STRUCTURAL BREADTH

The new river rejection system to be installed on the unoccupied first floor will contain new equipments and add tremendous new weight to the floor slab. The structural breadth will study and analyze the impact of the equipments on the beam and girder of the first floor.

METHODOLOGY

The first step in analyzing if the floor members can withhold the new mechanical system weight is to compile the square footage area of the required new system and also its weight. **Table 22** shows a breakdown of the weight and amount of space needed for each mechanical equipment. Extra space was given under "Misc Loads" for maintenance paths and walkways.

Table 20 – Mechanical Equipment Weight and Area

	Qty	Lbs/Each	Total Lbs	Area (ft^2)
Heat Exchanger	1	3,582	3,582	12
Pumps	2	660	1,320	24
Centrifugal Separators	2	722	1,444	6
Normal Weight Concrete Pad (lbs/ft^3)	16	150	2,400	0
45ft - 8"D Piping with water (lbs/ft^3)	15.7	62	973	30
Priming System - Vacuum pump	1	900	900	12
Misc Loads (5% Total)	0.05	10,619	531	120
		Total	**11,150**	**204**

To figure out how to load will affect the floor members; the location of the mechanical system needs to be laid out in order to determine which members will be affected. Figure 16 shows the sizes of beams and girders in question and also the space where the mechanical equipments will be placed.

Figure 17. First floor structural plan.

BEAM ANALYSIS

The dead load and the live load of the total area need to be added together to get the distributive load on the W14x90 beam. This is calculated by using the equation:

$$(1.2)(DeadLoad)+(1.6)(LiveLoad)=TotalLoad$$

Table 21 shows the breakdown of how the total load was computed.

Table 21 - Dead and Live Loads			
Dead Load	PSF	Live Load	PSF
2.5" LW Concrete	23.95	River Rejection System	161.9
MEP	5		
Metal Deck	2		
Total	**30.95**	**Total**	**161.9**

1.2D+1.6L= 296.18

The total load is calculated to be 296.18PSF. This load needs to be multiplied by the tributary length and divided by 1000 to get kips/linear foot. The load is 7.4 KLF. The next step is to find the ultimate moment of the beam; this will help size the beam that is able to bear the moment the equipments will be applying.

$$Mu=\frac{Wl^2}{8}=\frac{(7.4)(25)^2}{8}=578kip-ft$$

Using the *AISC Steel Construction Manual*, and using M_n=578 kip-ft and an un-braced length of 25ft, the beam was sized as a W18x130, with an I_x=1,750 in^4.

The next step is to check if this beam is under the depth of the W18x808 girder while also not exceeding the maximum defection. The depth of the W18x808 can be looked up in the dimensions section of the steel manual. The depth for the W18x808 is at 23inches. This means that the new beam W18x130 cannot exceed this depth. The depth of the W18x130 is 18.6inches, which does not exceed the girder and will work.

The last step is to analyze that the actual deflection does not exceed the maximum deflection limit. The equation for this is:

$$\frac{L}{360} > \frac{5Wl^4}{384IE}$$,where

L=25ft, W=7.4Kips/Linear Foot
I= 1750in^4, E= 29,000 KSI

$$.83 > 7.4E^{-4}$$

GIRDER ANALYSIS

The girder is sized at W18x808 and spans 90 feet across the building. The girder also carries the point loads from the beams on the first floor as well as the column loads from the twelve stories above. With such an enormous amount of load being put on the W18x808 girder already, the additional 10kips of mechanical equipment load is minuscule compared to the overall load.

CONCLUSION

In conclusion, the W14x90 will not be able to support the new mechanical system being placed on the unoccupied first floor of the building. Through checking the ultimate moment and the maximum deflection of the new load, a W18x30 is the best option to support the new load. Also, since the new load will affect the girder, an analysis was done to determine whether or not the W14x808 girder could stand up to the newly added 10kips. Being that the girder is already sized to handle the load of the beams of the first floor and also all of the twelve floors above, the 10 kip will not affect much of the girder.