Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 193 (2017) 385 – 392

Procedia Engineering

www.elsevier.com/locate/procedia

International Conference on Analytical Models and New Concepts in Concrete and Masonry Structures AMCM'2017

Research and numerical investigation of masonry – AAC precast lintels interaction

Wojciech Mazur[a,]*, Łukasz Drobiec[a], Radosław Jasiński[a]

[a]*Sielesian University of technology, Department of Building Structures, Gliwice, Poland*

Abstract

The paper presents the results of the experimental results and FEM simulations of interaction between masonry walls and lintels made of AAC. 3 different models with 1, 3 and 5 courses of masonry units placed on the lintel were tested. During the test, forces, displacements, deformations and cracks patterns were measured and observed. During numerical simulation three-parameter elastic-plastic model of Menétrey-Willam (M-W-3) was used for material of masonry units and lintels. All parameters were based on basic and accompanying material experimental results.

Peer-review under responsibility of the scientific committee of the International Conference on Analytical Models and New Concepts in Concrete and Masonry Structures

Keywords: Autoclaved Aerated Concrete; precast lintel; FEM; elastic-plastic model.

1. Introduction, objectives of the paper

Almost each building designed for people, especially designed as a resident building have masonry walls with openings spanned by lintels. Usually lintels are carried out as beams made of steel or reinforced concrete. Calculation model of the lintel is the most often simple or multi span beam. Difference of calculations between lintels and beams depends on method of loads calculation from considered area of wall over lintel [1 - 4]. Engineering calculations of capacity of lintel is a simplification because don't take into consideration interaction between wall and lintel. Solutions available in literature for example presented by Hendry at al. [5] apply to walls

* Corresponding author. Tel.: +48 32 237 11 27
E-mail address: wojciech.mazur@polsl.pl

Peer-review under responsibility of the scientific committee of the International Conference on Analytical Models and New Concepts in Concrete and Masonry Structures
doi:10.1016/j.proeng.2017.06.228

supported on steel or reinforced concrete beams which have different flexural rigidity and when proportion of height of wall h to opening span l is equal or bigger than 0,5. High quality of performance of masonry units from AAC allow to erect walls with thin-layer joints and mortar applied only for the bed joints. These quite new constructions haven't been already recognized enough to predict interaction between wall and lintel. Also calculation methods haven't been verified for situation when beam used as a lintel has elastic modulus similar to wall.

Principal objective of the paper is comparison results obtained from research and results obtained from numerical investigation of lintels interacting with wall different height.

2. Laboratory test

2.1. Materials

The models were erected using blocks and lintels made from Autoclaved Aerated Concrete (AAC) of one of polish manufacturer. The masonry units (600 kg/m^3 type) had dimensions 590 x 180 x 240 mm, special shape of head joints, characteristic compressive strength f_b = 4,0 MPa. System mortar for thin-layer joints of M5 class based on white cement was used.

Openings of models were spanned by precast reinforced lintels about total length of 2.0 m, width b = 180 mm and height h = 240 mm. AAC was 650 kg/m^3 type and characteristic compressive strength f_b = 4.19 MPa. Lintels were reinforced by horizontal bars with 8 mm diameter (three at bottom and two at top) and stirrups with 4.5 mm diameter. The stirrups were located in constant distance 150 mm along the lintel length. The ribbed bars were made of St3S-b-500 steel (class B in accordance to EC-2). Longitudinal bars and stirrups were cross-wire welded and coated by anticorrosion layer.

2.2. Models

The tests consisted of three sets (two elements in each set) of models responding to arrangement precast lintel-wall different high - bond beam. Set NI-N had five courses of AAC blocks over the lintel. Set NII-N had three courses and set NIII-N had one courses of blocks.

Length of all models was the same and equal 2680 mm and the height of wall over lintel was equal 1200 mm (set NI, h/l=0.8), 720 mm (set NII, h/l=0.48), 240 mm (set NIII, h/l=0.16). Mortar was applied only for bed joints. Opening span was the same in each model and was equal 1500 mm. All models were tested after at least 28 days after construction. Measurements of vertical displacements were measured by inductions gauge (0.002 mm accuracy) in the middle of the span and in one third of support length of lintel in accordance to [6, 10]. Four point vertical load was applied by hydraulic jack (1000 kN range). Horizontal load was applied by steel ties and springs to substitute for farther part of wall and measurement of force was conducted by force gauge (50 kN accuracy). Additionally in set NII reinforced concrete beams were added between wall and steel plates to ensure better uniform distribution of horizontal stress. Test stands and models of all sets are shown in Fig. 1. In case of models of sets NII and NIII on one side of wall instead of traditional measurements by induction gauges, non-contact method of strain measurement was used (Fig. 2).