MODERN PRACTICE IN WOOD-STAVE PIPE DESIGN AND SUGGESTIONS FOR STANDARD SPECIFICATIONS

IN the Proceedings of the American Society of Civil Engineers for August, 1917, a paper on this subject, by J. F. Partridge, Jun.Am.Soc.C.E., was printed. The following discussion of Mr. Partridge's paper, by O. P. M. Goss, Assoc.M.Am.Soc.C.E., and W. H. R. Nimmo, Assoc.M.Am.Soc.C.E., published in Proceedings of the American Society of Civil Engineers, September, 1917, will doubtless interest many readers.

O. P. M. Goss: The writer has read this paper with considerable interest. It contains some very interesting suggestions, and is believed to be a step in the right direction, at least in so far as it suggests the standardizing of specifications covering the design and construction of wood-stave pipe. This subject, however, is very important and should receive thorough consideration before any definite specification is approved.

There are, for example, certain statements in the paper which are not based on the natural laws underlying the most approved use of wood. In offering the following comments for consideration, the writer has endeavored to set forth certain facts which cannot be ignored in the general discussion of wood-stave pipe.

On page 565 of the April, 1917, Proceedings of the American Society of Civil Engineers the author states:

"Fir and pine are pitchy woods, and it is impossible to obtain commercial run lumber without sap, pitch, pitch seams, pitch pockets, and knots. Under conditions of partial saturation, this lumber will not last, and, even with saturation, the pitch and sap will be the cause of deterioration. Most failures are attributable to this fact. There are conditions under which fir or pine will have a long life and give perfect satisfaction."

Pitch does not in any way cause the deterioration of timber. Tests of recent date, made at the U.S. Forest Service Laboratory, indicate that wood containing resin deteriorates a little less rapidly, on the average, than that which is free from this substance. The following quotation is taken from a recent report issued from the U.S. Forest Products Laboratory, at Madison, Wis.:

"Relation of Resin to Strength and Durability.—Data on the effect of resin on durability were worked up for 105 samples of long leaf pine. The results, when considered as averages for four durability classes, indicate that increasing amounts of resin tend to be directly correlated with increased durability. Individual blocks do not necessarily bear out this relation, showing that there are other factors involved."

The following quotation is from page 567 of the paper:

"The cases of redwood pipe already cited illustrate its adaptability, whether laid on the surface of the ground, partly or completely buried, or run through salt marshes or tropical swamps in direct contact with the soil humus. Direct exposure to the rays of the desert sun, and alternate wetting and drying when the pipe is used intermittently in irrigation systems, do not lessen its efficiency."

The writer cannot see how any one can make such a broad statement, and particularly that "Alternate wetting and drying when the pipe is used intermittently in irrigation systems" does not lessen its efficiency. Again, tests made recently at the U.S. Forest Products Laboratory indicate that all woods are subject to decay under adverse conditions. It could only be considered good engineering when conditions are prevented which would tend to make any wood less durable. Heartwood from the California big trees, at the end of a 12-month test, showed a loss in weight of 35.1 per cent., due to deterioration. This wood is not the same as redwood, but is similar, and is used here in the absence of similar data for redwood. Western red cedar, an unusually durable wood, under similar conditions, showed a loss of 21.3 per cent., but it is reported that the samples were too wet to give a fair test, which indicates that 21.3 per cent. loss is lower than a fair test would have shown. Port Orford cedar, readily conceded to be one of the most durable woods, showed a loss of 22.6 per cent., which, again, is lower than the value would have been had the specimens been less saturated. Douglas fir showed a loss of 28.1 per cent., according to these tests. Deterioration, in this case, also, was somewhat retarded by an excess of moisture. These results show that the most durable woods are likely to decay if subjected to adverse conditions. Due to this fact, no wood pipe, regardless of the species from which the staves are made, should be laid under unfavorable conditions without taking practical precautions against decay of the wood fibre.

On page 570 the author (Mr. Partridge) states:

"Fir and pine, being hard woods compared with redwood, and being coarse-grained, having wide rings of hard and soft wood, enter the classification of woods giving excessive percolation, with slow and incomplete penetration. This is caused by the water passing rapidly through the soft summer wood, appearing in drops on the outer surface of the pipe, and of penetrating but slowly, and often through only a fraction of a stave, along the hard winter rings. The result is a stave showing percolation and incomplete penetration at alternate points throughout its cross-section."

Douglas fir, as a matter of fact, is one of the most difficult woods to penetrate with a liquid, and, in this respect, might about as well be classed with metal as with pine. In creosoting timber, throughout the United States, there has seldom if ever been found a wood which has required so much scientific study to secure thoroughly satisfactory impregnation as has been the case with Douglas fir. In the treatment of ties of this wood, it is highly desirable to perforate the sides of each tie with fine holes, uniformly spaced, in order to get an effective injection of creosote oil.

It is usually specified that pipe staves of Douglas fir shall be practically free from all defects, which means that this stock must not be cut from the centre of the log, which usually contains most of the knots and other defects. Due to this fact, the staves are cut from the fine-grained material found on the outer portion of the large fir logs, and not from the coarse-grained material, which is almost always confined to the centre portions of the tree.

In the selection of pipe staves, care is taken to eliminate coarse-grained material. No difficulty whatever is experienced in eliminating practically all the sap wood, and, in pipe properly manufactured, the sap is never allowed to occur on the outer portion of the stave. Sap is not considered a defect on the inner portion, in a line which is in continuous service, because of the fact that, under this condition, it is always thoroughly saturated.

In Douglas fir staves of medium and fine growth, the summer and spring wood bands of the annual ring are so close together that if either is thoroughly saturated the adjacent one must also be wet.

The soft portion of the annual ring of redwood is more porous than the corresponding part of Douglas fir, as