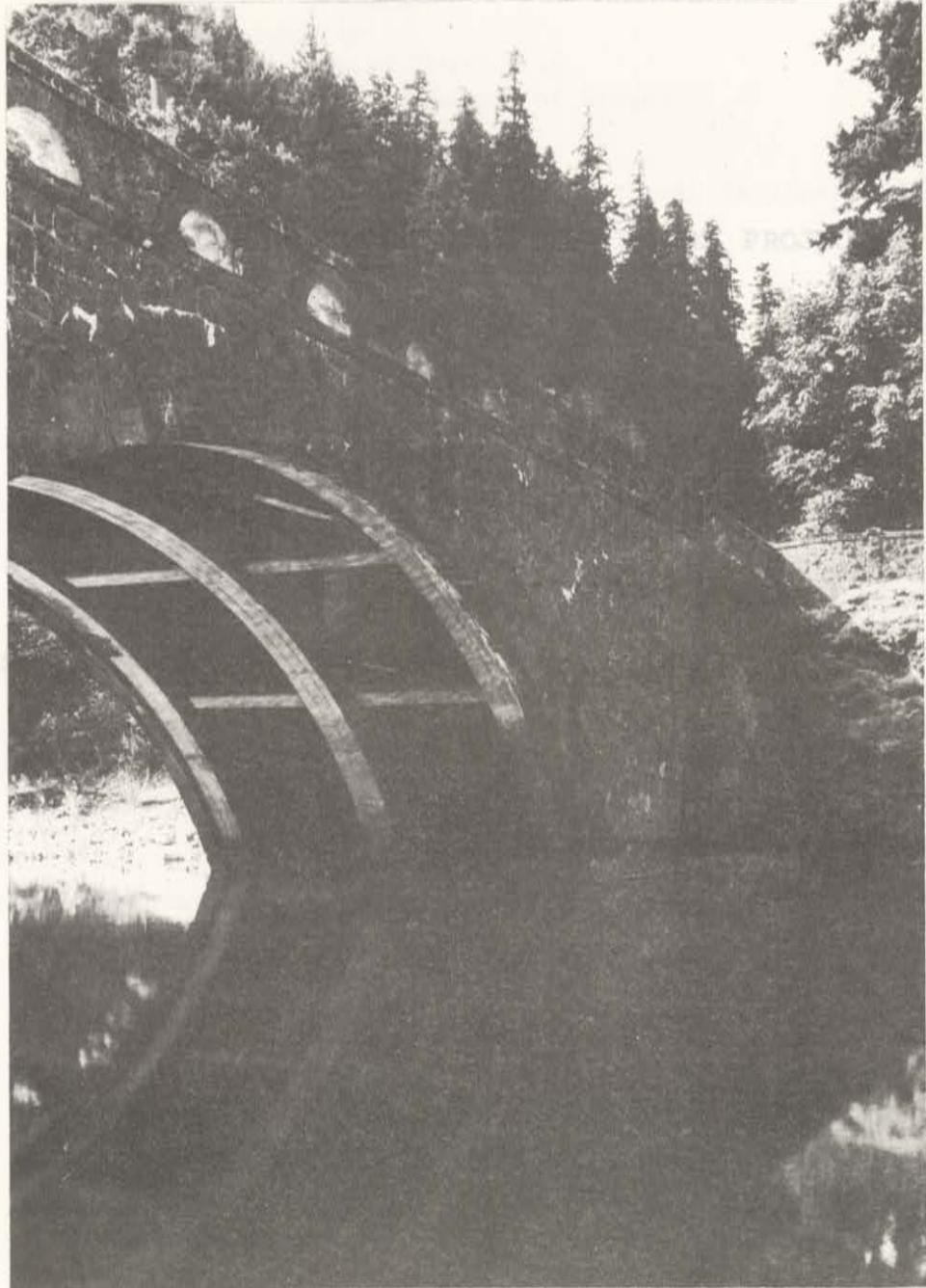


Columbia River Highway

Guide for Maintenance

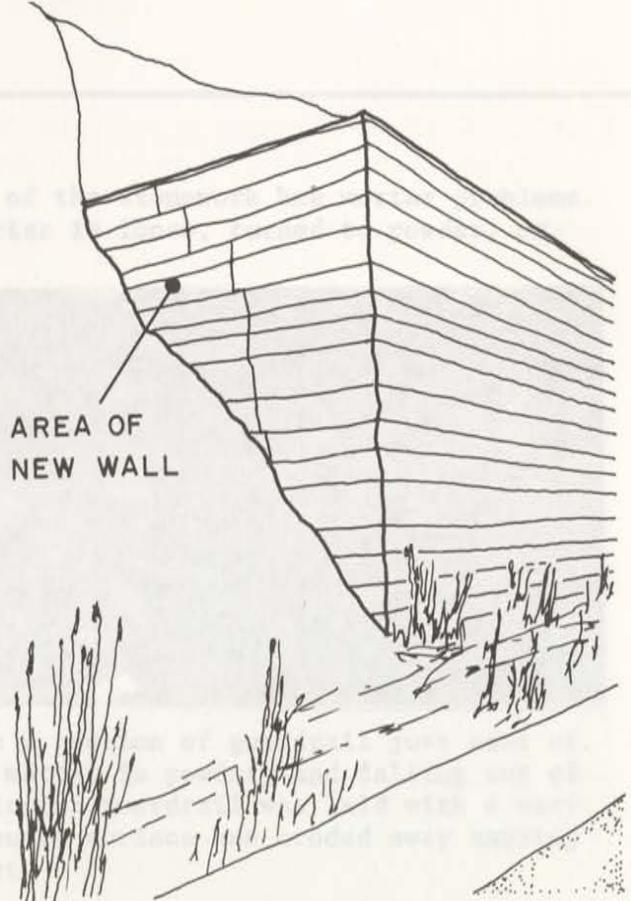
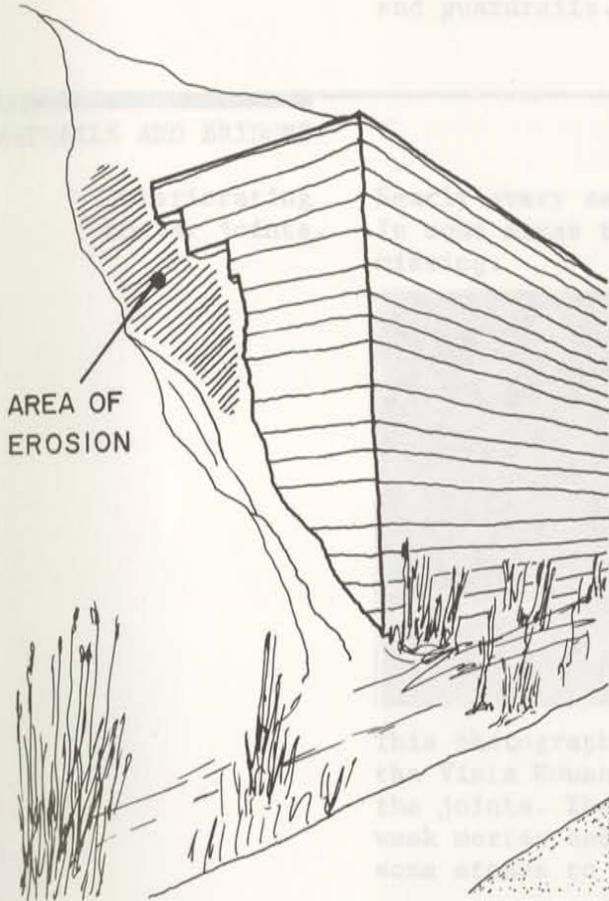
COLUMBIA RIVER HIGHWAY

GUIDELINES FOR MAINTENANCE



Columbia River Highway Project 1981

Essential Recommendation. Build support to the wall back into the hill using stone which matches the existing stone.



Lack of retaining walls.

In several areas along the highway rainwater has washed gullies into the hills above the road. Soil and debris washes onto the roadway creating a danger for automobiles.



Essential. Recommendation. Build retaining walls in areas where needed using the same type stone used in the other retaining walls and guardrails.

GUARDRAILS AND BRIDGES

Deteriorating mortar joints.

Nearly every section of the stonework has mortar problems. In some areas the mortar is loose, turned to powder, or missing.



This photograph shows a section of guardrail just east of the Vista House. The mortar is powdery and falling out of the joints. The particular guardrail was laid with a very weak mortar and the outer surface has eroded away causing some stones to be lost.

Urgent. Recommendation. Remove deteriorated mortar and repoint joints. Mortar should match the original (see specifications).

In this photograph of stonework, the mortar is missing in areas and loose in some sections.



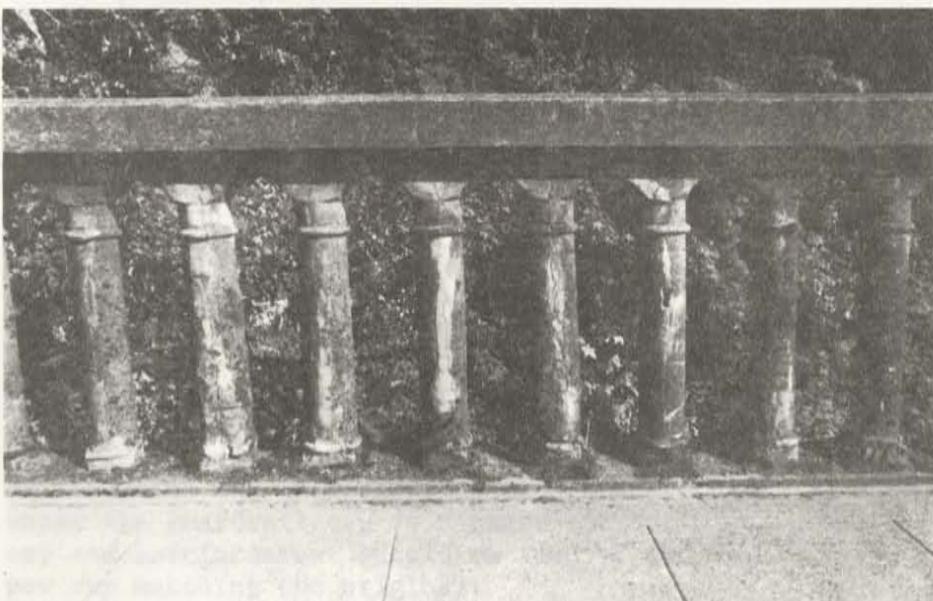
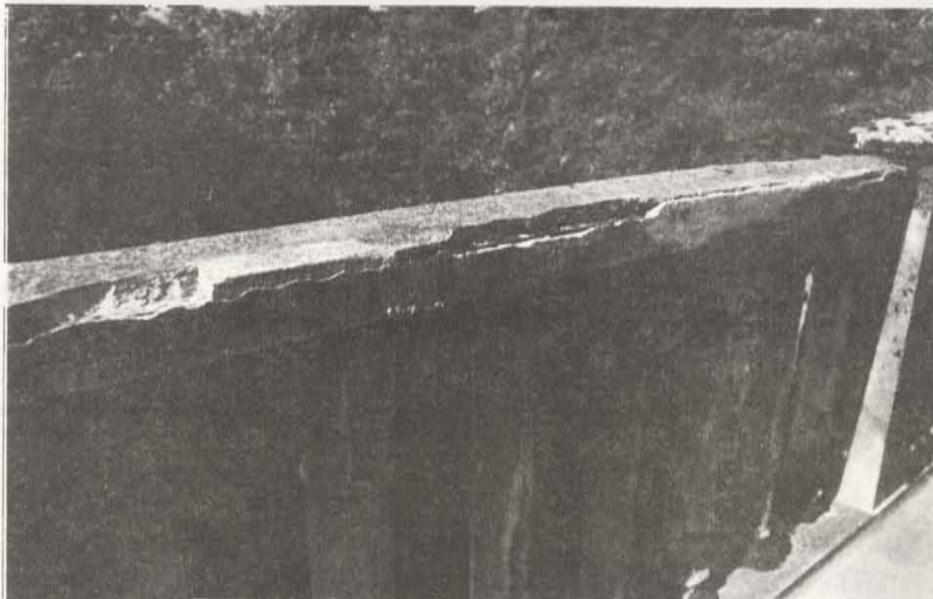
AREA OF EROSION



TO THE

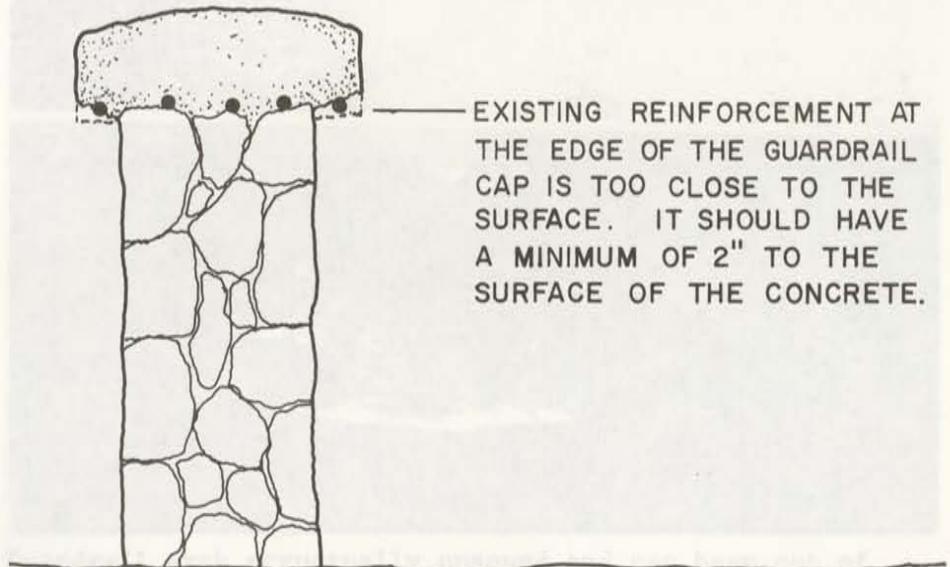
Essential. Recommendation. Missing areas and loose mortar should be removed and joints repointed. Mortar should match the original (see specifications).

Exfoliation of metal. In many locations the reinforcing bars are exposed to the weather and have started to rust. A very minimal amount of metal exfoliation causes the concrete to crack, allowing water to penetrate. The bridge railing has very thin members with exposed metal reinforcing. This condition is a very serious problem. As shown in these photographs, metal reinforcing is exposed on most guardrail sections and on the underside of the caps.





Urgent. Recommendation. In the area where elements can be replaced, such as the balusters of the bridge railing, they should be removed and replaced with balusters which match the originals. Where deteriorated elements on the bridges cannot be removed and replaced, exposed areas of reinforcement should be cleaned by sandblasting the metal free of rust, and the missing concrete replaced with concrete matching the original.



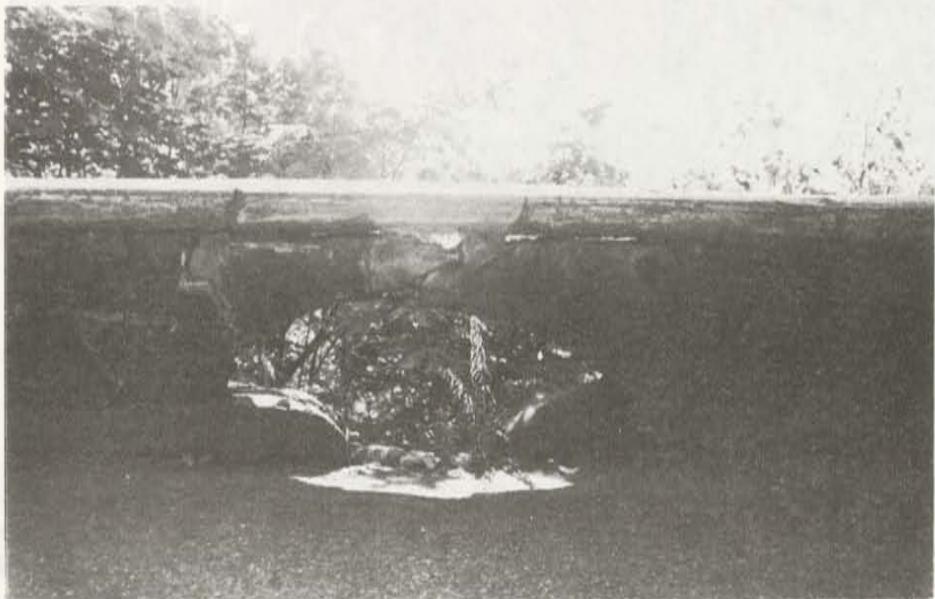
Essential. Recommendation. Exposed reinforcement on the stone caps of the guardrail should be cleaned of all rust and the concrete repaired in areas where exposure is limited. Where exposure is extensive the reinforcement should be removed. In areas where the guardrail cap is damaged and out of alignment, the cap and reinforcement should be removed and replaced by a new cap matching the original.

Vehicular damage to associated structures.

Throughout the highway, vehicles have caused damage to associated structures. Vehicles have sideswiped guardrails, guardstones, and other features, causing failure or loss.



Missing post guardrail, one-half mile west of Vista House.

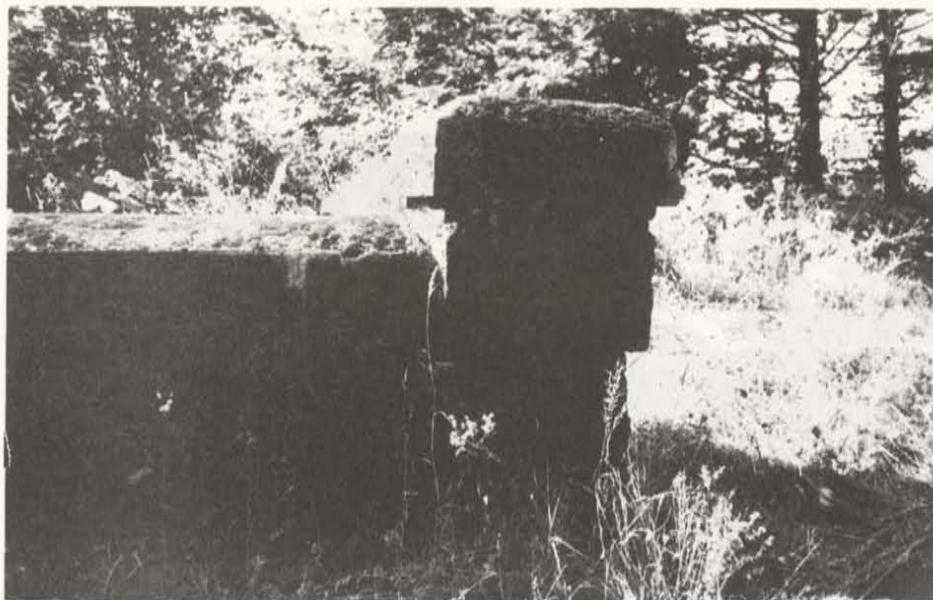


Guardrail arch structurally unsound and cap beam out of alignment, east of Vista House.

During periodic inspections should be made to assess damage and repairs needed. All repairs should follow the guidelines set forth in this guide.

Vehicle
associated

Structural cracks
in stone work.



Guardrail post out of alignment, one-quarter mile west of Vista House.



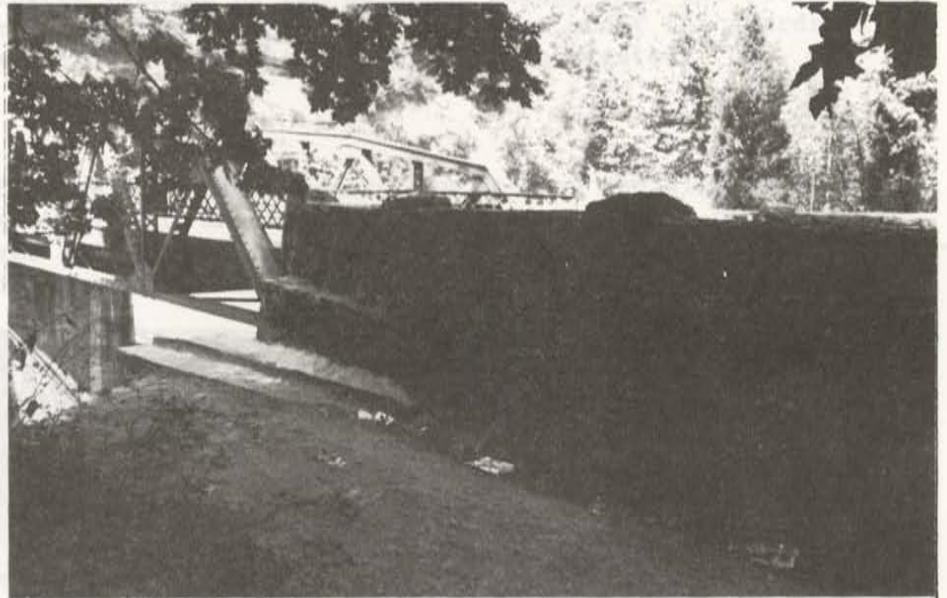
Missing area of guardstones and retaining wall, east of Multnomah Falls.

Essential.

Recommendation. Although nothing can be done to stop vehicles from damaging these features, periodic inspections should be made to assess damage and repairs needed. All repairs should follow the guidelines set forth in this guide.

**Structural cracks
in stonework.**

Although most structural cracking in the stonework of the guardrails was caused by vehicles, some areas have cracks caused by uneven settlement of the guardrails.



On the west end of the Sandy River-Stark Street Bridge, the guardrail adjacent to the bridge has a major structural crack at midspan. This is an old crack which has been repaired by grouting the crack with Portland cement. But, although the wall has been repaired, it has continued to move and the crack has reopened.

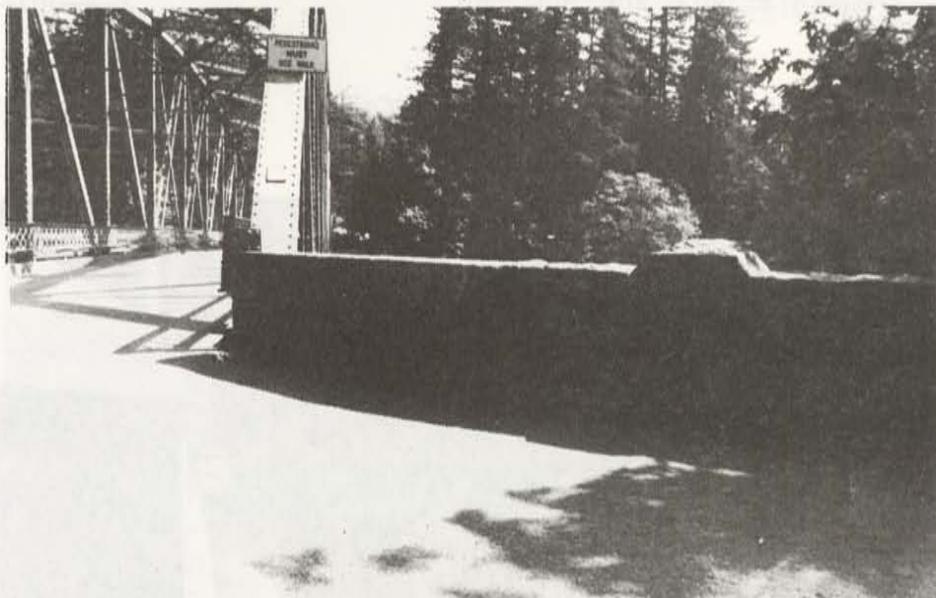


Essential.

Recommendation. Periodic inspection should be made to cracks, and as they reopen cracks should be grouted with a mortar matching the original mortar used in the stonework. The forces created by the adjacent bridge onto the river embankment may have caused the settlement under the guardrail, and this possibility should be investigated.

Existing repairs to damaged sections of guardrails and bridges.

Repairs have been made to features on the highway that are visually and materially inappropriate to the original. At the east end of the Sandy River-Stark Street Bridge, a missing section of the guardrail was replaced with concrete.



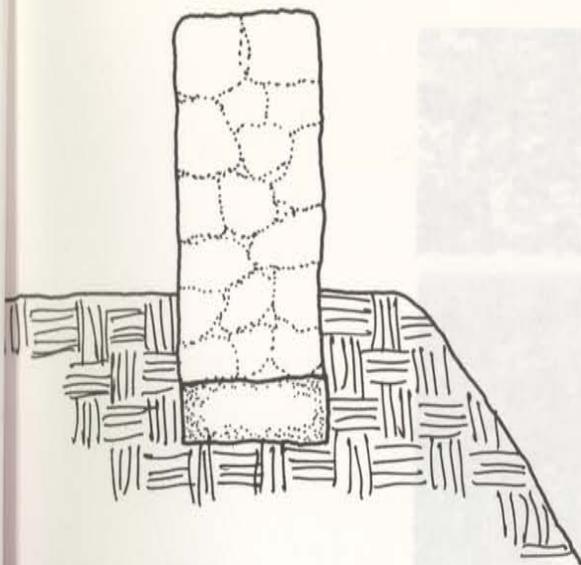
This photograph shows how the replacement has destroyed the appearance of the original guardrail.

Essential.

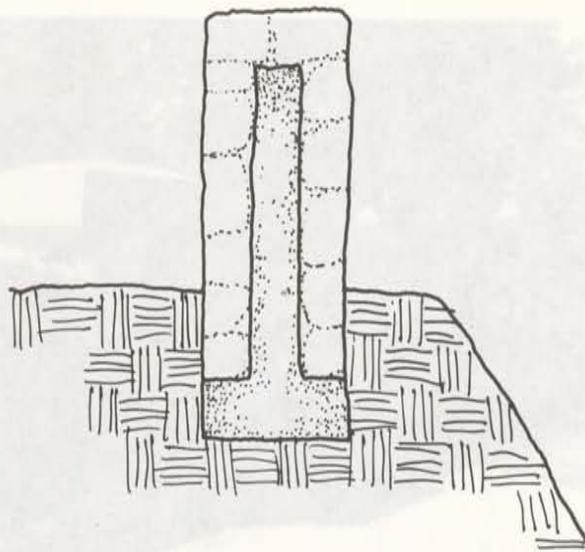
Recommendation. Missing areas should be replaced in stone matching the historic stonework in size, color, texture, and quality. The replacement of the missing areas of guardrail can be accomplished by either rebuilding the wall as a solid stone wall or as a concrete wall faced with stone to match the historic appearance of the original.

It is visible to pedestrians from the sidewalk. This kind of reinforcement should only be considered where it is visually and physically concealed.

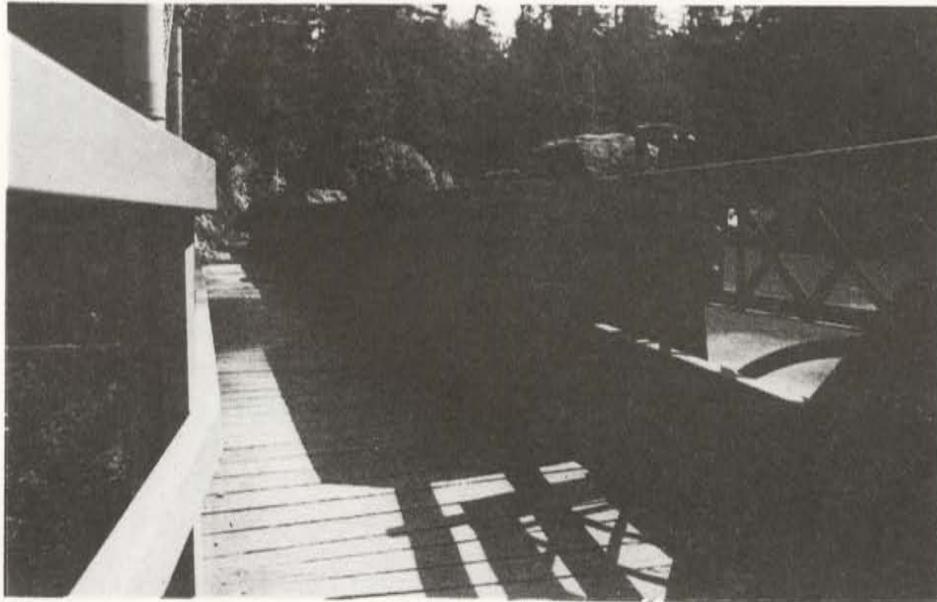
In several locations guardrail post caps were replaced with concrete replacements which do not match the historic appearance of the originals. These incompatible caps, as shown in the photograph below, should be removed and replaced with a post cap matching the original design, color, and texture.



EXISTING STONE GUARDRAIL



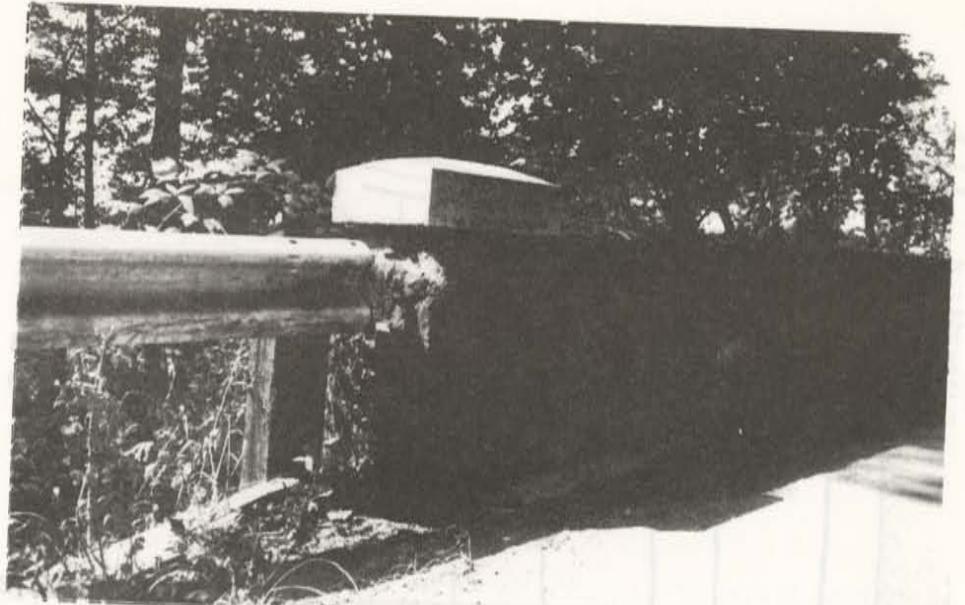
PROPOSED CONCRETE GUARDRAIL WITH STONE FACING



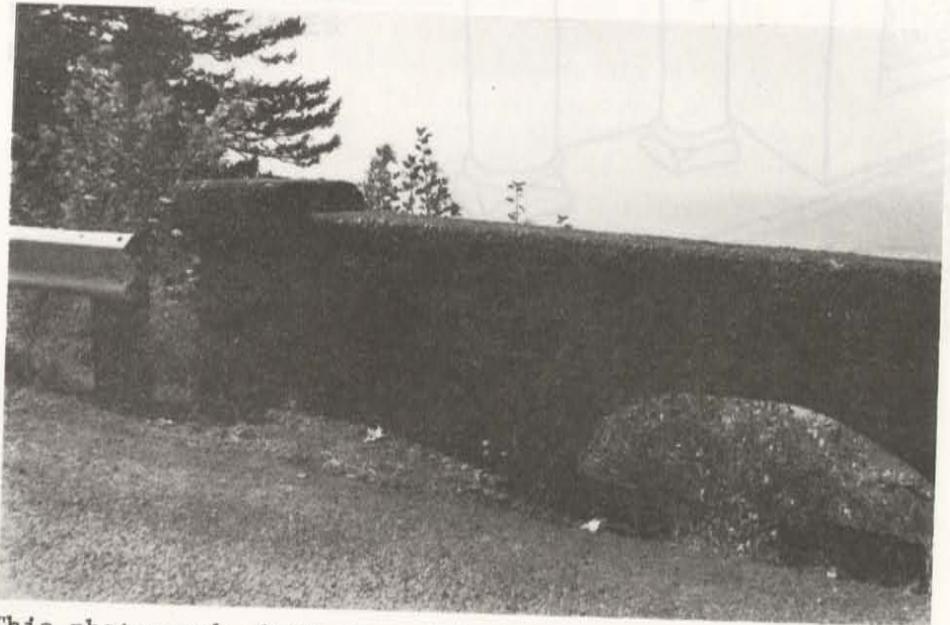
Along the walkway at the west end of the Sandy River-Stark Street Bridge, concrete reinforcement was added to the guardrail. It cannot be seen from the road which is good, but it is visible to pedestrians from the sidewalk. This kind of reinforcement should only be considered where it is visually and physically concealed.

Desirable.

In several locations guardrail post caps were repaired with concrete replacements which do not match the historic appearance of the originals. These incompatible caps, as shown in the photograph below, should be removed and replaced with a post cap matching the original design, color, and texture.



BALUSTERS IN APPROX.



This photograph shows an original guardrail and post cap.

Desirable.

Recommendation. On the bridge at Bridal Veil Falls, the rhythm of the balusters is interrupted by a change in size (see drawing on following page). It is not yet determined which balusters are original although it appears to be the thinner members. Investigation should be made into which size baluster is historically correct and any further replacements should be made to that size.

COLUMBIA RIVER HIGHWAY

SPONSORS The Columbia River Highway Project is supported by:
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Oregon State University
Oregon State Historic Preservation Office
Oregon Historical Society
Portland Women's Forum
Port of Cascade Locks
United States Forest Service

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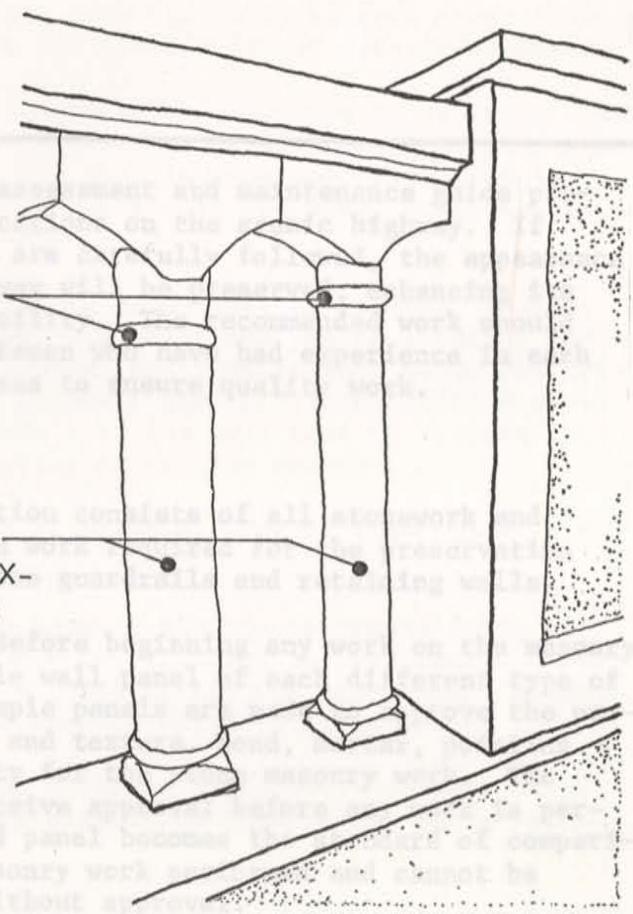
PROJECT ADVISORS National Park Service, Pacific Northwest Regional Office
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Nancy Roberts, Editor
Donnie G. Seale
Stephanie S. Toothman, Ph.D., Historian
CASCADE LOCKS, OREGON
1981
Paul Macapia, Photographer

SPECIFICATIONS

This section of the agreement and specifications contains sample specifications on the subject of these specifications are to be used in the work shown on the respective areas to ensure quality work.

DIFFERENT LOCATION OF THE ASTRAGALS

SIZE DIFFERENCE IN BALUSTERS IS APPROXIMATELY 1 1/2 INCHES IN DIAMETER.



Masonry

The work of this section consists of all stonework and masonry work shown on the respective areas to ensure quality work. Before beginning any work on the fabric, erect a sample wall panel of each different type of stonework. These sample panels are to be of a varied range of color and texture, and to show the technique, and quality of the masonry work. The sample panel must receive approval before work is formed. The approved panel becomes the standard of comparison for all stone masonry work and cannot be changed or altered without approval.

Quality assurance. American Society for Testing and Materials (ASTM).

Product handling. Store all materials including salvaged materials under cover in a dry place and in a manner to prevent damage or intrusion of water or foreign matter.

Materials

Stone. Stone must be sound and durable, and match existing stone in shape, range of sizes, range of color and texture, and quality.

Mortar materials. Lime mortar for setting and resetting masonry work must match existing lime mortar in place. All masonry required to be reset or replaced must be bedded in lime mortar.

Cement. All cement must conform to ASTM C150, Type 1, White. It must not have more than 0.60 percent alkali (expressed as sodium oxide) or not more than 0.15 percent water-soluble alkali by weight (in combination of lime and cement).

Lime. Lime must conform to ASTM C207, Type S, Hydrated Lime.

SPECIFICATIONS

This section of the assessment and maintenance guide presents sample specifications on the scenic highway. If these specifications are carefully followed, the appearance of the original highway will be preserved, enhancing its usage as a public facility. The recommended work should be performed by craftsmen who have had experience in each of the respective areas to ensure quality work.

Masonry

The work of this section consists of all stonework and masonry stabilization work required for the preservation and repair of the stone guardrails and retaining walls.

Sample wall panel. Before beginning any work on the masonry fabric, erect a sample wall panel of each different type of stonework. These sample panels are made to approve the proposed range of color and texture, bond, mortar, pointing technique, and quality for the stone masonry work. The sample panel must receive approval before any work is performed. The approved panel becomes the standard of comparison for all stone masonry work performed and cannot be changed or altered without approval.

Quality assurance. American Society for Testing and Materials (ASTM).

Product handling. Store all materials including salvaged materials under cover in a dry place and in a manner to prevent damage or intrusion of water or foreign matter.

Materials

Stone. Stone must be sound and durable, and match existing stone in shape, range of sizes, range of color and texture, and quality.

Mortar materials. Lime mortar for setting and resetting masonry work must match existing lime mortar in place. All masonry required to be reset or replaced must be bedded in lime mortar.

Cleaning. Immediately after being laid and while the mortar is fresh, all face stone must be thoroughly cleaned of mortar.

Cement. All cement must conform to ASTM C150, Type 1, White. It must not have more than 0.60 percent alkali (expressed as sodium oxide) or not more than 0.15 percent water soluble alkali by weight (in combination of lime and cement).

Lime. Lime must conform to ASTM C207, Type 5, hydrated lime for masonry purposes. A fineness of 85 percent minimum passing through a Number 200 mesh is required. This lime is required to assure high plasticity and water retention with a safe degree of strength.

Sand. Sand must conform to ASTM C144, be natural, washed, and free of impurities. Gradation must match existing mortar in walls. Sand color, size, and texture must match the original to provide the proper visual characteristics without other additives. A sample of the sand must be approved before beginning repointing or setting masonry.

Water. The water must be potable, free of impurities and organic material.

Mortar color. Provide sand in mixture to obtain color of existing lime. Match new mortar color to unweathered mortar sample obtained from a joint within the stonework. Pigment additives must not be used to obtain a color match.

Mortar mix. The mix is measured by volume: one part white cement, two parts high plasticity lime, eight parts washed sand.

Execution

General. Facing material must be protected against staining. When work is resumed, the top surface of work must be cleaned of all loose mortar and, in drying weather, thoroughly wet.

Masonry with high absorption rates (more than 0.025 ounces per square inch per minute) must be wetted sufficiently before laying so that the rate of absorption when laid does not exceed this amount.

Before closing up any inaccessible spaces with masonry, remove all rubbish and sweep out the area to be enclosed.

Where fresh masonry joins masonry that is partially or totally set, clean the exposed surface of the set masonry and wet it lightly so as to obtain the best possible bond with the new work.

Cleaning. Immediately after being lain and while the mortar is fresh, all face stone must be thoroughly cleaned of mortar

Pointing stains and must be kept clean until the work is completed. All cleaning must be by hand application using only fiber brushes and potable water. No acidic or alkaline substances can be used.

Weather limitations. Placing of masonry cannot be done in freezing weather except with written permission and then only with such precautionary methods as may be prescribed for doing the work and with protection at all times. Such permission and the use of the prescribed methods will not, however, release the contractor from his or her obligation to build a satisfactory structure. In hot or dry weather, the masonry must be satisfactorily protected from the sun and must be kept damp for a period of at least three days after completion.

Preparation of existing mortar. To prepare existing mortar, remove all loose and deteriorated mortar and damaged stone work. Salvage stone for reuse. Replace, repair, and repoint masonry to match existing work.

Mixing mortar. Mix all mortar materials by volume as dry as can be handled until thoroughly mixed. Just prior to resetting or repointing masonry, mix into the dry mortar sufficient water to make the mortar workable. Mix no more than that amount of mortar that can be used within one and a half hours after the addition of the water.

Placing and replacing stone. Stones must be set in lime mortar so as to produce the same effect produced by the existing stone work.

All stones shall be cleaned thoroughly and dampened before being set, and the bed which is to receive them must be cleaned and dampened before the mortar is spread. They must be laid in full beds of mortar. Bond must be as existing bond and keyed into the historic masonry.

The stones must be so handled as not to jar or displace the stones already set or in place. Suitable equipment must be provided for setting stones larger than those that can be handled by two people. The rolling or turning of stones on the walls will not be permitted. If a stone is loosened after the mortar has taken initial set, it must be removed, the mortar cleaned off, and the stone relaid with fresh mortar.

Beds and joints. The thickness of beds and joints for face stones must conform to existing surrounding masonry.

Backing. All openings and interstices in the backing must be filled completely with mortar or with spalls surrounded completely by mortar.

Pointing Upon completion of all masonry repair and resetting, all open joints must be repointed.

New work. In areas of newly laid masonry, after mortar has sufficiently dried, the joint must be raked clean to a $\frac{1}{2}$ -inch minimum depth using only hand tools.

Existing open joints. Care must be exercised not to rake existing open joints any deeper than necessary to provide a clean base for the lime pointing mortar.

Flushing joints. Prior to repointing, all joints, existing and new, must be carefully flushed with clear potable water exercising care to ensure that the existing mortar is not eroded or otherwise weakened.

Pointing. Repoint all existing and new open joints ensuring that the new work merges with and matches the existing pointing in quality of work and tooling.

McKee, Harley J. Introduction to Early American Masonry. Washington, D.C.: National Trust for Historic Preservation and Columbia University, 1973.

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----. "Repointing Mortar Joints in Historic Brick Buildings," Preservation Briefs 2. Washington, D.C.: Heritage Conservation and Recreation Service, Department of the Interior, April 1976.

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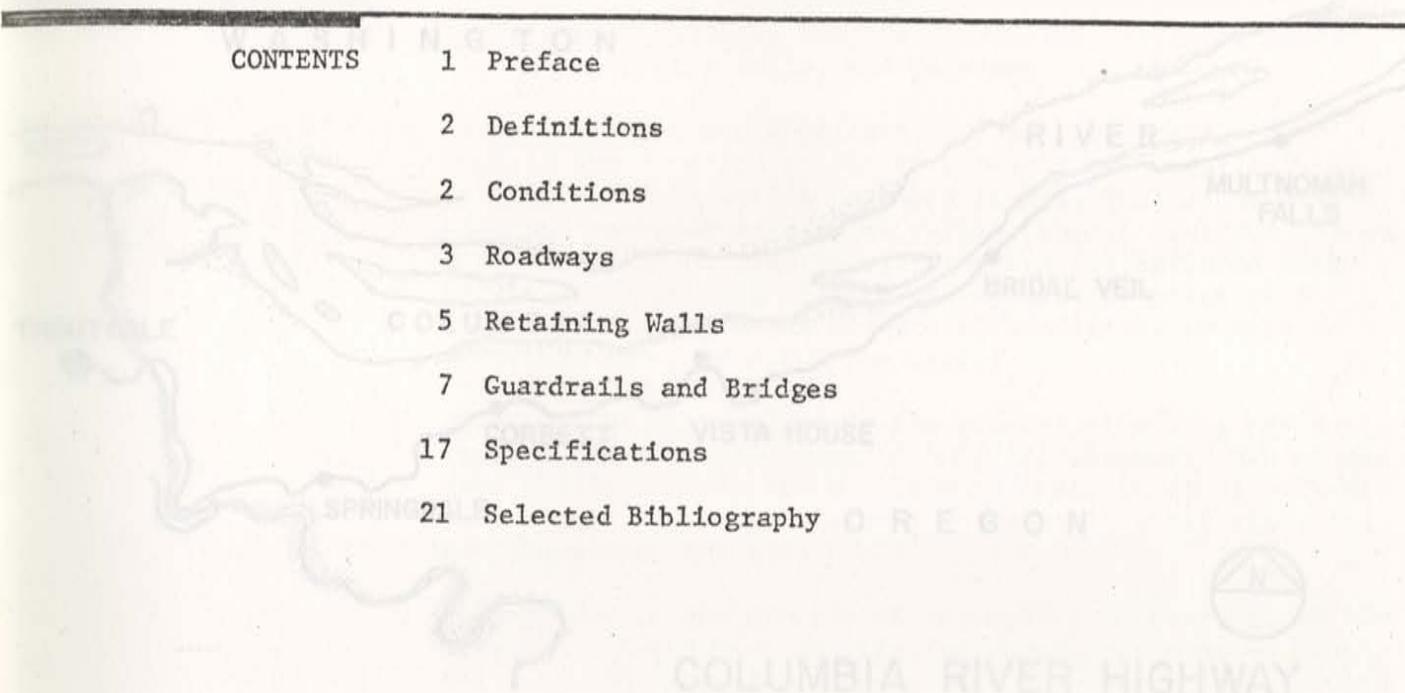
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Paul Macapia, Photographer

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COLUMBIA RIVER HIGHWAY

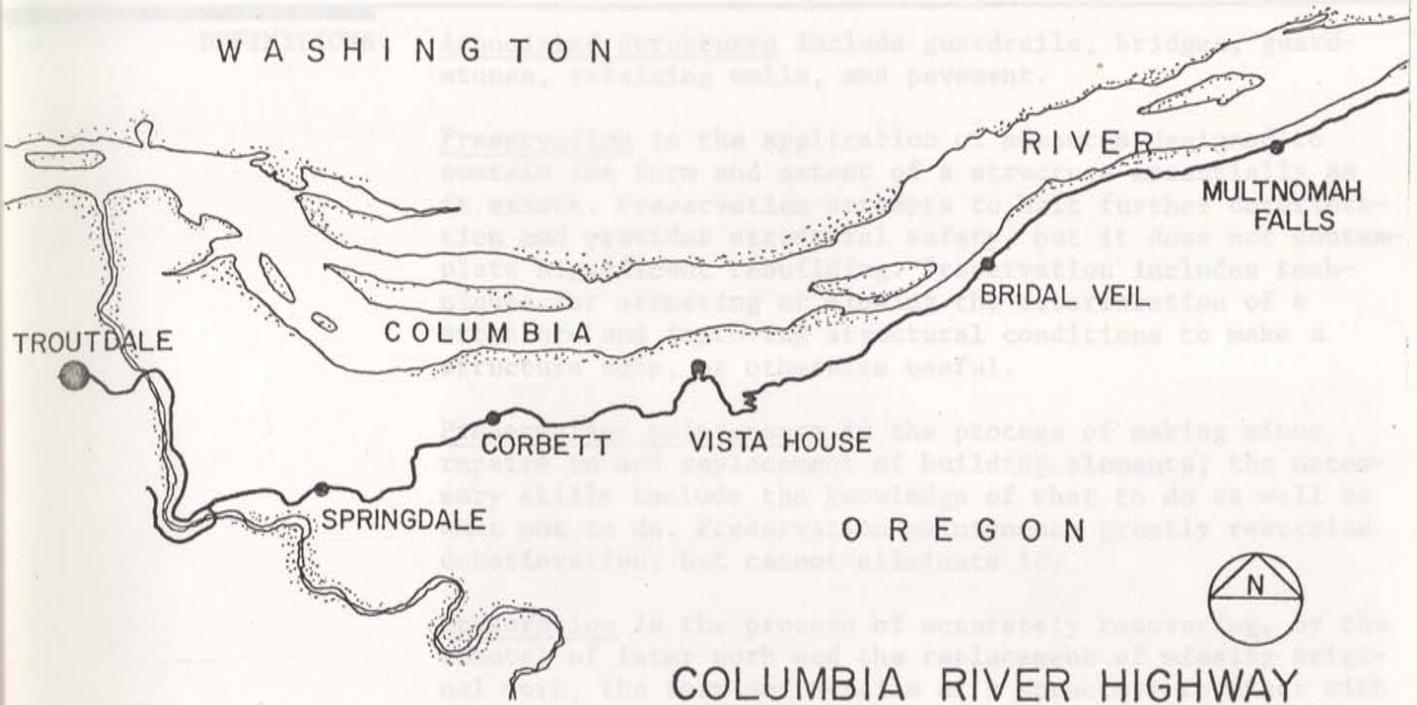


ASSESSMENT AND
MAINTENANCE GUIDELINES
PREFACE

The total preservation responsibility for historic property is maintenance. Maintenance often suffers from low priority but no preservation program should neglect its true, vital importance. Both managerial and financial support are essential if skilled maintenance is to be carried out properly.

The purpose of this report is to assist in the maintenance planning for the highway and its associated structures, and to explain some of the maintenance techniques appropriate for these structures.

The scope of this investigation consisted of a thirty-three mile portion of the highway between Troutdale and Multnomah Falls. Since this stretch of highway is the most widely used and in deteriorating condition, it is the most critical area requiring maintenance. The remaining segments of the highway have similar problems but the condition of the highway is not as serious because of limited rainfall and use.



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DEFINITIONS

Associated structures include guardrails, bridges, guardstones, retaining walls, and pavement.

Preservation is the application of measures designed to sustain the form and extent of a structure essentially as it exists. Preservation attempts to halt further deterioration and provides structural safety, but it does not contemplate significant rebuilding. Preservation includes techniques for arresting or slowing the deterioration of a structure and improving structural conditions to make a structure safe, or otherwise useful.

Preservation maintenance is the process of making minor repairs to and replacement of building elements; the necessary skills include the knowledge of what to do as well as what not to do. Preservation maintenance greatly restrains deterioration, but cannot eliminate it.

Restoration is the process of accurately recovering, by the removal of later work and the replacement of missing original work, the form and details of a structure together with its setting as it appeared at a particular period of time.

CONDITIONS

Highway associated structures display a varying range of maintenance requirements. Conditions generally range from:

Good condition. Stones, posts, caps, and alignment are intact. Structure is sound. Stones, caps, and mortar cannot be removed by hand. No maintenance is required.

Fair condition. Minor deterioration of stones, posts, caps, and alignment. Structure intact, mortar missing or loose but not powdery to the touch. Minimal maintenance required.

Poor condition. Major deterioration of structures. Stones, caps, posts and walls are missing, broken, or out of alignment. Mortar is powdery to the touch. Maintenance is required.

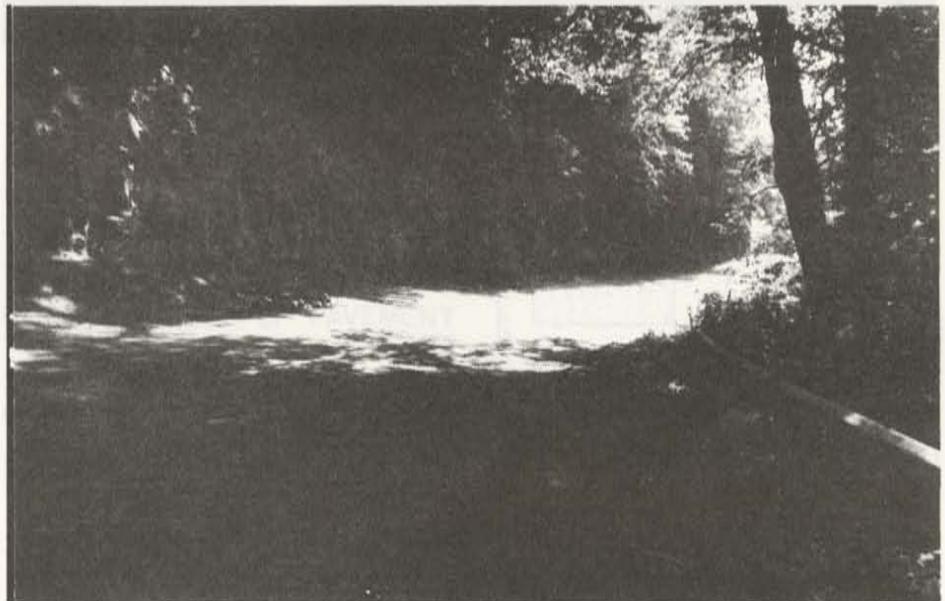
Urgent.

Recommendation. For years the state has been resurfacing this area of the road to build up the level of the roadway. This is the best short-term solution for this problem. However, at some time, a slide could force the closure of this section of highway. This section has more associated structures than any other segment, and it would be a great loss.

ROADWAYS

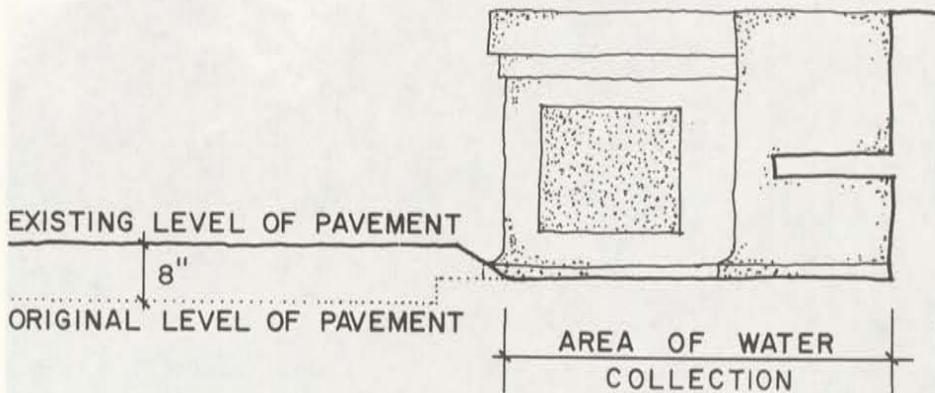
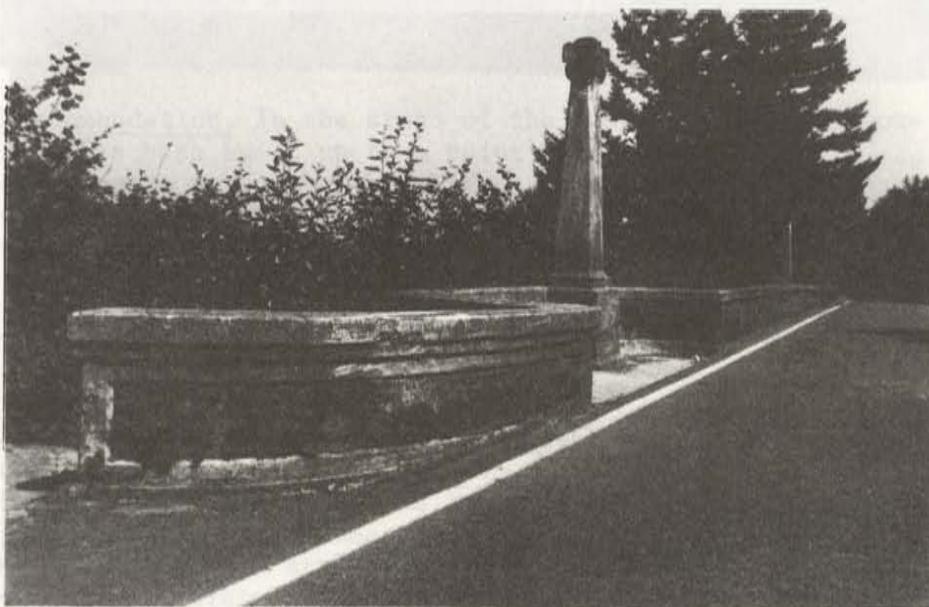
Subsidence of roadway.

About one mile west of the Crown Point Vista House is a section of the highway that is settling. This section is approximately fifty yards long. Information from the state landscape architect indicates that the road is sinking six inches a year in this area. The hillside in the area is settling to its slope of repose and, until this is reached, the roadway will keep sinking.



Urgent. Recommendation. For years the state has been resurfacing this area of the road to build up the level of the roadway. This is the best short-term solution for this problem. However, at some time, a slide could force the closure of this section of highway. This section has more associated structures than any other segment, and it would be a great loss to the highway. The state highway department should investigate this area for a long-term solution to the settlement problem.

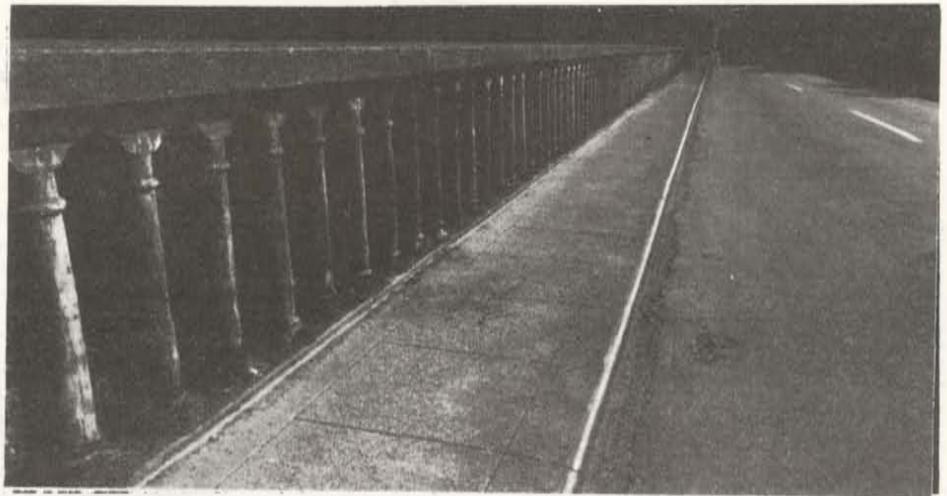
Paving material buildup. Drainage from road surface has changed since the historic surface was first laid. As seen at this exedra on a bridge near Troutdale, the road surface has been raised approximately eight inches.



EXEDRA - STARK STREET

Essential

Another example of paving buildup is Shepperd's Dell Bridge where the road surface has been raised to a level almost equal to the sidewalks on the bridge.



Desirable

Recommendation. In the areas of the roadway where the surface has been built up to a point where standing water could cause damage to the highway's historical features, the grade should be lowered to the original level, and original drainage re-established.

RETAINING WALLS

Soil erosion.

Just outside of Troutdale is a large retaining wall about ten to twelve feet in height. On the east end of the wall the earth is eroding behind and around the retaining wall. If the erosion continues the wall will lose its support which could cause structural cracks and collapse at the end of the retaining wall.

