Pearland Recreation Center and Natatorium
Pearland, Texas

Final Proposal

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Project Overview:

Use: Community Recreation Center
Size: 105,000 SF of Floor Space
Height: 2 Stories
Construction Dates: May 2009 - June 2010
Construction Cost: ~$17 Million
Delivery Method:
- Design-Bid Build
- Competitive Bid
- Lump Sum

Mechanical:

- Three (3) 2000-5000 CFM Outside AHUs
- Eight (8) 3000-19000 CFM Inside AHUs
- Two (2) 1,063,000 BTUH Natrual Gas Boilers
- Two (2) 1,699,000 BTUH Natural Gas Boilers
- Two (2) 135 Ton Chillers
- Seven (7) 100-340 GPM Pumps

Electrical:

- One (1) 600A Surface Mounted Distribution Panel
- One (1) 400 KW Back-Up Generator
- 3000A Building Power Supply

Project Team:

Owner: City of Pearland Texas
Pearland Independent School District
CM: EMJ Corporation
Architect: PBK
Structural Engineer: Conti, Jumper, Gardner, & Assoc.
MEP Engineer: PBK - MEP Group
Pool Consultant: Aquatic Excellence

Architecture:

Natatorium:
- One (1) 50 Meter X 25 Yard Indoor Competition Pool
- One (1) Four (4) Lane X 25 Yard Therapy Pool with Handicap Access Ramp
- Meeting/Training Room

Recreation Center:
- Competition Gym with Four (4) Lane Track
- Weight Room
- Men's/Women's Locker Rooms
- Offices
- Multi-Purpose Rooms

Structural:

Natatorium:
- Concrete Piers
- Glulam Structural Framing
- Concrete Slab on Grade

Recreation Center:
- Concrete Piers
- Structural Steel Framing
- Concrete Slab on Grade and on Elevated Steel Decking

Matt Smiddy
Construction Option

http://www.engr.psu.edu/ae/thesis/portfolios/2010/mds5055/

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Executive Summary:

This proposal is an introduction to four technical analysis topics of the Pearland Recreation Center and Natatorium building that will be researched in more depth. These research topics include a comparison of steel versus a glulam structural system, comparison of a cooling tower versus a chiller system, analyzing project team interaction, and a comparison of a welded versus a bolted connection for glulam arches.

Analysis #1 – Breadth Topic #1

Pearland Recreation Center and Natatorium is currently designed with a glulam structural system in the natatorium while the rest of the building uses a structural steel system. A comparative analysis between concrete with steel trusses and glulam structural systems focusing on construction cost, schedule, constructability, and life cycle costs could produce useful results. This research will involve calculating the structural building loads and will therefore constitute a structural breadth topic.

Analysis #2 – Breadth Topic #2

Currently the Pearland Recreation Center and Natatorium has a chiller system, however initially the owner insisted on using a cooling tower system. It would be interesting to compare the cost, schedule, and constructability issues associated with each type of system. This comparison will require calculating the building's cooling loads and will consequently be a mechanical breadth topic.

Analysis #3 – Critical Industry Issue, MAE Graduate Level Component

Project team interaction has become a popular topic of discussion in the construction industry. Various project delivery methods, including the ambiguously defined Integrated Project Delivery Method, have been experimentally applied to projects internationally in an effort to identify the ideal delivery method. Other aspects of team interaction, including contract types and project team selection, are also being researched. Analysis of Pearland Recreation Center and Natatorium's success could glean some useful conclusions that would be useful to future owners in selecting their project team and developing their contracts.

Analysis #4

Erection of the glulam arches in the natatorium of the Pearland Recreation Center and Natatorium was problematic due to the bolted connection that connected the glulam to the concrete footers. Glulam arches have small tolerances, which causes aligning a bolted connection to be difficult. Analyzing the alternative of using a welded connection at this location could prove

beneficial to future project teams facing a glulam structural system.

Project Introduction:

Pearland Recreation Center and Natatorium is a 105,000 square foot athletic facility located in Pearland, Texas; a suburb about 15 miles south of Houston, Texas. It houses a 50 meter X 25 yard competition swimming pool, 4-lane 25 yard instructional pool, full sized gym, weight room, racquetball courts, 4-lane running track, multi-purpose rooms, locker rooms, and offices which will serve the Pearland community. The recreation center portion of the facility is a 63,000 square foot 2-story structural steel building, while the natatorium's 42,000 square feet are enclosed by a glulam structural system. Detailed system and project team information is available in the abstract at the beginning of this proposal.

Construction of the $17 million building began in May 2009 and substantial completion is scheduled for June 2010. A design-bid build delivery system with a lump sum construction contract is being used for the project.

Technical Analysis #1 – Breadth Topic: Concrete with Steel Trusses Versus Glulam Structural System

Problem:

Unlike the steel structural system in the recreation center, the natatorium has been designed using a glulam structural system. It is unusual for a natatorium to use a glulam structural system. Additionally, glulam is significantly more expensive than concrete and steel and presents unique challenges during construction. The designer insists that structural steel, even with special coatings, corrodes and deteriorates in the humid environment of natatoriums.

Figure1-1: Natatorium with steel structural system. Courtesy of Penn State

Figure 1-2: Gymnasium with glulam structural system. Courtesy of Structure Mag

Goal:

Determine the structural and economic feasibility of using a steel structural system in place of the currently designed glulam system in the natatorium, including identifying the durability of steel and glulam in a natatorium's humid environment.

Analysis Method:

1) Determine the durability of concrete, steel and glulam structural systems in a natatorium environment, including consideration of all maintenance issues and costs.
2) Design a structural concrete and steel system to replace the glulam system.
3) Calculate the cost savings associated with using a structural concrete and steel system
4) Analyze the schedule impacts of using a structural concrete and steel system
5) Consider the constructability effects of using structural concrete and steel

Resources:

1) Penn State OPP -
2) Concrete, Steel and Glulam suppliers and contractors
3) Designers with experience in glulam and concrete and steel structural systems in natatoriums.
4) MS Project
5) Pearland Recreation Center and Natatorium project team.

Expected Outcome:

Analysis of the structural systems will result in a concrete life cycle cost of the glulam and steel and concrete structural systems, inclusive of all construction and maintenance costs. Additionally, it is expected that the construction durations of each structural system will be clearly identified.

Technical Analysis #2 – Breadth Topic: Cooling Towers Versus Chillers

Problem:

During the design phase of construction the owners of the Pearland Recreation Center and Natatorium insisted on using a cooling tower system to cool the water for the building's mechanical system. PBK, the project architect and MEP engineer, convinced them that using a cooling tower system would be unreasonable since the building was only 105,000 SF. Instead they suggested using a chiller system, which would be a more economical choice given the size of the building.

Figure 1-3: Cooling Tower (Courtesy of Zetacorp)

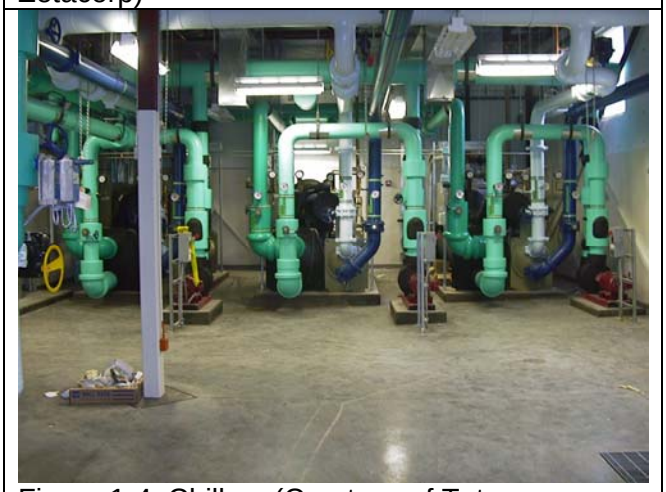

Figure 1-4: Chillers (Courtesy of Tatro Plumbing)

Goal:

The goal of this research topic is to compare the cost of a cooling tower and chiller system in order to determine the more economical option. Cost data is already available for the chiller system; however it will be necessary to size and develop a construction cost estimate for a cooling tower system.

Analysis Method:

1) Calculate the cooling loads on the Pearland Recreation Center and Natatorium
2) Select a cooling tower system that would satisfy the required cooling loads for the building.
3) Obtain construction cost information for the selected cooling tower system.
4) Compare the cost of the cooling tower system to the as designed chiller system to determine the more economical option.
5) Consider constructability factors that may make either option more feasible.

Resources:

1) Professor James Freihaut and AE – 310 HVAC Fundamentals course materials
2) Pearland Recreation Center and Natatorium project MEP engineer – PBK MEP
3) HVAC equipment manufacturers
4) EMJ Corporation

Expected Outcome:

It is expected that this research will result in identifying the most practical HVAC system for the Pearland Recreation Center and Natatorium while considering factors other than cost, such as constructability.

Technical Analysis #3 – Critical Industry Issue: Project Team Interaction

Problem:

Projects utilizing the traditional Design-Bid-Build delivery method tend to result in adversarial relationships between project team members. As Pearland Recreation Center and Natatorium approaches completion, it seems that the project is unique in that the project team is still working together effectively and the project is setup for an on-schedule, on-budget completion. It appears that this is a great opportunity to analyze some attributes of a successful project team using this delivery method. Design and construction of the project has been seamless. Throughout the design phase there was beneficial owner-designer interaction that resulted in many features of the building being modified to more effectively meet the owner's needs. During construction there were few problems encountered and the project is currently scheduled to be completed well ahead of schedule.

Goal:

The goal of this research is to determine the factors that contributed to the project's apparent success, including factors such as project team selection and contracting method. Conclusions obtained from this research will be targeted at helping owners select successful teams for their upcoming projects. Additionally, this research will potentially identify an ideal delivery method for public projects.

Analysis Method:

1) Issue questionnaires to project team members to collect their opinions of why the project was successful, as well as to determine if there were any aspects of the project that could have been improved.
2) Compare questionnaire responses to identify commonalities.
3) Interview select project team members to identify specific attributes that have contributed to the project's success.
4) Study the contract documents in order to locate language that contributed to the project's success.
5) Identify aspects of the project team selection process that led to the successful outcome.
6) Interview other public project teams using various delivery methods to potentially identify an ideal project delivery method for public projects.

Resources:

1) Project team surveys
2) Project team interviews
3) Project contract documents
4) Project team selection method
5) Case studies – Other Public Projects
6) AE – 572 Project Development and Delivery Planning course materials

Expected Outcome:

The expected outcome of this research is a list of specific contributing factors to the success of the Pearland Recreation Center and Natatorium project. This will include items in contractual language, project team selection, and project delivery method. Additionally, a preferred delivery method for public projects will be identified.

Technical Analysis #4: Bolted Vs. Welded Glulam Arch Connection

Problem:

In the natatorium of the Pearland Recreation Center and Natatorium a glulam structural system is used, including 14 glulam arches. These glulam arches are connected to the concrete footers using bolts. The bolted connections of these arches were difficult due to the small tolerances of the glulam arches. In hind sight, the contractor suggested that a welded connection would have been more constructible.

Figure 1-5: Glulam Arches (Courtesy of Structural Mag)

Goal:

The goal of this research is to identify the feasibility of using welded connections instead of the as-built bolted connections for the 28 connections (2 per arch) of the 14 glulam arches to the concrete footers.

Analysis Method:

1) Determine the cost of using a welded connection.
2) Identify the time required to construct a welded connection.
3) Compare the cost and time duration for a welded connection with that of a bolted connection.
4) Consider the durability of a welded connection versus a bolted connection.
5) Research the availability of qualified welders in the geographic area.

Resources:

1) Welding contractors
2) Pearland Recreation Center and Natatorium project team.
3) Glulam contractors
4) RS Means Cost Data
5) MS Project

Expected Outcome:

It is expected that this research will result in a comparison of a welded and a bolted connection between a glulam arch and a concrete footer. Additionally after considering all cost, schedule, and constructability factors; the economical and preferred connection option should be identified.

Conclusions:

Pearland Recreation Center and Natatorium has been a successful project that encountered few problems throughout the design and construction phases. Analyzing the team selection, contractual language, and interaction between team members on the project will provide beneficial examples for future project team's slection.

Additionally, comparative analyzes of the building's structural system, mechanical system, and superstructure connection to the foundations will result in useful data for future project teams.

Appendix 1

Breadth Studies & MAE Graduate Level Component

Technical Analysis #1 – Structural

Currently, the Pearland Recreation Center and Natatorium is designed with a glulam structural system in the natatorium and a structural steel system in the recreation center portion of the building. A glulam structural system costs more to construct, however it is argued that compared to structural steel and concrete, the glulam material holds up better in the humid environment of a natatorium.

This technical analysis will look at the structural redesign necessary to convert the structural system from glulam to structural concrete and steel construction. In order to obtain a useful cost comparison, it is necessary to know what type of steel members would be needed in order to support the building's loads. This data will be provided from this technical analysis.

Technical Analysis 2 – Mechanical

During the design phase of construction the owners of the Pearland Recreation Center and Natatorium insisted on using a cooling tower system to cool the water for the building's mechanical system. PBK, the project architect and MEP engineer, convinced the owner that using a cooling tower system would be unreasonable since the building was only 105,000 SF. Instead they suggested using a chiller system, which would be a more economical choice given the size of the building.

In order to select the correct cooling tower system, it will be necessary to identify the building cooling loads. This technical analysis will focus on calculating the building cooling loads for the Pearland Recreation Center and Natatorium.

MAE Graduate Level Component

Research on the critical industry issue of project team interaction will apply concepts learned in CE 531 – Legal Aspects of Engineering and Construction and AE 572 – Project Delivery and Development Planning. Concepts that were learned in CE 531, which dealt with contracting and litigation, will serve as a foundation of knowledge with which to base contract analysis while comparing different contract types. Aspects of delivery methods learned in AE 572 will be applied while analyzing the success and failure of various project delivery methods.

Appendix 2

Sample Owner Interview Questions

Sample Interview Questions for Owner:

1) Why was the Design-Bid-Build delivery method chosen?

2) If you were to redo the project, would you change the delivery method? If so, why?

3) What criteria were used to select the designer?

4) What would you change in these criteria if you were to re-do it?

5) What criteria were used to select the general contractor?

6) What would you change in these criteria if you were to re-do it?

7) Did the contract with the contractor and designer contain any specific language requiring interaction between the two parties? If so, what?

8) What language would you add/remove/change in the contract if you were to re-write it?

Appendix 3

Weight Matrix

Weight Matrix

Shown in Table 1-1: Time Weight Matrix is the distribution of total time that will be allocated to Research, Value Engineering, Constructability, and Schedule Reduction for each of the four analysis as well as the total distribution of time to each of the analyzes and areas.

Analysis	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
Glulam Vs. Steel		5%	15%	10%	30%
Cooling Tower Vs. Chillers	5%	15%	5%	5%	30%
Project Team Interaction	15%		5%	5%	25%
Glulam Connections		5%	5%	5%	15%
Total	20%	25%	30%	25%	**100%**

Table 1-1: Time Weight Matrix

Appendix 4

Thesis Milestone Dates

Project Activities:

Analysis #1

Activity	Start	Finish
1) Determine the durability of concrete and steel in a natatorium environment	January 18, 2010	February 5, 2010
2) Determine building loads and design structural concrete and steel system	January 18, 2010	January 25, 2010
3) Calculate cost information for concrete and steel system	January 26, 2010	January 30, 2010
4) Determine schedule implications of steel system	January 31, 2010	February 6, 2010

Analysis #2

Activity	Start	Finish
1) Calculate cooling loads on the building	February 7, 2010	February 12, 2010
2) Size cooling tower system	February 13, 2010	February 15, 2010
3) Calculate cost information for cooling tower system	February 16, 2010	February 19, 2010

Analysis #3

Activity	Start	Finish
1) Create and distribute questionnaires to project team.	February 8, 2010	February 20, 2010
2) Identify commonalities between questionnaire responses	February 21, 2010	February 22, 2010
3) Conduct interviews with select project team members	February 23, 2010	March 5, 2010
4) Research project contracts	February 23, 2010	March 5, 2010
5) Identify positive and negative characteristics of the project team.	March 15, 2010	March 16, 2010

Analysis #4

Activity	Start	Finish
1) Determine cost impacts of a welded connection.	March 17, 2010	March 24, 2010
2) Identify schedule implications of a welded connection.	March 25, 2010	March 28, 2010
3) Evaluate constructability challenges of a welded connection (including qualified welders in area)	March 29, 2010	April 3, 2010