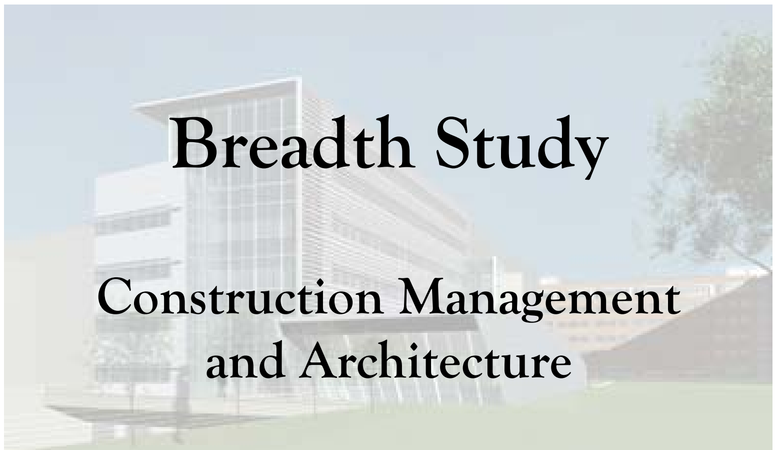


Breadth Study

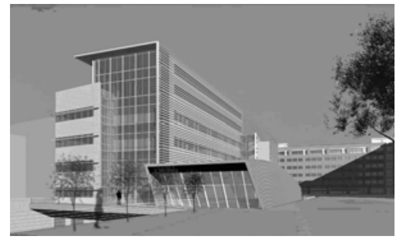
Construction Management and Architecture

CM cost and schedule analysis with considerations of the following:

Current System
Designed System A
Designed System B

Architectural façade design with consideration of the following:

Traditional Brick
Precast Brick
E.I.F.S.



CM Breadth

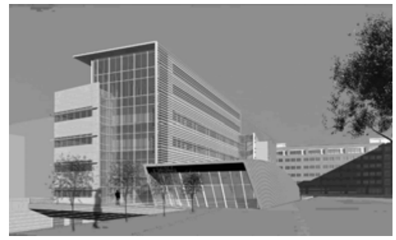
For my first breadth topic, I chose to look at the overall cost of both systems to find which is most economical. I made a take-off of all materials used in both the current system and the proposed systems. I then used R.S. Means, 2006 to find the overall cost.

Cost of Current System

For the original system I looked at the price for each bay based on the cost of the foundation system and slab-on-grade, including all material costs for concrete and rebar, labor of forming, pouring and finishing, and cost of equipment used. I also priced the cast-in-place concrete for all floors except the penthouse. These prices also included the cost for materials, labor, and equipment. The final price section was for the steel found in the penthouse and the cost for the concrete and decking for the roof systems. These again were priced with the same three categories of material, labor, and equipment. I did not look at any cost beyond the structural system, because these are the only changes that I am proposing for my thesis. As I have made it a criteria to provide an equivalent building as currently being provided, there should be no additional costs. The resulting price of the current structural system came to $4,492,275.00. The overall price of the construction was multiplied by 0.975 to reduce the overall cost to make it equivalent to the cost in the greater Washington, D.C. area.

Cost of Design A

For the cost of the first design, I looked at the cost of a reduced foundation size, due to the lower weight of the building, pricing all the same material, labor, and equipment as in the current system. I also priced all of the steel members, decking, concrete used in slabs, and reinforcement needed. These again were priced based on material costs, the labor for installation, and equipment required to complete the job. After including the D.C. price reduction, the



overall cost of this building came to $3,799,940.00. However, this system is not equivalent to the system that was provided using steel construction, due to the low vibration criteria, as well as no blast protection.

Cost of Design B

The second design, however, is more equivalent to the current system, with its increased vibration control. The overall price, looking all the same elements at the first design, came to a total of $3,392,223.00. Although this building allows for a better system, with overall larger members, the price did decrease from design a. The reasons for this decrease are, in part, due to the use of less material overall. There are far fewer large members than the smaller members used in the first design, and no extremely large members, like the ones found in the first design. This price decrease is also caused by the need for fewer connections, due to longer spans and a lower number of beams. However, because of a lack of blast resistance, this design still is not equivalent to the concrete design. Multiplying by the estimated price increase of making a building of this size and nature blast resistant causes the total price of the building to go up to $3,561,834.15. When looking at all four price increases

System	Price	Savings
Current (Concrete)	$4,492,275.00	$0.00
Redesign A (Steel N-S)	$3,799,940.00	$692,335.00
Redesign B (Steel E-W)	$3,392,223.00	$1,100,052.00
Redesign B w/ Blast Resistance	$3,561,834.15	$930,440.85

one can see that by designing the structural system using steel rather than concrete, there is a possible cost savings of 20.7%, even with an equivalent system of blast control and high vibration control.

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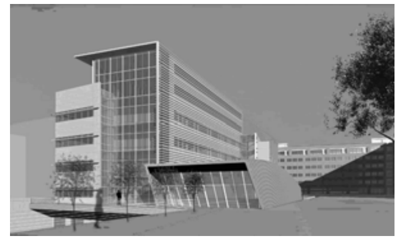
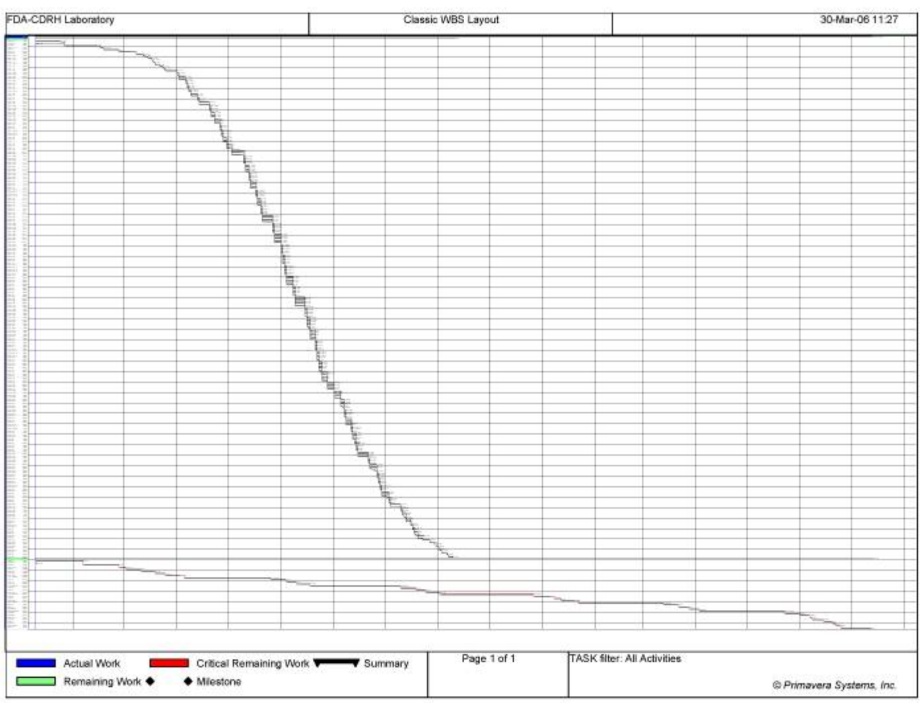
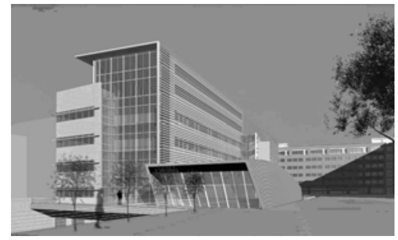


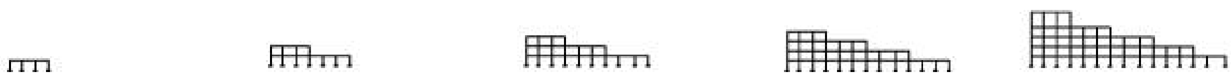
Schedule Analysis

Another benefit of the use of steel is the onsite schedule time decrease. While more lead time would be needed for the ordering and manufacturing of the steel elements, that is not needed for concrete. This job is well suited to a project requiring a large amount of lead time, due to its environment of being in a later phase of a very large campus project. The amount of time that is truly saved is variable, due to the possible use of additional crews. However, using RS Means to find time estimates for the construction of both the current system and designed system, and entering this data into Primavera, 2006, one can see the possibility of a great deal of time savings possible in steel construction over concrete. The schedule below shows the greatly increased slope, due to the ability of overlapping jobs during steel construction (top line), as compared to the low slope, due to the low amount of overlap of jobs possible in concrete construction (bottom line).

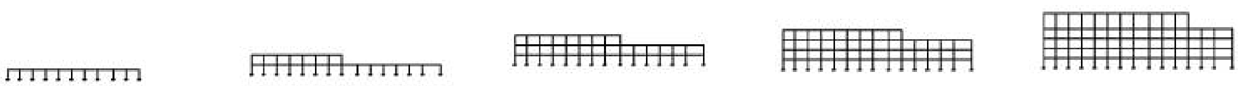




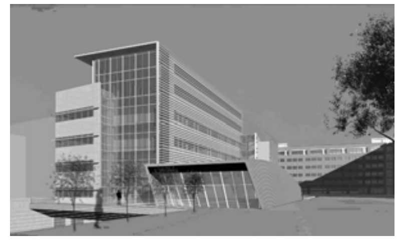
Another way to show that the greatest savings thought scheduling is through steel construction is by showing how the common process is to phase the construction in vertical sections. In this common steel construction method, sections can be completed, then moved. When the next phase is started on the base, the first phases second level can be started as can be seen in the diagram below.



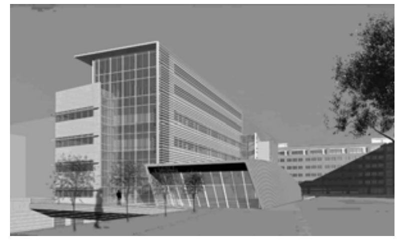
Concrete, on the other hand, is normally constructed in phases based on floors, giving very little possibility for overlap of systems. This construction process is displayed below.



The steel process is even better suited to the construction of the CDRH Laboratory due to its long and narrow footprint. This allows the long direction to be broken into 5 phase sections, which are equal to the five floors found in the laboratory. This way, a majority of the construction is being completed during optimum construction, when multiple phases are being constructed at the same time. If the splicing of the columns were to be changed from every floor, to having columns span several floors, such as having one splice just about the 3rd floor, there would be a reduction in connections needed. Making two beams, the first being 52' and the second being 38', is a viable layout to allow for less connection to be made, and more support available for the height roof columns. The only downfall with this construction is that the steel erection could not have as great of an overlap, since all floors between splices would need to be completed before continuing to the next level. This may provide cost savings in having less column connections, however, it would cause for time loss, without a great deal of structural benefit.



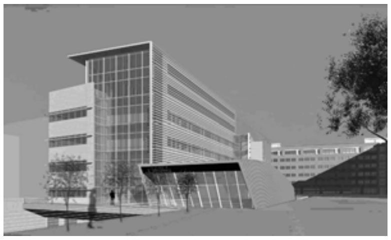
As stated in the structural depth, the second steel design provided the greatest cost savings. The savings of the second design, as compared to the first, although using larger members, provided for less members overall, and less connections. Both steel versions also provided a cost savings over the extremely expensive concrete structure. This is, in part, provided by the large cost of forming all of the cast-in-place members that make up the columns, girders, beams, and decking of the current system. This savings was also provided by having a vibration controlled system that was sufficient for the project, without having to provide massive concrete members. After looking at the possible construction schedule as well as the process, the CDRH Laboratory was well equipped to be constructed from steel, providing another process in favor of the designed systems.



Architectural Breadth

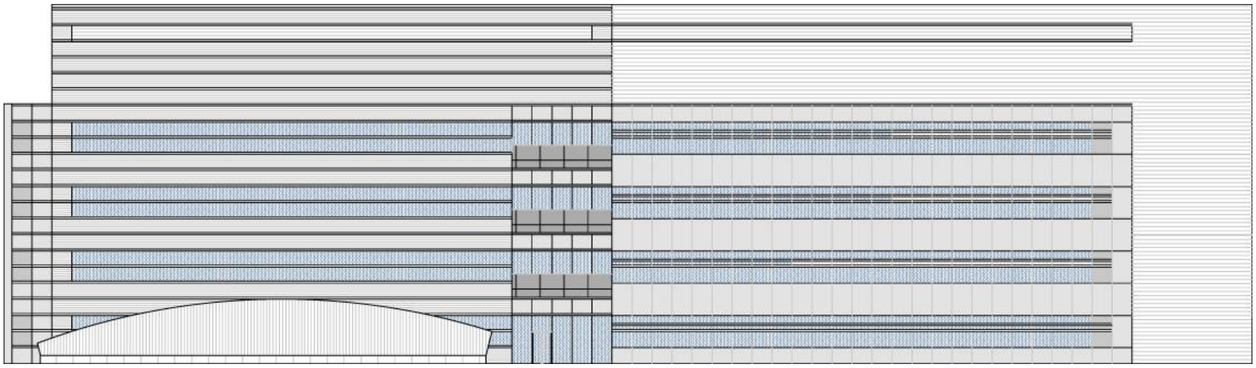
As stated before, the FDA White Oak Campus is made up of one original building, along with a great deal of new construction. The original building has an elegant, solid feel to it, with a stately entrance and a primary construction of a red-orange brick. The new buildings on site were built with similar attributes, including an organized, traditional window pattern, and the same exterior façade of red-orange brick. These buildings have a more updated look, using some aluminum sheathing around upper columns and a glass entrance rather than a stone one. However, the CDRH Laboratory does not have the same architectural dialoged with its historical predecessor. It uses a very modern looking steel façade with ribbon windows and extreme horizontality with its sunshields. This takes away from a uniformed campus feel, which is possible for a location that is being designed and built at the same time. I would like to provide a more centralized image for the FDA campus, which would better pertain to their original intent of bringing their dispersed offices to one central location.

The image above shows the extreme contrast found between the almost space aged looking laboratory, with the traditional brick façade of one of the new office buildings located on site.



Façade Design

I propose to change the current façade from its horizontal, steel look as seen in this elevation



to one with a much more traditional look, that is similar to the office buildings found on site.

The new elevation takes many cues from the surrounding buildings. The upper level aluminum columns break up the extensive amount of blank brickwork that is needed around the 25' penthouse. The ribbon windows are broken up to reflect the traditional window pattern found in an office building. The cast stone balconies work with this traditional façade just as well as with the modern façade, and provide a look of significance for the entrance.

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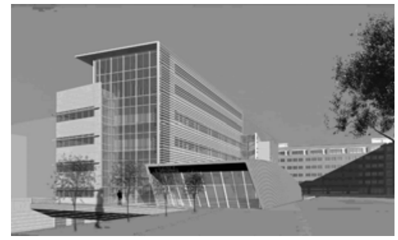
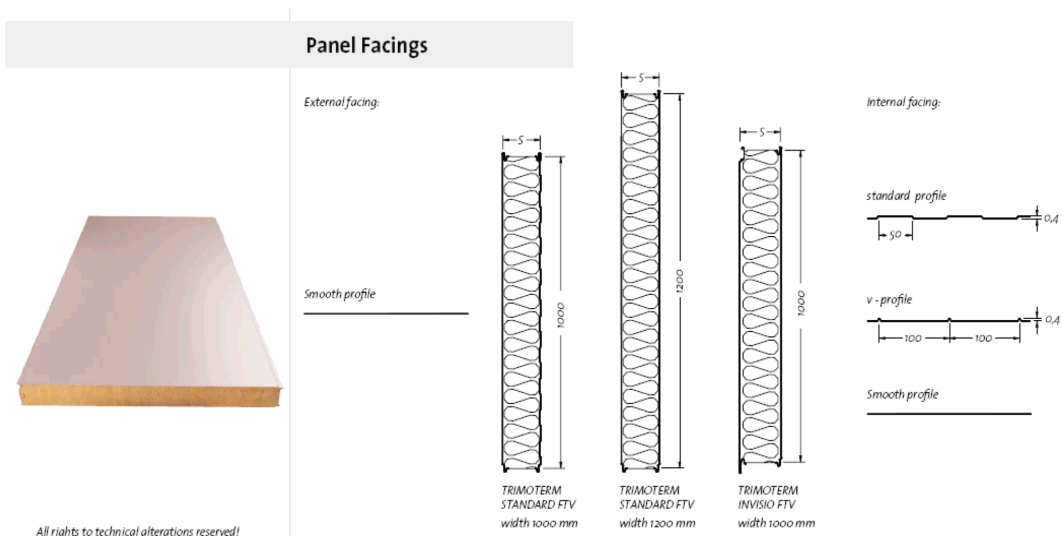


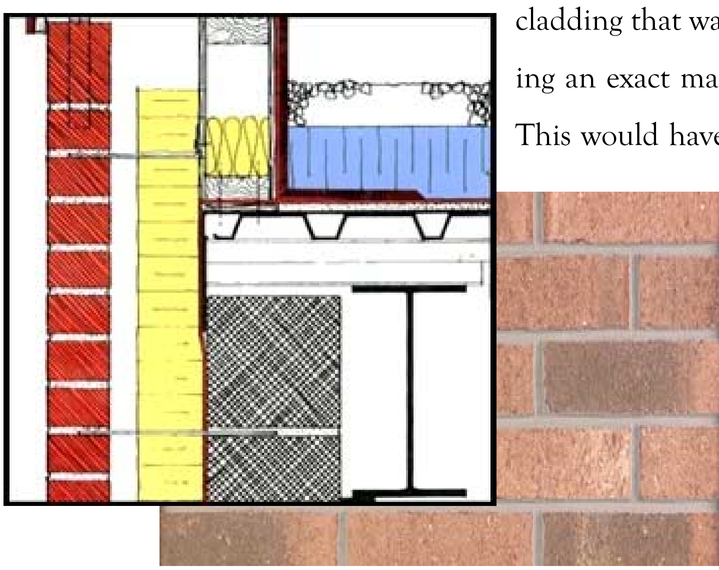
Current Façade Insulated Steel Panels

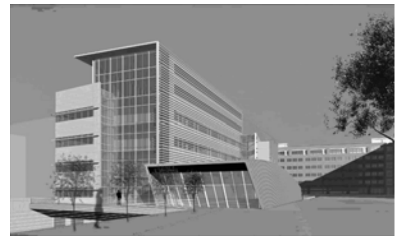
The traditional looking material that would replace the steel panels seen in the current building could be made from many different materials. I will propose three possible materials.



Traditional Brick

The first façade design that I will look at is a traditional brick façade. This is the same cladding that was used on the office buildings, providing an exact match to that of the rest of the campus. This would have a traditional construction process as seen to the far left. The color also seen to the left is similar to the color currently being used on the office buildings on the White Oak Campus. The use of the same color brick would allow for continued continuity throughout the site.

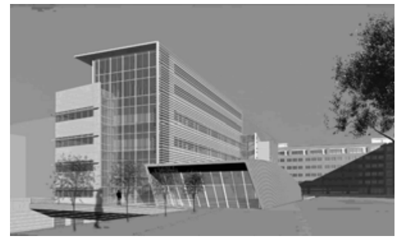


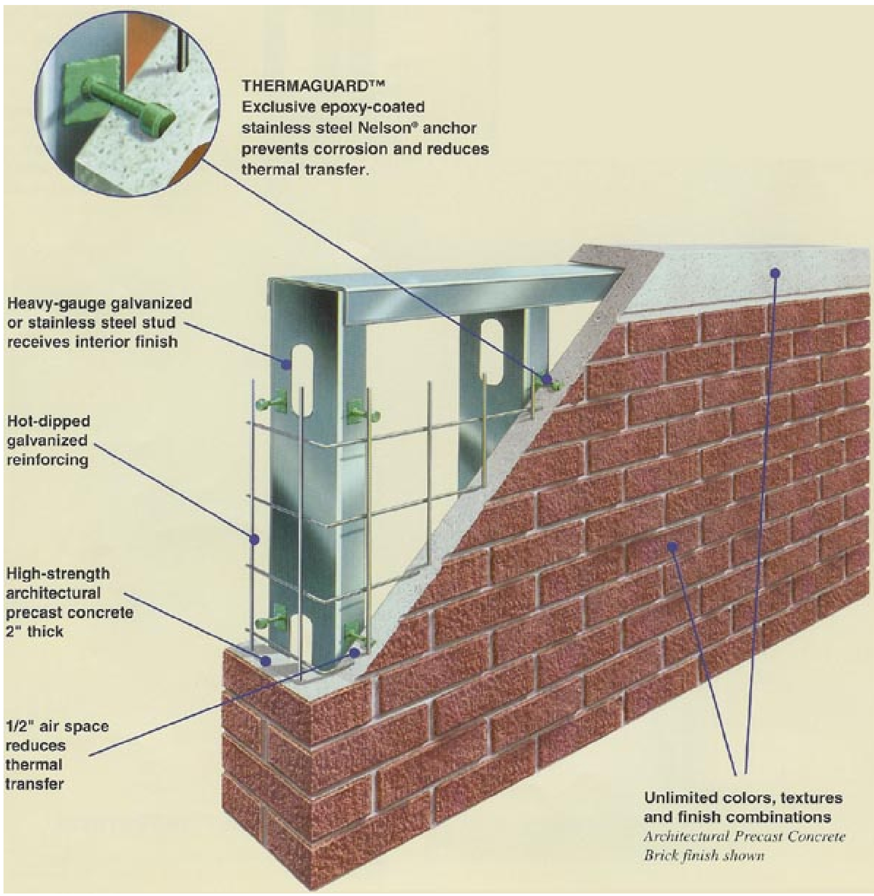


However, there are some downfalls to this façade. Unlike the original steel cladding, this façade does not provide insulation or a simple placement of interior wall finishes, will require additional trades to be on site, and will take a great deal more time to lay all the brick, as compared to just placing the prefabricated, pre-insulated, composite steel panels. Brick construction is also a great deal heavier than the current system, weighing 48psf as compared to the 11psf of the current system. This will also cause an increase in member sizes, not only because of the weight increase, but also because of the increased deflection criteria from l/360 to l/500 needed for the supporting beams. This will cause an increase in the typical beams to change from the current W27X84, W21X50, W18X40, to W30X90, W24X76, and W24X56 respectively. The average cost of this system also increases from the current façade system from $1,086,093.35 to $1,425,856.92. This, along with the structural cost changes, changes the overall cost by $509,516.02. This cost increase is not only because of the expense of material and labor, but the additional use of the brick cladding between the windows, rather than the ribbon window that is currently used.

Precast Brick

The next possible cladding application is a pre-cast brick façade, also know as a slenderwall façade. This façade will provide an almost identical look to that of the traditional brick already found on the campus. However, this cladding has the added bonus of having the ease of construction comparable to that of the current system. It, like the current system, could be fabricated off site, and can easily be put in place. It also has the potential for immediate placement for interior wall finishes, as found with the current system. This system is slightly heavier than the current system, weighing in at 28psf, which would require a larger crane than the current system.

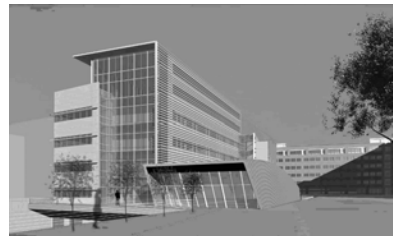




The structural member size increase in the typical beams for this system, as compared to the current system, would produce typical members of W30X90, W24X76, and W21X48. The average cost of this system also raises the façade cost from $1,058,941.01 to $1,418,678.90. This, along with the structural cost changes, causes an overall cost change of $488,900.10.

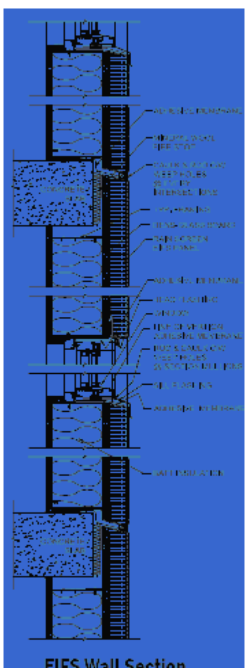
E.I.F.S. (exterior insulation and finish systems)

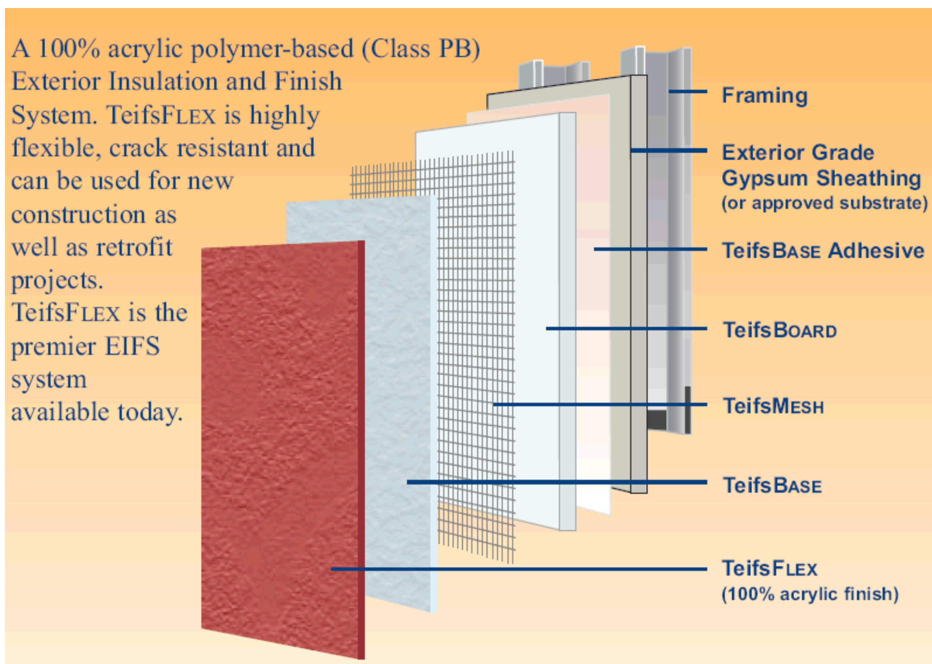
The finals façade that I looked at was an E.I.F.S. (exterior insulation and finish systems) façade. This façade provides an equivalent system to that found in the current structure. It is also prefabricated with the potential for immediate placement of interior wall finishes, like the



pre-cast panels; however, this system also weighs the same as the current system, 11psf. There would be a slight increase in the structural members, due to the increased area of cladding vs. glazing of the traditional layout as compared to the modern one. The new typical member sizes are W27X84, W24X55, and W21X44.

This system does have a reputation for being sub-par, especially with water penetration. This is normally caused by improper installation, especially in residential construction. However, advances in design, which can be seen below, along with proper installation, allows this cladding system to provide equal protection from the elements.





There is one major drawback for this cladding. Its look is not as prestigious as any of the other façades. The price for this façade is less than the current façade, at only $1,028,164.27. The total cost decrease, even with the increase in the price of the structural system, and the additional material needed to make a traditional looking window rather than the ribbon window, is $46,306.63

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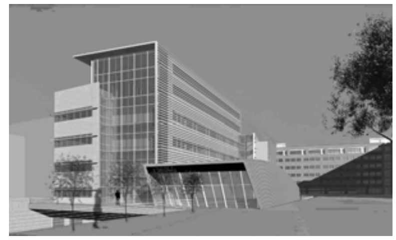

Façade	Cost	Difference	Stuctural Cost	Difference	Building Total	Difference Sum
Steel (Current)	$1,086,093.35		$3,561,834.15		$4,647,927.50	
Brick	$1,425,856.92	$339,763.57	$3,731,586.60	$169,752.45	$5,157,443.52	$509,516.02
Precast	$1,418,678.90	$332,585.55	$3,718,148.70	$156,314.55	$5,136,827.60	$488,900.10
E.I.F.S.	$1,028,164.27	-$57,929.08	$3,573,456.60	$11,622.45	$4,601,620.87	-$46,306.63

As shown above, there are many possibilities for producing a more traditional exterior façade for the CDRH Laboratory. Although some do allow for a great deal of cost savings, the end result on a project such as the CDRH Laboratory is very important. The E.I.F.S. panels provide equal protection for the building as the steel façade, as long as they are installed properly. A drawback of the panels is the "inferior" image that is associated with E.I.F.S., causing these panels to not be a viable solution to a client who is looking for a signature laboratory. The precast panels do not provide a great deal of cost savings as compared to the traditional brick layout, but do provide a great deal of time savings, and result in an almost exact replica of the surrounding buildings façade. The type of materials is an additional consideration. Due to the LEED Silver Rating that is currently being pursued by the CDRH Laboratory, the insulation values of each system as well as the use of renewable and reusable materials are very important. All of the systems can provide comparable insulation values. However, the current system and the E.I.F.S. systems have this already included in their exterior shell, while the precast and brick system must have 6" stud back-up walls to provide room for proper insulation values. Another consideration is the blast control capabilities of each system. The exterior shell of a building is its first line of defense against attack, and the precast and brick systems provide the sturdiest systems in resisting a blast.