

T.C. WILLIAMS HIGH SCHOOL

ALEXANDRIA, VA



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STRUCTURAL OPTION

THESIS PROPOSAL

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EXECUTIVE SUMMARY

T.C. Williams is a 3 Story 461,000 square foot high school that has recently finished construction in Alexandria, VA. This 85 million dollar building was designed to accommodate 2,500 students and features classrooms, a gymnasium, auditorium, library, cafeteria, and green roof as its prominent features.

The buildings primary structural system is comprised of steel framed beams with composite floor slabs. Lateral loads are resisted using concentrically braced frames between floor slabs, which act as rigid diaphragms. Frames use stiffness in the plane of the lateral load and act similarly to a truss to transfer the loads to the columns, which then transfer the loads to the foundation.

Due to the large budget, the structural system was designed using fairly conservative sizes, and a simple design. For the purpose of this thesis assignment two additional stories will be added to the school, and the existing building footprint will shrink, leaving approximately the same amount of volume. A valued engineering solution that will decrease construction costs, project duration, and material usage will be emphasized.

In technical report 2 it was found that the original composite beam and slab design wasn't the most efficient design available. The most economical solution happened to be steel joist construction, however problems with vibration makes this solution unacceptable. The system that will be analyzed further in this thesis will be composite steel joists. This system is a good compromise between the heavier, more costly steel beams and the more economical and light weight steel joists. A switch to lightweight concrete will also be studied to be used with the existing composite beams, and it shall be examined if LWC offers much savings in cost of the overall structure. The last solution that will reduce costs is the removal of exterior columns, which will be replaced by the already existing exterior masonry walls.

Designs will be carried out using various design manuals, and RAM Structural System 3D models, which will be back up with hand calculations. All loads used will be determined from ASCE 7-05.

The structural redesign of TC Williams High School will be further evaluated through breadth studies in non-structural design areas. First, a study of the buildings architecture will be undertaken, evaluating how the additional stories will affect the existing architecture. Secondly, I plan to examine the differences in cost and scheduling that will arise with an alternative structural system, using RS Means and Primavera.

BREADTH TOPICS

The structural redesign of TC Williams High School will be further evaluated through breadth studies in non-structural areas.

First, an architectural study will be undertaken, evaluating the effects of adding two additional stories. Adding stories will have an effect on the previously designed architectural design, and considerations will need to be made to best account for the additional stories. Adding height and possibly a small amount of volume will impact the MEP sizes, locations, and main distribution ducts, as well as impact the floor plan for column sizes.

The second breadth option will examine a cost analysis and the schedule impact between the existing and alternative structural systems from a hypothetical standpoint where both buildings will be assumed to be the same size of 5 stories in height. With the addition of two stories, cost would be much more of an impact on the redesign than what it was with the original design. RS Means and Primavera will be the primary tools used in the new scheduling and design process to minimize costs as best as possible.

SCHEDULE

STRUCTURAL

- 1A: Recalculate Seismic and Wind forces to account for the additional building stories.
- 1B: Update existing 3D RAM Structural Systems model to account for actual masonry walls and openings.
- 1C: Examine effects of LWC on existing 3D RAM Steel Beam Model.
- 1D: Design a Composite Steel Joists system, using NWC and LWC.
- 1E: Examine effects of vibration on composite steel joists using NWC and LWC, using the AISC Design Guide.
- 1F: Redesign exterior masonry walls to make them load bearing.

ARCHITECTURAL

- 2A: Research Codes for maximum building heights in the area.
- 2B: Find and examine existing design features.
- 2C: Architecturally account for the redesign to not have a negative effect on these features, and any other problems that may arise.
- 2D: Redesign floor plans to account for increase in column size, and MEP equipment.

CONSTRUCTION MANAGEMENT

- 3A: Gather information about total cost of existing system, using RS Means.
- 3B: Research total expected cost of new system for additional stories, using RS Means.
- 3C: Examine scheduling differences between existing and redesigned system, using Primavera.

MISCELLANEOUS

- 4A: Edit and Revise Final Paper
- 4B: Publish Final Paper
- 4C: Prepare and Practice Final Presentation
- 4D: Presentation