Steel Structure

Neglecting location, much of the time, concrete structures cost much more than steel buildings due to material costs, labor intensity, and erection time. An investigation study focused on the differences between steel and concrete and deciding which structure is more economical will be completed. The analysis and design were done based on the US standards mentioned above. RAM software was used to design the Agricultural Hall and Annex.

Design Loads

The same gravity loads mentioned above were used when analyzing the steel structure.

Frame Plan

The layouts of the floors were kept the same. Steel columns were placed at the same location as the original concrete columns. Several columns were added at the elevator shaft and stair wells because these were the braced frames locations. They help stiffen the frame to reduce the lateral drift. The Figure 43 shows the locations of these columns (red circles). The blue circles represent existing columns locations. All the steel beams were spaced 5' of center.

Fig. 43 – Typical floor plan
Red = new columns added
Blue = existing columns location
**Lateral System**

The first choice of the lateral resisting systems was to have only moment frames around the perimeter of the buildings. This was done mainly to test whether braced frames were needed around the elevator and stair wells or not. However, the drift exceeded the limit specified which was L/400. The drift due to wind and seismic was 11 inches. The only locations where braced frames can be added are around the elevator shaft and stair wells because of the layout of the floors. Braced frames could not be located on the perimeter of the building due to the openings of the windows. The added braced frames were not strong enough to limit the drift to L/400; therefore, moment frames were added around the perimeter of the buildings. Figure 38 shows the locations of the braced frames. The maximum drift obtained was 1.7 inches.

Figure 44 – Braced Frames locations – circled
Moment frames around the perimeter
Fig. 45 – 3D of Moment Frames and Bracing Frames
Typical Floor System Result

Figure 46 – Typical Flooring System Beams and Girders
Typical Framing Result

Frame 1

Frame 2

Frame 3

Figure 47
Frame 4

Frame 5

Figure 48
**Stress Design**

Once the lateral system was designed, members were checked for stress. This analysis was done to check the interaction equation based on the LRFD. The members that were overstressed had been resized to meet the code requirements. This was done with RAM software. Figure 43 shows the members that have been resized. Most of the members have green color which indicates a stress value between 0.80-0.89.

![Stress Check](image)

**Connection Check**

All gravity and lateral members were checked for connection strength. Both connections for the gravity beams and lateral members were checked. This check was done using RAM program. All the connection strength came out to be adequate and no warning was given by RAM.