BUREAU OF MATERIALS & RESEARCH

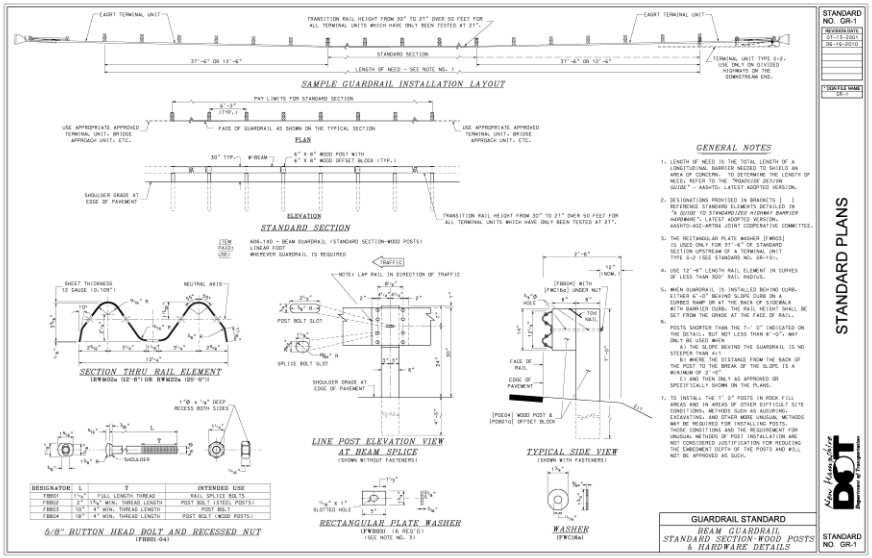
MISCELLANEOUS PROBLEM SOLVING PROJECT: MPS 2010-02

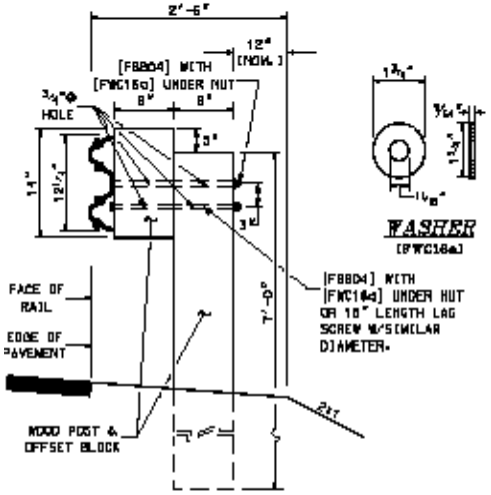
Performance of W-Beam Guardrail after Height Adjustment

Summary Report **March 2013**

Introduction and Project Description

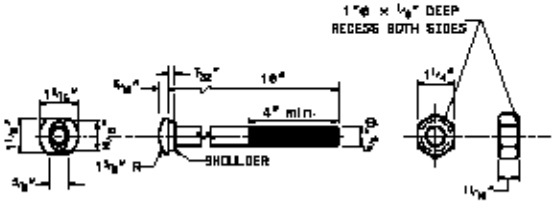
When a roadway is resurfaced, the additional pavement thickness reduces the height of the guardrail relative to the roadway. Adjusting the height of wooden guardrail offset blocks, while leaving the post as it was initially installed, is being studied to determine the effectiveness and safety of this procedure which is used to maintain proper guardrail height after resurfacing. The Special Provision for Item 606.915 – Resetting Guardrail, Blocks and Rail Only, states that this method be used to reset existing block and w-beam rail three inches higher on a wood post guardrail. The height of the rail, after raising the guardrail offset blocks will be between 27 to 30 inches, from the new pavement surface. The procedure consists of removing the existing block and rail, drilling a second hole in the post three inches above the existing hole, and then drilling a second hole in the block three inches below the existing hole. The block is then reattached to the post using one new bolt and nut and re-using the existing bolt and nut, if they are in usable condition. Existing blocks and rail shall be re-used unless it is determined that they are unacceptably damaged. It is also stated that the length of block and rail that is disassembled shall not be more than the length that can be fully reset in one day. This method is currently used in California, Washington, and Oregon.



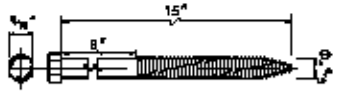


TYPICAL SIDE VIEW
(SHOWN WITH FASTENERS)

WASHER
[FWC16a]



5/8" BUTTON HEAD BOLT AND RECESSED NUT
[FBB04]



OPTIONAL LAG SCREW

GENERAL NOTES

1. LENGTH OF NEED IS THE TOTAL LENGTH OF A LONGITUDINAL BARRIER NEEDED TO SHIELD AN AREA OF CONCERN. TO DETERMINE THE LENGTH OF NEED, REFER TO THE *"ROADSIDE DESIGN GUIDE"* – AASHTO, 2002.
2. DESIGNATIONS PROVIDED IN BRACKETS [ ] REFERENCE STANDARD ELEMENTS DETAILED IN *"A GUIDE TO STANDARDIZED HIGHWAY BARRIER HARDWARE"*, 2005, AASHTO-AGC-ARTBA JOINT COOPERATIVE COMMITTEE.
3. ALL DIMENSIONS SUBJECT TO MANUFACTURER'S TOLERANCES.

FIELD NOTES

1. 3/4" DIA. HOLE IS DRILLED IN POST 3" ON CENTER ABOVE EXISTING MOUNTING HOLE.
2. 3/4" DIA. HOLE IS DRILLED IN BLOCKOUT AT THE SAME LOCATION AS THE EXISTING POST BOLT HOLE (SEE OPTIONAL SCREW ABOVE).
3. BLOCKOUT AND RAIL ARE RESET AND CONNECTED AT THE NEW HOLE AND THE EXISTING HOLE USING EXISTING BOLT AND A NEW BOLT MEETING THE SAME SPECIFICATIONS (LOWER BOLT HOLE COULD BE ATTACHED TO BLOCK BY SCREEN WITH FWC16a).
4. WHEN TRANSITIONING RAIL HEIGHT TO MEET EXISTING RAIL WITHIN A SINGLE RUN, NEW DRILLED BOLT HOLE CAN BE A MINIMUM OF 2" FROM EXISTING BOLT HOLE. THE REMAINING TRANSITION SHALL BE MADE UP WITHIN THE "PLAY" AT EITHER NEW OR EXISTING BOLT LOCATIONS.

RESET POST AND RAIL ON FIELD DRILLED HOLES

Research (Evaluation) Approach

The objective of this trial was to acquire information to adequately show that the in-service performance of reset wooden guardrail offset blocks is acceptable to FHWA requirements. The performance of areas where this method occurred was compared to nearby areas where traditional methods were used. This study was performed over a two-year time period, and was scheduled to be completed after the winter of 2011-2012.

The first task in this project was to locate wooden offset blocks that had been reset and document the initial conditions. Six areas were identified and initial information regarding locations was obtained from project plans. Initial site visits occurred in the spring-summer of 2010. The start and end of each section of guardrail were identified by GPS documentation, Mile Marker location, and/or other relevant information. Photographs were taken to document the general condition of the guardrail that had been reset. Any unusual conditions observed during initial observations were noted, including new sections of guardrail that replaced original re-set sections that were unable to be re-used due to damage. In addition, nearby guardrail that had been replaced using conventional (non-modified) techniques was observed for comparison purposes.

The chart below shows the six areas that were included in this study.

Project	Rte	Approximate Location	MM
Concord	I-93	Exit 15 - 17 NB & SB	39.4 – 43.4
Northfield-Sanbornton	I-93	Exit 20 - 22 NB & SB	59.4 – 68.8
New Hampton-Ashland	I-93	Exit 23 - 24 NB & SB	69.0 – 74.8
Grantham-Enfield	I-89	Exit 14 - 16 NB & SB	49.0 – 57.6
Epping-Exeter	101	Exit 7 - Exit 9 EB & WB	119.2 – 124.2
Salem-Atkinson	111	Ermer Rd - Hall Fame Rd	22.0 – 23.6

Materials and Research performed subsequent site visits after the 2010-2011 winter season to observe and document guardrail damage prior to repair or replacement of damaged sections. Site visits also occurred in the fall of 2011 prior to the winter season, and after the 2011-2012 winter season.

Initial Observations (Findings)

Initial field visits commenced during the summer of 2010. Figures 1 and 2 show the typical installation of reset guardrail that was observed during the initial inspection of Route 101. Figures 3 and 4 show an area near Mile Marker 122.6, eastbound, where an impact had occurred. Comment was made that even though the damage was noticeable, it was thought that the structural integrity of the guardrail had not been compromised.

Fig 1 and 2: Typical view of reset offset block

Fig 3 and 4: Damage observed on Rte 101 at mm 122.6 during initial inspection in June 2010

Initial observations along Route I-93 in the Concord area showed no areas of damage.

Reset guardrail was observed in close proximity to Mile Marker 49.0 through Mile Marker 49.4 northbound, near Exit 14 on Route I-89, during initial observations. Continuing north to the Exit 15 vicinity, more reset guardrail was observed between Mile Markers 52.8 and 59.8, and again between Mile Markers 57.4 and 57.6. Driving south along I-89, reset guardrail was identified between Mile Markers 50.4 and 49.2. These were all typical reset guardrail installations, with no crash damage observed and no new sections of rail identified.

In September 2010 initial observations occurred on Route 111 in the Salem to Atkinson area. The study area was between Island Pond Road, and the intersections of Lakeside Drive and Hall Farm Road. One area of damage was observed at the end of the second run of guardrail, beyond Island Pond Road heading east, and is shown in Figures 5 and 6. It did not appear that the structural integrity of the guardrail was compromised by this hit and no other damage was observed while driving west. Mile Marker posts were not present during this initial site visit, but were subsequently installed.

Fig 5 and 6: Damage observed on Rte 111 in September 2010 during the initial site visit

Spring 2011 Observations

Highway Maintenance was contacted and agreed to inform Materials and Research when a significant hit occurred in these areas. Over the course of the 2010-2011 winter season periodic e-mails were sent to the District Offices reminding them to forward information to Materials and Research when a hit occurred, however no notifications were received by Materials and Research.

A second round of site visits took place in March 2011 at the end of the winter maintenance season. No damage was observed in the Concord area on Route 93 (northbound and southbound) between MM 41.6 and 43.0. Typical reset guardrail along I-93 is shown in Figures 7 and 8.

Fig 7 and 8: Typical view of guard rail with no damage along Route 93 in the Concord area.

Continuing north damage was seen past Exit 20 along the high speed lane, at MM 63.4. The guardrail was detached from one block as seen in Figures 9 and 10, however the rail appeared stable.

Fig 9 and 10: Damage on I-93 at MM 63.4 northbound, along the high speed lane in March 2011

Damage was also observed along the travel lane at MM 65.4. Several posts were broken off however the guardrail itself showed little damage and appeared stable, as seen in Figures 11 and 12.

Fig 11 and 12: Damage on I-93 at MM 65.4 in the northbound travel lane

At MM 66.6, damage was seen along the high speed lane as shown in Figures 13 and 14. Several posts were detached from the guardrail. The guardrail appeared intact, though noticeably weakened.

Fig 13 and 14: Damage on I-93 at MM 66.6 along the high speed lane northbound

Continuing north to MM 70.8, damage was observed in both the travel and high speed lanes, as seen in Figures 15 and 16. No additional damage was observed continuing north.

Fig 15 and 16: Damage on I-93 at MM 72.8 northbound along high speed lane

Traveling south, damage was observed at MM 72.8. Several blocks were broken off and/or detached from the guardrail which resulted in noticeable instability. The guardrail was separated from the blocks and was sitting on the pavement and ground, as seen in Figures 17 and 18. A State of New Hampshire Traffic Accident Report (attached to this report) was obtained and it suggests that the guardrail did perform as expected and does not indicate that the performance was out of the ordinary. As indicated in the report, the only vehicle involved was a 1995 Ford F150 pick-up truck. Mixed precipitation had fallen and the roads were slippery. The vehicle was traveling between 60 and 65 miles per hour in the high speed lane, along side another vehicle, and lost control. There was no contact with the other vehicle however the driver could not maintain control of the F150 which struck the guardrail, after which the vehicle came to a stop. There was no mention in the Accident Report that the F150 overturned. The operator of the vehicle was taken to the hospital and was treated and released. The officer concluded that "the operator's speed was too fast for the conditions of the road surface."

Fig 17 and 18: Damage on I-93 at MM 72.8 along the southbound travel lane

No new damage was observed along Route I-89 during the visit in April 2011. In a couple of locations, damage was observed at the beginning of one run of guardrail, prior to the offset blocks, but it was not substantial enough to impact the blocks being studied.

No new damage was observed along Route 101, Route 111, or Route I-93 when visited in April and November of 2011. All of the guardrail in the study was in excellent condition for the upcoming 2011-2012 winter maintenance season.

Final visits to all locations took place in April through August 2012 with no new damage being observed.

Conclusions and Recommendations

Information from the Safety Analyst Report that was obtained from Highway Design was reviewed however no specific information was obtained regarding the hits observed during the site visits that were conducted. Observations of areas where hits occurred suggest that the guardrail did function as intended and no anomalies were detected. Following the winter of 2010-2011, one police report was located. It gave no indication that the guardrail did not perform as expected. The 1995 Ford F150 pick-up truck involved in this guardrail hit did not overturn and did not result in substantial injuries.

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