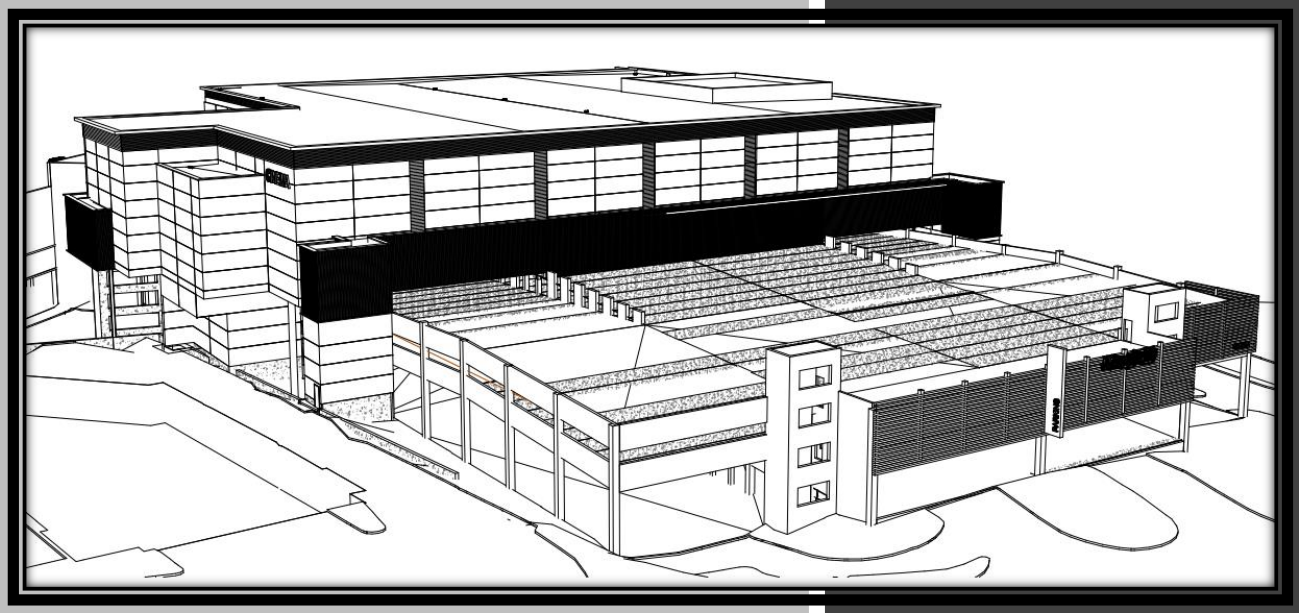
Cinema-Dining Terrace Expansion

Suburbia, USA

Technical Report II



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Executive Summary

This Technical Report provides an analysis of a detailed project schedule, detailed system estimates, site layouts, and BIM Execution Plan. The Cinema-Dining Terrace Expansion is a new 16 screen movie theater on top of an existing parking structure, an expansion to the food court, and the addition of restaurant space at the concourse level.

The detailed project schedule goes through the major categories including Preconstruction, Dining Terrace Demo & Construction, Site Work, Garage Renovation & Theater Structure, Enclosure, Garage Rough-Ins & Finishes, Expansion Rough-Ins & Finishes, Theater Rough-Ins & Finishes, and Closeout. The schedule lasts approximately 500 work days and around 2 years of total time.

The detailed system estimates include a detailed structural estimate, exterior envelope estimate, and a general conditions estimate.

The detailed structural estimate calculated the total Structural Concrete cost to be $2,387,350.00 and the Structural Steel cost to be $5,543,600.00. Resulting in a total estimated cost of the structural system to be $7,930,950.00. The system consists of concrete foundations, concrete shearwalls, concrete slabs, and a steel frame.

The Site Layout Plans discuss the major phases that the project goes through. Each phase was broken down into two site plans to show the activities on the ground level, fourth level, and second level. The major phases went through Demolition and Foundations, Steel Erection, and the envelope and fit-outs.

The General Conditions Estimate analyzes the cost of the staff for the GC and for the owner, and also shows the costs for the office and miscellaneous items. Insurance and trailers are two of the main costs for the office and miscellaneous work but the real costs come in from the staff costs for the GC and the Owner.

The three main constructability challenges discussed revolved around the structure and limited site. The foundation redesign was the main structural challenge, the Ring Road trying to remain open added safety hazards and even more site congestion, and the site limiting the crane location added soldier piles and lagging around the south excavation.

BIM could have been used in many aspects on the job to improve coordination and scheduling. The main BIM uses revolved around the use of a 4D model, 3D coordination, and performing an engineering analysis. Not all of the suggestions needed to be applied but it showed what options there were for the project.

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Detailed Project Schedule

The detailed project schedule develops the activities that were discussed in the project summary schedule included in Technical Report I. The schedule overall takes approximately 500 business days starting in mid-2012 and lasting all the way until mid-2014. The schedule describes in detail the major aspects of the project and has to work around the existing shopping centers schedule.

This schedule is broken down into 9 major categories including Preconstruction, Dining Terrace Demo & Construction, Site Work, Garage Renovation & Theater Structure, Enclosure, Garage Rough-Ins & Finishes, Expansion Rough-Ins & Finishes, Theater Rough-Ins & Finishes, and Closeout. These categories allow for a more detailed look at the activities in the main phases of the project.

(See Appendix A for the Detailed Project Schedule)

Preconstruction

The preconstruction phase of this project consists of the typical activities such as Design Development, Construction Documents, Permitting, Bidding & Awarding, and Procurement but also includes activities such as Food Court Tenant Coordination and Early Release Structural Steel. These two aspects were brought up early because they were seen as two keys to keeping this project on schedule. Since the food court would be going through a major renovation but still needed to stay open and active during this process, it was essential to start coordination with the tenants early. It was also known that structural steel was going to be a long lead item that could potentially bring the project to a stop if not on time so developing the Shop Drawings and Mill Orders were crucial.

Dining Terrace Demo & Construction

With the food court needing to stay open throughout the entire construction process, the demo & construction mostly took place at night and/or behind selective barriers. Many of the existing food court tenants were either relocating or leaving completely due to the renovation work. This made the work in some areas easier, but for the tenants to relocate, their new area needed to be finished ASAP. The majority of the work in the food court involved rough-ins and finishes such as MEP, Drywall, and Paint. In addition to the food court work, there will be new bathrooms and a new family room in the Dining Terrace.

Site Work

The site work began with setting the construction trailers and placing the construction fence and it wasn't short after that the demolition and site utility work was in full swing. One of the main activities during this site work was the excavation, sheeting, and lagging of the north and south areas. The north required sheeting and lagging because of the close proximity to the neighbors and the need for deep foundation work. The south required sheeting and lagging also because of deep foundation work, but the site was so limited on space that the only area where the 500 ton

Hydro crane could sit was right next to this excavation. This required soldier piles with lagging and tiebacks to ensure the stability of the ground around the excavation and under the crane. Minor work such as trees, light-poles, gutter, & sidewalks was also included in the site work for this project.

Garage Renovation & Theater Structure

To build a movie theater on top of an existing parking garage, extensive work needed to be done for the steel structure. The movie theater was going to take up half of the fourth floor of the parking garage so multiple existing staircases and that half of the existing precast concrete had to be demolished. In preparation for the steel erection, the column and tower crane foundations needed to be installed. The foundations for the columns created complications since they were incorporating the existing footings. In some areas, micro-piles and pile caps were used but in others they used what was called a sandwich footing. A sandwich footing involves pouring new footings on either side of the existing footing and then coring through all of them, placing a thread-bar, and then tightening it. Foundation work was also being done in the area where the large shear wall would be located. Once the foundations are complete and the tower crane placed, the shear wall installation and steel erection can begin. This includes columns, beams, decking, and slab on metal deck. Along with the steel and shear wall structures, the elevator and stair towers were constructed, and were primarily made of CMU.

Enclosure

The new building enclosure consists primarily of Metal Panels and Glass which can be seen in more detail in the Exterior Enclosure Estimate Section of this report. During this stage, the enclosure will be installed including the framing, air barriers, insulation, and skin for the roof, the elevations, and the stairways. The materials and sequence will be discussed in more detail in the later section.

(See Appendix C for the Detailed Exterior Enclosure Estimate)

Garage Rough-Ins & Finishes

The garage remediation's consisted of sidewalks, curb, gutter, concrete column encasement, and finishing the garage for an acceptable appearance in order to open back up. On the floors 2-4, along with power washing, painting, striping, and lighting, there is patching for the steel column penetrations through the precast concrete and then the precast pieces removed for the tower crane must be reinstalled. Once this work has been completed the garage can then be turned over.

Expansion Rough-Ins & Finishes

Before the rough-ins & finishes could begin, the areas had to go through architectural & MEP demolition where necessary. Once that was complete, the Electrical Room, Tenant Areas, Common Area, and back of house could be worked on. This work includes roof top unit

installations, MEP Rough – ins, Drywall, tile, and flooring. Doors & Hardware were also installed during this period. The expansion area mostly consists of the new area between the new movie theater and the existing food court. This expansion will include a new lobby, multiple new restaurants and a new main entrance.

Theater Rough-Ins & Finishes

The theater area has a new MEP room and Electrical room that will connect into the existing systems with a few added roof top units and electrical unit heaters. These rooms will include panel boards, transformers, and a Main switchboard for the theater. Conduit must be run from level 1 to the theater electrical room to connect into the existing system. MEP rough-ins for overhead and the walls must be put in before the framing and drywall are placed. Once that's been done, finishes and the sprinklers can be installed. Rough-ins and finishes are then finalized in the stairs which are primarily used as egress stairs for each of the theaters.

Closeout

Theater fitout is the only major activity left during the Closeout phase. This activity will finish all of the interior theaters including seats, screens, projector rooms, corridors, and the snack stand. This fitout completes on July 8th, 2014 and at that point project is considered complete.

Detailed Structural System Estimate

This project consists primarily of a steel structure that works with concrete shear walls and that concrete foundations to create the overall system.

Structural Concrete $2,387,350.00

Structural Steel $5,543,600.00

$7,930,950.00

(See Appendix B for the Detailed Structural Estimate)

The costs above represent the cost calculations for the food court, theater, and garage. The calculations were done using quantity takeoff in the attempt to get accurate quantities of steel and conrete. The cost data used was provided by The Whiting-Turner Contracting Company. This allowed the costs to be relatively accurate when compared to the actual costs on the project.

Structural Concrete

As briefly described in the detailed project schedule, this project had a unique structure and foundation. This was due to the fact that it had to be built on top of an existing parking garage. The main two areas that had structural concrete were the foundations and the shearwalls.

The foundations consist of sandwich footings, micro-piles & pile caps, and continuous footings. The sandwich footings were used where there was more room to excavate around the existing footing, whereas the micro-piles & pile caps could be used in areas that needed less evasion. There are 135 micro-piles installed throughout the project. For the quantity of concrete, the estimated Cubic Yards used for each footing was estimated and then multiplied by the total number of that footing. Since the cost data provided included rebar it allowed the cost to then be directly multiplied by the quantity of cubic yards.

For the Slab on deck, the cost was given for the units of Square Foot and also included rebar. This helped avoid costs that could have greatly differed from the actual costs if other cost data had been used.

Structural Steel

The structural steel columns and beams created the frame and support for most of the project. With cost data again being provided by Whiting-Turner, following the units given made the estimate relatively easy and straight forward. Using quantity takeoff, the square footage of the main areas was quantified. This then allowed for easy multiplication since the cost data provided was $/SF.

The cost data provided for the columns was $/EA meaning they provided an average cost for each column as opposed to providing individual costs of columns by length or tonnage. This

allowed for easy calculations since then a count was done using the column schedule and simply multiplied by the cost.

Exterior Enclosure Estimate

The exterior enclosure, as discussed in the schedule, consists primarily of Metal Paneling, EIFS, and Glazing. The roof consists of a single ply EPDM (ethylene propylene diene monomer) which is a type of synthetic rubber. This membrane is water resistant and does not pollute the run-off rainwater.

Theater Shell	$2,270,685.00
Food Court Renovation	$1,334,550.00
Garage Modifications	$187,800.00
	$3,793,035.00

Using Quantity Takeoff, the square footage of the materials could be easily measured using the elevations. Once the quantities were found, the costs/SF provided could be used to get the total cost of that material for each part of the project.

(See Appendix C for the Detailed Exterior Enclosure Estimate)

Theater Shell

The Theater Shell is about 80% EIFS, 15% Metal Panel, and 5% Glass Curtain Wall. The majority of the theater is supported by exterior metal studs & sheathing. This system adds to the cost but also creates an elegant appearance that could assist in drawing customers to the theater and mall.

Food Court Renovation

The food court renovation primary costs can be seen in the new entrance area. This new entrance consists of a Metal Panel canopy and Exterior Storefront Glazing that combine for nearly $1 million. Though the entrance uses the Metal Panel and Storefront Glazing, there is still plenty of EIFS used on the other areas of the renovation. This is a far cheaper material but still has an appearance that compliments the Metal Paneling and Glazing.

Garage Modifications

The concrete façade of the existing parking garage, though practical, doesn't compliment the EIFS, Metal Paneling, and Glazing used on the new theater. In order to improve the appearance of the garage, Decorative Aluminum Grilles were added on two sides of the garage exterior. The Grilles are expensive so not many were used for this project.

Site Layout Planning

Since the project is being performed on a mall that will still be operating during construction, the project had significant limitations on the site and schedule. The phasing for this project had to work around the malls limitations. For each phase, a plan was made showing the ground level and a plan was made showing the fourth level with some of the 2nd floor incorporated. This allowed seeing the parts of the project that have the most activity during the project. Parking for the construction teams was located on the 2nd floor of the parking garage. The food court work shown on the level 4 plans is done primarily at night because the food court is supposed to remain open throughout the entire construction process.

(See Appendix D for the Site Layout Plan)

Phase 1

This phase involved the demolition and foundation work done early in the project. For the ground level, foundation work is being done on the column footings and the new North & South stair tower locations. The foundation work became difficult in areas such as on the ring road. The ring road is a driveway that goes directly under the parking garage on the ground level. The mall wanted this to stay open for as long as possible to keep traffic moving but also for deliveries to the loading docks. The road only closed for a short period in order for the foundation work on the column footings directly in the middle of the road to be performed.

The two hydraulic cranes will be used for the demolition aspect. The west half of the 4th floor precast is to be demolished in order to make room for the Cinema. Precast is also being removed to allow for a tower crane to be placed for the later phases of the project.

The level 4 plan shows the construction trailers, the precast area being demolished, and the food court areas having work done simultaneously. The food court work is being done on the 2nd level but this plan had the space to display this information.

Phase 2

In phase 2, the primary activity is steel erection using the tower crane. The ground plan shows the tower crane and its span while also showing the laydown areas. During certain activities in this phase, the ring road and parking areas near the site had to be shut down.

The level 4 plan shows the steel sequencing for the theater structure. The sequence goes 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16. While this is going on, work on the food court is still active and has now included the new entrance and restaurant work in the expansion area.

Phase 3

In phase 3, level 1 shows the areas on the garage that are now open to public parking but also shows the theater support areas that are still under construction. These areas are the stairs and elevator shaft locations, such as the areas where the sheeting and shoring were used.

The level 4 plan shows the progression of the steel erection and the progression of the expansion area. The valet area and restaurant area are still under construction but get to fitout by the end of the phase.

General Conditions Estimate

The General Conditions Estimate was performed with data provided by The Whiting-Turner Contracting Company. Cost data was provided for the General Conditions of Whiting-Turner, the Anonymous Owner, and the Office & Miscellaneous Costs.

Whiting-Turner	$1,817,000.00
Anonymous Owner	$975,000.00
Office & Misc. Costs	$450,200.00
	$3,242,200.00

(See Appendix E for the General Conditions Estimate)

The staffing costs for this project take up most of the General Conditions Cost. It is not typical to have an owner that has employees as involved in a project as this was. The owner had a Project Manager, Accountant, and Administrator in the trailers working with the project team throughout the entire process. This allowed for easy communication and coordination with the owners desires but is also why their costs are included in the General Conditions.

The trailer complex was placed on the 4th floor of the parking garage so installation became a little more expensive for any aspect of the General Conditions. The trailers included everything a typical trailer would have including phone service, internet, Copier, Printer, Drinks/Snacks, First Aid, and Fire extinguishers. The General Conditions also include costs for Shipping Postage, Progress Photos, and Builders Risk Insurance. The Progress photos were taken once a month from a plane that flies over the site.

Constructability Challenges

The primary constructability challenges for this project revolve around the limited site and building a structure on top of an existing parking garage.

Structure Challenge

The original structural design involved a foundation using large caissons to support the new building structure. This became an issue when is actually came to constructing this because the height of the first floor of the parking garage wouldn't allow for the equipment needed to install caissons. They then turned to their senior superintendent who came up with the idea of using multiple micro piles at the challenged areas. The equipment needed for micro-piles is far smaller and much easier to install. This change did increase the cost slightly but in the end saved time over deliberations on how to fix the problem.

Ring Road Challenge

The ring road is the road that runs underneath the parking garage on the ground level. The mall desired this road to remain open throughout the entirety of construction in order to allow easy traffic movement and for deliveries to the loading docks of the stores. This became an issue during many aspects of the job especially during the foundation work that is located in the middle of the road. To allow for a safe working environment for the workers, the road had to shut down for short periods to allow for the foundation work to be completed. This helped keep the job running on time since the foundation work is critical for the entire project.

Site Limitations

The mall desired to keep as many parking spaces open for the public as possible. Since an entire parking garage was being shut down for the majority of the construction, they were even less inclined to give up parking spaces when we asked for them in order to place our hydro crane and lay down areas. This then forced us to put the hydro crane for too close to the south stair excavation. The weight of the 500 ton crane would have been far too much for the ground to support near that excavation area. In order to solve this problem, they used soldier piles with tiebacks at the edge of the excavation designed for the loads that the crane would cause. This then allowed excavation and the demolition to continue as scheduled.

Overall, the constructability challenges didn't cause too many problems throughout the project due to excellent problem solving plans by the construction team.

Building Information Modeling Use

BIM for this project was nearly not used at all. The architect made a Revit model but it was sent over late in the process and lacked allot of information.

X	PLAN	X	DESIGN	X	CONSTRUCT	X	OPERATE
	PROGRAMMING		DESIGN AUTHORING	X	SITE UTILIZATION PLANNING	X	BUILDING MAINTENANCE SCHEDULING
X	SITE ANALYSIS	X	DESIGN REVIEWS	X	CONSTRUCTION SYSTEM DESIGN		BUILDING SYSTEM ANALYSIS
		X	3D COORDINATION	X	3D COORDINATION		ASSET MANAGEMENT
		X	STRUCTURAL ANALYSIS		DIGITAL FABRICATION		SPACE MANAGEMENT / TRACKING
			LIGHTING ANALYSIS	X	3D CONTROL AND PLANNING		DISASTER PLANNING
			ENERGY ANALYSIS		RECORD MODELING	X	RECORD MODELING
			MECHANICAL ANALYSIS				
			OTHER ENG. ANALYSIS				
			SUSTAINABLITY (LEED) EVALUATION				
			CODE VALIDATION				
X	PHASE PLANNING (4D MODELING)	X	PHASE PLANNING (4D MODELING)	X	PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)
X	COST ESTIMATION	X	COST ESTIMATION	X	COST ESTIMATION		COST ESTIMATION
X	EXISTING CONDITIONS MODELING	X	EXISTING CONDITIONS MODELING	X	EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING

(See Appendix F for BIM Project Execution Plan)

When looking at BIM for this project, multiple areas could have been improved with the use of BIM.

Perform Engineering Analysis

A BIM model could have been helpful in performing an engineering analysis for the systems, especially the structure. That could have helped avoid the constructability challenge of the foundation.

Create 4D Model

A 4D model could have been used to accurately portray the demolition and steel sequencing. This could have assisted in scheduling and creating a set sequence for steel erection to help coordination the mill orders, deliveries, and erection.

Develop Virtual Prototype

Developing a Virtual Prototype could have been useful when designing the interior of the movie theater. Walk-throughs could have helped the owner make easier decisions when it came to the interior of the lobby, food court, and cinema.

Perform 3D Coordination

Performing 3D Coordination could have helped when it came to designing and building the MEP and structure around each other and the existing structure. Navisworks could have been used for clash detection and many of the mechanical conflicts that arose could have been avoided.

Compile Record Model

With the owner having a background in construction, having a BIM Record Model would be extremely useful and simple for them to handle. Maintenance and future projects would be much easier to do with this model for their reference.

Appendix A – Detailed Project Schedule

Appendix B – Detailed Structural System Takeoffs

Appendix C – Detailed Exterior Enclosure Estimate

Appendix D – Site Layout Plans

Appendix E – General Conditions Estimate

Appendix F – BIM Use Evaluation

Appendix G – References

References

BIM Use Evaluation

"Project." *BIM Execution Planning*. Web. 11 Oct. 2012. <http://bim.psu.edu/Project/resources/default.aspx>.