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J. Right-of-Way

All parties are reminded that highway right-of-way abuts upon private property. Any infringement or trespassing upon such private property could cause damage that would become a liability to the person or organization involved. Maintaining good relations with the public (especially private property owners) is very important.

K. Safety

Contractor must comply with provisions of the Federal and State Occupational Safety and Health Acts.

L. Nebraska One Call Notification System shall be explained by the Project Manager. The Diggers Hotline of Nebraska phone number is 1-800-331-5666.

M. Contractor has 48 hours to file notice with county sheriff when burial sites are discovered.

N. Water Pollution & Wetlands

The contractor's schedule and methods for control of water pollution and protection of wetlands should be reviewed. For more information, refer to Construction Manual Division 1100.

All disposal sites require NDR approval.

O. EEO Requirements (Federal Aid Projects)

1. Forms PR-1391, Manpower reports required. (Distribute sample form)
 - @ A. The Contractor (prime and subs) shall send two copies to State project manager. Contract Compliance Officer.
 - B. Submit by 10th of August.
 - C. Needed for the month of July only.
 - D. If no minorities or women employed - explain why.
 - E. Required of subcontractors, also, with subcontract of \$10,000 or more.
2. All subcontract and purchase agreements must include E.E.O. provisions.
 - A. All sections of Form PR-1273 must be attached to these agreements.
3. Not allowed to maintain segregated facilities of any kind.
4. Must pay comparable wages.

appropriate. The State Patrol can be contacted through the State Patrol District Office charged with responsibility for the area of the project being discussed.

It is beneficial to discuss utilities relocation, project staging, and/or traffic control early in the meeting before more detailed and time consuming construction matters are approached. You may excuse utility companies early.

- G. Plan and specification omissions must be discussed.
- H. Traffic Control *(PM shall present the NDOR Traffic Control Plan.)*

@

In addition, the following must be verified:

1. Letter of Certification stating brand and model of barricade light proposed to use.
2. Maintaining spare parts on project.
3. Checking barricades and signs at frequent intervals daily.
4. Phone number of person to call at night if barricades, or signs or devices are down or not working.

Name and Number _____ - _____

Name and Number _____ - _____

5. Notify Project Manager before picking up signs and also at first notice of damaged or stolen signs.
- I. Prompt Submittal of Certificates of Compliance, Certified Analysis etc. to insure payments.
 - J. Location of Field Laboratory and Field Offices
 - K. Subcontractors must be approved before they can begin working on project. We need to be notified when they are going to be working on project.
 - L. Contractor's Borrow Pits – Approval
 - M. Payrolls – Prime Contractor needs to check subcontractors
 - N. Welding on girders not allowed without written permission.
 - O. Labor, Payrolls, Wage Rates, Training & E.E.O.

E.E.O. Officer _____
Safety Officer _____

Contractor training special provisions requires the contractor to have a formal employee training program. During an EEO inspection, the training program should also be checked.

c. Required Posting

During the inspection, all required postings should be checked. Project Managers shall check to see that correct names and addresses appear in the boxes on posters entitled "Wage Rate Information Federal-Aid Highway Project" (FHWA-1495) and "Notice" (FHWA-1022). Copies of these forms are provided in *Appendix 2*.

d. Reports

- "Federal-Aid Highway Construction Contractors Annual EEO Report"

@ Contractors and subcontractors (with contracts over \$10,000) shall provide the ~~Project Manager~~ *Contract Compliance Officer in the Construction Division* two copies of "Federal-Aid Highway Construction Contractors Annual EEO Report" (FHWA-1391). A blank copy is provided in *Appendix 2*. These forms are to be completed for all federal-aid contracts for which work was performed during July.

@ ~~NOTE: Project Managers shall review, sign both copies, and distribute on or before August 5.~~

NOTE: If Prime or Sub submit the 1391 to the Project Manager, return them and tell the Prime or Sub that the 1391's must be submitted directly to the Contract Compliance Officer to avoid double counting.

Contractors will receive copies of Form FHWA-1391 from the Construction Division shortly after the contract is awarded. Each prime contractor gets two copies. A copy of Form FHWA-1391 is provided in *Appendix 2*. Copies can be ordered from:

Construction Division
Nebraska Department of Roads
1500 Hwy. 2
P.O. Box 94759
Lincoln, Nebraska 68509-4759

Instructions for completing this form are provided by the Construction Division on a yearly basis. Contractors are cautioned to be sure they have the CURRENT instructions. If there is any question about revision dates, contact the Construction Division in Lincoln (402) 479-4514.

Distribution: Route one copy to the Construction Division, Lincoln, and retain one copy in project file.

103.50 BARRICADES, DANGER, WARNING, AND DETOUR SIGNS

SSHC Subsection 107.07 provides for furnishing, erection, and maintenance of necessary barricades, lights, signs, and watchpersons, in accordance with the latest edition of the Manual ~~of~~ on Uniform Traffic Control Devices for Streets and Highways (each Project Manager should have a copy) and taking necessary precautions for the protection of the work and safety of the public by the contractor. The contractor must erect advance warning signs for traffic hazards created by his/her operations, and at points where the work crosses or coincides with an existing road, in accordance with the plan requirements.

Signs which have been furnished to the contractor at no cost for placement on projects under construction must be returned to the appropriate NDR location in reusable condition when they are no longer needed. A charge will be made to the contractor for the value of signs damaged or not returned. The office issuing the sign will determine the charge for damage or loss.

Requests to begin work after the tentative starting date shown in the proposal should be made by the contractor to the Construction Engineer in Lincoln.

Beginning the Counting of Working Days - The counting of working days or calendar days must begin on the date established in the written Notice to Proceed or on the actual beginning date, whichever is earlier. Accordingly, the "Weekly Report of Working Days" should be prepared and submitted beginning for the week which includes the established beginning date or actual beginning date, whichever is earlier.

@ Under specified conditions, some items of work may be performed for which working days or calendar days will not be ~~charged~~ charged. Work subject to this rule is listed in *SSHC Subsection 108.02*.

Calendar Day - *SSHC Subsection 101.0313* gives the definition of a calendar day.

Working Day - *SSHC Subsection 101.0399* gives the definition of a working day.

Current Controlling Operation - *SSHC Subsection 101.0326* gives the definition of the current controlling operation.

While the counting of calendar days is quite straightforward and is usually dependent only on the passage of time, the counting of working days requires a determination of the current controlling operation. A basic test for the determining the current controlling operation on any given day is whether or not the non-performance of that operation will delay the completion of the work.

The contractor's project schedule can be a very useful tool in determining the current controlling operation. The specifications require that the critical path activities be shown on the schedule; and those activities, in essence, are the controlling activities. Because the specifications allow several types of schedules and because contractors possess varying degrees of skill in preparing the progress schedule, it is strongly recommended that the Project Manager and Project Superintendent discuss the project schedule and come to some mutual agreement concerning the path of critical activities - as may be the case when a bar graph shows several activities occurring at the same time.

The contractor has the right to object to the charge of working days, and those kinds of objections will be minimized if there is an "up front" agreement regarding the controlling operation. There usually will be little dispute regarding whether or not the work was performed.

The current controlling operation should be shown in the Project Manager's diary and on the working day reports. Any discussions or agreements with the contractor regarding it should also be documented in the diary. The assessment of working days is a very important task for the Project Manager, but should not be considered extremely difficult. Common sense and fairness should prevail.

INSTRUCTIONS FOR CORRECTING EARTHWORK AREAS FOR CURVATURE

Excavation areas of cross sections on horizontal curves shall be corrected for curvature using the formula $C = \frac{Ae}{R}$ where:

$$C = \frac{Ae}{R}$$

A = the area of the cross section

e = the eccentricity

R = the centerline radius of the curve

The area A is the area of the section determined with a planimeter. The eccentricity is the distance between the centerline or base line of the cross section and the center of gravity of the cross section, and is a positive number when the center of gravity falls outside the centerline, and a negative number when the center of gravity falls inside the centerline. The correction is positive or negative depending upon the sign of the eccentricity.

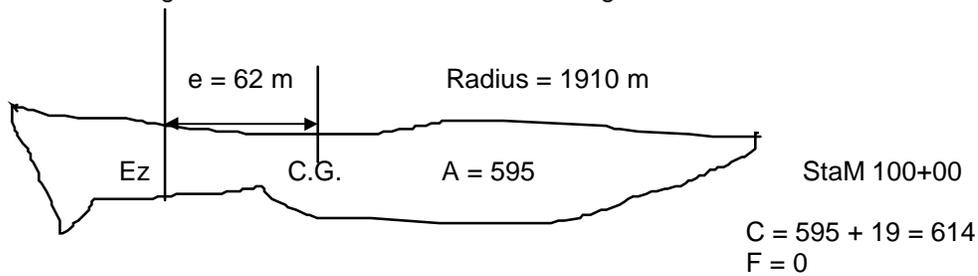
The center of gravity of the cross section in most cases can be determined by inspection. If the area and the eccentricity are large and the radius small, it may be necessary to determine the center of gravity of the section by the moment arm method, after determining the center of gravity of the smaller portions of the section by inspection.

In determining the center of gravity, it must be remembered that the center of area falls at the center of gravity only when the area is rectangular in shape.

All computations for the correction for curvature may be made with a slide rule.

EXAMPLE

Assume a three degree curve to the left with the following cross section on the curve at Station 100+00.



Then, $C = \frac{595 \times 62}{1910} = 19$

RADIUS COMPUTATION FOR AREAS IN SPIRAL CURVE

When the above area falls in a spiral curve, the radius must be computed for each station and plus using the formula $r = \frac{RL}{l}$ where:

r = Radius at Required Station on the Spiral

R = Radius of Main Curve

L = Length of Spiral

l = Distance from T.S. to Required Station

If the above Station 100+00 is 150 m from the T.S. and given a 300 m spiral, then $r = \frac{(1910)(300)}{150} = 3820$ m, the radius at Station 100+00.

Asphaltic Concrete Surface Course and Base Course - Tickets may be furnished by the Department or by the contractor. The contractor may furnish the tickets if he/she wishes to use automatic printing equipment. If the contractor desires a copy of the scale tickets, they should be prepared in triplicate. The original should be received by the laydown inspector. The first copy is the contractor's copy, and the second copy is for the project records.

The liters of asphaltic cement shall be measured as shown in *SSHC Subsection 503.05*. (HINT: A common final computation error is the failure to deduct asphalt cement used in wasted asphaltic concrete from the final pay quantity.)

Concrete Pavement - The number of square meters (square yards) of concrete pavement to be paid for will be the plan quantity. Widths and lengths of irregular areas built other than as shown in the plans shall be measured and recorded in a data collector and the areas computed, or computations made from staking data providing no changes occurred during the actual construction. Quite often the plans indicate the quantity (square meters) (square yards) involved in intersections, driveways, and the more complex sections of the projects. In these instances, the quantity indicated on the plans for a given area may be used as the final pay quantity, provided that no geometric changes have been made from those shown on the plans and that a rough check of the quantity shown has been made to determine if any apparent errors exist.

In determining the final quantities for concrete pavement or base course on an area basis, deductions will be made for fixtures in the roadway having an area greater than 1.0 m² in accordance with *SSHC Subsection 109.01, Paragraph 1.b*.

When municipal paving projects involve several items of work for which payment is made on an area or length basis, such as sidewalk, curb, curb and gutter, driveways, pavement, etc., it is suggested that complete sketches be prepared in CASIE or on cross section paper to show the actual work performed as well as the computations for the pay quantities. As a general rule, two complete sets of sketches should be prepared. One set should show the removal items and the other set should show the new work. The measurements and dimensions included with these sketches should be clearly identified as to whether they are actual field measurements or computed dimensions. The computations should always be shown on, or accompany such sketches.

When municipal paving projects contain various radii curves at street intersections, concrete paving area measurements and computations may be based on the chord and rise method. Dimensions used for final payment will be as staked dimensions. (This assumes any difference is a contractor error.) The only exception would be if the area was constructed smaller than it was staked.

Combination curb and gutter is measured for payment by the meter (linear foot). (*SSHC Section 606*)

Removal of Existing Structures and Preparation of Existing Structures (*SSHC Section 203*)

- A. **Removal of Existing Structures** - Unless the contract contains a unit bid for the removal of an old structure, the excavation necessary for such removal is paid

for by the cubic meter (cubic yard). Preconstruction cross sections shall be taken for all removals.

Pipe removal excavation limits are shown in the *SSHC* in *Figure 701.01*. Headwalls and box culverts may be removed on a unit basis and any removal excavation will be subsidiary. The volume occupied by them within the limits of the new work shall be included for payment as culvert excavation. However, deductions will be made for openings in structures, other than pipe and pipe-arch culverts, if the openings have an average cross sectional area over 2.0 m² (21.5 square feet). This means the nominal opening of the old concrete box regardless of the accumulated silt and debris. On old structures without paved floors, the PM shall measure and compute the average cross sectional area of the opening. (See *SSHC Subsection 702.04*.)

In the case of removal of old pipe and headwalls, where the headwall is removed on a unit price basis, the excavation limits for the old pipe removal will extend 500 mm (18 inches) beyond the end of the pipe the same as would be applicable if no headwalls were involved. Any necessary excavation for removing the old headwalls outside the pipe excavation limits would still be subsidiary. (See *SSHC Subsections 702.04* and *702.05*)

- @
- B. **Preparation of Existing Box Culverts** - When the contractor has the option of breaking the box culvert back 600 mm (2 feet) or drilling dowel holes to insure a structural tie, the concrete *and* excavation ~~and~~ pay item quantities shall be only the volume from the vertical plane that would be necessary for the doweling procedure. When the plans stipulate or the Project Manager orders removal of 600 mm (2 feet) of the box culvert barrel then the pay quantities shall be computed from the vertical plane 600 mm (2 feet) into the existing structure.

The excavation limits are to be computed as shown in *SSHC* in *Figure 701.01*.

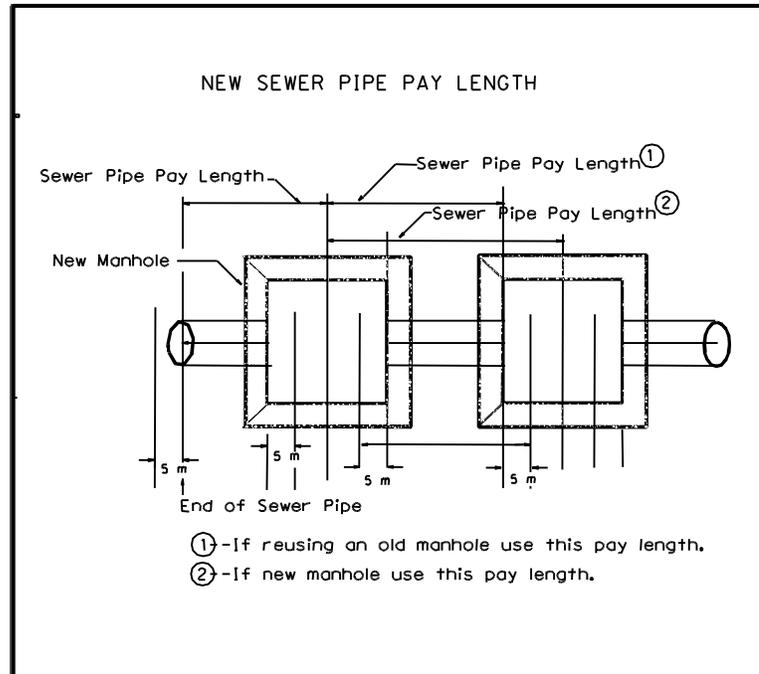
Excavation for Structures

- A. **Excavation for Bridges** - Excavation for bridges is computed in the Bridge Division at the time the plans are prepared. Payment is a lump sum for all abutments, piers and/or bents. No further computations need be made on this item unless the station location of the bridge or the depth of the footings is changed. The Project Manager should not change the location of any bridge without first consulting with the District Engineer, and the Bridge Division.

If it is decided that a change in location is necessary, any required information should be forwarded to the Bridge Division, via the Construction Division, for use in redetermining the excavation quantity.

- B. **Concrete Seal Course** - The construction of concrete seal course or removal of unsuitable material is extra work (see *SSHC Subsection 702.05*). These amounts shall be listed in the field book. The concrete seal course quantities shall be negotiated before the contractor begins the work.

@



Guardrail - The contractor shall be allowed payment for linear meters (linear feet) of guardrail complete in place measured from center to center of end posts (SSHHC Section 902).

Seeding and Slope Protection - Example field book records for Cover Crop Seeding, Seeding, and Slope Protection are in Appendix 3.

105.08 BORROW AND LOCAL PIT MATERIALS OBTAINED BY THE CONTRACTOR

Under State Option - All amounts to be paid by the contractor for royalty and borrow costs, to comply with the terms listed in the option block shown in the plans, will be deducted from the payment due on the final estimate. Such amounts will also be included in the retention in the additional estimate. This Department will make payment directly to the owner. Before such payment can be made, it will be necessary to obtain concurrence from the contractor as to the quantities and amounts in order to eliminate the possibility of overpayment to the owner. For this purpose, the Project Manager shall

Right-of-Way - No measurements or computations need to be submitted for right-of-way as payment will normally be made for right-of-way prior to the actual construction, in accordance with the terms of the right-of-way contract. Any requirement for additional right-of-way shall be submitted to the Right of Way Division, through the District Office, for their further handling.

Crop Damage - The acquisition of right-of-way and subsequent construction often results in crop damage claims being made by the landowner. In order that information is available to settle these claims, the following should be recorded for all growing crops within the right-of-way, borrow, local pit and channel change areas.

1. A sketch showing the boundaries of each tract within station locations, angles, and distances as necessary to locate the tract accurately with reference to project centerline and to compute the area. The tract should be identified by the owner's name and tenant (if any).
2. If the tract is subdivided with more than one type of crop, show the subdivision of tract into fields as necessary to locate the limits of each crop. Information shown should be similar to that required for the tract. Indicate the type of crop growing in each tract or subdivision.
3. Show date of measurement and the name of the person making the measurement.
4. As construction progresses, record for each tract whether the crops are harvested by their owners or are destroyed by the contractor's operations. If harvested, the date of harvest should be recorded or if this date is not known, the date that the contractor began work in the area and a notation indicating that harvesting was complete should be recorded. If the crop in an area is only partially destroyed, the damage should be noted or sketched in a manner such that the area of damage can be determined.
5. The right-of-way contracts and condemnation descriptions should be reviewed carefully with respect to the provisions ~~contained~~ pertaining to crop damage. Crops planted after contract has been signed will not be eligible for reimbursement.
6. Crop damage for each tract is to be reported by letter to the Right of Way Division with a copy to the District Engineer as soon as the disposition of the growing crops on that tract is complete. The report should contain the information listed above along with computation of the area in acres, and the legal description of the property (section or part, township and range).
7. A DR Form 44 must be submitted with the final records for each project included in a contract. See *Appendix 1* for examples of this form.
8. On projects in which the Federal government participates in the cost of the work, each project is subdivided to conform with accounting practices established by the Federal Highway Administration. These subdivisions are shown in the "detail estimate", copies which are forwarded to the Project Manager by the Contracts

SECTION 201.00 -- EARTHWORK INSPECTION CHECKLIST

EMBANKMENTS/EXCAVATION

SSHC References:

Section 205 Excavation & Embankment
Section 1033 Aggregates

Other References:

NDR, Materials & Tests, Earthwork Engineering Guide
NDR Materials and Sampling Guide
NDR Standard Test Methods

Inspection Crew:

Grade Inspector

Inspection Equipment:
(AASHTO T 238)

Nuclear Density Gauge (With Manual)
Nuclear Density Gauge probe puller or auger.
Thermometer (Surface)
Scale (Dept. of Ag. Certified)
Metal Thickness Ruler
3 m (10 foot) straightedge
Gravel Sampling Bags

Equipment
(NDR T 205)

Spade.
Rubber Balloon (flexible membrane)
Sand.
Calibrated container with an air valve and a volume indicator.
Base plate.

Embankment/Excavation
Procedures:

General Comments:

1. The operations of excavating the roadway and borrow material (Roadway Excavation) and the placing, compacting and finishing of the excavation material in the embankments or fills (Embankment) are inspected and controlled as a single "Grading operation".
2. The value of grading may be considerable.
3. *@* "No building is better than its foundation" and good quality embankments and subgrade are essential to the good performance and quality of the base course and pavement structure.
4. The grade inspector's work is of the utmost importance in producing a quality riding surface for the motorist.

5. The large and fast grading equipment employed by grading contractors means inspector should be on site to sample each lift.
6. The inspector should be thoroughly familiar with *SSHC Section 205 Excavation and Embankment*.
7. Check all contract documents for grading requirements.
8. The type of embankment compaction will be specified in the plans (generally on Sheet No. 3).
9. Construction notes in the plans should be noted and checked against physical features on the project. The right of way should be checked for physical features and obstructions which may not be shown in the plans. Typical items to be checked:
 - a. Check the construction widths needed, and fences which must be moved, and compare them with the available right of way and contracts for additional right of way, borrow and construction easements.
 - b. Utility pole lines - check against construction limits and utility agreement provisions.
 - c. Survey or other type monuments or markers - mark or relocate.
 - d. Selective placement notes.
 - e. Trees or shrubs which are indicated in the plans to be preserved -mark as necessary.
 - f. The Design file contains all of the preliminary and design information of the soils, pit sketches and contracts, preliminary soil compaction curves and soil tests.
10. Rights of adjacent property owners will be protected.
 - a. Tile lines and intakes should be located, replaced, and repaired to maintain the integrity of the subsurface drainage. (Preventing unintended drainage from reaching adjacent property.)
 - b. Right-of-way contracts should be checked for possible special negotiated items which should be included in the work being done.
11. ~~The~~ Any contractor's operation that causes damage to partially completed or completed work shall be reported to the Project Manager and noted in the Daily Diary.
12. Make sure the contractor installs silt fences prior to commencing soil disturbing work.

See Subsection 1300.03

@

205.00 EXCAVATION (*SSHC Section 205*)

205.01 DESCRIPTION

The importance of being able to identify soil types cannot be overemphasized. Some soil types have to be placed in the proper location. The inspector must be sure that the work is performed according to the plans.

The balance factor is the change in quantity from cut to fill and includes subsidence, change from borrow density to the final compacted density, incidental loss, and all other factors changing density.

205.02 MATERIAL REQUIREMENTS

Embankment and Excavation Soils Criteria (*SSHC Section 206*)

There are four basic categories of earthwork.

- Excavation
 - ◆ Usually final cross sections determine pay quantity.
 - ◆ No off-site borrow is required.
- Excavation (Established Quantity)
 - ◆ Payment is based on the plan quantities.
 - ◆ No off-site borrow is required.
- Excavation Borrow
 - ◆ Usually final cross sections determine pay quantities.
 - ◆ Borrow will be needed from off-site source(s).
- Earthwork-Measured-in-Embankment (*SSHC Subsections 205.04/205.05*)
 - ◆ Plan quantities of the proposed embankment are used to determine the payment quantity.
 - ◆ Contractor must forecast shrinkage. (A change from borrow density to compacted density.)
 - ◆ Borrow from off-site sources.

@ Although "Excavation" and "Excavation Borrow" is are paid based on final cross sections. The Project Manager may forego the final cross sections when the contractor agrees that the plan quantities accurately reflect the work done. If both parties agree that the plan quantities including revisions are accurate, then these quantities become the payment quantities and a Change Order should be executed changing the method of measurement and the pay quantity to Excavation (Established Quantity).

Corps of Engineers
Regulatory Branch
P.O. Box 5
Omaha, NE 68101-0005

ASCS aerial photos are available at county ASCS offices at a nominal cost. ASCS aerial photos cover agricultural ground only. In some instances, aerial photos of urban areas are not available from the ASCS.

Topographic maps may be obtained from the following source:

University of Nebraska
Conservation & Survey Division
113 Nebraska Hall
Lincoln, NE 68588-0517
Attn: Judy Otteman
(402) 472-7523

Approval For Soil Type (Contractor furnished borrow)

- The Contractor will obtain soil samples to verify material is acceptable. The Project Manager will forward the samples to the Materials & Tests Office for evaluation. (See *SSHC Subsection 205.02*.)

Preservation of Cultural Resources (*SSHC Subsections 205.03 and 107.10*)

Cultural resources are the composite of archaeological and historic/architectural resources in an area. A common cultural resource site is a burial ground or remains of a Native American village.

Nebraska law requires action be taken to insure that cultural resources are not damaged ~~nor~~ or destroyed.

If a cultural site is discovered during construction, the contractor is required to temporarily discontinue work at the site. Upon discovering such a site, the Project Manager shall notify the Construction Office of the finding.

Proper control of moisture content is significant for two reasons:

1. Uniformity of moisture content at the proper level aids in obtaining uniform density, meeting requirements.
2. Uniform moisture content, thoroughly distributed throughout the binder and aggregate mass, aids in the development of the necessary cohesion.

@

In the laydown of foundation course, it is best to lay the full thickness in one layer, when feasible. If there is only one layer, slippage between layers, a common problem in granular base courses, will be avoided.

After completion of the trimming operation, cross sections should be taken on the surface of the soil aggregate base course at 600 mm (2 feet) transverse intervals and at 300 m (1000 ft) longitudinal intervals matching the locations of the cross sections taken on the subgrade and recorded in the field book.

The Materials and Tests "*Materials Sampling Guide*" requires that density tests be made a 300 m (1000 foot) intervals or closer. At the time the density tests are made, following the trimming operation, the thickness of the soil aggregate base shall be carefully measured and recorded as documentation that the thickness requirements have been met. The thickness measurements shall be considered to represent only that width constructed and trimmed in a single operation. If any of these measurements show a deficiency from planned thickness of 12.5 mm (1/2 inch) or more and if payment is to be made by the square meter, additional measurements shall be made to define the extent of the soil aggregate base course shortage.

If a measurement shows a deficiency in thickness, a check measurement shall be taken 3 m (10 foot) either side of this location parallel to the centerline of roadway. If both check measurements fall within the 12.5 mm (1/2 inch) tolerance permitted, no deficiency is to be considered. If one or both are deficient in thickness, further checking shall be made at 15 m (50 foot) intervals from the original measurement and parallel to the centerline of roadway until a thickness within the tolerance is found in one or both directions as the case may be. Between this point and the location 15 m (50 foot) back, determine the point within 3 m (10 foot) at which the soil aggregate base course is within the tolerance permitted. If both categories of deficiency occur, the same procedure shall be used to determine the beginning and ending points of the two categories. The width of the deficiency shall be considered to be the full width constructed and trimmed in that particular operation.

Measurements for determining the thickness should be made at a maximum spacing of 150 m (500 feet) directly behind the trimming operation. This will prevent the priming of any deficient section that the contractor has the option to remove or that must be removed and replaced in accordance with the specifications.

The Project Manager shall enter all measurements and locations where made in a field notebook. In some cases a sketch may be necessary to clarify a nonpay area. Deductions in the pay quantity of the soil aggregate base course are to be computed and made by the field Project Manager.

The following examples shows measurements taken in a 150 m (500 foot) section where a thickness deficiency has occurred.

3. Conductors shall be color coded for safety and to facilitate maintenance of the lighting system. (SSHC Subsection 402.02)

PULL BOXES:

1. All pull boxes with a cast iron ring and cover must be grounded with all grounding connections securely made. (SSHC Subsection 406.01)
2. Check all wire sizes in pull box.
3. All conduit entrance bends must be tagged with a permanent tag indicating direction of the conduit run.
4. All cable connections in pull boxes must be made using approved URD submersible connectors. Check for proper cable insertion into connector; that all connections are tight and that all openings are covered or plugged.

@ POLES:

1. New light poles should not be placed directly under other ~~over~~ overhead distribution systems.
2. All poles must have handhole covers securely fastened.
3. Power foundations are to be flush with grade. Concrete foundations are allowed a 25 mm (1 inch) chamfer.
4. All settlement of soil around pole base and along conduit runs must be backfilled and compacted to 95 percent of maximum density as determined by NDR T 99 (SSHC Subsection 407.03).
5. Check for minimum of 300 mm (1 foot) cover over the grounding rod and for proper connection to the grounding rod. Contractor must use connectors detailed in the plans.
6. Check for proper grounding to pole (anchor type) or to transformer base (breakaway type). Contractor must use connectors detailed in the plans.

Poles and Towers (*SSHC Section 408*)

Conventional light poles are usually furnished by the Contractor complete with pole shaft, mast arm, luminaire, anchor bolts, foundation, and breakaway device (if required).

High mast towers are usually furnished by the Contractor complete with tower shaft, base plate, anchor bolts, lowering system with motor and foundation.

All poles and towers shall be plumb. Poles will be shimmed to stand plumb. Only regular "U" shaped shim stock is allowed. Towers will be supported solely by anchor bolts and nuts. The nuts will be adjusted to plumb the tower.

All poles and towers will be grounded to a grounding rod(s) as shown in the plans.

All poles must have a handhole with cover attached.

Unless indicated otherwise, all poles required to breakaway on impact will have a frangible transformer base ("T base") as its breakaway device.

Poles and towers shall conform to the requirements of Section 1073.

Poles and Tower Foundations (*SSHC Section 407*)

Pole foundation details will be shown in the plans. Tower foundations will usually be designed by the contractor.

Towers are installed using concrete foundations only. Poles are installed using either concrete or power foundations. Power foundations are allowed only when so indicated in the plans.

All excavations for concrete foundations shall be dry and free of loose dirt before the concrete is placed.

Foundations shall be installed before trenching for conduit and cable.

Backfill around foundations shall be compacted to 95 percent of maximum density as determined by NDR T 99.

Luminaires (*SSHC Section 412*)

All luminaires must be on the NDR Approved Products List or have been specifically approved for use on the project in question by the contractor's submittal of shop drawings or catalog cuts.

Most luminaires are factory set to meet photometric requirements. Occasionally, in order to meet specifications, the position of the lamp socket in each luminaire must be adjusted by following a set of manufacturer's instructions accompanying each luminaire.

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Unless indicated otherwise, all luminaires will be installed level in both horizontal ~~axis~~ axes.

Luminaires shall be installed to proper alignment and orientation with respect to the roadway.

404.00 CONSTRUCTION WORK ZONE TRAFFIC CONTROL

404.01 TRAFFIC CONTROL SPECIFICATION REFERENCES

@ The Project Manager shall prepare Traffic Control Plan and present it at the Preconstruction Conference. The Traffic Control Plan must be approved by the Traffic Division.

Contract documents include references to traffic control requirements in many locations. Project plans contain references to traffic control requirements in the traffic control plan tabulation usually found on estimate of quantities sheet. Plans may also contain project specific traffic control and/or staging details.

Traffic control specification references are found in:

- SSHC Section 422 - Temporary Traffic Control Devices
- SSHC Section 1069 - Temporary Centerline Stripe for Pavements
- SSHC Section 423 - Traffic Provisions

Traffic control requirements may also be found in the Specification Sections for specific construction activities.

DR Form 502, "Construction Signs and Posts", or a similar computer file shall be used to record transfer of signs to a contractor.

404.02 TRAFFIC CONTROL SIGNING CHANGES

Plan notes indicate signing changes cannot be made without concurrence of the District Construction Engineer and Traffic Engineering [(402) 479-4594]. Field flexibility is required by situations that will not fit standard traffic control layouts such as hilly terrain, permanent signs, guardrail location, or side roads and entrances impacting the location of temporary traffic control signs. Presence of unusual traffic generators that affect volume or high turning movements might also require sign location adjustments.

Evaluate construction work zones prior to installation of traffic control signing, and again when operational, to look for any problem areas that may affect operational quality. Traffic control evaluations shall be held during work hours, on weekends, and during nighttime hours. **Presence of skid marks are a good indication of a problem area.** Early review of proposed traffic control signing situations prior to the preconstruction conference will allow traffic control detail changes to be made prior to impacting public traffic.

Make **immediate** changes when obvious operational problems exist, then call the District Construction Engineer and Traffic Engineering Division as soon as possible to discuss needed changes. For other than obvious operational problems that could be dangerous to motorists or workers, contact the District Construction Engineer and Traffic Engineering Division **first** for concurrence of any proposed changes.

The following modifications to traffic control details **shall not** be made:

- Do **not** change taper lengths
- Do **not** change the sign word message or symbol

750 mm x 750 mm (30 inches x 30 inches) should be furnished by NDR Maintenance and placed by the contractor. Temporary stop sign should be mounted approximately 1.5 m (5 feet) high on a 1.5 m (5 feet) Type III barricade or other suitable support furnished by the contractor. See Standard Plan 920. This sign may be moved as needed to allow construction to proceed, but must be maintained in an effective position at all times traffic is staged through the intersection.

- When work at the intersection is completed to the point where the permanent stop sign can be installed, Maintenance should be notified to install the permanent stop sign. This notification should be given on an intersection by intersection basis and not delayed until entire project is completed.

404.05 "ROAD WORK AHEAD" AND "END ROAD WORK" SIGNS

@ When ~~TC~~ *Traffic Control* plans require contractors to place "Road Construction Ahead" (W20-1) and "End Construction" (G20-2) signs at appropriate ends of highway construction projects. On any mainline roadway where a "Road Work Ahead" sign is placed, the opposite end of the work zone shall have an "End Road Work" sign placed.

These signs are required to be in place during and after the milling operation until existing pavement has had a lift of resurfacing placed due to the roughened pavement surface.

404.06 NO PASSING ZONES ON CONSTRUCTION PROJECTS

Often it is necessary to place temporary no-passing zones through a traffic control zone. Guidelines to aid in proper use of no-passing zones follow:

- Never shorten an existing no-passing zone for temporary traffic control.
- If existing no-passing zone is lengthened, a black on orange "No Passing Zone" (W14-3) (pennant) sign should be erected at beginning of no-passing zone and existing black on yellow "No Passing Zone" (W14-3) sign should be removed or covered.
- If temporary no-passing zone falls within existing no-passing zone, no additional signs should be added. Either existing black on yellow "No Passing Zone" sign can remain or be replaced with black on orange "No Passing Zone" sign.
- If no-passing zone ends within 90 m (300 feet) of beginning of existing no-passing zone, then both no-passing zones should be connected to make one continuous no-passing zone. Only one "No Passing Zone" sign should be placed at the beginning of continuous no-passing zone.

404.07 EQUIPMENT AND MATERIAL STORAGE

When maintaining through traffic on construction projects, equipment and materials stored within the right-of-way during nonworking hours should normally be stockpiled as far as possible from the traveled way. Avoid storage areas in the following locations unless protected by temporary concrete barrier, rail or metal beam guardrail:

- Within 9 m (30 feet) of traveled way on primary highways

404.13 SIGN MOUNTING DEVICES

SSHC Section 422 states that signs for traffic control zones that are used 24 hours a day are permanent signs that shall be post mounted. Temporary signs may either be post mounted or temporarily mounted.

In urban areas, signs that require post mounting may be skid mounted at the post mounting heights required in the MUTCD provided that skid mounting devices are either a breakaway design or a design that would not become a hazard if hit by vehicles.

404.14 REMOVAL OF TEMPORARY PAVEMENT MARKINGS (*SSHC Section 422*)

Temporary pavement markings are necessary for most construction projects. Typical locations include shooflys, shifts, stage construction, etc. When temporary pavement markings are placed, they will eventually be removed as part of the project.

@ Removal depends on the type of pavement marking material placed and type of surface to which it is attached (new, old, ACC, or PCC). ~~temporary pavement markings are currently used.~~

Each temporary pavement marking material has its own removal characteristics.

All residue and/or debris shall be removed from the pavement surface when removing temporary pavement marking materials. Any removal process shall not cause damage to the final pavement surface.

It has been brought to our attention that some of the contractors have been using raised pavement markers in place of temporary pavement marking Type I or Type II.

When the project includes the pay item(s) "Temporary Pavement Marking, Type I," "Temporary pavement Marking, Type II," or "Temporary Pavement Marking, Type RPM," only that specific tape or raised pavement marker may be used and paid for at that contract unit price. The contractor is not allowed to use RPMs when the contract bid item is Temporary Pavement Marking, Type II. Only temporary removable preformed tape may be used for Temporary Pavement Marking, Type II.

When the project bid item is "Temporary Pavement Marking" without any type specified, the contractor is allowed to choose between the three different types of markings, provided that the type of material used complies with the plans and specifications. Therefore, if the plans call for TPM Type II at a crossover, for instances, and the other locations do not specify the type of marking, the contractor is required to use Type II markings at the crossover, and may choose to use another material for the rest of the project, providing it complies with the specifications.

Upon completion of the project, any temporary pavement marking which is not intended to remain in place must be removed. This includes stop bars, lane shifts, and any temporary markings left on travel lanes or shoulders.

Speed Limits in Construction Work Areas

The maximum speed limit through any construction and maintenance work area shall be 35 mph in rural areas and 25 mph in urban areas, provided signs are in place to give notice of the speed limit.

The Director-State Engineer may raise the 35 mph speed limit in rural areas and the 25 mph speed limit in urban areas, or may delegate the authority to raise the speed limits to Department of Roads' employees in a supervisory capacity. The speed limits shall be raised in 5 mph increments, and cannot exceed the statutory speed limits.

Speed limits above 35 mph in a rural area and 25 mph in an urban area will be effective when the Director-State Engineer, or any officer to whom authority has been delegated, gives a written order for the increase and signs identifying the speed limit are displayed.

Speed limit signs may be mounted on a fixed or movable stand. For a moving-type operation, speed limit signs may be mounted upon moving Department of Roads' vehicles.

Authorization

In order to raise the work area speed limit from 35 mph in rural areas and 25 mph in urban areas, the authorized supervisory employee shall complete a Speed Zone Authorization form identifying the speed limit, highway number, location, and starting and ending times that the speed limit will be in effect. The original Speed Zone Authorization form should be kept in the file of the individual signing the authorization. A copy of the Speed Zone Authorization should be forwarded to the individual in charge of the work crew.

The establishment of speed limits through construction work areas will be determined in the Lincoln office, and will be included in the contract provisions so that a contractor will be aware of a construction speed limit while preparing his/her bid.

If a situation arises where a construction speed limit is needed during the course of a construction project and no provision was made for the speed limit in the contract provisions, or if a speed zone established through the contract provisions needs to be raised or lowered, individuals designated by the Director-State Engineer may establish or alter speed limits in accordance with these guidelines.

Signing (SSHC Section 422)

All signing shall conform to the requirements of the *Manual on Uniform Traffic Control Devices*.

Speed limit signs are intended to supplement normal work area signing. They are not intended to replace any of the signs that are now being used, except under certain situations where advisory speed plates are used.

In order to make the "Double Fines" enforceable, the "FINES FOR SPEEDING DOUBLED IN WORK ZONES" sign must be posted at the beginning of each work zone, and On all speed limit signs, ~~is reduced below the preconstruction speed limit or not and all speed limits within work zones,~~ the "FINES DOUBLED" sign needs to be installed, except for 35 mph in rural areas and 25 mph in urban areas, must be set by utilizing the authorization form. If, for example, within the limits of an interstate construction project, there are two sections under work which require a reduced speed of 55 mph and the

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balance of the project maintains a 75 mph speed limit, an authorization form must be completed raising the speed limit on the two sections from 35 mph to 55 mph and the balance to 75 mph.

All existing speed limit signs that conflict with the work area speed limit should be removed or covered during the period of time that the work area speed limit is in effect, except that advisory speed limits that are lower than the work area speed limit being implemented should be left in place. The minimum length of a work area speed zone should be 1/2 mile.

A "Work Area - Speed Zone Ahead" sign should be placed approximately 250 m (800 feet) in advance of the first work area speed limit sign. If the work area is on a steep downhill grade, the 250 m (800 foot) distance should be extended to allow a motorist sufficient distance to decelerate from the statutory speed limit to the work area speed limit. In urban areas where lower speed limits exist, the 250 m (800 foot) distance should be decreased to from 100 m (300 foot) to 200 m (450 foot), depending on the reduction in speed limit that is being implemented through a work area.

The first speed limit sign should be placed approximately 200 m (450 m) in advance of the start of the work area. In urban areas where lower speed limits exist, the 200 m (450 m) distance should be decreased to from 30 m (100 feet) to 100 m (300 feet), depending on the reduction in the speed limit that is being implemented.

@ ~~Speed limit signs are intended to supplement normal work area signing. They are not intended to replace any of the signs that are now being used, except under certain situations where advisory speed plates are used.~~

~~All existing speed limit signs that conflict with the work area speed limit should be removed or covered during the period of time that the work area speed limit is in effect, except that advisory speed limits that are lower than the work area speed limit being implemented should be left in place.~~

The maximum length of a work area speed zone should be one-half mile, with the exception of work operations that are being performed simultaneously at the beginning, through, and at the end of a work area that is longer than one-half mile in length.

A "FINES FOR SPEEDING DOUBLED IN WORK ZONES" signs should be placed 500 to 1000 feet following the first work zone signs with the appropriate speed limit sign with the "FINES DOUBLE" plate 500 to 1000 feet beyond that.

For reduced speed areas, a "REDUCED SPEED AHEAD" sign should be placed approximately 800 feet in advance of the first work area speed limit signs. If the work area is on a steep downhill grade, the 800-foot distance should be extended to allow a motorist sufficient distance to decelerate from the statutory speed limit to the work area speed limit. In urban areas where lower speed limits exist, the 800-foot distance should be decreased to from 200 to 500 feet, depending on the reduction in speed limit that is being implemented through a work area.

The first speed limit sign with the "FINES DOUBLE" plate should be placed in advance of the start of the actual work area.

In reduced speed areas, a speed limit sign with the R2-1wz "FINES DOUBLE" plate shall be repeated at no greater than one mile intervals.

be corrected by hand tools. When the straightedge indicates no high or low spots, compaction should be permitted with the initial roller.

3. The third check with the straightedge is across the joint between cold pavement and hot mixture after compacted with initial roller. This third check indicates whether the correct amount of material has been placed. For instance, if freshly rolled layer is too high, it indicates too much material has been placed. If freshly rolled layer is too low, it indicates not enough hot mixture has been placed.

For that reason, high or low transverse joints are not usually corrected by additional rolling. Instead, corrections should be made by cutting or filling the rolled surface while the mixture is still warm and can be manipulated. If there are unusually high or low areas after rolling, paths must be shoveled through the pavement for finishing machine tracks. Finishing machine is then backed up to the joint and paving operation is started again.

The above procedure shall be repeated as necessary until the straightedge indicates that a good riding joint has been constructed. If repeated repaving operations cause the mixture to cool to the extent that reuse becomes impractical, it should be removed and wasted.

4. The final procedure for insuring proper construction at transverse joints is checking for true edge alignment. Edge of the freshly rolled layer should be carefully trimmed by hand tools until it matches the alignment of adjoining cold pavement.

502.50.3 ASPHALT CEMENT

When payment for an asphalt mixture is based on megagrams, payment will also be made for asphalt cement as a separate item. Compensation will be made for all megagrams of asphalt cement incorporated into the construction within Specification tolerances. (*SSHC Subsection 503.05*)

Megagrams of asphalt cement paid is not deducted from megagrams of asphalt mixture measured for payment.

When small quantities of asphalt cement are involved, the design plan may state that asphalt cement is considered subsidiary to asphalt. Check the special provisions for this reference.

For specific mixes used as patching materials, or in an alternate bid situation, payment may not be made for asphalt cement.

Tank Measurement and Asphalt Cement Content Determination

@ At batch plants, automatic or semi-automatic printouts record the actual mass of asphalt cement in each separate batch, ~~and~~ this quantity may be used for payment.

Volume measurements will be converted to mass by computation. The amount in storage at beginning of project will be measured or estimated by inspector and added to

602.40 PCC PAVEMENT PRECONCRETING CONFERENCE (SSHC Subsection 1002.03)

On all projects involving PCC pavement, the Project Manager and inspectors should meet with appropriate contractor and supplier personnel to discuss concrete production and pavement placement quality issues before any materials are placed. When ready mix concrete is used, the ready mix producer should also attend.

For the various types of work, the following items should be covered:

- Approvals and required quantities of aggregate and cement, class of mix, time and rate of delivery, percent of air, slump, batch weights, volume per truck, total quantity required, preparation of delivery tickets, testing arrangements, procedures in case of load rejection (air can be increased), responsibility for setting batch weights and amount of admixtures, placing, finishing and curing arrangements, and personnel work assignments.
- Adverse (cold or hot) weather plan of action.
- @
@ • Settings and condition of paving equipment, dust control, subgrade treatment, procedure for checking steel placement, utility and street return box outs, heading-up equipment, joint sawing and cleaning, joint sealing, rain damage prevention, and cold weather protection.

Only one preconcreting conference is considered necessary for thoroughly discussing the work and responsibilities and duties of all involved in the project. On small projects it may be possible to include a preconcreting conference with preconstruction conference.

602.401 PCC Daily Report of Pavement Laid (DR Form 85)

The daily inspection report on paving work is a record of the construction progress, working conditions, weather, etc. during paving and plant operations which may affect pavement quality. This report keeps the central offices advised on job status and serves as a detailed permanent record of the paving project. At the end of each day on which any pavement was placed, this report is to be completed by field inspection staff for appropriate distribution.

6. Proper placing and consolidation of the concrete.
- @ 7. Correct ~~placing~~ placement of steel reinforcement and dowel joint assemblies.
8. Strict compliance with required curing methods.
9. Timely sawing of transverse contraction joints.
10. Restriction of loads on pavement until it has gained the required strength.

Control of line and grade for both the subgrade and foundation course work is accomplished by using a reference line set from the offset hub line. It is supported and tensioned to prevent any measurable sag or transverse movement. The machines have sensors which use the reference line for alignment and automatic grade control. The use of these automatic controls is analogous to the form line in the conventional method. The maintenance of the cross-section of the subgrade or foundation course to the plan elevation, controls the thickness of the finished pavement. Once the subgrade or foundation course has been completed to plan requirements of line, grade and density, it is extremely important that it be protected, particularly the tracking path area, until the passage of the slip-form paver.

The concrete is delivered to the paver in any conventional manner. When possible, keep concrete trucks off the subgrade. The fresh concrete is deposited on the subgrade, by uniform distribution of batches, just ahead of the paver. The uniform distribution of the batches is very important in slip-form paving. For the purpose of metering the correct amount of concrete for the full paving width to the main screed, pavers of this type are normally equipped with an initial strike-off blade provided with power travel fore and aft independent of the forward travel of the paver. Some pavers are equipped with augers which effectively meter the fresh concrete to the main screed. The forward speed of the paver shall be adjusted to the average progress of the concrete production and delivery in order that operations shall be as continuous and uninterrupted as possible.

Because of physical limitations as to the mass of the machine and of the relatively large screed area, the importance of using concrete of proper consistency and uniform distribution is extremely critical. Large piles of concrete or dry batches will cause the paver to "float" or lift above the true grade and result in a high area or bump. Wet batches cause low spots and edge slump and irregularity.

The concrete, for the full paving width, shall be effectively consolidated by internal vibration with transverse vibrating units of a series of longitudinal vibrating units. The paver extrusion plate or screed shall extrude the concrete under load, properly shaping and compacting the concrete into a dense, stable mass to assure that the concrete remains stable, with a minimum amount of slumping after the passage of the paver. Some pavers may have more than one device for the screeding operation.

When the pavement is being constructed by slip-form method, all reinforcing steel shall be placed in accordance with *SSHC Subsection 603.03*, Paragraph 4. In some instances two slip-form pavers may be required in tandem in order to comply with the requirements.

Tine Determination

Depth of the grooves may be determined by using a standard commercial tire tread depth gauge, but normally a visual inspection without measurements is adequate.

Guidelines for Tining Concrete Pavement

1. Tine all concrete pavements where posted speed limit will be 40 mph or greater. When a mainline is tined, include tining in intersections, acceleration lanes, deceleration lanes, left-turn lanes and ramps.
2. Do not tine concrete shoulders.
3. On pavement built without curb, stop tining 150 mm (6 inches) from edge of pavement.
4. On pavement built with curb, stop tining 600 mm (2 feet) from back of curb.
- @ 5. ~~Tine all bridge decks where posted speed limit will be 40 mph or greater, except for county road bridges 30 m (100 feet) or less in length that have gravel approaches and no plans exist for future hard surfacing.~~
6. ~~On bridge decks, stop the tining 600 mm (2 ft) from the face of the bridge curb.~~

602.5023 Pavement Depression

A pavement depression prevents proper drainage of slab during periods of rain and may cause maintenance problems during the winter. This may be due to one or more of the following reasons:

- Screed not set correctly
- Poor workmanship by finishers in manipulating straightedge
- Improper tension between ends of trailing forms
- Improper adjustment of edges attached to trailing forms

Check this deficiency by placing a 3 m (10 ft) straightedge or 1.2 m (4 ft) carpenters level transversely on pavement surface and noting trueness of surface with bottom of straightedge.

602.5024 Pavement Station Stamping

Station location of all PCC pavement shall be stamped in plastic concrete at every station (100 m/100 ft) by the NDR inspector.

Permanent Station Numbers - Each station number shall be marked permanently in the surface of the concrete slab by the use of metal dies furnished by the department. The numbers should be stamped neatly in the concrete just before it takes its initial set. They should be placed about 150 mm (6 inches) in from the right-hand edge of the slab so that they can be read from the right roadway shoulder.

amount designated by the laboratory. The vertical edges of the slab shall be coated with the same quantity per square meter as the surface. Keep the material from coating any joint areas to which joint-sealing filler is to be applied.

@ *When curing with burlap, at times keeping the burlap in place and continuously in a dampened condition is an endless task. However, since proper curing is essential to good quality in the concrete, the curing requirements for the particular work should be reviewed and discussed with the contractor. It is the responsibility of the Project Manager to ensure that the contractor carries out the curing requirements as specified.*

Prior to start of paving operations the inspector should be assured that the contractor has sufficient material on hand, such as burlap, polyethylene sheeting or other approved material, to properly protect the pavement surface in case of rain. Sudden showers which might occur during paving operations or immediately after finishing operations require the exposed surface of the fresh concrete to be covered to prevent washing cement from the surface. Mixing and placing of concrete should cease immediately in the event of rain.

When hot dry and windy conditions prevail, the application or placement of curing material becomes extremely important.

@ ~~When curing with burlap, at times keeping the burlap in place and continuously in a dampened condition is an endless task. However, since proper curing is essential to good quality in the concrete, the curing requirements for the particular work should be reviewed and discussed with the contractor. It is the responsibility of the Project Manager to ensure that the contractor carries out the curing requirements as specified.~~

602.5027 Joints (SSHC Subsection 603.03)

@ Joints are sawed in PCC pavements to eliminate random cracking and to provide areas for pavement to expand and contract. These control joints are then cleaned and sealed with various types of sealants to keep out water and incompressibles such as soil, sand, and gravel.

Transverse Construction Joints - The header board used to form the construction joint at the end of the day's run should be cut from 50 mm (2 inch) material and approximately 37.5 mm (1 ½ inch) shorter than the width of the pavement. Holes bored in the board to receive the load transfer dowels should be at least 6 mm (1/4 inch) larger in diameter than the dowel bars.

When due to breakdowns, construction joints are necessary during the day, and work is resumed after a short delay, great care must be used in removing the header board from the green concrete. Any pressure or lift on the dowel bars will break the bond with concrete and cause the joint to spall at some future date.

Generally, header boards should be set 3 mm (1/8 inch) below normal crown at centerline. Observe the straightedging of the header joint the next morning and adjust the setting of the next header board, accordingly. When paving down steep grades (4 to 6 percent), set the header board 6 mm (1/4 inch) below crown elevation. When paving up steep grades, set the board exactly to crown elevation. Boards should be set at right angles to the pavement grade with dowel bars parallel to the subgrade.

Concrete pavement failures on the "morning" side of transverse construction joints have sometimes been noted. This is normally caused by unconsolidated concrete. Machine vibration should be observed at this point and if not considered adequate, hand vibrations for a few feet out from the header should be required.

Dowel bars on all joints shall be greased as shown in the plans.

Transverse Expansion Joints - The joint materials should be set at right angles to the pavement grade with dowel bars parallel to the subgrade and to the centerline of the

pavement. Tilted or skewed dowels will "blow up" the joint at some future date when the pavement expands. The joint material must touch the subgrade throughout its entire length and there should be no gaps between the mastic sections. Concrete plugs form in such gaps and defeat the purpose of the joint. Make certain that the expansion tubes are not driven on past the stop lugs or the joint will fail to function. The 25 mm (1 inch) temporary filler between the ends of the expansion material and the side form should be removed before placing the hot-poured joint material. *If the temporary filler is composed of unyielding material, it should be removed the day after the pavement is poured to prevent spalling the corners of the concrete slab when the pavement expands.*

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The strike bar on the spreader and the screeds of the finishing machine should be raised slightly when making their trip over the joint. Machines pushing a heavy roll of concrete tend to tilt the mastic, and shovelers should be employed to transfer such rolls across the joint. The inspector shall check all joints for position behind the finishing machine by inserting a thin wood stake about 0.8 m (30 inches) long in the concrete alongside and in contact with the joint material. If the stake contacts the joint material all the way to the subgrade and appears to be plumb, the joint will function properly. Tilted joints should be dug out and reset.

Contraction Joints - The specifications provide that plane of weakness joints shall be sawed. Great care and attention should be given to the planning of sawing joints. Sawing at the wrong time or sawing along side of a crack already formed can be the cause of extensive maintenance work. The cutting of transverse-control joints to relieve early shrinkage stresses may be necessary depending on the type of slab, the atmosphere conditions and the amount of shrinkage inherent in the concrete. No exact time can be given as to when sawing of transverse-control joints should start, and it will be necessary to prepare a sawing sequence for each project.

The plans should be carefully checked to determine the location and depth of sawing required. Usually the specified depth of cut is different for transverse and longitudinal joints. The depth of cut should be checked as soon as possible so that the contractor may seal the joints.

On Reinforced Concrete Pavement, with transverse contraction joints at 14.17 m (46.5 ft), it probably won't be necessary to cut control joints except in very hot weather periods. It is recommended that on the first day of concrete paving, sawing of the transverse joints begin as soon as possible without excessive raveling or tearing. The time at which this sawing should start may vary from 6 hours on warm days to 20 hours in cold, cloudy weather. Sawing of these joints should continue progressively at the plan spacing until concrete is encountered that is so green that it cannot be sawed without tearing. Some slight raveling of the concrete must be expected. If a sharp edge joint is being obtained, it is quite likely that the concrete may have hardened sufficiently to result in uncontrolled cracking. This would indicate that sawing should be earlier or control joints should be made.

The first joint following the previous day's construction joint should always be sawed as a control joint. The older concrete will place sufficient stress on the newly placed concrete to produce an uncontrolled crack near the header if a plane of weakness is not provided at this point.

SSHC Subsection 603.03, Paragraph 7 should be thoroughly reviewed and understood by both the inspector and contractor. Transverse joints near cracks developing before sawing should be skipped, the crack routed and filled with joint material. Sawing shall be

Sealing Equipment

Hot poured asphaltic joint material may be overheated in hot pour kettles. An overheated sealant has lost its elasticity and will prematurely fail. Thermometers on hot pour kettles need to be checked and replaced if necessary. Calibrated thermometers are available from Quality Assurance Manager to use in checking contractor's thermometers.

Backer Rod

Backer rod is approved on a brand name basis. Approved backer rods are shown in the NDR Approved Products List.

Doweled Support Assemblies (SSHC Subsection 603.03)

To insure that a doweled contraction joint will function as designed, it is critical that assembly be properly installed. Dowel bars provide load transfer across the joint without prohibiting the opening and closing of the joint during pavement temperature changes.

Dowel Tolerances

To permit pavement slabs to move longitudinally on the subgrade during expansion and contraction, dowels must be parallel to both centerline and surface of pavement. The plans show the dowel placement tolerances. Dowel assemblies should not be permitted to remain in place if wire supports cannot hold dowels in correct alignment. Position of outside dowel bar to edge of pavement slab shall be within plus or minus 25 mm (1 inch).

Dowel Assembly Placement

@ When placing assemblies on subgrade, contractors use bottom support wires of assembly to ~~serve~~ as a guide for bar alignment. This is not objectionable provided bars are fabricated at proper angle to wire supports. Assemblies should be inspected for proper fabrication when delivered to project.

Contractors shall not be permitted to block up or support the assemblies on bricks to obtain proper height of dowel bars. When paving project has two different slab thicknesses requiring load transfer devices, the contractor shall furnish correct height basket dowel assemblies specifically fabricated to position bars at mid-depth in slab for each slab thickness.

@ Temporary wire fasteners, which hold some assemblies together for shipping, are to be cut if they extend across a joint. Check for movement of assemblies during passage of slipform paver. If properly set, the side forms of the paver should not come in contact with the ends of wire bar supports. Check to insure vibrators on paver or finishing equipment are set to proper height so vibrators do not touch steel during passage over assemblies.

Workers who position steel and vibrate concrete must not step on joint assemblies. Assemblies must be firmly anchored to subgrade or subbase with a minimum of eight stakes per 3.6 m (12 feet) width to resist horizontal and vertical movement during concrete placement and subsequent finishing operations.

Marking Joint Locations

Prior to paving, dowel midpoint must be marked on the subgrade or granular foundation course so an accurate saw cut location can be made on cured pavement. A narrow band of paint can be applied to the subgrade at midpoint of dowels in same direction as proposed saw cut. This band of paint must be kept as narrow as possible to minimize chance of error in correctly locating saw cut. An alternate method would be to place a dowel basket staking pin on either side of pad line.

Dowel midpoint markings should then be transferred to PCC concrete surface. This may be accomplished with a string line marking plastic concrete or by use of a chalk line after concrete has hardened. This should insure that the transverse joint will be sawn over the center of the dowel bar basket assembly. Do not permit the saw operator to eyeball joint sawing from one edge of the slab to the other.

Blanking Bands

The plans may indicate a blanking band be used to blank out the transverse texture over the center of the dowel assemblies. Care needs to be taken to ensure that the blanking band is correctly located over the center of the dowel assemblies. Using a blanking band will ensure a smooth, nontextured pavement surface at the midpoint on the dowel assembly.

Longitudinal Joint Design

The standard plans show joint layout details. The joint layout designs for paving plans have specific requirements for certain type joints which consider traffic movements during and after construction and the effect of the joint type on these traffic movements.

Joints should be constructed as shown in the plans, unless the Standard Road Plans allow for alternates. Any requests by the contractor for joint substitution shall be submitted to the Construction Division for review.

Curing of Keyed and Doweled Joints

@ For curing, ~~t~~ The vertical sides of pavement in areas where joints are constructed, can be cured with the use of a liquid curing compound is an acceptable method of curing this portion of the slab.

@ Generally, little or no bond is obtained or expected between vertical faces of adjacent concrete. Deformation on tie bars provide adequate lateral support. ~~If a curing compound is sprayed on steel, this film should be removed before placing adjacent concrete.~~

@ Tie bars should not be sprayed with curing compound. They must be protected from the spray. If a curing compound is sprayed on steel, this film should be removed before placing adjacent concrete.

602.5028 Prevention of Rain Damage to Plastic Concrete

SSHC Sections 603 and 1002 require contractors to produce a quality product and have materials for proper protection of edges and surface of concrete available near work site. Contractor must protect pavement from damage due to rain. Failure to properly protect concrete may constitute cause for removal and replacement of defective pavement.

Reestablishing transverse grooving of corrected areas is not required but longitudinal grooves must be established. Equipment for regrooving shall be specifically designed for grooving concrete with a cutting head fitted with diamond blades. Use of hand held equipment is not permitted.

E. Limitations

Necessary corrective measures on hardened concrete shall only be made after concrete attains age and strength requirements in *SSHC Section 603*.

All required corrective measures shall be completed prior to coring for pavement thickness measurements.

Approval of the Construction Division is required before placing a bonded PCC overlay.

602.5030 Mud Ball Repair

Occasionally mud balls appear in the surface on new concrete pavements. These usually are due to clay balls from a quarry or mud thrown into dump trucks from portable batch plant located at a wet site.

Correction of any discovered mud balls in pavement surface shall be as follows:

- Any thin concrete skin around perimeter of mud ball should be removed so that nearly vertical void walls remain.
- Each void shall be cleaned by a high pressure washer, followed by air blasting to dry void.
- Voids shall be filled with an approved grout. This material shall be used according to manufacturer's recommendations.
- Surface of filled voids shall be given the same texture as surrounding pavement.
- Void shall be given proper cure time recommended by manufacturer prior to opening roadway to normal traffic.

@ If a severe problem with mud balls is suspected and the suspicions have been document,
@ then on a specific project formal acceptance by Project Manager should be delayed until the following spring. This will allow the winter freeze-thaw cycles and snowplowing activities to expose additional mud balls located adjacent to pavement surface. These newly discovered mud ball areas will then also require corrective measures as stated above. The Project Manager may also elect to have the contractor use a high pressure sprayer (1200 psi) to locate mud balls and allow the project to be finalized immediately after any repairs are made.

602.5031 Cold Weather Paving and Plant Operations

Cold Weather Pavement Protection

During cold weather, *SSHC Subsections 601.01, 603.03 and 1002.02* requires that newly placed paving be protected against freezing temperatures. This protection is necessary to allow the hydration process of the curing concrete to continue in cold weather. Adequate protection of concrete allows for paving to be placed later in the cold seasons.

Materials that may produce acceptable insulation include:

- 3 layers of Burlene.
- 1 layer of Fast Track Blankets.
- 1 layer of 12 mm (1/2 inch) extruded polystyrene, must be weighted down.
- 2 layers of 6 mm (1/4 inch) air celled polyethylene.
- 1 layer of 12 mm (1/2 inch) air celled polyethylene.

Do not advise contractor regarding cold weather protection.

When cold weather protection is required, the contractor will not be reimbursed for whatever protection is used.

Cold Weather Plant Operation

@ *SSHC Subsection 603.03* states that concrete mixing and placement may be started when air temperature is at least 5°C (40° F) and rising. In the late fall season before the subgrade begins to freeze and soil temperatures are still relatively warm, it is permissible to allow paving plant operations to begin below 5°C (40° F) providing a ~~warning~~ warming weather forecast is predicted. Paving plant operations basically self regulate during these conditions.

@ The intent is to maximize the remaining good paving weather still available in the fall. This provision is not intended to make a paving day out of one that is not but to allow for as much concrete pavement placement as possible during ~~a day forecast for~~ good weather.

After the subgrade begins to freeze, the above provisions should be halted and the Specifications strictly enforced.

602.60 PCC PAVEMENT METHOD OF MEASUREMENT

602.601 Smoothness Tests (Profilograph)

1. See *SSHC Section 602* for profilograph procedures.
2. When the contract Special Provisions require the smoothness of the concrete pavement to be tested by measurement with the profilograph, it is necessary and a requirement of the Provision that the thickness cores be taken ~~prior~~ after to any surface correction (grinding) by the contractor.
3. Since the thickness cores are taken by personnel from the Materials and Tests Division (Lincoln), it is necessary they be kept posted as far in advance as possible when the coring must be done. It is generally preferable to do the coring prior to opening the pavement (segments in some cases) to traffic. Accordingly, prior planning is necessary and shall be accomplished by the Project Manager. Contact Rhonda DeButts at 479-4760 or Dave Hall at 479-4837 in the M & T Quality Assurance Section.

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602.602 Requirements for Thickness

SSHC Subsection 603.05 indicates the thickness requirements and includes a table of payments to be made for concrete of less than plan thickness. The table is based on the premise that a pay deduction should be proportioned to the reductions in service resulting from thin pavement. Thus the reductions in payment are quite severe. ~~All contractors and NDR personnel involved in the work relating to the thickness of the pavement should be alert to the meaning of the table.~~

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602.603 Material Quantities

Concrete pavement is measured for payment in square meters in place and accepted, minus deductions. The reinforcing steel and dowel bars required by the Plans and Special Provisions will be considered subsidiary to the other pay items in concrete pavement construction.

SSHC Subsection 603.04 states that the quantity of concrete pavement will be measured by the square meter. This is interpreted by the Construction Division to mean that when the plans, stakes, etc., order a nominal width of pavement and the Project Manager determines that this nominal width requirement is met or exceeded, the nominal width will be used to compute the quantity for the concrete pavement item, i.e., the contractor should not be permitted to increase his/her compensation by purposely or inadvertently constructing the pavement to a width greater than the nominal width.

Base course, foundation course, and subgrade preparation are not measured quantities. They are established quantities that are based on the paved area.

602.604 Concrete Driveways

SSHC Subsection 609.04 states that concrete driveways will be measured by the square meter. This is interpreted by the Construction Division to mean that when the Project Survey Crew stakes the driveway for certain dimensions these are the dimensions that will be accepted. used to compute the area for payments.

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603.00 PCC PAVEMENT PATCHING

603.10 Full Depth PCC Patches

@ The plans show the details for full depth patches for PCC pavement or resurfaced PCC pavement. Each of these details identify the required depth of concrete for the patch. There are six pages of details that describe pavement repairs that will not receive an overlay and four pages of details that describe pavement repairs that will receive an overlay. However, only those details that are applicable are included in any set of plans. In general, if the length of the repair is 4' to 9', then it is considered "Joint Repair." If the repair is over 9', then it is called "Pavement (Panel) Repair."

The transverse and longitudinal faces of the pavement around the repair receive different treatments. The surface in the transverse (width of pavement) direction will either receive dowel bars or have the surface beveled to wedge the patch so it will not settle below the existing roadway surface. The longitudinal surface will be vertical and may have tie bars (see plans for details).

~~These details also show how to remove the pavement. All patching details include both a full depth saw cut and a 37 mm (1 ½ inch) saw cut. Full depth saw cut is usually performed with a wheel saw. These saw cuts are intended to sever pavement totally so existing pavement can be completely removed. The 37 mm (1 ½ inch) saw cut is intended to create a smooth vertical face for ease of finishing and to lower the chance of surface spalling at this final patch edge. The remaining portion of concrete between these two saw cuts shall be entirely removed with hand tools. This breakout area should have an essentially vertical face with very minimal undercut. It is preferable to have a slight protrusion rather than any undercutting for this face. Care needs to be taken to ensure that a nice, vertical, clean edge is provided in this patching operation.~~

The details also show how to remove the pavement. The detail for beveling the transverse ledge includes both a full depth saw cut and a 2 inch + ¼ inch deep saw cut. The full depth saw cut is usually performed with a wheel saw. These saw cuts are intended to sever the pavement totally so the existing pavement can be completely removed. The breakout area between the full depth cut and the 2 inch depth cut should create a beveled ledge that will wedge the patch in place and prevent it from slipping below the roadway surface.

603.20 SAW CUTS IN FULL DEPTH PCC PATCHES

Some contractors have delayed saw cuts for joints in full depth PCC patches until after minimum 5-hour cure period (on two-lane roadways). Due to rapid setting concrete used for these patches, random cracks often appear when joints are not sawn quick enough. Any joints in full-depth patches shall be sawn as soon as possible as long as ravelling of saw cut edges does not happen. This early sawing will require temporary removal and replacement of required insulation boards in cold weather.

Any random cracks that appear due to a delay of the saw cut operation shall be repaired by the contractor. Repair will consist of routing random cracks with a crack saw and sealing with hot pour sealant. These repairs will be at the expense of the contractor.

Inspection Equipment:

Slump Cone
Air Meter (pressure)
Cylinder Molds and Lids
Rod
Mallet
Strike Off Bar
Ruler

Placement Procedures:

1. Preplacement check of equipment.
2. Check condition and placement of steel.
3. Check Form setting and alignment. Verify location coordinates and orientation.
4. Have contractor wet grade before concrete placement.
5. Test concrete for air content, slump, and make cylinders when mix changes, as a minimum according to Sampling Guide.
6. Watch concrete placement for compliance with specifications. Do not allow free fall greater than 1.5 m (5 ft).
7. Do not use water as a finishing aid; use an approved chemical finishing aid/evaporation retardant.
8. Check curing operation.

Construction Critical Area:

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1. Take pictures of any pavement under bridge before work begins.
2. Achievement of concrete consolidation without segregation.
3. The time between loads of concrete.
4. Trucks that segregate concrete or have cements balls must not be used.

NDR Tests:

1. NDR T 23 Making and Curing concrete test specimens.
2. NDR T 119 Slump of Portland Cement Concrete.
3. NDR T 141 Sampling of Fresh Concrete.
4. NDR T 152 Air Content of Freshly Mixed Concrete by the Pressure Method.

701.03 CONCRETE BRIDGE FLOORS CHECKLIST

SSHC References:

Section 706 Concrete Bridge Floors
Section 1002 Portland Cement Concrete
Section 1010 White Opaque Polyethylene Film and White Burlap--Polyethylene Sheeting For Curing Concrete
Section 1011 Burlap For Curing Concrete
Section 1014 Joint Sealing Filler
Section 1015 Preformed Joint Filler
Section 1016 Preformed Polychloroprene

*Elastomeric Joint Seals
Section 1033 Aggregates*

Inspection Crew:

Project Manager
Placement Inspector
Plant Inspector

Inspection Equipment:

Slump Cone
Air Meter (pressure)
Cylinder Molds and Lids
Rod
Mallet
Strike Off Bar
Ruler
3 m (10 ft) straightedge
Anemometer
Thermometer
Hygrometer

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Placement Procedures:

1. Preplacement check of equipment.
2. Check condition and placement of steel.
3. Check Form setting and alignment.
4. Check slab thickness.
5. Check deck for cleanliness
6. Have contractor wet forms before concrete placement.

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(Note: It's best to place deck and approach slabs at the same time.)

7. Test concrete for air content and make cylinders when mix changes, as a minimum according to Sampling Guide.
8. Watch concrete placement for compliance with specifications.
9. Do not use water as a finishing aid; use an approved chemical finishing aid/evaporation retardant.
10. Check surface with straightedge. Remove depressions and irregularities.
11. Check tining operation.
12. Check cure operation.
13. Make sure a water service and tanks are available to soak burlap.

Construction Critical Area:

1. Take pictures of any pavement under the deck before work begins.
2. Maintain a uniform roll, of about 100 mm (4 inch), of concrete ahead of the front screed and a minimum of a 50 mm (2 inch) roll ahead of the rear screed.
3. The time between loads of concrete.
4. Trucks that segregate concrete or have cements balls must not be used.
5. Avoiding placement when temperatures and wind velocities may cause plastic shrinkage cracking.

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9. Rockers, rollers, expansion devices, etc., shall be set according to the temperature at time of installation. (See Plans.)
10. Check matchmarks on all girders, separators, angle braces, etc.
11. Verify that drift pins do not enlarge holes or distort the metal.
12. Stop the contractor from hammering if it appears the metal will be damaged or injured.
13. The Construction Division will be notified of all major misfits and determine what procedures will be allowed.

701.05 CONCRETE BRIDGE DECK REPAIR WITH SILICA FUME CONCRETE

SSHC References:

- Section 710 -- Concrete Bridge Deck With Silica Fume Concrete*
- Section 1002 -- Portland Cement Concrete*
- Section 1010 -- White Opaque Polyethylene Film and White Burlap--Polyethylene Sheeting For Curing Concrete*
- Section 1011 -- Burlap For Curing Concrete*
- Section 1014 -- Joint Sealing Filler*
- Section 1015 -- Preformed Joint Filler*
- Section 1016 -- Preformed Polychloroprene Elastomeric Joint Seals*
- Section 1033 -- Aggregates*

Inspection Crew:

- Placement Inspector
- Plant Inspector

Inspection Equipment:

- Slump Cone
- Air Meter (pressure)
- Cylinder Molds and Lids
- Rod
- Mallet
- Strike Off Bar
- Ruler
- 3 m (10 ft) straightedge
- Anemometer
- Thermometer
- Hygrometer

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Placement Procedures:

1. Preplacement check of equipment.
2. Check condition and placement of steel.
3. Check Form setting and alignment.
4. Check slab thickness.
5. Check deck for cleanliness.
6. Have contractor wet deck and forms before concrete placement.
7. Test concrete for air content and make cylinders when mix changes, as a minimum according to Sampling Guide.

8. Watch concrete placement for compliance with specifications.
9. Do not use water as a finishing aid; use an approved chemical finishing aid/evaporation retardant.
10. Check surface with straightedge. Remove depressions and irregularities.
11. Check tining for conformance to specification.
12. Check cure operation.

Construction Critical
Area:

1. Check finish machine (template & rails).
2. Check repair areas.
3. Deck shall be uniformly wet, without puddles prior to placement.
4. Bonding grout shall not be allowed to dry out.
5. Maintain a uniform roll, of about 100 mm (4 inch), of concrete ahead of the front screed and a minimum of a 50 mm (2 inch) roll ahead of the rear screed.
6. The time between loads of concrete.
- @ 7. Trucks that segregate concrete or have cements balls must not be used.
8. Avoiding placement when temperatures and wind velocities may cause plastic shrinkage cracking (see SSHC Figure 710.01).
9. Fogging system should be operating from time concrete is finished until the cure is in place.
10. Check tining operation.
11. The timing of cure application.

Safety Areas:

NDR Tests:

1. NDR T 23 Making and Curing concrete test specimens.
2. NDR T 119 Slump of Portland Cement Concrete.
3. NDR T 141 Sampling of Fresh Concrete.
4. NDR T 152 Air Content of Freshly Mixed Concrete by the Pressure Method.

701.06 CONCRETE BRIDGE DECK REPAIR WITH HIGH DENSITY LOW SLUMP CONCRETE

SSHC References:

Section 711 Concrete Bridge Deck With High Density Low Slump Concrete
Section 1002 Portland Cement Concrete
Section 1010 White Opaque Polyethylene Film and White Burlap--Polyethylene Sheeting For Curing Concrete
Section 1011 Burlap For Curing Concrete
Section 1014 Joint Sealing Filler
Section 1015 Preformed Joint Filler
Section 1016 Preformed Polychloroprene Elastomeric Joint Seals
Section 1033 Aggregates

Inspection Crew:

Placement Inspector

Inspection Equipment:

Nuclear Density Gauge & Operator
Slump Cone
Air Meter (pressure)
Cylinder Molds and Lids
Rod
Mallet
Strike Off Bar
Ruler
Yield Bucket
Strike Off Plate
Scale
3 m (10 ft) straightedge
Anemometer
Thermometer
Hygrometer

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Placement Procedures:

1. Preplacement check of equipment. Calibrate the mobile mixer.
2. Calibrate nuclear density gauge.
3. Check condition of existing deck and steel.
4. Check Form setting and alignment.
5. Check slab thickness.
6. **The deck must be dry.**
7. Blow down deck ahead of grout for cleanliness.
8. Test concrete for air content and make cylinders when mix changes, as a minimum according to Sampling Guide.
9. Check concrete density according to Sampling Guide.
10. Watch concrete placement for compliance with specifications.
11. Do not use water as a finishing aid; use an approved chemical finishing aid/evaporation retardant.

- 12. Check surface with straightedge. Remove depressions and irregularities.
- 13. Check tining for conformance to specification.
- @ 14. Check burlaping & ~~converting~~ curing operation.

Construction Critical
Area:

- 1. Check finish machine (template, rails).
- 2. Check repair area.
- 3. Apply grout to curb for low density concrete to bond to.
- 4. Deck shall be dry just prior to placement.
- 5. Bonding grout shall not be allowed to dry out.
- 6. Achievement of density.
- 7. Avoiding placement when temperatures and wind velocities may cause plastic shrinkage cracking.
- 8. The timing of cure application.

Safety Areas:

NDR Tests:

- 1. NDR T 23 Making and Curing concrete test specimens.
- 2. NDR T 119 Slump of Portland Cement Concrete.
- 3. NDR T 141 Sampling of Fresh Concrete.
- 4. NDR T 121 Weight Per cubic Meter (yd), Yield, and Air Content (Gravimetric) of Concrete
- 5. NDR T 152 Air Content of Freshly Mixed Concrete by the Pressure Method

702.00 EXCAVATION FOR STRUCTURES (SSHC Section 702)

702.01 DESCRIPTION

All excavation should be done as shown in the plans. Excavation is very dangerous work and appropriate OSHA regulations must always be observed (see SSHC Figure 701.01).

Inspector should be present when an area is being backfilled. The inspector should check to see that the backfill materials are as specified. The materials shall be placed as prescribed in the *SSHC Subsection 205.03 or 702.03* as appropriate.

Structure excavation includes all excavation, removal of obstruction, bailing, draining, pumping, sheathing, construction and removal of cofferdams, backfilling, compacting and disposal of any excess material necessary to construct the structure in question.

702.02 MATERIAL REQUIREMENTS

Unsuitable Material Excavation (SSHC Subsection 702.05)

When unstable material is encountered it shall be removed and backfilled with approved material. The material shall be measured in cubic meters (yds) before it is placed. Payment for the extra work material and all work involved will be made at 10% of the contact unit price for box culvert concrete (when gravel or rock is used). The inspector should make an inspection of all structure footings as they are being excavated by the contractor.

702.03 CONSTRUCTION METHODS

Culvert Excavation (SSHC Subsection 702.03)

All culverts should be constructed with a minimum of approximately 300 mm (12 inches) of cover exclusive of surfacing. An accepted method for obtaining specified bedding for these culverts is to require the contractor to furnish a template conforming to the dimensions of the culvert pipe. This template is then used for shaping the trench to the specified depth.

The inspector must be knowledgeable of the Occupational Safety and Health Act (OSHA) requirements concerning excavation and trenching. Pipe culvert excavation by OSHA definition would normally be considered a trench.

Never allow any part of a pipe culvert to rest on rock or other unyielding materials. When rock is encountered in the bottom of the trench, it shall be removed to a depth of at least 150 mm (6 inches) below the subgrade and back filled with suitable earth or sand.

The Specifications provide that where unstable subgrades are encountered under pipes or pipe-arch culverts, the unsuitable material shall be removed and the excavated area refilled with gravel, crushed rock, or other suitable material. When crushed rock is used, care should be taken ~~or~~ to place the fine rock immediately beneath all metal pipe to prevent abrasion of the spelter coating. When gravel or crushed rock is used, it will be measured in cubic meters before it is placed. Payment for furnishing, hauling and placing this material will be made at 10% of the contract unit price for concrete for box culverts. When box culverts are

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not included in the contract, the NDR average unit price for box culvert concrete shall be used. (*SSHC Subsection 702.05*)

General Structure Backfilling (*SSHC Subsection 702.03*)

This operation may involve *SSHC Sections 205, 702, and Table 702.01*. The inspector should insure that all applicable sections are followed. The compaction of backfill material close to structures must given special attention. Mechanical tampers should be operated carefully in such a manner as to obtain the required density without damaging the structure.

Concrete Seal Course (*SSHC Subsection 702.03*)

When it is impossible to dewater the foundation bed or box culvert footing or if live springs develop within the area a seal course should be constructed below the elevation of the bottom of the footing. Concrete for seals constructed underwater shall contain 10% excess cement and be placed in accordance with *SSHC Subsection 704.03*. The concrete shall be allowed to harden a minimum of 72 hours after completing the final pour before unwatering and continuing work on the structure. Seepage through inadequate or poorly constructed cofferdams shall not be justification for placing a seal course.

Before any material is placed, the area to be backfilled should be inspected for trash or perishable matter. The materials to be used for backfill should be given careful consideration. Only those that will produce a dense, well-compacted backfill should be used. Granular materials are desirable as much less effort is needed to compact them than clay.

When abutments are tied to an anchor or deadman by means of tie rods, care should be taken in the back filling operation. The backfill should be placed in layers, starting at the anchor or deadman and working toward the abutment. Hand tamping may be required around the tie rods, abutment and anchors.

Backfilling must not be started without the permission of the Project Manager and in the case of concrete structures not until test cylinders show a minimum strength of at least 14 MPa.

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Backfill should be brought up evenly to the elevation shown in the plans. Granular material must be placed in not more than 200 mm (8 inch) layers (lifts) and should have sufficient moisture to facilitate compaction. Do not allow dumping of granular material directly from the truck into the excavation.

Special attention should be given to culvert wingwalls and flumes to insure proper compaction to prevent erosion and possible washout. The soil should be brought up even with these walls so the surface water will flow over these walls and not along them. Heavy equipment should be kept 1 m (3 feet) or more away from these wingwalls. Compaction within 1 m (3 ft) of the wingwall shall be with pneumatic hand tampers or small hand operated vibratory plate compactors.

Backfill for Bridges - Moisture and density requirements for backfill which is to provide support for subsequent construction will be shown in the plans. Backfill which is not to support later construction shall be compacted to 95% of maximum density without definite moisture limits.

Diagonal bracing, including connections, must conform to details shown on the falsework drawings.

Diagonal bracing should be inspected after any falsework has been adjusted to grade. Connections must be securely fastened to ensure their effectiveness in resisting horizontal forces. Bolted connections may need retightening.

Timber posts may be wedged at either the top or bottom for grade adjustments, but not at both locations. Large posts may require two or more sets of wedges (side by side) to reduce compression stresses perpendicular to the grain.

Blocking and wedging should be kept to a minimum. It is poor workmanship to extend a short post by piling up blocks and wedges. This practice should not be permitted.

Particular attention should be given to falsework bents where grade adjustment is provided at the bottom of the posts. Differential grade adjustment of posts within a particular bent may induce undesirable stresses in the diagonal bracing.

Splicing of wood posts will not be allowed unless shown on approved falsework plans.

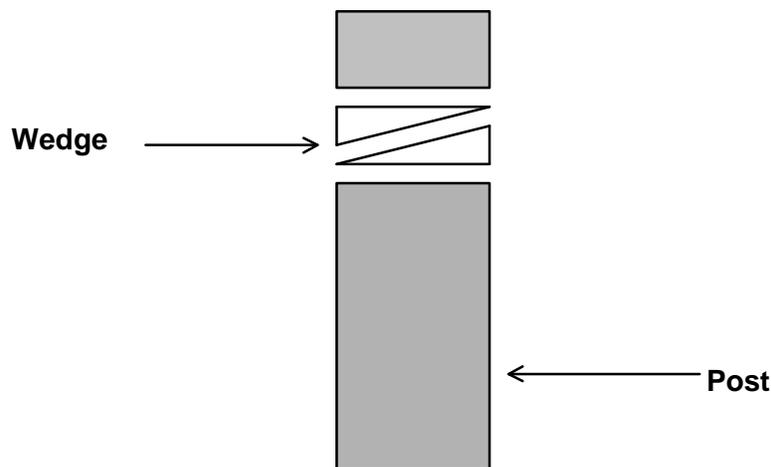
@ The ends of spliced posts must be cut square. ~~Properly size splice plates, and the proper size, pitch and edge distance of nails need to be vertical.~~ The need for a post splice should have been anticipated by the contractor and the splice detail shown on falsework drawings. If this is not the case, the contractor must submit a detail for approval.

Posts must be plumb and centered over the falsework pad or corbel.

Abutting edges of soffit plywood should be set parallel to the joists and continuously supported on a common joist.

A sufficient number of telltales must be installed to accurately determine the amount of joint take-up and settlement. Telltales should be attached to the joists as close as possible to the supporting post or bent.

Full bearing must be obtained between all members in contact. Deficiencies in this respect may be improved by feather wedging. If the joint requires more than a single shim or wedge, extra care should be taken to ensure that full bearing is obtained.



- When using wedges, it is a good practice to use wedges inserted from both sides rather than deeply setting a single wedge. Using only one wedge increases the twisting effect on the member.
- When using wedges, it is good practice to install them parallel to and with the flat (nontapered) side against the main member. This improves contact with the main member and decreases the chance of a wedge "backing out" from vibration.
- Nail or clamp the wedge in place after installation.

B. Steel Shoring (Scaffolding)

This checklist may be used as a guide by inspectors when inspecting falsework constructed of steel shoring.

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- Shoring components should be inspected prior to erection. Any component that is heavily rusted, bent, dented or rewelded, or which is otherwise defective, should be rejected. Fabricated units having individual members that are bent, twisted, broken, or where welded connections are cracked or show evidence of rewelding should be rejected.
 - A base plate, shore head, or screw jack extension device should be used at the top and bottom of all vertical components.
 - All base plates, shore heads, and extension devices must be in firm contact with the footing at the bottom and the cap or stringer at the top.
 - Shoring components should fit together evenly, without any gap between the upper end of one unit and the lower end of the other unit. Any component which cannot be brought into proper contact with the component it is intended to fit, should not be used.
 - Shore heads, extension devices, and similar components must be axially loaded. Eccentric loads are not permitted on any shoring component.

Falsework and Centering

It is the contractor's responsibility to provide form work adequate to support the dead load of the fresh concrete. However, the inspector shall consult with the contractor and the Project Manager concerning any form work which he/she has reason to believe is inadequate to support the load capacity. In calculating the strength of centering, a mass of 2400 kg/m³ (150 lb/ft³) shall be assumed for fresh concrete.

All falsework shall be rigidly braced and cross braced. Timber piling shall be free from defects with at least a 175 mm (7 inches) butt and a 125 mm (5 inches) tip, measured under the bark. The contractor shall provide jacks or suitable wedges to take up any settlement in the form work during the placing of the concrete. When setting grades for falsework or structure forms, allow 1.5 mm (1/16 inch) settlement or "take-up" for each lap in the falsework timbers. Settlement caused by the concrete loads may be checked as placing of the concrete progresses by means of vertical "telltales" fastened to the bottom of the floor form. When this settlement has reached the amount allowed for "take-up" in the falsework timbers, any further settlement should be prevented by means of the wedges or jacks previously noted. Any adjustments that have to be made must be completed before the concrete has taken its initial set. If adjustments are made after the concrete has set, the concrete may be damaged irreparably.

Removal of Falsework (SSHC Table 704.02)

Specifications and applicable special provisions, contain specific criteria which must be met before falsework may be removed. Project Managers and inspectors should review these sections prior to falsework removal operations.

The Project Manager should discuss falsework removal methods and procedures at the preconstruction and/or prepour meeting. The need to provide for employee and public safety is of particular concern.

In general, all elements of the falsework bracing system must remain in place for the specified time period or until concrete attains the specific strength. In the case of cast-in-place, post tensioned construction, falsework elements must not be removed until stressing is completed.

Bridges-Steel Beam

@ On bridges using weathering steel (A 588) for steel structures, *the contractor* shall:

- Use "high strength," A325M Type III bolts, A563 Grade DH3 nuts, and F463 Type III washers.
- Limit shop painting to only areas under expansion joints and all bearings. Shop painting will be with a Zinc-rich primer and a colored top coat. Field touch-up will be required for paint that is damaged and to fasteners in these areas and it will be done with same color and type of paint as the original painting.
- Require special care to assure concrete slobbers are eliminated (or at least removed) from steel surfaces before the concrete hardens. Washing with water is the preferred method of removing concrete slobbers.

SSHC Subsection 708.03, paragraph 10.h. Turn-of-Nut method shall be followed for tightening all high strength fasteners.

High Strength bolts and nuts, which have been torqued as outlined below, shall not be reused. This includes both black and galvanized bolts and nuts.

A. Bolting

Receiving Shipments

Prior to installation, check shipping certifications and compare these to bolting kegs on site. Check for size, length, heat numbers, and general fastener condition i.e., rusted black bolts or non-lubricated galvanized nuts. Rotational-Capacity (RCA) lots will need to be checked.

Installation Checklist

- A pre-bolting meeting is strongly recommended/encouraged. Bolting procedures, Turn-of-Nut process described below, and the inspection process need to be discussed.
- Site storage of fasteners is important. Storage should be in a sealed container within a sheltered storage shed.
- Black bolts and nuts shall be oily to the touch when delivered and installed.
- Galvanized nuts shall be checked to verify lubrication. A uniform dye color indicates lubricant has not been damaged. If there is no color, or color is not uniform, bolts and nuts shall be field lubricated with bees wax, stick wax, or other approved dry wax prior to installation.
- Rusted or dirty bolts or nuts shall be cleaned and relubricated prior to installation.
- @ • Faying surfaces shall be free of burrs, and foreign material; and bolted faying surfaces are to be painted with zinc rich paint.
- All fasteners shall be free of dirt, moisture, rust, and be "well" lubricated.
- Washers (when required) are to be placed under the "**turned element.**"
- Often contract documents will specify which way a bolt is to be installed. If there is no specific guidance, threaded ends of bolts will be turned inside and away from normal exposure to pedestrian and/or vehicular traffic for aesthetic reasons.
- During installation, particular care should be exercised so a snug-tight condition is achieved.

- Scribe a line at the center of each bearing on all masonry plates or concrete.
- Set beams and make snug tight connections proceeding to the forward pier. Then go back and straighten the beam line, checking to be sure bearings remain centered on their seats. Once the previous span is aligned and tightened, proceed to the next forward span.
- Check to be sure beam ends are aligned prior to tightening the splice.

This will require coordination between survey and inspection crews and the contractor.

G. Galvanized Bolts

When using galvanized hardware, a lubricant approved by ASTM A 563 shall be applied to the nuts. Galvanized nuts "typically" are delivered to the project pre-lubricated. Usually, pre-lubricated nuts are stained and have a distinguishing color. If a lubricant has been applied at the fabrication shop, a field reapplication is not necessary provided original lubrication has not been removed in some manner. For situations where fabrication shop lubricant is in question, field application of bees wax, stick wax, or some other dry lubrication shall be required. Rotational-Capacity requires the test to be conducted with fasteners in the same condition as they will be during installation.

A WORD OF CAUTION:

Lubrication is required to minimize galling during installation. Since nuts are lubricated (both threads and faces), it is important that nuts be rotated during tightening.

Fasteners (bolts and nuts of any type) shall not be tightened, then removed, reinstalled, and retightened.

Welding (SSHC Subsection 708.03)

- @ Contractors may be allowed to tack weld form hardware to the shear connectors on steel girders. (The intent is to eliminate the request procedure.)

This policy does not apply to the rebar stirrups which extend out of the top of prestressed girders.

Weld Spatter

Spatter does not affect weld strength but does produce a poor appearance and increases cleaning costs.

1. Be sure to control excessive spatter: Try lowering the current. Be sure the current is within the recommended range for the type and size electrode (see attached Table).
2. Be sure the polarity is correct for the electrode type.
3. Try a shorter arc length.
4. If the molten metal is running in front of the arc, change the electrode angle.
5. Watch for arc blow.
6. The electrode is not too wet.

Undercut

Generally, the only harm from undercutting is impaired appearance. However, undercutting may also impair weld strength, particularly when the weld is loaded in tension or subjected to fatigue. To minimize undercut:

1. Reduce current, travel speed, or electrode size until the puddle is manageable.
2. Change electrode angle so the arc force holds the metal in the corners. Use a uniform travel speed and avoid excessive weaving.

Rough Welding

If polarity and current are within the electrode manufacturer's recommendations but the arc action is rough and erratic, the electrodes may be wet. Try electrodes from a fresh container. If the problem occurs frequently, store open containers of electrodes in a heated cabinet.

Porosity and Surface Holes

@ Most porosity is not visible. But severe porosity can weaken the weld. The following practices minimize porosity:

1. Remove scale, rust, paint, moisture, or dirt from the joint. Generally use an E6010 or E6011 electrode for dirty steel.
2. Keep the puddle molten for a long time, so that gases may boil out before the metal freezes.
3. Steels very low in carbon or manganese or those high in sulfur or phosphorus should be welded with a low-hydrogen electrode. Minimize

Bridge Diaphragms

Steel diaphragms, if allowed, are shown in the plans for prestressed beam structures. Shop drawings are required for steel diaphragms showing details of beam layouts, location of the diaphragms, and location of mounting holes.

High strength bolts for steel diaphragms shall be tightened by Turn-of-Nut method. (Refer to *SSHC Subsection 708.03* for information on proper bolt inspection and installation.) Inspection and field installation acceptance will be based on observing proper Turn-of-Nut procedures. (A tensioning device and inspection torque wrench is recommended, but will not be required.)

Concrete diaphragms (bent plate separators) are intended to be placed monolithically with the deck slab. However, there are instances where allowance has been given for specific diaphragms to be placed prior to slab placement. If there is a construction option shown in the plans, the diaphragm can be poured separate from the deck. Note the construction joint detail will show how to strike-off the surface. Consult with the Construction Division in situations where the contractor requests to place concrete diaphragms before a deck placement.

Contractor shop drawings are required to cover diaphragms.

Girder Shims

Definition

A girder shim is defined as the distance measured from top of girder to top of finished slab. There are three different types of bridges which we build that have girder shims. The first type is a steel girder bridge, either a rolled beam section or a plate girder section. The second type is a prestressed girder (NU Girder Section). The third type is a prestressed twin tee girder. When taking shim shots on a prestressed twin tee girder, they should be taken at the edges of the twin tee. *Take shim shot on steel girders or NU girders along the girder centerline.*

@

For each type, the definition of the girder shim is the same; girder shim is the distance measured from the top of girder to top of finished slab.

Stages of the Girder Shim Process

The Bridge Division, upon completion of the design, will prepare the shim input forms. After the project has been let, we send these forms to the Project Manager. After the girders are erected and prior to forming the deck for the slab, shim shots are required to be taken. These shim shots should be taken at the bearings, field splices, and at 3 m intervals along the length of the girder. The shim shots can be recorded on the input forms.

The H.I. Elevation needs to be recorded by the inspector at the time the shim shots are taken.

The rod readings at each location are recorded on RDP Form 50a. This information is normally sent by computer to the Bridge Division.

The Bridge Division will run a computer program which uses the grade of the roadway, crown of roadway, the dead load deflection of the girder, and your rod readings to determine the amount of shim at each location.

The Bridge Division will look at the shims to see if they are too large or too small. The final shim information will be sent to the Project Manager along with solutions to any problems which may have occurred.

The proper girder shims are critical to ensure that construction of the bridge is in accordance with the intended design.

Composite Girders

There are two methods of designing girders. One method is a non-composite design and the other method is a composite design. The non-composite design is basically the slab sitting on top of the girders. By providing shear connectors on the top of the top flange, we can tie the slab to the girders into what we call a composite section. On prestressed girders, the stirrups extending out of the girder into the slab provide the composite action. The composite section produces a more economical design. The Bridge Division designs the girders as a composite section.

AASHTO Specifications

In order for this composite action to actually take place, it is critical that these shear connectors extend into the slab the proper amount. For steel girders, AASHTO specifications require that the shear connectors penetrate at least 50 mm (2 inch) above the bottom of the slab.

The AASHTO specifications also state that the clear depth of concrete over the tops of the shear connectors for steel girders shall not be less than 50 mm (2 inch). So this gives the Bridge Division a range for the location for the top of the shear connectors.

Proper vs. Improper Shims

When you are inspecting a job, a visual inspection of the relationship of the shear connectors to the slab reinforcement will help you determine if something is wrong. Based on the slab thicknesses that we normally use, 190 mm (7.5 inch) or 205 mm (8 inch) thick, the length of stud that we normally use (125 mm (5 inch) long) and if the slab ~~is reinforcement-reinforced~~, the end of the shear connector should be located somewhere between the top and bottom transverse slab reinforcing steel.

We specify 25 mm (1 inch) of clearance between the bottom of the slab and the bottom transverse reinforcing steel. A 20 mm (3/4 inch) bar is the largest bar specified. Therefore, knowing that we need 50 mm (2 inch) of penetration for the shear connectors, the top of the shear connector should always be above the transverse bar in the bottom of the slab.

Problems and Solutions

When we have the problem of too large of a shim, there are a couple of things we can do to solve this problem. One solution is to provide some reinforcing bars at each shear connector location that properly extend into the slab. Another solution is to weld a plate onto the top of the shear connectors to gain the proper penetration length.

along a rib. In most instances, the thickness of the epoxy coating will be very low in these areas or there may be no coating at all where the sharp edges are present.

@ Materials and Tests Division personnel will inspect epoxy coated rebars at the coating applicator's plant, in some, but not all cases. In cases where inspection is made at the applicator's plant, the bars will have a maximum of two holidays per meter, plus handling damage when they arrive at the site. In addition, the coating thickness, on bars inspected at the applicator's plant, must meet the specification requirements for thickness of coating. Bars not so inspected at the applicator's plant will have an unknown number of holidays and possibly uncoated sharp edges plus handling damage when they arrive at the site and, in addition, the coating thickness will not have been checked. Bars that contain rolling defects or have uncoated sharp edges that are found during the inspection shall be rejected.

The basis for acceptance will be the total of defects per 300 mm (foot) of bar, i.e., holidays plus handling defects as located with the electronic detector.

A total of six defects in any 300 mm (foot) of the bar will be permitted. As an example, in a bar of given length, if any 300 mm (foot) section of that bar has no more than the two allowable holidays and four handling defects, the bar is acceptable, providing none of the four handling defects has an area greater than 225 (1.0025 ft²) mm². (A square measuring 15 mm x 15 mm (0.05 ft x 0.05 ft) has an area of 225 (0.0025 ft²) mm²). All handling defects having an area greater than 225 mm² must be repaired.

The following points may be helpful in the inspection and repair of epoxy coated rebars in the field.

1. Inspect bars for coating defects, using the electronic detector, as they come out of the bundle.
2. It may not be necessary to check all bars in each bundle, but enough bars out of each bundle should be checked in order to determine the quality of coating on all bars in the bundle.
3. When the number of defects per 300 mm (1 foot) section exceeds six, only the number of defects necessary to bring the bar into compliance need be repaired. Only exception is that all defects greater than .035 mm² (.00005 in²) must be repaired.
4. Repair of defects is accomplished with an approved two component epoxy compound supplied by the coating manufacturer.
5. Epoxy compounds used for repair have a minimum temperature at which they may be used and a limited pot life, as recommended by the manufacturer.
6. Any rust showing through the defect must be removed before applying the epoxy compound. A file or grinding wheel may be used provided no substantial reduction in the area of the bar occurs.
7. Coating thickness of the painted repair area must be as specified for the factory applied coating.

Splicing

All reinforcement shall be furnished in the full lengths indicated in the plans. Splices, not shown in the plan, shall not be allowed without approval of the Project Manager. Welding shall be allowed only if shown in the plans or authorized by the Construction Engineer in writing.

When splices are required, they should be staggered as far as possible in order that a plane of weakness is not caused in the member. The laps should be at least as long as is shown in the plans and if no lap is shown, the bars should be lapped as required in SSHC Subsection 707.03. Splices should preferably be made in areas of low stress concentration. The bars in the top of a slab or beam should be spliced in a positive moment section (bottom of slab or beam in tension) and the bars in the bottom of a slab or beam should be spliced in a negative moment section (top of slab or beam in tension). For example, the longitudinal bars in the top of a slab should be spliced near the center of the span rather than over a pier and the longitudinal bars in the bottom of the slab should be spliced near the pier rather than in the middle of a span. Following is a tabulation of 24 and 36 diameter lap requirements for the various sizes of rebars.

@

ASTM Standard Reinforcing Bars				
Bar Size Designation	Weight Pounds per Foot	Nominal Dimensions - Round Sections		
		Diameter Inches	Cross-Sectional Area - Sq. Inches	Perimeter Inches
#3	.376	.375	.11	1.178
#4	.668	.500	.20	1.571
#5	1.043	.625	.31	1.963
#6	1.502	.750	.44	2.356
#7	2.044	.875	.60	2.749
#8	2.670	1.000	.79	3.142
#9	3.400	1.128	1.00	3.544
#10	4.303	1.270	1.27	3.990
#11	5.313	1.410	1.56	4.430
#14	7.650	1.693	2.25	5.320
#18	13.600	2.257	4.00	7.090

706.00 CONCRETE CONSTRUCTION (SSHC Section 704)

706.01 DESCRIPTION

@ This section of the Specifications deals with the construction of structures composed of portland cement concrete. ~~The~~ *This* work ~~involved~~ includes constructing, setting and supporting the forms, and handling, placing, finishing and curing the concrete for bridges, box culverts, arch culverts, headwalls, retaining walls and steps, and the miscellaneous structures listed in the incidental construction portion of the Specifications.

706.02 MATERIAL REQUIREMENTS

Composition of Concrete

The class of concrete to be used in the work is specified in the plans or special provisions and shall be one of those described in *SSHC Subsection 1002.02*. In the event that the contractor has a choice of several classes, he/she is required to advise the Project Manager by letter of the one to be used. This information should be obtained prior to any concrete construction to allow engineering personnel to make provisions for necessary inspection and testing. The contractor may not change classes of concrete during construction without the written permission of the Project Manager.

SSHC Subsection 1002.03 prescribes requirements for concrete materials. The Contractor's responsibility for material requirements may be summarized as follows:

1. Check with Materials & Tests as to the approval of cement, coarse aggregate, fine aggregate, air-entraining agent and curing compound.
2. Submit samples of non-approved materials to the Central Testing Laboratory in sufficient time before use to allow time to receive results. The size and frequency of samples are provided in the "*Materials Sampling Guide*".
3. Materials for which approval has not been received must not be used in the work.

The inspector is concerned not only with the approval of materials but also with the storage of materials. Bag cement shall be stored in a dry location. If stacked more than 8 bags high for a period of time the lower layers take on a "warehouse set" and should not be used. Cement stored over 90 days must be retested before use.

706.03 CONSTRUCTION METHODS

Use of Ready Mixed Structural Concrete

Prepour Meeting

It is very important to use the prepour meeting to discuss the specifics of placement, establish communication, and resolve potential "sticky" issues prior to placement. Generally it is recommended to discuss:

- Chain-of-command. Who is in charge for the contractor? Who needs to be notified if material tests do not comply with specifications? Establish prior to placement how test

- F. If there is a specific truck which is identified as causing a problem with consistency, that truck shall be rejected from further use.
- G. Transit mixers shall be completely emptied of wash water before reloading. If the truck's top fill hopper is washed after loading, no wash water shall be allowed to enter the mixer.
- H. The inspectors will need to satisfy themselves regarding compliance with the specifications for the number of drum revolutions at mixing speed.
- I. If water, air entrainment or other admixtures are added at the project site, acceptance testing will not be performed until all additions have been made AND required mixing has been completed following the change.

Admixtures

Admixtures are those ingredients in concrete other than portland cement, water, and aggregates, that are added to the mixture immediately before or during mixing. Admixtures typically encountered on our jobs can be classified by function as follows:

- Air entraining admixtures
- Water reducing admixtures
- Set retarding admixtures
- Set accelerating admixtures
- Finely divided and permeability mineral admixtures (Fly Ash & Silica Fume)
- Coloring agents (normally not used for NDR work)

@ The amount of any admixture used in a mix should be as recommended by the manufacturer. Effectiveness of an admixture depends upon such factors as type, brand, and amount of cement; water content; aggregate shape; gradation and proportions; mixing time; slump; and temperatures of concrete and air.

Concrete with a low air content shall not be incorporated into work. One addition of air entraining admixture is allowed at the site according to specification.

Concrete with a high air content should not be incorporated into work except under extreme circumstances. If low compressive strengths result, the concrete may be required to be removed and replaced. (*SSHC Subsection 106.05*)

Air Entraining Admixtures

Air entraining admixtures are used to purposely entrain microscopic air bubbles in concrete. Air entrainment will dramatically improve the durability of concrete exposed to moisture during cycles of freezing and thawing. Entrained air greatly improves concrete's resistance to surface scaling caused by chemical deicers.

Rules-of-Thumb

- As cement content increases, air agent must increase to maintain equal entrained air.
- As cement fineness increases, the amount of air agent must increase to maintain equal entrained air.
- As coarse aggregate size decreases, the air content increases for a given amount of air agent.
- As fine aggregate volume increases, the air content increases for a given amount of air agent.
- As mixing water increases, the air content increases for a given amount of air agent.
- Air entraining admixtures should be introduced into mix at the plant, but additional may be added at the site to adjust mix for correct air content.
- Air entraining admixtures should (usually) be added to the front of the truck at the plant. If corrosion inhibiting admixture is used, air entraining agents should be added to the back of the truck.

Water Reducing Admixtures (Type A)

Water reducing admixtures are used to reduce the quantity of mixing water required to produce concrete of a certain slump or reduce the water/cement ratio. Regular water reducers reduce water content by about 5% to 10%.

Adding a water reducing admixture to a mix without reducing water content can produce a mixture with a much higher slump.

Rules-of-Thumb

- Typically, water reducing admixtures do not reduce the rate of slump loss; in most cases, it is increased. Rapid slump loss results in reduced workability and less time to place concrete at the higher slump.
- Typically, water reducing admixtures have no effect on bleed water.
- Certain types of sulfate starved portland cements may cause false set with certain brands of water reducers. Typically, water reducers contain lignosulfonates and these sulfates are easily attracted by sulfate starved cements. This action may cause early false set.
- Despite reduction in water content, water reducing admixtures can cause a significant increase in drying shrinkage.

Rules-of-Thumb

- Retarders are sometimes used to delay initial set of concrete when difficult, long placement times, or unusual placement conditions exist.
- Retarders offset the set acceleration effect of hot weather.
- Retarders can be added at the site.
- In general, some reduction in strength at early ages (one to two days) accompanies the use of retarders.
- Use of retarders must be closely monitored, because there is probably no single admixture which has caused more field problems.
- If too much retarder has been used in a mix:
 1. Time will usually counter the effects.
 2. "Be sure" to maintain the cure during the added time.

Accelerating Admixtures

Accelerating admixtures (accelerators) are used to accelerate the setting time and strength development of concrete at an early age. Strength development can also be accelerated by using:

- Type III "high-early" cement
- Lowering water/cement ratio
- Curing at controlled higher temperatures

Calcium Chloride (CaCl_2) is the material most commonly used in accelerating admixtures. Besides accelerating strength gain, calcium chloride also causes an increase in drying shrinkage, potential reinforcement corrosion, discoloration, and potential scaling.

Rules-of-Thumb

- Always add calcium chloride in solution form as part of the mixing water.
- Calcium chloride is not an antifreeze agent. When used in allowable amounts, it will only reduce the freezing point of concrete by a few degrees.

Finely Divided Mineral Admixtures

These admixtures are powdered or pulverized materials added to concrete to improve or change the properties (plastic or hardened) of concrete. Based on the mineral's chemical or physical properties, they are classified as: (1) Cementitious, (2) Pozzolans, (3) Pozzolanic and Cementitious, and (4) Nominally inert. Typical PCC mix designs use pozzolanic and cementitious minerals.

NOTE:

1. No payment will be made for methods taken to keep concrete temperatures within specifications.
 2. If pour has to be delayed because of temperature, and pouring is the controlling operation, no working days will be charged.
- @ B. Location of permissible headers should be discussed with the contractor. If during the pour, it appears the temperature may exceed 30°C (85°F).

General - The wind velocity temperature relationships stated in the specifications should be enforced to avoid loss of water from the concrete surface faster than it can be replaced by normal bleeding and to avoid the resultant formation of plastic shrinkage cracks. Anemometers and thermometers must be available on site to measure wind velocity and temperature.

Concrete in bridge floors shall be placed uniformly on both sides of the centerline and shall be placed continuously between specified joints. The sequence of placing shall be in accordance with the pouring diagram shown in the plans. If no pouring diagram is shown in the plans, concrete shall be placed as directed by the Project Manager.

The deck forms shall be dry before placing the concrete. Concrete shall be adequately vibrated to encase the lower bars of the reinforcing mat where these are near the deck form.

Special attention shall be given to finishing the riding surface on the bridge floors. Specifications Section 706.03, 710.03, and 711.03 explains concrete bridge floor finish.

It has been the policy to permit the contractor to use mechanical finishing machines of an approved type whether or not they are required by the plans or special provisions.

Method of Finish - When the hand method described in Section 704 is employed, the concrete surface shall be struck off with a strike board which conforms to the cross section shown in the plans. If this is pulled by hand, care shall be taken not to displace the reinforcing steel by the workmen doing the pulling. A small air winch anchored to a girder outside of the day's pour will pull the strike off at a slow, uniform rate, giving a truer surface with no displacement of the reinforcing steel. The strike board shall be operated with a combined longitudinal and transverse motion, always carrying a small roll of concrete in front of the cutting edge. The strike off shall be pulled a sufficient number of times to properly distribute the concrete. A longitudinal float generally is required and is described in *SSHC Section 704*. The longitudinal float shall be lapped 1/2 its length when moved to a new position and shall be operated across the surface a sufficient number of times to produce a uniform, smooth riding surface. Occasionally during the finishing operation, conditions may require the use of the long-handled transverse float, which require extreme care in its use to preserve the desired cross-section and a smooth riding surface.

Regardless of whether hand 3m (10 foot) machine finishing methods are used, the floor surface shall be tested for trueness with a straightedge. The bridge contractor is required to furnish a 3 m master straightedge for use in trueing and checking the working straightedges.

- Check discharge for potential segregation problems.
- In adverse weather (hot and/or windy conditions), long belt runs need to be covered.

Pump Placement

The modern mobile pump with hydraulic placing boom is economical to use in placing both large and small quantities of concrete. These units are used to convey concrete directly from a truck unloading point to the concrete placement area.

Points-to-Watch For

- Typically, pumps are initially flushed with a thin water/cement paste mixture to coat the lines. This slurry must be wasted and the lines charged with the project mix before beginning. Observe, and be sure initial pump charge is thoroughly removed from the pipelines.
- Always pump at a constant rate and keep pipelines full of concrete. High air loss can occur when concrete is allowed to free-fall inside pump lines.
- Avoid, if at all possible, having steep angles in the pump pipelines. Steep angles and slow placement rates are probably the worst conditions for minimizing air loss and segregation. If this condition occurs:
 1. Attempt to relocate the pumper, thereby minimizing lift angle.
 2. If discharge is not maintaining a constant flow with the partial concrete head in the pipe, request the pump operator to place a reducer and short section of hose at the discharge end. The purpose is to avoid free falling concrete from impacting the deck or forms at high velocity.
 3. If the above condition is unavoidable, watch and test the discharge frequently for loss in air and potential segregation.

Rule-of-Thumb for Pumping

- Pump concrete with pipelines as flat as possible (or at least with minimal down angle).
- Minimize (or eliminate) free falling concrete in the pipelines. To do this, maintain some amount of concrete head in the pipelines.
- Pump concrete through as few elbows and restrictions as possible.
- Pump concrete at "some" constant rate.
- @ • Watch for, and test the air content frequently, when ~~situations are not optimized~~ drop may exceed 5 feet.

4. Placement of 0.6 m (2 ft) of flowable mortar.

Joints (*SSHC Subsection 704.03*)

The location and dimensions for construction joints will generally be shown on the plans.

In cases where the pour is larger than can be accomplished at one time, or for some other reason it is necessary to make a construction joint not shown on the plans, approval should come from the Construction Engineer.

When an emergency arises, construction joints shall be placed as directed by the Project Manager. If there is some doubt as to the proper location of the joint, the District Construction Engineer should be contacted.

Construction joints shall be paid for as outlined in SSHC 704.04.

Where it is necessary to transfer shear, shear keys or inclined reinforcement shall be used. It should be pointed out that in practically all cases, shear transfer is essential and therefore shear keys or inclined reinforcement will usually be required. When inclined reinforcement is used as a means of shear transfer No. 5 bars at 300 mm (1 foot) centers should be considered a minimum. The angle of inclination should be approximately 15 degrees (~~60°~~) from the direction of shear and the length of bar should be at least 685 mm (2'-3") in order that 20 bar diameters can be placed in both sections of the pour.

@

Shear keys should be formed with beveled strips or boards at right angles to the direction of shear. Typical dimensions for a shear key are shown in the following sketch.

A. Inspection Checklist

Neoprene cellular joints, if properly installed, provide a leak-proof joint capable of functioning within expansion limits of the bridge. To insure that a joint will function properly, there are a number of precautions that should be noted regarding the installation of this type of joint. Precautions:

1. A neoprene seal can be placed in two positions, one correct and one incorrect. Make sure that the seal is not installed upside down or sideways.
2. Position of the 13 x 6 mm (1/2 x 1/4 inch) keeper bars on vertical face of the expansion plate angles has to be consistent with the recommendations of the manufacturer of the neoprene seal. The depth that a seal is set varies greatly with the different manufacturers.
3. The neoprene seal has to be installed so bottom of the seal touches top of the 13 x 6 mm (1/2 x 1/4 inch) keeper bars, but should not be forced past the keeper bars.
4. Make sure expansion opening between angles of the expansion device are consistent with the expansion setting shown on design plans and that the same expansion opening is maintained from gutter to gutter.
5. The neoprene seal must project beyond the outside edge of slab as shown on the plans.

B. Summary

When uncertain as to which side of the seal is top, or when the position of keeper bars is in question, the contractor must be required to submit drawings prepared by the manufacturer which indicate correct position of installation.

@

Curing Concrete

The structure inspector should give careful attention to the curing, since proper curing is essential to good quality concrete. It is important, that when a "wet" burlap cure is employed, the burlap be kept wet to insure proper curing. This is particularly important when weather conditions such as wind, temperature, and humidity make it especially difficult to keep the burlap wet.

The Specifications require that bridge decks be cured by the application of any one of three different liquid curing compounds, which is followed by covering with either burlap or a plastic cover. The inspector is cautioned that windy conditions make the application of the plastic cover difficult and extra effort may be required of the contractor to securely anchor these covers.

Concreting in Cold Weather (*SSHC Subsections 704.03 and 1002.02*)

As colder weather approaches each fall, the Department experiences a series of problems connected with concrete construction in cold weather. The first indication of the problem usually shows up as a low test result on a 7 day cylinder. At that stage, it is not known if the problem is an improperly fabricated cylinder. A cylinder which has been exposed to colder

conditions than the structure, or if the low strength actually represents the concrete in the structure. Sometimes the later cylinder tests show satisfactory results, but in other cases, low strengths are found in these tests also. In some cases, definite information regarding the true condition of the concrete in the structure can only be obtained by coring the material and carrying out a series of special tests.

Troubles and expense of this sort could virtually be eliminated by careful and detailed inspection by project personnel during construction and proper handling of test cylinders.

Missed Texturing

There will be times, due to various reasons, when texturing will have to be omitted from a pour. One such event could be when inclement weather catches a pour and covering prevents texturing. Obviously this condition is **NOT** desirable.

After full cure time has expired, grind in the required texture.

Approach Sections

Bridge Approach Tapers

On deck overlay construction, normally some treatment of the approach is necessary and will be indicated on the plans. Watch the contract documents for bid items for ACC material. For projects where asphalt tapers are proposed and no quantity for ACC is given, an extra work order will be required.

Shoulder Maintenance

When temporary concrete barrier rails are used on deck repair and overlay jobs, traffic is constricted into a narrower lane. This in turn could cause a rapid deterioration of shoulders at bridge approaches and require the following corrective measures:

- @ A. Ruts developing in earth and granular shoulders should be ~~maintained~~ repaired as necessary with a granular surfacing material. This is extra work order and a change order will be issued for this work.

- @ B. Ruts and loss of asphaltic cement concrete surfacing on Interstate shoulders should be ~~maintained~~ repaired using an asphalt cement concrete pre-mix, hot mix, or some similar treatment to minimize the development of holes or ruts. A change order may be needed for this work unless there is an ACC contract item for shoulder maintenance and even then it may have to be extended.

- C. When shoulder strengthening was not included as a bid item, but is needed for the project, the change order must consider:
 - 1. Present shoulder construction and experience with shoulder stability in the immediate area.
 - 2. Traffic volumes, percent of trucks, and duration of potential problem.

707.00 BRIDGE DECKS AND OVERLAYS (SSHC Sections 710 and 711)**707.01 DESCRIPTION**

The concrete bridge floor is the wearing surface of the bridge superstructure and is commonly referred to as the bridge "deck". This work consists of forming, reinforcing, and placing concrete to the lines, grades, and typical cross sections shown in the plans.

707.02 MATERIAL REQUIREMENTS**Concrete****Concrete Mobile Mixers (used mainly with High Density-Low Slump Concrete)**

Continuous concrete mobile mixers are equipped with a recording water meter, as well as a cement meter - register. It is possible to determine, within a reasonable degree of accuracy, the water/cement ratio of the concrete mix. Since moisture tests to determine the water in the aggregates are not routinely performed, a precise water/cement ratio cannot be made. It will provide relative data with regard to the mix that has not been obtainable.

Data from bridge deck repair projects of the last several seasons have been reviewed. The evaluation indicates that the actual water/cement ratios are very close to the design, or intended, water/cement ratio. Therefore, no maximum or limiting water/cement ratio specification for the low slump, bridge repair concrete is recommended. The water/cement ratio of low slump concrete need not be determined for bridge overlay surface courses. The witnessing and documentation of the dilution procedure of the air and water reducing admixtures must be observed.

Existing specifications presently allow a mobile concrete mixer to be used for certain structural concrete repair, if part of a bridge deck repair project. For these, and any other concrete construction for which the Project Manager might authorize this equipment a water/cement ratio limit is specified. Thus, the water/cement ratio must be checked, and documented, for compliance when low-slump concrete is not being produced.

Frequency of Checks

- @ Concrete mobile mixers have cement and water meters that are continuously recording, and a water/cement ratio check may be made at any interval, e.g. hourly, half days, or at the end of a placement. A minimum of one check per day's placement should be made and documented.

Density Testing

Durable, low maintenance bridge decks require impermeable (very dense) concrete. Therefore, checking density during placement is an essential part of deck surfacing and overlay inspection. Test frequencies for determining the density of bridge deck surfacing and overlays are listed in *SSHC Subsection 711.04*. A test should be taken at 1.5 m (5 ft), 3 m (10 ft), 4.5 m (15 ft), and every 15 m (50 ft) thereafter per placement width per bridge. Density tests will not be required for overlaying approach paving areas.

It is always desirable to take more than the minimum nuclear density tests per length of overlay placed. If densities are at or near the lower specification limits, additional testing will need to be performed.

Vibrating Mix at Test Well Location

On some projects, contractors have been vibrating the concrete mix in the test well with a hand-held vibrator prior to passage of the finishing machine. This practice will not be permitted.

If the oscillating screed vibrators are functioning properly, complying density of the concrete mix in the test well will be obtained without any difficulty. Obtaining required density at test well locations, without supplemental vibration, assures us that the contractors' equipment and placement procedures are capable of producing the desired results throughout the overlay being placed.

Density Test Wells on Bridge Deck Repair Projects

Follow guidelines in *SSHC Subsection 7110.04, para. 7.b.*

707.03 CONSTRUCTION METHODS

General - The wind velocity-temperature relationships stated in the specifications should be enforced to avoid loss of water from the concrete surface faster than it can be replaced by normal bleeding and to avoid the resultant formation of plastic shrinkage cracks. Anemometers and thermometers must be available on site to measure wind velocity and temperature.

@ Concrete in bridge floors shall be placed uniformly on both sides of the centerline and shall be placed continuously between specified joints. The sequence of placing shall be in accordance with the pouring diagram shown in the plans. If no pouring diagram is shown in the plans, concrete shall be placed as directed d by the Project Manager.

The deck forms shall be dry when using HD-LS but must be wet when using silica fume concrete before placing the concrete. Concrete shall be adequately vibrated to encase the lower bars of the reinforcing mat where these are near the deck form.

Special attention shall be given to finishing the riding surface on the bridge floors. Specifications Sections 706.03, 710.03, and 711.03 explains concrete bridge floor finish.

It has been the policy to permit the contractor to use mechanical finishing machines of an approved type whether or not they are required by the plans or special provisions.

Method of Finish - When the hand method described in Section 704 is employed, the concrete surface shall be struck off with a strike board which conforms to the cross section shown in the plans. If this is pulled by hand, care shall be taken not to displace the reinforcing steel by the workmen doing the pulling. A small air winch anchored to a girder outside of the day's pour will pull the strike off at a slow, uniform rate, giving a truer surface with no displacement of the reinforcing steel. The strike board shall be operated with a combined longitudinal and transverse motion, always carrying a small roll of concrete in front of the cutting edge. The strike off shall be pulled a sufficient number of times to properly distribute the concrete. A longitudinal float generally is required and is described in

- The temperature of concrete from previous placements could be taken.
- If a ready mix producer is placing concrete the day before a deck placement, this concrete could be checked for concrete temperature.

Regardless of the method used, make the best estimate of what the concrete temperature will be, probably during the warmest part of the day and go with it. Remember, concrete shall not be placed in new decks if the concrete temperature is above 30°C (85°F).

Use of Finishing Machine (*SSHC Subsections 710.03 and 711.03*)

The finishing machine shall be approved before use. Care must be taken to adjust the screeds to proper crown. Support rails must extend beyond the bridge at both ends at proper grade and sufficient distance to accommodate the machine. This permits finishing to begin promptly at the start of the run and also permits the required straightening to proceed on schedule at the end of the run.

Straightedging

Following the finishing machine, straightedging should be completed to check for longitudinal smoothness. Straightedges, 3 m (10 ft) in length, need to be operated parallel to centerline of roadway. Each pass should overlap the previous one by a half length. If bull-floating (mopping) is needed to close up the surface, it should always be followed by straightedging.

Tining (Transverse Grooving)

@ After straightedging, and as soon as practical following finishing, the entire traffic surface, except areas within approximately 600 mm (2 ft) from the curbs, shall be given a suitable tining with corrugated bull float.

@ Tine all bridge decks where posted speed limit will be 40 mph or greater, except for county road bridges 30 m (100 feet) or less in length that have gravel approaches and no plans exist for future hard surfacing.

On bridge decks, stop the tining 600 mm (2 ft) from the face of the bridge curb.

Do not overlap the grooving.

Retarders

SSHC Subsections 710.01 and 711.01 prescribes how to use admixtures.

Adequate Labor Force

At preplacement meetings talk about and, before starting a placement be sure the contractor has:

- Proper and adequate materials to protect the placement.
- Adequate numbers of sufficiently skilled laborers available.
- Proper tools on the job.
- Arranged for the rate of delivery of concrete to make the placement operation efficient.

- @ If above conditions are not acceptable to the contractor, a *an additional* 36-hour cure time will be required as per *SSHC Subsection 711.04*.

Placing Concrete and Form Removal

Placing Concrete

- @ Placing Concrete in Walls and Top Slab. *SSHC Subsection 704.03* states that culverts, sidewalls, and top of slab may be constructed as:

- A monolith unit or,
- Concrete in sidewalls may be placed and allowed to harden before the top slab is placed.

If the contractor chooses to use the hardened concrete method, keyways will have to be installed to anchor the cover slab.

Removal of Wall Forms

On large culvert jobs, it is a distinct advantage for the contractor to remove wall forms before the top slab has attained sufficient age to remove supporting forms. This will be permitted under the following conditions:

- Vertical forms may be removed as provided in *SSHC Subsection 704.03*.
- Slab forms must be supported independently of the wall forms.
- Vertical supports for the slab forms must be capped with timbers. Longitudinal spacing of supports with 100 x 150 mm (4x6 inch) caps on edge should not exceed 1.4 m (4.5 ft). With 100 x 200 mm (4x8 inch) caps, spacing should not exceed 1.8 m (6 ft). Rows of supports must not be over 1.2 m (4 ft) apart. There must be at least two rows of support, with the outside rows not more than 0.6 m (2 ft) from walls. Variance from the above suggested spacing should be reviewed by the Project Manager.
- Vertical posts shall not be smaller than 100 x 100 mm (4x4 inches), but may be built up of two 50 x 100 mm (2x4 inches) pieces of lumber. Lateral bracing will be required. A vertical clearance of 6 mm (1/4 inch) must be provided between the wall form studs and the slab form joists.

NOTE: Lumber may be sized in metrics using actual, not the conventional nominal sizes.

- The slab form must remain in place as provided in *SSHC Subsection 704.03*.
- The interior walls of the culvert must be coated with white pigmented curing compound as provided in *SSHC Subsection 704.03*.

The wing walls and exterior surfaces of the barrel may be cured by any method specified in *SSHC Subsection 704.03*.

Smoothness of Bridge Decks

Checklist

The following items should be checked and procedures followed prior to, during, and after the overlay is placed to insure a smooth riding deck surface:

- Guide rails are used to support and guide the finishing machine. Check for rail deflection during passage of finish machine. any vertical or horizontal movement could compromise smoothness and rideability. Request that the contractor readjust anchor legs and/or tie-downs.
- Check that all propulsion and control equipment are fully operational prior to placing concrete. The contractor shall traverse the finishing machine over the entire length of section to be placed. This not only serves to verify that equipment and control systems are functioning properly, but also provides a check to assure that screeds are adjusted for proper crown and height above existing surface.
- Sufficient materials (water, cement aggregate, and admixtures) are available on site to complete the intended placement in a continuous operation.
- @ • The contractor may have to limit size of placement or provide additional mixers (HD-L5 S only).
 1. If a mobile mixer is not large enough to provide adequate volume for the placement, or
 2. If there is no provision for recharging.
- Ensure that adequate number of vehicles are available at the work site to transport mix from mixer to the placement area at a volume necessary to provide a uniform rate of forward progress. Any equipment working on the deck should be checked for oil and hydraulic fluid leaks.
- Contractor must provide sufficient, trained personnel to carry out the various phases of deck placement. Timeliness is of utmost importance during placement operations. Be sure specialized crafts, such as finishers, are adequately represented and preferably have only one task during the placement.
- Check concrete for smoothness with the 3 m (10 ft) straightedge. The straightedge should be placed on the surface from a vertical position, not pushed over the surface. Irregularities can be detected by comparing deck surface with a straightedge. Irregularities noted at this time should be corrected.

Surface Checking (Not in Spec)

A 3 m (10 ft) straightedge surface check shall be conducted on all bridges and deck overlays not covered by the Smoothness Specification. Surface areas inaccessible to profilometer shall also be checked.

On some projects only one wheel path may be included in the placement width. For price adjustment or incentive pay, only the portion within the traveled lane shall apply. Variable width sections for on and off ramps, which are outside the through traveled lane, will be checked with the surface checker.

Test Procedure for Smoothness

@ A Special Provision entitled "Bridge Deck and Approach Slab Smoothness" will usually be included in the contract proposal. This Provision deals with the method of testing for smoothness and the method for correcting surfaces outside of the smoothness limits. The contractor is responsible for scheduling the testing, which will be performed by Materials and Tests Division personnel. The contractor must give the Project Manager seven days notice prior to the date he requests that testing be done. The Project Manager shall contact the Materials and Tests Division and arrange for testing on the requested date.

Evaluation

Materials and Tests Division will furnish a profile index to the contractor within 72 hours of the completion of the tests.

Surface Correction

Corrective work shall be done in the presence of the Engineer with a diamond bladed grinder at least one meter wide. Grinding residue must be controlled. After the deck is ground, a second test will be made to determine if the deck now meets the smoothness requirements. This second test will also be performed by Materials and Tests Personnel and it is anticipated they will be on-site at the time of grinding, in order that they may perform the retest while the grinding equipment is on-site.

Acceptance

Materials and Tests personnel will notify the Project Manager whether or not the corrective work has resulted in an acceptable deck surface. If grinding cannot correct the surface profile, the Specification requires removal and an overlay with high-density low slump concrete.

708.00 HAND RAILS (SSHC Section 716)

708.01 DESCRIPTION

This work shall consist of furnishing and erecting all steel or ornamental handrail and all miscellaneous hardware such as anchor bolts, capacity plates, and splices.

- County bridges usually only get one coat.
- New state structures usually get two coats.
- Repainting an existing structure usually means adding a third coat.

The Project Manager or inspector should check the dry film thickness of the shop and field coats of paint applied on structural steel in accordance with the following instructions:

Shop Coat - The shop coat of paint may or may not have been checked in the fabricator's shop; nevertheless the shop coat should always be checked in the field, and any deficiency in paint film thickness corrected, before the second coat is started. When the dry film thickness of the shop coat is found to be inadequate, the Materials and Tests Engineer should be notified in order that the particular fabricator involved may be made aware of the situation.

@ Second and Third Coats - Checking the thickness of the second and third coat with the magnetic gauge is accomplished by measuring the cumulative thickness of the first coat (or shop coat) and the additional coats. The dry film thickness of the second coat should always be checked and any deficiency in paint film thickness corrected before the third coat is started. Any deficiency in paint film thickness must be corrected before the work can be considered complete and consideration of acceptance given.

The equipment used to check the dry film paint thickness is called a magnetic dry film thickness gauge. One or two of these gauges are being furnished to each District Office for use in the District in checking the painting of steel structures. These gauges are expensive, delicate instruments and must be carefully handled and always kept in the carrying case when not in use. The procedure for using the gauge is as follows:

1. Turn dial to maximum reading.
2. Place pole on the surface to be measured.
3. Be sure the magnetic contact is touching the painted surface.
4. Slowly and as continuously as possible, rotate the dial clockwise until magnetic contact breaks. A click will be heard when the pin breaks contact. At this point the coating thickness can be read on the dial indicator. The reading will remain on the dial when the gauge is removed from the surface being checked. The gauge can also be held in any position to take a reading. The magnetic gauge reads directly in mils. A reading of 2 on the dial indicates that the thickness of the paint film is 2 mils or .002 inch.

The frequency of testing for paint thickness should be as follows:

1. Girders - Each line of girders should be checked at a maximum interval of 15 m (200 ft) and at each check point, 3 or 4 tests should be made. For example, on a 60 m (50 ft) bridge each line of girders should be checked at the abutments and at 3 intermediate points. At each one of these points three or four places should be checked such as a point on the web, a point on each flange, and a point on a stiffener.

711.00 CONCRETE PIPE CULVERTS (*SSHC Section 720*)

711.01 DESCRIPTION

This work shall consist of furnishing and installing new reinforced concrete culvert pipe (round, pipe-arch and elliptical), reinforced concrete slotted pipe and the relaying of existing reinforced concrete pipe.

711.02 MATERIAL REQUIREMENTS

Each section of pipe used should be marked with the fabrication inspector's initial and the class of pipe, when it arrives at the site. The culvert inspector should not permit the laying of any section that does not have these markings. The project manager will receive a copy of the "Report of Shipment of Reinforced Concrete Pipe" (Form DR-420), listing the size, class, length, number of sections of pipe, the inspector's identification mark and stock report number. The inspector will use the information contained in this report to verify approval of reinforced concrete pipe received on the project. The diameter, class, length, number of sections and the pipe identification number shall be recorded in the culvert notebook. Each section of pipe should be examined for damaged ends, cracks and evidence of poor manufacture. All irregularities should be referred to the Project Manager before using of the pipe.

Ordering Material

- The contractor is **not permitted to order or deliver** culvert pipe until a "culvert list" listing the correct sizes and lengths of pipe is furnished by the Project Manager. See Subsection 105 of this manual for detailed instructions on the field checking of culverts and the preparation and submission of the culvert list.

@

- ~~The Project Manager will not furnish a pipe list for driveway and storm sewer requirements.~~

711.03 CONSTRUCTION METHODS

Excavation and Backfilling

See Section 702 of this manual.

Installation

Begin laying concrete pipe at the downstream end of the culvert with the groove or bell portion of each section upstream.

Irrigation culverts shall be constructed of concrete pipe and must have approved gaskets at the joints. These gaskets shall be installed as per the manufacturer's recommendations and standards.

712.00 CORRUGATED METAL PIPE CULVERTS (SSHC Section 719)

712.01 DESCRIPTION

This work shall consist of furnishing and installing new corrugated galvanized metal pipes and pipe arches and the relaying of existing corrugated metal pipe and pipe arches.

712.02 MATERIAL REQUIREMENTS

SSHC Tables 1035.01 & 1036.01 contain the required minimum gage or sheet thickness for the various pipe diameters. The "Materials and Sampling Guide" provides that the necessary tests for acceptance will be handled by the Materials and Tests Division. Material samples need not be taken by project personnel unless a special request is made for samples. The diameter of the pipe and number of sections of pipe covered by each heat number and delivered to each culvert location should be recorded in the culvert notebook. The pipe shipment should be checked against the shipment report and any discrepancy should be reported to the Project Manager. The pipe shipment should also be checked for shipping damage and any damage noted should also be reported to the Project Manager.

Ordering Material

The contractor is not permitted to order or deliver corrugated metal pipe or pipe arches until a "culvert list" listing the correct sizes and lengths of pipe is furnished to him/her by the Project Manager. Subsection 105 of this manual for detailed instructions on the field checking of culverts and the preparation and submission of the culvert list.

@

~~Project Manager will not furnish a pipe list for driveways and storm sewer requirements.~~

712.03 CONSTRUCTION METHODS

Excavating and Backfilling

Refer to Section 702 of this manual.

Installation

The culvert inspector should insist of careful handling of the corrugated metal pipes or pipe arches. Corrugated metal pipes or pipe arches should be lifted and moved with a rope sling or similar device which will not damage the galvanized surfaces of the pipes or pipe arches. The contractor should not be allowed to drag the pipes or pipe arches over abrasive surfaces as this will also damage the galvanized surfaces.

Corrugated metal pipes and pipe arches shall be laid with the inside circumferential laps lapped downstream so that the water will flow over the lap. The pipe shall be rotated so that the longitudinal laps are horizontal. When joining sections of pipe, the connecting bands should be pulled up as tight as possible. The band should be tapped with a wooden mallet as the bolts are tightened. Excessive pressure on the bolts should be avoided to keep from pulling the steel angle loose from the band. A gap of about 25mm (1 inch) should be allowed between the pipe ends being joined, to allow the corrugations on the pipe and band to match. Corrugated metal pipe is not generally used for irrigation structures.

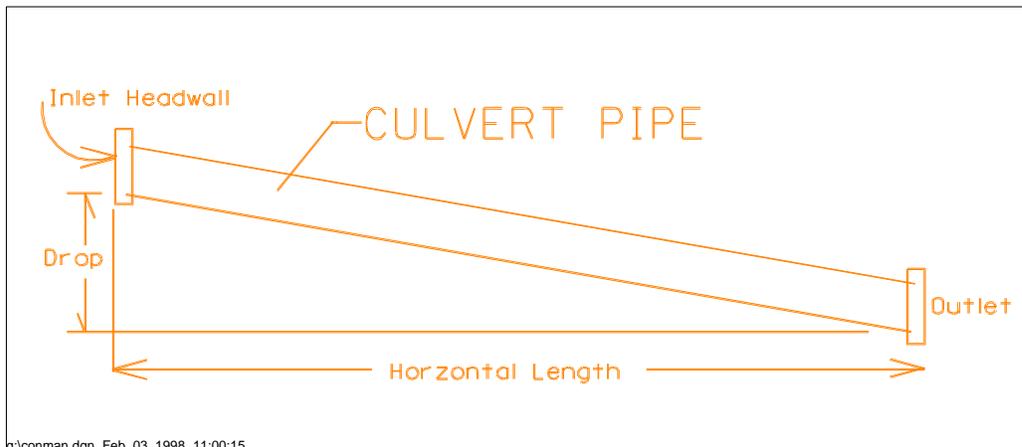
713.00 CULVERT PIPE (SSHC Section 718)

713.01 DESCRIPTION

This work shall consist of furnishing and installing culvert pipe. The contractor has the option to furnish any of the types of culvert pipe listed in the specifications.

713.02 CONSTRUCTION METHODS

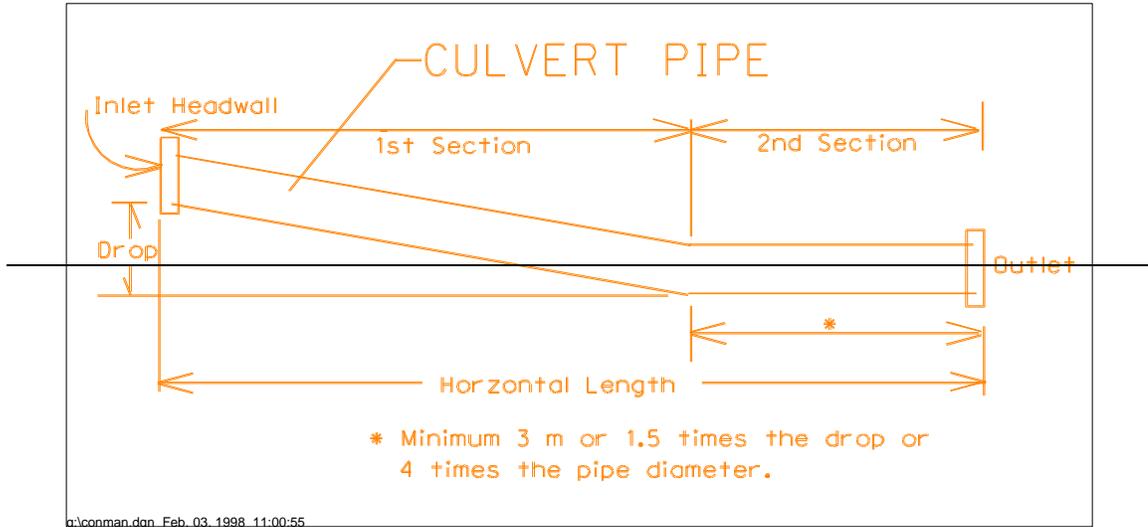
The contractor is not permitted to order or deliver culvert pipe until a "culvert list" listing the correct sizes and lengths of pipe is furnished to him/her by the Project Manager.



Straight Pipe

@ ~~When drop divided by horizontal length falls on or between the minimum and maximum values shown in the table "Slope Data for Culvert Pipes", use a straight pipe.~~

@



Broken-Back Pipe

When drop divided by horizontal length is greater than the maximum value shown in the table "Slope Data for Culvert Pipes", use a broken back culvert in two sections with the second section level and not less than 10', 1.5 times the drop or 40 in length.

Slope Data for Culvert Pipes		
Pipe Diameter in Inches	Drop in Elevation from Inlet to Outlet of Culvert Divided by Horizontal Length	
	Minimum	Maximum
18	0.030	0.090
24	0.020	0.060
30	0.015	0.045
36	0.012	0.036
42	0.010	0.030
48	0.008	0.024
54	0.007	0.021
60	0.006	0.018
66	0.005	0.015
72	0.0045	0.0135
78	0.004	0.012
84	0.0035	0.0105

809.00 SILT FENCING

The purpose of silt fence is to filter the soil from the runoff from our projects. Most of the time most of the silt will be left on our side of the fence. We may not catch all of the silt, but we can catch a large portion of it.

1. Q. - When do I have the silt fence installed?

@ A. - Before any soil is ~~distributed~~ disturbed on the project.

2. Q. - But the silt fence is in the way of construction.

A. - Adjust the installation to fit the situation or adjust the location.

3. Q. - When do I have the silt fence installed around an area inlet?

A. - As soon as there is something for the water to run into - even before the grate is set.

4. Q. - The silt fence is to be placed where no water will ever reach it.

A. - Take the fence to the water.

5. Q. - I took the fence to the water, but have lots of it we cannot use.

A. - Take it off the contractor's hands in the usual method. (Material furnished but not used on project -- CO/SA.)

6. Q. - There is no silt fence on this project and I can see the need for it.

A. - Change Order.

7. Q. - The high porosity silt fence is allowing too many fine's to pass.

A. - Install a low porosity fence on the downstream side of the high porosity silt fence.

8. Q. - There is no room on the downstream side of the silt fence.

A. - Use a low profile, either low or high porosity silt fence, on the upstream side.

9. Q. - The contractor tore holes in the silt fence when he/she cleaned it out.

A. - Repair work is on the contractor and is to be done immediately. Silt fence clean out is paid as equipment rental items. Make sure the equipment is capable of doing the work. A backhoe works usually but may require a CO/SA to add to the contract.

Lapping of Guardrail

Lapping of rail must be accomplished in a uniform manner. Details shown in the plans will achieve uniformity statewide. However, clarification may be helpful in obtaining this uniformity in specific instances.

Standard road plans indicate guardrail shall normally be lapped in direction of traffic flow. Following this general rule, most installations will be lapped correctly. Standard road plans provide a lapping procedure detail for each type of guardrail installation except:

- On long guardrail installations involving more than one hazard such as a combination of bridges, culverts, high fills, sign truss footings, etc., lap should protect near traffic from being speared by an end of a section of guardrail.
- Where guardrail alignment is curved away from centerline (bridge ends or end sections), lap should protect approach vehicles.

Keep in mind that the basic principle of lapping has to do with favoring the traffic for which the guardrail is being installed.

All laps of rail shall take place at a post. The 16 mm (5/8 inch) x 32 mm (1 ¼ inch) splice bolts at these laps should not have washers.

END ANCHORAGE

@ To insure that concrete does not become attached to bottom and sides of breakaway end anchorage post a small amount 25 or 50 mm (1 or 2 inch) of soil may be tamped around post bottom or bottom 150 mm (6 inch) of post may be wrapped with expanded polystyrene foam sheets in place as shown on the plans. If steel tubes are used, grease the bottom 300 mm (12 inches) of the wood post (inside of the sleeve generously). This is done so that it would be easy to remove the damaged ones.

Soil removed from all end anchorage holes should be disposed of away from the hole to insure proper installation height.

To remove post a small quantity of diesel fuel can be poured on expanded polystyrene foam. This will dissolve foam for easy removal.

SRT, MELT, and BCT are gating terminals. ET2000, and BEST are energy absorbing terminals.

BRIDGE CONNECTIONS

Bridge approach section type CD terminal section shall be installed under rail so a vehicle cannot be snagged by the end section. Exception to this is on trailing end of a one-way bridge where Type "J" terminal section shall be installed on outside of rail.

On guardrail attachments to concrete which require a bolt longer than 600 mm (2 ft), 22 mm (7/8 inch) bolt anchors may be grouted into concrete using threaded insert anchors with epoxy.

1002.00 APPROVED PRODUCTS LIST

1002.01 DESCRIPTION

Many material items are not described in detail in the plans and specifications but are authorized for use as shown on the NDR Approved Products List. The NDR Approved Products List is on file on the mainframe computer and is updated when a new product is added to the list or when a product is dropped from the list.

1002.02 ACCESS COMMANDS

The Approved Products List can be accessed from any mainframe terminal. After logging on and getting the "READY" prompt, type "YCCHP" and then press the enter key. This will bring up a screen with the following heading:

State of Nebraska
Department of Roads
Concrete Curing Compounds and Hot Pour Joint Sealers

Below the heading, one of the following three options can be selected:

1. Curing Compound
2. Hot Pour Joint Sealer
3. Approved Products List

@ Type "3" and press the "enter" key to bring up the beginning of the Approved Products List. Use the "enter" key to scroll forward through the list. There is ~~not~~ a command to scroll backward; however, there is a "Go to Page" command at the lower right corner of the screen where the prompt keys are located. When the cursor is at this location, go directly to a specific page, enter the page number and press the "enter" key. Scrolling backward and forward through the list can be accomplished in this manner.

To Print a Copy of the Approved Products List:

After logon, use one of the following commands for printing the Approved Products List:

1. Apprvprt
2. Apprvprt page #
3. Apprvprt page # page #

Example 1 - On the "Ready" screen, type on the command line:

apprvprt

Press "enter" and follow the prompts on the screen. This will print out the entire Approved Products List with the "Printed on:" date on each page in the upper right corner above the page number.

Example 2 - On the "Ready" screen, type on the command line:

apprvprt page # (apprvprt 27)

Press "enter" and follow the prompts on the screen. This will print out the page requested (27) with the "Printed on:" date on the page in the upper right corner above the page number.

Example 3 - On the "Ready" screen, type on the command line:

apprvprt page # page # (apprvprt 23 27)

Press "enter" and follow the prompts on the screen. This will print out the pages requested (23, 24, 25, 26, 27) with the "Printed on:" date on the page in the upper right corner above the page number.

After entering one of these three commands and pressing "enter", the screen will give the following message:

```
Ready;
IKF990D, AWAITING REPLY
IFK990D, AWAITING REPLY
```

REPORT 'APPRPROD LIST' has been created.

If you want the report printed, enter the identification of the printer you want the file sent to (i.e., V01E, PLN2, R921, RFA1, etc.)

If you want the report rotated, enter ROT after the printer address (i.e., V01E ROT, PLN2 ROT, etc.)

If you DO NOT want it printed, just press "enter".

@ *A print program (exec.) has been set up to print the Ready Mix Plant List that is in the YCCHP program. It is set up just like the Approved Products or Aggregate programs.*

To print the Ready Mix Plant List type RDYMXPRT. To print the Aggregate List, type AGGRTPT.

Contact Terry Masters in the NDR Materials and Tests Division at (402) 479-4754 if there are any questions concerning the viewing or printing of the Approved Products List.

1002.03 ADDITIONS/DELETIONS TO THE APPROVED PRODUCTS LIST

The Approved Products List is normally updated on Friday. Materials that meet NDR's *Standard Specifications for Highway Construction* may be added to the list at any time. Materials may also be deleted from the list at any time.

@ Contact the Physical Testing Section in the NDR Materials and Tests Division at (402) 479-4746 to obtain information on required certification and documentation that is necessary for a specific products.

SSHC Subsection 1001.03 identifies details relating to the use of the Approved Products List and the procedure for using a material that is not included on the Approved Products List.

A large portion of "who's in charge" confusion can be attributed to the complex nature of environmental laws. This confusion can be, and is, further compounded by the mixture of regulating authorities in charge of enforcing these laws. The laws require action depending on the chemical(s) present and have significantly different action levels depending on how much of any one constituent is found. The final blow often comes when conversation is composed mostly of acronyms.

1100.12 REGULATORY AUTHORITIES

EPA

In Nebraska, U.S. EPA is responsible for CERCLA and RCRA programs. These are administrated by EPA's Region VII in Kansas City, Kansas.

OSHA

@ In Nebraska, OSHA is administrated by Nebraska Department of Labor. ~~The Nebraska Department of Labor does not e~~ *Enforcement of OSHA that is the responsibility of* left to the federal Occupational Safety and Health Administration. All complaints regarding maritime operations should be referred to the Federal Office in Kansas City, MO, except those involving State or local governmental employees which continue to be covered by the Nebraska Department of Labor.

Nebraska Department of Environmental Quality (DEQ)

DEQ is responsible for specific environmental regulatory functions. Most of DEQ's environmental authority and powers are listed in its legislated guidance. "Generally" this authority includes:

- Air Quality
Clean Air Act and Clean Air Act Amendments, plus additional regulations codified by Nebraska legislature.
- Land Quality
Nonhazardous waste disposal.
All underground storage tanks.
- Water Quality
Storm water pollution
Water pollution
Wetlands
Public and private wells
- Waste Reduction
- Compliance and Enforcement

1100.13 ENVIRONMENTAL LAWS

Principle legislative acts which govern most of DEQ's work.

- AHERA** Asbestos Hazardous Emergency Response Act: Federal law codified in 1986. This act promulgates regulations which require inspection of buildings for materials which contain asbestos. If the material is found, it must be removed prior to demolition for health and environmental protection reasons. NDR has chosen to prepare and let a separate contract for removing asbestos. However, asbestos could be removed in conjunction with demolition.
- @
- CAAA** Clean Air Act Amendments: Federal law codified in 1990 and regulates air quality issues.
- CERCLA** Comprehensive Environmental Response, Compensation, and Liability Act: Federal law codified in 1980, sometimes referred to as "Superfund." CERCLA gives the federal government the power to respond to releases, or threatened releases, of any hazardous substance into the environment as well as a substantial danger to public health or welfare.
- CERCLA is a remedial statute designed to deal with problems of past mismanagement of hazardous waste. Under CERCLA, the government created a process for identifying liable parties and ordering them to take responsibility for cleanup operations.
- CWA** Clean Water Act: Federal law codified in 1977. The objective is to restore and maintain the chemical, physical, and biological integrity of the Nations waters.
- NPDES** National Pollutant Discharge Elimination System: Federal law codified through publication in 55 FR 47990 (November 16, 1990) and 57 FR 11394 (April 2, 1992). In a simple "nutshell", this is the Storm Water Pollution program.
- OSHA** Occupational Safety and Health Act: Federal law codified in 1968. Established for the regulation of site safety procedures, worker training, and worker safety and health standards.
- Health related requirements of OSHA typically key on the presence of "TOTAL" amounts of listed elemental constituents. Be careful when considering constituents because OSHA often considers elements according to valence charges. For example; Trivalent chromium Cr⁺³ has one action level, while hexavalant chromium Cr⁺⁶ has another, and chromium (metal) has still another. Most of OSHA's regulations are found in *Title 29 Code of Federal Regulations (CFR) Sections 1910 and 1926*. A specific listing of chemicals is found in *Table Z, 29 CFR 1910.1000*.
- RCRA** Resource Conservation and Recovery Act: Federal law codified in 1976 which provided for the development of federal and state programs for the regulation of land disposal of waste materials and the recovery of materials and energy resources. The act regulates not only the generation,

@ transportation, treatment, storage, and disposal of hazardous wastes, but also municipal solid waste disposal facilities. Several amendments to RCRA have imposed a series of even more stringent requirements than the original law.

RCRA is a federal statute enacted to ensure that wastes are managed in an environmentally sound manner, and to protect human health and the environment from the potential hazards of waste disposal. Whereas CERCLA focuses on the cleanup of uncontrolled or abandoned sites, RCRA seeks to better manage active hazardous waste treatment, storage, and disposal facilities so new superfund sites will not be created in the future.

SARA Superfund Amendments and Reauthorization Act: A federal law codified in 1986. Amended CERCLA and introduced more stringent and detailed guidelines for cleanups. Also established regulations for industries using chemicals and releasing pollutants into the environment.

TITLE III of SARA requires that communities and the public be supplied with information on chemical inventories, release reporting, accidents/spills. TITLE III also provides for full public participation in planning and preparing for chemical emergencies arising from local industries.

SDWA Safe Drinking Water Act: Federal law codified in 1974. This law is intended to protect drinking water resources at the tap. Establishes control of contaminants in public drinking water and sets baseline national drinking water standards.

TSCA Toxic Substance Control Act: Federal law codified in 1976. Established for the regulation of toxic substances.

1100.14 WETLANDS

Special Environmental Conditions

New procedures have been established to bring specific attention to those environmental issues or documents directly (or indirectly) affecting our construction projects.

Reference is made to the attached Project Development Summary Sheets. These summary sheets will normally be two pages or less in length and pertain to such things as wetlands, waterway permits, historic bridges, and other environmental issues. These sheets will be sent to the districts, and the information shown thereon must be carefully compared to the provisions of the actual permits issued for the work involved.

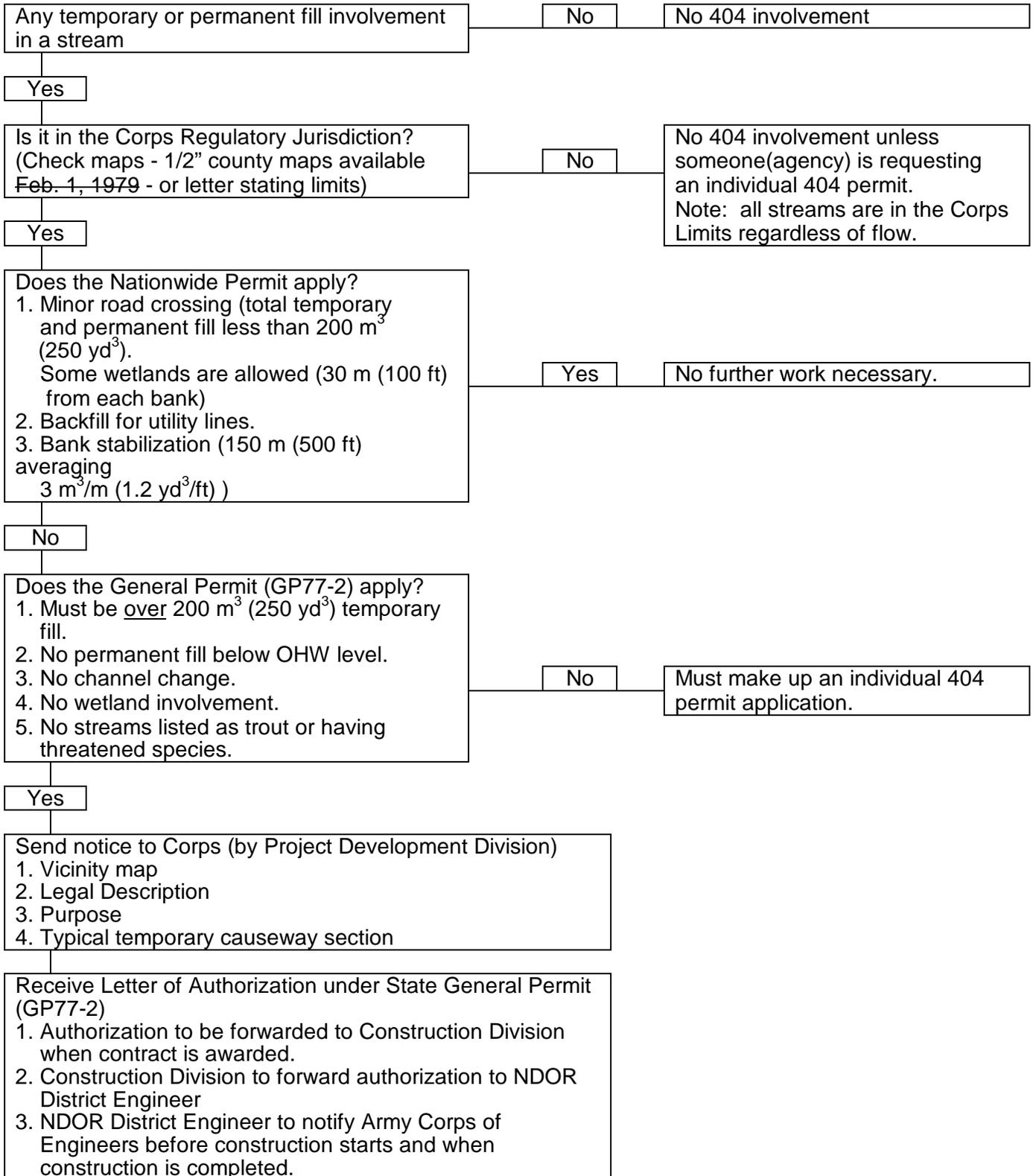
Additional information will also be shown in the plans. Project Development will be preparing one or more "2W" sheets for inclusion in the plans. The "2W" sheets will provide delineation of wetland areas (on and off the project) and notes pertaining to special conditions or environmental issues. These plan sheets, also, should be checked against the provisions of actual permits issued for the work involved.

In order to insure that all parties involved are aware of the environmental issues affecting a project, please see that the following procedures are followed:

- Thoroughly review the plans and special provisions for environmental issues.

404 Determination Checklist

@



F. Site Safety

1. If, based on site conditions and situations, the inspector or contractor feels there is an immediate threat for **explosion**, the contractor shall:

- @
- @
- Immediately shut-off all operating equipment, extinguish all sources of ignition (i.e., cigarettes etc.), and evacuate the area. This includes all personnel.
- After the site is evacuated, establish controls to prevent site access and contact local authorities.

The inspector shall contact the Construction Division.

2. If, based on site conditions and situations, the inspector or contractor feels there is an **immediate** danger to life or health **other than** by explosion, the contractor shall:

- Immediately evacuate the area. This includes all personnel and could include equipment.
- After the site is evacuated, establish controls to prevent site access.

The inspector shall contact the Construction Division.

3. If, based on site conditions and situations, the inspector or contractor feels there is an immediate danger to a water supply, the contractor shall:
(Threats to life or health and explosion are not present)

- Using whatever means are available, immediately establish positive restrictions to limit or prevent migration of contamination to a water supply.
- Watch for changing conditions which could present threats due to explosion and/or danger to life or health. If site conditions change, implement the appropriate response as noted above.

The inspector shall contact the Construction Division.

G. Removal of Contaminated Soil

If the site is determined to be contaminated, one method of remediation is to overexcavate. Contaminated soil which has been over-excavated must be "properly" disposed. **DEQ must provide approval prior to over-excavation**

H. Disposal Options

There are several approved methods for disposal, however, DEQ must preapprove any disposal option. Some options which have been successfully used include:

1. Removal of soil and disposing in a sanitary landfill. This not only requires prior approval by DEQ, but also approval from the local receiving landfill.

- B. The contractor has demonstrated ability and willingness to keep erosion control measures current and maintained within existing work areas.
- C. Consideration must be given for the time of year before exposing additional areas. For example: It would not be unreasonable to deny a request for additional working area in a situation where it is late in the grading season and the contractor is falling behind in finishing, applying mulch, or temporary seeding.

Also, it would not be unreasonable to place a condition on approving an additional spread. For example: "Contractor, you may open area "X" as soon as you have finished and stabilized up to Station "Y.""

- D. The contractor has successfully followed their erosion control work plan. The Project Manager has not noted storm water violations, and has every reason to believe additional open areas will **not** over-extend the contractor's ability to comply with our Storm Water Pollution Permit.

It is strongly recommended that the Project Manager approve additional area on a case-by-case basis and consider approval on the contractor's previous work experience as well as site conditions.

- Contractors have been told it is their responsibility to maintain the project within storm water compliance. They have also been told about the need to be prepared to complete requirements of the Pollution Prevention Plan should a subcontractor not be able to perform.

@ We mean just that fully recognizing that Pollution prevention is necessary even
@ through most of the erosion control work is subcontracted to DBEs. However, compliance is a must and project administrators **MUST** be sure the project is maintained within storm water requirements and that the Pollution Prevention Plan is followed.

1100.33 QUESTIONS OFTEN ASKED

The weather is not favorable to establish temporary seeding or silt fences. What do we do?

- A. Stabilization

Regulations say if an area will not have any activity for 21 days; by the 14th day, some form of stabilization will be required. There is very little latitude in that statement even if it is wet or freezing.

To be in compliance with storm water regulations, something needs to be done. For example, incorporating mulch, using HydroMulch or Soil Binders which are comprised of wood fiber and paper mulch. Both work, but tend to be expensive knowing it is less than temporary and we will have to ultimately seed.

Best solution is to conduct temporary seeding in a timely manner and not let the contractor get so much open that it cannot be stabilized by seeding. At the least keep it to a minimum so if one of the other alternates is necessary, costs can be kept to a minimum.

Closed Abrasive Blast - (Vacuum Blasting)

Compressed air is used to propel abrasive particles against the surface to be cleaned. The blast nozzle is fitted into a localized containment assembly, which is attached to a vacuum. Dust, abrasive, and paint debris are vacuumed simultaneously with the blasting operation. Debris is separated for disposal and the abrasive is returned for reuse. Typically, hard metallic abrasives are used for this system.

As with Open Abrasive blasting, NDR will NOT approve a system that uses water or water filters.

The most limiting factors of vacuum blasting are its reduced production rate and operational problems cleaning edges and irregular surfaces. NOTE: To be completely effective, the whole nozzle assembly must be sealed against a surface. This is the only way to maintain proper suction for the vacuum operation.

Vacuum blasting equipment is expensive, however, both worker exposure to dust and environmental emissions are substantially reduced if the operations are conducted properly. Thus the Special Provisions may allow vacuum blasting to be conducted without requiring full containment.

Hand and Power Tool Cleaning

Supplemental Specifications may identify cleaning by methods other than abrasive blasting. In these cases SSPC - SP 2, SP 3, or SP 11 will typically be noted as acceptable surface preparation standards. (Steel Structures Painting Council "SSPC" is an organization whose purpose is to develop industry standards for painting. The above noted standards, i.e., SP 2, SP 3, etc. are visual standards used to evaluate cleanliness of steel surfaces.)

A. Hand Tool Cleaning

Hand tool cleaning involves manual operated impact, scraping, sanding, and brushing tools. Typical equipment would be slag hammers, chipping hammers, putty knives, paint scrapers, and wire brushes. Hand tool cleaning will produce little dust however, only loose material is removed while intact rust, sound paint, and mill scale remain.

B. Power Tool Cleaning

Power tool cleaning uses electric and/or air operated impact grinding, or brushing tools. Usually power chippers, needle guns, descalers, power wire brushes, and grinding wheels comprise equipment for this. Power tool cleaning produces some dust and can generate airborne debris.

Because airborne dust and debris are generated, workers must have respiratory and dress protection. However, protection for power tool work is considerably less stringent than required for abrasive blasting where the operator and helpers would be required to wear air supplied blasting hoods and some type of encapsulating suits.

DIVISION 1200 -- SITEMANAGER

1200.01 INTRODUCTION

SiteManager™ is one of the most powerful software support systems available to transportation agencies. It seamlessly integrates field-based data collection, administration of contract records, contractor payments, project-oriented civil rights monitoring, and materials management. All this is combined with a state-of-the-art, client/server environment and is available to field, project, district, laboratory and central office personnel.

1200.02 IMPLEMENTATION SCHEDULE

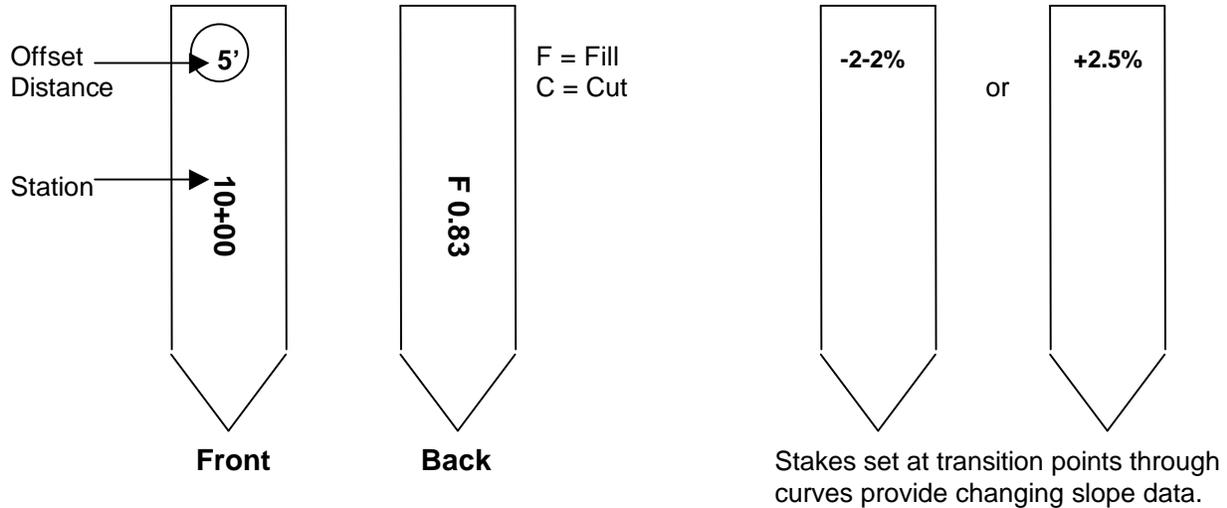
The Department has begun to use SiteManager. As each District gets their computers and are trained in their use, the Department will shift to complete project management under “~~site manager~~”. “SiteManager”. The network will interface with the NDR mainframe computer data bases.

1200.03 GUIDANCE

@ Each lap top that is used for Construction Inspection and management has the ~~Site Manager~~ SiteManager documentation installed on the hard drive. This is the official source for guidance and use of ~~Site Manager~~ SiteManager.

Typical guard stake information in English dimension.
 Stakes containing metric information should carry "m" designation on top of front face.

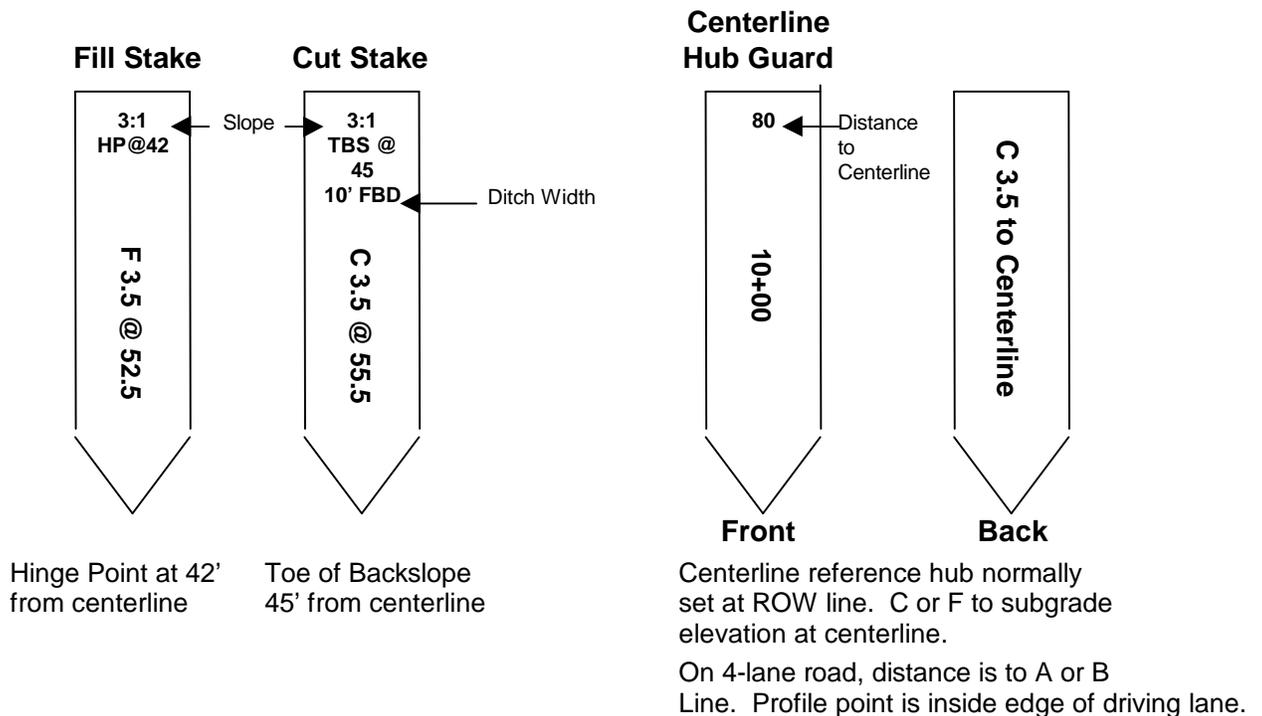
PAVING STAKES



Fill (cut) is to the top of the pavement at outside edge.

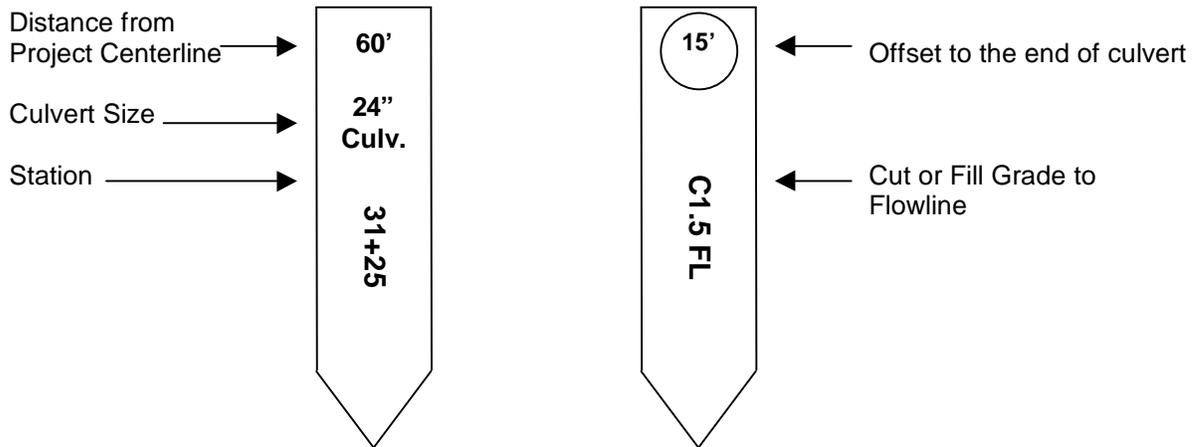
Pavement grades may be computed flat from edge of pavement to paving hub, or on projected slope of pavement out to paving hub. Coordinate with contractor for method preferred.

SLOPE STAKES

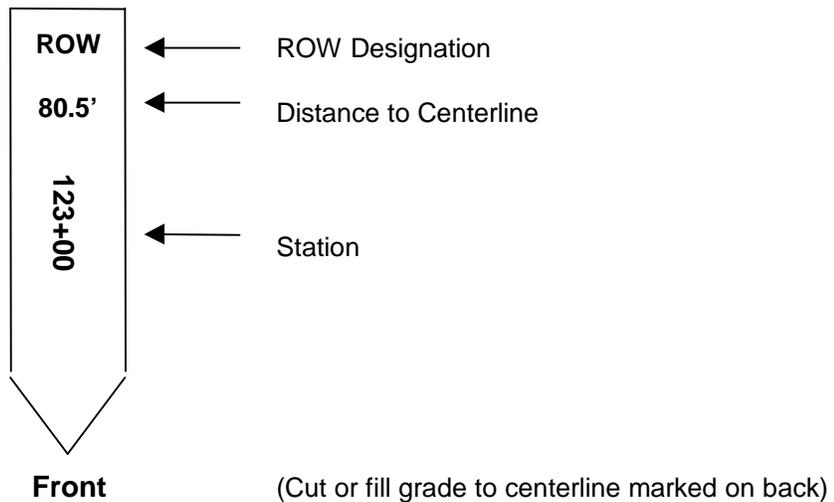


Typical guard stake information in English dimension.
Stakes containing metric information should carry "m" designation on top of front face.

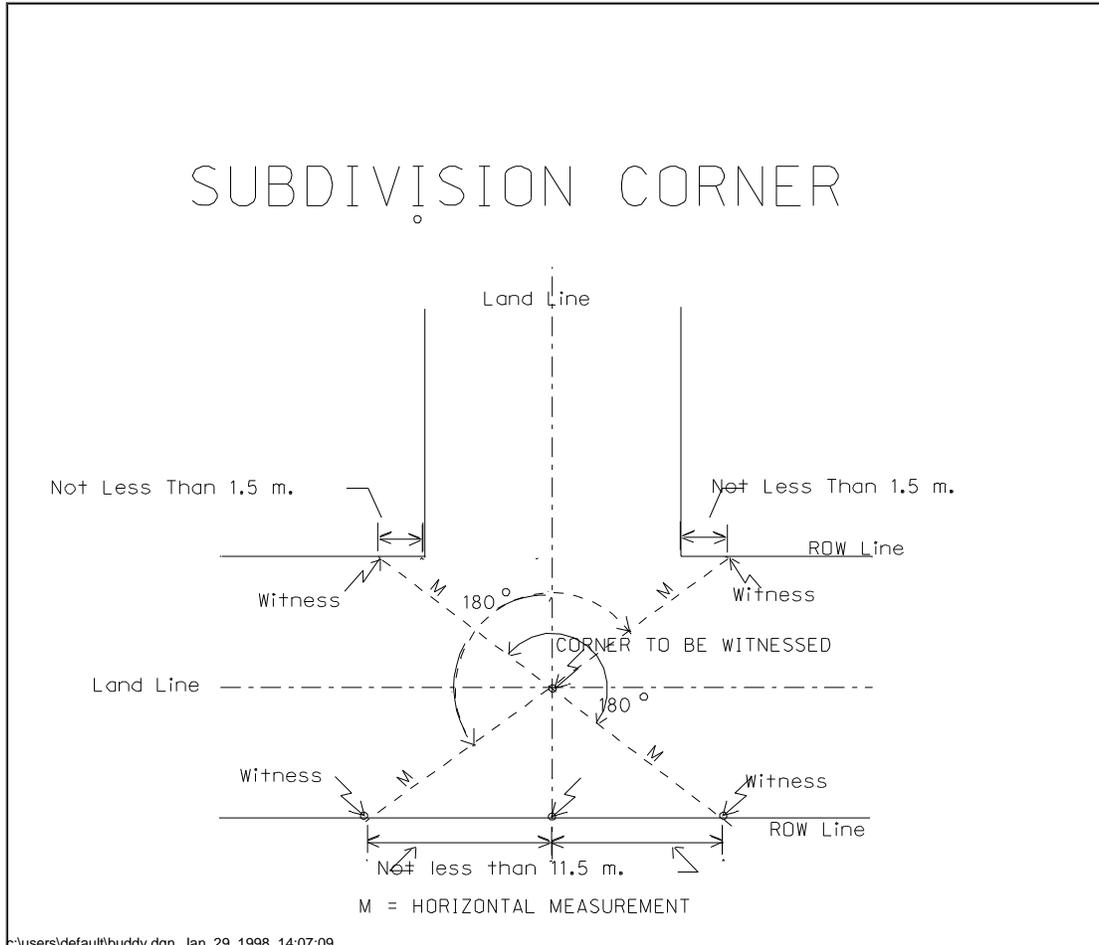
CULVERT STAKES



ROW STAKES



Hub Flags: Green-Yellow flag for easements.
Orange flag for ROW.



A "Section Corner Tie Sheet" DR-77 shall be prepared for each corner perpetuated by the Project Manager. Three copies shall be submitted to the Deputy State Surveyor by the Deputy State Surveyor employed by this Department. The Deputy State Surveyor shall forward one of these copies to the State Surveyor, and forward one to the county for their records. Signatures and addresses of two local residents observing the perpetuation of the corner markers and establishment of witnesses should be secured as witnesses. In the event local residents are not present, signatures and permanent addresses of other members of the party shall be secured as witnesses.

@

Slope stakes are normally set on both sides of the road at every station; and every 15 m (50 ft) on horizontal curves having a radius of 230 m (750 ft) or less. Use Type "D" 12.5 x 50 x 450 mm (1/2 x 2 x 10 inch) pine stakes.

Some intermediate points at which slope stakes should also be set are:

1. P.C. and P.T. of horizontal curves.
2. Beginning and ending of superelevation.
3. Points where shoulder and backslope change.
4. Change in width of roadbed.
5. Change in width of side ditch or borrow.
6. Any other points helpful to the contractor.

Balance points shall be well marked on the ground with a lath and red flag. Call the contractor's attention to these points and see that he/she works to them.

The plan data pertinent to each station shall be placed in the slope stake notebook. This data gives the trial distance for the first rod reading and also a check between the plan and the stake as actually set in the field. The information from the plans and the staking data should be similar to the example shown in Appendix 3. This example also shows the method for setting stakes for high fills when the instrument height (H.I.) is below the new plan grade.

- B. The plans contain a Design Data listing which includes information also shown in the slope stake book. If additional information is necessary, it may be obtained from the plotted cross sections which are furnished on all projects. ~~On grade centerline reference stakes by means of a transit or level, it is policy to~~ check the elevation of the project centerline. If this agrees with the Design Data listing within 90 mm (0.3 ft), then the slope stake is "measured in" (i.e., staked based on plan dimensions) using the information contained in the listing. However, if the centerline elevation differs by more than 90 mm (0.3 ft), then the slope stakes are set with the transit.

On the Design Data listing the distance shown in the Slope Stake Point column is the distance from centerline to the cut point of the backslope in excavation sections, or the foreslope intersection point in embankment sections. Intercepting ditches at the top of the backslope shall be constructed as shown on the plans. Whether the letter "E" appears in the Extension column it signifies that the preliminary cross section was not wide enough and was extended by the machine. (An "S" indicates the section was hand computed beyond the distance shown.) The machine extension will be a horizontal line from the last rod reading taken. A preconstruction cross section extension will be required at each location where the letters "E" or "S" appear. Since the horizontal slope used by

Setting Trimming or Paving Form Stakes

When the roadway is in condition for the surface structure, trimming or paving stakes may be set. They should be aligned and graded by instrument.

The riding quality of the surface structure depends to a large extent on the vertical accuracy of the stakes and the accuracy with which the trimming is performed or the forms are set. The approved method is to set accurate grades to millimeters for each side of the surfacing at a uniform offset (consult the contractor). Grades may be indicated by stakes either driven to grade or driven flush with the ground and marked with a cut or fill. Stakes driven flush are least likely to be disturbed. The alignment shall be given on one side only and indicated by tacks in the top of the stakes. The appearance of the grade may be checked visually from both directions by sighting along the contractor's string line before the trimming or form setting operation begins.

On curves, the tack line may be run on the offset line after computing a chord length for the offset radius, or the centerline of the curve may be run and the tack line set by double chaining the offset line, again using the proper chord length for the offset radius.

Stakes are normally set at 15 m (50 ft) intervals on tangent alignments and on horizontal curves up to 818.511 m (1/2 mile) radius which have straight or long vertical curve grades. On horizontal curves over 818.511 m (0.1 ft) radius and on vertical curves having a grade that varies more than 30 mm (0.1 ft) from the tangent grade in 15 m (50 ft), a 7.5 m (25 ft) interval should be used. The ST, CS, SC & TS or PC & PT of all horizontal and the PVC & PVT of all vertical curves should be clearly marked for the contractor.

Lining and Grading Contractor's Forms on Large Structures

@ On viaducts and bridges, the staking crew shall give the contractor line and grade on all bents, piers, abutments, walls, etc. This duty will be continuous throughout the duration of the construction. Using the stakes previously set, the Project Manager shall stake or check all pile layouts, centerline, and grade on all footings, columns, caps and anchor bolts before and after the pouring of concrete. Columns, pier caps and anchor bolts should be checked while the concrete is still fresh enough to allow for adjusting the forms or anchor bolts to line and grade. In addition to checking the line from the survey stakes, anchor bolts may also be checked by steel taping from pier to pier. Temperature, force on the tape, and plumbing for elevation must all be considered when this method is used. On steel girder bridges, a final check shall be made on span lengths, pier and abutment angles, and bearing plate seat elevations before attempting to set the girders in place. This should be done as soon as possible to allow time for minor adjustments in the girders should they be necessary. The following steps are used in making this check:

1. From a transit setup on centerline on the abutment, mark the centerline of the structure on the pier caps.
2. From a setup on the pier caps, turn the pier angles and mark the centerline of the pier at the center of each set of anchor bolts.

Rod readings beyond the shoulder will not be necessary in embankment sections unless the elevation of the subgrade is below the grade line of the existing embankment prior to grading (locations where the old embankment is lowered or cored out to place a subbase or base course) or it is necessary to accurately determine the quantity of embankment in order to compute overhaul.

The Project Manager will be responsible for inserting the shoulder rod readings into the final cross sections.

Two (2) methods will be used to determine the shoulder point:

1. Slope Stake Data (preferred)
2. Theoretical Shoulder Point

The Project Manager will state, in the transmittal letter, what method(s) was used and where.

- (c) Shoulder Construction - On both rigid and flexible pavements the quantity of material required for the earth portion of the shoulder construction will usually be either subsidiary to the subgrade preparation work or measured for payment as "Shoulder Construction". Accordingly, the excavation for the shouldering material is not a pay item. The Project Manager should take complete final cross sections after grading is complete and prior to surfacing and shoulder construction. If final cross sections cannot be taken until shouldering is complete, the quantity of excavation for shoulders should be deducted from the excavation pay quantity. If possible, this deduction should be computed by cross section method of material at the source. When it is not possible to cross section the material at the source, the volume may be computed by using the typical section for shouldering and multiplying by a balance factor of 1.35.
- @
- @
- (d) Topsoil Placement - When the plans provide for topsoil placement as a part of the grading construction, final cross sections should be taken after the topsoil has been placed. This is in accordance with Subsection 929.04 of the specifications which provides no payment for undercutting for topsoil placement.
5. Preconstruction Cross Section Notes - Where preconstruction cross section notes are taken to supplement or replace preliminary cross sections, this fact shall be noted in the letter of transmittal. Give the book and page number location of such notes. The letter of transmittal shall also contain the book and page number location of all extensions to preconstruction and preliminary cross sections.

The closure of all final cross sections in excavated areas shall be checked in the field office. All cross sections shall close within 90 mm 150 mm (6 inch). A project whose design was based on photogrammetric data may close only within 300 m (12 inch). Check the cross section sheets to see if preliminary survey was from field survey of photogrammetric data. Cross sections which do not close within these limits shall be field checked or explained by an entry in the final notes. If an error in the preliminary can be substantiated, for example, when slope stake elevations agree with final cross section elevations, an entry for the correction of the preliminary cross section elevations should be placed in the final notes.

Notebooks shall be given a permanent number and completely indexed in the front to show the location of all data included therein. The project number and the name and address of the Project Manager shall be entered on the inside of the front cover.

Final cross section notebooks shall be prepared in accordance with these instructions and submitted to the Construction Division. Projects up to approximately 10 km long shall be submitted in their entirety. Projects over 10 km may be submitted in two sections if this will speed up the processing of the final records. If the preliminary notes are at the field office, those stations covered by the final cross sections being submitted shall also be sent to the Construction Division. Final notebooks will not be returned to the field unless specifically requested by the Project Manager. The data submitted to the Construction Division shall be addressed as follows:

Department of Roads, Construction Division
Final Earthwork Quantities
P.O. Box 94759, State House Station
Lincoln, Nebraska 68509

Plotting Cross Sections

Final cross sections need to be plotted only on those projects not designed under the computer program or those portions of projects (channels, intersections, etc.) which are being computed in the field office.

For those projects computed in the field office, after checking all H.I.'s, the preconstruction and final cross section notes are reduced and checked. The points are then accurately plotted on cross section paper using a scale of 25 mm equals 1.5 m (1 inch = 5 ft) vertically and 1.5 m (5 ft) horizontally, or 1.5 m (5 ft) vertically and 3.0 (10 ft) horizontally. All plotting should be checked by reading the elevations and distances back from the cross section sheets. Preconstruction cross sections shall not be inked.

The final cross sections for excavation only are plotted over the preliminary or the preconstruction cross sections using the same coordinates and drawing in the final with a dashed line.

If the preliminary cross sections are being used, the preliminary template may be erased before plotting the final excavation cross sections. If the cross section sheets are not too crowded, the preliminary template may be left in place and the final cross sections

- Staking culvert, bridges, and sewers.

Department will:

- Perform a level circuit to check benchmarks prior to start of construction.
- Stake right-of-way break points.
- Take elevation readings of settlement plates.
- Reestablish land corners and section corners.
- Establish permanent benchmarks and permanent ties to all required points.

Special Attention Items

The Project Manager should be notified and/or consulted for guidance if the following conditions occur:

- Proposed culvert is staked and its location does not fit existing ground elevations.
- Conflicting conditions occur such as existing water line located at same location ~~of~~ as the proposed sewer line.
- Farm subdrains are present. Contractor will determine their location, size, and elevation. Project Manager will establish final size, location, and elevation for construction of tile line to be staked by the contractor.
- Slope stakes do not match design cross section.

Documentation

Field notes are to be kept in the bound field books. After project completion, field books become the property of the Department.

Contract Administration

By Specification, "construction survey" is identified as a "specialty item."

"Construction survey" is considered a professional service, therefore Davis-Bacon requirements do not apply.

If survey work is performed by someone other than the contractor, a "Subcontract Request and Approval" form shall be submitted. All requirements of subcontractors are to be fulfilled with the exception of Davis-Bacon requirements.

Always switch the power off before removing the standard battery.

- @ Remove the standard battery from the Total Stations before putting it in the case.
- @ When the Total Stations is placed in the carrying case, follow the layout plan.

Make sure that the Total Stations and the protective lining of the carrying case are dry before closing the case. The case is hermetically sealed and if moisture is trapped inside, damage to the instrument could occur.

Someone should always be near the instruments when it is set up in the roadway or in any other location where it may be disturbed.

Total Stations (Maintenance)

Wipe off moisture completely if the instrument gets wet during survey work.

Always clean the instrument before returning it to the case. The lens requires special care. Dust it off with the lens brush first, to remove minute particles. Then after providing a little condensation by breathing on this, wipe it with a soft clean cloth or lens tissue.

Do not wipe the displays and keyboard or carrying case with an organic solvent.

Store Total Stations in a dry room where the temperature remains fairly constant.

If the battery is discharged excessively, its life may be shortened. If it is stored, it should have somewhat of a charge in it.

Check the tripod for loose fit and loose screws.

When removing the Total Stations from the carrying case, never pull it out by force. The empty carrying case should be closed to protect it from moisture.

Check the Total Stations for proper adjustment periodically to maintain the instrument accuracy.

Electronic Digital Theodolite/Transit (Precautions)

When the theodolite/transit is not used for a long time, check it at least once every three months.

Handle the theodolite/transit with care. Avoid heavy shocks or vibration.

If any problems are found with the rotatable portion, screws or optical parts (e.g., lens) send it in to the Engineering Equipment Shop.

After removing the theodolite/transit from the carrying case, close the case to exclude dust and moisture.

Never place the theodolite/transit directly on the ground. (Attached dirt may damage the base plate and centering screw.)

Never carry the theodolite/transit on the tripod to another site.

Protect the theodolite/transit with an umbrella against strong sunlight and precipitation of any kind.

When the operator leaves the theodolite/transit, the vinyl cover should be placed over the instrument.

Always switch the power off before removing the internal battery on the theodolite.

Make sure the theodolite/transit and the protective lining of the carrying case are dry before closing the case. (The case is hermetically sealed; if moisture is trapped inside, damage to the instrument could occur.)

- @ Someone should always be near the instruments when it is set up in the roadway or in any other location where it may be disturbed.

Electronic Digital Theodolite/Transit (Maintenance)

Wipe off any moisture if the instrument gets wet during operation.

Always clean the instrument before returning it to its case. The lens requires special care. Dust it off with the lens brush first, to remove minute particles. Then, after providing a little condensation by breathing on the lens, wipe it with a soft, clean cloth or lens tissue. (theodolite only) when cleaning the display, keyboard and carrying case, never use any organic solvent (e.g., thinners).

Store the instrument in a dry room where the temperature remains fairly constant.

Check the tripod for loose fitting and loose screws.

Survey Levels, (General Precautions)

Be sure to carry the instrument to the job site in the plastic case.

Handle with care.

Do not place instrument directly on the ground.

After taking the instrument and accessories out of the plastic case, be sure to close the case cover to keep out dust and dirt.

Use both hands to hold the instrument when carrying it at the job site. Remember that when moving the instrument from one job site to another, it must be removed from the tripod for transporting.

If the instrument is left mounted on the tripod for any length of time, cap the objective lens and cover the entire instrument with the vinyl cover.

Be careful not to expose the instrument to direct sunlight and precipitation. If it gets wet, wipe it with a dry cloth before putting it back in the plastic case.

Store the accessories in the specified places in the case.

Use neutral cleanser or water to clean up the plastic case.

- @ Someone should always be near the instruments when it is set up in the roadway or in any other location where it may be disturbed.

Survey Levels (Maintenance)

Moisture affects the surveying instrument. Completely wipe off any moisture if the instrument gets wet during surveying work.

After use, clean every part of the instrument before putting it back in the case. Breathe on the lens to moisten them and gently clean them with a lens cloth, a clean cloth (preferably, worn out cotton), or soft tissue paper.

The tripod shoes may become loose or the legs may become shaky due to faulty wing nuts when used for a long period. Check them periodically.

If foreign matter appears to have entered any movable parts or screws or when condensation or fungi appears on the lens, prisms, etc., in the telescope, put on work order and send in to Engineering Equipment Shop.

- @ It is recommended to subject the instrument to annual or semi-annual checking and inspection to maintain the high quality necessary for your surveying works.

1300.26 ADJUSTMENT OF INSTRUMENTS

All instruments issued to Project Managers should be in proper adjustment when received from the Lincoln Office. They should, however, be checked for accuracy and necessary adjustments made at regular intervals. Adjustments should be made only by the Project Manager or a qualified member of the party who has been authorized by the Project Manager to perform such work. All adjustments should be carefully made strictly in accordance with methods prescribed in surveying handbooks. Any adjustment which requires dismantling must be made in the Lincoln repair shop.

All Total Station adjustments should be made in the Lincoln repair shop.

Experience has shown that if the sieves are carefully cleaned with the brush after each sieve test and occasionally washed in soap and water, no serious blinding of the wire cloth should occur.

If properly handled and cared for, testing sieves should retain their accuracy during the life of the sieve, since ordinary wear on the wire screen has no measurable effect on the size of the opening. Most of the abrasive action is on the top of the wire knuckles and so does not affect the opening.

1300.29 CONCRETE CYLINDERS

Plastic cylinder molds are to be used for molding of concrete cylinders except cylinders for Latex Concrete and in instances where more than two cylinders are required for a concrete pour. Cardboard molds for the latter may be ordered from Purchasing & Supply.

- @ Plastic cylinders for concrete tests specimens should be lightly coated with form oil before used to facilitate removal and cleaning, especially older cylinders.

1300.30 DAMAGED EQUIPMENT

All damaged equipment listed in the Department's Statewide Inventory System missing (lost or stolen) is to be reported on DR Form 159.

Damaged equipment, especially surveying instruments, should not be used or motions tested to determine the extent of damage until it has been inspected in the Lincoln repair shop. This precaution is necessary for the reason that all damage to the instrument may not be visible. For example, after an instrument has had a fall, the delicate graduated edges of the plates may be seriously damaged by the slightest movement of the plates.

All damaged equipment, together with all worn or broken parts, should be promptly shipped to the Purchasing & Supply Division for repair. Equipment returned to the Purchasing & Supply Division for repair, adjustment or exchange must be accompanied by DR Form 124, Shop Work Orders. The action desired must be described on this form. The appropriate OE and Activity Coding shall be shown.

1300.31 SHIPPING

If at any time it becomes necessary to ship an instrument, it should be packed securely in its case and arrangements shall be made through the District Construction Engineer for the transfer of the instrument to Lincoln. Total stations and electronic theodolites should be by truck or car and not to be shipped.

Other equipment shall be carefully packed in the cases provided for that purpose. If cases are not provided, the equipment should be packed in a box or carton of ample strength for protection during shipment. All equipment should be sent to Lincoln in the same manner as transits and levels.

1300.38

NON-NDOR EQUIPMENT CALIBRATION POLICY

@

HIGHWAY CONSTRUCTION WORK

This policy is applicable to all non-NDOR equipment used for the inspection of highway construction work under the jurisdiction of the Nebraska Department of Roads.

1. NDOR will not provide calibration services for consultants, contractors, or other testing firms performing inspection work; however, the calibration must be performed by a commercial laboratory or business.

2. All equipment shall be calibrated at least annually and at any other time when the results of tests are questionable or unreliable. (With the development of Nebraska's Quality Assurance Program for Construction, a set calibration schedule will be implemented for the various types of inspection equipment. This calibration schedule may be other than annual.)

3. A "Certificate of Calibration" shall be available for inspection by NDOR personnel at any time. The "Certificate of Calibration" shall provide, at a minimum, the following information:
 - a. Serial number or identification number of the equipment.
 - b. Date of calibration.
 - c. Results of the calibration.
 - d. Name of the laboratory or company performing the calibration.
 - e. Signature of the individual performing the calibration.

The "Certificate of Calibration" shall be available for inspection by NDOR personnel at any time. The "Certificate of Calibration" shall provide, at a minimum, the following information:

4. NDOR inspection personnel have the right to verify the calibration of any inspection equipment owned by a consultant, contractor, or other testing firm by performing an independent calibration check. The decision to perform an independent calibration check rests solely with NDOR personnel and will not be performed on a request basis.