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FLOOD CONTROL CHANNEL BRIDGE

Power Road South of Williams Field Road
Maricopa County, Arizona

Prepared for

Henry B. Haws & Associates, Inc.
613 South Mesa Drive
Mesa, Arizona

THOMAS-HARTIG & ASSOCIATES, INC.
SOIL & FOUNDATION ENGINEERS

LETTER OF TRANSMITTAL

HENRY HAWS & ASSOCIATES
613 SOUTH MESA DRIVE
MESA, ARIZONA 85202
TELEPHONE: (602) 964-1509

HENRY HAWS & ASSOCIATES
A DIVISION OF HAWS INC.
LANDSCAPE ARCHITECTS, CIVIL ENGINEERS, PLANNERS, & SURVEYORS

TO:

Maricopa County Flood Control
3335 W. Durango
Phoenix, Az 85009

ATTENTION: Nick Karan, P.E.
Chief, Engineering Division

PROJECT NUMBER	DATE 10-17-86
PROJECT TITLE Power Road Bridge over the R.W.C.D. Floodway, Reach 4	

SENT VIA			
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COPIES	DATE	NUMBER	DESCRIPTION
1			Soil Report
1			Structural Calcs.
1			Preliminary Plans

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OCT 20 '86

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REMARKS	

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REMARKS:

We are in the process of revising the bridge plans to conform to flatter profiles on both Power Road and the floodway.

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SIGNED Delmar E. Fox
Delmar E. Fox, P.E.
Director of Engineering

F-038

(If enclosures are not as noted, kindly notify us at once)

THOMAS-HARTIG & ASSOCIATES, INC.

SOIL AND FOUNDATION ENGINEERING • MATERIALS TESTING

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Henry B. Haws & Associates, Inc.
613 South Mesa Drive
Mesa, Arizona

21 June 1985
Revised 26 August 1985

Attention: Del Fox

Project: Flood Control Channel Bridge
Power Road South of Williams Field Road
Maricopa County, Arizona

Project No: 85-622

This report presents the results of the soil engineering services authorized on the site for the proposed bridge. The purpose of these services is to determine the soil conditions at the locations indicated which thereby provide a basis for the design discussions and recommendations presented herein. This firm should be notified for evaluation if conditions other than described herein are encountered during construction.

The services performed provide an evaluation at selected locations of the surface and subsoils throughout the zone of significant foundation influence. Our field services have not included exploration for underlying geologic conditions or evaluation of potential geologic hazards such as seismic activity, faulting, and ground subsidence/cracking potential due to ground water withdrawal.

The recommendations included are presented based upon the project information received and described in "Scope" Part I. This firm should be contacted for review if the design conditions are changed substantially.

Complimentary to this report, we will be pleased to review project plans and specifications relative to compliance to the intent of this report.

Respectfully submitted,

THOMAS-HARTIG & ASSOCIATES, INC.

By: Roger A. Brewer, P.E. Reviewed by: John P. Boyd, P.E.

Registered Professional Engineer (Civil) CERTIFICATE NO. 13241 ROGER A. BREWER Date Signed 8/26/85 ARIZONA, U.S.A.

Registered Professional Engineer (Civil) CERTIFICATE NO. 7354 JOHN P. BOYD Date Signed 8/26/85 ARIZONA, U.S.A.

/cms

Copies to: Addressee (3)

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PART I

REPORT

SCOPE

The proposed bridge will be a four-lane, two or three-span structure constructed across the flood control channel on Power Road south of Williams Field Road as shown on the accompanying site plan. The bridge will be approximately 95 feet long by 68 feet wide, and the deck elevation will be established at approximately Elevation 1330 feet. The channel will be lowered by approximately 7 feet with finished flow line near Elevation 1310 feet. Structural loadings have been estimated by Wilson & Company to be approximately 800 kips at abutments and 2100 kips at interior piers.

This firm should be contacted for review and possible supplemental recommendations if design concepts are modified significantly.

SITE DESCRIPTION

The site is located on Power Road approximately 1/8 mile south of Williams Field Road in Maricopa County, Arizona. Power Road is currently two lanes wide and crosses the flood control channel via an existing two-lane bridge. The new bridge will be constructed approximately 100 feet west of the existing two-lane bridge. At the new bridge location, the channel is approximately 100 feet wide and has man-made berms ranging from approximately 3 feet high on the south bank to 8 feet high on the north bank. The low point in the channel is approximately 5 feet lower in elevation than the ground surface behind the berms. The land on the south side of the channel is native desert land. The land on the north side contains spread fills which were apparently derived and placed during construction of either the flood control channel or the RWCD Canal, which runs approximately parallel to and about 300 feet north of the flood control channel. At the time of test drilling, vegetation in the area of the proposed bridge consisted of typical desert grass and scrub.

INVESTIGATION

Three test borings were drilled at the locations shown on the accompanying site plan using a rotary auger (CME-55) drilling rig and 7 inch diameter, hollow stem augers. The results of the test drilling are presented in "Appendix A, Field Results".

Representative samples obtained during the field investigation were subjected to the following laboratory analyses:

Test	Sample(s)	Purpose
Compression	Undisturbed (3)	Settlement Analysis
Direct Shear	Undisturbed (3)	Foundation Bearing Capacity Analysis
Sieve Analysis & Plasticity Index	Representative Subsurface Soil (2)	Classification
*Dry Density and Moisture Content	Undisturbed (25)	In-situ Density and Moisture Determination to Correlate Engineering Properties

*Reported on Boring Logs.

The results of testing are presented in "Appendix B, Laboratory Results".

SOIL CONDITIONS

As disclosed by the test borings and illustrated on the attached boring logs, the subsurface soil stratification encountered in the test borings was somewhat variable. At the channel bank (borings 1 and 3), the man-made berms were 8 feet and 3 feet in thickness, respectively, and generally consisted of variable mixtures of clayey sand and sandy clay. Beneath the berms at borings 1 and 3, and starting at ground surface in boring 2, the natural soil was irregularly stratified and generally ranged from variably cemented sandy clays and clayey sands of low plasticity to stratified sands and gravels. Detailed soil information is presented on the boring logs.

The moisture contents were generally described as slightly damp to moist, and no free groundwater table was encountered in the test borings at the time of test drilling.

DISCUSSION AND RECOMMENDATIONS

General: Soil engineering recommendations for support of the new bridge are presented in the following sections. These recommendations are based upon the results of the field and laboratory testing. Alternative recommendations may be possible and will be considered upon request.

Foundations: Because the wash is intermittent and subject to relatively high flow stages, there is a potential for scour at this site. However, a determination of the design scour level was not available at the time of this investigation.

Foundations deriving support below the design scour level will be required, and all of the footing depths shown below are based on depths below this level.

We recommend that the foundations consist of either deep spread footings or straight-shafted cast-in-place caissons. Under-reamed caissons are not recommended because there are numerous sand and gravel lenses present which would probably result in excessive caving. Design recommendations for the two types of foundations are presented in the following sections. Alternative recommendations may be possible and will be considered upon request.

I. DEEP SPREAD FOOTINGS

Footing Type	*Footing Depth	Allowable Foundation Bearing Pressure	Foundation Load	Estimated Settlements
Spread	4 ft.	7000 psf	800 - 2100 kips	0.5 - 0.8 in.±
Spread	5 ft.	7500 psf	800 - 2100 kips	0.6 - 0.9 in.±
Spread	6 ft.	8000 psf	800 - 2100 kips	0.7 - 1.0 in.±

*Bearing on undisturbed natural soils at minimum indicated depth below scour level.

II. STRAIGHT-SHAFTED CAISSONS

Allowable axial bearing capacities for circular-drilled, straight-shafted caissons are presented on the following page (Figure No. 1). All embedment depths are referenced below the scour level. Drilling may be difficult where hard cemented soils are encountered, and some raveling or caving may occur where localized, clean sand or gravel lenses are encountered. Most of the drilling spoil must be cleaned from the bottom of shaft excavations (no more than 3 inches remaining). It may be possible to satisfactorily clean the excavations using mechanical (drill rig) cleaning. Contractors should be permitted to perform a test hole, if desired, for bidding purposes.

10-24-84

Spread footings with D = 0

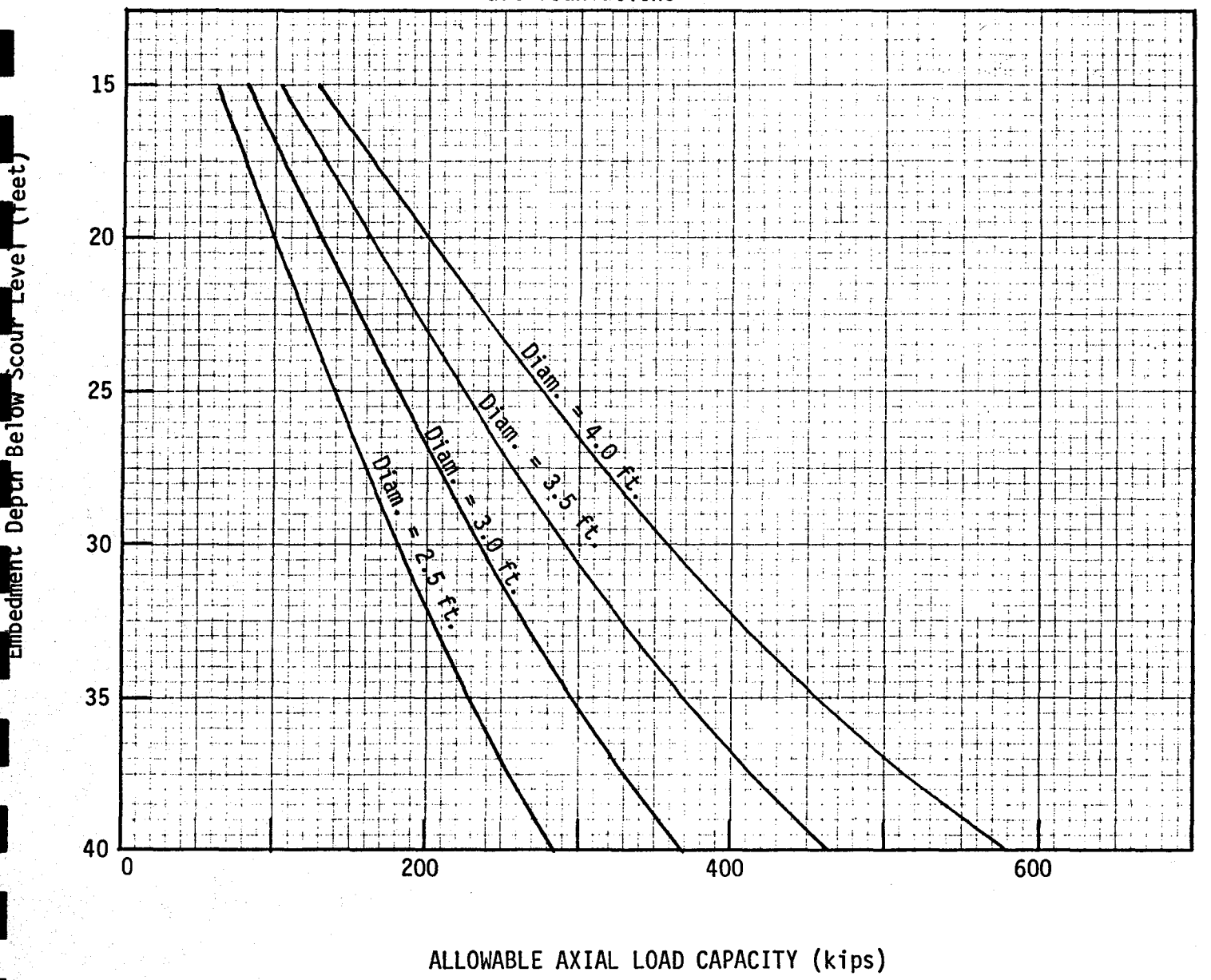
from above table the effect of 1' of surcharge is 500 psf

∴ Allow soil p = 7000 - (4 × 500) = 5000 psf

2000

2½ tons.

FIGURE NO. 1: Load Capacity for drilled, cast-in-place machine-cleaned, straight-shaft foundations



As noted in the previous tabulations, footing depth refers to the depth of the base of the footing below scour level. All foundation excavations should be observed by a qualified geotechnical engineer to verify bearing conditions. Drilling spoil must be removed from drilled excavations as previously recommended. Proper removal of drilling spoil from under-reamed shafts will most likely require hand cleaning. A minimum shaft diameter of 2.5 feet is recommended for shafts which are hand cleaned, and these shafts must be cased with protective casing per applicable code requirements.

Recommended foundation bearing pressures and axial load capacities should be considered allowable maximums for dead plus design live loads, and may be increased by one-third when considering total loads including wind or seismic forces. The weight of the foundation concrete below grade may be neglected in dead load computations. Three (3.0) feet is recommended as the minimum width of footings designed on an end-bearing basis.

The estimated settlements for end-bearing foundations are based on soils remaining at normal low moisture contents. Some minor additional post-construction settlement could be experienced by the deep foundations if the bearing soils become wet during prolonged flooding. Estimated settlements for the straight-shafted caissons are on the order of 1/2 inch or less with similar minor additional settlement possible during prolonged flooding.

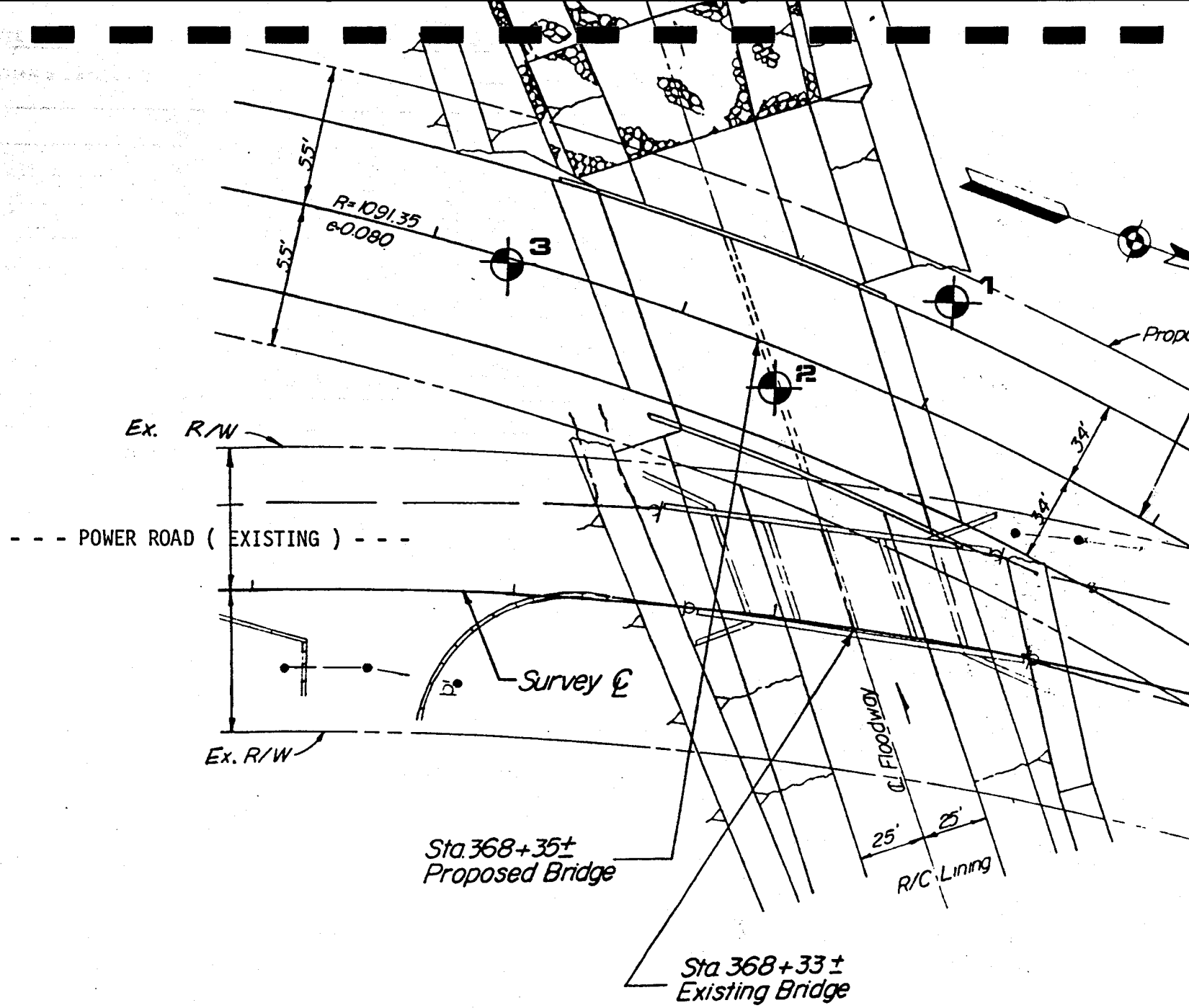
Lateral Earth Pressures: Recommended lateral earth pressures against abutment walls, other retaining structures, and drilled pier elements are presented in the following tabulation.

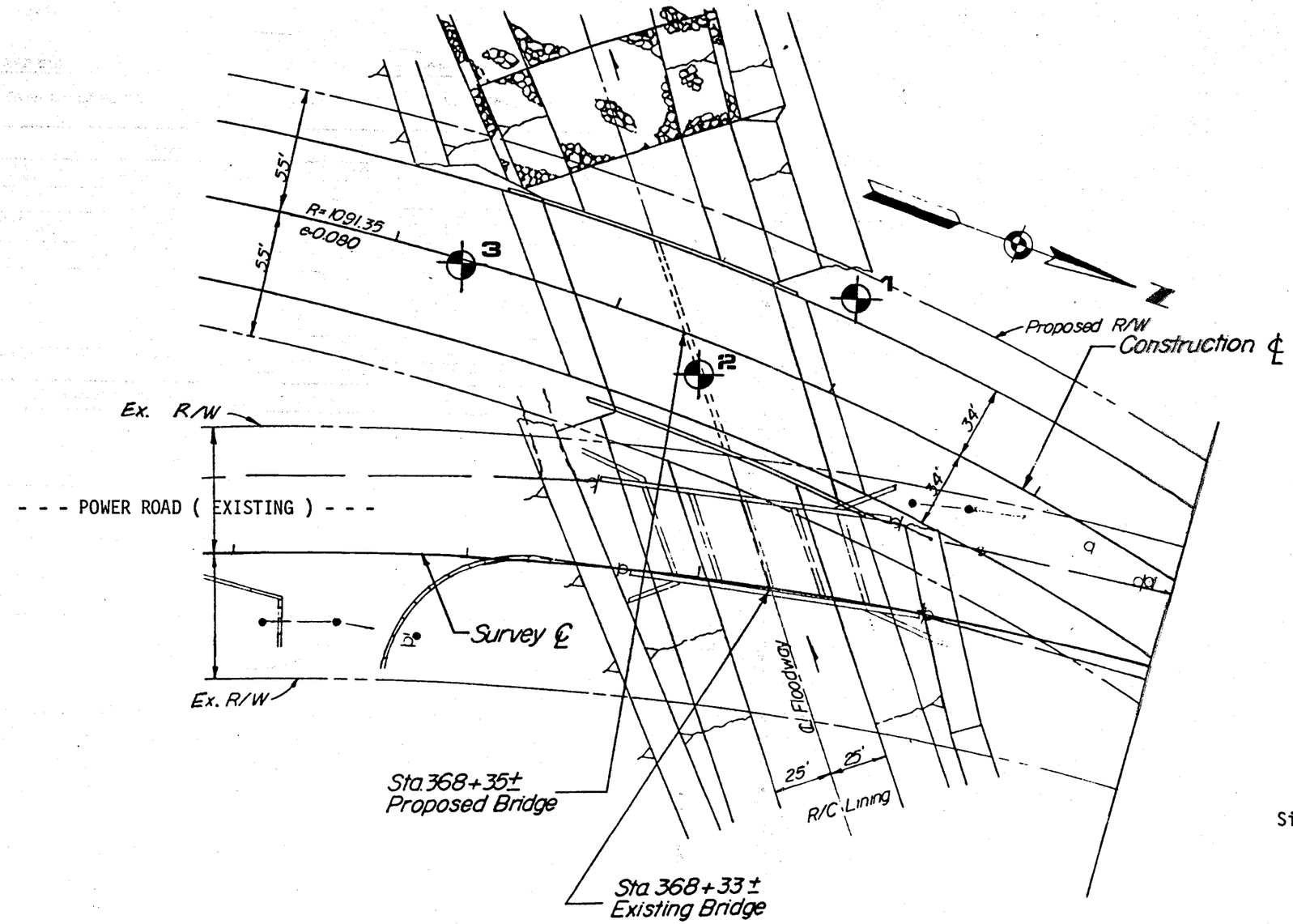
Equivalent "Active" Soil Pressure (yielding structure)	30 psf/ft.
Equivalent "At-Rest" Soil Pressure (rigid structure)	50 psf/ft.
Passive Pressures:	
In a direction parallel with channel slope	500 psf ft.
In a direction normal to channel slope	350 psf/ft.

Backfill required against retaining structures should be granular soils meeting the Arizona Highway Department's Specifications for Select Backfill Materials. Compaction should be accomplished to a minimum 95 percent of the AASHTO: T-180 maximum density. Retaining structures should be braced to resist equipment loadings during compaction of the backfill.

APPENDIX A

FIELD RESULTS


55'
55'
R=1091.35
e=0.080
3
1
2
Ex. R/W
- - - POWER ROAD (EXISTING) - - -
34'
34'
Survey ℄
Ex. R/W
℄ Floodway
25'
25'
R/C Lining
Sta. 368+35±
Proposed Bridge
Sta. 368+33±
Existing Bridge



LEGEND

Location of test borings

Site plan prepared by Henry Haws & Assoc.

THOMAS-HARTIG & ASSOCIATES, INC.

Project No: 85-622

LEGEND

SOIL CLASSIFICATION ASTM: D2487

COARSE-GRAINED SOIL

MORE THAN 50% LARGER THAN 200 SIEVE SIZE

Symbol	Letter	DESCRIPTION	MAJOR DIVISIONS
	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% - 200 FINES	GRAVELS More than half of coarse fraction is larger than No. 4 Sieve size.
	GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% - 200 FINES	
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% - 200 FINES	
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% - 200 FINES	
	SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% - 200 FINES	SANDS More than half of coarse fraction is smaller than No. 4 sieve size.
	SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% - 200 FINES	
	SM	SILTY SANDS, SAND-SILT MIXTURES MORE THAN 12% - 200 FINES	
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES MORE THAN 12% - 200 FINES	

FINE-GRAINED SOIL

MORE THAN 50% SMALLER THAN 200 SIEVE SIZE

Symbol	Letter	DESCRIPTION	MAJOR DIVISIONS
	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	SILTS AND CLAYS Liquid limit less than 50
	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
	OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY	
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS, ELASTIC SILTS	SILTS AND CLAYS Liquid limit greater than 50
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	

log denotes visual approximation unless accompanied by mechanical analysis and Atterberg limits.

GRAIN SIZES

U.S. STANDARD SERIES SIEVE: 200, 50, 16, 4

CLEAR SQUARE SIEVE OPENINGS: ¾", 3", 6"

SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

MOISTURE CONDITION (INCREASING MOISTURE ⟶)

DRY — SLIGHTLY DAMP — DAMP — MOIST — VERY MOIST — WET (SATURATED)

(PL) (LL)

DEFINITIONS

Penetration Resistance — Blows per foot using 'A' rod and 140 lb. hammer with 30 inch free fall unless otherwise noted.

N Standard Penetration Resistance (ASTM:D1586), 2.0 inch O.D. split barrel sampler.

C Continuous Penetration Resistance, 2.0 inch O.D. Bull Nose.

R Penetration Resistance, 2.42 inch I.D. Ring Sampler

Sample Type

R - Ring T - Shelby Tube S - Standard Split Barrel B - Block
G - Grab C - Cutting V - Vertical Face Cut

CONSISTENCY			RELATIVE DENSITY	
CLAYS & SILTS	BLOWS/FOOT*	STRENGTH‡	SANDS & GRAVELS	BLOWS/FOOT*
VERY SOFT	0-2	0-¼	VERY LOOSE	0-4
SOFT	2-4	¼-½	LOOSE	4-10
FIRM	4-8	½-1	MEDIUM DENSE	10-30
STIFF	8-16	1-2	DENSE	30-50
VERY STIFF	16-32	2-4	VERY DENSE	OVER 50
HARD	OVER 32	OVER 4		

* Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-⅜ inch I.D.) split spoon (ASTM D-1588).

‡ Unconfined compressive strength in tons/sq. ft. Read from a pocket penetrometer.

Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

SOIL BORING LOG

NO. 1 ELEV: 1328.8 ft. SIZE OF HOLE 7 in. FIELD ENGR: SJ DATE: 5/16/85

DEPTH FT	PENETRATION RESISTANCE BLOWS/FT C	PENETRATION RESISTANCE BLOWS/FT R	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION	SOIL CLASSIFICATION	GRADATION WELL	GRADATION MED	GRADATION POOR	GRAIN SHAPE ANGULAR	GRAIN SHAPE SURANGULAR	GRAIN SHAPE ROUNDED	GRAIN SHAPE SUBROUNDED	RELATIVE DENSITY LOW	RELATIVE DENSITY MED	RELATIVE DENSITY HIGH	PLASTICITY NONE	PLASTICITY LOW	PLASTICITY MEDIUM	PLASTICITY HIGH	CONSISTENCY SOFT	CONSISTENCY FIRM	CONSISTENCY STIFF	CONSISTENCY VERY STIFF	CONSISTENCY HARD	CEMENTATION NONE	CEMENTATION WEAK	CEMENTATION MEDIUM	CEMENTATION STRONG
1					sli	Fill: (Channel Bank); variable	SC-																							
2					damp	mixture of clayey sand and	CL																							
3						sandy clay, apparently deri-																								
4						ved on-site and placed during																								
5		7	R	94	9	construction of channel.																								
6						(Note: fill may be different																								
7						at other locations on banks).																								
8																														
9						Sandy Clay to Clayey Sand;	CL-			X		X							X					X			X	X	
10		10	R	92	7	light brown to brown, stra-	SC																							
1					sli	tified, calcareous with vari-																								
2					damp	able weak to moderate cemen-																								
3						tation, occasional sandy silt/																								
4						silty sand (ML/SM) lenses.																			X		X	X	
5		50/10"	R	100	6																									
6																														
7																														
8																														
9																														
20		50/10"	R	100	7																									
1																														
2																														
3																														
4						Fine to Coarse Sand; gray-	SP-		X			X		X		X	X	X									X			
5		37	R	*	3	brown, slightly silty, appro-	SM																							
6					sli	ximately 30% gravel to 1½ in.																								
7					damp																									
8																														
9						Sandy Clay to Clayey Sand;	CL-			X		X							X						X		X	X	
30		50/10"	R	101	15	light brown to brown, stra-	SC																							
1					sli	tified, calcareous with vari-																								
2					damp	able weak to moderate cemen-																								
3						tation, occasional sandy silt/																								
4						silty sand (ML/SM) lenses.																								
5		37	R	101	14																									
6					sli	Silty Sand & Gravel; gray-	SM-		X			X		X		X	X	X									X	X	
7					damp	brown to brown, stratified	GM																							
8						by grain size distribution,																								
9						variable silt content.																								
40		50	R	121	4																									

*Sample too disturbed to determine in-situ density.

CONTINUED

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. This boring data was compiled primarily for design purposes, and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring logs.

SOIL BORING LOG

NO. 1 ELEV: 1328.8 ft. SIZE OF HOLE 7 in. FIELD ENGR: SJ DATE: 5/16/85

DEPTH FT	PENETRATION RESISTANCE BLOWS/FT C	PENETRATION RESISTANCE BLOWS/FT R	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION (CONTINUED)	SOIL CLASSIFICATION	GRADATION WELL	GRADATION MED	GRADATION POOR	GRAIN SHAPE ANGULAR	GRAIN SHAPE SUBANGULAR	GRAIN SHAPE ROUNDED	GRAIN SHAPE SUBROUNDED	RELATIVE DENSITY LOW	RELATIVE DENSITY MED	RELATIVE DENSITY HIGH	PLASTICITY NONE	PLASTICITY LOW	PLASTICITY MEDIUM	PLASTICITY HIGH	CONSISTENCY SOFT	CONSISTENCY FIRM	CONSISTENCY STIFF	CONSISTENCY VERY STIFF	CONSISTENCY HARD	CEMENTATION NONE	CEMENTATION WEAK	CEMENTATION MEDIUM	CEMENTATION STRONG
41					sli	Silty Sand & Gravel; gray-	SM-		X			X		X		X	X	X									X	X		
2					damp	brown to brown, stratified	GM																							
3						by grain size distribution,	CL-			X		X							X							X			X	X
4						variable silt content.	SC																							
5		50/6"	R	109	11	Sandy Clay to Clayey Sand;																								
6						light brown to brown, stra-																								
7						tified, calcareous with vari-																								
8						able moderate to strong cemen-																								
9						tation, occasional sandy																								
50		50/4"	R	113	16	silt/silty sand (ML/SM)																								
1						lenses.																								
2																														
3						Very difficult drilling																								
4						50 to 60 feet.																								
5		50/4"	R	119	12																									
6																														
7																														
8																														
9																														
60																														
1																														
2																														
3																														
4																														
5																														
6																														
7																														
8																														
9																														
70																														
1																														
2																														
3																														
4																														
5																														
6																														
7																														
8																														
9																														
80																														

Stopped test drilling at: 60 feet

Ground water encountered: none

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. This boring data was compiled primarily for design purposes, and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

SOIL BORING LOG

NO. 2 ELEV: 1316.8 ft. SIZE OF HOLE 7 in. FIELD ENGR: SJ DATE: 5/15/85

DEPTH FT.	PENETRATION RESISTANCE BLOWS/FT. C	PENETRATION RESISTANCE BLOWS/FT. N& R	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION	SOIL CLASSIFICATION	GRADATION WELL	GRADATION MED	GRADATION POOR	GRAIN SHAPE ANGULAR	GRAIN SHAPE SURANGULAR	GRAIN SHAPE ROUNDED	GRAIN SHAPE SUBROUNDED	RELATIVE DENSITY LOW	RELATIVE DENSITY MED	RELATIVE DENSITY HIGH	PLASTICITY NONE	PLASTICITY LOW	PLASTICITY MEDIUM	PLASTICITY HIGH	CONSISTENCY SOFT	CONSISTENCY FIRM	CONSISTENCY STIFF	CONSISTENCY VERY STIFF	CONSISTENCY HARD	CEMENTATION NONE	CEMENTATION WEAK	CEMENTATION MEDIUM	CEMENTATION STRONG
1					damp	Sandy Clay to Clayey Sand;	CL-			X		X							X						X	X	X	X		
2						light brown to brown, stra-	SC																							
3						tified, calcareous with vari-																								
4						able weak to moderate cemen-																								
5		22	R	103	16	tation below approximately																						X	X	
6						4 feet, occasional sandy silt/																								
7						silty sand (ML/SM) lenses.																								
8																														
9																														
10		30	R	102	16																									
1						Gravelly lens from 11 to 14																								
2						feet.																								
3																														
4																														
5		22	R	100	15																									
6																														
7																														
8																														
9						Silty Sand & Gravel; gray-	SM-	X			X		X		X	X	X									X			
20		25	R	102	9	brown to brown, stratified	GM																							
1					sli	by grain size distribution,																								
2					damp	occasional clean lenses																								
3						(SP/GP).																								
4																														
5		19	R	101	5																									
6																														
7																														
8																														
9																														
30		33	S	**	**																									
1																														
2																														
3																											X	X		
4																														
5		46	S	**	**																									
6																														
7					moist	Sandy Clay to Clayey Sand;	CL-			X		X							X						X			X	X	
8					to	light brown to brown, stra-	SC																							
9					damp	tified, calcareous with vari-																								
40		27	R	102	23	able weak to strong (CONTD.)																								

**Not measured (split spoon sample)

CONTINUED

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. This boring data was compiled primarily for design purposes, and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

SOIL BORING LOG

NO. 2 ELEV: 1316.8 ft. SIZE OF HOLE 7 in. FIELD ENGR: SJ DATE: 5/15/85

DEPTH FT.	PENETRATION RESISTANCE BLOWS/FT. C	PENETRATION RESISTANCE BLOWS/FT. N& R	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION (CONTINUED)	SOIL CLASSIFICATION	GRADATION WELL	GRADATION MED	GRADATION POOR	GRAIN SHAPE ANGULAR	GRAIN SHAPE SUBANGULAR	GRAIN SHAPE ROUNDED	GRAIN SHAPE SUBROUNDED	RELATIVE DENSITY LOW	RELATIVE DENSITY MED	RELATIVE DENSITY HIGH	PLASTICITY NONE	PLASTICITY LOW	PLASTICITY MEDIUM	PLASTICITY HIGH	CONSISTENCY SOFT	CONSISTENCY FIRM	CONSISTENCY STIFF	CONSISTENCY VERY STIFF	CONSISTENCY HARD	CEMENTATION NONE	CEMENTATION WEAK	CEMENTATION MEDIUM	CEMENTATION STRONG
41					moist	Sandy Clay to Clayey Sand;	CL-			X		X							X						X			X	X
2					to	light brown to brown, vari-	SC																							
3					damp	able weak to strong cemen-																				X			X	X
4						tation, occasional sandy																								
5		50/6"	R	106	18	silt/silty sand (ML/SM)																								
6						lenses.																								
7																														
8																														
9																														
50		90/6"	R	105	19																									
1																														
2																														
3																														
4																			X	X								X	X	
5		45	R	104	24																									
6																														
7																														
8					sli	Fine to Coarse Sand; gray-	SP-		X			X	X			X	X									X	X		
9					damp	brown, slightly silty, trace	SM																							
60		50/6"	R	109	5	gravel.																								
1																														
2																														
3					moist	Sandy Clay to Clayey Sand;	CL-			X		X							X						X			X	X
4						light brown to brown, stra-	SC																							
5		50/9"	R	100	23	tified, calcareous with vari-																								
6						able moderate to strong cemen-																								
7						tation.	SM-		X			X	X			X	X									X	X		
8					sli	Silty Sand & Gravel; gray-	GM																							
9					damp	brown, stratified, variable																								
70		50/6"	R	94	6	silt content.																								
1																														
2																														
3																														
4																														
5																														
6																														
7																														
8																														
9																														
80																														

Stopped test drilling at: 70 feet

Ground water encountered: none

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. This boring data was compiled primarily for design purposes, and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

SOIL BORING LOG

NO. 3 ELEV: 1324.7 ft. SIZE OF HOLE 7 in. FIELD ENGR: SJ DATE: 5/16/85

DEPTH FT	PENETRATION RESISTANCE BLOWS/FT C	PENETRATION RESISTANCE BLOWS/FT R	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION	SOIL CLASSIFICATION	GRADATION WELL	GRADATION MED	GRADATION POOR	GRAIN SHAPE ANGULAR	GRAIN SHAPE SUBANGULAR	GRAIN SHAPE ROUNDED	GRAIN SHAPE SUBROUNDED	RELATIVE DENSITY LOW	RELATIVE DENSITY MED	RELATIVE DENSITY HIGH	PLASTICITY NONE	PLASTICITY LOW	PLASTICITY MEDIUM	PLASTICITY HIGH	CONSISTENCY SOFT	CONSISTENCY FIRM	CONSISTENCY STIFF	CONSISTENCY VERY STIFF	CONSISTENCY HARD	CEMENTATION NONE	CEMENTATION WEAK	CEMENTATION MEDIUM	CEMENTATION STRONG
1					sli	Fill: (Channel Bank); vari-	SC-																							
2					damp	able mixture of clayey sand	CL																							
3						and sandy clay, apparently																								
4						derived on-site and placed	CL-			X		X							X						X		X	X		
5		24	R	100	4	during construction of chan-	SC																							
6						nel. (Note: fill may be dif-																								
7						ferent at other locations on																								
8					sli	banks).	SM		X			X				X	X	X									X			
9					damp	Sandy Clay to Clayey Sand;																								
10		37	R	110	5	light brown, variable weak																								
1						calcite cementation.																								
2						Silty Sand; brown, stratified,																								
3						variable silt content, pre-				X																	X	X		
4						dominantly fine sand, occa-																								
5		23	R	100	12	sional clayey sand/sandy clay																								
6					sli	(SC-CL) lenses.																								
7					damp																						X			
8					to																									
9					damp																									
20		17	R	106	8																									
1																														
2																														
3																														
4																														
5		45	R	103	10																									
6																														
7																														
8																														
9																														
30		36	R	98	13																									
1																														
2																	X											X		
3																														
4																														
5		50/11"	R	101	11																									
6																														
7																														
8					mdst	Sandy Clay-Clayey Sand lens																								
9						from 38 to 43 feet.																						X	X	
40		48	R	102	20																									

CONTINUED

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. This boring data was compiled primarily for design purposes, and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or

SOIL BORING LOG

NO. 3 ELEV: 1324.7 ft. SIZE OF HOLE 7 in. FIELD ENGR: SJ DATE: 5/16/85

DEPTH FT.	PENETRATION RESISTANCE BLOWS/FT C	PENETRATION RESISTANCE BLOWS/FT R	SAMPLE TYPE	DRY DENSITY PCF	MOISTURE CONTENT	DESCRIPTION (CONTINUED)	SOIL CLASSIFICATION	GRADATION WELL	GRADATION MED	GRADATION POOR	GRAIN SHAPE ANGULAR	GRAIN SHAPE SUBANGULAR	GRAIN SHAPE ROUNDED	GRAIN SHAPE SUBROUNDED	RELATIVE DENSITY LOW	RELATIVE DENSITY MED	RELATIVE DENSITY HIGH	PLASTICITY NONE	PLASTICITY LOW	PLASTICITY MEDIUM	PLASTICITY HIGH	CONSISTENCY SOFT	CONSISTENCY FIRM	CONSISTENCY STIFF	CONSISTENCY VERY STIFF	CONSISTENCY HARD	CEMENTATION NONE	CEMENTATION WEAK	CEMENTATION MEDIUM	CEMENTATION STRONG
41					moist	Silty Sand; brown, stratified,	SM			X	X						X	X							X			X	X
2						variable silt content, pre-																								
3					damp	dominantly fine sand, occa-																								
4						sional clayey sand/sandy clay																					X	X		
5		50/9"	R	108	12	(SC-CL) lenses.																								
6																														
7																														
8					sli																									
9					damp																									
50		50/11"	R	103	8																									
1																														
2					damp	Sandy Clay to Clayey Sand;	CL-SC			X	X								X						X			X	X
3						light brown to brown, stra-																								
4						tified, calcareous with vari-																								
5		75/7"	R	105	19	able moderate to strong																								
6						cementation, occasional																								
7						sandy silt/silty sand (ML/SM)																								
8						lenses.																								
9																														
60		50/3"	R	113	14																									
1																														
2																														
3																														
4																														
5																														
6																														
7																														
8																														
9																														
70																														
1																														
2																														
3																														
4																														
5																														
6																														
7																														
8																														
9																														
80																														

Stopped test drilling at: 60 feet

Ground water encountered: none

NOTE: The data presented on the boring logs represents subsurface conditions only at the specific locations and at the time designated. This data may not represent conditions at other locations and/or times. This boring data was compiled primarily for design purposes, and should not be construed as part of the plans governing construction or defining construction techniques. Bidders are fully responsible for interpretations or conclusions they draw from the boring log.

Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

APPENDIX B

LABORATORY RESULTS

REPORT ON LABORATORY TESTS

SAMPLE: Date 6/11/85

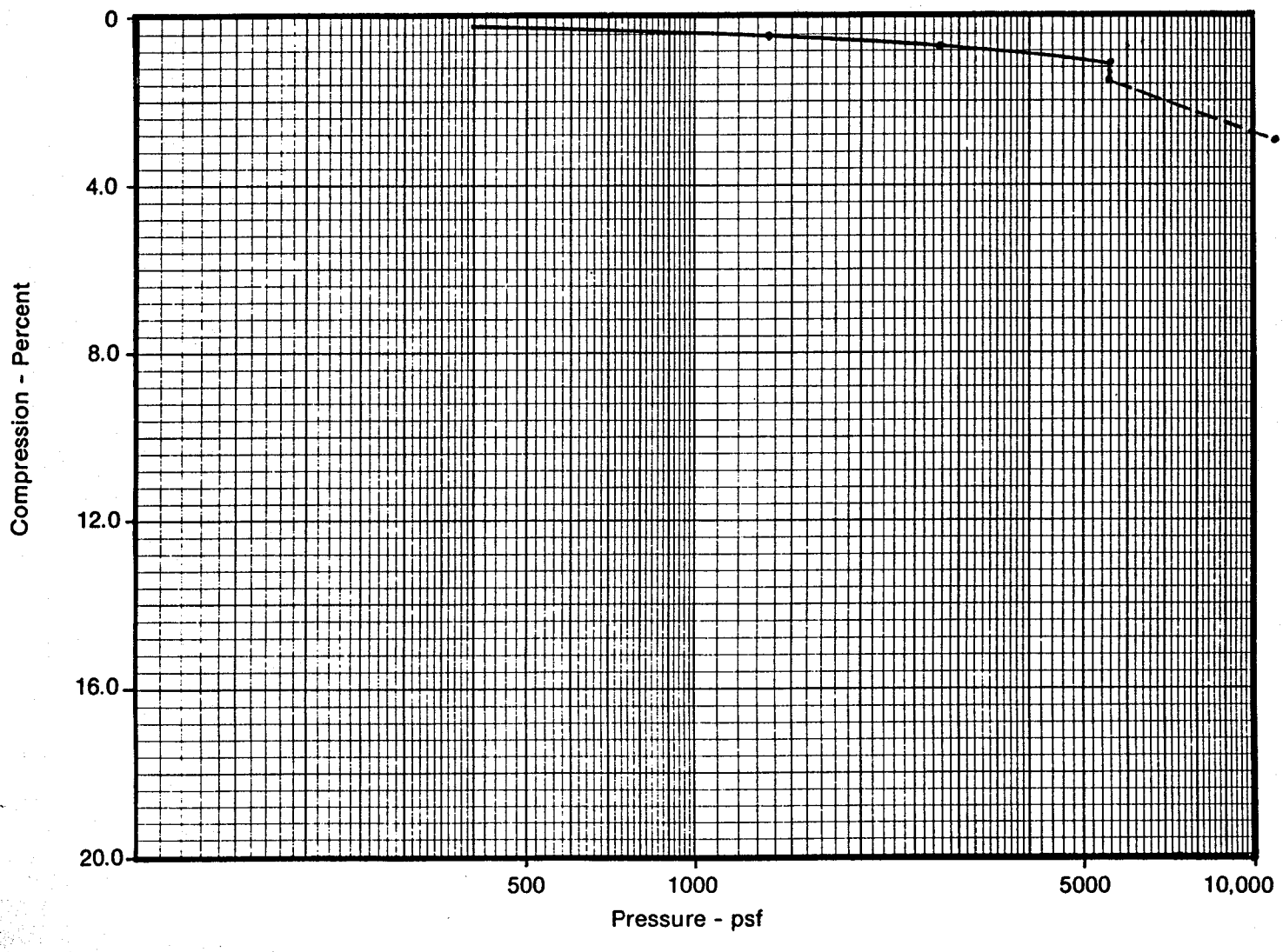
Source Test boring #1; 19 - 20'

Type Driven ring sample; 100 pcf dry density; 7% field moisture

Material Sandy Clay-Clayey Sand (CL-SC)

Sampled By Journell

TESTED: Compression; test sample soaked at 5545 psf



Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 6/11/85

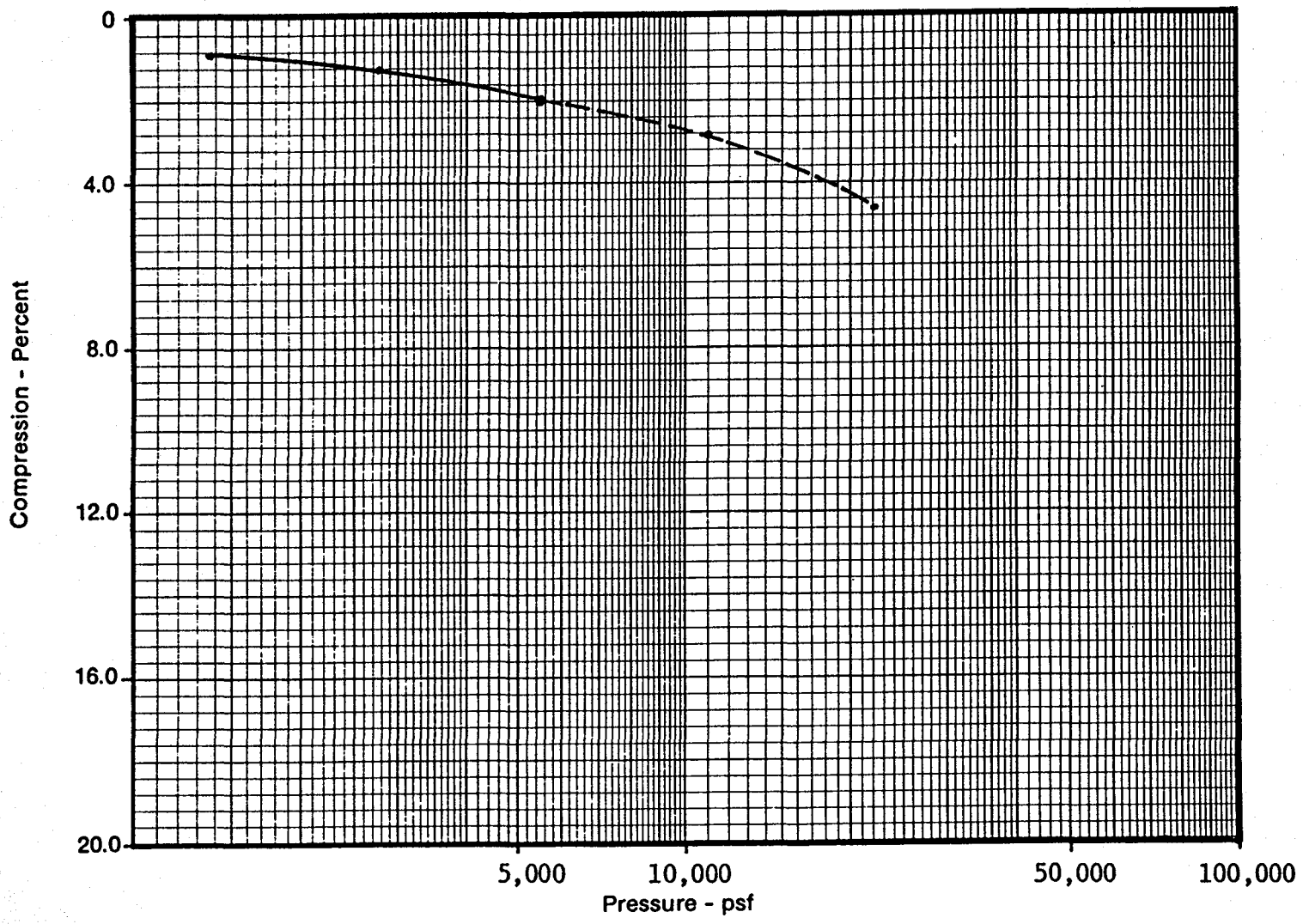
Source Test boring #1; 34 - 35'

Type Driven ring sample; 101 pcf dry density; 14% field moisture

Material Silty Sand-Sandy Silt (SM-ML)

Sampled By Journell

TESTED: Compression; test sample soaked at 5545 psf



Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 6/11/85

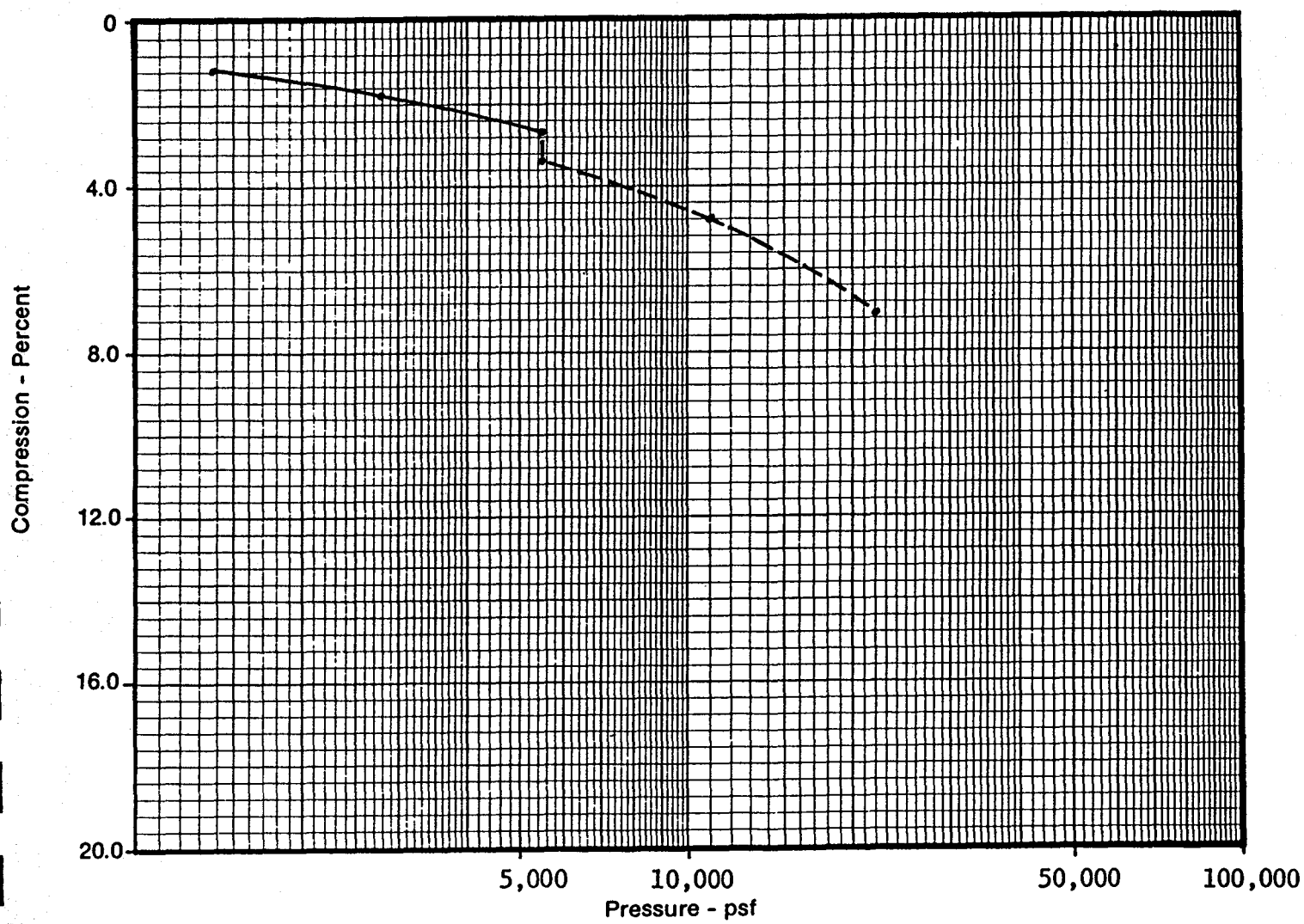
Source Test boring #3; 44 - 45'

Type Driven ring sample; 108 pcf dry density; 12% field moisture

Material Silty Sand (SM)

Sampled By Journell

TESTED: Compression; test sample soaked at 5545 psf



Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 6/11/85

Source Test boring #1; 29 - 30'

Type Driven ring sample; 101 pcf dry density; 15% field moisture

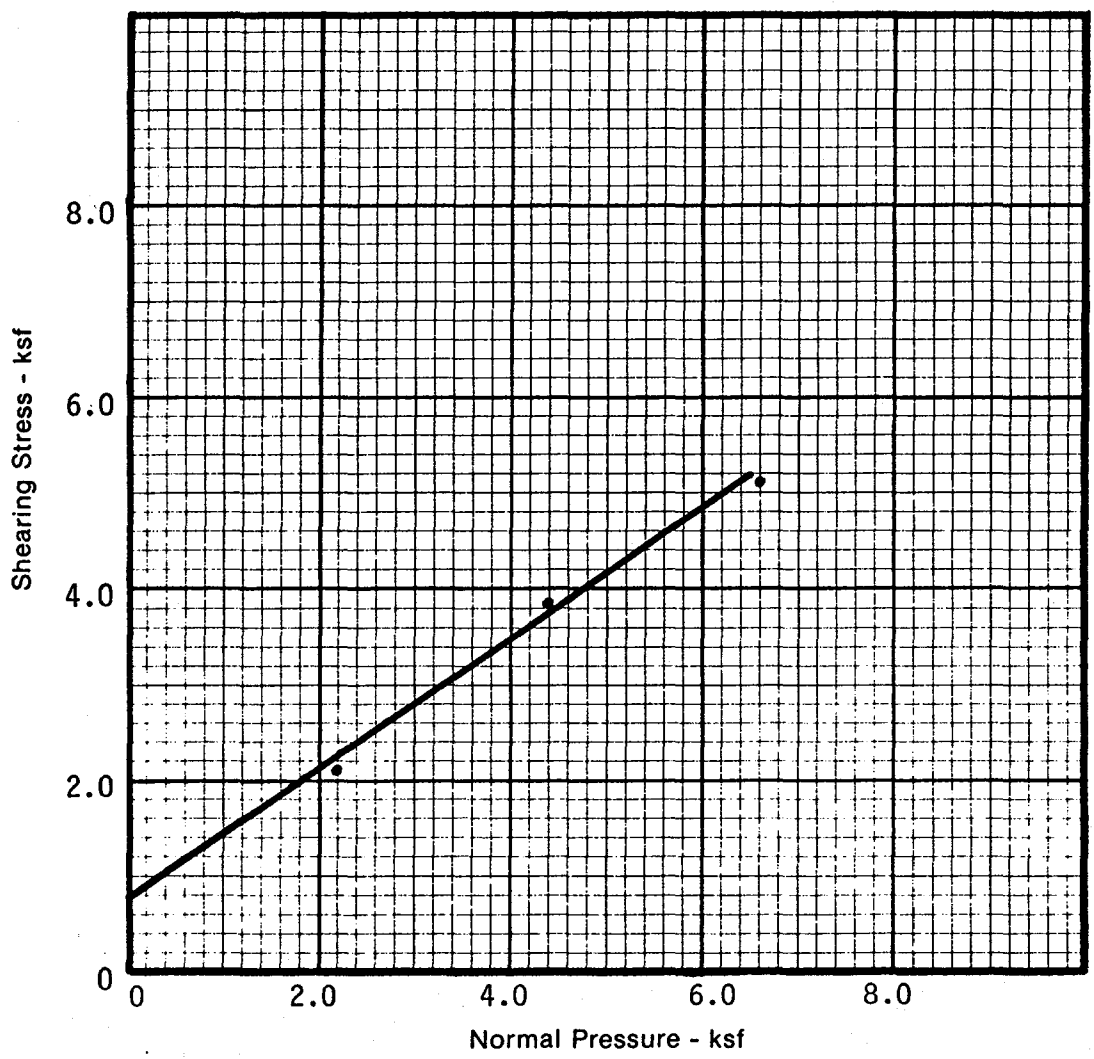
Material Clayey Sand (SC)

Sampled By Journell

TESTED: Direct Shear

RESULTS:

Friction Angle (Ø) = 34° Cohesion (c) = 0.8 ksf



Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 6/11/85

Source Test boring #3; 19 - 20'

Type Driven ring sample; 106 pcf dry density; 8% field moisture

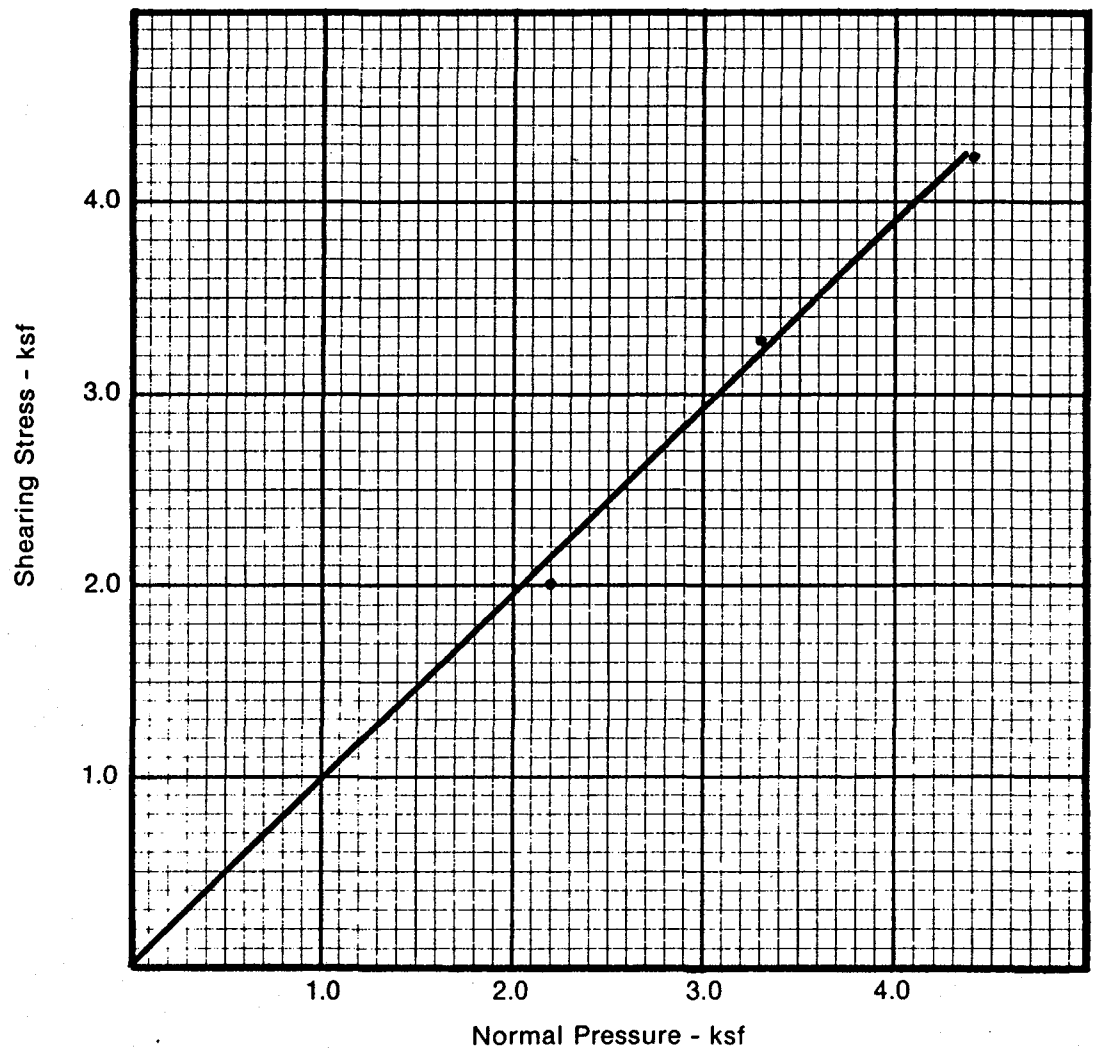
Material Silty Sand (SM)

Sampled By Journell

TESTED: Direct Shear

RESULTS:

Friction Angle (Ø) = 44° Cohesion (c) = 0



Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 6/11/85

Source Test boring #3; 39 - 40'

Type Driven ring sample; 102 pcf dry density; 20% field moisture

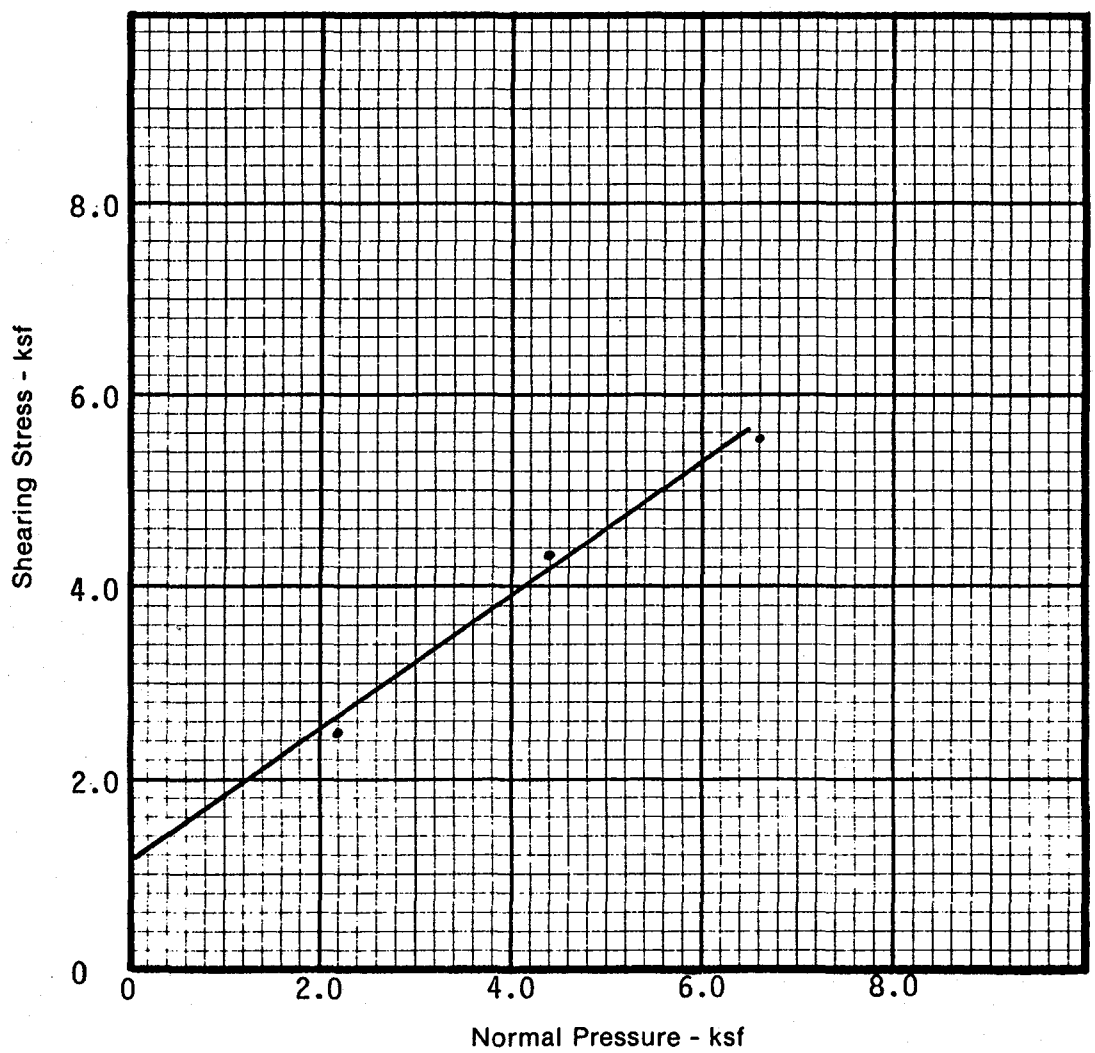
Material Sandy Clay-Clayey Sand (CL-SC)

Sampled By Journell

TESTED: Direct Shear

RESULTS:

Friction Angle (Ø) = 34° Cohesion (c) = 1.2 ksf



Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

REPORT ON LABORATORY TESTS

SAMPLE: Date 6/11/85

Source Noted Below

Type Auger Cuttings

Material Surface and Subsurface Soils

Sampled By Journell

TESTED: Sieve Analysis and Plasticity Index

RESULTS:

Sample	LL	PI	Sieve Size - Accum. % Passing 200	100	50	30	16	8	4	3/4"	1"	2"	3"	* Class
2; 0 - 3'	22	4	36	47	58	85	95	98	99	100				SC-SM
2; 3 - 11'	31	13	49	61	73	85	92	96	98	100				SC

* Unified Soil Classification

Project No. 85-622

THOMAS-HARTIG & ASSOCIATES, INC.

FROM: VVJ 18 Oct 85

WILSON & COMPANY
ENGINEERS & ARCHITECTS

PROJECT: Arizona FILE 85-411

SUBJECT: Pr over RWCD Pkway (1)

Haunch Properties: Run "PHAUNCH" Program

Input	L	a	b	c	d	e	Ha	Hm	Hb
Span No. 1	30.5	0	0	10.5	18.5	1.5	20	20	32
2	40	1.5	18.5	0	18.5	1.5	32	20	32
3	30.5	1.5	18.5	10.5	0	0	32	20	20

Basic $I = bd^3/12 = 12(20)^3/12 = \underline{8000}\ in^4$

	Span No. 1		Span No. 2		Span No. 3	
Pt.	d_x	I_x	d_x	I_x	d_x	I_x
0	20	1.000	34.025	4.924	34.025	4.924
.05	"	"	31.360	3.855	31.068	4.084
.10	"	"	28.076	3.041	30.073	3.400
.15	"	"	26.872	2.426	28.342	2.846
.20	"	"	25.040	1.965	26.774	2.300
.25	"	"	23.506	1.624	25.360	2.041
.30	"	"	22.244	1.376	24.128	1.756
.35	"	"	21.262	1.202	23.040	1.531
.40	20.101	1.015	20.561	1.087	22.133	1.355
.45	20.365	1.056	20.140	1.021	21.381	1.222
.50	20.701	1.123	20	1.000	20.701	1.123
.55	21.381	1.222	20.140	1.021	20.365	1.056
.60	22.133	1.355	20.561	1.087	20.101	1.015
.65	23.040	1.531	21.262	1.202	20	1.000
.70	24.128	1.756	22.244	1.376	"	"
.75	25.360	2.041	23.506	1.624	"	"
.80	26.774	2.300	25.040	1.965	"	"
.85	28.342	2.846	26.872	2.426	"	"
.90	30.073	3.400	28.076	3.041	"	"
.95	31.068	4.084	31.360	3.855	"	"
1.00	34.025	4.924	34.025	4.924	"	"

VU) 18 Oct 85 Arizona 85-411

Rt over RWCD Pldwy (2)

LONGEST STRIP RWCD FLDWY 85411

```
    3.000    4.000    0.000    0.151    0.000  330.0000111    0.0000
   38.400    0.159  330.000
   13.440 1000.000
   15.360 1015.000
   17.280 1056.000
   19.200 1123.000
   21.120 1222.000
   23.040 1355.000
   24.960 1531.000
   26.880 1756.000
   28.800 2041.000
   30.720 2399.000
   32.640 2846.000
   34.560 3400.000
   36.480 4084.000
   38.400 4924.000
   52.400    0.143  330.000
    0.000 4924.000
    2.620 3855.000
    5.240 3041.000
    7.860 2426.000
   10.480 1965.000
   13.100 1624.000
   15.720 1376.000
   18.340 1202.000
   20.960 1087.000
   23.580 1021.000
   26.200 1000.000
   28.820 1021.000
   31.440 1087.000
   34.060 1202.000
   36.680 1376.000
   39.300 1624.000
   41.920 1965.000
   44.540 2426.000
   47.160 3041.000
   49.780 3855.000
   52.400 4924.000
   41.700    0.154  330.000
    0.000 4924.000
    2.090 4084.000
    4.170 3400.000
    6.260 2846.000
    8.340 2399.000
   10.430 2041.000
   12.510 1756.000
   14.600 1531.000
   16.680 1355.000
   18.770 1222.000
   20.850 1123.000
   22.940 1056.000
   25.020 1015.000
   41.700 1000.000
    0.000
    0.000
    0.000
```

VVJ 18 Oct 85 Arizona 85-411

Br over RWCD Fldwy (3)

SHORTEST STRIP RWCD FLDWY 85-411

```
  3.000    4.000    0.000    0.153    0.000  330.0000111    0.0000
 36.900    0.161  330.000
 12.920 1000.000
 14.760 1015.000
 16.610 1056.000
 18.450 1123.000
 20.300 1222.000
 22.140 1355.000
 23.990 1531.000
 25.830 1756.000
 27.680 2041.000
 29.520 2399.000
 31.370 2846.000
 33.210 3400.000
 35.060 4084.000
 36.900 4924.000
 49.900    0.143  330.000
  0.000 4924.000
  2.500 3855.000
  4.990 3041.000
  7.490 2426.000
  9.980 1965.000
 12.480 1624.000
 14.970 1376.000
 17.470 1202.000
 19.960 1087.000
 22.460 1021.000
 24.950 1000.000
 27.450 1021.000
 29.940 1087.000
 32.440 1202.000
 34.930 1376.000
 37.430 1624.000
 39.920 1965.000
 42.420 2426.000
 44.910 3041.000
 47.410 3855.000
 49.900 4924.000
 39.400    0.157  330.000
  0.000 4924.000
  1.970 4084.000
  3.940 3400.000
  5.910 2846.000
  7.880 2399.000
  9.850 2041.000
 11.820 1756.000
 13.790 1531.000
 15.760 1355.000
 17.730 1222.000
 19.700 1123.000
 21.670 1056.000
 23.640 1015.000
 39.400 1000.000
  0.000
  0.000
  0.000
```

VVJ 18 Oct 85 Arizona 85-411

Pr over RWCD Fldwy (4)

EDGE BEAM STRIP RWCD FLDWY 85-411

```
  3.000    4.000    0.000    0.179    0.000  330.0000111    0.0000
 38.400    0.179  330.000
 13.440 1000.000
 15.360 1015.000
 17.280 1056.000
 19.200 1123.000
 21.120 1222.000
 23.040 1355.000
 24.960 1531.000
 26.880 1756.000
 28.800 2041.000
 30.720 2399.000
 32.640 2846.000
 34.560 3400.000
 36.480 4084.000
 38.400 4924.000
 52.400    0.179  330.000
  0.000 4924.000
  2.620 3855.000
  5.240 3041.000
  7.860 2426.000
 10.480 1965.000
 13.100 1624.000
 15.720 1376.000
 18.340 1202.000
 20.960 1087.000
 23.580 1021.000
 26.200 1000.000
 28.820 1021.000
 31.440 1087.000
 34.060 1202.000
 36.680 1376.000
 39.300 1624.000
 41.920 1965.000
 44.540 2426.000
 47.160 3041.000
 49.780 3855.000
 52.400 4924.000
 41.700    0.179  330.000
  0.000 4924.000
  2.090 4084.000
  4.170 3400.000
  6.260 2846.000
  8.340 2399.000
 10.430 2041.000
 12.510 1756.000
 14.600 1531.000
 16.680 1355.000
 18.770 1222.000
 20.850 1123.000
 22.940 1056.000
 25.020 1015.000
 41.700 1000.000
  0.000
  0.000
  0.000
```

FROM: VVJ 18 Oct 85

WILSON & COMPANY ENGINEERS & ARCHITECTS

Arizona FILE 85-411

SUBJECT: Pr over RWCD FLDWY (6)

Max Loads on Substructure:

	Ab #1	Pr #1	Pr #2	Ab #2
DL Sub	617	673	681	537
DL Sup	382	1615	1773	466
ΣDL	999	2288	2454	1003
LL (slower)	251	343	343	257
Max. R	1250k	2631k	2797k	1260k

Load/shaft using 6 shafts/Sub

Max Ld	208k	439k	466k	210k

Using graph by THAI

∴ use 34' deep shaft (30'ø) for Abutments

Use 36' deep shaft (48'ø) for Piers

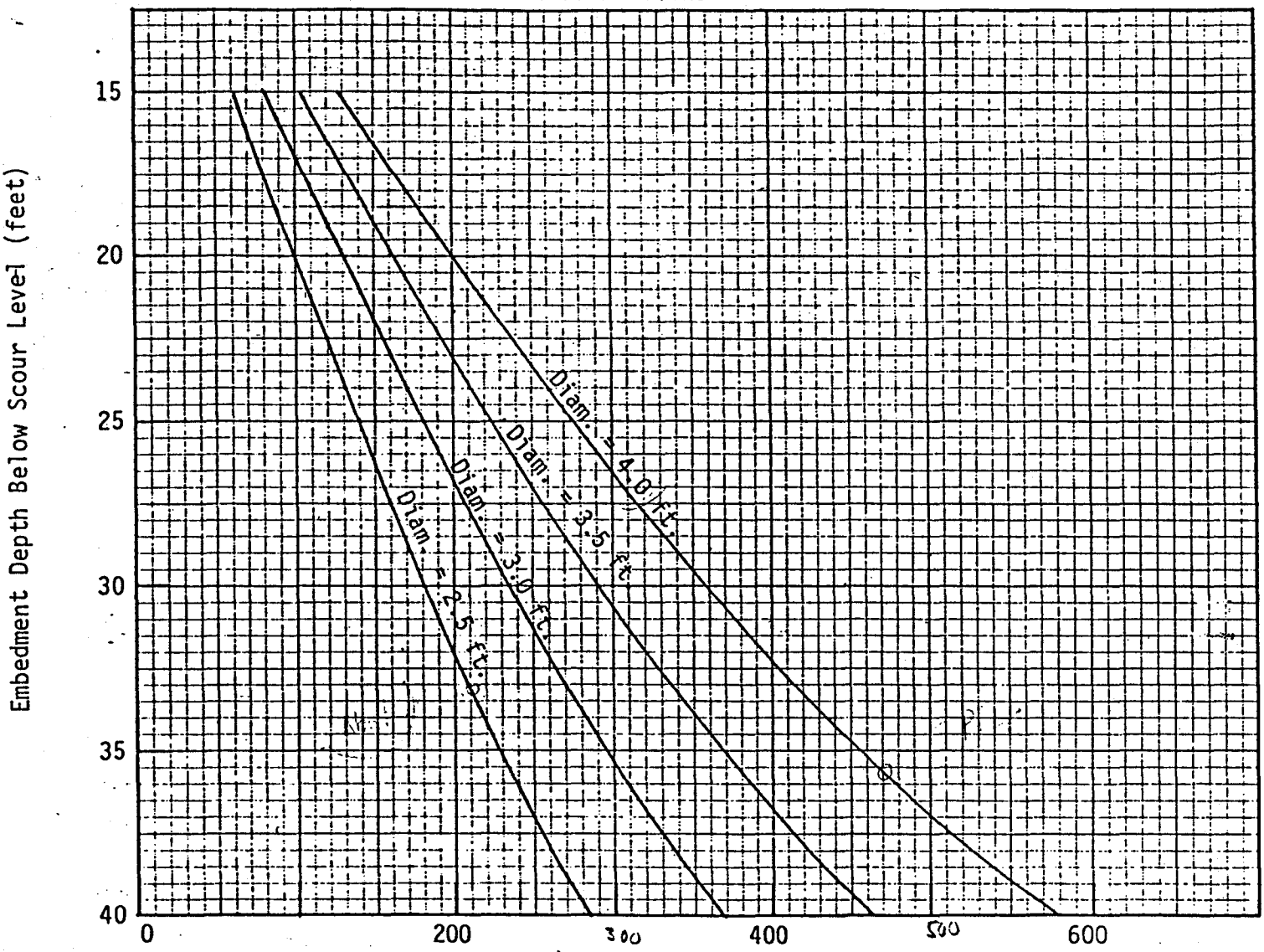
Below scour line

No determined scour level (Assumed scour level at Sug Elev. 1303 ± (about 8'± below new channel bed Elev. 1311 ±)

VV) 18 Oct 85

Arizona 85-411
Br over RWCD pldwy (7)

FIGURE NO. 1: Load Capacity for drilled, cast-in-place machine-cleaned, straight-shaft foundations



ALLOWABLE AXIAL LOAD CAPACITY (kips)
(By Thomas-Hartig & Assoc. Inc.)

PROJECT NO: 85-622

FROM: VVJ 21 Oct 85

WILSON & COMPANY ENGINEERS & ARCHITECTS

[redacted]: Arizona FILE 85-411

SUBJECT: Br over RWCD Tldwy (8)

Moment Envelope (Longest Strip):

			LLM		Mw		Mu	
Pt	h	DLM	Pos	Neg.	Pos	Neg	Pos	Neg
0	20	0	0	0	0	0	0	0
.1	"	13	17	-3	30	-	54	-
.2	"	22	27	-7	49	-	87	-
.3	"	26	31	-10	57	-	101	-
.4	20.10	24	32	-14	56	-	101	-1
.5	20.79	18	31	-17	49	-	91	-13
.6	22.13	7	27	-21	34	-14	68	-36
.7	24.13	-8	21	-24	13	-32	35	-62
.8	26.77	-29	12	-27	-	-56	-	-96
.9	30.07	-55	8	-31	-	-86	-	-139
1.0	34.03	-85	12	-39	-	-124	-	-195
.1	28.98	-45	7	-25	-	-70	-	-113
.2	25.05	-14	11	-19	-	-33	6	-59
.3	22.24	7	21	-16	28	-9	55	-26
.4	20.56	20	28	-12	48	-	87	-
.5	20	23	30	-11	53	-	95	-
.6	20.56	18	28	-14	46	-	84	-7
.7	22.24	3	22	-18	25	-15	52	-35
.8	25.05	-21	12	-22	-	-43	-	-75
.9	28.98	-53	7	-27	-	-80	-	-127
2.0	34.03	-95	9	-40	-	-135	-	-210
.1	30.07	-60	7	-29	-	-89	-	-141
.2	26.77	-30	12	-26	-	-56	-	-95
.3	24.13	-6	21	-23	15	-29	38	-58
.4	22.13	12	29	-20	41	-8	78	-28
.5	20.79	24	33	-16	57	-	103	-3

FROM: VVJ 21 Oct 85

WILSON & COMPANY ENGINEERS & ARCHITECTS

[redacted]: Arizona FILE 85-411

SUBJECT: Pr over RWCD Fldwy (9)

Moment Envelope (Longest Strip):

For Superstr. Design

Pt	h	DLM	LLM Pos	LLM Neg	Mw Pos	Mw Neg	Mu Pos	Mu Neg
.5	20.79	24	33	-16	57	-	103	-3
.6	20.10	31	35	-13	66	-	116	-
.7	20	32	34	-10	66	-	115	-
.8	"	27	29	-7	56	-	98	-
.9	"	16	18	-3	34	-	60	-
1.0	"	0	0	-0	0	0	0	0

Required strength, $f_c' = 4$ ksi

Design strength, $f_c' = 3$ ksi

Run "LPDSLB" Program

$f_y = 60$ $f_c' = 3.0$ $Z = 130$ Cover = { 1" for Pos. Mom. / 2 for Neg. Mom.

Deduct 1/2" for wearing surf. from from slab depth for Pos. Mom.

For Pos. Mom.

h	cover	Size	Spa	fs	J	Capacity Mw	Capacity Mu	
10.75	1"	#7	8"	36	.92	45	70	
"	"	#8	8"	36	.91	59	91	
"	"	#9	8"	36	.90	73	112	← Use all spans
"	"	#10	8"	36	.89	92	139	

For Neg. Mom

34.03	2"	#8	6"	30.32	.92	115	213	
"	"	#9	6"	29.84	.91	142	265	← Use over piers
"	"	#10	6"	29.15	.90	174	329	

Use graphical solution for determining cut-off points

Plot Service Load (Mw) moment curves as basis of solution

FROM: VUJ 23 Oct 85

WILSON & COMPANY ENGINEERS & ARCHITECTS

Arizona FILE 85-011

SUBJECT: Pr over RWCD FLdwy (10)

Check Edge Beam Reinf.:

Positive Bars:

Span →	1	2	3
DLM	26	23	24
LLM	35	37	41
Mw	61	60	65
Mn	110	110	124

Max

Supplied steel = #9@6"

Run "LFDSLB" Program

$f_y = 60$ $f_c' = 3$ $Z = 130$

Cover = 1" Slab t = 10.75"

Allow $f_s = 36$ $j = 0.89$

Mw = 97'k > 65 } ∴ #9@6

Mn = 145'k > 124 } is O.K.

Negative Bars:

Pier	1	2
DLM	85	95
LLM	46	49
Mw	131	144
Mn	210	230

Max

Supplied steel = #9@5"

Run "LFDSLB" Program

$f_y = 60$ $f_c = 3$ $Z = 130$

Cover = 2" slab t = 54.03

$f_s = 31.71$ } Mw = 180'k > 144 } ∴ #9@5

$j = 0.90$ } Mn = 314'k > 230 } is O.K.

FROM: UVJ 22 Oct 85

WILSON & COMPANY
ENGINEERS
ARCHITECTS

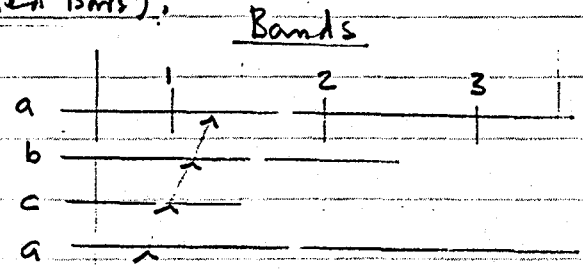
Arizona FILE 85-411

SUBJECT: Br over RWCD Fldwy (11)

Positive Bars (Band Capacities of Supplied Bars):

Run "SLABARS" Program

Band	1	2	3
A_s/f	1.50	1.00	0.50
Ave Spcg.	8"	12"	24"



$d_c = 1 + 1\frac{1}{4}/2 = 1.625"$ Mid-Span #9 @ 8" ℄ Support

Reduced 1/4" for Wearing

		Band Capacities					
		Band 1		Band 2		Band 3	
Pt	t	Mw	Mn	Mw	Mn	Mw	Mn
0	19.75	73	112	45	77	18	40
.1	"	"	"	"	"	"	"
.2	"	"	"	"	"	"	"
.3	"	"	"	"	"	"	"
.4	19.85	74	113	45	78	18	40
.5	20.54	77	118	47	81	19	41
.6	21.88	82	127	51	87	21	44
.7	23.88	91	140	56	96	23	49
.8	26.52	102	158	63	108	25	55
.9	29.82	116	180	71	122	29	62
1.0	33.78	133	207	82	140	33	71
.1	28.73	112	173	68	118	28	60
.2	24.80	95	147	58	100	24	51
.3	21.99	83	128	51	87	21	45
.4	20.31	76	116	47	80	19	41
.5	19.75	73	112	45	77	18	40

Symm about this line

FROM: VVJ 22 Oct 85

WILSON & COMPANY
ENGINEERS & ARCHITECTS

Arizona FILE 85-411

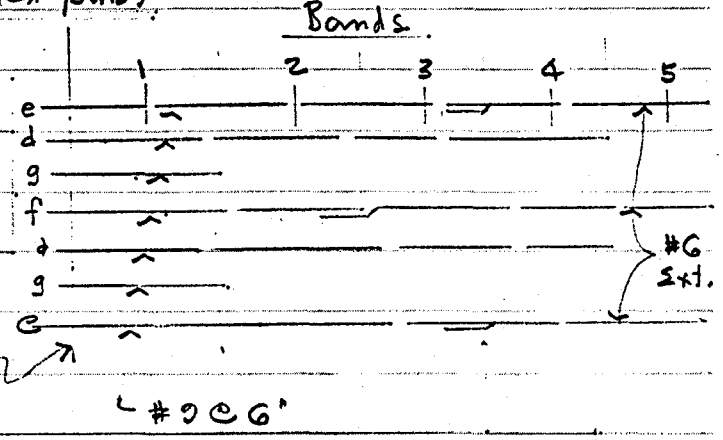
SUBJECT: Bri over RWCD Fldwy (12)

Negative Bars (Band Capacities of Supplied Bars):

Run "SLABARS" Program

Band	1	2	3	4	5
A_s/f	2.00	1.33	1.15	0.96	0.79
Ave. Spcg.	6"	9"	9"	9"	18"

$d_c = 2 + 1\frac{1}{4}/2 = 2.625"$



		Band Capacities									
		Band 1		Band 2		Band 3		Band 4		Band 5	
Pt	t	Mw	Mn	Mw	Mn	Mw	Mn	Mw	Mn	Mw	Mn
0	20	77	139	45	96	39	84	33	71	8	22
.1	"	"	"	"	"	"	"	"	"	"	"
.2	"	"	"	"	"	"	"	"	"	"	"
.3	"	"	"	"	"	"	"	"	"	"	"
.4	20.10	77	140	46	97	40	85	33	71	8	22
.5	20.79	80	146	48	101	41	88	35	74	9	23
.6	22.13	86	158	51	109	45	95	37	80	9	25
.7	24.13	96	176	57	121	49	105	41	89	10	28
.8	26.77	108	200	64	137	56	119	47	100	12	31
.9	30.07	124	229	73	156	63	136	53	115	13	35
1.0	34.03	142	265	84	180	73	157	61	132	15	41
.1	29.98	123	229	73	156	63	136	53	114	13	35
.2	25.05	100	184	59	126	51	110	43	93	11	29
.3	22.24	87	159	51	110	45	96	38	81	9	25
.4	20.56	79	144	47	100	41	87	34	73	9	23
.5	20	77	139	45	96	39	84	33	71	8	22

Symm about this line

FROM: WJ 22 Oct 85

WILSON & COMPANY
ENGINEERS & ARCHITECTS

[redacted]: Arizona FILE 85-411

SUBJECT: Br over RWCD Pldwy (13)

Bars Cut-Off Points:

Span No. 1 - S = 38.4'

Bar. Extension:

15 db

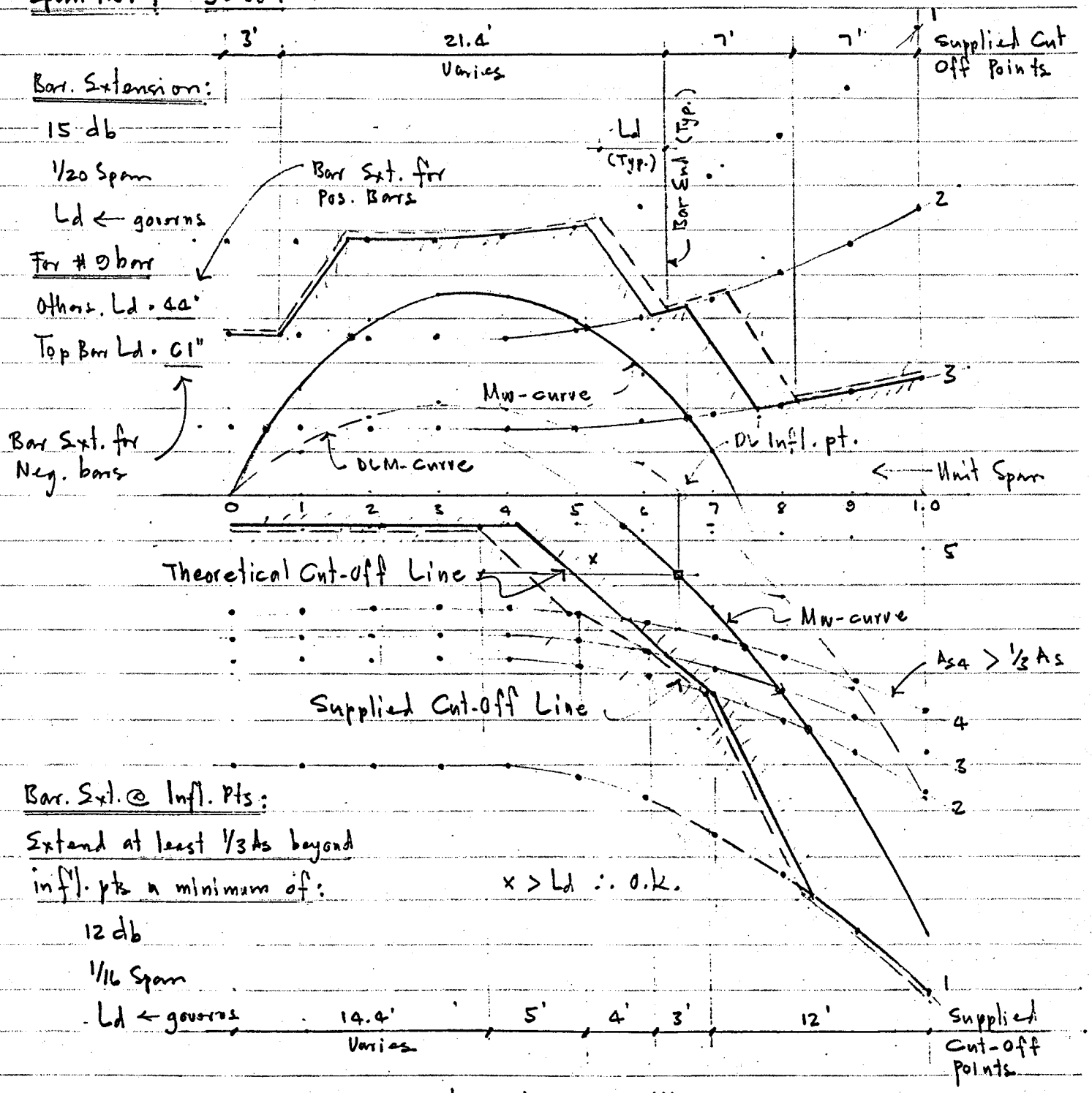
1/20 Span

Ld ← governs

For #9 bars

Others. Ld = 44"

Top Bar Ld = 61"



Bar. Ext. @ Infl. Pts:

Extend at least 1/3 As beyond infl. pts a minimum of:

12 db

1/16 Span

Ld ← governs

x > Ld ∴ O.K.

Vert. Scale: 1" = 40'k

FROM: VVJ 22 Oct 85

TO:

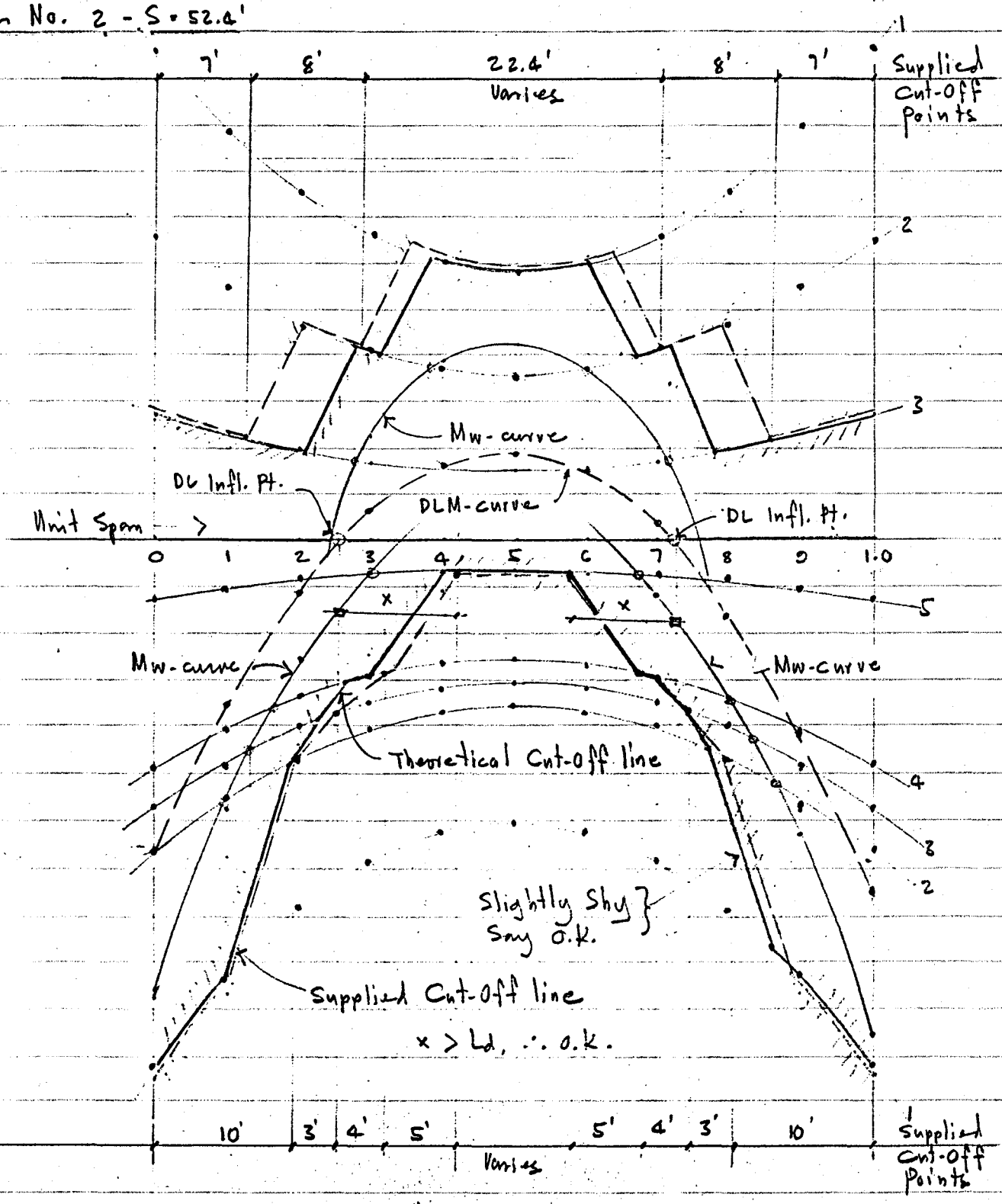
WILSON & COMPANY
ENGINEERS
ARCHITECTS

Arizona FILE 85-411

SUBJECT: Bar over RWCD Pldwy (14)

Bars Cut-off Points:

Span No. 2 - S = 52.4'



Vert. Scale: 1" = 40'

FROM: VVJ 22 Oct 85

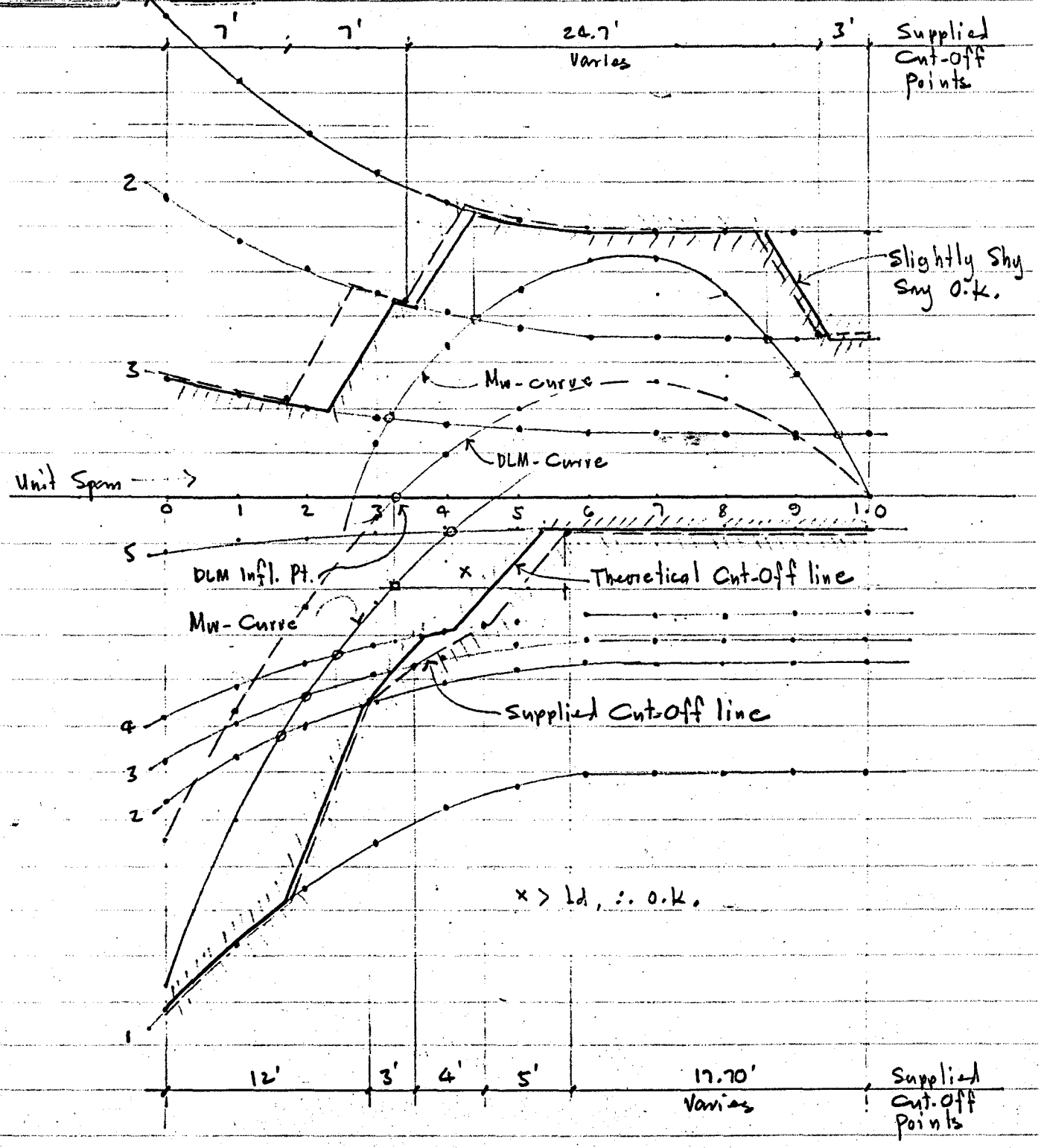
WILSON & COMPANY ENGINEERS & ARCHITECTS

Arizona FILE 85-411

SUBJECT: Pr. over RWCD Pldwy (15)

Bars Cut-Off Points:

Span No. 3 - S = 41.7'



Vert. Scale: 1" = 40'k

FROM: VVJ 1 Nov 85

WILSON & COMPANY ENGINEERS & ARCHITECTS

Arizona FILE 85-411

SUBJECT: for over RWCD Fldwy (16)

Barrier Curb Design:

$P = 10^k$

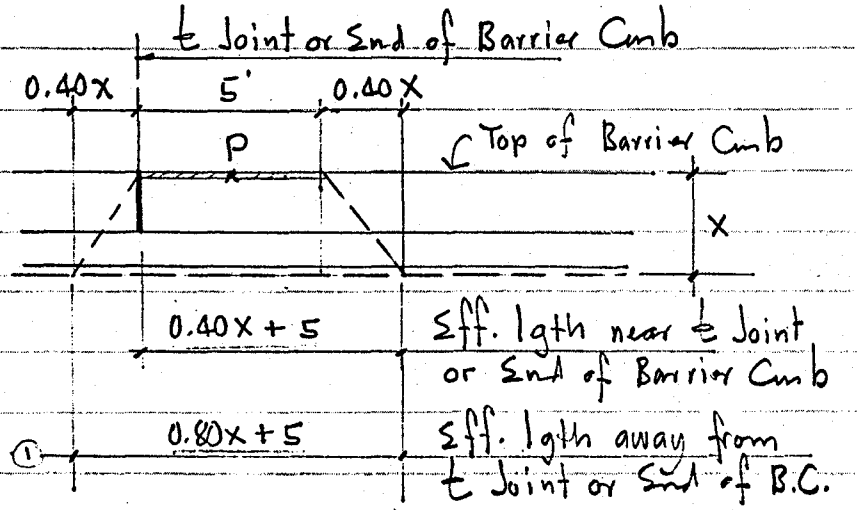
x = height of barrier curb = 2'-8" (usually)

LL Mom. = Px

Moment per ft of barrier

a) Near ℄ Jt. or End of Barrier

$LLM/f = Px/(0.40x+5)$ — ①



Load Distribution

b) Away from Jt. or End of BC

$LLM/f = Px/(0.80x+5)$ — ② ← AASHTO 3.24.5.2

$E = 0.80x + 5.0$ ft

Use item a) for design ← Most Critical!!

Moment Stresses: (Using Eq. ①)

1) At Level b-b: $x = 1'-7"$

$LLM = 2.81'^k$ $DLM = 0$

$M_w = D + L = 2.81'^k/f$

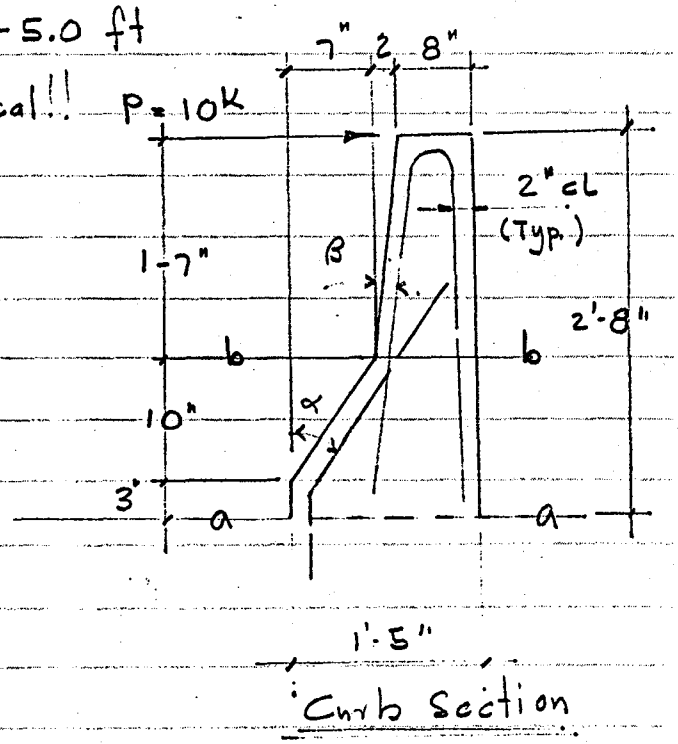
$M_n = 1.3(D + 5/3L) = 6.09'^k/f$

2) At. Level a-a: $x = 2'-8"$

$LLM = 4.40'^k$ $DLM = 0$

$M_w = D + L = 4.40'^k/f$

$M_n = 1.3(D + 5/3L) = 9.52'^k/f$



Curb Section

FROM: VU 1 Nov 85

WILSON & COMPANY ENGINEERS & ARCHITECTS

Arizona FILE 85-411

SUBJECT: Pri over RWCD Tldwy (17)

Barrier Comb Design:

$f_c' = 3$ ksi $f_y = 60$ ksi $\phi = .90$

$z = 130$ ksi

1. At level a-a: $\alpha = \tan^{-1} 7/10$

Supplied steel = #5 @ 12"

Since reinf. is at an angle α.

Eff. $A_s = 0.31 \cos\alpha = 0.254$ in²/f

Run "DESLAB" Program

Input: $f_c' = 3$

$f_y = 60$

$n = 9$

$z = 130$

$a_s = 0.254$

$d_c = 2 + \frac{1}{2}(11/16) = 2.34$"

$d = 17 - 2.34 = 14.66$"

$s = 12$"

Output:

$f_s = 25.57$ ksi

$J = 0.95$ ✓

$M_w = 7.54'$ k > 4.40

$M_u = 16.47'$ k > 9.52

∴ Section is O.K.

2. At level b-b: $\beta = \tan^{-1} 2/10$

Supplied steel:

#5 @ 12" @ angle α

Eff. $A_{s1} = 0.31 \cos\alpha = 0.254$

#4 @ 12" @ angle β

Eff. $A_{s2} = 0.20 \cos\beta = 0.199$

Eff $A_s = 0.254 + 0.199 = 0.453$

Run "DESLAB" Program

Input: $f_c' = 3$

$f_y = 60$

$n = 9$

$z = 130$ k/in

$a_s = 0.453$ in²

$d_c = 2.34$"

$d = 10 - 2.34 = 7.66$"

$s = 12$"

Output:

$f_s = 25.57$ ksi

$J = 0.91$

$M_w = 6.75'$ k > 2.81

$M_u = 14.71'$ k > 6.00

∴ Section is O.K.

FROM: VVJ 22 Oct 85

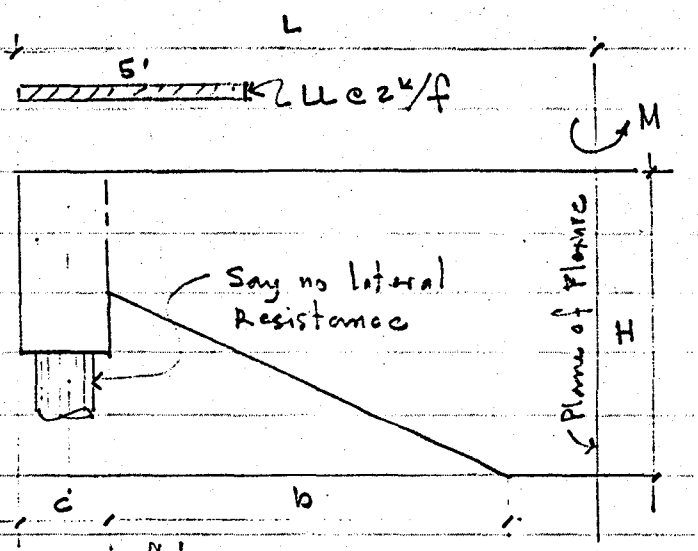
WILSON & COMPANY ENGINEERS ARCHITECTS

Arizona FILE 85-411

SUBJECT: Br over RWCD Pldwy (18)

Wingwall Design:

Run "LNGWW" Program



	Abut. No. 1		Abut. No. 2	
WW	33'-0"	17'-0"	20'-0"	11'-0"
Inpnt:				
ρ	.040 →	→	→	→
H	14'-6"	7'-10"	12'-10"	5'-4"
L	32'-3"	16'-3"	28'-3"	10'-3"
a	11'-3"	5'-10"	9'-7"	3'-4"
b	27'	14'	23'	8'
c	3'	0	3'	0
d	8'-0"	0	7'-1"	0
Outpnt (f.k)				
DLM	589	54	383	13
LLM	298	138	258	78
Mw	886	192	640	91
Mw/f	61	25	50	17
Mn	1410	369	1056	185
Mn/f	97	47	82	35

$f_y = 60$ $f_c' = 3$ $Z = 170$

Output:

$M_w = 60^{1k} \sim 61$ } Slightly shy
$M_n = 105^{1k} > 97$ } Say O.K. 2% I.S.

Check Supplied Reinf:

Abut No. 1 - WW = 33'-0"

Supplied steel

12-#10 — 15.24 } 23.03
11-#8 — 8.60

$A_s/f = 23.03/14'-6" = 1.65 \square''$

Avg Spcg = 14.5 x 12/23 = 7.57"

$d_c = 2 + 9/16 + 1\,7/16/2 = 3.28"$

slab t = 1'-7" (19")

Run "SLABBRS" Program

Abut No. 1 - 17'-0" WW

Supplied steel:

10-#8 = 7.90 □"

$A_s/f = 7.90/7'-10" = 1.01 \square''$

Avg. spcg = 7'-10" x 12/10 = 9.40"

$d_c = 2 + 9/16 + 1\,1/8/2 = 3.13"$

slab t = 19"

Run "SLABBRS" Program

$f_y = 60$ $f_c' = 3$ $Z = 170$

Output:

$M_w = 36^{1k} > 25$ } ∴ steel
$M_n = 68^{1k} > 47$ } is O.K.

FROM: VVJ 23 Oct 85

WILSON & COMPANY ENGINEERS & ARCHITECTS

Arizona FILE 85-411

SUBJECT: Br over RWCD Fldwy (19)

Wingwall Design (Cont'd):

Abut No. 2 – 29'-9" WW

Supplied Steel:

8 – #10 – 10.16 } 18.85
11 – #8 – 8.69

A_s/f = 18.85 / 12'-10" = 1.47 □"

Ave Spcg = 12'-10" × 12 / 19 = 8.11"

d_c = 2 + 9/16 + 1 7/16 / 2 = 3.28"

Run "SLABARS" Program

f_y = 60 f_c' = 3 Z = 170

Output:

M_w = 52'K > 50 } ∴ steel
M_u = 94'K > 82 } is O.K

Abut. No. 2 – 11'-9" WW

Supplied steel:

7 – #8 — 5.53 □"

A_s/f = 5.53 / 5'-4" = 1.04 □"

Ave Spcg = 5'-4" × 12 / 7 = 9.14"

d_c = 2 + 9/16 + 1 1/8 / 2 = 3.13"

Run "SLABARS" Program

f_y = 60 f_c' = 3 Z = 170

Output:

M_w = 38'K > 17 } ∴ Steel
M_u = 70'K > 35 } is O.K.

85-411

VV J 12 Nov 85 Br over RWCD Fldwy (20)

```
100000010   1287.5   38.400      0.0    -84.9    0.330        0    0.000
  8000.  8000.  8000.  8000.  8120.  8984. 10840. 14048. 19192. 27200. 39392.
```

12-NOV-85 10:59:01

SPAN NO 1 - RWCD FLDWY 85-411

PT.	STA. (FEET)	DEFLECTION (INCHES)	DEFLECTION (FEET)	MOMENT (FT-KIPS)	Final Deflection
0	0.000	0.000	0.0000	0.00	0
1	3.840	0.159	0.0133	13.41	0.008
2	7.680	0.288	0.0240	21.95	0.015
3	11.520	0.363	0.0303	25.62	0.019
4	15.360	0.378	0.0315	24.43	0.019
5	19.200	0.336	0.0280	18.38	0.017
6	23.040	0.254	0.0212	7.45	0.013
7	26.880	0.159	0.0132	-8.34	0.008
8	30.720	0.074	0.0062	-28.99	0.004
9	34.560	0.018	0.0015	-54.51	0.001
10	38.400	0.000	0.0000	-84.90	0

END ROTATION LT. (RADIANS) = 0.0035784

END ROTATION RT. (RADIANS) = 0.0000659

Supplied $f_c' = 4$ $E_c = 57\sqrt{f_c'} = 3{,}605$ ksi ← short term

At long Term, $\Delta = 2.8 \times$ short term deflection

$\therefore$ Long Term $E_c = 3{,}605/2.8 = \underline{1{,}287.5}$ ksi

Are skew $\measuredangle = 90 - 51.5 = 38.50$

Multiply Defl. by $(100 - 38.50)/100 = \underline{0.615}$

VVJ 12 Nov 85 Br over RWCD Flowy 85-411 (21)

```
100000010   1287.5   52.400   -84.9   -95.0   0.330   0   0.000
39392. 24328. 15720. 11008. 8696. 8000. 8696. 11008. 15702. 24328. 39392.
12-NOV-85 11:02:59
SPAN NO 2 RWCD FLOWY 85-411
```

Final Deflection

PT.	STA. (FEET)	DEFLECTION (INCHES)	DEFLECTION (FEET)	MOMENT (FT-KIPS)	
0	0.000	0.000	0.0000	-84.90	0
1	5.240	0.046	0.0038	-45.14	0.002
2	10.480	0.156	0.0130	-14.43	0.008
3	15.720	0.297	0.0247	7.21	0.015
4	20.960	0.413	0.0344	19.79	0.021
5	26.200	0.451	0.0376	23.31	0.023
6	31.440	0.391	0.0325	17.77	0.020
7	36.680	0.261	0.0217	3.17	0.013
8	41.920	0.119	0.0099	-20.49	0.006
9	47.160	0.021	0.0018	-53.22	0.001
10	52.400	0.000	0.0000	-95.00	0

END ROTATION LT. (RADIANS) = 0.0001285

END ROTATION RT. (RADIANS) = 0.0003467

85-411

VV) 12 Nov 85 Rd over RWCD Pldwy (22)

100000010 1287.5 41.700 -95.0 0.0 .330 0 0.000
39392. 27200. 19192. 14048. 10840. 8984. 8120. 8000. 8000. 8000. 8000.

12-NOV-85 10:57:57

SPAN NO 3 RWCD RDDWY 85-411

Final Deflection

PT.	STA. (FEET)	DEFLECTION (INCHES)	DEFLECTION (FEET)	MOMENT (FT-KIPS)	
0	0.000	0.000	0.0000	-95.00	0
1	4.170	0.048	0.0040	-59.68	0.002
2	8.340	0.146	0.0121	-30.09	0.007
3	12.510	0.278	0.0232	-6.25	0.014
4	16.680	0.419	0.0349	11.86	0.021
5	20.850	0.534	0.0445	24.23	0.027
6	25.020	0.588	0.0490	30.86	0.030
7	29.190	0.558	0.0465	31.75	0.029
8	33.360	0.437	0.0364	26.91	0.022
9	37.530	0.241	0.0201	16.32	0.012
10	41.700	0.000	0.0000	0.00	0

END ROTATION LT. (RADIANS) = 0.0004135

END ROTATION RT. (RADIANS) = -0.0049741

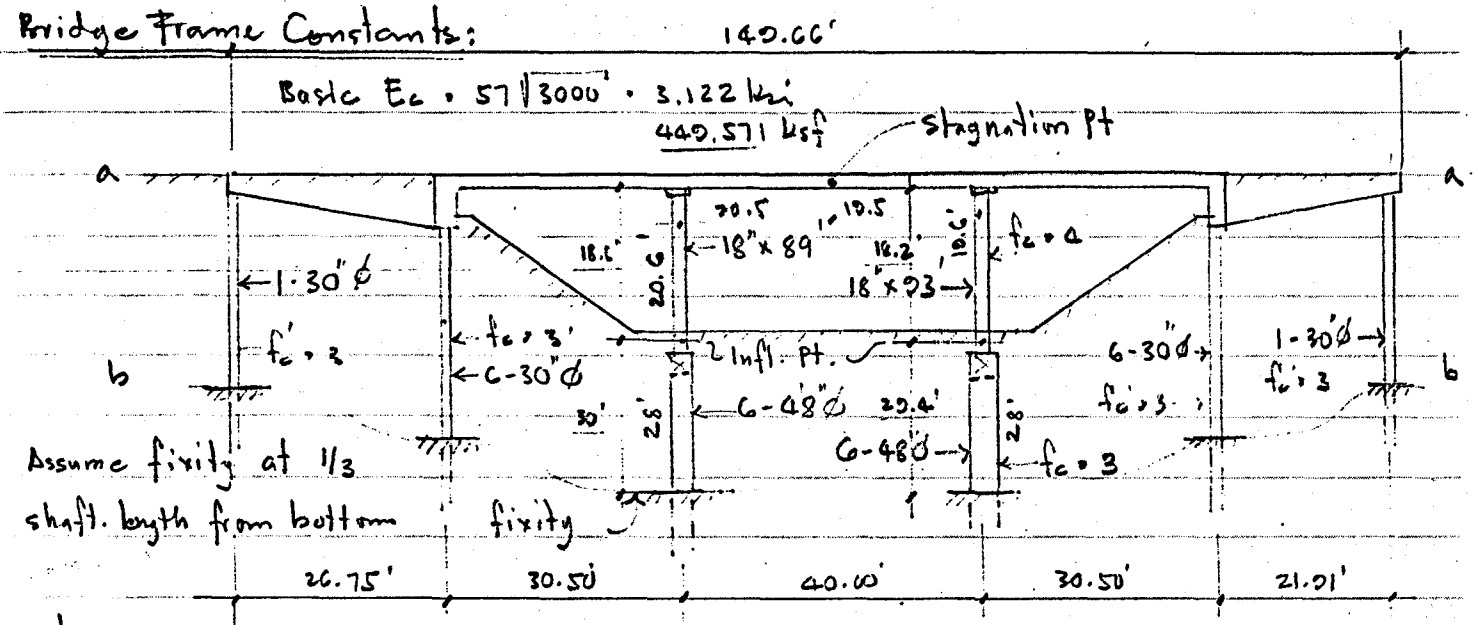
FROM: VVJ 31 Oct 85

WILSON & COMPANY ENGINEERS & ARCHITECTS

Arizona FILE 85-411

SUBJECT: Pr over RWCD Fldwy (23)

Bridge Frame Constants:



h →	33'	33'	48.6'	47.6'	33'	33'
Itop →	1.92	11.5	28.9	30.2	11.5	1.92
Ibot. →	1.92	11.5	75.4	75.4	11.5	1.92

Irelative, Basic I = 6-30"ϕ = 11.5 f^4 → EI = 5,170,067 ksf

Itop →	0.17	1.0	2.51	2.51	1.0	0.17
Ibot. →	0.17	1.0	6.56	6.56	1.0	0.17

Determine Relative Shear Rating: Run "MODIFAC" Program

Ksr →	2.04	12	51.54	51.55	12	2.04
Xa →	16.5'	16.5'	18.6'	18.2'	16.5	16.5
Cab →	0.5	0.5	0.72	0.72	0.5	0.5
Cba →	0.5	0.5	0.35	0.35	0.5	0.5
Kab →	0.68	4	11.46	11.49	4	0.68
Kba →	0.68	4	23.52	23.59	4	0.68

Substr. is very stiff in the transverse direction ΣSR = 8,932

SR = Ksr EI/h³ =	50	1726	2321	2519	1726	50

Lateral Shear Distr. Factor (∴ Neglect effect of shafts @ wingwalls)

KHL →	Negli.	0.21	0.28 (ΣSR = 8292)	0.30	0.21	Negli.

← Say limber

stagnation pt X = [2519 × 40 + 1726 (70.5 − 30.5)] / ΣSR = 20.5' Rt. of ℄ Pier #1

FROM: VV) 31 Oct 85

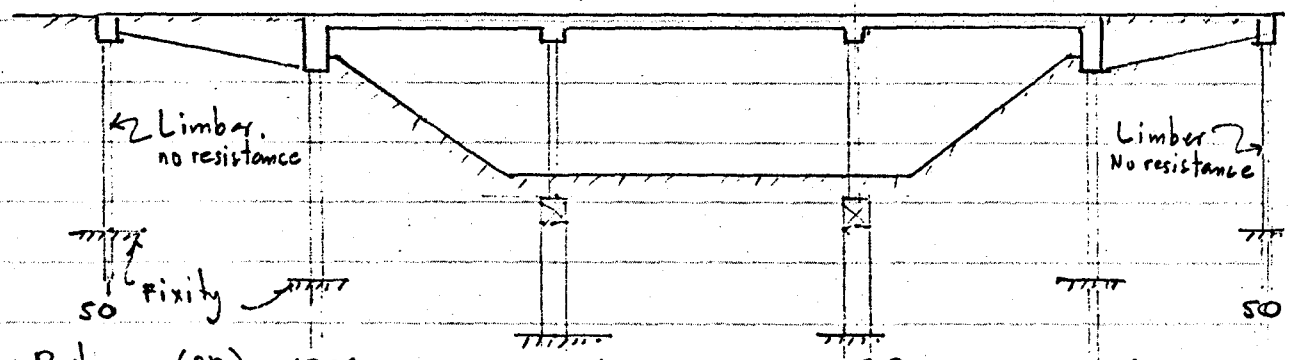
WILSON & COMPANY ENGINEERS & ARCHITECTS

Arizona FILE 85-411

SUBJECT: Pr over RWCD Pldwy (24)

Summary of Substructure Loads:

Substructure is very stiff in the transverse direction, so neglect transverse loads



Shear Ratings (SR)	1726	2321	2510	1726	
	26.75'	30.50'	40.00'	30.50'	21.91'
Lat. Distr. Factors	0	0.21	0.28	0.30	0.21	0
Supersh. DLR →	900^k	1615^k	1773^k	1003^k	($\Sigma W = 5300^k$)
LLR (5 lanes) w/o Imp	251^k	343^k	343^k	257^k	

(Assume Longit Forces ∝ SR)

Wind on Superstr.: $L = 150'$ $W = 10.5'$ $\Sigma W_L = WL \times .012 = 19.0^k$

W_L →	4.0^k	5.3	5.7^k	4.0^k

Wind on Live Load $L = 101'$ $\Sigma W_{L_L} = 101 \times .040 = 4.0^k$

W_{L_L} →	0.9^k	1.1^k	1.2^k	0.9^k

Longit. Force (5% of LLR)

LF →	12.6^k	17.2^k	17.2^k	12.9^k

(R+S+T) Max @ 45° Fall $\alpha = 6 \times 10^{-6}$ $\Delta = \alpha T L$. $(R+S+T) = \Delta SR$

L →	51'	20.5'	19.5'	50'
(R+S+T) →	23.7^k	12.9^k	13.3^k	23.3^k

Earthquake: Use Zone I, $C = .06$ $F = 1.00$ $\Sigma EQ = CFW = 323.4^k$

EQ_L →	67.9^k	90.6^k	97.0^k	67.9^k

Max

[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

Column Design (Load Factor): 30"ϕ shaft for Joint No. 2 - Max. Stress @ Top of Shaft

DL = (1003/6)·.75 = 125 ᵏ; LL = 257/6 = 43 ᵏ

Longit. Dim. = 16.5'

* Use 75% of TOTAL DEAD LOAD ON COLUMN

	Load	P	Lateral H_T	Lateral H_L	Moment M_T	Moment M_L	β Factors for Various Group Loadings I	II	III	IV	V	VI	VII	VIII	IX
1	D*	125	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2	L	43	-	-	-	-	1.67	-	1.0	1.0	-	1.0	-	1.0	-
3	CF	-	-	-	-	-	1.0								
4	E	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	B	-	-	-	-	-									
	SF	-	-	-	-	-									
5	OW	-	-	-	-	-	-	1.0	0.3	-	1.0	0.3	-	-	1.0
	W	-	-	0.7	-	12									
6	WL	-	-	0.2	-	3	-	-	1.0	-	-	1.0	-	-	-
	LF	-	-	2.2	-	36									
7	R+S+T	-	-	3.9	-	60	-	-	-	1.0	1.0	1.0	-	-	-
8	Ø Sup	-	-	11.3	-	186	-	-	-	-	-	-	1.0	-	-
	Ø Sub	-	-	-	-	-									
9	ICE	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0
						γ	1.3	1.3	1.3	1.3	1.25	1.25	1.3	1.3	1.2
						P_u	256	163	218	218	156	210	163		
						M_T	-	-	-	-	-	-	-	-	-
						M_L	0	16	55	83	95	133	242		
						δ_T	-	-	-	-	-	-	-	-	-
						δ_L	1.46	1.25	1.37	1.37	1.24	1.35	1.25		
						M_r	0	20	75	114	118	180	303		
						e	0	1.5"	4.2"	6.3"	9.1"	10.3"	22.3"		
						Cap P_u							166		
						P.R.							0.98		

	Transv.	Longit.
L_u	-	33
k	-	1.2
r	-	0.625
kL_u/r	-	63
EI*	-	178.608 f²
ϕP_c	-	808 ᵏ

Run "DESCOL" Program

For short columns

$100 > kL_u/r > 22$ — Run "CIRCOLE" Program

$P_c = \left(\frac{\pi}{kL_u}\right)^2 EI$

* From CIRCOLE

$\delta = \frac{C_m}{1 - \frac{P_u}{\phi P_c}}$, where $\phi = 0.70$, $C_m = 1.00$

$M_r = \sqrt{(\delta_T M_T)^2 + (\delta_L M_L)^2}$

Try 8-#8 Bars

$e = \frac{M_r}{P_u} \times 12$

∴ O.K. to use 8-#8

COMP. VVJ DATE 1 Nov 85 CK.

WILSON & COMPANY ENGINEERS ARCHITECTS

LOC. Brizzolara PROJ. Power Pl SUBJ. Pt Grey RWCD Plant SHEET 25 OF FILE 85-4-11

Column Design (Load Factor): 48"ϕ shafts for Pier No. 2 - Max. stress @ Bottom of Shaft

DL = (1773 + 681 + 271)/6] .75 = 341ᵏ LL = 343/6 = 57ᵏ

Superstr. Substr. Shafts

Longit. Arm = 29.4'

* Use 75% of TOTAL DEAD LOAD ON COLUMN

	Load	P	Lateral H_T	Lateral H_L	Moment M_T	Moment M_L	β Factors for various Group Loadings I	II	III	IV	V	VI	VII	VIII	IX
1	D*	341	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2	L	57	-	-	-	-	1.67	-	1.0	1.0	-	1.0	-	1.0	-
3	CF	-	-	-	-	-	1.0								
4	E	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	B	-	-	-	-	-									
	SF	-	-	-	-	-									
5	OW	-	-	-	-	-	-	1.0	0.3	-	1.0	0.3	-	-	1.0
	W	-	-	1.0	-	29									
6	WL	-	-	0.2	-	6	-	-	1.0	-	-	1.0	-	-	-
	LF	-	-	2.0	-	85									
7	R+S+T	-	-	2.2	-	65	-	-	-	1.0	1.0	1.0	-	-	-
8	Ø Sup	-	-	16.2	-	476	-	-	-	-	-	-	1.0	-	-
	Ø Sub	-	-	-	-	-									
9	ICE	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0
						γ	1.3	1.3	1.3	1.3	1.25	1.25	1.3	1.3	1.2
						P_u	567	443	517	517	426	408	443		
						M_T	-	-	-	-	-	-	-	-	-
						M_L	0	38	130	85	118	206	610		
						δ_T	-	-	-	-	-	-	-	-	-
						δ_L	1.45	1.32	1.30	1.30	1.30	1.37	1.32		
						M_r		50	181	118	154	283	815		
						e		1.4"	4.2"	2.7"	4.3"	6.8"	22.1"	Max	
						Cap P_u							689ᵏ		
						P.R.							0.64		

	Transv.	Longit
L_u	-	29.4
k	-	2.1
r	-	1.0
kL_u/r	-	57
EI*	-	1014688 f²
ϕP_c	-	1830

Run "DESCOL" Program

For short columns $100 > kL_u/r > 22$ — Run "CIRCOLE" Program

$P_c = \left(\frac{\pi}{kL_u}\right)^2 EI$

* From CIRCOLE

$\delta = \frac{C_m}{1 - \frac{P_u}{\phi P_c}}$, where $\phi = 0.70$, $C_m = 1.00$

$M_r = \sqrt{(\delta_T M_T)^2 + (\delta_L M_L)^2}$

Try 12-#10 bars

O.K. To use 12-#10 bars

Max

Pier over Pldwyd

COMP. WJ 4 Nov 85

CK: DATE

WILSON & COMPANY ENGINEERS ARCHITECTS

LOC. Arizona PROJ. Power Pl SUBJ. SHEET 26 FILE 85-411

FROM: VVJ 1 Nov. 85

WILSON & COMPANY ENGINEERS & ARCHITECTS

Arizona FILE 85-411

SUBJECT: Pr. over RWCD Fldwy (27)

30"ϕ shaft as a struct. Member:

Main bars = #8

$d_c = 3 + 9/16 + 1\frac{1}{8}/2 = 4.13"$

Try 8-#8 Vert Bars, $A_s = 6.32^{\square"}$

$A_g = \pi(15)^2 = 706.9^{\square"}$

$\rho = A_s/A_g = 0.009 \lessgtr \begin{matrix} 0.010 \\ 0.007 \end{matrix}$ } o.k.

∴ Use equivalent col. with 1% steel

Reduced $A_g = 6.32/.01 = 632$

$d = 24.23"$ { $R = \sqrt{A_g/\pi} = 14.18"$; $r = R - d_c = 10.05"$

Run "CIRCOLE" Program

$f_c = 3$ $f_y = 60$

$I_g = 1.53\ f^4$ $P_o = 1382^k$

$EI = 178{,}608$ $.10 f_c A_g = 190^k$

c		Pn	e
Max c = d =	24.23	1019	3.0"
25% Tens	20.67"	841	4.7"
50% "	18.02"	693	6.3"
75% "	15.97"	569	8.0"
100% "	14.34"	462	10.0"
	12	315	13.8"
	10	195	19.9"
→	9.5	166	22.5"
	8	78	41.0"
	6.65	0	∞

Use 8-#8 bars per shaft

Bar Spa. = $2\pi r/8 = 7.9"$

48"ϕ shaft

Main bars = #10

$d_c = 6 + 9/16 + 1\frac{7}{16}/2 = 7.28"$

Try 12-#10 Vert. Bars, $A_s = 15.24^{\square"}$

$A_g = \pi(24)^2 = 1810^{\square"}$

$\rho = A_s/A_g = .0084 \begin{matrix} > .010 \\ < .007 \end{matrix}$ } ∴ ok

∴ Use equivalent col. with 1% steel

Reduced $A_g = 15.24/.01 = 1524^{\square"}$

$R = \sqrt{A_g/\pi} = 22.03$; $r = R - d_c = 14.75"$ } $d = 36.78"$

Run "CIRCOLE" Program

$f_c = 3$ $f_y = 60$

$I_g = 8.92\ f^4$ $P_o = 3{,}334^k$

$EI = 1{,}014{,}688$ $.10 A_g f_c' = 457^k$

c		Pn	e
Max c = d =	36.78"	2401	5.0"
25% Tens	31.37"	1974	7.5"
50% "	27.35"	1619	10.0"
75% "	24.24"	1320	12.6"
100% "	21.77"	1062	15.8"
	10.45"	829	19.6
→	18"	689	22.6"
	14"	313	41.3"
	12"	130	86.0"
	10.58	0	∞

Use 12-#10 bars

Bar Spa. = $2\pi r/12 = 8.75"$

Column Design (Load Factor): 18" Th. Wall for Pier No. 2 - Max. Stress @ Top

DL = 1773 × .75 = 1330 k LL = 343 k

Longit. Arm = 18.2'

* Use 75% of TOTAL DEAD LOAD ON COLUMN Wall Length = 93'

	Load	P	Lateral H_T	Lateral H_L	Moment M_T	Moment M_L	β Factors for Various Group Loadings I	II	III	IV	V	VI	VII	VIII	IX
1	D*	1330	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2	L	343	-	-	-	-	1.67	-	1.0	1.0	-	1.0	-	1.0	-
3	CF	-	-	-	-	-	1.0								
4	E	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	B	-	-	-	-	-									
	SF	-	-	-	-	-									
5	OW	-	-	-	-	-	-	1.0	0.3	-	1.0	0.3	-	-	1.0
	W	-	-	5.7	-	104									
6	WL	-	-	1.2	-	22	-	-	1.0	-	-	1.0	-	-	-
	LF	-	-	17.2	-	313									
7	R+S+T	-	-	13.3	-	242	-	-	-	1.0	1.0	1.0	-	-	-
8	Ø Sup	-	-	97.0		1765	-	-	-	-	-	-	1.0	-	-
	Ø Sub	-	-	-	-	-									
9	ICE	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0
						γ	1.3	1.3	1.3	1.3	1.25	1.25	1.3	1.3	1.2
						P_u	2472	1729	2175	2175	1663	2091	1729		
						M_T	-	-	-	-	-	-	-	-	-
						M_L	0	135	476	315	433	760	2205		
						δ_T	-	-	-	-	-	-	-		
						δ_L	1.22	1.14	1.19	1.19	1.14	1.18	1.14		
						M_r	0	154	564	373	492	894	2621		
						e	-	1.1"	3.1"	2.1"	3.6"	5.1"	18.2"	Max	
						Cap P_u							3618		
						P.R.							0.48		

	Transv.	Longit
L_u	-	18.2
K	-	2.1
r	-	0.45
KL_u/r	-	85
EI*	-	2,942,334 f^2
ϕP_c	-	13,916 k

Run "DESCOL" Program

For short columns

100 > KL_u/r > 22

"WALLCOL" Run ~~"CIRCOLS"~~ Program

$P_c = \left(\frac{\pi}{KL_u}\right)^2 EI$

$\delta = \frac{C_m}{1 - \frac{P_u}{\phi P_c}}$, where $\phi = 0.70$, $C_m = 1.00$

$M_r = \sqrt{(\delta_T M_T)^2 + (\delta_L M_L)^2}$

Try #8 @ 12 1/4"

∴ #8 @ 12 1/4" is O.K.

* From "WALLCOL" ~~CIRCOLS~~

COMP. VVJ 5 Nov 85

CK.

DATE

WILSON & COMPANY
ENGINEERS
ARCHITECTS

LOC. Arizona FILE 85-411

PROJ. Power Rd SHEET 28

SUBJ. Pre over RWCD Pl. Ave OF

FROM: VVJ 5 Nov 85

WILSON & COMPANY ENGINEERS & ARCHITECTS

Arizona FILE 85-411

TO:

SUBJECT: Bri over RWCD Hdwy (29)

18" Th. as a Rect. Col.

Main bars = #8

$d_{c1} = d_{cv} = 2 + 9/16 + 1\frac{1}{8}/2 = 3.13"$

$A_{s1} = A_{sv} = \#8 @ 12\frac{1}{4} = \underline{0.77}\ \square"$

$A_t = A_{s1} + A_{sv} = \underline{1.55}\ \square"$

$A_g = 12 \times 18 = 216\ \square"$

$\rho = A_s/A_g = .0072 < .01 > .007 \therefore$ O.K.

Reduced $A_g = 1.55/.01 = 155\ \square"$

Reduced $L = 155/18 = \underline{8.61"}$

Use equiv. col. w/1% steel

Run "WALLCOL" Program

$f'_c = 4 \quad f_y = 60 \quad L = 8.61" \quad B = 18"$

$A_{s1} = A_{sv} = 0.77\ \square" \quad d_1 = d_v = 3.13"$

f't. $\begin{cases} I_g = \underline{0.20}\ f^4 & P_o = \underline{430}^k \\ EI = \underline{31.638}\ f^2 & .10 f'_c A_g = \underline{62}^k \end{cases}$

c	c	Pn
Max $c = B/\beta = 21.18"$	0	430^k
0% Tens. c = d = 14.87"	2.2"	320^k
25% " c = 12.68	4.2"	243^k
50% " = 11.06"	5.3"	207^k
75% " = 9.80"	6.5"	177^k
100% " = 8.50"	7.8	149^k
7	9.4"	114^k
6	10.6	93^k
5	12.5	70^k
4	16.4"	46^k
→ 3.75	18.2"	39^k
3.5	21.0	32^k
2.57	∞	0