OPTIMUM DESIGN OF BRIDGE PIER

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The bridge is an important structure for transportation purposes. But the cost for constructing a bridge is very high. Therefore the duty of structural engineers is to reduce the total cost while satisfying all the basic requirements. This can be achieved by finding optimum cross sectional dimensions for every component of the bridge system using structural optimization theories. In this case study, the cost of construction of the pier is considered.

Optimal design of structures is always a goal of engineers, whether or not mathematically based approaches are used to drive optimization procedures. In current practice, most bridge designs are optimized by trial and error combined with the experience of the designer. It is a time consuming process but using optimization algorithms we can make computer programs to expedite the procedure. In general, optimum design problems seek to minimize a function (usually cost) using a set of design variables subjected to constraints.

Today it is common practice to build bridge piers with reinforced concrete. Economy and aesthetics are probably the main reasons. It is reasonable to build piers of reinforced concrete, for by using different configurations most conditions can be accommodated. In this case study hammerhead circular shaft pier type was selected for the optimization process. Piers perform a support function. They convey vertical and horizontal loads from the superstructure via the bearing shelf, stem and foundation slab to the supporting soil. The main constraints are slenderness check for column and factor of safety against overturning, sliding and bearing checks considered at foundation level.

This paper presents a simple design procedure that aims at minimizing the cost of the pier. The procedure was carried out using *Visual Basic* program developed for the purpose and the *Microsoft Excel* spreadsheet (Reduced Gradient method is used during the structural optimization process in *MSExcel*). This software consists of data entering Modules and it is linked with the *MSExcel Solver*.

The proposed method is simple and can be programmed using ordinary spreadsheets. This provides the user with full capability of checking and controlling all the calculations. This optimization capability was used to achieve the optimum design of a bridge pier. The effectiveness and ease of the proposed optimum design for pier is demonstrated.

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