An Investigation of Concrete Strength and Ultrasonic Pulse Velocity for an Existing Bridge Group

Ferhat Akgul

Department of Engineering Sciences, Middle East Technical University, Ankara, Turkey

Contact: akgulf@yahoo.com

Abstract

Preventive maintenance of civil engineering structures is a highly crucial measure, not only for achieving efficient distribution of limited budgets over existent aging infrastructures but also for maximizing their service lifespans. This paper presents the results of an experimental field study of penetration resistance and ultrasonic pulse velocity test measurements for a pilot bridge group containing 10 bridges located in North-West region of Turkey. Due to maximum energy transmission from the transmitted ultrasonic pulse and the possibility to have access to two faces of the member, direct method is chosen for ultrasonic pulse velocity measurements on middle piers and the girders of the bridges. Decks and the abutments were not tested. The results of concrete strength vs. pulse velocity for the bridges did not show a notable correlation as opposed to typical correlated plots in the literature. However, although the empirical formulas obtained in this study do not follow the typical correlation plots presented in the literature, it seems possible that the formulas obtained in this study may estimate (from pulse velocity) the concrete strength of the middle piers and girders of all reinforced concrete bridges in Turkey built between 1950s and late 1970s.

Keywords: bridges, non-destructive evaluation, field testing, penetration resistance, ultrasonic pulse velocity, reinforced concrete.

1 Introduction

Preventive maintenance of civil engineering structures is a highly crucial measure, not only for achieving efficient distribution of limited budgets over existent aging infrastructures but also for maximizing their service lifespans. In the context of road bridges, their functional failure often causes serious impact on safety and logistics, which could turn out to be detrimental to the social economy. To appropriately maintain a huge number of aging infrastructures, a strategic maintenance program, facilitating both the global- and local-diagnostic approaches that is effective in assessing early damage is of high demand. In bridge maintenance, non-destructive evaluation (NDE) methods are generally used for selected bridges after a visual inspection program is conducted for a larger bridge group.

NDE methods for reinforced concrete members generally include the surface hardness, penetration resistance, pull-out, break-off, maturity, permeation, resonant-frequency, ultrasonic pulse velocity, magnetic-electric, reinforcement corrosion, radar, stress wave propagation, infrared thermography and acoustic emission techniques.

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