that the flooring system can be easily reused without additional erection tolerances. The degree of shear connection of the tested beams with demountable shear connectors was 21.6 %, much smaller than the lower bound of 40% specified in EN 1994-1-1 (CEN2004) for welded shear studs, the slip capacity at 90% of beam resistance was 6 mm in average and fulfilled the ductility requirement. This finding demonstrates the benefits of unpropped composite construction, in terms of reduce slip requirement and lower degree of shear connection.

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