# RESEARCH NOTES

OREGON DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICES SECTION
800 AIRPORT ROAD S.E.
SALEM, OREGON (503) 378-2318

## TWO-RAIL STEEL-BACKED TIMBER GUARDRAIL

**Crown Point Highway**
**Multnomah County, Oregon**

**October 1992** **RSN 92-7**

The Oregon Department of Transportation (ODOT) recently installed a two-rail steel-backed timber guardrail along a section of the Crown Point Highway. The guardrail was installed as an Experimental Features Project to see how an aesthetically designed guardrail would perform on a scenic highway. The two-rail steel-backed timber guardrail was approved for use by the Federal Highway Administration (FWHA) after it was crash tested by the Texas Transportation Institute.

The guardrail was constructed from Douglas-fir wood and galvanized steel. The wood was pressure treated with ammoniacal copper zinc arsenate (ACZA). The steel used for the hardware was hot-dipped galvanized.

The posts used for the guardrail were fabricated from 8″ × 10″ (nominal) lumber, which is larger than the standard size of 6″ × 8″ (nominal). Because of this, the guardrail posts could not be installed by the standard method of mechanically driving them into the ground. The posts had to be installed by auguring a hole, placing the post, and filling the hole in around the post. This added to the cost of the guardrail and contributed to the cost of $41.00/linear foot, which is over 3-½ times more expensive than a typical type 2A guardrail ($11.00/linear foot).

Three problems were discovered on a site visit in August 1992, five months after installation. First, the white paint that was applied to the guardrail was discolored and had turned a blue-green color. Secondly, the paint was starting to peel and flake off in some spots. Finally, inspection of the galvanized steel hardware showed that rust was starting to form; on a typical section of the guardrail, there was visible corrosion on the hardware at most of the posts.

The discoloration of the paint can be directly credited to the leaching of the ACZA. Even when ACZA treated wood is not painted, a blue-green tint can be seen. However, if the preservative is not completely dry, it can leach and discolor the paint. A second and third coat of paint was applied to some sections of the guardrail immediately after installation, but the preservative still discolored the paint.

The flaking of the paint was most prominent on the end grains of the guardrail posts. Since fluids travel more easily along the longitudinal direction of wood, most of the ACZA leached through the tops of the posts, causing a relatively high level of preservative in contact with the paint. Although a chemist from the paint manufacturer felt the paint would be compatible with the preservative, it was never tested. Even if tests had been performed under normal conditions, it is uncertain how the paint would perform with high levels of preservative on the surface of the wood.

The corrosion of the galvanized steel can also be attributed to the preservatives used in the wood. Recent work done by Andrew J. Baker[1] tested the affects of two types of preservative in contact

[1]Baker, A.J. 1992. Corrosion of nails in CCA- and ACA-treated wood in two environments. Forest Products Journal. 42(9):39-41.

with various nail alloys. Most closely representing the conditions of the guardrail was the use of ammoniacal copper arsenate (ACA) pressure treated wood in contact with hot-dipped galvanized nails. The tests showed that nails lose weight by corrosion when exposed to high humidity conditions and contact with ACA.

Stan Lebow, of the Forest Research Laboratory at Oregon State University, said that in his opinion the wood used for the guardrail did not dry properly. He said that as long as there is ammonia that has not evaporated, there will be copper in a soluble state. In that form, there is a favorable energy exchange potential and the copper will take electrons from the iron causing the corrosion. If, on the other hand, the ammonia has evaporated, the copper would have precipitated out and would not have reacted with the iron. He suggested the use of better drying techniques. Stan said that zinc in the ACZA was added to the preservative to replace some of the arsenic for environmental reasons and to cut down on costs. He does not believe this will make the ACZA that much different from the ACA with regards to corroding potential, since the amount of copper in the preservative remains the same.

## RECOMMENDATIONS

To achieve a more aesthetic look, the wood should be left unpainted. The pressure treatment alone should be sufficient to avoid attack from microorganisms and insects. This would solve the problem of the preservative discoloring and flaking the paint, and give the guardrail a natural wood look that would better suit the surrounding environment.

The leaching of the preservative should be corrected to stop the corrosive reactions with the galvanized steel. The drying of the wood after treatment is important. If air drying is to be used, care must be taken to make sure that the evaporation rate is high enough to dry the wood. Kiln drying offers much better control of the surrounding environment and should be used when possible. The wood should also be spaced properly when drying to allow a good flow of air between the members.

To help reduce installation costs, standard post sizes should be considered. Reducing the spacing between posts and using a 6″ × 8″ (nominal) will allow the contractor to use available equipment to drive the posts. This would be more efficient than auguring a hole, placing the post, and filling in around the post. For safety considerations, this should be crash tested before implementation.

## ADDITIONAL INFORMATION

Recently, a report for this research project was published titled "Two-Rail Steel-Backed Timber Guardrail, Construction Report." To obtain a copy of this report or any additional information regarding this project, please contact:

**Kevin Groom or Scott Nodes**
**Oregon Department of Transportation**
**Engineering Services Section**
**Research Unit**
**800 Airport Road S.E.**
**Salem, OR 97310**
**(503) 378-2318**