OPTIMUM DESIGN OF MASS CONCRETE BRIDGE ABUTMENT

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The application of structural optimization approach to bridge abutment is presented in this paper. The bridge design must be an optimum solution with respect to construction cost, maintenance, aesthetics, inconvenience during and after construction, environmental impacts, risk in view of geology and construction, and construction time. But in this case study, cost of the construction of abutment is considered.

The abutments, or end bents, are located at the ends of the bridge unit. They serve multiple purposes for the design of the unit. Abutment is used to connect the bridge deck with the road. In this case study, mass concrete abutment is considered as it is economic for small height retaining walls. The abutment consists of ballast wall, capping beam, abutment wall, and foundation. The objective function of the optimization problem is the cost (volume) of the abutment. That is total cost for concreting (which is function of dimension of abutment cross section area and the length of the abutment). The main constraints are factor of safety against overturning and the tensile stress, the compressive stress of the mass concrete at every step levels. At foundation level, in addition to these sliding and bearing checks are considered.

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

Design values are given to Excel, and objective function values and constraint values are read from Excel trough the developed software. This allows for an easy data transfer, which is direct if does not need text files. After data transferring, optimization routing was implemented using the *Excel solver* add-in. After several iterations, it will give optimum design variables with respect to satisfy all the constraints. The developed procedure was tested by solving an actual design example, and the result is illustrated. The study shows that the optimized results are economical than the manual design results.

The proposed method is simple and can be programmed using ordinary spreadsheets, thus providing the user with full capability of checking and controlling all the calculations. This optimization capability was used to achieve the optimum design of bridge abutment. The effectiveness and easiness of the proposed optimum design for abutment is demonstrated.

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