Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 161 (2016) 133 – 136

Procedia Engineering

www.elsevier.com/locate/procedia

World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium 2016, WMCAUS 2016

Steel Connections Post-Earthquake Fire Tests Setup

Tudor Petrina[a,*]

[a]*UTCN, 15 C. Daicoviciu Str., 400020 Cluj-Napoca, Romania*

Abstract

This paper presents the setting up of a test stand, the design and construction of a furnace and the testing procedure in order to analyse the behaviour of steel beam to column end-plate bolted connections under the post-earthquake fire action. 12 real scale beam – node – column substructures were created for this goal. The main problem was how to simulate the seismic action on the specimens immediately followed by fire action. For the first part, the recommendations inside the document of ECCS – Technical Committee 1 were developed and applied for this case; for the fire action, the special furnace was designed and constructed around the connection.

Peer-review under responsibility of the organizing committee of WMCAUS 2016

Keywords: end-plate connections; post-earthquake fire action; testing procedure; furnace; connection deterioration;

1. Introduction

After the majority of earthquakes, especially in the urban areas, big fires occurred, sometimes making more calamities than the actual ground movement. During the 1906 San Francisco earthquake, for instance, the post seism fire produced 80% of the total damage; it was the biggest human life loss in California and together with hurricanes Galveston (1900) and Katrina (2005) are the largest natural disasters of the USA.

A testing programme was realized in 2014-2015 at the Technical University of Cluj-Napoca, Romania, Faculty of Civil Engineering Testing Facility, on real scale steel beam-connection-column substructures. The programme was aimed to find the behaviour of steel beam to column end-plate connections under the post-earthquake fire action. After

* Corresponding author. Tel.: +40 747929585.
E-mail address: tudor.petrina@mecon.utcluj.ro

Peer-review under responsibility of the organizing committee of WMCAUS 2016
doi:10.1016/j.proeng.2016.08.510

the cyclic action made according to ECCS document [1], the deteriorated connections were immediately subjected to fire, following a real time-temperature curve according to Petrina [2]. New connections were also tested for fire action in order to find differences to the previous deteriorated case.

2. Conception of the testing programme

2.1. Initial design and simulation

During earthquakes, the connections are elements of structures that may develop a permanent damage in terms of resistance and stiffness. International literature on fire tests, like in Ramli-Sulong et al. [3], offers good information about the behaviour of steel beam to column connections under fire, but poor information on the post-earthquake fire behaviour of this specific type of connection (with end-plate). The author is aiming at finding the effect of connection's seismic damage on the post-earthquake fire behaviour of the structure.

Firstly, the connection was designed following prescriptions according the European design code EN 1993 [4] and after that, numerical simulations by using the advanced models VULCAN, SAFIR and other were performed on the studied substructure. The simulations were done in order to know whether the conception is right or not, before executing the specimens for experimental testing. The testing procedure follows the recommendations of the document of ECCS [1].

2.2. The specimen

The specimen is a steel beam, column, endplate bolted connection (12 ensembles). The scale was 1:1 - the column is made up by an H type compound profile having the flanges of 15mm thickness and web of 10mm thickness and the beam is of I type compound profile with the thickness of the flanges of 15mm and the web of 8mm. The bolts are of type 10.9 with controlled tense. The connection is a steel beam-to-column bolted connection. The column is 3.0m high and the cantilever beam has the length of 2.0m. Total weight of one specimen was 415kg. The type of the material used is according to Petrina [5], the structural steel S235JR.

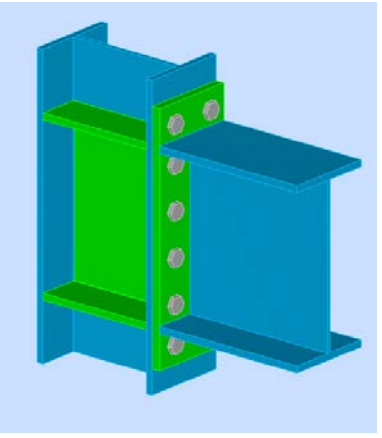

Fig. 1. Studied connection according to Petrina [5].

2.3. Required characteristics for the test stand

The next main characteristics were followed for the stand:

- to assure a pinned fitting of the column base and upper end;
- to block the dilatation of the column;
- to block possible translations on a direction normal to the plane of the ensemble.