TECHNICAL ASSIGNMENT THREE

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

***I*dentification of areas of the project that will serve as good candidates for research, alternative methods, value engineering, and schedule compression** is the basis of the Technical Assignment Three for the Duval County Unified Courthouse Facility (DCUCF). Once completed, this project will be one of the largest structures in the Jacksonville, Florida area with a size measuring in at approximately 798,000 SF. With such a large-scale parameter, simulated problematic areas can be identifiable (but are subjective by the reviewer) for study and are awaiting confirmation in the form of an interview with the project manager of the project. **Since contact is still in progress for an interview, issues for examination of constructability challenges, schedule acceleration scenarios, and value engineering topics will be added as an addendum at a later date.**

The contents of this report 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 structural steel system, integration of a green roof, and addition of a photovoltaic system.

CONSTRUCTABILITY CHALLENGES

***Will be added at a later date as an addendum**

SCHEDULE ACCELERATION SCENARIOS

***Will be added as an addendum at a later date**

VALUE ENGINEERING TOPICS

***Will be added as an addendum at a later date**

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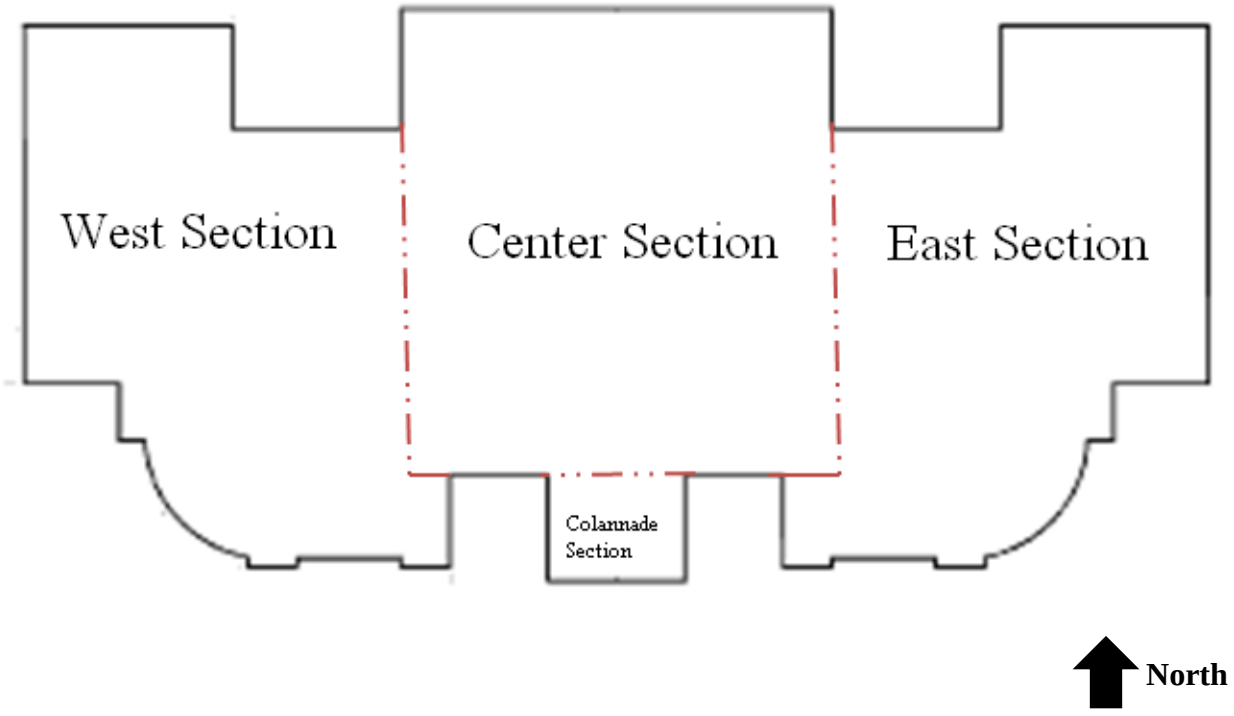
PROBLEMATIC IDENTIFICATION

From an extensive investigation of the specifications and contract documents, several possible problematic features were identified within the parameters of constructability challenges, schedule acceleration scenarios and value engineering. These problematic areas are only assumed and awaiting confirmation so they are subjected to revision. The following issues are potential topics for approaching research analysis:

CAST-IN-PLACE CONRETE FLOORING

The Duval County Unified Courthouse Facility consists of seven floors at an average of 100,000 SF per floor. Of these floors, four sections were devised into west, center, east, and colonnade for the concrete pouring phases which can be referenced in Figure 1. The task to pour the concrete and conduct slab infill activities takes roughly five word-day months for the foundation, one work-day month for the second floor, and one work-day week for third through seventh floor. This job task takes majority of the time of the schedule compared to all other tasks allotted in the two year project span. All other tasks are dependent on this critical path activity which greatly impacts the DCUCF project.

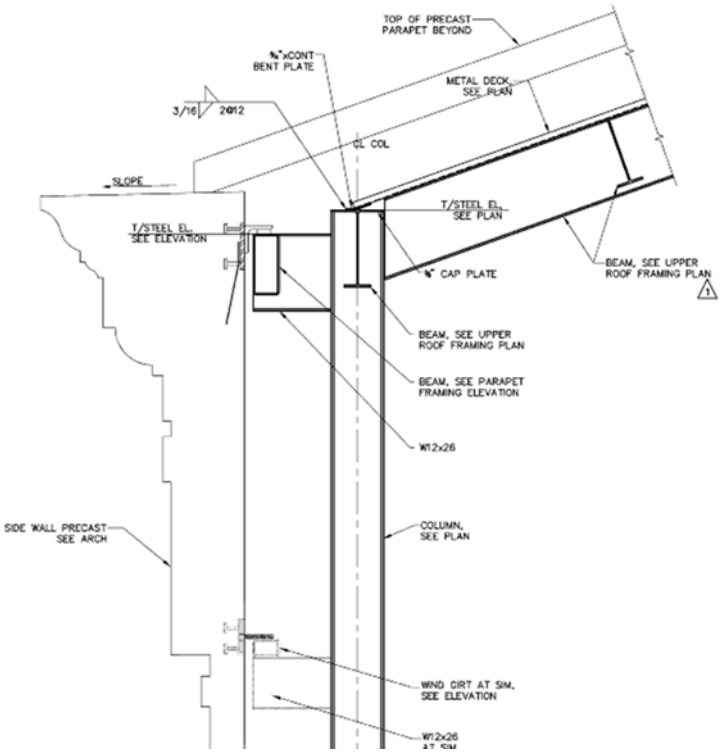
Figure 1. Building Zones



STEEP ROOF CONNECTION

The existing structure is composed of concrete beams, girders, and columns for the main structure and steel trusses for the two steep roof systems. These roof systems are utilized within the center and colonnade section of the building. The steep roof connection can be referenced in Figure 2. With two different material systems being assembled together, special techniques with welded plates and anchors had to be used. Crew members with specialty labor were used to construct the work at-hand. This task required more time connection compared to other tasks.

Figure 2. Steep Roof Connection



WATER EFFICIENCY WITHIN LEED CERTIFICATION

The Duval County Unified Courthouse Facility was able to achieve a LEED Certified rating. Within the LEED checklist, five out of the thirty-two points were awarded for water efficiency and redistribution. Sustainable features constructed within the flat roof systems are best represented for the water collection from seep hole penetrations which allow for the redistribution of storm water design. A look for water efficiency methods could be explored to gain insight of a higher LEED rating since the current rank was border-line from a promotion.

POWER GRID SYSTEM LOADING

The energy consumption rate for the Duval County Unified Courthouse Facility is extended over the average consumption rate on the power grid of the area. Observing these rates of the project, predicted values are expected to elevate usage on the grid system currently in the Jacksonville, Florida area The product idea of using photovoltaic systems was presented but not supported for construction due to budget limits.

TECHNICAL ANALYSIS METHODS

TECHNICAL ANALYSIS METHOD #1: Uniform Prefabrication Engineering

Prefabrication is a beneficial tactic already used for the concrete paneling exterior enclosure of the Duval County Unified Courthouse Facility. Using this wide spread innovation of construction process was able to save time and cost efforts for such a large-scale project. From this principle the flooring system will be scrutinized for the same positive outcomes. The current flooring system is composed of cast-in-place concrete pan joists at a strength of 4,000 PSI. This system typically spans over an average of a 30'x28' bay for all six elevated floors divided into a West, Center, and East section.

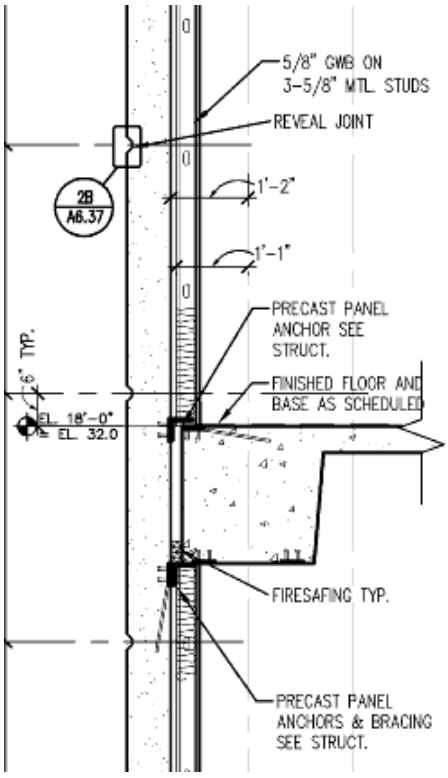
First a look at the size and span of a prefabricated floor plank will be calculated to see about the actual manufacturing capabilities. From prior knowledge of spanning prefabricated panels, the assembly of these planks will require a girder/additional support to bisect the middle of each 30'x28' or larger span. The implementation of a structural subtopic will be researched to see if any precautions must be taken on from the loading influences of the additional girders. Girder connectivity methods to existing beam members and to floor planks will be gathered for project success due to the influences that will be imposed. Also building live and dead loads must be taken into account for loading transference which could result with additional bracing components form the new support system. The manufacturing company will have to be contacted in order to see if cut-outs can be constructed for infill activities that must be inscribed within the flooring system layout. Transportation scheduling of material will be looked at to see if scheduling acceleration can be achieved. Cost estimation will also be analyzed for project cash flow gain from possible new savings for the restructuring.

TECHNICAL ANALYSIS METHOD #2: Structure Assembly with Steel Implementation

The existing structure is composed of concrete beams, girders, and columns for the main structure and steel trusses for the two steep roof systems. With these two different material systems being assembled together, special techniques with welded plates and anchors had to be used. . This process takes a surplus of manpower from constructing welds and additional metal connections. Coordination between the concrete and steel erection is initiated and requires more time for installation and is task dependent on trades after these activities.

Changing the structure to a steel system would result with a more effective assembly of the trusses to the main structure. Economic steel-to-steel connections will have to be researched for effective assembly productivity. Existing bracing methods such as the chevron bracing would be analyzed to see if it would be best suited for the new structure. For this to occur, steel calculations of strength with dead and live loads and spans for loading must be inferred. These calculations will lead to the proper conditions of steel sizing and placement for each component of the structure. New crews, tier crane lifts, and manpower related to steel processes would have to be estimated into the overall project estimate and schedule since different trades will used for the restructuring task. Façade connectivity to the new steel system will have to be analyzed to see if the same constructability can stall in place. The current assembly of precast panels to the pan joist flooring can be referenced in Figure 3. Based on previous knowledge from the PSU architectural engineering courses, fireproofing would become an important aspect to analyze due to steel fire rating. This research will have to meet the Florida Fire Prevention Code and National Fire Protection Association regulations.

Figure. 3 Precast Panel Connection to Pan Joist Flooring



TECHNICAL ANALYSIS METHOD #3: Green Roof Utilization

The two flat roof systems are devised for water retention to support the LEED Certification. This support received minimum points for the LEED rating system from the dewatering holes surrounding the perimeter of both roofs. A system then retrieves the water for redistribution throughout the building.

For this analysis, an in-depth research of Green Roof components and background will be needed to fully understand this particular system. An accessible route to the Green Roof will have to be designed so that maintenance can occur. This design will affect the analysis architecturally because of layout requirements. The entrance/exit location will have to be tested structurally to see if it is plausible and safe. Load calculations will have to be done by hand to see if this system can be supported by the DCUCF's structure. A takeoff will then be performed to see if the life cycle cost will offset the construction process of this analysis. Finally, a LEED checklist with guidelines should be applied to see if the rating of the new design will surpass the current rating.

TECHNICAL ANALYSIS METHOD #4: Photovoltaic (PV) System on the Grid System

The two steep roofs of the roofing systems were used in junction with thermal glazing to maintain direct daylight gain and historical courthouse aesthetics. . This system is currently exposed to a yearly sunlight gain of roughly 45% more than a structure located in Pennsylvania, according to the City Data of Jacksonville. The direct sunlight gain would be best employed with Solar Photovoltaic Panels which are currently making a positive trend on the U.S. economy for energy efficiency. Using the PV panels would reduce energy costs for this large structure after project turnover. Through energy consumption rates of the project, predicted values are expected to elevate usage on the grid system currently in the Jacksonville, Florida area.

To start this analysis, an investigation of photovoltaic system applications and LEED benefactors must be conducted. All system background information will have to be obtained for efficient procedural examination. Local suppliers and manufacturers will have to be located to discover their current trends of PV paneling and rates for transporting the devices. A calculation of PV quantities must be established to evaluate the application to the steep roofing system. Routing systems allocation would be explored through the structure of the roof to efficiently install the PV system to the current systems. A study will be implemented to see the structural impacts of the design on the building. Predictions have been brainstormed to believe that little influence will be encountered. Estimates for the photovoltaic system will be calculated for the life cycle cost of the carbon footprint to see how economical this analysis is to the project. Once all the above information is gathered, a compare/contrast method will then be practical to the grid system versus the PV system procedure. This would involve inquiry of energy consumption rates/energy peak times of the DCUCF versus the photovoltaic panels and their effects on the current grid system. If extraordinary paybacks are managed, sustainable devices may be imposed

to take the current LEED Certified rating to a LEED Silver rating. a routing system allocation would be explored through the structure of the roof to efficiently install the PV system to the current systems.