



ASSESSMENT OF POLY-CARB FLEXOGRID BRIDGE DECK OVERLAY SYSTEM

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16. Abstract Mark-163 Flexogrid by Poly-Carb is a high friction bridge deck overlay system that is designed to be used for the waterproofing and skid proofing of bridge decks. This product was tested on Town Highway 4, Bridge 8 in Waterford VT, as it passes over I-93 in May 2013. The Flexogrid system has performed as expected, providing good skid resistance, and waterproofing the deck. Some aggregate has been observed to be raveling off the surface, but not at a concerning rate.			
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Abstract

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1. Introduction

1.1. Project Location and Summary

Poly-Carb Mark-163 Flexogrid was applied to bridge 8 over I-93 in the town of Waterford, on Town Highway 4 as a part of the IM MEMB(31) membrane replacement project. The bridge deck area to which Flexogrid was applied is 1000 square yards. The existing bridge overlay was removed on April 11, 2013 and then the bridge deck was repaired. Flexogrid was installed by the vendor, Poly-Carb along with a subcontractor, Nicom on May 30th and 31st, 2013. Figure 1 shows bridge 8 in Waterford, Vermont, and the study area for this project. Bridge 8 was constructed in 1982. In a 2008 study, an ADT of 700 was recorded with 2% of the traffic being truck traffic. The condition of the bridge, prior to rehabilitation can be seen in Figure 2.

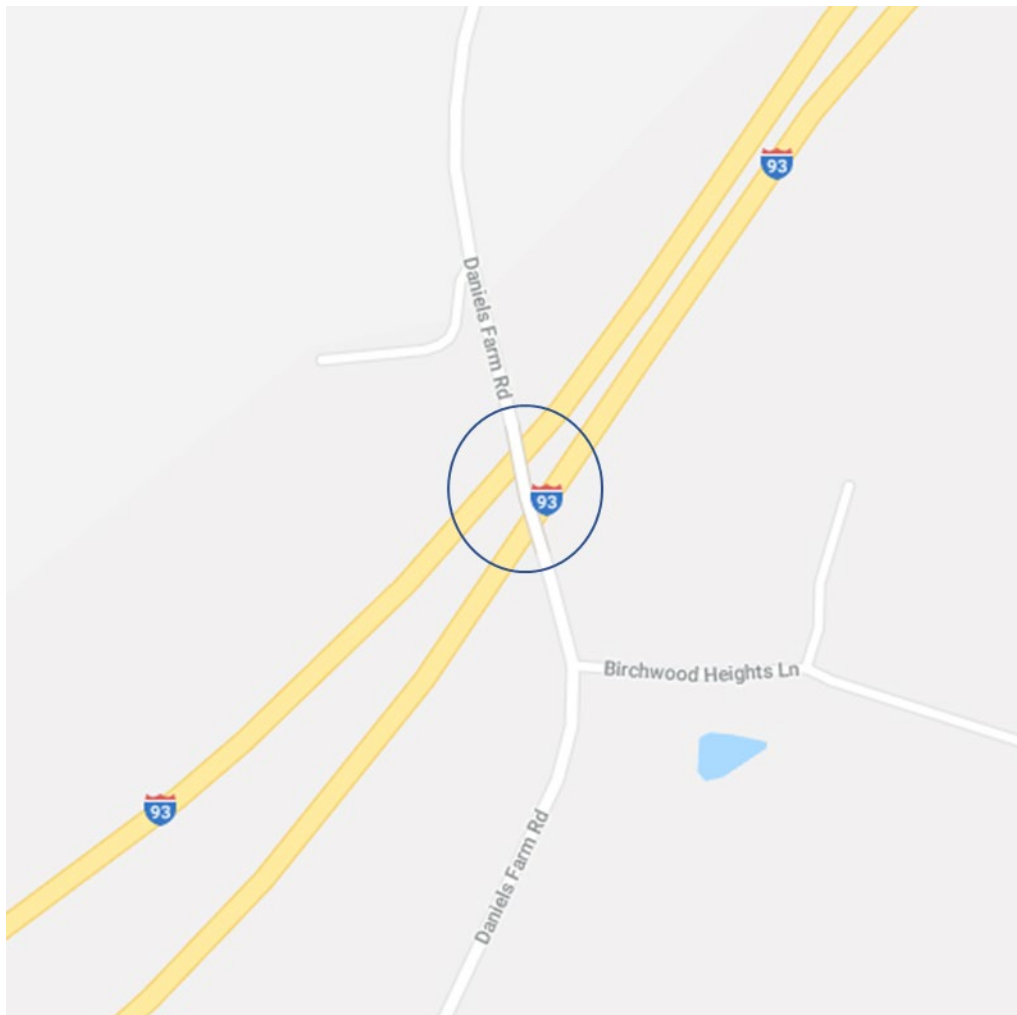


Figure 1: Project area - Bridge 8 in Waterford, Vermont



Figure 2: Condition of the previous bridge overlay in 2012

1.2. Material Description

The material used in the construction of the bridge deck overlay system is Mark-163 Flexogrid produced by Poly-Carb. Flexogrid is a hybridized copolymer made of a combination of epoxy and urethane molecules and is designed to be used for the waterproofing and skid proofing of bridge decks. Flexogrid works well on bridge decks due to its ability to adapt to movements in concrete structures or changes in weather conditions. Flexogrid is a good test product for the Accelerated Bridge Program due to its fast curing nature. According to Poly-Carb, its fast curing system allows traffic to be resumed within hours.

2. Installation

Prior to the application of Flexogrid, the bridge deck must be checked for delaminations and repaired. For a concrete surface, the deck must be shotblasted as to remove any weak concrete on the surface and to obtain a uniform surface. If there is excessive cracking in the concrete deck, these must be repaired. Poly-Carb recommends the use of their product, Mark-135 Safe-T-Seal prior to the application of Flexogrid.

Construction began on the bridge on April 11, 2013 by JP Sicard, Inc. as the prime contractor with the removal of the existing bridge deck overlay. Once the overlay was removed, deck repair was completed, and silane was applied to the exposed concrete. Poly-Carb along with Nicom as the subcontractor, installed the Flexogrid on May 30th and 31st, 2013. The deck was opened to traffic as soon as each lane was completed. Figure 3 shows the specialty equipment from Poly-Carb, which houses the materials and a special feeder system and hopper to broadcast the aggregate after the epoxy is applied.

To apply Flexogrid, the hybridized copolymer must be mixed on site for three to four minutes. Once mixed, it is squeegeed onto the surface until it covers 35 square feet per gallon. After the Flexogrid is applied, aggregate is broadcasted onto the surface at a rate of 15 pounds per square yard. After the aggregate has been applied and has been given time to set, any excess aggregate is removed. Next, a second coat of Flexogrid is applied at a rate of 15-20 square feet per gallon and an aggregate distribution rate of 15 pounds per square yard. A close up of the material, showing its coarse texture can be seen in Figure 4.



Figure 3: Flexogrid being Applied to the Deck



Figure 4: Surface texture of the Flexogrid

3. Performance

Following the application of Flexogrid, observations and photos of the performance and appearance of the Flexogrid System were taken. Four specific locations were closely monitored for skid resistance during the first two annual site visits. Two locations in each traffic direction were chosen. These locations were each on the leading edge of their respective traffic direction and each contained one point in the right wheel path and another point in the middle of the two wheel paths. At these locations, British pendulum skid tests were performed to measure the friction level of the overlay.

Site visits were performed on November 14th 2013, July 18th 2014, October 15th 2015, June 9th 2016, and August 23rd 2017. Table 1 shows the results of these tests in each monitoring point during the first two visits.

Table 1: Friction values for British Pendulum Tests

Test Number	Test Date	Northbound Wheel path	Northbound Non-wheel path	Southbound Wheel path	Southbound Non-wheel path
1	14-Nov-13	100	113	93	100
2	14-Nov-13	105	112	91	100
3	14-Nov-13	103	114	95	97
4	14-Nov-13	105	117	88	101
5	14-Nov-13	106	104	88	103
Average	14-Nov-13	103.8	112	91	100.2
1	18-Jul-14	78	79	82	78
2	18-Jul-14	78	78	80	78
3	18-Jul-14	76	78	82	82
4	18-Jul-14	78	76	78	80
5	18-Jul-14	78	79	82	84
Average	18-Jul-14	77.6	78	80.8	80.4

British pendulum skid testing on November 14th 2013 (after 5 months) shows a range of values from 88 to 117 British Pendulum Number (BPN). Testing on July 18th 2014 (after 14 months) resulted in values ranging from 76 to 84 BPN. As a method of comparison, a VTrans' research project that was recently performed on a bare concrete deck had a skid resistance of between 50 and 80 BPN. After 14 months of service there is no measurable difference in friction between the wheel path and non-wheel path test spots although visually there seems to be a slight difference in wear characteristics. The BPN drop between the 5 and 14 month intervals was quite large, from an overall average of 102 down to 79. This time period did include the first winter plowing season, which is most likely the cause of the drop. The upslope lane decreased far more in friction (30 BPN average) than did the downslope lane (15 BPN) as could be expected given that more force is typically applied from a vehicle going uphill. Skid resistance testing was ended after the first two visits.

During the third site visit on October 15th 2015, no new surface deterioration was noticed on the bridge deck surface. The only evidence of damage was some evidence of cracking around the bridge joints which can be seen in Figure 5. While the source of this cracking is unknown, it is believed to be caused by damage to the concrete bridge joint underneath the Flexogrid system.



Figure 5: Cracking around bridge joints

The fourth site visit on June 9th, 2016, showed very similar levels of wear to the first site visit a year earlier. The Flexogrid membrane had maintained good condition and showed no new signs of wear. The cracking around the bridge joint had increased slightly since the prior visit. Figure 6 shows the level of wear on the full bridge deck.



Figure 6: Overall view of Bridge 8 looking northbound

Site visit five was conducted on August 23rd, 2017. During this site visit, slight wear to the wheel paths had begun to appear. Along with this wear, small amounts of loose aggregate from the Flexogrid system surface were found around both the wheel paths and the bridge curb. Given that the Flexogrid system was installed in 2013, the surface is showing excellent resiliency to wear for being in its fourth year of use and had undergone five winter maintenance seasons. Other signs of wear can be seen in the slight rusting of the metal curb protector and the pavement cracking in the north and south approaches to the bridge. This wear can be seen in Figures 7 and 8. The deterioration of the metal curb protector is most likely attributed to the run off from agents used during the 5 seasons of winter maintenance. The north and south-bound approaches to the bridge experienced significant transverse and longitudinal cracking and some alligator cracking. The underside of the bridge along with the bridge abutments were in excellent condition. This is helped by the installation of an extended gutter which has carried the runoff from winter maintenance deicers away from the bridge.



Figure 7: Loose aggregate from Flexgrid surface and rusting of metal curb protector



Figure 8: Cracking of southbound approach to bridge 8

Bridge inspection records ([here](#)) from September 2018 show the bridge to be in good condition, with the deck rated as good as well. Joint leaks were noted, but are unrelated to the Poly-carb overlay. Inspection photos ([here](#)) show no signs of membrane issues.

4. Summary

The Poly-carb Flexogrid system, an aggregate chip seal affixed by a synthetic polymer epoxy, is both a bridge membrane and overlay system. Skid resistance measured in the first year of service show high friction, though down from its peak immediately after construction. Annual site visits and structures inspections show the bridge and overlay to be in good condition. Some raveling has been observed, but not at a concerning rate. Overall, the Poly-carb Flexogrid performed as specified and has shown few signs of wear.