



PROBLEM STATEMENT AND SOLUTION OVERVIEW



Problem Statement

Sherman Plaza is a complex building, and its structural system has been designed with careful consideration. While the existing system is an adequate and efficient design, the building will be reanalyzed in order to gain a greater understanding of the complexities involved in designing a high-rise building's gravity and lateral systems. This study investigates a different structural system in an attempt to produce a new system that will improve constructability, shorten construction time, and lower costs without decreasing the building's quality.

Several floor framing systems were analyzed in Structural Technical Report 2 to determine which could provide a suitable alternative to the existing system. It was found that the existing system had some drawbacks:

- The current building design has a reinforced cast-in-place concrete structure. This system is somewhat difficult and time-consuming to construct due to the need to place the formwork and shoring.
- The existing structural system is somewhat inefficient in terms of material usage. Due to the limited strength of the structural material, the bay sizes are restricted, resulting in a dense column grid. The lateral resisting system also uses a large amount of concrete for the shear walls and the large columns and edge beams that make up the moment frames.
- The reinforced concrete system has a high weight, which results in the need for large foundations. The shear walls also need a large grade beams for support.

To achieve the goals of shortening construction time and reducing weight and building costs, the structural depth study of this report examines the effects of changing the structural material from concrete to steel. In addition to the structural analysis, two other building disciplines were investigated in order to determine the effect that the structural material change would have on them. A study was performed in the construction management breadth area in order to compare the time and costs of the two structural systems. The acoustics of the new wall and floor systems were also analyzed to determine if they provide adequate sound transmission loss.

Problem Solution Overview

The building analysis in this report attempts to produce a structural system that is efficient in material usage, constructability, time and has a lower weight than the existing system. To accomplish this goal, the existing reinforced concrete system was replaced by a new structural steel system. A study was performed to investigate the effectiveness of this system and the impact it will have on other aspects of the building.

In Structural Technical Report 2, two steel floor framing systems were analyzed to compare the pros and cons with the existing system. It was found that both a composite and non-composite system would work for the building, but each of the systems has its strengths and weaknesses. A drawback to the steel systems is that they have a large ceiling to floor section depth. This larger depth increases the total building height, which causes an increase in costs in items, such as exterior cladding, mechanical equipment, etc. Therefore, the non-composite system was not considered, because it has an even larger section depth than the composite system. Although the composite system depth is larger than the existing concrete depth, the cost and schedule analysis determines if the other advantages to the steel system outweigh this drawback.

The steel system allows savings in time and cost in other areas and has the following advantages over the existing concrete system:

- The building's weight was reduced by switching to steel, which in turn allowed the size of the foundations to be reduced. Since the foundations are belled caissons extending 70 feet with a maximum diameter of 15 feet, a smaller caisson size resulted in significant savings in concrete.
- The steel system is easier to construct, because it does not require the use of the formwork and shoring necessary for the concrete flat plate floor system. Therefore, the construction time was reduced.
- The use of steel for both the gravity and lateral systems of the building eliminates the need to schedule both concrete and steel workers on the construction site which shortens the construction time.

There are also several considerations other than the floor framing to take into account about the structural system when changing the structural material. As already stated, the foundations were resized because of the decrease in building weight. In addition, the lateral resisting system was redesigned. The current system incorporates both concrete moment frames and shear walls. The concrete moment frames were replaced by steel frames. It was determined that steel braced frames would also be used instead of shear walls, in order to eliminate the need to tie the steel beams into the concrete walls. A steel lateral system required much less material, because the shear walls and large grade beams underneath were eliminated.