Ain Shams University
Faculty of Engineering
Department of Structural Engineering

Behavior of steel tubular poles partially filled with concrete

A Thesis submitted in the Partial Fulfillment for the Requirement of the Degree of

Master of Science in civil engineering (Structural)

Submitted by

Moamen Ahmed Khalifa Salem

B.Sc. in Civil Engineering -Structural Engineering

Ain Shams University - Faculty of Engineering

Supervised by

Dr. Amr Abdelsalam Shaat

Associate Professor

Structural Engineering Department

Ain Shams University

Dr. Sherif Mohamed Ibrahim

Associate Professor

Structural Engineering Department

Ain Shams University

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By
Moamen Ahmed Khalifa Salem
B.Sc. in Civil Engineering -Structural Eng.-2012
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EXAMINERS COMMITTEE:

Prof. Ashraf Mahmoud Gamal El-din Osman ....
Professor of Steel Structures.
Structural Engineering Department
Cairo University

Prof. Adel Helmy Salem ....
Professor of Steel Structures.
Structural Engineering Department
Ain Shams University

Dr. Sherif Mohamed Ibrahim ....
Associate Professor
Structural Engineering Department
Ain Shams University

Dr. Amr Abdelsalam Shaat ....
Associate Professor
Structural Engineering Department
Ain Shams University

STATEMENT

This thesis is submitted to Ain Shams University, Cairo, Egypt, in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering (Structural department).

The work included in this thesis was carried out by the author at steel lab of the faculty of engineering, Ain Shams University.

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

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

Date: / 2017

Name: Moamen Ahmed Khalifa

Signature: *Moamen Khalifa*

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ABSTRACT

Steel circular poles are superior to be traditional poles, as they are more durable and lighter in weight. Thin walled steel circular poles often fail by local buckling in bending, before reaching the max. tensile strength of steel. This problem can be solved by increasing wall thickness, but this solution will increase material cost significantly. An economical and simple solution is to stuff the pipe partly with concrete. this research aims to conduct the optimum concrete stuffed length to achieve the max. moment strength with possible least self-weight in steel poles.

The study consists of both testing and analytical phases. Nine steel pipes are divided equally into three groups. All of nine pipes have the same length (2000 mm) and the same wall thickness (2 mm) but with different diameters. Diameters are 114.3, 160, and 202mm.

The three pipes of each group were stuffed with different lengths of concrete, ranging from 11 to 100% of the cantilevered length. The specimens were tested until reaching failure under bending from a single concentrated load at the free end. The results showed that the obtained optimum concrete stuffing ratios were 0.32, 0.43, and 0.50 of the cantilevered length for specimens with diameters 114.3, 160, and 202 consecutively. This is known as the least stuffing length which specimen needs to get the fully stuffed pipe strength.

Analytical methods have been improved for studying the behavior of partly concrete stuffed steel pipes and used to predict the optimum length percentage of concrete stuffing. The methods integrate ovalization methods improved for fully stuffed and empty pipes. The method accounts

for the non-linearity of concrete and plasticity of steel. The method also accounts for local buckling and ovalization of the empty part. The method was verified successfully with testing results. Also, it used in a parametric study to study the influences of key parameters which are D/t ratios, steel yield and ultimate strengths. It was determined that the optimum stuffing length percentage increase as D/t ratio is increased. Also, the optimum stuffing length percentage increases when the ratio between ultimate and yield strength increases.

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