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SENTRE AND TREND ATTENUATOR FIELD INSTALLATIONS

Construction Report

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16. Abstract

Arizona's canal network is extensive and necessitates the existence of many short bridges on the highway network. The necessity for maintaining access to adjacent canal roads dictates that any barrier installation intended to shield errant vehicles from the bridge rail hazard must fit within the limited space between the bridge end and the canal road. The available space for such an installation is often less than 35 feet.

Energy Absorption Systems, Inc. (EASI) has developed two similar attenuating end terminals, the SENTRE system and the TREND system, for use in such limited space applications. EASI has demonstrated that both their TREND and SENTRE systems meet the dynamic performance requirements set forth in NCHRP-230. The conclusion that these systems conform to dynamic performance specifications is based on full scale crash testing. The length of time, however, that these devices have been formally monitored on highways is not sufficient for validating the adequacy of in-service performance.

The objective of this research effort is to evaluate the in-service performance of the TREND and SENTRE attenuator systems when installed on appropriate ADOT projects. Two construction projects, both involving canal bridge rail modification, were selected for test installations. This research effort embraces two separate experimental projects, and hence two experimental project numbers. The SENTRE system was installed and reported to the FHWA as Experimental Project Number AZ-8802 and the TREND system was installed and reported to the FHWA as Experimental Project Number AZ-8803.

At the time that the TREND and SENTRE projects were constructed, both systems were classified as Experimental by the FHWA. Although the SENTRE attenuator has since been upgraded to Operational status, both installations will continue to be evaluated for the full two year evaluation period specified in the original workplan. Upon completion of the evaluation period a Final Report will be prepared which contains all in service performance data.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

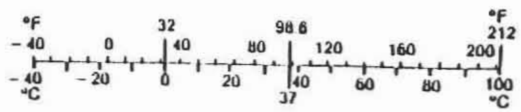
Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
in	inches	25.4	millimetres	mm
ft	feet	0.305	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km
	AREA			
in^2	square inches	645.2	millimetres squared	mm^2
ft^2	square feet	0.093	metres squared	m^2
yd^2	square yards	0.836	metres squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometres squared	km^2
	VOLUME			
fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft^3	cubic feet	0.028	metres cubed	m^3
yd^3	cubic yards	0.765	metres cubed	m^3

NOTE: Volumes greater than 1000 L shall be shown in m^3.

Symbol	When You Know	Multiply By	To Find	Symbol
	MASS			
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5(F-32)/9	Celcius temperature	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi
	AREA			
mm^2	millimetres squared	0.0016	square inches	in^2
m^2	metres squared	10.764	square feet	ft^2
ha	hectares	2.47	acres	ac
km^2	kilometres squared	0.386	square miles	mi^2
	VOLUME			
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m^3	metres cubed	35.315	cubic feet	ft^3
m^3	metres cubed	1.308	cubic yards	yd^3
	MASS			
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
	TEMPERATURE (exact)			
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F



* SI is the symbol for the International System of Measurement

(Revised April 1989)

TABLE OF CONTENTS

INTRODUCTION 1
  Background 1
    Roadside Barrier Elements 1
    Roadside Barrier Service Requirements 1
    Barrier Classification 1
  Problem Statement 2
    ADOT Standard End Treatments 2
    Limited Space Available for Barrier System 3
    Alternate End Treatment 3
    FHWA Approved on Experimental Basis 6
  Objectives 6
    Field Installation 6
    In-Service Evaluation 6
PROJECT LOCATION AND DESCRIPTION 6
  AZ-8802: SENTRE Attenuator Field Installation 6
    Accident History 7
  AZ-8803: TREND Attenuator Field Installation 8
    Accident History 8
CONSTRUCTION PLANS 8
MATERIALS TESTING 8
DESIGN 8
    Requirements 8
    Barrier Design 9
CONSTRUCTION 9
  General Activity Description 9
    Traffic Control 9
    Concrete Footings 9
    SENTRE Transition Segment 10
    Base Plates 10
    Panel Support Posts 10
    Thrie Beam Panels and Sand Containers 13
    SENTRE Splice to Transition Segment 13
    TREND Splice to Concrete Parapet Wall 14
    Redirecting Cable 15
    Completed Systems 15
  Economics 17
    Construction Costs - Alternates vs. SENTRE and TREND 17
    Cost Analysis 17
PRELIMINARY EVALUATION 18
  Concerns and Potential Problems 18
  Conclusions 19
REFERENCES 20

TABLE OF CONTENTS (continued)

APPENDIX A - CURRENT ADOT STANDARD DETAILS A1
APPENDIX B - EASI TECHNICAL DISCUSSION B1
APPENDIX C - FHWA APPROVED WORKPLAN C1
APPENDIX D - CONSTRUCTION PLANS FOR AZ-8802 (SENTRE) D1
APPENDIX E - CONSTRUCTION PLANS FOR AZ-8803 (TREND) E1

LIST OF FIGURES

Figure 1	Breakaway Cable Terminal (BCT)	2
Figure 2	Standard Attenuator Assembly	2
Figure 3	Canal Road Access to be Maintained	4
Figure 4	Full LON Segment is Provided	4
Figure 5	The SENTRE Attenuator System	5
Figure 6	The TREND Attenuator System	5
Figure 7	AZ-8802 - SENTRE Attenuator Installation Site	7
Figure 8	AZ-8803 - TREND Attenuator Installation Site	7
Figure 9	SENTRE Concrete Footing	10
Figure 10	SENTRE Transition Segment	10
Figure 11	Drilling Bolt Hole	11
Figure 12	Pouring Epoxy into Bolt Hole	12
Figure 13	Base Plate Hardware	12
Figure 14	Hole at Bottom of Post 1	12
Figure 15	Mushroom Bolt Assembly	13
Figure 16	Sand Container Configuration	13
Figure 17	Special Downstream Splice	14
Figure 18	Proper Upstream Splice	14
Figure 19	Bracket Attaching TREND to Front of Concrete Parapet Wall	15
Figure 20	Attachment of TREND Backstrap to Back of Concrete Parapet Wall	15
Figure 21	Front Anchor of Redirection Cable	16
Figure 22	Rear Anchor of Redirection Cable	16
Figure 23	Completed SENTRE	16
Figure 24	Completed TREND	17
Figure 25	Panel Lap is a Concern on Departure Side	19

INTRODUCTION

Background

Roadside Barrier Elements

Roadside barriers are highway appurtenances used to prevent vehicles from impacting rigid or otherwise dangerous objects located within an established clear zone along a highway border. These longitudinal barrier elements are designed to intercept and safely redirect errant vehicles away from all potential hazards. Since roadside barriers will themselves be impacted by errant vehicles, they are warranted only when their inclusion is expected to reduce the severity of a potential accident at the installed location.

The total longitudinal barrier length required for shielding roadside hazards is called the *length-of-need* (LON) and generally consists of a long standard guardrail section with a short transition section near rigid objects. When the end of a roadside barrier falls within the clear zone a crashworthy end terminal is installed.

Roadside Barrier Service Requirements

The criteria by which roadside barriers are evaluated are delineated in the National Cooperative Highway Research Program report numbered 230 (NCHRP-230), *RECOMMENDED PROCEDURES FOR THE SAFETY PERFORMANCE EVALUATION OF HIGHWAY APPURTENANCES*[1]. This report, published in 1981, is an expansion on previous publications[2,3,4,5,6] dating back to 1972; however, the qualitative performance criteria has changed very little from report to report. The order of priorities in roadside barrier design is safety first and economics second.

The dynamic performance of a roadside barrier system determines the safety of that system. The primary measurements of dynamic performance are structural integrity, vehicle deceleration, and vehicle postimpact trajectory. The structural integrity of a barrier system is determined by its ability, in terms of strength and geometry only, to restrain vehicles in a predictable and acceptable manner. Furthermore, vehicle deceleration levels should be minimized in order to reduce the magnitude of interior compartment impact forces imparted on vehicle occupants. Finally, redirected vehicles should not have postimpact trajectories in the direction of traffic regardless of the initial angle of impact.

While satisfaction of dynamic performance requirements is the first consideration when selecting a barrier system, the optimal system is the one offering the greatest safety at the least cost. In addition to the first cost for the actual barrier system, other costs to be considered are system installation, routine maintenance and damage repair. These costs can be estimated with varying accuracies to arrive at an economic measure for comparing different systems that satisfy dynamic performance requirements.

Barrier Classification

The AASHTO *GUIDE FOR SELECTING, LOCATING, AND DESIGNING TRAFFIC BARRIERS*[2] outlines three different stages of roadside barrier development. An *operational barrier system* is one which has performed satisfactorily in full scale crash tests and has demonstrated satisfactory in-service performance. Determination of satisfactory performance was somewhat subjective in the past; however, the standardization of crash testing and performance evaluation provided by NCHRP-230 has introduced objectivity into barrier classification. An *experimental barrier system* is one which has performed satisfactorily in full scale crash tests and shows promise for satisfactory in-service performance. This classification implies that a barrier system has performed adequately under controlled conditions and will be classified as operational only after a historical data base showing adequate performance in an uncontrolled environment is established. An *R & D barrier system* is one for which an insufficient amount of both crash testing and in-service performance evaluation exists. No conclusions, positive or negative, can be drawn about this type of system.

In order to qualify for federal funding on any construction project involving the installation of a barrier system classified as experimental by the FHWA, the responsible agency must agree to monitor and report on the performance of that barrier in-service for a prescribed period of time. The data collected from the performance of that barrier is then used by the FHWA in conjunction with data from numerous other projects nationwide to determine whether or not the system should be upgraded to an operational status. When a barrier system is already classified as operational, or when the project on which it is installed does not involve federal funds, no formal monitoring is required by the FHWA.

Problem Statement

ADOT Standard End Treatments

Although proprietary systems have been used in the past, ADOT currently has only two standard end treatment designs. The two systems used are the standard Breakaway Cable Terminal (BCT) and the standard Attenuator Assembly. Figures 1 and 2 below show these two systems. Typical ADOT details for both of these assemblies are contained in Appendix A of this report.

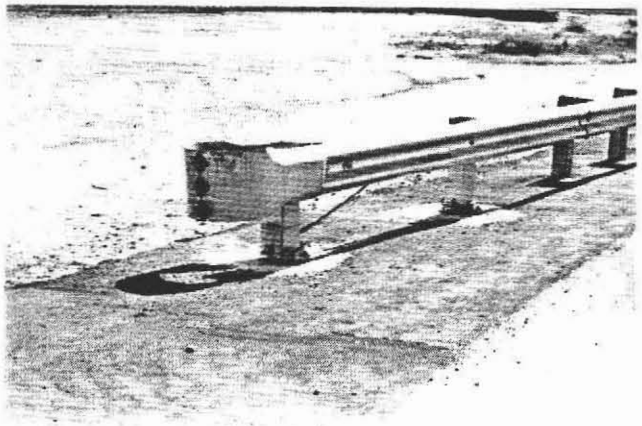


Figure 1 Breakaway Cable Terminal (BCT)

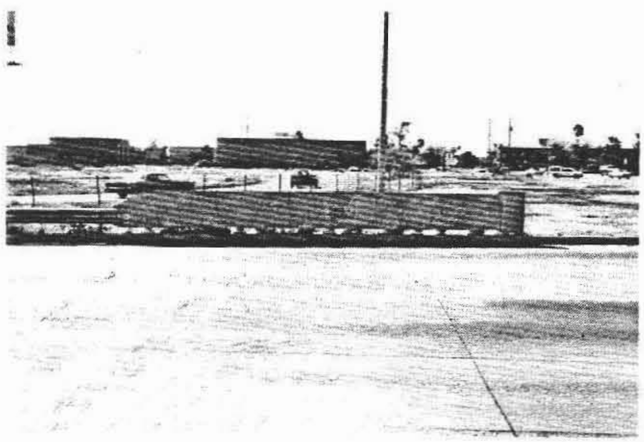


Figure 2 Standard Attenuator Assembly

The BCT is a guardrail end treatment which provides the end anchorage required for developing redirective forces when hit laterally as opposed to end-on. The standard attenuator assembly, often used as a median barrier, incorporates standard BCT features while providing intentional attenuating capability when impacted end-on. The standard BCT was recommended for field installation in NCHRP report number 129[5]. A system similar to ADOT's standard attenuator assembly was introduced in Transportation Research Record (TRR) report number 488[6]. These reports discuss the respective results of crash testing performed on each of these systems in the early 70's. Both the BCT and the attenuator assembly systems appear to have performed in a crashworthy manner although the criteria subsequently outlined in NCHRP-230 is not addressed directly.

Typical details similar to those contained in Appendix A have existed and been used regularly on ADOT projects since approximately 1974; however, no formal data base has been established to support any conclusions about the in-service performance of either system. Regardless of this fact, both systems are considered operational when used in conjunction with other appropriate roadside barrier elements so that dynamic performance requirements are predicted to be satisfied.

Limited Space Available for Barrier System

Arizona's canal network is extensive and necessitates the existence of many short bridges on the highway network. The necessity to maintain access to utility roads adjacent to the canals creates a condition requiring a modified approach to bridge rail protection. Figure 3 shows a typical canal access road and the limited space available for installation of a roadside barrier.

Longitudinal rail elements typically used on canal bridges consist of concrete parapet walls or other rigid guardrail type barriers. An appropriate barrier configuration for shielding both the rigid bridge rail and the canal would consist of a several hundred foot long LON guardrail segment with an increasingly stiff transition segment near the bridge end and a standard BCT on the terminating end. Figure 4 shows this full LON configuration used on a bridge very similar to the type used at a canal crossing except that in this instance their is no canal road to consider.

The necessity for maintaining canal road access dictates that any barrier installation intended to shield errant vehicles from the bridge rail hazard must fit within the limited space between the bridge end and the canal road. The available space for such an installation is often less than 35'. While this design constraint precludes provision of the full LON segment, the necessity for providing some type of safety appurtenance meeting the stated dynamic performance requirements still remains.

One approach to this problem is to forgo attempts at shielding the hazard of the canal itself and to concentrate on shielding only the rigid bridge rail. A short longitudinal barrier installed between the bridge and the canal road capable of safely slowing an impacting vehicle while redirecting it away from the rigid bridge rail, but not into the highway or canal, would be acceptable.

Alternate End Treatment

According to one safety barrier manufacturer, a device satisfying the requirements as stated does exist. Energy Absorption Systems, Inc. (EASI) has developed two similar barrier end terminals which function as both a transition section and an attenuating end treatment. These two end terminals are the TREND which stands for TRansition END treatment, and the SENTRE which stands for Safety barrier ENd TREatment. The systems are essentially the same except for the different type of rigid barrier, or bridge rail in this case, that they are expected to shield. Aside from the different rigid barrier elements that the two systems tie into, both systems consist of the same components and behave in the same manner. EASI drawings of the SENTRE and TREND are shown in Figures 5 and 6 respectively.

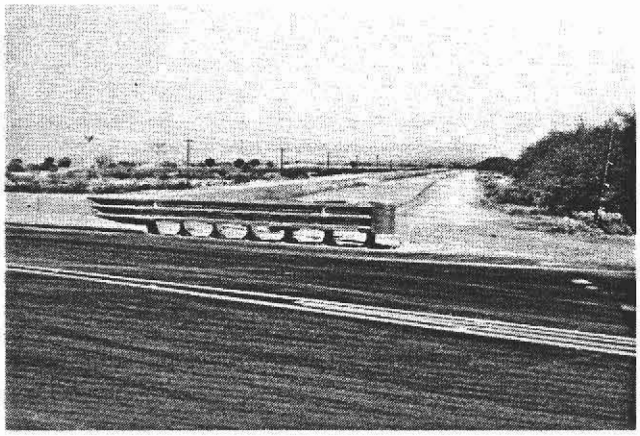


Figure 3 Canal Road Access to be Maintained

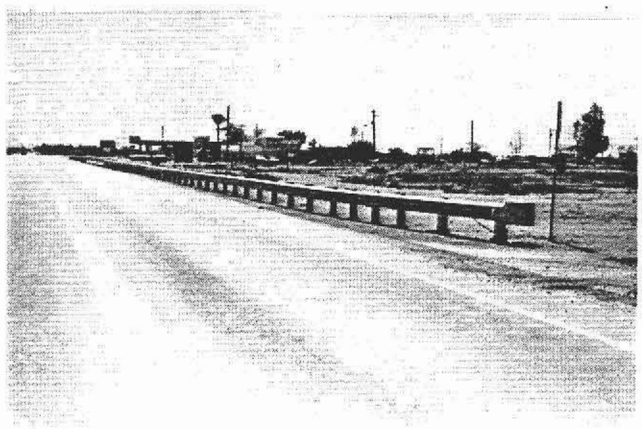


Figure 4 Full LON Segment is Provided

The physical composition common to both systems is as stated in literature supplied by EASI[7,8] and summarized below. The SENTRE has five nested overlapping thrie beam panels supported on vertical posts which are positioned on slip bases. For the TREND, there are six of these panels. Slip bases consist of a top plate welded to the vertical support post and a bottom plate anchored in a concrete footing. Both the top and bottom plates have open ended slots to accommodate bolting together in a controlled breakaway manner. Subsequent to end-on vehicle impact, the support posts will successively breakaway at the base level and progress rearward causing the attached fender panels to collapse in a telescoping manner. The first three posts include sand containers of sufficient mass to dissipate the kinetic energy not removed by the slip bases as they overcome frictional forces and separate. The first support post is also connected to a redirecting cable which will guide vehicles away from the hard point of the rigid barrier being shielded. The description provided here is rudimentary and the manufacture's much more detailed technical discussion is contained in Appendix B of this report.

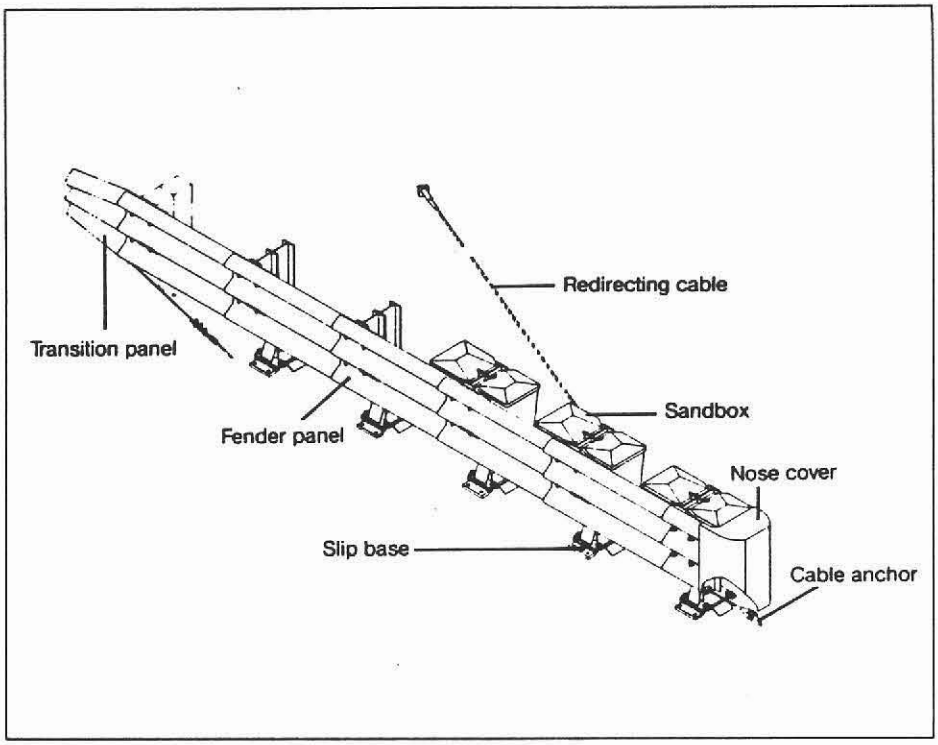


Figure 5 The SENTRE Attenuator System

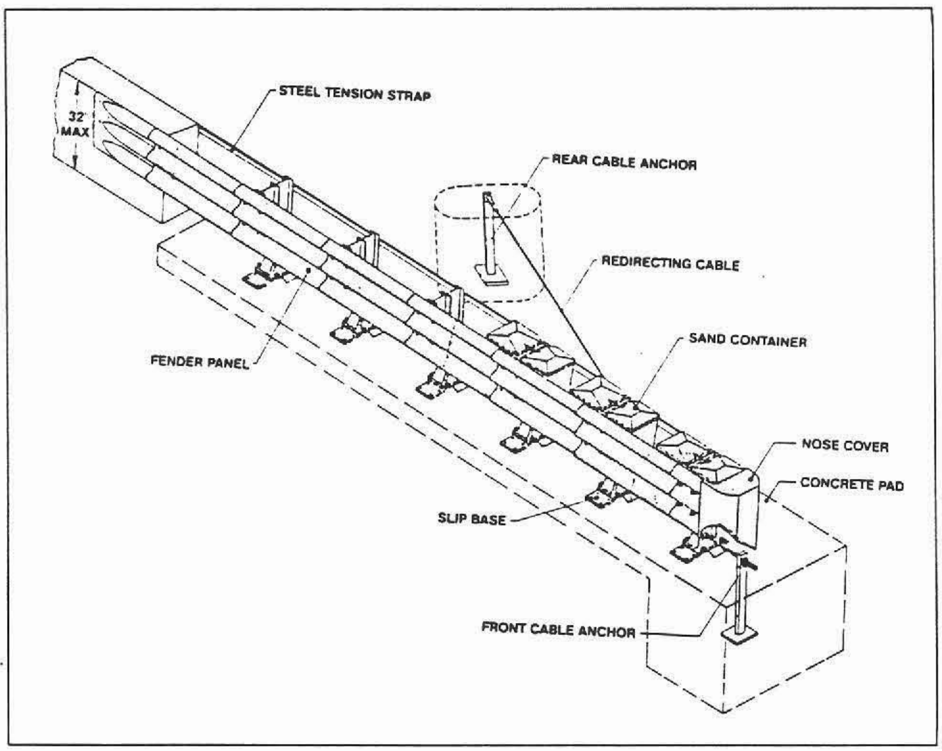


Figure 6 The TREND Attenuator System

FHWA Approved on Experimental Basis

EASI prepared two certification reports[7,8] supporting their pronouncement that both the TREND and SENTRE systems meet the dynamic performance requirements set forth in NCHRP-230. Based on the reported full scale crash test results, the FHWA agreed that these systems do conform to dynamic performance specifications; however, niether of these devices had been formally monitored for a sufficient period of time to validate the adequacy of in-service performance. As a result, at the onset of this experimental effort, the TREND and SENTRE attenuator systems were approved by the FHWA on an experimental basis only.

Objectives

Field Installation

The objective of this research effort is to evaluate the in-service performance of the TREND and SENTRE attenuator systems when installed on appropriate ADOT projects. Two construction projects, both involving canal bridge rail modification, were selected for test installations. The TREND system was installed on a project where a concrete parapet type bridge rail was constructed. The SENTRE system was installed on a different project where a tubular thrie beam bridge rail was constructed.

In-Service Evaluation

Installations at both these project locations will be evaluated in accordance with the procedures for in-service evaluation as presented in NCHRP-230. The systems will be monitored for a period of two years at which time it is anticipated that a recommendation will be made regarding the use of these systems on Arizona highways. The formal FHWA Approved Workplan developed for this research effort is included in Appendix C of this report. The workplan delineates the evaluation procedures to be followed.

The reason for field installations is not to assess a barrier's dynamic performance under severe impact conditions. In an uncontrolled environment this type of analysis is precluded by the level of monitoring required for a useful quantitative crash evaluation. In the event of an in-service impact, the dynamic performance of a barrier can only be assessed in a qualitative manner. The primary reason for an in-service evaluation period is to alleviate unanticipated problems and design deficiencies that may only be manifested during construction or operation. If such deficiencies exist, affected departments can propose system modifications for improving operations or lowering costs prior to wide spread implementation.

PROJECT LOCATION AND DESCRIPTION

This research effort embraces two separate experimental projects, and hence two experimental project numbers, in accordance with the requirements stated in the Federal-Aid Highway Program Manual[9]. The SENTRE system was installed and reported to the FHWA as Experimental Project Number AZ-8802 and the TREND system was installed and reported to the FHWA as Experimental Project Number AZ-8803. Figures 7 and 8 show the two project sites prior to construction.

AZ-8802: SENTRE Attenuator Field Installation

Four SENTRE attenuators were installed on ADOT construction project HES-022-2(33)P, Wickenburg-Phoenix Hwy (US 60) which is located at approximately milepost 138.0 on US 60. The 1989 design ADT[10] for this two lane highway is 8,309 of which 62% are passenger type vehicles. Among other safety related activities, the work on this project included retrofitting a new railing system on the Beardsley Canal bridge. This involved removal of the existing concrete curb down to the bridge deck level and reconstruction of a new curb configuration wide enough and stout enough to accommodate a tubular thrie beam bridge rail assembly. The existing 40' clear roadway width was maintained.

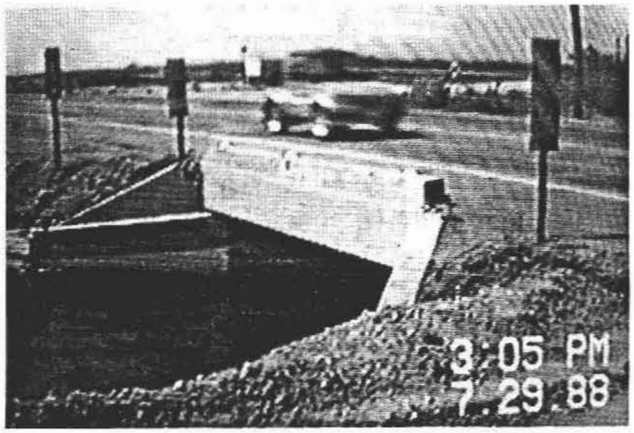


Figure 7 AZ-8802: SENTRE Attenuator Installation Site on US 60 Prior to Construction.

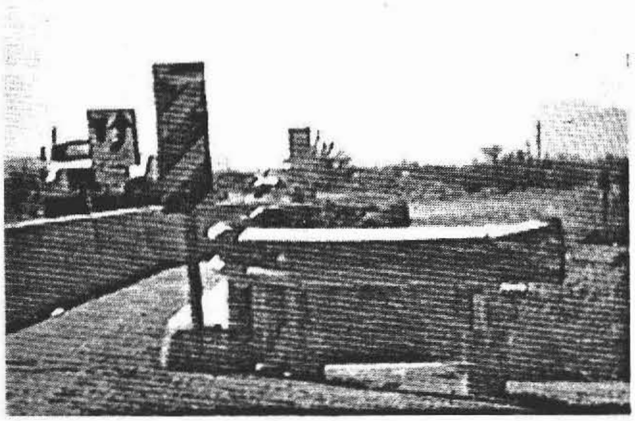


Figure 8 AZ-8803: TREND Attenuator Installation Site on US 89 Prior to Construction.

The total bridge span across the canal is 20.5'. The new tubular thrie beam bridge rail has four support posts anchored in the new concrete curb. The average distance from each of the rigid bridge rail ends to its respective canal access road is approximately 37.5' and this is the total distance available for installation of a protective barrier system. The SENTRE was selected since this assembly has a 17.5' total length, allowing for an additional 20' transition section to make up the difference. The transition section consists of the same tubular thrie beam as the bridge rail; however, the support posts are anchored in soil rather than concrete. The result is that the rigidity of the transition section falls between that of the bridge rail and that of the SENTRE. Photos of the completed installation are contained later in this report.

Accident History

An accident record listing[11] for US 60 near MP 138 spanning the period 1973-1988 was obtained from the ADOT Traffic Studies Branch. During this period there were 55 reported accidents. The majority of these were livestock related. Of the 55 accidents, 13 involved some sort of collision with the existing bridge rail and 6 involved injury. The highway is flat and the view is unobstructed. Immediately east of this project is a tavern and a convenience store presenting a potential merging hazard.

AZ-8803: TREND Attenuator Field Installation

Four TREND attenuators were installed on ADOT construction project F-081-1(2), Oracle Jct-Florence Hwy (US 89) which is located at approximately milepost 132.6 on US 89. The 1989 design ADT[10] for this two lane highway passing through the town of Florence is 2,565 of which 57% are passenger type vehicles. Along with milling and overlaying the existing roadway, the work on this project included retrofitting a new railing system on the Casa Grande Canal bridge. This involved removal of the existing concrete curb and attached W-section bridge rail, and construction of a new concrete parapet wall type bridge rail. The existing 40' clear roadway width was maintained.

The total length of the new parapet wall is approximately 100', leaving an average distance of 70' on each side for the canal access road and the attenuator. The TREND was selected since this assembly has a 21' total length, still leaving a typical canal access road entry way approximately 49' wide after installing the attenuator. Photos of the completed installation are contained later in this report.

Accident History

An accident record listing[11] for US 89 near MP 132.6 spanning the period 1973-1988 was obtained from the ADOT Traffic Studies Branch. During this period there were only 3 reported accidents. The canal bridge is located just north of the convergence of US 89 and SR 287 and approximately two tenths of a mile south of the developed portion of Florence. The accident record listing showed a much larger number of accidents than is cited here; however, all but three were in the adjacent developed area and not at the canal bridge.

CONSTRUCTION PLANS

Plans for the SENTRE and TREND projects are contained respectively in Appendix D and Appendix E of this report. These plans have been reduced and should not be used for scaling distances. These copies are not as-builts and do differ slightly from the actual field installations.

The plans for the Beardsley Canal project incorrectly refer to the TREND system. The TREND system was originally specified for both projects until realizing that the SENTRE system was required at the Beardsley Canal bridge due to the thrie beam type bridge rail specified for use on that bridge.

MATERIALS TESTING

The only material tests applicable on these projects are the concrete footing compressive strengths and the soil classification of the soil supporting the SENTRE's transition section. The concrete compressive strength will affect the anchorage of the support post slip base plates and redirecting cable. The soil properties on the SENTRE project will affect the rigidity of the transition section. At the time of this report, only the concrete compressive strength test results were available. The actual 28 day compressive strength for the SENTRE footing concrete was 4829 psi and for the TREND was 5839 psi.

DESIGN

Requirements

The 1977 AASHTO Guide[2] was used to determine the LON required on a typical canal bridge. The design data for the Beardsley Canal project was used. The bridge rail must be protected, but the required length-of-need is governed by the additional requirement of keeping vehicles out of the canal should they become errant earlier in their approach to the bridge.

Figure III-A-3 of the AASHTO Design Guide indicates that for a design speed of 60mph, obstacles less than 30' from the travelled edge of the roadway must be shielded. The travelled roadway edge at the Beardsley Canal bridge is 8' from the bridge rail which is less than the required 30' clear zone distance; therefore, a roadside barrier is required. Furthermore, Figure III-A-6 of the AASHTO Guide indicates that since the 40' bridge width is less than twice the required 30' clear zone distance, barriers are required in both directions on both the leave the approach ends of the bridge.

Section III-E-4 of the AASHTO Guide outlines the variables of interest and the method for calculating the LON dimension. Projected ADT design data, a 60mph design speed, the fact that no flare is provided, and a minimum allowable unobstructed clear zone of 30' is sufficient information for determining the required LON dimension. Equation III-E-1 of the AASHTO Guide yields a LON dimension parallel to the roadway of 293'.

As discussed earlier, only 37.5' was available for a barrier system. Because of this constraint, provision of the full LON segment was excluded and only the rigid bridge rail was shielded. Having protected the most severe hazard, no further safety provisions were considered necessary by the designers. Additional guardrail could have been specified on the other side of the canal access roads up to the full LON; however, any projected gains in safety from such action would not have compensated the added expense.

Barrier Design

The SENTRE and TREND are proprietary barrier systems. ADOT designer's are only responsible for specifying use of these systems and any available options. EASI engineers are responsible for the actual design of the system. Shop drawings with details applicable to the specific project are provided by EASI and sealed by a mechanical engineer registered in the state of California.

CONSTRUCTION

The activities involved in constructing the SENTRE system are nearly identical to those involved in constructing the TREND system. The forthcoming activity description will therefore be considered typical of both systems. Construction differences that do exist between the two systems will be described as they occur.

General Activity Description

Traffic Control

The traffic control specified on both of these projects was functionally identical. The actual work area was protected by temporary concrete barrier wall located a few feet away from the new bridge rail location, thus narrowing the road. The concrete barrier was tapered toward the shoulder over a 75' distance beyond the approach and leave ends of the bridge. On the approach side, additional Type II barricades were tapered over a distance of 500' beyond the concrete barrier from the shoulder stripe to the edge of the pavement. The traffic control plans for each project, as specified by ADOT's Traffic Design Services, are contained in the construction plans included in Appendix D and Appendix E of this report.

During construction of the SENTRE systems there was one reported accident which involved the traffic control. According to the accident record listing, a semi-truck ran off the travelled roadway and struck the temporary concrete barrier wall. The DPS report attributed this non-injury accident to driver inattention. The attenuator installation had not been started at the time of the accident.

Concrete Footings

The attenuators were constructed on concrete footings specified as Class S concrete with f'_c=4000psi. The footings provide anchorage to the redirecting cable and the bottom half of the slip bases and are of sufficient mass for preventing overturn. The footings were finished smooth and level with the roadway surface.

The footing dimensions for the TREND are shown on both sets of construction plans. The SENTRE dimensions are not shown because the TREND was originally specified on both projects as discussed earlier. The TREND footing is 21' long, 4' wide, and 8" deep except in the last 3' on the end away from the bridge where the depth is increased to 3' to accommodate embedment of the redirection cable front anchor. The SENTRE footing is the same except that the length is only 17.5' because this system uses five posts compared to the TREND's six posts. Both footings have two mats of longitudinal and transverse reinforcement as shown on the plans.

The cable front anchor was the only hardware required to be embedded in the footing. The base plate bolts can be embedded in fresh concrete or epoxied in at a later date. The SENTRE system also has an option for downstream tensioning. If this option is selected by the installing agency, the footing is thickened near the fourth post and a hook is anchored at that location, allowing for the introduction of an initial tension to the guardrail beyond the attenuator. This option was not used on the SENTRE installation featured in this report.

Figure 9 shows one of the SENTRE concrete footings with only the redirecting cable front anchor embedded.

SENTRE Transition Segment

A 20' transition segment was used between the SENTRE system and the tubular thrie beam bridge rail. Seven posts with the same cross section and spacing as those to be used on the SENTRE were driven in the soil spaced at 3' O.C. in the transition section as shown in Figure 10.

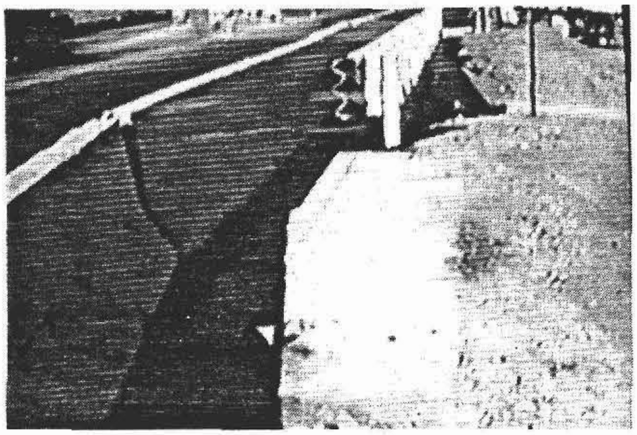


Figure 9 SENTRE Concrete Footing

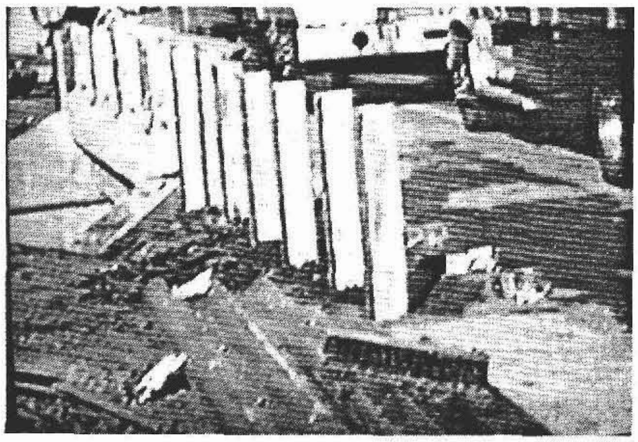


Figure 10 SENTRE Transition Segment

Base Plates

The SENTRE has five base plates and the TREND has six. The bottom half of each base plate is anchored in the concrete footing by six 7.5" long 3/4" diameter bolts. The layout of the base plates is critical since it determines the alignment of the attenuator and the ease of assembly. The base plate locations relative to the footing edges and to the new rail systems where not clearly defined on the project constructions plans; however, this information was shown on the EASI shop drawings. Base plates were spaced 36" O.C. for the SENTRE and 37.5" O.C. for the TREND. The attenuator alignment was specified to be straight and not flared on these projects.

The plate locations were layed out on the hardened concrete footings and the bolt hole locations were determined using the plates as templates. Bolt holes with 7/8" diameter were drilled 6" deep and the debris was blown out of the holes with air. Washers and hex nuts were then screwed onto the bolt ends so that an acceptable amount of thread would be left on the bolt ends when installed. A two component epoxy, which is part of the SENTRE and TREND packages, was mixed and poured into the drilled holes. The bolts were then pushed by hand through their respective base plate holes into the epoxy filled holes and allowed to set for two hours. After the epoxy set the six bolts were tightened with the specified 120 ft-lbs of torque.

Rather than epoxying the bolts into the footing as was done on this project, another option is to set hook ended bolts in the fresh concrete. This option was not chosen for these projects since the epoxy method requires less precision and allows for layout modification. The drilling and epoxying activities do consume a considerable amount of time, however, and an alternate anchoring method may be considered on future installations.

The drilling and epoxying activities are shown in Figures 11 and 12 respectively.

Panel Support Posts

Prior to attaching the posts, additional hardware is required on the slip bases. On each slip base four 2.5" long 3/4" diameter bolts were positioned in the slotted holes with washers and a bolt keeper plate as shown in Figure 13. The support posts also have slotted 1/2" thick plates welded to their bases. The two plates were bolted together with a specified 60 ft-lbs of torque. Insuring proper torque is important since this determines the amount of energy dissipated by the slip base breakaway action in the event of a longitudinal collision.

The actual support posts consist of 32" long W6.5x9 A36 steel posts to which an additional 21" long W6.5x9 steel blockout is attached with two 3/4" bolts. All posts are interchangable except the front post which is designated as Post 1, and the next two posts designated as Post 2 and Post 3. Post 1 has a hole in the bottom to accommodate passage of the redirecting cable as shown in Figure 14. Post 1, Post 2 and Post 3 all have holes to attach sand containers. All posts have two holes for attachment of a backstrap, but these are only used on the TREND system.

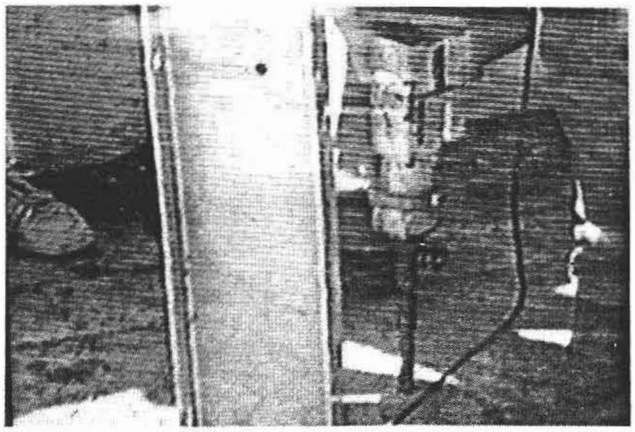


Figure 11 Drilling Bolt Hole

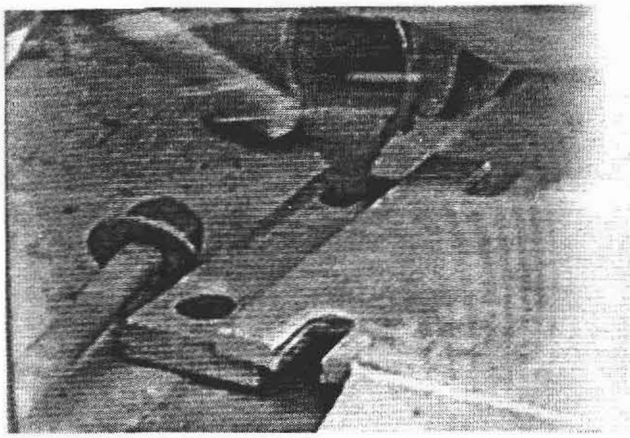


Figure 12 Pouring Epoxy into Bolt Hole

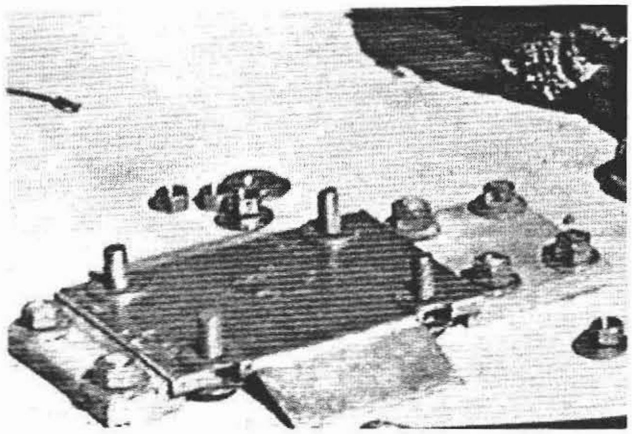


Figure 13 Base Plate Hardware

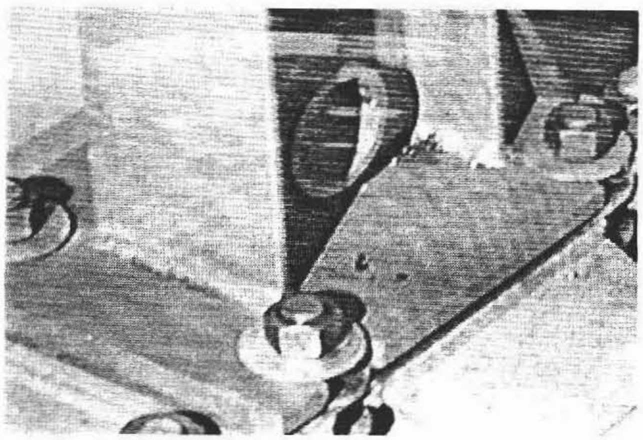


Figure 14 Hole at Bottom of Post 1

Thrie Beam Panels and Sand Containers

One thrie beam panel was bolted to each post blockout such that adjacent panels overlap. The overlap is away from the direction of travel on approach side installations and just the opposite on corresponding departure side installations. The panels were set such that their top edges were 32" above the footing. Adjacent panels were connected together through horizontal slots by a mushroom bolt to allow a telescoping action upon longitudinal impact. The mushroom bolt attachment is shown in Figure 15.

Sand containers were attached to each of the first three posts. Posts 1 and 2 each support two 100 pound containers and Post 3 supports two 150 pound containers. Figure 16 shows the sand container arrangement. Each container was filled to the top with dry sand and the container lid was secured. The sand container lids snap tightly shut by hand.

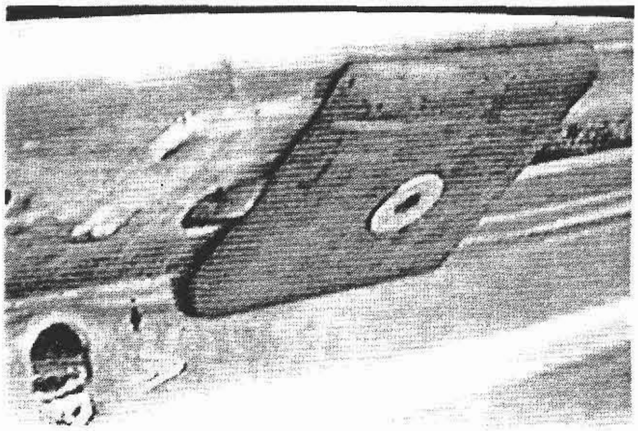


Figure 15 Mushroom Bolt Assembly

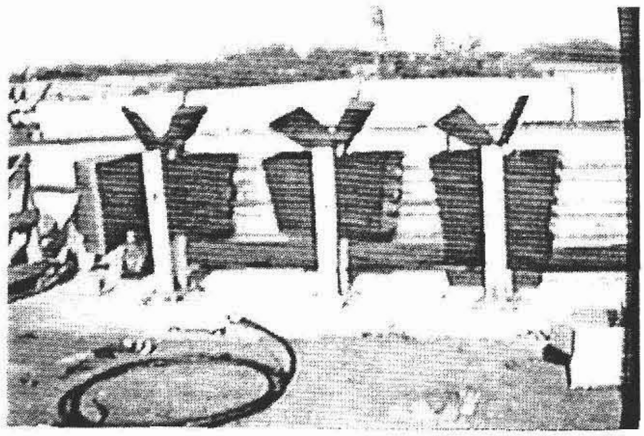


Figure 16 Sand Container Configuration

SENTRE Splice to Transition Segment

The fifth panel of the SENTRE system must tie into the transition segment. In this case the transition segment is a tubular thrie beam which becomes singular at the end to accommodate a splice with another section of thrie beam. In order to accomplish a clean splice, care must be taken during design and construction to insure that the singular end portion of the transition section is situated such that its concavity is compatable with the concavity of the SENTRE singular thrie beam panels.

This special requirement was not forseen in the construction of this field installation. The upstream ends of the tubular thrie beam matched up properly with the SENTRE panels; however, the downstream ends did not. On the downstream ends the thrie beam panels had their convavity pointing opposite that of the SENTRE panels. This situation required a special splice on the downstream ends which is best illustrated by Figure 17. For comparison, the proper splice configuration is shown in Figure 18.

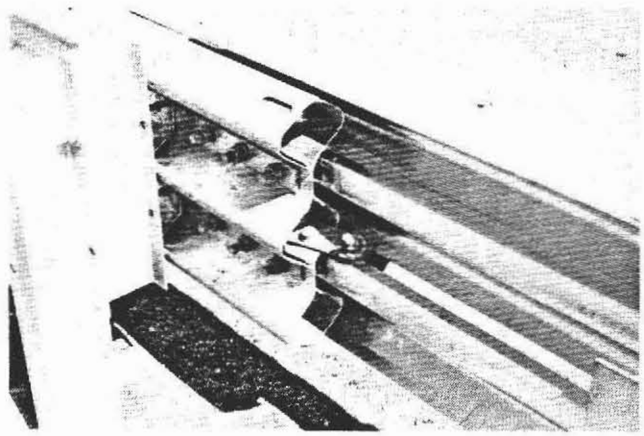


Figure 17 Special Downstream Splice

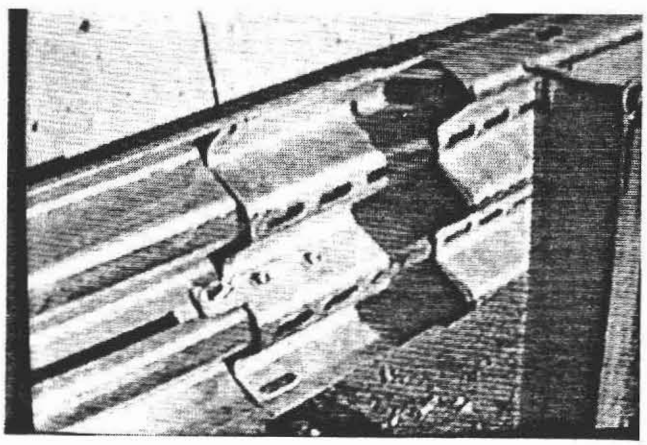


Figure 18 Proper Upstream Splice

TREND Splice to Concrete Parapet Wall

The TREND end panel was spliced to the concrete parapet wall by a bracket assembly which was anchored at the end of the wall with two 3/4" diameter bolts as shown in Figure 19. The steel strap that runs along the back of the TREND was also anchored in the concrete parapet wall as shown in Figure 20.

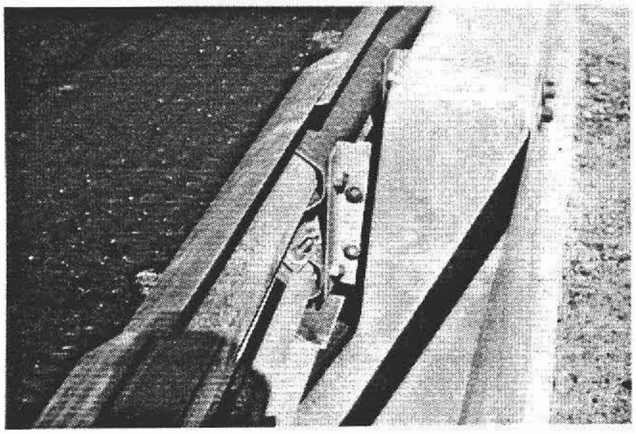


Figure 19 Bracket Attaching TREND to Front of Concrete Parapet Wall

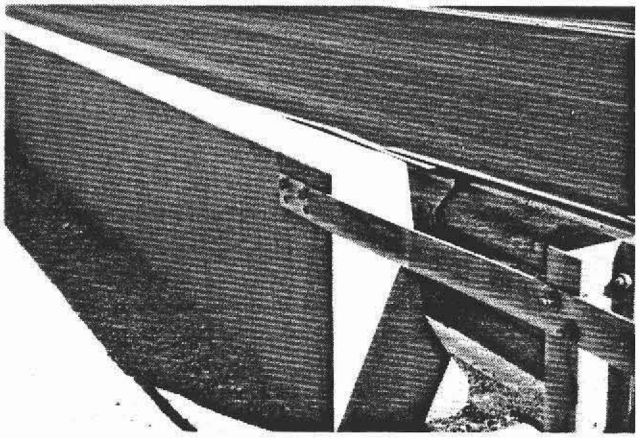


Figure 20 Attachment of TREND Backstrap to Back of Concrete Parapet Wall

Redirecting Cable

A 23 foot steel cable with threaded ends was supplied as part of the system. The cable was passed through the hole in Post 1 and bolted to the front anchor as shown in Figure 21. The cable was then extended to the rear anchor location forming an approximate angle of 25° with respect to the roadway. A hole of approximate dimensions 2' square by 4' deep was then dug at the location of the free end of the cable and the specified reinforcement was placed. The hole was then filled with concrete into which the rear anchor was imbedded as shown in Figure 22. After the specified concrete strength was reached, the cable was tensioned by applying the specified 100 ft-lbs of torque to the tightening bolt.

Completed Systems

The completed systems are shown in Figures 23 and 24. The individual Districts in charge of maintaining these systems have enhanced their respective systems with reflective stickers and signs as shown. The time required for a two man crew to install the four SENTRE units on completed footings was approximately three days. This works out to be 12 manhours per unit. Construction of the TREND units was faster since a larger crew was used.

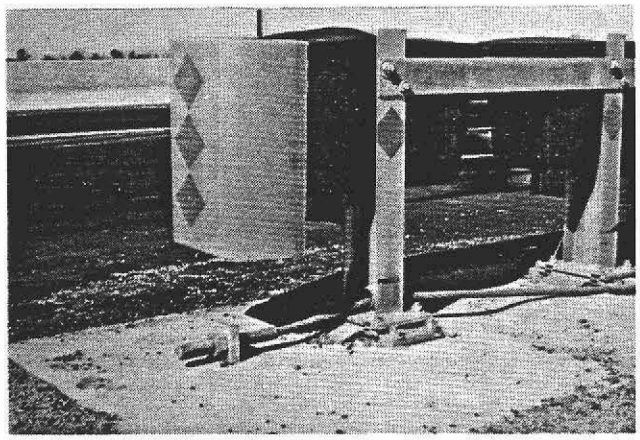


Figure 21 Front Anchor of Redirection Cable

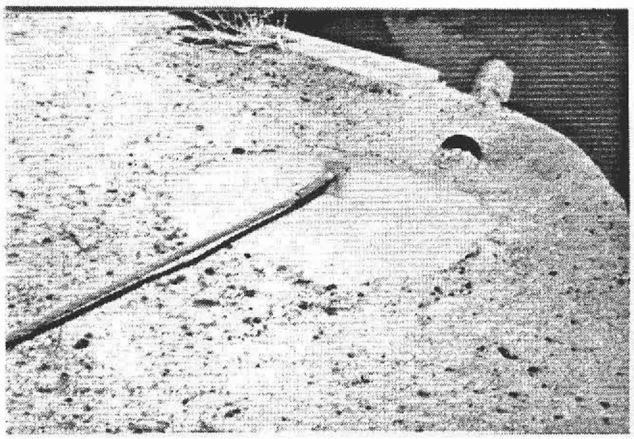


Figure 22 Rear Anchor of Redirection Cable

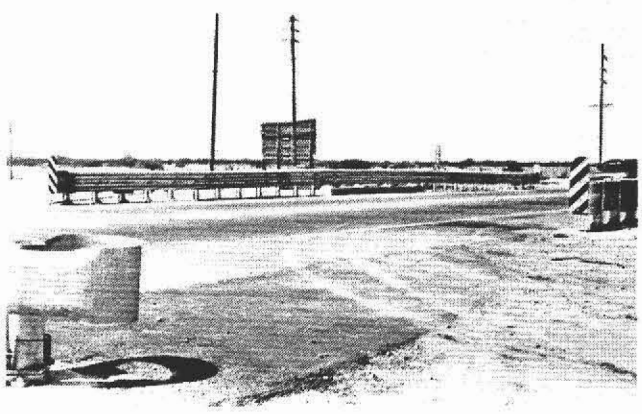


Figure 23 Completed SENTRE

Figure 24 Completed TREND

Economics

Construction Costs - Alternates vs. SENTRE and TREND

In the design stage, a decision was made to concentrate efforts on shielding only the rigid bridge rails so that the canal roads would not be blocked. If the restriction of maintaining access to these roads was removed, the full LON guardrail would have been provided and the SENTRE and TREND would not have been necessary. Based on 1987 construction costs published by ADOT[12], the average cost per foot of installed W-section guardrail on projects containing more than 1000' of rail was $10.69/lf. The average cost of an installed BCT based on all projects involving installation of 4 or less BCTs was $887.05. As previously discussed, the total required LON on these projects was 293'; therefore, this length of guardrail with one BCT on the end would cost approximately $4019 installed.

Another alternative which conceivably could have been employed if redirection subsequent to head-on impact was not a primary objective is the standard ADOT attenuator. These devices will fit within the restricted space, however, their performance is different than that of the TREND or SENTRE. Based on the average of the three low bids on the single ADOT standard attenuator installed in 1987, the cost per attenuator would be $3558 installed.

The cost per unit for the SENTRE system was $7421 installed and for the TREND was $8600. The approximate portion of this attributable to the steel and plastic attenuator components was $2500. The footing volume is approximately 4CY so using a conservative estimate of $100/CY in-place, the footing material is another $400 bringing the material total to $2900. The result is that several thousand dollars in excess of actual cost was bid on each attenuator. Since no special expertise is required for installation of these attenuators and one unit can be installed in an average of 12 manhours, the differential seems high. This high price is in part the result of including traffic control costs in the price of the attenuators.

Cost Analysis

Cost analyses are inconclusive until consideration is given to the functional differences between the TREND and SENTRE type systems and the systems ADOT usually employs. The TREND and SENTRE should not be compared directly with the BCT and standard ADOT attenuator on a cost basis because their applications, while similar, are not the same. These new systems were chosen due to the special circumstances of the projects on which they were installed.

The alternate design which provides the full LON and uses a BCT on the end is clearly desirable from a first cost standpoint, but the design objectives are not met. The canal road access is not maintained. Implementation of this alternative would require realignment of the canal roads and in addition to being expensive, would often not even be feasible.

The alternate design which employs the standard ADOT attenuator is less expensive, but again all design objectives are not met. For vehicle impacts that are not end-on, the standard attenuator and the TREND and SENTRE systems will provide similar redirective capability. This statement may not be true for end-on impacts. Crash testing of systems similar to the ADOT standard attenuator[6] appears to indicate that vehicles impacting end-on will be stopped within the systems 25' longitudinal dimension at 60mph (5g deceleration). However, if the impacting vehicle has sufficient momentum to continue beyond the entire 25' attenuator length, the vehicle will impact the hard point of the bridge rail. The TREND and SENTRE units are designed with a redirecting cable intended to turn vehicles impacting end-on away from the hard point. This is an added safety feature which the standard ADOT attenuator does not have.

Clearly the cost analysis is complex. Weighting factors must be assigned by the installing agency which reflect the relative importance of each of the design objectives. The objective of keeping existing canal roads clear will take on different levels of importance depending on the available alternate options in a given situation. The objective of redirecting end-on impacting vehicles away from the hard point may achieve extremely high priority when considering potential litigation costs that may result from not providing such an added safety feature.

Maintenance costs will also be a consideration in determining the relative economy of systems. Maintenance data for the TREND and SENTRE systems are not available but will be collected throughout the length of these projects. Consideration will be given to the availability of replacement parts in a limited application environment such as this and compared to a projected full scale implementation situation where parts can be purchased in bulk and stock piled.

PRELIMINARY EVALUATION

Concerns and Potential Problems

The actual construction of both the SENTRE and TREND systems was completed without difficulty. Problems and concerns did exist, but were not construction related. The first potential problem was related to the specification of the SENTRE system on the Beardsley Canal bridge. As previously discussed, the TREND system was incorrectly specified on both projects. The SENTRE system was later specified on the Beardsley Canal project by way of change order and the downstream tensioning option of the SENTRE was not included.

Exclusion of the downstream tensioning option does not represent a design deficiency although it did create some confusion. The final determination was made by ADOT's Highway Plans design engineers that the downstream tensioning option was unnecessary due to the rigidity of the thrie beam bridge rail system being used on that project. Other situations may warrant use of the downstream tensioning option. Regardless of this decision, the apparent ability of the SENTRE to provide adequate end anchorage to the connecting guardrail system will be assessed in the event of future vehicle impacts.

The second concern which was expressed by ADOT District 1, District 2, District 3 and Highway Plans had to do with an inherent feature of the SENTRE and TREND systems. In two way highway applications such as these where attenuators are installed on both the approach and departure ends of bridges, a potential problem is created. As discussed previously, the thrie beam fender panels of the system are attached to their posts with a lap so that telescoping of the panels will occur upon longitudinal impacts. The lap is away from the direction of traffic on the approach end, but is toward traffic on the departure end. The departure end panel lap is shown in Figure 25. Having the panels lap toward the traffic may be hazardous to vehicles barely brushing the departure end attenuator. Vehicles which may only experience minor damage in a brush by encounter with an attenuator where the lap is away from traffic have potential for snagging on an attenuator where the lap is toward traffic. Any effects of this feature will be evaluated on these projects.

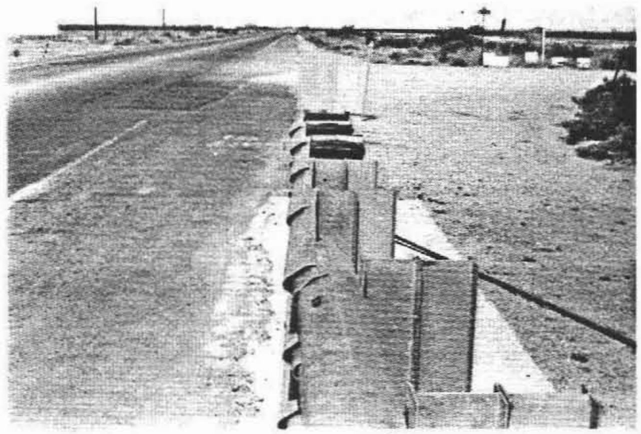


Figure 25 Panel Lap is a Concern on Departure Side

Conclusions

Between the time that the TREND and SENTRE attenuators were installed and the time that this report was prepared a significant change of roadside barrier classification has occured. In April of 1989 the SENTRE attenuator system status was upgraded from Experimental to Operational by the FHWA Office of Engineering. Regardless of this change, the Experimental Project currently at hand will continue and all previous commitments concerning this project will be satisfied.

As of January 1990 there have been a total of four impacts with the attenuator systems in place. All of these impacts have apparently been by heavy construction vehicles working on adjacent construction projects and are clearly not representative of the type of impacts for which the TREND and SENTRE systems were designed. However, the resulting damage has required repair which will facilitate in assessing the maintenance features of these attenuators.

No data or conclusions will be presented at this point in the investigation of the SENTRE and TREND systems. The evaluation of both of the systems will be carried out in accordance with the workplan contained in Appendix C of this report. This workplan covers both the SENTRE and TREND evaluation activities and has been adhered to thus far.

REFERENCES

(1) Michie, Jarvis D., *"Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances."* NCHRP Report 230 (March 1981).

(2) American Association of State Highway and Transportation Officials, *"Guide for Selecting, Locating, and Designing Traffic Barriers."* (1977).

(3) Michie, Jarvis D., and Bronstad, M.E., *"Location, Selection, and Maintenance of Highway Traffic Barriers."* NCHRP Report 118 (1971).

(4) Bronstad, M.E., and Michie, Jarvis D., *"Recommended Procedures for Vehicle Crash Testing of Highway Appurtances."* NCHRP Report 153 (1974).

(5) Michie, Jarvis D., and Bronstad, M.E., *"Guardrail Crash Test Evaluation. New Concepts and End Designs."* NCHRP Report 129 (1972).

(6) Bronstad, M.E., and Michie, Jarvis D., *"Development of a New Median Barrier Terminal."* Transportation Research Record 488 (1974), P. 24-33.

(7) Energy Absorption Systems, Inc., "TREND (Transition End Treatment) NCHRP 230 Certification Report.", (December 1985).

(8) Energy Absorption Systems, Inc., "SENTRE (Safety Barrier End Treatment) NCHRP 230 Certification Report.", (May 1983).

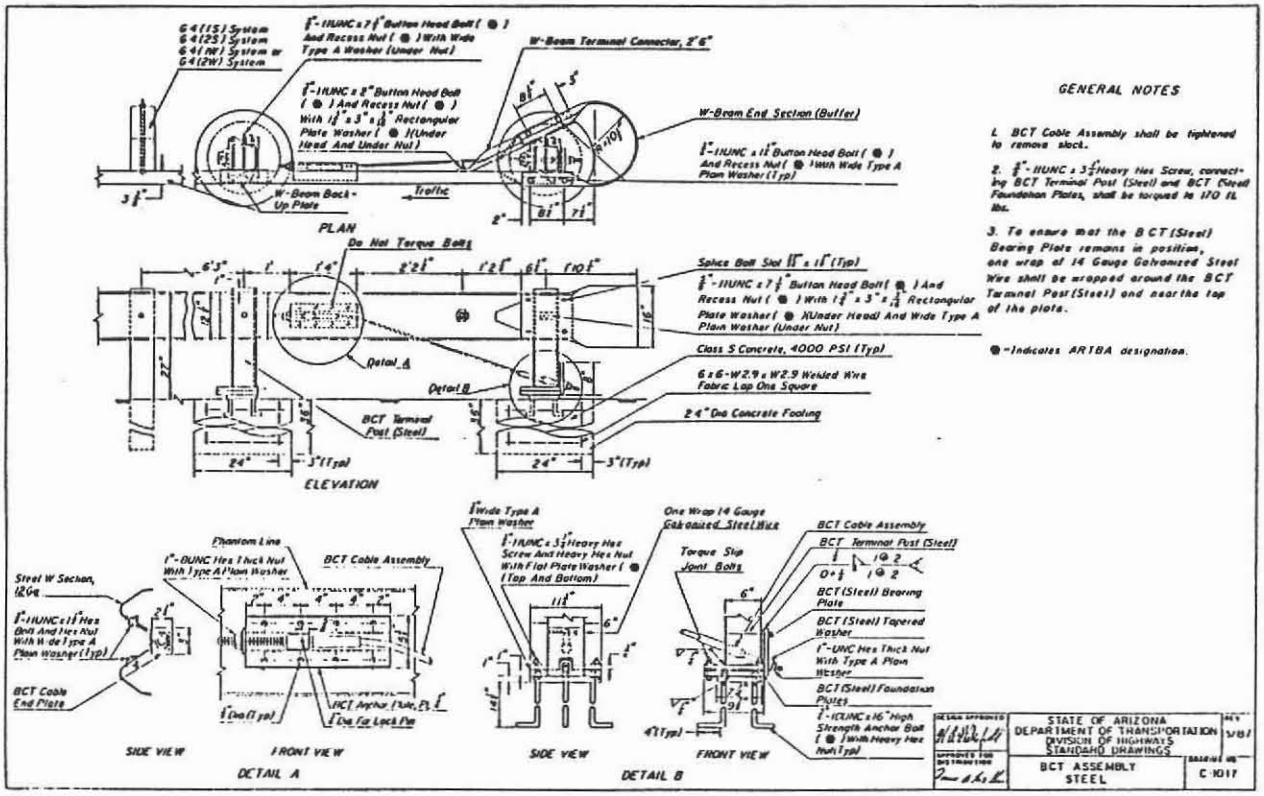
(9) Federal-Aid Highway Program Manual, Volume 6, Chapter 4, Section 2.

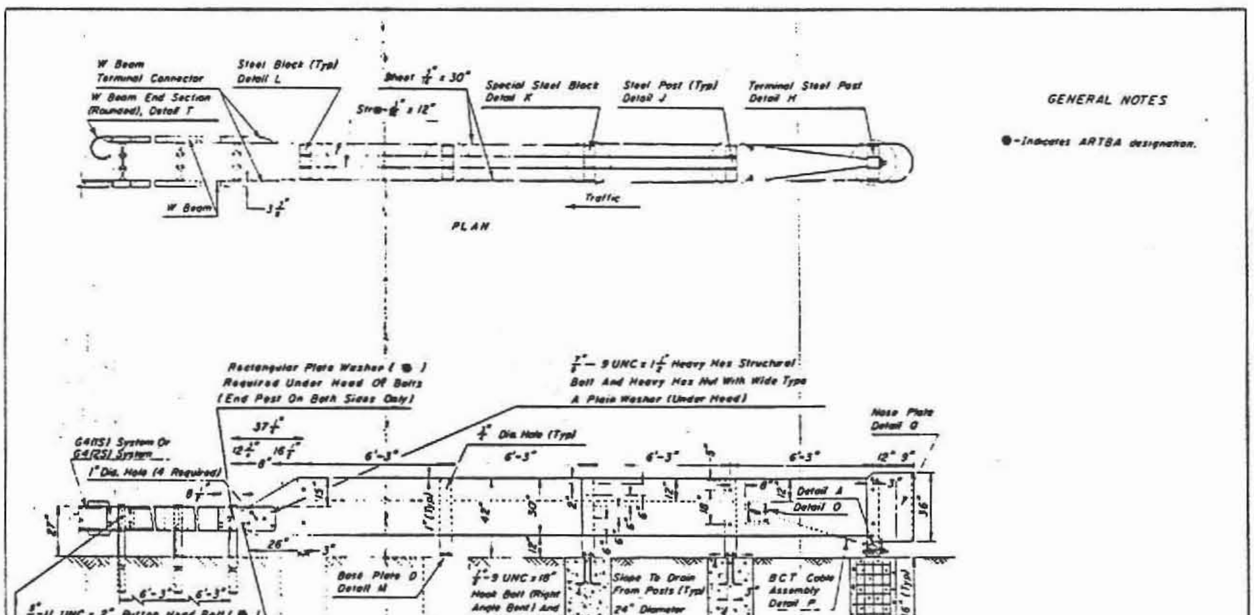
(10) 1989 Traffic Design Data, ADOT Materials Pavement Services

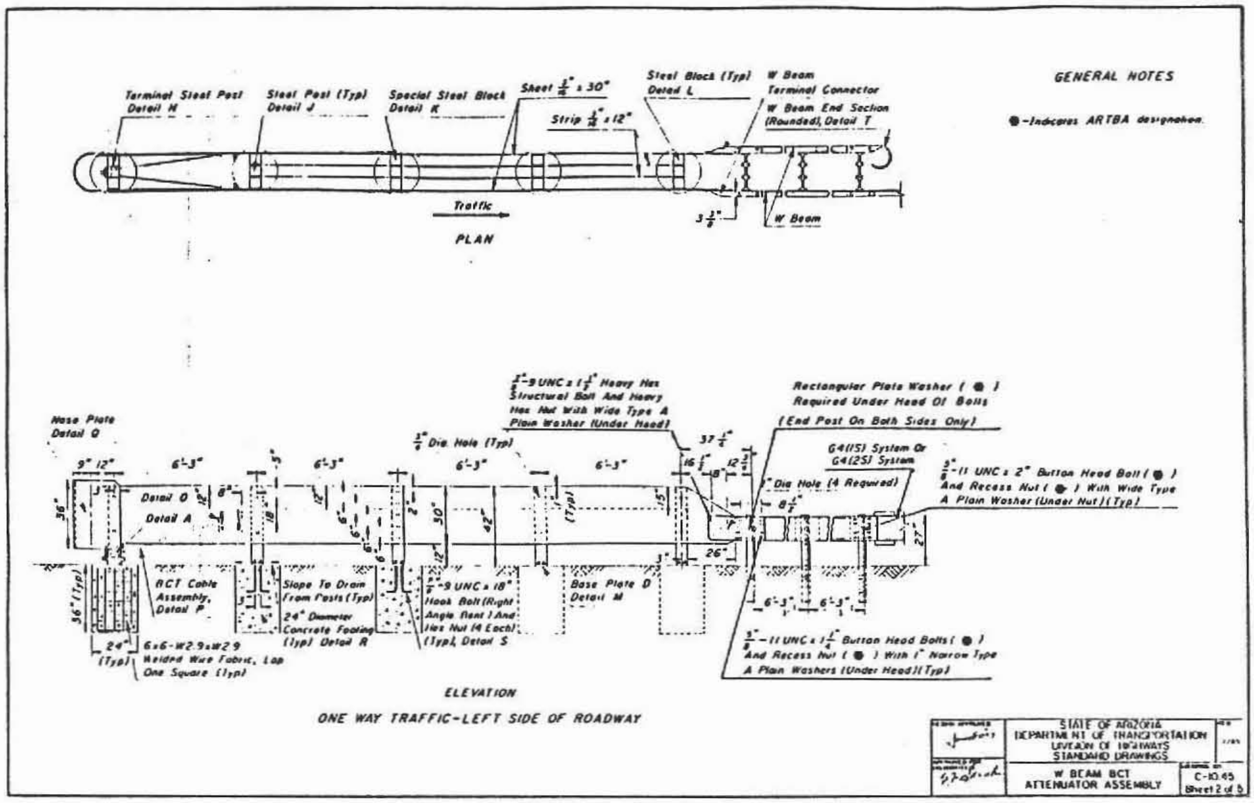
(11) Accident Location Identification & Surveillance System (ALISS), ADOT Traffic Studies Branch

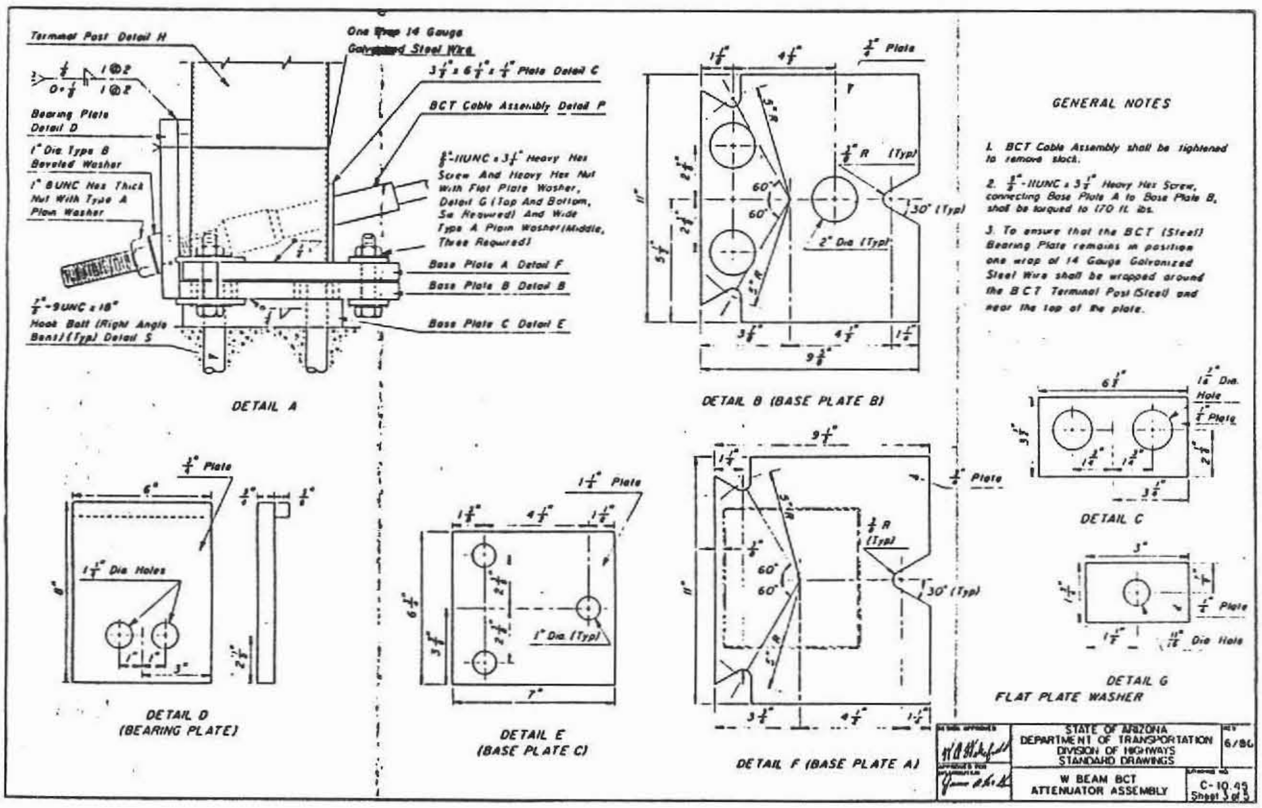
(12) Construction Costs 1987, ADOT Contracts and Specifications

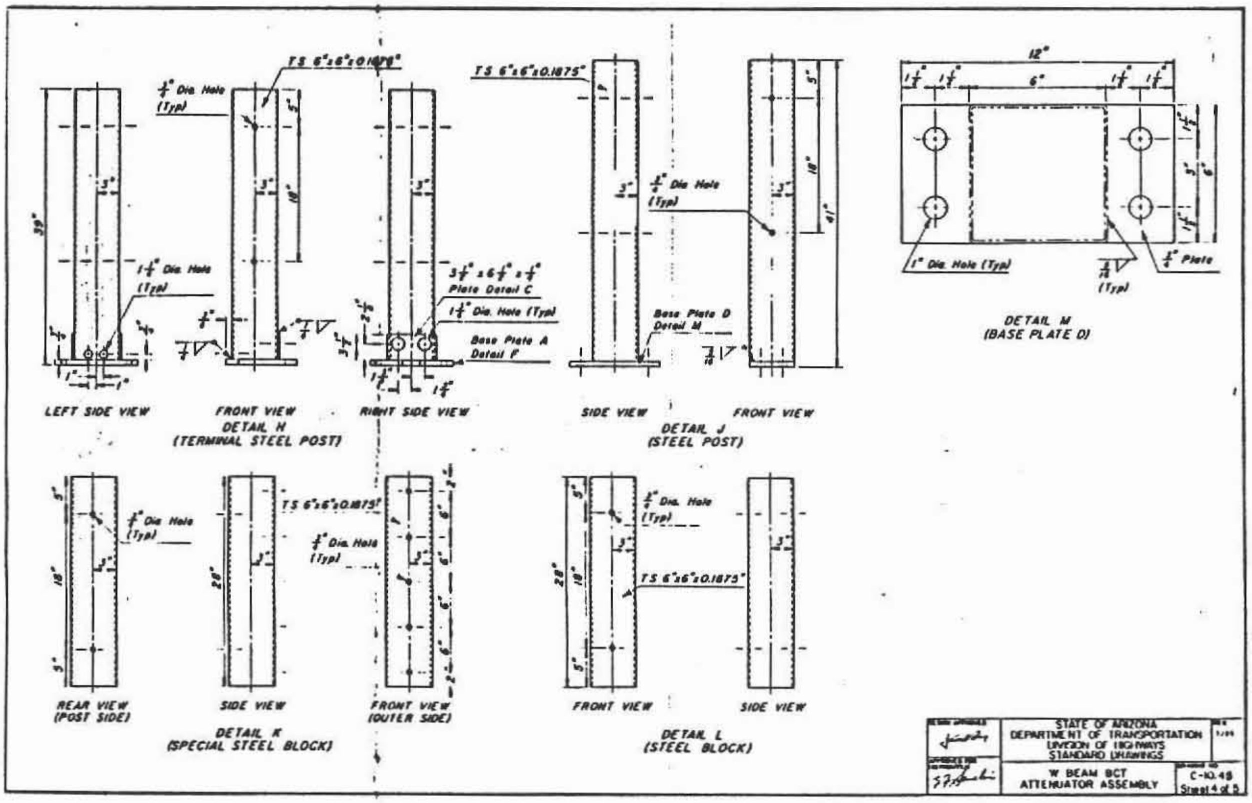
APPENDIX A - CURRENT ADOT STANDARD DETAILS

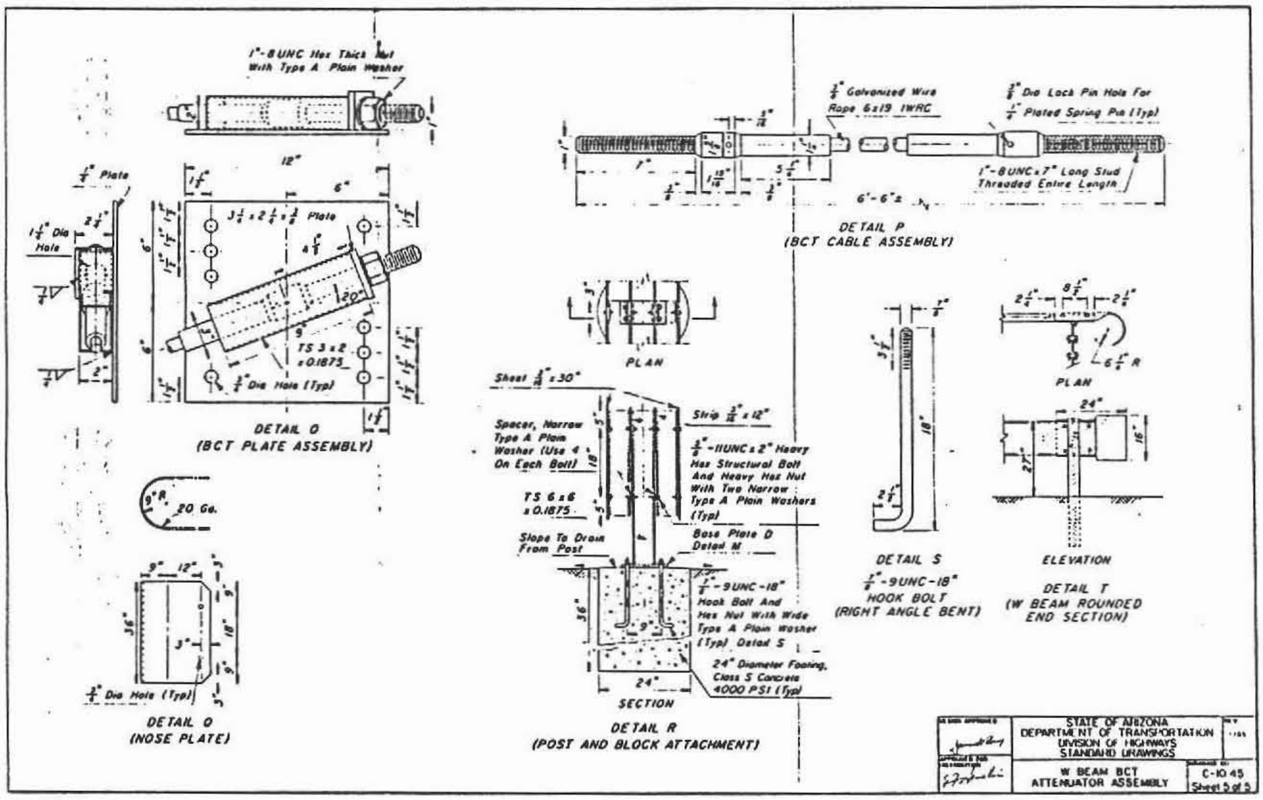

GENERAL NOTES
1. BCT Cable Assembly shall be tightened to remove slack.
2. ⅝"-11UNC x 3½" Heavy Hex Screw, connecting BCT Terminal Post (Steel) and BCT (Steel) Foundation Plates, shall be torqued to 170 ft. lbs.
3. To ensure that the BCT (Steel) Bearing Plate remains in position, one wrap of 14 Gauge Galvanized Steel Wire shall be wrapped around the BCT Terminal Post (Steel) and near the top of the plate.
●-Indicates ARTBA designation.
PLAN
ELEVATION
SIDE VIEW
FRONT VIEW
DETAIL A
SIDE VIEW
FRONT VIEW
DETAIL B
W-Beam Terminal Connector, 2'6"
W-Beam End Section (Buffer)
W-Beam Back-Up Plate
Traffic
Do Not Torque Bolts
Detail A
Detail B
BCT Terminal Post (Steel)
Class S Concrete, 4000 PSI (Typ)
24" Dia Concrete Footing
BCT Cable Assembly
BCT Terminal Post (Steel)
BCT (Steel) Bearing Plate
BCT (Steel) Tapered Washer
BCT (Steel) Foundation Plates
Phantom Line
BCT Cable End Plate
STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DRAWINGS
BCT ASSEMBLY
STEEL
C-10.17


GENERAL NOTES
●-Indicates ARTBA designation.
W Beam Terminal Connector
W Beam End Section (Rounded), Detail T
Steel Block (Typ) Detail L
Special Steel Block Detail K
Steel Post (Typ) Detail J
Terminal Steel Post Detail H
W Beam
Traffic
PLAN
Rectangular Plate Washer (●) Required Under Head Of Bolts (End Post On Both Sides Only)
Nose Plate Detail G
Detail A
Detail O
Base Plate D Detail M
Slope To Drain From Posts (Typ)
24" Diameter Concrete Footing (Typ) Detail R
BCT Cable Assembly Detail P
6x6-W2.9xW2.9 Welded Wire Fabric, Lap One Square (Typ)
ELEVATION
ONE WAY TRAFFIC-RIGHT SIDE OF ROADWAY
OR TWO WAY TRAFFIC
STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DRAWINGS
W BEAM BCT
ATTENUATOR ASSEMBLY
C-10.45
Sheet 1 of 5


Terminal Steel Post Detail H
Steel Post (Typ) Detail J
Special Steel Block Detail K
Steel Block (Typ) Detail L
W Beam Terminal Connector
W Beam End Section (Rounded), Detail T
W Beam
Traffic
PLAN
GENERAL NOTES
● - Indicates ARTBA designation.
Nose Plate Detail Q
Detail O
Detail A
BCT Cable Assembly, Detail P
Slope To Drain From Posts (Typ)
24" Diameter Concrete Footing (Typ) Detail R
Hook Bolt (Right Angle Bent) And Hex Nut (4 Each) (Typ), Detail S
Base Plate D Detail M
6x6-W2.9xW2.9 Welded Wire Fabric, Lap One Square (Typ)
Structural Bolt And Heavy Hex Nut With Wide Type A Plain Washer (Under Head)
Rectangular Plate Washer (●) Required Under Head Of Bolts (End Post On Both Sides Only)
G4(1S) System Or G4(2S) System
Dia Hole (4 Required)
Button Head Bolt (●) And Recess Nut (●) With Wide Type A Plain Washer (Under Nut) (Typ)
Button Head Bolts (●) And Recess Nut (●) With 1" Narrow Type A Plain Washers (Under Head) (Typ)
ELEVATION
ONE WAY TRAFFIC-LEFT SIDE OF ROADWAY
STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DRAWINGS
W BEAM BCT ATTENUATOR ASSEMBLY
C-10.45
Sheet 2 of 3


Terminal Post Detail H
One Wrap 14 Gauge Galvanized Steel Wire
Plate Detail C
BCT Cable Assembly Detail P
Bearing Plate Detail D
1" Dia Type B Beveled Washer
1" 8UNC Hex Thick Nut With Type A Plain Washer
Heavy Hex Screw And Heavy Hex Nut With Flat Plate Washer, Detail G (Top And Bottom, Six Required) And Wide Type A Plain Washer (Middle, Three Required)
Base Plate A Detail F
Base Plate B Detail B
Base Plate C Detail E
Hook Bolt (Right Angle Bent) (Typ) Detail S
DETAIL A
DETAIL B (BASE PLATE B)
GENERAL NOTES
1. BCT Cable Assembly shall be tightened to remove slack.
2. Heavy Hex Screw, connecting Base Plate A to Base Plate B, shall be torqued to 170 ft. lbs.
3. To ensure that the BCT (Steel) Bearing Plate remains in position one wrap of 14 Gauge Galvanized Steel Wire shall be wrapped around the BCT Terminal Post (Steel) and near the top of the plate.
Dia Holes
DETAIL D (BEARING PLATE)
1" Dia (Typ)
DETAIL E (BASE PLATE C)
DETAIL F (BASE PLATE A)
DETAIL C
Dia Hole
DETAIL G FLAT PLATE WASHER
STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DRAWINGS
W BEAM BCT ATTENUATOR ASSEMBLY
6/86
C-10.45
Sheet 3 of 3


TS 6"x6"x0.1875"
LEFT SIDE VIEW
FRONT VIEW
DETAIL H
(TERMINAL STEEL POST)
RIGHT SIDE VIEW
Base Plate A Detail F
Plate Detail C
SIDE VIEW
FRONT VIEW
DETAIL J
(STEEL POST)
Base Plate D Detail M
DETAIL M
(BASE PLATE D)
1" Dia. Hole (Typ)
REAR VIEW
(POST SIDE)
SIDE VIEW
FRONT VIEW
(OUTER SIDE)
DETAIL K
(SPECIAL STEEL BLOCK)
FRONT VIEW
SIDE VIEW
DETAIL L
(STEEL BLOCK)
STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DRAWINGS
W BEAM BCT
ATTENUATOR ASSEMBLY
C-10.45
Sheet 4 of 5


1"-8UNC Hex Thick Nut With Type A Plain Washer
DETAIL O
(BCT PLATE ASSEMBLY)
20 Ga.
DETAIL O
(NOSE PLATE)
Galvanized Wire Rope 6x19 IWRC
Dia Lock Pin Hole For Plated Spring Pin (Typ)
1"-8UNC x 7" Long Stud Threaded Entire Length
DETAIL P
(BCT CABLE ASSEMBLY)
PLAN
Spacer, Narrow Type A Plain Washer (Use 4 On Each Bolt)
TS 6x6 x0.1875
Slope To Drain From Post
Base Plate D Detail M
Hook Bolt And Hex Nut With Wide Type A Plain Washer (Typ) Detail S
24" Diameter Footing, Class S Concrete 4000 PSI (Typ)
SECTION
DETAIL R
(POST AND BLOCK ATTACHMENT)
DETAIL S
HOOK BOLT
(RIGHT ANGLE BENT)
PLAN
ELEVATION
DETAIL T
(W BEAM ROUNDED END SECTION)
STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DRAWINGS
W BEAM BCT
ATTENUATOR ASSEMBLY
C-10.45
Sheet 5 of 5

APPENDIX B - EASI TECHNICAL DISCUSSION

TECHNICAL DISCUSSION

TEST CONDITIONS

Test Facility

The Energy Absorption Systems Inc. test facility is located at the Lincoln Airport in Lincoln, California. The test area is situated on fully asphalted level ground and has been cleared of all obstructions for unrestricted trajectory of the vehicle. The soil is composed of very stiff to hard silts and clays and can be classified as a NCHRP 230 type S-1.

Test Article (Design)

The SENTRE (see Figure D-1) has been designed and constructed to provide structural adequacy, minimum occupant risk, and minimum vehicle trajectory as set forth in NCHRP 230 Table 3--. "Crash Test Conditions for Minimum Matrix". (Table 1)

The SENTRE is designed as an end treatment for w-beam or thrie beam guardrail which will redirect the nose of the impacting vehicle away from the unyielding guardrail while at the same time dissipate the energy of the impacting vehicle.

The SENTRE consists of five nested overlapping thrie beam fender panels which telescope rearward in response to a longitudinal impact force and an angled side cable for urging the first fender panel and post assembly laterally away from the fixed guardrail end. The fender panels and angle side cable function to direct the nose of the impacting vehicle away from the hard point on the guardrail while at the same time dissipating the impact energy of the vehicle.

The fender panels are slotted and secured together in a nested fashion by fasteners which allow the fender panels to telescope upon the application of an axial impact force. The fender panels are supported above the ground on vertical support posts which are positioned on slip bases. These slip bases allow the posts to break away from submerged ground anchors so that the fender panels may telescope.

The first fender panel, or more specifically its vertical support post is connected to a redirectioning cable. This cable is secured to an anchor located at the front of the unit, and a rear anchor located at a lateral position away from the guardrail. This cable is positioned so that when a longitudinal impact force is imposed on the front of the system, the cable will urge the first fender panel laterally as it telescopes rearward. The lateral force of the cable and first post in conjunction with lateral forces contributed by the subsequent posts will urge the vehicle away from the hard point on the guardrail.

Test Article (Construction)

The SENTRE drawings are shown in Appendix D. The following discussion will describe how the individual components are constructed and assembled into a working unit.

The 52 inch, 10 gauge thrie beam fender panels include 32 inch slots and are secured together by fasteners (mushroom bolt assembly). These slots allow the fender panels to telescope upon the application of a longitudinal force.

The mushroom bolt assembly is designed with a shoulder that travels in the slot of the fender panel. The assembly secures two overlapping fender panels with a grade 5, flat head 3" x 5/8" diameter bolt which passes through a hole in the center of the mushroom washer and a hole in the underlying fender panel. The mushroom bolt assembly is constructed so that it does not solidly clamp the two fender panels together, but rather secures them in a position relative to one another with sufficient tolerance to allow the first fender panel to telescope into the second panel. The longitudinal movement of the first fender panel is halted when it reaches the end of the slot.

The fender panels are supported above the ground by vertical support posts. The 32" long posts are W 6.5 x 9 steel "I" beams to which an additional 21 inch W

6.5 x 9 "I" beam blockout is bolted with two 1 1/2" x 3/4" diameter bolts. The fender panels are then attached to the blockout with two 2" x 3/4" diameter grade 2 bolts. The purpose of the blockout is to prevent automobiles with small wheels from snagging on the vertical support posts of the SENTRE during a side angle impact.

The vertical support posts are welded to a 1/2" x 8" x 11" steel slip base. The slip base assembly includes a top plate and a bottom plate which are secured to each other. The bottom plate is attached to an earth anchor.

The top and bottom slip base plates each include four open ended slots which are designed to receive 2" x 3/4" diameter bolts which secure the plates together. The plates are large enough so that they will not yield during a lateral impact. The slots are open ended so that when a sufficient longitudinal impact force is applied to the vertical support post by the impacting vehicle, the plates will slide apart. To insure that the plates will slip apart in a predictable manner, they are separated by four 3/4" diameter flat washers. The washers provide a consistant bearing area between the two plates so that the force needed to cause the plates to slide can be controlled. Testing has shown that the vehicle sustains acceleration levels of 4 to 5 "Gs" when a torque of 60 ft.-lbs. is applied to the four slip base bolts.[22]

The vertical support posts also include a 4" x 4" steel gusset attached from the vertical support post to the top of the slip base plate. This gusset strengthens the vertical support post during redirective impacts.

An additional 3" x 6" angle plate is welded to the bottom slip base to provide a ramp and prevent possible snagging on each other as they break away and move rearward in response to a longitudinal impact force.

The first vertical support post is similar in construction to the other posts except that it contains a 1 3/4" x 2" diameter schedule 80 steel pipe grommet. The grommet is located 1 1/2" from the top of the slip base and is designed to receive a 1 1/2" diameter threaded steel fitting which is swedged to the end of a 7/8" diameter steel cable. The cable extends from the previously mentioned front cable anchor, through the grommet, to the rear cable anchor. The rear anchor is located on an imaginary line which runs through the center of the first vertical post at an angle of 25 degrees with respect to the centerline of the roadway. The cable forces the first fender panel and vertical post to move laterally upon the application of a longitudinal impact force.

The front and rear cable anchors are typically embedded in a concrete foundation measuring 18" diameter by 4 feet deep. The front and rear anchor consist of a 1" x 3" x 29" steel bar welded to a 1/2" x 5" x 7" plate. The anchors are designed to be universal and secure each end of the cable. The front cable anchor is positioned ahead of the first vertical support post and secures the clevis end of the cable using 1 5/8 " diameter pin and cotter pin. The cable passes through the grommet in the first vertical support post and is then secured to the rear cable anchor by inserting the threaded fitting on the end of the cable through the 1 3/4" diameter hole in the steel anchor and attaching a washer and nut. The 1 1/2" nut is torqued to approximately 100 ft.-lbs. The cable aids in redirectioning vehicles which impact the SENTRE head on. By urging the first fender panel laterally the cable imposes a lateral force on the fender panels. The cable is constructed from 7/8", 6 x 25 IWRC, galvanized, steel cable and will stretch 1 to 1 1/2 % of its length upon application of a longitudinal impact force.

The lateral force will now be described in more detail. When a vehicle impacts the guardrail end terminal head on, the first panel is forced backwards telescoping into the second panel. As the vehicle continues its motion, the first vertical post impacts a second vertical support post causing the top plate of the second slip base to disengage. The rearward movement of the first panel stretches the cable until the cable will not stretch any further. The cable then urges the first panel laterally causing the first fender panel to give a small lateral impulse to the nose of the impacting vehicle. As the first fender panel reaches the end of its travel the second fender panel begins to telescope into the third fender panel. The first fender panel reaches the end of its longitudinal movement before the second slip base breaks free. Each slip base decelerates and dissipates some of the energy of the impacting vehicle. This process continues until all the slip bases of the SENTRE have disengaged giving a large lateral force to the impacting vehicle. The net consequence of this lateral force moves the vehicle away from the hard point.

The SENTRE includes additional mass in the form of sand because the slip bases do not remove a sufficient amount of energy to keep an impacting vehicle from hitting the hard point. The sand is held in containers which add 200 lbs. to the first and second vertical support posts at a 24 in. center of gravity and 300 lbs. to the third vertical support post at a 21 in. center of gravity. The 200 lbs. of sand is equally divided into two 100 lb. containers for each of the first two posts. A 100 lb. container is placed on each side of the block out and vertical post so that two 2" x 3/8" diameter bolts can be inserted and clamp the containers to the vertical post assembly. The 300 lb. sand mass is equally divided into two 150 lb. sand contaners and attached to the third post in the same manner as the 100 lb. sand containers. A lid is included on each container to keep moisture from entering the sand. The lid is designed with a self locking feature so no assembly tools such as rivets are required.

A bull nose has been included as part of the design to aid in the aesthetic appeal. The bull nose is made of gray plastic and includes a flat section on the nose which may be used to attach reflective markers.

The SENTRE may be attached to either w-beam or thrie beam guardrail. Both guardrail types must include an end anchoring system which extends from a ground anchor to the section of guardrail immediately following the SENTRE. A transition panel must be included when installing the SENTRE on w-beam guardrail. The transition panel is connected from the last fender panel of the SENTRE to the hard point of the length of need guardrail. A 7/8" 6 x 19 IWRC cable extends from a concrete deadman, located betweeen posts 4 and 5, to a cable anchor on the transition panel. The cable and concrete deadman are strong enough so that the L.O.N. guardrail develops its full tensile strength during a redirect impact.

APPENDIX C - FHWA APPROVED WORKPLAN

AZ-8802 (SENTRE)

AZ-8803 (TREND)

WORKPLAN

1. *Evaluate and document the site selection criteria, and design conditions.* This will include expected service requirements of the project and anticipated service life of the device. The geometric alignment, device location, traffic volume, vehicle operating speeds and mix, environmental conditions, and soil stratigraphy will be documented.

2. *Perform a risk analysis and pre-installation safety evaluation.* Traffic and accident data will be obtained and analyzed for each installation for the period 2 years prior to award of the construction project. An appropriate risk analysis program will be selected and used to determine the probability for collision for each device. Local maintenance authorities/ DPS officers will be interviewed to determine if any unique safety or environmental conditions are prevalent.

3. *Assign reporting procedures and responsibilities.* The ATRC will develop field evaluation forms for use by ADOT construction and maintenance personnel and DPS officers. The frequency and content of reporting will be established by the ATRC in conjunction with the participating personnel.

4. *Monitor and document the construction of the devices.* The as-built condition of each device and roadway condition will be documented and an emphasis placed on verifying that design goals were achieved. Roadway friction testing will be conducted to document skid properties at the time of construction. Field construction/contractor personnel will be interviewed for suggested design/ procedural changes and/or improvements.

5. *Prepare a construction report documenting the design and construction of the devices.* A construction report will be prepared in accordance with ATRC procedures for reporting of experimental projects and submitted to the FHWA within 120 days after construction of the last device.

6. *Monitor in-service performance.*

    * The in-service evaluation will be conducted for 2 years.

    * Monthly field inspections will be performed by ADOT maintenance forces to record "brush hits" and drive away collisions, damage to the appurtenance, required repairs, routine maintenance, and evidence of near misses. The availability of replacement parts, level of technical support by the supplier, and total down time of the appurtenance will be documented. Unique problems such as vandalism or corrosion will be identified.

    * Reported accidents will be investigated by the ATRC as required. Damage to appurtenances will be documented and video taped. Accident reporting will be performed using techniques of the National Accident Sampling System or other acceptable procedures.

    * Traffic volume and mix will be obtained annually.

    * ATRC will perform scheduled inspections of the installation at 6 months, 1 year, and 2 years after construction. Interviews with maintenance personnel and DPS officers will be performed annually.

    * Annual maintenance costs will be collected by the ATRC.

7. *Evaluate in-service performance.* A before and after evaluation will be performed which evaluates the relative effectiveness of the appurtenances. Specific appurtenance performance will be evaluated on the basis of three factors: structural adequacy, occupant risk, and vehicle trajectory after collision. The evaluation criteria are as follows:

   a) Structural Adequacy: Measure of geometrical, structural and dynamic properties of an appurtenance to interact with a selected range of vehicle sizes and impact conditions in a predictable and acceptable manner. Nonvehicle collision-type forces such as wind are not included. Criteria:

      Acceptable redirection of vehicle.

      Controlled penetration of vehicle.

      Controlled stopping of a selected range of vehicle sizes impacting the installations at specified conditions.

      Detached elements, fragments, or other debris should not penetrate or show potential for penetrating the passenger compartment, or present undue hazard to other traffic.

   b) Occupant Risk: Vehicle responses of acceleration and velocity changes. Criteria:

      Vehicle remains upright during and after collision although moderate roll, pitching, and yawing are acceptable.

      Minimize velocity change in vehicle. Small cars at both low and high impact speeds are the critical test.

      Minimize vehicle velocity change prior to occupant impact.

   c) Vehicle Trajectory: Criteria:

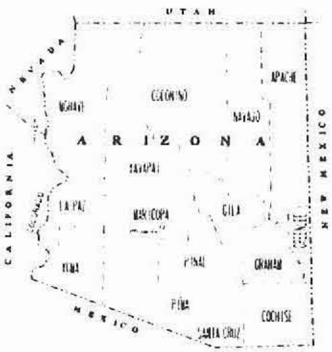
      Vehicle trajectory and final stopping position should intrude a minimum distance, if at all, into adjacent or opposing traffic.

      For longitudinal barrier terminals, vehicle trajectory behind the test article is acceptable in theory.

   The evaluation will determine if the design goals were achieved, identify special problems that affected appurtenance performance, examine impact the devices exhibited on other highway conditions, and document the initial cost and annualized maintenance cost.

8. *Prepare a final report.* A final report detailing the efforts of this study and the conclusions and recommendations will be prepared. This report will be prepared within 90 days of the completion of the final evaluation in accordance with ATRC procedures for reporting experimental projects.

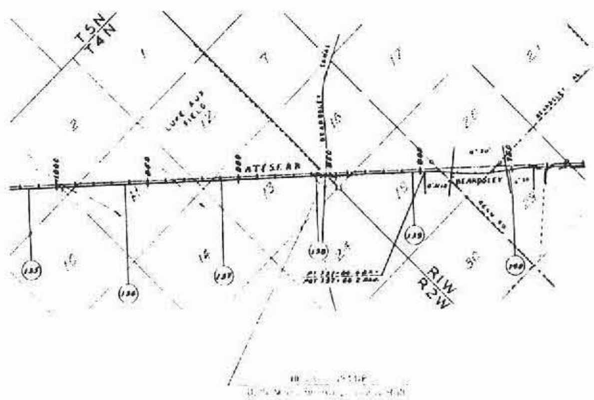
APPENDIX D - CONSTRUCTION PLANS FOR AZ-8802 (SENTRE)



STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

PLAN AND PROFILE OF PROPOSED

STATE HIGHWAY
WICKENBURG-PHOENIX HWY (US 60)
MARICOPA COUNTY
HES-022-2(33)P



ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
APPROVED: W. D. FORD
ASSISTANT DIRECTOR
STATE ENGINEER

APPROVED DATE

DEPUTY STATE ENGINEER

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED DATE

DIVISION ADMINISTRATOR

BEARDSLEY CANAL

REDUCED SIZE
DO NOT SCALE

A. D. O. T. STANDARD DRAWINGS

FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	ARIZ		1A	

CONSTRUCTION

REVISION DATE	STANDARD NO.	SUBJECT
	C-01.10	PLANS SYMBOLS
	C-01.11	PLANS SYMBOLS
	C 01.12	PLANS SYMBOLS
1-83	C 01.30	GENERAL ABBREVIATIONS
1-83	C 01.31	GENERAL ABBREVIATIONS
1/83	C 01.32	GENERAL ABBREVIATIONS
1-83	C 02.10	SLOPES, INTERSTATE & CLASS A-A ROADWAYS
1-83	C 02.20	SLOPES, CLASS A & B ROADWAYS
1-83	C 02.30	SLOPES, CLASS C & D ROADWAYS
4/83	C 02.40	PAVEMENT CROWN, PARABOLIC
1/83	C 03.10	DITCHES AND DIKES
1-83	C 03.20	CHANNELS & DIKES TYP. PARALLEL INSTALLATIONS
1-83	C-04.10	SPILLWAY, EMBANKMENT
1/83	C 04.20	DOWNDRAIN, EMBANKMENT
1/83	C 04.30	SPILLWAY, EMBANKMENT LENGTH TABLE
1-83	C 04.40	DOWNDRAIN, EMBANKMENT LENGTH TABLE
3/87	C 05.10	SINGLE CURB, CURB & GUTTER EMBANKMENT CURB
1-83	C 05.20	CONCRETE SIDEWALK & DRIVEWAY
1-83	C-06.10	TURNOUT & DRIVEWAY LAYOUT
1-83	C 6.20	GEOMETRICS, DETOUR
11-83	C 07.10	PAVEMENT, CONCRETE, TRANSVERSE JOINTS
11/83	C-07.20	PAVEMENT, CONCRETE, LONGITUDINAL JOINTS
1/83	C 07.30	PAVEMENT, CUT & REPLACEMENT
1-83	C- 8.10	GEOMETRICS, EXIT RAMP
1/83	C 8.20	GEOMETRICS, ENTRANCE RAMP
1-83	C- 9.10	GROOVING FOR BITUMINOUS SHOULDERS
1/83	C 9.20	GROOVING FOR CONCRETE SHOULDERS
1/83	C 10.01	TYPE A GUARD RAIL INSTALLATION, REFLECTOR TAB
1/83	C 10.02	TYPE B GUARD RAIL INSTALLATION, REFLECTOR TAB
7/85	C 10.03	MEASUREMENT LIMITS FOR W BEAM AND THRIE BEAM SYSTEM
7/85	C 10.04	G4(1W) AND G4(2W) BLOCKED OUT W BEAM (TIMBER POST)
7/85	C 10.05	G4(1S) AND G4(2S) BLOCKED OUT W BEAM (STEEL POST)
7/85	C 10.06	G4(1S MODIFIED) BLOCKED OUT W BEAM (STEEL POST) WITH SPECIAL CURB AND GUTTER
7/85	C 10.07	G9(A) AND G9(B) BLOCKED OUT THRIE BEAM (STEEL POST)
7/85	C 10.08	G9(C) BLOCKED OUT THRIE BEAM (STEEL POST)
1/83	C 10.09	HALF BARRIER, CAST IN PLACE, SLIP FORM
11/83	C 10.10	HALF BARRIER, CAST IN PLACE, FIXED FORM
1/83	C-10.11	HALF BARRIER, PRECAST
1/83	C 10.12	MEDIAN BARRIER, CAST IN PLACE, SLIP FORM
1/83	C-10.13	MEDIAN BARRIER, CAST IN PLACE, FIXED FORM
1/83	C 10.14	MEDIAN BARRIER, PRECAST
7/85	C 10.15	FLARED BREAKAWAY CABLE TERMINAL ASSEMBLY (TIMBER POST)
7-85	C 10.16	FLARED BREAKAWAY CABLE TERMINAL ASSEMBLY (STEEL POST)
3 87	C 10.17	BCT ASSEMBLY STEEL
10-87	C 10.18	BCT ASSEMBLY TIMBER
3/87	C 10.21	GUARD RAIL ANCHOR ASSEMBLY STEEL TERMINAL POST
6/86	C 10.22	GUARD RAIL ANCHOR ASSEMBLY TIMBER TERMINAL POST
7-85	C 10.23	BURIED & BOLTED ANCHOR TIMBER POST
7-85	C 10.24	BURIED & BOLTED ANCHOR STEEL POST
3/87	C 10.25 SH 1	TRANSITION W BEAM (TIMBER POST) TO CONCRETE HALF BARRIER
6-86	C 10.25 SH 2	TRANSITION W BEAM (TIMBER POST) TO CONCRETE HALF BARRIER
3-87	C 10.25 SH 3	TRANSITION W BEAM (TIMBER POST) TO CONCRETE HALF BARRIER
7-85	C 10.25 SH 4	TRANSITION W BEAM (TIMBER POST) TO CONCRETE HALF BARRIER
3-87	C 10.25 SH 5	TRANSITION W BEAM (TIMBER POST) TO CONCRETE HALF BARRIER
6-86	C 10.30 SH 1	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER
6 86	C 10.30 SH 2	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER
3.87	C 10.30 SH 3	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER
7/85	C 10.30 SH 4	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER
3.87	C 10.30 SH 5	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER
6-86	C 10.35 SH 1	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER, CURB INSTALLATION
6-86	C 10.35 SH 2	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER, CURB INSTALLATION
6/86	C 10.35 SH 3	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER, CURB INSTALLATION
7 85	C 10.35 SH 4	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER, CURB INSTALLATION
7-85	C 10.35 SH 5	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER, CURB INSTALLATION
6-86	C 10.40 SH 1	TRANSITION W BEAM TO CONCRETE MEDIAN BARRIER
6-86	C 10.40 SH 2	TRANSITION W BEAM TO CONCRETE MEDIAN BARRIER
7 85	C 10.40 SH 3	TRANSITION W BEAM TO CONCRETE MEDIAN BARRIER
7-85	C 10.40 SH 4	TRANSITION W BEAM TO CONCRETE MEDIAN BARRIER
7 85	C 10.45 SH 1	W BEAM BCT ATTENUATOR ASSEMBLY
7-85	C 10.45 SH 2	W BEAM BCT ATTENUATOR ASSEMBLY
6-86	C 10.45 SH 3	W BEAM BCT ATTENUATOR ASSEMBLY
7 85	C 10.45 SH 4	W BEAM BCT ATTENUATOR ASSEMBLY
7 85	C 10.45 SH 5	W BEAM BCT ATTENUATOR ASSEMBLY
7 85	C 10.50 SH 1	W BEAM BCT ATTENUATOR ASSEMBLY, CURB INSTALLATION
1-86	C 10.50 SH 2	W BEAM BCT ATTENUATOR ASSEMBLY, CURB INSTALLATION
6 86	C 10.50 SH 3	W BEAM BCT ATTENUATOR ASSEMBLY, CURB INSTALLATION
7 85	C 10.50 SH 4	W BEAM BCT ATTENUATOR ASSEMBLY, CURB INSTALLATION
7-85	C 10.50 SH 5	W BEAM BCT ATTENUATOR ASSEMBLY, CURB INSTALLATION
7-85	C 10.55 SH 1	MEDIAN W BEAM BCT ATTENUATOR ASSEMBLY
6 86	C 10.55 SH 2	MEDIAN W BEAM BCT ATTENUATOR ASSEMBLY
7-85	C 10.55 SH 3	MEDIAN W BEAM BCT ATTENUATOR ASSEMBLY
7-85	C 10.55 SH 4	MEDIAN W BEAM BCT ATTENUATOR ASSEMBLY
1-83	C 10.96	GLARE SCREEN, TYPE "F", CONC. MEDIAN BARRIER
11-83	C 10.97	GLARE SCREEN, TYPE "G", CONC. MEDIAN BARRIER

REVISION DATE	STANDARD NO.	SUBJECT
1/83	C 11.10	ROADWAY CATTLE GUARD FOOTING TYPE
1/83	C 11.11	ROADWAY CATTLE GUARD - GRILL & GRILL CLAMP DETAIL
1/83	C 11.12	ROADWAY CATTLE GUARD FOOTING TYPE, MISC. DETAILS
1/83	C-11.20	CATTLE GUARD, DRAINAGE
1/83	C-11.30	CATTLE GUARD, RAILROAD
5/85	C-12.10 SH 1	FENCE, WOVEN WIRE
5/85	C-12.10 SH 2	FENCE, BARBED WIRE
5/85	C-12.10 SH 3	FENCE, GATE, TYPE 1 & 2, FLOOD GATE
5/85	C-12.10 SH 4	FENCE, FLOOD GATE INSTALLATION
3/87	C-12.10 SH 5	FENCE, MISC. DETAILS
8/87	C 12.20 SH 1	FENCE, CHAIN LINK TYPE 1
8/87	C 12.20 SH 2	FENCE, CHAIN LINK TYPE 2
8/87	C 12.20 SH 3	FENCE, CHAIN LINK GATES
11/83	C 13.10	PIPE CULVERT INSTALLATION
5/85	C 13.15	TYPICAL PIPE INSTALLATION
1/83	C-13.20	PIPE, REINFORCED CONCRETE END SECTION
1/83	C-13.25	PIPE, CORRUGATED METAL, END SECTION
1/83	C-13.30	PIPE & PIPE ARCH, CORRUGATED METAL CONCRETE INVERT PAVING
1/83	C-13.35	STRUCTURAL EXCAVATION PAYMENT LIMITS
11/83	C-13.40	STRUC. EXC. PAYMENT LIMITS STR. BACKFILL PLACEMENT
11/83	C-13.45	STRUCTURE BACKFILL PLACEMENT
11/83	C-13.50	STRUCTURE BACKFILL MEASUREMENT
1/83	C 13.55	PIPE, CATTLE-VEHICLE PASS, MITERED END TREATMENT
1/83	C 14.10	HEADWALL, PIPE, STRAIGHT & "L" TYPES
1/83	C-14.20	HEADWALL, NORMAL TO PIPE 42" - 84" PIPE
1/83	C-14.21	HEADWALLS, 42" - 84" PIPE SKEWED
1/83	C-14.30	HEADWALL, DROP INLET
6/86	C 15.10	CATCH BASIN, TYPE 1
12/87	C 15.20	CATCH BASIN, TYPE 3
6/86	C 15.30	CATCH BASIN, TYPE 4
6/86	C 15.40	CATCH BASIN, TYPE 5
1/83	C-15.50	CATCH BASIN, GRATES, LONGITUDINAL BARS
1/83	C 15.60	CATCH BASIN, GRATES, TRANSVERSE BARS
6/86	C 15.70	CATCH BASIN MISC. DETAILS
1/83	C 15.80	CATCH BASIN, MEDIAN FLUSH
6/86	C-15.90	CATCH BASIN, MEDIAN DIKE, PRECAST
1/83	C 16.10	IRRIGATION HEADWALLS 18" TO 60" DIAMETER PIPES
1/83	C 16.20	IRRIGATION STANDPIPES
1/83	C 16.30	IRRIGATION VALVE & GATE
6/86	C-17.10	BANK PROTECTION, RAIL TYPES 1, 2 & 3
6/86	C 17.20	BANK PROTECTION, RAIL TYPES 4, 5 & 6
1/83	C-18.10	MANHOLE DETAILS
1/83	C-18.20	MANHOLE FRAME & COVER
1/83	C 19.10	FORD CONCRETE WALLS
1/83	C 19.20	FORDS TYPES 1 & 2
1/83	C 21.10	SURVEY MONUMENT, FRAME AND COVER, RIGHT OF WAY MARKER
1/83	C 21.20	STANDARD MARKER
1/83	C 22.10	UTILITY LINE, PROTECTIVE CONCRETE SLAB

STRUCTURES - 1987

REINFORCED CONCRETE BOX CULVERTS

REVISION DATE	STANDARD NO.	SUBJECT
10/86	B 01.10	MISCELLANEOUS DETAILS FOR STANDARD BOX CULVERTS
10/86	B 02.10	SINGLE BARREL BOX CULVERT
10/86	B 02.20	DOUBLE BARREL BOX CULVERT
10/86	B 02.25	DOUBLE BARREL BOX CULVERT
10/86	B 02.30	TRIPLE BARREL BOX CULVERT
10/86	B 02.35	TRIPLE BARREL BOX CULVERT
10/86	B 02.40	FOUR BARREL BOX CULVERT
10/86	B 02.45	FOUR BARREL BOX CULVERT
10/86	B 02.50	FIVE BARREL BOX CULVERT
10/86	B 02.55	FIVE BARREL BOX CULVERT
10/86	B 02.60	SIX BARREL BOX CULVERT
10/86	B 02.65	SIX BARREL BOX CULVERT
10/86	B 03.10	10' X 14' CATTLEMENT PASS
	B 04.10	OUTLET WINGS, CULVERT HEIGHT 3' TO 7', SKEW 0 TO 20
	B 04.20	OUTLET WINGS, CULVERT HEIGHT 8' TO 12', SKEW 0 TO 20
	B 04.30	INLET WINGS, CULVERT HEIGHT 3' TO 7', SKEW 0 TO 20
	B 04.40	INLET WINGS, CULVERT HEIGHT 8' TO 12', SKEW 0 TO 20
	B 04.50	INLET & OUTLET WINGS, CULVERT HEIGHT 3' TO 7', SKEW 25 TO 45
	B 04.60	INLET & OUTLET WINGS, CULVERT HEIGHT 8' TO 12', SKEW 25 TO 45
	B 05.10	HEADWALL QUANTITIES, 2:1 SLOPE
	B 05.20	HEADWALL QUANTITIES, 4:1 SLOPE
	B 05.30	HEADWALL QUANTITIES, 6:1 SLOPE
	B 06.10	OUTLET APRON DETAIL
	B 06.20	OUTLET APRON DIMENSIONS & QUANTITIES, 2:1 SLOPE
	B 06.30	OUTLET APRON DIMENSIONS & QUANTITIES, 4:1 SLOPE
	B 06.40	OUTLET APRON DIMENSIONS & QUANTITIES, 6:1 SLOPE

REVISION DATE	STANDARD NO.	SUBJECT
7/76	B-08.10	INLET OR OUTLET LEVEL WINGS, HEIGHT 3' TO 7'
7/76	B-08.20	INLET OR OUTLET LEVEL WINGS, HEIGHT 8' TO 12'

CONTINUOUS SPAN CONCRETE SLAB BRIDGES

REVISION DATE	STANDARD NO.	SUBJECT
10/86	B 09.10	CONTINUOUS SPAN SLAB, HS20 44 LOADING
8/85	B 09.20	CONTINUOUS SPAN SLAB WITH HINGE, HS20 44 LOADING
10/86	B 09.30	CONTINUOUS SPAN SLAB, INTERSTATE LOADING
8/85	B-09.40	CONTINUOUS SPAN SLAB WITH HINGE, INTERSTATE LOADING
10/86	B 10.10	SLAB HINGE JOINT AND HINGE SPAN REINFORCING DETAILS
10/86	B 10.11	SLAB HINGE JOINT AND HINGE SPAN REINFORCING DETAILS (STUD ALTERNATE)

REINFORCED CONCRETE HEADWALLS FOR PIPE CULVERTS

REVISION DATE	STANDARD NO.	SUBJECT
10/86	B 11.10	PIPE CULVERT HEADWALLS, MISCELLANEOUS DETAILS
7/76	B 12.10	INLET HEADWALL, RIGHT ANGLE PIPE CULVERT
7/76	B 12.20	OUTLET HEADWALL, RIGHT ANGLE PIPE CULVERT
9/72	B 12.30	INLET AND OUTLET HEADWALLS, RIGHT ANGLE PIPE CULVERT, 2:1 SLOPE
9/72	B 12.40	INLET AND OUTLET HEADWALLS, RIGHT ANGLE PIPE CULVERT, 4:1 SLOPE
9/72	B 12.50	INLET AND OUTLET HEADWALLS, RIGHT ANGLE PIPE CULVERT, 6:1 SLOPE
7/76	B 13.10	INLET AND OUTLET HEADWALLS, 15 SKEW PIPE CULVERT
9/72	B 13.20	INLET AND OUTLET HEADWALLS, 15 SKEW PIPE CULVERT, 2:1 SLOPE
9/72	B 13.30	INLET AND OUTLET HEADWALLS, 15 SKEW PIPE CULVERT, 4:1 SLOPE
9/72	B 13.40	INLET AND OUTLET HEADWALLS, 15 SKEW PIPE CULVERT, 6:1 SLOPE
7/76	B 14.10	INLET AND OUTLET HEADWALLS, 30 SKEW PIPE CULVERT
9/72	B 14.20	INLET AND OUTLET HEADWALLS, 30 SKEW PIPE CULVERT, 2:1 SLOPE
9/72	B 14.30	INLET AND OUTLET HEADWALLS, 30 SKEW PIPE CULVERT, 4:1 SLOPE
9/72	B 14.40	INLET AND OUTLET HEADWALLS, 30 SKEW PIPE CULVERT, 6:1 SLOPE
7/76	B 15.10	INLET AND OUTLET HEADWALLS, 45 SKEW PIPE CULVERT
9/72	B-15.20	INLET AND OUTLET HEADWALLS, 45 SKEW PIPE CULVERT, 2:1 SLOPE
9/72	B 15.30	INLET AND OUTLET HEADWALLS, 45 SKEW PIPE CULVERT, 4:1 SLOPE
9/72	B 15.40	INLET AND OUTLET HEADWALLS, 45 SKEW PIPE CULVERT, 6:1 SLOPE
9/72	B 16.10	MULTIPLE HEADWALLS
9/72	B 17.10	OUTLET APRONS
9/72	B 17.20	OUTLET APRON STEEL LIST 2:1 SLOPE
9/72	B 17.30	OUTLET APRON STEEL LIST 4:1 SLOPE
9/72	B 17.40	OUTLET APRON STEEL LIST 6:1 SLOPE

RETAINING WALLS

REVISION DATE	STANDARD NO.	SUBJECT
10/86	B 18.10	CANTILEVER RETAINING WALL DETAILS
12/82	B 18.20	CANTILEVER RETAINING WALLS ON SPREAD FOOTING
12/82	B 18.30	CANTILEVER RETAINING WALLS ON STEEL PILES
3/83	B 18.40	CANTILEVER RETAINING WALLS ON CONCRETE PILES

MISCELLANEOUS STANDARDS

REVISION DATE	STANDARD NO.	SUBJECT
10/86	B 19.10	MISCELLANEOUS DETAILS FOR BRIDGES
10/86	B 19.20	SLOPE PAVING DETAILS
2/82	B 20.10	PRECAST AND CAST IN PLACE CONCRETE PILES
12/82	B 20.20	PRESTRESSED CONCRETE PILES
8/85	B 21.10	W BEAM TERMINAL CONNECTOR, DADO CONNECTION
8/85	B 21.18	BRIDGE CONCRETE BARRIER DETAILS
10/86	B 21.19	BRIDGE CONCRETE BARRIER TRANSITION WITH CURB
10/86	B 21.20	BRIDGE CONCRETE BARRIER TRANSITION
10/86	B 21.21	BLOCK AND TERMINAL CONNECTOR ASSEMBLY DETAILS
	B 22.40	TRAFFIC AND PEDESTRIAN RAIL
	B 22.41	TRAFFIC AND PEDESTRIAN RAIL
	B 22.50	PEDESTRIAN FENCE DETAILS WITH CURB
	B 22.60	PEDESTRIAN FENCE DETAILS WITH PARAPET
10/86	B 23.10	RAIL BANK PROTECTION FOR BRIDGES
10/86	B 24.10	ROADWAY JOINT STEEL
10/86	B 24.11	ROADWAY JOINT STEEL (STUD ALTERNATE)
10/86	B 24.20	ROADWAY JOINT POLYCHLOROPRENE
10/86	B 24.21	ROADWAY JOINT POLYCHLOROPRENE (STUD ALTERNATE)
	B 30.10	CONCRETE SOUND BARRIER WALLS
	B 30.20	MASONRY SOUND BARRIER WALLS

REDUCED SIZE
DO NOT SCALE

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ		18		

A. D. O. T. STANDARD DRAWINGS

REVISION DATE	STANDARD NO.	SUBJECT
		SIGNING & MARKING DETAILS
7/85	4 M 1.01	PAVEMENT MARKINGS FOR CROSSWALKS, PARKING & INTERSECTIONS
1/77	4 M 1.02	CURB MARKINGS FOR RAISED MEDIAN & ISLANDS
8/86	4 M 1.03	PAINTED CHANNELIZATION
8/86	4 M 1.03.1	CENTERLINE AND REVERSE CURVE DETAILS
10/82	4 M 1.04	INSPECTION STATION MARKINGS FOR FREEWAYS
10/82	4 M 1.05	INSPECTION STATION MARKINGS FOR NON FREEWAYS
10/82	4 M 1.06	TRANSITION STRIPING TWO LANE TO FOUR LANE
10/82	4 M 1.07	STRIPING AND DELINEATION FOR FREEWAY TERMINALS
11/78	4 M 1.08	UPHILL PASSING LANE STRIPING DETAILS
7/85	4 M 1.09	STRIPING FOR ENTRANCE RAMPS, EXIT RAMPS AND EDGE LINES
10/82	4 M 1.10	APPROACH MARKINGS FOR OBSTRUCTIONS IN THE ROADWAY
1/87	4 M 1.11	RAILROAD MARKINGS
7/85	4 M 1.12	8' WORD MARKINGS
7/85	4 M 1.13	8' PAVEMENT LETTERS
6/85	4 M 1.14	8' PAVEMENT LETTERS
6/85	4 M 1.15	8' PAVEMENT NUMBERS
8/86	4 M 1.16	STORAGE LANE MARKINGS AND ARROW DETAILS
10/82	4 M 1.17	PLACEMENT OF CENTERLINES, LANE LINES & EDGE LINES
5/83	4 M 1.18	TURNING LANE TYPICAL PAVEMENT MARKINGS
7/85	4 M 1.23	FREEWAY PAVEMENT MARKINGS
5/87	4 M 1.25	STRIPING AND DELINEATION FOR TRUCK ESCAPE RAMPS
7/87	4 M 2.02	RAISED PAVEMENT MARKER DETAILS
7/87	4 M 2.03	STRIPING DETAILS
12/84	4 M 2.04	TYPICAL INSTALLATIONS OF RAISED PAVEMENT MARKERS
9/86	4 M 2.05	TEMPORARY PAVEMENT MARKERS FOR CHIP SEAL PROJECTS
7/87	4 M 2.10	RUMBLE STRIP DETAILS
7/87	4 M 3.01	OBJECT MARKER DETAILS
8/86	4 M 3.02	OBJECT MARKER PLACEMENT DETAILS
1/85	4 M 3.03	OBJECT MARKER FOR SAND BARREL CRASH CUSHION
2/85	4 M 3.04	OBJECT MARKER FOR G.R.E.A.T. CRASH CUSHION
7/87	4 M 4.01	DELINEATOR DETAILS
8/86	4 M 4.02	ROADWAY DELINEATOR PLACEMENT
8/86	4 M 4.03	INTERCHANGE DELINEATOR SPACING
10/82	4 M 4.04	TRANSITION DELINEATION
8/86	4 M 5.01	MILEPOST DETAILS
10/82	4 M 6.01	OFF MAINLINE REFERENCE MARKER DETAILS
10/82	4 M 9.01	SNOW MARKER DETAILS
7/85	4 M 10.01	BRIDGE & BARRIER MARKER DETAILS
9/81	4 M 10.02	BRIDGE & BARRIER MARKER PLACEMENT & INSTALLATION DETAILS
7/87	4 M 10.03	GUARDRAIL B.C.F. DELINEATION DETAILS
10/82	4 S 1.01	INSPECTION STATION SIGNING FOR FREEWAYS
10/82	4 S 1.02	INSPECTION STATION SIGNING NON FREEWAYS
7/81	4 S 1.03	TRANSITION SIGNING FOR FREEWAY TERMINALS
6/78	4 S 1.04	TRANSITION SIGNING
6/74	4 S 1.05	SIGNING FOR UPHILL PASSING LANES
8/86	4 S 1.06	STANDARD SAFETY PULLOUT SIGNING
6/74	4 S 1.07	TYPICAL CROSSROAD SIGNING TRUMPET INTERCHANGE
7/80	4 S 1.08	TYPICAL CROSSROAD SIGNING CLOVERLEAF INTERCHANGE
6/80	4 S 1.09	TYPICAL CROSSROAD SIGNING DIAMOND INTERCHANGE
10/78	4 S 1.10	TYPICAL REST AREA INTERIOR SIGNING
11/87	4 S 1.11	TYPICAL INTERCHANGE REGULATORY SIGNING SIGNALIZED ONE WAY STREET
11/87	4 S 1.12	TYPICAL INTERCHANGE REGULATORY SIGNING SIGNALIZED NARROW MEDIAN
8/86	4 S 1.13	TYPICAL INTERCHANGE REGULATORY SIGNING SIGNALIZED WIDE MEDIAN
8/86	4 S 1.14	TYPICAL INTERCHANGE REGULATORY SIGNING STOP SIGN CONTROL
3/83	4 S 1.15	TYPICAL RAILROAD CROSSING SIGNING
3/87	4 S 1.16	TYPICAL SIGNING TRUCK ESCAPE RAMP
8/86	4 S 2.01	EXIT NUMBER PANEL AND EXIT SIGN FORMAT
9/86	4 S 2.02	REST AREA SIGN FORMAT
11/74	4 S 2.03	SCENIC VIEW SIGN FORMAT
11/85	4 S 2.04	SERVICES SIGN FORMAT
8/85	4 S 2.05	SERVICES SIGN FORMAT
8/85	4 S 2.06	SERVICES SIGN FORMAT
9/86	4 S 2.07	SERVICES SIGN FORMAT
6/74	4 S 2.08	ARROW FORMAT DETAILS
10/87	4 S 3.01	ALUMINUM EXTRUSION SIGN PANEL DETAILS
10/87	4 S 3.01.1	ALUMINUM EXTRUSION EXIT NUMBER PANEL DETAIL
10/87	4 S 3.02	LAMINATED ALUMINUM SIGN PANEL DETAILS
10/87	4 S 3.02.1	LAMINATED ALUMINUM SIGN PANEL MOUNTING DETAILS
6/74	4 S 3.04	OVERLAID PLYWOOD PANEL DETAILS FOR GROUND MOUNTED SIGNS
4/86	4 S 4.01	BREAKAWAY POST LOCATION GUIDE SIGNS
4/86	4 S 4.02	BREAKAWAY POST LOCATIONS WARNING & REGULATORY
4/86	4 S 4.03	TENSION FUSE PLATE AND HINGE
3/87	4 S 4.04	BREAKAWAY POST DETAILS W SHAPE GUIDE SIGNS
3/87	4 S 4.05	BREAKAWAY POST DETAILS S SHAPES
10/87	4 S 4.06	EXIT NUMBER PANELS INSTALLATION DETAILS
6/74	4 S 4.07	AUXILIARY SIGN INSTALLATION DETAILS
7/76	4 S 4.08	SIGN INSTALLATION DETAILS WING CHANNEL
5/74	4 S 4.09	SIGN INSTALLATION DETAILS WARNING & REGULATORY
4/86	4 S 4.10	SIGN INSTALLATION ON POLE
6/74	4 S 4.11	SIGN INSTALLATION ON SIGNAL POLE

REVISION DATE	STANDARD NO.	SUBJECT
6/74	4-S 4.12	CROSSROAD SIGN MOUNTING DETAILS BREAKAWAY POSTS
11/74	4 S 4.13	CROSSROAD AUX. SIGN PANEL MOUNTING DETAIL BREAKAWAY POSTS
11/74	4 S 4.14	TYPICAL STANDARD SIGN LOCATIONS FOR CROSSROAD SIGNING
1/83	4-S 4.16	FOUNDATION DETAILS FOR P-1 PERFORATED POST (SINGLE)
11/74	4-S 4.17	FOUNDATION DETAILS FOR P-2 PERFORATED POST (TELESCOPING)
6/80	4-S 4.18	SIGN PANEL MOUNTING ON PERFORATED POSTS
8/86	4-S 4.19	MILEPOST DETAILS
6/74	4 S 4.20	OVERHEAD SIGN LIGHTS
1/83	4-S 5.01	TAPERED TUBE SIGN STRUCTURE
3/83	4-C 1.01	SAND BARREL CRASH CUSHION
8/86	4-C 1.02	SAND BARREL CRASH CUSHION TYPICAL INSTALLATION
11/80	4-C 1.03	SAND BARREL CRASH CUSHION MODULE COMPONENTS
3/83	4-C 2.01	TEMPORARY CONCRETE BARRIER
3/83	4-C-2.02	TEMPORARY CONCRETE BARRIER TYPICAL INSTALLATIONS
3/83	4-C-2.03	TEMPORARY CONCRETE BARRIER TYPICAL INSTALLATIONS
11/80	2-S-5.01	OVERHEAD SIGN STRUCT. 8 PANEL TRUSS #1 TO #3 ONE WAY TRAFFIC
6/74	2-S 5.02	OVERHEAD SIGN STRUCT. 10 PANEL TRUSS #4 TO #10 ONE WAY TRAFFIC & TWO WAY TRAFFIC
6/74	2-S 5.03	OVERHEAD SIGN STRUCT. 16 PANEL TRUSS #11 TO #16 ONE WAY TRAFFIC
6/74	2-S-5.04	OVERHEAD SIGN STRUCT. 16 PANEL TRUSS #11 TO #16 TWO WAY TRAFFIC
6/74	2-S-5.05	OVERHEAD SIGN STRUCT. 16 PANEL TRUSS #17 TO #25 FIELD SPLICE TWO WAY TRAFFIC
6/74	2-S 5.06	OVERHEAD SIGN STRUCT. 16 PANEL TRUSS #17 TO #25 FIELD SPLICE ONE WAY TRAFFIC
11/74	2-S-5.07	OVERHEAD SIGN STRUCT. GENERAL RECAP SHEET
11/74	2-S 5.08	OVERHEAD SIGN STRUCT. TRUSS DETAILS
6/74	2-S 5.09	OVERHEAD SIGN STRUCT. TRUSS DETAILS
11/74	2-S-5.10	OVERHEAD SIGN STRUCT. COLUMN DETAILS
11/74	2-S 5.11	OVERHEAD SIGN STRUCT. COLUMN DETAILS
6/74	2-S 5.12	OVERHEAD SIGN STRUCT. WALKWAY SUPPORT-GRATING-HDRL & DRIP PAN DETAILS
11/74	2-S 5.13	OVERHEAD SIGN STRUCT. WALKWAY SUPPORT-GRATING-HDRL & DRIP PAN DETAILS
11/74	2-S 5.14	OVERHEAD SIGN STRUCT. WALKWAY SUPPORT-HANDRAIL & SIGN CONNECTION DETAILS
11/74	2-S 5.15	OVERHEAD SIGN STRUCT. GRATING SIGN CONNECTION DETAILS
8/86	2-S 5.16	OVERHEAD SIGN STRUCT. FOUNDATION DETAILS
5/87	2-S 5.17	CANTILEVER TRAFFIC SIGN STRUCTURE
5/87	2-S 5.18	CANTILEVER SIGN LAYOUT DETAILS
5/87	2-S 5.19	CANTILEVER SIGN TOWER DETAILS
5/87	2-S 5.20	CANTILEVER SIGN TRUSS DETAILS NO. 1
5/87	2-S 5.21	CANTILEVER SIGN TRUSS DETAILS NO. 2
5/87	2-S 5.22	CANTILEVER SIGN HANDRAIL DETAILS
5/87	2-S 5.23	CANTILEVER SIGN HANDRAIL SUPPORT DETAILS
5/87	2-S 5.24	CANTILEVER SIGN LADDER AND GRATING DETAILS
5/87	2-S 5.25	CANTILEVER SIGN SIGN CONNECTION DETAILS
5/87	2-S 5.26	CANTILEVER SIGN OVERHEAD LIGHT SUPPORT MOUNTING DETAILS
5/87	2-S 5.27	CANTILEVER SIGN FOUNDATION DETAILS
		TRAFFIC SIGNALS & LIGHTING DETAILS
	T.S. 0	SYMBOLS
7/85	0-1	PLAN SYMBOLS
	T.S. 1	PULL BOXES
7/85	1-1	NO. 3 1/2 PULL BOX
7/85	1-2	NO. 5 PULL BOX
7/85	1-3	NO. 5 PULL BOX EXTENSION
7/85	1-4	NO. 7 PULL BOX
7/85	1-5	NO. 7 PULL BOX EXTENSION
10/86	1-6	TYPICAL PULL BOX INSTALLATION AND WIRING DETAILS
	T.S. 2	FOUNDATIONS
11/87	2-1	FOUNDATION FOR TYPE II LOAD CENTER CABINET
11/87	2-2	FOUNDATION FOR TYPE III CONTROL CABINET
11/87	2-3	FOUNDATION FOR TYPE IV & V CONTROL CABINETS
	T.S. 3	CABINETS
7/85	3-1	TYPE I LOAD CENTER CABINET
10/86	3-2	TYPE II LOAD CENTER CABINET
10/86	3-3	TYPE II LOAD CENTER CABINET CIRCUIT DETAILS
11/87	3-4	TYPE III LOAD CENTER CABINET AND FOUNDATION
7/85	3-5	TYPE III LOAD CENTER CABINET CIRCUIT DETAILS
11/87	3-6	TYPE IV LOAD CENTER CABINET AND FOUNDATION
7/85	3-7	TYPE IV LOAD CENTER CABINET CIRCUIT DETAILS
7/85	3-8	TYPE I PEDESTAL CABINET AND FOUNDATION
7/85	3-9	TYPE I CONTROL CABINET
7/85	3-10	TYPE II CONTROL CABINET
11/87	3-11	TYPE III CONTROL CABINET
11/87	3-12	TYPE IV CONTROL CABINET
11/87	3-13	TYPE V CONTROL CABINET
7/85	3-14	CONTROL CABINET MOUNTED SERVICE ENCLOSURE
7/85	3-15	JACK MOUNTED COMPONENTS
7/85	3-16	METER PEDESTAL CABINET
10/86	3-17	CONTROL CABINET MOUNTED SERVICE EQUIPMENT
	T.S. 4	POLES AND POSTS
10/86	4-1	TYPE 'A' POLE
10/86	4-2	TYPE 'B' POLE AND MAST ARM
10/86	4-3	TYPE 'C' POLE AND MAST ARM
10/86	4-4	TYPE 'D' POLE AND MAST ARM
10/86	4-5	TYPE 'E' POLE AND MAST ARM
10/86	4-6	TYPE 'F' POLE AND MAST ARMS
10/86	4-7	TYPE 'G' POLE AND MAST ARM

REVISION DATE	STANDARD NO.	SUBJECT
10/86	4-8	TYPE 'H' POLE AND MAST ARM
10/86	4-9	TYPE 'I' POLE AND MAST ARM
10/86	4-10	TYPE 'J' POLE AND MAST ARM
11/87	4-11	TYPE 'K' POLE AND MAST ARM
10/86	4-12	TYPE 'Q' POLE AND MAST ARMS
11/87	4-13	TYPE 'R' POLE AND MAST ARMS
10/86	4-14	TYPE 'S' POLE
10/86	4-15	TYPE 'T' POLE AND LUMINAIRE MOUNTING BRACKET
10/86	4-16	TYPE 'U' POLE AND ANCHORAGE DETAIL
10/86	4-17	POLE HAND HOLE DETAIL
10/86	4-18	POLE DRILLING DETAIL
7/85	4-19	PEDESTRIAN PUSH BUTTON POST
10/86	4-20	ANCHOR BOLTS
	T.S. 5	POLE BASES - SPECIAL
7/85	5-1	BREAK AWAY BASE FOR 30' POLE
10/86	5-2	SLIP AWAY BASE FOR 30' POLE
10/86	5-3	SLIP AWAY BASE FOR 40' - 50' POLES
	T.S. 6	LIGHTING - POLE OFFSETS
7/85	6-1	HIGHWAY LIGHTING OFFSETS IN CUT AND FILL SECTIONS
	T.S. 7	DETECTORS
7/85	7-1	LOOP DETECTOR LOCATION AND INSTALLATION DETAILS
7/85	7-2	MAGNETOMETER DETECTOR
6/86	7-3	LOOP DETECTORS FOR TRAFFIC COUNTERS
7/85	7-4	TYPICAL LOOP INSTALLATION FOR RAMP METERING
	T.S. 8	SIGNAL ASSEMBLIES
10/86	8-1	SIGNAL FACES WITH BACKPLATES
7/85	8-2	VISORS FOR 8" AND 12" SIGNALS
	T.S. 9	MOUNTING ASSEMBLIES - SIGNAL
7/85	9-1	TYPE I & II MOUNTING ASSEMBLIES
7/85	9-2	TYPE III & IV MOUNTING ASSEMBLIES
7/85	9-3	TYPE V MOUNTING ASSEMBLY
7/85	9-4	TYPE VI MOUNTING ASSEMBLY
7/85	9-5	TYPE VII MOUNTING ASSEMBLY
7/85	9-6	TYPE VIII MOUNTING ASSEMBLY
7/85	9-7	TYPE IX MOUNTING ASSEMBLY
7/85	9-8	TYPE X MOUNTING ASSEMBLY
7/85	9-9	TYPE XI MOUNTING ASSEMBLY
	T.S. 10	MOUNTING CASTINGS - SIGNAL
7/85	10-1	MISCELLANEOUS SIGNAL MOUNTING PARTS
7/85	10-2	MAST ARM PLUMBIZER
7/85	10-3	POLE PLATE DETAIL
7/85	10-4	TERMINAL COMPARTMENT, SIDE MOUNTED AND POLE TOP MOUNTED
	T.S. 11	PEDESTRIAN DETAILS
7/85	11-1	TYPE I PEDESTRIAN PUSH BUTTON
7/85	11-2	TYPE II PEDESTRIAN PUSH BUTTON
7/85	11-3	SIGNS FOR PEDESTRIAN PUSH BUTTON
7/85	11-4	SIGNS FOR INTERNATIONAL SYMBOL PUSH BUTTON
	T.S. 12	FLASHERS
7/85	12-1	POLE FLASHER
7/85	12-2	OVERHEAD FLASHER DETAIL
	T.S. 13	ILLUMINATION - SIGNS
7/85	13-1	OVERHEAD SIGN LIGHTING & FLUORESCENT FIXTURE DETAIL
7/85	13-2	SIGN LIGHTING & FLUORESCENT FIXTURE DETAILS
7/85	13-3	PLACEMENT OF LIGHTING FIXTURES FOR OVERHEAD SIGNS
	T.S. 14	ILLUMINATION - SPECIAL
7/85	14-1	PEDESTRIAN TUNNEL LIGHT FIXTURE
	T.S. 15	SERVICE
7/85	15-1	120/240 V. SERVICE
7/85	15-2	120/240 V. SERVICE WITH CONTROL ENCLOSURE
7/85	15-3	240/480 V. SERVICE
7/85	15-4	240/480 V. SERVICE WITH CONTROL ENCLOSURE
7/85	15-5	PHOTO ELECTRIC CELL MOUNTING DETAILS
7/85	15-6	POLE MOUNTED BREAKER PANEL & TRANSFORMER
7/85	15-7	SPLIT CIRCUIT BREAKER MAIN DISCONNECT

REDUCED SIZE
DO NOT SCALE

FAHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.	HES-027-2(33)P	2	10	

LENGTH OF PROJECT

Sta 847+00 to 860+00 = 1300'
MP 137.99 to 138.24
Total Length = 0.25 Miles

INDEX OF SHEETS

Sheet No.	Sheet Type
1	Face Sheet
1a - 1b	List of Standards Sheets
2	Design Sheet
3	Barrier Summary Sheet
4	Special Detail Sheet
5	Plan Sheet
6-7	Traffic Design Sheets
8-10	Structure Sheets

REFERENCES

Milepost Log
Structures Log
S N F A 84-A (3)

DESIGN DATA

1988 ADT = 8350
2008 ADT = 15350
Min Design Speed = 60 MPH

Item # 520
FC # 82520
Dist 3
Route US 60

GENERAL NOTES

The roadway plans for this project have been designed using the 1986 Construction Standard Drawings (C Series) and current revisions.

Delineators, Object Markers, and Milepost Markers which interfere with the project shall be removed and reinstalled as directed by the Engineer.

It is intended that the Grader Roads be constructed with a minimal amount of earthwork, and minimal disturbance to existing topography.

	NAME	DATE
DESIGN	Gene Clough	1-88
DRAWN	Gene Clough	1-88
CHECKED	M. Vigaraces	4-88
TEAM LEADER	M. Vigaraces	4-88

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
HIGHWAY PLANS SERVICES

DESIGN SHEET

US 60 | 138.0 | BEARDSLEY CANAL STRUCTURE

9	AZ	RES 027 2(33)P	3	10

Beginning Station (Approximate)	Plan Reference No.	'A' C-10.01, 'B' C-10.02	TYPE INSTALLATION: New Guard Rail (Linear Feet)	Reconstruct Guard Rail (Linear Feet)	Construct Guard Rail from Salvage (Linear Feet)	Remove and Salvage Guard Rail (Linear Feet)	Remove Guard Rail (Linear Feet)	Reconstruct BCT	Construct BCT from Salvage	Remove and Salvage BCT	Timber C-10.04	Steel *	BARRIER TYPE: Guard Rail Full C-10.12,13&14	Guard Rail Half C-10.09,10&11	Concrete Barrier Linear Feet	END TREATMENT: Anchor Steel C-10.21	Anchor Timber C-10.22	Anchor Each	End Posts C-10.17 Steel / C-10.18 Timber	BCT Assembly Timber C-10.15	BCT Assembly Steel C-10.16&17	BCT Assembly Each	MISCELLANEOUS: Bolted Anchor Timber C-10.23	Bolted Anchor Steel C-10.24	Bolted Anchor Each	Buried Anchor Timber C-10.23	Buried Anchor Steel C-10.24	Buried Anchor Linear Feet	TRANSITION: W-Beam or Thrie-Beam Timber C-10.25	W-Beam or Thrie-Beam Steel C-10.30	W-Beam or Thrie-Beam Standard or Detail	W-Beam or Thrie-Beam Each	Rub Rail (Each) New	Rub Rail (Each) Reconstruct	Rub Rail C-10.25	Rub Rail C-10.30	Rub Rail Standard or Detail	Half Barrier Linear Feet	Half Barrier Standard or Detail	ATTENUATOR: Each	ATTENUATOR: Standard or Detail	GLARE SCREEN: Linear Feet	REMARKS
LT 849+87	1	A	162.5								X	X							X		X	1							X	X	Std	1	1										• Steel Post Guard Rail Std C-10.05; Transition on Bridge
RT 848+37	2	A	312.5								X	X							X		X	1							X	X	Std	1	1										• Steel Post Guard Rail Std C-10.05; Transition on Bridge
LT 851+16	3						33																																				
RT 851+16	4						33																																				
LT 852+61	5						50																																				
RT 852+61	6						50																																				
LT 852+61	7	A	237.5								X	X							X		X	1							X	X	Std	1	1										• Steel Post Guard Rail Std C-10.05; Transition on Bridge
RT 852+61	8	A	237.5								X	X							X		X	1							X	X	Std	1	1										• Steel Post Guard Rail Std C-10.05; Transition on Bridge
LT 855+56	9		12.5									X																											Detail A	1			See Detail A Std C-10.07
RT 855+56	10		12.5									X																											Detail A	1			See Detail A Std C-10.07
LT 856+13	11		12.5									X																											Detail A	1			See Detail A Std C-10.07
RT 856+13	12		12.5									X																											Detail A	1			See Detail A Std C-10.07
Total			[illegible]				[illegible]															4										4	4										

(42) Reference numbers correspond to numbers in diamonds on plan sheets.

* [illegible] bearing plates utilized with Standard Drawings C-10.17 and C-10.18 shall conform to ASTM [illegible] that the dimension from bottom of plate to center of hole shall be 2½".

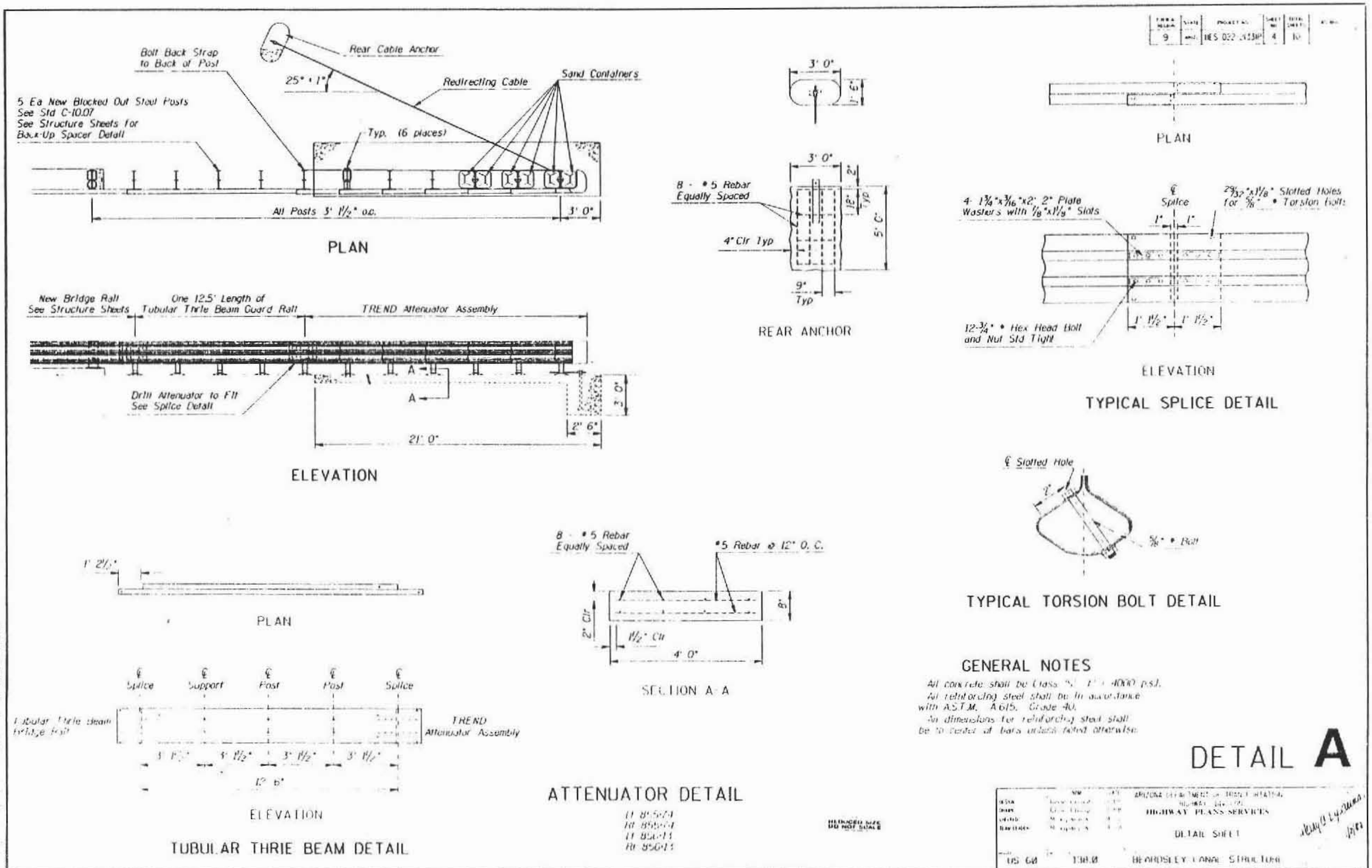
NOTE:
All barrier items shown in the summary shall be delineated in accordance with Standard Drawings 4-M-10.02, 4-M-10.03 and other standard drawing referenced thereon. No separate measurement or payment will be made for this work.

REDUCED SIZE DO NOT SCALE

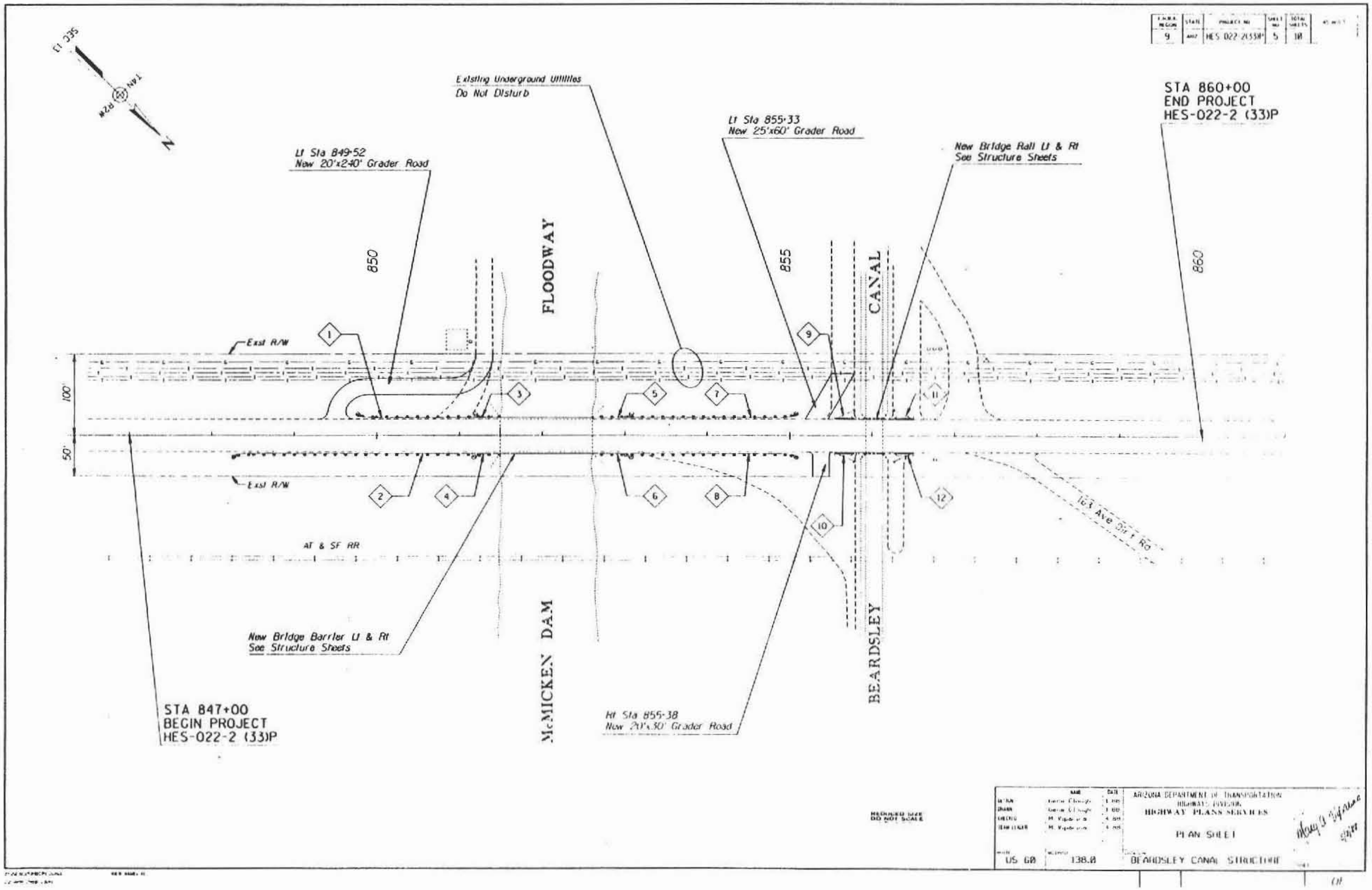
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
HIGHWAY PLANS SERVICES

BARRIER SUMMARY SHEET

US 60 | 138.0 | BEARDSLEY CANAL STRUCTURE



9
HES 022-A(33)P
4
10
Bolt Back Strap to Back of Post
Rear Cable Anchor
25° ± 1°
Redirecting Cable
Sand Containers
5 Ea New Blocked Out Steel Posts
See Std C-10.07
See Structure Sheets for Back-Up Spacer Detail
Typ. (6 places)
All Posts 3' 1½" o.c.
3' 0"
PLAN
New Bridge Rail
See Structure Sheets
One 12.5' Length of Tubular Thrie Beam Guard Rail
TREND Attenuator Assembly
Drill Attenuator to Fit
See Splice Detail
A
A
3' 0"
2' 6"
21' 0"
ELEVATION
3' 0"
1' 6"
3' 0"
8 - #5 Rebar Equally Spaced
4" Clr Typ
5' 0"
9" Typ
REAR ANCHOR
PLAN
℄ Splice
4 - 1¾"x3/16"x2' 2" Plate Washers with ⅞"x1⅛" Slots
29/32"x1⅛" Slotted Holes for ⅝" # Torsion Bolts
1" 1"
12-¾" # Hex Head Bolt and Nut Std Tight
1' 1½" 1' 1½"
ELEVATION
TYPICAL SPLICE DETAIL
℄ Slotted Hole
⅝" # Bolt
TYPICAL TORSION BOLT DETAIL
1' 2½"
PLAN
℄ Splice
℄ Support
℄ Post
℄ Post
℄ Splice
Tubular Thrie Beam Bridge Rail
TREND Attenuator Assembly
3' 1½"
3' 1½"
3' 1½"
3' 1½"
12' 6"
ELEVATION
TUBULAR THRIE BEAM DETAIL
8 - #5 Rebar Equally Spaced
#5 Rebar @ 12" O. C.
8"
2" Clr
1½" Clr
4' 0"
SECTION A-A
ATTENUATOR DETAIL
GENERAL NOTES
All concrete shall be Class "S" f'c = 4000 p.s.i.
All reinforcing steel shall be in accordance with A.S.T.M. A615, Grade 40.
All dimensions for reinforcing steel shall be to center of bars unless noted otherwise.
DETAIL A
REDUCED SIZE DO NOT SCALE
ARIZONA DEPARTMENT of TRANSPORTATION
HIGHWAY PLANS SERVICES
DETAIL SHEET
US 60
138.0
BEARDSLEY CANAL STRUCTURE



9
HES 022-2(33)P
5
10
STA 860+00
END PROJECT
HES-022-2 (33)P
Existing Underground Utilities
Do Not Disturb
Lt Sta 855+33
New 25'x60' Grader Road
New Bridge Rail Lt & Rt
See Structure Sheets
Lt Sta 849+52
New 20'x240' Grader Road
850
855
860
FLOODWAY
CANAL
Exst R/W
100'
50'
AT & SF RR
163 Ave Dirt Rd
New Bridge Barrier Lt & Rt
See Structure Sheets
McMICKEN DAM
BEARDSLEY
STA 847+00
BEGIN PROJECT
HES-022-2 (33)P
Rt Sta 855+38
New 20'x30' Grader Road
REDUCED SIZE
DO NOT SCALE
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAY PLANS SERVICES
PLAN SHEET
US 60
138.0
BEARDSLEY CANAL STRUCTURE

GENERAL NOTES:

1. ADJUSTMENTS TO SIGNS AND THEIR LOCATIONS MAY BE NECESSARY DUE TO CONSTRUCTION ACTIVITIES, AS DIRECTED BY THE ENGINEER.
2. ALL EXISTING SIGNS IN CONFLICT WITH THE CONSTRUCTION SIGNS SHALL BE REMOVED, COVERED WITH PLYWOOD, OR RELOCATED.
3. SIGN MOUNTING HEIGHT IS A MINIMUM FIVE FEET AS MEASURED FROM THE BOTTOM OF THE SIGN TO THE NEAR EDGE OF THE PAVEMENT.
4. ALL ORANGE CONSTRUCTION SIGNS SHALL USE HIGH INTENSITY REFLECTIVE SHEETING. ALL OTHER SIGNS MAY USE STANDARD INTENSITY REFLECTIVE SHEETING.
5. FLASHING WARNING LIGHTS (TYPE A) AND FLAGS SHALL BE USED TO CALL ATTENTION TO THE WARNING SIGNS.
6. ALL SIGNS ARE BLACK LETTERS ON AN ORANGE BACKGROUND, UNLESS OTHERWISE NOTED.
7. TYPE II BARRICADES ARE TO BE PLACED FORTY FEET O. C. ALONG TAPERS AND EIGHTY FEET O. C. ALONG TANGENTS.
8. A STEADY BURNING YELLOW LIGHT (TYPE C) SHALL BE MOUNTED ON EVERY TYPE II BARRICADE.
9. TEMPORARY CONCRETE BARRIER SHALL REMAIN IN PLACE UNTIL ALL NECESSARY WORK TO COMPLETE BRIDGE BARRIER AND APPROACH GUARDRAIL IS FINISHED.
10. FOR TEMPORARY CONCRETE BARRIER DETAILS, SEE STANDARD DRAWING NUMBERS 4-C-2.01, 4-C-2.02, AND 4-C-2.03.
11. BARRIER MARKERS BM 1 (WHITE) OR BM 2 (YELLOW) SHALL BE INSTALLED AT 25 FT. SPACING AS PER STANDARD DRAWING 4-M-10.01 AND 4-M-10.02. THE INSTALLED PRICE FOR THE MARKER SHALL BE CONSIDERED AS PART OF THE BARRIER COST.
12. SPEED LIMIT MAY BE CHANGED AS DIRECTED BY THE ENGINEER.
13. TRAFFIC CONTROL CONSTRUCTION SIGNS SHALL NOT BE DISPLAYED TO TRAFFIC MORE THAN 24 HRS. PRIOR TO ACTUAL START OF CONSTRUCTION. THESE SIGNS MAY BE INSTALLED SOONER, BUT THEY MUST BE COVERED OR TURNED AWAY FROM TRAFFIC. THE COST FOR COVERING OR TURNING THEM SHALL BE CONSIDERED PART OF THE SIGN INSTALLATION COST. NO FURTHER COMPENSATION WILL BE MADE. THESE SIGNS SHALL BE REMOVED WITHIN 24 HRS. AFTER COMPLETION OF THE CONSTRUCTION ACTIVITIES.
14. TEMPORARY STRIPES SHALL BE REFLECTORIZED PLASTIC PAVEMENT MARKING TAPE (TYPE II) OR STANDARD TRAFFIC PAINT. THE PAVEMENT TEMPERATURE MUST BE 60° F. OR HIGHER WHEN TAPE IS APPLIED TO PAVEMENT. IF PAVEMENT TEMPERATURE IS BELOW 60° F., STANDARD TRAFFIC PAINT SHALL BE USED AND STRIPES SHALL BE OBLITERATED BY SANDBLASTING OR OTHER APPROVED METHODS WHEN DETOUR IS COMPLETED.

APPROXIMATE TRAFFIC CONTROL QUANTITIES

ITEM		McMICKEN DAM FLOODWAY STA. 851 +		BEARDSLEY CANAL STA. 855 +		TOTAL QUANTITIES
		NORTH SIDE	SOUTH SIDE	NORTH SIDE	SOUTH SIDE	
STRIPE OBLITERATION	EXISTING					
	TEMPORARY					
TEMPORARY PAVEMENT MARKING	4" WHITE					
	4" YELLOW					
TEMPORARY CONCRETE BARRIER		240 LF	240 LF	160 LF	160 LF	800 LF
28" TRAFFIC CONE						
18" x 36" DRUM						
VERTICAL PANEL						
TYPE II BARRICADE		13 EA	13 EA	13 EA	13 EA	
TYPE III BARRICADE						
TYPE A FLASHING LIGHT		3 EA	3 EA	2 EA	2 EA	
TYPE B FLASHING LIGHT						
TYPE C STEADY BURNING LIGHT		13 EA	13 EA	13 EA	13 EA	
SMALL SIGN (HIGH INTENSITY SHEETING)						
MEDIUM SIGN (HIGH INTENSITY SHEETING)		8 EA	8 EA	8 EA	8 EA	
LARGE SIGN (HIGH INTENSITY SHEETING)						
SMALL SIGN (STANDARD INTENSITY SHEETING)						
MEDIUM SIGN (STANDARD INTENSITY SHEETING)						
LARGE SIGN (STANDARD INTENSITY SHEETING)						
SMALL SIGN STAND						
LARGE SIGN STAND		8 EA	8 EA	5 EA	2 EA	

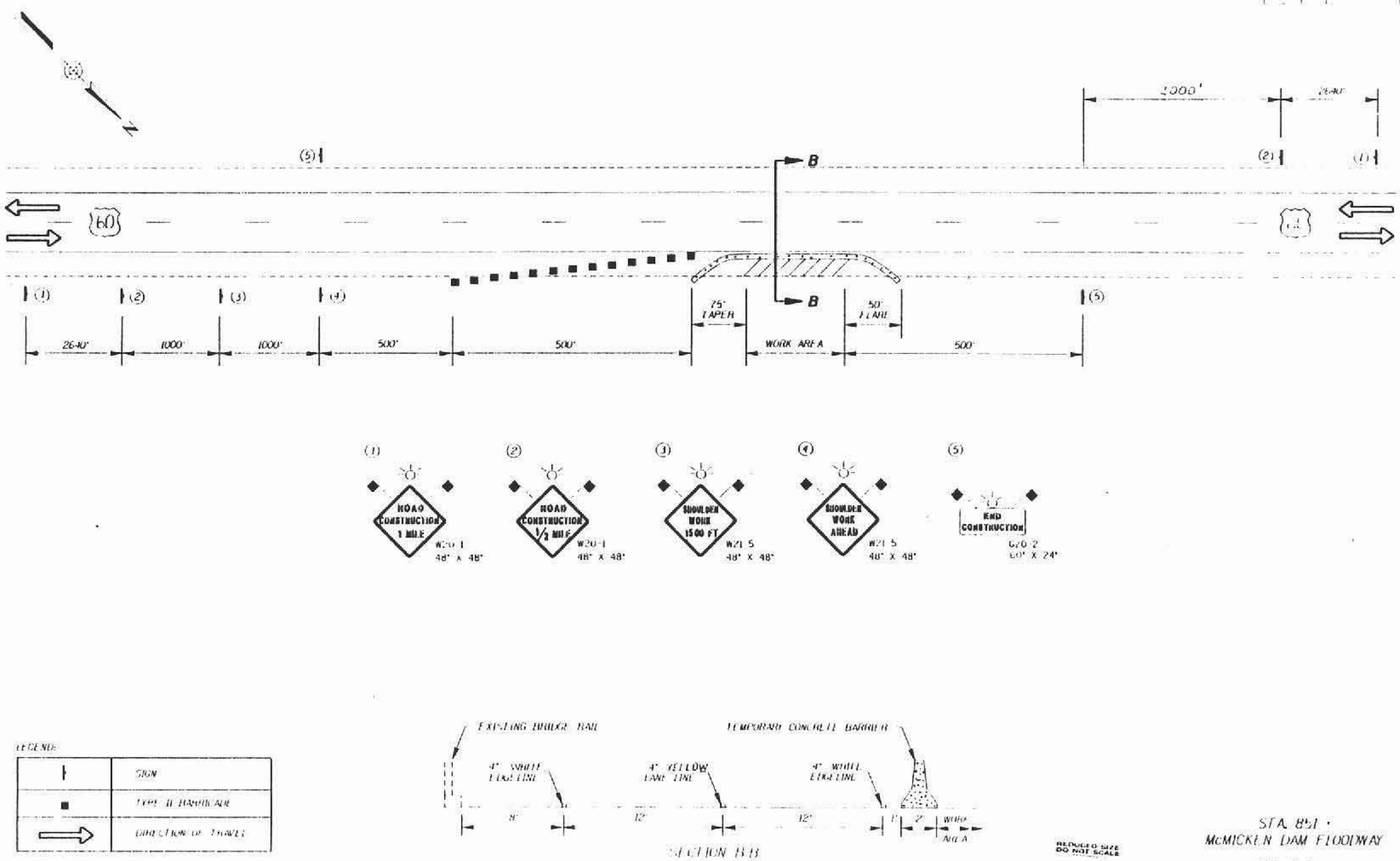
REDUCED SIZE
DO NOT SCALE

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
TRAFFIC DESIGN SERVICES

TRAFFIC CONTROL QUANTITIES

BEARDSLEY CANAL STRUCTURE

TRACS REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	ARIZ	HES-022-2(13)P		



REDUCED SIZE DO NOT SCALE

STA. 851 ± McMICKEN DAM FLOODWAY

STA. 855 ± BEARDSLEY CANAL

NOTE:

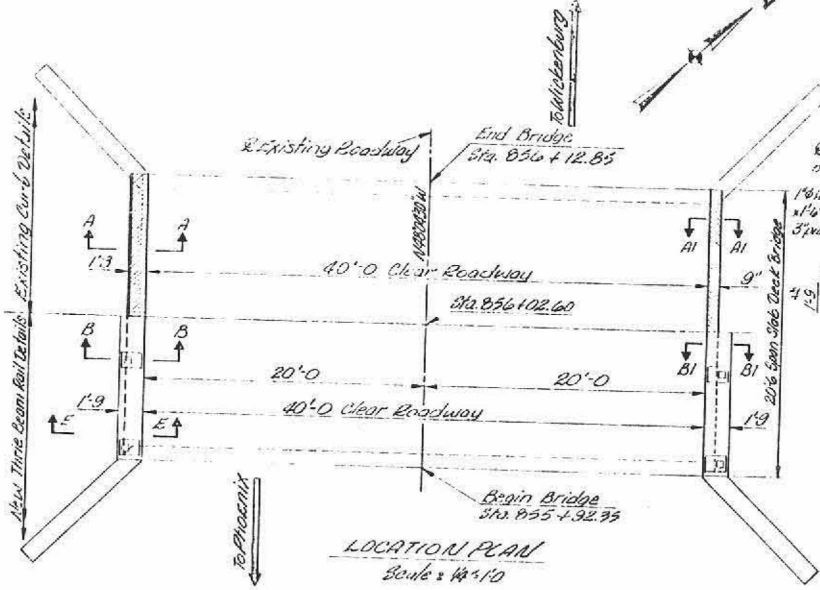
1. THIS PLAN SHOWS TRAFFIC CONTROL FOR WORK ON THE NORTH SIDE OF THE BRIDGE. TRAFFIC CONTROL FOR WORK ON THE SOUTH SIDE OF THE BRIDGE IS SIMILAR AND OPPOSITE.
2. CONTRACTOR SHALL WORK ON ONE SIDE AT A TIME.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
TRAFFIC DESIGN SERVICES

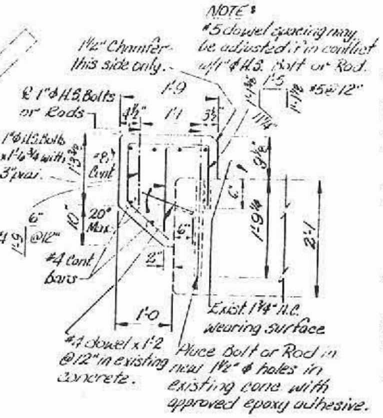
TRAFFIC CONTROL PLAN

BEARDSLEY CANAL STRUCTURE

WICKENBURG - PHOENIX HWY.(U.S. 60)
BEARDSLEY CANAL
MARICOPA COUNTY



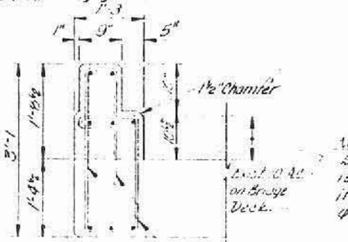
LOCATION PLAN
Scale: 1/8"=1'-0



SECTION B1-B1
Scale: 1"=1'-0

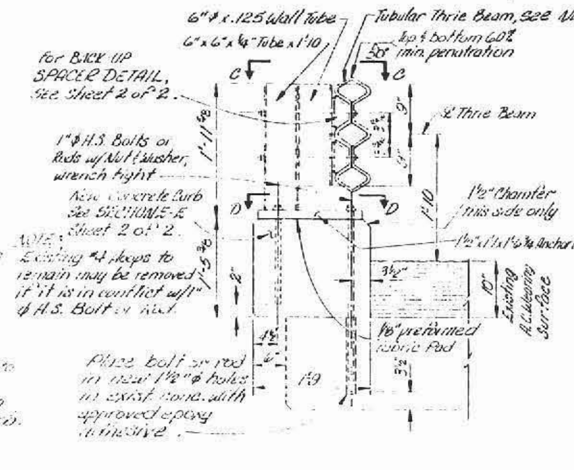
NOTE: New Railing not shown for clarity. For Railing Details see Section B-B. For Anchor Plate Detail see section D-D sheet 2 of 2.

NOTE:
Asphaltic concrete may be removed near exist. curb to facilitate removal of exist. curb, subject to approval of the Engineer. Existing material removed shall be replaced with asphaltic concrete to match existing grade.



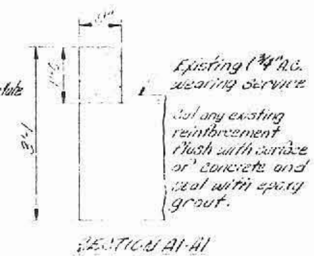
NOTE:
Concrete removed in wingwall flares, cut existing reinforcement flush with surface of concrete and seal with epoxy grout.

SECTION A-A
Scale: 1"=1'-0



SECTION B-B
No Scale

NOTE: For View C-C & Section D-D, see sheet 2 of 2.



SECTION A1-A1
Scale: 1"=1'-0

REDUCED SIZE DO NOT SCALE

GENERAL NOTES:

Construction - Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, Edition of 1987.

Design - AASHTO Standard Specification for Highway Bridges, 1983 Edition and 1984 thru 1986 Interim Specs.

All concrete shall be Class 'S', F'c=3,000psi.

Reinf. steel shall conform to ASTM Spec. A615 #4 Bars; Gr.40 Fs=20,000 psi (May be Furnished as Gr.60)

#5 Bars = Gr 60 fs = 24,000 psi

All dimensions for reinforcing steel shall be to center of bars. Bend dimensions are out to out of bar.

Chamfer all exposed concrete corners 3/4" as per Standard B-19.10 unless noted otherwise.

Dimensions shall not be scaled from drawings.

All reinforcing steel shall have 2" clear cover unless noted otherwise.

Contractor shall verify all relevant dimensions in field prior to fabrication of all materials.

NOTE:

Hatched areas indicate those portions of existing concrete structure to be removed.

The Contractor shall exercise due care in removal of concrete to prevent damage to the underside of existing deck slab. All damage shall be repaired at no cost to the State.

DOWEL NOTE:

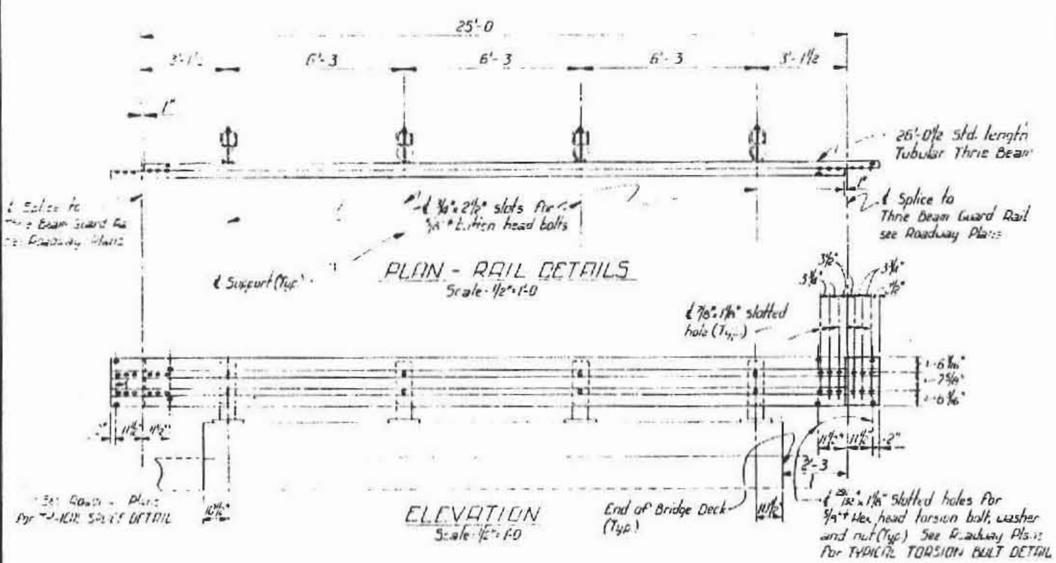
Epoxy dowel in hole with approved epoxy adhesive. Epoxy anchorage shall develop a tensile pull-out strength of 6 kips for #4 dowel; 9 kips for #5 dowel, and [illegible] kips for 1" bolt/rod.

Details of the anchorage system shall be submitted to the Engineer for approval prior to installation.

Drill slab 6" deep with 3/4" φ hole for #4 dowel, 7/8" φ hole for #5 dowel; core slab 13" deep with 1 1/2" φ hole for 1" φ bolt/rod. 1983 Structures Section Standard B-19.10.

Original Bridge built by Maricopa County in 1927 and widened under project FA 94-A(3) in 1941 by the Arizona Highway Department.

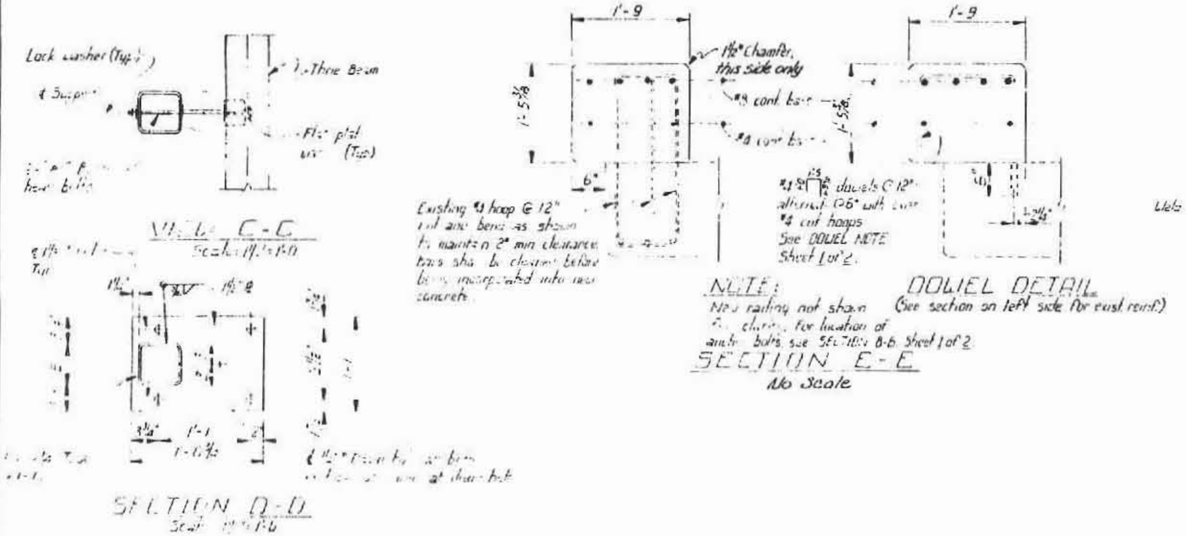
ARIZONA DEPARTMENT OF TRANSPORTATION	HIGHWAYS DIVISION
STRUCTURES SECTION	
STR. 8554	
BEARDSLEY CANAL BRIDGE	
EXISTING REHAB	
1 2 60	68.04	248	HFG-022-2(33)P

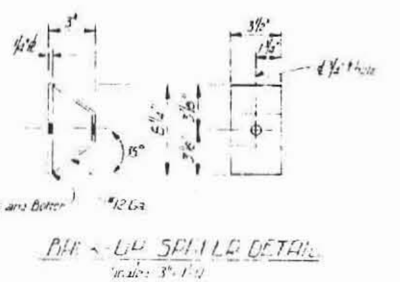


APPROXIMATE QUANTITIES	
CLASS 'S' CONCRETE f'c 3000 psi	3.70 C.Y.
REINFORCING STEEL	705 Lbs.
STRUCTURAL CONCRETE REMOVAL	1.9 C.Y.
PLACING DOWELS	63
TUBULAR THRIE BEAM	52 Lin. Ft.
STRUCTURAL STEEL	1460 Lbs.

NOTE:
Bolt lengths for the various connections shall be the min. required to furnish one diameter beyond end of tightened nut. Bolt heads shall be on traffic side of rail.

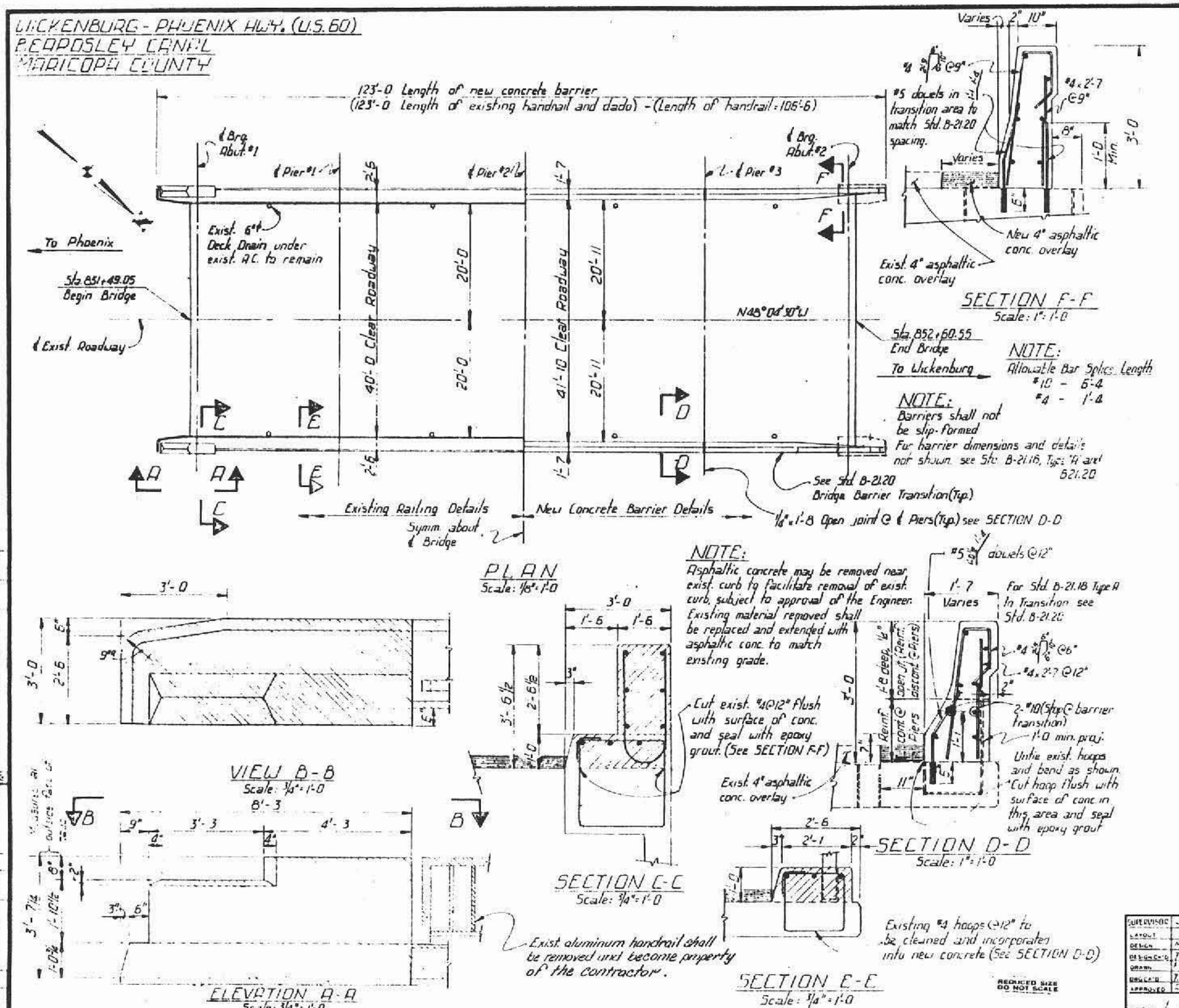
NEW RAILING NOTES:
Materials for rail ...
Materials -
Tubular Thrie Beam ...
U.S. bolts or rods, nuts and washers ...
Other bolts ...
All welding shall conform to the requirements of the American Welding Society, Structural Welding Code D1.1-80, revised to date and as modified by the AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges revised to date.
The new Thrie Beam Rail, rail posts, anchor bolts, bolts and all other metal parts shall be galvanized after fabrication in accordance with Section 604-3.05 and 1012-3 of the Standard Specifications.
All rail posts shall be ...





REDUCED SIZE
DO NOT SCALE

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STRUCTURES SECTION



GENERAL NOTES:

Construction - Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, Edition of 1987.

Design - AASHTO Standard Specifications for Highway Bridges, 1983 Edition and 1984 thru 1986 Interim Specs.

All concrete shall be Class 'S', F'c = 3,000 psi.

Reinf. steel shall conform to ASTM Spec. A615 #4 & #5 bars: Gr.40 Fs = 20,000 psi (May be furnished as Gr.60.)

#10 bars: Gr.60 Fs = 24,000 psi

All dimensions for reinforcing steel shall be to center of bars. Bend dimensions are out to out of bar.

Chamfer all exposed concrete corners 3/4" as per Standard B-19.10 unless noted otherwise.

Dimensions shall not be scaled from drawings.

All reinforcing steel shall have 2" clear cover unless noted otherwise.

Contractor shall verify all relevant dimensions in field prior to fabrication of all materials.

NOTE:

Hatched areas indicate those portions of existing concrete structure to be removed.

The Contractor shall exercise due care in removal of concrete to prevent damage to the underside of existing deck slab. All damage shall be repaired at no cost to the State.

DOWEL NOTE:

Epoxy dowel in hole with approved epoxy adhesive.

Epoxy anchorage shall develop a tensile pull-out strength of 9 kips for #5 dowel.

Details of the anchorage system shall be submitted to the Engineer for approval prior to installation.

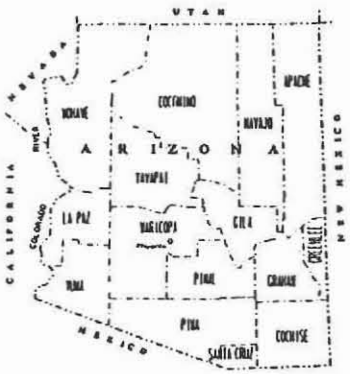
#5 Dowel reinforcing is included in reinforcing steel quantities.

Core slab 6" deep with 7/8" hole for #5 dowel

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STRUCTURES SECTION

APPENDIX E - CONSTRUCTION PLANS FOR AZ-8803 (TREND)

F-081-1(2)

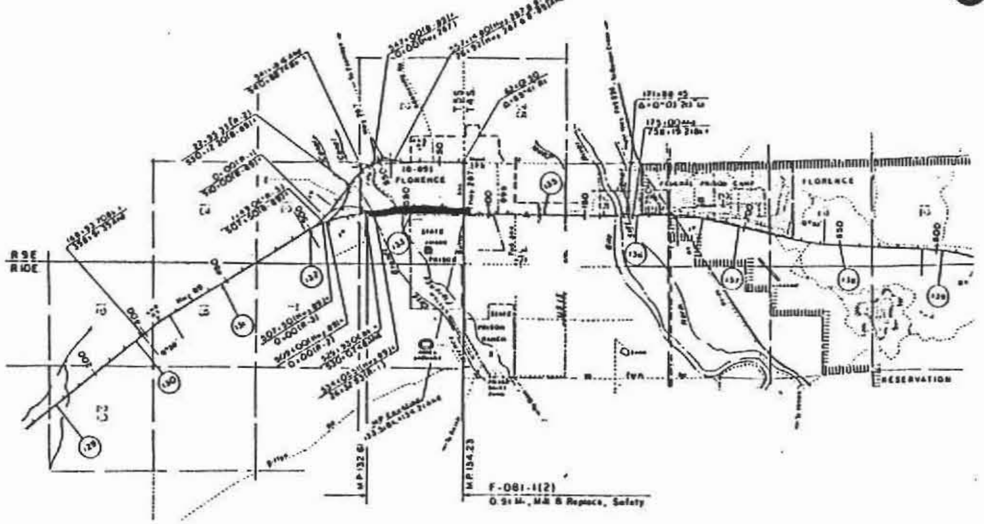


STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

PLAN AND PROFILE OF PROPOSED

STATE COUNTY
ORACLE JCT - FLORENCE HWY (US 89)
PINAL COUNTY
F-081-1(2)

Control Deck



PRELIMINARY PRINT

JAN 1 1988

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
APPROVED: R. O. FORD
ASSISTANT DIRECTOR
STATE ENGINEER

APPROVED DATE
CHIEF DEPUTY STATE ENGINEER

APPROVED DATE
DEPUTY STATE ENGINEER

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED DATE
DIVISION ADMINISTRATOR

OF

A. D. O. T. STANDARD DRAWINGS

FED. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ	F-041-1(2)	1A		

CONSTRUCTION

REVISION DATE	STANDARD NO.	SUBJECT
	C-01.10	PLANS SYMBOLS
	C-01.11	PLANS SYMBOLS
	C-01.12	PLANS SYMBOLS
1/83	C-01.30	GENERAL ABBREVIATIONS
1/83	C-01.31	GENERAL ABBREVIATIONS
1/83	C-01.32	GENERAL ABBREVIATIONS
1/83	C-02.10	SLOPES, INTERSTATE & CLASS A-A ROADWAYS
1/83	C-02.20	SLOPES, CLASS A & B ROADWAYS
1/83	C-02.30	SLOPES, CLASS C & D ROADWAYS
1/83	C-02.40	PAVEMENT CROWN, PARABOLIC
1/83	C-03.10	DITCHES AND DIKES
1/83	C-03.20	CHANNELS & DIKES TYP. PARALLEL INSTALLATIONS
1/83	C-04.10	SPILLWAY, EMBANKMENT
1/83	C-04.20	DOWNDRAIN, EMBANKMENT
1/83	C-04.30	SPILLWAY, EMBANKMENT LENGTH TABLE
1/83	C-04.40	DOWNDRAIN, EMBANKMENT LENGTH TABLE
1/83	C-05.10	SINGLE CURB, CURB & GUTTER EMBANKMENT CURB
1/83	C-05.20	CONCRETE SIDEWALK & DRIVEWAY
1/83	C-06.10	TURNOUT & DRIVEWAY LAYOUT
1/83	C-6.20	GEOMETRICS, DETOUR
11/83	C-07.10	PAVEMENT, CONCRETE, TRANSVERSE JOINTS
11/83	C-07.20	PAVEMENT, CONCRETE, LONGITUDINAL JOINTS
1/83	C-07.30	PAVEMENT, CUT & REPLACEMENT
1/83	C-8.10	GEOMETRICS, EXIT RAMP
1/83	C-8.20	GEOMETRICS, ENTRANCE RAMP
1/83	C-9.10	GROOVING FOR BITUMINOUS SHOULDERS
1/83	C-9.20	GROOVING FOR CONCRETE SHOULDERS
1/83	C-10.01	TYPE A GUARD RAIL INSTALLATION, REFLECTOR TAB
1/83	C-10.02	TYPE B GUARD RAIL INSTALLATION, REFLECTOR TAB
7/85	C-10.03	MEASUREMENT LIMITS FOR W BEAM AND THRIE BEAM SYSTEM
7/85	C-10.04	G4(1W) AND G4(2W) BLOCKED OUT W BEAM (TIMBER POST)
7/85	C-10.05	G4(1S) AND G4(2S) BLOCKED OUT W BEAM (STEEL POST)
7/85	C-10.06	G4(1S-MODIFIED) BLOCKED OUT W BEAM (STEEL POST) WITH SPECIAL CURB AND GUTTER
7/85	C-10.07	G9(A) AND G9(B) BLOCKED OUT THRIE BEAM (STEEL POST)
7/85	C-10.08	G9(C) BLOCKED OUT THRIE BEAM (STEEL POST)
1/83	C-10.09	HALF BARRIER, CAST IN PLACE, SLIP FORM
11/83	C-10.10	HALF BARRIER, CAST IN PLACE, FIXED FORM
1/83	C-10.11	HALF BARRIER, PRECAST
1/83	C-10.12	MEDIAN BARRIER, CAST IN PLACE, SLIP FORM
1/83	C-10.13	MEDIAN BARRIER, CAST IN PLACE, FIXED FORM
1/83	C-10.14	MEDIAN BARRIER, PRECAST
7/85	C-10.15	FLARED BREAKAWAY CABLE TERMINAL ASSEMBLY (TIMBER POST)
7/85	C-10.16	FLARED BREAKAWAY CABLE TERMINAL ASSEMBLY (STEEL POST)
3/81	C-10.17	BCT ASSEMBLY STEEL
10/81	C-10.18	BCT ASSEMBLY TIMBER
3/81	C-10.21	GUARD RAIL ANCHOR ASSEMBLY STEEL TERMINAL POST
6/86	C-10.22	GUARD RAIL ANCHOR ASSEMBLY TIMBER TERMINAL POST
7/85	C-10.23	BURIED & BOLTED ANCHOR TIMBER POST
7/85	C-10.24	BURIED & BOLTED ANCHOR STEEL POST
3/87	C-10.25 SH 1	TRANSITION W BEAM (TIMBER POST) TO CONCRETE HALF BARRIER
6/86	C-10.25 SH 2	TRANSITION W BEAM (TIMBER POST) TO CONCRETE HALF BARRIER
3/87	C-10.25 SH 3	TRANSITION W BEAM (TIMBER POST) TO CONCRETE HALF BARRIER
7/85	C-10.25 SH 4	TRANSITION W BEAM (TIMBER POST) TO CONCRETE HALF BARRIER
3/87	C-10.25 SH 5	TRANSITION W BEAM (TIMBER POST) TO CONCRETE HALF BARRIER
6/86	C-10.30 SH 1	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER
6/86	C-10.30 SH 2	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER
3/87	C-10.30 SH 3	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER
7/85	C-10.30 SH 4	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER
3/87	C-10.30 SH 5	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER
6/86	C-10.35 SH 1	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER, CURB INSTALLATION
6/86	C-10.35 SH 2	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER, CURB INSTALLATION
6/86	C-10.35 SH 3	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER, CURB INSTALLATION
7/85	C-10.35 SH 4	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER, CURB INSTALLATION
7/85	C-10.35 SH 5	TRANSITION W BEAM (STEEL POST) TO CONCRETE HALF BARRIER, CURB INSTALLATION
6/86	C-10.40 SH 1	TRANSITION W BEAM TO CONCRETE MEDIAN BARRIER
6/86	C-10.40 SH 2	TRANSITION W BEAM TO CONCRETE MEDIAN BARRIER
7/85	C-10.40 SH 3	TRANSITION W BEAM TO CONCRETE MEDIAN BARRIER
7/85	C-10.40 SH 4	TRANSITION W BEAM TO CONCRETE MEDIAN BARRIER
7/85	C-10.45 SH 1	W BEAM BCT ATTENUATOR ASSEMBLY
7/85	C-10.45 SH 2	W BEAM BCT ATTENUATOR ASSEMBLY
6/86	C-10.45 SH 3	W BEAM BCT ATTENUATOR ASSEMBLY
7/85	C-10.45 SH 4	W BEAM BCT ATTENUATOR ASSEMBLY
7/85	C-10.45 SH 5	W BEAM BCT ATTENUATOR ASSEMBLY
7/85	C-10.50 SH 1	W BEAM BCT ATTENUATOR ASSEMBLY, CURB INSTALLATION
6/86	C-10.50 SH 2	W BEAM BCT ATTENUATOR ASSEMBLY, CURB INSTALLATION
6/86	C-10.50 SH 3	W BEAM BCT ATTENUATOR ASSEMBLY, CURB INSTALLATION
7/85	C-10.50 SH 4	W BEAM BCT ATTENUATOR ASSEMBLY, CURB INSTALLATION
7/85	C-10.50 SH 5	W BEAM BCT ATTENUATOR ASSEMBLY, CURB INSTALLATION
7/85	C-10.55 SH 1	MEDIAN W BEAM BCT ATTENUATOR ASSEMBLY
6/86	C-10.55 SH 2	MEDIAN W BEAM BCT ATTENUATOR ASSEMBLY
7/85	C-10.55 SH 3	MEDIAN W BEAM BCT ATTENUATOR ASSEMBLY
7/85	C-10.55 SH 4	MEDIAN W BEAM BCT ATTENUATOR ASSEMBLY
1/83	C-10.96	GLARE SCREEN, TYPE "P", CONC. MEDIAN BARRIER
11/83	C-10.97	GLARE SCREEN, TYPE "O", CONC. MEDIAN BARRIER
1/83	C-11.10	ROADWAY CATTLE GUARD-FOOTING TYPE
1/83	C-11.11	ROADWAY CATTLE GUARD GRILL & GRILL CLAMP DETAIL
1/83	C-11.12	ROADWAY CATTLE GUARD-FOOTING TYPE, MISC. DETAILS
1/83	C-11.20	CATTLE GUARD, DRAINAGE
1/83	C-11.30	CATTLE GUARD, RAILROAD
5/85	C-12.10 SH 1	FENCE, WOVEN WIRE
5/85	C-12.10 SH 2	FENCE, BARBED WIRE
5/85	C-12.10 SH 3	FENCE, GATE, TYPE 1 & 2, FLOOD GATE
5/85	C-12.10 SH 4	FENCE, FLOOD GATE INSTALLATION
3/81	C-12.10 SH 5	FENCE, MISC. DETAILS
8/81	C-12.20 SH 1	FENCE, CHAIN LINK TYPE 1
8/81	C-12.20 SH 2	FENCE, CHAIN LINK TYPE 2
8/81	C-12.20 SH 3	FENCE, CHAIN LINK GATES
11/83	C-13.10	PIPE CULVERT INSTALLATION
5/85	C-13.15	TYPICAL PIPE INSTALLATION
1/83	C-13.20	PIPE, REINFORCED CONCRETE END SECTION
1/85	C-13.25	PIPE, CORRUGATED METAL, END SECTION
1/83	C-13.30	PIPE & PIPE ARCH, CORRUGATED METAL CONCRETE INVERT PAVING
1/83	C-13.35	STRUCTURAL EXCAVATION PAYMENT LIMITS
11/83	C-13.40	STRUC. EXC. PAYMENT LIMITS STR. BACKFILL PLACEMENT
11/83	C-13.45	STRUCTURE BACKFILL PLACEMENT
11/83	C-13.50	STRUCTURE BACKFILL MEASUREMENT
1/85	C-13.55	PIPE, CATTLE-VEHICLE PASS, MITERED END TREATMENT
1/83	C-14.10	HEADWALL, PIPE, STRAIGHT & "L" TYPES
1/83	C-14.20	HEADWALL, NORMAL TO PIPE 42" - 84" PIPE
1/83	C-14.21	HEADWALLS, 42" - 84" PIPE SKEWED
1/83	C-14.30	HEADWALL, DROP INLET -
6/86	C-15.10	CATCH BASIN, TYPE 1
6/86	C-15.20	CATCH BASIN, TYPE 3
6/86	C-15.30	CATCH BASIN, TYPE 4
6/86	C-15.40	CATCH BASIN, TYPE 5
1/83	C-15.50	CATCH BASIN, GRATES, LONGITUDINAL BARS
1/83	C-15.60	CATCH BASIN, GRATES, TRANSVERSE BARS
6/86	C-15.70	CATCH BASIN MISC. DETAILS
1/83	C-15.80	CATCH BASIN, MEDIAN FLUSH
6/86	C-15.90	CATCH BASIN, MEDIAN DIKE, PRECAST
1/83	C-16.10	IRRIGATION HEADWALLS 18" TO 60" DIAMETER PIPES
1/83	C-16.20	IRRIGATION STANDPIPES
1/83	C-16.30	IRRIGATION VALVE & GATE
6/86	C-17.10	BANK PROTECTION, RAIL TYPES 1, 2 & 3
6/86	C-17.20	BANK PROTECTION, RAIL TYPES 4, 5 & 6
1/83	C-18.10	MANHOLE DETAILS
1/83	C-18.20	MANHOLE FRAME & COVER
1/83	C-19.10	FORD - CONCRETE WALLS
1/83	C-19.20	FORDS - TYPES 1 & 2
1/83	C-21.10	SURVEY MONUMENT, FRAME AND COVER, RIGHT OF WAY MARKER
1/83	C-21.20	STANDARD MARKER
1/83	C-22.10	UTILITY LINE, PROTECTIVE CONCRETE SLAB

STRUCTURES - 1987

REINFORCED CONCRETE BOX CULVERTS

REVISION DATE	STANDARD NO.	SUBJECT
10/86	B-01.10	MISCELLANEOUS DETAILS FOR STANDARD BOX CULVERTS
10/86	B-02.10	SINGLE BARREL BOX CULVERT
10/86	B-02.20	DOUBLE BARREL BOX CULVERT
10/86	B-02.25	DOUBLE BARREL BOX CULVERT
10/86	B-02.30	TRIPLE BARREL BOX CULVERT
10/86	B-02.35	TRIPLE BARREL BOX CULVERT
10/86	B-02.40	FOUR BARREL BOX CULVERT
10/86	B-02.45	FOUR BARREL BOX CULVERT
10/86	B-02.50	FIVE BARREL BOX CULVERT
10/86	B-02.55	FIVE BARREL BOX CULVERT
10/86	B-02.60	SIX BARREL BOX CULVERT
10/86	B-02.65	SIX BARREL BOX CULVERT
10/86	B-03.10	16' X 14' EQUIPMENT PASS
	B-04.10	OUTLET WINGS, CULVERT HEIGHT 3' TO 7', SKEW 0 TO 20
	B-04.20	OUTLET WINGS, CULVERT HEIGHT 8' TO 12', SKEW 0 TO 20
	B-04.30	INLET WINGS, CULVERT HEIGHT 3' TO 7', SKEW 0 TO 20
	B-04.40	INLET WINGS, CULVERT HEIGHT 8' TO 12', SKEW 0 TO 20
	B-04.50	INLET & OUTLET WINGS, CULVERT HEIGHT 3' TO 7', SKEW 25 TO 45
	B-04.60	INLET & OUTLET WINGS, CULVERT HEIGHT 8' TO 12', SKEW 25 TO 45
	B-05.10	HEADWALL QUANTITIES, 2:1 SLOPE
	B-05.20	HEADWALL QUANTITIES, 4:1 SLOPE
	B-05.30	HEADWALL QUANTITIES, 6:1 SLOPE
	B-06.10	OUTLET APRON DETAIL
	B-06.20	OUTLET APRON DIMENSIONS & QUANTITIES, 2:1 SLOPE
	B-06.30	OUTLET APRON DIMENSIONS & QUANTITIES, 4:1 SLOPE
	B-06.40	OUTLET APRON DIMENSIONS & QUANTITIES, 6:1 SLOPE
7/76	B-08.10	INLET OR OUTLET LEVEL WINGS, HEIGHT 3' TO 7'
7/76	B-08.20	INLET OR OUTLET LEVEL WINGS, HEIGHT 8' TO 12'

CONTINUOUS SPAN CONCRETE SLAB BRIDGES

REVISION DATE	STANDARD NO.	SUBJECT
10/86	B-09.10	CONTINUOUS SPAN SLAB, HS20-44 LOADING
8/85	B-09.20	CONTINUOUS SPAN SLAB WITH HINGE, HS20-44 LOADING
10/86	B-09.30	CONTINUOUS SPAN SLAB, INTERSTATE LOADING
8/85	B-09.40	CONTINUOUS SPAN SLAB WITH HINGE, INTERSTATE LOADING
10/86	B-10.10	SLAB HINGE JOINT AND HINGE SPAN REINFORCING DETAILS
10/86	B-10.11	SLAB HINGE JOINT AND HINGE SPAN REINFORCING DETAILS (STUD ALTERNATE)

REINFORCED CONCRETE HEADWALLS FOR PIPE CULVERTS

REVISION DATE	STANDARD NO.	SUBJECT
10/86	B-11.10	PIPE CULVERT HEADWALLS, MISCELLANEOUS DETAILS
1/76	B-12.10	INLET HEADWALL, RIGHT ANGLE PIPE CULVERT
1/76	B-12.20	OUTLET HEADWALL, RIGHT ANGLE PIPE CULVERT
9/72	B-12.30	INLET AND OUTLET HEADWALLS, RIGHT ANGLE PIPE CULVERT, 2:1 SLOPE
9/72	B-12.40	INLET AND OUTLET HEADWALLS, RIGHT ANGLE PIPE CULVERT, 4:1 SLOPE
9/72	B-12.50	INLET AND OUTLET HEADWALLS, RIGHT ANGLE PIPE CULVERT, 6:1 SLOPE
1/76	B-13.10	INLET AND OUTLET HEADWALLS, 15 SKEW PIPE CULVERT
9/72	B-13.20	INLET AND OUTLET HEADWALLS, 15 SKEW PIPE CULVERT, 2:1 SLOPE
9/72	B-13.30	INLET AND OUTLET HEADWALLS, 15 SKEW PIPE CULVERT, 4:1 SLOPE
9/72	B-13.40	INLET AND OUTLET HEADWALLS, 15 SKEW PIPE CULVERT, 6:1 SLOPE
1/76	B-14.10	INLET AND OUTLET HEADWALLS, 30 SKEW PIPE CULVERT
9/72	B-14.20	INLET AND OUTLET HEADWALLS, 30 SKEW PIPE CULVERT, 2:1 SLOPE
9/72	B-14.30	INLET AND OUTLET HEADWALLS, 30 SKEW PIPE CULVERT, 4:1 SLOPE
9/72	B-14.40	INLET AND OUTLET HEADWALLS, 30 SKEW PIPE CULVERT, 6:1 SLOPE
7/76	B-15.10	INLET AND OUTLET HEADWALLS, 45 SKEW PIPE CULVERT
9/72	B-15.20	INLET AND OUTLET HEADWALLS, 45 SKEW PIPE CULVERT, 2:1 SLOPE
9/72	B-15.30	INLET AND OUTLET HEADWALLS, 45 SKEW PIPE CULVERT, 4:1 SLOPE
9/72	B-15.40	INLET AND OUTLET HEADWALLS, 45 SKEW PIPE CULVERT, 6:1 SLOPE
9/72	B-16.10	MULTIPLE HEADWALLS
9/72	B-17.10	OUTLET APRONS
9/72	B-17.20	OUTLET APRON STEEL LIST 2:1 SLOPE
9/72	B-17.30	OUTLET APRON STEEL LIST 4:1 SLOPE
9/72	B-17.40	OUTLET APRON STEEL LIST 6:1 SLOPE

RETAINING WALLS

REVISION DATE	STANDARD NO.	SUBJECT
10/86	B-18.10	CANTILEVER RETAINING WALL DETAILS
12/82	B-18.20	CANTILEVER RETAINING WALLS ON SPREAD FOOTING
12/82	B-18.30	CANTILEVER RETAINING WALLS ON STEEL PILES
3/73	B-18.40	CANTILEVER RETAINING WALLS ON CONCRETE PILES

MISCELLANEOUS STANDARDS

REVISION DATE	STANDARD NO.	SUBJECT
10/86	B-19.10	MISCELLANEOUS DETAILS FOR BRIDGES
10/86	B-19.20	SLOPE PAVING DETAILS
2/82	B-20.10	PRECAST AND CAST-IN-PLACE CONCRETE PILES
12/82	B-20.20	PRESTRESSED CONCRETE PILES
8/85	B-21.10	W BEAM TERMINAL CONNECTOR, DADO CONNECTION
8/85	B-21.18	BRIDGE CONCRETE BARRIER DETAILS
10/86	B-21.19	BRIDGE CONCRETE BARRIER TRANSITION WITH CURB
10/86	B-21.20	BRIDGE CONCRETE BARRIER TRANSITION
10/86	B-21.21	BLOCK AND TERMINAL CONNECTOR ASSEMBLY DETAILS
	B-22.40	TRAFFIC AND PEDESTRIAN RAIL
	B-22.41	TRAFFIC AND PEDESTRIAN RAIL
	B-22.50	PEDESTRIAN FENCE DETAILS WITH CURB
	B-22.60	PEDESTRIAN FENCE DETAILS WITH PARAPET
10/86	B-23.10	RAIL BANK PROTECTION FOR BRIDGES
10/86	B-24.10	ROADWAY JOINT-STEEL
10/86	B-24.11	ROADWAY JOINT-STEEL (STUD ALTERNATE)
10/86	B-24.20	ROADWAY JOINT POLYCHLOROPHENE
10/86	B-24.21	ROADWAY JOINT POLYCHLOROPHENE (STUD ALTERNATE)
	B-30.10	CONCRETE SOUND BARRIER WALLS
	B-30.20	MASONRY SOUND BARRIER WALLS

REV.: 11-24-87

A. D. O. T. STANDARD DRAWINGS

REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ	F-051-1(2)	18		

REVISION DATE	STANDARD NO.	SUBJECT
		SIGNING & MARKING DETAILS
1/83	4-M-1.01	PAVEMENT MARKINGS FOR CROSSWALKS, PARKING & INTERSECTIONS
1/77	4-M-1.02	CURB MARKINGS FOR RAISED MEDIAN & ISLANDS
8/86	4-M-1.03	PAINTED CHANNELIZATION
8/86	4-M-1.03.1	CENTERLINE AND REVERSE CURVE DETAILS
10/82	4-M-1.04	INSPECTION STATION MARKINGS FOR FREEWAYS
10/82	4-M-1.05	INSPECTION STATION MARKINGS FOR NON-FREEWAYS
10/82	4-M-1.06	TRANSITION STRIPING TWO LANE TO FOUR LANE
10/82	4-M-1.07	STRIPING AND DELINEATION FOR FREEWAY TERMINALS
11/78	4-M-1.08	UPHILL PASSING LANE STRIPING DETAILS
1/85	4-M-1.09	STRIPING FOR ENTRANCE RAMPS, EXIT RAMPS AND EDGE LINES
10/82	4-M-1.10	APPROACH MARKINGS FOR OBSTRUCTIONS IN THE ROADWAY
1/87	4-M-1.11	RAILROAD MARKINGS
1/85	4-M-1.12	8' WORD MARKINGS
1/85	4-M-1.13	8' PAVEMENT LETTERS
8/85	4-M-1.14	8' PAVEMENT LETTERS
8/85	4-M-1.15	8' PAVEMENT NUMBERS
8/86	4-M-1.16	STORAGE LANE MARKINGS AND ARROW DETAILS
10/82	4-M-1.17	PLACEMENT OF CENTERLINES, LANE LINES & EDGE LINES
3/83	4-M-1.18	TURNING LANE TYPICAL PAVEMENT MARKINGS
1/85	4-M-1.23	FALLWAY PAVEMENT MARKINGS
3/87	4-M-1.25	STRIPING AND DELINEATION FOR TRUCK ESCAPE RAMPS
7/87	4-M-2.02	RAISED PAVEMENT MARKER DETAILS
1/87	4-M-2.03	STRIPING DETAILS
12/84	4-M-2.04	TYPICAL INSTALLATIONS OF RAISED PAVEMENT MARKERS
8/86	4-M-2.05	TEMPORARY PAVEMENT MARKERS FOR CHIP SEAL PROJECTS
1/87	4-M-2.10	RUMBLE STRIP DETAILS
7/87	4-M-3.01	OBJECT MARKER DETAILS
8/86	4-M-3.02	OBJECT MARKER PLACEMENT DETAILS
1/85	4-M-3.03	OBJECT MARKER FOR SAND BARREL CRASH CUSHION
2/85	4-M-3.04	OBJECT MARKER FOR C.R.E.A.T. CRASH CUSHION
1/81	4-M-4.01	DELINEATOR DETAILS
8/86	4-M-4.02	ROADWAY DELINEATOR PLACEMENT
8/86	4-M-4.03	INTERCHANGE DELINEATOR SPACING
10/82	4-M-4.04	TRANSITION DELINEATION
8/86	4-M-5.01	MILEPOST DETAILS
10/82	4-M-6.01	OFF MAINLINE REFERENCE MARKER DETAILS
10/82	4-M-9.01	SNOW MARKER DETAILS
2/85	4-M-10.01	BRIDGE & BARRIER MARKER DETAILS
8/81	4-M-10.02	BRIDGE & BARRIER MARKER PLACEMENT & INSTALLATION DETAILS
2/87	4-M-10.03	GUARDRAIL B.C.T. DELINEATION DETAILS
10/82	4-S-1.01	INSPECTION STATION SIGNING FOR FREEWAYS
10/82	4-S-1.02	INSPECTION STATION SIGNING NON-FREEWAYS
2/81	4-S-1.03	TRANSITION SIGNING FOR FREEWAY TERMINALS
8/78	4-S-1.04	TRANSITION SIGNING
6/74	4-S-1.05	SIGNING FOR UPHILL PASSING LANES
8/86	4-S-1.06	STANDARD SAFETY PULLOUT SIGNING
6/74	4-S-1.07	TYPICAL CROSSROAD SIGNING TRUMPET INTERCHANGE
7/80	4-S-1.08	TYPICAL CROSSROAD SIGNING CLOVERLEAF INTERCHANGE
6/80	4-S-1.09	TYPICAL CROSSROAD SIGNING DIAMOND INTERCHANGE
10/78	4-S-1.10	TYPICAL REST AREA INTERIOR SIGNING
8/86	4-S-1.11	TYPICAL INTERCHANGE REGULATORY SIGNING SIGNALIZED-ONE WAY STREET
8/86	4-S-1.12	TYPICAL INTERCHANGE REGULATORY SIGNING SIGNALIZED-NARROW MEDIAN
8/86	4-S-1.13	TYPICAL INTERCHANGE REGULATORY SIGNING SIGNALIZED-WIDE MEDIAN
8/86	4-S-1.14	TYPICAL INTERCHANGE REGULATORY SIGNING STOP SIGN CONTROL
3/83	4-S-1.15	TYPICAL RAILROAD CROSSING SIGNING
3/87	4-S-1.16	TYPICAL SIGNING TRUCK ESCAPE RAMP
8/86	4-S-2.01	EXIT NUMBER PANEL AND EXIT SIGN FORMAT
8/86	4-S-2.02	REST AREA SIGN FORMAT
11/74	4-S-2.03	SCENIC VIEW SIGN FORMAT
11/85	4-S-2.04	SERVICES SIGN FORMAT
8/85	4-S-2.05	SERVICES SIGN FORMAT
8/85	4-S-2.06	SERVICES SIGN FORMAT
8/86	4-S-2.07	SERVICES SIGN FORMAT
6/74	4-S-2.08	ARROW FORMAT DETAILS
5/85	4-S-3.01	ALUMINUM EXTRUSION SIGN PANEL DETAILS
1/85	4-S-3.01.1	ALUMINUM EXTRUSION EXIT NUMBER PANEL DETAIL
6/74	4-S-3.02	LAMINATED ALUMINUM SIGN PANEL DETAILS
8/86	4-S-3.02.1	LAMINATED ALUMINUM SIGN PANEL MOUNTING DETAILS
6/74	4-S-3.04	OVERLAID PLYWOOD PANEL DETAILS FOR GROUND MOUNTED SIGNS
4/86	4-S-4.01	BREAKAWAY POST LOCATION GUIDE SIGNS
4/86	4-S-4.02	BREAKAWAY POST LOCATIONS WARNING & REGULATORY
8/86	4-S-4.03	TENSION FUSE PLATE AND HINGE
8/86	4-S-4.04	BREAKAWAY POST DETAILS W-SHAPE GUIDE SIGNS
8/86	4-S-4.05	BREAKAWAY POST DETAILS S-SHAPES
6/74	4-S-4.06	EXIT NUMBER PANELS INSTALLATION DETAILS
6/74	4-S-4.07	AUXILIARY SIGN INSTALLATION DETAILS
7/76	4-S-4.08	SIGN INSTALLATION DETAILS WING CHANNEL
6/74	4-S-4.09	SIGN INSTALLATION DETAILS WARNING & REGULATORY
8/86	4-S-4.10	SIGN INSTALLATION ON POLE
6/74	4-S-4.11	SIGN INSTALLATION ON SIGNAL POLE
6/74	4-S-4.12	CROSSROAD SIGN MOUNTING DETAILS BREAKAWAY POSTS
11/74	4-S-4.13	CROSSROAD AUX. SIGN PANEL MOUNTING DETAIL BREAKAWAY POSTS
11/74	4-S-4.14	TYPICAL STANDARD SIGN LOCATIONS FOR CROSSROAD SIGNING
1/83	4-S-4.16	FOUNDATION DETAILS FOR P-1 PERFORATED POST (SINGLE)
11/74	4-S-4.17	FOUNDATION DETAILS FOR P-2 PERFORATED POST (TELESCOPING)
6/80	4-S-4.18	SIGN PANEL MOUNTING ON PERFORATED POSTS
8/86	4-S-4.19	MILEPOST DETAILS
6/74	4-S-4.20	OVERHEAD SIGN LIGHTS
1/83	4-S-5.01	TAPERED TUBE SIGN STRUCTURE
3/83	4-C-1.01	SAND BARREL CRASH CUSHION
8/86	4-C-1.02	SAND BARREL CRASH CUSHION TYPICAL INSTALLATION
11/80	4-C-1.03	SAND BARREL CRASH CUSHION MODULE COMPONENTS
3/83	4-C-2.01	TEMPORARY CONCRETE BARRIER
3/83	4-C-2.02	TEMPORARY CONCRETE BARRIER TYPICAL INSTALLATIONS
3/83	4-C-2.03	TEMPORARY CONCRETE BARRIER TYPICAL INSTALLATIONS
11/80	2-S-5.01	OVERHEAD SIGN STRUCT. 8 PANEL TRUSS #1 TO #3 ONE WAY TRAFFIC
6/74	2-S-5.02	OVERHEAD SIGN STRUCT. 10 PANEL TRUSS #4 TO #10 ONE WAY TRAFFIC & TWO WAY TRAFFIC
6/74	2-S-5.03	OVERHEAD SIGN STRUCT. 16 PANEL TRUSS #11 TO #16 ONE WAY TRAFFIC
6/74	2-S-5.04	OVERHEAD SIGN STRUCT. 16 PANEL TRUSS #11 TO #16 TWO WAY TRAFFIC
6/74	2-S-5.05	OVERHEAD SIGN STRUCT. 16 PANEL TRUSS #17 TO #25 FIELD SPLICE-TWO WAY TRAFFIC
6/74	2-S-5.06	OVERHEAD SIGN STRUCT. 16 PANEL TRUSS #17 TO #25 FIELD SPLICE-ONE WAY TRAFFIC
11/74	2-S-5.07	OVERHEAD SIGN STRUCT. GENERAL RECAP SHEET
11/74	2-S-5.08	OVERHEAD SIGN STRUCT. TRUSS DETAILS
6/74	2-S-5.09	OVERHEAD SIGN STRUCT. TRUSS DETAILS
11/74	2-S-5.10	OVERHEAD SIGN STRUCT. COLUMN DETAILS
11/74	2-S-5.11	OVERHEAD SIGN STRUCT. COLUMN DETAILS
6/74	2-S-5.12	OVERHEAD SIGN STRUCT. WALKWAY SUPPORT-GRATING-HORL & DRIP PAN DETAILS
11/74	2-S-5.13	OVERHEAD SIGN STRUCT. WALKWAY SUPPORT-GRATING-HORL & DRIP PAN DETAILS
11/74	2-S-5.14	OVERHEAD SIGN STRUCT. WALKWAY SUPPORT-HANDRAIL & SIGN CONNECTION DETAILS
11/74	2-S-5.15	OVERHEAD SIGN STRUCT. GRATING SIGN CONNECTION DETAILS
6/86	2-S-5.16	OVERHEAD SIGN STRUCT. FOUNDATION DETAILS
5/87	2-S-5.17	CANTILEVER TRAFFIC SIGN STRUCTURE
5/87	2-S-5.18	CANTILEVER SIGN LAYOUT DETAILS
5/87	2-S-5.19	CANTILEVER SIGN TOWER DETAILS
5/87	2-S-5.20	CANTILEVER SIGN TRUSS DETAILS NO. 1
5/87	2-S-5.21	CANTILEVER SIGN TRUSS DETAILS NO. 2
5/87	2-S-5.22	CANTILEVER SIGN HANDRAIL DETAILS
5/87	2-S-5.23	CANTILEVER SIGN HANDRAIL SUPPORT DETAILS
5/87	2-S-5.24	CANTILEVER SIGN LADDER AND GRATING DETAILS
5/87	2-S-5.25	CANTILEVER SIGN SIGN CONNECTION DETAILS
5/87	2-S-5.26	CANTILEVER SIGN OVERHEAD LIGHT SUPPORT MOUNTING DETAILS
5/87	2-S-5.27	CANTILEVER SIGN FOUNDATION DETAILS
		TRAFFIC SIGNALS & LIGHTING DETAILS
	T.S. 0	SYMBOLS
7/85	0-1	PLAN SYMBOLS
	T.S. 1	PULL BOXES
7/85	1-1	NO. 3 1/2 PULL BOX
7/85	1-2	NO. 5 PULL BOX
7/85	1-3	NO. 5 PULL BOX EXTENSION
7/85	1-4	NO. 7 PULL BOX
7/85	1-5	NO. 7 PULL BOX EXTENSION
10/86	1-6	TYPICAL PULL BOX INSTALLATION AND WIRING DETAILS
	T.S. 2	FOUNDATIONS
7/85	2-1	FOUNDATION FOR TYPE II LOAD CENTER CABINET
7/85	2-2	FOUNDATION FOR TYPE III CONTROL CABINET
7/85	2-3	FOUNDATION FOR TYPE IV & V CONTROL CABINETS
	T.S. 3	CABINETS
7/85	3-1	TYPE I LOAD CENTER CABINET
10/86	3-2	TYPE II LOAD CENTER CABINET
10/86	3-3	TYPE II LOAD CENTER CABINET CIRCUIT DETAILS
10/86	3-4	TYPE III LOAD CENTER CABINET AND FOUNDATION
7/85	3-5	TYPE III LOAD CENTER CABINET CIRCUIT DETAILS
10/86	3-6	TYPE IV LOAD CENTER CABINET AND FOUNDATION
7/85	3-7	TYPE IV LOAD CENTER CABINET CIRCUIT DETAILS
7/85	3-8	TYPE I PEDESTAL CABINET AND FOUNDATION
7/85	3-9	TYPE I CONTROL CABINET
7/85	3-10	TYPE II CONTROL CABINET
10/86	3-11	TYPE III CONTROL CABINET
10/86	3-12	TYPE IV CONTROL CABINET
10/86	3-13	TYPE V CONTROL CABINET
7/85	3-14	CONTROL CABINET MOUNTED SERVICE ENCLOSURE
7/85	3-15	JACK MOUNTED COMPONENTS
7/85	3-16	METER PEDESTAL CABINET
10/86	3-17	CONTROL CABINET MOUNTED SERVICE EQUIPMENT
	T.S. 4	POLES AND POSTS
10/86	4-1	TYPE "A" POLE
10/86	4-2	TYPE "B" POLE AND MAST ARM
10/86	4-3	TYPE "C" POLE AND MAST ARM
10/86	4-4	TYPE "D" POLE AND MAST ARM
10/86	4-5	TYPE "E" POLE AND MAST ARM
10/86	4-6	TYPE "F" POLE AND MAST ARMS
10/86	4-7	TYPE "G" POLE AND MAST ARM
10/86	4-8	TYPE "H" POLE AND MAST ARM
10/86	4-9	TYPE "I" POLE AND MAST ARM
10/86	4-10	TYPE "J" POLE AND MAST ARM
10/86	4-11	TYPE "K" POLE AND MAST ARM
10/86	4-12	TYPE "Q" POLE AND MAST ARMS
10/86	4-13	TYPE "R" POLE AND MAST ARMS
10/86	4-14	TYPE "S" POLE
10/86	4-15	TYPE "T" POLE AND LUMINAIRE MOUNTING BRACKET
10/86	4-16	TYPE "U" POLE AND ANCHORAGE DETAIL
10/86	4-17	POLE HAND HOLE DETAIL
10/86	4-18	POLE DRILLING DETAIL
7/85	4-19	PEDESTRIAN PUSH BUTTON POST
10/86	4-20	ANCHOR BOLTS
	T.S. 5	POLE BASES - SPECIAL
7/85	5-1	BREAK-AWAY BASE FOR 30' POLE
10/86	5-2	SLIP-AWAY BASE FOR 30' POLE
10/86	5-3	SLIP-AWAY BASE FOR 40' - 50' POLES
	T.S. 6	LIGHTING - POLE OFFSETS
7/85	6-1	HIGHWAY LIGHTING OFFSETS IN CUT AND FILL SECTIONS
	T.S. 7	DETECTORS
7/85	7-1	LOOP DETECTOR LOCATION AND INSTALLATION DETAILS
7/85	7-2	MAGNETOMETER DETECTOR
6/86	7-3	LOOP DETECTORS FOR TRAFFIC COUNTERS
7/85	7-4	TYPICAL LOOP INSTALLATION FOR RAMP METERING
	T.S. 8	SIGNAL ASSEMBLIES
10/86	8-1	SIGNAL FACES WITH BACKPLATES
7/85	8-2	VISORS FOR 8" AND 12" SIGNALS
	T.S. 9	MOUNTING ASSEMBLIES - SIGNAL
7/85	9-1	TYPE I & II MOUNTING ASSEMBLIES
7/85	9-2	TYPE III & IV MOUNTING ASSEMBLIES
7/85	9-3	TYPE V MOUNTING ASSEMBLY
7/85	9-4	TYPE VI MOUNTING ASSEMBLY
7/85	9-5	TYPE VII MOUNTING ASSEMBLY
7/85	9-6	TYPE VIII MOUNTING ASSEMBLY
7/85	9-7	TYPE IX MOUNTING ASSEMBLY
7/85	9-8	TYPE X MOUNTING ASSEMBLY
7/85	9-9	TYPE XI MOUNTING ASSEMBLY
	T.S. 10	MOUNTING CASTINGS - SIGNAL
7/85	10-1	MISCELLANEOUS SIGNAL MOUNTING PARTS
7/85	10-2	MAST ARM PLUMBIZER
7/85	10-3	POLE PLATE DETAIL
7/85	10-4	TERMINAL COMPARTMENT, SIDE MOUNTED AND POLE TOP MOUNTED
	T.S. 11	PEDESTRIAN DETAILS
7/85	11-1	TYPE I PEDESTRIAN PUSH BUTTON
7/85	11-2	TYPE II PEDESTRIAN PUSH BUTTON
7/85	11-3	SIGNS FOR PEDESTRIAN PUSH BUTTON
7/85	11-4	SIGNS FOR INTERNATIONAL SYMBOL PUSH BUTTON
	T.S. 12	FLASHERS
7/85	12-1	POLE FLASHER
7/85	12-2	OVERHEAD FLASHER DETAIL
	T.S. 13	ILLUMINATION - SIGNS
7/85	13-1	OVERHEAD SIGN LIGHTING & FLUORESCENT FIXTURE DETAIL
7/85	13-2	SIGN LIGHTING & FLUORESCENT FIXTURE DETAILS
7/85	13-3	PLACEMENT OF LIGHTING FIXTURES FOR OVERHEAD SIGNS
	T.S. 14	ILLUMINATION - SPECIAL
7/85	14-1	PEDESTRIAN TUNNEL LIGHT FIXTURE
	T.S. 15	SERVICE
7/85	15-1	120/240 V. SERVICE
7/85	15-2	120/240 V. SERVICE WITH CONTROL ENCLOSURE
7/85	15-3	240/480 V. SERVICE
7/85	15-4	240/480 V. SERVICE WITH CONTROL ENCLOSURE
7/85	15-5	PHOTO ELECTRIC CELL MOUNTING DETAILS
7/85	15-6	POLE MOUNTED BREAKER PANEL & TRANSFORMER
7/85	15-7	SPLIT CIRCUIT BREAKER MAIN DISCONNECT

REV.: 10-22-87

9		F-081-1(2)	2		

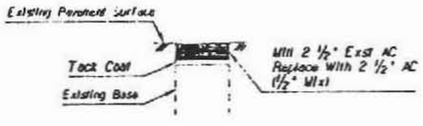
REFERENCES

NS-246(6)1B, 1961
F-019-1(6), 1959
Mile Post Log
Bridge Record
District 2

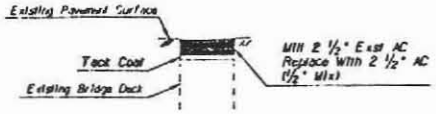
Memo #87-69-1
Fund #82512
Item #490
District 2

DESIGN DATA

1986 ADT = 2700
2006 ADT = 8300

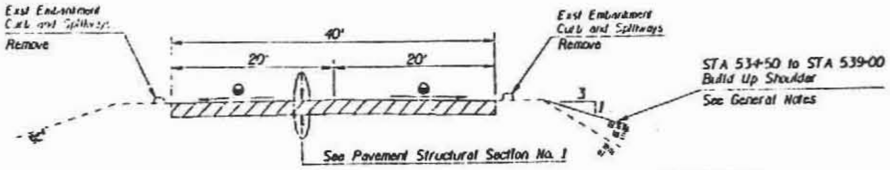


Total Thickness = 2 ½"
SECTION NO. 1



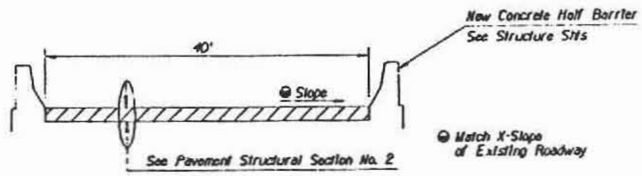
Total Thickness = 2 ½"
SECTION NO. 2

Thicknesses are "Nominal"
PAVEMENT STRUCTURAL SECTIONS



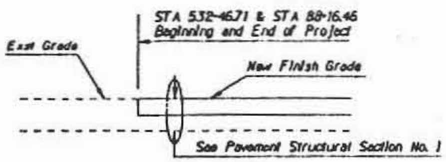
⊖ Match X-Slope of Existing Roadway

US-89 MAINLINE
TYPICAL SECTION
STA 532+46.71 to STA 549+00
(Taper Section STA 549+00 to 553+05Lt
STA 549+00 to 553+25Rt)

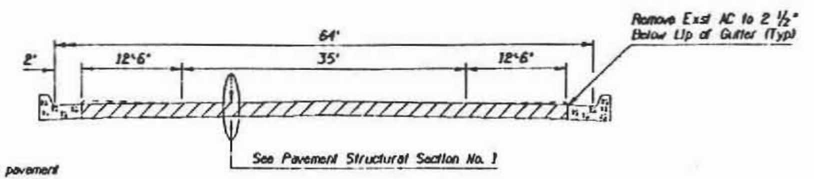


⊖ Match X-Slope of Existing Roadway

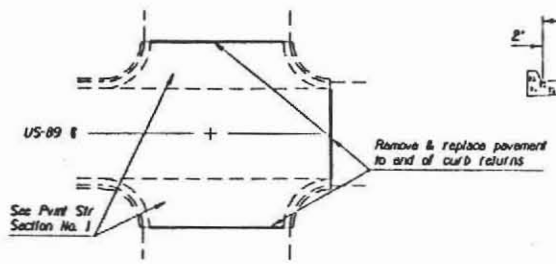
CASA GRANDE CANAL BRIDGE
STA 532+98.26 to STA 533+57.74
TYPICAL SECTION



TREATMENT AT BEGINNING AND END OF PROJECT



US-89 MAINLINE
TYPICAL SECTION
STA 533+25 to STA 579+89.65Bk
STA 87+46.46Ahd to STA 88+16.46



TREATMENT AT END OF PROJECT TURNOUTS
INTERSECTION OF US-89 & BUTTE AVENUE

LENGTH OF PROJECT

STA 532+46.71 to 532+98.26 = 51.55'
STA 532+98.26 to 533+57.74 = 59.48' Bridge
STA 533+57.74 to 579+89.65Bk = 4631.91'
STA 87+46.46Ahd to 88+16.46 = 70.00'

Net and Gross Length = 0.91 Mi = 4812.94'
MP 132.61 to 133.51Bk = 0.90 Miles
MP 134.22Ahd to 134.23 = 0.01 Miles

INDEX OF SHEETS

Sheet No.	Sheet Type
1	Face Sheet
1A-1B	ADOT Standard Drawings
2	Design Sheet
3-4	Special Details
5	Plan Sheet
6-7	Traffic Sheets
8-9	Structures Sheets
10-11	Materials Sheets

GENERAL NOTES

The roadway plans for this project have been designed utilizing the 1986 Construction Standard Drawings (C-Series), and current revisions.

The project roadway will be striped by ADOT forces in accordance with the current edition of the Pavement Marking Standards.

Delineators, Object Markers and Milepost Markers that interfere with the project shall be removed and reinstalled as directed by the Engineer.

Approximately 2050 lin ft of exst conc Emb Curb and six Spillways 180 lin ft shall be removed as directed by the Engineer.

Any area where the removal operation breaks through to the base shall be inspected for stability and suitability for placement of new pavement by the Engineer.

An adjustment in milling depth may be required to prevent encountering PCCP at depths shallower than 2 ½" in the area of Butte Avenue (MP. 133.5±).

Two concrete equipment crossings each 54 sq yds at Stations 532+ and 533+ shall be milled to a depth sufficient to accommodate the asphaltic concrete replacement. Equipment crossings at 547+ and 548+ shall remain.

Unless stockpiled by the Contractor for future use as recycled asphaltic concrete, all milled asphaltic concrete shall be salvaged to ADOT PIT #5058 Picacho Maintenance Yard, as directed by the Engineer.

Approximately 2850 cy of borrow shall be used to build up roadway shoulder areas and an additional 80 cy to build up dike radii as directed by the Engineer.

AVERAGE PROJECT ELEVATION = 1525

Design	M. YALUNG	10/87
Drawn	M. YALUNG	10/87
Checked	C.E.	12/87
	M. VIPARINA	12/87

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
HIGHWAY PLANS SERVICES

DESIGN SHEET

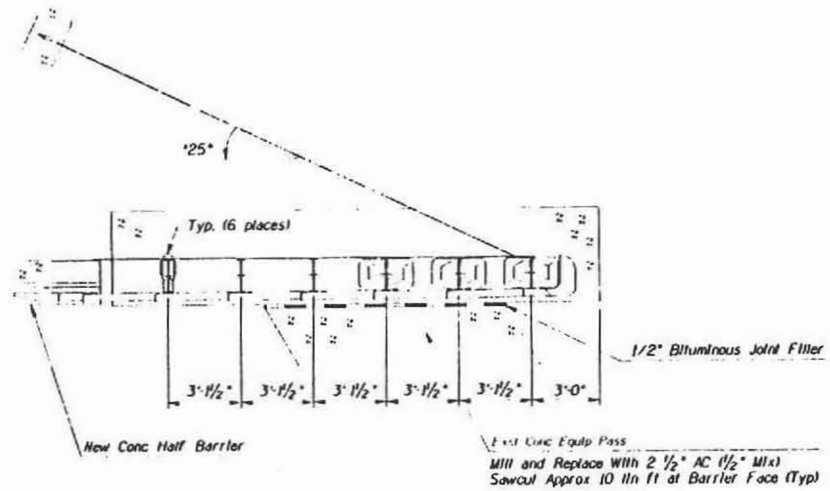
US-89 | 132.6 - 134.2 | FLORENCE STREETS

SHEET 1 OF 1

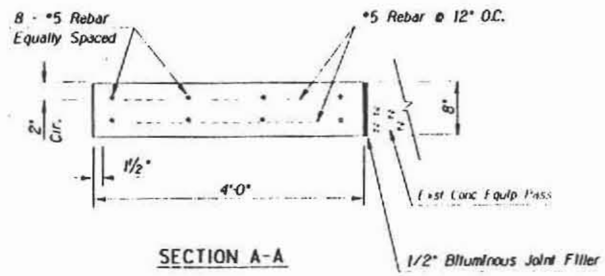
___ OF ___

GENERAL NOTES

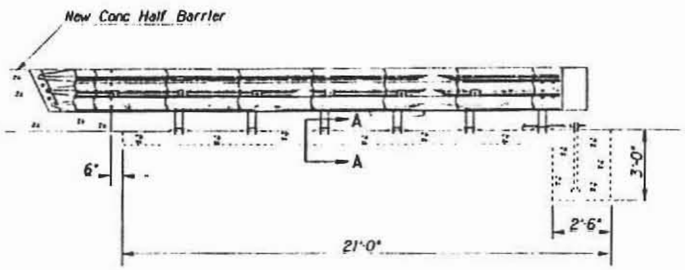
All concrete shall be Class S: f'c = 4000 p.s.i.
All reinforcing steel shall be in accordance with A.S.T.M. A 615, Grade 40.
All dimensions for reinforcing steel shall be to center of bars unless noted otherwise.
Refer to design data from Energy Absorption Systems for details not shown on TREND system Model *1 85.



PLAN



SECTION A-A



ELEVATION

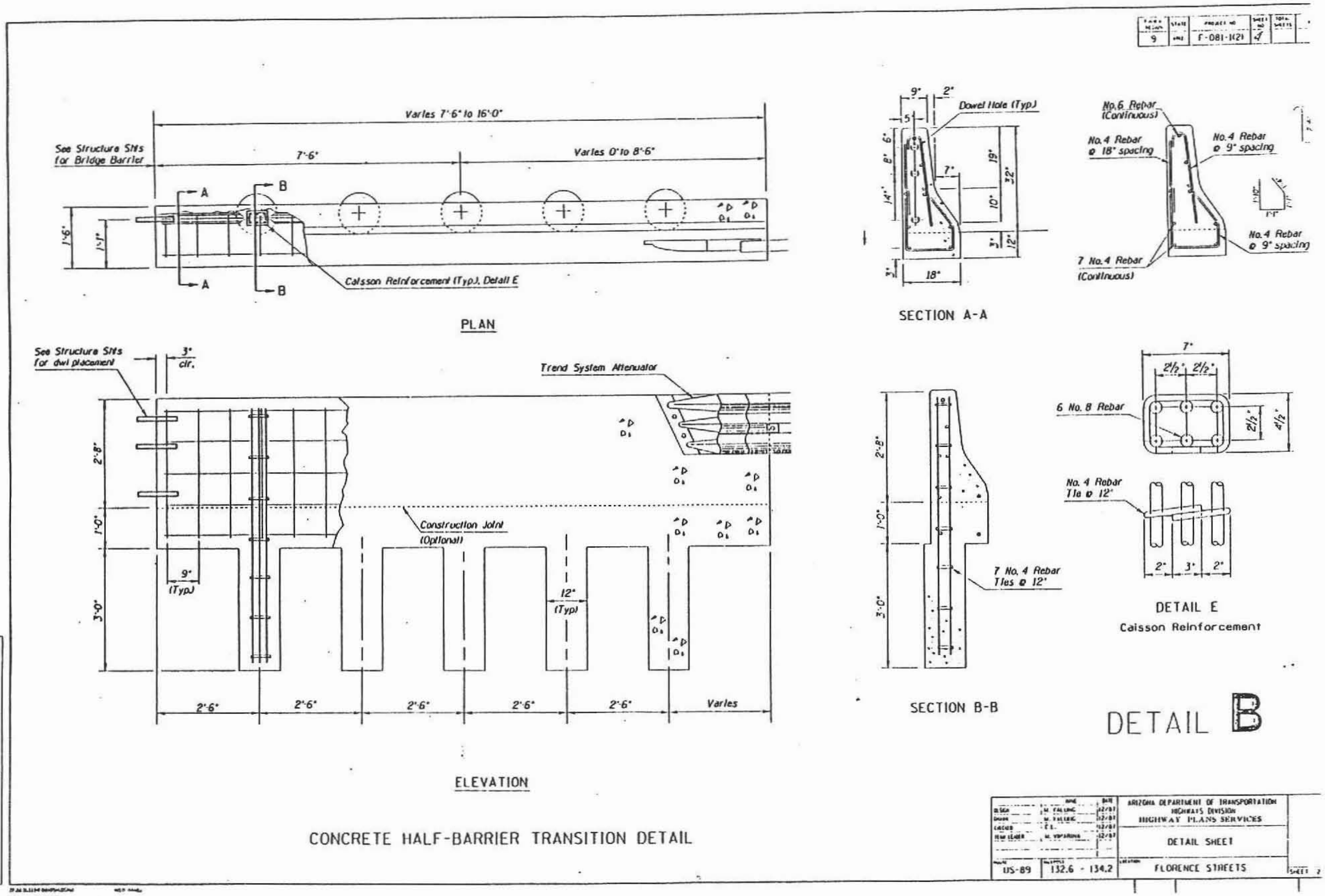
DETAIL **A**

BARRIER ATTENUATION DEVICE DETAIL

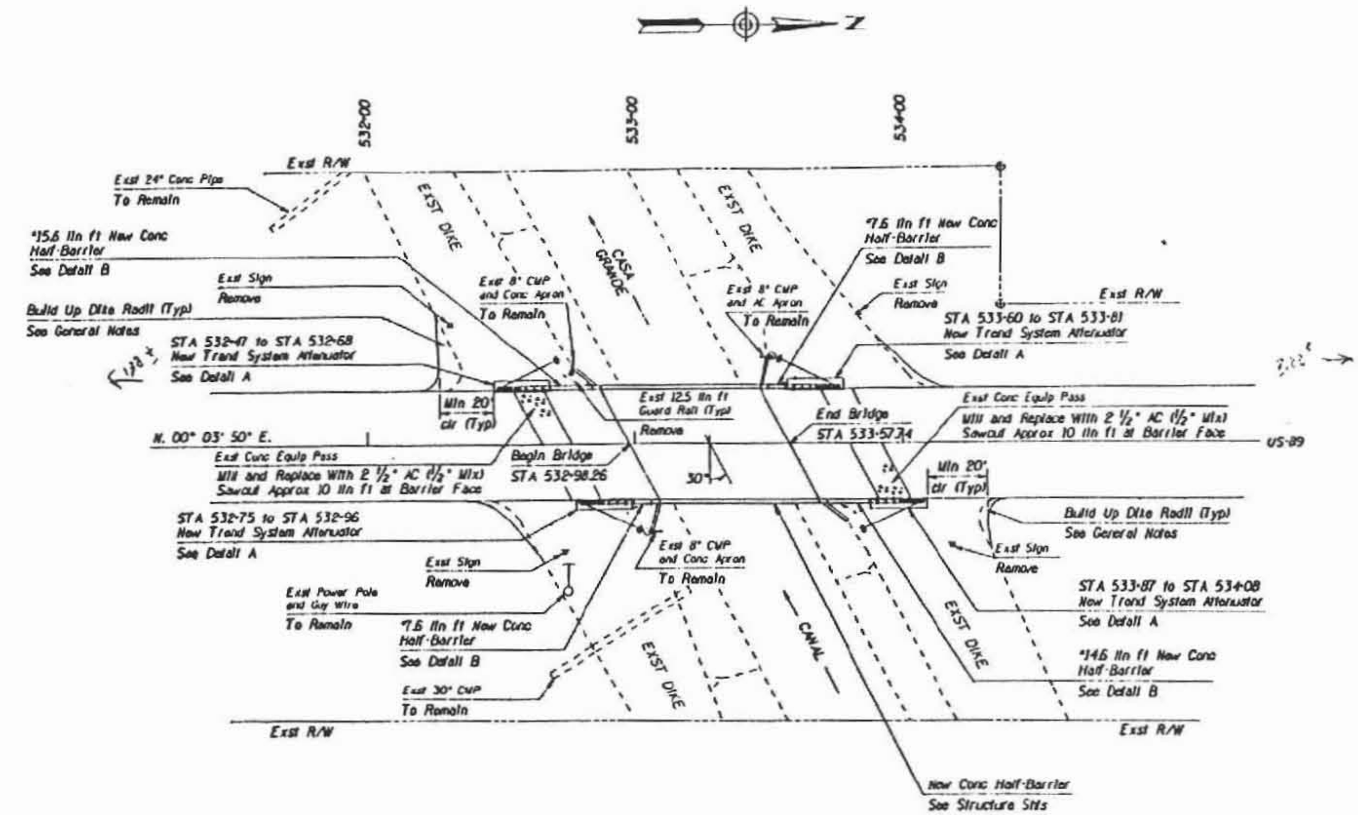
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
HIGHWAY PLANS SERVICES

DETAIL SHEET

Route	Milepost	Location
US-89	132.6 - 134.2	FLORENCE STREETS



9
F-081-1(2)
4
See Structure Shts for Bridge Barrier
Varies 7'-6" to 16'-0"
7'-6"
Varies 0' to 8'-6"
1'-6"
1'-1"
A
B
Caisson Reinforcement (Typ), Detail E
PLAN
9"
2"
5
Dowel Hole (Typ)
6"
8"
14"
19"
32"
7"
10"
3"
12"
18"
SECTION A-A
No.6 Rebar (Continuous)
No.4 Rebar @ 18" spacing
No.4 Rebar @ 9" spacing
7 No.4 Rebar (Continuous)
See Structure Shts for dwl placement
3" clr.
Trend System Attenuator
2'-8"
1'-0"
3'-0"
Construction Joint (Optional)
9" (Typ)
12" (Typ)
2'-6"
2'-6"
2'-6"
2'-6"
2'-6"
Varies
ELEVATION
2'-8"
1'-0"
3'-0"
7 No. 4 Rebar Ties @ 12"
SECTION B-B
7"
2½"
2½"
6 No. 8 Rebar
2½"
4½"
No. 4 Rebar Tie @ 12"
2"
3"
2"
DETAIL E
Caisson Reinforcement
DETAIL B
CONCRETE HALF-BARRIER TRANSITION DETAIL
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
HIGHWAY PLANS SERVICES
DETAIL SHEET
US-89
132.6 - 134.2
FLORENCE STREETS



9	ARIZ.	F-081-1(2)	

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
HIGHWAY PLANS SERVICES

PLAN SHEET

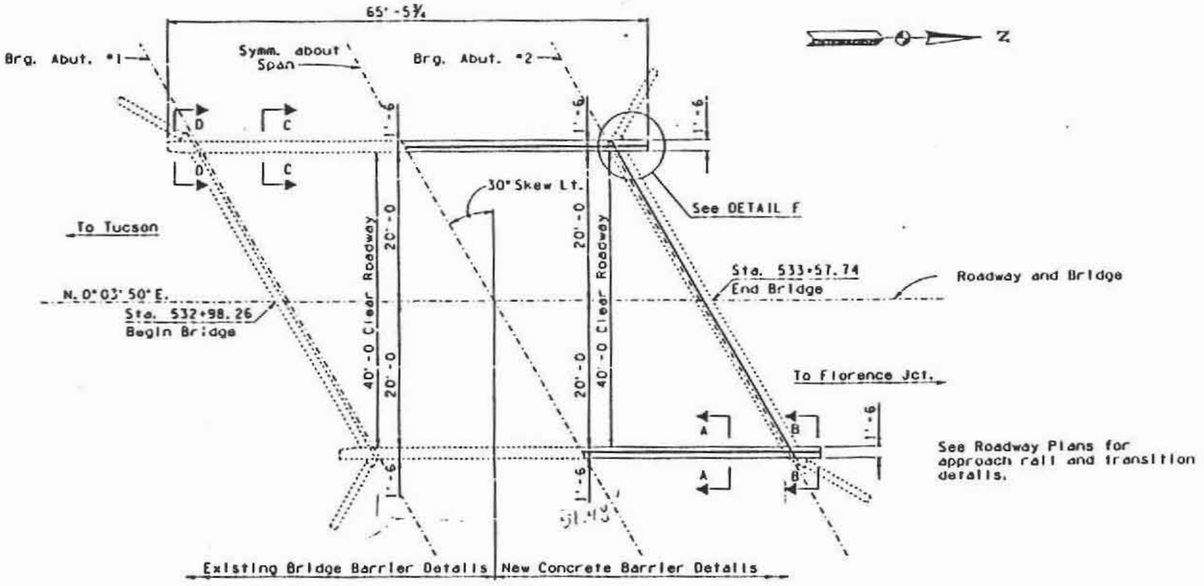
US-89	132.6 - 134.2	FLORENCE STREETS

SHEET 1 OF 1

_OF_

CASA GRANDE - FLORENCE HWY. (US 89 SR 83) ... FLORENCE STREETS
PINAL COUNTY

9	ARIZ	F-081-1(2)	6		



LOCATION PLAN
Simple Span Bridge
Scale : ⅛" = 1'-0

GENERAL NOTES:

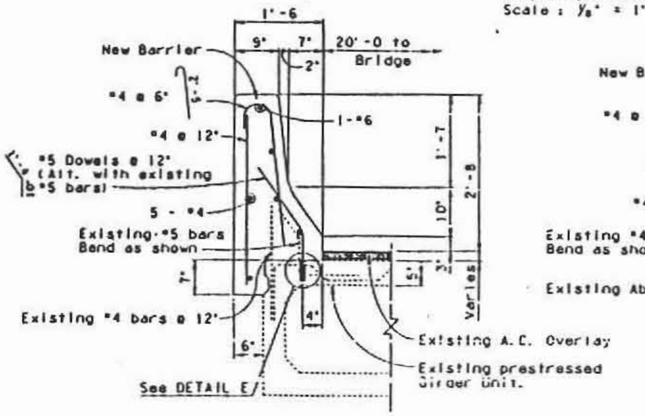
Construction - Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, Edition of 1987.
Design - AASHTO Standard Specifications for Highway Bridges 1983 Edition and 1984, 1985 and 1986 Supplements.
All concrete shall be Class 'S' concrete unless not otherwise.
Reinforcing steel shall conform to ASTM Specification A615. All bars shall be designed as Grade 40 and furnished as Grade 40 or 60.
Stresses -
Class 'S' Concrete............ fc' = 3,000 psi.
Grade 40 Reinforcing Steel.... fs = 20,000 psi.
All dimensions for reinforcing steel shall be to center of bars unless noted otherwise.
All reinforcing steel shall have 2" clear cover unl noted otherwise.
Chamfer all exposed concrete corners ¾" as per Standard B-19.10 unless noted otherwise.
Dimensions shall not be scaled from drawings.

DOWEL NOTE:

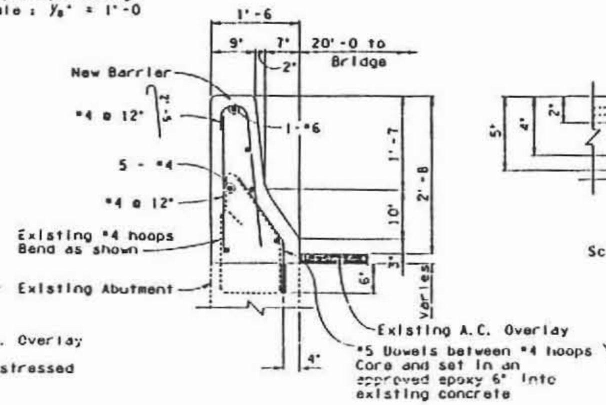
Core abutment wall 6" deep and box girder 4" deep w ⅞" diameter hole for #5 dowel. Epoxy dowel in t with approved epoxy adhesive. Epoxy anchorage sy develop a tensile pullout strength of 7 kips. Details of the anchorage system shall be submit to the Engineer for approval prior to installati

NOTE:

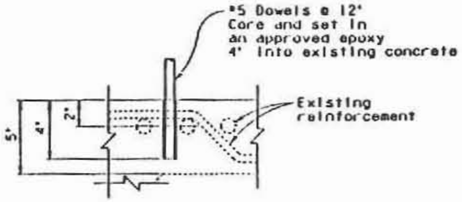
All details shown are based on 'As-Built' plans. Details in field may vary from those shown and shall be adjusted as required and directed by th Engineer.



SECTION A-A
Scale : 1" = 1'-0



SECTION B-B
Scale : 1" = 1'-0



DETAIL E
Scale : 3" = 1'-0

APPROXIMATE QUANTITIES			
Structural Conc. Removal	Class 'S' Conc. f'c=3000 psi	Reinforcing Steel	Placing Dowels
C.Y.	C.Y.	LBS.	EA.
9.1	15.5	1790	122

Existing Bridge built under Project No. NS-246(61)B, 1...

For SECTIONS C-C, D-D and DETAIL F,
See Sheet 2 of 2.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STRUCTURES SECTION

STA. 532+
CASA GRANDE CANAL BRIDGE
NEW BARRIER DETAIL

FLORENCE STREETS

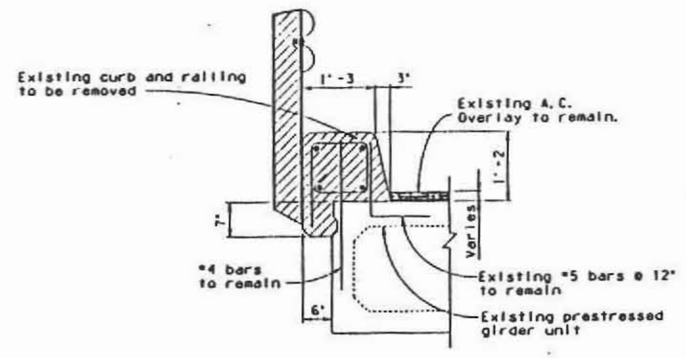
89	132.62	0644

K. BORMANN 8/87
R. CHOLAKIA 8/87
J. KESSLER 8/87
K. BORMANN 8/87
R. CHOLAKIA 8/87

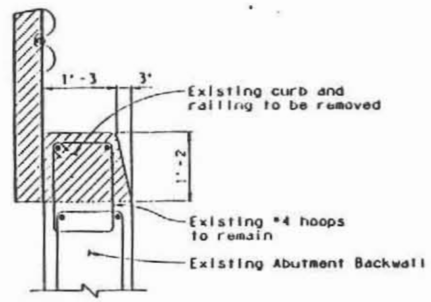
SHEET 1 OF 2

9	ARIZ.	F-081-1(2)	7		

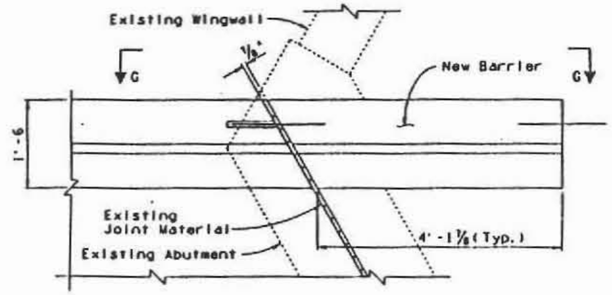
NOTE: Hatched areas indicate those portions of existing structure to be removed.



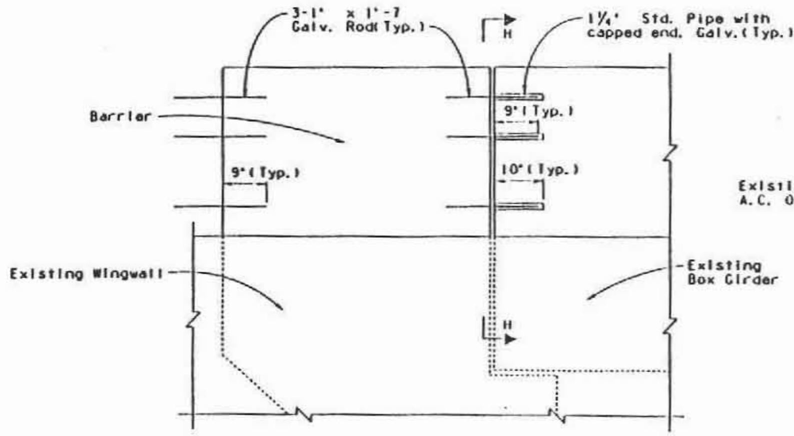
SECTION C-C
Scale : 1" = 1'-0



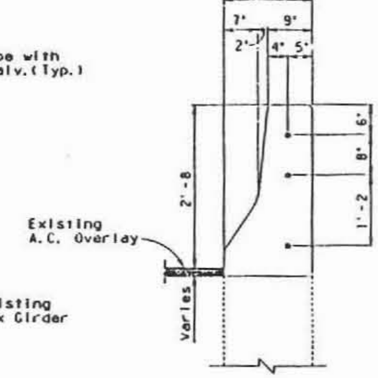
SECTION D-D
Scale : 1" = 1'-0



DETAIL F
Scale : 1" = 1'-0



VIEW G-G
Scale : 1" = 1'-0



SECTION H-H
Scale : 1" = 1'-0

DESIGN	K. BORMANN	8/87
DESIGN CKD		8/87
DRAWN	J. HESSLER	8/87
DWG CKD	K. BORMANN	8/87
APPROVED TEAM LEADER		8/87
APPROVED SUPERVISOR		

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STRUCTURES SECTION

STA. 532+
CASA GRANDE CANAL BRIDGE
NEW BARRIER DETAILS

ROUTE	MILEPOST	STRUCTURE NO.	LOCATION
89	132.62	0644	FLORENCE STREETS

BRIDGE SHEET 2

Control Desk

GENERAL NOTES:

1. ADJUSTMENTS TO SIGNS AND THEIR LOCATIONS MAY BE NECESSARY DUE TO CONSTRUCTION ACTIVITIES. AS DIRECTED BY THE ENGINEER.
2. ALL EXISTING SIGNS IN CONFLICT WITH THE CONSTRUCTION SIGNS SHALL BE REMOVED, COVERED WITH PLYWOOD, OR RELOCATED.
3. SIGN MOUNTING HEIGHT IS A MINIMUM FIVE FEET AS MEASURED FROM THE BOTTOM OF THE SIGN TO THE NEAR EDGE OF THE PAVEMENT.
4. ALL ORANGE CONSTRUCTION SIGNS SHALL USE HIGH INTENSITY REFLECTIVE SHEETING. ALL OTHER SIGNS MAY USE STANDARD INTENSITY REFLECTIVE SHEETING.
5. FLASHING WARNING LIGHTS (TYPE A) AND FLAGS SHALL BE USED TO CALL ATTENTION TO THE WARNING SIGNS.
6. ALL SIGNS ARE BLACK LETTERS ON AN ORANGE BACKGROUND, UNLESS OTHERWISE NOTED.
7. TYPE II BARRICADES ARE TO BE PLACED FORTY FEET O.C. ALONG TAPERS AND EIGHTY FEET O.C. ALONG TANGENTS.
8. A STEADY BURNING YELLOW LIGHT (TYPE C) SHALL BE MOUNTED ON EVERY TYPE II BARRICADE.
9. TEMPORARY CONCRETE BARRIER SHALL REMAIN IN PLACE UNTIL ALL NECESSARY WORK TO COMPLETE BRIDGE BARRIER AND APPROACH GUARDRAIL IS FINISHED.
10. FOR TEMPORARY CONCRETE BARRIER DETAILS, SEE STANDARD DRAWING NUMBERS 4-C 2.01, 4-C 2.02, AND 4-C-2.03.
11. BARRIER MARKERS BM-1 (WHITE) OR BM-2 (YELLOW) SHALL BE INSTALLED AT 25 FT. SPACING AS PER STANDARD DRAWING 4-M 10.01 AND 4-M 10.02. THE INSTALLED PRICE FOR THE MARKER SHALL BE CONSIDERED AS PART OF THE BARRIER COST.
12. SPEED LIMIT MAY BE CHANGED AS DIRECTED BY THE ENGINEER.
13. TRAFFIC CONTROL CONSTRUCTION SIGNS SHALL NOT BE DISPLAYED TO TRAFFIC MORE THAN 24 HRS. PRIOR TO ACTUAL START OF CONSTRUCTION. THESE SIGNS MAY BE INSTALLED SOONER, BUT THEY MUST BE COVERED OR TURNED AWAY FROM TRAFFIC. THE COST FOR COVERING OR TURNING THEM SHALL BE CONSIDERED PART OF THE SIGN INSTALLATION COST. NO FURTHER COMPENSATION WILL BE MADE. THESE SIGNS SHALL BE REMOVED WITHIN 24 HRS. AFTER COMPLETION OF THE CONSTRUCTION ACTIVITIES.
14. TEMPORARY STRIPES SHALL BE REFLECTORIZED PLASTIC PAVEMENT MARKING TAPE (TYPE II) OR STANDARD TRAFFIC PAINT. THE PAVEMENT TEMPERATURE MUST BE 60° F. OR HIGHER WHEN TAPE IS APPLIED TO PAVEMENT. IF PAVEMENT TEMPERATURE IS BELOW 60° F. STANDARD TRAFFIC PAINT SHALL BE USED AND STRIPES SHALL BE OBLITERATED BY SANDBLASTING OR OTHER APPROVED METHODS WHEN DETOUR IS COMPLETED.
15. UTILIZE FIGURE 5-7 ON PAGE 5-8 OF THE ADOT TRAFFIC CONTROL MANUAL FOR MILLING AND OVERLAY OPERATIONS.

APPROXIMATE TRAFFIC CONTROL QUANTITIES

ITEM		CASA GRANDE CANAL BRIDGE STA 532+ EAST SIDE	CASA GRANDE CANAL BRIDGE STA 532+ WEST SIDE	OVERLAY OPERATIONS	TOTAL QUANTITIES
STRIPE OBLITERATION	EXISTING				
	TEMPORARY				
TEMPORARY PAVEMENT MARKING	4" WHITE				
	4" YELLOW			150 L.F.	150 L.F.
TEMPORARY CONCRETE BARRIER		200 L.F.	200 L.F.		400 L.F.
28" TRAFFIC CONE				75 EA	
18" x 36" DRUM					
VERTICAL PANEL					
TYPE II BARRICADE		13 EA	13 EA		
TYPE III BARRICADE					
TYPE A FLASHING LIGHT		10 EA	14 EA	12 EA	
TYPE B FLASHING LIGHT					
TYPE C STEADY BURNING LIGHT		13 EA	13 EA		
SMALL SIGN (HIGH INTENSITY SHEETING)					
MEDIUM SIGN (HIGH INTENSITY SHEETING)		10 EA	10 EA	12 EA	
LARGE SIGN (HIGH INTENSITY SHEETING)					
SMALL SIGN (STANDARD INTENSITY SHEETING)					
MEDIUM SIGN (STANDARD INTENSITY SHEETING)					
LARGE SIGN (STANDARD INTENSITY SHEETING)					
SMALL SIGN STAND					
LARGE SIGN STAND		10 EA	14 EA	12 EA	

PRELIMINARY PRINT
FOR ENGINEERING USE ONLY

SUBJECT TO DESIGN CHANGES, ADDITIONS, ALTERATIONS & CORRECTIONS

DATE FEB 01 1988 BY ____

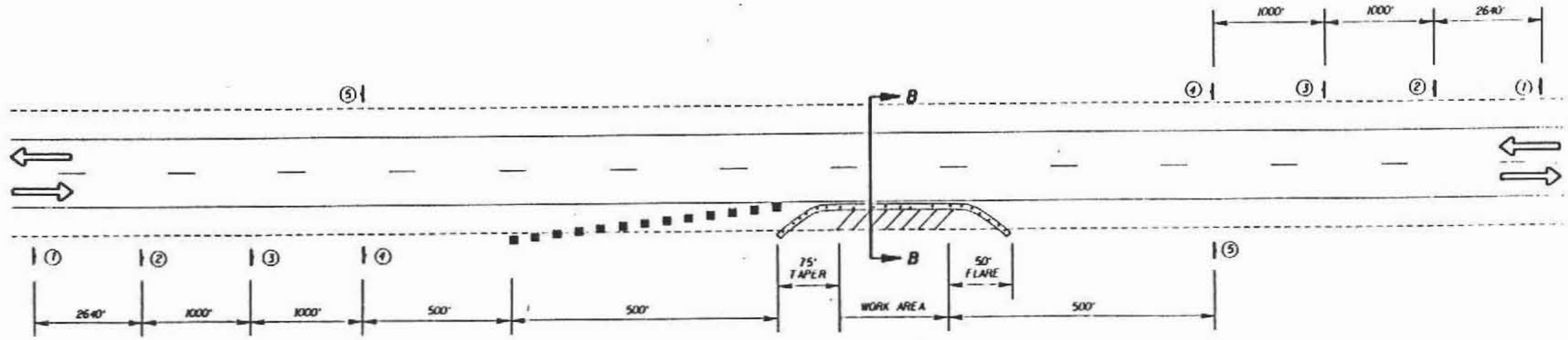
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
TRAFFIC DESIGN SERVICES

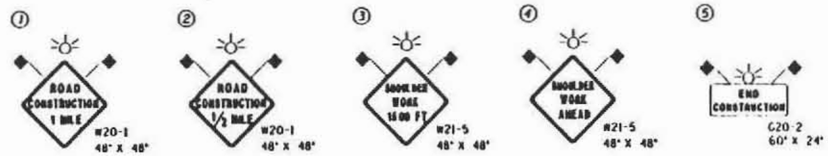
TRAFFIC CONTROL QUANTITIES

LOCATION: FLORENCE STREETS

SHEET 1 OF 2

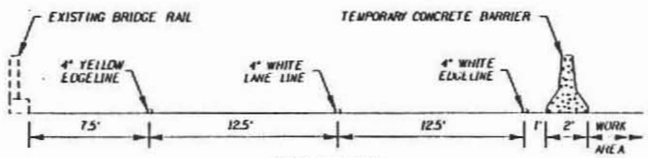
___ OF





LEGEND:

┃	SIGN
■	TYPE II BARRICADE
⇨	DIRECTION OF TRAVEL



SECTION B-B

STA. 532 ·
CASA GRANDE CANAL BRIDGE

NOTE:

THIS PLAN SHOWS TRAFFIC CONTROL FOR WORK ON THE EAST SIDE OF THE BRIDGE.
TRAFFIC CONTROL FOR WORK ON THE WEST SIDE OF THE BRIDGE IS SIMILAR AND OPPOSITE.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
TRAFFIC DESIGN SERVICES

TRAFFIC CONTROL PLAN

FLORENCE STREETS

SHEET 2 OF 2

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