

ABSTRACT

Leiva, Stefan Ph.D., Purdue University, August 2019. Superstructure Bridge Selection Based on Bridge Life-Cycle Cost Analysis. Major Professor: Mark D. Bowman.

Life cycle cost analysis (LCCA) has been defined as a method to assess the total cost of a project. It is a simple tool to use when a single project has different alternatives that fulfill the original requirements. Different alternatives could differ in initial investment, operational and maintenance costs among other long term costs. The cost involved in building a bridge depends upon many different factors. Moreover, long-term cost needs to be considered to estimate the true overall cost of the project and determine its life-cycle cost. Without watchful consideration of the long-term costs and full life cycle costing, current investment decisions that look attractive could result in a waste of economic resources in the future. This research is focused on short and medium span bridges (between 30-ft and 130-ft) which represents 57% of the NBI INDIANA bridge inventory.

Bridges are categorized in three different groups of span ranges. Different superstructure types are considered for both concrete and steel options. Types considered include: bulb tees, AASHTO prestressed beams, slab bridges, prestressed concrete box beams, steel beams, steel girders, folded plate girders and simply supported steel beams for dead load and continuous for live load (SDCL). A design plan composed of simply supported bridges and continuous spans arrangements was carried out. Analysis for short and medium span bridges in Indiana based on LCCA is presented for different span ranges and span configurations.

Deterministic and stochastic analysis were done for all the span ranges considered. Monte Carlo simulations were used and the categorization of the different superstructure alternatives was done based on stochastic dominance. First, second, almost

first and almost second stochastic dominance rules were used to determine the efficient set for each span length and all span configurations. Cost-effective life cycle cost profiles for each superstructure type were proposed. Additionally, the top three cost-effective alternatives for superstructure types depending on the span length are presented as well as the optimum superstructure types set for both simply supported and continuous beams. Results will help designers to consider the most cost-effective bridge solution for new projects, resulting in cost savings for agencies involved.