INSPECTOR'S HANDBOOK

GRADING

IOWA STATE HIGHWAY COMMISSION

AMES, IOWA

1969

GRADING

Al Leber

INTRODUCTION

The function of a grading inspector is to assure work of good quality in accordance with plans, proposals, and specifications. He should leave nothing to chance. He must know how the work is to be done and why it is to be done in a certain way. Competent inspection prevents mistakes and encourages efficient work that will produce a finished product of high quality.

Keep in mind the overall construction program as you do your work. When the grading is completed something else is going to be done with this road. Portland Cement Concrete Paving, Asphalt Concrete Paving, Erosion Control Work, or Tree Planting will follow under other contracts. The results of your work affects subsequent operations. Proper drainage of cut and fill areas is an example.

Water that may drain and collect a short distance from the roadway may not interfere with your daily construction and may seem unimportant for the present, but in the months to come, when the contractor starts the finish portion of his work in this area, a saturated condition could result in delays in finishing, initially poor ditch construction, and also hamper the erosion control progress.

We have striven to present the material in a simple, practical manner designed specifically for the beginner. With this in mind the following is suggested:

1) Have the Standard Specifications on or near your possession at all times during construction hours. Know and understand the various sections on "Method of Measurement" and Method of Payment".

2) Obtain a copy of the "Field Book Setups". (Construction Records)

3) Take the Plan Reading Course available in your Resident Office.

4) Be familiar with the safety handbooks on demolition and trench excavation published by the State of Iowa Employment Safety Commission.

5) Study this manual.

CONTENTS

Project Plans

The Highway Commission has an excellent plan reading course available to you. No attempt will be made here to improve or duplicate this course. It is suggested that you take this course for it will be of great help to you in the understanding and knowledge of the current project plans.

The plans are foremost in all the specifications, documents, and tools available to you to get the job completed. Briefly, the plans, sheet by sheet, give you in detail what work is to be done and where it is to be done. The index sheet will list by page number the description of the work and the individual sheets will give you the exact location of the work to be done.

Study the general notes sheet. This is most important for it gives you information as to items to remove or replace, what work is incidental to the contract, detours, payments, time to do various phases of work called stage construction, information pertaining to the utility companies, signing, lighting, etc. A complete understanding of the estimated project quantities and the pertinent notes is a must.

The back section of the plans contain the standard design sheets that graphically explain how the work is to be done. These include size and dimensions of pipe, dikes, fences, signs, guard rail, barricades, and many more items. Read and reread the plans so that no item is omitted in the construction stage.

Contract Documents

The contract is a written agreement between the contracting authority (State of Iowa) and the contractor, setting forth the obligations of the parties thereunder, including, but not limited to, the performance of the work, the furnishing of labor and material, and the basis of payment.

The contract shows the type of work, project number, miles in the contract and the contractor's signature. A contract number is assigned to each separate contract. The contract item, the quantity and unit of work such as cubic yard, lineal feet, tons, etc., are also listed. The contractor's bid price for each item is shown opposite the contract items. The date to begin and the date to complete the work is posted on the front sheet.

The number of items needed to complete the work will determine the number of sheets in any given contract. A copy of a contract with Miller Excavating Company of Omaha, Nebraska, is shown on Exhibits A and B. Exhibits C and D are copies of the contract. The contracts are reproduced on white 6"x 8" cards to facilitate handling as they can be pasted in the back of the field book. This makes them handy references and checks on the contract items. The illustration is in two parts due to being reproduced for this manual. Normally one card with the contract items on both sides is used.

In addition to the contract, the contract documents include the Standard and Supplemental Specifications, Special Provi-

sions, the plans, and any agreements which are required to complete the work.

TR 13088
Form 3830 (04-64) 5-14-67

CONTRACT NO. 01458

Type of Work GRADING Project No I-IG-F-29-2/6/49--05-78
M es 1.637
Co's Contract $ (By County POTTAWATT.
ON INTERSTATE ROUTE 29 IN SECS.7 & 18-74-43 SOUTH OF
COUNCIL BLUFFS

THIS AGREEMENT made and entered by and between the Iowa State Highway Commission, Ames, Iowa, consisting of the following members
HARRY J. BRADLEY, JR., DERBY D. THOMPSON, ROBERT BARRY,
KOERT S. VOORHEES, & JOHN R. HANSEN party of the first part, and
MILLER EXCAVATING CO. OF OMAHA, NEBRASKA 30160

party of the second part.

WITNESSETH: That the party of the second part, for and in consideration of $**662,660.46 payable as set forth in the specifications constituting a part of this contract, hereby agrees to construct various items of work and, or, furnish various materials or supplies in accordance with the plans and specifications therefor, and in the locations designated in the notice to bidders, as follows:

Item No.	ITEM	Quantity	Unit	Unit Price	Amount
1	EMBANKMENT	835,497	CU YD	.63900	533,882.58
2	EXCAVATION, CLASS 20	495	CU YD	.75	371.25
3	BACKFILL, COMPACTING, ADJACENT TO CULVERTS AND STOCKPASSES	207	CU YD	1.50	310.50
4	COMPACTING EMBANKMENT WITH MOISTURE & DENSITY CONTROL	146,241	CU YD	.04	5,849.64
5	REMOVAL OF EXISTING STRUCTURES	LUMP SUM			1,200.00
6	BACKFILL, GRANULAR	3,129	CU YD	2.40	7,509.60
7	BACKFILL, POROUS	74	CU YD	8.00	592.00
8	TOPSOIL, STRIP., SALVAGE AND SPREADING	6,369	CU YD	.45	2,866.05
9	CULVERT, CONCRETE ROADWAY PIPE [illegible] IN. DIA.	300	L.F.	7.50	2,250.00
10	[illegible]ERT, CONCRETE ROADWAY PIPE [illegible]N. DIA.	800	L.F.	9.50	7,600.00
11	CULVERT, CONCRETE ROADWAY PIPE 36 IN. DIA.	278	L.F.	12.25	3,405.50
12	CULVERT, CORR. METAL ROADWAY PIPE, 36 IN. DIA.	74	L.F.	9.50	703.00
13	APRONS, CONCRETE, 24 IN. DIA.	8	ONLY	66.50	532.00
14	APRONS, CONCRETE, 30 IN. DIA.	12	ONLY	82.50	990.00

[illegible]party of the second part certifies by his signature on this contract that he has complied with 324.17(8) of the 1962 Code of Iowa as amended [illegible] said specifications and plans are hereby made a part of and the basis of this agreement, and a true copy of said plans and specifications is now on file in the office of the Iowa State Highway Commission under date of JULY 13, 1967
That in consideration of the [illegible] the party of the first part hereby agrees to pay the party of the second part, promptly and according to the requirements [illegible] the prices set forth, subject to the conditions as set forth in the specifications.

The [illegible] the notice and instructions to bidders, the proposal filed herein, the general specifications of the Iowa State Highway Commission for 1964, together with special provisions attached, together with the general and detailed plans, if any, for said project I-IG-F-29-2/6/49--05-78, together with second party's performance bond, are made a part hereof, and together with this instrument constitute the contract between the parties hereto.

That it is further understood and agreed by the parties of this contract that the above work shall be commenced on or before

Date to Begin	Date to Complete
AUG. 28, 1967	OCT. 5, 1968

That time is the essence of this contract and that said contract contains all of the terms and conditions agreed upon by the parties hereto
IN WITNESS WHEREOF the parties hereto have set their hands for the purposes herein expressed to this and three other instruments of like tenor, as of
the [illegible] day of AUG 29 1967, 19[illegible]

IOWA STATE HIGHWAY COMMISSION

Party of the First Part

A

[illegible]LER EXCAVATING CO. OF OMAHA, NEBRASKA

Party of the Second Part

ITEM NO	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
15	APRONS, CONCRETE, 36 IN. DIA.	4	ONLY	113.70	454.80
16	APRONS, METAL, 36 IN. DIA.	1	ONLY	100.00	100.00
17	DIAPHRAGM, CORR. METAL, TYPE A 36 IN.	1	ONLY	50.00	50.00
18	GATE, OUTLET CONTROL, FLAP, 36 IN.	1	ONLY	260.00	260.00
19	SUBDRAIN, CORR. METAL PIPE 6 IN. DIA.	215	L.F.	2.00	430.00
20	SUBDRAIN, CORR. METAL PIPE PERFORATED, 6 IN. DIA.	470	L.F.	2.10	[illegible]
21	OUTLET, RF-22	3	ONLY	50.00	
22	TRENCH, SUBDRAIN - TYPE 4	1,470	L.F.	1.25	1, [illegible]
23	DRAIN, VERTICAL SAND PILE	7,074	L.F.	4.00	28,296.00
24	SURFACING, CLASS A CRUSHED STONE, DRIVEWAY	200	TONS	3.00	600.00
25	BARRICADES	9	ONLY	100.00	900.00
26	FENCE, CHAIN LINK, 72 IN. HT.	79,840	STAS.	240.00	19,161.60
27	FENCE, FARM FIELD RIGHT OF WAY	66,300	STAS.	65.00	4,309.50
28	SEEDING, STABILIZING CROP	70.700	ACRES	32.00	2,[illegible].40
29	FERTILIZING FOR STABILIZING CROP SEEDING	70.700	ACRES	35.00	2,474.50
30	CONCRETE, STRUCTURAL	9.100	CU YD	100.00	910.00
31	STEEL, REINFORCING	916	LBS.	.15	137.40
32	MANHOLE, SPECIAL AS PER PLAN	1	ONLY	400.00	400.00
33	TEE-SECTION, CONCRETE PIPE 48 IN. ON 48 IN.	1	ONLY	140.00	140.00
34	CULVERT, REMOVE & STOCKPILE CONC. PIPE, 48 IN. DIA.	609	L.F.	10.00	6,090.00
35	CULVERT, CONCRETE ROADWAY PIPE 48 IN. DIA.	608	L.F.	35.18	21,424.62
36	FIELD LABORATORY	1	ONLY	500.00	500.00
37	CLEARING & GRUBBING	2003			2,723.02
				TOTAL	$662,660.46

B

Proj. No. I IG-F-29-2/6/49--05-78
Res Engr. JAMES W. PRESNELL
Letting Date ~~AUG. 10, 1967~~ 8-11-67
Special Prov. DEC. 1965 #PR 1273 & PR 1274, 7/24/67 #607, 11/9/65 #593, 6/20/67 #615, 7/18/67 #616, 7/18/67 #617, 5/24/65 #581, 4/25/59 #42[illegible]

County POTTAWATT.
Address COUNCIL BLUFFS, IOWA
Liquidated Damages $150.00

Date Started ______ Field Comp ______ Cert Comp ______

CONTRACT NO. [illegible]

Type GRADING
Project I IG-F-29-2/6/49--05-78
Miles 1.637
County POTTAWATT.
[illegible] IN INTERSTATE ROUTE 29 IN SECS. 7 & 18-74-43 SOUTH OF COUNCIL BLUFFS

THIS AGREEMENT [illegible] HARRY J. BRADLEY, JR., JERRY J. THOMPSON, ROBERT BARRY, ROBERT S. VOORHEES, & JOHN R. HANSEN
MILLER EXCAVATING CO. OF OMAHA, NEBRASKA 30160

[illegible] $**662,000.40 [illegible]

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	EMBANKMENT	835,437	CU. YD.	.63900	533,847.[illegible]
2	EXCAVATION, CLASS 20	495	CU. YD.	.75	371.25
3	BACKFILL, COMPACTING, ADJACENT TO CULVERTS AND UNDERPASSES	207	CU. YD.	1.50	310.5[illegible]
4	COMPACTING, EMBANKMENT WITH MOISTURE & DENSITY CONTROL	146,241	CU. YD.	.04	5,849.64
5	REMOVAL OF EXISTING STRUCTURES	[illegible]	LUMP SUM		1,[illegible]00.00
6	EXCAVATION, BACKFILL	[illegible],129	CU. YD.	[illegible]	[illegible],509.63
7	BACKFILL, [illegible]	74	CU. YD.	4.00	592.[illegible]
8	TOPSOIL, STRIP, SALVAGE AND SPREADING	6,369	CU. YD.	.45	2,866.[illegible]
9	CULVERT, CONCRETE ROADWAY PIPE [illegible] IN. DIA.	3[illegible]	L.F.	7.50	2,250.00
10	CULVERT, CONCRETE ROADWAY PIPE [illegible] IN. DIA.	8[illegible]	L.F.	9.50	7,600.00
11	CULVERT, CONCRETE ROADWAY PIPE [illegible] IN. DIA.	278	L.F.	12.25	3,405.50
12	CULVERT, CORR. METAL ROADWAY PIPE, 36 IN. DIA.	74	L.F.	9.50	703.00
13	APRONS, CONCRETE, 24 IN. DIA.	8	ONLY	66.50	532.00
14	APRONS, CONCRETE, 30 IN. DIA.	12	ONLY	82.50	990.00

[illegible]

AUG 29 1967

[illegible] STATE HIGHWAY COMMISSION

[illegible] of the First Part

MILLER EXCAVATING CO. OF OMAHA, NEBRASKA

C

Party of the Second Part

ITEM NO	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
15	APRONS, CONCRETE, 36 IN. DIA.	[illegible]	[illegible]	[illegible]	[illegible].80
16	APRONS, METAL, 36 IN. DIA.	[illegible]	ONLY	[illegible].00	[illegible].00
17	DIAPHRAGM, CORR. METAL, TYPE A 36 IN.	1	ONLY	50.00	50.00
18	GATE, OUTLET CONTROL, FLAP, 36 IN.	1	ONLY	260.00	260.[illegible]
19	SUBDRAIN, CORR. METAL PIPE 6 IN. DIA.	[illegible]15	L.F.	2.00	[illegible]30.00
20	SUBDRAIN, CORR. METAL PIPE PERFORATED, 6 IN. DIA.	470	L.F.	2.10	98[illegible]
21	OUTLET, RF-22	3	ONLY	50.00	150.[illegible]
22	TRENCH, SUBDRAIN - TYPE 4	1,47[illegible]	L.F.	1.25	1,837.5[illegible]
23	DRAIN, VERTICAL SAND PILE	7,074	L.F.	4.00	2[illegible]
24	SURFACING, CLASS A CRUSHED STONE, DRIVEWAY	200	TONS	3.00	600.[illegible]
25	BARRICADES	9	ONLY	100.00	900.[illegible]
26	FENCE, CHAIN LINK, 72 IN. HT.	[illegible]	STA.	240.00	1[illegible],161.6[illegible]
27	FENCE, FARM FIELD RIGHT OF WAY	[illegible]	STA.	65.00	[illegible],309.5[illegible]
28	SEEDING, STABILIZING CROP	[illegible]	ACRE	[illegible]	[illegible]
29	FERTILIZING FOR STABILIZING CROP SEEDING	[illegible]	ACRE	[illegible]	[illegible]
30*	CONCRETE, STRUCTURAL	[illegible]	[illegible]	[illegible]	[illegible]
31	STEEL, REINFORCING	[illegible]	[illegible]	[illegible]	[illegible]
32	MANHOLE, SPECIAL AS PER PLAN	[illegible]	[illegible]	[illegible]	[illegible]
33	TEE SECTION, CONCRETE PIPE 48 IN. ON 48 IN.	1	[illegible]	[illegible]	[illegible]
34	CULVERT, REMOVE & STOCKPILE [illegible] PIPE, 48 IN. DIA.	[illegible]	[illegible]	[illegible]	[illegible]
35	CULVERT, CONCRETE ROADWAY PIPE 48 IN. DIA.	[illegible]	L.F.	[illegible]	[illegible]
36	FIELD LABORATORY	[illegible]	ONLY	[illegible]	[illegible]
37	CLEAN-IN [illegible]	200[illegible]			[illegible]
				TOTAL	$662,[illegible]

D

Proposal Form

When a contract is ready to be let the commission sends out the proposal form to the various contractors who plan to submit bids. The contractor uses this form for estimating and to determine what his final bid price will be. From the combined proposal forms submitted the commission can determine which contractor has made the lowest bid.

The heading shows the project number, type of work, etc. as does the contract.

The front sheet will give the group or division number, amount of proposal guaranty, date to begin, a date the work is to be completed and the liquidated damages per calendar day.

Group or division number is assigned by the commission. Whether the work is urban or rural, type of work, and the monetary participation by the State and Federal Agencies will determine the group or division number.

Amount of proposal guaranty - this is the security furnished by the bidder with his proposal for a project, as guaranty he will enter into a contract for the work if his proposal is accepted. If the contractor does not submit a certified check with his bid, his bid will not be read. All certified checks will be returned to the unsuccessful bidder.

The date to begin and the date to complete the work are self-explanatory.

Liquidated damages - this is the amount of money that could be charged the contractor per calendar day for each day he

works beyond the contract completion date.

The date of letting will also be shown on the bottom left hand corner.

An example of the front sheet of a proposal form is shown as Exhibit E.

Form . 2M-2-66—14216

PROPOSAL FORM

Proj. No. I-EG-F-29-2/6/49--05-78

Type of Work GRADING

System INTERSTATE ROAD Miles 1.637 County POTTAWATT.

Location and description ON INTERSTATE ROUTE 29 IN SECS.7 & 18-74-43 SOUTH OF COUNCIL BLUFFS

~~Decision No AG-14,120~~

~~6-12-67~~

Proposal of ______________________________ (name of bidder)

______________________________ (name of town) (State)

TO IOWA STATE HIGHWAY COMMISSION

ESTIMATING

..................hereby certify that ....the only person or persons interested [illegible] plans, specifications, and contract form, including the special [illegible] understand that the quantities of work shown herein are approximate only and [illegible] understand that all quantities of work, whether increased or decreased [illegible] propose to furnish all necessary machinery, equipment, tools, labor and other means of construction and to furnish all materials specified in the manner and the time prescribed and to do the work at the prices hereinafter set out, and that it is not in violation of the provisions of Section 314.2 Code of Iowa, 1962.

We further propose

To do all "Extra Work" which may be required to complete the work contemplated, at unit prices or lump sums to be agreed upon in writing prior to starting such work, or if such prices or sums cannot be agreed upon, to perform such work on a force account basis, as provided in the Specifications.

To execute formal contract within fifteen days or forfeit the proposal guaranty furnished herewith.

To begin work by the date specified and to complete the same within the contract period, or to pay the liquidated damages stipulated below accruing for each calendar day elapsing after the expiration of the contract period, before completion of the work.

Group or Division Number	Amount of Proposal Guaranty	Date to Begin	Date to Complete or Number of Working Days	Liquidated Damages Per Calendar Day
1	$31,000.00	AUG. 28, 1967	OCT. 5, 1968	$150.00

PROPOSAL

To furnish a contract bond in an amount not less than 100 percent of contract award, as security for the construction and completion of the work awarded.................. [illegible]

Enclosed herewith [illegible] ....dollars ($..................) as a proposal guaranty [illegible] the formal contract or bond is not executed, if award is made to the undersigned.

By virtue of statutory authority preference will be given to products and provisions grown and coal produced within the State of Iowa where applicable.

In submitting the following schedule of prices, we agree that the minimum wages paid shall be in accordance with:

NOTE--FOR MINIMUM WAGES TO BE PAID ON THIS PROJECT SEE TABULATION OF RATES ATTACHED TO PR #1273 INTERSTATE HIGHWAYS.

E

Date of Letting AUGUST 11, 1967 9 00 AM Signed ______________________________

Signatures are to comply with requirements of the specifications. ______________________________

Each proposal lists the specifications that apply to the contract. Included are the Standard Specifications, Supplemental Specifications, and all applicable Special Provisions as shown in the following Exhibits, F and G.

SPECIAL PROVISIONS AND SUPPLEMENTAL SPECIFICATIONS
for

Pottawattamie County Grading Projects I-IG-F-29-2(6)49--05-78
I-IG-80-1(54)3--04-78
F-92-1(2)--20-78

December 1965 Federal Aid Contracts -
Interstate Highways #PR-1273
Primary Highways #PR-1274
February 28, 1967 Supplemental Specifications for Construction Projects - Div. 2 #607
November 9, 1965 Manual on Uniform Traffic Control Devices (Part V) #583
June 20, 1967 Minimum Wages on Federal Aid Primary Projects #615
July 18, 1967 7000D Circular Reinf. Conc. Culvert Pipe #616
July 18, 1967 Vertical Sand Pile Drains and Granular Blankets #617
June 24, 1965 Standard Provisions for General Liability Policies, R.R. Protective Liability #581
August 25, 1959 Special Provisions for Railway Grade Separation Structures #420

UNIT BIDS must be typed or shown in ink and a total amount of the bid must be shown or the bid will be rejected.

Utilities Adjustments by the following companies will be carried on concurrently with other work on the project.

Iowa Power & Light Co.
Northwestern Bell Telephone Co.
American Oil Co.

Measuring Excavation

Excavation on this project will not be measured in cut - but instead will be measured in the embankment as constructed. The quantity measured for payment will be determined from measurements of the exposed neat lines of the embankment and the original ground line, or the ground line as corrected for subsidence as determined from settlement plates.

Fertilizer:

Rate: 300 lbs. of 18-46-0 chemically combined commercial fertilizer per acre.

F

Pottawattamie I-IG-r-29-2(6)49--05-78 (2 of 17) Grading
I-IG-80-1(54)3--04-78
F-92-1(2)--20-78

Berm fill and pier excavation necessary for construction of the bridges shall be completed by the following dates:

Design 3465	Sta. 5204+ 06	Over CB&Q R.R. Stage 1 by Winter Shutdown, Remainder by May 18, 1968
Design 2765	Sta. 5224+32.65	Over I-29 - June 1, 1968
Design 865	Sta. 5238+84	Over Mosquito Creek & N & W R.R.- June 1, 1968
Design 1566	Sta. 168+21.20	Over CB&Q R.R. - July 6, 1968
Design 2865	Sta. 218+14	Over Mosquito Creek - Winter Shutdown
Design 3765	Sta. 1275+88.8	Over Ramp B - June 1, 1968
Design 765	Sta. 310+50	Over CB&Q R.R. - Winter Shutdown
Design 5065	Sta. 13+93.5	Over Ia. 375 - Stage 1 by Winter shutdown, remainder by May 18, 1968.
Design 3565 & 3665		Over CMSt.P&PRR, CRI&P R.R. and N & W R.R.- Stage 1 by Winter Shutdow remainder by June 15, 1968.

One Field Laboratory has been estimated for the following work on each project.

Compacting Embankment with Moisture & Density Control G

One or more of these laboratories may be deleted if it is found that the total of three is more than needed.

The Right of Way Contract

The right of way is the land which is reserved or secured by the state for constructing the work, or obtaining the material for construction. The right of way contract is the agreement between the state and the property owner.

The inspector on the project and the survey party chief each should have a copy of this most important document. It shows

a station to station description of the land we acquire and information as to buildings, land, and fences. The items of construction, such as driveways and field entrances are shown on the back sheet and must be constructed as stated because of the controlled access provisions. Exhibits H and I are copies of a Right of Way contract.

Form C-1 6 Parcel No. 1 **CONTRACT** PROGRAM 1966 County Pottawattamie Asst Const. Engr.
Road No. 2.6 Project No. F-FG 4-1(1)-24-78

THIS AGREEMENT Made and entered into this 31st of August A.D., 1966 by and between Lynn E. Goodsell and Louise M. Goodsell

of the County of Pottawattamie Address Route #3 Council Bluffs party of the first part, and Iowa State Highway Commission, acting for the State of Iowa, party of the second part.

WITNESSETH:

In consideration of the agreements, covenants and provisions herein contained, the party of the first part hereby agrees to furnish to the second party a warranty deed to the real estate situated in Sec. 21 Twp. 75 N Rge. 43 W County of Pottawattamie State of Iowa, to-wit:

From Sta.	3206+00	to Sta.	3207+50	a strip	33-100	ft. wide	West	side,
From Sta.	3207+50	to Sta.	3208+12±(PL)	strip	100	ft. wide	West	side,
From Sta.		to Sta.		a strip		ft. wide		side,
From Sta.		to Sta.		a strip		ft. wide		side,
From Sta.		to Sta.		a strip		ft. wide		side,
From Sta.		to Sta.		a strip		ft. wide		side,
From Sta.		to Sta.		a strip		ft. wide		side,
From Sta.		to Sta.		a strip		ft. wide		side,
From Sta.		to Sta.		a strip		ft. wide		side,
From Sta.		to Sta.		a strip		ft. wide		side,

measured from centerline of proposed highway as shown on plans for said project, ~~INCLUDING ALL RIGHTS OF ACCESS TO AND FROM SAID HIGHWAY from Sta.~~ to Sta.

It is hereby agreed that possession of the premises is the essence of this contract and that party of the second part may take immediate possession of the premises upon signing of this contract, for the purposes above set forth, and first party further agrees to convey to second party for the consideration hereinafter named, on or before the 1st day of November, 1966.

Party of the second part agrees to purchase the above described real estate and to pay therefor upon delivery of warranty deed conveying good and sufficient title.

Approximately	1/5	acres of R. O. W. at $	~~per acre~~ $	100.00
Approximately		acres of Borrow at $	~~per acre~~ $	
Building		rods of new fence at $	~~per rod~~ $	
Moving	14	rods of old fence at $	~~per rod~~ $	
General			$	
Total	Land, fence and all damages of whatsoever nature		$	300.00 lump sum

~~Should the acreage taken for highway be more or less than shown above, same is to be paid for at the agreed unit prices.~~ Any and all verbal agreements are merged in this written contract. Should the highway as finally located require none of the real estate described, this contract becomes null and void. Any provisions on the reverse side of this contract are a part of this contract as fully as if written on this side. In consideration of the premises First Party consents to the establishment, realignment and/or any change of grade of said highway and waives any and all claims for damages arising therefrom.

(Signed) X Lynn E. Goodsell
Louise M. Goodsell
Party of the First Part

(Signed) IOWA STATE HIGHWAY COMMISSION
Party of the Second Part

Approval Recommended 8/31, 1966.

By David S. Williamson
Right of Way Agent

By James L. Stohr
Right of Way Engineer SEP 14 1966

H

MEMORANDA

Exact and full name of owner, as same appears of record . . . . . Lyna E. Goodsell and Louise M. Goodsell
Husband & Wife

If married, full name of spouse . . . . . .

If mortgage or other liens, show name of holders and addresses . . . . . None

If an estate, give full particulars below:

It is understood that the field entrance at Sta. 3207+90 westside will be eliminated.

The second party agrees to construct a joint field entrance at Sta. 3207+50 westside.

The lump sum payment on this contract includes full settlement to the first party for the cost of moving fence from its present location to the new Right of Way line from Sta. 3206+00 to 3208+12 westside.

ROW .2 acres @ $500/acre	$100.00	
Moving 4 rods of fence @ 2.50/rd	10.00	
Consequential damage	165.00	
Lump sum	300.00	code # 464-2

Damage items
irregular right of way line
extra fence offset
new gate
change of present entrance to a joint entrance

I

Grading Equipment

Hauling Equipment - The contractor may use any type hauling equipment he so desires in performance of his contract duties. The Iowa Highway Commission's primary concern is seeing that the contractor has adequate equipment to complete the work within the period of time designated on the contract.

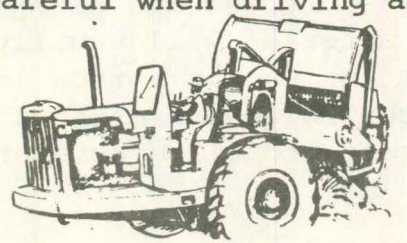
With the exception of sand fills which are sometimes dredged and plumped into place, embankment material will usually be transported from the cut or borrow to the fill by one of the following methods: cats and scrapers, self-propelled scrapers, or dump trucks.

Scrapers

Scrapers, both self-propelled and tractor drawn are designed to dig, load, haul, dump, and spread. A cutting edge on the forward edge of the scraper bowl is lowered into the ground and the forward motion of the scraper causes dirt to flow up into the bowl. When the scraper has a full payload on, the cutting edge is pulled out of the ground. Then the scraper transports this load to the fill area and dumps the dirt out in windrows. Scrapers vary in size from about three cubic yards up to about sixty cubic yards heaped capacity. Rubber-tired tractor scrapers normally require push loading, but with longer hauls or good haul roads or both, these machines will move far more material due to their high speed.

Track-type tractor drawn scrapers normally have the ability to load themselves without the aid of a pusher. These units are used where power, not speed, is the essential factor. This may be due to ground conditions, grades, short haul distance, or small size of the job.

As a safety precaution, do not stand close to the scrapers when they are hauling dirt. The scrapers are usually heaped high with dirt and due to their speed and mobility, lumps have a tendency to fall off. Be especially careful when driving and passing these units.



Axle loads from hauling equipment shall not exceed the values shown in the following table:

Span	Design Fill	Depth of Fill in Place	Max. Axle Load
*Under 8	0	0	50,000
*8 or more	0	0	45,000
*6 or less	0 or more	4 (minimum)	80,000
*8 or more	4 or more	4 "	80,000
*6 or less	0 or more	5 "	100,000
*8 or more	5 or more	5 "	100,000

The designed fill must be in place before scrapers may cross over box culverts, with the following exceptions:

1. Hauling of axle loads up to 80,000 pounds is permitted over culverts designed for 4 feet or more fill, after a fill of 4 feet is in place.

2. Hauling of axle loads up to 100,000 pounds is permitted over culverts designed for 5 feet or more fill, after a fill of 5 feet is in place.

3. Hauling of axle loads up to 80,000 pounds is permitted over culverts having a 6-foot span or less, designed for zero feet of fill or more, after a fill of at least 4 feet is in place.

*Haul speed of loaded scraper over these culverts must not exceed five miles per hour.

4. Hauling of axle loads up to 100,000 pounds is permitted over culverts having a six foot span or less, designed for zero feet of fill or more, after a fill of at least four feet is in place.

Hauling with scrapers over pipe culverts is permitted only after the height of fill over the pipe is as tabulated below for scrapers of given weight.

Axle Load	Height of Fill
80,000 pounds (maximum)	Equal to its inside diameter but not less than two feet.
Over 80,000 pounds to 100,000 pounds (maximum)	Equal to its inside diameter but not less than three feet.

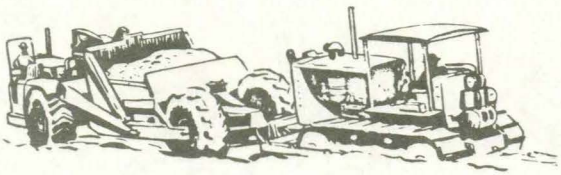
These restrictions do not relieve the contractor from responsibility for damage to reinforced concrete box culverts or pipe during the hauling operations.

Supporting Equipment

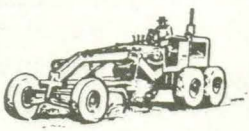
Supporting equipment is the machinery that, in addition to hauling units, is necessary to construct embankments. The following list describes some of the most common supporting equipment which would be encountered on most every grading project. The inspector must be satisfied that the contractor has supplied enough of this

equipment to comply with the compaction specifications.

Push Cats - Usually track-type tractors used to push the scrapers while loading.



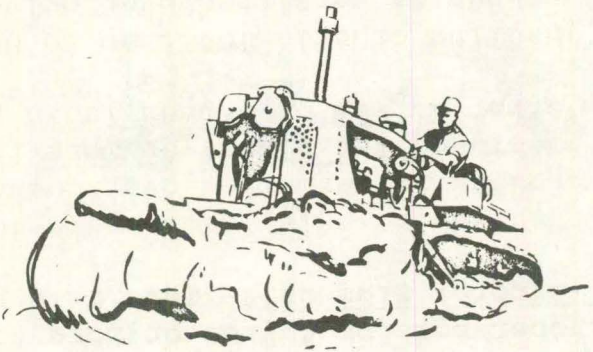
Patrols - (Motor Graders) - This is a mobile rubber-tired machine equipped with an adjustable blade. The primary purpose of this machine is "finishing"; for example, smoothing slopes, ditches, and other rough areas, and fine-grading the roadway top to given tolerances. This machine is used in earlier stages of construction to keep haul roads smooth; strike off lifts of embankment; and maintain drainage.



Dozers

The conventional straight dozer blade mounted on the majority of tractors is designed for moving earth, rock, etc. The dozer family consists of straight dozers,

angle dozers, tilt dozers, and rooters. Traditionally the straight dozer is known as the workhorse on most earth moving jobs. The dozer blade, whichever type is used, is attached to the tractor by two long push beams. The blade can be raised or lowered either hydraulically or by cable controls.



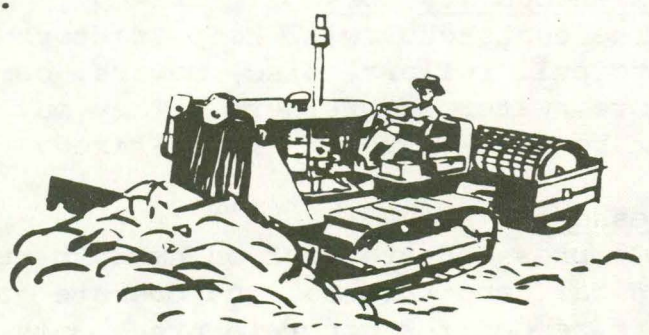
Discs

Discs are single axle or tandem axle earthworking machines comprised of flat circular blades fitted to the axles. These machines are used to reduce large lumps of dirt, grass, cornstalks, etc. to the desired composition. In grading operations, they are frequently used to aerate soil so it will dry, or to mix soil to which water has been added. They are pulled by a tractor and while operating trails at an angle.

Rollers

There are two common types of tamping rollers, the sheepsfoot and the grid roller. These can be self-propelled or pull type. Tamping type rollers consist of one or more cylindrical sections having studs or feet

projecting not less than six and one-half inches from the surface of the drum. The number of tamping feet and the area of the feet shall be such that the pressure on a single row of feet approximately parallel to the axis of the drum is not less than 200 pounds per square inch, when supporting the roller. Compaction starts at the bottom of the lift with this type roller. Compaction is achieved after the required amount of rolling, provided the roller walks out. Not more than three inch penetration of the feet is commonly referred to as "walking out".



The resident offices have a list of sheepsfoot rollers. The manufacturer's name, model and all the specifications are listed. When the contractor moves his equipment on the project site, make a visual check of his rollers and check the manufacturer's specifications to make sure the rollers are usable. Many rollers will not meet the required pressure of 200 pounds per square inch unless the weight of the roller is increased. This can be done with

a liquid. Water is most often used but diesel fuel has been used. Cold weather may require some anti-freeze solutions. The simplest method to get the required weight is to fill the drum while the roller is on the scales being weighed. Sand may be added to the water if water alone will not make the weight. Contractors sometimes drain the rollers when transporting them from project to project to lighten the load. Check each roller on the project. Check rollers for leakage.

Miscellaneous Tractors

The contractor will keep tractors on hand to pull rollers, disc, mowers, compressors, water wagons, etc. They may either be track type or rubber-tired.

Compressors

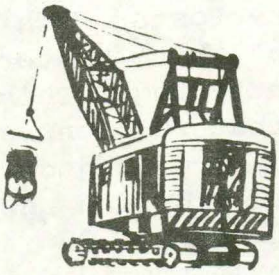
Compressors are kept on hand to run mechanical hand tampers, and operate jack hammers needed for concrete break-outs.

Water Wagon (Trucks)

If the excavation is so dry that it cannot be properly compacted, the engineer may require watering. This would necessitate a water wagon. Sometimes the contractor's haul road and the fill is so dry, and windy conditions make the working area so dusty that visibility is impaired. Water wagons may be requested by the engineer for safety's sake.

Dragline

This is normally a track-type mobile unit. They may also be truck mounted. The boom and dragline bucket will vary in size depending on type of work to be done. Some of the uses for draglines are channel excavation, loading hauling units, cutting ditches, and stockpiling material.



PREPARATION OF CONSTRUCTION SITE

Before the contractor actually starts moving dirt, there are a few things that must be done on and near the project site.

Set Project Signs

The general requirements for this sign are given in the plans. This sign shall be furnished and installed by the contractor. The message and the location of the sign shall be furnished by the Engineer.

Post the Wage Rate, Discrimination, and Fraud Poster

These posters are furnished by your resident office. They must be placed on the construction site so all the contractor's employees can see them at all times

and for the duration of the contract. The two most common places to set them are at the contractor's field office (usually a trailer) or at the area used by the contractor to park and service his equipment. These posters should be covered with plastic or some other transparent material to protect them from the weather. The contractor will post them.

1) Wage Rate Poster - This is an 11" x 16" white poster with bold black lettering. This poster states that the contractor's employees are subject to minimum wage rate provided under the Federal Aid Act of 1956. The card has a space provided for the State Highway Department Representative. The name to place in this block is your Resident Construction Engineer.

2) Discrimination Poster - This is a yellow, tan, and white poster, 11" x 14" in size which deals with civil rights act of 1964, and prohibits discrimination against employees because of race, color, religion, sex, or national origin.

3) Fraud Poster - This poster is also white, 9" x 14" in size, with bold black lettering. This poster states that anyone knowingly making any false statement, false representation, or false report as to character, quality, quantity, or cost of

material used or to be used in connection with our plans, specifications, or contracts may be punished by a fine of $10,000 or imprisoned not more than five years, or both. There are spaces for two names on this poster. Your Resident Construction Engineer's name is placed in the State Highway Department block. The name of the Bureau of Public Roads Division Engineer at Ames is to be placed in the block marked Bureau of Public Roads.

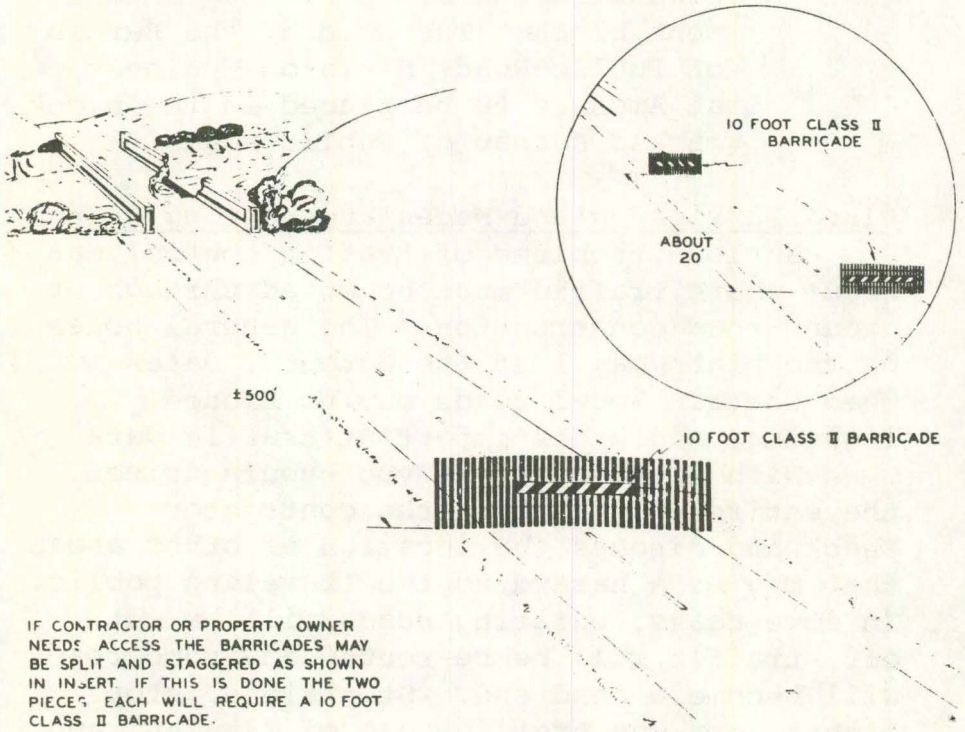
Place Barricades and Necessary Warning Signs

Serious problems of traffic control can occur where traffic must be moved through or around road construction. The general notes on the plans may list the detours, dates when certain local roads may be closed, lighting, and other important traffic data.

With a set of plans you should drive the entire project with the contractor. Check and discuss the location of other areas that may be a hazard to the traveling public. In some cases, existing roads will be cut off, traffic will be re-routed and some roads will become a dead end. Stop signs, stop lights, one-way traffic, use of flagmen, and even barricades must be used in various combinations to insure safety to the public. These signs and barricades must be placed before the construction begins.

It may be necessary to place additional barricades during and after construction. Barricades will be required on grading projects, on fills adjacent to streams, gullies,

or railroad tracks, as well as bridge projects at bridge approaches, even though the road is not open to public traffic or may not even be under construction. Barricades will be measured by count and paid for. Type, sketch, and installation is shown by Exhibit J. Remember - if <u>you</u> can drive around a barricade, so can a fool or a drunk.



No one standard sequence of signs or other control devices can be set up for all situations. The Manual of Uniform Traffic Control Devices, available in the Resident Office, defines, explains, and spells out the maintenance of all the signs used by

the Highway Commission. This manual also shows graphically various construction situations and the placement of signs as to type and the distance they are to be spaced.

The signs will be furnished by the maintenance department. They will be the responsibility of the contractor to be placed, protected, repaired if needed, kept clean, and returned.

It will be the inspector's responsibility to check and make sure of their proper use.

Visit your maintenance foreman as to your needs. He has had many years of experience and will be of great assistance to you.

Notify Utility Companies

The utility companies are aware of our construction limits and contract starting date. As soon as the contractor begins his work the utility company should be notified. In most cases the utility companies can't get all their line, poles, pipes, etc. moved during the first few weeks after the contractor starts his work. It will be necessary to keep a constant check on the grading progress and good communications with the utility companies. Cooperation between the utility companies and the grading contractor is essential.

PREPARATION OF THE EMBANKMENT SITE

After placing the necessary signs and barricades, the embankment site must be prepared. The embankment consists of placing the excavated material to the required elevation as shown on the plans and in accordance with the specifications. The preparation will consist of clearing and grubbing, removing existing structures, and disposing of vegetation.

Clearing and Grubbing

Except for trees, shrubs, and grasses which are to be preserved as indicated on the plans or designated by the engineer, all trees, stumps, logs, down timber, hedge, growing corn, weeds, grass, cornstalks, and other herbaceous vegetation and rubbish shall be removed from the right of way, and borrow pits furnished by the State of Iowa. A separate section of this manual will be devoted in detail to the method of clearing and grubbing to include estimates, procedures, measurements, and payment, but there are a few things that should be noted at this time.

1) When blasting trees, keep in mind possible damage to livestock, pole lines, pipe lines, buildings, and passersby.

2) Dragging full-sized trees through private property should be avoided due to the possible damage to fences, crops, or other trees.

3) Be on the lookout for roots of trees that sometimes show up in the excavated material. They should be removed from the embankment and disposed of by the contractor.

4) Be sure that the wind is not a hazard when burning trees.

5) Give some thought to the possibility of changing the drainage or a backslope slightly to save any ornamental trees in order to leave a pleasing appearance.

Fence Removal

Prior to the contract starting date, your Resident Engineer will send a letter to the property owners along the right of way. This letter will give the starting date the contractor plans to move on the project site and is a reminder that he is to remove his fences as stated in the Right of Way Contract. This is usually done one month in advance of the contract starting date.

When the contractor moves on the project you should check the entire right of way to be sure said fences are removed. If the fences are not removed, then you should call on the property owners at this time and remind them. If for some reason there will be an additional delay in the fence removal you should contact the contractor's foreman. The contractor will remove the fence

and will be paid as covered in the specifications.

Removing Existing Structures

If there are any existing structures to be removed, they will be so tabulated on the plans. They will include buildings, walls, foundations, old pavement, old sidewalk, and wells. These items must be disposed of before construction begins.

Buildings within the right of way are usually sold back to the owner or auctioned off and removed by the purchaser. If the building or buildings are not sold and removed at the time of construction, the contractor will remove them.

Urban Areas

Depending on the volume and conditions, a separate salvage and removal (demolition) contract may be let. In any case, check the project plans, Safety Rules for Demolition handbook, and Special Provisions for any detailed instructions. Be sure that all the utilities are shut off. Sewer lines must be sealed off. Burning becomes a critical problem and you should check with your local fire department before starting any building removal. The contractor should make arrangements for a dump site and the unburnt frame buildings, brick buildings, and foundations to include the floor will be hauled away. A check with city and county officials should be made to see if they want or need the brick or broken concrete foundations for local erosion control

work. The remaining cellar will be filled and compacted up to the natural ground line.

Rural

If the building is of frame construction and cannot be burned in place, the contractor normally uses a dozer to cave in the sides into a pile and then set it afire. Again good judgment as to safety should be exercised. The remaining ashes can be scattered over a wide area. Any rubbish or foundations that may be left will be disposed of separately. The County Engineer generally needs broken concrete or bricks for erosion control work on streams, so check with him. Any remaining brick or broken concrete can be scattered in an area that will have a fill of five feet or more. In areas with less than five feet, the broken concrete can be buried outside the fill area in places where erosion will not uncover the buried material. The buried material must have at least one foot of dirt cover.

Wells

Dug wells within the right of way must be filled prior to construction. With the use of a dozer cave in the brick sides to a depth of one foot minimum below natural ground. The well can be filled with the available soil on the project or with sand. Due to the low shrinkage factor, sand is much better than dirt. If sand is readily available, the contractor may himself choose to use sand. Drilled wells need only to be

filled if it has a well pit. The well pit averages five to six feet deep.

Cisterns

The depth of a cistern will vary throughout the state. Where the depth of a well may go in excess of 60 feet, the average cistern is 10 to 15 feet in depth. The sides are to be caved in, the brick and mortar scattered and the hole backfilled. The work is usually done with a dozer and the hole is widened or extended to allow the use of hauling unit to complete the backfilling.

Old Sidewalk and Pavement

The concrete should be broken up and then buried or scattered depending on the surrounding terrain. Existing structures are paid for and noted on the contract as a lump sum. To arrive at this lump sum figure, the contractor has listed and priced each item separately. To be sure each item is removed and properly paid for, this list should be made available to you. If for any reason, an item is not disposed of, no payment is to be made for that particular item. Old sidewalk and pavement is paid for by the square yard and must be measured and recorded in the field book prior to removal.

To continue with and better understand the preparation of the embankment site, a few terms should be explained at this time.

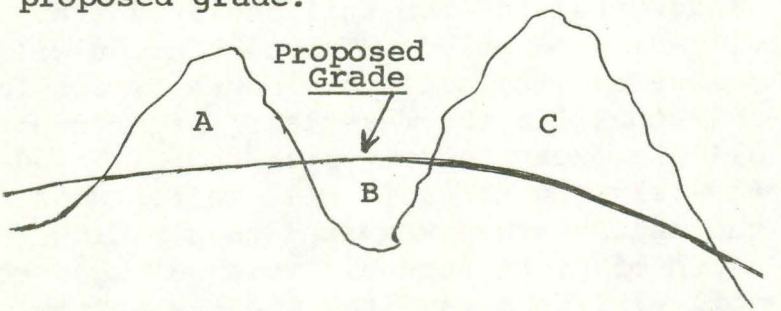
Embankment - The construction of the embankment is the placing and compact-

ing of available excavated material from borrows and cuts and placing this material to the required elevation shown on the plans within the bounds of our specification.

Proposed grade - The elevation or top surface along the centerline of the roadbed that is being constructed.

Cut - (A & C) That portion of dirt above the proposed grade. This cut dirt and the excavated dirt from the borrow area is deposited in the fill or wasted.

Fill - (B) The area below the proposed grade.



Borrow - A general term used to designate excavation to obtain material needed for the embankment but not available in the regular cuts. Side borrow is understood to mean borrow excavation outside the normal cut along the centerline but within the limits of the right of way. Borrow area is the area outside the right of way which the state has secured to

to borrow material without obtaining the title to the land. This area can be either adjacent to the right of way or at any given distance. This distance is normally within a few hundred feet from the right of way, and will revert to the landowner when we are finished.

Before any material is hauled from the side borrow or cut areas, the top soil will be stripped, salvaged, and stockpiled. All weeds, grasses, growing crops, and foliage are to be mowed, raked, and burned. The remaining sod should then be disced and chopped up in place. The borrow is now ready to haul from.

In borrows that will revert to the landowners, the top soil declared arable will be stockpiled. The contractor will remove the top soil to a depth of one foot and stockpile the material. After removing all the excavated material that is needed, the salvaged top soil will be replaced over the entire area excavated to a minimum depth of eight inches. This salvaged top soil will be a pay item and the borrow must be measured and paid for as stated in the Standard Specifications.

Before starting any excavation in these borrow areas, check the right of way contract for specific instruction as to how the borrow area is to be graded and how it is to be finished.

In fill areas where the height of the centerline fill is less than five feet, the

area should be treated as the borrow area. In preparing the fill site, all the sod under the embankment must be removed and placed in the outer five to six feet of the embankment.

The presence of sod in higher and heavier fills does not present a stability problem and its removal is not required.

Sod to be removed in fills and from cut and borrow areas should be removed first with a blade or motor patrol. Using a scraper or bulldozer has the tendency to cut too deep. The result is thick, heavy sod mixed with large quantities of earth and produces large windrows of material. As this sod must be deposited in the outer five to six feet of the embankment, it makes an eight inch lift difficult to lay out and rolling to compaction hard to obtain.

The use of a blade or motor patrol does an excellent job for the blade is more easily controlled and can cut a minimum of soddy material. The blade can windrow the material to the outer five to six feet of the embankment or windrow it in place and be picked up with the power scoops and deposited.

Temporary Drainage

It would be impractical to discuss all the possible combinations of drainage problems. The general notes and the individual plan sheets may list drainage areas or ditches to be rerouted. This is possible due to culvert construction or combination of culverts and let down structures. Let-down structures are a series of culverts

both concrete or pipe to carry water from one elevation to another.

Ditches running across the project can sometimes be rerouted until the proposed roadway pipe can be installed. Many times these ditches have to be crossed by the contractor with his equipment to get his work done. A metal pipe furnished by the contractor is installed and removed after the need for the pipe is no longer needed or the project is completed.

Metal pipes are sometimes installed in streams so that driving around culvert or bridge construction will save miles of driving and time.

Archaeological Salvage

Whenever the contractor's excavating operations may encounter remains of prehistoric people, dwellings, sites, or artifacts of historical or archaeological significance the operations shall be temporarily discontinued at the site.

The contractor usually has another area in which he can work and only a short delay will occur while moving his equipment.

Get in touch with your Resident Engineer immediately and he will contact the Ames office. Give the resident engineer a complete report as to depth the bones, etc. were uncovered, amount of salvage you think may be there, size of bones, and the exact location. The archaeological authorities will promptly examine the site and determine the disposition thereof.

It is not always possible for the scraper operators to see bones being scooped

up by their machine. Paying close attention to the embankment site will reveal bones and artifacts as the hauling units deposit their load.

When directed by the engineer, the contractor will excavate the site as to preserve the artifacts and remove them for delivery to the proper State authorities.

Crossroad Pipe

Staking, laying, and backfilling crossroad pipe will be covered in detail in another manual entitled "Pipe Culvert Inspection." Since the installation of pipe is normally completed during the preparation of the construction site, the following paragraphs contain a few suggestions to keep in mind.

Maintenance of the pipe, once it is laid in place, is the contractor's responsibility. He may protect the pipe by several methods. One method and the safest would be to drive around the pipe. Because of the terrain conditions this may not be the most efficient or quickest way to build the embankment.

Another method would be to lay the pipe and overlay the pipe with additional soil. The contractor could then drive over the pipe. This additional soil could be removed when the contractor was finished hauling in this area. The over-burden on the pipe does not relieve the contractor of his responsibility to protect the pipe from damage. A visual check should be made by crawling through the pipe. A flashlight will be needed at various times.

Crossroad pipe should have an overburden or the height of fill equal to the inside diameter of the pipe but not less than two feet with axle loads up to 80,000 pounds. If the inside diameter of the pipe is 36 inches, then the height of fill over the pipe should be an additional 36 inches. On an 18 inch diameter pipe the height of fill should be a minimum 2 feet. On axle loads from 80,000 to 100,000 pounds the height of fill should equal the inside diameter of the pipe but not less than 3 feet.

Rather than drive around a pipe or place the overburden the contractor may choose to lay the pipe at a later date. In fills of 6 feet or less this is a common practice. Once the embankment is completed the contractor with the use of a dozer or dragline will cut through the fill and then lay and backfill the pipe to the proposed dirt grade. If the contractor chooses this method it is very important that a check is made of the area to be sure natural drainage is not blocked or water ponded on the adjacent property owner before the pipe is placed.

Settlement Plates

Settlement plates are used to determine the settlement in a given area. Although they are placed in areas of high fills, bridge berms, and sand blankets, they are also placed in unstable areas. These unstable areas may be in fill areas of less than 5 feet.

Their location and placement will be

shown on the plans. They are furnished and placed by the contractor and are an incidental item to the contract.

The settlement plates are metal, 36"x 36" wide and 3/16" thick. They are to be placed six inches below natural ground and level. Welded to center of the plate is a 1 5/8" round steel bar one foot high, and the top of the bar is threaded to receive 1 1/4" iron pipe. The pipe extensions come in three foot lengths with threaded ends. A coupler is used to joint the three foot sections of pipe.

After the settlement plate is installed the contractor can start his embankment construction. As the layers of dirt are placed and the fill reaches the top of the pipe, another section of pipe is screwed on. This process continues until the fill is complete.

As the fill rises and a new section of pipe is added on, the survey party will shoot the elevation of each section of pipe. The survey party will record this information. Since the Resident or the District Engineer on his visit to the construction site may want this information, the inspector should have it as a handy reference.

The elevations will be taken daily during the construction of the embankment, weekly during any delays, and after the construction is complete. The central office will notify the resident office when it is no longer necessary to report the elevations.

It will be necessary to protect the settlement plate and the pipe extension.

Any damage or bending of the pipe would result in a false elevation recording. All bent pipe will be replaced and new elevations recorded. The easiest way to protect the settlement plate is to mark it out with wood stakes or steel fence post marked with red cloth or plastic.

VERTICAL SAND DRAINS, SAND BLANKETS, AND TRENCH SUBDRAINS

Since soils are compressible, special designs are sometimes needed to compensate for them. Compressibility of soils become a problem in the construction of high fills over natural ground and in the construction of bridge berms. Once the fill is in place the excess weight of the soil and time will cause the natural ground to settle and stabilize itself. This could take as long as a year. We can speed up this settlement in from 60 to 90 days in most areas. Underneath the ground surface may be various layers of soil and in many areas, water, which is a critical factor, must be removed for faster settlement.

There are two approved methods of constructing the vertical sand drains. They are the continuous hollow shaft method and the metal casing method.

Continuous Hollow Method

The plans will show the locations and depth of the sand drains. Basically, the construction of the vertical sand drains involves laying a sand blanket over the entire area designated on the plans. The

plans also show the thickness of the blanket, normally two or three feet. Holes are drilled through the sand into the soil at a pre-determined depth and spacing.

The drilling auger shall be a constant diameter and a hollow shaft.

It is important that means are provided that the soil does not enter the shaft during augering. The auger shall be placed by screwing with a rate of advance for each revolution approximately equal to and not greater than the pitch length.

At the desired depth the auger is stopped and then rotated one complete revolution. As the auger is being pulled up, sand is pumped through the hollow stem and fills the hole. The auger should not be rotated during the withdrawal.

Several test holes should be drilled and the auger withdrawn without filling the hole with sand. The sides of the holes should not have a slick or polished finish but a torn appearance. A polished finish will have a tendency to restrict the flow of water into the vertical hole. When you are satisfied that the holes are properly drilled, fill them with sand and continue with the normal operation.

The soil removed from the hole as the auger is withdrawn is scattered on top of the sand blanket. This soil becomes part of the first lift in the ensuing fill.

As the weight of the completed fill presses down, the natural soil is compressed. From this pressure, water is also being squeezed out into the vertical drains and

out through the sand blanket.

Depending on the underlying moisture conditions, six inch corrugated metal and six inch perforated corrugated metal drain pipe is installed in the sand blanket to expedite the flow of water outside the fill area.

Metal drain pipe, when needed, will be installed in the following manner:

> After the sand blanket has been laid out to the desired depth, the sand will be removed for the entire length of the proposed pipe and 18 inches wide. For ease of construction, the trench should be made in sections a few feet longer than the lengths of pipe. Plywood or some other method should be used to protect the sides of the sand blanket from caving in. Place six inches of porous backfill material in the trench. Porous material looks much like granular or sand material and normally has larger size particles in it for the freer flow of water. After a section or length of pipe is placed in the trench, cover the pipe with with porous material an additional foot. The plans may indicate other than the above mentioned dimensions if the situation demands it. Trench out another section, join another section of pipe onto the first piece of pipe, install the band furnished for this pur-

pose, and repeat with the porous backfill until the entire length of planned pipe is completed. Install the end piece called reducer and apron if called for on the plans. Cover the porous material in the trench with the excavated granular material. Corrugated metal subdrain pipe is to be installed with the perforations placed down.

Metal Casing Method

A suitable metal casing having an external diameter as shown on the plans is driven at the location and depth indicated on the plans in such a manner as to prevent the adjacent soil from entering the casing. Jetting is not permitted. Jetting is the use of water under pressure to aid the penetration of the casing into the soil. Before extracting the metal casing, sand, meeting the designated particle size requirements, must be placed into the casing. The sand must completely cover the bottom of the casing at all times during extraction. This is accomplished by placing the sand through an opening near the top of the casing; the opening is closed and with the use of an air compressor, sand is forced to the bottom of the casing. A trapdoor-type-bottom permits the sand to fill the hole as the casing is being extracted. As the casing is being extracted, it is important to check to be sure that the sand completely fills the hole and that any mud balls that may be present

are removed from the sand to insure proper drainage. If the sand blanket is not placed prior to driving the casing, then be sure to mound the sand at least two feet above the adjacent ground level and fill all low and depressed areas with sand.

Trench Subdrains

The area of installation, number of trenches, and other details are again shown on the plans. Although trench drains will vary in length and number, we will discuss a typical subdrain. Trench subdrains are a series of parallel trenches five feet deep and twenty feet apart. The trenches are joined by another trench called a collector trench. The collector trench is drained with six inch perforated metal corrugated pipe and installed as stated in the previous paragraph. This pipe may have a vertical standpipe attached to equalize the pressure if the terrain does not permit an on-grade outlet.

When filling the trenches with sand, check to make sure soil does not enter the granular material. This material is normally hauled in and stockpiled prior to and during the construction of the trenches. As the granular material is being picked up and placed in the trenches, check again to be sure soil is not mixed or deposited with the granular material.

The quantity of granular and porous material required for construction of sand blankets, trench drains, and vertical sand blankets will be shown on the plan in cubic

yards. Trucks hauling this material must be weighed and this weight is shown in tons. To be sure the proper amount of material is delivered and proper payment is made, tons must be converted to cubic yards.

The boxes of several trucks should be measured. The trucks should then be loaded and weighed at the producer's site. The load should be struck off and leveled, filling the corners. You now have enough information to compute tons to cubic yards. For example:

Box measurements -
14'x 7.25' x 2.80' = 284.20 cubic feet

Hoist measurements -
.8'x 1.55'x 2.75' = 3.41 cubic feet

$$\frac{284.20 - 3.41}{27} = 10.399 \text{ cubic yards}$$

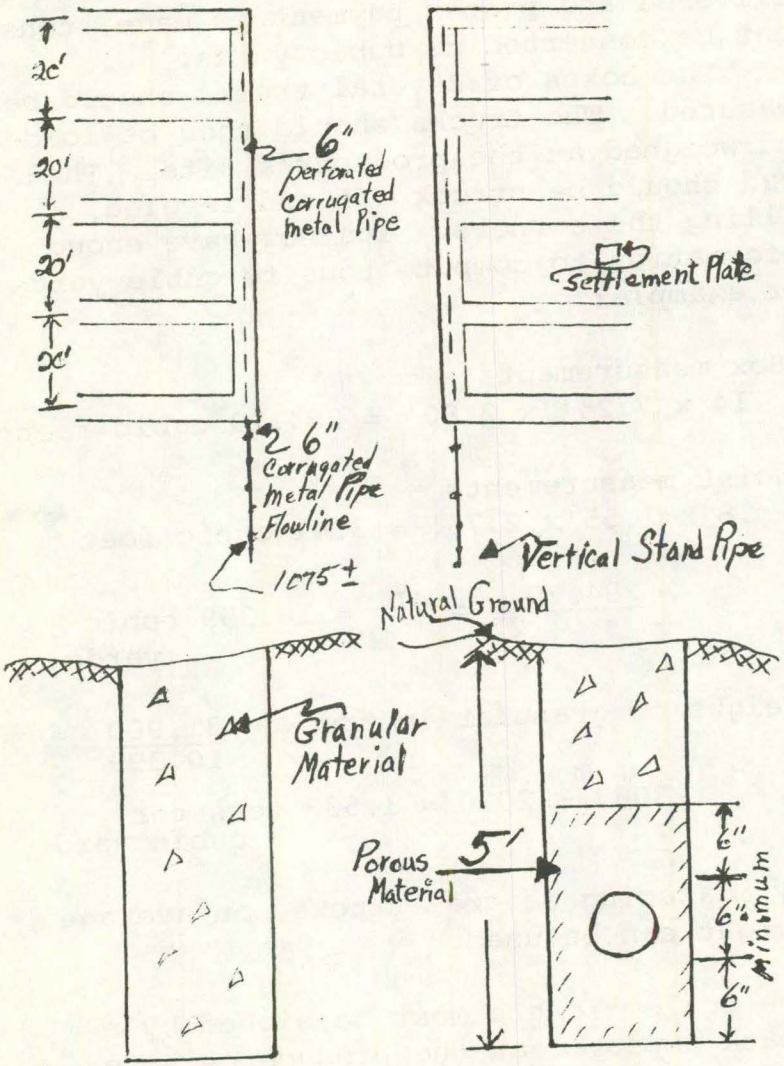
$$\text{Weight of granular in truck} = \frac{31,900}{10,399} =$$

3067 ÷ 2000 = 1.533 tons per cubic yard

By measuring several trucks, an average weight can be used.

The scale tickets must be signed by a state employee at the producer's site and again on the embankment site when the truck discharges its load.

TYPICAL TRENCH SUBDRAIN



CONSTRUCTION PROCEDURE

Except for rock fills, which will be discussed later, all embankments shall be carried up in horizontal layers (normally called lifts) not over eight inches in loose thickness, measured after the lift has been struck off with a bulldozer or motor grader. The embankment construction and compaction shall be in accordance with the requirements and additional provisions for the type of compaction indicated or specified in the special provisions or on the plans.

When the soil being used to build the embankment contains a quantity of roots or other vegetable matter in amounts too numerous to pick out or remove by hand methods, the material will be deposited in the outer limits of the fill or as directed by the engineer. If the embankment slopes are designed to be flatter than 1½:1, the material will be deposited outside a line drawn down from the proposed slope. This material should be spread in uniform eight inch lifts and compacted before succeeding layers are put on.

The embankment should be constructed in such a manner that the center of the fill is kept continually higher than the outer portion of the fill so that if it should rain during working hours or during periods of time that the contractor is shut down, the fill will drain properly. Water ponded on the embankment may result in unsatisfactory compaction in the ponded

areas or lengthen the time the contractor is shut down due to rain.

Occasionally, in the process of removing dirt from a cut or borrow pit, a layer of soil with an abnormal amount of moisture will be encountered. When this condition exists, the inspector should request the contractor to place alternate lifts of wet and dry soil, provided that this request does not increase the average length of haul or completely disrupt the contractor's operation. Wet soils, as referred to here, are those soils that contain water in amounts that prevent the lift from being satisfactorily compacted by rolling.

Another method of handling wet soils is to lay out a four inch layer of wet and four inch layer of dry soil, then incorporate the two lifts by discing until the lifts are thoroughly mixed and will readily compact by rolling.

If the width of fill is 36 feet or more, the excavated material, as it is being brought from the cut or borrow, will be dumped on the embankment site in long windrows. A long windrow would be between 500 to 1,000 feet. The depth of this material as it is dumped will have to be regulated but should be of a depth that when it is struck off with a motor grader (patrol) or bulldozer will be a uniform eight inch thick layer and approximately fifteen feet wide. These windrows will be equal in length and succeeding windrows will be parallel to the first and will progress from one side of the embankment to the other.

The hauling units will not drive through the material dumped by the units hauling ahead of them; they must drive parallel to the windrow and at the end of the dumped material, cut in and dump their load. The length of the windrow will generally be determined by the contractor and his decision will be influenced by the length of time it takes to compact a given area and prepare it to receive another lift. Weather conditions and natural moisture in the soil may affect the windrow length.

Once the entire embankment is covered from side to side with the excavated material and after the lift is smoothed to the eight inch depth, the rollers will start the compaction. The hauling units will haul ahead or behind the prepared area and start the same windrow pattern. In this way, the hauling and rolling will not be going on at the same time in the same area. The material for each layer shall be deposited over the dump area as a separate and distinct operation and at no time will the compaction operation be conducted on the same windrow that is being laid out.

If the embankment is less than 36 feet in width, the <u>empty</u> hauling units may travel on the dump areas in which compaction operations are in progress as necessary to pass the loaded hauling units. Hauling units should not follow the tracks of other hauling units but should spread out over the fill.

If the embankment width is less than 30 feet at the height at which the layer

is being placed, the area to be covered will not be required to be separated into separate and distinct areas.

Hauling units will be permitted to travel through areas where discing, smoothing, and compacting operations are in progress to the extent that specific compaction operations are not restricted.

If material that is being dumped on the grade contains on the average of one large lump per square yard, the area shall be covered by at least one passage of a tandem axle disc or two passages of a single axle disc. For all practical purposes, a large lump may be defined as having at least one dimension greater than twelve inches. The disc shall be used in such a manner as to cut and stir the full depth of the layer.

After the layer has been disced, if required, it shall be smoothed by motor patrol or bulldozer with sufficient power to do the work involved. The equipment that is used to do the smoothing, may also be used to pull a roller, but the rolling shall be conducted as a completely separate operation. If the soil is of a nature that the contractor is unable to keep the layer continuously smooth and evenly distributed over the dump area with a dozer, the inspector may require the use of a motor patrol, instead of or in conjunction with a dozer or other equipment, to obtain the desired results.

On all contracts that are over one-half mile in length or involve more than 100,000 cubic yards of earthwork, a patrol may also be required.

Type A Compaction

Type A Compaction refers to embankments on which a minimum of one rolling per inch depth of each lift is required, and it is further required that the roller continue operation until it is supported on its tamping feet. A roller will be considered to be supported entirely on its tamping feet when the tamping feet penetrate not more than three inches into an eight inch lift or one-third the depth of the layer being compacted.

After the surface of the layer has been smoothed and before material for the next layer is deposited upon it, the layer shall be compacted with not less than one passage of a tamping type roller per inch of loose thickness of the layer and until the roller is supported entirely on its tamping feet.

It will be the contractor's prerogative to make a determination as to whether the moisture content of the material is excessive or suitable for satisfactory compaction.

The contractor may elect to start rolling operations immediately after the smoothing operations described above, or he may elect to delay rolling operations and, instead, aerate the material in preparation for rolling. Aeration and compaction operations shall proceed in an orderly fashion without unreasonable and unnecessary delay.

Rolling operations made prior to any aeration operations with equipment other than the roller will not be counted as any of the required coverages per inch of lift.

Should the soil be dry to the extent that it is likely to fail to be satisfactorily compacted by rolling, the contractor will be granted permission to moisten the material, or the engineer may order the material to be moistened uniformly before it is compacted. Authorization may be given for the use of water in the final finishing of the roadbed.

Type B Compaction

Type B Compaction refers to embankments on which a specified number of discing and rolling coverages is required.

After the surface of the layer has been smoothed and before material for the next layer is deposited upon it, the layer shall be disced and compacted, or compacted in the following manner:

1) If, at the time it is deposited, the soil in the layer is wet to the extent that it will not be compacted by one passage of the roller per inch of loose thickness of the layer to a degree that the entire weight of the roller is supported on its tamping feet, the engineer may require not to exceed one discing per two inches of loose thickness of the layer, in addition to the initial discing that may be required above. A discing shall consist of a complete coverage of the layer with either a tandem-axle disc or a single-axle disc.

The disc shall be so designed and operated as to cut and stir to the full depth of the layer. The engineer may require an interval of not longer than two hours between successive discings. After the discing has been completed, the layer shall be compacted by one passage of a tamping roller per inch of loose thickness of the layer.

2) If at the time it is deposited, the soil in the layer is in such condition that it will be compacted by one passage of the roller per inch of loose thickness of the layer to the degree that the entire weight of the roller is supported on its tamping feet, the layer shall be compacted by one passage of a tamping-type roller per inch of loose thickness of the layer.

Unless noted on the plans or stated in the special provisions, Type A compaction will be used. If the contractor chooses to use Type B compaction, he can do so, but he must request permission by written notification to the engineer. This substitution will be limited to once for each embankment or specific area.

The manipulation (discing) and compaction specified above is normal to the contractor's operations and is considered incidental to the work. If additional manipulation is required by the engineer, extra compensation will be made to the contractor.

Dump trucks and bottom dump trucks are often used to haul the excavated material to the fill. The trucks should space their dumped load in a windrow so that the dozer can smooth the piles to an eight inch layer with a minimum of work.

Moisture and Density Compaction

The method of compaction where a higher degree of compaction and embankment stability are needed, requiring that the moisture content of the soil be first brought within certain limits as specified in the special provisions and rolled until a definite density is obtained in each lift built, is called moisture and density compaction.

In constructing an embankment with moisture and density, the type of compacting equipment is not specified. The tamping type roller, with rare exceptions, is the best method of obtaining density.

There are two requirements which must be satisfied in compacting embankments with moisture and density control:

1) The moisture content of the material must be brought within the limits specified in the special provisions or plans prior to compaction.

2) The required density must be obtained for each lift.

The plans will show the areas in which the embankments are to be constructed and

will also show the distance below the elevation of the completed grading work that the moisture and density work is to be done. This depth is usually two feet in the cut areas and three feet in fill areas.

Cut Area

When designated on the plans, the excavation shall be removed as indicated to within six inches of the lower limit of the moisture density. It will be necessary to check the grade stakes set previously by the survey party to determine where the finish dirt grade should be. If two feet of moisture density is planned, this means that one and one-half feet below the finished dirt grade is to be excavated and the next six inches will be left in place. This excavation shall be made for the full width of the road bed. The remaining six inches will be thoroughly scarified and the moisture content will be increased or reduced as necessary to bring the moisture throughout this six inch layer to that specified in the plans or special provisions.

This moisture content will be shown by a note that, for example, states "moisture content shall be within the limits of minus 3 and plus 1 percentage points of optimum for maximum density within the area described".

The density of soil or soil aggregate mixtures will be measured by determining the weight per cubic foot and moisture content of a representative sample of the material when compacted by a specific method in a standard test and known as a Proctor Test.

The next few pages will be devoted to the Proctor Test from which data, we may determine the moisture content at which the greatest compaction and density may be obtained.

This six inch layer left in place that is scarified and brought to the proper moisture shall be compacted to not less than 90 percent of the proctor density determined in the Proctor Test. When this lift has been checked and accepted, the remainder of the lifts shall be deposited in eight inch loose layers and compacted up to the completed grade. Each layer shall be uniformly moistened or dried as necessary to bring it within the specified moisture limits and shall then be compacted to not less than 95 percent of maximum density.

If the excavated material from the borrows are within the moisture limits in their natural state then the contractor can begin his moisture and density operations without any manipulation of the soil, except to prepare the lift to the eight inch level layer, as stated previously.

Fill Area

When moisture and density control is designated in embankment sections outside of cuts all the excavated material will be deposited in eight inch loose lifts and uniformly moistened or dried as necessary to bring it within the specified moisture limits. The first layer shall be compacted to not less than 90 percent of maximum density. Each succeeding layer shall be compacted to not less than 95 percent.

If compaction is interrupted or delayed on a layer, the layer shall be brought within the specified moisture limits before compaction is resumed.

MOISTURE AND DENSITY TESTING

Equipment Needed:

Field Laboratory - This will be furnished by the contractor. Such things as space, heat, running water, and other requirements are listed in the specifications. The field labs are required for moisture and density work.

Balance (scale) - 5000 gram capacity.

One Rubber Hammer

Apparatus - This consists of a cylindrical mold, a metal rammer, steel straightedge, sieves, various-sized pans, and a large mixing spoon.

The mold is a brass cylinder, 4 inches inside diameter by 4.6 inches high with a detached top collar and removable bottom plate. The volume of the mold is 1/30 of a cubic foot. The collar serves to confine the loose material during compaction and the removable bottom enables the operator to push the compacted material from the mold easily. A special tool is used to push out the compacted material. The rammer has a 2 inch diameter face and weighs 5.5 pounds. With this

equipment, a guide is provided for the rammer which enables the operator to control the height of fall of the rammer and location of the point of contact in the compaction of the soil.

Apparatus base

Core sampler and wrench

Stoves - gas or electric

One volume overflow meter

One glass (plastic) cylinder - graduated in c.c. or ml.

Six metal pans

Six one gallon cans with lids

Five gallons of Kerosene

SOILS

Before the contractor begins his operations, the inspector should secure samples of all types of soils likely to be encountered in the operations. He should run the Proctor Test on the soils and determine the optimum moisture and Proctor (laboratory) density. Proctors should be run on soils in the borrow areas and should be repeated in the same areas as the height of the cut decreases. If the soil appears to change or if the contractor begins to have density failures, a Proctor should be run for a re-check.

Soils have properties that influence their behavior and value. The color of soil will vary with its moisture content.

The texture of soil is given to tell as much as possible about a soil in a few words. Below are more of the common soils we will work with.

Sand

Individual grains can be seen and felt readily. Squeezed in the hand when dry, this soil will fall apart when the pressure is released. Squeezed when moist, it will form a cast that will hold its shape when the pressure is released but will crumble when touched.

Sandy Loam

Consists largely of sand, but has enough silt and clay present to give it a small amount of stability. Individual sand grains can be seen and felt readily. Squeezed in the hand when dry, this soil will fall apart when the pressure is released but moist, will withstand careful handling without breaking. The stability of the moist cast differentiates this soil from sand.

Loam

Consists of a moderate amount of fine grades of sand, a small amount of clay, and a large quantity of silt particles. Lumps in a dry, undisturbed state appear quite cloddy but they can be pulverized readily; the soil then feels soft and floury. When wet, silt loam runs together and puddles. Either dry or moist casts can be handled

freely without breaking. When a ball of moist soil is pressed between thumb and finger, it will not press out into a smooth unbroken ribbon but will have a broken appearance.

Clay Loam

A fine-textured soil which breaks into clods or lumps that are hard when dry. When a ball of moist soil is pressed between the thumb and finger, it will form a thin ribbon that will break readily, barely sustaining its own weight. The moist soil is plastic and will form a cast that will withstand considerable handling.

Clay

A fine-textured soil that breaks into very hard clods or lumps when dry and is plastic and unusually sticky when it is wet. When a ball of moist soil is pressed between the thumb and finger, it will form a long ribbon.

PROCTOR TEST

For laboratory compaction test, it is of utmost importance that the sample of soil or soil aggregate mixture be truly representative of the material that is to be used in the embankment construction. The specimen on which density is measured is only 1/30 cubic foot and any variation of the composition will affect the results obtained.

Proctor Test Procedure

The sample must first be separated into individual particles if possible. The mixing pan full of material will be a large enough sample. This will require partial air drying if the material is very wet. The initial moisture content should be such that when a handful is compressed, the lump will be friable and not sticky. Mixing the material in the mixing pan with a large spoon or with your hands will produce the desired results.

Filling the mold will be done in three layers or increments. By experimenting, you can determine the amount of the sample required so that in three increments the mold will be slightly more than filled.

The container, with base plate and collar attached, should be set in place under the rammer guide. Place one increment of the sample in this mold, and while turning the mold, apply 25 blows with the hammer, covering the entire cross section of this mold with the 25 blows and dropping the hammer one foot. The height of fall is controlled by the bottom stop on the highest rammer guide. Introduce the second increment of the sample and apply 25 more blows allowing the hammer to fall one foot by raising the stop to the second notch. Repeat with the third increment of the sample with the stop in the third notch.

Now remove the mold and detach the collar. With the straightedge, remove the excess material above the top of the mold. Any rocks or pebbles disturbed in this

smoothing of the top of this mold should be replaced by material which may be compacted to give a reasonably smooth dense surface by using the rubber hammer.

Weigh the mold and compacted specimen. Remove the bottom plate and press the specimen out of this mold. Split the specimen and take out a moisture sample of 500 to 800 grams.

Return the remainder of this specimen to the soil mixture and break it into small particles and mix with the remainder of the sample. Add a small amount of water, usually one to two percent of the weight of the sample, and mix thoroughly again.

When the moisture is uniformly mixed through the material, repeat the operation of molding and weighing the material at the new moisture content. Take a moisture sample, add additional moisture and continue until the sample appears definitely wet and plastic. Five to eight trials are usually needed.

Moisture

Each moisture sample shall be placed in a tared pan and weighed immediately to avoid loss in weight by evaporation. The pan is then placed on the hot plate or in the oven and completely dried. When dry, cool to air temperature and weigh. Compute the loss in weight as percentage of final dry weight of material by weighing a 500 gram wet sample. Subtract the dry weight from the wet weight. The difference between the wet and dry weight is called the moisture loss. To find the percent of moisture divide the moisture loss by the dry weight.

With these percentages of moisture, compute the weights of dry material per cubic foot for compacted weights for each of the various moisture contents.

Exhibit K is an example of the computations to determine the moisture content and dry weight pounds per cubic feet.

DATA REQUIRED TO DETERMINE PROCTOR (LAB) DENSITY

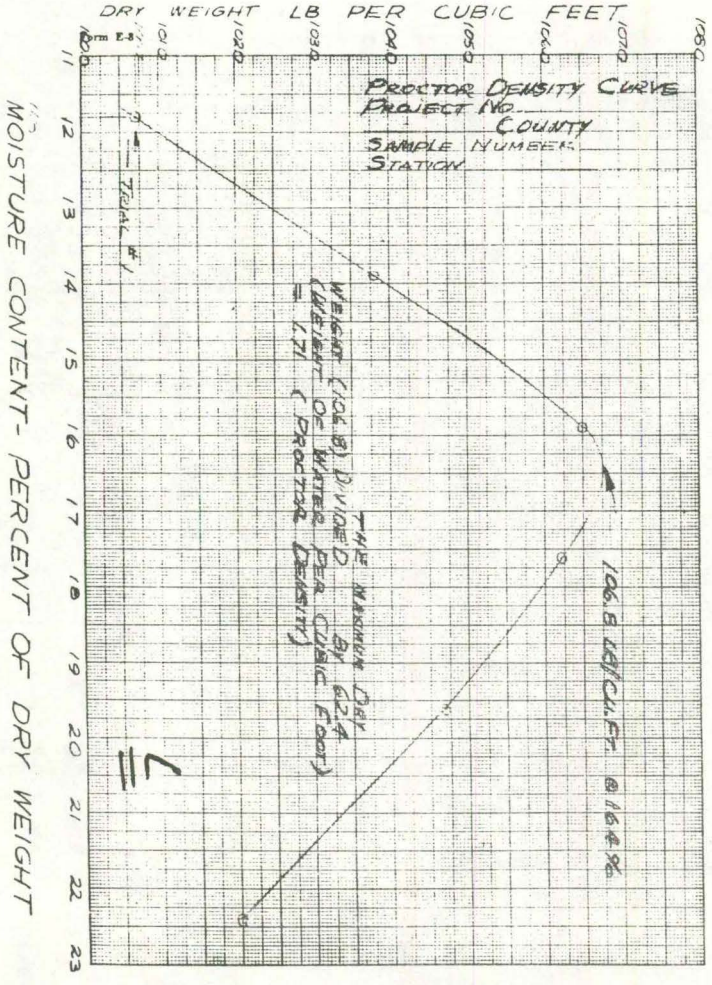
TEST NO.	DETERMINATION	1	2	3	4	5	6	7	
	WATER ADDED TO GROSS SAMPLE	0	90	90	60	60	50	40	WATER ADDED VARIES WITH SIZE OF GROSS SAMPLE TAKEN, AND DECREASES ON EACH TRIAL BECAUSE SAME MATERIAL IS REMOVED EACH TIME.
1.	WET WEIGHT OF SPECIMEN	1792	1787	1868	1890	1893	1900	1887	← GRAMS WEIGHED
2.	WET WEIGHT	500	500	500	500	500	500	500	← GRAMS WEIGHED
3.	DRY WEIGHT	461	455	449.5	445	440	438	433	
4.	MOISTURE LOSS	39	45	50.5	55	60	62	67	GRAMS DIFF., LINE #2 - LINE #3
5.	PER CENT MOISTURE	11.8	13.9	15.9	17.6	19.6	20.4	22.4	LINE 4 / LINE 3 × 100
6.	CALCULATED DRY WEIGHT	1522	1569	1611	1607	1583	1578	1542	LINE 1 / LINE 5 (EXPRESSED AS DECIMAL)
7.	DRY WEIGHT (LB/CU.FT.)	1007	1038	1065	1063	1047	1044	1020	LINE 6 × 30/454

NOTE: "MAKE A COUNTER-BALANCE FOR MOLD AND SCALE PAN" USING SMALL CANS WITH LIDS & SHOT. THIS WILL ELIMINATE SUBTRACTING THE "WEIGHT OF THE MOLD AND SCALE PAN AND POSSIBLE ERRORS"

* THESE ITEMS ARE PLOTTED ON GRAPH PAPER TO DELINEATE THE CURVE.

K

Exhibit L is the resulting curve by plotting the moisture content and dry weight. From this we can see the optimum moisture and maximum density.



Field Test

From the proctor (laboratory) test, we have determined the proctor moisture or optimum moisture and the maximum density of the soil we are going to use in the embankment construction. We must now have some method of testing each lift to find out if the soil is within the moisture limits and if the density is within the 90 or 95 percent of maximum density as required.

After the contractor has a lift laid out and ready for compaction, a moisture test will be taken. Fill one of the gallon cans with material from the lift that has been prepared for rolling. Place the lid on the can to prevent moisture loss while transporting the sample back to the field lab. It is a good policy to place in the can a note recording the station from which the sample was taken, the distance in feet left or right of centerline and identify the lift as to first, second, etc. It is not uncommon to take as many as 10 to 15 samples each day and at various places along the embankment, so it is important to keep a record of the moisture samples.

In general a moisture sample should be taken every 500 feet although one density and one moisture per lift for each compacted area may be sufficient.

Measure out a 500 gram portion of the sample brought in from the embankment. Cook out the moisture and let it cool. There are several ways to determine if the sample is dry:

1) Stir the cooking sample with a

metal trowel breaking up any small lumps. When the sample is dry, material will not stick to the trowel.

2) Place another pan over the sample cooking and if moisture is still present, it will show up in the cover pan.

3) Tear off a piece of scratch paper approximately one inch by two inches and when the sample looks dry, place the paper on it. If moisture is present the paper will curl.

Weigh the cooled sample; subtract the dry weight from the wet weight. This difference is the moisture loss. Divide the moisture loss by the dry weight and the result is the percent of moisture in the sample. If this percent of moisture is within the minus three or plus one of the optimum (lab) moisture, the contractor can begin his rolling operations. If the percent of moisture is outside these limits, before rolling can begin, the contractor must wet or dry out the lift, another moisture sample must be taken, and the process repeated.

All the computations used in moisture, density, and proctor test must be recorded in the field. Record-keeping is more completely covered later in this handbook.

Field Core Density Test

After the lift that has been laid out has passed the moisture requirements and the rolling has been completed, the contractor will notify the inspector. The amount of rolling needed for compaction to density will be determined by the contractor.

Some method is needed to determine density in the field so it can be compared to the proctor density. This is called the field core density method.

Equipment Needed:

Apparatus - a core cutter for taking an undisturbed, in place sample of the soil. The apparatus consists of a core bit approximately ten inches long and four inches outside diameter. The cutting edge of the bit is rolled slightly so the bit will produce little friction on the sides of the sample as the core is pushed into it.

The diameter between the cutting edges of the bit is approximately three and three-fourths inch. A bit head is fastened to the top of the bit by four cap screws. A driving shaft. A core driver or pounder with handles is used to drive the bit into the embankment.

Wrench - 9/16 inch.

Six one-gallon cans.

Paper for sample identification.

Wax paper.

Pedestal core extractor.

The laboratory equipment needed to check the density consists of:

Balance scales.

Moisture and scale pans.

500 cc graduate.

Volume displacemeter - a device to check the volume of a specimen to within 1cc accuracy. It is an overflow meter that will consistently cut off the flow of kerosene to the same level each time providing there is no interference with air or mechanical vibration on the surface of the liquid.

Pocket knife - 4 inch blade.

5 gallon can of Kerosene.

Rags.

Procedure

The contractor will notify the inspector when the lift has been compacted and is ready for a density test. A core cutter, one can for each sample to be taken, scratch paper, wax paper, and the core extractor and wrench are all the equipment needed to get a sample.

The sample can be taken anywhere within the compacted area. It is a good practice to take most of the samples throughout the project at various distances from centerline.

Pick a spot and remove the top inch or two of loose material. This can be kicked away with the toe of your shoe. Place the core bit and shaft in an upright position, and drive the bit into the compacted lift with the core driver. Drive the bit through the lift you are testing. Do not overdrive into the soil. During this procedure the bit head must be kept tight with the cap screws. By rolling or rotating the driving head in a circle the core will be broken loose and may be lifted out easily.

Remove the cap screws and remove the dirt sample. If the sample cannot be pushed out with the hands, use the pedestal extractor. The sample should then be wrapped in wax paper to maintain the moisture during transportation back to the laboratory. The wrapped specimen is identified with stationing, date, lift, and distance from centerline by placing this information on paper and putting it into the can with the wrapped sample.

After arriving at the laboratory the sample must have a moisture test and a density determined. Remove the sample from this container and with the knife, shave or trim the sides. The soil shaved from the sample will be used for a moisture test. Weigh out 600 grams and proceed with the moisture determination as previously

stated. The remaining sample should be a core approximately six inches high and weighed and recorded. The core should weigh between 750 and 900 grams. Larger cores will displace more than 500 cc and chances for errors in handling the kerosene displaced are increased. The top and bottom of the core should also be trimmed of all loose material so that portions of the core will not flake off while soaking in kerosene.

Soak the core in a container of kerosene prior to placing it in the overflow meter. There should be enough kerosene in the container to completely cover the soaking core. Soaking the core in kerosene will fill all the air voids so that we will not get an erroneous figure as to volume of the core and should be continued until there is little or no escape of air. After the air bubbles cease to appear, lift out the core and remove the excess kerosene by blotting with rags or blotting paper.

A metal rack that is part of the volume displacemeter is used to support the core in the kerosene. This rack will make for easier handling and protects the core from damage.

Place the metal rack in the volume displacemeter. Place an empty container under the overflow pipe and fill the displacemeter with kerosene to above the overflow pipe. The kerosene will drain through the overflow pipe and shut off at the same level each time.

Place an empty 500 cc graduate under the overflow pipe. Remove the rack from the displacemeter and place the core on the rack. Return the core and rack into the displacemeter. The volume of kerosene displaced as measured in the graduate will be recorded as the volume of the sample core. Remove and throw out the core. Refill the displacemeter so it is ready for the next sample.

The following example shows how to record the core sample data and how to arrive at the field density and its comparison to proctor density.

Date	7/17/68
Station	2530+00
Lane	Loop "B"
Lift no.	4
Wet wt.	500.0
Dry wt.	436.0
Moist loss	64
Moist before rolling	14.7

This is the moisture test that was run prior to rolling. The 14.7 percent of moisture is within the minus 3 percentage points.

Date	7/17/68
Station	2534+00
Dist. ℄	18 lt.
Wet wt. of core	888.0
Wet wt.	500.0
Dry wt.	433.0
Moist. loss	67
% Moist.	15.5
Kero. Disp.	455
Calc. Dry wt.	768.8
Dry Density	1.69
Proc. Density	1.71
% Proc. Density	98.8
Proc. moist.	16.4
Results	Pass
Sta. covered	2527+00 2536+00
Date reported	7/22/68
Inspector	Dallas Carlisle

This moisture is the moisture test run from the soil trimmed from the core sample.

To find the calculated dry weight divide the wet weight of the core (888) by one plus the percent of moisture in a decimal (1.155)

To find the dry density divide the calc. dry weight (768.8) by the kerosene displacement (455)

By dividing the proctor density (1.71) by the dry (field) density (1.69 you will arrive at the percent of proctor density.

Report immediately to the contractor the results of the sample taken. The station of the sample taken and whether the sample passed or failed is all the contractor usually wants to know.

ROCK CUTS

The contractor prepares the site as for normal grading. He then removes the soil overburden with normal earth moving equipment (crawler tractors and scrapers or self-propelled earth movers) until they encounter the rock ledges or rock and shale of sufficient size and hardness that he can no longer load or move this material in this manner. He will usually then bring in a piece of equipment called a "Ripper" which is usually mounted on a large crawler tractor. The "Ripper" is nothing more than a large metal hook or prong shaped tool which hooks under the rock ledge and breaks it loose so it can be loaded with the scrapers. The "Ripper" is usually mounted on the rear of the tractor and hydraulically operated, or it may be the pull type, independent of the tractor.

When the rock can be no longer broken up and removed this way feasibly, the contractor will start drilling for blasting. If the plans call for pre-splitting of the rock cut, the contractor will drill on the intended cut line and slope to the elevation or depth required. Then he will either load and blast the pre-split, or he will drill on the portion of center cut he desires to remove, load this portion also, and use what is called a delayed shot with the pre-splitting line detonating just prior to the center cut.

Normally the contractor will blast the rock into as small particles as he can without overblasting. He does this in order to facilitate loading his scrapers. After the blasting he usually hauls this rock with crawler tractors and scrapers. The particle sizes after blasting will usually depend upon the hardness of rock, depth of cut, and stratification. Usually a shallow rock cut will not break up very uniformly with blasting and the contractor will usually try to break up these shallow rock cuts with the "Ripper".

ROCK FILLS

I believe the Specifications are clear on this. The rock is hauled onto the fill area in either crawler tractors and scrapers or self-propelled scrapers, and spread in horizontal layers not exceeding four feet in depth, depending on the size of the particles, and consolidate this with a dozer. The consolidation is usually done by the dozer moving the material back and forth and leveling. If, after consolidation there are numerous voids, depending on the size of the particles, earth or smaller rock fragments are used to choke these voids on the lift. Normally only an amount of choking material sufficient to fill these voids is used. After the choking is done, a succeeding lift will be placed on the fill. Four foot lifts can be brought up to within two feet of grade and the next foot can be of smaller rock particles, with the remaining foot constructed of other material, earth, or whatever the plans call

for. The side slopes of rock fills are covered with a minimum of one foot of earth.

REMOVAL AND DISPOSAL OF OLD PAVEMENT

When the construction of a new road passes over a paved road the existing pavement must be removed or broken up in place. This is also true for the reconstruction of an existing paved road.

The plans will show and tabulate the areas of removal, areas to be left in place and areas that are to be broken up and left in place. These areas will be listed by stations. The concrete that is removed can be used in the new embankment so the plans will also list by stations where to place this concrete. If the height of fill does not permit the placing of broken concrete in the embankment or the haul distance is too great, the plans will note a waste area or have the contractor find his own areas of waste.

Again, it is a good policy to check with the County Engineer and our Maintenance Engineer as to their need for broken concrete.

If the fill over the old pavement is ten feet or more, the concrete is left in place and building the embankment can proceed in the normal manner.

If the fill over the old pavement is from five to ten feet, the concrete is to be broken up and left in place. This is a pay item and must be measured and recorded in the field books. A special machine called a "pavement breaker" is used to break up the pavement. This is a rubber-tired machine with a gravity drop hammer.

In fills of less than five feet, the old pavement is to be broken up, removed, and disposed of. The old pavement shall be broken up into pieces having an area not to exceed one-fourth square yard. If the pavement contains reinforcing steel, the steel shall be cut off to within one inch of the encasing concrete. This is to be done prior to loading and hauling to the specified fill areas. The broken concrete is picked up with some form of end loader and hauled by trucks. When dumped by the truck, a dozer is used to level off the deposited piles prior to building the embankment.

The area to be removed is also a pay item and must be measured and recorded prior to removal.

SAND FILLS

The quantity of suitable soil for the construction of the embankment may not be available in some areas. Or the soil may be available but the haul distance may be so great that the cost of construction would be high. Construction near rivers would be an example of this condition. Using sand for the fill material and capping with available soil to the depth stated on the plans is another construction method.

When the sand is available in borrows, regular grading equipment such as scrapers and supporting equipment can be used to build the embankment. The top soil in the borrow is stockpiled and either used on the slopes as a sand cover or replaced depending on the agreement in the right of way contract.

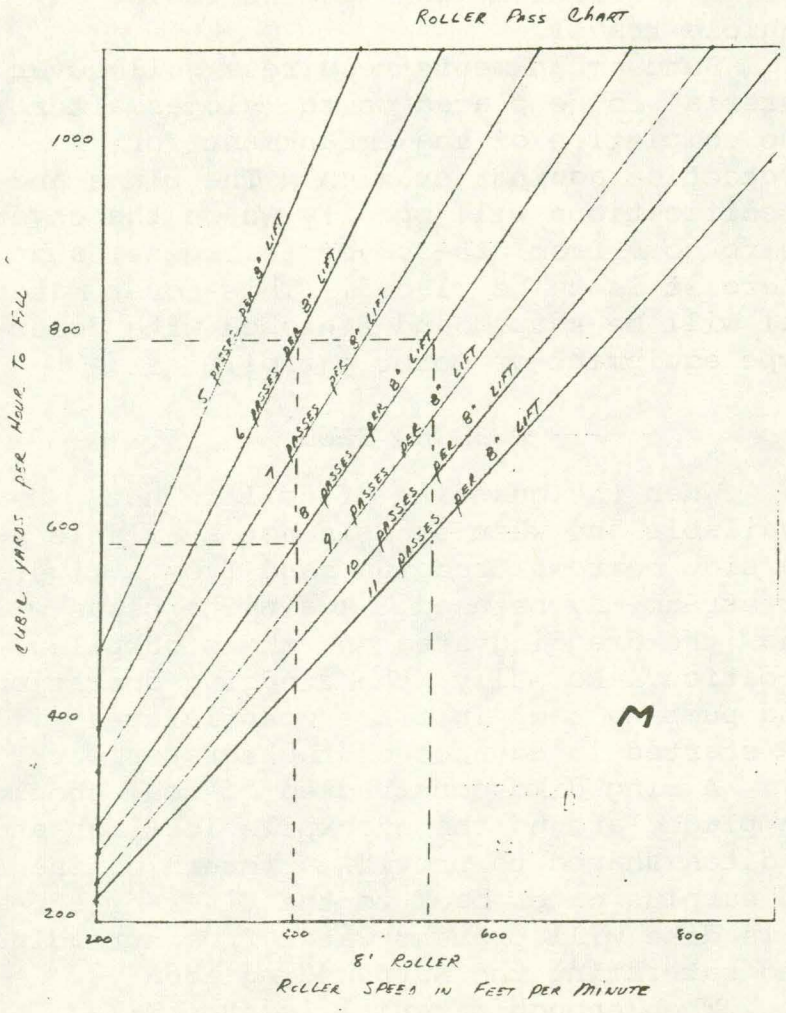
The hauling and placing of the sand follows the regular construction procedure with one notable exception. If a tamping type roller is used for type "A" compaction you will not get the normal walk out or support of the roller on its tamping feet in sand. Since it is not possible to check this walk out visually it would be well to set up a roller pass chart for periodic inspection to insure the required number of passes that are being made for each inch of lift placed.

Exhibit M will illustrate a roller pass chart. Two factors must be determined by you in order to use the roller pass chart, to determine whether or not rolling is adequate. First determine the number of cubic yards of material being delivered to the fill per hour. To do this you will have to determine how many units are hauling, the amount each unit hauls and how many trips each hauling unit makes per hour, thus; the number of units times an average load in cubic yards times the number of trips each unit makes in an hour will equal cubic yards per hour to the fill. Find this number along the left hand side of the chart.

Then determine the number of feet per minute the roller travels and find this figure along the bottom of the chart. These lines will intersect at the number of passes of the roller per eight inch lift.

Example: If 800 cubic yards are delivered to the fill in an hour and the roller speed is 400 feet per minute, you are getting 6 passes of the roller for each 8 inch lift;

therefore, you must either increase the roller speed to 540 feet per minute, or increase the number of rollers or reduce the number of cubic yards of material coming onto the fill to 590 cubic yards, the point where the required 8 passes per lift are reached.



Working in sand fills makes moving up and down the grade in vehicles hazardous. Dry sand slows down the hauling equipment and pickups and cars get stuck easily. A four-wheel drive jeep with oversized tires is found to be an excellent vehicle for this type of work. Moisture in sand makes for more efficient work and is easier on vehicle travel.

Sand embankments require a soil cover material to be placed on the slopes after the completion of the embankment for protection against erosion. The plans and specifications will specify where the cover is to come from, the cover thickness, and where it is to be placed. This cover material will be shaped and finished with dozer-type equipment or motor patrol.

DREDGED SAND

When the quantity of soil is not available and when sand is not available in side borrows dredging sand from a river or stream may be used. Again the plans will show the dredging area and the stockpile location. Normally, the dredging operation and pumping sand into a stockpile area will be started in advance of the scraper work.

A ring dike constructed of soil should be placed around the stockpile location and a ditch shaped to provide a return drainage of surplus water back to the river or stream. This dike will prevent water from spreading and saturating the surrounding area.

When enough material is stockpiled, the grading equipment can proceed with the embankment construction. Compaction, cover material, and shaping is the same as previously noted.

On embankments constructed primarily of sand or granular material which will not readily compact with the tamping type roller, the contractor may, at his option or at the direction of the engineer substitute a pneumatic-tired roller weighing not less than 200 pounds per square inch width of roller.

BACKFILLING STRUCTURES

Backfilling structures will be done by either the culvert contractor or the grading contractor or both contractors. Here is an area of construction in which understanding and cooperation is most essential. Both contractors, with a mutual agreement between them, can work more efficiently together and in some cases by working apart from each other.

The word, "structures" refers to a concrete box culvert.

The culvert contractor is responsible to backfill up to the natural ground unless otherwise noted on the plans. If the flow line of the culvert is four feet below natural ground, the culvert contractor will be required to backfill all the area he excavated and up to four feet in height on both sides of the culvert. The grading contractor may do this for him if an agreement between the two contractors is made, either verbal or written. The remaining fill above the natural ground will then be the responsibility of the grading contractor. If the culvert is not constructed below natural ground, all the backfill is the responsibility of the grading inspector.

The backfilling material shall be free from spongy or vegetable substance, free from frozen material and free of boulders and broken concrete over eight inches in the greatest dimension. Do not place soil in water. If water is present there are several ways to correct the situation. Small amounts of standing water puddles along the footing can be pumped out several days prior to backfilling. This will allow time for the soil to dry. These small puddles can also be pushed ahead to the outlet end of the culvert with a dozer if the excavated width is adequate. Dry material can be pushed ahead with a dozer to dry up the wet areas. As the water is soaked up into the dry dirt the dozer can push this material ahead and out of the footing area and more dry material can be used to repeat the process until the footing area is dry and firm. Normal backfilling of the culvert can then begin. Running water caused by springs may require more extensive work. You should check with the Resident Engineer as to the method of correction because a granular material or even drain tile may be found necessary. Backfill can start as soon as seven days has elapsed after the concrete has been placed and provided the test beam that was made by the culvert inspector developed a modulus of rupture of 550 psi.

Culverts constructed in or adjacent to an old channel may require a granular material backfill. Granular backfill shall be constructed in not more than eight inch lifts. Each layer shall be tamped or

vibrated to insure compaction.

Backfill material shall be deposited in layers of not more than eight inches of loose thickness. Each layer shall be thoroughly compacted before the next layer is placed. All compaction shall be accomplished with an approved roller or by tamping with a mechanical tamper except that backfill around the wing wall of a culvert will be done with a mechanical or hand tamper. Hand tampers are usually made from lumber by the contractor. Rollers may be used not closer than three feet from the wing wall face. The backfilling of the culvert shall proceed simultaneously on both sides of the culvert so that the fills are kept at approximately the same elevation.

When the top of the culvert is reached with the backfilling it is a good practice to dump a windrow of soil along the edge of the culvert. Using a dozer or patrol spread a uniform layer of material over the concrete top and then start the compaction with the roller. By repeating this process the height of fill can be placed over the culvert until it is safe for the hauling units to travel over the culvert.

If the backfill material is too dry to compact properly, the engineer may, as extra work, order the contractor to moisten the soil.

REMOVAL AND DISPOSAL OF UNSUITABLE MATERIAL

It is simple to say we must remove all unsuitable material and dispose of it in a specified disposal area. It is difficult to explain to someone just what types of soil

are unsuitable. In fact, many people who have been involved in grading work for years would not be able to spot all the various soils we call unsuitable.

For this reason A.A.S.H.O. (American Association of State Highway Officials) devised a system of classification of soils. This is the standard method the Iowa State Highway Commission conforms to. Soil samples are taken in the field while the project is in the planning stages. These samples are taken and tested in the laboratory at Ames for both textural and standard A.A.S.H.O. classification, and strength and consolidation characteristics when required. These test results together with field notes are then used to plot the soil sheets for a project. These soil profiles will show unsuitable soil locations. Also on these soil sheets we will find test holes plotted and the sample results recorded. Some of the results shown on these sheets that we use in the field are cut moisture and density, proctor moisture and density, plastic limit, A.A.S.H.O. classification, color of material, and a code to identify it by as clay, silty clay, sand, loam, loamy sand, etc.

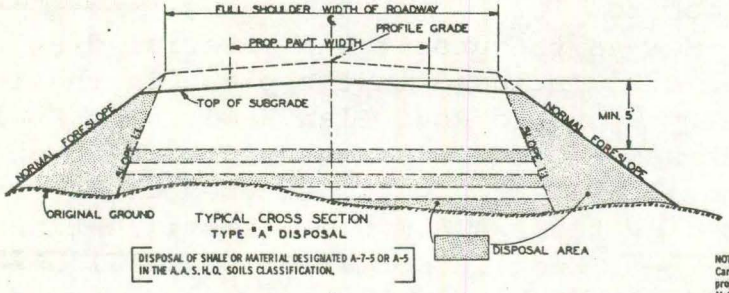
If you need more information about location of unsuitable material refer to the cross sections where it will also be plotted, showing approximately the elevation at which the material will be encountered, and how deep it goes. Now if you want a cubic yard breakdown by stationing, refer to the sheets in the plans containing the template quantities where

you will find a tabulation of unsuitable material, as well as all other earth quantities.

With this information one should have a close idea of what to look for and where to look for it.

How is the unsuitable material disposed of? Included in the plans is the Iowa Highway Standard Road Plan RL-1. The RL-1 sheet has typical cross sections which show disposal areas for various types of material listed by their A.A.S.H.O. classifications (See RL-1 Sheet). Normally, you will observe, all unsuitable types listed can be wasted outside a line extending downward from the shoulder line on a 1:1 slope. Other soils may not be used in the upper five feet of embankment, upper three feet in some cases, depending on the respective types of soil. Unstable soil, you will notice, is spread in alternating stable and unstable layers as per Specification. No unstable soil can be used in the upper five feet of embankment. Remember, we can only waste unstable soil in the fill by specific permission of the engineer.

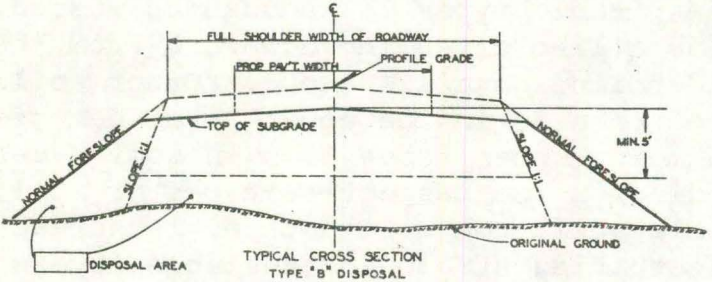
What is unstable soil? Any type of soil may be unstable if it comes out of the cut too wet. There are also soil types that are unstable without being too wet. These unstable soils may be either suitable or unsuitable by classification. Just remember that if it cannot be consolidated in the fill it should be disposed of.



TYPICAL CROSS SECTION
TYPE "A" DISPOSAL

DISPOSAL OF SHALE OR MATERIAL DESIGNATED A-7-5 OR A-5 IN THE A.A.S.H.O. SOILS CLASSIFICATION.

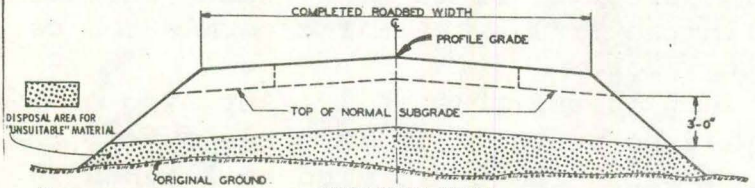
NOTE:
Care should be exe
proper drainage in
Material listed as '
earthwork quantiti
herein for the par
also to the project
survey sheets for



TYPICAL CROSS SECTION
TYPE "B" DISPOSAL

DISPOSAL OF DESIGNATED MATERIAL SUCH AS CLAY PAN, GUMBO, RESIDUAL SHALEY CLAY OR MATERIAL CLASSIFIED AS A7-6 (9-20) IN THE AASHO SOILS CLASSIFICATION.

REFER TO COLUMN C-5 ON EARTH WORK TABULATION



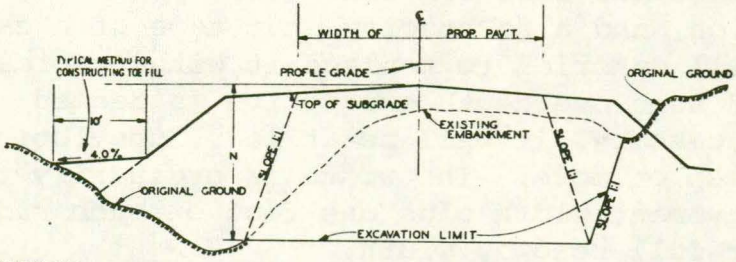
TYPICAL CROSS SECTION
TYPE "C" DISPOSAL

REFER TO QUANTITY LISTING AND BALANCES FOR DETAILS OF DISTRIBUTION OF "UNSUITABLE" MATERIAL.

DISPOSAL OF SOILS DESIGNATED AS UNSUITABLE TOPSOIL OR CLASSIFIED BY COLOR AS BLACK OR BROWNISH BLACK IN THE AASHO SOILS CLASSIFICATION A-4, A-6 OR A7-6 UNSUITABLE FOR USE IN CONSTRUCTION OF THE UPPER 3 FEET OF ANY EMBANKMENT.

REFER TO COLUMN C-3 ON EARTH WORK TABULATION.

RL-1



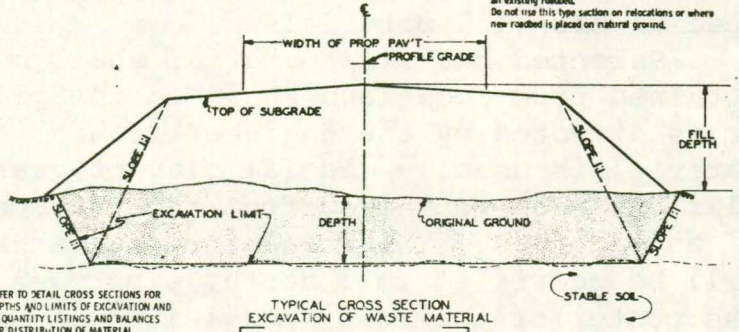
TYPICAL CROSS SECTION
REBUILDING EMBANKMENTS
(PLOWING & SHAPING)

rcised in setting toe fills so that side ditches is maintained. "unsuitable" in the tabulation of es shall be disposed of as detailed ticular soil types identified. Refer cross sections and plan soil additional information.

NOTE:
Material excavated in rebuilding embankments may be redeposited in the same area or any adjacent embankment approved by the engineer. No payment for overhaul will be allowed on material excavated in "Rebuilding Embankments".

N MAXIMUM = 5'-0"

Excavate from grade down on 1:1 slope to natural ground or to five foot below grade whichever is less. This will insure that new pavement will rest completely on uniformly stable bearing soil.
Rebuild embankments only when new roadbed overlaps an existing roadbed.
Do not use this type section on relocations or where new roadbed is placed on natural ground.



REFER TO DETAIL CROSS SECTIONS FOR DEPTHS AND LIMITS OF EXCAVATION AND TO QUANTITY LISTINGS AND BALANCES FOR DISTRIBUTION OF MATERIAL.

TYPICAL CROSS SECTION
EXCAVATION OF WASTE MATERIAL

PEAT & MUCK OR OTHER MATERIAL WHICH MUST BE WASTED AND IN NO CASE USED IN CONSTRUCTION OF EMBANKMENT.

WOD DISPOSAL TYPES — LAST REVISION DATE 3-31-67

IOWA HIGHWAY COMMISSION
STANDARD ROAD PLAN RL-1

RECOMMENDED
ROAD ENGINEER — DATE 4/5/67
DESIGN ENGINEER — DATE 4/6/67

APPROVED
DEPUTY CHIEF ENGINEER — DATE 4-7-67

DETAILS OF EMBANKMENTS
(DISPOSAL OF UNSUITABLE MATERIAL)

Pottawattamie COUNTY — I-80-1(61)12--01-78 — 78

SELECTED AND SPECIAL BACKFILL

If unsuitable or unstable soils are encountered at finished grade line, the plans may call for some overdepth excavation, and also specify what type of backfill material to replace it with. Normally, if some overdepth excavation is deemed necessary, it will be at least one foot deep or more. The width is ordinarily the pavement width plus one foot on each side or full roadway width.

It has been mentioned that the type of backfill material will be specified. These treatment areas, as they are referred to, will either be filled with selected or special backfill materials.

Selected backfill material shall be obtained from locations shown on the plans or as directed by the engineer. This material is usually glacial clay or granular material reclaimed from the surface of an old road. This reclaimed surfacing will be scarified full depth, windrowed to the center of the road, pulverized if necessary, and loaded for transportation from the windrow.

Special backfill material shall be furnished by the contractor and shall pass gradation specifications set forth by the Iowa Highway Commission. When this material is to be delivered to the project the Highway Commission must be notified by the contractor so that a man can be assigned to the scales at the producer's site. This man must witness each truck being weighed and sign or initial the ticket which will

accompany the load to the project. Another inspector will be on the job site and gather tickets as the trucks arrive. The tickets will again be initialed by the inspector on the grade. Don't forget that the specifications call for certain moisture requirements on both select and special backfill materials. Standard moisture test will be run on these materials.

The condition of the underlying material may limit the amount of compaction that can be attained in the bottom foot of the treatment area, regardless of the type of compaction specified. It may be necessary to doze the material in place.

Except for this bottom one foot of the treatment area, select and special backfill material shall be placed and compacted in accordance with the particular type of compaction specified. These instructions are all detailed in the specification book.

REMOVAL AND DISPOSAL OF BOULDERS

Boulders encountered in the embankment site and their disposition is very well covered in the Standard Specifications. No attempt will be made to improve upon the specification in this publication except for this reminder. When boulders are anticipated in the excavation and are a pay item in the contract, the contractor will have to deposit them in a heap or pile for measurement. Method of measurement and payment are also covered in the Standard Specifications.

INTERCEPTING DITCHES

When the slope of adjacent land towards the backslope of road excavation and the extent of the area drained would result in sufficient water flowing over the backslope to cause serious erosion, a dike shall be constructed to intercept the flow of surface water and conduct it down the entire length of the backslope and into proper drainage channels. This dike is called an intercepting ditch.

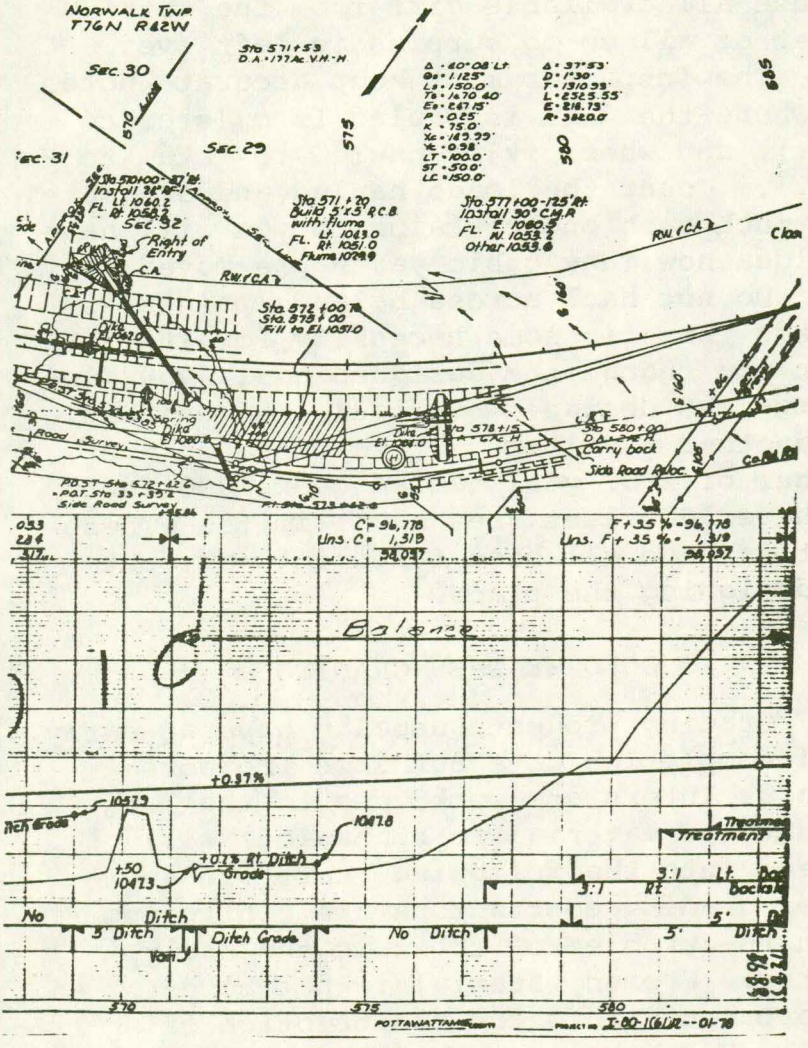
The ditch shall be formed by excavating or blading earth from the down hill side of the ditch location. This material shall be deposited in a windrow and compacted with a patrol to form the ditch and provide the bank for the down hill side.

Although the contractor may choose to build the intercepting ditches during his finish operations, I would urge him to construct them as he takes down his cut dirt. The dirt is readily available and the ditches can be working all during the construction season. Less erosion means less work when finishing the project.

BALANCE POINTS

Balance points will be shown on the profile section of the plans. In the area between any consecutive balance points, the amount of cut equals the amount of fill plus shrink. Shrink is the loss in volume from cut to fill resulting from compaction.

Now look at the example plan profile sheet. You will notice that this balance is calculated using 35% shrink. All the dirt used to make the fill comes from


NORWALK TWP
T76N R42W
Sec. 30
Sec. 31
Sec. 32
Sec. 29
Sta 571+53
D.A.=177 Ac. V.H.-H
Δ = 40°08' Lt
Do = 1°25'
Ls = 150.0'
Ts = 70.40'
Es = 6.47.15'
P = 0.25'
K = 75.0'
Xc = 149.39'
Yc = 0.98'
LT = 100.0'
ST = 50.0'
LC = 150.0'
Δ = 37°53'
D = 1°30'
T = 1910.39'
L = 2525.55'
E = 218.73'
R = 3820.0'
570
575
580
585
Sta 571+20
Build 5'x5' R.C.B.
with Flume
Lt 1043.0
Rt 1051.0
Flume 1049.9
Sta 577+00-125' Rt.
103 Fall 90° Cmp.R
E 1060.5
FL. W 1053.2
Other 1053.6
Right of Entry
RW (CA)
Sta 572+00 Fill to El. 1059.0
Sta 573+00 Fill to El. 1059.0
Sta 578+15
D.A.-CAC.H
Sta 580+00
D.A.-CAC.H
Carry back
Side Road Reloc.
Spring
Road Survey
P.O.T. Sta 572+42.6
+P.O.T. Sta 33+39.2
Side Road Survey
C= 96,778
Uns. C= 1,319
96,057
F+35%-96,778
Uns. F+35%- 1,319
96,057
Balance
+0.37%
Neck Grade
1057.9
1047.8
+50
1047.3
+0.1% Rt Ditch Grade
Treatment
3:1 Rt
3:1 Lt
backslope
No Ditch
3' Ditch
Varies
Ditch Grade
No Ditch
5'
Ditch
570
575
580
POTTAWATTAMIE
PROJECT NO I-80-1161(2R)--01-78

within the balance in this case. Oftentimes, dirt from some borrow area is also necessary to make up a balance. In case dirt from a borrow is called for, remember to use all available dirt from the cut first of all so no surplus is left over.

The inspector must keep accurate notes of where the dirt is hauled from (sta. to sta.), and where it is hauled to (sta. to sta.). Count the loads hauled and estimate how much each one contains so you will have an idea how many cubic yards are moved.

Do not haul across balance points unless there is some necessity for it. When you change the designed haul, you also change the designed overhaul, and overhaul is another pay item. It is based on the number of sta. yds. hauled over 1000 feet. We have 1000 feet free haul limits. These factors have all been taken into account in designing the plans.

COLD WEATHER GRADING

Grading projects usually have an early fall completion date but some projects such as Interstate work, due to the large amounts of material to be hauled, will extend into the following year. In any case, grading contractors are confronted with the problem of frost in the early winter. Frozen material is not to be incorporated into the construction of a fill. Nevertheless, the ground does freeze and we are faced with what to do with the frozen material.

The weather prediction may be that the present cold snap will be for a short

duration and the problem is temporary. In this case, the frost may only be an inch or so deep each day and may not be a tight frost. Using a motor grader on the fill will break up the frozen material and, in many cases, dissolve the frost. Meanwhile, the borrow area can be scraped frost free and hauling can begin.

When the frost is light as described above, a good practice is to cover the fill with a loose layer of uncompacted material at the end of the day. This will protect the compacted layer below and the loose material will not freeze as tight as it would if compacted.

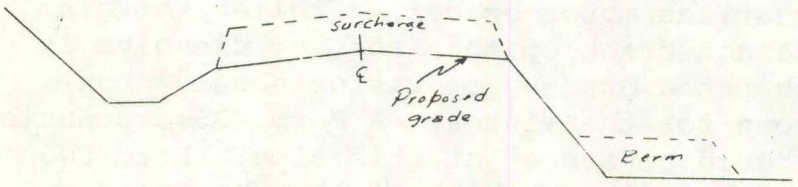
As the days get colder and the frost gets to be more serious, the contractor may choose to haul off the frost and stockpile the frozen material in the borrow area and replace this with unfrozen material. This must be his choice as this method can be expensive.

The contractor may choose to work two shifts around the clock so that the ground does not freeze quickly enough to stop his operation.

Just how much frost is too much is a judgment thing, but if the frost is such that the motor grader, a roller, or disc cannot break up the frost or dissolve it then the grading operation should shut down for the winter. A Form 806 suspension should be issued at this time. Form 806 is shown in the back of this handbook.

WASTE OR SURPLUS MATERIAL

Unsuitable material that is designated not to be used in the embankment or channel excavation at the outlet end of a culvert, may have to be wasted. Waste areas will have to be located for the contractor if the waste areas are not designated. Surplus material that will sometimes occur in the road design can be stockpiled at designated areas to be saved and used for shoulder construction after the pavement is completed. Sometimes the plans provide for an additional fill on top of the designed proposed grade. This is called an overload or surcharge and is usually five feet in height. Its purpose is to speed up any anticipated settlement. Removing this overload prior to paving will result in surplus material. Besides hauling this material back to the borrow area if economical to do so or stockpiling for future use, we can place this surplus material against the designed foreslope to form a berm.



BRIDGE BERMS

Bridge berms will be built by the grading contractor. The special provisions will list the additional information needed for construction, as shown in the following example:

Design 3665 Sta. 5204+06

Over CB & Q R.R. Stage 1 by winter shutdown. Remainder by May 18, 1968.

Because of the high fills at bridges and the problem of total settlement of the fill prior to bridge construction, it is a must that these berms be completed in time. A time delay of 30 to 90 days is usually required after the completion of the berms before the bridge contractor can begin his pile driving operations in these berms. Any delay in berm completion by the grading contractor results in delays for the bridge contractor. In some cases, a monetary penalty is imposed upon the grading contractor if the berms are not completed on time.

Prior to construction of the berms, make sure all the survey stakes are in place and keep checking against the berm fill as the work progresses up to the proposed finish grade. Before the grading contractor turns over the berms to the bridge contractor, he must finish the side and top to the plan shape and proposed grade. Berms should be checked first with a

survey or hand level and then visually for smoothness and shape.

Be sure that bricks and broken concrete from site preparation does not get buried in the berm area. Driving piles into buried debris could result in damage to the pile.

FINISHING

A rule that would convey to the new inspector a definite idea of finish desired on earthwork, would be difficult to write. Obviously, the subject cannot be dismissed by specifying the number of times a given piece of equipment will be used since the nature of soil and its moisture content would determine the results obtained. Results are more important than the method.

A foreslope is the sloping surface of an embankment, ditch, or borrow pit of which the downward inclination is away from the traveled way.

A backslope is the sloping surface of a cut, borrow pit, or ditch of which the downward inclination is towards the traveled way.

A cross-section is an end view of the existing ground line plotted to scale in reference to elevations. The cross-sections will show the cut and fill areas, ditch locations, rate of slope for the foreslope and backslope finish. The cross-section shall be used with the plans during the embankment construction and finishing operations.

The best time to start the finish operation is when the soil contains the right amount of moisture, but this is not always practical. With the proper moisture, lumps and clods will crumble easily under the use of finish equipment. Some soils that are too dry will not hold a patrol on the slopes, causing the machinery to slide. Ruts and loose material on the slopes are unsightly and will result in excessive erosion.

The road bed, ditches, and slopes should be carefully bladed to a smooth, uniform surface. The most satisfactory method of finishing the backslope of a cut is to carry the finish down as the dirt from the cut is being removed. Any excess dirt that is left in the foreslopes during construction is usually pushed up from the toe of the fill to the top of the road with a dozer prior to blading the foreslopes smooth. This dirt can be incorporated into roadtop finish.

The operation of the dozer can move the dirt more efficiently and give the foreslopes the additional compaction it needs for smooth surface. Special finish on each slope is not ordinarily attempted but the effort should be directed toward securing slopes that conform closely to the cross-sections.

During the finish operations, the contractor shall collect and dispose of all surface boulders, rocks, broken concrete, roots, and other debris such as oil cans and pieces of broken cable.

Check the right-of-way contracts again to be sure that the borrows are finished as agreed upon. Borrow pits that do not drain are a never-ending source of trouble.

On primary projects after the backslopes have been finished to the extent that they reasonably conform to the cross-section with all bulges removed and sags filled, as a final operation, all backslopes shall be roughened by scarifying to a depth of three inches except those slopes which contain sufficient sand or rocks to make scarifying impractical.

Hand finish will be required in areas that cannot be reached or when satisfactory results cannot be obtained by machinery.

REPORTS AND RECORDS

Test Reports

Before any material such as pipe, aprons, and granular material can be used in the construction of the embankment, that material must meet the requirements set forth by the state under the Standard Specifications. When this material is tested and approved, a report will be sent to the Resident Office. A copy of this report should be filed by the inspector. A check with the Resident Engineer should be made as to his policy on the recording and distribution of the test reports. Exhibit N is a copy of a test report for Concrete Culvert Pipe.

FORM 286 6M 8 67
14689 PB 11491
CP41405 A 67

IOWA STATE HIGHWAY COMMISSION
MATERIALS DEPARTMENT
TEST REPORT — Drain Tile & Culvert Pipe

County Pottawattamie
Proj. No. I-IG37-29-2(6)M
05-78
Date 7/15/68

Material Concrete Culvert Pipe — Lab. No. A68P 1099-1100

Material Producer Wilson Concrete Co. — Plant Avery, Nebr.

Contractor Miller Excavating Co. — No. of Lineal Feet 54'

Inspected ~~Sampled~~ by J. Arm & P. Danala — Date Sampled — Date Received

Tested by — at — Date Tested

Grade 2CD — Kind Reinforced — Type T & O

Lab Number	Sender's Number	Date Made	Weight Pounds	Average Diameter Inches	Length Feet	Ave. Wall Thickness Inches	Load Per Linear Ft. Cracking Load	Load Per Linear Ft. Ultimate	Percent Absorption
4 pcs.	24 x 30			24	7.5	2CD			30'
4 pcs.	24 x 72			24	6	2CD			24'

MEASUREMENTS OF REINFORCEMENT

Laboratory Number	Cage Length Inches		Lap Inches	Circumferential Reinforcement Cage No.	Circumferential Reinforcement Spacing In.	Longitudinal Reinforcement Cage No.	Longitudinal Reinforcement Spacing In.	PLACEMENT
23243 Ticket		Single						Area
		Outside						Robert Bartle
		Inside						James Presnell
		Single						Pile
		Outside						
		Inside						

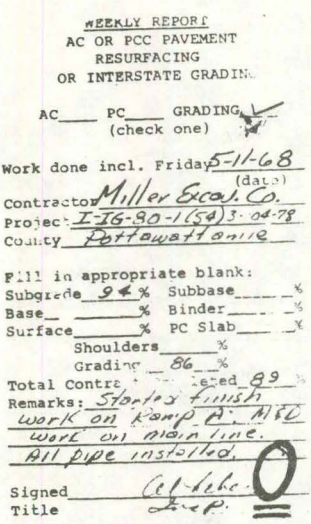
DISPOSITION Approved if Stamped.
Note to Engr.
This pipe should be inspected by your office at destination for damage due to handling & shipping
Also for Iowa Highway Commission Stamp.

Signed Frank Danala
Laboratory Chief

N

Post Cards

On all Interstate grading projects, the inspector must send in a weekly progress report to the Construction Engineer in Ames, Iowa. This report will be made out on postcards furnished by the Resident Office, and should leave your office on Friday of each week in order to arrive in Ames on Monday morning. This postcard can also be used for Asphaltic or Portland Cement projects.



WEEKLY REPORT
AC OR PCC PAVEMENT
RESURFACING
OR INTERSTATE GRADING

AC____ PC____ GRADING ✓
(check one)

Work done incl. Friday 5-11-68
(date)
Contractor Miller Excav. Co.
Project I-IG-80-1(54)3-04-78
County Pottawattamie

Fill in appropriate blank:
Subgrade 94 % Subbase____ %
Base____ % Binder____ %
Surface____ % PC Slab____ %
Shoulders____ %
Grading 86 %
Total Contract Completed 89 %
Remarks: Started finish
work on Ramp A. also
work on main line.
All pipe installed.

Signed Carl Lebo
Title Insp.

Form 387-A Rev.

This form is used to report the moisture and density results to higher authority. This information is copied from the field books used in the laboratory. Due to weather or other delaying conditions, it is permissible to send this report in once a week when only one or two tests are made during the day. Four copies should be made. The original and two copies are to be turned in to the Resident Office and the fourth copy should be retained by the inspector.

Be sure that no mistakes are made when copying this information from field books. Do not report the failures on this report.

This report will be much neater if made out in ink. See Exhibit P.

FORM 387A REV
20M-2-67-14721
PB14728—46098

IOWA STATE HIGHWAY COMMISSION

Construction Department

DAILY REPORT – BASES & MOISTURE DENSITY EMBANKMENTS

Primary or Secondary Roads

Contractor Miller Excav. Co. Miles in Project 1.7

County Pottawattamie
Project I-IG-F-29-2(6)45 05-78
Date 5-16-68
Report No. 3
Res. ■ Engr. James Presnell

Plan Thickness	Type	Section Worked Sta. to Sta	Distance Test hole from CL	Proctor or A. C. Lab. Density	Field Density	% Proct. or A. C. Lab. Density	Proctor Moisture	Measured Depth	*Percent Moisture	Lane ~~Pass Rdwy or Ry or C.~~	Course Laid	Tot. Miles Completed
6"	Sandy Clay	192+00 - 197+00	25 Lt	1.73	1.67	96.5	17.6	6"	17.6	Left	1st	
6"	Sandy Clay	192+00 - 197+00	15 Rt	1.73	1.68	97.1	17.6	6"	17.9	Right	2nd	
6"	Sandy Clay	169+37 - 175+00	15 Rt	1.73	1.66	96.0	17.6	6"	17.6	Right	2nd	
6"	Sandy Clay	175+00 - 180+00	20 Lt	1.75	1.71	98.8	17.6	6"	17.9	Left	4th	
6"	Sandy Clay	197+00 - 202+00	10 Rt	1.73	1.70	98.5	17.6	6	17.8	Right	5th	
6"	Sandy Clay	202+00 - 207+00	12 Rt	1.73	1.75	100.0	17.6	6	18.5	Right	5th	

P

REMARKS: Moisture in the borrow close to optimum moisture. No problems getting density

*Bases – % moisture at time of density test.
Grading – % moisture before compaction.

Signed: Dallas Carlisle
Inspector

Diary and Sample Field Books

The duties of a good inspector do not end with seeing that the work itself is performed in accordance with the plans and specifications. Record-keeping is a must. The method of measurement and basis for payment must be as familiar to you as the specifications. Your records should show when the work was performed, when an item was measured for payment, who made and checked the computations. Your records should be neat, legible, and well-indexed, and should show your signature.

It will be necessary to study the plans, number of pay items, and length of contract period so that there is ample space to record the work done. Do not clutter up the field book as it will become a permanent part of the records and will be used many times before the completion of the project.

An inspector is only as good as his record keeping. If an inspector has to be replaced on the job because of accident or illness, his records should be in such condition that his replacement can take over with a minimum of confusion.

A complete set of diary and field book sample setup has been published and are in the Resident Office. The following Exhibits Q and R are examples of two field book setups.

APRIL EQUIPMENT RECORD

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TD-18A DOZ.		X	X	X	X	X		X	X	O	O	6	X		X
TD-14A-PUSH		X	X	X	X	X		X	X	X	X	X	X		X
END LDR.		X	X	X	X	X	SUNDAY	–	–	–	–	–	–	SUNDAY	X
TRUCK (ST)		X	X	X	X	X		–	–	–	–	–	–		X
"C" PULL		X	X	X	X	X		O	4	X	X	X	O		X
"C" PULL		X	X	X	X	X		X	X	X	X	X	X		X
"C" PULL		X	X	X	X	X		X	X	X	X	X	X		X
LET-WEST SHEEPSFOOT		X	X	X	X	X		X	X	X	X	X	X		X
ROME DISC.		X	X	X	X	X	SUNDAY	X	X	–	–	–	–	SUNDAY	X
ADAMS Motor Grader		X	X	X	X	X		X	X	X	X	X	X		X
P.H. DRAGLINE		X	X	X	X	X		–	–	–	–	–	–		X
SAND DRAIN EQUIPMENT		BROUGHT IN ON APRIL 9										X	X		X

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
TD-18A DOZ.			6	X	X											
TD-14A-PUSH			6	X	X											
END LDR.	RAIN	RAIN	6	X	X	SUNDAY										
TRUCK (ST)			6	X	X											
"C" PULL			6	X	X											
"C" PULL			6	X	X											
"C" PULL			6	X	X											
LET-WEST SHEEPSFOOT			6	X	X											
ROME DISC.	RAIN	RAIN	6	X	X	SUNDAY										
ADAMS Motor Grader			6	X	X											
P.H. DRAGLINE			6	X	X											
SAND DRAIN EQUIPMENT			4	SAND DRAIN COMPLETED-EQUIP.												
				REMOVED ON APRIL 19, 65												

X - Worked normal day.

6 - Number of hours worked. (Less than a normal day)

0 - Equipment broke down. (Not available)

– - Available but not worked.

Q

SAMPLE DIARY SET UP

4-8-64 MONDAY — WARM SHOWERS 80°

HOURS - 6:00 - 8:00 9:30 - 6:00

DELAYS - RAIN 8:00 - 9:30

WORKED - CL. 10 BAL 932± & 942±
- SELECT CLAY 452 - 472+00
- SPEC. COMPACTION
- ROWY. PIPE 945+26
- FINISH WORK

REMARK'S - HAULING CL. 10 FROM - BORR. "B" BUILDING SUBGRADE STA 932± TO 942± SELECT CLAY FROM CUT DITCH SECTION 448 - 460.

SPEC'AL — SCOOPS RUTTING HAUL ROAD CAUSING A SOFT SPOT WHICH WILL NEED CORRECTION STA. 920+00 to 923+00. SPECIAL COMPACTION IS COMPLETED IN THIS AREA.

E.W.O. PAGE — E.W.O NEEDED FOR UNCOVERED WELL. STA. 732+56 FILLED WITH BROKEN CONC. FROM STA 602+50

1

EWO PAGE 26 — REMOVED AND REPLACED ROWY. PIPE AT STA. 945+26 - PIPE STAKED WRONG BY SURVEY PARTY.

MR. JONES — TALKED TO MR JONES (TENANT ABOUT REMOVING TEMP. FENCE, SO WE CAN COMPLETE CH. CH. STA 941+60

FINISH WORK STARTED TODAY AT STA 85+00 - 130

ACCIDENT PAGE 75 BOOK 6 — CAR ACCIDENT WITH "C" PULL TODAY SEE DETAILS ON PG. 75 BOOK 6.

VISITOR — DIST. ENGR. VISITED PROJECT TODAY. DISCUSSED DEPTH OF TRENCH STA 622 - 626. SAID WE SHOULD INCREASE THE DEPTH TO 3.0 INSTEAD OF 2.0 AS SHOWN ON THE PLANS.

SIGNATURE District Engineer)

NOTE: One page or more can be used for one days entry but start each day on a new page. Underline all important key words as shown in diary narrative.

R

[illegible] (INSP.)

Form 806

This is a form to aid in making credits and charges against the construction period, and to keep the contractor informed of these credits and charges. The Form 806 comes in a booklet with carbon paper. Four copies are made. The white copy is for the contractor, the blue copy goes to the District Engineer, and the pink copy is for the Resident Engineer's file. The yellow copy is left in the booklet for the inspector's copy and file.

When, for any reason, the contractor stops work on a project, either voluntary or by order of the engineer, this form is to be filled out and sent to those designated thereon.

Shutdowns caused by weather amounting to more than fifty percent of the normal work day will require the filling out of Form 806.

By striking out and inserting appropriate words, this form may be used to give original authorization for the contractor to begin operations.

Exhibits S and T on the following pages are samples of Form 806 and how it is used.

2M Books 11-44-13979
PB 12718

to begin project

Iowa State Highway Commission
Form No. 006

Notice of ~~Suspension or Resumption of~~ Work

No. 1

Date August 30 1967 Project No. I-IG-F-29-2(6)49--05-78 Pottawattamie County

To: Miller Excavating Co.
(Contractor)

You are hereby notified to suspend operations on the above project because of _____, effective on _____ 19____ until further notice.

You are hereby notified ~~that, since the conditions causing suspension of work on the above project no longer exist~~, you are to start operations August 31 1967, on which date the charging of days of time against your contract period will be resumed until further suspension, or completion of the project.

This copy for CONTRACTOR

Al Loken
Resident or County Engineer-Inspector

2M-Books 11-44-13979
PB 12718

Iowa State Highway Commission
Form No. 006

Notice of (Suspension) or Resumption of Work

No. 2

Date Sept 12 1967 Project No. I-IG-F-29-2(6)49--05-78 Pottawattamie County

To: Miller Excavating Co.
(Contractor)

You are hereby notified to suspend operations on the above project because of 1" Rain _____, effective on Sept 12 1967 until further notice.

You are hereby notified that, since the conditions causing suspension of work on the above project no longer exist, you are to resume operations _____ 19____, on which date the charging of days of time against your contract period will be resumed until further suspension, or completion of the project.

This copy for CONTRACTOR

Al Loken
Resident or County Engineer-Inspector

S

25d-Books 11-64-13979
PB 12718

Iowa State Highway Commission
Form No. 826

Notice of Suspension or Resumption of Work

No. 3

Date Sept 15 1967 Project No. I-IG-F-29-2(6) 49-05-78 Pottawattamie County

To: Miller Excavating Co.
(Contractor)

You are hereby notified to suspend operations on the above project because of _____, effective on _____ 19____ until further notice.

You are hereby notified that, since the conditions causing suspension of work on the above project no longer exist, you are to resume operations Sept 15 1967, on which date the charging of days of time against your contract period will be resumed until further suspension, or completion of the project.

This copy for CONTRACTOR

Al Leber
Resident ~~or County Engineer~~ Inspector

25d-Books 11-64-13979
PB 12718

Iowa State Highway Commission
Form No. 826

Notice of Suspension or Resumption of Work

No. 36

Date Oct. 5 1968 Project No. I-IG-F-29-2(6) 49--05-78 Pottawattamie County

To: Miller Excavating Co.
(Contractor)

You are hereby notified to suspend operations on the above project because of project is Completed, effective on Oct 5 1968 until further notice.

You are hereby notified that, since the conditions causing suspension of work on the above project no longer exist, you are to resume operations _____ 19____, on which date the charging of days of time against your contract period will be resumed until further suspension, or completion of the project.

This copy for CONTRACTOR

Al Leber
Resident ~~or County Engineer~~ Inspector

T
=

PERSONAL EQUIPMENT

The inspector should have in his possession the following items:

1. A copy of the specifications and documents mentioned in the beginning of this manual.
2. Six-foot rule.
3. Hand (eye) level.
4. Level rod (3 piece).
5. 100-foot cloth tape.
6. Test reports.
7. Hard hat.
8. Safety vest.

The six-foot rule, hand level, level rod, and tape will be used to check the grade stakes set by the survey party and to check any staking the contractor might set. An example of this would be where the contractor would set out intermediate stakes when fine grading the flow line of a crossroad pipe. The use of this equipment will be explained in another manual entitled, "Construction Survey".

SAFETY

The construction department has made many items of safety equipment available to the inspector. This list includes the very latest and best hard hat, cold weather liners, and face shields; seat belts to include rear seat belts on passenger cars; and, orange vests that can be seen from a great distance. Signs are available at

the maintenance department for the protection of all people involved on construction projects and the traveling public.

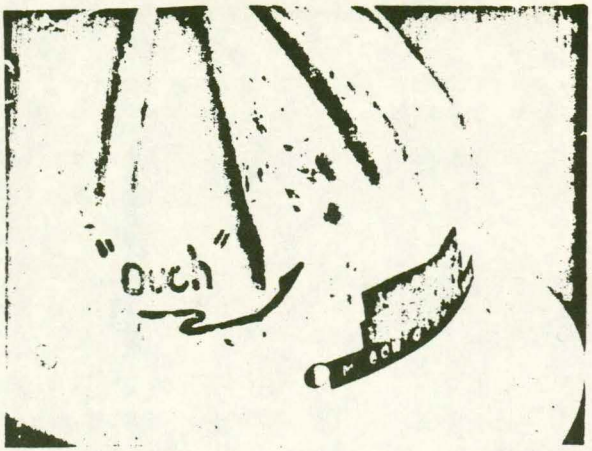
In addition to the safety program sponsored by the construction department, special safety rules have been adopted by the State Employment Safety Commission and are a part of our Standard Specifications which provide that "the contractor shall comply with all applicable federal, state and local laws governing safety, health and sanitation."

In general, safety precautions, whether specified in detail or not, consist simply of the use of common sense in the operation of tools and equipment.

Although the Highway Commission is not an enforcement agency for the Employment Safety Commission, unsafe practices on highway construction projects should be called to the attention of the contractor. Read and understand the manual on Uniform Control Devices for Streets and Highways Specification.

Since inspectors work outdoors around large mobile units, dusty conditions during the hot summer makes visibility an additional hazard. Whenever possible, park your vehicle off the embankment being constructed. When working on the embankment, position yourself so that you can be seen. Be especially watchful when it is necessary to pass moving vehicles on the embankment.

There is no end to the number of words that can be written about safety and safety precautions. Exhibit U, taken from the Highway Hilites, shows in a very few words, a lesson in safety and safety equipment.



Hardhat protection

"I've decided to wear my hardhat because I know I can live with it."

Terrill G. West, an inspector in the Mason City Construction Residency didn't say that in exactly those words, but he certainly subscribes to the philosophy of wearing a hardhat.

During the last construction season, West was inspecting the concrete breaking operation as the curb was removed from U.S. 69 in Winnebago County.

A piece of broken concrete about two inches wide by three inches long was picked up by the rear wheels of a passing truck and thrown through the air. The piece of concrete struck the front of West's hardhat with enough force to knock it off and stun him momentarily.

The projectile left a big dent in West's hardhat, but he was not injured.

"The hardhat gave him the required protection when he needed it," Roger W. Gotschall, Resident Construction Engineer said.

Wayne Wilson, the Highway Commission's Safety Coordinator, said, "There are always a number of people in any organization who have decided that safety procedures are designed 'for the other guy'."

"I am constantly receiving reports of how an extra margin of safety so often makes the crucial difference," Wilson said. "It has long been recognized that the hardhat is a valuable item for many jobs."

2/69

Terrill G. West, with dented hardhat.

"Accidents are costly to you, the employee, and to the Commission, the employer. Avoid injury to yourself by learning to do your job correctly. Guidelines have been established in the Safety Manual as a means of reducing hazards and lessening damage to equipment and property."

"Protect yourself--you can live with it," Wilson said.

NOTES