DEVELOPMENT OF ULTRA-THIN TIMBER-CONCRETE COMPOSITE UPGRADES

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ABSTRACT: Timber floors can suffer from poor serviceability performance and require upgrade. By stiffening floors with a thin (20mm), polymer modified, fibre reinforced floor screed, excessive in-service deflections and vibrations are remediated. This paper describes the recent development of the upgrade technique through: characterisation of shear connectors under static and cyclic loading; a programme of short-term bending tests of panels; floor vibration testing and a collapse test of a complete floor. It was found that a thin topping upgrade increased the bending stiffness by up to 114%, reduced the number of modal frequencies below 40Hz from 5 to 4 and reduced the peak acceleration of the vibration response by 56.8%.

KEYWORDS: Timber-Concrete Composite, Thin, Vibration, Serviceability

1 INTRODUCTION

Timber-concrete composites (TCC) are an established construction technique for both new build and refurbishment of existing structures. Despite being utilised in Australasia, the United States of America and continental Europe [1,2,3] their implementation in the UK is not widespread. However there is good potential for exploiting TCCs in the UK as there is a trend to living older properties which require upgrade and refurbishment. Whilst modern expectations are for buildings that perform at higher standard than in the past 81% of dwellings in England predate 1980 [4]. Older buildings require upgrade to improve acoustic separation between dwellings, stiffen floors and reduce excessive vibration. Previous upgrade solutions have used toppings with a depth of 40mm or greater. A recent research programme at the University of Bath has been developing a thin topping (20mm) solution which reduces the mass added to the existing fabric, the need to prop the floor during construction and the change in finish floor to ceiling height.

This paper describes the recent development of the upgrade technique through: characterisation of shear connectors under static and cyclic loading; a programme of short-term bending tests of panels; floor vibration testing and a collapse test of a complete floor.

2 TEST PROGRAMME

2.1 PUSHOUT TESTS

Pushout tests were conducted in accordance with EN26891 [5] to establish the stiffness and strength of suitable shear connectors for a thin topping application [6]. A central timber element was loaded whilst the topping sides were supported at the base. Displacement transducers were arranged as shown in Figure 1 and measured the relative slip between interlayer and timber, timber and topping, and the in-plane rotation of the specimen.

From these preliminary tests inclined screws were identified as having the most potential. To better understand the behaviour of screw connectors with thin
toggings a factorial experiment was undertaken, establishing the effect of timber density, screw inclination and topping depth on the strength and stiffness of the connections [6].

2.4 VIBRATION TESTS

Two full-scale floors were subjected to vibration testing before and after upgrade to establish the effect of the upgrade. A variety of excitation methods, including: impact hammer, shaker and mass release, were used to excite the floors whilst accelerometers measured the floor response.

3 RESULTS

It was found that a thin topping upgrade increased the bending stiffness by up to 114%, reduced the number of modal frequencies below 40Hz from 5 to 4 and reduced the peak acceleration of the vibration response by 56.8%.

4 CONCLUSIONS

Through an extensive research programme including characterisation of connectors, short-term bending tests and vibration testing, thin topping upgrades have shown to be a suitable upgrade method for upgrading timber floors to improve serviceability performance.

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REFERENCES