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# ENGINEERING INSTRUCTION

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

SUBJECT: BRIDGE DESIGN MANUAL
DESIGN CRITERIA FOR BRIDGES

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Supersedes: EI 84-40

This Engineering Instruction transmits the following updated rehabilitation guidelines:

1. Table of Current Rehabilitation Specifications and Guidelines (3 pages).
2. Concrete Repair Chart (1 page).
3. Design Guidelines (22 pages).

The purpose of this instruction is to provide an easy reference to the more commonly used rehabilitation items. No attempt has been made to include all items related to rehabilitation projects.

When using concrete repair items, the Designer should make a determination whether or not the full replacement of a structural element is more appropriate for specific situations.

Questions or comments regarding this Engineering Instruction should be directed to John Sadowski, Structures Design and Construction Division, Design Section at (518) 457-4453.

# CURRENT REHABILITATION SPECIFICATIONS AND GUIDELINES

| ITEM NO. | TITLE | UNIT | CURRENT ISSUANCE | |
|---|---|---|---|---|
| | | | SPECIFICATIONS | GUIDELINES |
| 202.19 | Removal of Substructures | C.Y. | Std. Specs.(1-2-90) | EI 93-005 & EI 92-020 |
| 12202.1991 | Canal Structure Conc. Rem. (Non-Explosive) | C.Y. | EI 91-16 | EI 91-16 |
| 12202.1992 | Canal Structure Conc. Rem. (Explosives Allowed) | C.Y. | EI 91-16 | EI 91-16 |
| 15558.50 | Membrane Waterproofing System For Structural Slabs | S.F. | DQAB Insert(11-19-76) | EI 93-005 & EI 90-39 |
| 564.10XXnn | Struct. Steel Repl. Pound | Lbs. | Std. Specs.(1-2-90) | EI 93-005 |
| 564.70XXnn | Struct. Steel Repl. Each | Ea. | Std. Specs.(1-2-90) | EI 93-005 |
| 15566.31 | Weep Tubes for Struct. Slabs | Ea. | DQAB Insert(8-23-78) | EI 93-005 |
| 15566.91-.96 | Vertical Adjustment of Bridge Drainage Devices 1 thru 6 | Ea. | DQAB Insert(6-22-78) | |
| 15567.60 | Removal of Exist'g Steel Joint Systems | L.F. | DQAB Insert (undated) | |
| 15567.91-.96 | Vertical Adjustment of Joint Systems - 1 thru 6 | L.F. | DQAB Insert(12-27-76) | |
| 578.01 | Bonded Concr. W.S. for Str. Slabs | S.F. | Std. Specs.(1-2-90) | EI 83-22(5-17-83) |
| 579.01 | Structural Slab Scarification | S.F. | Std. Specs.(1-2-90) | |
| 579.02 | Reinforcing Bar Exposure | S.F. | Std. Specs.(1-2-90) | EI 91-7 (4-15-91) |
| 580.01 | Removal of Struct. Concr. | C.Y. | Std. Specs.(1/2/90) | EI 93-005 |
| 580.02 | Removal of Steel Supp. Struct. Slab (with shear conn.) | S.F. | Std. Specs.(1/2/90) | EI 93-005 |
| 580.03 | Removal of Steel Supp. Struct. Slab (w/o shear conn.) | S.F. | Std. Specs.(1/2/90) | EI 93-005 |
| 580.04 | Removal of Concr. Approach Slab | S.F. | Std. Specs. (1/2/90) | |
| 580.11 | Removal of Concr. Pylons | Ea. | Std. Specs. (1/2/90) | |
| 580.21 | Removal of Concr. from Struct. Steel Members | L.F. | Std. Specs. (1/2/90) | |
| 581.01 | Removal of Bit. Concr. Overlay (Bridge) | S.F. | Std. Specs. (1/2/90) | EI 93-005 |

|  |  |  | CURRENT ISSUANCE |  |
|---|---|---|---|---|
| ITEM NO. | TITLE | UNIT | SPECIFICATIONS | GUIDELINES |
| 581.02 | Removal of Cem. Concr. Overlay (Bridge) | S.F. | Std. Specs.(1/2/90) | EI 93-005 |
| 582.05 | Removal of Struc. Concr.-Repl. w/Class A. Concr. | C.Y. | Std. Specs.(1/2/90) | EI 93-005 |
| 582.06 | Removal of Struc. Concr.-Repl. w/Class D. Concr. | S.F. | Std. Specs.(1/2/90) | EI 93-005<br>& EI 90-39 |
| 582.07 | Removal of Struc. Concr.-Repl. w/Vert. & Overhead Patching Material | S.F. | Std. Specs.(1/2/90) | EI 93-005 |
| 583.01 | Shotcrete | Bags | Std. Specs.(1/2/90) | EI 93-005<br>& EI 90-39 |
| 584.0102 | High Density Concrete Overlay | S.F. | Std. Specs.(1/2/90) | (Min.thick =2") |
| 584.1102 | Latex Modified Concrete Overlay | S.F. | Std. Specs.(1/2/90) | (Min.thick =1½") |
| 584.1201 | Micro-Silica Concrete Overlay | S.F. | Std. Specs.(1/2/90) | (Min.thick =1½") |
| 585.01-.06 | Struc. Lifting Operations Type A-F | Ea. | Std. Specs.(1/2/90) | EI 93-005 |
| 586.01 | Drilling and Grouting Bolts or Reinforcing Bars | L.F. | Std. Specs.(1/2/90) |  |
| 586.05 | Removal of Rivets and Repl. with High-Strength Bolts | Ea. | Std. Specs.(1/2/90) |  |
| 586.10 | Field Drill Holes in Existing Struct. Steel | Ea. | Std. Specs.(1/2/90) |  |
| 15586.19 | Drilling & Grouting H.S. Anchor Bolts | L.F. | EI 84-57 (12/6/84) | EI 84-57(12/6/84) |
| 587.01 | Bridge Railing Removal and Disposal | L.F. | Std. Specs.(1/2/90) |  |
| 587.02 | Bridge Railing Removal and Storage | L.F. | Std. Specs.(1/2/90) |  |
| 587.03 | Install. of Stored Br. Rail'g. (Painting Req.) | L.F. | Std. Specs.(1/2/90) |  |
| 587.04 | Install. of Stored Br. Rail'g. (Painting not Req.) | L.F. | Std. Specs. (1/2/90) |  |

| ITEM NO. | TITLE | UNIT | CURRENT ISSUANCE<br>SPECIFICATIONS | GUIDELINES |
|---|---|---|---|---|
| 15587.0501 | Steel Bridge Railing Replacement Clamp | Ea. | EI 84-35 (7/13/84) | |
| 587.20 | Thrie Beam Br. Rail - Attach. to Exist Br. Rail | L.F. | Std. Spec.(1/2/90) | |
| 587.21 | Thrie Beam Br. Rail - New Post Install. Mounted on on Conc. Surf. | L.F. | Std. Spec.(1/2/90) | |
| 587.22 | Thrie Beam Br. Rail - New Post Install. on Steel Surf. | L.F. | Std. Spec.(1/2/90) | |
| 589.01XXnn | Removal of Exist.Steel Pound | Lbs. | Std. Spec.(1/2/90) | EI 93-005 |
| 589.52XXnn | Removal of Exist. Steel Each | Ea. | Std. Spec.(1/2/90) | EI 93-005 |

# CONCRETE REPAIR CHART

| Item | Normal Depth of Repair | Desirable Max. Depth of Repair | Location | Desirable Min. Quant. |
|---|---|---|---|---|
| 580.01 Removal of Structural Concrete | Any Depth | No Limit | Use this item if concrete is not replaced or if it is to be replaced with a different volume. | No Minimum |
| 580.02 Removal of Steel Supported Structural Slab (with Shear Connector) | Entire thickness of structural slab | No Limit | Use this item to remove structural slab only (including overlays) | No Minimum |
| 580.03 Removal of Steel Supported Structural Slab (without Shear Connector) | Entire thickness of structural slab | No Limit | Use this item to remove structural slab only (including overlays) | No Minimum |
| 582.05 Removal of Structural Concrete-Replacement w/Class A Concrete | >5" avg. | No Limit | Horizontal or Vertical locations. Pockets, within locations of 1½" avg. depth or less, which exceed this avg. by more than 5". | No Minimum |
| 582.06 Removal of Structural Concrete-Replacement w/Class D Concrete | 1½" to 5" avg. | No Limit | Horizontal or Vertical locations. Pockets, within locations of 1½" avg. depth or less, which exceed this avg. by 1½" to 5". | No Minimum |
| 582.07 Removal of Structural Concrete-Replacement w/Vertical and Overhead Patching Material | ½" to 1½" avg. @ Vertical locations,<br>1" @ Overhead locations | 2" | Vertical locations as indicated. Overhead locations shall not exceed 1" unless formwork or anchoring devices are employed. | No Minimum |
| 583.01 Shotcrete | 0" to 5" | 8" to 12" | Vertical or Overhead locations (large areas). | Approx. 40 Bags |

# DESIGN GUIDELINES

## ITEM 202.19 - REMOVAL OF SUBSTRUCTURES

This item shall be used to remove existing substructures and surrounding material within the limits shown on the plans. Previously, payment for removing existing substructures has been included in the unit price bid for unclassified excavation. This specification has been written so that substructure removal and unclassified excavation can be separated.

Do not use this specification to remove concrete from a substructure that is to be repaired or altered and reused. Use one of the removal of concrete specifications for that type of work since they contain provisions that control the Contractor's operations and also limit the size of the removal equipment that he can use. The removal of substructures specification does not contain these restrictions.

The designer must clearly indicate on the plans those portions of the existing substructure that are to be removed and the corresponding payment limits. If existing plans are available, plan and elevation views of the substructure shall be shown. If existing plans are not available, the designer shall show assumed plan and elevation views of the existing substructure elements that are to be removed. They shall be determined from field investigation and any other information that may be available. A note shall be placed on the plans indicating that the sections shown are assumed and that the actual size and configuration may not agree with those shown on the plans.

Vertical pay limits for the removal of substructures, below existing ground, will normally be located 3'-0" outside of the face or edge of the substructure element that is to be removed. Vertical payment limits for the removal of substructures, above existing ground, shall be coincident with the original structure lines. Upper and lower payment limits shall also be clearly shown on the plans. The number of cubic yards of material to be paid for under the removal of substructures item shall be computed from the payment limits shown on the plans.

If the depth of surrounding material that is to be removed exceeds 5 feet, but does not exceed 20 feet, safe operation sheet piling shall be used. The sheeting shall be shown on the plans and shall be paid for under its own item. If the Contractor receives the permission of the Engineer, he may, as an option, open the sides of the excavation to a stable slope as indicated in the specification. This opening of the excavation would be in lieu of the safe operation sheet piling, and the Contractor would get the same pay for this option that he would have had he used safe operation sheet piling.

## ITEM 202.19 - REMOVAL OF SUBSTRUCTURES (cont'd.)

If the depth of excavation exceeds 20 feet, designed sheeting shall be used and details shall include the minimum section modulus required per linear foot of plan area and the minimum penetration depth required.

All known materials, such as sheeting, piles, utilities or drainage systems that are embedded in or attached to the substructure shall also be shown on the plans. The plans shall clearly indicate which of the materials and attachments are to be included in the substructure removal item and which ones are to be paid for under other items. For example, light poles that are supported on the substructure and electrical conduit that passes through the backwall would probably be removed under their own items. However, removal of the anchorage system for the light pole and the pipe sleeves embedded in the backwall that allowed conduit expansion shall be included in the substructure removal item.

All known piling or sheeting which is integral with the existing substructures shall be shown on the plans. If the sheeting or piling is to be left in place, the designer shall indicate the cut-off elevation on the plans. If the sheeting or piling is to be extracted, the designer shall indicate on the plans how payment will be made for the extraction. It shall be paid for under a special sheeting or piling extraction item, not available at present.

On some occasions it is necessary to remove only a part of the substructure, e.g. a wingwall, etc. Under that circumstance, provided the entire part, or a substantial portion of that part is to be removed, then Item 202.19 should be used.

Check for the presence of asbestos and take appropriate action by contacting the Consultant Management Bureau if present or unknown.

## ITEM 15558.50- MEMBRANE WATERPROOFING SYSTEM FOR STRUCTURAL SLABS

## ITEM 15566.31- WEEP TUBES FOR STRUCTURAL SLABS

Use of Item No. 15558.50 - "Membrane Waterproofing System for Structural Slabs" shall be subject to the following restrictions:

1. Membranes shall not be used on new structural slabs except where specifically approved by the Deputy Chief Engineer (Structures).
2. The first course of bituminous concrete placed on the completed membrane system shall be Item 403.18, Asphalt Concrete - Type 7 Top Course. (Regional special bituminous mixes having the same aggregate gradation may also be used.)
3. Provision shall be made to drain the surface of the membrane system by weep tubes and/or by drain slots cut into existing drainage devices.
4. Membranes shall not be used on spans where the grade is in excess of 4 percent. If a structure ends near an intersection and has a grade near 4 percent, then consideration should be given to other deck protective systems.

Suggested longitudinal spacing for drains on structures where the structural slab is sloped toward the curb lines is given by the following formula:

$$S = \frac{12}{D}\,[20 + (5 \times G)]$$

where D = distance from crown line to curb line.
G = longitudinal grade in percent.

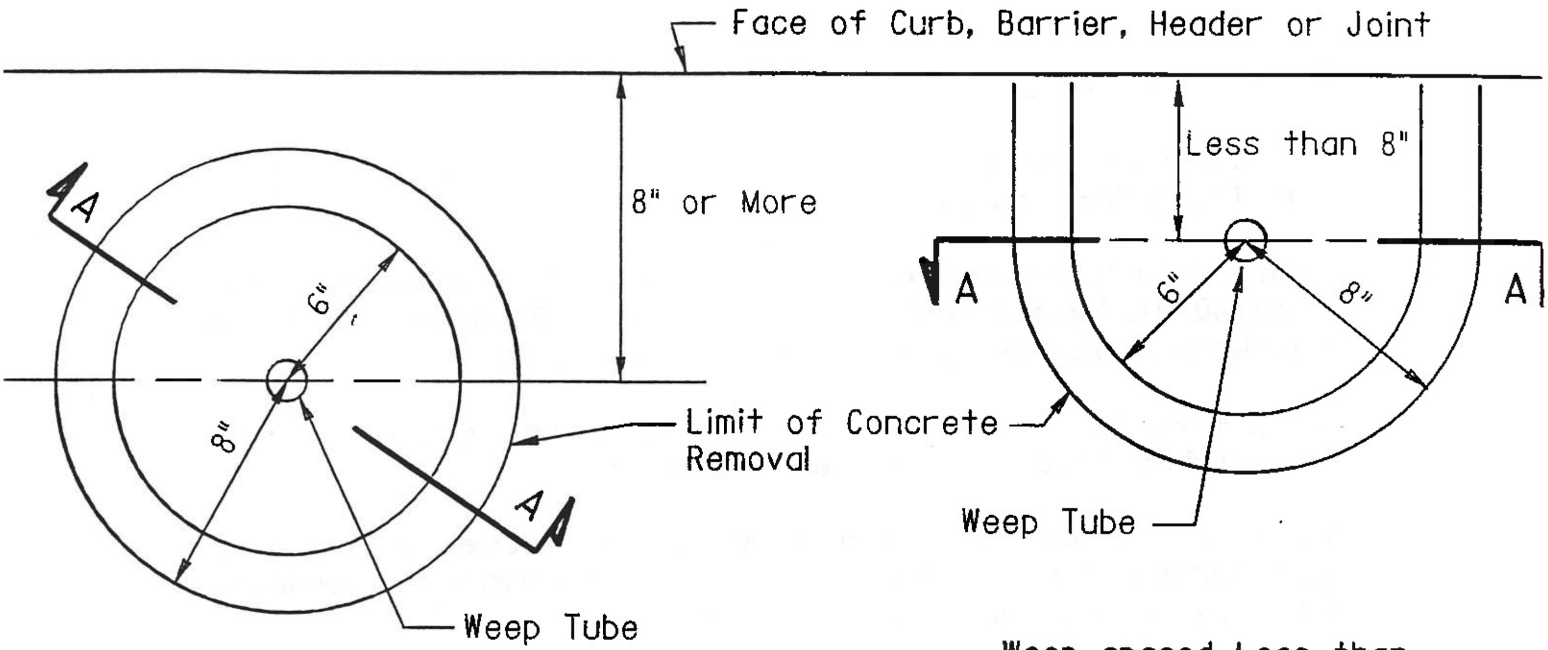
Example: 28' Curb-Curb, crown at Centerline, 2 percent grade.

$$S = \frac{12}{14}(20 + 5 \times 2) = \frac{12}{14} \times 30 = 25.7' \text{ use } 26'\pm$$

Suggested transverse spacing of drains on the uphill side of joints or joint headers is 10 feet.

When Item 15566.31 - "Weep Tubes for Structural Slabs," is used, the Plans shall include the information shown on Plate I - Concrete Removal at Weep Tube Locations. This removal is necessary to ensure drainage because of the additional thickness of the membrane system at weep tube locations.

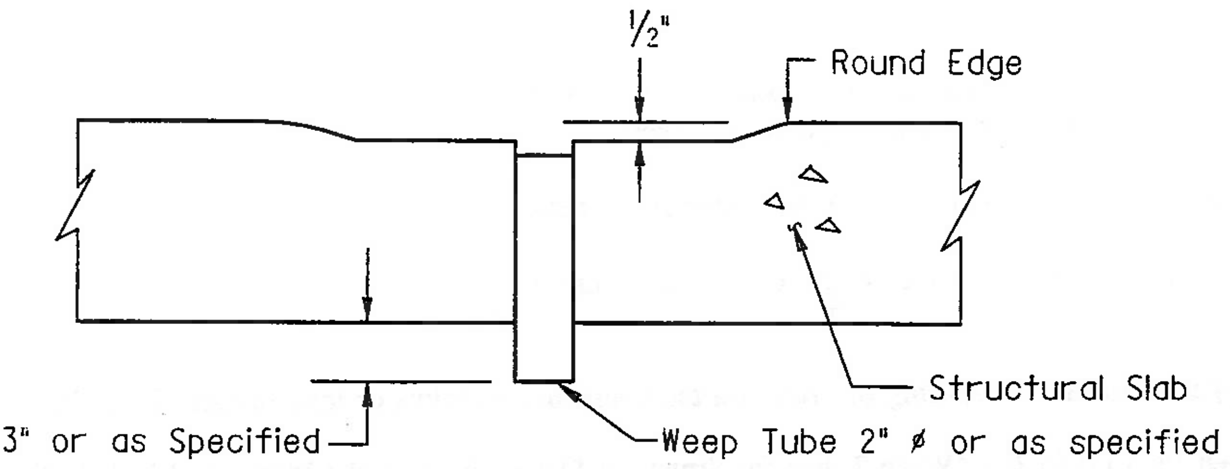
When membranes are used on new structural slabs, the weep tubes should be installed under the structural slab item and the surrounding surface should be depressed.



**Weep spaced 8 or more inches from Vertical Face**

**Weep spaced Less than 8 inches from Vertical Face**

PLAN



SECTION A-A

# CONCRETE REMOVAL AT WEEP TUBE LOCATION

PLATE I

## PROTECTION AND OVERLAYING OF MEMBRANE WATERPROOFING SYSTEM FOR STRUCTURAL SLABS

The bituminous concrete overlay shall be placed on the structural slab preferably within 24 hours but not later than seven (7) days after the placement of the membrane waterproofing system.

For the Bituthene and Protecto-Wrap Performed Sheet Membrane Systems and for all of the Liquid Membrane Systems, the temperature of the first course of bituminous paving material, at the time of placement, shall be not less than 275°F nor greater than 310°F. For the Royston Performed Sheet Membrane System, the temperature of the first course of bituminous paving material, at the time of placement, shall be not less than 290°F nor greater than 325°F.

On grades, bituminous paving equipment shall be operated in the "downhill" direction to minimize damage to the membrane.

Traffic shall not be allowed on liquid membrane systems until the membrane has been covered by the protective sheet. Only that equipment necessary for transporting, placing, and compacting the overlay shall be allowed on the completed membrane system. Bituminous concrete pavers shall be rubber-tired. Vehicles transporting the overlay material shall be rubber-tired and operated at slow speeds (not to exceed 5 mph). All vehicles shall avoid making sharp turns, sudden stops, and starts, or other movements on the membrane that may cause breaks, lifting, or other damage. If vehicle tires cause pickup of the membrane or protective sheet, small quantities of talc, cement, or powdered limestone may be used to dust the tires.

Any damage to the waterproofing system during the overlay operation shall be repaired immediately and prior to the placement of bituminous concrete. A quantity of repair material shall be kept on hand for any such repairs. No additional payment will be made for any areas that require repairs.

Blisters that may raise during the overlay operation shall be vented to insure adhesion of the membrane system and overlay to the deck. Blistered areas will be most noticeable during the rolling operation. Venting shall be done by inserting an icepick or other suitable instrument into the affected area. These vent holes need not be repaired.

## COMPACTION OF ASPHALT OVERLAYS ON BRIDGE DECKS

Compaction of asphalt overlays within the six foot width immediately adjacent to the headers or joints shall be obtained using a vibratory roller having a maximum width of 36 inches. The vibratory roller shall appear on the Department's current Approved List for Bituminous Concrete Vibratory Compaction Equipment - Small Vibratory Rollers. Compaction in accordance with §401-3.12 "Compaction" shall overlap this area and proceed as near as practical to headers or joints.

## SUGGESTED PAVING SYSTEMS FOR STRUCTURES USING MEMBRANE WATERPROOFING SYSTEM FOR STRUCTURAL SLABS

| TOTAL OVERLAY DEPTH | | STANDARD BITUMINOUS MATERIAL[1] | MIX TEMPERATURE |
|---|---|---|---|
| 2" - 3" | 1" - | Item 403.18, Asphalt Concrete - Type 7 Top Course | 275-310°F |
| | 1"-2" - | Item 403.1701, Asphalt Concrete - Type 6F Top Course (High Friction) Marshall Design | Standard |
| | | or | |
| | | Item 403.1901, Asphalt Concrete - Type 7F Top Course (High Friction) Marshall Design | |
| 3½" | 1" - | Item 403.18, Asphalt Concrete - Type 7 Top Course | 275-310°F |
| | 1½" - | Item 403.13, Asphalt Concrete - Type 3 Binder Course | Standard |
| | 1" - | Item 403.1701, Asphalt Concrete - Type 6F Top Course (High Friction) Marshall Design | Standard |
| | | or | |
| | | Item 403.1901, Asphalt Concrete - Type 7F Top Course (High Friction) Marshall Design | |
| 4" | 1" - | Item 403.18, Asphalt Concrete - Type 7 Top Course | 275-310°F |
| | 1½" - | Item 403.13, Asphalt Concrete - Type 3 Binder Course | Standard |
| | 1½" - | Item 403.1701, Asphalt Concrete - Type 6F Top Course (High Friction) Marshall Design | Standard |
| | | or | |
| | | Item 403.1901, Asphalt Concrete - Type 7F Top Course (High Friction) Marshall Design | |

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[1] Regional Special bituminous mixes having the same gradation and properties may be substituted.

## ITEM 580.01 - REMOVAL OF STRUCTURAL CONCRETE

This item shall be used for the removal of sound or unsound concrete in the following cases:

1. The concrete removed is not to be replaced, such as a sidewalk or concrete parapet removal.

2. The concrete removed constitutes an entire element of a structure or a substantial portion of an element, such as a pier cap or part or all of a wingwall. The element removed may or may not be replaced. If replaced, the appropriate construction items shall be used.

3. The removed concrete will be replaced, but the items of replacement will differ from the original limits. Examples are removal of portions of a backwall or wingwall when the replaced portion is higher or longer than the original.

This item shall not be used for removal of all or part of structural slabs nor for the removal of an entire substructure unit. In those cases use the appropriate structural slab removal or removal of substructures item.

Reconstruction Note 55, found in Appendix B of the "Standard Details for Highway Bridges", shall be included in the plans if new concrete is to be applied to existing concrete surfaces.

Payment limits for the removal of concrete shall be shown on the plans. Sometimes the exact limit of removal will be known at the time of plan preparation and at other times the exact limits must be determined in the field. When removing sound concrete, the designer shall show definite payment limits on the plans for the concrete removal. Generally, it will not be necessary to limit the weight of chipping hammers beyond the limits of the specification when removing sound concrete.

When removing unsound concrete and the designer is not sure where sound concrete will be encountered, the designer shall show a payment limit on the plans and indicate by note that the concrete shall be removed to the payment limit shown on the plans, or to a sound surface, whichever is deeper.

Check for the presence of asbestos and take appropriate action by contacting the Consultant Management Bureau if present or unknown.

## ITEM 580.02 - REMOVAL OF STEEL SUPPORTED STRUCTURAL SLAB (WITH SHEAR CONNECTORS)

## ITEM 580.03 - REMOVAL OF STEEL SUPPORTED STRUCTURAL SLAB (WITHOUT SHEAR CONNECTORS)

These items shall be used to remove either all or portions of the structural slab. Use the appropriate item depending on whether or not there are existing shear connectors.

The designer must clearly indicate on the plans the materials that are to be removed under the slab removal item. Generally, materials that are embedded in or are an integral part of the slab, such as bar reinforcement, scuppers, manholes, conduit, curbs, sidewalks, roadway overlays, parapets and raised medians should be included in the slab removal item. Granite curbs, railings, utilities, light poles, and any other materials that are likely to be removed in a separate operation or with different equipment should be removed under their own items.

When utilities are located on the structure, the designer should check with the Regional Structures Engineer to insure that all necessary work involving those utilities has been addressed. The plans must clearly indicate who is responsible for removing or relocating the existing utilities; who is responsible for furnishing the materials for any new utility work, and who is responsible for the installation of the utility; the utility locations and details should be shown on the plans.

The number of square feet of structural slab removed and disposed of shall be measured in the field. There shall be no deductions in area for small openings (approximately 10 square feet or less) such as scuppers, manholes, joints or holes completely through the slab. However, in situations where there are large open areas such as continuous or intermittent sections of open grating, the open areas will be deducted from the plan area. The designer must clearly identify those special areas and indicate limits on the plans to exclude such areas from the slab removal item.

For spans over water, railroads, roadways and any other spans where necessary, the designer should include Reconstruction Notes 49, 50 and 51,. found in Appendix B of the "Standard Details for Highway Bridges", on the plans stating that the Contractor shall prevent all materials from falling below.

## ITEM 580.02 - REMOVAL OF STEEL SUPPORTED STRUCTURAL SLAB (WITH SHEAR CONNECTORS) (cont'd.)

## ITEM 580.03 - REMOVAL OF STEEL SUPPORTED STRUCTURAL SLAB (WITHOUT SHEAR CONNECTORS) (cont'd.)

If shear connectors exist, the Contractor will usually have the option of either retaining and reusing them or removing and replacing them with new stud shear connectors. The designer shall include the design spacing and details for the new stud shear connectors on the plans. The cost of furnishing and installing new stud shear connectors shall be included in the price bid for the removal of structural slab item.

The designer shall include Reconstruction Note 47 to assure that concrete to remain is not damaged.

When bridge rehabilitation work requires complete deck replacement, it is recommended that the deck and all overlay materials be removed under the price bid for the deck removal item (e.g. Item 580.02 - Removal of Steel supported Structural Slab [with shear connectors]) or whichever other item is appropriate to remove the deck proper. The designer shall clearly indicate on the plans all overlay materials that are to be included in the deck removal item.

Check for the presence of asbestos and take appropriate action by contacting the Consultant Management Bureau if present or unknown.

## ITEM 581.01 - REMOVAL OF BITUMINOUS CONCRETE OVERLAY (BRIDGE)

## ITEM 581.02 - REMOVAL OF CEMENT CONCRETE OVERLAY (BRIDGE)

Item 581.01 should be used when it is necessary to remove a bituminous concrete overlay from a bridge superstructure or approach slab.

Item 581.02 should be used when it is necessary to remove a cement concrete overlay from a bridge superstructure or approach slab.

These items can be used to remove the overlay from the entire or a portion of the superstructure or approach slab when necessary.

The designer should be reasonably sure of the thickness of overlay that is to be removed and the thickness should be shown on the plans. If cores have been taken, the thickness can be verified from the core report. The designer can obtain any available core data from the Bridge Deck Evaluation Report. Otherwise, a comparison of existing curb height (exposed) with that shown on the original plans will yield the approximate additional thickness of the overlay.

The horizontal payment limits should also be clearly shown on the plans.

If there is a membrane waterproofing system under the overlay that is also to be removed, its removal shall be paid for under another item that contains provisions for cleaning. Usually the new membrane item will also contain provisions for cleaning.

All patched areas or miscellaneous materials within the payment limits shall be removed and included in the price bid for removing the overlay. The patched areas and miscellaneous materials should be shown on the plans.

If there is a bituminous concrete overlay and also a cement concrete overlay, both of which are to be removed, the payment for the removal of each overlay shall be made under its respective item. Although the payment lines may be the same, separate pay items shall be used. The Contractor may elect to remove both overlays in the same operation. This will not create a problem, since he will be paid for the removal of each overlay separately, regardless of when it is removed.

## ITEM 581.01 - REMOVAL OF BITUMINOUS CONCRETE OVERLAY (BRIDGE) (CONT'D)

## ITEM 581.02 - REMOVAL OF CEMENT CONCRETE OVERLAY (BRIDGE) (CONT'D)

If the designer intends to utilize saw cutting to provide a sharp line between the existing overlay and the new overlay, the details and locations for the saw cutting shall be shown on the plans. A note should accompany the details indicating how to pay for saw cutting.

When bridge rehabilitation work requires complete deck replacement , it is recommended that the deck and all overlay materials be removed under the price bid for the deck removal item (e.g. Item 580.02 - Removal of Steel Supported Structural Slab [with shear connectors]) or whichever other item is appropriate to remove the deck proper. The designer shall clearly indicate on the plans all overlay materials that are to be included in the deck removal item.

# DESIGN GUIDELINES

## ITEM 582.05 - REMOVAL OF STRUCTURAL CONCRETE - REPLACEMENT WITH CLASS A CONCRETE

## ITEM 582.06 - REMOVAL OF STRUCTURAL CONCRETE - REPLACEMENT WITH CLASS D CONCRETE

These items should be used to repair any deteriorated concrete that can be readily repaired with Class A or Class D concrete.

The areas that will normally be repaired with these items will be deteriorated vertical surfaces and top horizontal surfaces. Cores should be taken to determine the depth of deteriorated concrete when removal limits are uncertain.

Since there is no separate payment for concrete removal under these items, it is desirable that the volume of concrete removed and the volume of concrete replaced be approximately equal.

These items may be used by themselves or in combination with shotcrete. When the items are used, the designer should be sure that the depth of repair will be deep enough to allow Class A or D concrete to be placed between the remaining sound concrete surfaces and the forms, and the reinforcing steel spacing will allow passage of the concrete. The designer shall indicate on the plans those areas that are to be repaired with these items.

If there are deep repairs that can be poured and shallow repairs that cannot be poured, adjacent to each other, the designer should use these specifications in combination with the shotcrete specification, Item 583.01. The designer shall indicate on the plans that the repairs are to be made using all items. Reconstruction Notes 53 and 54 , found in Appendix B of the "Standard Details for Highway Bridges", shall also be used.

These are repair items. They shall not be used to remove and replace all or part of structural slabs or any large structural concrete element. If all or part of a large concrete structure is to be replaced, the designer shall use the appropriate structural removal item.

## ITEM 582.07 - REMOVAL OF STRUCTURAL CONCRETE - REPLACEMENT WITH VERTICAL AND OVERHEAD PATCHING MATERIAL

This item should be used to make small shallow repairs, generally, on vertical or overhead horizontal surfaces. This item was written to allow hand plastering of patching material in lieu of poured concrete or shotcrete. Do not use this item to patch roadway surfaces.

The maximum depth of repair allowed with this item is 2 inches. When calling for this item, the designer should be reasonably sure that the depth of repair will not exceed the 2 inch limit. If the existing concrete is already spalled 1-1/2 to 2 inches and the remaining surface exhibits considerable cracking and/or efflorescence, or perhaps gives off a dull hollow sound when struck with a hand-held hammer, then the designer should anticipate that the final depth of repair will probably exceed 2 inches. In these cases, cores should be taken to determine the depth of deteriorated concrete when removal limits are uncertain and the designer should use shotcrete or poured concrete instead of patching material.

The designer should not use this item in combination with shotcrete to repair adjacent deteriorated surfaces. If the anticipated quantity is large enough to justify a shotcrete operation, then all the repairs should be made with shotcrete. The patching material specification should not be used.

The designer shall indicate on the plans those locations that are to be repaired with patching material. Reconstruction Note 54, found in Appendix B of the "Standard Details for Highway Bridges", shall also be used.

For unusual situations not outlined in Section 582 of the Standard Specifications, contact Materials Bureau personnel at (518) 457-5956 prior to using this item.

# DESIGN GUIDELINES

## ITEM 583.01 - SHOTCRETE

### PAYMENT:

Shotcrete shall be paid at the unit price bid. However, for overruns only, a negotiated percentage of the overrun quantity will be paid. For instance, for overruns up to 100% of the estimate quantity, a negotiated percentage not to exceed 80% of the overrun quantity will be paid. For an additional overrun over 100% of the estimate quantity, a negotiated percentage not to exceed 60% of the additional overrun quantity will be paid.

When using this shotcrete item, the designer should note that all the following work is paid for under unit price bid: concrete removal, preparation of concrete surfaces and existing reinforcement, installation of galvanized wire mesh, application of shotcrete, and curing.

### ESTIMATE:

When estimating the number of bags of cement required, the designer should use the following square foot factor for each 1" of depth:

Overhead = 19 S.F./bag　Vertical = 27 S.F./bag　Horizontal = 33 S.F./bag

These factors are based on a yield of 3.25 C.F. per bag of cement and maximum losses allowed in the specification of 50% for overhead, 30% for vertical, and 15% for horizontal.

### GENERAL:

Shotcrete is mortar or concrete conveyed through a hose and pneumatically projected at high velocity onto a surface.

Properly applied, shotcrete is structurally adequate, durable and bonds well to concrete. However, its properties and performance are largely dependent on the conditions under which it is placed, the capability of the particular equipment selected and especially on the competence of the shotcrete operator. To control construction problems, a qualification test is required for the shotcrete operator prior to the start of all projects. Additional qualification tests are required for each 100 bags placed and more often if the Engineer feels that the quality of the shotcrete operation is declining.

Rebound is sand and cement paste which ricochets off the surface during application of shotcrete because of collision with the hard surface, reinforcement, or with sand particles themselves. The amount of rebound varies with the position of the work, air pressure, cement content, water content, maximum size and grading of sand, amount of reinforcement and thickness of layer. Rebound should not be worked back into the construction by the shotcrete operator. If rebound does not fall clear of the work, it must be removed. This is covered in the specification.