

- Benner Pike Shops
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Analysis #2 – Exterior Wall Tilt-up Construction

Overview

The majority portion of the exterior wall in the Benner Pike Shops is created with 12” concrete blocks with horizontal wall reinforcing at every other course. Because of the massiveness, the total masonry job for the projects takes about three months of the total schedule. In addition, there are number of other trades that could not start until the exterior wall has been set up. Tilt-up concrete panels can substitute the existing CMU walls to increase efficiency, and workability while reducing the cost and the schedule. The advantage of tilt-up construction is in the low cost of forms and the placing of concrete and reinforcing.

Tilt-up has repeatedly proven to be more economical than competing construction methods for similar types of buildings. A shorter construction duration, together with the elimination of scaffolding and elevating devices, result in lower construction costs. Tilt-up construction suits well with the Benner Pike Shops because of the large construction site area. Since Tilt-up construction can be performed for any reasonable shapes and sizes, the exterior walls of the shops have the perfect potential for the job. Walls will be broken into several sections so that it is easier to work with.

The following analysis contains thorough items that need to be emphasized when designing a Tilt-up construction. Site congestion is determined since the system needs decent amount of concrete pouring area. Site logistics are to be redefined to incorporate Tilt-up construction into the project. The building was considered to have four sides to it. Since the majority portion of the front facade is consisted of glass walls and doors, two sides and the back of the building exterior walls were suggested to be switched to tilt-up construction.

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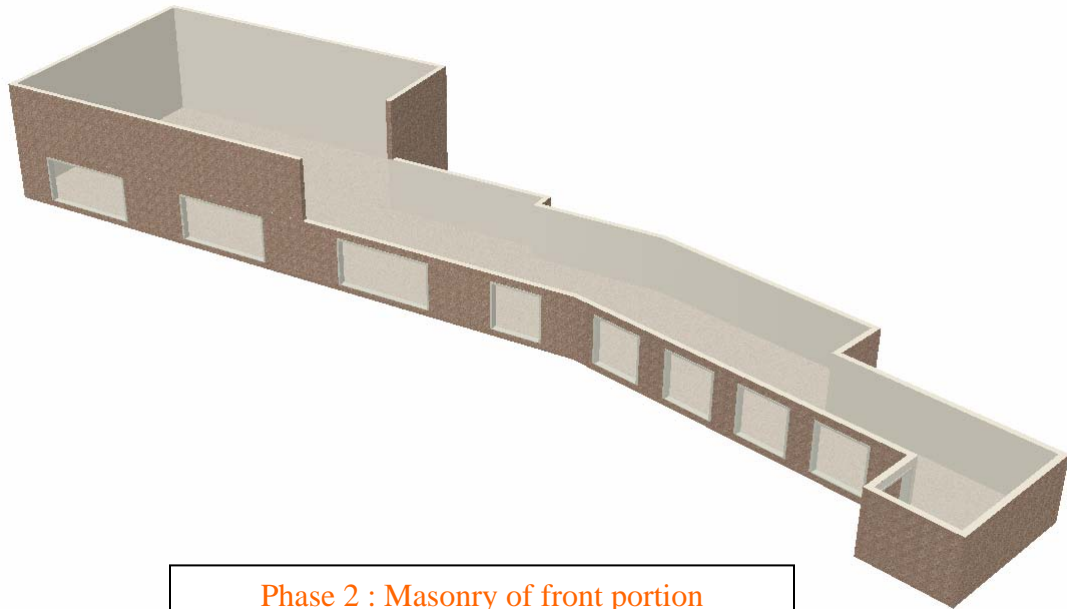


Layout Plan

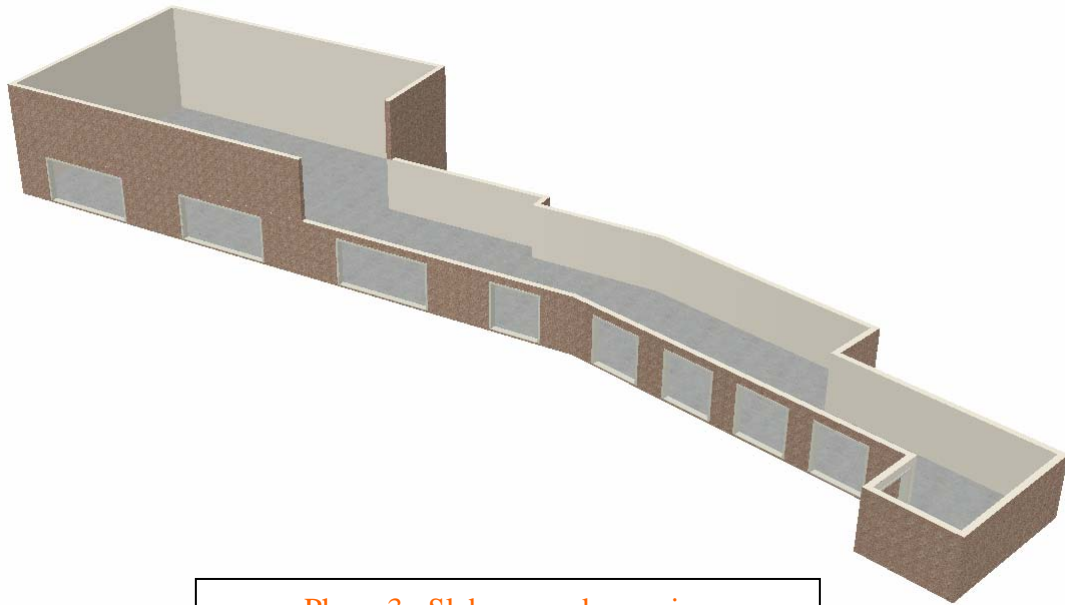
As mentioned earlier, only the rear portion of the exterior wall is going to be replaced to tilt-up construction. Since there is not enough space for the poured concrete to be tilted up, the pour will occur at the inside of the building space. In another words, there needs to be slight change in the schedule of enclosing the building. As shown in the following drawings, rear wall is going to be poured first then tilted. As soon as the walls go up, necessary masonry job is going to take place for front walls and miscellaneous. Since there is going to be openings for front windows and doors, slab on grade can be poured through the opening by a pump. The longest reach that the pump should make is 200 feet which falls within the range. Building floor slabs should be poured first and be a minimum of 5” thick with 100% compaction. The slab on grade for the Benner Pike Shops has thickness of only 4”. This is another reason why tilt-up construction would be executed before the floor slab.



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Phase 2 : Masonry of front portion

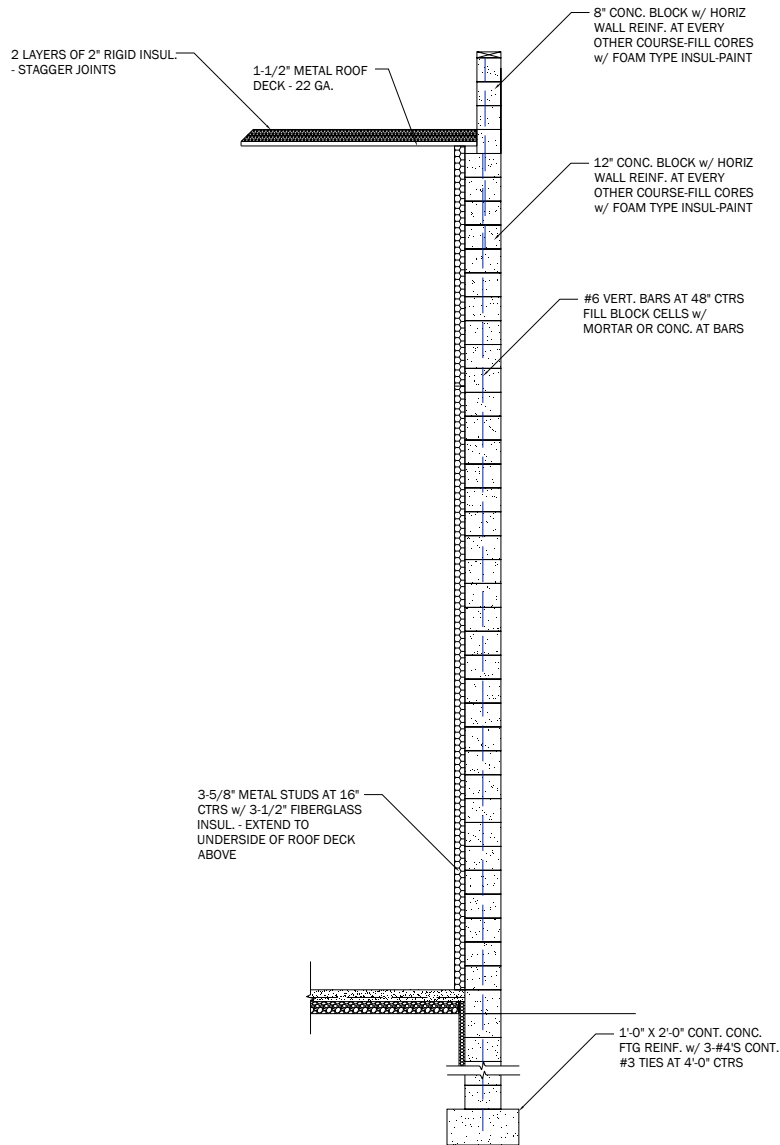


Phase 3 : Slab on grade pouring

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Structural design



As seen in the typical section of exterior wall, it is consisted of 12" CMU's with reinforcement at every other course. For vertical reinforcing, #6 bars are installed at 48" on center. The walls stick out 3' higher than the top elevation for protection from falling at the roof. Those 3' portion is finished with 8" CMU's with the same reinforcing.

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Tilt-up construction is going to have the same characteristics as CMU's except for its thickness. Instead of 12" thickness, 8" will be poured with the same horizontal and vertical reinforcing placed. After the panels are tilted, metal studs with insulation will be installed to the inside of the panels and the same painted finish will be executed to the outside of the panels.

Schedule reduction

The advantage of tilt up construction is in the high efficiency of productivity. Once slabs are poured, they can be tilted after seven days of curing. This is one of the reasons why tilt up construction is becoming popular in the industry. For the Benner Pike Shops, following duration could be saved from switching to tilt up system:

| | Daily Output | Quantity | Total Duration | |
|----------------------|-------------------|------------|----------------|---------|
| Tilt up Construction | 1550 S.F. per day | 26808 S.F. | 15.36 | 15 days |
| CMU Construction | 250 S.F. per day | 23808 S.F. | 95.232 | 96 days |

This is a save of approximately 81 days, which is 11 weeks. It is a critical reduction especially when the project is a shopping mall. Indirect cost saving could be tremendous if the mall could open 11 weeks earlier than it was supposed to. Possible incentives could take place because of the early finish.

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Cost Estimate

| Description | Size | Quantity | Unit | Unit Cost | | | Total Cost |
|-----------------------------|---|----------|------|-----------|--------|-----------|------------------|
| | | | | Material | Labor | Equipment | |
| Existing System | | | | | | | |
| Concrete Block | 8"x16"x12" thick reinforced alt. courses | 23808 | S.F. | 3.59 | 6.15 | | \$231,890 |
| Vertical Reinforcement | Walls, #3 to #7 | 4.47 | ton | 810.00 | 420.00 | | \$5,498 |
| TOTAL | | | | | | | \$237,388 |
| Modified System | | | | | | | |
| Tilt-up | Wall panel construction walls only, 8" thick | 23808 | S.F. | 4.93 | 4.52 | | \$224,986 |
| Vertical Reinforcement | Slab, #3 to #7 | 4.47 | ton | 810.00 | 550.00 | | \$6,079 |
| Horizontal Reinforcement | Slab, #3 to #7 | 5.96 | ton | 810.00 | 550.00 | | \$8,106 |
| Crane Rental | 120 ton hydraulic | 3 | week | | | | \$22,650 |
| TOTAL | | | | | | | \$261,820 |

Just looking at the cost comparison, it is clear that tilt up construction has about 10% cost increase compared to CMU construction. Despite the cost swell, it is still recommended to apply tilt up system because one will eventually save money considering long run. Fast installation results in shortened project schedule that causes project staff to be on site less time. Following general conditions estimate shows how much is saved.

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| Description | Quantity | Unit | Unit Cost | Total Cost |
|---------------------------------|----------|------|-----------|------------|
| Project Staff - Previous | | | | |
| Project manager | 40 | Week | \$1,625 | \$65,000 |
| Superintendent | 40 | Week | \$1,500 | \$60,000 |
| Superintendent | 24 | Week | \$1,500 | \$36,000 |
| Field engineer | 48 | Week | \$995 | \$47,760 |
| Field engineer | 48 | Week | \$995 | \$47,760 |
| Field engineer | 48 | Week | \$995 | \$47,760 |
| Total | | | | \$304,280 |
| Project Staff - Modified | | | | |
| Project manager | 29 | Week | \$1,625 | \$47,125 |
| Superintendent | 29 | Week | \$1,500 | \$43,500 |
| Superintendent | 13 | Week | \$1,500 | \$19,500 |
| Field engineer | 37 | Week | \$995 | \$36,815 |
| Field engineer | 37 | Week | \$995 | \$36,815 |
| Field engineer | 37 | Week | \$995 | \$36,815 |
| Total | | | | \$220,570 |

Impact on R-Value

| | |
|----------------------------|---------|
| CMU Construction | R-Value |
| Outside Air Film | 0.17 |
| 12" Concrete Block | 1.28 |
| 3 1/2" Fiberglass Batt | 11 |
| 1/2" Gypsum Board | 0.45 |
| Inside Air Film | 0.68 |
| Total | 13.58 |
| Tilt up Construction | |
| Outside Air Film | 0.17 |
| Poured Concrete (8" thick) | 0.64 |
| 3 1/2" Fiberglass Batt | 11 |
| 1/2" Gypsum Board | 0.45 |
| Inside Air Film | 0.68 |
| Total | 12.94 |

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There is a different of 0.64 for R-value of tilt up system. Since two values are pretty high and the difference is not significant to affect any thermal insulation issues.

Safety issue

Since Tilt-up construction involves movements of massive concrete walls, contractors need to pay attention to safety issues. Especially, the braces between the walls and the structure should be examined very carefully. OSHA regulations require the following before braces can be removed:

Welders connect the wall panel to the roof trusses with structural fillet welds

The Tilt-up contractor stabilizes the wall panels by grouting at the base, between the panels and the footing

The Tilt-up contractor completes the structural connection from the wall panels to the floor with concrete in the pour-back / leave-out strip

Some of the safety issues that need to be considered for the construction are follows:

Lack of training and understanding of tilt-up construction and its hazards

Inadequate support of Tilt-up panels

Failure to ensure the panel's permanent connections to the structure (welds, grout, pour-back strip) were complete and acceptable before removing temporary braces

Failure to train inspection employees on job specifications and hazards of Tilt-up construction