Problem Statement

With the previous technical reports, it was determined that the SAC Hotel addition was adequately designed to carry applied loads and resist lateral forces. Calculations performed for each technical report showed that the individual steel members may have been slightly larger than required, which could have been due to multiple reasons, such as differing load calculations between ASD and LRFD, serviceability requirements outside the scope of these technical reports, or availability of materials. The SAC Hotel addition also ties-into an existing hotel tower with a similar framing scheme as the new addition, so design consistency could have been another factor.

Solution

Technical Report 2 was specifically focused on researching alternative designs for the gravity framing system in the SAC Hotel Addition. A staggered truss system was investigated and found to be a potential option due to the repetitive floor plan used in a majority of the hotel. The analysis of the staggered truss only took account of gravity loads from precast concrete planks, so a look at how the trusses would perform under lateral loads was required. Implementing the truss system would require a few concerns to be addressed, as well as considerations other than structural design. These include:

- The most effective layout of the trusses to carry gravity loads and work as the lateral system in the N-S direction, replacing the existing braced frames
- Change in overall building weight with use of precast planks
- Redesign of foundation due to change in overall building weight
- Impact on layout of interior spaces
- Constructability and site coordination for erection of truss and plank members

The following pages illustrate how the staggered truss may impact the existing floor plans and how the truss will line up with the hotel room walls and corridor.

Breadth Topic I

Since the staggered truss system requires moving the location of the trusses as they move up the building, the layout of the hotel rooms will be impacted significantly. A common feature of hotels is the inclusion of a connecting door between rooms with a shared wall. The web members of the truss could obstruct these doors in the existing layout of the rooms. Also, potential truss locations may obstruct specific rooms, requiring building geometry modifications or rearranging of interior spaces. The goal will be to keep a consistent truss layout while keeping the trusses hidden within walls and making the best possible use of affected interior spaces.

Breadth Topic II

With the staggered truss system, precast concrete planks will be used for the floors. Using prefabricated members would allow for quicker erection and no time would be needed for the curing of concrete. A new site plan will be developed to communicate the flow of construction over time, detailing site access and crane locations. Precast member weights will be evaluated and an appropriate crane will be selected in order to adequately maneuver members.

Task and Tools

Structural Depth: Staggered Truss

- Develop initial plan of truss locations and layout per floor
- Create computer model
- Determine precast plank specs based on existing bay sizes
- Determine required member sizes
- Check loads from planks on trusses and redesign accordingly
- Perform lateral analysis
- Design standard steel framing for sections of hotel that will not be supported by trusses, such as the stairwell at one end of the building, and the lower floor levels
- Redesign foundation for new loads, determine whether piles should be changed to caissons

Breadth I: Architectural Impact (Interior)

- Check initial layout of trusses with room locations
- Determine best truss locations that require the least amount of room layout changes
- Make changes needed to building geometry or interior spaces
- Develop floor plans implementing new changes

Breadth II: Site Plan

- Determine approximate weights of truss and precast plank
- Create existing site plan
- Research and choose construction crane capable of carrying largest member weight
- Develop new site plan with crane location and site access

Conclusion

This thesis will focus on redesigning the Seneca Allegany Hotel addition's structural system by way of a staggered truss. Through use of computer modeling and careful planning, the staggered truss will be compared to the existing metal deck on steel framing system to determine whether or not the staggered truss could be a viable alternative. The truss will take the place of interior columns and remove filler beams in an attempt to lighten the overall weight of the building. This will impact the foundations considerably, requiring a redesign to reduce the size and number of the existing steel piles.

After a reasonable layout of trusses is developed, a study of their impact on the interior room layout will be conducted. Depending on where the trusses may fall, the building's geometry may be altered and interior spaces my need rearranging. Spaces affected will be shown through new floor plans. The use of precast members will impact the construction process, so a new site plan will be created to show crane locations and site access. An appropriate size of crane will be chosen based on the precast member that weighs the most.