of contact surface will be increased as the temperature of the dam body increases.

Thus far only arch dams have been mentioned, but it would not require much explanation to show the advantage of tight grouted contraction joints on straight gravity dams also.

Grouting the contraction joints under pressure on straight dams throws longitudinal compression on the structure, and enables it to act as a beam held at both ends, at least until the initial compression has been overcome by the beam tension. A trial calculation will prove that the factor of safety has been greatly improved, especially at the lower levels, unless the dam is very long.

Grouting Worth Its Cost

The grouting of the joints naturally improves the watertightness of the dam, and, for this benefit alone, it is worth its cost. Judging from the results of analysis of leakage water through concrete dams, there are good reasons for assuming that a tight dam is going to remain safe for a longer time than a leaky one, although the writer is not attempting to predict the probable natural life of any dam.

A straight dam which has its contraction joints grouted under pressure during the cold season, will automatically have this pressure increased during the warm season, at the site of about 11 lbs. per square inch for each degree of rise of temperature of the concrete of 1° Fahr., as this material tries to expand and cannot. This, of course, should be allowed for, when selecting the grouting pressure for a straight dam. There could be no objection, however, to having a longitudinal compression of, say, from 200 to 300 lbs. per square inch, or even more, on the concrete during the warm season.

A typical grout piping arrangement for a rather large dam section is shown by Figs. 5 and 6.

Feed Pipes Remain in Dam

On the plan of the contraction joint on Fig. 5 there are two vertical feed pipes which are desirable on a joint of the kind shown. Each vertical pipe feeds a system of horizontal pipes arranged at different levels. These horizontal pipes are provided with slots wherever they cross the open space of a joint (Fig. 5). When the pipes are put in place, these slots are covered with paper and cheesecloth to prevent the concrete from entering the pipes from the outside and blocking them. Later, when the contraction joints open, this covering will either adhere to the concrete, or the grout pressure will burst it open.

The pipes cannot be recovered, but will remain forever buried in the dam. They are necessary, however, in order to keep the grout in a liquid condition from the time it leaves the pump until it passes through a slot very close to the desired point of deposit. The iron walls of the pipes do not absorb any of the water in the grout; the absorption, however, commences as soon as the grout leaves the exit slot in the pipe and comes in contact with the concrete walls of the joint. Therefore, his outside grout sets first and shrinks, to a large extent. The grout in the pipe system, being fluid for a long time, is able to follow up the shrinkage and fill out the cavities and keep the joint under pressure until the filler has solidified, in from ½ to 1 hour or more.

Avoiding Air Pockets

To avoid air pockets as much as possible, and otherwise to insure uniform work, the grouting should proceed from the bottom up; therefore a second, and movable, pipe is inserted in the stationary vertical pipe at the time grouting is to be done, as indicated in Fig. 5.

When starting to grout, one end of this movable pipe is to be at the bottom of the vertical pipe, the upper end being connected to the grout pump by a flexible connection. Grout is forced through the movable pipe and flows through the lower Tee, the lower horizontal pipes, and the slots in them; out into the space between the walls of the contraction joints, and rises vertically.

Before grouting commences the down-stream end of the contraction joints should be caulked (with lead wool) except for small stretches left open for exploration purposes. These are closed when the grout starts to flow out of them. The up-stream end of the contraction joints are generally provided with copper plates or other kinds of effective stops.

When the grout has reached the second story of horizontal pipes, or nearly to it, the movable pipe is raised so that the lower end is just above the Tee connection leading to those pipes. Grout is then forced into them, and, proceeding in the same manner as previously described, the crest is eventually reached. Then, finally, the pressure is kept on until the filler has thoroughly set. It is the grout pressure used on the last, or preferably on the last two joints, spaced one-third of the arch length apart, that determines the initial arch compression, and therefore on these the greatest care should be exercised.

Grouting During Cold Weather

If a dam is so large and high that it takes two or three seasons to build it, it is advisable to grout the lower third of the height at the end of the cold season, before the construction of the dam is continued; otherwise, the lateral expansion (Poisson's ratio), due to the weight of material on top, will tend to close the contraction joints. These spaces will always be narrower close to the foundation than higher up, due to shearing stresses, developed by shrinkage in the concrete close to the rock bottom, tending to prevent complete contraction.

When grouted during cold weather, an arch dam will always be under the influence of compressive stresses, and any knee in the deflection curve, due to inequalities in temperature during the construction period, will be flattened out. All told, the arch dam will act more nearly as intended, carry the load as calculated, and be more water-tight than without the grouting of the contraction joints. A straight dam will have its factor of safety increased, due to the positive beam action, and also be more water-tight.

Figs. 7 and 8 illustrate a simple arrangement of grout piping for the contraction joints of a small dam.

The public utilities of the city of Edmonton are all on a satisfactory basis, with the exception of the street railway system, and new rates have been adopted with a view to wiping out the deficit on this account. The statement of revenue and expenditure of the different departments for the month of March, 1918, shows a net surplus of $5,403 for all utilities. The surplus for the first three months of this year is $37,543, compared with $20,122 for the corresponding period in 1917.

A company, known as the Beaver Cove Lumber Company, Limited, has commenced the construction of a large pulp and lumber mill at Beaver Cove, B.C., 165 miles north of Vancouver. It is understood about $3,000,000 or $4,000,000 will be invested, and the daily capacity of the plant will be 40 tons of pulp and 100,000 feet of lumber. The company has timber resources totalling five billion feet. and the cost has been over $2,000,000. The property includes some fine spruce, which it is the intention to cut as soon as possible for use in aeroplane construction.