Technical Assignment 3: Alternative Methods Analysis

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The Salamander Resort and Spa

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EXECUTIVE SUMMARY

This technical assignment takes a look at several areas in which I can build upon for my final thesis proposal. The main areas of focus for this report are constructability challenges, schedule acceleration scenarios, value engineering topics, and critical issue research. The information provided in this document is from a telephone interview with the on-site project manager as well as my observations. I was able to hold a telephone interview with Mark Miller, the Turner Construction project manager, and get his thoughts on several of the most difficult design and constructability issues, schedule acceleration opportunities, and value engineering topics.

The top constructability and design issues on The Salamander Resort and Spa include the chimney design and construction on the main building, the chimney constructability on the guest lodge, and lodge air handling unit constructability. In the main building, the chimneys were not fully designed so the structural steel was placed in the vertical space that the chimneys needed to occupy. In the lodge, the placement of the chimneys was not designed until after the roof trusses were installed thus requiring some demolition for them to be placed. The final main constructability issue was that the energy recovery air handling units required additional production time and were delivered on-site five months after the regular AHU's were placed and sheathing and roofing was complete. This required the project team to cut holes in the roofing to place the additional AHU's.

The project's critical path is discussed in the Schedule Acceleration Scenario section. The most critical activity on the project that posed a risk of delay was the construction of the chimneys in the main building and lodge. The greatest potential for acceleration comes from eliminating the eleven month gap between roof dry-in and the start of interior work. There would be very few additional costs involved because the original baseline schedule did not include this gap. Several of the largest cost saving value engineering points came from eliminating sound proofing between guest rooms and changing all bathroom fixtures in the main building and guest lodge. A couple value engineering points that were identified by the contractor but rejected by the owner are also listed.

The final two sections include Problem Identification and Technical Analysis Methods. Problem Identification lists a number of construction and design issues that could pose problems for this project. Technical Analysis Methods identifies four of these problem areas and describes my process of how I will analyze and research these areas. The four analyses I chose are post-tensioned concrete, sustainable design, lighting/heating controls, and water management for landscaping.

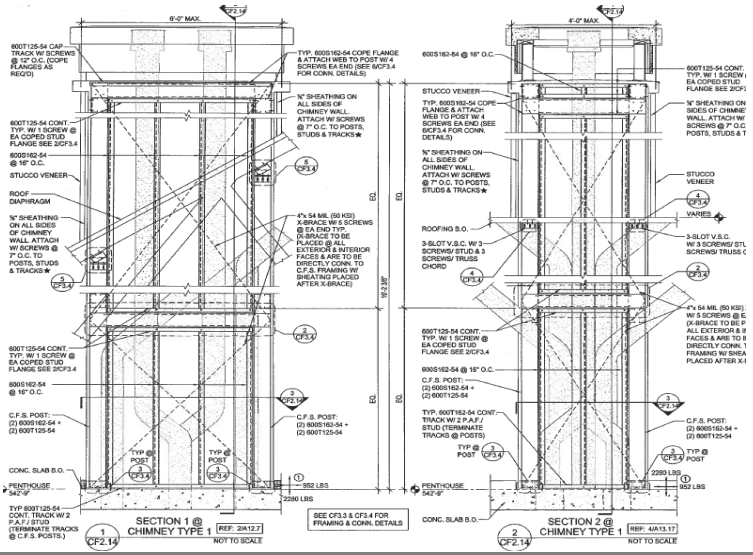
CONSTRUCTABILITY CHALLENGES

Chimney Design and Construction

The Salamander Resort and Spa has a total of twelve chimneys in the main building alone. Four of the largest chimneys, arranged back to back on opposite ends of the lobby area, have created a significant number of problems for the Turner Project Team. When the chimneys were being installed, the team realized that there was not enough room to extend them to the roof because the structural steel did not leave enough clearance. The gap in the steel was not more than a few inches.

As it turned out, the chimneys were never fully designed by the architect, only their plan location was determined. All the other subcontractors went ahead with their design and no one picked up the design of the chimneys. It was not specified as to who was to design them, so in the end no one did. Another problem was that it was discovered fairly late in the project, after the structural steel and lightgage roof trusses had already been placed.

The solution to this problem turned out to be more difficult than the project team initially suspected. The RFI process was especially long because it included many trades, steel, HVAC, plumbing, and roofing. The exhaust pipes within the chimneys were rerouted to avoid the structural steel. Tube steel was also added for structural support and custom brackets to mount them had to be designed. Once the chimney got to the penthouse level it conflicted with the lightgage steel trusses. Several of the steel trusses were removed or modified to allow the chimney to pass up through.



Lodge Chimney Constructability

Almost all the guest rooms at The Salamander Resort and Spa have a working fireplace. This poses a problem for the ventilation and exhaust of the air. Unlike the main building, the guest lodge uses faux chimneys and exhausts all the air out of separate external vents. The problem therefore does not involve the movement and design of the exhaust pipes, but instead the placement, design, and construction of the fake chimneys.

Just as in the main building, the architect only determined the approximate plan location of the chimneys, none of the connections or construction drawings were produced. The biggest problem was the chimney to roof connection and maintaining a waterproof seal. The other problem was the structural support of the mass of the chimney. All while this was going on, the owner was continuously value engineering so one design never received approval before a new one was coming out.

This indecision from the owner caused the project team to just continue with concrete pouring and truss installation and deal with the chimney once the design was finalized. Once the final design came in, the chimneys were constructed on the ground and then hoisted up into place. In order to drop them into the correct location, the steel roof trusses that were in the way needed to be cut out. Also, because the location on the chimneys was unknown at the time of concrete pouring, the concrete subcontractor did not include any steel plates for structural support. Instead, the project team was forced to do extensive plate modifications right before the chimneys were placed. The following pictures show the construction of the chimneys on the ground and the placement of them on the lodge.

Lodge Air Handling Unit Installation

The Salamander Resort and Spa utilizes six energy recovery AHU's in the guest lodge. They are all located on the roof of the lodge. These special AHU's had an especially long lead time of twenty-six weeks. This created problems with the schedule because the lightgage steel roof trusses, sheathing, and roofing were to be installed before the delivery of the energy recovery AHU's.

The regular AHU's were installed on time prior to the roof completion in October 2008. By installing the AHU's they already had on site allowed them to make the proper connections and ensure that they would not get behind schedule. At the locations where the energy recovery AHU's were to be placed, the project team decided to cover the holes over with sheathing and roofing while the AHU's were being manufactured and shipped. The AHU's were delivered in March 2009, five months after the roof installation was completed. Holes were cut in the roofing and the AHU's were dropped into place. The connections and roofing was then replaced around the units. The project team decided to do it this way instead of leaving holes in the roof during the winter months and prevented water and weather damage to the interior.

SCHEDULE ACCELERATION SCENARIOS

The critical path for The Salamander Resort and Spa followed that of a typical commercial construction project. The critical path includes the following activities; concrete frame, steel frame, core/shell, enclosure, and interiors. A delay to any of these activities would cause a delay in the overall project completion date. The roof dry-in milestone was the most critical point in the schedule as it occurred between the enclosure and the interiors. This was an important point to reach because it then allowed the extensive interior work to begin. The importance of this milestone was later negated due to the one year delay the owner placed on the entire project.

One of the largest risks to the project being completed on time is the chimney construction on the lodge and main building. As mentioned in the above section, the chimneys posed a difficult situation for the project team because they were designed too late to be installed when the schedule stated. This delay nearly caused the roof dry-in milestone to be pushed back. The chimney design issue was resolved by the project team with no significant delay in the schedule. Other than this issue, there have been no other significant delays to the schedule.

There is one significant area for schedule acceleration for this project. As per the owners request, the whole schedule was delayed by one year due to the current economic climate. The Turner schedulers were given the task of lengthening the schedule and increasing durations while not increasing the overall cost of the project. The biggest area where this stretching occurred was immediately following the enclosure and roof dry-in. From January 2009 to November 2009, all interior work was put on hold while the rest of the project slowed down. On most construction projects, the owner is pushing for the fastest, cheapest, and highest quality product, while in this case the owner is looking for a high quality product but allowing additional time for completion.

The cost of accelerating the schedule and eliminating the eleven month gap between enclosures and interiors would be very minimal because that is how the original schedule was arranged. The modified schedule would have more trade overlap between the interior and exterior workers that would need to be accommodated for on site.

VALUE ENGINEERING TOPICS

Due to the length and complexity of this project, the owner, Salamander Hospitality, was constantly doing value engineering on all aspects of the building. Nearly every major component, before it was installed, was value engineered to some degree. The most extensive set of changes involved the lodge and main building restrooms. All the fixtures including the lavatory, shower heads, and faucets were changed from the original design. The total savings from the restroom value engineering alone was approximately $250 thousand.

The lodge was originally designed to have a layer of soundproofing between the guestrooms that would reduce sound penetration by up to 75%. It consisted of two sheets of different thickness separated by a layer of insulation. The total thickness of this system is only 32mm and was to be installed over top the drywall. By removing this option and increasing the drywall thickness to 5/8", the owner saved over $315 thousand.

Another large savings came from the use of steel deck with plywood instead of Homasote. All of these value engineering issues were approved by the owner, Salamander Hospitality, but with a cost to the overall image of the project. Removing the soundproofing took away some of the privacy that people paying for a high class resort might expect. Also, Homasote is a recycled material that initially helped this project become LEED certified.

Several value engineering ideas proposed by the contractor were rejected by the owner. The largest issue, cost wise, was substituting Trane brand equipment and controls to a different manufacturer. Most of the other rejected options involved changing the existing external patios, sidewalks, and courtyards to brick pavers or interlocking unit pavers. These options were rejected by the owner because they did not want to change the overall experience, which they had intended on, while someone was outside.

To date, there are over $430k of accepted, $1.5 million pending, and $600 rejected value engineering issues dealt with. These numbers are expected to increase as the value engineering process continues through the life of the construction phase.

PROBLEM IDENTIFICATION

This section identifies several areas or systems of the building which caused problems for the contractor during construction.

Chimney Construction

The chimneys found in both the main building and the guest lodge was never fully designed by the architect. This created many problems with trade coordination because space was not left for the extension of the chimney from the floor through the roof in the main building. In the guest lodge, the location of the chimneys was not known until after the roof trusses had been installed. In order to place them, holes needed to be cut in the trusses and additional reinforcing had to be installed to support the mass.

Air Handling Unit Installation

Several of the AHU's had an extra long lead time of twenty-six weeks which prevented them from being delivered with the rest of the regular AHU's. While the project team waited for the delivery, they decided to place sheathing and roofing over the holes that were cut for the special AHU's so they could continue with interior work and not have to worry about water intrusion. Holes were then cut in the sheathing and roofing when the AHU's arrived on site and fitted with the correct connections.

Post-Tensioned Concrete

The guest lodge utilizes post-tensioned concrete slabs for all the elevated floors. This is an especially difficult system to use and coordinate as the concrete team must come back after the concrete is cured in order to tension the steel cables. The use of either pre-tensioned or pre-fabricated concrete panels might be better suited for this project.

Obtaining Construction Documents

The owner was continually value engineering all the systems on the project which made it difficult for the contractor to obtain the most up to date construction documents. A lot of the systems, like the chimney design, were not designed in time for installation as determined by the schedule. This created onsite coordination issues with subcontractors having to redo work.

LEED Consideration

The Salamander Resort and Spa is trying to achieve the 'Certified' LEED level. Being such a high profile resort tailored to the wealthy, the owner should consider trying to obtain a higher rating

such as Silver or Gold. This could also be a marketing tool to attract customers as the US is becoming more involved with energy conservation and 'green'.

Wind and Energy Considerations

The resort is located in the middle of a large field with very few trees in the immediate vicinity to create shading or reduce wind disturbances. This project has the potential to use photovoltaic panels to decrease the net energy use of the building. Since the building is in a large field, the wind gusts can create disturbances to the occupants and it would be worth looking into a wind analysis to determine first if there are problem areas, and if so, how to mitigate them.

Transportation Costs

Many of the interior finish materials are very high in quality and must be shipped in from all over the country. This not only increases the lead time but also detracts from the basis of LEED. The owner should explore alternative methods which can be obtained closer to the site.

Water Management for Landscaping

The landscaping for The Salamander Resort and Spa is very extensive and covers much of the area surrounding the building, horse stable, and swimming pool. The owner has the opportunity to save a significant amount of money by installing an efficient automated watering system that collects and redistributes rain and gray water.

TECHNICAL ANALYSIS METHODS

Sustainability Analysis

The Salamander Resort and Spa is designed to achieve the 'Certified' LEED Accreditation level by the USGBC. The owner would see much more benefits over the lifecycle of the building if they chose to go for a Silver of even a Gold certification. This is even more important because the name of the owner, Salamander Hospitality, is part of the name for the resort and can directly affect how people see their company in terms of sustainability and 'green' behavior. For a LEED analysis I would look into additional points that could be achieved on this project.

The main downfall in the current project regarding LEED is the lack of energy conservation, only three of the possible eighteen points in the 'Energy and Atmosphere' category are confirmed. I would also explore the possibility of adding photovoltaic panels on the site to recoup some of the energy use. Using the software Autodesk Ecotect, I would conduct a shadow and energy radiation analysis to determine the ideal location of the PV panels. I would also look into the effect of wind using the software Fluent Airpak and determine how to better channel the wind in order to cause the least amount of disturbances to the guests. Both of the software's require the use of a 3D model. A secondary analysis would be required to determine the cost and schedule impacts of these changes.

Post-Tensioned Concrete

For a schedule coordination and value engineering analysis I might look into eliminating the post-tensioned concrete used in the guest lodge. Trade coordination becomes an issue when the concrete workers come back after the concrete has cured in order to tension the steel cables. I will have to perform an analysis to compare the costs and schedule impacts of different systems such as pre-fabricated, pre-tensioned, and normal FRP concrete to the actual cost of the post-tensioned installed. The current column schedule will also have to be evaluated to determine whether they will adequately support each of the different slab systems. If prefabricated panels are used I must also consider the additional time the crane must be on site.

Lighting/Temperature Controls in Lodge

There are 165 guest rooms in the Salamander Resort and Spa and this provides a unique opportunity to reduce the energy consumption in one room and replicate it across all others. First, I would have to research the average energy consumption per guest room and decide on the areas on which I could reduce energy use. Second, I would research automated lighting controls that detect occupancy and shut off when no one is in the room. LED lighting could also

be utilized to cut down on energy output. Research into heating control that act in a similar manner to that of the lighting controls will also have to be done. After all the controls and fixtures are replaced, a final energy consumption analysis will be run to show the savings of the new system to that of the old one. Finally, a cost analysis must also be completed to show which system is more cost efficient. If the new system has a higher upfront cost and lower energy use, determine the payback period.

Water Management for Landscaping

The landscaping for this project is very important to the owner which is why they hired Oculus, a landscape architect. The landscape design surrounding the buildings is very complex and includes many different types and species of flowers, trees, and shrubs. Without an organized watering system, a small expense can become very large, very quickly. Annual rainfall data must be research for Middleburg, Virginia. The originally designed plants and trees will have to be researched to find typical watering requirements and compared to see whether the natural annual rainfall is enough. If the rainfall is not enough water for the plants, alternative plants can be found, with a focus on native plant species that are known to survive in the region on rainfall alone.

If these analyses conclude that additional water is required, I can look into automated irrigation systems that draw from rainfall runoff and gray water. In order to reduce excessive watering, plants and trees that require the most water will be placed together, and ones that require less water will also be grouped. Lastly, a cost comparison will be done to show the price of the original plan to that of the one with the new plants and irrigation system.