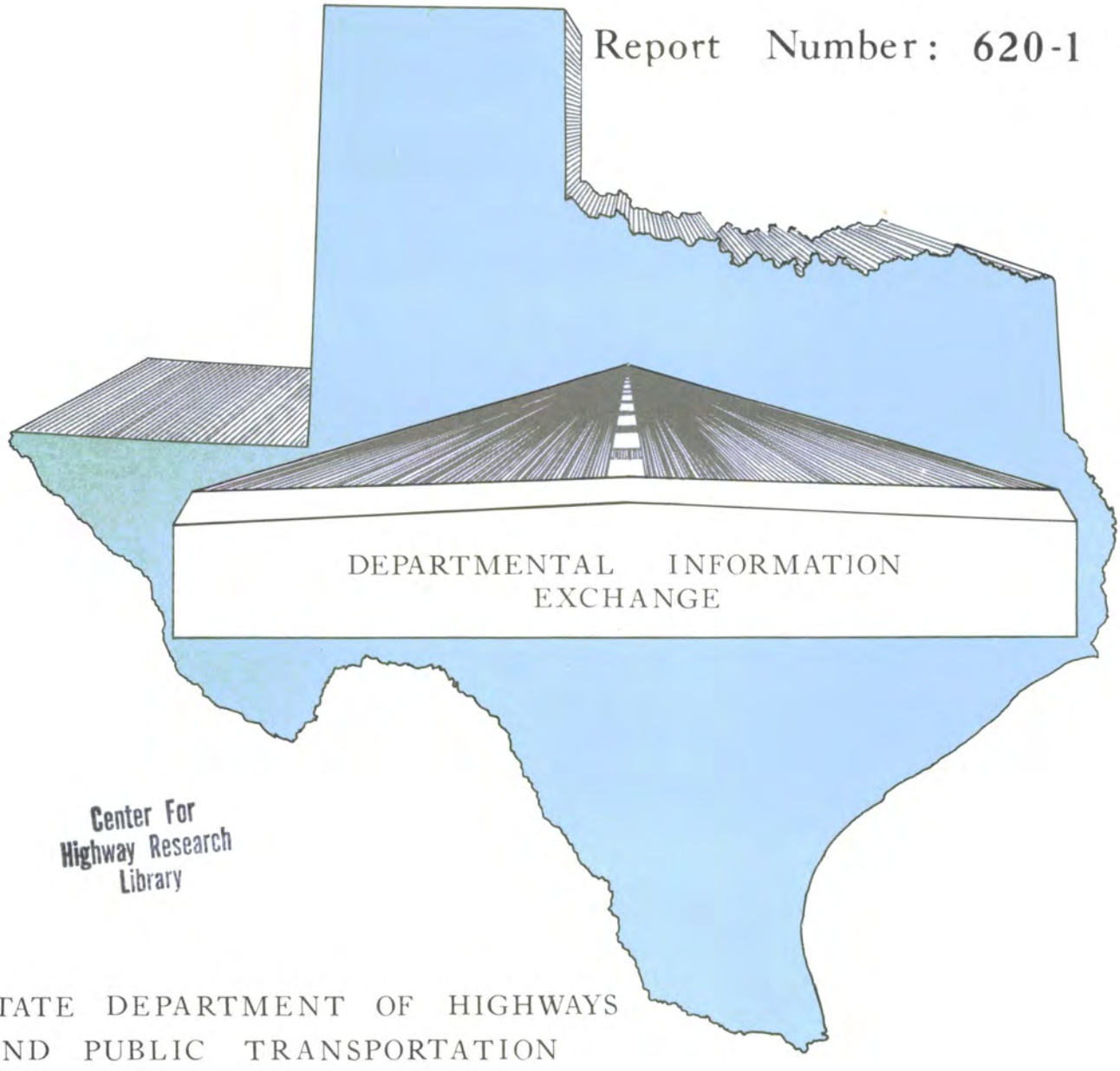
EXPERIMENTAL PROJECTS

GRATES FOR EXISTING CULVERTS

Report Number: 620-1



STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

STATE DEPARTMENT OF HIGHWAYS

AND

PUBLIC TRANSPORTATION

GRATES FOR EXISTING CULVERTS

by

B. R. Lindley
Asst. District Engineer
District 8

Report No. 620-1

June, 1976

DISCLAIMER STATEMENT

The material contained in this report is experimental in nature and is published for informational purposes only. Any discrepancies with official views or policies of the DHT should be discussed with the appropriate Austin Division prior to implementation of the procedures or results.

HISTORY

For many years traveling motorist have been faced with a fixed object hazard just off the paved surface. Concrete headwalls were designed in the early years to be very close to the pavement and in most cases were 12 inches wide and two or three feet above the shoulder.[1] Unfortunately the reconstruction rate has not kept up with the velocity of the traveling public or the design of automobiles. These headwalls still exist and are claiming their victims very consistently.

In early 1972 the staff of District Eight decided to plan a method for reducing the danger of headwalls that would be quick and less expensive. With regular maintenance forces many of these dangerous headwalls were removed down to the natural ground.[2] Removing the headwalls is a tremendous improvement but in many instances it leaves an open area that a vehicle will not span. By doing research on accident records, it was determine that most critical accidents were caused by the vehicle hitting the headwall or on large culverts the vehicle would jump the culvert's span and crash into the wingwall. With this in mind it was decided to eliminate the headwall and also provide a grate on the existing wingwalls.[3] This grate was designed to have a grid large enough to prevent a thirteen inch wheel from entering and strong enough to carry a legal load across the structure. If the grate is damaged and still prevents a critical accident, it is believed the purpose is accomplished.

CONTRACT PROJECTS

Early in 1972 inflation was eating away at our programmed projects and we found that in most cases we could only construct approximately one half

1. See Appendix 1
2. See Appendix 2
3. See Appendix 2

of the roadway mileage with program funds if the full compliance safety design criteria was utilized. Projects under consideration at this time were rural sections that had a low volume of traffic. In most cases, it would be almost impossible to be in full compliance because of lack of right-of-way. An estimate was made at this time using grates as illustrated above and downscoping our original roadway design and it was determined that it would be possible to construct the programmed length with minor overruns of funds.

The next step was to investigate the effects the grates will have on hydraulics. It was found that the grates would hinder, to some degree, the flow of water through the structure, and it is possible that drifts would catch on the grates and completely stop them up. We have now had three years experience with these grates and have had only very minor problems, but the possibility of problems is constantly present. The grates are designed so that cleaning operations are relatively simple because the attachment is swiveled at the headwall.[4] A lift may be used to raise the grate or remove it completely.

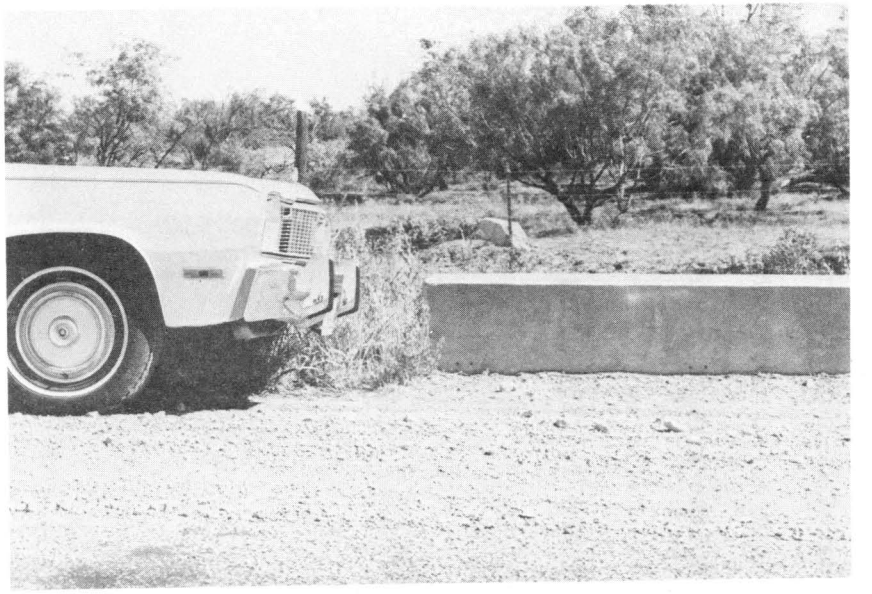
These grates have been used and approved on four Federal-Aid contracts.[5] Very soon after the first grate was installed, a tandem wheel truck ran off the roadway and one set of dual wheels ran across the grate. There was no apparent damage to the grate or to the truck. The tracks indicate the truck did not slow down and pulled back into the driving lane.

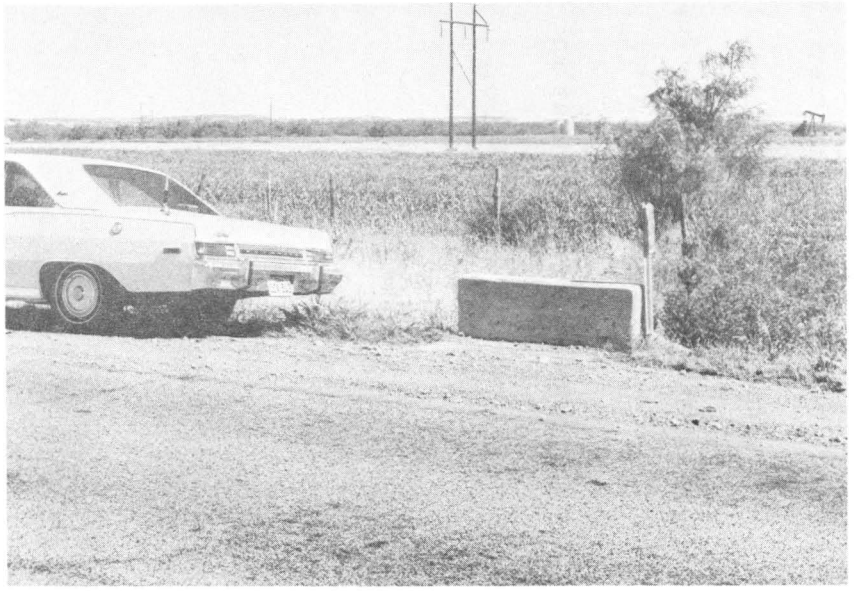
CONCLUSION

We realize these grates are not the ultimate design for safety but the financial outlook and limited right-of-way has dictated this design. This, like most designs, should be used as good engineering judgment

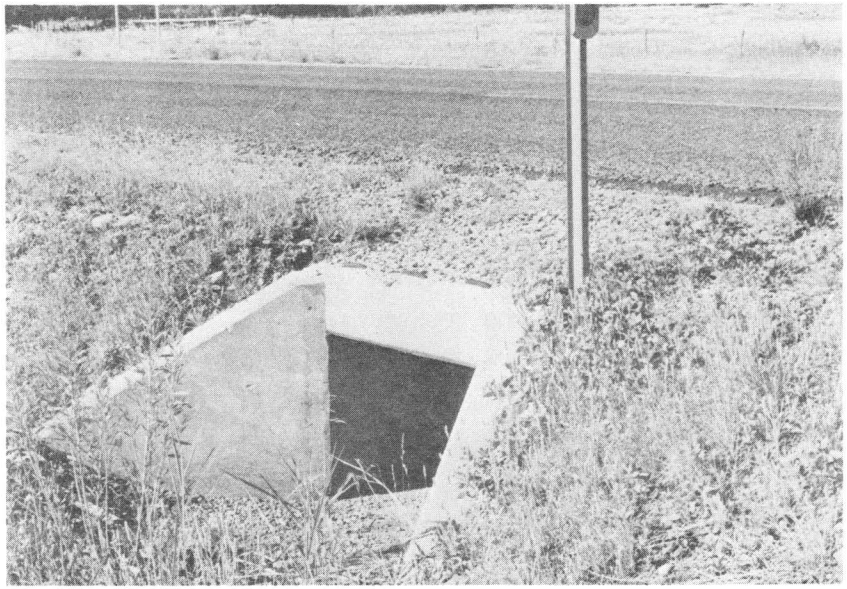
4. See Appendix 4
5. See Appendix 5

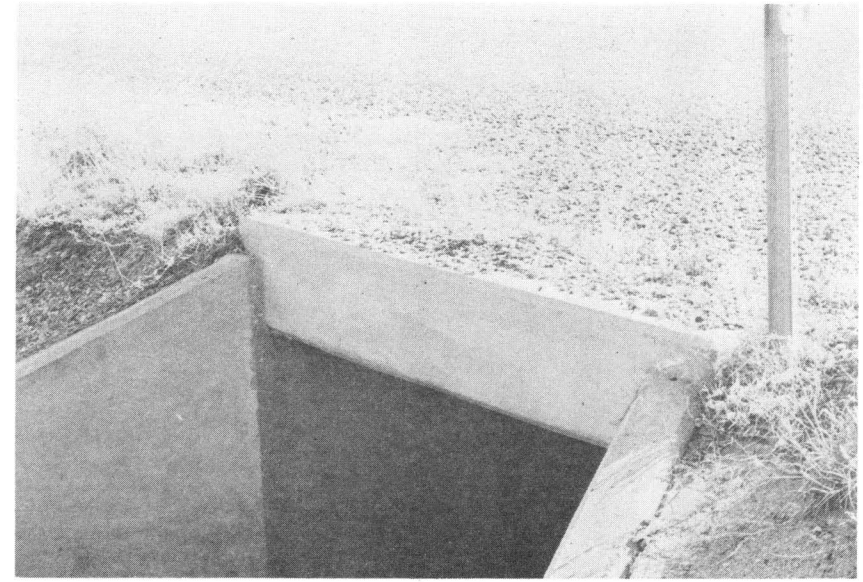
dictates. There are culverts that are located downstream from a drainage area that has been cleared and there is no doubt that small pieces of timber will wash down and stop up the flow. Other structures are situated in locations that are extremely hazardous and should be lengthened no matter what the right of way and funding problems are.

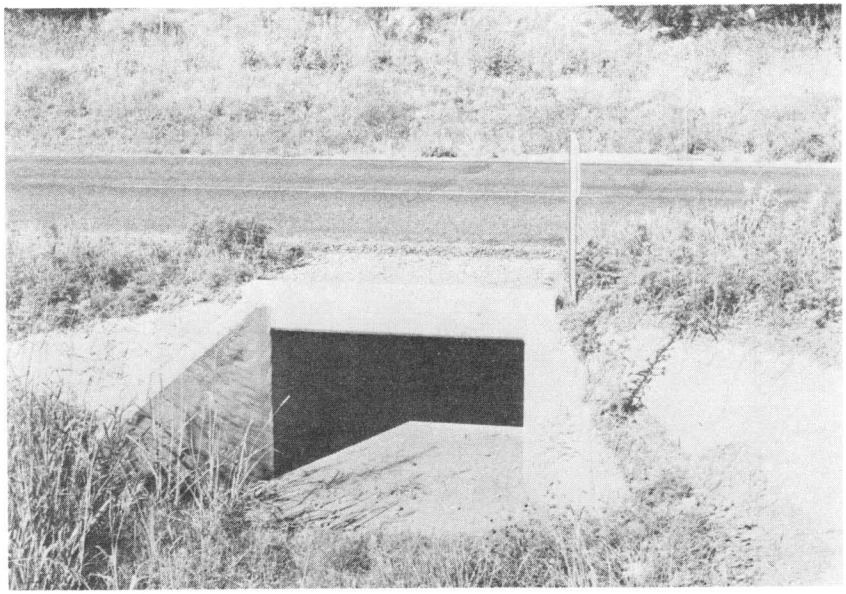




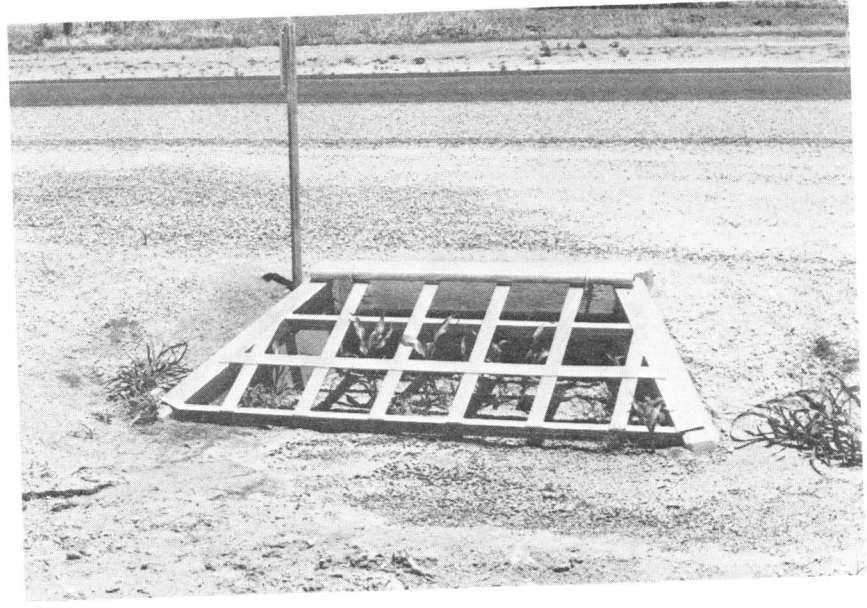
Appendix 1

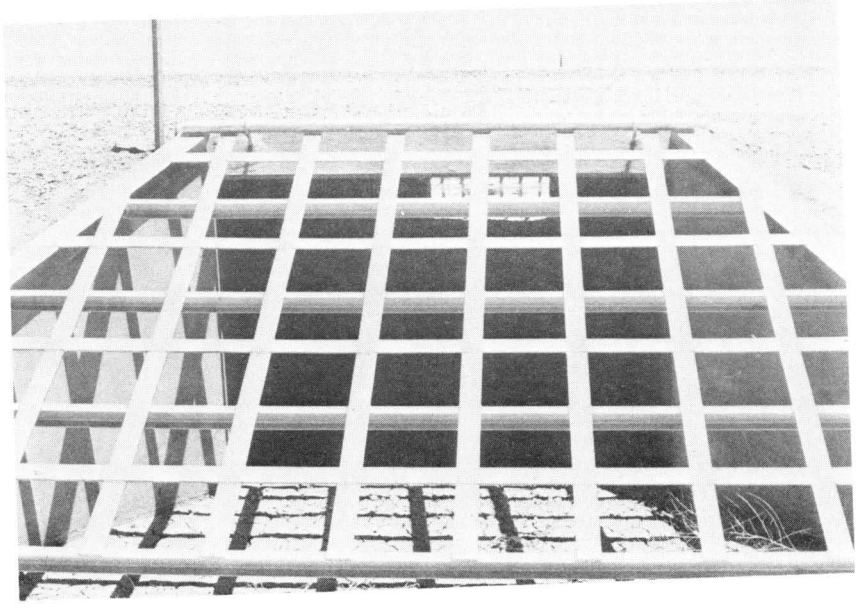


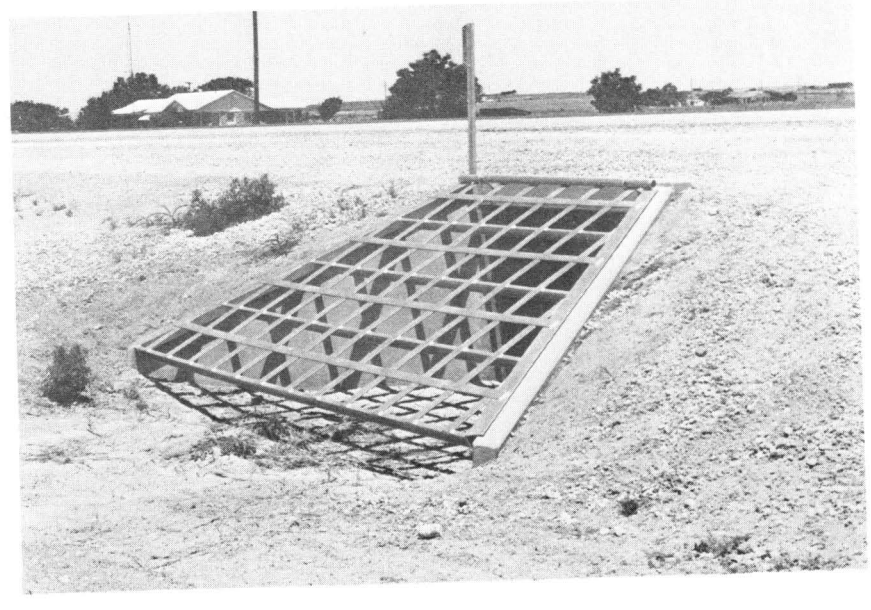




Appendix 2

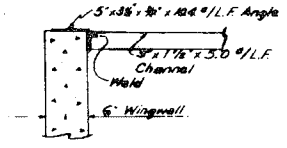






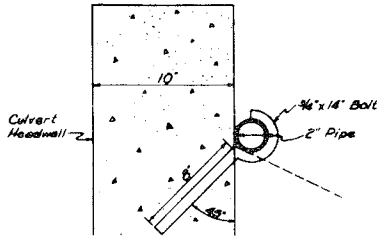
Appendix 3

Appendix 4



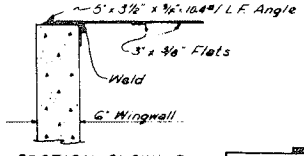
SECTION SHOWING CHANNEL BEAM

Note: View shown is Channel C_2. Weld C_1 & C_3 ⅜" lower.

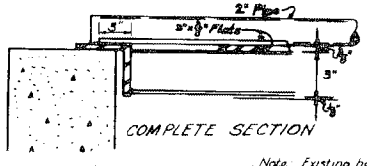


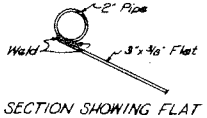
SECTION SHOWING BOLT HINGE

Note: Drill hole at 45° to existing headwall and grout bolt in place. Bolt, ¾" x 14" to have end fixed to encircle 2" pipe to form hinge.

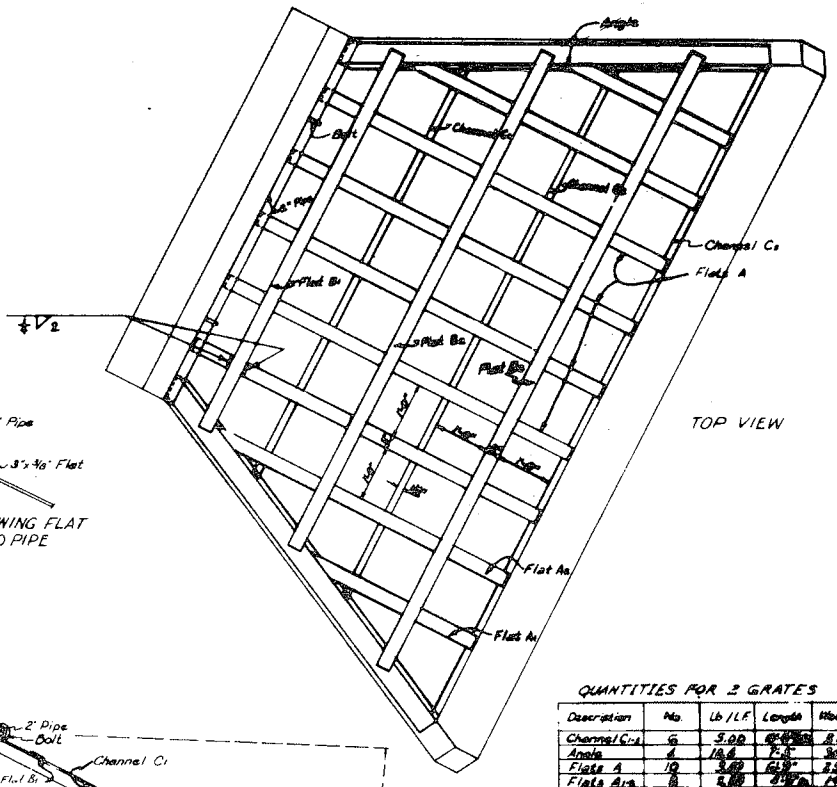


SECTION SHOWING FLATS





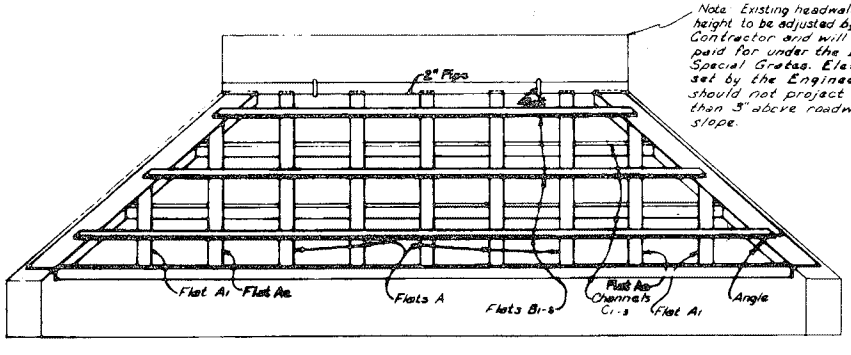
SECTION SHOWING FLAT WELDED TO PIPE



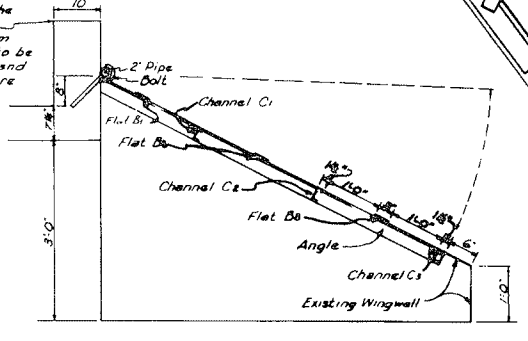
TOP VIEW

QUANTITIES FOR 2 GRATES

Description	No.	Lb/L.F.	Length	Weight
Channel C_{1-3}	6	5.00	[illegible]	817
Angle	4	10.4	7'-6"	312
Flats A	10	3.00	6'-3"	188
Flats A_{1-2}	8	5.00	3'-4"	200
Flats B_{1-3}	5	3.00	3'-4"	125
2" Pipe	2	3.68	7'-6"	30

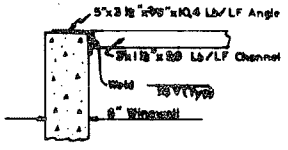


END VIEW



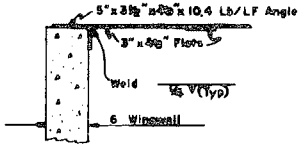
SIDE VIEW

DETAIL OF GRATE
STA 512+00
STA 572+40
Existing 6'x3' Single Box Culvert with Old Standard W-2 Wings

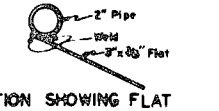


SECTION SHOWING CHANNEL BEAM

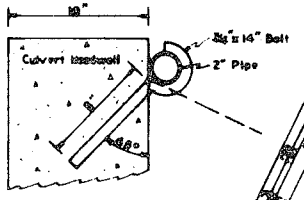
NOTE: View Shown is Channel C_1. Weld C_2 & C_3 ⅜" Lower.



SECTION SHOWING FLATS

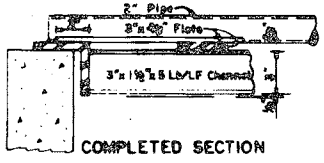


SECTION SHOWING FLAT WELDED TO PIPE

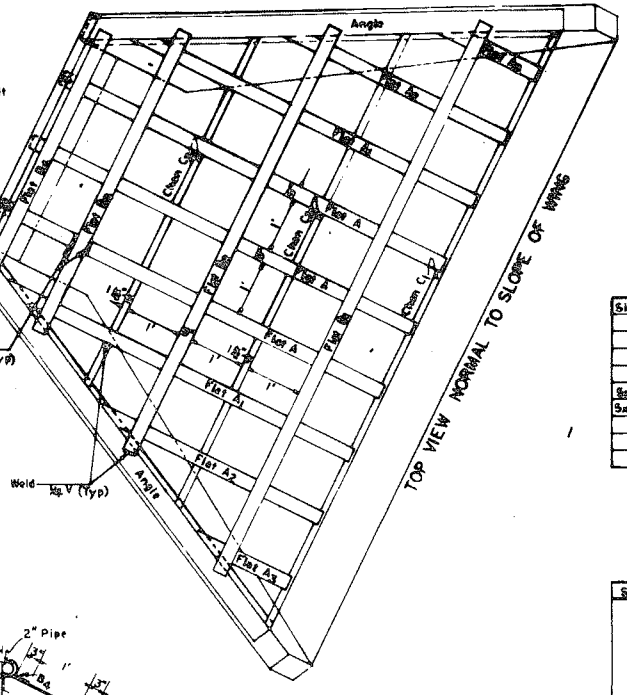


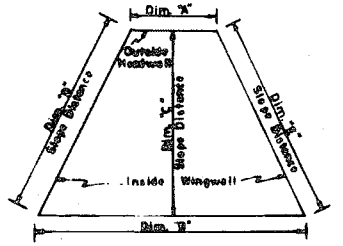
SECTION SHOWING BOLT HINGE

⅝"x 14" Bolt To Have End Fixed To Encircle 2" Pipe To Form Hinge. Drill Hole At 45° To Existing Headwall And Grout In Place With Mate Approved Non-Shrink Grout.



COMPLETED SECTION

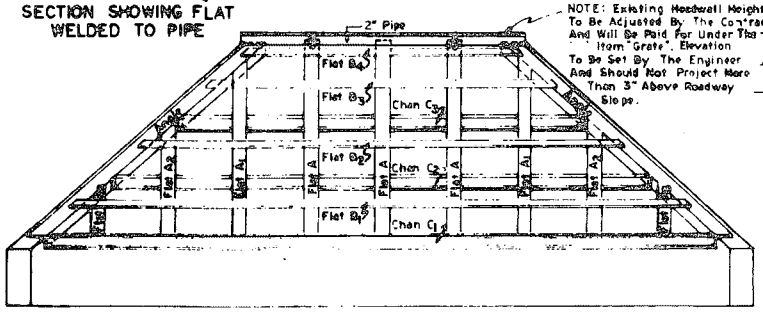




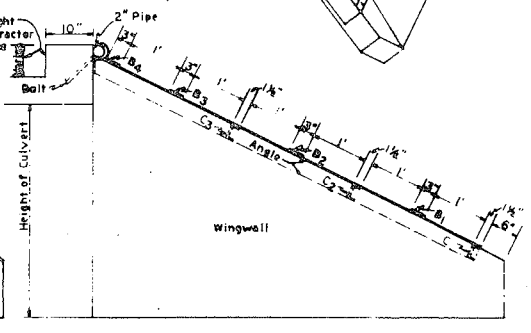
NOTE: It Shall Be The Responsibility Of The Contractor To Obtain An Accurate Field Measurement Of The Existing Wingwalls Prior To Fabricating These Grates.

TABLE OF WING DIMENSIONS FOR FABRICATING GRATES

Size Culv	Location	End	Dim."A"	Dim."B"	Dim."C"	Dim."D"	Dim."E"
3x2	489+00	Lt					
3x2	489+00	Rt					
3x2	494+88	Lt					
3x3	491+82	Lt					
3x2-45°RF	371+20	Lt					
3x2-45°LF	371+68	Rt					



END VIEW



SIDE VIEW

ESTIMATED QUANTITIES FOR ONE GRATE

Size Of Culvert	Description	No	Lb/Ft	Length	Weight*
3 x 2	Channel C_{1-3}	3	5.0	6'6" Av	98
	Angle	2	10.4	6'4"	132
	Flats A	3	3.83	5'7"	64
	Flats A_1	2	3.83	3'0"	29
	Flats B_{1-3}	3	3.83	6'7"Av	76
	2" Pipe	1	3.65	4'0"	15
	Total				409
3 x 3	Channel C_{1-3}	3	5.0	9'2"Av	138
	Angle	2	10.4	7'8"	159
	Flats A	5	3.83	6'6"	128
	Flats A_{1-2}	4	3.83	3'-2"Av	49
	Flats B_{1-3}	3	3.83	8'-5"Av	97
	2" Pipe	1	3.65	6'-0"	22
	Total				593
5 x 2 45° LFS	Channel C_{1-3}	3	5.0	0'-10"Av	162
	Angle	2	10.4	7'-8"Av	161
	Flats A	6	3.83	9'-4"	123
	Flats A_{1-5}	5	3.83	2'-10"Av	54
	Flats B_{1-3}	3	3.83	13'-5"Av	154
	2" Pipe	1	3.65	8'-0"	32
	Total				686

* For Information Only. Grates Will Be Paid For Per Each Under Item 471.

OLD STANDARD W-2 & W-2-45° WINGS

GRATE DETAILS

		RF 1013(6)	
A	SCURRY		

Appendix 5

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
826 FEDERAL OFFICE BUILDING
AUSTIN, TEXAS 78701

CHIEF ENG.	R. & D.	
ADM. DESIGN	FIELD	✓
DIV. DESIGN	D-8 FILE	✓
URBAN		

May 26, 1972

FHWA-06-41

IN REPLY REFER TO

Texas F 1018(10)
Borden County
Control 295-3-18
US Highway 180

Mr. J. C. Dingwall
State Highway Engineer
Austin, Texas 78701

Attention: Mr. R. L. Lewis

Dear Sir:

Please refer to your letter of May 11, 1972 to Mr. J. C. Roberts setting up a field review on the subject project. A copy of that letter was furnished our office. This letter is to record the general agreements reached during the meeting at the project site.

On this project and on low traffic facilities similar to this project in District 8 the following handling of safety clearance will be satisfactory.

1. We do not consider 30' clear area to be an unalterable requirement but a desirable goal where the physical characteristics of the site, right-of-way considerations and other features are conducive to its use.

2. If a structure is widened at all, it should be widened to at least 20' clear distance from the edge of the traveled lanes.

3. Any structure terminating within 20' of the edge of the traveled lane will be modified to eliminate the headwall and protected with grates or provisions will be made for guardrail protection.

Specific agreements reached on the subject project include widening the bridge length structure at Station 457+86.

Sincerely yours,

J. F. Cary
Division Engineer

DE
ADE
DCE
DDE
DME
DRA
CA

P. O. Box 150
Abilene, Texas 79604
July 12, 1972

Mr. J. C. Dingwall
State Highway Engineer
Texas Highway Department
Austin, Texas 78701

Re: Project F 1018(10)
Control 295-3-18
U.S. Highway 180
Borden County
IFE 62

Attention: File D-5

Dear Sir:

Our 1971-72 and 1973-74 Consolidated programs included several projects in which we intend to place black base on shoulders and ACP level-up on the present pavement. Our finished structures would include 26' travel lanes and two 8' paved shoulders, or a roadway section of 42'. Our program called for not extending culvert-type structures if their roadway clearance were presently 42' or more unless grade line required their adjustment

The Federal Highway Administration expressed some concern about certain culverts on the above project and requested a field inspection. A copy of their letter is attached.

Messrs. Dean Carlson and Bill Dallas made the field inspection for F.H.W.A. on May 24, 1972, and as a result of that meeting the following guide lines were established:

1. All culverts of over 3' in barrel height should be extended to a minimum safety clearance of 20' from pavement edge.

2. Culverts of 3' or less barrel height may remain at the 42' roadway clearance provided grates were constructed to be fastened to the present wing. This grate design should be just strong enough to guide an out-of-control vehicle across safely. A new grate could replace those that are damaged. It was also decided at this meeting that these grates could be placed by our maintenance forces.

3. Headwalls should not extend above finished grade.

We have designed a grate for use on one size culvert. We have studied the change in hydraulic efficiency by using this grate and find that its effect is negligible. This attached design sheet is preceding our P.S.& E. Please review this design and favor us with your comments.

Sincerely yours,

J. C. Roberts
District Engineer

RAB/sa
Attachment

cc: File D-8, Attn: Joe Davis
Mr. Homer Ray, Resident Engineer

DE
ADE
DCE
DDE
DME
DRA
CA

P. O. Box 150
Abilene, Texas 79604
September 14, 1972

Mr. J. C. Dingwall
State Highway Engineer
State Highway Department
Austin, Texas 78701

RE: F 1018(10)
Control 295-3-18
U. S. 180: From Near Bull Creek
To 4.9 Miles East
Borden County

Dear Sir:

This is in reply to your letter dated September 11, 1972 concerning the above captioned project. We offer the following comments for your consideration and further action.

Items 1 and 2 of your letter are correct as you have them and we can make no further comments. We have, however, several comments concerning Item Number 3 in the aforementioned letter.

We are presently operating on an austerity type program in that we are providing as safe a roadway as possible and covering as much territory as possible with funds that are available. We feel that rehabilitating the old narrow pavements and paving the shoulders is far more important than widening small structures that create a hazard only to the person that drives off the road in one particular spot. We have even provided a solution to this problem and that is to cover this small opening with a grate that will transport the out-of-control vehicle to safety.

On May 24, 1972 we made an inspection of this project in the presence of Mr. Dean Carlson, Bill Dallas, R. S. Williamson, Joe Davis and Bob Lindley. It was decided by all parties at this meeting that the procedures outlined above were the product of good Engineering judgment and that widening these small structures would almost be ridiculous. We did agree that providing grates for the existing wingwalls would be a safe practice on those structures we did not widen. This was mentioned under Item 3 of

the Federal Highway Administration's letter dated May 26, 1972. This letter was from Mr. J. F. Cary, so we are certain that he is cognizant of decisions reached at this meeting and the problems involved.

Based on decisions reached at the above mentioned meeting we have several sets of plans complete and ready for contracting. We are urgently in need of resolving this matter so that we might continue with our program of work. If there is any way we might help in reaching a decision please advise.

Sincerely,

J. C. Roberts
District Engineer

BRL:bkt

Attached is a copy of the Federal Highway Administration's letter dated May 26, 1972 for your ready reference. We feel that we have complied with agreements mentioned in this letter.

CONTRACT COST

LOCATION	SIZE CULVERT	COST EACH
S.H. 70 Fisher County	3' X 2' thru 6' X 1.5'	7 @ $179.00
U.S. 180 Borden County	6' X 3'	4 @ $750.00
U.S. 180 Scurry County	5' X 2' thru 7' X 5'	10 @ $355.00
U.S. 84 Scurry County	3' X 2'	2 @ $500.00