JOHNS HOPKINS UNIVERSITY
CHARLES COMMONS
BALTIMORE, MARYLAND

REVISED PROPOSAL
FEBRUARY 9, 2006

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Thesis Proposal: Research & Breadth

Executive Summary

Currently, the latest state-of-the-art dormitory for Johns Hopkins University (JHU) is going to be late for the Fall '06 grand opening. Two years ago, Charles Commons was a schematic sketch of a facility that would house 600+ students as part of JHU's five-year plan. Since Spring '05, Charles Commons is site of the most grueling 24-hour, 7-day shiftwork due to program/design changes, MEP coordination/imbeds issues, and delays associated with the first two floors of St. Paul Building. This report details the preventative medicines for these issues and aims to arm owners with a better roadmap to their project's future.

Charles Commons, as in every construction project, has its accomplishments and its problems. The investigations are:

- Assessment of Design-Build-Operate-Maintain and Build-Operate-Transfer As Delivery Methods in Building Construction
- Partial Redesign of Post-Tensioned Slabs with Alternative Systems
- MEP Coordination/Resizing for the Alternative Structural Systems

The main theme for these investigations is preventing the schedule delays experienced at Charles Commons. This, in turn, would help alleviate the shiftwork problems and lower the overall costs for JHU.

Construction Management Research, Analysis I:

Assessment of Design-Build-Operate-Maintain and Build-Operate-Transfer As Delivery Methods in Building Construction

Problem:

Currently, the latest state-of-the-art dormitory for Johns Hopkins University (JHU) is going to be late for the Fall '06 grand opening. Two years ago, Charles Commons was a schematic sketch of a facility that would house 600+ students as part of JHU's five-year plan. A fateful program change in Spring '05 permitting a dining commons to be placed on the third floor of the St. Paul building changed the complexion of the project. This addition and steel market fluctuations caused a huge increase in the cost of Charles Commons. The cost-cutting process that followed caused anxiety amongst the project team.

Very little could have been done to prevent JHU's program change. However, a different delivery method could have prepared the project team better for this change and accelerate the design processes. For instance, the construction on the building's substructure and superstructure should have occurred immediately following a finalized design than at the conclusion of the demolition.

Design-Build has been driving alternative delivery method for a few decades and has just recently begun branching into other building processes. In addition to design and construction, Design-Builders are taking on the risks of the Operations and Maintenance (O&M) and the financing of the project. Thus, Design-Build-Operate-Maintain (DBOM)

and Build-Operate-Transfer (BOT) was born. Can entities like Johns Hopkins University benefit from DBOM or BOT?

Research/Survey: The research goals for this assessment are:

1. Analyze issues in case studies in which DBOM/BOT are effective and make market comparisons and outlook.

2. Evaluate the effects from using DBOM/BOT delivery methods on Charles Commons.

3. Generate an Owner's Guide to DBOM/BOT for use in the Building Construction Industry.

Research would begin with internet resources/papers that document the effectiveness of DBOM/BOT on civil infrastructure projects, where DBOM/BOT are more frequent. In addition, research would be conducted with the construction journals to develop an interview questionnaire that would be given to Mike DiProspero, the Owner's representative for Johns Hopkins University, and other various building case studies to discuss the effectiveness of the cross-over from civil to buildings. Equipped with this input, one could begin work on an Owner's guide to delivery methods and such a document could be circulated among owner representatives and construction professionals to get feedback.

Schedule Reduction: As mentioned, an estimate to the schedule savings would be compiled. It has been studied that DBOM/BOT deliveries have been known to streamline design schedules in the face of high public scrutiny and high risk in the civil infrastructure sector.

Anticipated Results: The DBOM method of delivery could be quite useful in future university work when the delivery becomes more tested in buildings. The BOT method of delivery

would benefit large organizations with five-year expansion programs due to the overwhelming interest in urban redevelopment and investment. A less risky Design-Build delivery can still provide cost and schedule benefits for university projects, especially for JHU.

Structural Breadth, Analysis II:

Partial Redesign of Post-Tensioned Slabs with Alternative Systems

Problem: The current cost and schedule projections are behind what was initially planned one year ago. After discussions with the project manager, project engineer, and the superintendents, it was found that the complicated post-tensioning slabs in the St. Paul building slowed the schedule extensively. The second-fourth floors of the St. Paul building are extensively complicated and include high live loads from dining and meeting spaces. Also the second floor features a large open staircase and a perimeter open space making post-tensioning much more convoluted. In addition, the post-tensioned slabs are on the critical path for the project and were underestimated in scheduling.

The alternatives for a two-way partially post-tensioned slab on the second-fourth floors of St. Paul building are few and far in between when the building height cannot be compromised. First, it is important to define what components are already incorporated in the existing structure:

- *Post-tensioning* – standard four-strand tendons are in bundles comprising of one up to thirty-four tendons.
- *Concrete* – 4500 psi and 6000 psi concrete is used at 8" thickness used to hold live loads at 125 psf.
- *Concrete reinforcing* – a partially post-tensioned system requires various rebar located at the top and bottom of the slab to take loads residual from the post-tensioning and increase stiffness.
- *Drop-caps* – spans averaging 26' require drop-caps of 16" depths

Alternative Analysis and Redesign: Forming, delivering, placing, and tracking all of these different components for a structural slab is what makes post-tensioning difficult. Alternatives for the second-fourth floors of St. Paul consist of:

- *Flat plate reinforced concrete slab*
- *Two-way reinforced concrete beams with flat plate reinforced concrete slab*
- *Two-way reinforced concrete beams with precast hollow core planks*

Value Engineering: Equipped with a detailed estimate of the existing structure, a detailed estimate of the three proposed alternates would prove the most cost-efficient structure.

Constructability Review: A constructability review discussing the factors of site congestion, weather, formwork, and crew experience would isolate the best solution to construct.

Schedule Reduction: The schedule reduction associated with each alternative would take in consideration the installation of formwork for the slabs, bending rebar and setting post-

tensioning tendons, setting embeds, pouring each floor altogether, stripping the formwork, and stressing the tendons.

Anticipated Results: The redesign will require more concrete and more reinforcing in nearly all cases. The justification will be schedule savings, constructability, and general conditions cost savings.

Mechanical Breadth, Analysis III:

MEP Coordination/Resizing for the Alternative Structural Systems

Problem: Charles Commons is a state-of-the-art student housing complex, hence the MEP infrastructure is complex and a very tight fit with the partially post-tensioned structure. Since the previous analysis deals with using alternate structural systems to remedy this, it would be prudent to investigate the tight plenum region and the slab imbeds. The mechanical systems were extremely restricted in the post-tensioned design since the floor could not be breached as other systems.

Value Engineering: A series of duct resizings and relocations will free space for the ceiling, which may be compromised due to larger slab/beam thicknesses. This redesign may produce less ductwork and losses, saving money for JHU.

Constructability Review: MEP Coordination in itself is a constructability review of fitting ductwork into a complicated labyrinth above a drop ceiling. This will be analyzed using 3D and 4D CAD to lessen conflicts or mistakes.

Weight Matrix

Description	Research	Value Eng.	Const. Rev.	Sched. Rev.	Total
Assessment of Design-Build-Operate-Maintain and Build-Operate-Transfer As Delivery Methods in Building Construction	X			X	25%
Partial Redesign of Post-Tensioned Slabs with Alternative Systems		X	X	X	38%
MEP Coordination/Resizing for the Alternative Structural Systems		X	X		37%
Distribution	15%	28%	28%	29%	100%

Alternate Thesis Ideas

Description	Research	Value Eng.	Const. Rev.	Sched. Rev.	Total
OCIP vs. CCIP	X	X		X	
Brick Façade vs. Precast Split-Brick Panels		X	X	X	
Foundations Redesign, Caissons vs. Spread Footings		X	X	X	
Glazing Redesign for Energy Savings	X	X	X		
4D CAD Structural Sequencing & Imbed Coordination	X		X	X	
Distribution					