Ministry of Higher Education
and Scientific Research
Al-Muthanna University
College of Engineering
Department of Civil Engineering

Structural Health Monitoring for a Bridge: Case Study

A thesis submitted to the council of the College of Engineering at Al-Muthanna University in partial fulfillment of the requirements for the degree of Master of Science (M.Sc.) in Civil Engineering

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2024 September 1446 Rabi al-Awwal

Summary

Bridges are of great importance in the Republic of Iraq and are structures susceptible to damage and deterioration for various reasons. Moreover, decision-makers lack a culture of enacting legislation that stipulates periodic maintenance and inspection of existing bridges. A Structural Health Monitoring (SHM) system aims to accurately and effectively monitor the structure's behavior, evaluate its performance under various service loads, and identify the presence of damage or deterioration. The current study aims to analyze and predict the condition of bridges in the Republic of Iraq, using a case study of the most common types of bridges.

Many developing and developed countries face difficulties in managing deteriorating buildings and assessing their remaining service life. This study followed two approaches. The first involves researching and exploring previous literature on the structural efficiency of structures in books, scientific papers, and studies published in international journals. The alternative research approach involves selecting the Northern AL-Samawah Bridge in Al-Muthanna Governorate to represent the case study as one of the most common types of bridges in Iraq.

The monitoring process was conducted on two spans within the bridge: a 24-m concrete span with ten prestressed concrete girders, and a 45-m composite steel span with six steel girders. In both spans, the girders support a reinforced concrete deck. Due to the bridge's exposure to heavy vehicle loads and unregulated traffic, this research was chosen to evaluate its overall performance and response to these loads.

Two LVDT devices and three strain gauges were installed, followed by a load test to extract the bridge's characteristics and compare them with AASHTO standards and limits. The short-term monitoring also included observing the bridge for one month. FEM was created and calibrated using data from short-term monitoring and static and moving load tests, where a 50-ton truck was positioned at the center of the specified beam in the selected spans.

The maximum deflection for the static case was estimated for both the selected concrete and steel spans, which were 2.33 mm and 9.54 mm respectively, significantly lower than the maximum required according to the AASHTO code for bridge evaluation. Similarly, the maximum displacements for spans 5 and 6 were 9.9 mm and 2.5 mm, respectively. Additionally, the tensile stresses of the steel diaphragm for static and moving loads were 4.3 MPa and 4.9 MPa, respectively.

Live load distribution factors (DF) were calculated for all load test scenarios and compared with those extracted from the AASHTO code.

The load rating factor (RF) was calculated using AASHTO criteria and the results of live load distribution factors extracted from field data, which were 2.3 for the concrete bridge and 3 for the steel span, respectively, based on the test vehicle and single-lane traffic pattern. The load-carrying capacity of the structure was calculated using the previous data.

The efficiency of the bridge girders was evaluated using estimates of modal curvature, neutral axis, and dynamic characteristics. According to all the previously discovered results for bridge evaluation, the results show that the structure's behavior is safe in many indicators and characteristics such as maximum deflection, modal curvature, and neutral axis. This analysis demonstrates that all indicators and parameters are below AASHTO standard levels, and the inspection generally indicates no abnormal condition on the bridge.

وزارة التعليم العالي والبحث العلمي
جامعة المثنى
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مراقبة السلامة الانشائية لجسر: دراسة حالة

رسالة مقدمة الى مجلس كلية الهندسة في جامعة المثنى وهي جزء من متطلبات الحصول على درجة الماجستير في علوم الهندسة المدنية

من قبل

حسن فليح عذاب الاعاجيبي

بكالوريوس هندسة مدنية /٢٠٠٧

بإشراف

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ربيع الاول 1446 ايلول 2024