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Structural Option

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School of Engineering and Applied Science Building

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Executive Summary

Miami (OH) University's School of Engineering and Applied Science Building consists of four stories above grade, three of which are designated for classrooms and labs for students, as well as faculty offices. The fourth floor is a mechanical penthouse floor under a mansard roof which houses the building's main HVAC equipment. The building also has three levels of below-grade parking. The new building connects to the existing Benton Hall by way of a skywalk at the 2nd through 4th floor. The architectural voice of the new building is largely based upon the aesthetic concepts of Benton Hall.

The structure's gravity load system uses a steel frame with composite concrete floor slabs on steel columns. Lateral loads are resisted with steel moment frames in the longitudinal (east-west) direction and concentrically braced steel frames in the transverse (north-south) direction.

Based on previous research, it was found that the composite floor system may not be the best possible floor system for economic and scheduling reasons. The structural depth of this thesis will propose to redesign the building's floor system to be a precast hollowcore plank floor bearing on steel angles that are welded to supporting steel beams. The structure's basic lateral resisting system will remained unchanged in design, but members will need to be resized based on new seismic loads. Moving to a totally prefabricated structure where both the steel beams and hollowcore floor planks are fabricated and manufactured at plants, shipped in, and are quickly and easily erected on site. This can lead to a shorter construction schedule and decreased field labor costs.

As the first breadth topic, a precast architectural insulated wall panel system will be designed to replace the building's current enclosure system that uses steel stud walls with a face brick façade. This will also shorten the construction schedule by enclosing the building faster, allowing other trades to begin their work sooner. The second breadth topic will investigate the proposed changes' impact on various construction management issues. Detailed cost and schedule comparisons will be made between the proposed precast/prefabricated systems against the building's current structure and building enclosures.

Breadth Options

Since the main focus of this thesis will be redesigning the floor to a precast solution to speed the construction process, it lends itself well to a couple breadth topics with similar goals. A precast wall panel option will be considered as a building enclosure breadth, and the impact of the precast floor and wall systems will be covered as a construction management breadth.

Precast architectural wall panels offer a number of advantages over the current face brick on steel stud wall system. Construction time will be decreased significantly, offering the benefit of decreased labor cost and faster enclosure of the building. Other trades will be able to begin their work on the project much sooner, and hence allow faster completion of the building. The overall look of the façade will not need to be altered significantly, since wall panels with a “thin brick” face are easily produced in a precast plant. These insulated wall panels are sometimes referred to as sandwich panels, since they are essentially made with a layer of rigid insulation sandwiched between two concrete wythes.

A construction management breadth is a necessity for this thesis, since the main goal of switching to precast building element is for faster erection and increased economy. An in depth study of the new construction timeline and erection sequence will be performed to analyze the impact of the proposed changes. Also, detailed cost estimation takeoffs will need to be calculated to evaluate the cost savings or increase of the new systems.