Montana Department of Transportation
Helena, Montana 59601-1001

Documentation of Great Falls Experimental Whitetopping Repair Project

Location: Great Falls, Montana; Intersection of N. W. Bypass & 3rd St. N. W. (U5206 & U5203). Three southbound lanes of 3rd N. W.

P. O. Number: 305626 (Original Project)

Repair Date: March 28 & 29, 2001

Report Date: April 30, 2001

Report Origin: Pavement Analysis & Research Section
Craig Abernathy

History

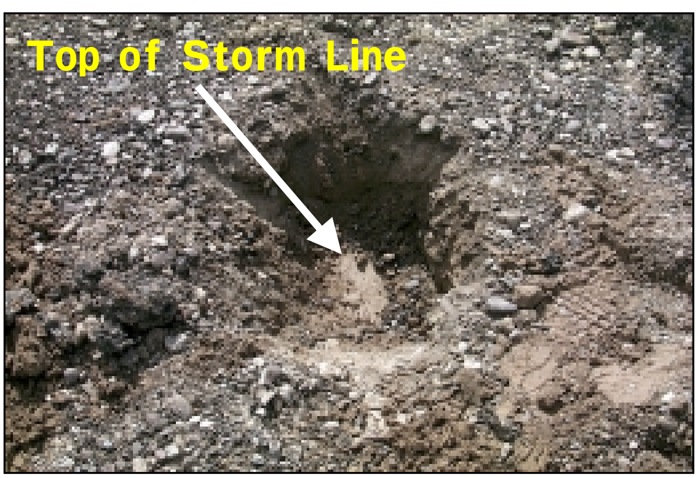
This Whitetopping project was initially constructed in fall of 1999 to alleviate the continued heavy rutting and shoving of the asphalt concrete at this intersection. During late summer of 2000, a small portion of the right-turn lane developed severe cracking. This was documented in the fall of 2000 evaluation report on this project. This failure of the pavement occurred at a rapid rate, estimated at 3-6 weeks. The failed section comprised five panels longitudinally and three panels transversely, approximately 10' x 15'. This section went through the entire 2000-2001 winter in this condition, withstanding freeze-thaw cycles, traffic and maintenance snow removal.

Purpose

The goal of this report is to document the repair effort coordinated by Great Falls MDT Maintenance and performed by United Materials Inc., and to ascertain the plausible reason(s) of this premature failure. The image of Whitetopping above shows the area (outlined with white paint) that has deteriorated to the extent that it must be removed and replaced with full-depth PCCP. A concrete saw was used to score a deep

enough cut to break the damaged panels cleanly away from the panels not affected. Care was taken to prevent disturbing the adjacent viable panels during the removal of the cracked panels. A spud bar and picks initially were used to remove a section of panel large enough to allow a backhoe to begin removing the PCCP layer. The backhoe operator carefully began removing panels to expose the underlying asphalt layer. Once the whitetop had been removed, they began to excavate the remaining pavement layer from the area. The construction crew had to alternate loading the dump truck from either side of the pit to eliminate disturbing the intact panels by the backhoe bucket. The asphalt layer came out in relatively small pliable chunks. All debris was removed down to the subgrade by the contractor.

The contractor then used a compaction whacker to consolidate the sub-grade material. After about twenty minutes, he stopped work and asked the inspection team to stand behind the compactor as he operated in the pit. Substantial vibration could be felt throughout the entire surface area of the repair site. Standing in the area, you could feel and see the surface floating at your feet. This was a strong indicator that the compaction device was drawing water toward the surface. With subsequent digging into the subgrade, an inordinate amount of moisture was in the ground at about twelve inches below grade. In one shovel full, you could actually squeeze water from the silty sandy material. It was also found that the top of the storm line was located approximately six inches below the surface of the subgrade (see photo below).

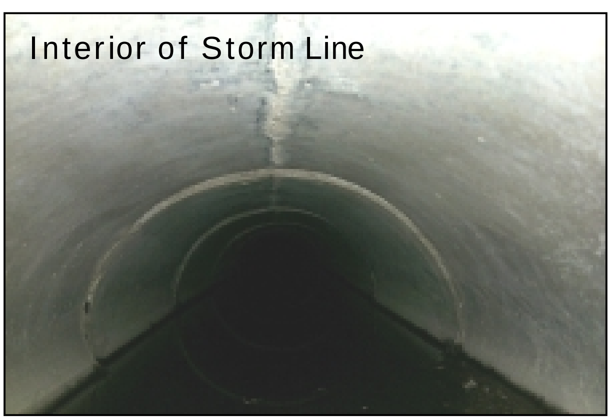


In consultation with the contractor and MDT Maintenance staff, it was decided there was too much moisture present in the subgrade. In addition, the subgrade material itself was not able to adequately support the structure. With the amount of water present, poor soil, and the close proximity of the storm line it was decided to remove several feet of the subgrade and replace it with 1.5" minus aggregate fill material. The contractor proceeded to re-compact the soil. There was a noticeable difference in the feel of compaction compared to the original material. The contractor noted the new material was more dense and stable after compaction. It was determined that a geotextile fabric would be necessary to line the pit prior to the addition of new fill in an effort to reduce fines migration and to assist in stabilizing the fill material. The material used was Synthetic Industries 315ST Slit Film Geotextile. The PCCP slab was set at approximately 9" in depth. Due to the size of the placement, it was decided that this slab could be free-floating without joints. Tar paper lined the interior perimeter of the pit to form a bond-breaker to the existing AC and PCCP composite. Number 4 rebar was set at 18" centers. Chairs supported the grid approximately 4" in height from the base.

4.2 cubic yards of Type II PCCP air-entrained concrete mixed with 3lb/yd of polypropylene fibers were placed in the excavated pit. Vibration was used to consolidate the concrete. Conventional troweling and tining finished the project. A steam-injected cover was used to prevent premature curing. The contractor was asked not exceed 160º F. There was concern that too high of heat may cause the slab to cure inconsistently which may cause curling and/or premature cracking.

Failure Analysis

As stated earlier in the report, these panels failed in a relatively short period (3-6 weeks). On inspection of the underside of the PCCP layer, most of the AC was still attached in a thin layer of Asphalt cement and stone. This indicates that minimum debonding of the composite layer had taken place. The AC layer was very soft and pliable and could easily be broken apart. The AC had a strong odor to it; some of the inspection team members called it a swampy and/or sewage-like odor. Visually the AC exhibited severe stripping. It was apparent that moisture had been a factor in the deterioration of the AC layer. A storm line runs longitudinally under the problem area. Two manhole covers were opened to inspect the line. The storm pipe was filled with sediment and water approximately fifty-percent (see photo). It was impossible to see if the line had deflected to the extent of allowing moisture into the surrounding subgrade through a breached joint. The inspection staff also stated that the manhole covers had blown off during heavy rains in the past. It was also noticed that the interior smell of the storm line was the same odor on the AC layer. It would be difficult to ascertain if the clogged condition of the storm line was the source of the moisture that has deteriorated the AC. It may be a naturally occurring event since the Missouri river is only a few blocks away with this site slightly above elevation. It was suggested that the soil around the storm line may also have been the bedding material in which this line was laid and the porosity of this material may be greater than the subgrade surrounding the failure area.



Conclusion

Regardless of the potential sources of moisture, the overall failure cause for this small section of whitetop panel is the lack of structural support by the underlying AC layer due to stripping.

In addition, the subgrade was of the type that promoted migration of moisture. Another supplemental factor could be the type of asphalt cement to which the PCCP was bonded. It may be dissimilar than in the other area of the project and more prone to structural failure. Whitetopping is only effective when the AC layer is structurally viable to support an overlaying PCCP layer. Additional panel cracking has been observed in the same lane toward the south end of the project in line with the storm pipe. There may be additional failure of panels as seen in this current repair project. Upon a cursory inspection, adjacent lanes are exhibiting no additional cracking since the fall of 2000 evaluation. Figure 1 shows an overview and cross section of the affected area.

MDT Research would like to thank those individuals whose field input and review made this report possible:

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