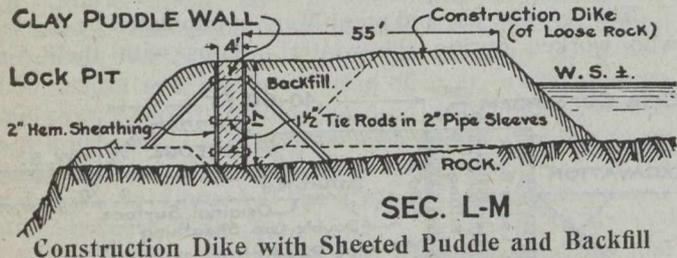


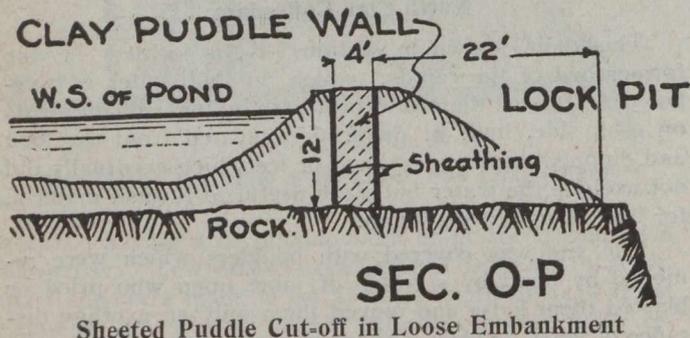
covered with tarpaulins under which exhaust steam was discharged at night. The puddlers wore rubber boots and used wooden rammers. The puddling shrunk 33 1/3 per cent, from box measurement. Portions of the wall pro-



jecting above the surface of the ground were confined by sheeting of horizontal boards, nailed or braced vertical posts. This trench was dug and puddled in 4 months by an average force of 50 men. The cost was \$545 for stripping boulders, \$8,433 for 2,845 yds. excavation, \$2,227 for labor and supplies required for 3,000 yds. clay puddled, \$2,099 for 4,790 yds. of clay box measure, and \$1,092 for labor on 550 yds. of backfill, making a total cost of \$10.96 per linear foot or \$0.934 per square foot of wall. In the construction of this dam the extra cost of drilling and blasting frozen materials was more than compensated by the reduced amount of pumping and the cheaper hauling in sleighs that was secured by doing the work in winter instead of summer.

**Northwest Cofferdam**

The northwest cofferdam, 540 ft. long, consists of a dike made of rock fill 20 to 30 ft. wide on top made in 16 ft. of water with spoil dumped in position at no extra cost



**Sheeted Puddle Cut-off in Loose Embankment**

and provided with a puddled clay core wall, as shown in section L-M.

About 190 ft. of the puddled clay wall was built in a shallow trench and the remaining 350 ft. of puddled wall, which is much higher, was built between walls of wooden sheeting set up in an open trench. Both sides of the wall were backfilled with loose rock. A leak through a rock seam under the cofferdam was capped with a 4 x 4-ft. concrete box having a 4-in. vent pipe overflowing into the tailrace. The rock seam was caulked several feet both sides of the box.

The cost of this section of the dam was \$605 for development and incidental labor, \$3,744 for excavation, \$919 for sheeting lumber and labor, \$2,552 for wall clay and labor, \$1,149 for backfill, and \$1,711 for ramming leaks, etc., making a total of \$10,680.

**West Clay Cofferdam**

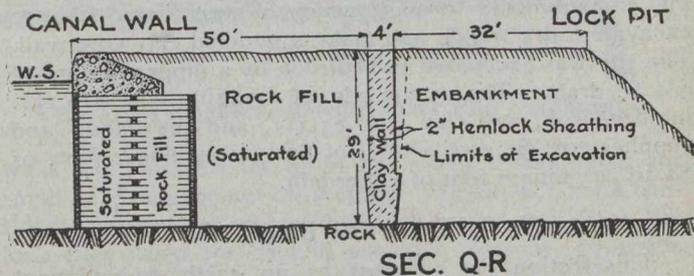
The west clay dam, 258 ft. long, shown in section O-P, is a puddled clay wall with earth embankment on both sides, part of it being built without excavation and part being built in an excavation through an embankment

which furnished material for the side slopes. The cost for excavation was \$711, clay wall labor and materials, \$1,632, sheeting, lumber and labor, \$292, backfill and labor, \$572, total, \$12.43 per linear foot, or 97c. per square foot.

**Southwest Clay Dam**

The dam, 179 ft. long, is shown in section Q-R and consists of a puddled clay wall built in an existing rock fill.

The trench was excavated through frozen embankment, the sides sheeted with 2-in. vertical hemlock plank. The maximum width of the puddle was 5 ft., and the maximum depth of the trench 35 ft. The cost was \$1,934 for 603 yds. of excavation, \$420 for sheeting, labor and timber,



**Crib and Rock Fill with Sheeted Puddle Cut-off**

and \$1,102 for clay wall labor, making \$19.31 per linear foot, or 64c. per square foot of wall.

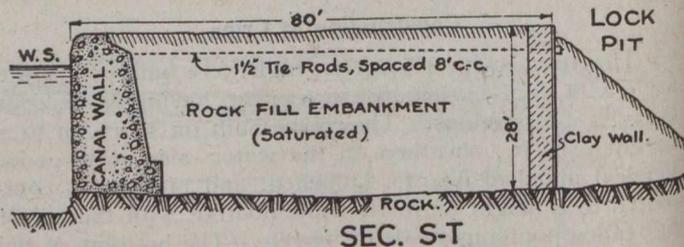
**Southwest Clay Dam**

The Lally dam consisted of a wide saturated rock fill embankment faced by a concrete canal wall and was supplemented at one end by 240 ft. of anchored sheeting 22 to 28 ft. deep, puddled with stock-rammed clay.

Six-inch by 12-inch hemlock sheeting was driven to rock in an old puddled clay wall and anchored with 1 1/2-in. horizontal tie rods 8 ft. apart. It was built at a cost of \$2,550 for timber and iron, \$1,747 for labor, and \$375 for stock ramming clay and labor, making a total of \$12.24 per linear foot of wall.

**Unwatering the Cofferdam**

The amount of pumping to keep the cofferdam dry varied from a minimum daily average of 850,000 gallons in winter to a maximum daily average of about 3,000,000 in summer, the maximum of any single day being about 4,000,000 gallons. The water was handled by an 8-in. pump with 85-h.p. motor, one 6-in. with 50-h.p. motor, one 5-in. with 20-h.p. motor, and one 4-in. with 15-h.p. motor, besides which there was kept in reserve a 10-in.



**Concrete Wall and Rock Fill with Anchored Clay Cut-off**

with 100-h.p. motor, all the pumps being of the centrifugal type.

Between September 26th, 1909, and October 23rd, 1911, 1,242,628,000 gallons was pumped at a total cost of \$21,816, including \$11,428 for labor and \$6,975 for electric power at 1c. per kw.-hr.