

9.50 PROTECTION, CURING, AND REPAIR

9.51 PREVENTION OF RAIN DAMAGE TO PLASTIC CONCRETE

[Specifications 1105.04](#) and [2301.3, K, 4](#) require contractors to produce a quality product and have materials for proper protection of edges and the surface of concrete available near the work site. The Contractor must protect the pavement from damage due to rain. Failure to properly protect concrete may constitute cause for removal and replacement of defective pavement.

At the preconstruction conference, it is important to emphasize that protective coverings and temporary forms must be available and that protection of fresh pavement from rain damage is the Contractor's responsibility. The contractor should be advised to follow weather forecasts closely to prevent being caught unprepared in case of rain. Plastic film is preferred for surface and edge protection, since burlap alone in a heavy rain is insufficient to prevent access of water and subsequent pavement surface erosion.

When using concrete mixtures containing slag, the concrete often gains strength much slower than a mix without slag. This can be a problem when a rain event occurs. When slag is being used it is often necessary for the contractor to cover a significantly larger section of pavement to prevent rain damage on the surface.

The District should be notified when pavements are damaged by rain so an evaluation of damage can be made. Acceptance or rejection of damaged portions of the pavement will be based on extent of damage incurred as provided in [Specification 1105.04](#) and [Construction Manual 2.53](#). Repair of damaged edges and surface may be considered, but extensively damaged pavement may require removal and replacement.

9.52 CURING OF KEYED AND DOWELED JOINTS

For curing vertical sides of the pavement in areas where KT and K joints are constructed, the use of liquid curing compound is an acceptable method of curing this portion of the slab. Generally, little or no bond is obtained or expected between vertical faces of adjacent concrete. Deformations on tie bars provide adequate lateral support.

9.53 REPAIR OF DEFICIENT PAVEMENT

Pavements damaged by rain, vehicles traveling on unhardened concrete, and deficiencies caused by poor workmanship may be repaired or restored to an acceptable condition without complete removal and replacement of damaged areas.

Rain damage varies considerably depending on rainfall intensity, duration, and protective measures taken by the Contractor. Covering and side forms placed by the Contractor afford sufficient protection to unhardened concrete in some cases. In other cases, surface and edges may erode to such a degree that removal and replacement of the slab is the only solution.

Guidelines follow for corrective measures that may be taken or used to restore damaged pavement to an acceptable condition. This instruction is not intended to cover the whole spectrum of deficiencies that may occur on a paving project during construction. Other proposed procedures or methods suggested by the contractor may be considered.

Recommended Repair Method**A. Rain Damage and Excessive Edge Slump****1. On plastic concrete:**

- Pavement surfaces which have slight surface damage due to placement of protective covering or sandy appearance may be retextured provided concrete is still plastic and in workable condition.
- Eroded edges may be repaired by setting side forms and replacing eroded concrete with fresh mix.
- Excessive edge slump may be corrected by setting side forms of proper height along slumped edge and refinishing to correct elevation.

NOTE: *When fresh concrete mix is added to plastic pavement for the purposes of replacing eroded mix or repairing excessive edge slump, the mix shall be vibrated to ensure proper consolidation.*

2. After concrete has hardened:

- Pavement surfaces that have lost the texture without affecting the surface profile shall have the necessary texture reestablished. This may include diamond grinding or grooving. Grooving shall be reestablished in the same direction as placed in the adjacent pavement.
- Pavement surfaces which have been severely eroded require reprofiling by diamond grinding equipment.
- Minor edge erosion and edge slump with a key and doweled joint where an adjacent slab needs to be butted to the existing pavement. Establish a new edge, not to exceed 75 mm (3 inches) in from previous edge, by sawing to the top of the tie bar, remove the concrete and replace it when the new adjacent pavement is poured. If necessary to go more than 75 mm (3 inches) from edge of pavement to correct eroded or slumped edge, the edge shall be repaired by using Class A bridge repair methods prior to pouring the adjacent slab.
- Excessive edge slump may be repaired by using Class A bridge repair methods.
- Edges or panels that have been severely eroded may require all or a section of lane to be removed or replaced. If determined that a section of lane more than 600 mm (2 feet) in width should be removed, then the entire lane or panel shall be removed and replaced with new concrete. Areas less than 600 mm (2 feet) in width shall require full depth repair with holes drilled and tie bars installed to anchor new concrete to remaining concrete.
- For areas with an extreme severely eroded surface and edges, the contractor should be required to place an ACC or bonded PCC overlay.

B. Vehicle Traffic on Plastic Concrete

Remove and replace sections where rutting is severe.

Minor wheel track rutting may be repaired by using Class A bridge floor repair methods.

C. Random/Uncontrolled Cracking

[Specification 2301.03, N](#) requires the Contractor to repair random and uncontrolled cracks at no additional cost to the Contracting Authority. The intent of this specification is to hold the Contractor responsible for cracking resulting from the Contractor's operations. Methods of repair are to be submitted to the Engineer for

approval. Recommended methods of repair for random or uncontrolled cracks are included in [Appendix 9-6](#). Project specific circumstances may dictate that repair methods other than those listed in [Appendix 9-6](#) be allowed with approval of the Project Engineer.

D. Shrinkage Cracks

Remove and replace affected areas with new pavement in severe cases.

Minor cracks may be filled with pressure injected epoxy or repaired using Class A bridge floor repair methods.

E. Rough Pavement Sections

Surface variations, which exceed the specification smoothness requirements, require correction by the Contractor. Surface correction shall be accomplished with approved diamond grinding equipment. Use of milling machines, Roto Mill, Galion Scarifier, or other impact devices shall not be permitted.

F. Edge Damage

Throughout the various activities involved in construction of a PCC pavement, the edges of the pavement can become damaged. Whether it be damage from a maintainer while preparing subgrade and base material for shoulders, or a trencher excavating a subdrain trench, or a roller compacting granular or HMA shoulder material, the edges of a PCC pavement can be exposed to harsh treatment.

While edge damage typically is not a structural problem, it is unsightly and a result of substandard workmanship. Edge damage can affect the functional performance of the pavement by influencing drainage and reducing the effective width of pavement markings. In many cases typical repair methods such as partial depth patching may not be practical for minor edge damage. [Construction Manual 2.53](#) includes recommended repairs and/or price adjustments for PCC pavement edge damage based on severity of the damage.

G. Limitations

Necessary corrective measures on hardened concrete shall only be made after concrete attains age and strength requirements in [Specification 2301.03, U](#).

All required corrective measures shall be completed prior to coring for pavement thickness measurements.

Consultation with the Office of Construction is recommended before placing an HMA or bonded PCC overlay.

9.54 MUD BALL REPAIR

Occasionally mud balls appear in the surface on new concrete pavements. These usually are due to clay balls from a quarry, trucks dropping mud from their axles when dumping from a bridge over a dump pit, or end loader operators digging too deep when removing material from a stockpile.

Correction of any discovered mud balls in a pavement surface shall be as follows:

- Any thin concrete skin around the perimeter of the mud ball should be removed so that nearly vertical void walls remain.

- Each void shall be cleaned by a high pressure washer, followed by air blasting to dry the void.
- Voids shall be filled with material meeting [Materials I.M. 491.20, Appendix A](#). This material shall be used according to manufacturer's recommendations.
- The surface of filled voids shall be given the same texture as the surrounding pavement.
- A void repair shall be given the proper cure time recommended by the manufacturer prior to opening the roadway to normal traffic.

If a severe problem with mud balls is suspected on a specific project, formal acceptance by the Project Engineer should be delayed until the following spring. This will allow the winter freeze-thaw cycles and snowplowing activities to expose additional mud balls located adjacent to pavement surface. These newly discovered mud ball areas will then also require corrective measures as stated above.

9.55 COLD WEATHER PAVING AND PLANT OPERATIONS

Cold Weather Pavement Protection

During cold weather, [Specification 2301.03, K, 3](#) requires that newly placed paving, less than 36 hours old, be protected against freezing temperatures. This protection is necessary to allow the hydration process of the curing concrete to continue in cold weather. Adequate protection of concrete allows for paving to be placed later in the season.

The required cold weather protection needed during any given day should be mutually agreed upon between the Contractor and Project Engineer. A daily predetermined weather forecast should be used. For example, the low temperature forecast from the 4:00 pm local radio newscast could be the agreed upon temperature forecast. Once a decision is made as to the appropriate cold weather protection needed, any changes to the amount of protection needed must be agreed between the Contractor and Project Engineer to avoid potential claims.

Below -4°C (25°F), [Specification 2301.03, K, 3](#) requires four layers of burlap between layers of 1.0×10^{-4} mm (4 mil) plastic or an equivalent commercial insulating material approved by the Project Engineer. Equivalent materials include:

- 3 layers of Burlene
- 1 layer of insulating blankets with a minimum R-value of 1.0
- 1 layer of 12 mm (1/2 inch) extruded polystyrene, must be weighted down
- 2 layers of 6 mm (1/4 inch) air celled polyethylene
- 1 layer of 12 mm (1/2 inch) air celled polyethylene

[Specification 2301.03, K, 3](#) also includes provisions for removal of the cold weather protection. Often a night or two of low temperatures is followed by several days of warmer temperatures. The provisions in [2301.03, K, 3](#) provide a means for allowing the removal of cold weather protection when it will no longer be necessary. This is especially important in that it allows the Contractor to reuse covering materials more quickly rather than unnecessarily leaving them on pavement that no longer needs to be covered.

When cold weather protection is required, the Contractor will be reimbursed for extra work per [Specification 2301.05, J](#). The reimbursement amount is the same value regardless of number of layers of protection required.

Cold Weather Plant Operation

[Specification 2301.03, S](#) states that concrete mixing and placement may be started when the air temperature is at least 1° C (34° F) and rising. In the late fall season before the subgrade begins to freeze and soil temperatures are still relatively warm, it is permissible to allow paving plant operations to begin below 1° C (34° F) providing a decent weather forecast is predicted. Paving plant operations basically self regulate during these conditions.

The intent is to maximize the remaining good paving weather still available in the fall. This provision is not intended to make a paving day out of one that is not, but to allow for as much concrete pavement placement as possible during a day forecast for good weather.

After the subgrade begins to freeze, the above provisions should be halted and specifications strictly enforced.

9.56 CURING

White pigmented liquid curing compound is required to be used to cure concrete pavements. The purpose of the curing compound is to provide a protective, semi-impermeable coating to aid in retaining moisture in the concrete. This helps to ensure that adequate moisture will be available for thorough hydration and strength gain.

Cure is typically delivered to a project site in reusable plastic totes. Each tote should be properly labeled to identify the brand and lot number of the cure within. Occasionally totes have been refilled on a project by a tanker directly from the supplier. This is an acceptable practice provided the totes are relabeled to identify the new material. If a different brand of cure or cure from a different lot is used to refill the tote, the tote should be relabeled to properly identify the material. In addition, any label that does not correctly identify the new material should be removed.

The cure shall be applied to the pavement as soon as practical after the finishing operation is complete. This is normally applied with a machine that both applies the curing compound and creates the texture. This is a stop and go operation since curing and texturing can be accomplished faster than the paving operation. Curing shall not be delayed simply because the tines are creating too deep of a texture groove. The goal is a shallow groove and the texture machine can be adjusted in order for the tines to apply less pressure on the surface of the fresh concrete. With a consistent concrete mixture, the downward pressure on the tines can be adjusted in order to allow the tining machine, and thereby the curing process, to be kept right behind the finishers.

The curing shall be applied no later than one half hour after placement. In very hot, dry, windy conditions this is not soon enough. A price adjustment schedule is provided as Table C5 in [Appendix 2-34C](#) for areas of pavement where cure is not applied in a timely manner.

