United States

Department of the Interior

# Cafeteria Modernization

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1849 C Street NW, Washington D.C.

November 29, 2010

Technical Report

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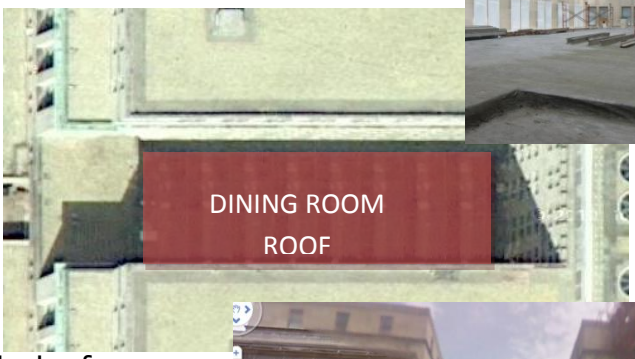
# Executive Summary

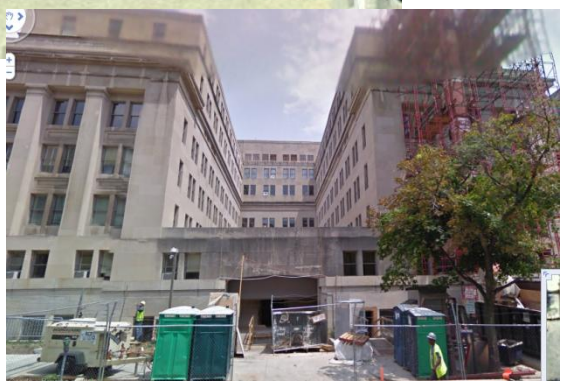
Technical Analysis 3 is a look into the Department of the Interior Cafeteria Modernization project for opportunities of research, value engineering, schedule compression, and alternative construction methods. This is achieved through an interview analysis of the Project Manager as well as self-observations.

The Project Manager interview concentrates on constructability challenges, schedule acceleration scenarios, and value engineering topics. The top three issues for constructability lie in the access to the Dining Room Roof, the determination of demolition and abatement, and the installation of the architectural finishes. Also in this interview analysis, the critical path is discussed as well as the acceleration techniques for demolition and abatement, the Dining Room roof dry-in, the interior fit out, and the punch list activities. Finally this section concludes with a review of the Value Engineering considerations made for the historic preservations, the Servery skylights, the high performance lighting system, and the granite counter tops.

The second portion of this report goes in identifying the problems that occurred during the construction of the cafeteria. The six largest problems identified included: the dining room roof system, the punch list process, the quality control program, the Dining Room lighting system, mechanical dehumidification, and historic preservation. Finally, four of those problems were taken into further review by developing the technical analysis methods that would best serve to examine and rectify these problems.

## Dining Room Roof



The roof above the cafeteria is completely enclosed by the surrounding building. North, South, and East wall continues 5 stories above the cafeteria, while the West Wall is two stories high. Construction on the roof is even further complicated by access, since there are no doors to go on and off the roof. The lack of space, as well as lack ofaccess raises a whole sort of constructability issues.

The first issue the construction team dealt with for the roof construciton was the lack of access. They needed a way to get crews on an off the roof in a timely and safe manner. It was decided that the best means of access would be to enter through a window on the first floor South wall of Wing 3. This would provide large enough access passage, as well as a safe method of egress since the window ledge was only 2 feet above the roof. The other reason this proved to be effective was that because Wing 3 was under construction, they would not need to worry about tracking mud of damaging anything with everyone going in and out. Another positive thing about this solution was that even when Wing 3 would be close to completion and construction access would not be feasible, Wing 2 would be beginning construction. The North wall of Wing 2 also contained window access and would be in the demolition phase for the remaining construction time for the roof. The other access issue would be getting the mechanical equipment and skylights onto the roof. For this, the construction team used a truck mounted crane which would come to the site during night shifts. Fortunately the crane would only be necessary for a day at a time as each row of skylights would be installed and then again at the end for the mechanical equipment. By using the crane at night, more of the traffic lanes could be blocked off to give the crane room. A truck crane was ideal, because it could come and go from the sight and yet would able to reach over the 2 story high west wall.

## Demoliton/Abatement

As previously stated, the Department of the Interior was built in the 1940's. Almost all construction from this time period is riddled with lead and asbestos containing materials. Abatement is a very slow process, and is very schedule intensive. Performing demolition in areas, where the contractor has no idea what to expect is also a very

schedule instensive procedure. The combination of these two issues creates a lot of constructability complications, due to their uncertainties.

The construction team decided to handle this issue by using selective demolition based on previous lessons learned in the demolition and abatement of the previous Wings. The goal of selective demolition is to only disturb areas that absolutely must be demolished. By doing this, they averted having to unnecessarily abate areas that they did not need to. If there is asbestos behind a wall, and it is completely closed in, then it harms no one. One method they used to carry out selective abatement was to you two colors of spray paint to call out areas of demolition. Green spray paint meant, demolish and abate. Red spray paint meant do not disturb. This system was both cheap and easy, and yet very effective in communicating with laborers.

Kitchen Area Demolition

## Architectural Finishes

In public gathering spaces, such as a cafeteria, architectural finishes are a significant part of architect's design. Every material decision from the ceramic wall tile, terrazzo floor, Pyrock ceiling, granite counter tops, and quarry tile floor were results of hours upon hours of deliberation by the architectural team. Unfortunately many of these architectural considerations were not subjected to constructability review. The general contractor installed each finish the way they best knew how, and in many instances, the end result was not what the architect had intended. Often times, these situations arose due to lack of quality control, but that will be discussed later in this report.

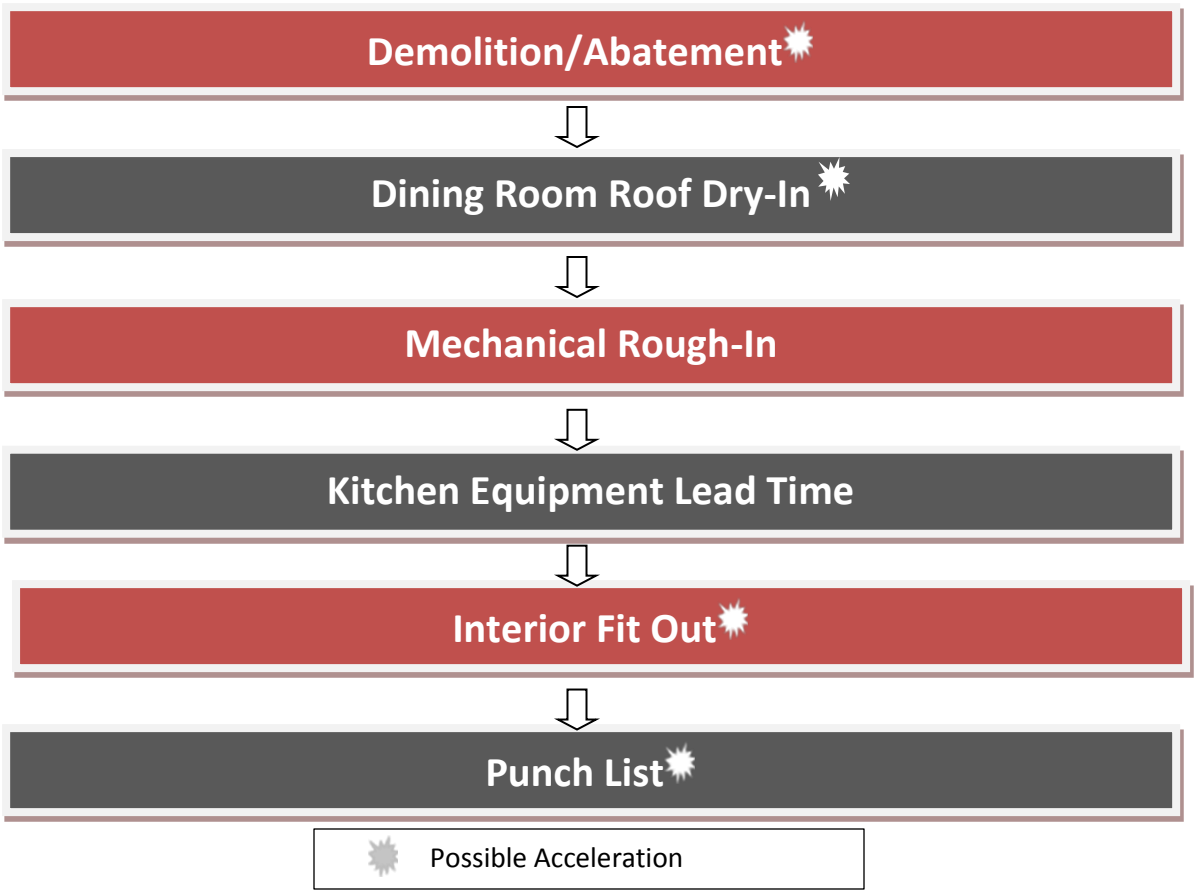
**Architectural Finish Issues**

- Pyrock ceiling did not have consistent color through out
- Terrazzo Floor had a hazy finish
- Grout in ceramic tiles miscolored
- Caulking at storefronts too light
- Uneven grouting in quarry tile floor
- Stainless Steel Kitchen Equipment Buffing

The way the construction team handled any disagreements on architectural finishes was by using the specifications in the contract documents as the final word. Strict

interpretation of every single phrase in the specification was scrutinized. The specification worked in the General Contractors favor at some instances and in the Architect's favor at other times. Having a detailed specification for each piece of construction proved to be critical in conflict resolution. The downfall of this solution was that most of the issues that came up in the architectural finishes were settled with one party being disgruntled. This proved to be problematic throughout the project, and created constant tension between the construction and design team.

## Critical Path




## Demolition/Abatement

### Description

The demolition/abatement phase of construction requires a significant amount of schedule and man power. Demolition occurs over nearly 9 months while abatement is also taking place during the majority of that time. No construction in an area can begin until the demolition and abatement are completely finished, and thus this becomes a huge factor in the project critical path.

### Risk

As with demolition and abatement in older buildings, there is a significant amount of uncertainty as far as what you will find. Unfortunately, this project unveiled a lot of previously unforeseen conditions which significantly delayed the schedule and increased project cost.

### Acceleration Technique

Scheduling abatement and demolition proved to be difficult because of the need to not disturb the neighboring tenants. For this reason, all abatement and demolition work were perform during night shifts. Schedule acceleration may be possible if some demolition and abatement work can be scheduled during day shifts and/or weekend shifts.

### Cost

There is a cost associated with adding more work shifts to the demolition/abatement phase. Depending on the subcontractor or union agreements, laborers may have to be paid more for working either extra hours per week, or for working non-standard hours such as weekends or nights. This may also be counter balanced by savings from reducing this activity duration.

## Dining Room Roof Dry In

### Description

The cafeteria dining room is receiving new skylights and a new roofing system. Demolition of the existing roof leaves everything in the dining room available to water damage from rain. For this reason, any construction that would be damaged by exposure to the elements cannot begin until the roof is dried in.

### Risk

Delays in the skylight installation, or any leaks in the new roof will delay all other activities. Any leaks resulting in water damaged after the roof is deemed dried in will be even more crippling to the project schedule.

### Acceleration Technique

The only solution to accelerate the roof dry in is to either re-phrase the skylight installation, or to increase the shifts working on the roof. The original skylight installation uses a SIP (Short Interval Production) Schedule for the five sections of roof. The schedule may be accelerated if the roof was broken down into 2 sections instead, because more crews can be working in a larger area of the roof at the same time.

### Cost

The cost associated with this acceleration stems from the increased amount of crews and equipment. More scaffolding and formwork will be needed since more area will completed at a single time. Instead of buy one set of formwork and scaffolding and using it five times, three sets may need to be purchased and only used twice. The increased cost for

the amount of crews working at a time will be offset by the time saved unless after hour shifts are utilized.

## Interior Fit Out:

### Description

The interior fit out is perhaps the most critical part of the construction schedule. This phase consist of installing walls, placing dry wall, painting, and also the finishes for the floor and countertops. It critical to the schedule because project close out rest solely on the completion of these tasks.

### Risk

The risks to Interior Fit Out lies in the ability of the subcontractor and general contractor to do exactly what the construction documents call for. Every time a wall is placed in the wrong location, a tile doesn't transition to the base incorrectly, or a finish does not match mock up, it must be removed and then redone. These fixes delay the project and increase cost.

### Acceleration Technique

A possible acceleration technique would be to utilize a SIP schedule and phase the construction so that subcontractors remain on site and can work continuously rather than coming and going when needed. By doing this, most likely the same crew will be placed on the project and thus will be familiar with what needs to be done and how to do it. By having the same paint crew on site each day, they are familiar with exactly the contract documents call for and where they need to stop and start. The simple convenience of a subcontractor being able to keep their same crew on the same project for consecutive days or weeks ensures that a standard of work will be done throughout and nothing will be over sighted.

### Cost

This acceleration will decrease cost in a couple ways. The first decrease will come from the increased productivity of each trade. The second cost saving, will come from not having to rip out and replace any work that was done wrong. The only cost of this occur in the increased planning necessary for developing the SIP schedule to place crews in a particular location on a particular day.

## Punch List

### Description

The punch list project was originally scheduled for a two week period. The actual punch list process took more than two months to complete. The reasons for this will be explained later in this report.

### Risk

The risk of punch list delays is due to the fact that all items had to be completed prior to two weeks before the vendor would occupy the cafeteria kitchen. The two week window was left to allow for mechanical flush out. During this flush out period, no construction that would produce dust, odor, or fumes could be performed. If the punch list was not complete, the general contractor would be liable for any issues with the vender and would have to complete the rest of the punch list around the times the vendor specified.

### Acceleration Technique

The best acceleration technique would be to completely revise the punch list process. The entire process is filled with inefficiency and will be evaluated later in this report.

### Cost

The cost of this acceleration lies in the time spent in planning a new punch list process. No addition labor crews will be necessary.

# Value Engineering

As with most Publicly Funded projects, value engineering is especially important because tax payer money is being spent for every aspect of the design. Not only must the General Services be accountable for every dime that placed in a design decision, they must be able to rationalize the decision based on short and long term cost as well as overall quality. The Department of the Interior Cafeteria was no exception.

## Historic Preservation

The first issue that went through value engineering was the decision towards historic preservation of the original cafeteria. The design team and owner were forced to balance the cost of preservation, versus the cost of new material, versus the sentimental value of the existing design. This evaluation was done for every possible design feature in the cafeteria.

| Historic Preservation Considerations | |
|---|---|
| **Preserved** | **Not Preserved** |
| Ceramic Wall Tile | Original Skylights |
| Stone Bases | Original Terrazzo |
| Stone Floor Transitions | Original Dining Room Ceiling |
| Murals | |

## Servery Sky Light

It was decided that the original skylights in the dining room would be removed and replaced by a new skylight system. During the design phase, the idea was also contemplated to create new skylights that would bring natural light into the servery area. This design would force relocation of two air handlers as well as structural modifications to the existing roof structure. For those reasons, it was decided that the value of natural light in the servery was not worth the cost of construction. The owner's original goal of bringing in as much natural light as possible was slightly stunted, but it was determined that the cost savings were ample enough to justify this decision.

Servery Area

## High Performance Lighting

The value engineering analysis of high performance lighting is being done in nearly every construction project. For the General Service Administration, who plans to own this building for the next 100 years as well as pay the utility bills for that period, the decision to use high performance lighting is easy. While Energy efficient fixtures and bulbs may cost a significant amount initially, they more than pay for themselves in the long term with savings in electricity consumption. In addition to the long term cost savings for GSA, this value engineering decision is a strong marketing tool to encourage the public to be energy efficient as well.

Wall Sconce

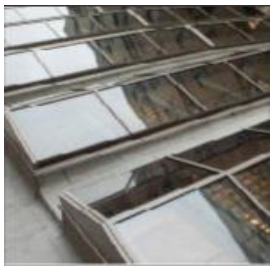
## Granite Counter Tops

Granite is recognized by most people to be best material for counter tops for both performance and appearance. This value engineering decision is often made in residential construction or renovation. This consideration balances the cost of either, single piece granite slabs, granite squares, or any other cheaper material. Single piece granite slabs are the most expensive, and provide a seamless counter top free of any imperfections. Granite squares provide similar appearance and performance as solid granite slabs, but cost much less. The downfall of granite squares is that transitions are often rough and patterns in the natural granite can be interrupted. The last consideration is to use a material other than granite such as marble, soapstone, or laminate which may cost less, but is not as good in performance and appearance. GSA decided to use whole slabs of granite for two reasons. GSA builds there buildings to last, and thus granite will provide great durability. The second reason being that this cafeteria will be a meeting place for thousands upon thousands of people through its lifetime. GSA wants to provide the highest quality possible for it visitors and tenants, and thus whole slabs of granite would provide the most aesthetic appeal.

Trash Station Counter

As with any project, there were a significant amount of issues that arose through the construction of the Department of Interior Cafeteria Modernization. The following problems were identified as conflicting with cost, schedule, or efficiency:

## Dining Room Roofing System



Dining Area Roof

The cafeteria's dining room is the only area in the cafeteria with a roof. Unfortunately this roof is extremely hard to access, considering it is surrounded by six stories of building on 3 sides, and 2 stories on one side. Additionally, the only way to enter the roof area is through a window 10 feet high in loading dock space.

The system proposed by the original design consists of 7 bays of pyramid skylights and a cold applied roofing surface elsewhere. In order to install the skylights, concrete curbs had to be built around each bay of skylights. Due to lack of space, phasing of each skylight bay was critical to preserve lay down and material storage space.

As with many old buildings, leaks are prevalent everywhere. The roof dry-in milestone was pushed back many times due to failed inspections. Even months after the inspection was passed, a few leaks were still found.

## Punch List Process

In most projects, the punch list phase of close-out is scheduled for two weeks. The punch list on this project consisted of over 1600 items, and lasted almost three months. The first issue, was the lack of quality control throughout the project by the general contractor. The second issue, was that too many parties were creating their own punch list which often were unclear or duplications. Perhaps the biggest cause for punch list delay was lack of efficiency during inspections. The general contractor would have the punch list for a week, and then return it saying 85% of the items are complete. The construction management agency would then take a week to review the punch list and would find that only 25% was actually completed up to their standard and would find an addition dozen or so items. This back and forth process would continue so long that the owner would eventually declare substantial completion with 150 items still left. This leads to the fourth and final reason for the drawn out punch list process, lack of owner buy-in. Throughout close out, the owner frequently undermined the construction manager's quality standards and did not hold the general contractor responsible for the drawn out punch list project.

## Quality Control

A large part of the cafeteria modernization project is interior fit-out work. As with all interior fit-out the quality installation of finishes is crucial. There were a wide variety of issues with construction materials due to lack of quality control. Nearly every major finish had issues from the quarry tile floor, to the ceramic wall tile, wainscoting, terrazzo floor, carpet, paint, and even polishing of stainless steel kitchen equipment. Even an issue such as selecting the 6 trees for the dining room planters as per the height requirements in the specification slipped through the quality control process. The only systems that did not in fact have any major issues were systems that had used a mock up to set a standard for quality. In large part, this lack of quality control is the reason a punch list of 1600 items. Blame for this problem can be spread to everyone from poor subcontractor work, to lack of supervision by the general contractor, and lack of accountability by the construction manager.

Terrazzo Floor

Stain Steel Equipment

Wall Tile

## Dining Room Lighting System

Dining Room Lighting

The original dining room was completely closed-in and relied entirely on artificial light. The new dining room is flooded with natural light from the newly exposed skylights but also contains an artificial lighting system to supplement the natural light when it is not ample enough to illuminate the space. Unfortunately the two lighting systems are not coordinated together, and thus do not fully take advantage of the energy savings possible. The artificial light is programmed to a timer control and thus changes the amount of light output based on the time of day and not the amount of light being let in by the skylights. All this system is more efficient than a standard lighting system there is much room for improvement.

## Dehumidification

Dehumidification became an issue late in the construction process on this project. The mechanical system's original design does not perform any dehumidification but instead controls the amount of outside air brought into the building in order to ensure no dehumidification is necessary. Unfortunately, in order to perform a flush out for the LEED Indoor Air Quality points, the mechanical system must use 100% outside air for a

certain number of hours while maintaining an average temperature of 75˚ F and less than 60% Humidity. These standards are near impossible to reach when it is 95˚F outside in the middle of a humid Washington D.C. summer without a means of dehumidification. Unfortunately, due to the delays in the rest of the construction process, the flush out period fell in the middle of a summer heat wave. This over site led to the cafeteria project not achieving a point for indoor air quality because the necessary amount of hours for flush out could not be achieved before the opening of the cafeteria to the public.

## Historic Preservation

Historic Preservation played a large part in both the design and construction phases of the cafeteria modernization. Most of the walls in the corridors as well as the columns were covered in a ceramic tile that had been there since the 1950's. Although the cafeteria is not on the National Registry for Historic Buildings, the owner requested that architect preserve some of the historic presence of the original design. The architect chose to remove all existing ceramic tile, have it refinished and then reinstalled. Removing the 60 year old tiles without damaging them would be very hard and labor intensive. In the end many tiles that had cracks or chips needed to be reused, and also corner tiles and end pieces that did not match exactly had to be used. Although reusing tiles may have attributed to the reuse of materials LEED credit, and preserved some historic appearance it came with a heavy price.

Ceramic Wall Tile

## Technical Analysis #1: Alternative Roofing System

The original roofing system is schedule and cost intensive. It consists of five phases for the installation of skylights followed by the installation of the cold applied roofing surface. The skylights themselves are custom made and thus have a significant cost associated with them. They also require placement of a concrete curb to support them. The placement of the curbs themselves involves a cost and also requires a significant part of the schedule.

Original Roofing Sequence

- Demolition/Abatement
- Concrete Curb Formwork
- Concrete Curb Rebar
- Place/Finish Curb
- Remove formwork
- Set Skylights
- Apply Roofing Member
- Finish Roofing System

An analysis will be performed to complete a roofing system that provides a better end product as well as cost and/or schedule savings. The first analysis will be done is looking for an alternate skylight system that will not require a concrete curb, has equal or better performance, and equal or lower cost. An additional cost and schedule savings may be made is a skylight system that does not require a crane to be used. The second analysis will be done for the roofing surface. With the savings in the dead load without the concrete curb and heavy skylights, a green roof system may be possible to handle storm water. A cost analysis as well as a structural analysis will be necessary in determining whether the existing structure could handle this loading, and is economically feasible. Finally, a schedule analysis will be performed for the installation of a new roofing system as opposed to the original phased installation.

## Technical Analysis #2: Punch List Process

The punch list process is normally a routine procedure that last around two weeks. The punch list process on this project began 2 months prior to substantial completion and yet 159 items were still on the punch list at that milestone. Almost a dozen rounds of inspections were made by the various parties responsible and thus countless billable hours spent on a routine process. An analysis will be performed to organize a procedure that will ensure a quality and yet reduce man hours. As mentioned above there are four main causes for the cafeteria's drawn out punch list process:

Punch List Problems

1. Quality Control During Construction
2. Responsible Parties
3. Punch List Procedure
4. Owner Buy In

The first downfall was the lack of quality control throughout construction. This issue will be evaluated further in the next technical analysis, because it plays a major part in project controls.

The second flaw in the punch list process that will be analyzed is determining who shall be responsible for making punch list items. By having an architect, CM, and GC creating and merging punch list, all types of problems occurred. Some items were duplicated and thus checked off as complete; other items were thought to be duplicates and were in fact not and thus falsely crossed off. Another issue that arose, came about when the contractors could not find or understand a punch list item because each party used their own format. This analysis will look into the best possible way for each responsible party to contribute to the punch list in a clear and efficient manner.

The third analysis will dwell on how to proceed with the punch list process. In the current system, each party does a full inspection and creates a punch list which may take up to a week to do. After the punch lists were merged they were then given to the GC to work on, which took 2 weeks. The punch list would then bounce back and forth between the GC and CM, each party taking up to a week with it. The problem with this process was that the GC would hand back the punch list saying it was 100% complete but after the CM reviewed it only 50% was actually deemed complete. This process would continue for months and items would be inspected almost a dozen times before they were actually done. The analysis will quantify the cost and schedule delays due to bringing back subcontractors, repeat inspections by the general contractor, and repeat inspections by the construction manager. It will also look into the conflicts in the construction team relationships due to the inefficiency is this system.

Finally, the last analysis will be in developing ways to get the owner to buy in to the punch list process. Not having an owner to stand behind the construction management agency on tasks such as punch list can create issues throughout the construction process. All of these issues that arose in the punch list process have deeper roots than just the punch list, and by working out these issues the entire project would run smoother for all parties.

### Technical Analysis #3: Quality Control Process

Quality Control is a vital part of construction. Most General Contractors, have a dedicated position to ensure that submittals are properly handled, deliveries contain the right materials, installations are done per specification, and in the end, the owner is getting what they paid for. Everyone on the project team is responsible for project control to some extent, but on this project many issues were not picked up by anyone until too late. This analysis will go into detail outlining the best practices for each level of quality control throughout the construction process. Most importantly, this analysis

will calculate the cost associated with each rejected submittal, wrongly delivered material, improperly installed system, and every notice to comply issue on the project. It will also calculate impacts to schedule for every instance where new work had to be taken down and redone because it was not done to specification.

### Technical Analysis #4: Historic Preservation Value Engineering

The Department of the Interior Building was built in the 1940's under President Roosevelt's New Deal. The original building materials used, are almost as meaningful to the Department of the Interior office, as the murals upon its walls. For this reason, the architect was instructed to preserve some of the cafeteria's original design, to ensure that some of its history could live on. The architect decided to save all the wall murals, the dining room wall and column tiles, the stone wall bases, and the stone floor transitions. Many of these decisions were made purely for design reasons, and did not take constructability or value engineering into mind. This analysis will evaluate each of the historic preservations from, how to protect the wall murals without interfering with construction, to the cost to budget and schedule for removing/refinishing/reinstalling the ceramic wall and column tile. By determining the cost and schedule impact for each historic preservation better value engineering could have be taken advantage of and thus delivering a better project to the owner.