# Computer-aided design for optimum concrete mixtures

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## Abstract

Using neural networks and optimization technologies, it is possible to apply analytical methods to search for the optimum mixture of concrete composition, a mixture with the lowest cost and required performance, such as strength and slump. The concrete mixture design problem is first transformed into an optimization formulation, including objective function and constraint functions, appropriate for application of optimization technologies. Then the functions in the formulation, including strength and slump, can be modeled using modeling module based on neural networks. Finally the optimization formulation can be solved using optimization module based on nonlinear programming and genetic algorithms. These modules are integrated in a Computer-Aided Design (CAD) system. To evaluate the system, it was used to obtain a set of optimum concrete mixtures with wide ranges of workability (5 to 25 cm in slump) and strength (25 to 55 MPa in compressive strength). It was found that (1) the modeling module can generate rather accurate models for compressive strength and slump for concrete, (2) the optimization module can generate the lowest cost mixtures for wide range of required strength and slump and their combinations, (3) the dependence of required strength and slump on the design parameters (component contents) meets expectations.

Keyword：mixture; concrete; compressive strength; workability; optimization; neural networks.