Proposal

PROPSAL

PROBLEM DEVELOPMENT

It is typical practice in most design offices to evaluate multiple structural systems for any given project the office is approached with. This report acknowledges and respects the design professional's original steel structure design for Eight Tower Bridge. However, there are obviously multiple solutions to the design of a high-rise office building, with the most feasible being dependant of several factors. A few of these factors include site location, material availability, practicality of design and overall system cost, with the last two items being weighted most heavily in the ultimate design choice. While the composite steel system may have been rated highly among these criteria, it is possible that an alternate concrete structural system for Eight Tower Bridge could be designed. Being a completely different material, a concrete system would require a different design method than a steel system, as well an analysis to determine the performance under both gravity and lateral loadings. Whenever a part of building system is altered, such as the building superstructure, there will invariably be consequences in the other disciplines related to building design, especially construction cost and management issues.

PROBLEM STATEMENT

Two alternate concrete structural systems will be designed for Eight Tower Bridge in this report and evaluated for Eight Tower Bridge and compared to the existing composite steel superstructure. The first design will be a reinforced concrete slab and post-tensioned beam concrete system, with post-tensioning in beams spanning both principle building directions. Beam spacing in this system will increase from the current 9'4" found in the steel system to 14' on center, with a 6" slab reinforced in the orthogonal direction.

The second alternate system will be very similar to the first, although the reinforced concrete slab will be replaced with a post-tensioned slab. The intermediate beam spacing of this design will be increased from 14' in the first concrete design, to 28' on center, creating a typical bay size of 44'4"x 28'. The slab thickness will remain the same. Columns will be designed to carry both flooring systems, as the overall system weight is expected to be comparable.

Once the elements of the gravity system have been designed, the building's lateral system will be designed. Concrete shear walls, with an expected thickness of 10"-12" will be placed within the building core. The same lateral system will be employed by both floor system designs.

SOLUTION METHOND

As described above, altering the material of the building will require the redesign of all structural elements, including concrete beams, columns and shear walls. These elements will be designed in accordance with ACI 318-05.

Building Loads		
Live		80 psf
Dead		
	Slab	75 psf
	Exterior Wall	60 psf
	SI Dead	20 psf
	MEP/Finishes	10 psf
Roof Live		10 psf
Snow Load		22 psf

The design loads will be updated from ASCE7-98 and the BOCA 96 code used in the original design, to the more current ASCE7-02 and IBC 2000. The loads governing the design of the alternate systems are given in the table to the right. The mechanical room live load of 125 psf and rooftop mechanical system live load of 200 psf used in the original steel system design will still be used. A schematic of this loading plan can be found in Appendix A. The derivation of roof live and snow loads can also be found here.

Several computer design and analysis programs will be used for the alternate system design for Eight Tower Bridge. The first program used will be RAM Con*cept*, a concrete design program that allows you to design both regularly reinforced and post-tensioned concrete sections. Beam reinforcement from this program will be verified by manual hand calculations.

Once the floor framing member sizes have been determined, column loads and moments will be determined in order obtain preliminary column sizes. These columns will be designed using the program PCACOL. It should be noted that this program designs concrete sections referencing ACI 318-89.

With initial column sizes determined, an ETABS model of the concrete structure will be constructed in order to design the lateral force resisting shear walls. The program will be run using various models with the placement of the walls in different locations in order to find an economical and satisfactory placement. The column moments created from these lateral loads in this model will be re-entered in to PCACOL to verify the initial column sections designed have enough capacity to resist sway.

Both of these systems will be compared to each other, as well as the original steel structure in regards to system performance and efficiency. The overall story height possible by each system will be reviewed to determine if the building could be shortened or additional stories added without increasing the building height.

BREADTH STUDY PROPOSALS

CONSTRUCTION MANAGEMENT BREADTH

A breadth study will be conducted regarding the construction management issues involved with altering the superstructure of Eight Tower Bridge from steel to concrete. A superstructure cost estimate will be conducted for the new concrete system, and a construction schedule will also be formed. The cost estimates and construction schedules of both systems will be compared to the steel bid package and construction duration obtained from Grossi & Sons Steel, the steel contractor for this project. It should be noted that the 2005 Edition of RS Means will be used through the computer software Cost Works to conduct an estimate for the new concrete systems. The estimated for the alternate concrete systems will then be converted to 2001 dollars, the time the structural package was received by Gross & Sons.

MECHANICAL BREADTH

The current mechanical system for Eight Tower Bridge will be redesigned to incorporate a ground source heat pump for used for heating and cooling fluid currently in the chilled water loop found in Eight Tower Bridge. A closed loop system containing water or refrigerant will run through the bore holes in the ground, using the constant temperature of the earth as a thermal reservoir for extracting heat from and discharging heat to. This system would be used in replacement of the current cooling towers located on the roof of the building. This system will largely be evaluated for feasibility while still attempting to reduce the cooling loads of the tower and mechanical system operating costs. It will be based on the period to positive return length, which will ideally fall between 3 and 5 years.