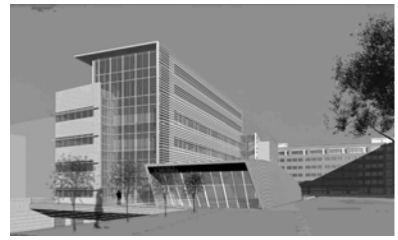
Timothy Mueller
Structural Option
Walter Schneider



FDA CDRH Laboratory

Silver Spring, Maryland

Executive Summary:

The FDA-CDRH Laboratory is currently being built on the Food and Drug Administration's White Oak Consolidation Campus. It is a four story building with a full below grade ground floor and fifth floor penthouse suite, to be used as offices and laboratory space for the FDA. A high bay laboratory is located on the west side of the main building. The CDRH Laboratory has a total square footage of 139,805 and a height of 86' above grade.

The laboratory is currently made of cast-in-place concrete with only two exceptions, sections of the penthouse and high bay laboratory which is a steel construction with moment connections. Due to the monolithic construction of cast-in-place concrete, coupled with the long and low profile of the building, no additional lateral support is needed throughout the laboratory's structural system. The use of concrete for the construction of the building also assists in minimizing the vibrations of the building, which is of concern due to the nature of the building as a laboratory. For my depth work, I propose to minimize the need of two skilled trades, which are currently found on the job site, and only use steel as the main structural system. This will reduce the amount of materials to be used in the foundation system since it no longer needs to support the extremely large masses produced by a concrete structure, as well as reducing the amount of time workers will be on site, due to the speed in steel erection. Due to my redesign of the structural system, two main concerns I will have to look at are; a lateral resistive system that will not interrupt the architectural design of the exterior façade or the interior layout. I will also have to look at how to minimize the effects of vibration on the floor systems of the building either through control systems, or the thickening of the concrete slab.

For my breadth work, I will look at two components that are both engaged with the structural system, the cost and duration of the building and construction, as well as the architectural façade of the building. I will look at how using a steel system affects the overall cost of the building as well as duration of construction. I will then look at how that cost and duration changes due to the addition of vibration controls and additional materials used for slab thickening to find if the economy of a steel structure is outweighed by necessity to have a vibration sensitive structure. The other breadth will look at using a more traditional looking façade that will assist in the continuity of the site, that can be seen in the surrounding FDA office structures. These façades will include tradition masonry construction, an EIFS system, and a precast system. I will then again look at the affects that these different systems have on the overall structure due to changing masses of the curtain wall, and therefore the changes to the cost of the overall structural system that would also incur.

The following proposal includes:

Background on the FDA-CDRH Laboratory
Description of the current structural system
Proposed alternative structural system
Methods to be used for the redesign
Tasks and tools to be used for the redesign
Proposed schedule

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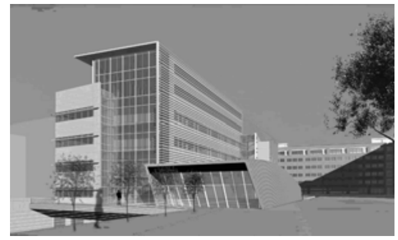

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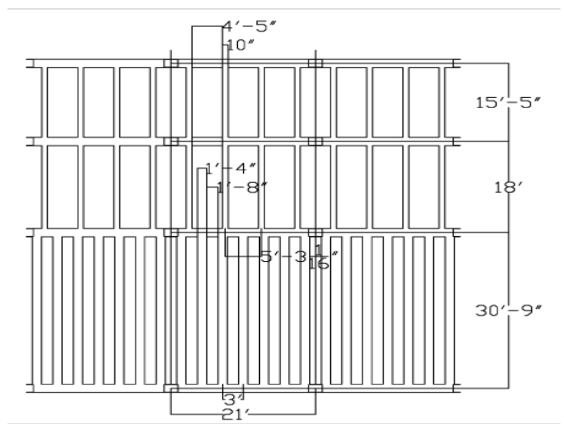
Background:

The FDA CDRH Laboratory is an office and laboratory space located on the Food and Drug Administration's White Oak Consolidation Campus. It is a four story building with a full below grade ground floor and fifth floor penthouse suite for a total square footage of 133,833. The overall height of the building is 86' above grade, with a one story high bay laboratory located on its west side of the main building, with 5,972 square feet of space.

The main building is completely enclosed by a curtain wall. This is made up of the central tower whose north end is made completely of an aluminum window curtain wall that is completely comprised of glazing and aluminum mullions. The central area is flanked on the east by a four-story, more traditional layout, metal panel and aluminum ribbon window curtain wall. This wall also includes sun screens made of thin aluminum strips placed on the upper quadrant of the windows. The west wall is dominated by horizontal bands made of aluminum, also acting as sun shields. All sides of the building are made of the aluminum panels of different sizes and orientations allowing for a very clean and industrial secondary design element. These panels are the main component of the typical wall with an insulated panel on the exterior and GWB mounted on metal studs on the interior. On the west side of the main building is the specialized high-bay laboratory which is made by a curved metal roof over an aluminum panel curtain wall.

Current Structural System:



The building is made mainly out of cast-in-place concrete. Which allows for its frame, made of pan-joist and columns to act as both a gravity and lateral system. The one-way concrete system spans 3 separate bays of 30'-9", 18'-0", and 15'-5". The continuity of the bays is kept in the long direction by having columns spaced, on average, every 21'. All floor structural depths are kept to a similar depth with the maximum having a total beam depth of 20.5'. The slab depth throughout the structure is kept at a constant 4.5".

By using a pan-joist system the longer the span, the wider the beams become to allow support over the longest span. The beams therefore become very wide with rather small spacing, which allows for a extremely solid floor structure, reducing the susceptibility to vibration to be practically negligible. Due to the monolithic nature of the building's concrete structural system, all the members are fixed and allow loads to travel through them. They also allow the transfer of moments caused by lateral forces.

The penthouse suite as well as the high-bay laboratory is made of a combined steel and concrete structure, in which any lateral resistive member made of steel has moment connections. The entire roof system is made of a steel structural system, with a composite steel and concrete roof slab, topped with a build-up roof and stone ballast.

The building rests upon a foundation that is made of a step footing around the entire perimeter, and spread footings below each of the columns. No special consideration was necessary for the foundation construction, other than the need to compact any ground that was disturbed during excavation, even with the massive forces from the solid concrete construction of the laboratory.

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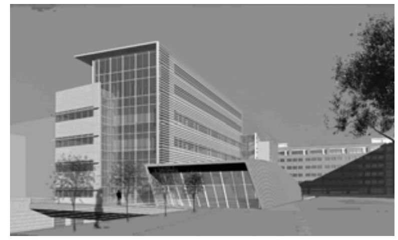

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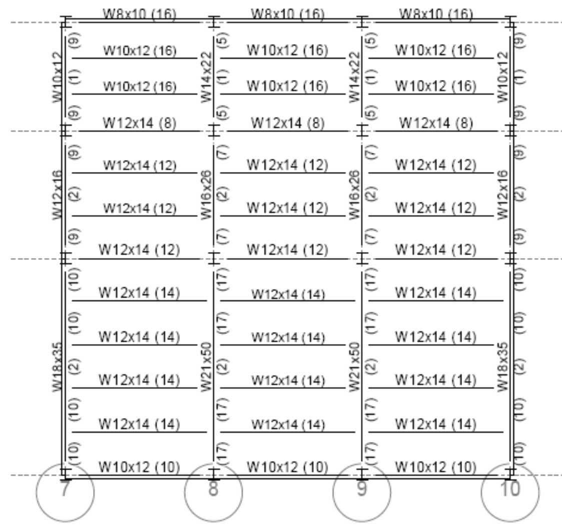
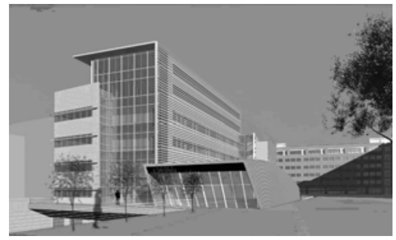
Proposed Alternative Structural System:

I will propose to build the entire building out of steel. Due to the use of steel currently in the building's penthouse and high-bay laboratory space, if the entire building were to be constructed out of steel, it would minimize the number of skilled laborers from different trades that would be necessary. Many other positive contributions could also come from a completely steel constructed building. First, the erection time could be cut to a minimum, which would reduce the amount of time the trades would be on site, as well as allowing the owner (GSA-U.S. General Services Agency) to collect rent from the tenant (FDA-The Food and Drug Administration). Also, this creates a much lighter overall construction load, which could also reduce the size of the foundation system, allowing for another possible cost savings due to the reduction of needed material. There is also a good likelihood that the use of less material, and the lack of formwork needed also allows for a reduction in cost of the overall building



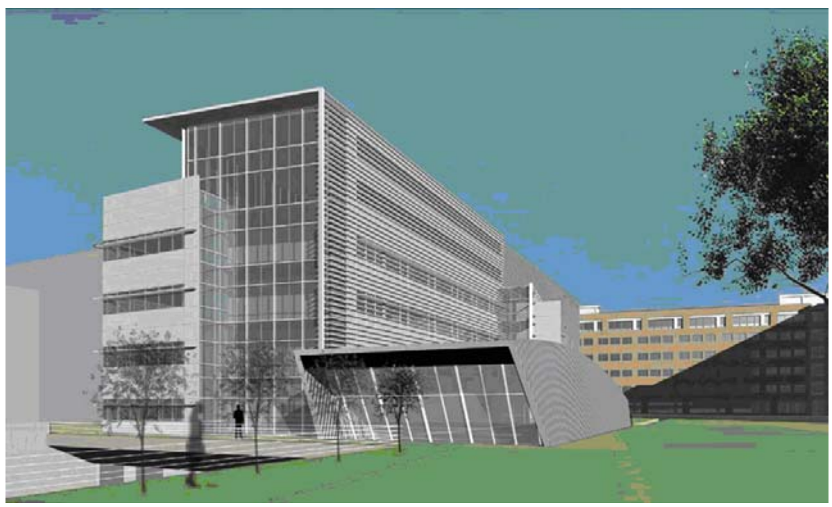
Some concerns that could arise from the conversion of a prevalently concrete structure to a steel structure cause for a choice of lateral resistive systems, which will either have costly moment connections throughout the building, or braced members which, will either cause for problems in the placement of ribbon windows on the exterior of the building or could have complications of interior open spaces and openings in interior walls. Another possible problem is the need for additional fireproofing on the steel material which is not necessary for the concrete. This additional fireproofing can add a great deal of cost to the structure. Also, additional lead time that is necessary for the construction of steel can be a problem that may or may not effect the overall schedule depending on the time it takes to complete the foundation system. However, the dominant concern with the conversion of the CDRH Laboratory from concrete to steel is the possible increase of susceptibility to vibration of the slabs due to the reduced size of the overall slab depth and greater spacing of structural members. Vibrations of the slab are an important concern due to the sensitive nature of the some laboratory equipment and experiments performed by the FDA. There are possible solutions to control these vibrations. One such solution is to utilize a vibration control system was that will be looked at to control the vibrations, such as shock and vibration isolators. Another possible solution is to utilize a composite deck system to allow all the members of the structure to work together to work against vibration. Finally, one can increase the overall thickness of the slabs to allow for a reduction of the vibrations prevalent in the slabs. This is most likely the easiest solution with the greatest output, however, it also requires for additional materials such as more concrete, and a larger member sizes, again causing for a higher overall cost.



Methods to be used for the redesign:

To design the proposed steel structural system, I will use the loading of the first technical report along with the load cases from the third technical report. I will be able to determine the preliminary sizing of the beams from the LRFD method of design and utilizing SAP2000 to confirm the sizing of all members as well as the necessary bracing required for the building.

The proposal will have to demonstrate what locations of the building will be able to support lateral bracing without effecting the exterior architectural integrity as well as the interior layout. The architectural design of the exterior of the building can be changed to allow for more continuity on the site with the buildings surrounding the CDRH Laboratory. However, if a similar styling is used, as compared to the other architecture on the site, cross bracing can still be a problem within the exterior bays. Another concern with using a more traditional looking façade, such as the red-orange color brick seen on the other building on site, could allow for additional weight to the overall structural system, however, this also provides the option of using a more modern system such as an External Insulation & Finish System (EIFS) or a precast system, that has a traditional look without the cost of a finished aluminum or a traditional masonry system.



By looking into the susceptibility of vibration and the overall deflection of the loaded floors, I will be able to find the necessary member and slab requirements, as well as looking at alternative vibration reduction systems, that when used alone or incorporated with a thickened slab, may allow for a cost effected solution to using a steel structural systems in place of the current concrete system with equivalent resistance to vibrations. Finally, a brief look at the effect of the new loading on the foundation system can be developed to find the amount of savings that is possible by the reduction of material that is possible through the overall reduction of building mass.

The cost and duration of the current system will be compared with the proposed system as well as a system using vibration controls. The costs will be found using R.S. Means and ICE 2000 Estimating. Again, the time savings of the proposed system as compared to the original system can be found by through information provided by R.S. Means and entering it into Primavera.

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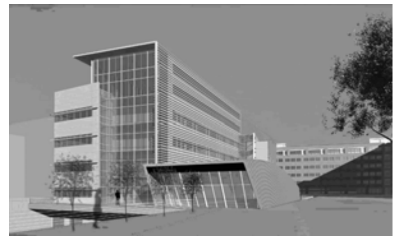

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Tasks And Tools To Be Used For Redesign:

Task 1—Compound all prior information and enter information into SAP
- A. Check and confirm all information regarding gravitational loading from technical reports
- B. Determine load distribution of building
- C. Model the building in SAP

Task 2—Run SAP to find needed lateral support
- A. Check and confirm all information regarding lateral loading from technical reports
- B. Model lateral loading constraints in SAP
- C. Find loading on individual members
- D. Locate needed lateral bracing

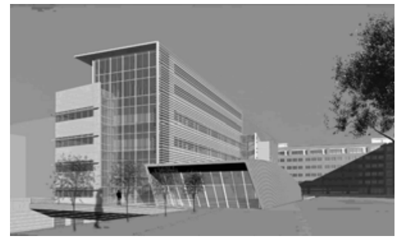
Task 3—Determine allowable placement of all lateral braces and moment connections
- A. Find acceptable locations for lateral cross bracing without affecting current architecture
- B. Using AISC LRFD manual, size the members and connections
- C. Find necessary locations of moment connections
- D. Using AISC LRFD manual, size the members and connections

Task 4—Determine deflection and vibration caused by loading conditions on designed members
- A. Enter all lateral resistive systems into SAP and find resulting deflections
- B. Research vibration limitations and reduction alternative
- C. Find new foundation systems needed based on lightened loading of steel system

Task 5—Determine needed vibration controls and slab thicknesses
- A. Find slab thickness needed to equate thickness of concrete structural system
- B. Find reductions of vibration available through external systems
- C. Find best combined solution to slab thickness and vibration controls
- D. Find new foundation systems needed based on middle loading of controlled system

Task 6—Find pricing of systems using R.S. Means
- A. Find labor/material pricing and duration of original system
- B. Find labor/material pricing and duration of new system without vibration controls
- C. Find labor/material pricing and duration of new system with vibration controls

Task 7—Study existing cost and duration with proposed cost and duration
- A. Determine total cost of all systems using ICE 2000 Estimating
- B. Determine total duration of all systems using Primavera
- C. Compare overall cost of concrete system and steel system
- D. Compare overall cost of concrete system and vibration controlled steel to find economical system
- E. Compare overall time of projects to compare time savings in producing the most economical system



Task 8—Study new architectural design
- A. Research possible material to produce traditional exterior used on surrounding buildings
- B. Calculate overall loading of new façade as compared to current façade
- C. Change structural system as needed by the redesigned façade
- D. Change foundation system as needed by the redesigned façade
- E. Find changed pricing based on new materials and foundation systems
- F. Finalize best façade system based on image, building loading, and cost
- G. Prepare rendering of the building with new façade

Task 9—Prepare final presentation
- A. Prepare final report with printing and binding
- B. Prepare final presentation using Microsoft PowerPoint

Proposed Schedule:

Week	Tasks To Be Accomplished
8-Jan	Task 1
15-Jan	Task 2
22-Jan	Task 3
29-Jan	Task 4
5-Feb	Task 5
12-Feb	Task 5
19-Feb	Task 6
26-Feb	Task 7
5-Mar	Spring Break
12-Mar	Task 7
19-Mar	Task 8
26-Mar	Task 8
2-Apr	Task 9
9-Apr	Presentations