

# MISSISSIPPI DEPARTMENT OF TRANSPORTATION

## *Inter-Departmental Memorandum*

TO: Squad Leaders

DATE: June 11, 1997

FROM: Steven W. Reeves *SWR*  
Quality Control Engineer  
Roadway Design

SUBJECT OR PROJECT NO: Earthwork

INFORMATION COPY TO:

COUNTY:

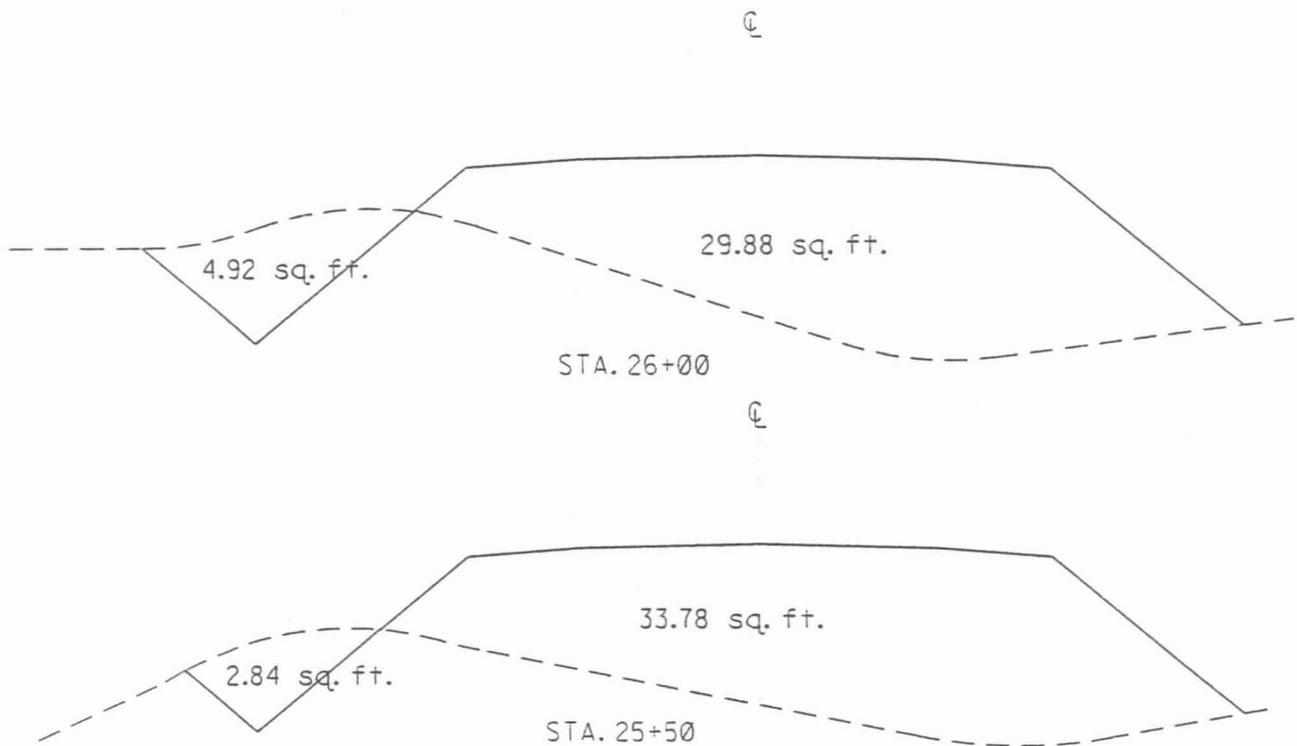
Roadway Design Division Engineer  
John Pickering  
Ray Balentine  
Roadway Design Section Engineers  
File

Earthwork quantities will be shown on plan/profile sheets when possible. If plan/profile sheets can not be used to show earthwork, than earthwork sheets may be used. Original and finish profiles must be shown on both options. The distribution of earthwork DOES NOT need to be shown or calculated. The center of mass DOES NOT need to be shown or calculated. The cuts and fills will be shown. Sheet totals are required for each sheet. The last plan/profile sheet shall also show project totals for cut, fill, borrow, excess, etc.

Please find enclosed in your packet definitions of terms, examples, methods for balancing a job and other information. If you need to share this information with squad personnel, you may obtain extra packets in my office.

If you have any questions or comments, please call my office.

SWR/swr



STATION	CUT AREA	CUT VOL	FILL AREA	FILL VOL
25+50	2.84		33.78	
26+00	4.92	7.18	29.88	58.94

$$\text{CUT VOL} = \frac{2.84 + 4.92}{2} \times 50 \div 27 = 7.18 \text{ CY}$$

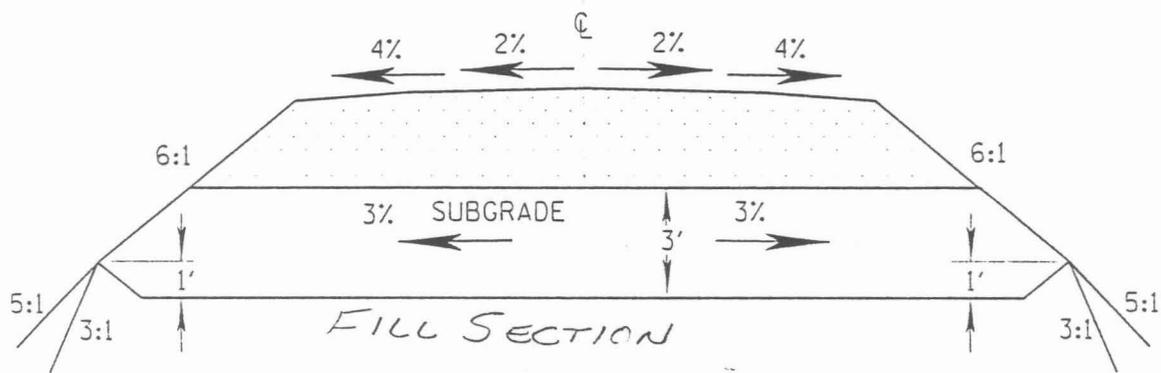
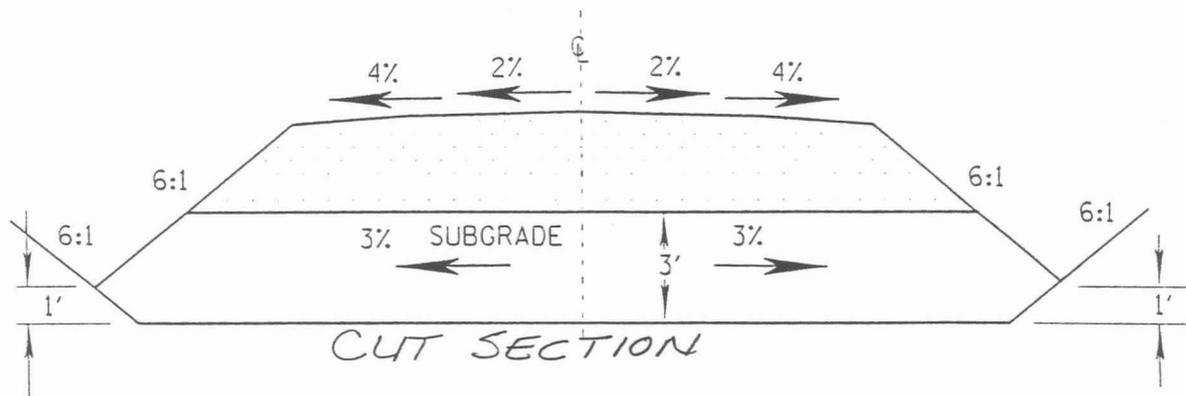
$$\text{FILL VOL} = \frac{33.78 + 29.88}{2} \times 50 \div 27 = 58.94 \text{ CY}$$

USE 25% SHRINKAGE FACTOR

$$\frac{7.18}{1.25} = 5.74 \text{ CY}$$

$$\text{BORROW} = 58.94 - 5.74 = 53.2 \text{ CY}$$

$$\text{UNCL. EXC} = 7.18 \text{ CY}$$



HIGH VOLUME CHANGE SOIL

CUT	219 20+99	391 1020 25+60	314 1400 31+33	731 32+19	987 40+25	EXCESS
FILL	375 21+69	7350 28+19	469 33+60	701 42+16		

TOTAL CUT  $219 + 1020 + 1400 + 731 + 987 = 31243$

TOTAL FILL  $375 + 7350 + 469 + 701 = 8895$

CUT IS > FILL x SF      EXCESS REQ'D

$CUT - (FILL \times SF) = EXCESS$

$13243 - (8895 \times 1.25) = 2124.25 \text{ CY OF EXCESS}$

## EARTHWORK COMPUTATION

### DEFINITIONS

#### F.M.E. - (FINAL MEASURE EMBANKMENT)

When using **F.M.E.**, the plans may also identify a certain amount of estimated excavation quantity by the symbol **E.S.F.E.**. When you use **F.M.E.** you are telling the contractor how much earthwork it will take to provide the final constructed roadway template. When computing borrow for **F.M.E.**, do not reduce the amount of borrow by the **E.S.F.E.** quantity.

#### EXAMPLE:

##### **DO NOT DO THIS !**

14,758 C.Y. FME REQUIRED

- 612 C.Y. ESFE (FROM CUTS & DITCHES)

14,146 C.Y. BORROW REQUIRED <----- **WRONG**

##### **DO LIKE THIS !**

14,758 C.Y. FME REQUIRED

612 C.Y. ESFE (FROM CUTS & DITCHES) (FOR INFO. ONLY)

**14,758 C.Y. BORROW REQUIRED <----- CORRECT !**

#### E.S.F.E - (Estimated State Furnished Excavation)

Quantities of **E.S.F.E.** shown on the plans are for the contractor's information only and may vary or may be varied by the engineer. Excavation designated as **E.S.F.E.** is required to be performed and will not be measured in its original position. **E.S.F.E. suitable for use in embankment or other features of the work shall be used and will be included in measured quantities of borrow excavation (F.M.E.).** Any materials designated as **E.S.F.E.** which are found to be unsuitable shall be removed and disposed of as provided elsewhere in the contract.

#### F.M. - (FINAL MEASURE)

Quantities of material shown as **F.M.** indicate that the material is to be measured for payment in its original position. In order to do this, the original position of the material will be cross-sectioned before any excavation is done. Then when excavation is complete, the area will be cross-sectioned again. The change of volume will be the pay quantity.

## TYPES OF EXCAVATION

**UNCLASSIFIED EXCAVATION** - Unclassified excavation is all excavation materials of whatever character encountered in the work except for those classes of excavation for which separate pay items are provided. This is the most common type of excavation we use.

**ROCK EXCAVATION** - When shown as a pay item, rock excavation will consist of material which cannot be excavated without blasting and shall include large boulders and detached stones having volumes of one-half cubic yard or more.

**MUCK EXCAVATION** - When shown as a pay item, muck excavation will consist of the excavation, removal, and disposal of natural deposits of soils and organic matter in accordance with the provisions of Section 203.03.7 of the standard specifications.

**BORROW EXCAVATION** - Borrow excavation will consist of approved material required for the construction of embankments or other portions of the work and shall be obtained from sources outside the R.O.W. except as provided in 203.03.3. Unless otherwise provided in the contract, the contractor shall make arrangements for obtaining borrow and pay all costs involved.

**CHANNEL EXCAVATION** - When shown as a pay item, channel excavation will consist of excavation and disposal of all material from widening, deepening, or straightening of an existing channel, or the construction of a new channel. Material designated as channel excavation and used in the roadbed or other required embankment construction shall be measured for payment as channel excavation only.

**EXCESS EXCAVATION** - When shown as a pay item, excess excavation will consist of excavation which cannot be satisfactorily used or disposed of within the R.O.W. exclusive of muck excavation, excess excavation may include any type, kind, or class of excavation which the engineer determines must be removed from the R.O.W.

**SURPLUS EXCAVATION** - When shown as a pay item, surplus excavation will consist of excavation within the R.O.W. which is in excess or unsuitable for embankments but can be satisfactorily used or disposed of within the r.o.w.

**STRUCTURE EXCAVATION** - This work consists of the removal of material necessary for the construction of foundations for box culverts, box bridges, pipe culverts and headwalls, and other construction. To calculate structure excavation, use the structure excavation tables for pipe culverts, headwalls, box culverts, and minor structures pamphlet (SOP no. CSD-50-17-50-000). **The depth allowed will be that actually removed between the natural ground line or the bottom of the graded section (whichever is lower) and the bottom of the footing or the bottom of the trench in the case of pipe.**

## HOW TO DETERMINE THE METHOD FOR BALANCING A JOB

- 1) Total all cuts.
- 2) Total all fills.
- 3) Determine the balance (shrinkage) factor.
- 4) Decrease the computed excavation (cut) quantity by the balance factor to determine the amount of embankment (fill) that will be produced.
- 5a) If the yielded cut  $[\text{cut}/(1+s.f.)]$  is greater than the fill, then the job can be balanced using material from within the r.o.w. the earthwork can then be distributed as shown in figure 5-3.04a on page 5-11 of the design manual.
- 5b) If the yielded cut is approximately 15% or more of the required embankment, the excavation is to be distributed and the remaining embankment is to be obtained by the contractor. The earthwork can then be distributed as shown in figure 5-3.04b on page 5-12 of the design manual.
- 5c) If the yielded cut is less than approximately 15% of the required embankment, the excavation is identified as **E.S.F.E.** And becomes the property of the contractor. The earthwork can then be distributed as shown in figure 5-3.04c on page 5-12 of the design manual.

**Note !!!** If your job is to be constructed in phases, make sure dirt from one phase can be used in the other phase(s). Do not just blindly assume that it can be done.

## CROSS-HAUL

When earthwork can be balanced using material from within the r.o.w. haul distances should be computed and recorded. One method of keeping up with this is using the earthwork distribution diagram. Haul distances should be kept to a minimum with waste and cross-haul avoided unless it is an absolute necessity. To determine the most efficient haul scheme, you can plot the mass diagram. To use the mass diagram, identify the peaks and valleys (inflection points) of the diagram. The most efficient distribution is from the peak(s) to the valley(s). You can use geopak's earthwork dialog to plot the mass diagram for a job worked on cadd.

## FREQUENTLY MISUNDERSTOOD CONCEPTS

1. How to apply the shrinkage factor.

If the shrinkage factor is 25%, then  $[(\text{CUT}/1.25) = \text{Ammt. Yielded}]$ .

**MULTIPLYING THE CUT BY 0.75 IS NOT THE SAME AS DIVIDING BY 1.25 AND IS NOT CORRECT.**

2. The following equation should always be true:

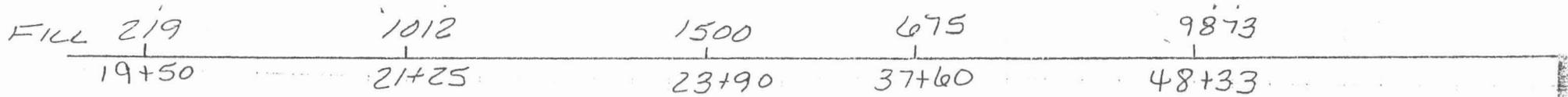
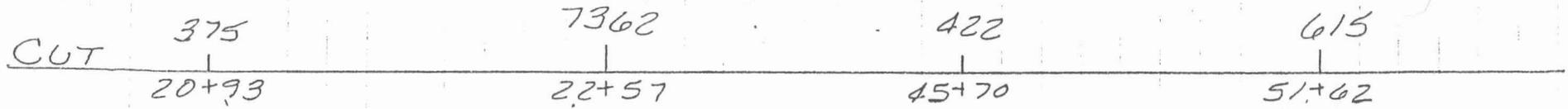
$$[(\text{CUT TO BE YIELDED})/(1+\text{S.F.}) + (\text{UNYIELDED CUT}) + \text{BORROW}] = [(\text{FILL REQUIRED}) + \text{EXCESS} + \text{SURPLUS}]$$

3. Often earthwork on 5-lane projects (projects where we are going from 2 lanes to 5 lanes) has to be considered as two separate projects. One will be constructing the left side. The other will be constructing the right side. If there is extra dirt from large cuts on one side, it generally can not be used on the other side for the fills. The extra dirt will need to be hauled away as excess, and the required dirt will be paid for as borrow.
4. Earthwork on bridge replacement projects (with a detour) generally has to be done in 3 stages.
  - First the detour construction and all cuts and fills associated with it. NOTE: you will not be able to use dirt from the mainline to construct the detour. If you need additional dirt, it has to be borrow.
  - Second, the mainline earthwork construction has to be determined. Usually part of the detour embankment can be utilized as a part of the ultimate mainline embankment. Take care to ensure that the "median" will drain throughout the project.
  - Third, once the traffic is shifted to the newly constructed bridge, some of the detour will have to be removed. Some of this dirt can be used to make the permanent slopes of the mainline prism (on the median side only), but most of it will be hauled away as excess.
5. On bridge replacement projects which may have multiple site, the excess described in the third stage listed in #4 above may be utilized at another site. This "excess dirt" will be paid for as either excess when removed from the old site or as borrow at the new detour site, but it will not be paid for as both excess and as borrow.

## ewh98m.txt

000000000000 111111111 222222222 333333333 444444444

160+50.00/1	0	1069.87	1.83	0
161+00.00/1	1910	992.67	0.00	2
161+50.00/1	1659	798.69	39.52	37
162+00.00/1	1417	731.68	22.63	58
162+50.00/1	988	335.52	19.53	39
163+00.00/1	343	34.38	198.78	202
163+50.00/1	32	0.00	937.74	1052
164+00.00/1	0	0.00	1535.66	2290
164+50.00/1	0	0.24	2016.96	3289
165+00.00/1	4	4.11	2283.10	3982
165+50.00/1	6	2.17	2493.18	4422
166+00.00/1	10	9.04	2575.85	4694
166+50.00/1	13	5.06	2555.41	4751
167+00.00/1	9	4.28	2453.32	4638
167+50.00/1	6	1.71	2344.35	4442
167+97.63/1	2	0.21	2158.76	3972
168+50.00/2	0	0.00	947.76	2876
169+00.00/2	0	0.00	809.03	1627
169+50.00/2	0	0.00	637.02	1339
170+00.00/2	0	0.00	484.06	1038
170+50.00/2	0	0.00	166.15	602
171+00.00/2	557	601.85	38.11	189
171+50.00/2	1020	500.17	42.56	75
172+00.00/2	654	205.84	168.42	195
172+50.00/2	267	82.93	201.40	342
173+00.00/2	111	36.81	218.21	389
173+50.00/2	84	53.94	212.21	399
174+00.00/2	141	98.31	188.57	371
174+50.00/2	224	143.98	175.00	337
175+00.00/2	341	224.60	165.85	316
175+50.00/2	948	798.83	90.08	237
176+00.00/2	1936	1292.58	0.00	83
176+50.00/2	2678	1600.02	0.00	0
177+00.00/2	2390	981.68	0.18	0
177+50.00/2	1310	433.20	0.61	1
178+00.00/2	524	132.33	98.54	92
178+50.00/2	141	20.26	220.70	296
179+00.00/2	21	2.29	306.35	488
179+50.00/2	18	17.62	303.56	565
180+00.00/2	138	131.85	257.99	520
180+50.00/2	427	328.92	231.47	453
181+00.00/2	745	475.59	201.36	401
181+50.00/2	1382	1017.20	58.61	241
182+00.00/2	2323	1491.54	0.00	54
182+50.00/2	2993	1741.16	0.00	0
183+00.00/2	3405	1935.87	0.00	0
183+50.00/2	3692	2051.31	0.00	0



$$\text{TOTAL CUT} = 375 + 7362 + 422 + 615 = 8774$$

$$\text{TOTAL FILL} = 219 + 1012 + 1500 + 675 + 9873 = 13279$$

FILL IS > CUT BORROW NEEDED

$$\text{FILL} - (\text{CUT} / 1.25) = \text{BORROW}$$

$$13279 - (8774 / 1.25) = 6259.8 \text{ CY BORROW REQ'D}$$