

## Concrete Compressive Strengths of Major Existing Buildings in Kuwait

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**Abstract :** Due to social and economic considerations, owners all over the world desire to keep and use existing structures, including aging ones. However, these structures, especially those that are dear, need accurate condition assessment, and proper safety evaluation. More than half of the budget spent on construction activities in developed countries is related to the repair and maintenance of these reinforced concrete (R/C) structures. Also, periodical evaluation and assessment of relatively old concrete structures are vital and imperative. If the evaluation and assessment of structural components of a particular aging R/C structure reveal that repairs are essential for these components, these repairs should not be delayed. Delaying the repairs has the potential of losing serviceability of the whole structure and/or causing total failure and collapse of the structure. In addition, if repairs are delayed, the cost of maintenance will skyrocket as well. It can also be concluded from the above that the assessment of existing needs to receive more consideration and thought from the structural engineering societies and professionals. Ten major existing structures in Kuwait city that were constructed in the 1970s were assessed for structural reliability and integrity. Numerous concrete samples were extracted from the structural systems of the investigated buildings. This paper presents the results of the compressive strength tests that were conducted on the extracted cores. The results are compared for the buildings' columns and beams elements and compared with the design strengths. The collected data were statistically analyzed. The average compressive strengths of the concrete cores that were extracted from the ten buildings had a large variation. The lowest average compressive strength for one of the buildings was 158 kg/cm<sup>2</sup>. This building was deemed unsafe and economically unfeasible to be repaired; accordingly, it was demolished. The other buildings had an average compressive strengths fall in the range 215-317 kg/cm<sup>2</sup>. Poor construction practices were the main cause for the strengths. Although most of the drawings and information for these buildings were lost during the invasion of Kuwait in 1990, however, information gathered indicated that the design strengths of the beams and columns for most of these buildings were in the range of 280-400 kg/cm<sup>2</sup>. Following the study, measures were taken to rehabilitate the buildings for safety. The mean compressive strength for all cores taken from beams and columns of the ten buildings was 256.7 kg/cm<sup>2</sup>. The values range was 139 to 394 kg/cm<sup>2</sup>. For columns, the mean was 250.4 kg/cm<sup>2</sup>, and the values ranged from 137 to 394 kg/cm<sup>2</sup>. However, the mean compressive strength for the beams was higher than that of columns. It was 285.9 kg/cm<sup>2</sup>, and the range was 181 to 383 kg/cm<sup>2</sup>. In addition to the concrete cores that were extracted from the ten buildings, the 28-day compressive strengths of more than 24,660 concrete cubes were collected from a major ready-mixed concrete supplier in Kuwait. The data represented four different grades of ready-mix concrete (250, 300, 350, and 400 kg/cm<sup>2</sup>) manufactured between the year 2003 and 2018. The average concrete compressive strength for the different concrete grades (250, 300, 350 and 400 kg/cm<sup>2</sup>) was found to be 318, 382, 453 and 504 kg/cm<sup>2</sup>, respectively, and the coefficients of variations were found to be 0.138, 0.140, 0.157 and 0.131, respectively.

**Keywords :** concrete compressive strength, concrete structures, existing building, statistical analysis.

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