THE DESIGN OF A TOWER FOR A 50,000-GALLON HEMISPHERICAL BOTTOM TANK.*

PERHAPS the most common size and type of elevated steel water tank in use to-day is the 50,000-gallon tank with hemispherical bottom. Its average height is about 75 feet and it is usually supported on a four-post tower. We will attempt to go through the various steps in the design of the tower in the shortest and simplest way.

The structure must be strong enough to withstand the following loads: (1) The water in the tank; (2) the weight of the tank and tower itself; (3) the wind load.

Other loads sometimes considered are snow on the roof, and the weight of people on the balcony, but it is evident that snow would not stay on a roof while the maximum wind load was acting, and it is not customary for any one to take a pleasure trip up to the balcony of an exposed water tower when a hurricane is blowing at the rate of 100 miles per hour.

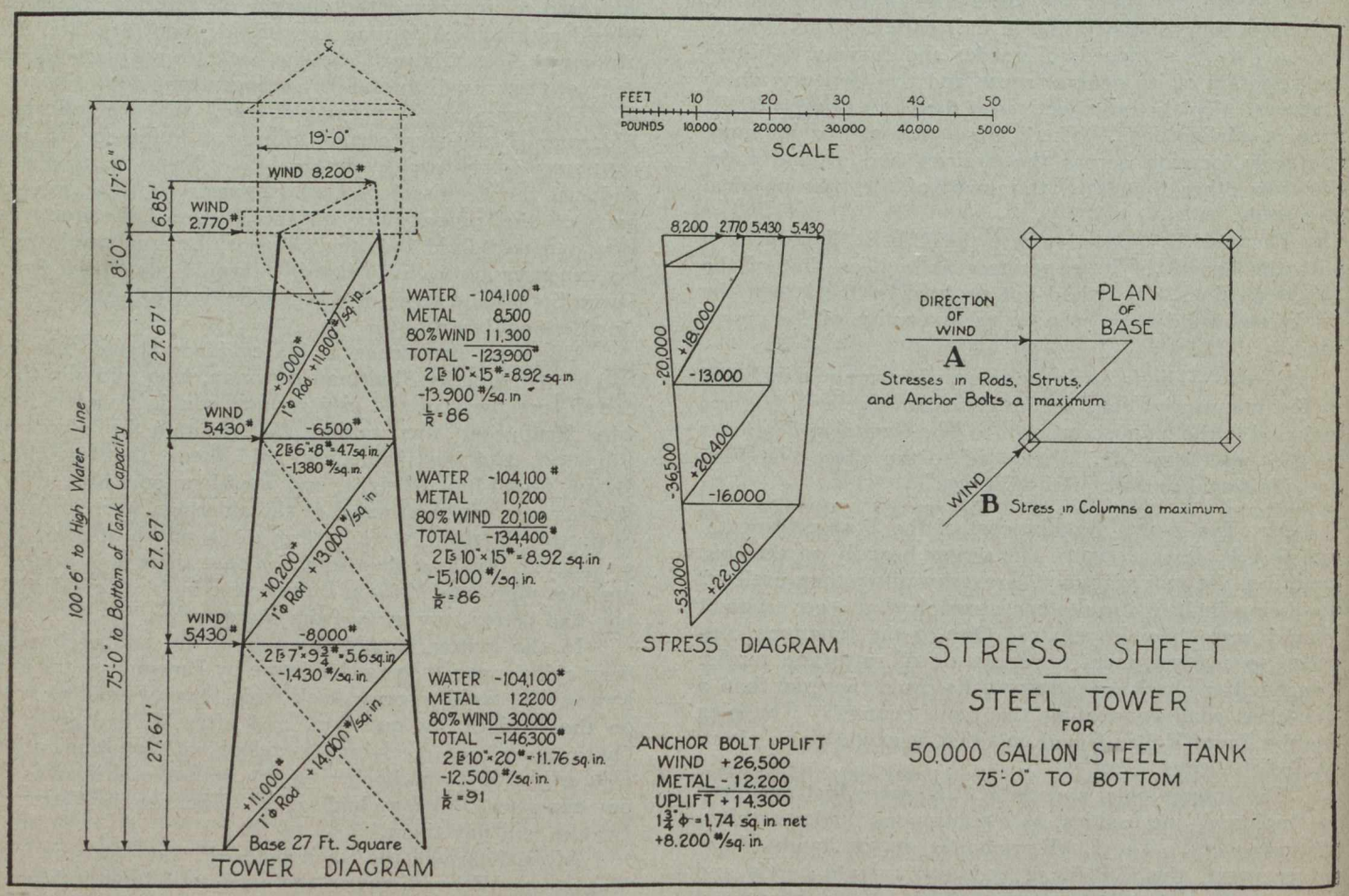
The stresses caused by the above loads will be considered in the order given.

(1) Water Load.—The weight of the water is transmitted directly to the foundations through the columns. The struts and rods receive no part of this load. Each column takes one-quarter of the total water load, or 104,100 pounds. Opposite each panel on the diagram is given the loading on the columns. The water load is given first and it remains the same in each panel.

(2) Metal Load.—The weight of the tank and tower itself, or metal load, can be only approximated at first. After the design is finished and the total weight of the structure is calculated, the correct metal loads can be substituted, and the stresses recalculated.

(3) Wind Load.—The maximum wind velocity in any part of this country will produce a pressure of about 15 pounds per square foot of projected area on a surface such as that of a hemispherical bottom tank. For the particular tank given this load is 8,200 pounds, and it is considered acting at the centre of gravity of the projected area, which is 6.85 feet above the balcony line.

It is common practice to assume the wind load on a four-post tower to be 200 pounds per vertical foot and to assume that it acts at the panel point, or strut line. The tower is 83 feet to balcony and has three panels of 27⅔ feet each. The tower wind load is then 2,770 pounds at the balcony and 5,430 pounds at each panel point. These loads are shown on the tower diagram with arrows indicating their direction and point of application.



The wind stresses are usually determined by the graphical method, as this is perhaps the easiest and quickest way. It is not material just how the stress diagram is drawn; although the result should be the same as that shown, another system may give a diagram in the reverse order. In the case given, the loads were laid off at the top and the forces were taken counter-clockwise around each point.

The maximum stresses in the rods and struts occur when the wind is blowing from direction A. These stresses are one-half of those obtained from the stress diagram, as the wind loads used in drawing the diagram were the loads for both sides of the tower.

The maximum column stresses occur when the wind is blowing from direction B and they are equal to .707

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