Sallie Mae Headquarters
Reston, VA

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Structural Option
Technical Assignment #2
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Executive Summary

For this assignment I will be analyzing four alternative systems for my building, Sallie Mae HQ. Sallie Mae is located in Reston, Virginia and consists of an underground parking garage and a 9 story office building. The parking garage was left out for this assignment due to the fact that it will remain concrete and alternative systems seem impractical. On the other hand, I analyzed a typical floor for the office building portion of Sallie Mae. The existing system for the office building is structural steel with a high quantity of cambered beams. The controlling factor for the design of all my systems would be the 45'-55' spans of the exterior bays spanning E-W. For the purpose of this assignment I simplified a strip in the E-W direction into a set of rectangular bays.

My alternative systems are post-tensioning, steel joist, precast concrete, and steel framing. For this design I came to the conclusion that post-tensioning won't work for slabs less than 13" deep because of the long spans. Also increasing slab depth over 14" would be very uneconomical due to the self-weight of the slab. Also the long exterior span is followed by a short 25' middle span which causes the tendon profile to be critical in my design. For post-tensioning to work 2-4 strands of ½ in. diameter, 7 wire, 270ksi strands are needed per foot of width. This makes post-tensioning a very possible solution.

The next two systems ended up with solutions that required 32" of structural depth. For the one way joist system a 32LH12 LH-SERIES JOIST is needed, and 4 rows of horizontal bridging is required with 16' max spacing. Also the decking could be reduced to a total depth of 4" due to the 4' spacing between the joists. Another concrete system that seemed reasonable was precast double tees. From analyzing Nitterhouse Concrete product catalog's, I picked a 32" x 12" Double Tee with .6 in. diameter, 7 wire, 270ksi strands.

The steel beam layout of the existing system was originally spaced at 9'o.c. So I attempted to change that spacing to 7'. The beam size needed for a 53' span was a W24 x 76 due to the fact that deflection controlled the design. It seemed that a lot of strength was being wasted on deflection, and I can understand why the original design had W27 x 84's spaced at 9' and cambered to resist that deflection. This design seemed to be a failure do to the fact that an extra beam per bay for 9 stories would be very costly.

Overall an alternate steel system is not a very efficient design, the joist and double tees are still probable, but post-tensioning seems like the forerunner for the best alternative design. This is due to the fact that there is a possibility because of the small depth compared to the existing systems, that another floor can be added to the building. In the long run this extra floor can offset any additional construction cost of the post-tensioning system.