



Fire Tests on the Pre-cast Concrete Sandwich Walls with GFRP Connectors

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Abstract

Precast concrete sandwich panels are known for their inherently good thermal, acoustic and structural properties. When using glass fibre reinforced polymeric (GFRP) connectors coupling the concrete layers, excellent thermal properties and high structural stiffness can be achieved. However lack of knowledge on fire resistance of sandwich panels and fire behavior of GFRP connectors remain an important issue limiting their wider use in the construction. This paper presents results of fire tests performed on real size sandwich walls in terms of fire behavior of the GFRP connectors and its impact on fire resistance of the entire walls. All the three tested sandwich walls met the REI 120-M criteria for load-bearing fire walls. The connectors showed in general good fire resistance and did not contribute to fire spread. The tests delivered important information on structural behaviour of sandwich walls with GFRP connectors loaded with fire and vertical eccentric and impact load.

Keywords: GFRP connector; sandwich wall; fire tests; fire resistance; fire wall.

1. Introduction

Precast concrete sandwich panels (PCSP) with outer layers out of normal strength concrete have been used as exterior wall systems for many years and have proven themselves in practice [1-3]. The PCSP have a three-layer structure consisting of a concrete facing layer, a thermal insulation layer and a concrete load-bearing layer. There is a wide range of connector types available on the market [1,2]. The type of connectors finding more and more application in modern sandwich panels are various products made from glass fibre reinforced polymer (GFRP) composite. Beside their good mechanical properties, they show excellent durability and thermal characteristics reducing thermal bridging [3], thus improving thermal characteristics of the whole wall.

Despite favourable properties of PCSP, considering their enhanced thermal characteristics, estimation

of their fire resistance awakes questions considering behaviour of their components in fire. Especially fire behaviour of non-metallic connectors, degradation of their stiffness and strength as well as their anchorage strength and potential damage of concrete wythes by melted or pulled out connectors remain a serious concern. Assessment of GFRP connectors' fire performance is difficult due to number of their possible forms and materials used. Another difficulty is the standard assessment methods adopted in the testing codes tailored for flat surface materials [4]. The actual performance of such connectors should be tested in the conditions similar to their real-case application of limited oxygen influx and under load, as it is the case in a real wall. There are no codes and only limited published research, according to the author's knowledge, addressing estimation of fire resistance of concrete sandwich panels. [5, 6].