شبكة المعلومات الجامعية

# بسم الله الرحمن الرحيم

# شبكة المعلومـــــات الجامعية

# التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

# جامعة عين شمس

## التوثيق الالكتروني والميكروفيلم

## قَسَــــم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد اعدت دون آية تغيرات

## يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of
15 – 25c and relative humidity 20-40 %

# بعض الـوثـــائق

# الأصـلية تـالفـــة

# بالرسالة صفحات

# لم ترد بالأصـــــل

Menoufia University

Faculty of Engineering

Civil Engineering Department

# FINITE ELEMENT ANALYSIS OF SINGLE PLANE CABLE-STAYED BRIDGES UNDER CONSTRUCTION BY CANTILEVERING METHOD

BY

**HESHAM EL-SAYED NOUR EL-DEEN OTHMAN**

B. Sc. 1993, Civil Engineering Dept.

Menoufia University

A THESIS PRESENTED FOR THE DEGREE OF MASTER OF SCIENCE IN STRUCTURAL ENGINEERING ( STRUCTURES )

**UNDER THE SUPERVISION OF**

**PROF. DR. OSAMA MOHAMMED TAWFIK**

Professor of theory of structures

Faculty of Engineering - Menoufia University

**PROF. DR. HASSAN IBRAHIM HEGAB**

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Faculty of Engineering - Ain Shams University

**DR. MOHAMMED TAHER MOHAMMED NEMIR**

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**EXAMINERS COMMITTEE**

**PROF. DR. ADEL HELMY SALEM**

Professor of steel structures

Faculty of Engineering - Ain Shams University

**PROF. DR. HASSAN ABD EL-AZIZ EREIBA**

Professor of steel structures

Faculty of Engineering - Cairo University

**PROF. DR. OSAMA MOHAMMED TAWFIK ( Supervisor )**

Professor of theory of structures

Faculty of Engineering - Menoufia University

**PROF. DR. HASSAN IBRAHIM HEGAB ( Supervisor )**

Professor of theory of structures

Faculty of Engineering - Ain Shams University

1997

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# STATEMENT

This thesis is submitted to the department of Civil Engineering, Faculty of Engineering, Menoufia University, for the degree of M. Sc.

Thesis Title :

**FINITE ELEMENT ANALYSIS OF SINGLE PLANE CABLE-STAYED BRIDGES UNDER CONSTRUCTION BY CANTILEVERING METHOD**

The work included in this thesis has been carried out by the author in the department of Civil Engineering, Faculty of Engineering, Menoufia University.

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

Author's Name : **Hesham El-Sayed Nour El-deen Othman**
Signature :
Date : 11/11/1997

The above statement has been signed by the author.

Supervisors
( )
( )
( M. )

Head of the Department
( )

# ABSTRACT

During the construction of a cable-stayed bridge by the cantilevering method, the bridge supports its own weight and the weight of the construction equipment. At this phase, the statical system of the bridge is a double-stayed cantilever girder, which has a remarkably less stiffness than the final statical system of the bridge.

A three-dimensional nonlinear finite element analysis for a two-node beam-column element is formulated. Each node has seven degrees of freedom; three displacements, three rotations, and the warping of the cross section. The formulation is based on the theory of torsional-flexural behaviour, originally presented by Vlasov. The derived formulation is valid for both open- and closed-type sections. All sources of geometric nonlinearity, such as cable sag, beam-column effect, and change of bridge geometry due to large displacements, are considered in the analysis. A computer program, originally presented by Davies, that uses the derived formulation in an iterative incremental procedure by the elimination method, is used.

A real bridge is chosen as an example and solved at the end of all its sixteen construction stages, and under many cases of live load, respectively. The results show that cable-stayed bridges are usually highly geometrically nonlinear, especially when the pretensioning forces are applied to the stay cables. While the deflections of the deck during construction are much more than the deflections obtained from the live load condition, the forces in the stays are slightly less than those obtained from the live load condition.

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