1300.05 FINAL CROSS SECTIONS AND FINAL QUANTITIES

A. General

As a general rule, final cross sections are not required as long as the contractor has not disputed the plan quantities and any correction made during construction and agreed to accept the plan quantity as the final pay quantity.

B. Final Cross Section Guidance

When final cross sections must be taken, the following is provided as guidance:

1. Final cross sections may be taken on each 1 mile (1.7 km) as soon as the grading work on that 1 mile (1.7 km) section has been completed and accepted. Final cross sections may be taken while awaiting acceptance if the Project Manager is sure there will be no further work which might change the elevation of any excavation cross section.

2. Final cross sections must be taken at all points where a preconstruction or preliminary cross section was taken, if excavation was made at that point. If it develops that a final cross section must be taken at some plus station which has no preconstruction cross section, a preconstuction section must be interpolated at that point. The final cross section should extend well beyond the construction limits [5 to 10 ft (1.5 to 3 m)]. A rod reading should always be taken on the first definite “natural ground” and this information recorded in the notebook. In addition the surveyor must locate all breaks in each cross section and the maximum distance between shots in each cross section is 20-feet.

3. The excavation involved in undercutting slopes, ditches, borrow pits and shoulders in preparing such areas for the placement of topsoil is not measured for payment and final cross sections shall be taken after the topsoil has been placed.

4. The Project Manager must clearly separate each borrow pit quantity from one another. If the borrow pit is adjacent to the roadway excavation, the final cross section notes must include a rod reading at the R.O.W. line (shear section) and cross sections for the adjacent borrow pit must be separate from the roadway cross sections and computed separately.

5. The option pit block on the plans should be stamped participating and at the end of the detailed estimate breakdown of costs for each such borrow pit will appear. The borrow material costs will be computed in the Lincoln Office. These instructions are in addition to those required in Subsection 109.11, Paragraph V. of this manual.

6. On normal grading contracts, in which no changes in plans are made which would involve overhaul, final cross sections will not be taken for sections which include embankment only. However, when taking the final cross sections for excavation, centerline and shoulder shots should be taken on the embankment at each full station. At locations involving excavation only, or excavation and embankment in the same location, final cross sections shall be taken as necessary to include the excavation.

7. On linear grading contracts where the plans show a grade line elevation (not county agreement projects), the Project Manager shall take a final cross section at each station consisting of shots on centerline and each shoulder of the finished roadway. This may be done at the time the final check is made on the roadway surface to see that it meets the tolerance set forth in the specifications and/or special provisions, and should be submitted as part of the final records. On projects constructed under agreement by county forces, sufficient checks should be made of the finished grade to substantiate conformance with plans, specifications and special provisions.

8. Preconstruction surveys for rebalancing, or additional preconstruction cross sections might be necessary to determine pay quantities. Changes in plan or grade line which might involve overhaul cannot be anticipated during design or at the start of work. It is essential that preconstruction information be complete, so that if necessary, the final cross sections may be adjusted to reflect the existing ground elevations at the start of the project if different from the original preliminary cross sections.

9. When changes in plans involve overhaul, the final cross sections must include all embankment as well as excavation for the balance that the overhaul has occurred in. See Subsection 105.07 of this manual for additional instructions.

C. Earthwork Calculations

1. The final earthwork quantities on all in-house projects can be computed/verified via Microsoft/GeoPak. The Finals Section of the Construction Division can assist with or perform these calculations. However, the specific quantities and their location are necessary to verify or calculate quantities. There are two basic ways that projects are surveyed currently:

   - Total Stationing
   - Conventional Surveying

   The Construction Division will convert conventional data to a Microsoft/GeoPak file to accomplish any quantity calculations. The following are required when requesting convention survey verification of quantities:

   a. Final cross section notes

   b H.I. data

c. Curve data

d. Surfacing data

e. Preconstruction cross section notes

f. Zero-zero sections

g. Interpolated cross sections

h. Width of preconstruction (preliminary) cross sections

i. Preparation and submittal of records

2. Field Notebooks

a. Final Cross Section Notes – A special effort should be made to keep the notes clear and legible. Do not crowd the notes. Not more than four single line cross sections should be recorded on each page of a 4½ x 7½ inch (115 x 190 mm) field book. It is suggested that a 3H pencil be used in taking notes.

b. Notes should be recorded with the stationing reading from the bottom of the page to the top. If there is insufficient room for all readings on one line, the readings should be completed on the next line. The station of each line shall be shown. All shots must be recorded on the proper side of the centerline. See Division III of this manual for example.

c. Rod readings shall be expressed in ± 1/10 foot (30 mm) on dirt. Surfacing shots will be expressed in 1/100 foot (3 mm). Use a slightly elevated decimal figure in lieu of a decimal point. All plus rod readings shall be indicated by a plus symbol (+) preceding the reading. Horizontal distances shall be recorded to the nearest 1 ft (300 mm).

d. A cross section shall be taken at all equations.

e. Final roadway cross sections may originate on either the right or left side of centerline of the project. The cross section must have a centerline (zero distance) rod reading. This also applies to borrow pits or channels cross sectioned from a base (zero distance) line.

f. When it becomes necessary to take the final cross sections after completion of the surfacing work, sufficient room shall be left by the note recorder for inserting calculated rod readings. These rod readings will reflect the elevation of the typical grading section shoulder-subgrade point.

g. Don't use any harder pencil than 3H. When the final earthwork computation listing sheet is returned to the field, the correction notes are to be reviewed thoroughly. All notes indicating further action are to be addressed at the field office.

h. H.I. Data – The H.I. shall be shown on each page of notes near the location of the centerline shots. When one cross section has been taken from two or more H.I.'s, the portion of the section represented by each H.I. shall be clearly indicated.

i. The Project Manager shall check the reduction of all H.I.'s with care. It is essential that the following details be recorded:

(1) Six digits in the elevation shall be recorded for each H.I. entered in the notes such as 1225.75 or 0925.87.

(2) If a correction in levels is made when "checking in " or turning on a benchmark, the correction shall be shown in the notes in the following manner.

+5.20 0930.00 Correct to - B.M. Elev. 0924.80
^

-1.00 0924.75

0925.75
^

3. Curve Data – In order to permit the computation of corrections for curvature electronically, it is essential for a cross section to be taken at each P.C. and P.T., for each P.C. and P.T. to be properly identified and the degree of curvature to be shown in the notes for all simple curves. The direction of the curve shall be shown as right or left. The degree of the curve shall be recorded to the nearest hundredth of a degree (not degrees and minutes). The following example shows the proper method of recording information for a 2º25' simple curve to the left.

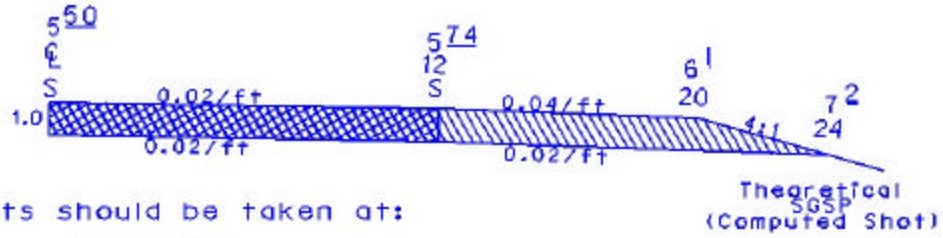
125 + 16.21 P.C. 2° 25'12" Curve Left	10^2	10^6	11^3
	75	60	53
	OG	**OG**	

The correction for a spiral curve is applied near the mid-points of the spiral curvature. Accordingly, the cross section nearest the mid-points of spiral curvature for curves with spiral easements shall be designated by the Project Manager as the point to begin the curve correction.

D. Surfacing Data

1. Portland Cement Concrete Pavement – The Project Manager should take complete final cross sections after grading is complete prior to performing any surfacing structure work. If cross sections are taken after the surfacing is complete, the following three examples show where rod readings must be taken to reflect the excavation due the contractor in each instance. The letter “S” which indicates surfacing shall be placed under rod readings as shown in the examples. If pavement thickness, foundation course and surfaced shoulders are constructed other than as shown on the typical cross section of improvement sheet of the plans or the station limits are changed from those shown on this plan sheet, this information shall be shown in the notebook and also in the letter of transmittal.

Sufacing w/ Earth Shoulder
English
Concrete Pavement



Shots should be taken at:

- Centerline
- Edge of driving surfaces or at lane breaks for multiple lane roadways
- Edge of surfaced shoulders
- Hinge points
- All ground breaks - not to exceed 20' between shots

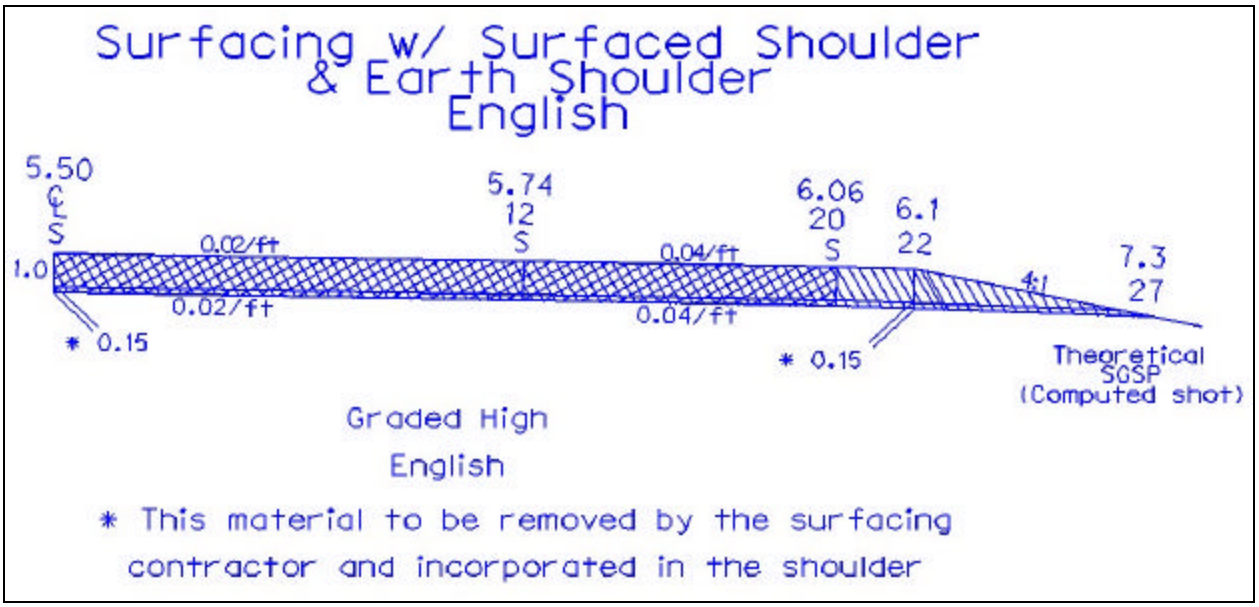
Theoretical Subgrade Shoulder Point (SGSP) should be computed and inserted into the x-section.

English

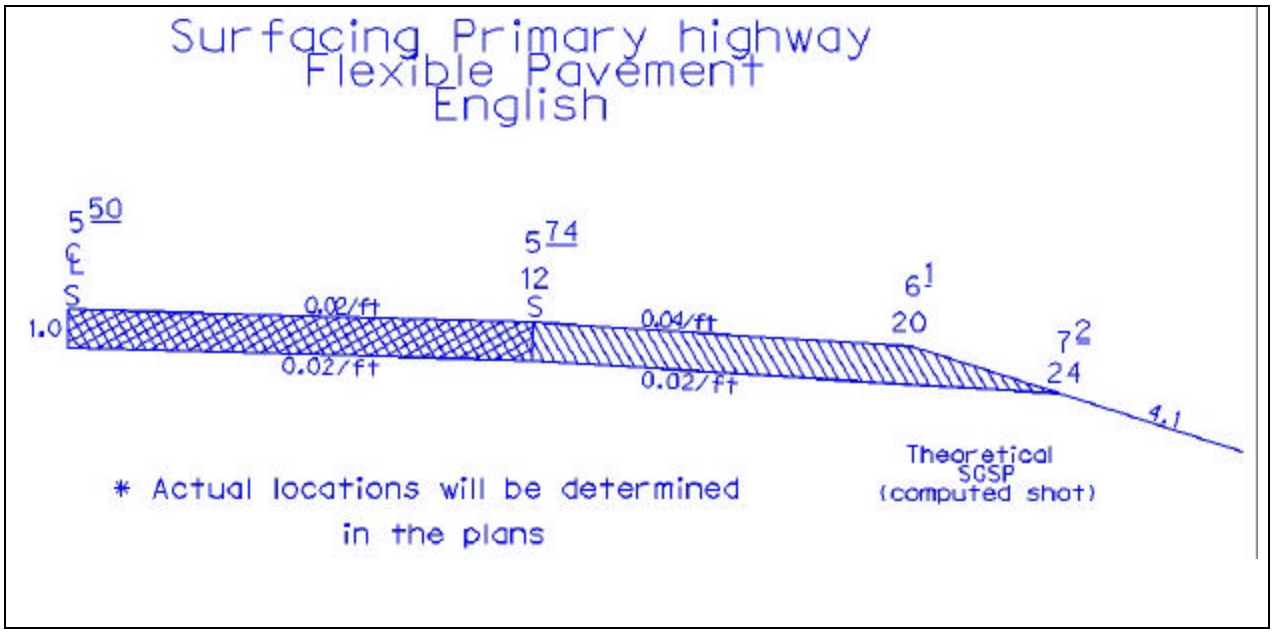
- Surfacing shots read to the nearest hunredth of a foot.
- Ground shots read to the nearest tenth of a foot.

Metric

- Surfacing shots read to the nearest thousandth of a meter.
- Ground shots read to the nearest hundredth of a meter.



2. Flexible Pavements (Asphaltic Concrete, Bituminous, and Base and Armour Coat Surface Courses) – The Project Manager should take complete final cross sections after grading is complete prior to surfacing and shoulder construction. When cross sections are taken after the surfacing is complete, all rod readings taken on the surfacing shall be identified with the letter “S” (indicating surfacing) under the distance. If the surface structure is constructed other than as shown on the typical cross section of the improvement sheet of the plans or the station limits are changed from those shown on this plan sheet, this information shall be shown in the notebook and also in the letter of transmittal. The following sketch shows the rod readings and distances required on the roadway for a 7.3 m (24 ft) asphaltic surface course constructed directly on the subgrade.



3. Any rod readings, other than those shown in the above sketch, necessary to show additional excavation required to be made in constructing variable width surfacing shall be taken, recorded and identified by the letter “s” under the rod reading. One such case would be at channelized intersections.

4. 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.

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

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

   a. Slope Stake Data (preferred)

   b. Theoretical Shoulder Point

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

E. Shoulder Construction

1. 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. If the typical cross section provided for the subgrade to be graded “high” and the material trimmed is to provide the shoulder material, no deduction is required.

2. 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 the topsoil placement.

F. 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.

G. Zero-Zero Sections

The location of zero areas for cut may be shown in the notes without taking a final cross section when there is no cut whatever at the location. Examples: (1) Cut on Lt., C=00 Rt. take final cross section of Lt. (2) Cut on Rt., C=00 Lt. take final cross section on Rt. (3) No Cut Rt. or Lt., C=00 Rt. or Lt., no final cross section is necessary.

H. Interpolated Cross Sections

Final cross sections for which a preliminary or preconstruction cross section is not included in the original notes shall be identified by a note in the final cross section book giving the location in the records where the interpolated cross section may be found. The necessary interpolation shall be made by the Project Manager before submitting the note to the Lincoln Office and shall consist of elevations and distances.

I. Width Of Preliminary And Preconstruction Cross Sections

The Project Manager shall check the preliminary cross section notes, the "Slope Stake Book" and his/her own preconstruction cross section notes to determine whether in all instances these cross sections extend at least as far from centerline as the final cross sections he/she has taken at the same locations. In instances where the preliminary or preconstruction cross sections are not as wide as the final cross section, it will be necessary to extend the preliminary cross section using other available information. This will usually consist of reference hub elevations, slope stake elevations, or as a last resort, the final cross section elevation. The data on which the closure is based shall be entered in the final notes on the left-hand page opposite the inadequate cross section.

J. Example Of Note. The note should show the elevation and the distance from centerline of the point to be used to extend the preliminary (preconstruction) cross section and the manner in which it was established as shown in the following example.

17 Extd. Prelim. to El. 55.6 @ 90 m Lt. S.S. Bk. No. 4
+50 Extd. Prelim. to El. 55.0 @ 90 m Lt. Final Elev.
16 Extd. Prelim. to El. 54.4 @ 100 m Lt. S.S. Bk. No. 4

K. Extension Made Without Note. When no preliminary cross section extension note is given by the Project Manager, the extension will be made by using the last final shot as the last preliminary elevation and distance.

L. Preparation And Submittal of Records

The elevations of all H.I.'s should be reduced and carefully checked to insure their accuracy.

1. The notes should not be reduced to show the elevations of the individual shots on the cross sections except where necessary to check closing shots.

2. The closing shots of all final cross sections in excavated areas shall be checked in the field office to verify closure with the preliminary survey. Cross sections normally will be closed on undisturbed ground. However, this ground often is a plowed field where 6-inch elevation differences are to be expected. Therefore the Department's tolerance on all cross section closures at or near the limits of construction shall be ± 6 inch (150 mm). 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, with slope stake elevations, then an entry correcting the preliminary cross section elevations should be placed in the final notes.

3. 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.

4. 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 – Finals Section
1500 Hwy 2
P.O. Box 94759
Lincoln, Nebraska 68509-4759

M. Plotting Cross Sections

1. Microstation/GeoPak may be used in lieu of hand calculations.

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

3. 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 1 inch=5 ft (25 mm equals 1.5 m) vertically and 5 ft (1.5 m) horizontally, or 5 ft (1.5 m) vertically and 10 ft (3.0 m) horizontally. All plotting should be checked by reading the elevations and distances back form the cross section sheets. Preconstruction cross sections shall not be inked.

4. 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.