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Non-linear Model of Elasticity of Compressive Strength of Concrete

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Abstract : Non-linear models have been found to be useful in modeling the elasticity (measure of degree of responsiveness) of a dependent variable with respect to a set of independent variables ceteris paribus. This constant elasticity principle was applied to the dependent variable (Compressive Strength of Concrete in MPa) which was found to be non-linearly related to the independent variable (Water-Cement ratio in kg/m3) for given Ages of Concrete in days (3, 7, 28) at different levels of admixtures Superplasticizer (in kg/m3), Blast Furnace Slag (in kg/m3) and Fly Ash (in kg/m3). The levels of the admixtures were categorized as: S1=Some Plasticizer added & S0=No Plasticizer added; B1=some Blast Furnace Slag added & B0=No Blast Furnace Slag added; F1=Some Fly Ash added & F0=No Fly Ash added. The number of observations (samples) used for the research was one-hundred and thirty-two (132) in all. For Superplasticizer, it was found that Compressive Strength of Concrete was more elastic with regards to Water-Cement ratio at S1 level than at S0 level for the given ages of concrete 3, 7and 28 days. For Blast Furnace Slag, Compressive Strength with regards to Water-Cement ratio was more elastic at B0 level than at B1 level for concrete ages 3, 7 and 28 days. For Fly Ash, Compressive Strength with regards to Water-Cement ratio was more elastic at B0 level than at B1 level for Ages 3, 7 and 28 days. The research also tested for different combinations of the levels of Superplasticizer, Blast Furnace Slag and Fly Ash. It was found that Compressive Strength elasticity with regards to Water-Cement ratio was lowest (Elasticity=-1.746) with a combination of S0, B0 and F0 for concrete age of 3 days. This was followed by Elasticity of -1.611 with a combination of S0, B0 and F0 for a concrete of age 7 days. Next, the highest was an Elasticity of -1.414 with combination of S0, B0 and F0 for a concrete age of 28 days. Based on preceding outcomes, three (3) non-linear model equations for predicting the output elasticity of Compressive Strength of Concrete (in %) or the value of Compressive Strength of Concrete (in MPa) with regards to Water to Cement was formulated. The model equations were based on the three different ages of concrete namely 3, 7 and 28 days under investigation. The three models showed that higher elasticity translates into higher compressive strength. And the models revealed a trend of increasing concrete strength from 3 to 28 days for a given amount of water to cement ratio. Using the models, an increasing modulus of elasticity from 3 to 28 days was deduced.

Keywords : concrete, compressive strength, elasticity, water-cement
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