Construction and Building Materials 40 (2013) 405–410

Contents lists available at SciVerse ScienceDirect

Construction and Building Materials

journal homepage: www.elsevier.com/locate/conbuildmat

AAC-concrete light weight precast composite floor slab

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HIGHLIGHTS

- ▶ We test nine different full scale slabs to find optimum solution for AAC precast slabs.
- ▶ We examine changes in the layout of precast floor and amount of AAC.
- ▶ The dead load of the slab can be reduced by using proposed composite slab 32-23 % compeered to solid RC.
- ▶ Based on strain monitoring of the test specimens, structures perform in a fully composite manner until the ultimate load.
- ▶ Ductility and maximum deflection of the all tested slabs are well enough to give warning before failure.

ARTICLE INFO

Article history:
Received 27 August 2012
Received in revised form 20 September 2012
Accepted 12 October 2012
Available online 12 December 2012

Keywords:
Composite
Light weight slab
Aerated concrete
Ferrocement

ABSTRACT

In this study, the use of Autoclaved Aerated Concrete (AAC) as an in fill material for semi precast panel is investigated experimentally. The effectiveness of proposed light weight slab is reached by comparing the behavior of specimens with that of conventional solid precast slab. The comparisons were based on structural performance and total weight reduction. The composite AAC slabs section chosen are one way slabs with a size of 1m × 3m × 0.130 m (Width × Length × Depth). The specimens vary in the AAC blocks layouts and total weight reduction ratio. The test results showed that the AAC composite precast panel provides reasonable weight reduction without sacrificing the structural capacity.

1. Introduction

A slab structure occupies the biggest percentage of total dead load and volume for an ordinary residential structure. A simple load calculation for a residential building shows that approximately 40–60% of dead load is self weight of slab structure [1]. Thus approximately 10% of self weight reduction from floor slab may lead to 5% of self weight reduction of entire building. Moreover, it directly faces the live load and transfers the load to beam and columns. Clearly, more mass means higher inertia force. Therefore, lighter buildings sustain the earthquake shaking better. Under horizontal shaking of the ground, horizontal inertia forces are generated at level of the mass of the structure, usually this situated at the floor levels [2]. These duties increase floor slab significance and complexity. The traditional solid precast slab is found to be challenging for large scale projects because of its heavy self weight which leads to dependency on heavier equipment, transportation difficulties, expensive connections and joints solution. In addition, heavy precast slabs needs extra temporary supports during construction and larger beam and column size which result in the escalation of the overall cost [3,4].

In terms of better structural performance and lower cost, the development of varieties of light weight slab has become a crucial need. The use of semi precast panels is increasing rapidly due to it is versatile solution for transportation, handling and effective joint practice. In the recent past, a large number of semi precast panel have been developed using either ferrocement or composite cold steel deck with different type of toping concrete [5–9]. Insulating and light weight core panels were then developed which greatly increased the desirability of this type of construction. The panel consists of two thin skins high strength layers and elastic moduli separated by a core thick layer of normally much weaker and lower material density [10–13]. More than 15 different types of precast slab are being used successfully in construction market. Five general criteria has to be considered for the capacity of flooring units; bearing capacity, shear capacity, flexure; capacity, deflection limits, handling restriction [3]. There is no system fulfilling all of the

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0950-0618/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.conbuildmat.2012.10.011

above mentioned criteria. Nevertheless researches are going on to achieve the best fit slab system for different environments and projects.

The composite slab systems were found structurally effective with thin layer of precast member taking into account of the benefits which include: shorter construction time, less dependent on heaver equipment on job site, less wastage of material, high quality smooth surface finish, in situ structural concrete topping and in-fill forming monolithic structures, eliminates or greatly reduces props, eliminate convention formworks [14–18].

Thinner precast structure of the composite slab could be achieved with ferrocement technology. Ferrocement provides considerable reduction in cracks number and their spacing (64–84%) was observed. Additionally, it enhances the ductility and energy absorption properties [1]. Ferrocement is not only an extension of reinforced concrete but also is now considered a member of the family of laminated composites, it can be reinforced with steel, or non-metallic meshes such as fiber reinforced polymeric (FRP) meshes [16]. The addition of fibers or micro-fibers as secondary reinforcement in the cement matrix, to improve performance, makes ferrocement a hybrid composite.

Light weight semi precast composite slab systems have been practicing mostly for roof panel. Weight reduction is achieved by replacing the core of panel with low density concrete and some other type of light weight infill blocks [19,20]. Different types of composite roof panel with low density infill as core element have been practiced [21,22]. Composition of light weight aerated concrete and ferrocement in sandwich structure shows effective load carrying performance in some applications [23]. Compared to other conventional wall and roof systems, AAC composite panels reduce energy consumption of buildings significantly with its excellent insulation qualities. It is considered as environmental friendly, no pollutants or toxic by AAC products are released that could affect indoor air quality [24,25]. Moreover, AAC can be obtained in any dimension, it is easy to handle which increase the construction speed, and it is widely practicing and available in construction marked.

However, there is no significant experimental works has been recorded for semi precast slab with ferrocement precast layer and AAC as in fill material where ferrocement work as precast layer and AAC as efficient thermal insulator and light weight core element. Therefore, this paper presents one of the attempts to develop a light weight composite floor system to address these

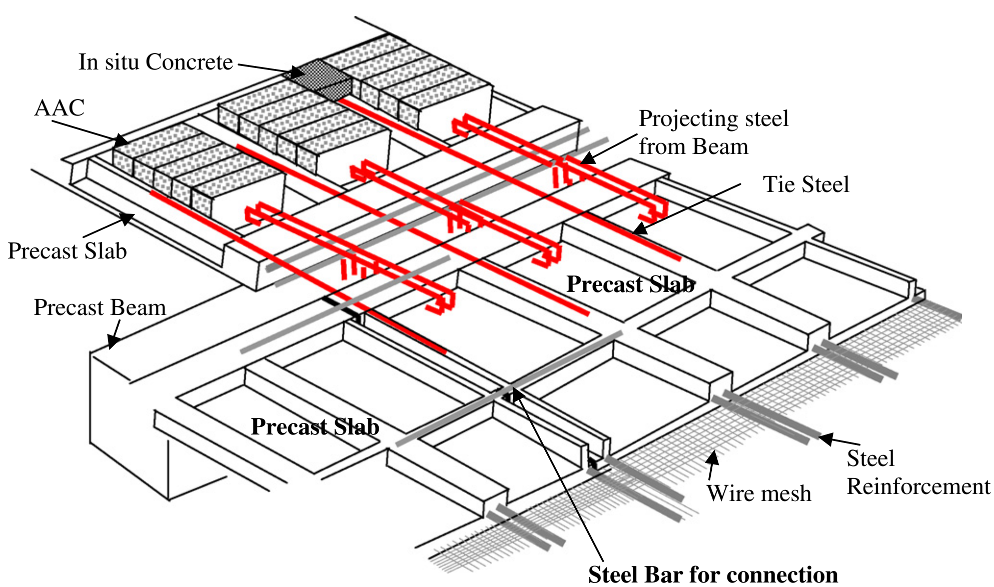

Fig. 1. Ferrocement–AAC composite Slab.

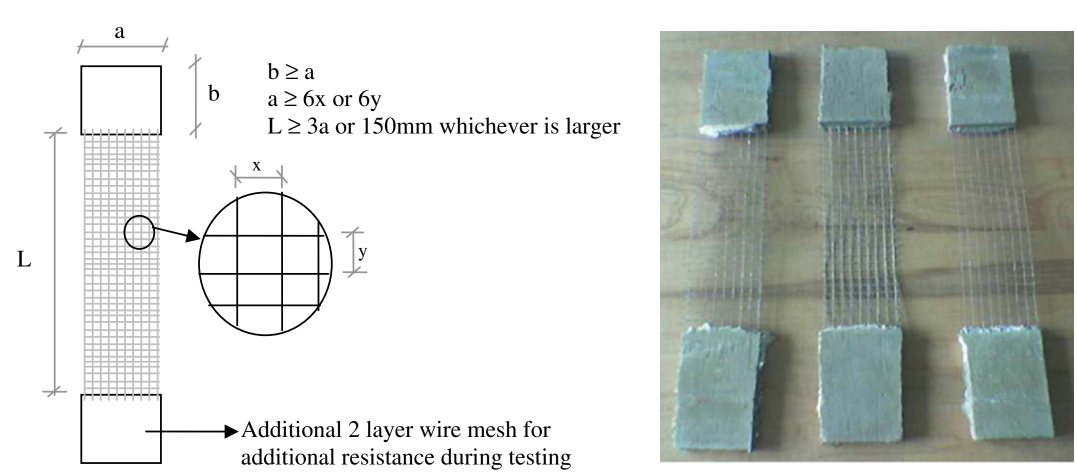

Fig. 2. Detail test sample for tension test of wire–mesh.