D. CONSTRUCTION RESEARCH

STREAMLINING THE SUPERSTRUCTURE DESIGN & CONSTRUCTION THROUGH COMPUTER MODELING

1. Chapter 1: Introduction

a. In July 2005, the General Services Administration (GSA) announced that all new projects require their funding will be required to include a building information model (BIM) as part of the project proposal.

   i. The term BIM is a relatively new term in the industry, but in the past as been noted as a project model and multi-dimensional (MD) modeling.

   ii. Essentially a building information model is a materialized 3D model meaning that everything in the building is drawn with its true properties. An example of this is with an exterior masonry wall. A typical 3D model would just draw the dimensions of the wall, whereas a BIM details the wall with its brick façade, air barrier, sheathing, studs, etc. for the wall properties.

   iii. The GSA's requirement with a BIM needed for all of their future projects is a new approach to project design and delivery. In the past, many projects have been designed in three dimensions, but have not included the object properties which would make it a BIM.

   iv. Computer aided project development has been in the industry for quite some time, however implementing it has been a hardship. Many owners, architects, and construction managers have not seen the value that these models can bring to a project mostly due to initial costs and time to develop the models.

b. Ongoing Construction Industry Problems:

   i. Duplication during the steel sequence continues to be a problem in the industry. The structural engineer designs the steel structure for the building and then the structural steel contractor, upon award, redesigns the building through steel shop drawings. Because of the need to produce these shop drawings, steel cannot begin fabrication until six to eight weeks after an award is made to the steel contractor.

ii. Coordination between various fabricators involved with the structural package is many times a problem. There is often improper coordination between metal deck, metal joists, and structural steel which leads to fabrication and construction delays.

c. This research proposal will focus on a BIM model of the superstructure for *Medlar Field at Lubrano Park*. The goals and objectives of this research are to answer the following questions:

i. Can the construction industry reduce the waste in the steel shop drawing process through implementing building information modeling?

ii. Can BIM help with fabrication coordination (supply-chain management) between structural steel, decking, and joist suppliers?

(1) Decrease material delivery time.

(2) Better coordination methods allowing for less re-work and added cost.

d. By analyzing existing practices (shop drawings and coordination) during the steel phase of a project, I will propose a more streamline process for the steel phase of a project.

2. Chapter 2: Background/Literature Review

a. Currently, there has been a lot of research devoted to computer aided design/construction research. Most of this research is based on project case studies and not how to effectively implement computer aided models on a construction project.

b. Most projects are documented with a 3D model which is made during the preconstruction phase of a project. These models are used to develop a rendering of the project which is mainly used for marketing purposes. Unfortunately, these models are 3D models and not building information models. Furthermore, these models are very rarely taken from the design phase of a project and implemented in the construction phase.

c. During the summer of 2005, I began my initial study of building information modeling. My research paper was tilted, “Integrating Building Models In the

Construction Workplace," and documented some of the current practices with computer modeling within the industry.

    i. The most valuable information received during the research timeline were the responses to a series of survey's I sent to architects/engineers, owner representatives, and construction managers. The survey's asked a series of questions relating to implementing a 3D and 4D model on the project and the value that each can bring to a project.

  d. Many industry members are interested in implementing new technology on a project, but either do not know how or cannot afford the cost and time associated with developing a model. Some trades in the industry already implement 3D models to assist with pre-fabrication of systems with the steel trade being at the top of the list in terms of implementing technology.

3. Chapter 3: Objectives and Methods

  a. Problem Statement

    i. Duplication of structural design delays fabrication of structural members and coordination of structural systems between fabricators (ex. decking, joist, etc.), is a problem that effects each project in the construction industry.

  b. Specific Measurable Objectives

    i. Review literature and understand current practice.

    ii. Develop a solution through a model and delivery flow chart.

    iii. Test and validate proposed solution.

    iv. Leave ideas for future research.

  c. Methods

    i. First, I will read articles documenting projects that have implemented building information modeling and understand how the research was performed.

    ii. Next, I will find any articles relating to the shop drawing sequence of a project in order to see if there is already documented waste in this process.

    iii. Then I will find any articles relating to the steel fabrication of a project and any known documented problems that may exist.

iv. Through building information modeling during the design phase, the time invested during the shop drawing phase can be decreased and coordination between steel material fabricators can be more easily achieved.

(1) I will make a building information model of the superstructure sequence of the project using Autodesk REVIT 8.0. This program has all of the structural members and shapes that are in the current steel manual including joists and decking which will allow me to produce an accurate model.

v. I will then obtain a copy of the SIST 2 modeling standards which describe the information that must be on all steel shop drawings.

vi. Once the computer model is made, I will contact three (3) steel contractors and discuss with them the items that are needed to go from design to fabrication. I will also with these steel contractors the current means and methods of coordinating between various steel suppliers (decking, joists, structural, etc.).

vii. I can then document the difference between the items documented on a building information model and those needed per SIST 2 standards. By documenting the differences between a SIST 2 and BIM model and discussing what is needed from a contractor's perspective to go from design to construction, I can propose an alternative means and methods to the structural design and approval phase of a project.

viii. In order to better streamline the coordination process between various fabricators, I will use the BIM to determine if each entity can use the model and implement to fit their need.

ix. Most likely, the model will need to be altered to fit the different fabricators and I can outline those needed steps.

x. Lastly, I will describe the overall affect of implementing a BIM for the structural sequence of a project and document the value of such a model for fabrication and coordination.

d. Expected results / outcome / benefits

   i. In developing a BIM of the superstructure for *Medlar Field at Lubrano Park*, I will be able to address better techniques in going from steel design to fabrication stage of a project. Furthermore, I will be able to address better coordination techniques between steel suppliers.

   ii. This research project will help me identify current problems and time constraints associated with the steel/structure phase of a project and allow me to suggest alternative methods to beginning the construction of a steel structure.

   iii. Because the steel phase of a project is often on the critical path, any time that might be able to be saved could result in a quicker delivery of the entire project. This research will benefit structural designers, construction managers, and steel fabricators as well as leave ideas for continued research in streamlining the design to construction of the structural sequence.

e. Timeline

   i. January 2006

      (1) Read articles about current BIM projects, studies performed with the steel sequence, and any articles with current fabrication practices.

      (2) Develop a BIM of *Medlar Field at Lubrano Park's* superstructure.

   ii. February 2006

      (1) Contact steel contractors and discuss questions proposed above.

      (2) Analyze the results of the study.

      (3) Find any missing areas that more research can be applied to.

   iii. March 2006

      (1) Summarize and document results of study.

   iv. April 2006

      (1) Present results of study to construction industry members.