

ABSTRACT

TaeHoon Hong. Ph.D., Purdue University, May 2005. Life Cycle Cost Assessment Model of Composite Materials in Construction, Major Professor: Makarand Hastak.

To further enhance the application of fiber reinforced composites in construction, it will be important to assess the life-cycle costs of replacing conventional construction materials with advanced composites. However, the lack of sufficient reference data or maintenance records for advanced-composite applications in construction makes it difficult to make a credible assessment for life-cycle costs. The available reference data are limited to include performance information from recent applications, initial cost figures, some deterioration models, and its material properties.

Therefore, a practical method is required that would allow probable assessment of the life-cycle cost of advanced composite applications in construction in relation to conventional materials. The overall objective of this research was to develop a performance-based probable life-cycle cost assessment model for composite materials in construction. To achieve these objectives, the research *focused* on a specific application of composites in construction: *FRP bridge deck panels*. The model thus developed can then be used for other applications of composites in construction.

The life-cycle cost assessment model for FRP bridge deck panels comprises of a life-cycle performance module (module-1) and a life-cycle cost optimization module (module-2). The objective of module-1 is to develop an analytical model that is capable of predicting the structural deterioration over time in order to assess the deterioration rating per year (CR/year) of FRP bridge deck panels. The objective of module-2 is to develop an analytical model that is capable of assessing the optimal life-cycle cost of FRP bridge deck panels. Three case studies were conducted to validate the logic and results of the process algorithm for the life-cycle cost assessment. The main results of this research include:

- (1) a model for the probable life-cycle cost assessment of composite materials in construction;
- (2) a method for comparative assessment of composite and conventional materials through deterioration models;
- (3) life-cycle performance curves at three levels: material, component, and structural levels;
- (4) performance enhancement due to MR&R actions;
- (5) feasible MR&R strategies for composite materials;
- (6) a method for analyzing the life-cycle cost issues of new construction materials, which could potentially affect the future direction of the construction industry as a whole.