accordance with common practice, and gives good results, although there is no apparent justification for the reduced unit stress. The tank plates are just as strong as structural shapes, and the loads coming upon them are just as capable of exact calculation. Of course, the ordinary reason for using a reduced unit stress is to provide extra section to cover corrosion and other forms of deterioration. It would seem more rational to provide for this by an arbitrary addition to the thickness computed from the static pressure and net section. In fact, the writer has found it desirable and not any great hardship to specify an additional thickness of 1-16 inch for tanks designed for a unit stress of 12,000 lbs.

The allowable shear on rivets is given as 12,000 lbs., with no stipulation that there shall be any reduction of this unit stress for rivets in tank plates. If the tank plates are designed for 12,000 lbs. per square inch in tension, the rivets certainly ought to be designed for proportionately low unit stresses in shear and bearing. The allowed shear on field rivets and bolts is lower than that usually permitted. It is customary to prescribe that the number of field rivets shall be increased 25 per cent. more than the number required for shop-driven rivets. On this basis the shear in field rivets would be 9,600 lbs. per square inch instead of 9,000 lbs.

No information is given in the specifications as to the efficiency of riveted joints. This is an important feature in designing tanks and boilers, as the computations, usually are made directly on the basis of the efficiency of the joint, rather than by the more indirect process of computing the net section. It would be desirable to include a table showing the computed efficiencies of single- and double-lapped joints and single-, double-, and triple-riveted butt joints for various thicknesses of plates and diameters of rivets. Such tables are used by every manufacturer, and are published by some of them.

The use of the percentage of efficiency in the joint results in a simple formula for determining the thickness of plates in tanks subjected to hydrostatic pressure. Thus, if D = the diameter of the tank, in feet, H = the height, in feet, from the point considered to the surface of the water; the pressure, in pounds per square inch = 0.434 H. The tension in the plate for 1 inch in height = t = 2.6 D H. The required net area of the plate for 1 inch in height = A = t ÷ f, f being the unit stress, in pounds per square inch of net section. For f = 13,000 A = 2.6 D H ÷ 13,000 = 0.0002 D H. For an efficiency of two-thirds in the riveted joint, the gross area in 1 inch of height = the thickness of the plate, in inches = A ÷ ⅔ = 0.0003 D H. To this should be added the additional thickness of 1-16 inch already referred to. This formula, thickness of plate = 0.0003 D H, makes a convenient and rapid method of determining the thickness of tank plates. For a unit stress in tension of 12,000 lbs. the same formula results, if an efficiency of 72 per cent. is assumed.

It is customary to design on a basis of efficiency of at least 66 per cent., and that would rule out all single-riveted lap joints. Section 14 specifies lap joints for vertical seams in plates ⅜-inch thick and less, but does not specify whether they shall be single or double. They should be specified as double-riveted, with the possible exception of ¼-inch plates, in which the full strength of the plate is not developed. Double-riveted butt joints with the rivet diameters specified in section 15, will secure an efficiency of at least 70 per cent. up to and including a thickness of ¾-inch. For that reason it would seem desirable to design for an efficiency of 70 per cent., and specify triple-riveted butt joints for plates having a thickness of 13-16-inch or more.

The unit stress in compression should be limited to a maximum of 15,000 lbs. for short columns.

Section 10 is ambiguous in that it allows unit stresses of 20,000 lbs. in bracing, without specifying whether the unit stress referred to is for tension, compression, shear, or bearing. It gives a desirable addition to the bracing—which otherwise may be designed too light—to assume an arbitrary initial stress in all bracing members of 5,000 or 10,000 lbs.

Section 12, specifying that plates forming the sides of cylindrical tanks shall be of different diameters, is not explicit. Of course, it means that the inside diameter of one plate shall be the same as the outside diameter of the next one.

In Section 13 it is not clear just wheat is meant by radial seams in a spherical bottom.

Section 16 specifies that plates more than ⅝-inch thick shall be sub-punched and reamed, but does not specify the diameter of the punched hole and the amount to be removed by reaming.

Section 29 gives a rule for proportioning the stiffening member around the top of the tank, and specifies that the section modulus may be reduced under certain conditions, but does not specify definitely to what extent it may be reduced.

Section 35 allows an additional height of 6 inch for overrun. This is not clear. Presumably the meaning is that 6 inch in height shall be added to that required for the specified capacity in gallons.

Section 36 specifies that the bracing in towers shall be adjustable. Certainly riveted bracing for towers is better practice, although adjustable bracing may be allowable, on the score of economy, and the riveted bracing should not be excluded.

Section 37 specifies unit stresses in the anchor-bolts not exceeding 15,000 lbs. per square inch. Presumably, this refers to unit tensile strength, but it is not explicit. There is no specification covering the excess of the area at the root of the thread, and no specification which would produce good details in the design of the anchorage connections. Too many anchor-bolts are connected simply through the base plate of the column without provision for developing properly the full strength of the bolt, and this should be covered by a specification which will insure a good detail.

Section 38 specifies concrete sufficient in quantity to take the uplift, but does not provide any factor of safety. It is good practice to provide at least 1½ or two times the computed uplift in the weight of the concrete. Furthermore, the specification should include a provision that the arrangement of the anchorage in the concrete shall be such as to develop the full weight without depending on the tenacity of the concrete to hold the mass together; otherwise, this provision is apt to be overlooked, thus resulting in bad practice.

Sections 40 and 41 specify that the quality of materials and workmanship shall be according to certain specifications referred to by name. It would add little to the bulk of these specifications and much to their completeness if the specification for quality of materials and workmanship were written out in full.

(Continued on Page 22.)

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

7279—June 1—Authorizing the Essex Terminal Railway Co. to take additional lands for the purpose of alterating its line at the Windsor Fair Ground and Driving Association, Windsor, Ont.

7280—June 18—Ordering the C.P.R. early in the spring of each and every year, and before the water commences to run, to clear away any ice and snow that may have formed during the winter months underneath the bridge over Buffalo Lake on the north-east quarter of Section 32, Township 2, Range L, west first principal meridian, Manitoba.

7281—June 18—Directing the Canada Atlantic Railway (G.T.R.) to provide a suitable crossing where the company's railway abuts the land of Thos. Wilson, in the County of Carleton, Ont., near Ottawa, Ont.

7282—June 18—Approving by-law of the Salisbury and Harvey Railway, authorizing A. Sherwood, general manager for receiver, to prepare and issue tariffs of tolls to be charged for all or any tariffs carried by that company.

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