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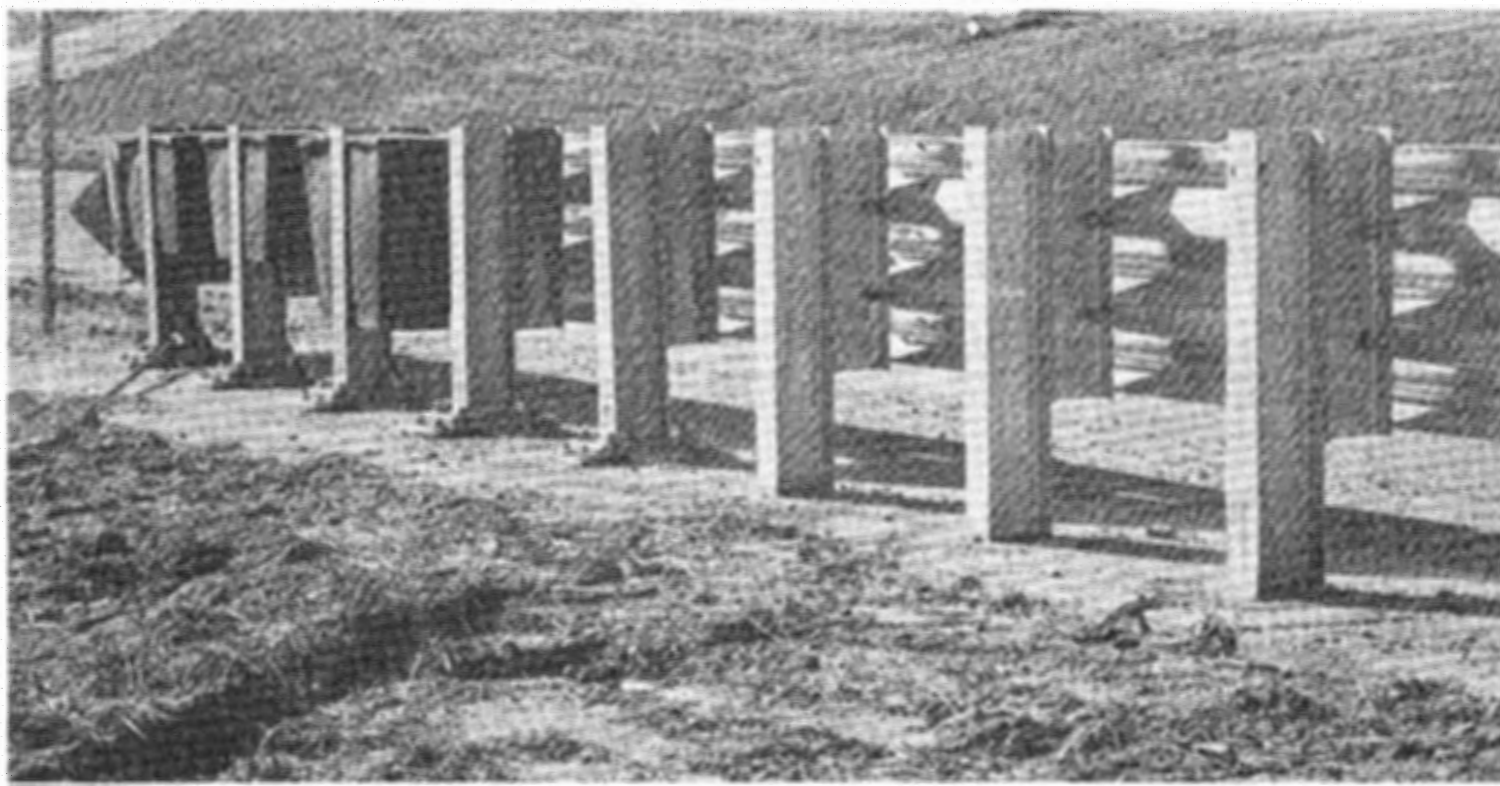
OKLAHOMA DEPARTMENT OF TRANSPORTATION



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MODIFICATION AND EVALUATION of **SENTRY[™]** IMPACT ATTENUATION DEVICES



MARCH, 1990

RESEARCH AND DEVELOPMENT DIVISION

OKLAHOMA DEPARTMENT OF TRANSPORTATION

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16. ABSTRACT This report covers a study of SENTRE Impact Attenuation Devices, done to identify potential design or installation improvements, to make these improvements, and evaluate performance of the devices once the indicated modifications were made. During the study, a total of 21 SENTRE devices were installed on I-40 in Oklahoma City. Ten accidents involving SENTRES were documented. Analysis of these accidents led to modifications in amount of torque applied to anchor bolts, type of clips holding posts to base plates, and depth of topsoil covering the redirecting cable. The limited number of SENTRE installations, and the even more limited number of accidents precluded a statistical comparison of accidents involving SENTRES to those with exposed guardrail ends or other types of impact attenuation. In all of the accidents occurring after the modifications were made, the SENTRE units performed as the designers intended, suggesting that they were effective in reducing impact severity.			
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EXECUTIVE SUMMARY

The SENTRE impact attenuation device was evaluated by the Oklahoma Department of Transportation with two separate objectives. The first objective of the study was to determine if the devices were operating as their designers intended, to reduce accident severity when struck by vehicles, and if not, make the modifications necessary to "make the SENTRE's work".

As units were struck, their performance was analyzed, and areas where improvement was needed were identified. Modifications in installation procedure or unit design were then made to improve their performance. Modifications made under this objective included: changing torque requirements on anchor bolts, adding reinforcing clips to post bases, and specifying the amount of cover required over redirecting cables.

The second objective consisted of evaluating SENTRE performance, once necessary modifications were made. A total of 10 accidents involving the SENTRE units were documented during the study. The first five accidents included situations where performance of the units indicated the need for design or installation changes. The remaining five accidents were cases where the units performed as intended, suggesting that they were effective in reducing the accident severity.

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INTRODUCTION

The Insurance Institute for Highway Safety reports that in 1988, 1,229 deaths could be attributed to collisions with guardrails¹. With the trend toward smaller cars, untreated guardrail ends pose a very serious threat.

Energy Absorption System's SENTRE end treatment had been tested under federal standards for impacts by light and heavy cars before ODOT's investigation began.² ODOT's investigation was conducted with the intent of satisfying two objectives: (1) identifying any design or installation characteristics which could be modified to achieve better unit performance, making these modifications, and (2) evaluating SENTRE performance under actual roadway conditions.

A typical SENTRE unit installation is illustrated in Figure 1. The SENTRE reduces impact severity using a system of telescoping panels connected to the exposed end of a guardrail or barrier*. The system gently slows an impacting vehicle while a redirecting cable guides the panels and the vehicle sideways, away from the guardrail "hard spot". Posts supporting the SENTRE unit are on slip bases which allow them to slide with the impact when hit. Also, SENTRE units have plastic sand containers

*NOTE: This evaluation began in 1985. At that time, SENTRE units were used for protection on ends of both barriers and guardrail, with different transition rails used between the units and the protected structures. Since then, Energy Absorption Systems has developed the TREND unit to be used on barriers, while SENTRE units are now used only as end protection on guardrails.

mounted on the first three posts facing the traffic. These rupture during impact, which helps to dissipate the collision energy.

A total of 21 SENTRE units were installed on I-40 in Oklahoma City, at the locations shown in Table 1. Bid price per unit, which included installation by the contractor was \$4,100 each (\$86,100 total). This amount could probably be lowered somewhat on projects where larger numbers of SENTREs were installed.

Maintenance and repair of the units has been done by the ODOT Interstate Maintenance Unit, 2901 East Reno, Oklahoma City.

Figure 1. SENTRE Unit.

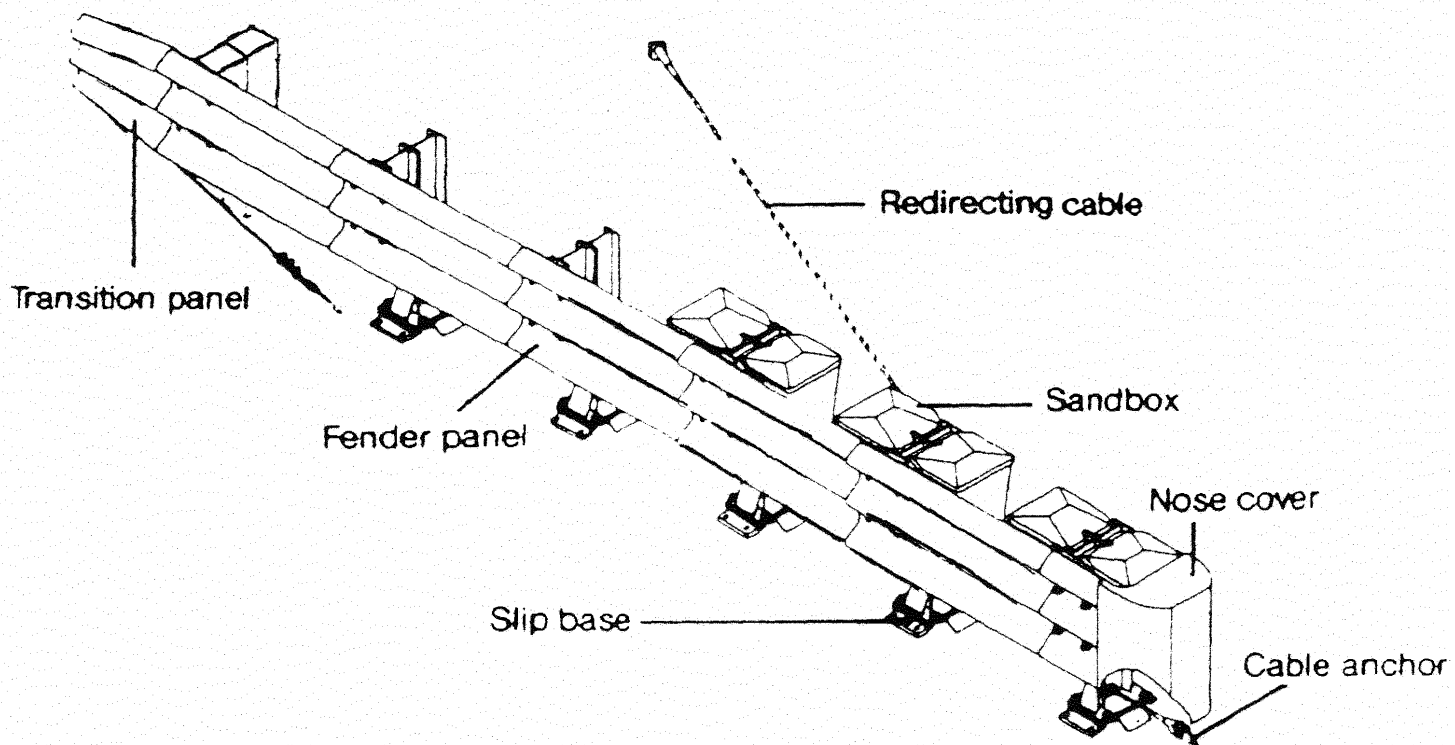


Table 1. SENTRE Unit Locations

SENTRE Units on I-40 Eastbound

1. Entrance ramp onto eastbound I-40 from northbound I-44.
2. Immediately west of May Avenue Underpassn
3. Immediately east of May Avenue Underpass.
4. Agnew/Villa Avenue exit rampn
5. Immediately west of Agnew/Villa Avenue Underpassn
6. Agnew/Villa Avenue entrance ramp to eastbound I-40.
7. Immediately west of Pennsylvania Avenue Underpassn
8. Virginia Avenue entrance ramp to eastbound I-40.
9. Immediately west of Western Avenue Underpass.
10. Western/Reno Avenue exit ramp (north side of ramp)n
11. Western/Reno Avenue exit ramp (south side of ramp)n
12. Reno Avenue entrance ramp to eastbound I-40.

SENTRE Units on I-40 Westbound

13. Immediately east of Western Avenue Underpassn
14. Immediately west of Sheridan Avenue ramp to westbound I-40.
15. Immediately east of Virginia Avenue underpass.
16. Pennsylvania Avenue entrance ramp to westbound I-40.
17. Immediately east of Agnew/Villa Avenue Underpass.
- 18a Agnew/Villa entrance ramp to westbound I-40.
19. May Avenue exit rampn
20. Immediately east of May Avenue underpass.
21. Exit ramp from westbound I-40 to northbound I-44.

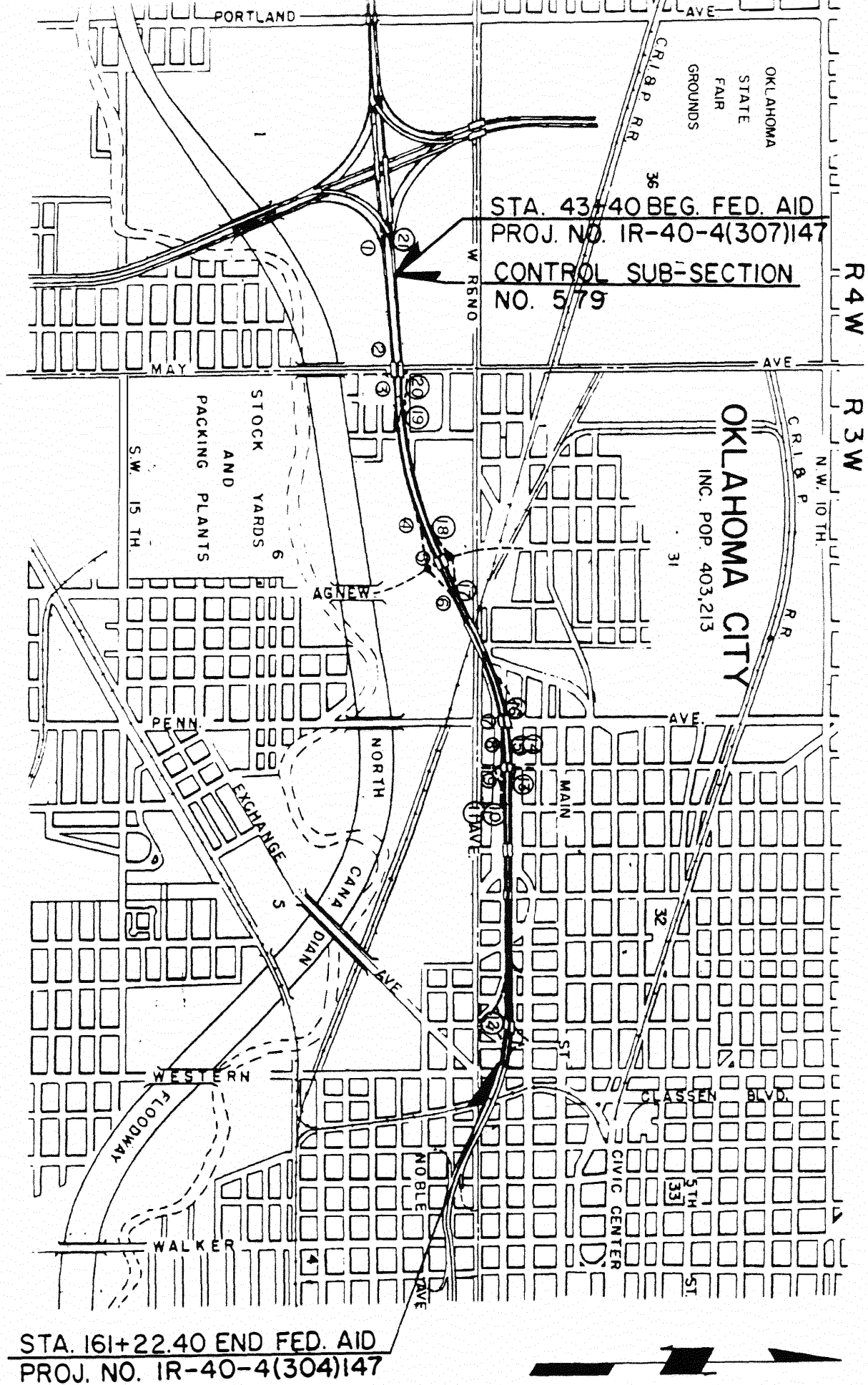


Figure 2. Scentre Unit Locations.

PROJECT LENGTH = 2.224 MI.

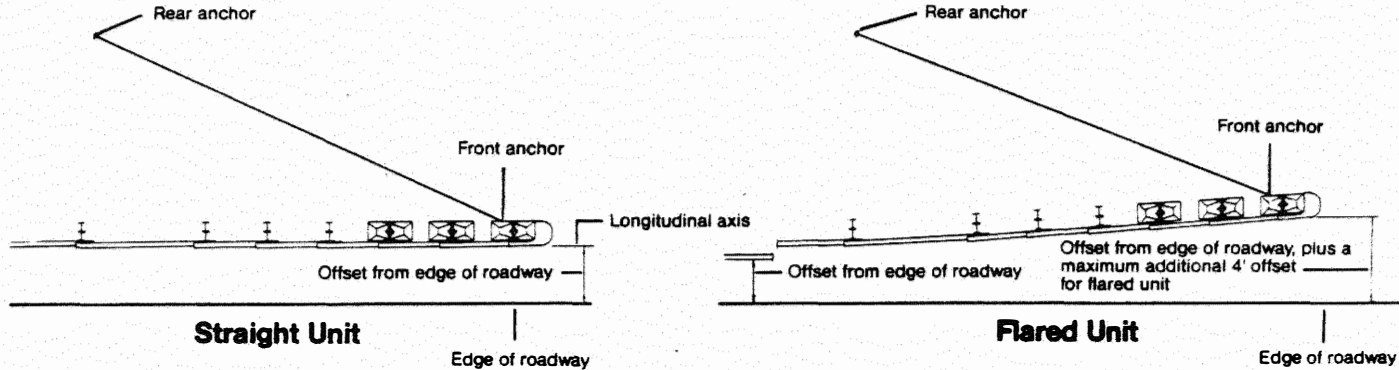
EQUATIONS ——— STA. 77+96.49 BK. = STA. 78+34.43 FWD.

INSTALLATION

Site Preparation

The appropriate location for a SENTRE guardrail/barrier end treatment includes an area extending forward from the end of guardrail or barrier, (see Figure 3 below) in the direction of oncoming traffic, for a distance of 20 feet. The site area should be level and free of obstruction. Any guardrail or posts extending into the site area should be removed.³

Figure 3. Straight and Flared SENTRE Unit Locations.



Pad Construction

Each SENTRE unit is constructed on a 4'-0" x 18'-0" x 0'-7" reinforced concrete pad. Pad design is illustrated in Appendix B. The first 3'-0" on the exposed end of the pad is 3'-0" thick, the purpose of the thickened section is to furnish the weight and physical shape necessary for the pad to resist the collision forces specified in the Special Provisions, (Appendix F). Also, one end of the redirecting cable is anchored in the thickened section. Reinforcing steel must be placed accurately, (as shown in Appendix B), to avoid interference with concrete anchor bolts.

Rear Cable Anchor Unit

The rear cable anchor is located as shown in Figure 1. Although the original plans (Appendix B) show this embedded anchor set in concrete in a rectangular hole, this was later modified. The anchor unit hardware remains the same, but it is embedded in concrete poured in a four foot diameter augered hole. The additional concrete furnishes greater mass, since depth remains the same. Also, the hole can be augered, where the rectangular hole originally called for, had to be dug by hand.

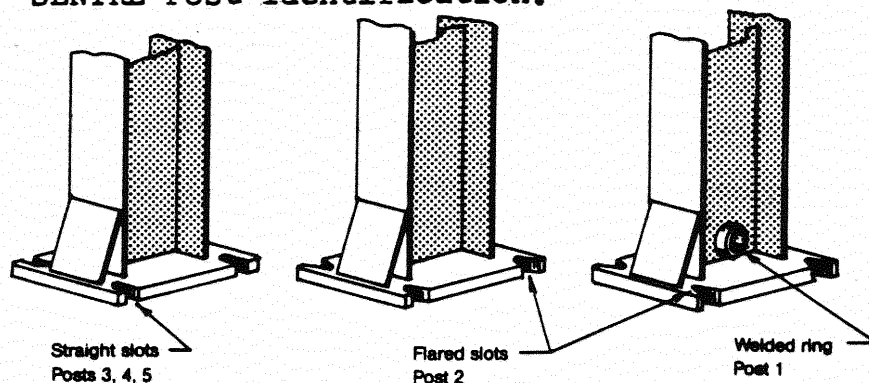
Slip Base and Cable Anchor Installation

The SENTRE unit may be installed on either straight guardrail or on guardrail that has been flared away from the traffic (see Figure 3).

Two different types of slip bases are specified for SENTRE units (Figure 4). The slip bases for posts 1 and 2 have flared slots, allowing for easier slip if hit at an angle. Posts 3, 4, and 5 have straight slots.

During installation, the bases are arranged next to the proper post locations before proceeding to the anchoring process. The slip bases should be installed so that the ramp ends touch the slab.

Figure 4. SENTRE Post Identification.



MODIFICATIONS

Anchor Footing Elevations

During the evaluation period, some SENTRE units failed to operate properly because the posts did not slide along the directing cable as the designers intended. Investigation determined that this was due to the rear footings of many units being installed at improper elevations, leaving the cable buried under one foot or more of soil.

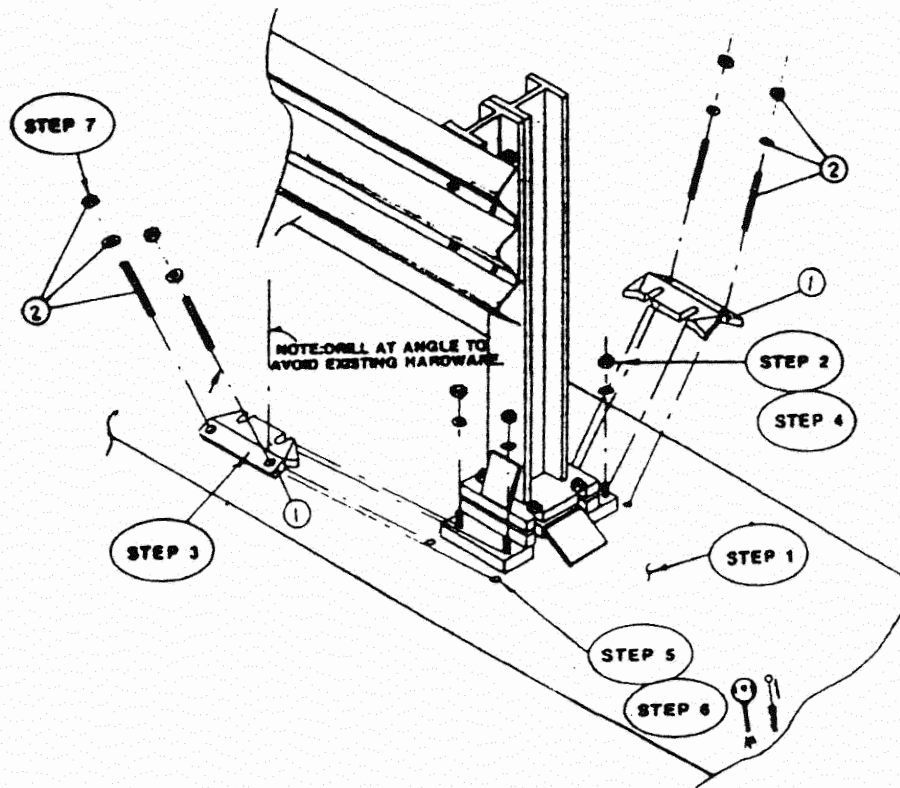
This problem resulted from footings being poured to existing shoulder elevations at the time they were constructed. Later, as shoulders and slopes were "dressed" to their final elevations, the footings and cables were buried with whatever depth of soil was needed to shape the slope. Experience during the study, (after corrections were made), indicated that one to three inches of cover would not affect the performance of the units. To prevent the cables from interfering with maintenance mowing operations, this depth of cover should be provided.

Retro-fitting

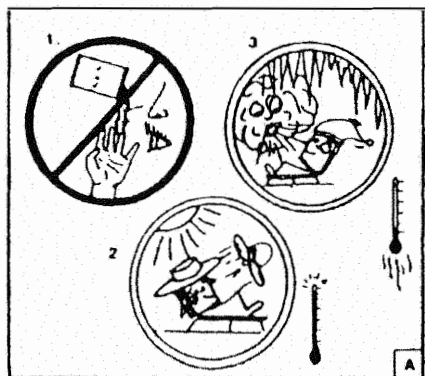
Early in the evaluation period, many of the collisions involving the SENTRE units resulted in a failure of the anchor bolts to hold the base plates to the concrete pad. This was eliminated by a design change, made by the manufacturer. The "Molly Wedge" anchor bolts originally used, were replaced with Hilti MP3 anchors set in drilled holes, with "C-10" a two-part epoxy system. "EASI" reinforcing clips were installed on the

slip bases at the same time the MP3 anchors were installed. "EASI" clips, and instructions for their installation, are shown in Figure 5 on the following page. All SENTRE units being evaluated received these modifications. Instructions for installing MP3 anchors are reproduced in Figure 5. Another factor which contributed to unit failures early in the evaluation period, was that pinch bolts were frequently over-torqued by the installation crews, making it impossible for the slip bases to function as intended. Pinch bolts should have been torqued to between 60 and 70 ft-lbs. In most cases, they were uniformly torqued to 125 ft-lbs. This was corrected during the retro-fit phase. This effect can be seen from the collision listing, Table 3, page 13.

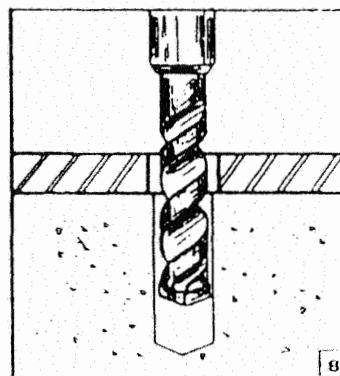
Figure 5. Typical ~~SENTE~~ Reinforcing Clip Installation.



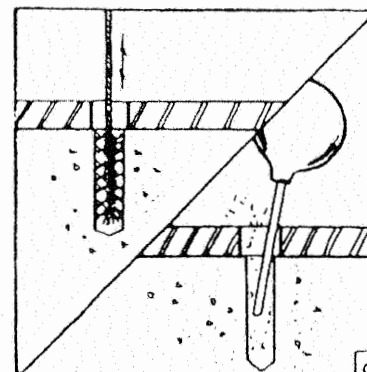
- Step 1: Thoroughly clean area surrounding posts to expose a flat concrete surface and post base plate.
- Step 2: Remove nuts and washers on the (4) existing expansion anchors through base plate. (Do not remove slip base bolts.)
- Step 3: Position reinforcing clips over the edges of the base plate so that the slotted holes fit over the existing expansion anchor studs then push the clips as close to the base plate as possible.
- Step 4: If possible, replace the expansion anchor washers and nuts and torque them down to hold the clips firmly in position.
- Step 5: Using a rotary impact concrete drill with a 7/8" bit drill through the large holes in the clips to a depth of 6 +/- 1/4" as measured from the surface of the concrete. Drill the holes at an angle to avoid interfering with the existing fender panels and sandboxes. The holes must be drilled to a depth of 5 3/4" minimum, cutting through rebar may be required.
- Step 6: Thoroughly blow out the concrete dust from the hole, brush the hole and then blow it out again. Install the 7 1/2" long 3/4" diameter Grade 5 HD galvanized studs with the polyester chemical, carefully following the instructions on the package. Under no circumstances should the studs project more than 2" above the concrete surface.
- Step 7: When the polyester chemical has cured (see package instructions) torque the anchors to 125 +/- 5 ft/lbs to firmly secure the reinforcing clips.
- Step 8: Conduct steps 1-7 for all posts on the ~~SENTE~~.



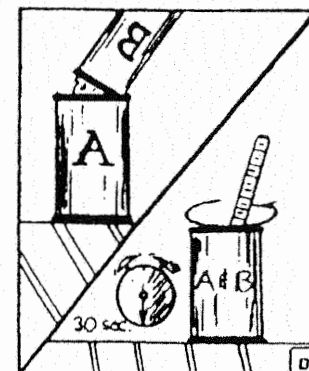
CAUTION: 1) Do not allow contact with skin or eyes (wear protection). Use in well ventilated area. 2) in hot weather, over 90 deg. F. keep kit cool until immediately before use. 3) in cold temperatures, below 60 deg. F. keep kit warm until immediately before use (pot life at 90 deg. F - 15 min, at 75 deg. F - 30 min, at 61 deg. F - 60 min, at 45 deg. F - 130 min)



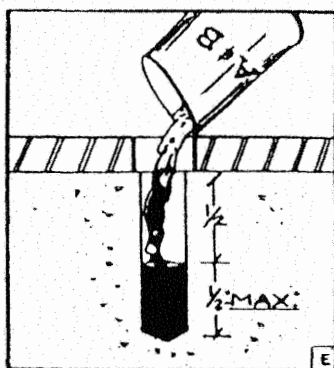
Position the part to be anchored according to the plans supplied with the unit. Drill the holes to the correct size and depth (1/8" larger than anchor diameter) following the recommendations on the plans. (NOTE: do not use a diamond drill as full strength may not be achieved). Check to be sure all the holes line up with the part to be anchored.



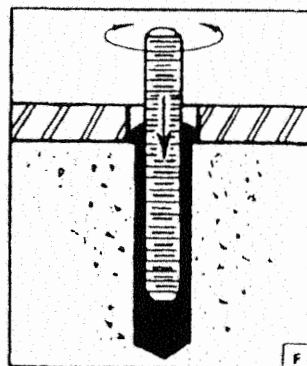
IMPORTANT: Brush the hole with a stiff bristled brush and blow it clean with oil-free compressed air to remove the concrete dust.



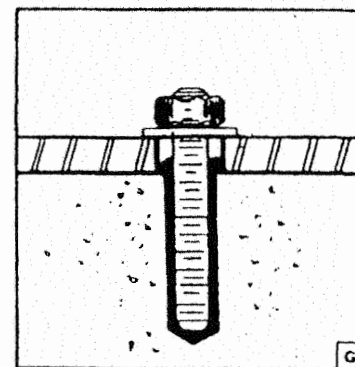
Remove the lids from the MP3 part A - Resin and part B - Hardener containers. Pour part B - Hardener into part A - Resin then mix vigorously and thoroughly for 30 seconds. (An anchor stud makes a suitable stirring rod)



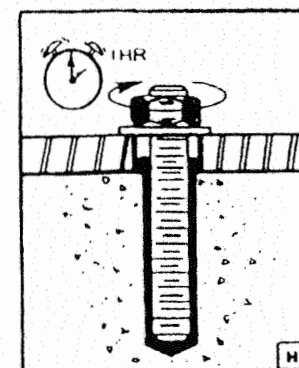
Pour MP3 MIX down into the clean hole through the part to be anchored, fill the hole approximately 1/3 - 1/2 full. Do not over or under fill.



Force the stud through the part being anchored down into the grouted hole leaving enough stud exposed to attach the nut and washer. Give the stud several twists to wet the threads.



Place a flat washer onto the stud then thread a nut on until it is flush with the top of the stud. Do not disturb the stud until the material has hardened.



Once the material has hardened, torque the nut to the values indicated in the plans.

Figure 6. How to Use MP3 Anchors.

COLLISIONS INVOLVING SENTRES

Individual collisions in which SENTRE units were hit during the study are listed on Table 3, page 13. Observations regarding the accidents and performance of the units, which led to corrective actions taken during the retro-fit phase, are included, as are actions taken.

Statistics regarding the ten accidents occurring during the study are listed in Table 2 below. It is the opinion of the author that dollar amounts for damages to attenuators could be lowered with installation of a greater number of units.

Table 2. Accident Statistics - Damages Due to Vehicle Impacts

	ESTIMATED DAMAGE TO IMPACTING VEHICLE (1)	DAMAGE TO ATTENUATOR (2)	TOTAL DAMAGE
Average	\$3,800	\$ 950	\$4,750
Median	\$5,000	\$ 566	\$4,165
Minimum	\$1,150	\$ 169	\$1,669
Maximum	\$8,000	\$2,665	\$8,300

(1) Estimated by Oklahoma Highway Patrol Trooper investigating accident.

(2) From ODOT Maintenance Crew records. Includes labor.

NOTE: Average, Median, Minimum and Maximum damages to vehicle and attentuator did not occur during the same accidents.

Table 3. Collisions Involving SENTRE Units

DATE	DESCRIPTION	SENTRE PERFORMANCE	CORRECTIVE MEASURES
4-26-85	Unit at Virginia St. & I-40 (east bound) hit.	Posts did not come off slipbases as intended. Pinch bolts were over-torqued.	Manufacturer had anchor bolts on all units torqued to 65 ft-lbs.
12-13-85	Unit at May & I-40 (eastbound) hit.	Posts did not come off slipbases. 1st post was torn off anchor plate.	None. This was considered to be due mainly to the angle of the collision.
8-25-85	Unit at Air Depot & I-40 (eastbound) hit.	Posts did not come off slipbases. Anchor plate was pulled out of concrete pad.	Manufacturer was notified that earlier corrections didn't solve the problem.
8-17-86	Unit at Engle Rd. & I-40 (eastbound) hit.	Anchor bolts failed.	Manufacturer notified. They decided to retrofit at this point.
4-26-87	Unit at Klein & I-40 (eastbound) hit.	Slipbases performed as intended, but cable was buried too deeply for posts to slide down it.	ODOT Mainten. crew will raise cables when their workload allows.
5-12-87	Unit at Klein & I-40 (eastbound) hit.	Car hit unit on nose & rolled down backslope. Only the 1st two posts came off the slipbases. Both posts were bent.	None. Angle of impact appears to be the reason unit performed as it did.
7-4-87	Unit at Virginia Ave. & I-40 (east bound) hit.	Unit was hit on nose. Car rolled over after hitting it. Unit collapsed as intended. Front 2 posts bent, but did slide off bases. Six anchor bolts pulled out.	None.

**Table 3. Collisions Involving SENTRE Units
(Continued)**

DATE	DESCRIPTION	SENTRE PERFORMANCE	CORRECTIVE MEASURES
8-24-87	Unit at Sunnyslane Rd. & I-40 (east bound) hit.	Unit collapsed as intended. Two posts were bent.	None.
12-15-87	Unit at Reno & I-40 (westbound) hit.	Unit collapsed as intended. Two posts were bent.	None.
12-15-87	Unit at Klein & I-40 (eastbound) hit.	Unit collapsed as intended. Three posts were bent	None

Repairs After Collisions

When the evaluation began, it was thought that maintenance costs might be lowered with the use of SENTRE units. This was based on the assumption that most principal components could be repositioned and reused after most impacts. According to the ODOT maintenance crew who did the repair work after collisions involving the units, and their records, their experience did not show this.

Except for the pad, redirecting cable, and cable anchor which were not damaged during any of the accidents, all components actually involved in the collisions had to be replaced with new parts. Essentially, the only reuseable parts were those located far enough from the point of impact (i.e. Post 5, when first impact occurred on the nose), so that they were not affected.

Typically, fender panels and posts bend, even when they do telescope and come off slip bases as designed.

Also, a crew of three to five men is required for repairs, which in our experience, took approximately half a day. This amount of time is required because units must be disassembled for repairs, then reassembled with new components replacing those which are damaged.

Repair Costs

Components of a single SENTRE unit, and their cost, as of April 21, 1988, the date of ODOT's last replacement parts order, are listed in Table 4 on the following page. Nuts, bolts, washers, etc. are not listed. For a complete listing, including all hardware, see Appendix B.

Table 4. SENTRE Component Costs

NO.	COMPONENT	UNIT COSTS	TOTAL COSTS
1	Nose Cover	\$ 65.00 ea.	\$ 65.00
1	Post, No. 1	\$ 95.00 ea.	\$ 95.00
1	Post, No. 2	\$ 85.00 ea.	\$ 85.00
1	Posts, No. 3, 4 & 5	\$ 65.00 ea.	\$ 195.00
5	Blockouts	\$ 20.80 ea.	\$ 104.00
4	Sand Containers, 100 lb.	\$ 45.50 ea.	\$ 182.00
2	Sand Containers, 150 lb.	\$ 58.50 ea.	\$ 117.00
2	Base Plates, No 1 & 2	\$ 31.50 ea.	\$ 63.00
3	Base Plates, No. 3, 4 & 5	\$ 19.50 ea.	\$ 58.50
5	Bolt Keeper Plates	\$ 11.70 ea.	\$ 58.50
1	Redirecting Cable, 25' (threaded both ends)	\$299.00 ea.	\$ 299.00
5	Thrie Beam Fenders	\$279.50 ea.	\$1,397.50

NOTE: Based on prices as of April 21, 1988.

Numbers of individual components actually used for replacement during the study (other than nuts, bolts and washers), are tabulated on page 12. Note that 14 nose covers and hazard markers were used when only 10 collisions were reported. Also, some of the sand containers replaced were damaged by vandalism in addition to those damaged by vehicle impacts.

Table 5. Replacement Components Used

NUMBER USED	COMPONENT
33	100 lb. Sand Containers
12	150 lb. Sand Containers
23	Blockouts
14	Nose Covers
14	Hazard Markers
11	Fender Panels
10	Post No. 1
6	Post No. 2
8	Posts No. 3, 4, & 5
2	Base Plates

ACCIDENT STUDY

In an attempt to compare accident history prior to installation of the SENTRE devices to that after installation, a study of fixed object accidents covering the area where the SENTREs were installed was requested from the ODOT Traffic Engineering Division. Time periods used in compiling this information were: April 25, 1982 through April 25, 1985, and April 26, 1985 through April 26, 1988. This represented roughly three years before SENTRE installation, and three years after. These tabulations are shown in Appendix E.

Information regarding guardrail accidents, extracted from this study, is summarized in Table 6, below.

Table 6. Guardrail Accidents

TIME PERIOD	TOTAL NO. OF GUARDRAIL ACCIDENTS	TOTAL PROPERTY DAMAGE	NO. OF ACCIDENTS W/INJURIES	NO. OF ACCIDENTS W/FATALITIES
4-25-82 to 4-25-85	64	\$220,675	23 (35.9%)	2 (3.1%)
4-26-85 to 4-26-88	21	\$ 70,565	11 (52.4%)	0

It should be noted that construction was in progress during most of the 1985 - 1988 study period, on various parts of the study area. Speeds were lowered on some sections, some exits were closed, and some traffic was rerouted. These factors contributed to less traffic, and less accident exposure over much of the

second half of the study period. These factors are the likely reason for the marked reduction in property damage, injuries, and fatalities.

As can be seen from Table 6, the percentage of the guardrail accidents resulting in injuries actually increased, although the number of accidents decreased.

The first five accidents involving SENTRE units occurred during the phase of the study when the units were being developed, and modifications discussed earlier, were made after accidents occurred. The next five accidents occurred after all modifications had been made and no corrective action was required. Although the accident study could not show this statistically, it is the opinion of the author, that the SENTRE's did reduce accident severity. During the last five accidents (those occurring after modifications), the units operated as the designers intended during every impact.

CONCLUSIONS

The modifications to the installation procedure, discussed earlier, are now addressed in the current version of the manufacturer's installation manual. The changes in the type of anchor bolts and reinforcing clips used are now standard features.

It is an important point that pinch bolts must be torqued to between 60 and 70 ft-lbs, or slip bases will not function properly. This has also been addressed in the current installation manual.

Although the number of collisions occurring after modifications was limited, SENTRE unit performance during those collisions suggests that the SENTREs do contribute to reducing accident severity.

Repair of the units, once a collision has occurred, can be expected to require approximately four hours, for a three to five-man crew. Also, repairs done during the study indicate that any components actually involved in the collision must be replaced. With the exception of the pad, redirecting cable, and cable anchor, the only reuseable parts are those located far enough from the point of impact so that they are not affected. To repair a SENTRE, the entire unit must be disassembled, the damaged parts replaced, then the unit must be reassembled.

RECOMMENDATIONS

1. Consideration should be given to using SENTRE units on future projects where guardrail end protection is desired.
2. Installation of SENTRE units should be planned, and then checked by construction inspectors, to insure that the redirecting cable anchors are placed at the proper elevation, so that the cable has 1 to 3 inches of cover.
3. A torque wrench should be used during installation of slip bases. Nuts holding slip bases should be tightened to between 60 and 70 ft - lbs torque. This should be checked by inspectors during construction.
4. Maintenance forces attempting to estimate numbers of components for repair stockpiles should consider:
 - a. Nose covers and hazard markers can be expected to require replacement in 100% of the accidents involving SENTREs.
 - b. Sand containers may be damaged by vandalism as well as by vehicle impacts.
 - c. Components placed toward the end of the unit facing traffic are more likely to sustain damage, and require replacement than those on the "transition" end.

REFERENCES

1. IIHS Facts 1989, Insurance Institute for Highway Safety, July, 1989.
2. SENTRE (Safety Barrier End Treatment), NCHRP 230 Certifications Report, Energy Absorption Systems, Inc., May, 1983.
3. SENTRE Guardrail End Treatment, Installation Manual, Energy Absorption Systems, Inc., 1984.
4. Drawing Number 80-04-03, Concrete Pad Detail, Energy Absorption Systems, Inc., 1980.
5. MP3 Anchor Instructions, Hilti Corporation. 1984

APPENDIX A
PHOTOGRAPHS



Figure 1. SENTRE unit after installation on guardrail end.

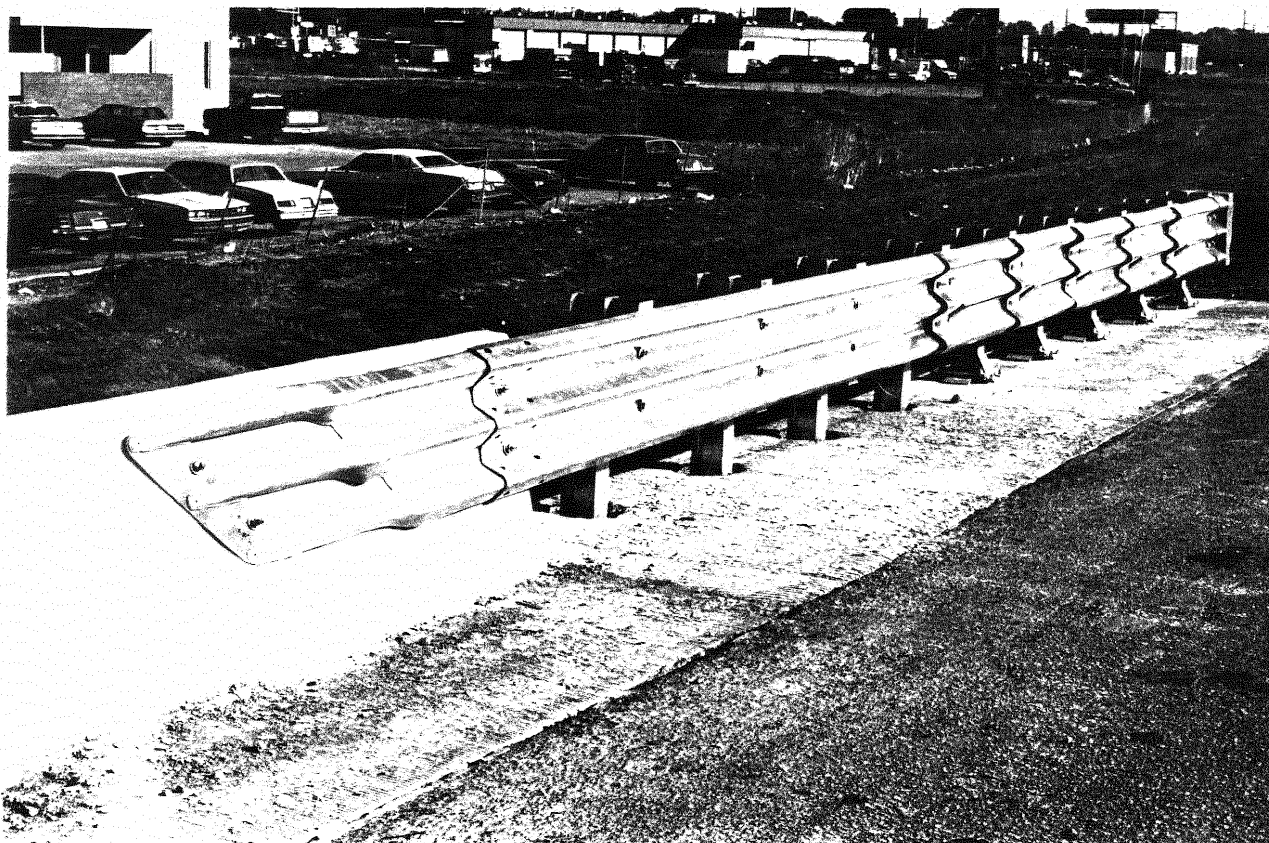


Figure 2. SENTRE unit after installation on barrier end.

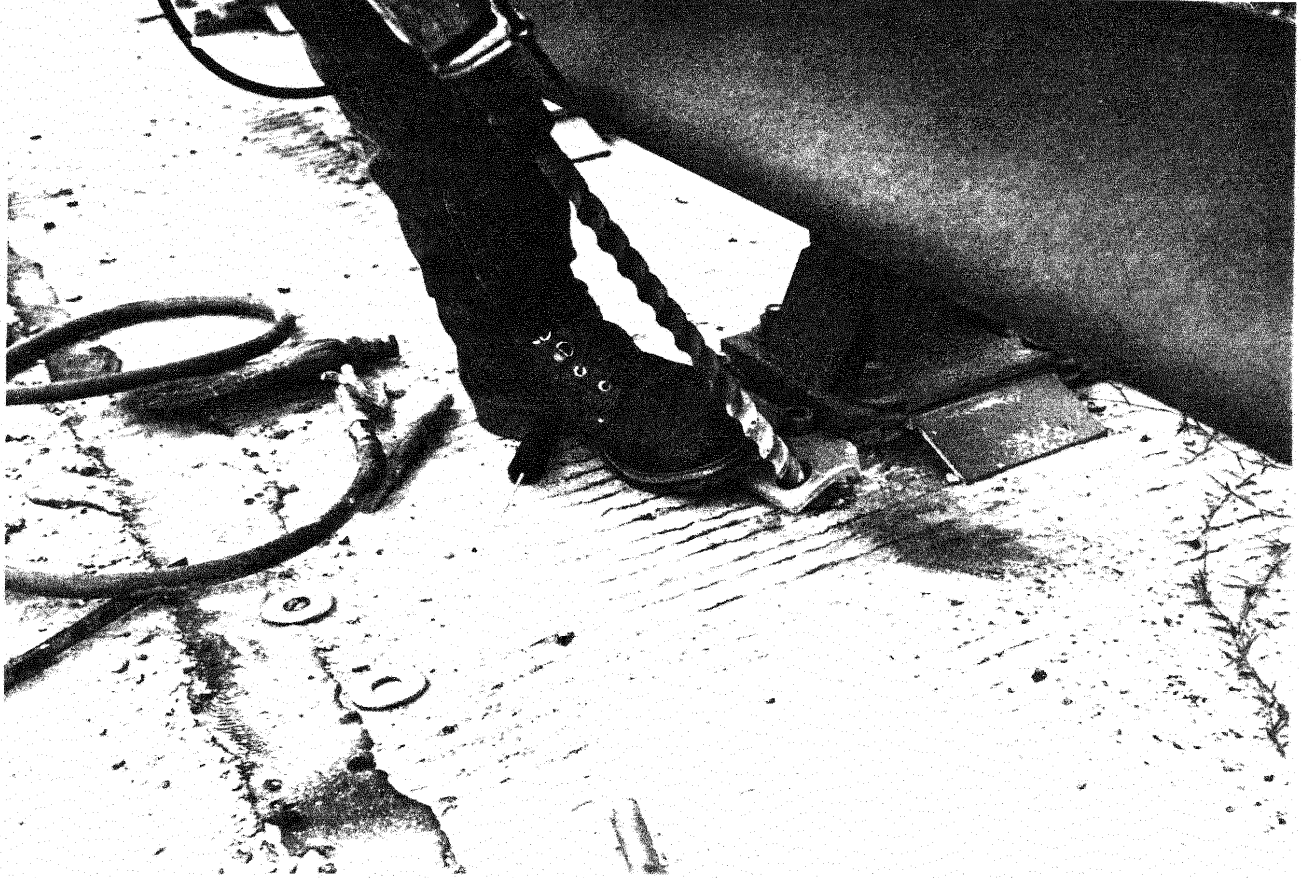


Figure 3. Drilling holes for "MP-3" anchors during retrofit.

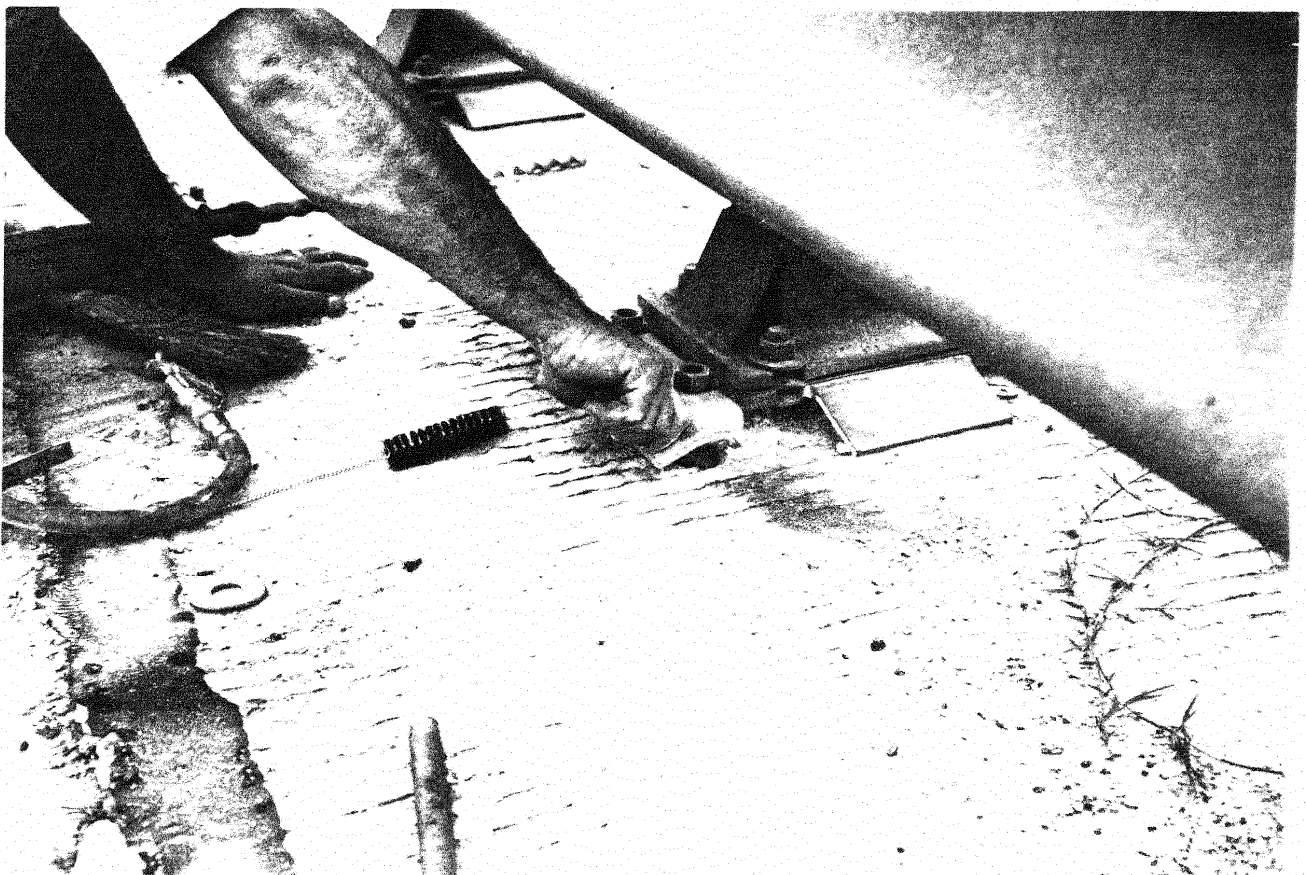
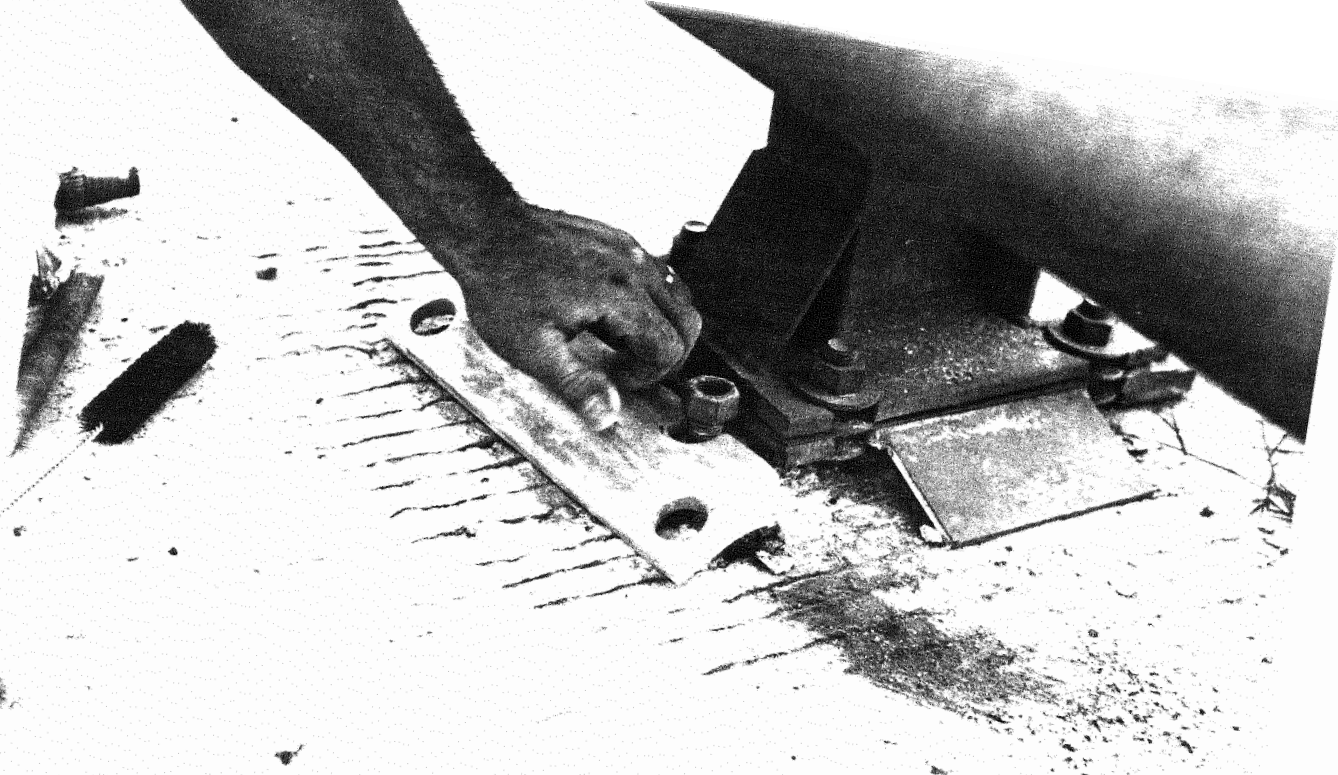
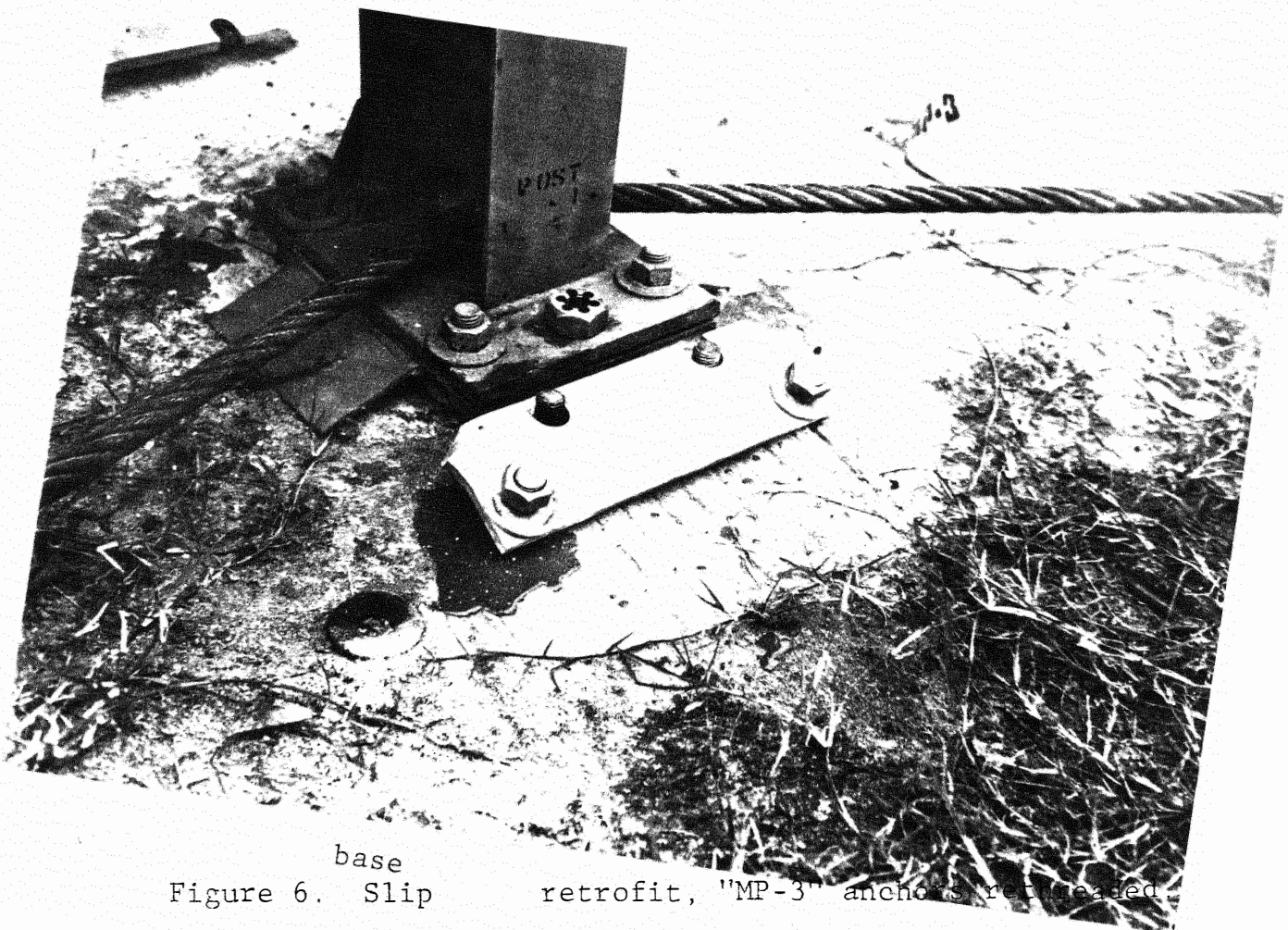


Figure 4c Placing "MP-3" anchors after cleaning hole - retrofit phase.



Fi

gure 5. Reinstallation of slip base, retrofit phase.



base
Figure 6. Slip retrofit, "MP-3" anchors reinstalled



Figure 7. After collision - unit functioned as intended.

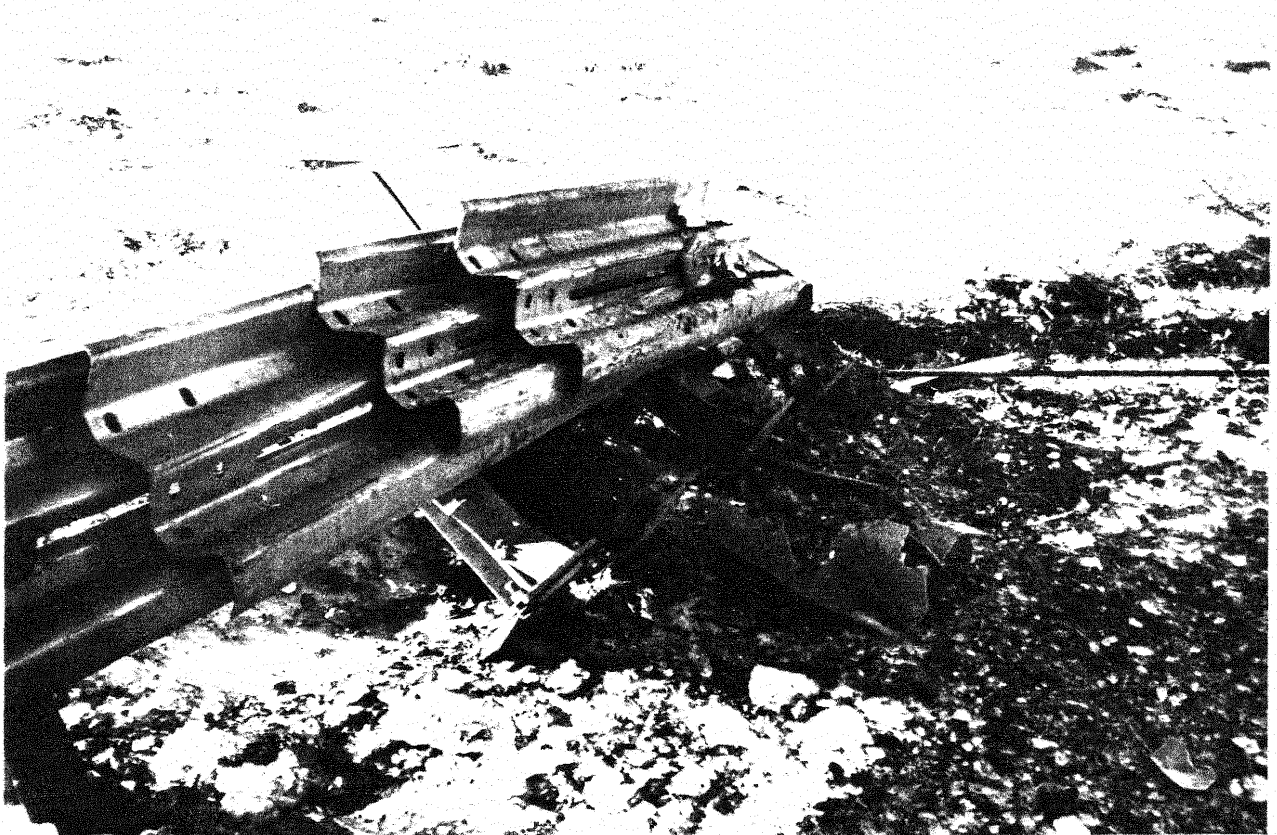


Figure 8. Unit after collision - unit functioned as intended.

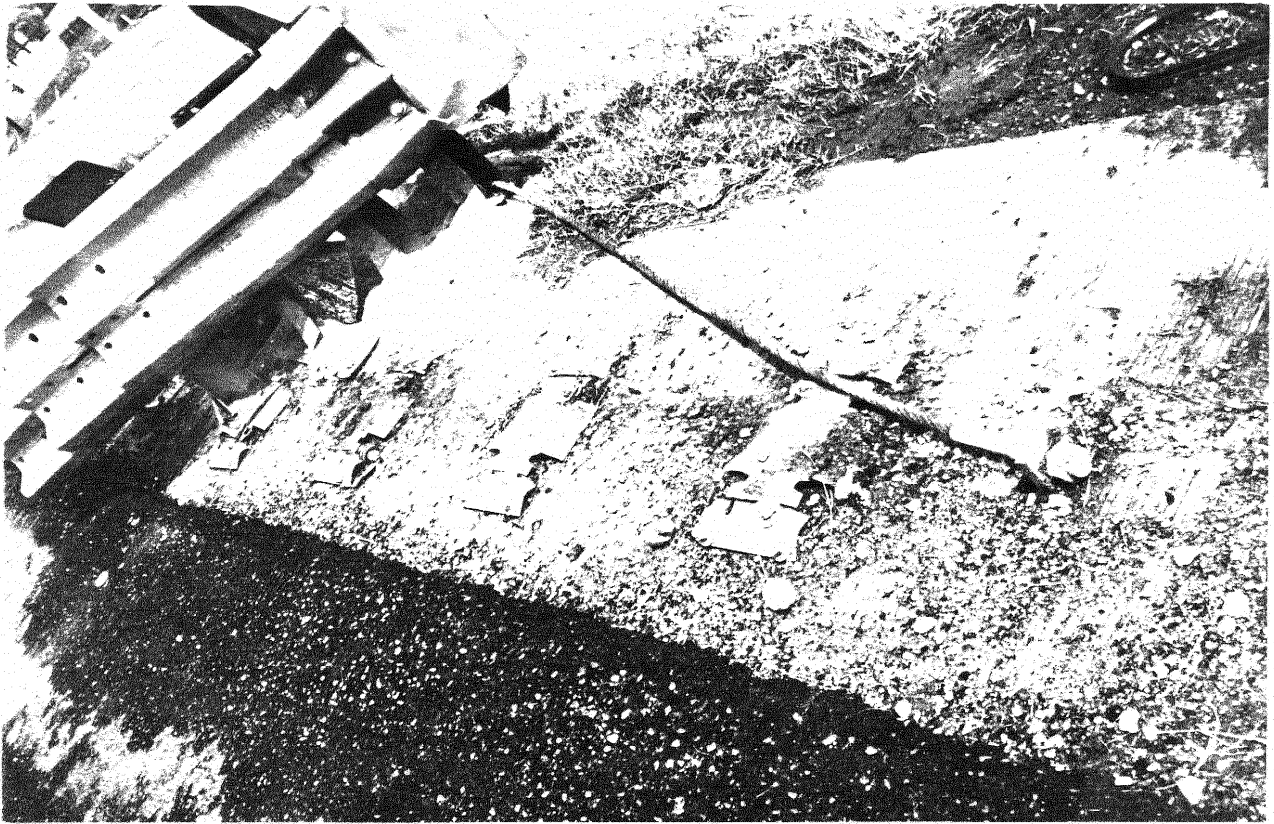


Figure 9. After impact, first three slip bases performed as intended.



Figure 10. SENTRE unit after impact. Slip bases failed to work due to over-torqued pinch bolts.



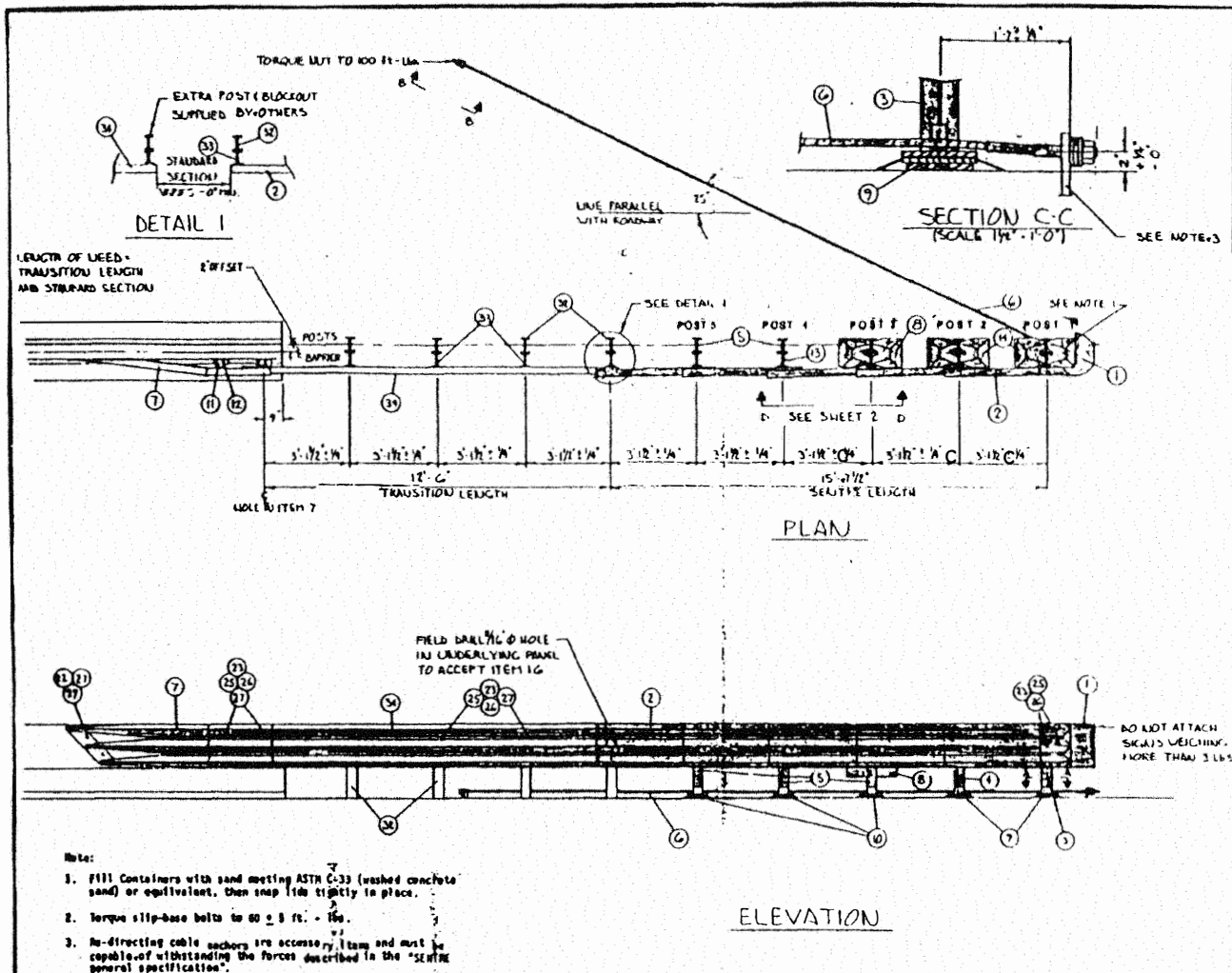
Figure 11. Slip base after impact, base did not perform.



Figure 12o SENTRE unit after impact, unit generally performed as intended, but anchor bolts were pulled out of slab

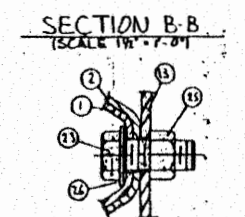
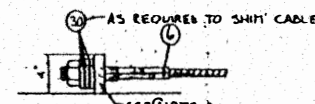
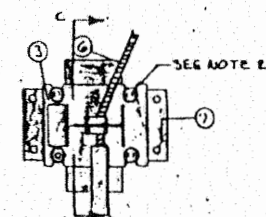
APPENDIX B
SENTE PLANS

B-1



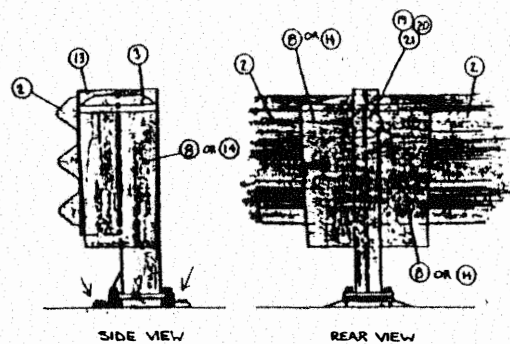
ITEM	QUANTITY	PARTS LIST	REMARKS
1	20-20-931	BLANK NOSE (PLASTIC)	
2	21-58-111	FIELD PANEL	
3	21-58-011	POST #1	
4	21-58-021	POST #2	
5	21-58-031	POST #3	
6	21-58-181	REDIRECTING CABLE 15' L	
7	21-58-241	TRANSITION PANEL (4' 0" x 12' 6")	
8	20-20-141	SAND CONTAINER 150 LBS (PLASTIC)	
9	21-58-041	BASE PLATE (POSTS #1, 2)	
10	21-58-051	BASE PLATE (POSTS #3, 4)	
11	21-58-251	SUPPORT BRACKET	
12	21-01-261	CONC. ANCHOR SYSTEM TWO 3/4" x 8"	
13	21-58-061	BLOCKOUT	
14	20-20-151	SAND CONTAINER 100 LBS (PLASTIC)	

(CONTINUED ON SHEET 2)

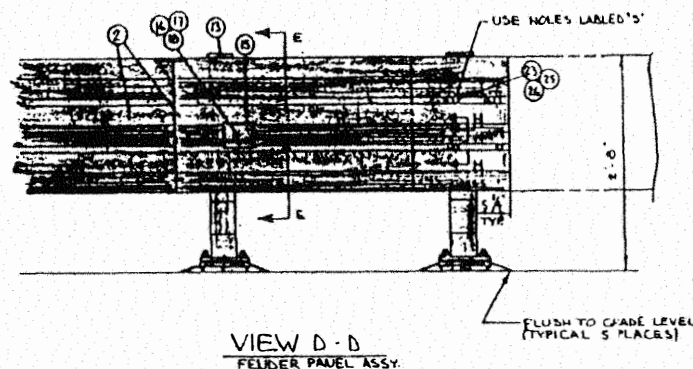


Customer Prints JUL 12 1984
STANDARD SENTRE COMPONENTS ARE SHADED

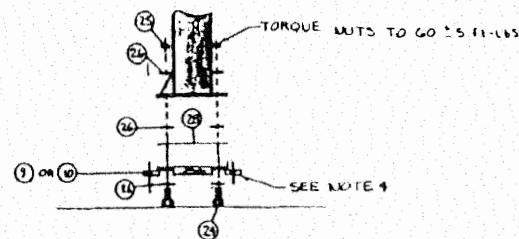
Revisions SEE SHY 2 ADDED DETAIL 1		Date Rev By Cld App 1/84 A T.J. 2/84 2/84 R T.J. 2/84	DESIGN SPEED _____ M.P.H. AVERAGE G's _____ EST. FORCE ON BACKUP STRUCTURE _____ KIPS Designed _____ Drawn T.J. JACKSON 1/16/84 Checked J.R. 1/8/84 Approved J.M. 2/9/84 Tolerances: a. Angular b. Linear Unless Otherwise Noted	REFERENCES Project No _____ Sales Order No 10919 Serial No _____ Color _____ TYPICAL POST & ASST 80-00-01 SHY 3 TRANSITION DATA FOR FLARED INSTALLATIONS 80-00-01 SHY 4 CONCRETE PAD 80-04-01 CABLE ANCHORAGE DETAIL (REDIRECTING) 80-02-01		ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT SENTRE W/ TRANSITION TO N.J. BARRIER 1/8 1/57 C 80-00-03 1/8 B
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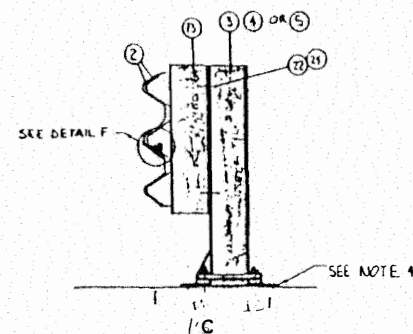
SAND CONTAINERS
(TYPICAL POST 3)



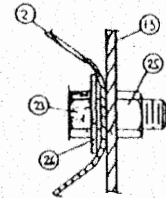
VIEW D-D
FEEDER PANEL ASSY.



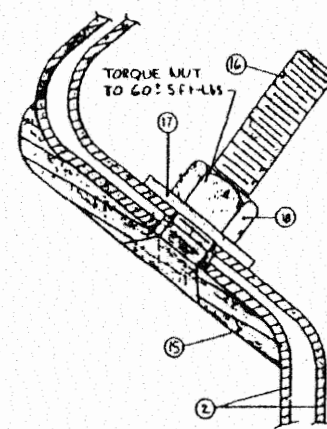
EXPLODED SLIPBASE ASSEMBLY



SECTION E-E
TYPICAL POST ASSY.



SECTION H-H
(SCALE 1/2" = 1')



DETAIL F

SCALE FULL
(MUSHROOM BOLT
ASSEMBLY)

STANDARD SENTRE COMPONENTS ARE SHOWN

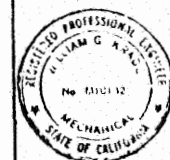
NOTES: (Continued)

4. The SENTRE slip base plates (items 9 & 10) must be attached to an anchor or concrete pad which can be locally designed to resist the loads described in the SENTRE general specifications.

Revision	Date	Rev.	By	Cl'd	App.	DESIGN SPEED	M.P.H.
ITEMS 3 & 4 WERE W/ G.I.S. AND ARE W/ G.I.T.	10/11/84	A	T.J.	PL	OK	AVERAGE G's	
SEE SHIT 1	10/11/84	B	T.J.	PL	OK	EST. FORCE ON BACKUP STRUCTURE	KIPS
						Designed	10/11/84
						Drawn	T. J. JACKSON
						Checked	10/11/84
						Approved	10/11/84
						Tolerances:	
						a. Angular	
						b. Linear	
						Unless Otherwise Noted	

REFERENCES

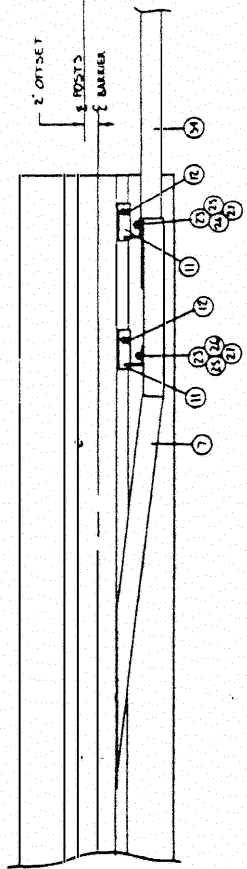
Project No. _____ Sales Order No. _____
Serial No. _____ Color _____



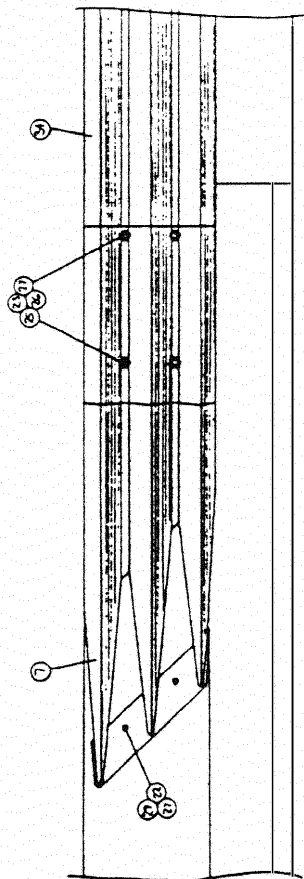
ENERGY ABSORPTION SYSTEMS, INC.

ENGINEERING AND RESEARCH DEPARTMENT

SENTRE



TOP VIEW

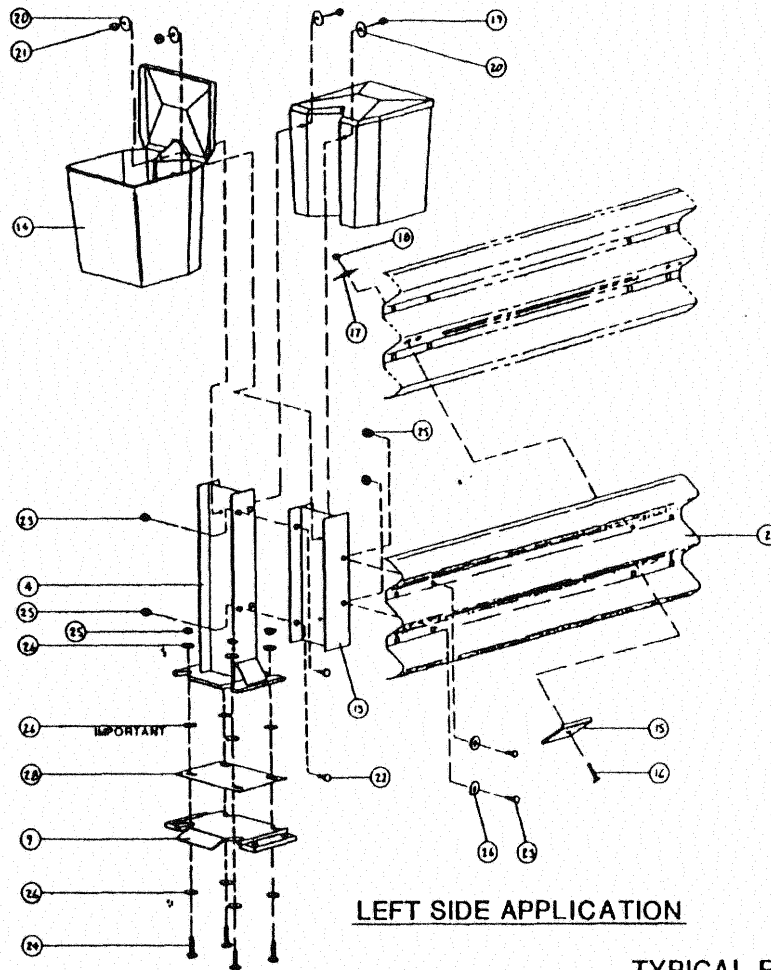


SIDE VIEW

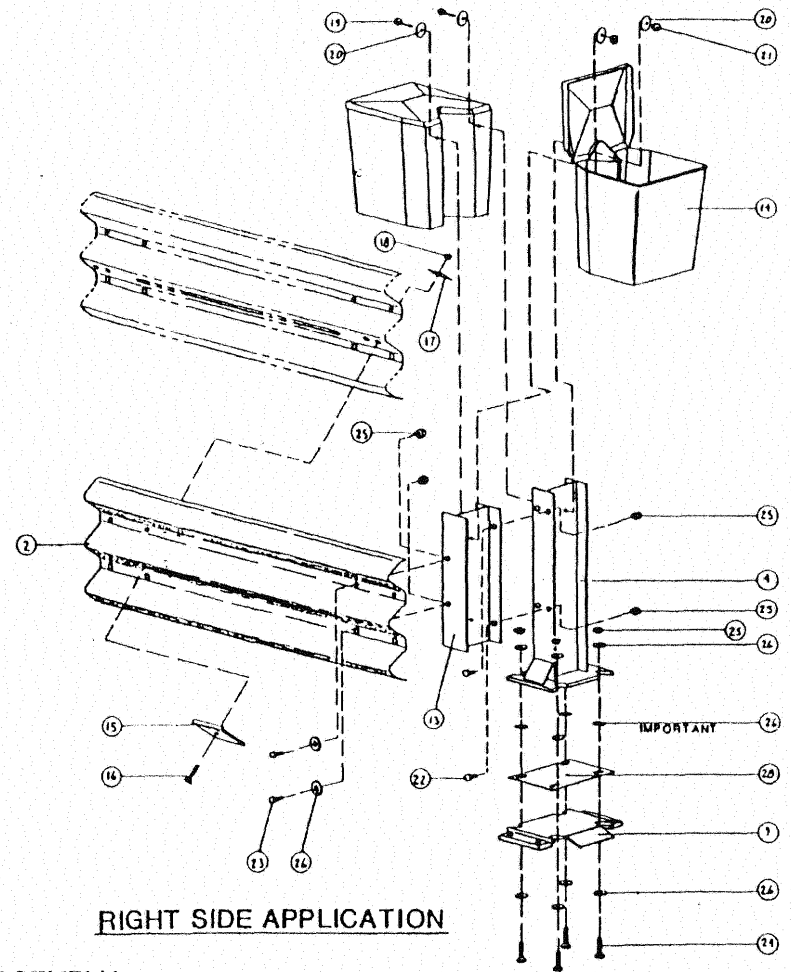
SIDE VIEW W/O TRANS PANEL

REVISIONS SEE SHIT. 2 SEE SHIT. 1		DESIGNED T. J. JACKSON 11-31-64	CHECKED T. J. JACKSON 11-31-64	APPROVED W. G. MOORE 12-9-64	MATERIAL 111-100
DATE 11-31-64	BY T. J. JACKSON	App T. J. JACKSON	Cld T. J. JACKSON	DESIGNED T. J. JACKSON 11-31-64	CHECKED T. J. JACKSON 11-31-64
DESIGNED T. J. JACKSON 11-31-64	CHECKED T. J. JACKSON 11-31-64	APPROVED W. G. MOORE 12-9-64	MATERIAL 111-100	PROJECT NO. 111-100	SERIAL NO. 111-100
REFERENCES Project No. _____ Serial No. _____ Order No. _____ Color _____					
ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT SENTRY 111-100 80-00-03 111-100					

B-4



LEFT SIDE APPLICATION



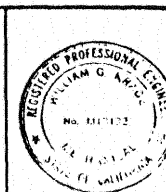
RIGHT SIDE APPLICATION

TYPICAL POST 2 ASSEMBLY

80 00 03

Revisions	Date	Rev	By	Chd	App	DESIGN SPEED	M.P.H.
SEE SMT 2	2-28-83	C	T.J.	277	277	AVERAGE G's	
SEE SMT 1	2-28-83	D	T.J.	277	277	EST. FORCE ON BACKUP	
SEE SMT 2	2-28-83	E	T.J.	277	277	STRUCTURE	21PS
SEE SMT 1	2-28-83	F	T.J.	277	277	Designed	21PS
SEE SMT 1	2-28-83	G	T.J.	277	277	Drawn T.J. JACKSON	2-28-83
						Checked W.G. FRAZ	6-28-83
						Approved W.G. FRAZ	12-28-83
						Tolerances	
						a Angular	
						b Linear	
						Unless Otherwise Noted	
Material							

REFERENCES	
Project No	_____
Serial No	_____
Sales Order No	_____
Color	_____

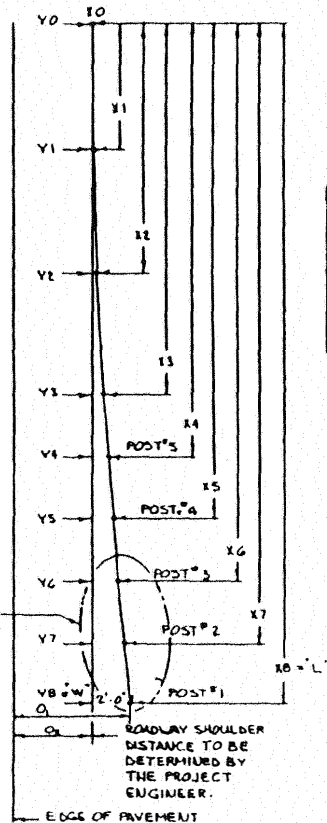


ENERGY ABSORPTION SYSTEMS, INC.	
ENGINEERING AND RESEARCH DEPARTMENT	
SENTRE	
Scale 1/4" = 1'-0"	80-00-01
Sheet 3 of 6	Rev C

B-5

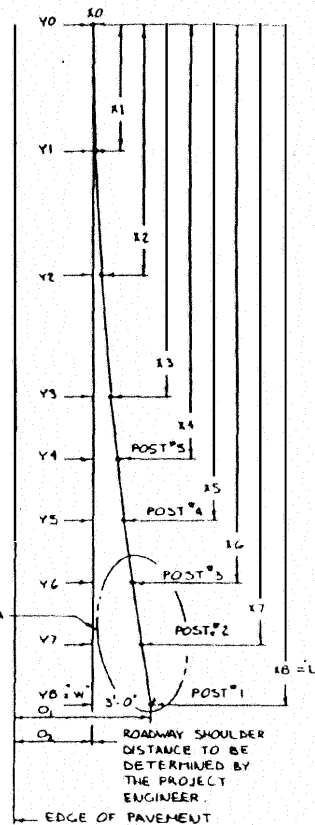
2'-0" FLARE

TRANSITION DATA		
	X (FT)	Y (FT)
0	0'-0"	0'-0"
1	2'-3"	0'-0"
2	4'-2"	0'-3"
3	6'-9"	0'-7"
4	9'-10"	0'-9"
5	12'-0"	1'-0"
6	14'-1"	1'-4"
7	16'-5"	1'-7"
8	18'-4"	2'-0"



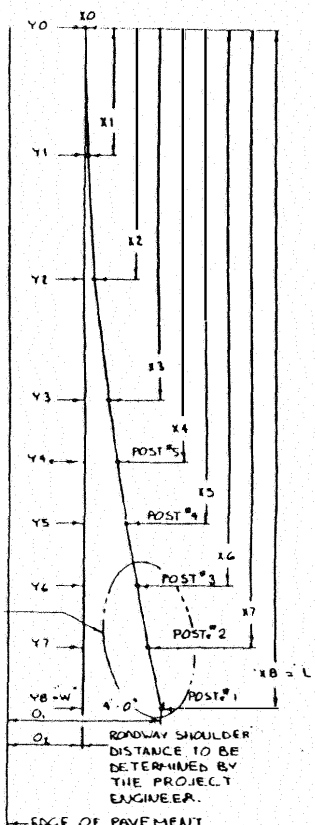
3'-0" FLARE

TRANSITION DATA		
	X (FT)	Y (FT)
0	0'-0"	0'-0"
1	2'-3"	0'-0"
2	4'-2"	0'-3"
3	6'-9"	0'-7"
4	9'-10"	0'-9"
5	12'-0"	1'-0"
6	14'-1"	1'-4"
7	16'-5"	1'-7"
8	18'-4"	2'-0"



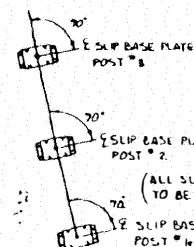
4'-0" FLARE

TRANSITION DATA		
	X (FT)	Y (FT)
0	0'-0"	0'-0"
1	2'-3"	0'-0"
2	4'-2"	0'-3"
3	6'-9"	0'-7"
4	9'-10"	0'-9"
5	12'-0"	1'-0"
6	14'-1"	1'-4"
7	16'-5"	1'-7"
8	18'-4"	2'-0"



NOTE:

1. W = TOTAL LATERAL TRANSITION OF GUARDRAIL = 0'-0"
2. L = TOTAL LENGTH OF TRANSITIONAL PORTION OF GUARDRAIL
3. POST LOCATIONS CALCULATED USING $Y = \frac{X^2}{L}$
4. Q = DISTANCE FROM EDGE OF ROADWAY TO SENTRE POST #1.

TRANSITION DATA FOR FLARED
SENTRE™ INSTALLATION

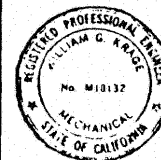
DETAIL A

SCALE: 1" = 1'-0"

Revisions	Date	Rev.	By	Cld	App	DESIGN SPEED	M.P.H.
SEE SMT. 1	8-23-83	B	T.J.	W	W	AVERAGE G's	
SEE SMT. 2	8-23-83	E	T.J.	W	W	EST. FORCE ON BACKUP STRUCTURE	KIPS
SEE SMT. 1	8-23-83	F	T.J.	W	W	Designed	
SEE SMT. 1	8-23-83	G	T.J.	W	W	Drawn T.J. JACKSON	8-23-83
						Checked	8-23-83
						Approved L. K. RAGE	8-23-83
						Tolerances:	
						Angular	
						Linear	
						Unless Otherwise Noted	

REFERENCES

Project No. _____ Sales Order No. _____
 Serial No. _____ Color. _____



80 00 03
 ENERGY ABSORPTION SYSTEMS, INC.
 ENGINEERING AND RESEARCH DEPARTMENT

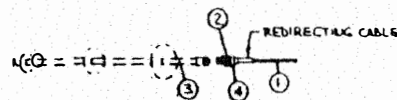
SENTRE

SCALE: 1" = 1'-0" 80 00 01

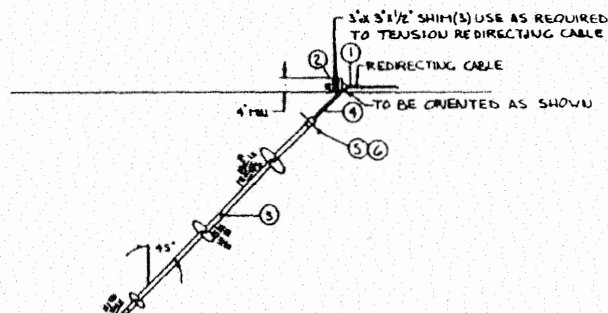
27-52-09

27-52-091

PARTS LIST			
ITEM	STACK NO.	DESCRIPTION	REQ
1	27-42-10	REDIRECTING CABLE	1
2	27-28-22	SHIM 3" X 1/2"	1
3	27-42-02	1/2" DIA. EARTH ANCHOR	1
4	27-20-51	1/2" DIA. EARTH ANCHOR	1
5	27-04-21	1/2" DIA. EARTH ANCHOR	1



TOP VIEW

SECTION A-A
(SEE DWG. 80-02-01)TWIST IN EARTH ANCHOR
TECHNIQUE

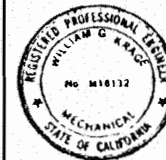
NOTE:
1. The twist-in earth anchor has been designed to resist the forces described in the "SENTE general specifications".

Revisions	Date	Rev	By	Chd	App	DESIGN SPEED	M.P.H.
REVISED NOTES, MADE DWG. 80-02-01	8/28/83	A	T.J.	BY	W.C.	AVERAGE G1	
REVISED EMBEDDED ANCHOR TECHNIQUE	8/28/83	B	T.J.	BY	W.C.	EST. FORCE ON BACKUP STRUCTURE	RIPS
ADDED NOTE 1, 3" DIA. OUTRENDERING ANCHOR WAS 1"	8/28/83	C	T.J.	BY	W.C.	Designed	8/28/83
						Drawn T.J. JACKSON	8-10-83
						Checked J.H.	8-23-83
						Approved W.C. REALE	8-24-83
						Tolerances:	
						0 Angular	
						0 Linear	
						Unless Otherwise Noted	

REFERENCES

Project No. _____ Sales Order No. _____

Serial No. _____ Color: _____



ENERGY ABSORPTION SYSTEMS, INC.

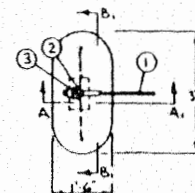
ENGINEERING AND RESEARCH DEPARTMENT

SENTE SYSTEM

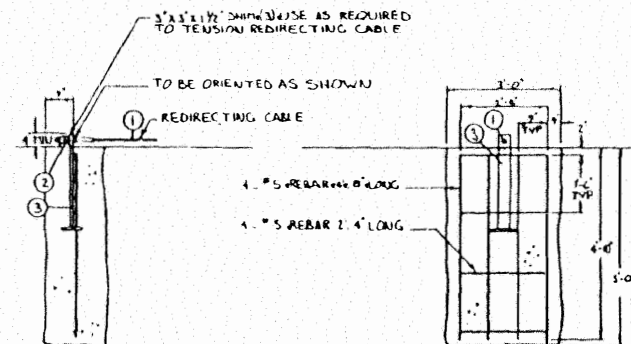
CABLE ANCHORAGE DETAILS
FRONT & REAR REDIRECTING CABLE ANCHOR

Scale: 1/2" = 1'-0" C 80-02-02

PARTS LIST			
ITEM	STACK NO.	DESCRIPTION	REQ
1	27-42-10	REDIRECTING CABLE	1
2	27-28-22	SHIM 3" X 1/2"	1
3	27-44-13	ANCHOR	1



TOP VIEW



SECTION A-A

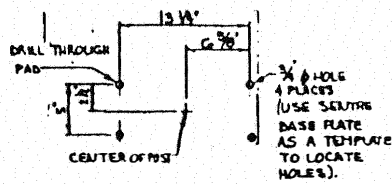
SECTION B-B

SECTION A-A
(SEE DWG. 80-02-01)

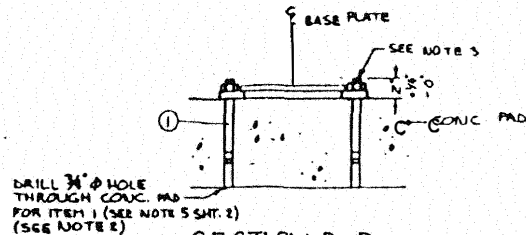
EMBEDDED ANCHOR

NOTE:
1. The embedded anchor has been designed to resist the forces described in the "SENTE general specifications".

TECHNIQUE 80 00 03



DETAIL A
(SCALE 1 1/2" = 1'-0")
TYPICAL ALL POSTS

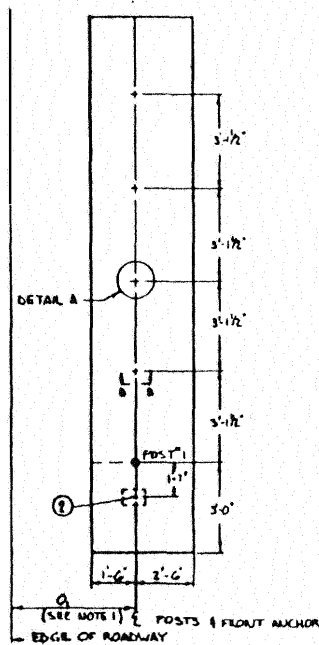


SECTION B-B
(SCALE 1 1/2" = 1'-0")

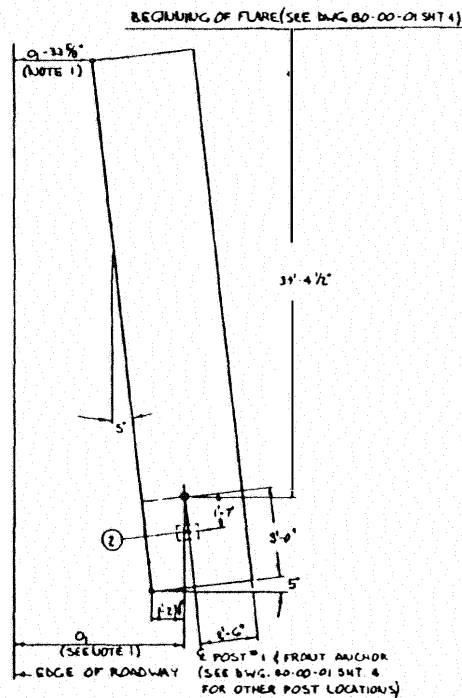
PARTS LIST		
ITEM	ITEM NO.	DESCRIPTION
1	27-01-671	CONC. ANCHOR BOLT 1/2" x 8 1/2"
2	27-44-131	EMBEDDED ANCHOR
3		

NOTE:

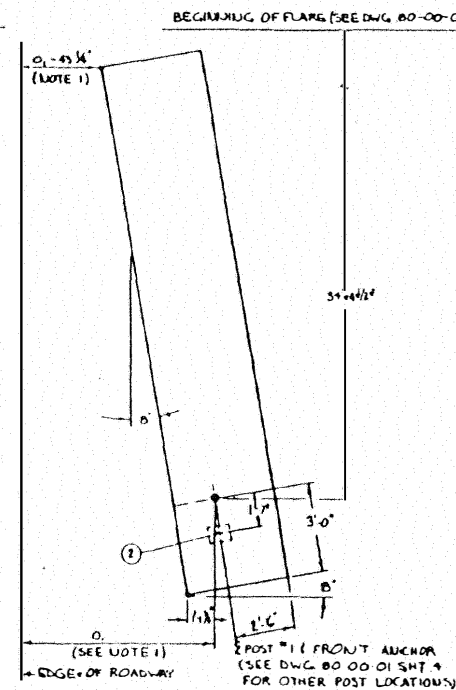
1. O₁ = DISTANCE FROM EDGE OF ROADWAY TO SENTRE POST¹ (DETERMINED IN THE FIELD, REF. DWG. 80-00-01 SHT. 4)
2. USE SENTRE SLIPBASE PLATE AS A TEMPLATE TO LOCATE HOLES FOR ITEM 1.
3. TORQUE NUT TO 125 FT.-LBS. (MIN.)



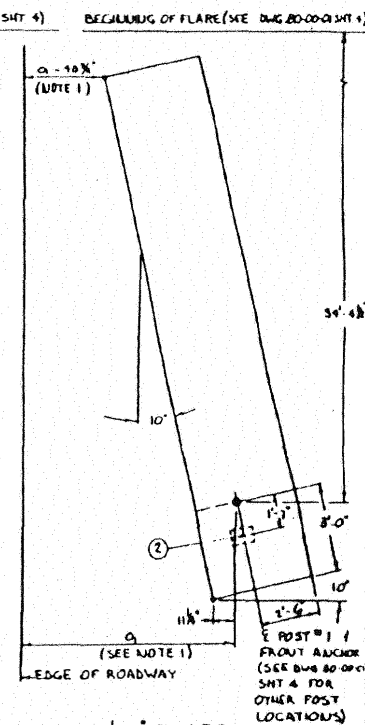
STRAIGHT CONDITION



2'-0" FLARE



3'-0" FLARE

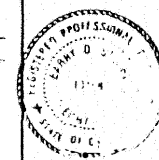


4'-0" FLARE

10440 D.O.T. DIST. #1 **80 00 03**

Revisions	Date	Rev.	By	Chd	App	DESIGN SPEED	M.P.H.
						AVERAGE G's	
						EST. FORCE ON BACKUP STRUCTURE	KPS
						Designed	1-31-84
						Drawn	T. J. JACKSON
						Checked	W. J. JACOB
						Approved	1-31-84
						Tolerance:	
						Angular	
						Linear	
						Unless Otherwise Noted	

REFERENCES
Project No. _____ Sales Order No. _____
Serial No. _____ Color. _____



ENERGY ABSORPTION SYSTEMS, INC.

ENGINEERING AND RESEARCH DEPARTMENT

SENTRE SYSTEM

CONCRETE PAD DETAILS
FOR UNITS IN FRONT OF NEW JERSEY BARRIER

1/2" x 1/2" C 80-04-03 1 OF 2

APPENDIX C
ACCIDENT STUDY

OKLAHOMA DEPARTMENT OF TRANSPORTATION
 ANAL010.0RINT
 COUNTY0 (55) OKLAHOMA

HIGHWAY TABULATION
 ACCIDENT CONCENTRATION LISTING FOR IN-HOUSE USE
 I-40 MAINLINE FIXED OBJECT ACCIDENTS FROM I-44 EAST TO SUNNYLANE

TRAFFIC ENGINEERING DIVISION
 04-26-85 THRU 04-26-88

CS	INT	MI	DIAG	LOCATION	SPECIAL	INT	#	PEOPLE	PROP	TYPE	CAUSE OF	CONDITIONS					
CITY #	#	POST	CODE	DESCRIPTION	FEATURES	REL	D1	D2	VE	IN-FAT	DMG	ACCIDENT	ACCIDENT	LIGHT	ROAD	SEV	DATE
70	68	00	0029	00000	N.CANADIAN RI BRIDGE	NO	NW	NW	2		1650	F-O(BR POST)	UNSAF-SPD	DARK	IC-S	PD	12-10-85
70	68	00	0029	00000	N.CANADIAN RI BRIDGE	NO	E	E	2		2675	F-O(RETN WALL)	UNSAF-SPD	DYLG	IC-S	PD	02-08-86
70	68	00	0029	00000	N.CANADIAN RI BRIDGE	NO	E		1		5050	F-O(RETN WALL)	UNSAF-SPD	DARK	WET	PD	05-24-86
70	68	00	0029	00000	N.CANADIAN RI BRIDGE	NO	W		1		3050	F-O(BR RAIL)	UNSAF-SPD	DARK	WET	PD	09-29-86
70	68	00	0029	00000	N.CANADIAN RI BRIDGE	NO	W	W	2		2850	F-O(RETN WALL)	UNSAF-SPD	DYLG	DRY	PD	09-30-86
70	68	00	0029	00000	N.CANADIAN RI BRIDGE	NO	E		1	1	800	F-O(RETN WALL)	UNSAF-SPD	DARK	WET	INJ	10-05-86
(70)	OKLAHOMA CITY		I-40														
70	68	00	0030	00000		NO	E		1		700	F-O(RETN WALL)	INATT	DYLG	DRY	PD	04-29-85
70	68	00	0030	00000		NO	W		1	1	3450	F-O(GD-RAIL)	DEF-VEH	DYLG	DRY	INJ	07-15-85
70	68	00	0030	00000		NO	E		1	1	1150	F-O(RETN WALL)	UNSAF-SPD	DAWN	IC-S	INJ	02-07-87
(70)	OKLAHOMA CITY		I-40														
70	68	00	0037	00000		NO	E		1		2500	F-O(RETN WALL)	UNSAF-SPD	DARK	IC-S	PD	12-03-86
(70)	OKLAHOMA CITY		I-40														
70	68	00	0038	00000		NO	E		1		2500	F-O(RETN WALL)	UNSAF-SPD	DARK	WET	PD	09-28-86
70	68	00	0038	00000		NO	W		1		1200	F-O(RETN WALL)	UNSAF-SPD	DARK	IC-S	PD	02-16-87
70	68	00	0038	00000		NO	E		1		1200	FIXED-O(OTHER)	NO-IMP-ACT	DYLG	DRY	PD	03-24-88
(70)	OKLAHOMA CITY		I-40														
70	68	51	0042	00000		NO	E		1		2500	F-O(RETN WALL)	UNSAF-SPD	DARK	WET	PD	11-19-85
(70)	OKLAHOMA CITY		I-40														
70	68	51	0048	00000	CONSTRUCTION	NO	E	E	2		675	F-O(RETN WALL)	FOL-CLOSE	DARK	DRY	PD	08-23-85
70	68	51	0048	00000		NO	W		1		2500	F-O(RETN WALL)	UNSAF-SPD	DAWN	WET	PD	11-27-85
(70)	OKLAHOMA CITY		I-40														
70	68	51	0051	00000		NO	W		1		2675	F-O(RETN WALL)	UNSAF-SPD	DYLG	DRY	PD	02-14-86
(70)	OKLAHOMA CITY		I-40														
70	68	51	0058	00000		NO	W		1		5050	FIXED-O(OTHER)	UNSAF-SPD	DARK	DRY	PD	09-07-85
(70)	OKLAHOMA CITY		I-40														
70	68	51	0059	00000		NO	W		1		125	F-O(RETN WALL)	NO-IMP-ACT	DYLG	DRY	PD	03-10-86
(70)	OKLAHOMA CITY		I-40														
70	68	51	0068	00000		NO	W	W	2		850	F-O(RETN WALL)	UNSAF-SPD	DYLG	IC-S	PD	02-07-86
70	68	51	0068	00000		NO	W		1		500	F-O(RETN WALL)	UNSAF-SPD	DYLG	IC-S	PD	02-07-86
70	68	51	0068	00000		NO	W		1		2500	F-O(RETN WALL)	UNSAF-SPD	DYLG	IC-S	PD	02-07-86
70	68	00	068	00000		NO	W		1		700	FIXED-O(OTHER)	UNSAF-SPD	DARK	IC-S	PD	02-16-87
70	68	51	0068	00000		NO			2		3500	F-O(RETN WALL)	NO-IMP-ACT	DYLG	DRY	PD	03-18-87
(70)	OKLAHOMA CITY		I-40														
70	68	51	0069	00000		NO	W		1	1	600	F-O(RETN WALL)	OTHER	DYLG	DRY	INJ	12-10-85
(15)	DEL CITY		I-40														
15	68	00	0078	00000		NO	W		1		2300	F-O(RETN WALL)	UNSAF-SPD	DYLG	IC-S	PD	12-28-87
(15)	DEL CITY		I-40														
15	68	00	0079	00000		NO	W		1	1	5400	F-O(GD-RAIL)	UNSAF-SPD	DYLG	WET	INJ	11-27-87
(15)	DEL CITY		I-40														
15	68	00	0080	00000		NO	E		1		5500	FIXED-O(OTHER)	UNSAF-SPD	DYLG	DRY	PD	04-19-88
(15)	DEL CITY		I-40														
15	68	00	0083	00000		NO	E		1	1	400	F-O(RETN WALL)	D-W-I	DYLG	DRY	INJ	05-20-86
(15)	DEL CITY		I-40														
15	68	00	0088	00000		NO	E		1	1	800	F-O(RETN WALL)	UNSAF-SPD	DYLG	IC-S	INJ	12-11-85
15	68	00	0088	00000		NO	E		1		2500	F-O(RETN WALL)	OTHER	DYLG	DRY	PD	04-17-86
15	68	00	0088	00000		NO	W		1	1	1075	F-O(GD-RAIL)	UNSAF-SPD	DYLG	WET	INJ	06-04-86
(15)	DEL CITY		I-40														
15	68	00	0095	00000		NO	E		1		700	F-O(RETN WALL)	NO-IMP-ACT	DARK	OT	PD	09-12-85
(15)	DEL CITY		I-40														

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HIGHWAY TABULATION
 ACCIDENT CONCENTRATION LISTING FOR IN-HOUSE USE
 I-40 MAINLINE FIXED OBJECT ACCIDENTS FROM I-44 EAST TO SUNNYLANE

TRAFFIC ENGINEERING DIVISION

04-26-85 THRU 04-26-88

CS	INT	MI	DIAG	LOCATION	SPECIAL	INT	#	PEOPLE	PROP	TYPE	CAUSE OF	CONDITONS					
CITY #	#	POST	CODE	DESCRIPTION	FEATURES	REL	D1	D2	VE	IN-FAT	DMG	ACCIDENT	ACCIDENT	LIGHT	ROAD	SEV	DATE
(70)	OKLAHOMA CITY	I-35															
70	15	00	0613	00000		NO	E		2	1	3125	F-O(GD-RAIL)	UNSAF-SPD	DYLG	IC-S	INJ	02-08-86
(70)	OKLAHOMA CITY	I-35							MILE 127								
70	15	00	0614	00000	MILE 127	NO	E		1		1400	F-O(GD-RAIL)	UNSAF-SPD	DARK	DRY	PD	02-07-87
(70)	OKLAHOMA CITY	I-35															
70	15	00	0616	00000		NO	N		1	1	600	F-O(BARRIER)	UNSAF-SPD	DARK	DRY	INJ	11-03-86
(70)	OKLAHOMA CITY	I-35															
70	15	00	0621	00000		NO	W	W	2		3450	FR-O(RETN WALL)	UNSAF-SPD	DARK	IC-S	PD	12-03-86
(70)	OKLAHOMA CITY	I-35															
70	15	00	0641	00000		NO	W		1		2500	F-O(GD-RAIL)	NO-IMP-ACT	DYLG	DRY	PD	04-10-86
70	15	00	0641	00000	CONSTRUCTION	NO	W		1	1	4900	FR-O(RETN WALL)	D-W-I	DYLG	DRY	INJ	06-27-87
(70)	OKLAHOMA CITY	I-35															
70	15	00	0659	00000		NO	W		1		2000	F-O(GD-RAIL)	UNSAF-SPD	DYLG	DRY	PD	08-30-87
(70)	OKLAHOMA CITY	I-35															
70	15	00	0661	00000		NO	E		1		2500	FIXED-O(OTHER)	D-W-I	DARK	DRY	PD	09-14-85
70	15	00	0661	00000	CONSTRUCTION	NO	W		1		2500	F-O(RETN WALL)	UNSAF-SPD	LIGHT	WET	PD	11-25-86
70	15	00	0661	00000	CONSTRUCTION	NO	W		1		1000	FG-O(RETN WALL)	UNSAF-SPD	DYLG	DRY	PD	11-06-87
(70)	OKLAHOMA CITY	I-35															
70	15	00	0665	00000		NO	E		1		3450	F-O(RETN WALL)	UNSAF-SPD	DYLG	DRY	PD	07-19-86
(70)	OKLAHOMA CITY	I-35															
70	15	00	0670	00000		NO	W		1	1	1250	F-O(GD-RAIL)	INATT	DYLG	DRY	INJ	12-19-85
(70)	OKLAHOMA CITY	I-35															
70	15	00	0672	00000		NO	E		1		700	F-O(RETN WALL)	NO-IMP-ACT	DYLG	WET	PD	04-29-85
70	15	00	0672	00000		NO	E		1		2500	F-O(RETN WALL)	UNSAF-SPD	DYLG	DRY	PD	07-24-85
(70)	OKLAHOMA CITY	I-35															
70	15	00	0673	00000	CONSTRUCTION	NO	W		1		750	F-O(RETN WALL)	FOL-CLOSE	DYRG	DRY	PD	04-22-87
(70)	OKLAHOMA CITY	I-35															
70	15	00	0674	00000		NO	E		1		1000	F-O(GD-RAIL)	NO-IMP-ACT	DYLG	WET	PD	07-17-87
70	15	00	0674	00000		NO	E	E	2	1	2800	FIXED-O(OTHER)	NO-IMP-ACT	DYLG	WET	INJ	07-17-87
(70)	OKLAHOMA CITY	I-35															
70	15	00	0678	00000		NO	E		1		700	F-O(RETN WALL)	UNSAF-SPD	DYLG	WET	PD	06-05-85
(70)	OKLAHOMA CITY	I-35															
70	15	00	0681	00000		NO	W		1		500	F-O(RETN WALL)	UNSAF-SPD	DYLG	DRY	PD	09-09-85
70	15	00	0681	00000		NO	W	W	2		3050	F-O(RETN WALL)	UNSAF-SPD	DYLG	DRY	PD	03-07-86
70	15	00	0681	00000		NO	W	W	2		2850	F-O(RETN WALL)	NO-IMP-ACT	DYLG	WET	PD	04-03-86
70	15	00	0681	00000		NO	E		1	1	1250	F-O(GD-RAIL)	NO-IMP-ACT	DYLG	DRY	INJ	05-19-86
70	15	00	0681	00000	CONSTRUCTION	NO	W		1		400	F-O(RETN WALL)	NO-IMP-ACT	DYLG	WET	PD	07-17-87
(70)	OKLAHOMA CITY	I-35															
70	15	00	0691	00000		NO	W		1	1	2600	F-O(BR PIER)	UNSAF-SPD	LIGHT	DRY	FAT	07-29-86
70	15	00	0691	00000	CONSTRUCTION	NO	W		1	1	2600	F-O(RETN WALL)	IMP-LN-CHG	DYLG	DRY	INJ	12-19-86
70	15	00	0691	00000		NO	E		1		600	F-O(GD-RAIL)	NO-IMP-ACT	DYLG	DRY	PD	12-02-87
(70)	OKLAHOMA CITY	I-35															
70	15	52	0699	00000	RENO AVEC OP BRIDGE	SH-77H	RENO	AVR	OP	*32*							
70	15	52	0699	00000	RENO AVEC OP BRIDGE	NO			1	1	4000	F-O(GD-RAIL)	UNSAF-SPD	DARK	WET	INJ	10-30-87
70	15	52	0699	00000	RENO AVEC OP BRIDGE	NO	S		1		1500	F-O(RETN WALL)	D-W-I	DARK	DRY	FAT	12-13-87
(70)	OKLAHOMA CITY	I-35															
70	15	11	0721	00000		NO	W		1		2500	F-O(GD-RAIL)	NO-IMP-ACT	DARK	WET	PD	12-15-86
(70)	OKLAHOMA CITY	I-40															
70	68	00	0029	00000	N.CANADIAN RI BRIDGE	NO	W		1		2850	F-O(GD-RAIL)	INATT	DARK	DRY	PD	05-04-85
70	68	00	0029	00000	NRCANADIAN RI BRIDGE	NO	W		1		500	F-O(RETN WALL)	NO-IMP-ACT	DYRG	DRY	PD	05-04-85
70	68	00	0029	00000	N.CANADIAN RI BRIDGE	NO	W		1		900	F-O(RETN WALL)	UNSAF-SPD	DYLG	IC-S	PD	11-27-85

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HIGHWAY TABULATION
 ACCIDENT CONCENTRATION LISTING FOR IN-HOUSE USE
 I-40 MAINLINE FIXED OBJECT ACCIDENTS FROM I-44 EAST TO SUNNYLANE

TRAFFIC ENGINEERING DIVISION

04-26-85 THRU 04-26-88

CITY	CS	INT	MI	DIAG	LOCATION	SPECIAL	INT	#	PEOPLE	PROP	TYPE	CAUSE OF	CONDITIONS	DATE				
#	#	POST	CODE	DESCRIPTION	FEATURES	REL	D1	D2	VE	IN-FAT	DMG	ACCIDENT	LIGHT	ROAD	SEV	DATE		
15	68	00	0097	00000			NO	E	1	700	F-O(RETN WALL)	UNSAF-SPD	DYLGT	WET	PD	03-11-86		
(15)	DEL CITY			I-40														
15	68	00	0103	00000			NO	E	1	3500	F-O(RETN WALL) D-W-I		DARK	DRY	PD	01-16-88		
(15)	DEL CITY			I-40														
15	68	00	0104	00000			NO	W	1	2500	FIXED-O(OTHER)	UNSAF-SPD	DYLGT	WET	PD	02-05-86		
(15)	DEL CITY			I-40														
15	68	00	0108	00000			NO	W	1	2500	F-O(RETN WALL)	UNSAF-SPD	DARK	IC-S	PD	12-13-85		
15	68	00	0108	00000	CONSTRUCTION		NO	E	1	2500	F-O(RETN WALL)	UNSAF-SPD	DYLGT	DRY	PD	04-24-86		
(15)	DEL CITY			I-40														
15	68	00	0109	00000			NO	W	1	2	4500	F-O(RETN WALL)	UNSAF-SPD	DYLGT	DRY	INJ	06-30-87	
(15)	DEL CITY			I-40														
15	68	00	0128	00000	CONSTRUCTION		NO	E	1	2500	F-O(RETN WALL) OTHER		DAWN	DRY	PD	08-23-85		
(15)	DEL CITY			I-40														
15	68	00	0152	00000	CONSTRUCTION		NO	W	1	2500	F-O(RETN WALL) UNSAF-SPD		DYLGT	WET	PD	03-11-86		
15	68	00	0152	00000			NO	W	1	3000	F-O(RETN WALL)	UNSAF-SPD	DUSK	WET	PD	03-02-88		
(15)	DEL CITY			I-40														
15	68	50	0162	00000			NO	W	1	760	FIXED-O(OTHER)	DEF-VEH	DYLGT	DRY	PD	02-09-88		
(55)	MIDWEST CITY			I-40														
55	68	50	0201	00000			NO	W	1	700	F-O(RETN WALL)	UNSAF-SPD	DYLGT	WET	PD	05-10-86		
(15)	DEL CITY			I-40														
15	68	50	0203	00000			NO	W	1	1	1000	F-O(RETN WALL) UNSAF-SPD	DYLGT	IC-S	INJ	03-03-88		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0579	00000			NO	E	1	2	1700	F-O(RETN WALL) OTHER	DARK	DRY	INJ	03-23-88		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0584	00000			NO	E	1	8620	F-O(GD-RAIL) D-W-I		DARK	WET	PD	02-26-87		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0587	00000	CONSTRUCTION		NO	E	1	1	1350	FIXED-O(OTHER)	OTHER	LIGHT	DRY	INJ	10-03-87	
(70)	OKLAHOMA CITY			I-40														
70	69	00	0596	00000	CONSTRUCTION		NO	E	1	4250	F-O(RETN WALL) UNSAF-SPD		LIGHT	DRY	PD	09-07-87		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0597	00000	MAY. AVE. O.P. BRIDGE		NO	E	1	1	600	F-O(RETN WALL) DEF-VEH	DYLGT	WET	INJ	10-21-86		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0598	00000			NO	E	1	2500	F-O(RETN WALL) D-W-I		DYLGT	DRY	PD	06-22-86		
70	69	00	0598	00000			NO	W	1	1	3000	F-O(RETN WALL) D-W-I	DYLGT	DRY	INJ	02-04-88		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0607	00000			NO	W	1	900	F-O(RETN WALL) UNSAF-SPD		DYLGT	WET	PD	08-04-85		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0617	00000			NO	W	1	2850	F-O(RETN WALL)	UNSAF-SPD	DYLGT	DRY	PD	01-03-88		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0637	00000			NO	W	W	2	1	1	5900	F-O(RETN WALL) D-W-I	DYLGT	DRY	FAT	12-29-85
70	69	00	0637	00000	CONSTRUCTION		NO	E	1	3000	FIXED-O(OTHER)	UNSAF-SPD	DYLGT	DRY	PD	05-04-87		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0643	00000			NO	E	1	700	F-O(RETN WALL)	UNSAF-SPD	DUSK	WET	PD	07-25-85		
70	69	00	0643	00000			NO	W	1	1500	F-O(RETN WALL)	UNSAF-SPD	DYLGT	IC-S	PD	01-17-87		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0654	00000			NO	E	1	2500	F-O(RETN WALL) UNSAF-SPD		LIGHT	WET	PD	02-08-86		
70	69	00	0654	00000			NO	E	1	1	2600	F-O(RETN WALL) NO-IMP-ACT	DYLGT	DRY	INJ	07-30-86		
(70)	OKLAHOMA CITY			I-40														
70	69	00	0663	00000			NO	W	1	2500	F-O(RETN WALL)	UNSAF-SPD	DYLGT	IC-S	PD	11-02-85		
70	69	00	0663	00000			NO	E	1	1	15100	F-O(RETN WALL)	UNSAF-SPD	DYLGT	DRY	INJ	03-14-86	

OKLAHOMA DEPARTMENT OF TRANSPORTATION

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COUNTY: (55) OKLAHOMA

HIGHWAY TABULATION

ACCIDENT CONCENTRATION LISTING FOR IN-HOUSE USE

I-40 MAINLINE FIXED OBJECT ACCIDENTS FROM I-44 EAST TO SUNNYLANE

TRAFFIC ENGINEERING DIVISION

04-26-85 THRU 04-26-88

CS	INT	MI	OIAG	LOCATION	SPECIAL	INT	#	PEOPLE	PROP	TYPE	CAUSE OF	CONDITIONS					
CITY #	#	POST	CODE	DESCRIPTION	FEATURES	REL	D1	D2	VE	IN-FAT	DMG	ACCIDENT	ACCIDENT	LIGHT	ROAD	SEV	DATE
(70)	OKLAHOMA CITY	I-40															
70	69 00	0669	00000			NO	W		1	1	2600	F-O(RETN WALL)	NO-IMP-ACT	DYLGT	DRY	INJ	08-26-85
(70)	OKLAHOMA CITY	I-40															
70	69 00	0673	00000			NO	W		1	1	2600	F-O(RETN WALL)	NO-IMP-ACT	DARK	DRY	INJ	08-25-85
70	69 00	0673	00000			NO	W		1		900	F-O(RETN WALL)	UNSAF-SPD	DAWN	IC-S	PD	12-10-85
70	69 00	0673	00000			NO	W	W	2	3	2850	F-O(RETN WALL)	IMP-LN-CHG	OYLGT	DRY	INJ	09-19-86
(70)	OKLAHOMA CITY	I-40															
70	69 00	0683	00000			NO	W		1		2500	F-O(RETN WALL)	UNSAF-SPD	DARK	WET	PD	10-17-85
(70)	OKLAHOMA CITY	I-40															
70	69 00	0684	00000			NO	E		1		2500	F-O(RETN WALL)	NO-IMP-ACT	DYLGT	DRY	PD	06-11-85
70	69 00	0684	00000			NO	E		1		750	FIXED-O(OTHER)	NO-IMP-ACT	DAWN	DRY	PD	09-02-87
(70)	OKLAHOMA CITY	I-40															
70	69 00	0694	00000			NO	W	W	2		2600	F-O(RETN WALL)	UNSAF-SPD	DYLGT	WET	PD	09-13-85
70	69 00	0694	00000			NO	E		1		700	F-O(RETN WALL)	UNSAF-SPD	DARK	IC-S	PD	12-10-85
70	69 00	0694	00000			NO	E		1	1	2600	F-O(RETN WALL)	UNSAF-SPD	DYLGT	DRY	INJ	03-23-86
70	69 00	0694	00000			NO	W		1		500	F-O(RETN WALL)	D-W-I	DARK	DRY	PD	04-19-86
70	69 00	0694	00000			NO	W		1	1	2600	F-O(RETN WALL)	UNSAF-SPD	DAWN	IC-S	INJ	12-03-86
70	69 00	0694	00000			NO	W		1	1	2600	F-O(RETN WALL)	UNSAF-SPD	DAWN	IC-S	INJ	12-03-86
70	69 00	0694	00000			NO	E		1		1500	FIXED-O(OTHER)	DEF-VEH	DYLGT	DRY	PD	12-04-87
(70)	OKLAHOMA CITY	I-40															
70	69 00	0698	00000			NO	W		1	1	800	F-O(RETN WALL)	NO-IMP-ACT	DYLGT	IC-S	INJ	11-19-87
(70)	OKLAHOMA CITY	I-40															
70	69 00	0703	00000			NO	W		1		500	F-O(RETN WALL)	UNSAF-SPD	DAWN	WET	PD	04-02-86
(70)	OKLAHOMA CITY	I-40															
70	69 00	0708	00000			NO	W		1		2500	F-O(RETN WALL)	UNSAF-SPD	DYLGT	DRY	PD	07-30-85
(70)	OKLAHOMA CITY	I-40															
70	69 00	0717	00000	VIRGINA/RR OP BRIDGE		NO	W		1		1000	F-O(RETN WALL)	UNSAF-SPD	DYLGT	DRY	PD	04-27-87
(70)	OKLAHOMA CITY	I-40															
70	69 00	0718	00000			NO	W		1		125	F-O(RETN WALL)	NO-IMP-ACT	DYLGT	DRY	PD	03-28-86
(70)	OKLAHOMA CITY	I-40															
70	69 00	0724	00000			NO	W		1		3000	F-O(RETN WALL)	NO-IMP-ACT	LIGHT	WET	PD	03-02-88
(70)	OKLAHOMA CITY	I-40															
70	69 00	0728	00000			NO	W		1		900	F-O(RETN WALL)	NO-IMP-ACT	DYLGT	DRY	PD	02-04-86
(70)	OKLAHOMA CITY	I-40															
70	69 00	0737	00000			NO	W		1		2500	F-O(RETN WALL)	DEF-VEH	DYLGT	DRY	PD	02-25-86
70	69 00	0737	00000			NO	W		1		500	F-O(RETN WALL)	DEF-VEH	DYLGT	DRY	PD	11-07-86
(70)	OKLAHOMA CITY	I-40															
70	69 00	0745	00000			NO	W		1		2000	F-O(RETN WALL)	INATT	DARK	DRY	PD	03-22-87
(70)	OKLAHOMA CITY	I-40															
70	69 00	0747	00000			NO	W		1		2500	F-O(RETN WALL)	NO-IMP-ACT	DYLGT	WET	PD	11-04-86
70	69 00	0747	00000		CONSTRUCTION	NO	N		1	3	8300	F-O(GD-RAIL)	D-W-I	DYLGT	DRY	INJ	07-04-87
70	69 00	0747	00000			NO	W		1	1	2000	F-O(RETN WALL)	UNSAF-SPD	DARK	IC-S	INJ	12-26-87
70	69 00	0747	00000			NO	W		1		400	F-O(RETN WALL)	UNSAF-SPD	DARK	IC-S	PD	12-26-87
(70)	OKLAHOMA CITY	I-40															
70	69 00	0757	00000			NO	W		1		2675	F-O(RETN WALL)	NEG-DRIVING	DYLGT	DRY	PD	05-30-86
(70)	OKLAHOMA CITY	I-40															
70	69 00	0765	00000			NO	E		1		4000	F-O(RETN WALL)	D-W-I	DARK	DRY	PD	01-06-87
(70)	OKLAHOMA CITY	I-40															
70	69 00	0775	00000			NO	W		1		2500	F-O(RETN WALL)	NO-IMP-ACT	DYLGT	DRY	PD	07-18-86
(70)	OKLAHOMA CITY	I-40															

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OKLAHOMA DEPARTMENT OF TRANSPORTATION
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 COUNTY# (55) OKLAHOMA

HIGHWAY TABULATION
 ACCIDENT CONCENTRATION LISTING FOR IN-HOUSE USE
 I-40 MAINLINE FIXED OBJECT ACCIDENTS FROM IN-44 EAST TO SUNNYLANE

TRAFFIC ENGINEERING DIVISION
 04-26-85 THRU 04-26-88

CITY #	CS INT MI # POST	DIAG CODE	LOCATION DESCRIPTION	SPECIAL FEATURES	REL	D1	D2	# PEOPLE IN-FAT	PROP DMG	TYPE ACCIDENT	CAUSE OF ACCIDENT	CONDITIONS LIGHT ROAD	SEV	DATE
70	69 00 0785	00000			NO	W		1	2500	F-O(BR RAIL)	NO-IMP-ACT	OYLG	DRY	PD 07-11-85
70	69 00 0785	00000			NO	E		1 1	2600	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	INJ 07-28-85
70	69 00 0785	00000			NO	W		1	300	F-O(RETN WALL)	OTHER	OYLG	DRY	PD 02-14-86
70	69 00 0785	00000			NO	E		1 1	3900	F-O(GO-RAIL)	UNSAF-SPD	LIGHT	IC-S	INJ 12-27-87
(70)	OKLAHOMA CITY	I-40								RAMP O.P. *75*				
70	69 00 0791	00000	RAMP O.P. *75 BRIDGE		NO	E		1 1	5500	F-O(GD-RAIL)	D-W-I	LIGHT	DRY	INJ 04-26-87
(70)	OKLAHOMA CITY	I-40												
70	69 00 0795	00000			NO	W		1	2500	F-O(RETN WALL)	NO-IMP-ACT	OYLG	DRY	PD 08-23-85
70	69 00 0795	00000			NO	W		1	125	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	PD 11-13-85
70	69 00 0795	00000		CONSTRUCTION	NO	W	E	2 5	39500	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	INJ 05-24-87
70	69 00 0795	00000			NO	W		1	900	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	PD 05-27-87
70	69 00 0795	00000		CONSTRUCTION	NO	W		1	1550	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	PD 06-09-87
70	69 00 0795	00000		CONSTRUCTION	NO	W		1	12000	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	PD 06-19-87
70	69 00 0795	00000		CONSTRUCTION	NO	W		1	100	FIXED-O(OTHER)	NO-IMP-ACT	DARK	WET	PD 07-29-87
70	69 00 0795	00000			NO	W		1	2100	F-O(RETN WALL)	UNSAF-SPD	OYLG	IC-S	PD 12-27-87
(70)	OKLAHOMA CITY	I-40												
70	69 00 0798	00000			NO	E		1	8000	F-O(GD-RAIL)	UNSAF-SPD	DARK	DRY	PD 05-12-87
(70)	OKLAHOMA CITY	I-40												
70	69 00 0801	00000		CONSTRUCTION	NO	W		1 1	500	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	INJ 05-21-87
70	69 00 0801	00000		CONSTRUCTION	NO	W		1	1000	F-O(RETN WALL)	UNSAF-SPD	DARK	WET	PD 05-28-87
(70)	OKLAHOMA CITY	I-40												
70	69 00 0802	00000	BEGIN ELEVATI		NO	E		1	300	F-O(RETN WALL)	UNSAF-SPD	OYLG	DRY	PD 10-07-86
(70)	OKLAHOMA CITY	IG-40												
70	69 00 0806	00000		CONSTRUCTION	NO	W		1 2	5700	F-O(RETN WALL)	D-W-I	DARK	DRY	INJ 07-23-87
(70)	OKLAHOMA CITY	IG-40												
70	69 00 0815	00000			NO	E		1	2300	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	PD 03-17-87
(70)	OKLAHOMA CITY	I-40												
70	69 00 0820	00000			NO	E		1	2500	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	PD 05-26-86
(70)	OKLAHOMA CITY	I-40												
70	69 00 0835	00000			NO	E		1	700	F-O(RETN WALL)	NO-IMP-ACT	OYLG	DRY	PD 07-23-86
(70)	OKLAHOMA CITY	I-40												
70	69 00 0836	00000			NO	W		1	900	F-O(RETN WALL)	DEF-VEH	OYLG	DRY	PD 05-18-86
(70)	OKLAHOMA CITY	I-40												
70	69 00 0840	00000			NO	W		1	2500	F-O(RETN WALL)	NO-IMP-ACT	DARK	DRY	PD 04-19-86
70	69 00 0840	00000			NO	W		1	125	F-O(RETN WALL)	NO-IMP-ACT	OYLG	DRY	PD 10-09-86
70	69 00 0840	00000		CONSTRUCTION	NO	E		1 1	1500	FIXED-ON(OTHER)	UNSAF-SPD	OYLG	DRY	INJ 03-31-87
70	69 00 0840	00000			NO	E		1 1	1000	F-O(RETN WALL)	UNSAF-SPD	DAWN	IC-S	INJ 11-19-87
(70)	OKLAHOMA CITY	I-40												
70	69 00 0850	00000	WALKER O.P. BRIDGE		NO	W		1	1000	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	PD 06-09-87
70	69 00 0850	00000	WALKER O.P. CONSTRUCTION		NO	E		1	2800	F-O(RETN WALL)	DEF-VEH	DARK	DRY	PD 10-15-87
70	69 00 0850	00000	WALKER O.P. CONSTRUCTION		NO	W		1	800	F-O(RETN WALL)	NO-IMP-ACT	OYLG	DRY	PD 11-14-87
(70)	OKLAHOMA CITY	I-40												
70	69 00 0852	00000			NO	E		1	2500	F-O(RETN WALL)	UNSAF-SPD	OYLG	DRY	PD 09-10-86
70	69 00 0852	00000			NO	E		1	1000	F-O(RETN WALL)	UNSAF-SPD	OYLG	DRY	PD 01-24-88
70	69 00 0852	00000			NO	E		1 1	100	F-O(RETN WALL)	NO-IMP-ACT	DARK	DRY	INJ 03-11-88
(70)	OKLAHOMA CITY	I-40												
70	69 00 0853	00000			NO	W		1	2200	F-O(RETN WALL)	NO-IMP-ACT	OYLG	IC-S	PD 12-31-87
(70)	OKLAHOMA CITY	I-40												
70	69 00 0854	00000			NO	E		1	500	F-O(RETN WALL)	UNSAF-SPD	OYLG	WET	PD 07-25-85
70	69 00 0854	00000			NO	E		1	800	F-O(RETN WALL)	UNSAF-SPD	OYLG	IC-S	PD 11-19-87

OKLAHOMA DEPARTMENT OF TRANSPORTATION

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COUNTY (55) OKLAHOMA

HIGHWAY TABULATION

ACCIDENT CONCENTRATION LISTING FOR IN-HOUSE USE

I-40 MAINLINE FIXED OBJECT ACCIDENTS FROM I-44 EAST TO SUNNYLANE

TRAFFIC ENGINEERING DIVISION

04-26-85 THRU 04-26-88

CS	INT	MI	DIAG	LOCATION	SPECIAL	INT	#	PEOPLE	PROP	TYPE	CAUSE OF	CONDITIONS	DATE
CITY #	#	POST	CODE	DESCRIPTION	FEATURES	REL	D1	D2	VE	IN-FAT	DMG	ACCIDENT	LIGHT ROAD SEV
(70)	OKLAHOMA CITY	I-40											
70	69 00	0859	00000			NO	E		1	800	F-0(RETN WALL)	UNSAF-SPD	DYLGT IC-S PD 11-19-87
(70)	OKLAHOMA CITY	I-40											
70	69 54	0875	00000			NO	E		1	500	F-0(RETN WALL)	NO-IMP-ACT	DYLGT DRY PD 08-20-86
70	69 54	0875	00000		CONSTRUCTION	NO	E		1	2000	F-0(RETN WALL)	NO-IMP-ACT	DYLGT WET INJ 02-05-87
70	69 54	0875	00000			NO	E		1	1050	F-0(RETN WALL)	UNSAF-SPD	DYLGT DRY PD 03-31-87
(70)	OKLAHOMA CITY	I-40											
70	69 54	0876	00000			NO	W		1	2675	F-0(RETN WALL)	UNSAF-SPD	LIGHT WET INJ 04-29-85
70	69 54	0876	00000			NO	W		1	2600	F-0(RETN WALL)	D-W-I	DARK DRY INJ 12-31-85
70	69 54	0876	00000			NO	W	W	2	1450	F-0(RETN WALL)	UNSAF-SPD	DYLGT IC-S PD 02-07-86
70	69 54	0876	00000			NO	W		1	2500	F-0(RETN WALL)	UNSAF-SPD	DYLGT DRY PD 10-31-86
70	69 54	0876	00000			NO	W		1	500	F-0(RETN WALL)	DEF-VEH	DYLGT WET PD 11-17-86
70	69 54	0876	00000			NO	W		1	1500	F-0(RETN WALL)	UNSAF-SPD	DAWN IC-S PD 02-07-87
70	69 54	0876	00000		IMPACT ATNU8	NO	E		1	3000	FIXED-O(OTHER)	UNSAF-SPD	DARK WET PD 02-16-87
70	69 00	0876	00000			NO	W		1	150	F-0(RETN WALL)	NO-IMP-ACT	DYLGT DRY INJ 07-02-87
70	69 54	0876	00000			NO	W		1	1500	F-0(RETN WALL)	UNSAF-SPD	DYLGT WET PD 11-18-87
70	69 00	0876	00000			NO	W	W	2	1200	F-0(RETN WALL)	UNSAF-SPD	DYLGT IC-S INJ 02-02-88
70	69 00	0876	00000			NO	W		1	2000	F-0(RETN WALL)	UNSAF-SPD	DYLGT WET PD 04-17-88
(70)	OKLAHOMA CITY	I-40				US-77	ROBINSON	O.P.	F77*				
70	69 54	0879	00000	ROBINSON O.P. BRIDGE		NO	E		1	2050	F-0(RETN WALL)	UNSAF-SPD	DARK IC-S INJ 12-28-87
(70)	OKLAHOMA CITY	I-40											
70	69 00	0886	00000			NO	W	W	2	3400	F-0(RETN WALL)	UNSAF-SPD	DARK IC-S INJ 03-03-88
(70)	OKLAHOMA CITY	I-40											
70	69 00	0920	00000			NO	E		1	800	F-0(RETN WALL)	UNSAF-SPD	LIGHT IC-S INJ 01-15-88
(70)	OKLAHOMA CITY	I-40											
70	69 00	0929	00000			NO	W		1	1000	F-0(RETN WALL)	UNSAF-SPD	DARK IC-S PD 02-07-87
(70)	OKLAHOMA CITY	I-40											
70	69 00	0949	00000			NO	E		1	2600	F-0(RETN WALL)	DEF-VEH	DYLGT DRY INJ 10-13-86
70	69 00	0949	00000		CONSTRUCTION	NO	E		1	1750	F-0(BARRIER)	UNSAF-SPD	DARK DRY PD 06-22-87
(70)	OKLAHOMA CITY	I-40											
70	69 00	0971	00000			NO	W		1	400	F-0(RETN WALL)	UNSAF-SPD	DARK IC-S PD 12-25-87
(70)	OKLAHOMA CITY	I-40											
70	69 00	0980	00000		CONSTRUCTION	NO	E		1	1500	F-0(RETN WALL)	UNSAF-SPD	LIGHT DRY INJ 05-12-87
(70)	OKLAHOMA CITY	I-40											
70	69 53	0989	00000			NO	E		1	675	F-0(GD-RAIL)	DEF-VEH	DYLGT DRY PD 07-16-86
(70)	OKLAHOMA CITY	I-40											
70	69 53	0999	00000			NO	W		1	900	F-0(RETN WALL)	D-W-I	DARK IC-S PD 02-09-86
70	69 00	0991	00000		CONSTRUCTION	NO	W		1	8000	F-0(RETN WALL)	D-W-I	DARK DRY PD 02-13-87
(70)	OKLAHOMA CITY	I-40											
70	69 10	0994	00000		CONSTRUCTION	NO	W		1	2850	FIXED-O(OTHER)	DEF-VEH	DYLGT DRY INJ 06-09-86
70	69 10	0994	00000		CONSTRUCTION	NO	E		1	6400	F-0(RETN WALL)	D-W-I	DARK DRY INJ 09-01-87
(70)	OKLAHOMA CITY	I-40											
70	69 00	0999	00000	MILE 151	CONSTRUCTION	NO	W		1	3070	F-0(GD-RAIL)	UNSAF-SPD	DYLGT WET INJ 06-19-87
(70)	OKLAHOMA CITY	I-40											
70	69 00	1002	00000			NO	E	E	2	2850	F-0(RETN WALL)	UNSAF-SPD	DARK WET PD 08-23-85
(70)	OKLAHOMA CITY	I-40											
70	69 00	1012	00000		CONSTRUCTION	NO	E		1	2000	FIXED-O(OTHER)	D-W-I	DARK DRY INJ 06-22-87
(70)	OKLAHOMA CITY	I-40											
70	69 00	1020	00000		CONSTRUCTION	NO	E		1	1000	F-0(RETN WALL)	UNSAF-SPD	DYLGT WET PD 07-17-87

OKLAHOMA DEPARTMENT OF TRANSPORTATION

ANAL010.PRINT

COUNTY: (55) OKLAHOMA

HIGHWAY TABULATION

ACCIDENT CONCENTRATION LISTING FOR IN-HOUSE USE

I-40 MAINLINE FIXED OBJECT ACCIDENTS FROM I-44 EAST TO SUNNYLANE

TRAFFIC ENGINEERING DIVISION

04-25-82 THRU 04-25-85

CITY #	CS	INT MI	DIAG	LOCATION	SPECIAL	INT	#	PEOPLE	PROP	TYPE	CAUSE OF	CONDITIONS	DATE
		# POST	CODE	DESCRIPTION	FEATURES	REL D1 D2	VE	IN-FAT	DMG	ACCIDENT	ACCIDENT	LIGHT ROAD SEV	
(70) OKLAHOMA CITY	I-40												
70	69 53	0986	00000			NO E	1	1	875	F-0(GD-RAIL)	NO-IMP-ACT	DARK DRY	INJ 07-11-83
(70) OKLAHOMA CITY	I-40												
70	69 00	0989	00000			NO W	1		700	F-0(RETN WALL)	UNSAF-SPD	LIGHT WET	PD 05-17-83
(70) OKLAHOMA CITY	I-40												
70	69 00	0994	00000			NO E	1	1	2600	FIXED-O(OTHER)	D-W-I	DARK DRY	INJ 02-04-84
70	69 00	0994	00000			NO W	1		2500	F-0(RETN WALL)	UNSAF-SPD	LIGHT DRY	PD 03-29-84
(70) OKLAHOMA CITY	I-40												
70	69 00	0998	00000			NO W	1		500	F-0(RETN WALL)	UNSAF-SPD	DYLGIC-S	PD 12-04-83
(70) OKLAHOMA CITY	I-40												
70	69 00	1001	00000			NO E	1		3050	F-0(GD-RAIL)	UNSAF-SPD	DYLGIC-S	PD 03-10-84

TABULATION OF ACCIDENT DATA FROM 04-26-85 TO 04-26-88
I-40 MAINLINE FIXED OBJECT ACCIDENTS FROM I-44 EAST TO SUNNYLANE

RUN DATE 01/19/89
STUDY LENGTH : .00

ACCIDENT SEVERITY

	1985				1986				1987				1988				1989			
	FAT	INJ	P-D	TOTAL	FAT	INJ	P-D	TOTAL	FAT	INJ	P-D	TOTAL	FAT	INJ	P-D	TOTAL	FAT	INJ	P-D	TOTAL
ACCIDENTS	1	9	31	41	1	16	49	66	1	24	44	69		7	9	16				
PERSONS	1	11		12	1	20		21	1	34		35		10		10				

STUDY TOTAL (SEVERITY)				
ACCIDENTS	FATAL	INJURY	PROPERTY DAMAGE	TOTAL
PERSONS	3	56	133	192
	3	75		78

ACCIDENT TYPE & DAMAGE CAUSED

COLLISION TYPE	1985				1986				1987				1988				1989			
	FAT	INJ	P-D	TOTAL	FAT	INJ	P-D	TOTAL	FAT	INJ	P-D	TOTAL	FAT	INJ	P-D	TOTAL	FAT	INJ	P-D	TOTAL
OVR-TRN(IN-RD)																				
PEDESTRIAN																				
PARKED-VEHICLE																				
RAILROAD-TRAIN																				
ANIMAL																				
FIXED-OBJECT	1	9	31	41	1	16	49	66	1	24	44	69		7	9	16				
RAN-OFFROAD																				
S-S(SAME-DIR)																				
REAR-END																				
HEAD-ON																				
S-S(OPP-DIR)																				
ANGLE(TURN)I																				
ANGLE(TURN)NI																				
ANGLE(I)																				
ANGLE(NIA)																				
OTHER																				
TOTAL(P.D.A)	\$79,275				\$137,875				\$208,990				\$34,510							

STUDY TOTAL (ACCIDENT TYPE)

	FATAL	PERCENT	INJURY	PERCENT	PROPERTY DAMAGE	PERCENT	TOTAL	PERCENT
OVR-TRN(IN-RD)								
PEDESTRIAN								
PARKED-VEHICLE								
RAILROAD-TRAIN								
ANIMAL								
FIXED-OBJECT	3	100.0	56	100.0	133	100.0	192	100.0
RAN-OFF-ROAD								
S-S(SAME-DIR)								
REAR-END								
HEAD-ON								
S-S(OPP-DIR)								
ANGLE(TURN)I								
ANGLE(TURN)NI								
ANGLE(I)								
ANGLE(NIA)								
OTHER								
TOTAL	3	100.0	56	100.0	133	100.0	192	100.0

STUDY TOTAL (DAMAGE CAUSED) \$460,650

TABULATION OF ACCIDENT DATA FROM 04-26-85 TO 04-26-88
I-40 MAINLINE FIXED OBJECT ACCIDENTS FROM I-44 EAST TO SUNNYLANE

RUN DATEN 01/19/89
STUDY LENGTH : .00

SPEED CONDITIONS

TYPE OF VEHICLE	OPERATING SPEED										TOTAL	PERCENT
	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+	UNKNOWN		
SINGLE UNIT (NORMAL)	5	11	17	23	52	59	15	3	1		186	88.1
SINGLE UNIT (LARGE)	1	1	2		1	1					6	2.8
DUAL UNIT			1	3	6	9					19	9.0
OTHER												
TOTAL	6	12	20	26	59	69	15	3	1		211	100.0
PERCENT	2.8	5.6	9.4	12.3	27.9	32.7	7.1	1.4	.4		100.0	

ACCIDENT OCCURRENCE

DAY	HOUR OF THE DAY																								TOTAL	PERCENT	
	-AM-												-PM-														
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	PERCENT	
MON	1				2	2	2	1	1	1	1	1		1	1	3		4	1	1			1	1	25	13.0	
TUE	1				1	3	1	4	1	1	1	1			1	3	5	1		1	2	2	2		31	16.1	
WED						7	1	2	2		1	1		3	6		2	1	1	2					29	15.1	
THU			1	1		1	3	4	1	1	1	3			1	1	2		3			2	1	1	27	14.0	
FRI			1		1	4		3	3		4	1	2	3	2	1	6	1				2	2		36	18.7	
SAT		2	2		1	1	2	1	1	2	1		1		1		1		2	1		2	2	1	24	12.5	
SUN	1	2		1	1				2	3	2	1	1			2			1		1		2		20	10.4	
	EARLY MORNING-SUNRISE					MORNING PEAK					MID MORNING-MID AFTERNOON					AFTERNOON PEAK					EVENING-LATE NIGHT					TOTAL	100.0
TOTAL	37					35					53					30					37					192	
PERCENT	19.2					18.2					27.6					15.6					19.2					100	

POTENTIAL INFLUENCING CONDITIONS

ROADWAY CONDITIONS	LIGHTING CONDITIONS					TOTAL	PERCENT
	DAYLIGHT	DARKNESS	TWILIGHT	LIGHTED	UNKNOWN		
DRY	66	23	3	5		97	50.5
WET/WATERN	33	13	4	4		54	28.1
WET (ICE OR SNOW)	18	14	6	2		40	20.8
MUDDY							
NOT REPORTED		1				1	.5
TOTAL	117	51	13	11		192	100.0
PERCENT	60.9	26.5	6.7	5.7		100	

WEATHER CONDITIONS	TOTAL	PERCENT
CLEAR	63	32.8
PARTLY CLOUDY	48	25.0
OVERCAST	23	11.9
RAINING	44	22.9
OTHER	14	7.2
TOTAL	192	100.0

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TABULATION OF ACCIDENT DATA FROM 04-26-85 TO 04-26-88

RUN DATE: 01/19/89

I-40 MAINLINE FIXED OBJECT ACCIDENTS FROM I-44 EAST TO SUNNYLANE

STUDY LENGTH : .00

CAUSE OF ACCIDENT	OFFENDING DRIVERS CONDITION																		ACCIDENT SEVERITY				
	APPARENTLY NORMAL			ALCOHOL INVOLVED						SLEEP SUSPECTED			PHYSICAL DEFECT			OTHER CONDITION							
				ABILITY IMPAIRED			ODOR DETECTED																
	FAT	INJ	P-D	FAT	INJ	P-D	FAT	INJ	P-D	FAT	INJ	P-D	FAT	INJ	P-D	FAT	INJ	P-D	FAT	INJ	P-D	TOTAL	PCT
F-YIELD																							
F-STOP																							
F-SIGNAL																							
IMP-TURN																							
IMP-START																							
IMP-STOP																							
IMP-BACK																							
IMP-PARK																							
IMP-PASS																							
IMP-LN-CHG		1						1												2		2	1.0
L-CENTER																							
FOL-CLOSE			2																		2	2	1.0
UNSAF-SPD		25	67			1	1	3	3								9	1	28	80	109	56.7	
O-W-I				2	8	8											1	2	9	8	19	9.8	
INATT									1			1		1	1				1	3	4	2.0	
NEG-ORVING			1																	1	1	.5	
DEF-VEH		4	7															1		4	8	12	6.2
WRNG-WAY																							
NO-IMP-ACT		7	26											1			1	2		9	28	37	19.2
OTHER		1	3					1						1						3	3	6	3.1
TOTAL		38	106	2	8	9	1	5	4			1		3	1		2	12	3	56	133	192	100.0
PERCENT		19.7	55.2	1.0	4.1	4.6	.5	2.6	2.0			.5		1.5	.5		1.0	6.2	1.5	29.1	69.2	100	

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APPENDIX D

ODOT SPECIAL PROVISION
March 28, 1984

OKLAHOMA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
FOR
EXPERIMENTAL SAFETY BARRIER END TREATMENT
(SENTRE)
ON
FEDERAL AID PROJECT IR-40-4(304)147
OKLAHOMA COUNTY

These Special Provisions revise, amend, and where in conflict supersede applicable Sections of Standard Specifications for Highway Construction Edition of 1976.

DESCRIPTION The SENTRE unit shall consist of interlocking collapsible three beam fender panels, wide flange posts, slip bases, sand containers, and a redirecting cable. These components shall form a crashworthy end treatment which shall meet the minimum test requirement specified in the National Cooperative Highway Research Program (NCHRP) report 2302.

1. Impact at 25 degrees into the beginning of length of need (i.e., beginning of tensioned guardrail and/or concrete parapet) at 60 mph with a 4500 lb. car.
2. Impact at 0 degrees into center nose of the device (0" offset from centerline of vehicle) at 60 mph with a 4500 lb. car.
3. Impact at 15 degrees into side of the device midway between nose and beginning of length of need at 60 mph with an 1800 lb. car.
4. Impact at 0 degrees into nose of the device (with 1.25 ft offset from centerline of vehicle) at 60 mph with an 1800 lb. car.

When hit head-on, the unit shall be capable of simultaneously collapsing and moving laterally to re-direct an impacting vehicle away from the end of the downstream traffic barrier.

The redirecting cable shall be anchored at both ends with anchors that are capable of withstanding a minimum pullout force of 50,000 lbs.

The base plate of each SENTRE post shall be rigidly held in place by anchors that are capable of withstanding a 15,000 lb. shear and 26,500 ft-lbs moment in the longitudinal axis of the SENTRE and 27,000 lb. shear and 49,500 ft-lbs of moment in the lateral axis of the SENTRE.

MATERIALS (a) General. All SENTRE components shall be assembled in accordance with the manufacturer's standards and requirements.

1. Fender Panels The fender panels shall be fabricated from 10 gauge steel triple corrugated guardrail sections which meet AASHTO Guide M-180 specifications. Each fender panel shall

be drilled and slotted in accordance with the manufacturer's specifications. When assembled in the field, all fender panels shall be bolted to a break away post by means of two bolts. The back end of each triple corrugated fender panel shall overlap and be connected to the fender panel of the next bay by means of a bolt and mushroom washer which fits through the long horizontal slot in the forward fender panel and the short vertical slot in the underlying panels. This connection method shall permit movement, front to back, of one set of fender panels relative to the panels in the underlying section.

2. Redirecting Cables. The front post of the SENTRE shall have one 7/8" diameter, 6 x 19 galvanized steel wire rope passing through it. The wire rope material shall be made from improved plow steel with a minimum load limit of 71,200 lbs.

3. Sand Containers. The front three posts shall be fitted with sand containers which hold either 100 or 150 pounds of sand. Two small (100 pound) sand containers shall be fastened to each of the front two posts. Two large (150 pound) sand containers shall be fastened to the third posts. The sand containers shall be molded from a black plastic having sufficient U.V. stabilizers and anti-oxidants to provide good weatherability. Each sand container shall have a hinged plastic lid which snaps firmly in place after the containers have been filled with sand. Sand mass for the containers shall meet the requirements of Subsection 701.05 and shall contain not more than two percent moisture by dry weight of the aggregate at the time of placement.

4. Nose Cover. The front of the SENTRE shall be fitted with a grey plastic "bull nose". The nose shall be molded from a plastic having sufficient U.V. stabilizers and anti-oxidants to provide good weatherability. The nose shall interface to the front triple corrugated fender panel. The nose shall have a flat surface on its forward section which shall be suitable for mounting reflective sheeting.

5. Fasteners. All bolts, nuts and washers used to assemble the SENTRE shall be zinc coated, commercial quality "American National Standard" unless otherwise specified.

6. Metal Work. All metal work shall be fabricated from either M1020 Merchant Quality or ASTM A-36 steel. After fabrication, all metal work shall be hot dipped galvanized in accordance with ASTM A-123. All welding shall be done by or under the direction of a certified welder.

(b) Materials Certification. A type "D" Materials Certification shall be required in accordance with Subsection 106.12.

CONSTRUCTION METHODS. Installation of the SENTRE shall be accomplished by experienced workmen in accordance with the recommendations of the manufacturer. As a replacement supply, the Contractor shall furnish a spare parts package. The quantity and materials of this package will be as shown on the Plans. These unassembled materials will become the property of the Oklahoma

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Department of Transportation and shall be delivered to the Department Warehouse designated by the Engineers

METHOD OF MEASUREMENTs Each SENTRE installation will be measured by the unit for each installation as shown on the Planss Replacement packages will be measured by the unit delivered to the designated warehouse in accordance with these Specificationss

BASIS OF PAYMENTs Accepted SENTRE and replacement packages, measured as provided above, will be paid for at the contract unit price for

SPs	SAFETY BARRIER END TREATMENT (SENTRE)	EA.
SPo	SAFETY BARRIER END TREATMENT (SENTRE) & (REPLACEMENT PACKAGE)	EA.

which shall be full compensation for furnishing all containers, guardrailss postss and all other materials, equipments labor and incidentals to complete the work as specified.