



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Vol ., No., 30 September, 2007.

SCIENTIFIC BULLETIN
Received on :
Accepted on :
pp. :

PROPOSED TECHNIQUE FOR IDENTIFYING DAMAGE LOCATION USING CHANGE IN MODE SHAPES PARAMETERS

Shehab Eldin M. Mourad

Assistant Professor, Faculty of Engineering, Ain Shams University

ABSTRACT

Structural defects cause changes in the dynamic characteristic of the structures that include changes in its frequencies and mode shapes. Such changes have been widely used for safety inspection, maintenance and damage detection to define the damage location. Different techniques for damage detection based on change of dynamic characteristics were used in literature, however its' results vary depending on the sensitivity and complexity of each technique. In this paper, a technique based on the Square Root of Sum Squares (SRSS) of change in absolute displacement and curvature of mode shapes is compared with the other techniques. The proposed technique is applied on different structural models either statically determinate or indeterminate structures with either single or multiple damage scenarios. From the presented study, the technique of SRSS of change in absolute curvature of mode shapes was found to be a powerful method for damage detection for all studied structural models even with multiple damage scenarios.

ملخص:

العيوب الإنشائية تسبب تغير بالخصائص الديناميكية للمنشآت و التي تشمل التغير في تردداتها و أشكال اهتزازاتها الطبيعية. و قد تم الاستفادة من تلك التغيرات في أعمال فحص و صيانة المنشآت و تحديد أماكن التي بها أضرار إنشائية. يوجد بالمراجع العديد من التقنيات المختلفة و المبنية على تغير الخصائص الديناميكية للمنشآت للبحث عن أماكن الضرر، و لكنها تختلف من حيث صعوبتها و حساسيتها. يختص هذا البحث بتقديم تقنية مبنية على الجذر التربيعي لمجموع المربعات للتغير المطلق بالإزاحات و الانحناءات لأشكال الإهتزازات، مع مقارنتها بالتقنيات المختلفة. تم تطبيق التقنية المقترحة على نماذج إنشائية مختلفة سواء كانت منشآت محددة إستاتيكية أو غير محددة إستاتيكية و سواء بها أضرار أحادية أو متعددة. قد تبين من خلال الدراسة المقدمة أن تقنية استخدام الجذر التربيعي لمجموع المربعات للتغير المطلق للانحناءات لأشكال الإهتزازات تعتبر طريقة فعالة لتحديد أماكن الأضرار بالمنشآت سواء كان بها أضرار أحادية أو متعددة.

Cable-Stayed Bridge Model Update Using Dynamic Measurements

Eng. H. M. Abozeid

Ph.D. Student, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

E-Mail: hossam_abozeid@yahoo.com

Dr. M. N. Fayed

Prof., Faculty of Engineering, Ain Shams University, Cairo, Egypt.

Dr. S. M. Mourad

Assoc. Prof., Faculty of Engineering, Ain Shams University, Cairo, Egypt.

Dr. A. H. Khalil

Assoc. Prof., Faculty of Engineering, Ain Shams University, Cairo, Egypt.

ABSTRACT

SHM “Structural Health Monitoring” and damage detection at the earliest possible stage is considered one of the most interesting issues of the civil engineering community, especially for those structures with long design life, life-safety implications and high capital expenditures like cable-stayed bridges. The EMA “Experimental Modal Analysis” gives the required measurements that used in model update and needed for those damage detection techniques that based on changes in modal properties.

This paper presents the technology of determining the structural properties of the cable-stayed bridges using dynamic measurements. A proposed computerized analysis tool is introduced that uses the EMA output data to extract the modal properties of the measured structure. The Suez-Canal cable-stayed bridge is assumed as a case study to perform the model update operation using the dynamic measurements. The paper addresses the EMA test setup, the modal parameters extracting technique and the model update strategy.

Keywords: Experimental Modal Analysis; Mode shapes; Natural Frequencies; Model Update.

DAMAGE DETECTION OF CABLE-STAYED BRIDGES USING CURVATURE CHANGES IN MODAL MODE SHAPES

Eng. H. M. Abozeid

Ph.D. Student, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

E-Mail: hossam_abozeid@yahoo.com

Dr. M. N. Fayed

Prof., Faculty of Engineering, Ain Shams University, Cairo, Egypt.

Dr. S. M. Mourad

Assoc. Prof., Faculty of Engineering, Ain Shams University, Cairo, Egypt.

Dr. A. H. Khalil

Assoc. Prof., Faculty of Engineering, Ain Shams University, Cairo, Egypt.

ABSTRACT

Presenting SHM “Structural Health Monitoring” techniques that based on changes in modal characteristics for flexible structures such as cable-stayed bridges is one of the important challenges due to the importance of these structures in the society, taking into consideration the complexity of their dynamic behavior.

In this paper, a proposed damage detection technique based on changes in curvatures of mode shapes is introduced. The results are compared with another two methods, the first based on changes in displacement and the second is the COMAC “Coordinate Modal Assurance Criteria” value using the same procedures of the proposed technique in a verification example of a simple beam using both single and multiple damage scenarios. A proposed computerized analysis tool is introduced to simplify the study.

A case study for The Suez-Canal cable stayed bridge was performed to implement the proposed technique with the proposed analysis tool for both single and multiple damage scenarios.

Keywords: SHM; Damage Identification; MAC; COMAC; Mode Shapes; Displacement; Curvature.



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Vol 40., No.3, 30 September, 2005.

SCIENTIFIC BULLETIN

Received on : 23/4/2005

Accepted on : 28/9/2005

pp. : 131 -164

MITIGATION OF POUNDING BETWEEN ADJACENT BUILDINGS UNDER EARTHQUAKES LOADS

Fayed, M. N.¹, Mourad, S.², Embabay, A.² & Ahmed, O.³

1. Abstract

In recent decades, due to the available land resources in modern cities are limited; the buildings are being constructed close to each other (adjacent buildings). In most cases the separation distances between such buildings may be not sufficient to prevent any pounding effects that can occur during an earthquake event. The objective of this study is to investigate the minimum required separation distance which may mitigate or prevent the effects of pounding for new constructed buildings. The pounding effects may also be reduced in case of existing adjacent buildings with insufficient separation distances by placing a mechanical damper with a proper damping coefficient between such buildings. The effectiveness of such mechanical damper was investigated through a parametric study for different separation distances between buildings. Linear dynamic time-history analysis was conducted for the studied cases under the action of three different artificial earthquakes. The efficient value of damping coefficient of the damper was investigated for the studied cases to mitigate pounding effects. The resulted separation distances that prevent the occurrence of pounding were compared with those listed in different international codes.

ملخص البحث



DYNAMIC RESPONSE OF FIXED OFFSHORE STRUCTURES UNDER ENVIRONMENTAL LOADS

**SHEHAB MOURAD¹, MOHAMED FAYED², MOSTAFA ZIDAN²,
and MOHAMED HARB³**

ABSTRACT

Waves have a nonlinear behavior. Thus, the application of direct dynamic analysis on offshore structures will face some difficulties. Therefore, some adjustments are required to the static analysis procedure in order to account for the dynamic nature of the wave-structure system and to present efficiently the behavior of offshore structures. A practical static approach for the design has been proposed by calculating dynamic amplification factors that represent the dynamic characteristics of the structure and the dynamic behavior of waves, so that it can be applied to static analysis that utilizes the nonlinear theories of waves. This paper presents a study of the dynamic response of fixed offshore structures under the effect of the environmental wave forces in order to determine the Dynamic Amplification Factors (DAFs), which will be applied to the static analysis to account for the dynamic nonlinear behavior of waves. These factors are determined through a linear dynamic analysis using different random wave records generated using the standard Pierson-Moskowitz spectrum are compared. These results are compared with those obtained from a linear static analysis. The same linear wave theory is utilized for both the dynamic and static analyses. Linear wave theory is implemented to determine the water particle velocities and accelerations at each time step and phase angle for each wave heading direction. However, wave forces are calculated using Morison's equation. Three models of selected real fixed offshore structures are analyzed to determine the effect of the dynamic nature of wave loads when applied at different angles, and to determine the corresponding DAFs for both base shear and overturning moments. The values of DAFs computed by a single sea-surface profile (single seed) and those calculated using a combination of a number of possible sea surface profiles (multi seeds) were compared. The obtained DAFs were compared with those determined from the approximate formula. The study includes the effect of marine growth on both the wave response analysis and on the generated stresses in members obtained from static inplace analysis, and its effect on DAF values. The results showed that the general tendency of the value of a DAF is to be inversely proportional to the ratio of the wave period to the platform period. In addition, useful conclusions were discussed

Keywords: Dynamic Amplification Factors, Dynamic Response, Offshore Structures, Marine Growth, Wave Spectrum.



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Vol. 39, No.3. September 30, 2004

SCIENTIFIC BULLETIN

Received on 4 / 9 / 2004

Accepted on : 23 / 9 / 2004

pp. : 295-321

DEVELOPMENT OF NEW LAUNCHING TECHNIQUE FOR OFFSHORE JACKETS INSTALLATION

SALEM, ADEL HELMY¹, MOURAD, SHEHAB ELDIN M.², AHMED
KAMAL³

Abstract

Usually, offshore jackets can be installed by lifting or launching from a launch barge into the water, and then it will be upended by flooding. This traditional launching method uses a launching truss to support the jacket weight during launching. Any reduction of such additional weight can result in significant saving in the jacket weight and cost. A new launching technique is proposed in order to eliminate the presence of the launching truss. The new launching technique involves adding horizontal skid beams at the same level of the barge longitudinal skid beams to allow the jacket to slide on its legs directly on the barge runners. A launching analysis was performed on two actual offshore jackets using the improved launching method in order to examine the differences between the improved launching and the traditional launching analysis. The analysis includes a time history description of the jacket and barge motion including displacement, velocity and acceleration. Launch motion and hydrodynamic forces are considered in three dimensions and include the hydrodynamic characteristics of the barge. A brief summary, discussion, conclusions of the results will be given.

:

¹ Prof. of Structural Eng.-Faculty of Engineering-Ain Shams University

² Assoc. Prof. of Structural Eng.-Faculty of Engineering-Ain Shams University

³ Senior Structural Engineer at Engineering company for Petroleum and Process Industries



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Vol. 39, No.4 , December 31, 2004

SCIENTIFIC BULLETIN

Received on : 6/12/2004

Accepted on : 27/12/2004

pp. : 251 - 267

SIMPLIFIED MODEL FOR EVALUATING THE TRANSVERSAL STIFFNESS FOR SKEW BRIDGES

**MOURAD¹, SHEHAB M. , KHALIL², AYMAN H.,
FAYED³, MOHAMED N., and BASSYOUNI⁴, GAMAL E.**

ABSTRACT

Bridge surroundings including natural or man-made obstacles might enforce using skew bridge configuration where the longitudinal axes form an acute angle with the piers. The cross bracings and the concrete deck slab considerably affect the transversal stiffness of such bridge and it enhance its performance in distributing the live loads among the longitudinal girders. The aim of this paper is to simulate a three-dimensional skew steel plate girder bridge model by a simplified two-dimensional model in order to evaluate the transversal stiffness of such skew bridge and consequently to determine the live load distribution factors for the interior and exterior girders. Furthermore, the current AASHTO specifications do not account for the effect of cross bracings in evaluating the live load distribution factors, however by utilizing the described procedure such effect can be included. The proposed two-dimensional model was developed on the criteria that its transversal stiffness simulates that of the three-dimensional skew bridge modal with an acceptable range of error, for different skew bridge configurations resulted by varying the skew angle, number of girders and number of cross bracings. The computed transversal stiffness from the proposed two-dimensional model were used in determining the live load distribution factors by using developed empirical equations, those factors were compared and verified with those obtained from the three-dimensional finite element model.

ملخص: