

From: Terry HAUSSLER/Heidi HIRSBRUNNER
To: designers
Date: 8/3/00 4:37PM
Subject: Design Consistency and Guidance

Attached is a list that started out being a handful of items and ended up being 38. The intent is to answer many of the questions that the designers have had and to achieve more consistency and uniformity to our process and our PS&E packages. If you have any comments or concerns about major issues in the attached memo, please feel free to discuss with Heidi and Terry. Otherwise, let's plan to discuss some or all of these issues at a meeting later this fall.

Many of these issues apply to 4R projects only. Some of them, like the "Project Engineer Memo" and the "PS&E solicitation checklist" apply to 3R projects too.

If you're a PM or COE (or one of the other cc's to this email), don't feel obligated to read all 6 pages. If you do, however, you will see what some of our focus areas will be during the next 6 months. Any comments you have would also be appreciated. In case you're interested in only portions of the attached memo, it is broken down into these headings:

- 1) Construction staking, contractor testing, and contractor schedule
- 2) Earthwork
- 3) Curbs, paved ditches, curb and gutter
- 4) GEOPAK (includes a lot of staking stuff)
- 5) Guardrail
- 6) PS&E delivery
- 7) QA/QC (only one item, but the entire memo is related to QA/QC)
- 8) Miscellaneous

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Design Consistency and Guidance

August 3, 2000

Construction Staking, Contractor Testing, and Construction Schedule

1. Don't pay for "Miscellaneous surveying and staking" for staking curbs, guardrail, etc. The contractor's cost for surveying and staking should be included in the cost of the pay item. *The Project Engineer needs the "Miscellaneous Surveying and Staking" item to have survey capability, since we no longer have survey crews on the construction staff. The Project Engineer may need this item to check right-of-way boundaries, replace USGS geodetic points that get disturbed, measure stockpiles, measure borrow areas, etc. On most 4R projects, 100 to 200 hours of "Miscellaneous surveying and staking" should be more than enough.*
2. For minor approach roads, we don't necessarily need to generate slope stake notes, red top books, etc. If you decide to use GEOPAK to compute a line, grade, and earthwork quantities, you don't necessarily need to provide stakeout information to the Project Engineer. *Be sure to provide accurate earthwork quantities and stakeout information for major approach roads, long approach roads, or approach roads where the customer needs to know the precise impacts.*
3. Generally, set up a pay item for contractor testing under Section 154. This requires the contractor to perform the final acceptance testing, in addition to the quality control testing and inspection that is required under Section 153. Testing done under Section 153 is generally referred to as "process" testing, such as sampling and testing aggregate from the conveyor belt at the gravel pit. Sampling and testing done under Section 154 is used for "acceptance" of the final product. For instance, the crushed aggregate samples are taken from the roadway or from the windrow after processing. Do not set up a pay item for both Section 153 and 154. Use one or the other. Rely on the COE to make the final decision.
4. A pay item for a construction schedule should only be set up on complex projects.

Earthwork

5. Don't generally pay Roadway Excavation for stripping topsoil from "fill" areas (The new SCR for subsection 204.16 reflects this).
6. Do include a comprehensive Grading Summary and haul diagram in the 95% PS&E package. Include breaks at balance points, changes in shrink/swell factors, and at other "regular intervals." Other "regular intervals" means every kilometer or every P&P sheet – whatever you prefer. For the 70% PS&E package, you should also have a Grading Summary roughed out, but it doesn't have to be perfect. For a 30% field review, you don't need a Grading Summary, but you need to have thought about whether the job can be balanced or whether you will need to borrow or waste material. When you are evaluating the earthwork at the 30% phase, you should focus on the prism quantities and any major ordinate corrections, such as topsoil stripping, and subexcavation. Discuss the earthwork

situation at the 30% field review.

7. Don't show earthwork quantities on the bottom of the P&P sheets, like we did in the old days. Now that we do Grading Summaries, it is not necessary to also show quantities on the P&P sheets. Not only is it more work, but it also creates more opportunities for errors and quantities not matching. *This brings up another question about quantities on the bottom of P&P sheets. Do we really need to show clearing and seeding quantities here? Wouldn't it be easier to summarize them in a table or put a copy of the clearing and seeding reports on the internet?*

Curbs, Paved Ditches, Curb and Gutter

8. When using paved ditches or curb and gutter, let's generally define the back and top of the curb as the hinge point. Don't worry about designing beyond the "neat line" of the curb to allow for additional excavation to make room to construct the curb. We've talked to Seth Greenwell and Steve Boch. Both agree that just showing the "neat line" of the back face of the curb is OK. (*Criteria file for a standard paved ditch section is: fh_pav1.x08*). An exception to using the top of the curb as the hinge point may be when you need to design a flat area adjacent to the curb. A flat area may be shown in the cross sections to represent the backfill behind an embankment curb. A flat area may also be designed to provide an area for debris to collect off a sloughing cutslope.

The back face of paved ditch curb is currently being drawn as a vertical line by the paved ditch criteria files. In many cases this vertical back face of curb is causing problems when GEOPAK construction staking reports are generated. Don Knoedel is rewriting the criteria files to tilt the back of curb line to a rise:run of 100:1 to work around this problem.

9. When showing coordinates and elevations for curb and gutter, for staking purposes, show coordinates to the BACK and TOP of the curb – not the flowline.
10. Don't set up a pay item for curb backfill on 4R jobs. If you have a curb item in the plans, the FP-96 specifies that curb excavation and backfill shall be done according to Section 209. Section 209 specifies that curb excavation and backfill are NOT measured for payment. Besides, it's hard to measure in the field, given the fact that the excavated area behind the curb is irregular and that the backfilling is often done with a loader. *By all means, DO consider setting up a curb backfill item on 3R jobs, where there is no excavation or embankment on the project. This material will most likely need to be imported from off the project and can probably best be measured by the cubic meter in the hauling vehicle.*

GEOPAK

11. Don't necessarily show the GEOPAK "working" lines (e.g. retaining wall excavation line, retaining wall backfill limit, etc.) on drawings where they aren't needed. These "working" lines may be needed in your cross section file to compute quantities and they may be needed on a detail to show wall excavation limits or wall backfill areas, but don't complicate a "Section View" with these lines if they aren't needed.

12. During 70-95% design (prior to reference hubbing), be sure you look at the superelevation file created by GEOPAK for every curve. Don't trust GEOPAK to be perfect, especially where tangent lengths between curves are short. You are responsible to make sure there are no problems with the amount of superelevation, runoff lengths, transitions, etc. *Don't worry about scrutinizing the superelevation too closely when it's early in the design process. It's not as critical then.*
13. Do use a calculated tangent *runout length* for superelevation rather than a fixed tangent runout length as we have done in the past. Tangent *runout length* is the distance that GEOPAK computes to transition the template from the point of normal crown to a point where the inside lane is at normal crown and the outside lane is flat. The superelevation *transition length* (as opposed to the *runout length*) is the distance from this point to the point of full superelevation. Calculate the *runout length* by using the same transition rate as is used for superelevation runoff distance for the curve. In GEOPAK terms this means that in the Superelevation dialog box, you should: (1) set Transition Mode to Linear, (2) set Distribute Transition Over to Runoff Length Only, and (3) set Tangent Runout Distance to Compute. (In AASHTO Green Book terms this means that the relative gradient between the profile for the edge of traveled way and the profile for the roadway centerline is the same for both the superelevation *runoff* portion and the tangent *runout* portion.)
14. Do make sure to put your ditch relief culverts on even 20 m stations, wherever possible. Unlike culverts in natural drainage crossings, these generally don't need to be moved by the Project Engineer. Be sure you modify your cross section to reflect any widening and/or ditch lowering that may be required to accommodate the ditch relief culvert. This is almost always required to construct a catch basin at the bottom of sag vertical curves. For ditch relief in other areas, using an elbow to turn the end section up and toward the ditch flow minimizes the need for you to design a special ditch grade. You still may need to widen your normal ditch to make room for the elbow and end section. See the culvert standard drawings for more details, but don't worry about the odd transition lengths we show on them. Transitioning 20 m to your next cross section is generally OK.
15. Do make sure you have the appropriate cross section station interval in your cross sections prior to giving the job to the Survey Branch to reference hub. Make sure you have cross sections spaced at 10 m for curves with a radius of 75 m or less (per our new SCR in Section 152). Make sure you have cross sections spaced at 10 m intervals in retaining wall locations or other selective areas where more precision is required. Also, make sure you have all the necessary oddball cross sections included for turnouts, guardrail flares, ditch relief culverts that aren't on even stations, or any other location where you need extra stations to build any transitions and other appurtenances. *Always be thinking about making staking and constructing easier by putting turnouts, ditch relief culverts, etc. on even stations and making any transition lengths divisible by 20 m.*
16. Do check your skewed culvert cross sections closely. GEOPAK does a good job with the skewed template between the shoulder points, but sometimes has problems with the skewed

fill slopes. The skewed fill slopes should have an oddball slope ratio (e.g. 1:4.23) and should be flatter than the fill slopes shown in the mainline cross sections. You can manually compute what the skewed fill slope ratio should be by dividing the normal slope ratio by the cosine of the skew angle.

17. Do not include skewed culvert cross sections in the file you provide to the Survey Branch to stake out. Do not ask them to stake culvert cross sections, since the exact location of most culverts needs to be determined by the contractor and the Project Engineer.
18. Don't forget that the CFLHD website has a lot of useful GEOPAK criteria/Microstation information.

Guardrail

19. Do check with your customer and maintaining agency to see if they have a preference for guardrail type and end anchorages. The most common acceptable guardrail terminals are the SRT (Slotted Rail Terminal) and the GET (Guardrail Extruder Terminal). The SRT standards can be found on ArcGrabber and the CFLHD website. The GET terminal standards can be obtained from the appropriate State DOT.
20. The GET is often used in locations where there is not enough width to accommodate the standard terminal section flare, since it requires a minimal flare width.
21. Do use a CRT (Cable Releasing Terminal) terminal at the end of a guardrail that is wrapped around an approach road radius. Do show on the Plans where any specially-fabricated guardrail (shop bending) is needed (generally any radius 45 m or less). The CRT standards can be found on ArcGrabber and the CFLHD web page.
22. Do use guardrail backslope anchor terminals (G4-BAT) wherever it is possible to end a guardrail in a cutslope, since this is the safest terminal.

PS&E Delivery

23. Do complete a draft version of the "Highway Design Standards Form" (**L:DESIGN\PD_forms\CFL_HWD.wpd**) when you are working on the preliminary design. Don't wait until you are sending out the 95% PS&E package. If you draft the form while you are developing the standards early in the design process, it will be easy to finalize it and get signatures (including external signatures on 4R jobs) prior to sending the job upstairs for Larry's signature.
24. Don't set up a 70% Plan-in-Hand review or a 95% PS&E review meeting without first getting an OK from the COE. Their attendance is mandatory!
25. Do use QUATTRO PRO to compute quantities and to do tables for the Plans whenever possible. There are lots of different ways to put the tables in the Plans - both electronically and manually. You decide what works for you. *The point is – Use spreadsheets for what they're good for, which is tabulating quantities and developing tables. Minimize using*

Microstation for tables, Summary Sheets, etc.

26. Do use active voice when writing SCR's and general notes. (i.e. Install, Place, Remove, Provide, etc.). Avoid using "The contractor shall....."
27. Do document your unit price analysis for each pay item.
28. Do check to see that you have the latest Standards and Details in your PS&E. (A current list of standards, details, and revision dates can be found **L:\DESIGN\Rev_std\std_det.wpd**).
29. Do check to see that you have the latest SCR's included. (**L:\WPDOCS\SCR**).
30. Do NOT send out a 95% PS&E package for review until it is essentially 100% complete. If there are no internal or external comments, it should be ready to go to advertisement. Remember, this is the set of Plans that we will be most judged by our customers – internal and external.
31. Do use the PS&E advertisement checklist (**L:\DESIGN\PD_forms\PSEadchk.wpd**) when you send a job upstairs for Larry's signature.
32. Do put together a comprehensive package for the Project Engineer, similar to the one Mike McCann did for the Zuni Mountain project (**L:\DESIGN\PD_forms\PE_Transmit.wpd**). At a minimum, it should include two copies of staking information (one for the contractor and one for the PE), copies of pertinent correspondence, copies of design quantity computations organized by item number, copy of the Materials Report and Environmental Compliance document, and a "PE Memo." The PE Memo is your chance to clarify anything that may be confusing and to warn the Project Engineer of any pitfalls that he/she may encounter. It is your chance to alert the Project Engineer about design changes that he/she may be pressured into making and it is your chance to provide your input early on those. The PE Memo is also a good opportunity to alert the Project Engineer about any concerns you have with any of the survey data, property owners, slope stability, etc.
33. Do be prepared to produce full-size plans and/or cross sections if the Project Engineer or contractor requests them. We used to provide two full-size sets on all projects, but when we no longer needed full-size plans for reproduction purposes, we stopped providing them to the Project Engineer. Some Project Engineers like them to see more detail and to mark up for "As-constructed" drawings.

QA/QC

34. Do have an independent QA/QC check, prior to sending the job upstairs for advertisement. Have a fellow designer check your final plans and estimates, including all your final quantity calculations. Ensure the numbers match all schedules and the Summary of Quantities sheet. If necessary, consult with the Highway Design Manager or a Design Team Leader to designate a person to perform the QA/QC check.

Miscellaneous

35. Do try to get out and see your projects being constructed. This will help the Project Engineer and will also help you to be a better designer. Do try to attend the final inspection.
36. Do be patient while we work on the following:
 - QA/QC plan and checklists
 - Better guidance for setting up pay items and specifying locations in the Plans for soil erosion and pollution control devices. *For now, develop an erosion control plan (hand drawn on P&P sheets is fine) for calculating erosion control device quantities. In the future we will include erosion control plans in our PS&E package.*
 - Re-write Section 152 of the SCR's to clarify what is covered under "Miscellaneous Surveying and Staking." Describe and set up a pay item to have the contractor stake centerline on 3R jobs that are designed from "as-constructed" plans. Update the list of Government-furnished items for stakeout so that contractors get more xyz data and less data that they don't need.
 - A checklist for putting together the Project Engineer's package
37. Don't use a process or a procedure that doesn't make sense just because "we've always done it that way." Let's focus on the things that improve quality and add value to our PS&E packages.
38. Do ask a Design Team Leader or a Highway Design Manager if you're not sure of something. Don't fake it!