REPAIRING LEAKING EXPANSION JOINTS AT RECLAMATION FACILITIES

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Recently, the group at the Materials Engineering and Research Laboratory (MERL) used its expertise in chemical grouting methods and materials to repair a number of leaking expansion joints on some Bureau of Reclamation installations. Previous repair methods using other technologies were short-lived and not very effective. For these locations, a variety of polyurethane chemical grout materials were used to successfully stop water leaks through expansion joints.

Repairs were performed over the past 18 months on the Folsom Dam Power Plant deck (Fig. 1(a) and (b)), the Grand Coulee Pump Generation Plant deck (Fig. 2(a) and (b)), and the Davis Dam Power Plant and transformer decks and vertical expansion joints below the transformer deck (Fig. 3(a) and

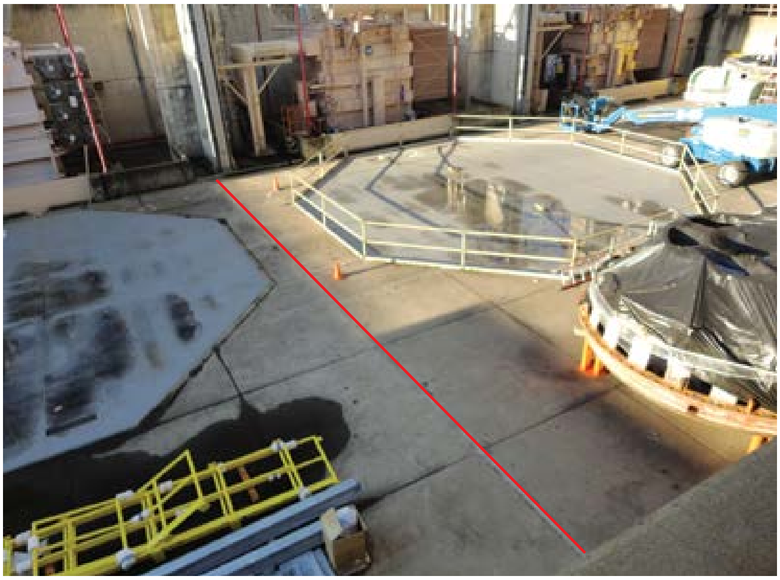


Fig. 1(a): Folsom Dam Power Plant deck—red line shows location of expansion joint

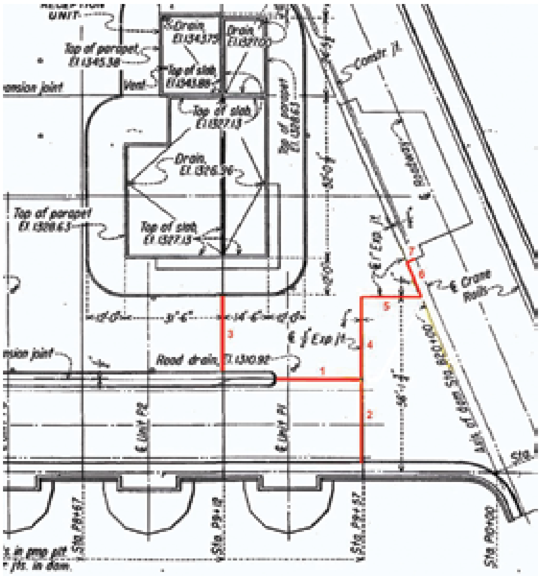


Fig. 2(a): Grand Coulee Dam—red lines show joints that were grouted

Fig. 1(b): Trash cans used to collect leaking water

Fig. 2(b): Photo of grout ports and grease zerks (b)). Leakage through the expansion joints was creating maintenance issues in the spaces below the joints. At Folsom and Davis, the water leakage was threatening electrical components in the power plants; and at Grand Coulee, the water leakage was affecting workers, materials, and equipment in the machine shops below the deck of the pump generation plant.

The specific reason the joints started to leak is unknown; however, badly deteriorated joint compound and corkboard were found in some areas of Davis Dam. At other locations, the leaking may have been the result of a failing waterproofing membrane and/or water seeping through existing rock pockets that resulted from poorly consolidated concrete during construction. During injection work at Folsom, stagnant water was pushed out of the joints by the expanding grout; at other locations, grout easily flowed out the bottom of the joint, indicating there was a path around the rubber waterstop.

Fig. 3(a): Davis Dam—typical expansion joint before grouting

Fig. 3(b): Repairs being performed below transformer deck

REPAIR METHOD

Numerous Bureau of Reclamation facilities are built with a similar expansion joint detail (refer to Fig. 4). While this detail appears sufficient and substantial, many of the facilities are experiencing leaks through these joints. MERL was first approached about trying to find a way to prevent leaks through the expansion joints at Folsom Dam Power Plant. Previously, Folsom's staff had tried unsuccessfully to repair the leaks by replacing the joint compound and rubber joint strip.

To determine the best way to repair the joints, a three-dimensional (3-D) cross-section drawing of a typical expansion joint at Folsom was created (Fig. 5). All of the relevant information about the

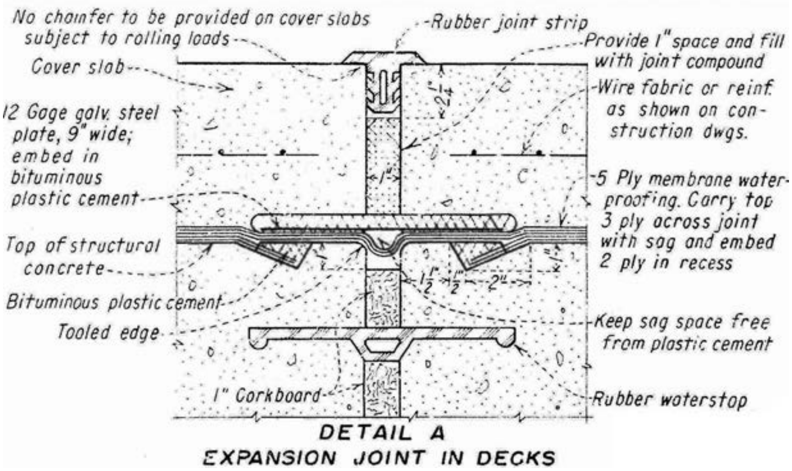


Fig. 4: Typical expansion joint detail (Note: 1 in. = 25.4 mm)

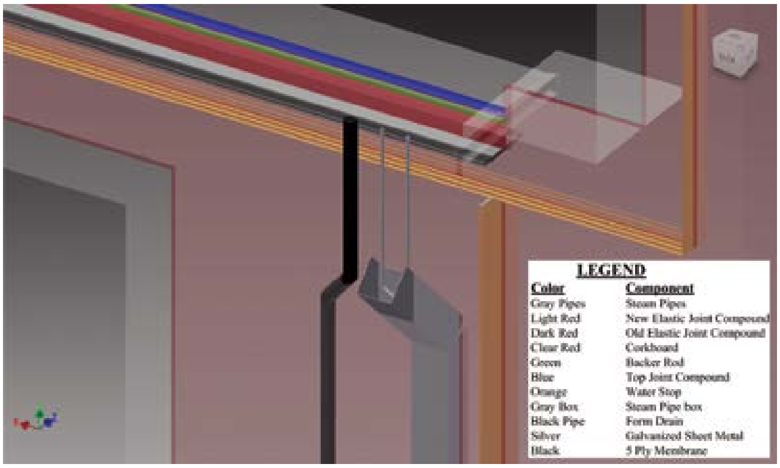


Fig. 5: 3-D drawing of expansion joint at Folsom Dam

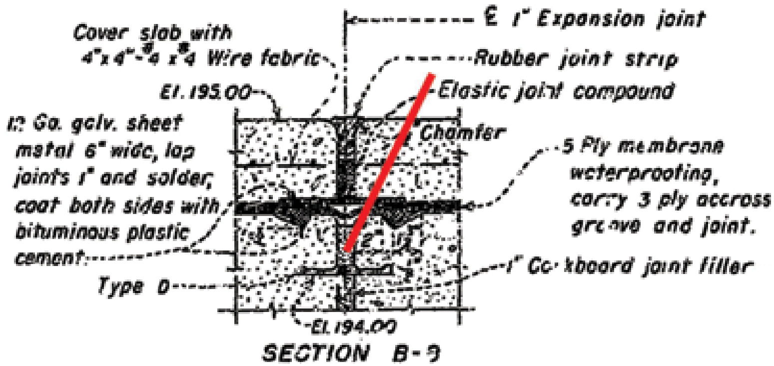


Fig. 6: Angled drill holes shown in red on Folsom Dam joint detail (Note: 1 in. = 25.4 mm)

Fig. 7: Drilling holes for injection ports—note color change of cuttings, indicating corkboard has been intercepted

Fig. 8: Plastic ports for grout injection at Folsom Dam

joint was shown, including the position of the metal plate and water stop, the location of any formed drains that might be present, and the location of embedded steam pipes and asphalt grout channels in or near the joints. This was needed for several reasons, including the following:

- Determining the best place to inject grout;
- Controlling where grout traveled during repairs; and
- Aiding in developing an adequate repair methodology, including material requirements, port locations, and port spacing.

After examining the joint details, it was determined that the best approach would be to drill holes for ports that were angled to deliver the grout between the top metal plate and the lower rubber water stop (Fig. 6 and 7). The metal plate and rubber water stop would serve to help contain the grout as it expanded, resulting in a more durable repair.

Because the majority of the grouting was at relatively low pressure, simple plastic ports installed with a hammer (Fig. 8) were able to be used for most of the work. After the plastic ports were installed, grease zerks were pushed into the open ends of the ports for attachment to the grouting assembly.

REPAIR MATERIAL

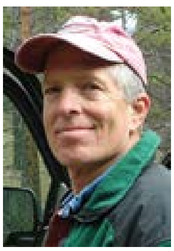
An important part of the repair was selection of an appropriate repair material that would remain flexible after injecting it into the joint. A material that would expand during and just after injection would help to ensure that repairs were watertight; however, the selected material would need to start curing relatively quickly. In some locations, the repairs were likely to stay wet indefinitely. In other areas, the repairs would be subjected to hot and cold temperatures but drier conditions.

For most of the work, a single-component polyurethane grout consisting of a water-activated hydrophilic resin was used. These resins tend to cure relatively quickly and form a flexible foam product. The resins are usually mixed with equal parts water and injected using special pumping equipment (Fig. 9) and a special fitting where the mixing occurs just prior to injection (Fig. 10).

For the hotter and drier locations, either a single-component water-activated hydrophobic resin or a mixture of a hydrophilic and hydrophobic resins was used. Foams from hydrophobic resins are usually rigid, so a formulation that resulted in foam with flexibility characteristics similar to those of hydrophilic foams was selected. Hydrophobic resins usually require a catalyst and react with a very small amount of water. To use these, water is injected into the joint first and then quickly followed by injection of the resin and catalyst mixture. Mixtures of hydrophilic and hydrophobic resins result in a tough, yet flexible foam.

SUCCESSFUL REPAIR

Chemical grouts can be used to repair leaks in cracked concrete and to seal off leaking around expansion joints. The MERL staff successfully performed chemical grouting of expansion joints using single-component water-activated polyurethane grouts and multiple-component polyurethane grouts. Because there have been no signs of leakage or leakage has been significantly reduced in the chemically grouted areas following subsequent storm events, the repairs appear to be successful.



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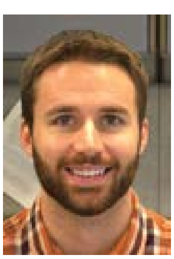

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Fig. 9: Air-powered pump for grouting

Fig. 10(a): "F" assembly for mixing grout and catalyst

Fig. 10(b): MERL employee injecting grout