SENIOR THESIS FINAL PROPOSAL

The Pennsylvania State AE Senior Thesis

Duval County Unified Courthouse Facility

Jacksonville, Florida

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Construction Management

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EXECUTIVE SUMMARY

The senior thesis final proposal will serve as a guide basis of the four research analyses for the final thesis report on the Duval County Unified Courthouse Facility (DCUCF). The contents of this proposal were studied for possible improvements sought out for project success and do not reflect current problematic areas. The topics to be carried out in thorough procedural examination include: installation of prefabricated floor planks, incorporation of a Short Interval Project Schedule (SIPS), investigation of financial project factors, and exploration of risk management.

ANALYSIS NUMBER 1: Critical Industry Issue

Prefabrication is a beneficial tactic already used for the concrete paneling exterior enclosure of the DCUCF. Using this wide spread innovation of construction process was able to save time and cost efforts for such a large-scale project. The goal of this analysis is to examine the cost, scheduling, and manufacturing of prefabricated floor planks. Through this introduction of process, results will be compared to see if an all prefabricated concrete structure will be substantially favorable to the construction industry.

ANALYSIS NUMBER 2: Introduction of a Short Interval Production Schedule (SIPS)

The current project duration is targeted at May 2009 - May 2012. Through multiple debates and research, the project cost and schedule have been issues before the project was initiated on paper. The goal of this analysis is to determine schedule efficiency which was contested before the project started. Appropriate contractor trades and systems will be investigated to utilize a SIPS schedule for sequencing issues.

ANALYSIS NUMBER 3: Financial Analysis Awareness

The Duval County Unified Courthouse Facility exhibited financial obstacles prior to May 2009 for construction due to material price inflation for design. The goal of this analysis is to sustain project costs for materials and to implement a financial arrangement to balance cash flow distribution. Bonds, securities, cash networks, and financial management strategies will be studied.

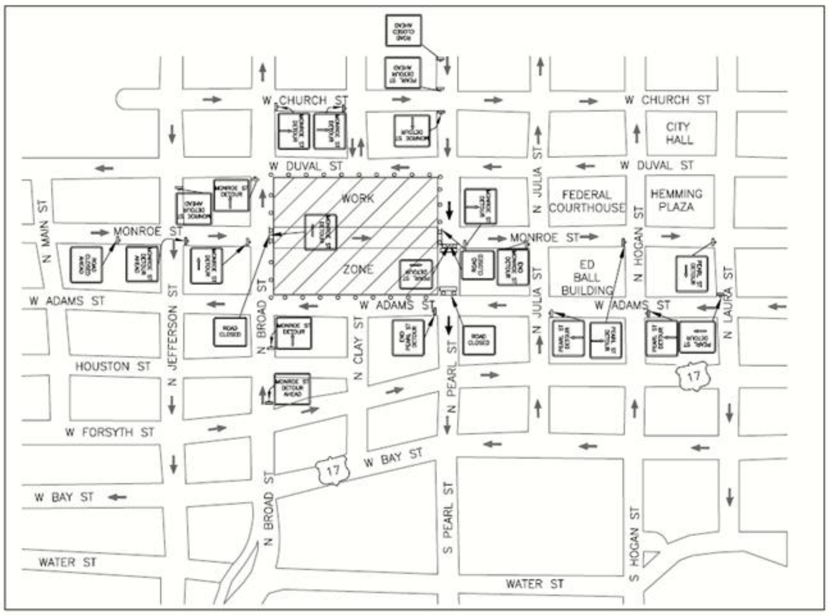
ANALYSIS NUMBER 4: Investigation of Project Risk Management

Risk management will be assessed to identify economical project influences. Revisions, liabilities, and credit for the project have been frequently looked into. Risks have been acknowledged through the project team, preconstruction, and construction services. The goal of this analysis is to observe transferring risk, evading risk, and limiting and accepting the negative aspects of risk that already exist.

PROJECT BACKGROUND

The Duval County Unified Courthouse Facility (DCUCF) is located near the heart of Jacksonville, Florida at the intersection of Clay Street and Monroe Street. The construction of this structure will take place over a 798,000 square foot desolate strip of land to help display architectural style and diligence to the Duval County area. An obstacle that this project faces is maintaining a maximum productivity site logistics plan in a high volume community environment. To sustain work efforts and community atmosphere, a plan was devised to reroute transition roads that led to the main stream roads of Clay Street and Monroe Street (Figure 1). This plan helped ease congestion within the project work area boundaries and allowed for effective transportation of site products and services.

Figure 1. Detour Site Logistics Plan



Project sequencing is broken-up into four sectional areas that include center, colonnade, west, and east respectively. The west section of the structure is first constructed then expands to the center and east components. After the basic structure is made, the interior work sequence starts on the outer limits and proceeds to the center portion to conclude with the colonnade section. Each section starts as the preceding section has the basic divisions finalized so multiple portions can be constructed at one time.

The building foundation system is constructed with auger and lateral piles at 125, 56, and 12 tons per pile with pile caps at 42” to 75” in depth. The foundation slab and floor slabs are poured and finished at 5” with 3,000psi concrete. These slabs contain 2-#4 x 3’-0” LG re-entrant bars that are centered at each re-entrant corner. Crack control, typical construction, and expansion joints at walls are best implemented with joints sealants and 1/8” sawcuts. Concrete footings vary with dimensions of 5’-6” x 3’-2”, 4’-0” x 3’-2”, 3’-0” x 3’-2”, and 2’-0” x 3’-0” valuing at 3,000psi concrete strength, dependent on loadbearing calculations.

The superstructure is mainly composed of W 8x29, W 19x29, W 27x29, and W 36x29 beams and joists. These beams and joists are constructed with 4,000psi concrete strength and follow a symmetrical pattern that are erected within the given parameters of four sections. A lateral bracing system is used to best resist in calculated live and dead loads. Concrete columns range from 16”x24” to 24”x28” with 10 to 20 bar at 50ksi. Sixteen shear walls exist within the structure and are designed for 4,000psi which withhold loading on elevator shafts and stairwells. Load bearing walls shall be constructed with Type II hollow concrete masonry units with ASTM C270, Type “S” mortar. This wall system is composed of masonry control joints, two vertical wall joint reinforcements, dowels, and masonry bond beams. All cells are filled with vertical reinforcing solid. Concrete masonry wall connection to precast concrete beam shall use a bolt connection on a steel plate with one-inch clearing to deck above. Precast paneling is used for a nicely finished façade. The panels have a concrete strength of 5,000psi at 28 days with 3/8” diameter reinforcing.

The steep roofing system is supported by steel beams of W 16x31, W18x40, and W 18x50. These beams help transfer loads from the metal roof back down to the ground using chevron and lateral bracing efforts. The assembly of a steep roof can be referenced in Figure 2. A flat roofing system is displayed on the west and east sections of the building (Figure 3). This system is made up of limestone aggregate concrete at 4,000psi with 1-1/2 “ deep metal decking and sloped pits for water drainage.

Figure 2. Steep Roof System

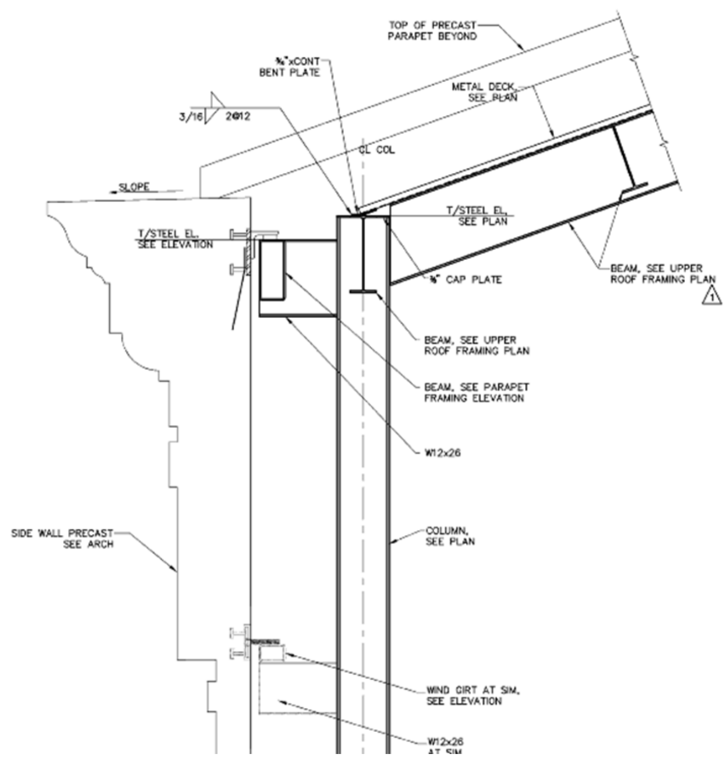
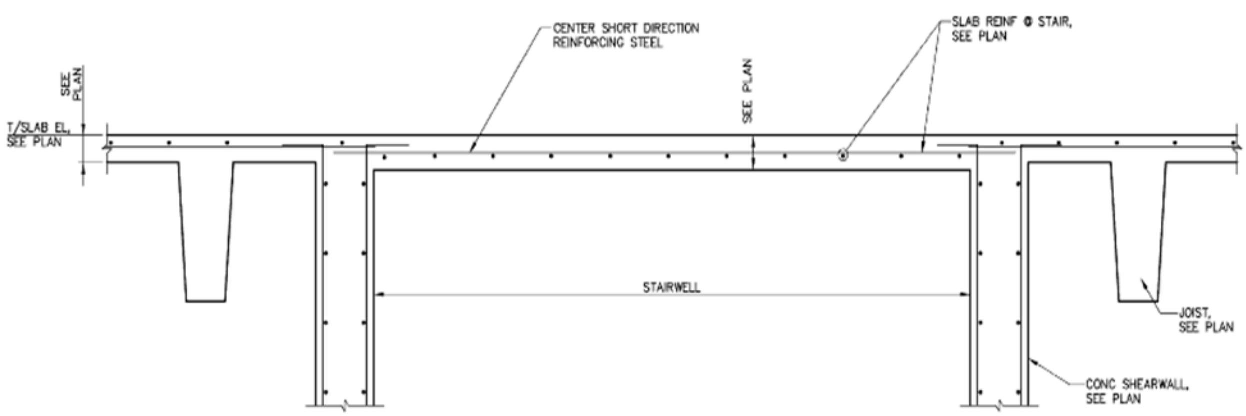


Figure 3. Flat Roof System



The DCUCF is awarded with the rating of LEED Certification. Efforts of sustainability are reached through recycled content of materials, regional materials, certified wood, low-emitting materials, site disturbance, construction waste management, and construction indoor air quality management. Recycling of material in the office and outside the office was urged to help promote “green” awareness. The office recycles aluminum and plastics and uses “green” cleaning products to aid in the environment. The field keeps track of steel and cardboard recycling divisions with the subcontractors. At one point wood recycling units were dispersed throughout the site until the recycler business loss occurred, and no other wood recycling businesses could be located within a 500 mile radius. Adhesive control limits ranged with VOC contents of 30 g/L to 775g/L that were within target of LEED requirements.

ANALYSIS NUMBER ONE: Uniform Prefabrication Engineering

REVISION IDENTIFICATION

Prefabrication is a newly used innovation service used to accelerate the schedule while promoting cost efficiency for the Duval County Unified Courthouse Facility. Since this project was of great size capacity, work processes were expected to fall out of range for the requirement of time and money established by the Duval County officials. To keep this project on "the drawing table" during a downfall economy for Jacksonville, Florida's budget, prefabricated concrete panels were manufactured for the exterior enclosure. Taking this same procedure and applying it to prefabricated concrete floor planks is predicted to seek out the same benefits. From this investigation, special considerations will be noted for flooring construction methods for a quicker and proper turn-over.

RESEARCH GOAL

The goal of this analysis is to perform detailed design aspects for the structuring of the prefabrication of concrete floor planks to fit an average of a 30'x28' bay spans for an earlier and equipped substantial completion.

METHODOLOGY

- Research typical span requirements for prefabricated concrete units
- Reference/calculate additional systems to support floor planks
- Note later installation objectives needed for floor placement
- Contact manufacturer to see if units can support special cut-outs for placement
- Research transportation requirements of units
- Calculate manpower of crews for assemblies
- Evaluate schedule for trade coordination for new "dual" activity relationships
- Perform estimates of new savings for restructuring

RESOURCE AND TOOL APPLICATIONS

- Turner Construction Project Team
- Prefab Manufacturing Company
- Professional Documentations and Readings
- Structural Engineer
- AE Faculty
- Industry Professionals
- PACE Seminar Contacts

EXPECTED OUTCOMES

From detailed research and design experiments, the prefabricated floor planks are expected to bring the schedule ahead of the previously stated schedule. Trades are predicted to be contributing work at the same time as floor planks are constructed since the floor layouts will be accessible to work on. This comes from the lack of waiting for the current cast-in-place concrete to cure. Cost estimates are foreshadowed to be lower since a constant rate for manufacturing is expected and the usage of the same crew from the exterior enclosure. Structurally, the building should support additional components to connect the concrete floor planks but are expected to add more loading transformation.

ANALYSIS NUMBER TWO: Introduction of Short Interval Production Schedule (SIPS) Efficiency

REVISION IDENTIFICATION

Project scheduling of the DCUCF was put under tight restrictions to be completed with proper cost establishments made by city officials of the Jacksonville, Florida area. Since the layout of the project displays consistent uniformity, a SIPS schedule seems like a possibility as a revision. Using this schedule will also require a cost effective analysis in order to outweigh the construction process of the large-scale complexity.

RESEARCH GOAL

The goal of this analysis is to implement a Short Interval Production Schedule to help improve project scheduling and sequencing efficiency.

METHODOLOGY

- Inquire about trades that could be beneficial to a SIPS schedule
- Research the key players affected
- Establish an order and structure for the project
- Test the process for a division of the building
- Produce a schedule
- Evaluate cost of new schedule
- Analyze cost comparisons between old and new schedule

RESOURCE AND TOOL APPLICATIONS

- Professor Dr. Hanagan
- Professor Dr. Leicht
- Professor Swagata Banerjee
- Turner Construction Project Team
- Structural Engineer
- AE SIPS Software
- Professional Documentation/Readings
- Industry Professionals

EXPECTED OUTCOMES

Performing extensive research, the newly imposed Short Interval Production Schedule is expected to produce an earlier project completion date. Work productivity of trades is foreshadowed to increase, since same work processes will be constructed periodically within the divisions. It is believed that the AE SIPS software will help provide the most economical loading simulation for scheduling and representation.

ANALYSIS NUMBER THREE: Financial Analysis Awareness

REVISION IDENTICATION

Financial turmoil struck the DCUCF before the current project could be constructed. Before it could receive the "Go" approval, a plan was devised to compensate for the condition of the construction economy. This plan was to offset new materials, since inflation hit the market for the desired material usage for the project. Recyclable and regional materials were sought which in turn help to aid in LEED Certification.

RESEARCH GOALS

The goal of this analysis is to obtain a financial procedure that could achieve maximum cash flow analyses through different project components for the owner and project team.

METHODOLOGY

- Investigate current financial arrangements of bonds, securities, and strategies
- Research other project financial plans that have been successful for construction
- Research and develop new financial plans
- Interview with the project financial staff
- Interview with PSU SMEAL College
- Research financial institutions
- Perform life cycle costs of plans to the DCUCF

RESOURCE AND TOOL APPLICATIONS

- SMEAL College Faculty and Staff
- AE Faculty
- Professional Documents/Readings
- Florida Financial Institutions
- Industry Professionals

EXPECTED OUTCOMES

The expected outcome of this analysis is to achieve an appropriate financial plan that could aid in financial risks that were encountered by the project team and owner. Other means of project efficiencies (other than material utilization) are expected to be obtained through research. A newly proposed financial plan is sought.

ANALYSIS NUMBER FOUR: Investigation of Project Risk Management

REVISION IDENTIFICATION

Risk management associated with the newly implemented precast floor units will be analyzed. Uncertainty of the objectives dealing with coordination and economical markets will be of issue and need to be investigated to monitor and control the impact of construction events. Features of legal liabilities, accidents, and project failures will be focused on for improvements.

RESEARCH GOAL

The goal of this analysis is to measure, monitor, and control risk management applications of the precast floor plank system.

METHODOLOGY

- Obtain risk management features that exist for the current floor system
- Outline risk management characteristics of the precast system
- Investigate legal liabilities accidents, and project failures
- Set-up virtual case study for impact
- Research potential risk treatments
- Create a new risk management plan

RESOURCE AND TOOL APPLICATIONS

- Professional Documentation/Readings
- SMEAL College Faculty
- MEP Contractors
- AE Faculty
- Industry Professionals

EXPECTED OUTCOME

After finishing a proper procedural analysis, it is expected that a new risk management plan will help minimize risk associated with the precast floor plank system construction. This plan will help control liabilities and failures that could possibly arise in future constructability efforts. Positive risk management knowledge will be obtained through a professional business manner.

ANALYSIS WEIGHT MATRIX

A weight matrix is used to illustrate the performance base of analysis for each of the four primary areas of study. Figure 4. shows the percentages assigned for the predicted effort and time management for each of the analyses provided in a semester long guideline.

Figure 4. Weight Matrix Percentages

Primary Analysis	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
Prefabricated Floor System	-	10%	10%	5%	25%
SIPS Schedule	-	5%	10%	10%	25%
Financial Analysis	10%	5%	10%	-	25%
Risk Management	10%	5%	10%	-	25%
Total	20%	25%	40%	15%	100%

TIMETABLE

***Reference Appendix B for the Spring Semester Timetable Schedule**

For successful time management and productivity tracking, an initial semester timetable schedule was created.

CONCLUSION

With thorough research and theoretical simulations, an economical perspective summary can be gained from referencing this technical analysis proposal. An investigation for uniform project prefabrication will be observed within the limits of the preconstruction phase therefore recognizing schedule and cost efficiencies. A Short Interval Production Schedule is predicted to increase work productivity and to produce a quicker turnover time. The financial review will yield new sources of stability to support the current system with cash flow observations and techniques. Lastly, the application of risk management will aid in risk control for the overall project success.

The intent of this proposal is to serve as a primary guidance factor for the overall senior thesis presentation and is subjected to change when commentary is received and analyzed from the thesis consultants.

APPENDIX A – BREADTH TOPICS

BREADTH TOPICS

Each breadth topic corresponds to a previously mentioned technical analysis that is indicated accordingly. The breadths are subjected to individual analysis to test substantial knowledge of specific architectural engineering options that have been acquired over an academic career period.

STRUCTURAL BREADTH

***Corresponds to Technical Analysis Number One**

Technical Analysis Number One

Designing a prefabricated floor plank system to substitute the existing cast-in-place concrete flooring system will require a detailed loading examination. Each plank will have to be tested for strength durability and loading in relation to exhibiting drilled holes for floor placement activities. With expected supplementary support systems to be added to accommodate for proper floor plank connections, internal and external loading will be utilized for these components by hand calculations and software devices. Concrete strength and materials will have to be tested. An expected structural analysis will be conducted of the durability and strength for welding additional components to bisect the average 30’x28’ bay.

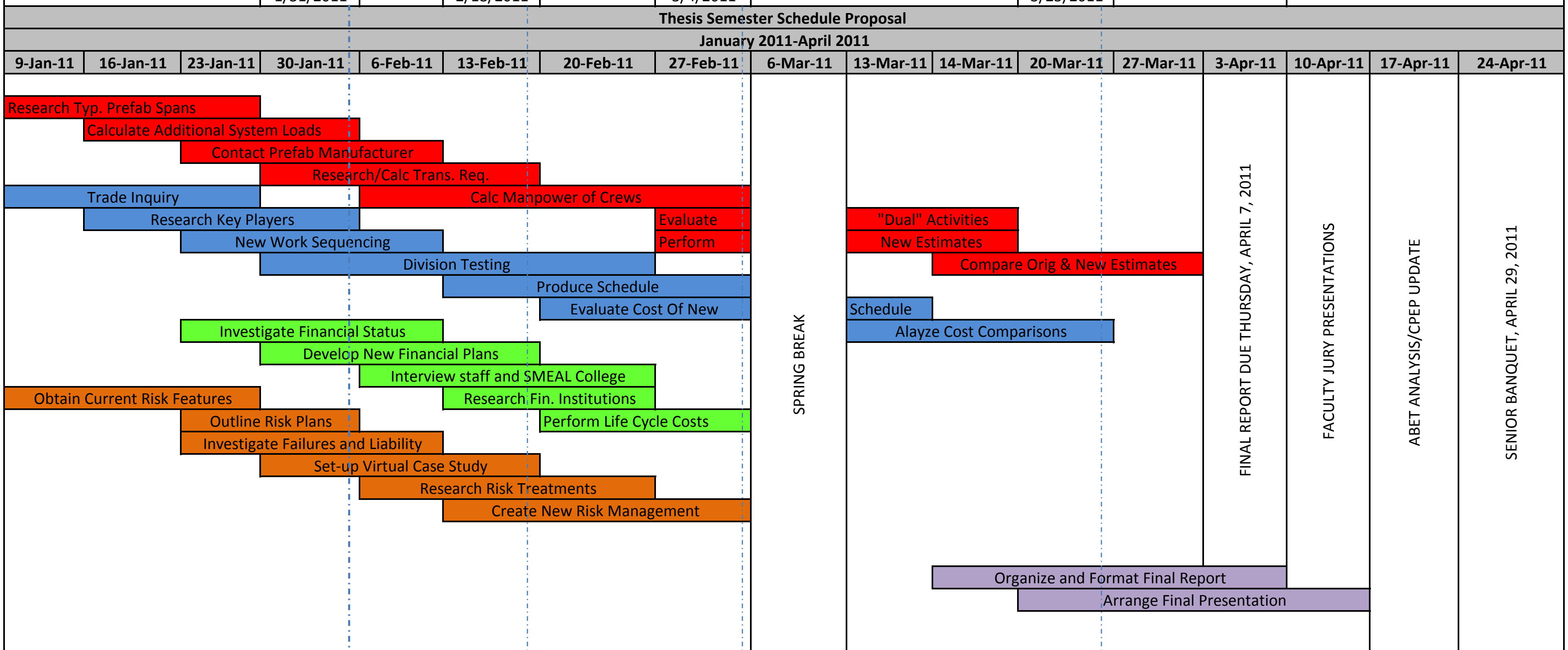
ACOUSTICAL BREADTH

***Corresponds to Technical Analysis Number One**

Implementing the prefabricated floor plank system in a factory-based environment will demand an acoustical analysis. Materials associated with the production of the prefabrication can either enhance or demote features of the room constructability. Sound and time reverberations will be affected which could cause an obstacle for ceiling and wall placement. Finishes and connections will be extensively looked into for capabilities of efficiency.

APPENDIX B – SPRING SEMESTER TIMETABLE SCHDULE

SENIOR THESIS FINAL PROPOSAL 1/31/2011	Duval County Unified Courthouse Facility	Darre'll Alston Construction Management Dr. Rob Leicht
	Milestone 1 1/31/2011; Milestone 2 2/18/2011; Milestone 3 3/4/2011; Milestone 4 3/25/2011	



Analysis 1: Uniform Prefabrication Engineering (Structural & Acoustical Breadth)
Analysis 2: Short Interval Project Schedule
Analysis 3: Financial Awareness
Analysis 4: Risk Management

Milestone 1: Complete all Steel Sizing/Load Calcs
Milestone 2: Sequencing of SIPS Schedule
Milestone 3: Evaluated Financial Plans
Milestone 4: Gather All Results and Findings and Begin Final Preparations