FAÇADE SEQUENCING

Objective

The façade sequencing analysis examines alternative façade construction sequences. The goal is to determine whether one sequence is better than another. The major focus will be on the duration length and the scheduling impact each sequence has on the entire project schedule.

Façade Materials

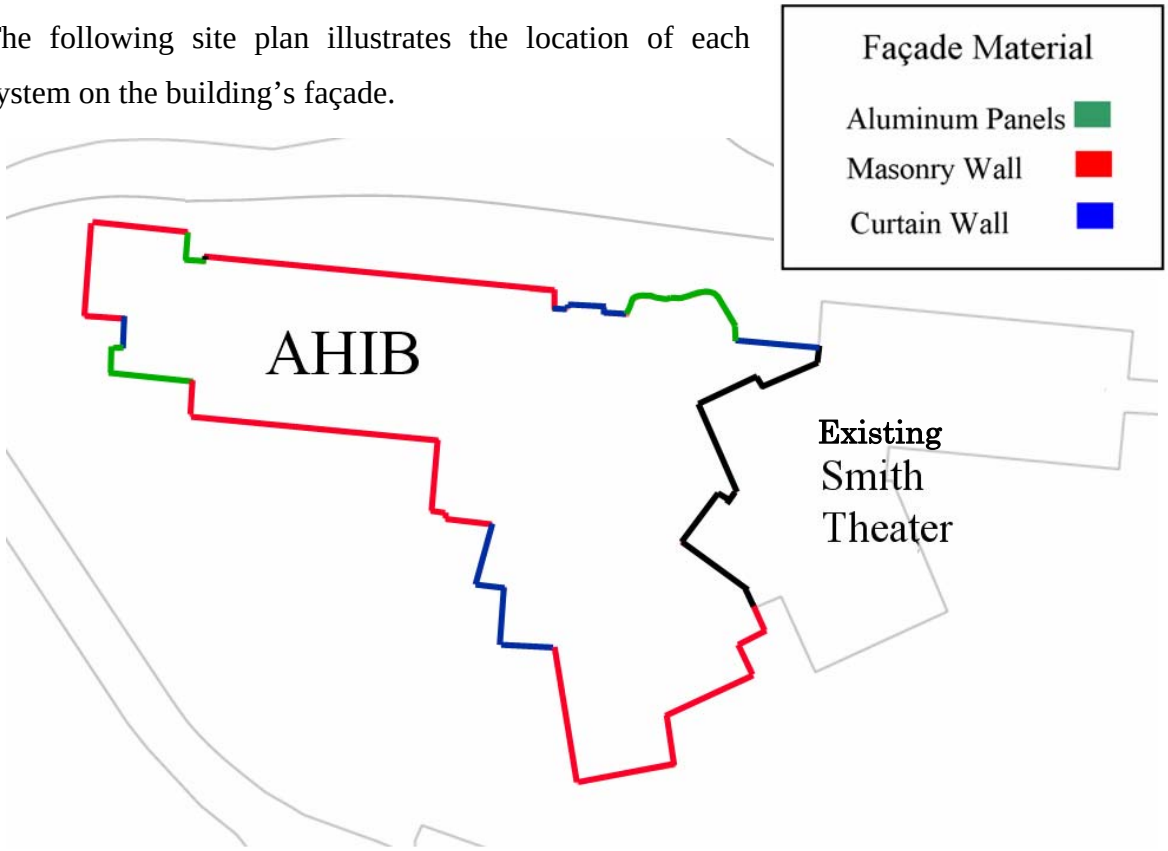
The majority of the façade surface can be broken down into three separate materials: the bulk of the façade is a brick face cavity wall; two additional façade materials are used—a curtain wall system and a pre-finished aluminum panel system.

A summary of the material quantities is listed below:

Masonry:	20,492 square feet
Curtain Wall:	6,492 square feet
Aluminum Panels:	6,044 square feet

Although the building's façade can be broken down into three distinct components, the placement of each material on the façade is awkward for constructability. All three of the materials can be found on all sides of the building, creating a difficult sequencing problem during erection.

The following site plan illustrates the location of each system on the building's façade.



Why Re-sequence?

The major reason to examine the façade sequencing is to determine the most logical and cost-effective process of construction for the façade. There is a trade-off with any construction process between time, money, quality, and safety. There is a potential for speeding up the installation of the façade by simply adding more workers to the job, but this will cost more money for additional crews, add potential overtime, and possibly additional equipment. In addition, constructing the facade too hastily may result in a loss of quality or possibly safety. On the other hand, if the installation takes a little longer, the length of the project increases. Increasing the schedule length may reduce the amount of money spent on labor if fewer crews are used, but it may also increase the amount spent on general conditionals costs. An evaluation of all these factors needs to be considered

before selecting the best sequence for the AHIB project. It is important to implement a good plan early in the process. Attempting to make up time on a construction schedule during the construction process can prove to be more costly than if the plan is established early and the necessary arrangements are made.

What is the Current Sequence?

A summary of the current construction sequence is as follows:

- Masonry Veneer
  - Tech Theater & Black Box
  - Music Multimedia
  - Stair 1
  - South Façade of West Teaching Wing
  - West Façade of West Teaching Wing
  - North Façade of West Teaching Wing
- Curtain Wall is installed as follows...
  - South Lobby 105 and Vestibule (followed Masonry Veneer at Tech Theater/Black Box and Music Multimedia)
    - North Lobby & 2nd Floor Offices (followed Masonry Veneer at Stair 1)
    - Stair 2 & West End Corridor (followed Masonry Veneer at South and West)
    - Stair 1 (followed Masonry Veneer at North Façade)
    - Light Monitors CW4 (followed Masonry Veneer at North Façade)
    - North Lobby 105 Vestibule
    - Smith Theater Lobby 104 CW5
- Aluminum Panel
  - South Façade (followed Curtain Wall)
  - West Façade (followed Curtain Wall)
  - North Façade (followed Curtain Wall)

Possible Alternatives

After examining the construction sequence, it looks as though there is room for improvement. A few key observations are listed below:

- The masonry crew jumps from the south façade to a small portion on the north façade and then back to the south façade.

  Problem:

  - This sequence requires the masonry contractor to move from one side of the building to the other and then back again. This takes time to set up the scaffolding, resulting in a longer duration.

- The curtain wall installation does not follow an easy construction flow either. The same pattern of south façade to north façade back to south façade is used.

  Problem:

  - The same broken flow as the masonry veneer results in extra time to set up and remobilize.

- The curtain wall is erected in short spurts of activity with weeks of inactivity between.

  Problem:

  - This particular sequence is also inefficient. It requires the curtain wall installer to man the job for a few weeks, leave the job for another few weeks and return to complete the installation. This process at the current sequence happens twice.

- The aluminum panels follow a continuous flow of construction, starting at the south façade and working continuously to the west façade, and finally the north façade.

  Problem:

  - The installation of the aluminum panels follows the most logical flow of working in a continuous direction. This construction is not as crucial to the schedule since the building is already watertight

by the time the aluminum panels are installed. Therefore, the aluminum panels are not delaying the interior construction.

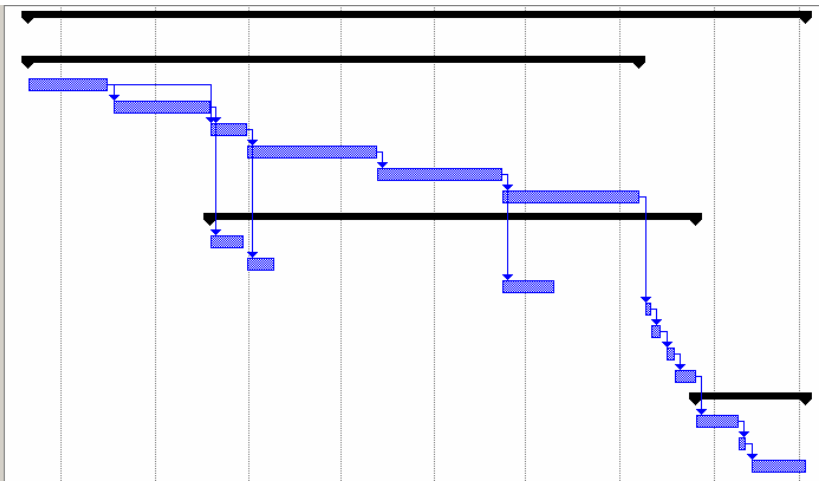
After reviewing the observations, specific goals are made to improve the scheduling sequence.

- Find a continuous work flow for the masonry veneer and curtain wall.
- Find a continuous work flow for the curtain wall.
- Group the curtain wall construction activities together.

The objective is to develop a continuous flow to make a more efficient construction schedule. Several alternatives are listed below.

The original sequence is the baseline for which all other alternatives will be compared. The original bar schedule is the following:

Façade Sequencing	184 days
Masonry Veneer	145 days
Tech Theater & Black Box	20 days
Music Multimedia	24 days
Stair 1	8 days
South Façade of West Teachi	31 days
West Façade of West Teachir	29 days
North Façade of West Teachir	33 days
Curtain Wall	114 days
South Lobby and Vestibule	7 days
North Lobby & 2 floor offics	7 days
Stair 2 & West End Corridor	13 days
Stair 1	2 days
Light Monitors	3 days
North Lobby Entrance	3 days
Smith Theater Lobby	5 days
Metal Panels	26 days
South Façade	10 days
West Façade	2 days
North Façade	14 days

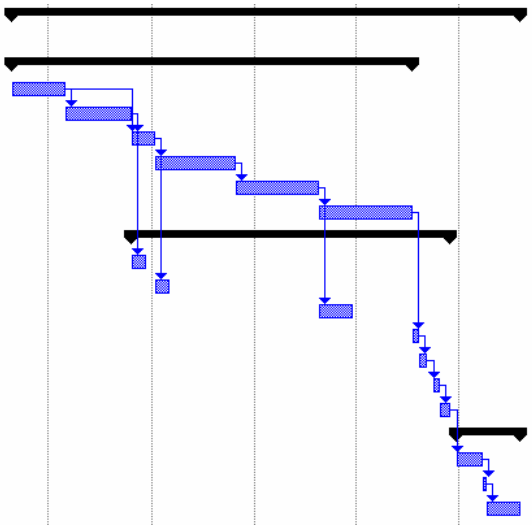


Alternative A

One possible alternative is to add additional construction crews to the project. The additional crews will compress the schedule, with the objective being to bring the curtain wall construction activities closer together. With additional crews, the façade will be constructed faster, but not at double the rate. Adding workers to the crew does have a few drawbacks. A loss of productivity will be encountered when there are too many members in the crew. The loss of productivity will be

compensated for when calculating the construction duration by reducing the daily output by 15%. Detailed estimates of all associated costs and durations can be found in Appendix B. The following schedule is developed from Alternative A.

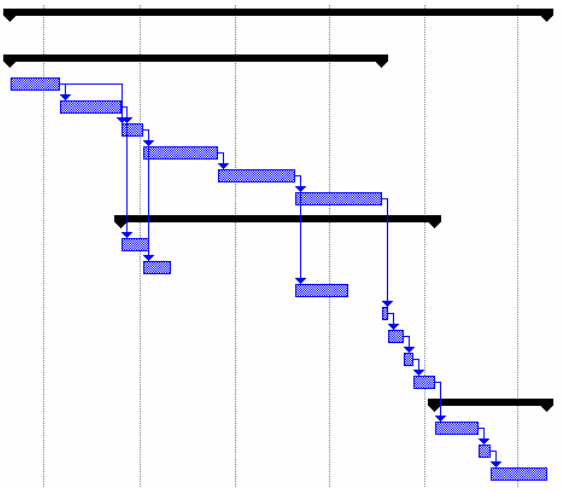
Façade Sequencing	110 days
Masonry Veneer	86 days
Tech Theater & Black Box	12 days
Music Multimedia	14 days
Stair 1	5 days
South Façade of West Teachi	18 days
West Façade of West Teachir	17 days
North Façade of West Teachir	20 days
Curtain Wall	69 days
South Lobby and Vestibule	4 days
North Lobby & 2 floor offics	4 days
Stair 2 & West End Corridor	8 days
Stair 1	2 days
Light Monitors	2 days
North Lobby Entrance	2 days
Smith Theater Lobby	3 days
Metal Panels	15 days
South Façade	6 days
West Façade	1 day
North Façade	8 days



Alternative B

Another alternative is to add an additional construction crew to the masonry veneer crew only. The construction will work in the same sequence. The previous alternative only compressed the schedule at the same rate, while leaving the construction of the curtain wall still broken. Additional masonry crews will shorten the schedule, with the objective being to bring the curtain wall construction activities closer together. The same loss of productivity will be applied to the masonry crews as the previous alternative.

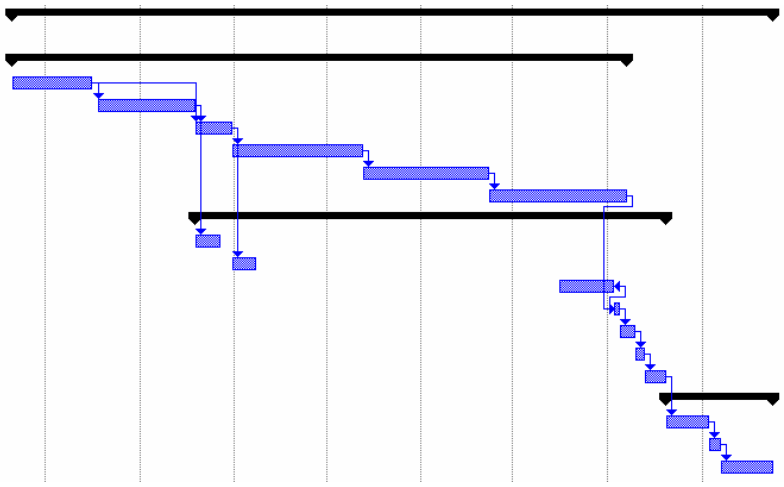
Façade Sequencing	125 days	Mon
Masonry Veneer	86 days	Mon
Tech Theater & Black Box	12 days	Mon
Music Multimedia	14 days	Wed
Stair 1	5 days	Tue
South Façade of West Teachi	18 days	Tue
West Façade of West Teachir	17 days	Fri
North Façade of West Teachir	20 days	Tue
Curtain Wall	73 days	Tue
South Lobby and Vestibule	7 days	Tue
North Lobby & 2 floor offics	7 days	Tue
Stair 2 & West End Corridor	13 days	Tue
Stair 1	2 days	Tue 1
Light Monitors	3 days	Thu 1
North Lobby Entrance	3 days	Tue 1
Smith Theater Lobby	5 days	Fri 1
Metal Panels	26 days	Fri
South Façade	10 days	Fri
West Façade	2 days	Fri 1
North Façade	14 days	Tue 1



Alternative C

This alternative sequence attempts to group the curtain wall in a more continuous construction pattern. The activity of constructing the curtain wall at stair tower #2 and the west corridor is moved to later in the project. This results in the curtain wall construction being less intermittent. Now, a longer work period exists at the end of the process, instead of a 4-week stoppage. In addition, a phased construction sequence of the north façade is proposed. If the curtain wall construction on the north façade is phased-in with masonry veneer on the north façade, the efficiency of the curtain wall construction is improved.

Façade Sequencing	179 days
Masonry Veneer	145 days
Tech Theater & Black Box	20 days
Music Multimedia	24 days
Stair 1	8 days
South Façade of West Teac	31 days
West Façade of West Teac	29 days
North Façade of West Teac	33 days
Curtain Wall	110 days
South Lobby and Vestibule	6 days
North Lobby & 2 floor offics	6 days
Stair 2 & West End Corridor	12 days
Stair 1	2 days
Light Monitors	3 days
North Lobby Entrance	3 days
Smith Theater Lobby	5 days
Metal Panels	25 days
South Façade	10 days
West Façade	2 days
North Façade	13 days



Alternative D

The final alternative investigated is to remove the aluminum panels from the stair towers and replace with masonry veneer. This is chosen because it provides for a continuous flow of masonry veneer. By eliminating the aluminum panels at the stair tower, the masonry crew can work in a more logical sequence from the south façade to the west façade and finally the north façade.

Re-sequencing Results & Costs

Detailed calculations can be found in Appendix B.

The results from re-sequencing demonstrate the following financial and logistical changes.

	Duration	Additional Labor Costs	Additional General Conditions Costs	Total Difference
Original Design	37 weeks	$ -	$ -	$ -
Alternative A	22 weeks	$71,208	($203,160)	($131,952)
Alternative B	25 weeks	$50,565	($162,528)	($111,963)
Alternative C	36 weeks	$ -	$ -	$ -
Alternative D	39 weeks	$23,058	$27,088	$50,146

Original Design

This sequence doesn't allow for a continuous flow of work causing an inefficient construction process.

Alternative A

Alternative A focused on productivity rates, and although the construction schedule was faster, the sequence is no better than the original design. Also, it is unknown whether the subcontractor is able to even provide the additional crews required.

Alternative B

Alternative B is problematic for the same reason as Alternative A. The sequence is not improved and the possibility of additional crews is unknown.

Alternative C

This schedule provides the most logical sequence of construction. The curtain wall activities are grouped closer together although not completely sequential. A more efficient and practical sequence is followed with this proposed schedule. Some drawbacks include the fact that the curtain wall crew is closely following the masonry crew, which could be a problem if the masonry slows down during the construction of the north façade.

Alternative D

Although this option is explored, it is not the most practical of alternatives. The addition of face brick drove up the cost compared to the aluminum panels. See Appendix B. Also, the aesthetics are altered, which would require owner approval to accept this change.

Conclusion

Although some alternative methods for constructing the façade exist, there may be a few reasons not to shorten the schedule. One possible reason is the lead time of construction materials. The façade materials may not be at the jobsite in time for a faster construction sequence. Other construction materials in the next phase of construction such as interior materials may have a long lead time and accelerating the schedule too much will only leave an idle site while the materials are still being delivered. Also, a condensed schedule may not leave enough float days in the schedule incase of bad weather or unforeseen circumstances.

The most logical sequence of construction to recommend is Alternative C. This sequence adds no additional costs and even reduces the façade schedule by a week. Alternative C is good choice because the sequencing of construction makes sense. The curtain wall construction is grouped for a better continuous flow. Phasing the northern façade is concluded to be the most reasonable and logical solution.