AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Structural Engineering

BEAM-TO-RECTANGULAR HOLLOW SECTION COLUMN CONNECTIONS USING LONG BOLTS: A NUMERICAL INVESTIGATION

By

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BSc Structural Engineering

Ain Shams University

A Thesis

Submitted in Partial Fulfilment for the Requirements

of the Degree of Master of Science

in Civil Engineering (Structural Engineering)

Supervised by

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Master of Science in Civil Engineering (Structural Engineering).

The work included in this thesis has been carried out by the author in the Department of Structural Engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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ABSTRACT

In steel structural systems, beam to column moment connections have always been a matter of interest. Bolted connections, in particular end plate connections, are considered one of the most familiar beams to column connections.

While numerous types of moment connections can be used in opened column sections (i.e. I-Section), using closed column sections such as RHS or SHS in bolted moment connections may be a problem. Unless joint is located at the near opened end of the column, difficulty in accessing the inner closed column face may stand as a barrier for utilizing common moment connections for these joints. Some solutions for this problem, which were recently utilized, varied between special preparations such as cutting a hole through hollow section column, using special bolts or using intermediate elements such as U channels. These solutions may overcome the difficulty of bolt placing, but still have some defects such as low resistance, low rigidity, high cost and the need of a high quality control.

Using long bolts is presented as a good alternative to be used for overcoming all the previously mentioned defects. One of the main advantages is that the column face would not be subjected directly to tensile stresses and so the applied forces will be resisted by the whole column. This would lead to improving the joint rigidity and resistance.

Numerical work was used for simulating this joint, but first the simulation for the moment connections was verified against a previous experimental work for beam to column moment end plate connection.

Also, a mesh sensitivity analysis was performed to help finding the most adequate mesh elements sizes for both accurate and a non-consuming time analysis.

Later, this study presents numerical analysis, where finite element models for beam to closed column moment connection through long bolts were modelled. ABAQUS software program is used to help having a better understanding for the behaviour of such joints. Connection elements are modelled as shell elements, while bolts are modelled as beam elements.

In this thesis, behaviour of such joints and different failure modes are discussed through studying different finite element models. Parametric study is made in order to study the effect of some parameters such as end plate and column wall thicknesses, bolt diameter, bolt grades, along with other special conditions. While studies for effect of different parameters are performed, highlights on prying force effect on the bolts of these joints are made.

Finally, conclusions for this study are summarized in the last chapter of this thesis. Future recommendations are proposed for end plate long bolts connections with closed column sections.

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