Montana Department of Transportation
Research Programs
March 2016

FINAL REPORT

EVALUATION OF STAY-TUFF WOVEN FENCE

Location:	Interstate I-15 (C000015P), Lewis & Clark County, Great Falls District; Approximate MP 230
Project Name:	I-15 Augusta Interchange to Craig (UPN 6531001)
Project Number:	IM 15-4(129)229
FHWA Project Number:	MT-11-01
Project Type:	Interstate Fencing Installation
Principal Investigator:	Craig Abernathy, Experimental Program Manager
Date of Documentation:	November 2011 - March 2016

Objective

Determine the effectiveness and durability of the Stay-Tuff woven fence. The product uses a hinge-joint knot resulting in solid vertical (stay) wires and reported improved fence flexibility and strength. Additionally, the product uses heavier gauge top and bottom horizontal (line) wires to reduce the potential of the fence sagging. The Department would like to determine if this can be a viable alternate to interstate fence specifications types (CM & CW).

Experimental Design

The following information is taken from the work plan submitted to FHWA for formal experimental status and will be modified if necessary to reflect actual construction practice.

Experimental trial incorporating Stay-Tuff fixed-knot, 12.0 gauge top and bottom line wires, 12.5 gauge internal line wires and all stay wires, high tensile strength (190,000 psi), class 3 galvanized, woven fencing on interstate project.

The following is the layout of the fencing plan:

- Station 685+50 to 725+50 (approximately 1219m/4000ft.) – require Stay-Tuff fencing on the south side of the project.

- Station 685+50 to 725+50 – require Interstate Type CW fencing (**control**) on the north side of the project.

Following are the design requirements associated with the Stay-Tuff product.

- Maximum Post Spacing of 25' (terrain dependent) as compared to the MDT Type CW specs of 16'-6".

- Maximum Panel Spacing of 1,320' (panels required for angle breaks may require more) as compared to the MDT specs of maximum distances of 660' for double panels and 330' for single panels.

- Fence will be a 42" high woven wire consisting of 8 line (horizontal) wires and 6" spacing between stay (vertical) wires. One line of barb-wire will be placed above the woven wire at a height of 48".

- Deadman quantities will be documented and compared to the CW control.

Evaluation Process

Research will document the installation for best practice and any constructions concerns germane to the performance of the product. Annual inspections will report on fence integrity and any other measurable outcomes. Additional site inspections may supplement the annual visits based on need.

District Maintenance will be asked to report on level of upkeep required. Initial cost of experimental feature comparative to the cost of the standard unit will be reported however it may not reflect an actual comparable cost that may be inflated due to contractor's unfamiliarity of the product.

Documentation

Status of the project as of March 2016 has been rated as performing well. District Maintenance staff have not reported any instance of repair needed. Visual inspection detected no performance issues to date.

The purpose of an experimental features report is to document the phases and events of any given project to gain the reader an understanding of the general activities required to install or incorporate the research element into an active construction or maintenance project. This report also establishes a baseline for defining performance for any given feature under actual service conditions to determine its relative merits.

Page 4: November 2011; Note that during this site visit the contractor had yet to install the single line of barb wire positioned over the top woven wire. As time and weather permits additional visual documentation will be added to this report to aid in the future site inspections and evaluations.

-Page 9: March 2012; details the extent of the damaged section caused by a fallen tree, and its subsequent repair, along with representative images of the current general condition of the Stay-Tuff fence.

-Page 15: 2013 spring evaluation.

-Page 17: 2014 spring evaluation.

-Page 18: 2015 spring evaluation.

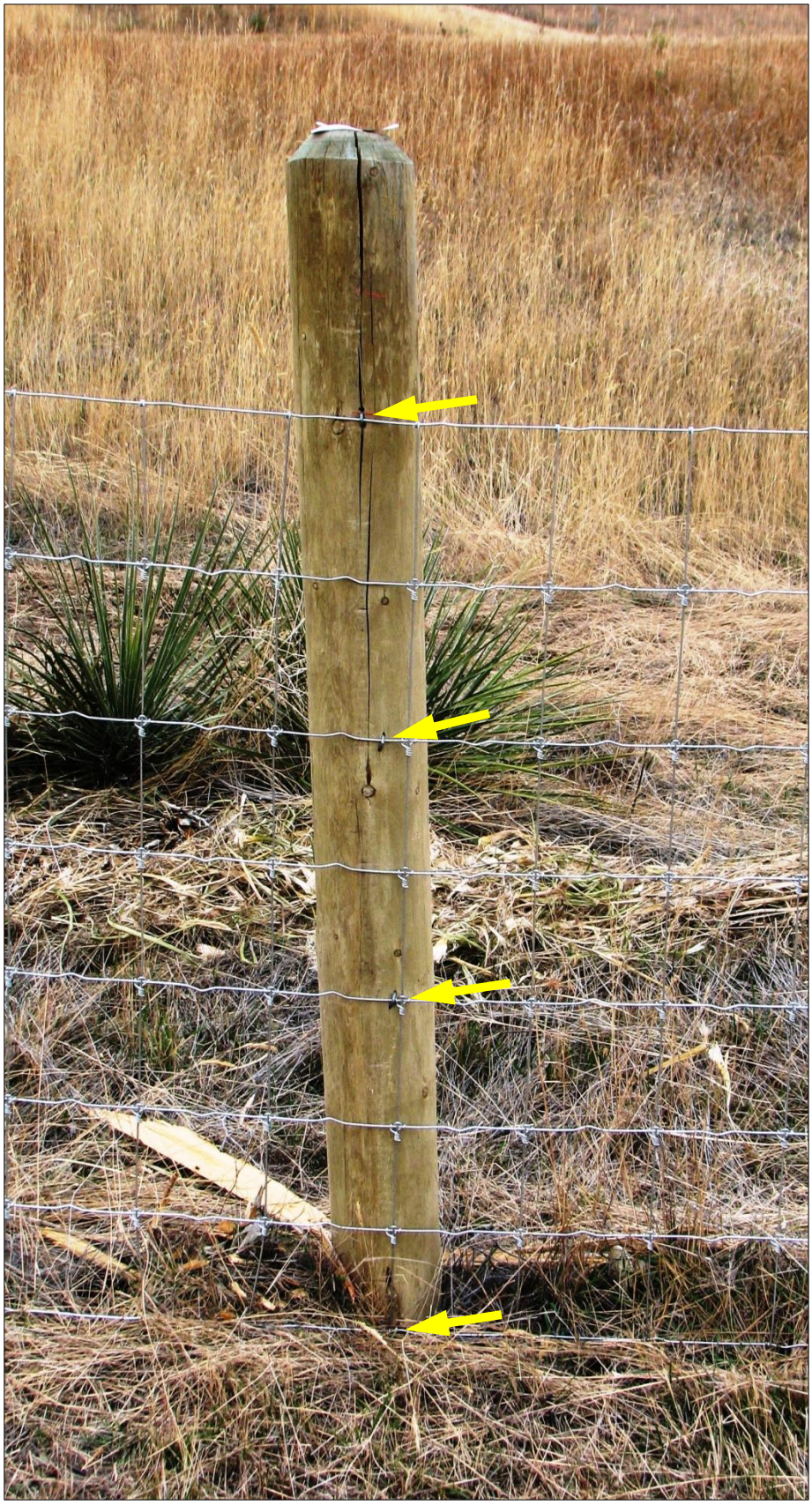
-Page 20: 2016 spring evaluation.

Stay-Tuff Woven Fence – November 2011

🡅 Overview of Stay-Tuff fencing – view North.

🡇 Image of Stay-Tuff double panel section.

🡸 Image of Stay-Tuff design with the fixed-knot configuration (red circle) and the enhanced vertical crimp (yellow circle).



🡸 Example of individual fence-to-post attachment using fence staples (as denoted by the yellow arrows).

Conventional CW & CM Fencing (Located North Side of Project)

🡅 Overview of conventional fencing – view North.

🡇 Image of conventional double panel section.

Supplemental: Fixed Knot and Hinge Joint Knot Comparison

One of the noted unique features of the Stay-Tuff fence is the fixed knot design as seen in the image to the left, as compared to the conventional CW/CM hinge-joint design in the above image.

Also note the level of vertical crimp (yellow circle) of the conventional fence (above image) as compared to the crimp reported on page four (4) of this report.

Site Inspection: March 2012 – Tree Damage to Fence Section

During the March 8, 2012 site inspection of the Stay-Tuff fencing a local rancher informed Research staff that a cottonwood tree had recently fallen over a section of the fence. The rancher had since cut the tree up for firewood. He did state the tree was about twenty (20) inches in diameter and had completely flattened the fence section to the ground. The location of the damaged section is approximately 4.9 miles (7.9 kilometers) north on the Craig River Rd. starting at the I-15 and Highway 287 interchange.

The section was repaired in early April. Bob Cloninger (Great Falls Maintenance Staff who supervised the repair) stated that normally with this sort of damage (regardless of the type of fence) they would have cut that section out and installed new material. Since at the time the Stay-Tuff product was not available, and the fencing section seemed fairly intact, they elected to keep the existing fence section in place. Mr. Cloninger remarked that due to its apparent stiffness and rigidity the material adapted well in being refitted to the fence supports. At this time Maintenance will leave the current repair as is.

The following are before and after images of the damaged section and subsequent repair. Research will continue documentation of this repair in future site inspection reporting.

The image below shows the extent of damage by the fallen tree. The yellow arrow depicts the approximate location of where the main trunk hit the fence.

🡅 Close-up of damaged fencing. Note that once the trunk was removed the woven fence recovered some flexibility as seen in its position relating to the metal post.

Maintenance stated no breakages of the wire strands were noticed.

🡄 South view of damaged fence section.

🡅 View north of damaged fence section.

🡅 Overview of repaired Stay-Tuff fence section.

🡇 Closer view of section at metal post support.

🡅 View south of repaired fence.

🡇 View north of repaired fence.

🡐 Maintenance reported the top barbed wire strand had stretched and needed to be cut and retightened with a supplement wire.

🡐 🡓 Representative images of the Stay-Tuff fence taken in early April 2012.

Site Inspection: April 2013 – Annual Evaluation

🡅 🡇 Representative images of the Stay-Tuff fence taken in April 2013; upper image is view south, lower image view north.

🡅 🡇 Images of the repaired Stay-Tuff fence section as document in March 2012, (page eight (8)).

Site Inspection: April 2014 – Annual Evaluation

🡐 General condition of the Stay-Tuff fence throughout the project.

🡐 Image of fence damaged in March 2012 (refer to page 8) in good condition as of April 2014.

Site Inspection: March 2015 – Annual Evaluation

🡸🡻 Stay-Tuff Woven; general condition of the fencing throughout the project.

No performance issues reported to date.

Fence Damage Update: Craig River Rd. – March 2015

🡅 Damaged section as reported in March 2012: No issues to report; repair still intact.

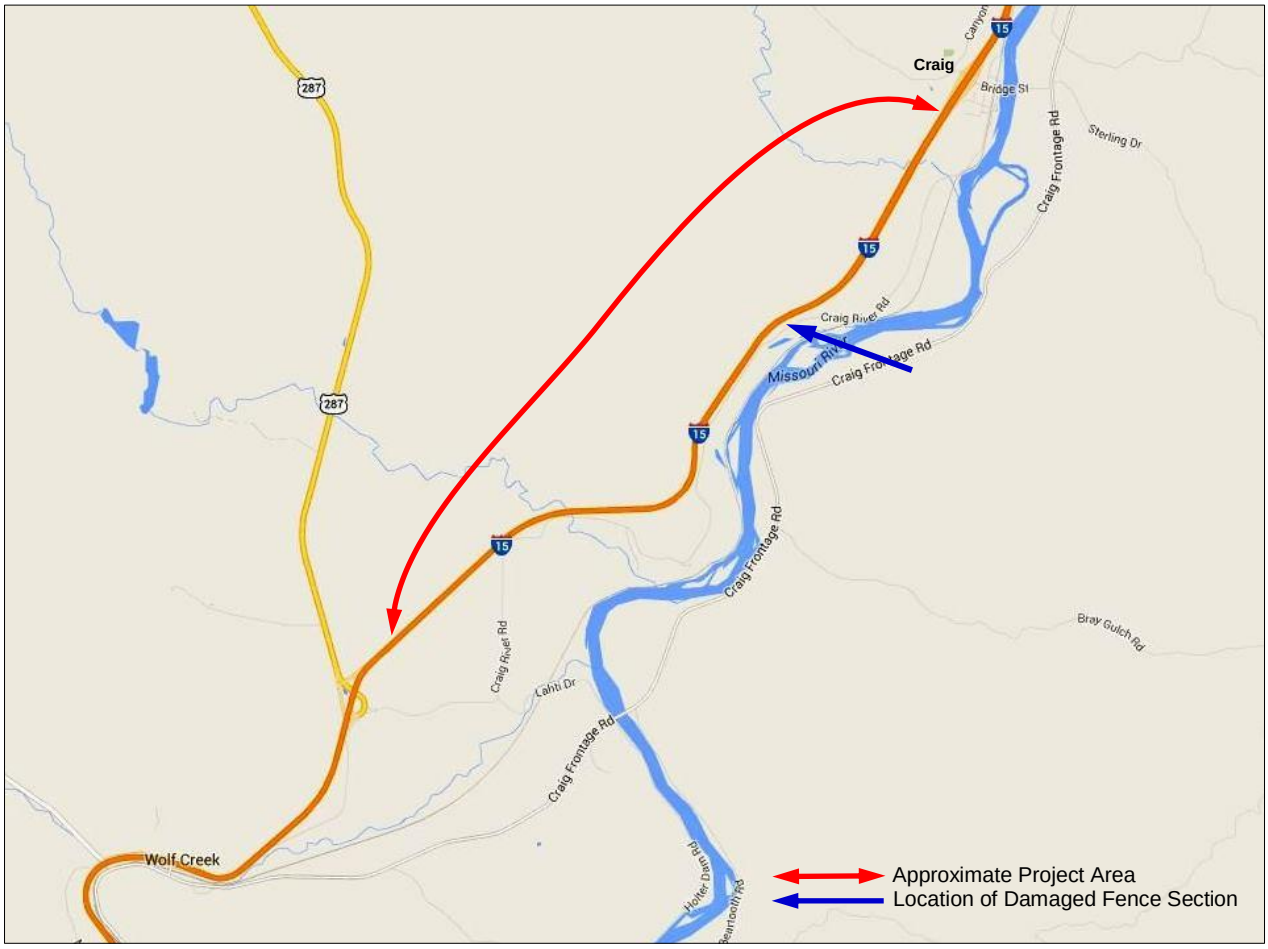
Site Inspection: March 2016 – Final Evaluation

🡸🡻 Stay-Tuff Woven; general condition of the fencing throughout the project.

No performance issues reported to date.

🡸 Section of fence flattened by a tree in the spring of 2012. The repair was to simply pull the fence back to the original shape and rewire to post. No issue to date.

<u>*Project Location Map: Interstate 15/Mile Point 230 – Lewis & Clark County</u>



***All values approximate – not to scale**

Disclaimer

The use of a product and/or procedure in the course of an evaluation does not constitute an endorsement by the Department nor does it imply a commitment to purchase, recommend, or specify the product in the future.

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