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Riveted Joints for Steel Penstocks and Tanks

Formulae and Tables for Their Design—Selection of Proper Type of Joint—Examples of Solution for Maximum Joint Efficiency — Discussion of the Heavier Types, Including Triple, Quadruple and Quintuple Riveted Butt and Double Strap Joints

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IN this paper the writers have endeavored to outline in a clear and practical way the essential points in connection with the choice and design of riveted joints in steel plate cylinders.

Very little is to be found in engineering texts on the design of the heavier type of riveted joints, that is the triple, quadruple and quintuple riveted butt and double strap joints. It is therefore hoped that the section of this paper covering that portion of the work may be of considerable interest to designers.

The selection of the proper type of joint to be used in any particular case, will first be discussed, followed by the method of design, numerical examples, and tables giving the dimensions recommended by the Hartford Steam Boiler Inspection & Insurance Co. for the various types of joints.

Nomenclature

e = Efficiency of joint, expressed in decimals.
f = Tensile strength of plate, in pounds per square inch.

FIG. 1—EUGENIA FALLS PENSTOCK, 54-INS. DIAMETER, WITH TRIPLE-RIVETED BUTT JOINT ON LONGITUDINAL SEAM AND DOUBLE-RIVETED LAP ON GIRTH SEAM

t = Plate thickness, in inches.
b = Butt strap thickness, in inches.
p = Pitch of rivets, in inches, in row having greatest pitch.
d = Rivet diameter after driving, in inches.
D = Internal diameter of cylinder, in inches.
a = Cross-sectional area of rivet after driving, in square inches.
s = Ultimate strength of rivets in single shear, in pounds per square inch.
S = Ultimate strength of rivets in double shear, in pounds per square inch.
p = Internal pressure, in pounds per square inch.

Selecting Proper Type of Joint

Where the thickness of the plate is dependent upon factors other than the internal pressure, such as rigidity of the section against collapsing, the type of joint depends

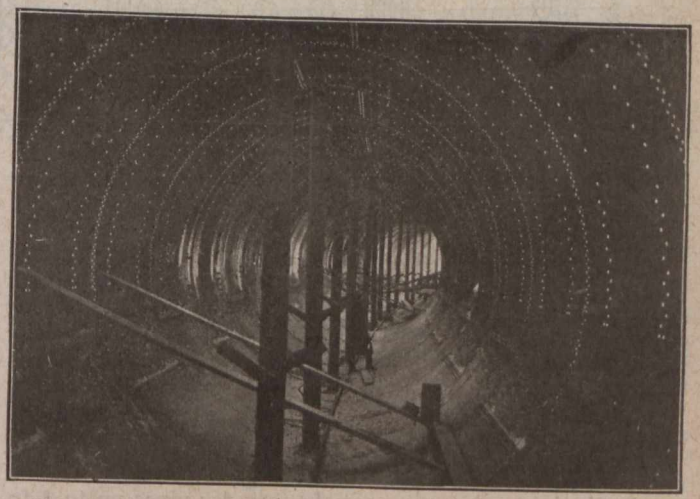

FIG. 2—DOUBLE-RIVETED LAP JOINT IN 18-FT. DIAMETER PIPE, ONTARIO POWER CO.

largely on the effiiciency required. To determine the efficiency, the following formula may be used:—

$$e = pD/2ft.$$

Having thus determined the efficiency, and knowing the thickness of plate, the proper type of joint can be selected from the accompanying standard charts, or it can be designed by the methods given in the latter part of this paper.

Where the plate thickness is governed by internal pressure, for a pipe of given diameter, the problem resolves itself into one of choosing that type of joint which will give the most economical pipe section. This is not always accomplished by using the most efficient joint, as will be pointed out later.

Riveted Lap Joints

On girth seams, the single riveted lap joints are sometimes used, particularly in the case of small diameter pipes, but are not to be recommended for pipes over 5 ft. in diameter.