CITY OF O'FALLON

David Drive (Red Hawk Drive)

Saint Charles County

Bridge No. 3210016

Design Calculations

KDG Project No. 980100-0001

CITY OF O'FALLON
Bridge No. 3210016
Design Calculations
David Drive
K*d*G Project No. 980100-0001

INDEX

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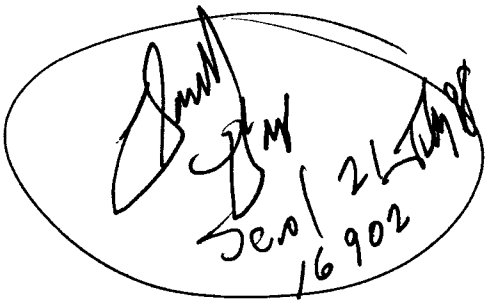


ENGINEERING CALCULATION COVER SHEET

PROJECT:	Bridge No. 3210012	DISCIPLINE:	Bridge
	David Drive	CALCULATION NO.:	Final
		NO. OF SHEETS:	See Index
JOB NO.:	980100-0001	CALCULATED BY:	JVS RCP
CONTRACT NO.:		CHECKED BY:	
DESIGN CODE:	AASHTO 1996	APPROVED BY:	
		APPROVED BY:	

CALCULATION DESCRIPTION:

Substructure Design

Quantities

DESIGN BASIS OR REFERENCES:

AASHTO 16th Edition, 1996

Missouri Highway & Transportation Department Bridge Manual of Design

CITY OF O'FALLON
Bridge No. 3210016
Design Calculations
David Drive
K*d*G Project No. 980100-0001

DESIGN SCOPE

Structure Type Rigid
Box Design
Double Cell
(8.0 Ft. Wide X 7.0 Ft. High)

Loading:
HS20-44
Load Factor Design
Earth 120#/Cu. Ft.
Equivalent Fluid Pressure 60#/Cu.Ft.

DESIGN CRITERIA

DESIGN SPECIFICATIONS

AASHTO - 1996 Sixteenth Edition

DESIGN LOADING

HS20
Earth 120#/cu.ft.
Equivalent Fluid Pressure 60#/Cu.Ft.

DESIGN UNIT STRESSES

Class B Concrete (Culverts)	$f'c$ =	3,000 psi
Reinforcing Steel (Grade 60)	$f'y$ =	60,000 psi

REINFORCING STEEL

Minimum clearance to reinforcing steel shall be 1-1/2", unless otherwise shown.

BAR COVER - AASHTO 8.22

Clear Dimensions to be shown on plans:

Top Slab	- Top Reinforcing	=	2" clear
	- Bottom Reinforcing	=	1-1/2" clear
Bottom Slab	- Top Reinforcing	=	1-1/2" clear
	- Bottom Reinforcing	=	3" clear
Sidewalls	- Reinforcement Stream Face	=	1-1/2" clear
	- Reinforcement Fill Face	=	2" clear

MAXIMUM BAR LENGTHS

Longitudinal bars should be made full length without splicing up to about 40'-0"; splice if longer. Bars #5 and larger may be used to a length of 60'-0" without splicing.

BAR SPLICES

See Section 2.4 for minimum bar lap and tension splices in reinforcement. Use a Class C splice for longitudinal bar (22" min.).

JOINT FILLER

All joint filler shall meet requirements of Standard Specification 1057.2.5, except as noted.

DESIGN LAYOUT

Division of Bridges

No. 3210016
Job. _____

Route David Drive County Saint Charles Rte. Winghaven Drive

STRUCTURE

SUPERSTRUCTURE Double Cell (8.0W x 7.0H) (Rigid)

Skew ..... 30º Right Advanced.
Roadway..... 3 - 12 foot lanes.
Loading HS20
Beg. Sta. .....
Alignment .....
Grade ..... H.P.I. Sta. 15+50.00 (Elev. 522.73) Bk. -1.00%, Ahd. +1.00%, Length = 120.00
Grade ..... V.P.I. Sta. 04+75.00 (Elev. 524.30) Bk. -2.00%, Ahd. +2.00%, Length = 200.00

SUBSTRUCTURE

Footing Loads ..... 2,000 lbs per square foot
Pile Type ..... N/A
Length ..... N/A
Elev Footing, Bott. ..... 511.10 High 510.56 Low

GENERAL

Revetment/Slope ..... Sideslope 3:1 (Normal)
End Fills..... Earth
Traffic Handling .....
Present Bridge ..... None

SPECIAL REQUIREMENTS

Profile Grade ..... Centerline of Winghaven Drive (Centerline Median)
Rail Road Alignment ..... N/A
Tie Station..... 05 + 29.73
Final Allowable Clearances ..... N.A.

Estimate includes 10% for Engineering and Contingencies and 5% for Preliminary Engineering

Dated: By: Estm. $

Date:	Notes or Revisions in Conference
Initials:	

Notes and Revisions after Conference (All revisions to be dated and initialed)

DRAWING LIST

Sheet No.	Title
1	Plan, Elevation, General Notes, and Quantities
2	Reinforcement
3	Cross Section and Wing Wall Details

CORRESPONDENCE

PICKETT RAY & SILVER

CIVIL ENGINEERS • PLANNERS • LAND SURVEYORS

July 14, 1998
Revised July 15, 1998

Mr. Ron Pagan
Kuhlmann Design Group, Inc
66 Progress Parkway
St Louis, Missouri 63043

RE WINGHAVEN - BOX CULVERT
PR&S PROJECT NO 97-034

Dear Ron

Per our meeting today, I am sending you "sealed" confirmation of box culvert information

	"S"	"H"	Elev 1	Elev 2	A Rt	A Lt	B	Des-Fill	Des-Fill
Winghaven Station 17+15	10	7	575 42	574 58	60	60	24	1	4
Winghaven Station 30+49	10	7	580.68	579.92	60	60	24	1	7
Winghaven Station 59+00	12	10	516 39	517 11	70	70	30	1	5
Charlie (Phoenix) Station 62+53.89	12	12	488 91	490 09	43	43	37	1	4
David (Red Hawk) Station 5+29 73	8	7	511.20	510 45	60	60	30	1	7

We will send Winghaven Station 30+49 as soon as the street is revised back to the previous grade. If you need anything else, please contact me or Mr Jim Cannady

Very truly yours,
PICKETT, RAY & SILVER, INC

Tanya J. Dietz
Project Design Supervisor

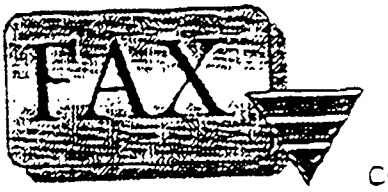
bjs
cc: Mr Joe McKee, Paric Corporation
Mr Dave Rogers, Fred Weber

STATE OF MISSOURI
HAROLD J. BARTON
NUMBER E-17751
REGISTERED PROFESSIONAL ENGINEER
7/14/98

PICKETT RAY & SILVER

CIVIL ENGINEERS • *PLANNERS* • *LAND SURVEYORS*

ADG. MH FILE 980100



JUL 16 1998

CONFIDENTIALITY NOTE

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PLEASE DELIVER THE FOLLOWING PAGES:

TO: Ron 434 8280

FROM: Jerry

PROJECT: Wingfield

PR&S PROJECT NO.: 97034

DATE AND TIME: 7/16/98

TOTAL NO. OF PAGES, INCLUDING COVER SHEET: 2

TELECOPY OPERATOR: CJS

3:40 pm

PLEASE NOTIFY US IMMEDIATELY IF THE MESSAGE IS INCOMPLETE OR UNCLEAR. THANK YOU.

333 MID RIVERS MALL DRIVE • ST. PETERS, MISSOURI 63376 • 314-397-1211/314-397-1104 FAX

PICKETT RAY & SILVER

CIVIL ENGINEERS • *PLANNERS* • *LAND SURVEYORS*

KDG, MH FILE 98-0100

July 14, 1998
Revised July 15, 1998

JUL 15 1998

Mr. Ron Pagan
Kuhlmann Design Group, Inc.
6[illegible] Progress Parkway
St. Louis, Missouri 63043

RE WINGHAVEN - BOX CULVERT
PR&S PROJECT NO. 97-034

Dear Ron:

Per our meeting today, I am sending you "sealed" confirmation of box culvert information.

	"S"	"H"	Elev 1	Elev 2	A Rt	A Lt	B	Des-Fill	Des-Fill.
Winghaven Station [illegible]	10	7	575.42	574.58	60	60	24	1	4
Winghaven Station 30+49	10	7							
Winghaven Station 59+00	12	10	516.39	517.11	70	70	30	1	5
Charlie (Phoenix) Station 62+53.89	12	12	488.91	490.09	43	43	37	1	4
David (Red Hawk) Station [illegible]	8	7	511.20	510.45	60	60	30	1	7

We will send Winghaven Station 30+49 as soon as the street is revised back to the previous grade. If you need anything else, please contact me or Mr. Jim Cannady.

Very truly yours,
PICKETT, RAY & SILVER, INC.

Tanya J. Dietz
Project Design Supervisor

STATE OF MISSOURI
HAROLD J. BARTHOLOMEW
NUMBER E-17751
REGISTERED PROFESSIONAL ENGINEER
7/14/98

bjs
cc Mr. Joe McKee, Parc Corporation
Mr. Dave Rogers, Fred Weber

PICKETT RAY & SILVER

CIVIL ENGINEERS • PLANNERS • LAND SURVEYORS

CONFIDENTIALITY NOTE

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PLEASE DELIVER THE FOLLOWING PAGES:

TO: Ken

FROM: Tony

PROJECT: Winghaven

PRS PROJECT NO.: 97034

DATE AND TIME: 7.14.98

TOTAL NO. OF PAGES, INCLUDING COVER SHEET: 15

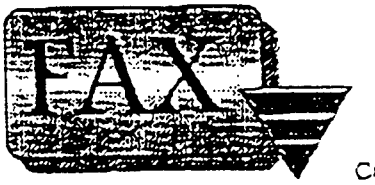
TELECOPY OPERATOR:

PLEASE NOTIFY US IMMEDIATELY IF THE MESSAGE IS INCOMPLETE OR UNCLEAR. THANK YOU.

333 MID RIVERS MALL DRIVE • ST. PETERS, MISSOURI 63376 • 314-397-1211/314-397-1104 FAX

PICKETT RAY & SILVER

CIVIL ENGINEERS • PLANNERS • LAND SURVEYORS



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PLEASE DELIVER THE FOLLOWING PAGES:

TO: RON PAGAN (434 8280)

FROM: TANYA

PROJECT: WINGHAVEN

PR&S PROJECT NO.: 97034

DATE AND TIME: 7.10.98

TOTAL NO. OF PAGES, INCLUDING COVER SHEET: 5

TELECOPY OPERATOR:

COPY TO MIKE HARMON - WEBER 3440970

PLEASE NOTIFY US IMMEDIATELY IF THE MESSAGE IS INCOMPLETE OR UNCLEAR. THANK YOU.

333 MID RIVERS MALL DRIVE • ST. PETERS, MISSOURI 63376 • 314-397-1211/314-397-1104 FAX

PICKETT RAY & SILVER

Civil Engineers
Planners
Land Surveyors

222 Mid Rivers Mall Dr
St. Peters, MO 63376

357-1211

PROJECT NAME_____

PROJECT #/JOB ORDER #_____

DATE_____

DESIGNER_____

PAGE_____

RON -

7.10.98

- BM @ BOX(S): HAS NOT BEEN SET.

- HW ELEV - PER MY CALC:

WINGHAVEN	521.3
PHOENIX	496.3
RED HAWK	520.6

F.P.

WINGHAVEN	522.0
PHOENIX	496.3
RED HAWK	N/A

UTILITY SURVEY - DELIVERED (THIS WK)

COMPLETE JOB PLANS - READY FRI. (7.10.98)

HW CALCS - ENCLOSED

" ELEV = ABOVE

PROJECT: Wingshaven - Charlie Dr.

STATION: 62+50

SHEET ____ OF ____

CULVERT DESIGN FORM

DESIGNER / DATE: Eby / 12/22/97

REVIEWER / DATE: ____ / ____

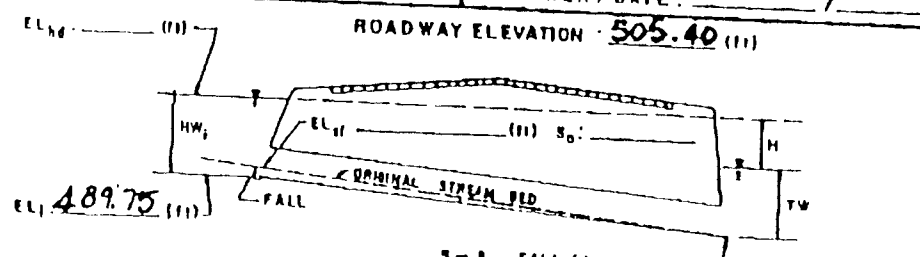
HYDROLOGICAL DATA

SEE ADD'L. NOTES

- ☐ METHOD ____
- ☒ DRAINAGE AREA: ____ ☐ STREAM SLOPE: ____
- ☐ CHANNEL SHAPE: ____
- ☐ ROUTING ____ ☐ OTHER ____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
15	3671.5	
100	5102.7	



S = S_o - FALL / L_o

S = .67%

L_o = 75

F.P. 496.5 ±

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N [1]	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D [2]	HW_i	FALL [3]	EL_hi [4]	OUTLET CONTROL TW [5]	d_c	(d_c+D)/2	h_o [6]	k_e	H [7]	EL_ho [8]	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
5 - 12'x12' Box.	3672	734	.70	9.4	-	498.2	-	4.8	8.4	8.4	0.5	.7	499.4	499.4		Culv!
5-12'x12' Box.	5103	1021	0.86	10.3	-	5000	-	6.1	9.0	9.0	0.5	1.4	499.6	500.0		inlet ctrl
Use FEMA Q.																
5-12'x12' Box	2495	499	.54	6.5	—	496.3		3.7	7.9	7.9	0.5	.3	1.943	496?		inlet control

5/A/98 using * from Fema chart (in file)

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW/D OR hw_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - [EL_{hd} - EL_{if}]$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e - (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i INLET CONTROL SECTION
o OUTLET
of. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE 5-12x12 Box

SHAPE SQUARE

MATERIAL: Concrete n .013

ENTRANCE: ____

PROJECT: Winghaven - David Dr.

STATION: 5+30

SHEET ____ OF ____

CULVERT DESIGN FORM

DESIGNER / DATE: [illegible] / 12/22/97

REVIEWER / DATE: ____ / ____

P2W4 93

HYDROLOGICAL DATA

SEE ADDITIONAL SHTS.

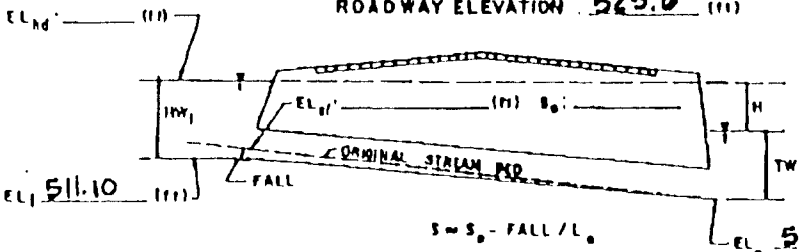
- ☐ METHOD: ____
- ☒ DRAINAGE AREA: ____ ☐ STREAM SLOPE: ____
- ☐ CHANNEL SHAPE: ____
- ☐ ROUTING: ____ ☐ OTHER: ____

DESIGN FLOWS/TAILWATER

200 Ac

R I (YEARS)	FLOW (cfs)	TW (ft)
15	780.8	
100	1085	

ROADWAY ELEVATION 525.6 (ft)



S = S_o - FALL / L_o

S = ____

L_o = 108

CULVERT DESCRIPTION: MATERIAL · SHAPE · SIZE · ENTRANCE	TOTAL FLOW Q (c.f.s.)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	d_c+D/2	h_o (6)	h_o	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
2 - 7'H x 8'W (15yr)	1608	390	1.2	8.4	-	519.5		4.2	5.6	5.6	.5	1.32	517.4			Inlet control
2 - 7H x 8 (100yr)	1085	542.5	1.36	9.52	-	520.6		5.2	6.1	6.1	.5	2.58	519.2			Inlet control

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{if})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_o + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i. INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE 7'H x 8'W - 2

SHAPE ____

MATERIAL Conc. n.013

ENTRANCE: ____

PROJECT: Winghaven - Winghaven Dr.

STATION 59+00

SHEET ____ OF ____

CULVERT DESIGN FORM

DESIGNER / DATE: TDH / 12/22/97

REVIEWER / DATE: ____ / ____

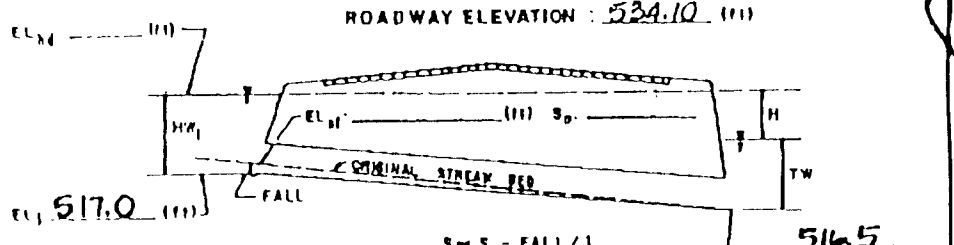
HYDROLOGICAL DATA

SEE ADD'L SHTS

- ☐ METHOD ____
- ☑ DRAINAGE AREA: ____ ☐ STREAM SLOPE ____
- ☐ CHANNEL SHAPE ____
- ☐ ROUTING ____ ☐ OTHER ____

DESIGN FLOWS / TAILWATER

R I (YEARS)	FLOW (cfs)	TW (ft)
15	3019	
100	4196	



CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	h_a	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
4 - 10'h x 12'w (15)	3019	755	0.85	8.5		525.5		4.9	7.45	7.45	0.5	1.1	524.1	526.5		Inlet Control
4 - 10'h x 12'w (100)	4196	1049	1.08	10.8		527.8		6.2	8.1	8.1	0.5	2.01	526.6	527.8		
use # from FEMA																
4 - 10'h x 12'w	244	305	.13	7.3		524.3										

6/4/98

240

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW/D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL_i (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + \left(29n^2 L\right)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

- a APPROXIMATE
- c CULVERT FACE
- hd DESIGN HEADWATER
- hi HEADWATER IN INLET CONTROL
- ho HEADWATER IN OUTLET CONTROL
- i INLET CONTROL SECTION
- o OUTLET
- sf STREAMBED AT CULVERT FACE
- tw TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE 4 - 10'h x 12'w

SHAPE: ____

MATERIAL: Concrete n=.012

ENTRANCE: ____

314 946 6713

Jul 02 98 10:13a Kuhlmann Design Group-SC 314-946-6713 p.1

KDG. MH FILE 980100

JUL 0 2 1998

Kuhlmann *design* ~~Group, Inc.~~

6 Westbury Drive, St. Charles, MO 63301-2571
Phone 314.946.5566 • Fax 314.946.6713

FACSIMILE TRANSMISSION

PLEASE DELIVER IMMEDIATELY

CORRECTION JULY 2, 98

Post-it® Fax Note 7671 — Date 7-2-98 — # of pages ▶ 1 — To JIM CANNADY — From SAL ELKOTT — Co./Dept. PRS — Co. KdG — Phone # — Phone # — Fax # — Fax #

DATE	2, 1998	TIME	
TO	Mr. Ron Pagan	FAX #	
COMPANY		PROJECT #	97023
FROM	Sal Elkott SdW	SENT BY	

[illegible] are the floor elevations for the Winghaven Drive tunnel as designed by Pickett Ray and Silver (PRS). These [illegible] based on PRS plans dated December 1997 and last revised on March 27, 1998. Mr. Jim Cannady verified these elevations for me this morning. In addition, He said that even though the tunnel floor elevations are not called out on [illegible] you have correctly stated), PRS' intent is for the tunnels to slope at one half of one percent (0.005 foot per [illegible] this slope and the centerline tunnel floor elevation that is shown on the roadway profile one can verify these elevations.

[illegible] Length 128' Centerline floor elevation = 575.00

West Side floor elevation = 574.68 (measured at end of tunnel ~~75'~~ 64' away from roadway centerline)

East Side floor elevation = 575.32 (measured at end of tunnel ~~75'~~ 64' away from roadway centerline)

[illegible] Length 100' centerline floor elevation = 580.30

West Side floor elevation = 580.05 (measured at end of tunnel 50' away from roadway centerline)

East Side floor elevation = 580.55 (measured at end of tunnel 50' away from roadway centerline)

[illegible] understands that you may need to change these lengths by few feet and the elevations by few tenths. It would [illegible] necessary to let Jim and us know of these changes. We at the St. Charles office have to design for the drainage of these tunnels.

Copy: Jim Cannady, Frank Bauer, Jim Poole

[illegible] COVER PAGE One

IF YOU ENCOUNTER DIFFICULTIES IN RECEIVING THIS TRANSMISSION
PLEASE CALL 314.946.5566

Kuhlmann *design* Group, Inc.
Transportation Department
66 Progress Parkway
St. Louis, Missouri 63043

Telephone: (314) 434-8898
Fax: (314) 434-8280
E-Mail: kdgmh@kdginc.com

FAX TRANSMITTAL COVER SHEET

TO: MR. FRANK GODWIN P.E.
CITY OF OFALLON
!38 SOUTH MAIN STREET
OFALLON MISSOURI 63366

FAX NO. 314 240 5511
DATE: 25 JUNE 1998
PHONE 314 240 2000

FROM: RONALD C. PAGAN, P.E.

PROJECT NO. 980100

MESSAGE:ATTACHED IS CULVERT DESIGN CRITERIA WE DISCUSSED.

THANK YOU
TOTAL NUMBER OF PAGED TRANSMITTED INCLUDING COVER PAGE: 2

If you encounter difficulties in receiving this transmission, please call (314) 434-8898.

Hydraulic Structures

REINFORCEMENT

BAR COVER - AASHTO 8.22

CLEAR DIMENSIONS TO BE SHOWN ON PLANS:

TOP SLAB	-	TOP REINFORCING	= 2" CL.
		BOTTOM REINFORCING	~~= 1" CL.~~ 1 1/2
BOTTOM	-	TOP REINFORCING	= 1-1/2" CL.
		BOTTOM REINFORCING	= 3" CL.
SIDEWALLS	-	REINFORCEMENT STREAM FACE	= 1-1/2" CL.
		REINFORCEMENT FILL FACE	= 2" CL.

MAXIMUM BAR LENGTHS

LONGITUDINAL BARS SHOULD BE MADE FULL LENGTH WITHOUT SPLICING UP TO ABOUT 40'-0"; SPLICE IF LONGER. BARS #5 AND LARGER MAY BE USED TO A LENGTH OF 60'-0" WITHOUT SPLICING.

BAR SPLICES

SEE SECTION 2.4 FOR MINIMUM BAR LAP AND TENSION SPLICES IN REINFORCEMENT. USE A CLASS C SPLICE FOR LONGITUDINAL BAR (22" MIN.).

BOX CULVERTS ON ROCK

VERTICAL BARS IN THE WALLS SHALL SET ON ROCK. E1 & E2 BARS IN THE WING SHALL BE SET 12" INTO ROCK AND GROUTED (SEE SEC. 4 F1 FOR NOTE FOR PLANS).

REINFORCEMENT

BAR COVER - AASHTO 8.22

CLEAR DIMENSIONS TO BE SHOWN ON PLANS:

1 1/2"

TOP SLAB	-	TOP REINFORCING	= 2" CL.
		BOTTOM REINFORCING	= 1" CL.
BOTTOM	-	TOP REINFORCING	= 1-1/2" CL.
		BOTTOM REINFORCING	= 3" CL.
SIDEWALLS	-	REINFORCEMENT STREAM FACE	= 1-1/2" CL.
		REINFORCEMENT FILL FACE	= 2" CL.

MAXIMUM BAR LENGTHS

LONGITUDINAL BARS SHOULD BE MADE FULL LENGTH WITHOUT SPLICING UP TO ABOUT 40'-0"; SPLICE IF LONGER. BARS #5 AND LARGER MAY BE USED TO A LENGTH OF 60'-0" WITHOUT SPLICING.

BAR SPLICES

SEE SECTION 2.4 FOR MINIMUM BAR LAP AND TENSION SPLICES IN REINFORCEMENT. USE A CLASS C SPLICE FOR LONGITUDINAL BAR (22" MIN.).

BOX CULVERTS ON ROCK

VERTICAL BARS IN THE WALLS SHALL SET ON ROCK. E1 & E2 BARS IN THE WING SHALL BE SET 12" INTO ROCK AND GROUTED (SEE SEC. 4 F1 FOR NOTE FOR PLANS).

GENERAL NOTES:

CONSTRUCTION SPECIFICATIONS:

All materials and methods of construction shall meet the requirements of MoDot Standard Specifications for Highway Construction 1996

DESIGN SPECIFICATIONS:

A.A.S.H.T.O. – 1996
Service Load Design

DESIGN LOADING:

HS20
Earth 120#/Cu. Ft.,
Equivalent Fluid Pressure 30#/Cu. Ft.

DESIGN UNIT STRESSES:

Class B Concrete (Substructure)	f'c = 3,000 psi
Reinforcing Steel (Grade 60)	fy = 60,000 psi

JOINT FILLER:

All Joint Filler shall meet the requirements of Std. Spec. 1057.2.4, except as noted.

Joint filler shall be securely stitched to one face of the concrete with No. 10 gage copper wire or No. 12 gage soft drawn galvanized steel wire.

REINFORCING STEEL:

Minimum clearance to reinforcing steel shall be 1–1/2", unless otherwise shown.

Lap all reinforcing 24 bar diameters unless otherwise noted.

'hru 13')
- 13')

Centered

12"(Typ.)

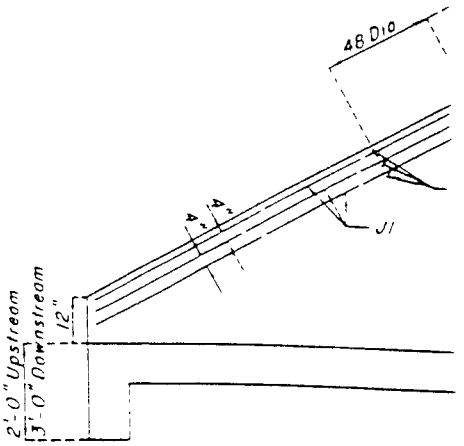
#4 - R2 at 12"cts

F Bars

#4 - R1 at 12"cts

TION A-A

LENGTH OF H BARS							
H1 (A) = 2KL NOTE H BARS TO BE CENTERED ON CENTER WALL							
H2 (B) = KL							
H3 (C) = 50L							
L = "S" + "T" K = COEFFICIENT SHOWN BELOW							
FOR DESIGN FILL SEE DATA SHEET	"S"						
	8'	9'	10'	11'	12'	13'	14' & OVER
12"	63	59	54	51	48	46	43
13" THRU 18"	55	52	48	46	43	42	40
19" THRU 2'-0"	52	49	45	44	42	41	39
2'-1" THRU 2'-11"	47	45	42	41	40	39	37
3'-0" THRU 3'-11"	42	41	40	39	37	37	36
4'-0" THRU 5'-0"	39	39	38	37	36	37	37
5'-1" & OVER	42	41	39	39	38	38	38



ELEVATION OF E
(SHOWING
(DOWNSTREA

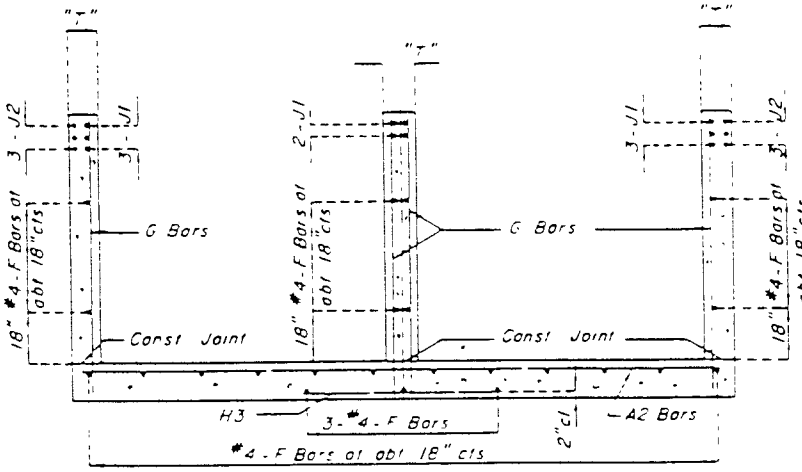
#4 - R2 at 12"cts

F Bars

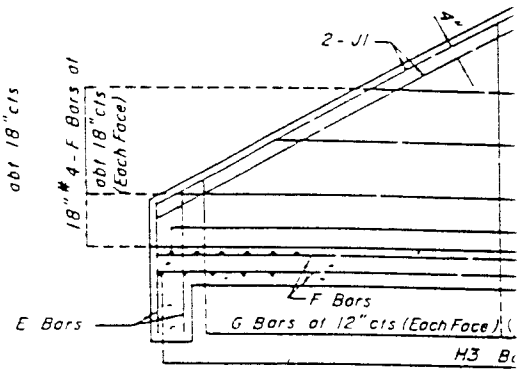
#4 - R1 at 12"cts

TION B-B

ELED HEADWALL TO BE
ATED AT UPSTREAM END



SECTION THRU WINGS



SECTION NEAR IN
(DOWNSTREAM

5/16" JOINT FILLER STD. SPEC. 1057.2.5

2" (TYP.)

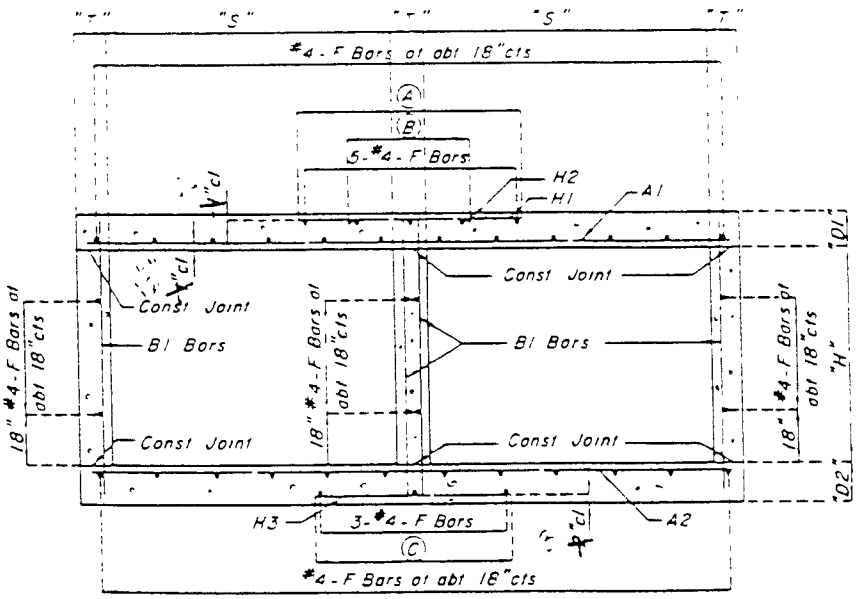
(TYP.)

TRANSVERSE JOINT
REL OF CULVERT

SVERSE JOINT WHEN BARREL
BETWEEN HEADWALLS AND NOT

OTH THREE FOOT IN WIDTH
NESS SHALL BE APPLIED TO
OINTS IN THE TOP SLAB AND
MATERIAL SHALL BE CENTERED
THE EDGES SEALED WITH A
WO SIDED TAPE. THE FILTER
GEOTEXTILE MEETING THE
ENGINEER AND HAVING A GRAB
OF 180 LBS. (ASTM D-4632)
SIZE OF 50 TO 100 (ASTM
EET PAYMENT WILL BE MADE
ND INSTALLING THE FILTER

ONAL TRANSVERSE JOINTS TO
MUM SPACING BETWEEN JOINTS.



SECTION THRU BOX

- D1

D1

Bars

SECTION D - D

D2 Length Each Side of ℄ Center Wall
= 48 Bar Dia or ¼ "S"
(Use Greater)

GENERAL NOTES:

FOR DIMENSIONS AND SIZE
BRIDGE SHEET AND STANDARD ?

LAP ALL LONGITUDINAL BARS

MINIMUM CLEARANCE TO RE
SHOWN

JOINT FILLER SHALL BE SEC
WITH NO 10 GAGE COPPER W
STEEL WIRE

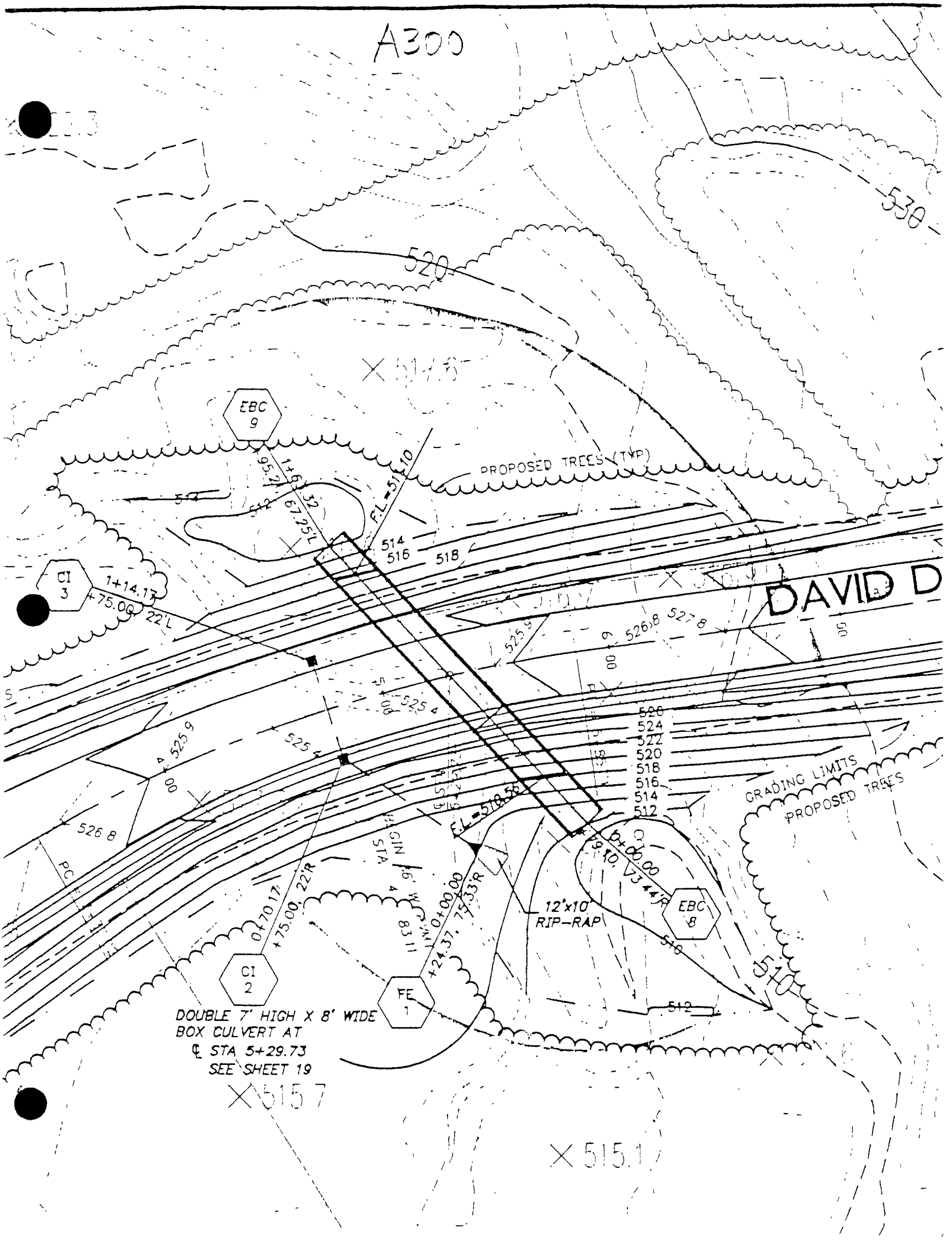
STATE OF MISSOURI
ALLEN L. AFFOLTER
NUMBER E-10903
REGISTERED PROFESSIONAL ENGINEER

12/27/96

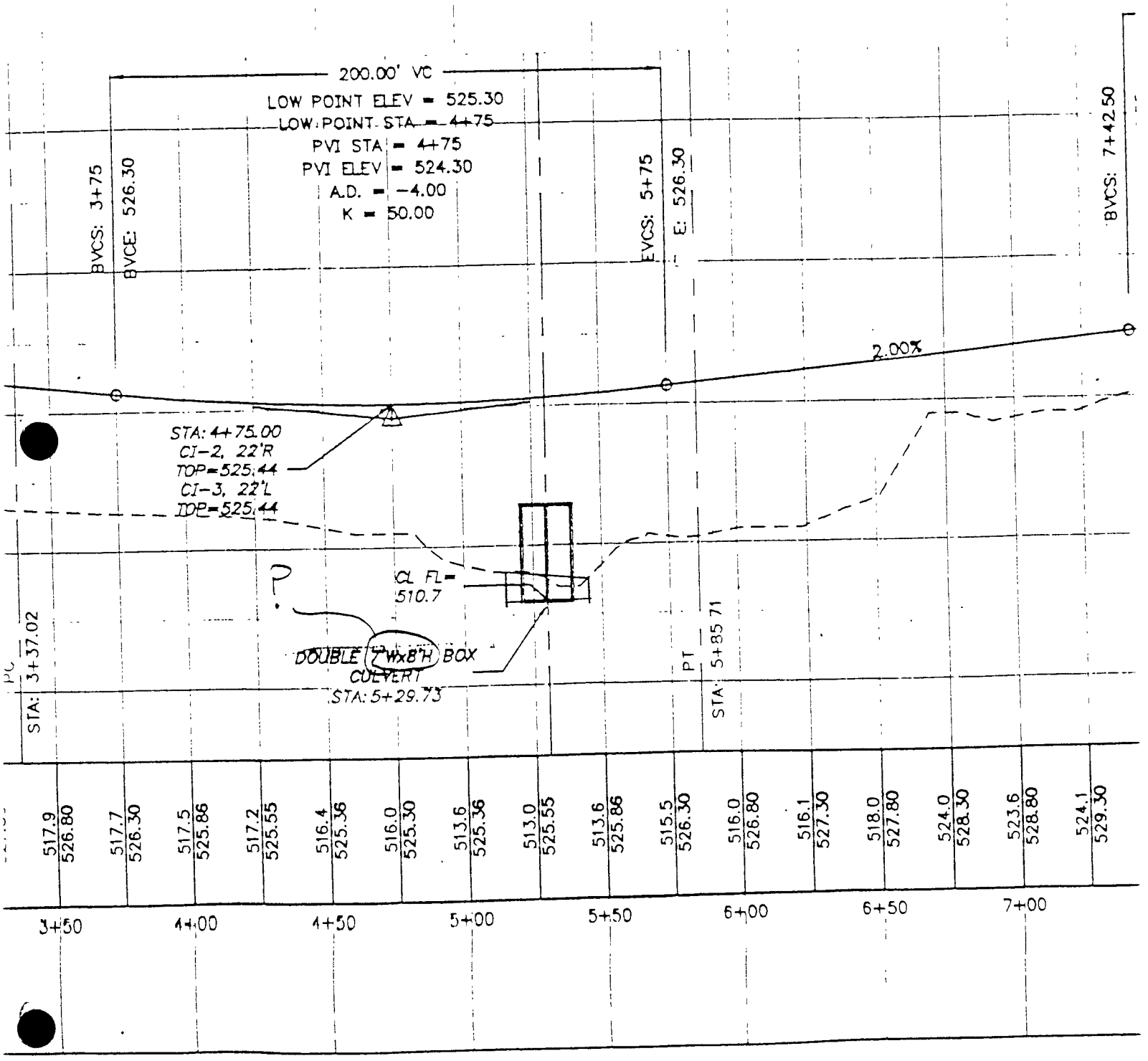
MISSOURI HIG

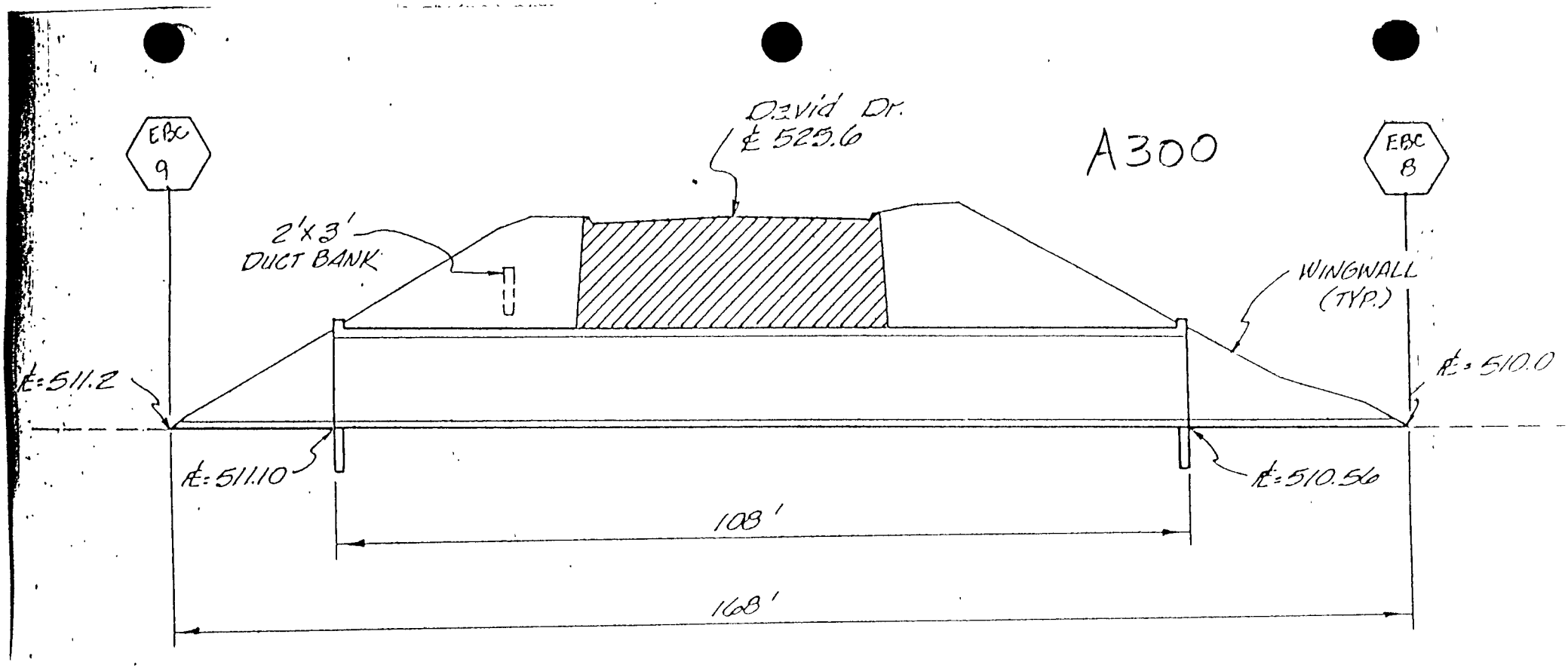
DOUBLE

REVISED AUGU


A300
EBC 9
PROPOSED TREES (TYP)
F.L.=511.10
CI 3
1+14.17
+75.00, 22'L
DAVID D
526.8
527.8
525.9
525.4
GRADING LIMITS
PROPOSED TREES
F.L.=510.56
BEGIN STA 4+00.00
0+70.17
+75.00, 22'R
0+00.00
+24.37, 75.33'R
12'x10' RIP-RAP
EBC 8
CI 2
FE 1
DOUBLE 7' HIGH X 8' WIDE
BOX CULVERT AT
℄ STA 5+29.73
SEE SHEET 19
515.7
515.1

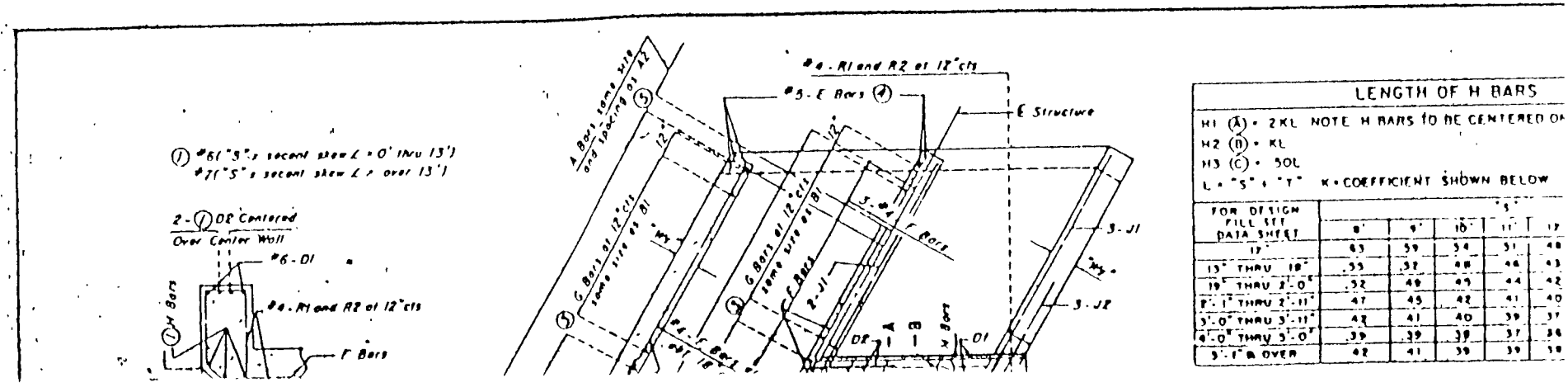
A300


200.00' VC
LOW POINT ELEV = 525.30
LOW POINT STA = 4+75
PVI STA = 4+75
PVI ELEV = 524.30
A.D. = -4.00
K = 50.00
BVCS: 3+75
BVCE: 526.30
EVCS: 5+75
E: 526.30
BVCS: 7+42.50
2.00%
STA: 4+75.00
CI-2, 22'R
TOP=525.44
CI-3, 22'L
TOP=525.44
℄ FL=
510.7
DOUBLE 7'Wx8'H BOX
CULVERT
STA: 5+29.73
PC
STA: 3+37.02
PT
STA: 5+85.71
517.9 526.80
517.7 526.30
517.5 525.86
517.2 525.55
516.4 525.36
516.0 525.30
513.6 525.36
513.0 525.55
513.6 525.86
515.5 526.30
516.0 526.80
516.1 527.30
518.0 527.80
524.0 528.30
523.6 528.80
524.1 529.30
3+50
4+00
4+50
5+00
5+50
6+00
6+50
7+00



DOUBLE 7'H.x 8'W. BOX CULVERT

SCALE: HORIZ. 1"=20'
VERT. 1"=10'



LENGTH OF H BARS					
H1 (A) = 2KL NOTE H BARS TO BE CENTERED ON					
H2 (B) = KL					
H3 (C) = SOL					
L = "S" + "T" K = COEFFICIENT SHOWN BELOW					
FOR DESIGN FILL SEE DATA SHEET	"S"				
	8'	9'	10'	11'	12'
12"	.63	.59	.54	.51	.48
13" THRU 18"	.55	.52	.48	.46	.43
19" THRU 2'-0"	.52	.48	.45	.44	.42
2'-1" THRU 2'-11"	.47	.45	.42	.41	.40
3'-0" THRU 3'-11"	.43	.41	.40	.39	.37
4'-0" THRU 5'-0"	.39	.39	.38	.37	.36
5'-1" & OVER	.42	.41	.39	.39	.38

GEOTECHNICAL REPORT

July 9, 1998

980100

KDG. MH FILE

JUL 17 1998

Mr. David Rogers
Fred Weber, Inc.
% Mr. Ronald C. Pagan, P.E.
Kuhlmann Design Group, Inc.
66 Progress Parkway
Maryland Heights, MO 63043-3706

RE: Addendum Nº 1
Winghaven Box Culverts
O'Fallon, Missouri
SCI Nº 980495.11

Dear Mr. Pagan:

This letter provides the additional geotechnical information for the Winghaven Box Culverts you requested to supplement our letter to you dated June 29,1998. Three specific items presented herein pertain to the following:

1) Rock mats for structural slab base footings.

2) Anticipated settlements.

3) Backfill and fluid pressures for below-grade walls.

We understand that the bearing capacity required for the box culverts in the lowland areas will be 1,500 pounds per square foot (psf) and we provided an allowable bearing capacity of 1,200 psf for one box culvert that will pass under Charlie Drive near station 62+50. We recommend that 2 feet of soil be removed below the footing subgrade elevation and replaced with compacted granular material for this culvert. The replacement material should consist of a 3-inch minus gradation crushed stone. This rock mat will help to bridge the soft and wet foundation soils. A similar procedure of varying depths may be utilized for the other culverts in the lowland areas since we anticipate construction difficulties due to the high groundwater elevations.

The box culverts in the highland areas (culverts A and B) will likely be constructed on excavated rock. We anticipate negligible settlements of the foundation rock due to the weight of the structures and fills. In the lowland areas, however, we anticipate total settlement of the foundation soils due to the weight of the structure and fill to be placed to be about 3 to 6 inches. Some of this settlement will likely occur during construction. If construction of the culverts in the lowland areas is not delayed until after the settlement due to the fill has occurred, the structure will likely settle. However, we anticipate this settlement will likely be relatively uniform across the footprint due to the rigidity of the reinforced concrete base mat and structure. A differential settlement of less than 1½ inches can be anticipated across the whole footprint for these structures.

Our letter dated June 29, 1998 states that to use the "granular" values of equivalent fluid unit weight for earth pressures that the granular backfill material should extend horizontally from the

wall at least half of the wall height. This distance is not required to provide positive foundation drainage to prevent buildup of hydrostatic pressures. A minimum horizontal distance of about 18 inches with a perforated drain pipe should be sufficient to provide this drainage. Therefore, an equivalent fluid unit weight of 60 pounds per cubic foot may be used to design the below-grade walls assuming the hydrostatic pressures are relieved through proper drainage.

We appreciate the opportunity to be of service to you on this project. If you have any questions or comments, please call.

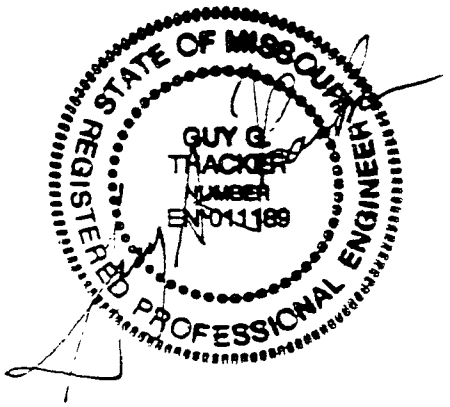
Respectfully,

SCI

Fred H. Held III
Project Engineer

Jerry Thacker, P.E.
Manager

FHH/GGT/tal



c: Mr. Dave Rogers, Fred Weber, Inc. (1)

980100

June 29, 1998

Mr. David Rogers
Fred Weber, Inc.
℅ Mr. Ronald C. Pagan, P.E.
Kuhlmann Design Group, Inc.
66 Progress Parkway
Maryland Heights, MO 63043-3706

RE: Winghaven Box Culverts
O'Fallon, Missouri
SCI Nº 980495.11

Dear Mr. Pagan:

At the request of Mr. David Rogers with Fred Weber, Inc., this letter provides geotechnical design recommendations for five box culverts planned for the Winghaven development roadways. Plan and Profile sheets prepared by Picket, Ray & Silver, Inc. (PRS), revised March 25 or 27, 1998, depict the locations and elevations of the culverts. Three of the culverts will cross under Winghaven Drive near stations 17+00, 30+50, 59+00. One culvert will pass under David Drive near station 5+50, and one culvert will pass under Charlie Drive near station 62+50. In this letter the box culverts will be named A, B, C, D and E, respectively. Culverts A and B will be tunnels for golf carts to underpass Winghaven Drive in the uplands part of the Winghaven development. The remaining will be multiple cell box culverts for existing creeks in lowland areas to pass under planned roadways. We understand that these culverts will be cast-in-place, reinforced concrete structures that will have light to moderate loads.

We previously explored parts of the Winghaven development in our report, "Preliminary Exploration of Subsurface Conditions and Foundation Recommendations - WINGHAVEN PROJECT SITE COMMERCIAL, RESIDENTIAL, AND GOLF COURSE COMMUNITY - O'FALLON, MISSOURI," dated July 1997 (Revised January 1998). In that exploration we drilled B2 and B3 in the uplands near the golf cart underpasses, B21 in the lowland area near culvert C, and B14 in the bottoms land near culvert E. The four boring logs are included in the Appendix of this letter. These borings indicate that excavations for culverts A and B will encounter rock in the form of weathered siltstone or shale for the full depths of the structures. Also, B2 encountered auger refusal near El. 576.5 and the planned bottom of culvert A is near El. 574. Some or all of this rock may be removed in open-cut excavations with bull dozers equipped with rippers. However, intact ledges of hard rock, boulders, or sound bedrock may be encountered that could require blasting.

SCI explored the subsurface conditions near culverts C, D and E on June 25, 1998 using hand auger methods. The hand auger borings, TH1, TH2, and TH3, were located near culverts C, D and E, respectively, by measuring from existing site features and improvements shown of the plans prepared by PRS. The hand augers were advanced to termination depths of 5, 6, and 7½ feet in TH1, TH2, and TH3, respectively. The soils generally encountered were soft to medium stiff, low plastic silty clays and clayey silts. TH1 terminated in a mixture of silty clay, gravel and sand at a depth of 5 feet, which is about 3 feet above the anticipated bearing elevation of culvert C. TH2 and TH3 terminated at depths of 6 and 7½ feet, respectively, due to caving conditions in the holes. We estimate the termination elevations were near the bearing

elevations of culverts D and E. Groundwater was encountered in the hand auger borings at depths of 4 or 5 feet. The nature and thickness of the soils encountered and the results of the field sampling and testing are shown on the Borings Logs, Figures 1-1 through 1-3.

The varied conditions at the culvert locations require different allowable bearing capacities for the locations. An allowable bearing capacity of 10,000 pounds per square foot (psf) may be used to design the structural base slab for culverts A and B if they bear on the weathered siltstone or shale as indicated by B2 and B3 or if they encounter bedrock. An allowable bearing capacity of 3,000 psf may be used to design culvert C if it bears on the anticipated mixture of gravel and sand with some or no clay. An allowable bearing capacity of 1,500 psf may be used to design culvert D if it bears on the silty clay encountered in TH2. An allowable bearing capacity of 1,200 psf may be used to design culvert E.

We understand that higher bearing capacities will be required for culverts D and E. The soft soils below the base of the culverts may be removed and replaced with compacted, crushed rock, such as MODOT Type I Aggregate. The area of removal should extend down and outside the base footprint at an angle of 45 degrees to form a larger area to bear on the soft soils. The depth of removal will vary depending on the allowable bearing capacity required. We anticipate about 5 feet of soft soil will need to be removed and replaced with crushed rock to increase the allowable bearing capacity of the culverts to 2,000 or 3,000 psf.

In the lowland areas, placing fill to raise the roadway above existing grade will result in settlement as consolidation of the soft, underlying soils occurs. A delay in construction is anticipated to allow some or most of that settlement to occur prior to construction. We anticipate this delay to be about 30 to 120 days. This delay will likely not apply to culvert C since we anticipate it will bear on sand and gravel near bedrock elevations. Culverts D and E should not be constructed until most of the settlement due to the weight of the fills has occurred. Surcharging can be used as a means to accelerate consolidation due to the weight of fill. Deep fill in the lowland areas should be monitored with settlement plates to assess when most of the settlement has occurred and construction can continue.

The below-grade walls of the box culverts will be required to resist earth pressures. These include the outside walls of the culverts and the wing-walls that may extend from the culverts designed to accommodate surface grade changes.

The equivalent fluid unit weights tabulated below provide recommended lateral earth pressures for design of these walls. Values for granular material should only be used if the granular backfill extends from the wall a lateral distance of at least one-half the wall height. This table assumes that positive foundation drainage is provided to prevent buildup of hydrostatic pressure. The below-grade walls should be designed to resist an additional uniform lateral load of one-half of the surface loads.

Backfill Type	Fixed-Headed Walls (pcf)	Free-Headed Walls (pcf)
Cohesive Soil	60	50
Granular Material	45	40

A fixed-headed wall is a wall which is not permitted to deflect at the top after backfilling. A free-headed wall is designed to deflect at the top and remain fixed at the base, such as a retaining wall. A wing-wall attached to a fixed-headed wall should be considered fixed-headed unless the structural design permits independent rotation.

The maximum toe pressures for wing-walls should not exceed the bearing capacities recommended in this letter. Walls bearing in soil can be designed with a coefficient of friction between the base of a concrete footing and the subgrade soil of 0.3. A passive soil resistance equal to a uniform pressure of 300 psf may be used for natural soil against the face of the exterior base or a key below the base of a retaining wall. Soil backfilled against the exterior face of a retaining wall should not be assumed to provide any lateral resistance.

We recommend that all below-grade walls and retaining walls be provided with a foundation drainage system. A typical below-grade wall drain detail is shown in Figure 2. It should consist of a perforated pipe to transport the fluids collected from the granular backfill to daylight. Granular drainage material around the pipe should consist of 1-inch clean, "GP" classified crushed rock. A synthetic filter fabric indicated on Figure 2 should be Mirafi 140N or equivalent. A minimum 4-inch diameter perforated drain pipe should be used.

We appreciate the opportunity to be of service to you on this project. If you have any questions or comments, please call.

Respectfully,

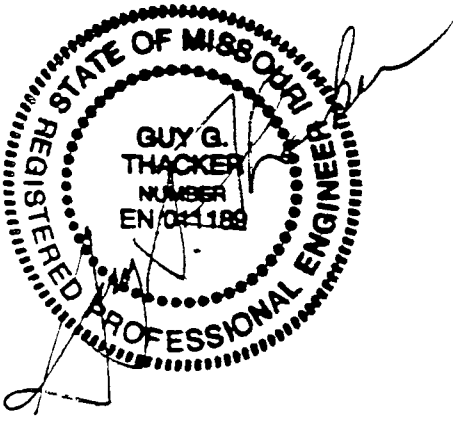
SCI

Fred H. Held III
Project Engineer

Jerry Thacker, P.E.
Manager

FHH/GGT/tal

c: Mr. Dave Rogers, Fred Weber, Inc. (1)



BORING LOG

LEGEND AND NOMENCLATURE

Items shown in Boring Logs refer to the following:
(Where shown in parenthesis, sampling and testing were performed in general accordance with applicable ASTM standard methods or practices)

1 **Depth** - Depth below ground surface (feet).

2. **Sample** - Types designated by letters.

SS - Split-spoon sample, disturbed, obtained by driving 2-inch O.D. split-spoon sampler (ASTM D 1586).

NX - Diamond core bit sample, nominal 2-inch diameter rock sample (ASTM D 2113).

ST - Thin-walled tube sample, undisturbed, obtained by penetration of a 3-inch diameter tube (ASTM D 1587).

CS - Continuous sample tube system, undisturbed, obtained by split barrel sampler in conjunction with auger advancement.

SV - Shear vane, field test to determine strength of cohesive soil by pushing or driving a 2-inch diameter vane then shearing by torquing soil in existing and remolded states (ASTM D 2573).

AS - Disturbed samples obtained from auger cuttings.

Recovery - Recovery is expressed as a ratio of the length recovered to the total length pushed, driven, or cored (inches), e.g. - 9/12.

Blows - Numbers indicate blows per six inches of sampler penetration when driven by a 140-pound hammer falling freely 30 inches (ASTM D 1586). When number of blows reaches 50 without six inches of sampler penetration, the result is shown as a ratio of 50 to the actual penetration, e.g. - 50/2 inches.

Vane Shear Strength - Shear strength of soil expressed as the peak strength (existing state)/residual strength (remolded state).

3 **Description** - Description according to the Unified Soil Classification: Description indicates soil constituents and other classification characteristics (ASTM D 2488). A solid line indicates approximate location of stratigraphic change between soil types and the transition may be gradual.

4. **Laboratory Test Results**

- Natural moisture content in percent (ASTM D 2216).
- Dry density of sample tested in pounds per cubic foot (pcf).
- Unconfined compressive strength (ASTM D 2166) in kips per square foot (ksf).
- Liquid limit (ASTM D 4318) in percent.
- Plastic limit (ASTM D 4318) in percent.

5. **Remarks/Other Data** - See notation at bottom of log for description of data entries.

RQD Rock Quality Designation; the ratio between the total length of core segments greater than 4 inches in length and the total length of core drilled (expressed as percentage).

TEST PIT LOG

PROJECT WINGHAVEN BOX CULVERTS — TEST PIT NO. TH-1

LOCATION O'Fallon, Missouri — SHEET 1 OF 1

EXCAVATOR SCI — PROJECT NO. 980495.11

SURFACE ELEVATION 524+/- — EQUIPMENT Hand auger — DATE EXCAVATED 6-25-98

DEPTH (FT.)	FIELD SAMPLE / TEST: NUMBER	FIELD SAMPLE / TEST: SAMPLE TYPE	FIELD SAMPLE / TEST: FIELD TEST TYPE	FIELD SAMPLE / TEST: SHEAR STRENGTH (KSF)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	LABORATORY TEST RESULTS: DRY DENSITY (PCF)	LABORATORY TEST RESULTS: UNCONFINED COMPRESSIVE STRENGTH (KSF)	LABORATORY TEST RESULTS: LIQUID LIMIT	LABORATORY TEST RESULTS: PLASTIC LIMIT	DEPTH (FT.)
0					Grayish brown, low plastic SILTY CLAY with trace of fine roots	CL							0
	1	BS						29					
2.5					Brown, low plastic SILTY CLAY with trace of fine gravel	CL							2.5
	2	BS						19					
	3	BS			Brown, low plastic SILTY CLAY and coarse SAND to fine GRAVEL	CL,GC		19					
5					Hand auger refusal at 5.0 ft.								5
7.5													7.5
10													10
12.5													12.5
15													15
17.5													17.5

WATER LEVEL:

_____ NO GROUNDWATER NOTED AT TIME OF EXCAVATION

5 FT WHILE EXCAVATING

_____ FT ____ HRS AFTER EXCAVATING

REMARKS:

FIGURE 1-1

TEST PIT LOG

PROJECT WINGHAVEN BOX CULVERTS — TEST PIT NO. TH-2
LOCATION O'Fallon, Missouri — SHEET 1 OF 1
EXCAVATOR SCI — PROJECT NO. 980495.11
SURFACE ELEVATION 516+/- — EQUIPMENT Hand auger — DATE EXCAVATED 6-25-98

DEPTH (FT.)	FIELD SAMPLE / TEST: NUMBER	SAMPLE TYPE	FIELD TEST TYPE	SHEAR STRENGTH (KSF)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	LIQUID LIMIT	PLASTIC LIMIT	DEPTH (FT.)
0					4 inches TOPSOIL								0
	1	BS			Brown with gray, low plastic SILTY CLAY with some gray, silt and trace of organics	CL		23					
2.5	2	BS	SV	2.8/	Brown and gray, low plastic CLAYEY SILT with trace of fine sand and organics	ML		25					2.5
	3	BS		1.4				21					
	4	BS			Gray with brown, low plastic SILTY CLAY with trace of fine gravel	CL		24					
5													5
					Hand auger terminated at 6.0 ft.								
7.5													7.5
10													10
12.5													12.5
15													15
17.5													17.5

WATER LEVEL:

_____ NO GROUNDWATER NOTED AT TIME OF EXCAVATION
4 FT WHILE EXCAVATING
_____ FT ____ HRS AFTER EXCAVATING

REMARKS:

FIGURE 1-2

SCI

TEST PIT LOG

PROJECT WINGHAVEN BOX CULVERTS — TEST PIT NO. TH-3

LOCATION O'Fallon, Missouri — SHEET 1 OF 1

EXCAVATOR SCI — PROJECT NO. 980495.11

SURFACE ELEVATION 494 +/- — EQUIPMENT Hand auger — DATE EXCAVATED 6-25-98

DEPTH (FT.)	FIELD SAMPLE / TEST: NUMBER	FIELD SAMPLE / TEST: SAMPLE TYPE	FIELD SAMPLE / TEST: FIELD TEST TYPE	FIELD SAMPLE / TEST: SHEAR STRENGTH (KSF)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	LABORATORY TEST RESULTS: DRY DENSITY (PCF)	LABORATORY TEST RESULTS: UNCONFINED COMPRESSIVE STRENGTH (KSF)	LABORATORY TEST RESULTS: LIQUID LIMIT	LABORATORY TEST RESULTS: PLASTIC LIMIT	DEPTH (FT.)
0					Brown, low plastic SILTY CLAY	CL							0
	1	BS			Grayish brown, fine SANDY SILTY CLAY with some fine gravel	SC		21					
2.5	2	BS			Grayish brown, low plastic CLAYEY SILT with fine sand	ML		19					2.5
5	3	BS			Brown and gray, low plastic CLAYEY SILT with some fine sand to fine gravel	ML		35					5
7.5	4	BS			Gray, low plastic CLAYEY SILT with trace of fine gravel	ML		29					7.5
					Hand auger terminated at 7.5 ft.								
10													10
12.5													12.5
15													15
17.5													17.5

WATER LEVEL:

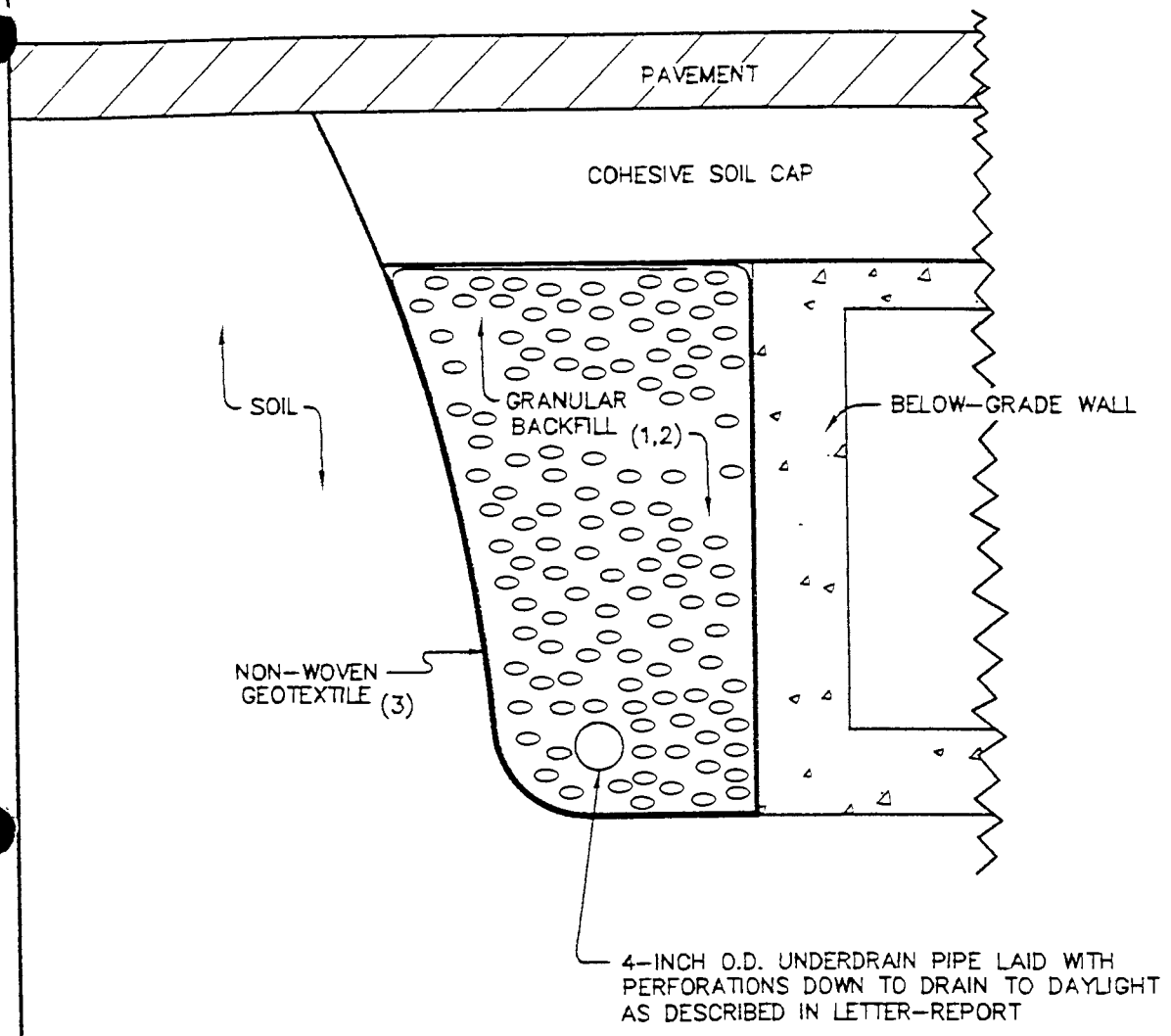
_____ NO GROUNDWATER NOTED AT TIME OF EXCAVATION

4 FT WHILE EXCAVATING

_____ FT _____ HRS AFTER EXCAVATING

REMARKS:

FIGURE 1-3



NOTES:

1. MINIMUM 6" FILTER MATERIAL AROUND PIPE.
2. 1" CLEAN CRUSHED LIMESTONE.
3. TYPICALLY FOUR-OUNCE PER SQUARE YARD

SCI

333 MID RIVERS MALL DRIVE
ST. PETERS, MISSOURI 63376

WINGHAVEN BOX CULVERT
O'FALLON, MISSOURI

BELOW-GRADE WALL DRAIN DETAIL

JUNE 1998 SCI NO. 980495.11

FIGURE 2

APPENDIX

BORING LOG

PROJECT WINGHAVEN PROJECT SITE
LOCATION O'Fallon, Missouri
DRILLER Midwest Drilling, Inc.
SURFACE ELEVATION 595+/- DRILLING METHOD 4" CFA

BORING NO. B-2
SHEET 1 OF 1
PROJECT NO. 97-384-411
DATE DRILLED 6-11-97

DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY (IN/IN)	BLOWS (PER 6 IN.)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	LIQUID LIMIT	PLASTIC LIMIT	DEPTH (FT.)
0					6 inches TOPSOIL								0
					Brown and gray, medium plastic SILTY CLAY	CL/CH							
2	1	SS		2 3 3				26					2
					Brown with some gray, low plastic SILTY CLAY	CL							
4	2	SS		2 2 3				28					4
6	3	SS		2 2 3	Brown with some gray, medium plastic SILTY CLAY	CL/CH		25					6
8	4	SS		3 5 7	Brown with some gray, high plastic CLAY	CH		29					8
10													10
12					Tan, WEATHERED SILTSTONE								12
14	5	SS		50/3				10					14
16	6	AS			Gray with some brown, SILTSTONE								16
18					Auger refusal at 17.5 ft.								18
20													20

WATER LEVEL:

X NO GROUND WATER NOTED AT TIME OF DRILLING
____ FT WHILE DRILLING
____ FT ____ HRS AFTER DRILLING
____ FT ____ HRS AFTER DRILLING

REMARKS:

FIGURE 2-2

BORING LOG

PROJECT WINGHAVEN PROJECT SITE
LOCATION O'Fallon, Missouri
DRILLER Midwest Drilling, Inc.
SURFACE ELEVATION 602+/- DRILLING METHOD 4" CFA

BORING NO. B-3
SHEET 1 OF 2
PROJECT NO. 97-384-411
DATE DRILLED 6-11-97

DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (IN/IN)	SAMPLE BLOWS (PER 6 IN.)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	LIQUID LIMIT	PLASTIC LIMIT	DEPTH (FT)
0					1 inch TOPSOIL		1						0
					Brown with some gray, medium plastic SILTY CLAY	CL/CH							
2	1	SS		3 3 4				26					2
					Brown with some gray, low plastic SILTY CLAY	CL							
4	2	SS		2 3 3				25					4
6	3	SS		2 3 4				22					6
8					Brown with some gray, high plastic CLAY	CH							8
	4	SS		3 3 5				33					
10													10
12													12
					Tan, high plastic SHALEY CLAY	CH							
14	5	SS		3 6 15				30					14
					Brown, WEATHERED SHALE								
16													16
18													18
	6	SS		27 50/3				10					
20													20

Continued on sheet 2 of 2

WATER LEVEL:
- X NO GROUND WATER NOTED AT TIME OF DRILLING
- _____ FT WHILE DRILLING
- _____ FT ____ HRS AFTER DRILLING
- _____ FT ____ HRS AFTER DRILLING

REMARKS:
1) Driller's observation

FIGURE 2-3a

BORING LOG

PROJECT WINGHAVEN PROJECT SITE
LOCATION O'Fallon, Missouri
DRILLER Midwest Drilling, Inc.
SURFACE ELEVATION 595+/- DRILLING METHOD 4" CFA

BORING NO. B-2
SHEET 1 OF 1
PROJECT NO. 97-384-411
DATE DRILLED 6-11-97

DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (IN/IN)	SAMPLE BLOWS (PER 6 IN.)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	LABORATORY TEST RESULTS: DRY DENSITY (PCF)	LABORATORY TEST RESULTS: UNCONFINED COMPRESSIVE STRENGTH (KSF)	LABORATORY TEST RESULTS: LIQUID LIMIT	LABORATORY TEST RESULTS: PLASTIC LIMIT	DEPTH (FT.)
0					6 inches TOPSOIL								0
					Brown and gray, medium plastic SILTY CLAY	CL/CH							
2	1	SS		2 3 3				26					2
					Brown with some gray, low plastic SILTY CLAY	CL							
4	2	SS		2 2 3				28					4
6	3	SS		2 2 3	Brown with some gray, medium plastic SILTY CLAY	CL/CH		25					6
8					Brown with some gray, high plastic CLAY	CH							8
	4	SS		3 5 7				29					
10													10
12					Tan, WEATHERED SILTSTONE								12
14	5	SS		50/3				10					14
16	6	AS			Gray with some brown, SILTSTONE								16
18					Auger refusal at 17.5 ft.								18
20													20

WATER LEVEL:

X NO GROUND WATER NOTED AT TIME OF DRILLING
____ FT WHILE DRILLING
____ FT ____ HRS AFTER DRILLING
____ FT ____ HRS AFTER DRILLING

REMARKS:

FIGURE 2-2

BORING LOG

PROJECT WINGHAVEN PROJECT SITE
LOCATION O'Fallon, Missouri
DRILLER Midwest Drilling, Inc.
SURFACE ELEVATION 602+/- DRILLING METHOD 4" CFA

BORING NO. B-3
SHEET 1 OF 2
PROJECT NO. 97-384-411
DATE DRILLED 6-11-97

DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (IN/IN)	SAMPLE BLOWS (PER 6 IN.)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	LABORATORY TEST RESULTS: DRY DENSITY (PCF)	LABORATORY TEST RESULTS: UNCONFINED COMPRESSIVE STRENGTH (KSF)	LABORATORY TEST RESULTS: LIQUID LIMIT	LABORATORY TEST RESULTS: PLASTIC LIMIT	DEPTH (FT.)
0					1 inch TOPSOIL		1						0
					Brown with some gray, medium plastic SILTY CLAY	CL/CH							
2	1	SS		3 3 4				26					2
					Brown with some gray, low plastic SILTY CLAY	CL							
4	2	SS		2 3 3				25					4
6	3	SS		2 3 4				22					6
8					Brown with some gray, high plastic CLAY	CH							8
	4	SS		3 3 5				33					
10													10
12													12
					Tan, high plastic SHALEY CLAY	CH							
14	5	SS		3 6 15				30					14
					Brown, WEATHERED SHALE								
16													16
18													18
	6	SS		27 50/3				10					
20													20

Continued on sheet 2 of 2

WATER LEVEL:
- X NO GROUND WATER NOTED AT TIME OF DRILLING
- _____ FT WHILE DRILLING
- _____ FT ____ HRS AFTER DRILLING
- _____ FT ____ HRS AFTER DRILLING

REMARKS:
1) Driller's observation

FIGURE 2-3a

BORING LOG

PROJECT WINGHAVEN PROJECT SITE
LOCATION O'Fallon, Missouri
DRILLER Midwest Drilling, Inc.
SURFACE ELEVATION 602+/- DRILLING METHOD 4" CFA

BORING NO. B-3
SHEET 2 OF 2
PROJECT NO. 97-384-411
DATE DRILLED 6-11-97

DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (IN/IN)	SAMPLE BLOWS (PER 6 IN.)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	LIQUID LIMIT	PLASTIC LIMIT	DEPTH (FT.)
22					Brown, WEATHERED SHALE								22
24	7	SS		50/3				12					24
					Drilling terminated at 25.0 ft.								
26													26
28													28
30													30
32													32
34													34
36													36
38													38
40													40
42													42

WATER LEVEL:

X NO GROUND WATER NOTED AT TIME OF DRILLING
_____ FT WHILE DRILLING
_____ FT ____ HRS AFTER DRILLING
_____ FT ____ HRS AFTER DRILLING

REMARKS:

FIGURE 2-3b

SCI

BORING LOG

PROJECT WINGHAVEN PROJECT SITE
LOCATION O'Fallon, Missouri
DRILLER Midwest Drilling, Inc.
SURFACE ELEVATION 494+/- DRILLING METHOD 4" CFA

BORING NO. B-14
SHEET 1 OF 1
PROJECT NO. 97-384-411
DATE DRILLED 6-9-97

DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (IN/IN)	SAMPLE BLOWS (PER 6 IN.)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	LIQUID LIMIT	PLASTIC LIMIT	DEPTH (FT.)
0					5 inches TOPSOIL	CL	1						0
					Gray and brown, low plastic SILTY CLAY								
2	1	SS		3 2 2				23					2
4	2	SS		2 2 4				22					4
6	3	SS		0 1 2				28					6
8	4	SS		0 1 1				31					8
10					Drilling terminated at 10.0 ft.								10
12													12
14													14
16													16
18													18
20													20

WATER LEVEL:
_____ NO GROUND WATER NOTED AT TIME OF DRILLING
5.5 FT WHILE DRILLING
_____ FT ____ HRS AFTER DRILLING
_____ FT ____ HRS AFTER DRILLING

REMARKS:
1) Driller's observation

FIGURE 2-14

BORING LOG

PROJECT WINGHAVEN PROJECT SITE
LOCATION O'Fallon, Missouri
DRILLER Midwest Drilling, Inc.
SURFACE ELEVATION 524+/- DRILLING METHOD 4" CFA

BORING NO. B-21
SHEET 1 OF 1
PROJECT NO. 97-384-411
DATE DRILLED 6-10-97

DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE RECOVERY (IN/IN)	SAMPLE BLOWS (PER 6 IN.)	DESCRIPTION	UNIFIED SOIL CLASSIFICATION	SEE REMARK NO.	LABORATORY TEST RESULTS: MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)	LIQUID LIMIT	PLASTIC LIMIT	DEPTH (FT.)
0					3 inches TOPSOIL		1						0
	1	SS		3 2 1	Brown and gray, low plastic CLAYEY SILT to SILTY CLAY	ML/CL		25					
2													2
	2	SS		3 2 5				22					
4					Brown and gray, low plastic SILTY CLAY with some rock fragments	CL							4
	3	SS		15 18 8	ROCK FRAGMENTS with some brown and gray, low plastic silty clay	GC		21					
6													6
8	4	SS		50/1	ROCK and ROCK FRAGMENTS		2						8
10					Drilling terminated at 10.0 ft.								10
12													12
14													14
16													16
18													18
20													20

WATER LEVEL:
_____ NO GROUND WATER NOTED AT TIME OF DRILLING
6 FT WHILE DRILLING
_____ FT ____ HRS AFTER DRILLING
_____ FT ____ HRS AFTER DRILLING

REMARKS:
1) Driller's observation
2) Driller's observation

FIGURE 2-21

July 23, 1997

Mr. Lloyd Schneider
c/o Mr. Paul McKee
Planc Corporation
685 Craig Road
St. Louis, Missouri 63141-7124

RE Preliminary Report of Subsurface Exploration
Winghaven Project Site
Commercial, Residential, and Golf Course Community
O'Fallon, Missouri
SCI No. 97-384-411 & 97-385-111

Dear Mr. Schneider,

Enclosed is our report "Preliminary Exploration of Subsurface Conditions and Foundation Recommendations - WINGHAVEN PROJECT SITE - COMMERCIAL, RESIDENTIAL, AND GOLF COURSE COMMUNITY - O'FALLON, MISSOURI" dated July 1997.

We appreciate the opportunity to be of service to you on this project. If you have any questions or comments, please call

Very truly yours,

SCI

Fred H. Hild III
Project Engineer

Carl L. Jacobi, P.E.
Director of Geotechnical Services

FHH/CLJ/al, jlf
Enclosures
Three copies submitted
c Mr. Lloyd Schneider; Novus Corporation (1)
Mr. Joe McKee; McEagle Corporation (1)
Mr. Jack Wolfner; c/o Mr. Tom Glosier; Stonewolf II (1)
Mr. Ken Ingram; Kuhlmann Design Group, Inc. (1)
Mr. Jerry Loomis; Loomis Boulton Pickett (1)
Mr. Hal Bartch; Pickett, Ray & Silver, Inc. (1)
Mr. Mike Harmon; Fred Weber, Inc. (1)

Preliminary Exploration of Subsurface Conditions
and
Foundation Recommendations

WINGHAVEN PROJECT SITE
COMMERCIAL, RESIDENTIAL, AND GOLF COURSE COMMUNITY
O'FALLON, MISSOURI

INTRODUCTION

At the request of Mr. Paul McKee with McEagle Corporation, on behalf of Mr Lloyd Schneider with Novus Corporation, we conducted a preliminary subsurface exploration for a future commercial residential and golf course development. The purpose of our exploration was to generally characterize and evaluate the subsurface conditions to provide general recommendations for foundations and to address other geotechnical aspects of the proposed project Our services were provided in general accordance with our proposal dated May 20, 1997

PROJECT AND SITE CHARACTERISTICS

The Winghaven project site is about 1100 acres and is the combination of several large properties in O'Fallon, Missouri The site extends from Highway N on the north to Dardenne Creek on the south, and lays north and east of U.S. Highway 40/61. The eastern boundary is comprised partly by Bates Road and partly by the boundary line between the City's of O'Fallon and Dardenne Prairie The property has frontage on Post Road near the northwestern corner and has extensive frontage along Highway 40/61, Highway N, and Bates Road. The property and surrounding road pattern is shown on the Vicinity Map, Figure 1.

In general the property slopes from north to south with drainage being tributary to Dardenne Creek, along the southernmost boundary line. A deep, wide draw drains southeastward through the south central part of the site. Numerous smaller draws drain into the major draw or directly into the floodplain. Approximately 120 acres of the property lies in the floodplain of Dardenne Creek. Total elevation difference across the project site is approximately 140 feet with the high at El 620 and the low at El. 480

Much of the property site has remained undeveloped and appears to have been used mostly for agricultural purposes. However, the Monsanto Company owned a majority of the property and constructed an animal research facility near the center of the tract. A laboratory building and numerous buildings housing poultry and livestock were constructed for this facility. Roadways and parking areas were constructed to serve the Monsanto facilities. In the southern portion of the property along Dardenne Creek, a wildlife theme park was once proposed and some preliminary grading and development was undertaken to create the park. This involved a manmade lake near the southeast corner of the property, and some grading was performed in that general area.

A concept plan which you provided indicates the tract will be developed for both residential and business usage in the higher portions of the property. This will entail single-family and multi-family residential areas and several business park areas, offering a wide variety of lot size for industrial and commercial development. A golf course is proposed in the floodplain area near the south property line and in the major draw. Much of the residential development will surround the golf course to the north. Most of the commercial development will be near Highway 40/61. A major roadway is planned through the central and northern portions of the property which will connect Highway 40/61 with Highway N and will eventually extend northward to connect with the Page Avenue extension (Highway D). This development scheme is a concept plan at this time, and numerous changes will likely be made in further planning for the phased development of both the residential and business portions of the property.

We understand the property has been used for agricultural purposes and that your intention is to continue farming the property as the development is phased over several years.

FIELD EXPLORATION

The field exploration for the residential and commercial developments consisted of drilling forty-seven borings at the approximate locations shown on the Site Plan. Three proposed borings (B5, B120, and B121) were inaccessible, and therefore, not drilled. B1 through B15 were drilled for proposed commercial roadways. B16 through B29, excluding B25, were drilled in proposed commercial development areas. B101 through B119 were drilled in areas of proposed residential or golf course development.

ations were established in the field by SCI engineer relative to existing roads, ments and topographic features. Approximate boring elevations were determined from phic Maps derived from aerial surveys prepared by Walker and Associates, Inc., dated 1996.

ngs were drilled on June 7 through 14, 1997. Continuous-flight augers powered by a ring were used to advance the borings to predetermined depths of 10 to 30 feet or refusal at depths ranging from 8½ to 44 feet. Standard penetration tests were ed at 2½- and 5-foot intervals throughout the soil overburden. The standard penetration vides a guide to soil strength and a disturbed sample for laboratory testing. The nature ness of the soils encountered and the results of the field sampling and testing are n the Borings Logs, Figures 2-1 through 2-29 (commercial development and roads) and 3-1 through 3-19 (residential and golf course development). Table 1 summarizes some illing information.

ATORY TESTING

obtained were described and classified in our laboratory by a soil technician using visual methods. Moisture contents were determined for each of the samples. The of these laboratory tests are shown on the Boring Logs.

ROFILE

ed herein is the general description of the soils encountered. Detailed information g the soil type and interpretive soil stratigraphy is presented on the Boring Logs. A Log Legend is included as Figure 2 to aid in the interpretation of the Boring Logs.

d three feet of fill was encountered in B8 and B19, respectively. In general, medium-stiff -stiff residual soils and glacial tills were found in the upland parts of the property and soft soils were found in the lowland or floodplain areas. The upland soils were generally with wind blown silt that has weathered to silty clay (modified loess). Topsoil 1 to s thick was usually underlain by a layer of low plastic silty clay that was underlain by astic clay. Some of the borings did not encounter the low plastic silty clay soil layer. The astic clays generally consisted of glacial tills or residual soils with various amounts of and rock fragments that generally increased with depth.

Auger refusal was encountered in 12 of the borings at depths ranging from 8½ to 44 feet. Excluding the high and low of 44 and 8½ feet, the average refusal depth was about 16 feet in the borings that refused. However, very rocky soils were encountered at relatively shallow depths in most of the borings. The materials encountered just before refusal were weathered siltstones, gravelly clays, rock and fragments, or clayey shales. Auger refusal is a designation applied to any material which cannot be further penetrated by the power auger. This material is usually indicative of a very hard or very dense material, such as boulders or the upper surface of bedrock. Rock coring was beyond the scope of this exploration, therefore, the character and continuity of the refusal materials could not be determined.

Groundwater was encountered in five of the borings generally in the lowland areas (B11, B14, B15, B29, and B110) at depths of 11½ to 14 feet, and one upland area (B118) at a depth of 16 feet. The other borings were dry upon completion of drilling. In relatively impervious soils, a suitable estimate of the groundwater level may not be possible, even after several days of observation. The groundwater table will fluctuate throughout the year depending on climate and rainfall conditions. It is not anticipated that groundwater will influence the construction phase of projects in the upland areas. However, excavations in the lowland areas may experience construction problems.

GENERAL DESIGN CONSIDERATIONS AND RECOMMENDATIONS

Heavily loaded commercial buildings may require deep foundations end bearing on rock due to concentrated column loads that make spread footing foundations uneconomical. The upland areas are conducive to the use of drilled piers. Estimating allowable bearing pressures for rock bearing foundations require rock coring which was beyond the scope of this exploration.

Shallow spread foundations will be suitable for support of light to moderately loaded residences and commercial buildings. Allowable bearing pressures for structures in upland areas will likely be 2,000 to 3,000 pounds per square foot (psf). Allowable bearing pressures for structures in lowland areas on soft soils will be about 1,200 to 1,500 psf. Allowable bearing pressures may be increased in the lowland areas if sufficient depths of fill are placed.

Settlements of foundations can be less than 1-inch excluding settlements induced by filling. Fill settlements should be minor in the upland areas and substantially occur in about 30 to

30 days or less

However, soft and compressible soils were encountered in the lowland areas. It is our opinion that excessive total and differential settlements will occur beneath column and wall loads supported on these natural, soft soils, if precautions are not taken to reduce the post-construction settlement. Shallow foundations with low contact pressures, however, should be suitable for support of most of the proposed improvements in the lowland areas with little reworking of the soil. Moderate contact pressures will require a sufficient thickness of compacted structural fill in the building area. The thickness of fill will be determined by the structural loading. Surcharging can also be used to reduce post-construction settlement if the final grades for the proposed improvements must remain at or near existing grades or as a means to accelerate consolidation due to the weight of fill.

In the lowland areas, placing fill to raise the site above existing grade will result in settlement as consolidation of the soft, underlying soils occurs. A delay in construction is anticipated to allow some or most of that settlement to occur prior to construction. The delay recommended will be based on the building location, building loads and the amount of fill placed in this area. We anticipate this delay to be about 30 to 120 days. Deep fill in the lowland areas should be monitored with settlement plates to assess when most of the settlement has occurred and construction can continue.

Mat and deep foundations are also acceptable foundation types for construction in the lowland areas, however, we anticipate these options will not be economical compared to the suggested remediation. A deeper exploration will be required if deep foundations are to be considered.

Although only a small amount of existing fill was encountered in our limited exploration, other existing fill will likely be encountered on the site due to existing development. Further explorations will be required to better identify the extent of existing fill located on the site. In general, existing fill located in areas to be developed should be removed to naturally occurring soils and replaced with properly compacted structural fill.

Seismic Design Considerations. The 1996 BOCA National Building Code requires the structural design of the proposed structures. A site coefficient is required for the calculation of minimum earthquake design forces. The coefficient is a function of the soil type, consistency,

[redacted]depth. The site can be essentially divided into two areas seismically, uplands and
s. Due to the depth to rock and the relatively stiff consistency of the soil in the
s, the soil-profile type is S_1 and the upland site coefficient (S) is 1.0. The lowlands,
re generally in the southern part of the site and in some of the wide draws, do not fit
the BOCA standard soil-profile types. Therefore, as required by the code, the soil-
type is S_4 and the lowland site coefficient (S) is 2.0

lastic Clay Considerations. High plastic clay soils are present at depths which may
construction. High plastic clay soils have the potential for volume change with
tions in soil moisture content. This volume change is normally evidenced by the
g and cracking of concrete floor slabs and, in severe cases, by the movement and
g of footings and foundation walls. Remedial measures, if necessary to avoid such
s may require overexcavation and replacement of these materials with low plastic silty
ils or crushed stone to a minimum depth of 2 or 3 feet below the base of footings and
abs

[redacted]ls with a marginal potential for soil heave can be reduced by not allowing the soils
cate prior to pouring the concrete slab. Maintaining the natural moisture content can
ompl shed by placing a thin polyethylene vapor barrier over these soils immediately after
ation. Other measures that may be utilized to reduce this problem include, but are not
to the addition of extra steel reinforcement in the top and bottom of foundation walls,
ating of floor slabs such that they are not structurally connected to or bonded to
ation walls or interior columns, the placement of foundation drains to reduce the
ility of water reaching the subgrade soils, and the placement of woven wire mesh to
ce the floor slab.

rainage and Grading. Positive site drainage should be provided to reduce infiltration of
e water around the perimeter of the buildings, residences, and beneath the floor slabs
des should be sloped away from the structures, and roof and surface drainage should
ected and discharged such that water is not permitted to infiltrate the backfill of the
ures

[redacted]SITE DEVELOPMENT RECOMMENDATIONS AND CONSIDERATIONS

refusal was encountered at depths of 8½ and 14 feet in B9 and B8, respectively. Rock

excavation will likely be required to achieve the proposed grades in those areas. The central part of the site and several ridge tops around the site will likely require rock excavation for general grading, utility trenches, and/or basement excavations. The rocky clay materials encountered prior to auger refusal can usually be excavated in open cuts, sometimes using large dozers equipped with rippers. However, large rock fragments, intact rock ledges or boulders are sometimes encountered in soils of this type. These materials can also prove very difficult in trench excavations and may require blasting. Further exploration can help to delineate the extent of rock excavation required for specific road and utility alignments, and building sites. A contingency fund should be established for rock excavation.

The surface soils at the site are silty. Such soils may exhibit a significant loss in strength when they become saturated and disturbed, as may occur due to trafficking of construction equipment. This may complicate construction of paved streets, parking areas, and foundations.

Erosion control measures should be taken during the general grading to prevent the transportation of these soils by surface runoff onto adjoining properties. Timely sodding or seeding of the sloped areas will reduce this potential problem.

Site Preparation. All existing vegetation in the cut and fill areas should be removed prior to placing fill. Trees and brush may be burned on site as approved by local ordinances. Burn pits should be located outside of building areas, street areas, or areas designed as slopes steeper than 1 vertical to 5 horizontal. Stumps should be removed from the site or buried in locations approved by the geotechnical engineer.

Soft soils are likely to be encountered in the bottoms of the draws, drainage swales, and in the floodplain or lowland areas. These soils should be removed to firm materials before placement of fill. The existing ponds should be drained, and soft soils removed from the bottom before placement of fill. If removal of soft soils is impractical due to their excessive depth, they should be stabilized or "bridged over" in a manner approved by SCI.

In areas to be developed, the existing buildings and related below-grade components must be properly demolished and the debris removed from the site. Existing foundation walls, cisterns,

septic fields and associated backfill must be removed entirely along with footings and below-grade utilities. Masonry rubble generated by the demolition may be placed in the deeper portions of fill areas as approved by a representative of SCI. Where the removal creates excavations below the final proposed grade, the excavations should be brought to final grade with engineered fill.

Our borings do not indicate any highly organic topsoil of any significant thickness on this site. However, if such organic soils are encountered, they should be stripped from the site and stockpiled for later use in lawn or landscaped areas. After stripping, the subgrade and fill areas should be scarified and proofrolled to a minimum depth of 1-foot and to a minimum dry density of 87 percent of the maximum dry density as determined by the modified Proctor compaction test (ASTM D 1557)

Fill Materials and Compaction. The available low to medium plastic silty clay soils encountered at the site may be used as structural fill. Large rubble pieces due to the demolition of the existing structures, in excess of three inches, should not be used as structural fi

We recommend that all fill placed in building areas near the footing and floor slab elevations have a liquid limit less than 45. Acceptable non-organic fill soils include materials designated CL-ML, CL, ML, SP, SW, GP, and GW soils by ASTM D 2487. Where practical, high plastic soils should be placed in deeper portions of fill areas or in landscaped areas. If high plastic clays are placed or are located within three feet of footing or floor slab elevations, remediation may be recommended. Such measures could range from ensuring that the soils do not dry out during construction to overexcavating below structural members and slabs.

Fill should be placed in horizontal lifts not exceeding 8 inches in loose thickness and compacted with a sheepsfoot or tamping roller to minimum dry density of 90 percent of the maximum dry density as determined by the modified Proctor compaction test (ASTM D 1557). Higher densities may be required for deep fills.

Some of the fill materials at the project site may be rocky clay or shaley materials that are traditionally not tested by conventional nuclear densimeter or drive-tube methods. Rock

fragments that are ripped or blasted would also fall into that category. Such materials are typically compacted by several passes of a heavy vibratory roller. The number of passes and minimum roller weight should be determined in the field. Density tests on the rocky material are generally not performed due to the varying quantities of soil and rock materials at any one location. Poorly compacted areas can generally be detected by observing the fill subgrade during passing of a loaded scraper or compactor over the fill area. Any poorly compacted areas detected should be recompacted with additional passes of the vibratory roller.

Cut and Fill Slopes. We recommend that all cut and fill slopes be no steeper than 1 vertical to 2 horizontal. Properly compacted fill slopes and cut slopes of less than 20 feet in height should be stable at this inclination. SCI should evaluate the stability of slopes higher than 20 feet. Slopes to receive fill which are steeper than 1 vertical to 5 horizontal should be benched prior to placement of fill. Benching will provide level surfaces for compaction and avoid the development of an inclined plane of weakness between the virgin soils and compacted fill. The benches should be spaced such that the maximum height of cut at the up-slope ridge of the bench is 4 feet.

PAVEMENT SUBGRADE CONSIDERATIONS

Pavement design recommendations are beyond the scope of work for this report. However, certain aspects should be considered in the design and construction of the paved areas. We suggest that the soil subgrade be compacted to a dry density of at least 90 percent of the material's modified Proctor maximum dry density (ASTM D 1557). The crushed rock base should be compacted to 92 percent of the same criteria. The asphaltic surface course and Portland Concrete pavements should be checked during placement to verify compliance with the specifications.

The natural soils encountered on the site, to a depth of approximately 3 feet below the present ground surface, are silty and exhibit a significant loss of strength when they become saturated and disturbed. The strength of these compacted, silty soils is dependent on the moisture content. Significant construction problems may be incurred if pavement construction takes place in the wetter portions of the year (November through April). Special measures may be required to facilitate construction during these periods.

The performance of a pavement section is dependent on the design life, traffic loads, subgrade strength, drainage characteristics, and the desired maintenance level. Pavement recommendations and/or materials testing services can be provided on request.

ADDITIONAL EXPLORATION PROGRAM

Many items should be addressed in one or more detailed subsurface explorations for the proposed development. Detailed explorations should be based on proposed grades, the site layout, and specific building clusters, or individual large or heavily loaded buildings. These explorations will include additional and possible deeper borings and more extensive laboratory testing. The detailed explorations should address the following:

- Recommendations for foundation support.
- Seismic coefficients for building design according to the BOCA code
- Estimation of the shrink/swell potential of subgrade soils.
- Site development recommendations.
- Geotechnical construction considerations
- Anticipated settlement based on general soil characteristics or based on laboratory consolidation tests
- Influence of ground water on design and construction
- Locations and descriptions of existing fill materials within the proposed building areas, if encountered.
- Structural fill considerations
- Suitability of on-site soils for use as structural fill
- Engineering criteria for placement of structural fill.
- Pavement subgrade recommendations.
- Lateral earth pressures for the design of below grade and retaining walls.
- Recommendations for design and construction of slopes.
- Provide lake and detention basin and dam design recommendations.
- Recommend a construction monitoring program.

LIMITATIONS

The recommendations provided herein are preliminary and are based on the information obtained at forty-seven specific drilling locations within the project area and regionally accepted practice. These recommendations should be reevaluated after a more detailed exploration is performed

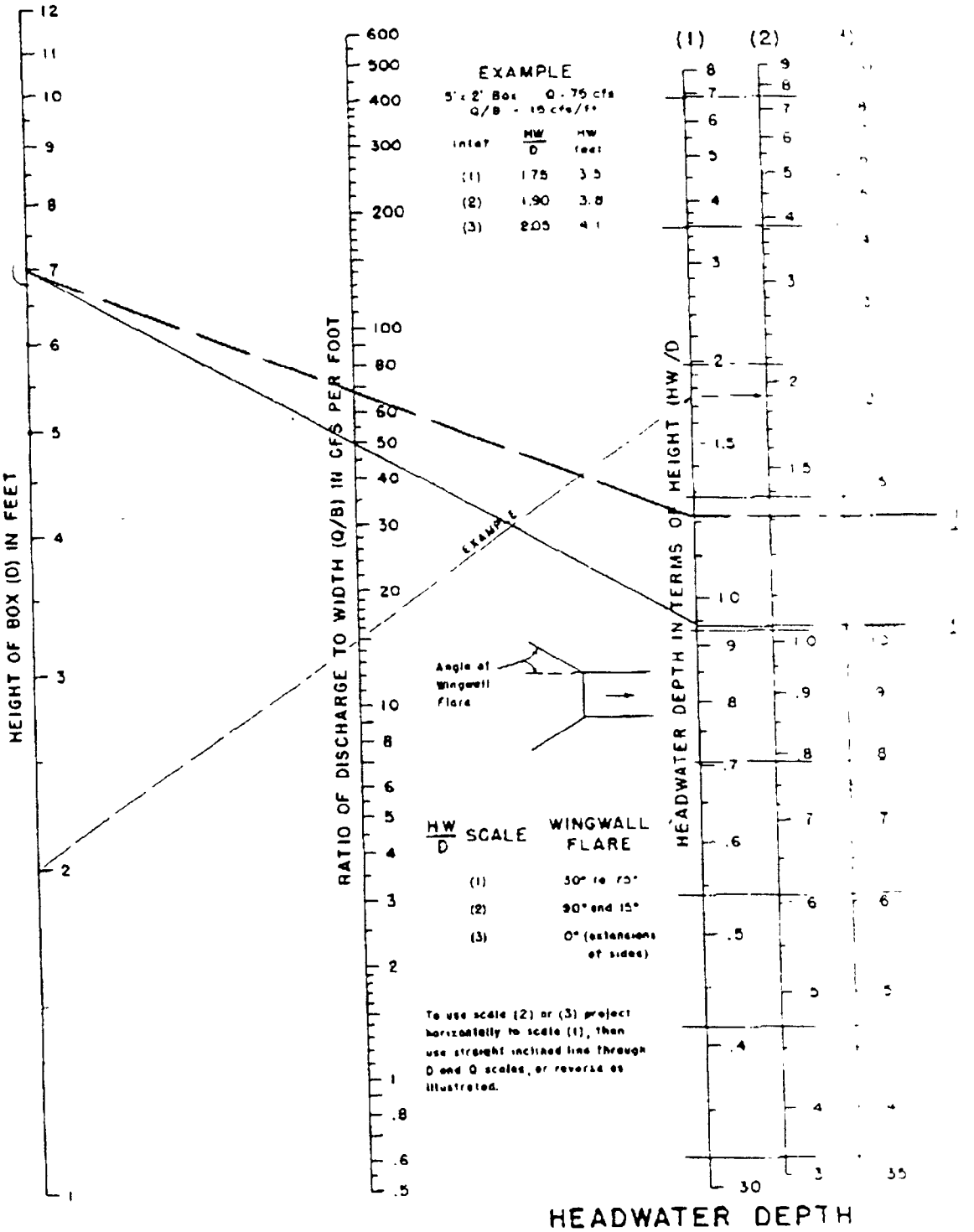
HYDRAULIC ANALYSIS

David Dr · (Wingharen 97034)

780.8 ÷ 2 · 390.4 ÷ 8 · 48 8 (1085 ÷ 2 · 5-[illegible]

?. 7'h x 8'w

CHART 8



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN 1963

PROJECT Winghaven : David Dr

STATION 5+30

SHEET OF

CULVERT DESIGN FORM

DESIGNER / DATE [illegible] / 12/22/97

REVIEWER / DATE /

2600 x C.

17 A: SF G2 W

43 A: MF 53

308.58
471.90
780.78

240

HYDROLOGICAL DATA

SEE ADDL SHTS

☒ DRAINAGE AREA ____ ☐ STREAM SLOPE ____

☐ CHANNEL SHAPE ____

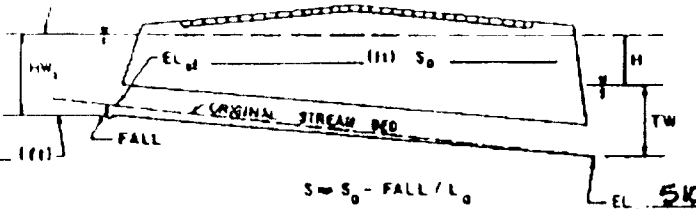
☐ ROUTING ____ ☐ OTHER ____

DESIGN FLOWS/TAILWATER

(2600 Ac)

R I (YEARS)	FLOW (cfs)	TW (ft)
15	7808	
100	1085	

ROADWAY ELEVATION 525.6 (ft)



S = So - FALL / Lo

S =

Lo = 108

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW1/D (2)	HW1	FALL (3)	EL h1 (4)	OUTLET CONTROL TW (5)	dc	dc+D/2	ho (6)	ke	H (7)	EL ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
2- 7'h x 8'w (15yr)	7808	3905	1.2	8.4	-	519.5		4.2	5.6	5.6	.5	1.32	517.44			Inlet control
2- 7x8 (100yr)	1085	542.5	1.36	9.52	-	520.6		5.2	6.1	6.1	.5	2.58	519.24			Inlet control

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_1/D = HW /D OR HW_1/D FROM DESIGN CHARTS

(3) FALL = $HW_1 - (EL_{hd} - EL_{of})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_N = HW_1 + EL_1$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f CULVERT FACE
hd. DESIGN HEADWATER
h1. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i INLET CONTROL SECTION
o. OUTLET
of STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION

CULVERT BARREL SELECTED:

SIZE 7'H x 8'W - 2

SHAPE

MATERIAL: Conc. n.013

ENTRANCE

PICKETT RAY & SILVER

CIVIL ENGINEERS • PLANNERS • LAND SURVEYORS

ENG. MH FILE 98010

JUN 29 1998

FAX

CONFIDENTIALITY NOTE

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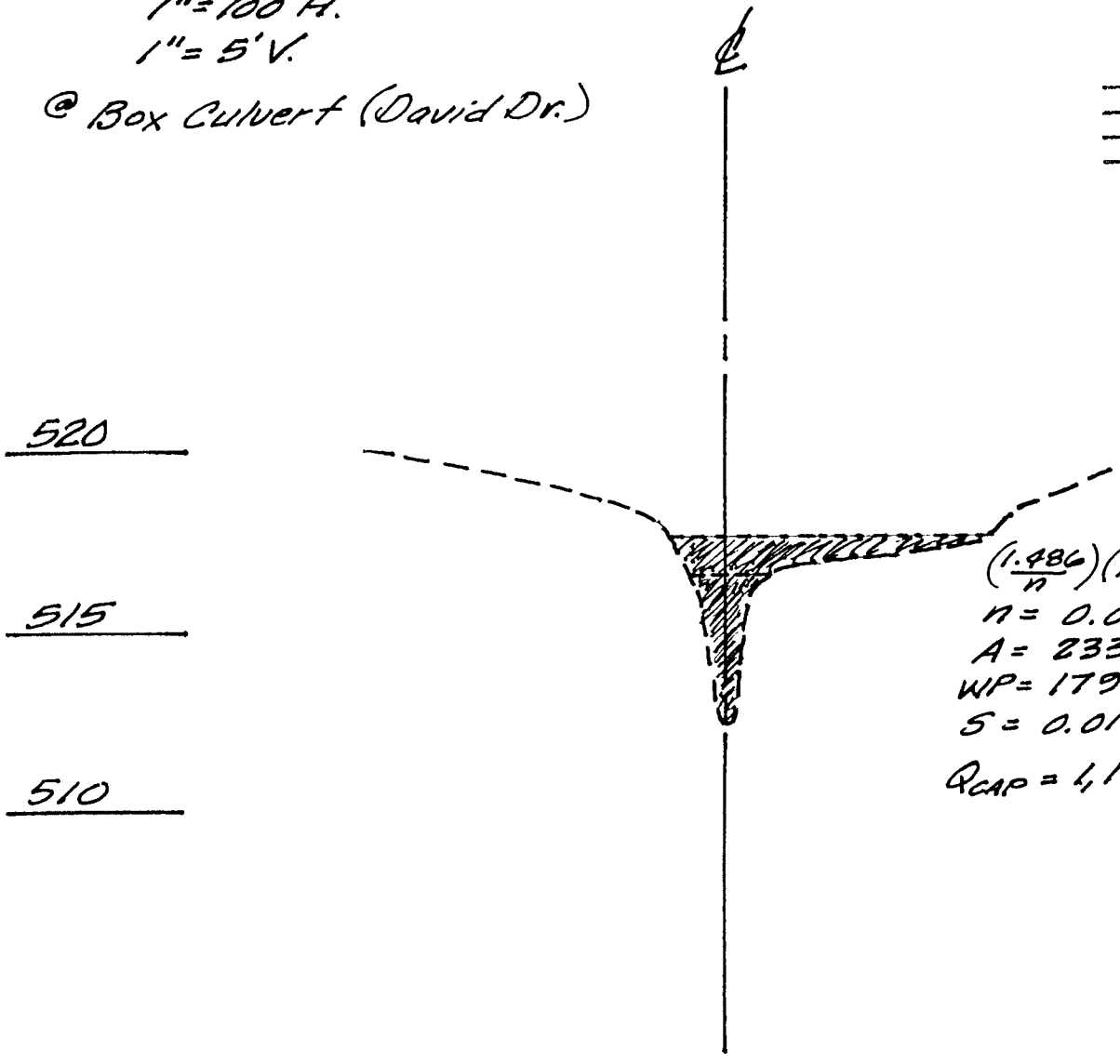
PICKETT RAY & SILVER
Civil Engineers
Planners
Land Surveyors
33 Mid Rivers Mall Dr
St. Peters, MO 63376
397-1211

KDG, MH FILE

JUN 2 4 1998

SECTION "B-B"

1"=100'H.
1"=5'V.
@ Box Culvert (David Dr.)



$\left(\frac{1.486}{n}\right)(A)(A/WP)^{2/3}(S)^{1/2} = Q$

n = 0.04
A = 233 sq.ft.
WP = 179 L.F.
S = 0.013'/ft.

Q_{CAP} = 4,176.58 cfs

PROFESSIONAL ENGINEER

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-28-1998 16:06:28
Watershed file: --> DAV-POST.WSD
Hydrograph file: --> DAV-POST.HYD

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
50 YEAR / 24 HOUR DESIGN STORM

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
GRASS / PAVED	256.01	74.0	0.40	0.00	6.40	3.52	.11 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 256.01 acres or 0.4000 sq.mi
Peak discharge = 834 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
GRASS / PAVED	0.35	0.00	0.40	0.00	No	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-28-1998 16:06:28
Watershed file: --> DAV-POST.WSD
Hydrograph file: --> DAV-POST.HYD

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
50 YEAR / 24 HOUR DESIGN STORM

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
GRASS / PAVED	834	12.3
Composite Watershed	834	12.3

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-28-1998 16:06:28
Watershed file: --> DAV-POST.WSD
Hydrograph file: --> DAV-POST.HYD

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
50 YEAR / 24 HOUR DESIGN STORM

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
GRASS / PAVED	25	35	51	108	199	382	659	834	808
Total (cfs)	25	35	51	108	199	382	659	834	808

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
GRASS / PAVED	607	420	304	230	146	108	89	77	69
Total (cfs)	607	420	304	230	146	108	89	77	69

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
GRASS / PAVED	62	54	48	44	39	35	31	30	28
Total (cfs)	62	54	48	44	39	35	31	30	28

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
GRASS / PAVED	25	23	20	17	0
Total (cfs)	25	23	20	17	0

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-28-1998 16:06:28
Watershed file: --> DAV-POST.WSD
Hydrograph file: --> DAV-POST.HYD

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
50 YEAR / 24 HOUR DESIGN STORM

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	25	14.8	46
11.1	28	14.9	45
11.2	32	15.0	44
11.3	35	15.1	43
11.4	40	15.2	42
11.5	46	15.3	41
11.6	51	15.4	40
11.7	70	15.5	39
11.8	89	15.6	38
11.9	108	15.7	37
12.0	199	15.8	37
12.1	382	15.9	36
12.2	659	16.0	35
12.3	834	16.1	34
12.4	808	16.2	33
12.5	607	16.3	33
12.6	420	16.4	32
12.7	304	16.5	31
12.8	230	16.6	31
12.9	188	16.7	31
13.0	146	16.8	30
13.1	127	16.9	30
13.2	108	17.0	30
13.3	98	17.1	30
13.4	89	17.2	29
13.5	83	17.3	29
13.6	77	17.4	28
13.7	73	17.5	28
13.8	69	17.6	27
13.9	66	17.7	27
14.0	62	17.8	26
14.1	59	17.9	26
14.2	57	18.0	25
14.3	54	18.1	25
14.4	52	18.2	25
14.5	50	18.3	24
14.6	48	18.4	24
14.7	47	18.5	24

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-28-1998 16:06:28
Watershed file: --> DAV-POST.WSD
Hydrograph file: --> DAV-POST.HYD

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
50 YEAR / 24 HOUR DESIGN STORM

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	24	22.4	15
18.7	24	22.5	15
18.8	23	22.6	14
18.9	23	22.7	14
19.0	23	22.8	14
19.1	23	22.9	13
19.2	22	23.0	13
19.3	22	23.1	12
19.4	22	23.2	12
19.5	22	23.3	11
19.6	21	23.4	11
19.7	21	23.5	11
19.8	21	23.6	10
19.9	20	23.7	10
20.0	20	23.8	9
20.1	20	23.9	9
20.2	20	24.0	8
20.3	20	24.1	8
20.4	19	24.2	8
20.5	19	24.3	7
20.6	19	24.4	7
20.7	19	24.5	6
20.8	19	24.6	6
20.9	19	24.7	6
21.0	18	24.8	5
21.1	18	24.9	5
21.2	18	25.0	4
21.3	18	25.1	4
21.4	18	25.2	3
21.5	18	25.3	3
21.6	18	25.4	3
21.7	17	25.5	2
21.8	17	25.6	2
21.9	17	25.7	1
22.0	17	25.8	1
22.1	17	25.9	0
22.2	16		
22.3	16		

Quick TR-55 Ver.5.46 S/N:
Executed: 16:08:08 04-28-1998 DAV-POST.TCT

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
50 YEAR / 24 HOUR DESIGN STORM

Tc COMPUTATIONS FOR:

SHEET FLOW (Applicable to Tc only)

Segment ID		1		
Surface description		GRASS		
Manning's roughness coeff., n		0.0240		
Flow length, L (total < or = 300)	ft	150.0		
Two-yr 24-hr rainfall, P2	in	3.500		
Land slope, s	ft/ft	0.0300		
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.04	=	0.04

SHALLOW CONCENTRATED FLOW

Segment ID		2		
Surface (paved or unpaved)?		Unpaved		
Flow length, L	ft	100.0		
Watercourse slope, s	ft/ft	0.0700		
$Avg.V = Csf * (s)^{0.5}$	ft/s	4.2688		
where: Unpaved Csf = 16.1345				
Paved Csf = 20.3282				
T = L / (3600*V)	hrs	0.01	=	0.01

CHANNEL FLOW

Segment ID		3		4		
Cross Sectional Flow Area, a	sq.ft	9.62		233.00		
Wetted perimeter, Pw	ft	11.00		179.00		
Hydraulic radius, r = a/Pw	ft	0.875		1.302		
Channel slope, s	ft/ft	0.0230		0.0130		
Manning's roughness coeff., n		0.0130		0.0400		
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	%15.8974		5.0633		
Flow length, L	ft	1300		5070		
T = L / (3600*V)	hrs	0.02	+	0.28	=	0.30

TOTAL TIME (hrs) 0.35

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
50 YEAR / 24 HOUR DESIGN STORM

Subarea descr.	Tc or Tt	Time (hrs)
	Tc	0.35

Quick TR-55 Ver.5.46 S/N:
Executed: 16:08:48 04-28-1998

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
50 YEAR / 24 HOUR DESIGN STORM

RUNOFF CURVE NUMBER SUMMARY

Subarea Description	Area (acres)	CN (weighted)
	256.01	74

Quick TR-55 Ver.5.46 S/N:
Executed: 16:08:48 04-28-1998

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
50 YEAR / 24 HOUR DESIGN STORM

RUNOFF CURVE NUMBER DATA

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN
GRASS (GOLF COURSE)	54.44	61
PAVED (SINGLE FAMILY RES.)	159.31	75
PAVED (MULTI-FAMILY RES.)	35.41	85
PAVED (COMMERCIAL)	6.85	98
COMPOSITE AREA --->	256.01	74.0 (74)

Quick TR-55 Version: 5.46 S/N:

>>>>> GRAPHICAL PEAK DISCHARGE METHOD <<<<<

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
50 YEAR / 24 HOUR DESIGN STORM

CALCULATED
DISK FILE: DAV-POST.GPD

Drainage Area	(acres)	256.01--->	0.4000 sq.mi.
Runoff Curve Number	(CN)	74	
Time of Concentration,Tc	(hrs)	0.35	
Rainfall Distribution	(Type)	II	
Pond and Swamp Areas	(%)	--->	0.0 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	50		
Rainfall, P, 24-hr (in)	6.4		
Initial Abstraction, Ia (in)	0.703	0.703	0.703
Ia/p Ratio	0.110	0.000	0.000
Unit Discharge, * qu (csm/in)	625	0	0
Runoff, Q (in)	3.52	0.00	0.00
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	882	0	0

Summary of Computations for qu

Ia/p	#1	0.100	0.000	0.000
C0	#1	2.553	0.000	0.000
C1	#1	-0.615	0.000	0.000
C2	#1	-0.164	0.000	0.000
qu (csm)	#1	630.355	0.000	0.000
Ia/p	#2	0.300	0.000	0.000
C0	#2	2.465	0.000	0.000
C1	#2	-0.623	0.000	0.000
C2	#2	-0.117	0.000	0.000
qu (csm)	#2	530.808	0.000	0.000
* qu (csm)		625	0	0

* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)
If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc))^2)$$

qp (cfs) = qu(csm) * Area(sq.mi.) * Q(in.) * (Pond & Swamp Adj.)

>>>>> GRAPHICAL PEAK DISCHARGE METHOD <<<<<

WINGHAVEN - BOX CULVERT @ DAVID DRIVE
100YEAR / 24 HOUR DESIGN STORM

CALCULATED
DISK FILE: DAV-POST.GPD

Drainage Area	(acres)	256.01--->	0.4000 sq.mi.
Runoff Curve Number	(CN)	74	
Time of Concentration,Tc	(hrs)	0.35	
Rainfall Distribution	(Type)	II	
Pond and Swamp Areas	(%)	--->	0.0 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	100		
Rainfall, P, 24-hr (in)	7.2		
Initial Abstraction, Ia (in)	0.703	0.703	0.703
Ia/p Ratio	0.098	0.000	0.000
Unit Discharge, * qu (csm/in)	630	0	0
Runoff, Q (in)	4.22	0.00	0.00
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	1063	0	0

Summary of Computations for qu

Ia/p	#1	0.100	0.000	0.000
C0	#1	2.553	0.000	0.000
C1	#1	-0.615	0.000	0.000
C2	#1	-0.164	0.000	0.000
qu (csm)	#1	630.355	0.000	0.000
Ia/p	#2	0.100	0.000	0.000
C0	#2	2.553	0.000	0.000
C1	#2	-0.615	0.000	0.000
C2	#2	-0.164	0.000	0.000
qu (csm)	#2	630.355	0.000	0.000
* qu (csm)		630	0	0

* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)
If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc))^2)$$

qp (cfs) = qu(csm) * Area(sq.mi.) * Q(in.) * (Pond & Swamp Adj.)

97-034

KDG, MH FILE 980100

JUN 2 4 1998

PROJECT NAME
PROJECT #/JOB ORDER #
DATE
DESIGNER
PAGE

PICKETT RAY & SILVER
Civil Engineers
Planners
Land Surveyors
333 Mid Rivers Mall Dr
St. Peters, MO 63376
397-1211

SECTION "C-C"

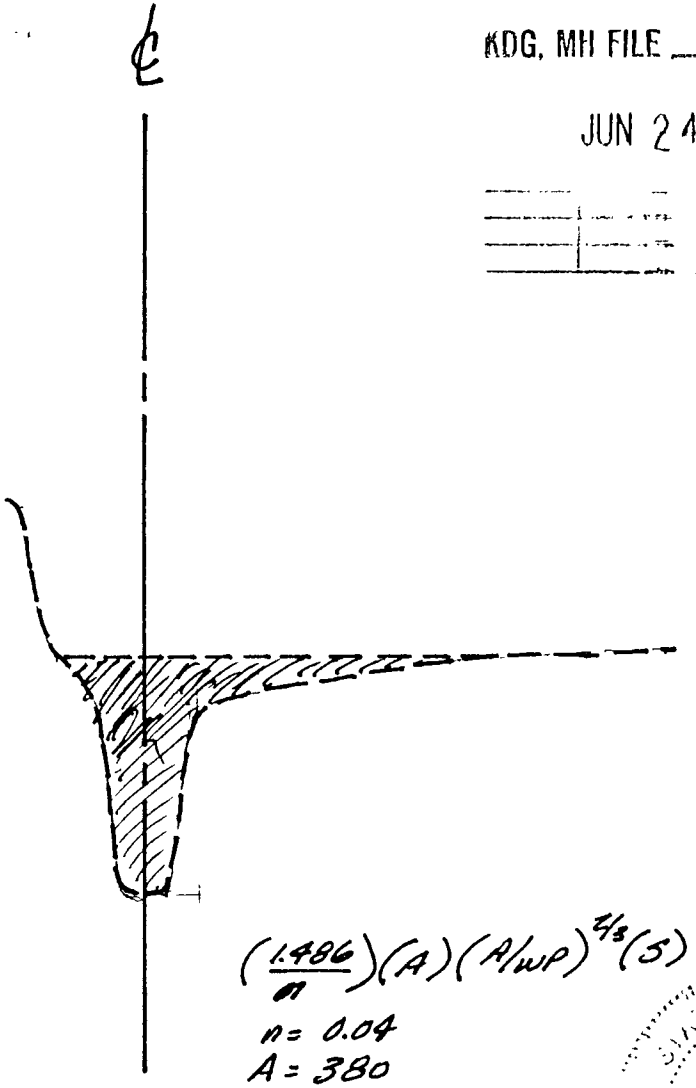
1"=100' H.
1"= 5' V.

℄ Box Culvert (Charlie Dr.)

500

495

490



$$\left(\frac{1.486}{n}\right)(A)(R/WP)^{2/3}(S)^{1/2} = Q$$

n = 0.04
A = 380
WP = 240
S = 0.0056'/ft.
Q_{CAP} = 1,435 cfs

STATE OF MISSOURI
RAY PICKETT
NUMBER E-14395
REGISTERED PROFESSIONAL ENGINEER

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-29-1998 13:29:57
Watershed file: --> CHL-POST.WSD
Hydrograph file: --> CHL-POST.HYD

WINGHAVEN - BOX CULVERT @ CHARLIE DRIVE
100YEAR / 24 HOUR DESIGN STORM

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
GRASS / PAVED	1557.10	83.0	0.75	0.00	7.20	5.22	.06 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 1557.10 acres or 2.4330 sq.mi
Peak discharge = 5385 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
GRASS / PAVED	0.74	0.00	0.75	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-29-1998 13:29:57
Watershed file: --> CHL-POST.WSD
Hydrograph file: --> CHL-POST.HYD

WINGHAVEN - BOX CULVERT @ CHARLIE DRIVE
100YEAR / 24 HOUR DESIGN STORM

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
GRASS / PAVED	5385	12.6
Composite Watershed	5385	12.6

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-29-1998 13:29:57
Watershed file: --> CHL-POST.WSD
Hydrograph file: --> CHL-POST.HYD

WINGHAVEN - BOX CULVERT @ CHARLIE DRIVE
100YEAR / 24 HOUR DESIGN STORM

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
RASS / PAVED	165	229	305	457	584	864	1461	2464	3734
otal (cfs)	165	229	305	457	584	864	1461	2464	3734

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
RASS / PAVED	4826	5385	5207	4686	3200	2184	1562	1181	940
otal (cfs)	4826	5385	5207	4686	3200	2184	1562	1181	940

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
RASS / PAVED	775	622	521	445	394	343	305	279	254
otal (cfs)	775	622	521	445	394	343	305	279	254

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
RASS / PAVED	241	216	191	152	0
otal (cfs)	241	216	191	152	0

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-29-1998 13:29:57
Watershed file: --> CHL-POST.WSD
Hydrograph file: --> CHL-POST.HYD

WINGHAVEN - BOX CULVERT @ CHARLIE DRIVE
100YEAR / 24 HOUR DESIGN STORM

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	165	14.8	483
11.1	186	14.9	464
11.2	208	15.0	445
11.3	229	15.1	435
11.4	254	15.2	425
11.5	280	15.3	414
11.6	305	15.4	404
11.7	356	15.5	394
11.8	406	15.6	384
11.9	457	15.7	374
12.0	584	15.8	363
12.1	864	15.9	353
12.2	1461	16.0	343
12.3	2464	16.1	335
12.4	3734	16.2	328
12.5	4826	16.3	320
12.6	5385	16.4	313
12.7	5207	16.5	305
12.8	4686	16.6	300
12.9	3943	16.7	295
13.0	3200	16.8	289
13.1	2692	16.9	284
13.2	2184	17.0	279
13.3	1873	17.1	274
13.4	1562	17.2	269
13.5	1372	17.3	264
13.6	1181	17.4	259
13.7	1060	17.5	254
13.8	940	17.6	251
13.9	857	17.7	249
14.0	775	17.8	246
14.1	724	17.9	244
14.2	673	18.0	241
14.3	622	18.1	238
14.4	588	18.2	236
14.5	555	18.3	234
14.6	521	18.4	231
14.7	502	18.5	228

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-29-1998 13:29:57
Watershed file: --> CHL-POST.WSD
Hydrograph file: --> CHL-POST.HYD

WINGHAVEN - BOX CULVERT @ CHARLIE DRIVE
100YEAR / 24 HOUR DESIGN STORM

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	226	22.4	137
18.7	224	22.5	133
18.8	221	22.6	129
18.9	218	22.7	125
19.0	216	22.8	122
19.1	214	22.9	118
19.2	211	23.0	114
19.3	208	23.1	110
19.4	206	23.2	106
19.5	204	23.3	103
19.6	201	23.4	99
19.7	198	23.5	95
19.8	196	23.6	91
19.9	194	23.7	87
20.0	191	23.8	84
20.1	189	23.9	80
20.2	187	24.0	76
20.3	185	24.1	72
20.4	183	24.2	68
20.5	181	24.3	65
20.6	179	24.4	61
20.7	177	24.5	57
20.8	175	24.6	53
20.9	173	24.7	49
21.0	172	24.8	46
21.1	170	24.9	42
21.2	168	25.0	38
21.3	166	25.1	34
21.4	164	25.2	30
21.5	162	25.3	27
21.6	160	25.4	23
21.7	158	25.5	19
21.8	156	25.6	15
21.9	154	25.7	11
22.0	152	25.8	8
22.1	148	25.9	4
22.2	144		
22.3	141		

Quick TR-55 Ver.5.46 S/N:
Executed: 13:30:19 04-29-1998 CHL-POST.TCT

WINGHAVEN - BOX CULVERT @ CHARLIE DRIVE
100YEAR / 24 HOUR DESIGN STORM

Tc COMPUTATIONS FOR:

SHEET FLOW (Applicable to Tc only)

Segment ID		1		
Surface description		GRASS		
Manning's roughness coeff., n		0.0240		
Flow length, L (total < or = 300)	ft	100.0		
Two-yr 24-hr rainfall, P2	in	3.500		
Land slope, s	ft/ft	0.0400		
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.03	=	0.03

SHALLOW CONCENTRATED FLOW

Segment ID		2		
Surface (paved or unpaved)?		Unpaved		
Flow length, L	ft	500.0		
Watercourse slope, s	ft/ft	0.0180		
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.1647		
where: Unpaved Csf = 16.1345				
Paved Csf = 20.3282				
T = L / (3600*V)	hrs	0.06	=	0.06

CHANNEL FLOW

Segment ID		3		4		
Cross Sectional Flow Area, a	sq.ft	1760.00		380.00		
Wetted perimeter, Pw	ft	242.00		240.00		
Hydraulic radius, r = a/Pw	ft	7.273		1.583		
Channel slope, s	ft/ft	0.0094		0.0056		
Manning's roughness coeff., n		0.0400		0.0400		
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	%13.5567		3.7868		
Flow length, L	ft	14400		4780		
T = L / (3600*V)	hrs	0.30	+	0.35	=	0.65

TOTAL TIME (hrs) 0.74

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

WINGHAVEN - BOX CULVERT @ CHARLIE DRIVE
100YEAR / 24 HOUR DESIGN STORM

Subarea descr.	Tc or Tt	Time (hrs)
	Tc	0.74

Quick TR-55 Ver.5.46 S/N:
Executed: 13:30:36 04-29-1998

WINGHAVEN - BOX CULVEPT @ CHARLIE DRIVE
100YEAR / 24 HOUR DESIGN STORM

RUNOFF CURVE NUMBER SUMMARY

Subarea Description	Area (acres)	CN (weighted)
	1557.08	83

Quick TR-55 Ver.5.46 S/N:
Executed: 13:30:36 04-29-1998

WINGHAVEN - BOX CULVERT @ CHARLIE DRIVE
100YEAR / 24 HOUR DESIGN STORM

RUNOFF CURVE NUMBER DATA

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN	
GRASS (GOLF COURSE)	164.74	61	
PAVED (SINGLE FAMILY RES.)	707.40	75	
PAVED (MULTI-FAMILY RES.)	62.57	85	
PAVED (COMMERCIAL)	622.37	98	
COMPOSITE AREA --->	1557.08	83.1	(83)

Quick TR-55 Version: 5.46 S/N:

)))))) GRAPHICAL PEAK DISCHARGE METHOD ((((((

WINGHAVEN - BOX CULVERT @ CHARLIE DRIVE
100 YEAR / 24 HOUR DESIGN STORM

CALCULATED
DISK FILE: CHL-POST.GPD

Drainage Area	(acres)	1557.1--->	2.4330 sq.mi.
Runoff Curve Number	(CN)	83	
Time of Concentration,Tc	(hrs)	.74	
Rainfall Distribution	(Type)	II	
Pond and Swamp Areas	(%)	--->	0.0 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	100		
Rainfall, P, 24-hr (in)	7.2		
Initial Abstraction, Ia (in)	0.410	0.410	0.410
Ia/p Ratio	0.057	0.000	0.000
Unit Discharge, * qu (csm/in)	427	0	0
Runoff, Q (in)	5.22	0.00	0.00
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	5425	0	0

Summary of Computations for qu

Ia/p	#1	0.100	0.000	0.000
C0	#1	2.553	0.000	0.000
C1	#1	-0.615	0.000	0.000
C2	#1	-0.164	0.000	0.000
qu (csm)	#1	427.428	0.000	0.000
Ia/p	#2	0.100	0.000	0.000
C0	#2	2.553	0.000	0.000
C1	#2	-0.615	0.000	0.000
C2	#2	-0.164	0.000	0.000
qu (csm)	#2	427.428	0.000	0.000
* qu (csm)		427	0	0

* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)
If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc))^2)$$

qp (cfs) = qu(csm) * Area(sq.mi.) * Q(in.) * (Pond & Swamp Adj.)

97-034

KDG, MH FILE

JUN 24 1998

PROJECT NAME

PROJECT #/JOB ORDER #

DATE

DESIGNER

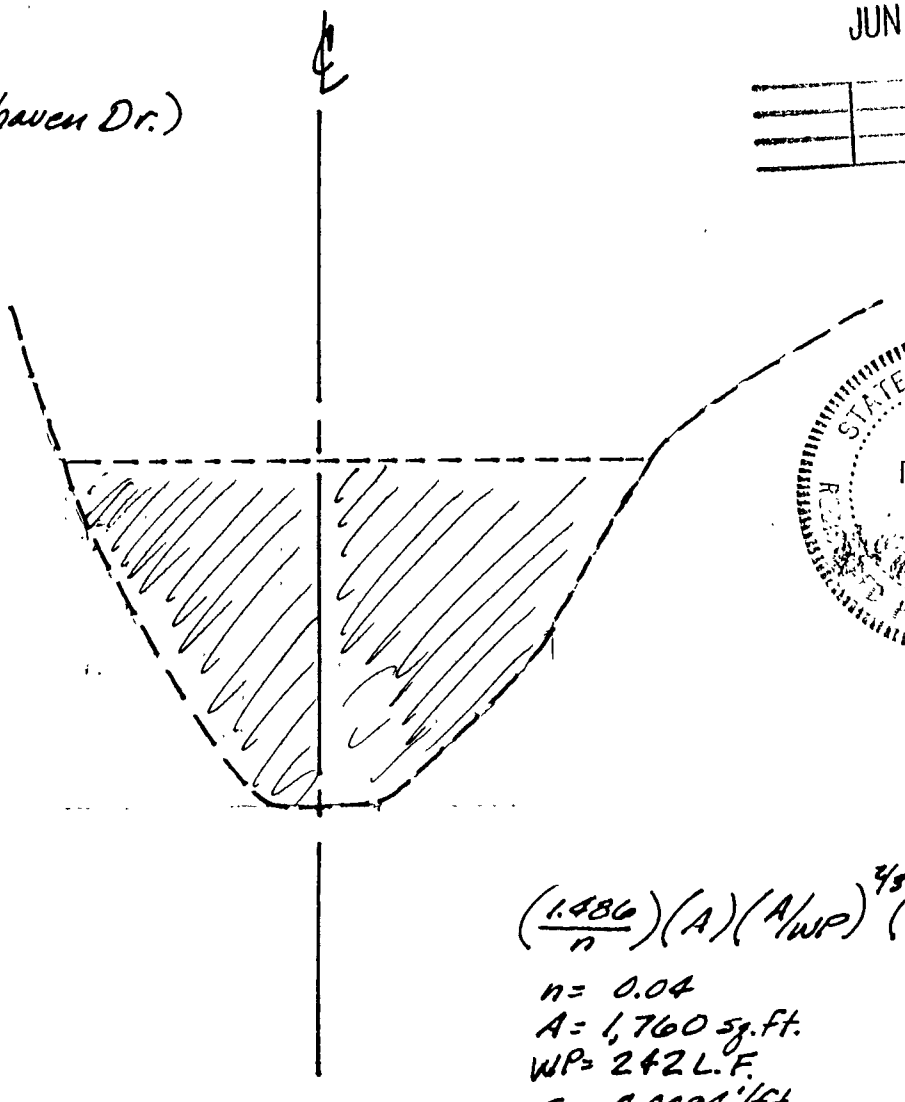
PAGE

PICKETT RAY & SILVER
Civil Engineers
Planners
Land Surveyors
33 Mid Rivers Mall Dr.
St. Peters, MO 63376
397-1211

SECTION "A-A":

1" = 100' H.
1" = 5' V.

@ Box Culvert (Winghaven Dr.)



STATE OF MISSOURI
RAY O. PICKETT
NUMBER E-14395
REGISTERED PROFESSIONAL ENGINEER

$$\left(\frac{1.486}{n}\right)(A)(A/WP)^{2/3}(S)^{1/2} = Q$$

n = 0.04
A = 1,760 sq.ft.
WP = 242 L.F.
S = 0.0094 ft/ft
Q_{CAP} = 23,796 cfs

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-29-1998 13:21:43
Watershed file: --> WH-POST .WSD
Hydrograph file: --> WH-POST .HYD

WINGHAVEN - BOX CULVERT @ WINGHAVEN DRIVE
100YEAR / 24 HOUR DESIGN STORM

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
GRASS / PAVED	1220.70	80.0	0.40	0.00	7.20	4.88	.07	.10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 1220.70 acres or 1.9073 sq.mi .
Peak discharge = 5510 cfs

>>>> Computer Modifications of Input Parameters <<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
GRASS / PAVED	0.39	0.00	0.40	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD

Type II Distribution
(24 hr. Duration Storm)

Executed: 04-29-1998 13:21:43
Watershed file: --> WH-POST .WSD
Hydrograph file: --> WH-POST .HYD

WINGHAVEN - BOX CULVERT @ WINGHAVEN DRIVE
100YEAR / 24 HOUR DESIGN STORM

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
GRASS / PAVED	5510	12.3
Composite Watershed	5510	12.3

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-29-1998 13:21:43
Watershed file: --> WH-POST .WSD
Hydrograph file: --> WH-POST .HYD

WINGHAVEN - BOX CULVERT @ WINGHAVEN DRIVE
100YEAR / 24 HOUR DESIGN STORM

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
GRASS / PAVED	168	233	335	717	1312	2522	4356	5510	5343
Total (cfs)	168	233	335	717	1312	2522	4356	5510	5343

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
GRASS / PAVED	4012	2774	2010	1517	968	717	586	512	456
Total (cfs)	4012	2774	2010	1517	968	717	586	512	456

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
GRASS / PAVED	410	354	316	289	261	233	205	195	186
Total (cfs)	410	354	316	289	261	233	205	195	186

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
GRASS / PAVED	168	149	130	112	0
Total (cfs)	168	149	130	112	0

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-29-1998 13:21:43
Watershed file: --> WH-POST .WSD
Hydrograph file: --> WH-POST .HYD

WINGHAVEN - BOX CULVERT @ WINGHAVEN DRIVE
100YEAR / 24 HOUR DESIGN STORM

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	168	14.8	302
11.1	190	14.9	296
11.2	211	15.0	289
11.3	233	15.1	283
11.4	267	15.2	278
11.5	301	15.3	272
11.6	335	15.4	267
11.7	462	15.5	261
11.8	590	15.6	255
11.9	717	15.7	250
12.0	1312	15.8	244
12.1	2522	15.9	239
12.2	4356	16.0	233
12.3	5510	16.1	227
12.4	5343	16.2	222
12.5	4012	16.3	216
12.6	2774	16.4	211
12.7	2010	16.5	205
12.8	1517	16.6	203
12.9	1242	16.7	201
13.0	968	16.8	199
13.1	842	16.9	197
13.2	717	17.0	195
13.3	651	17.1	193
13.4	586	17.2	191
13.5	549	17.3	190
13.6	512	17.4	188
13.7	484	17.5	186
13.8	456	17.6	182
13.9	433	17.7	179
14.0	410	17.8	175
14.1	391	17.9	172
14.2	373	18.0	168
14.3	354	18.1	166
14.4	341	18.2	164
14.5	329	18.3	162
14.6	316	18.4	160
14.7	309	18.5	158

TR-55 TABULAR HYDROGRAPH METHOD
Type II Distribution
(24 hr. Duration Storm)

Executed: 04-29-1998 13:21:43
Watershed file: --> WH-POST .WSD
Hydrograph file: --> WH-POST .HYD

WINGHAVEN - BOX CULVERT @ WINGHAVEN DRIVE
100YEAR / 24 HOUR DESIGN STORM

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	157	22.4	101
18.7	155	22.5	98
18.8	153	22.6	95
18.9	151	22.7	92
19.0	149	22.8	90
19.1	147	22.9	87
19.2	145	23.0	84
19.3	143	23.1	81
19.4	141	23.2	78
19.5	140	23.3	76
19.6	138	23.4	73
19.7	136	23.5	70
19.8	134	23.6	67
19.9	132	23.7	64
20.0	130	23.8	62
20.1	129	23.9	59
20.2	128	24.0	56
20.3	127	24.1	53
20.4	126	24.2	50
20.5	126	24.3	48
20.6	125	24.4	45
20.7	124	24.5	42
20.8	123	24.6	39
20.9	122	24.7	36
21.0	121	24.8	34
21.1	120	24.9	31
21.2	119	25.0	28
21.3	118	25.1	25
21.4	117	25.2	22
21.5	116	25.3	20
21.6	116	25.4	17
21.7	115	25.5	14
21.8	114	25.6	11
21.9	113	25.7	8
22.0	112	25.8	6
22.1	109	25.9	3
22.2	106		
22.3	104		

Quick TR-55 Ver.5.46 S/N:
Executed: 13:22:00 04-29-1998 WH-POST.TCT

WINGHAVEN - BOX CULVERT @ WINGHAVEN DRIVE
100YEAR / 24 HOUR DESIGN STORM

Tc COMPUTATIONS FOR:

SHEET FLOW (Applicable to Tc only)

Segment ID		1	
Surface description		GRASS	
Manning's roughness coeff., n		0.0240	
Flow length, L (total < or = 300)	ft	100.0	
Two-yr 24-hr rainfall, P2	in	3.500	
Land slope, s	ft/ft	0.0400	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.03	= 0.03

SHALLOW CONCENTRATED FLOW

Segment ID		2	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	500.0	
Watercourse slope, s	ft/ft	0.0180	
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.1647	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.06	= 0.06

CHANNEL FLOW

Segment ID		3	
Cross Sectional Flow Area, a	sq.ft	1760.00	
Wetted perimeter, Pw	ft	242.00	
Hydraulic radius, r = a/Pw	ft	7.273	
Channel slope, s	ft/ft	0.0094	
Manning's roughness coeff., n		0.0400	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	%13.5567	
Flow length, L	ft	14400	
T = L / (3600*V)	hrs	0.30	= 0.30

::

TOTAL TIME (hrs) 0.39

Quick TR-55 Ver.5.46 S/N:
Executed: 13:22:00 04-29-1998 WH-POST.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS
(Solved for Time using TR-55 Methods)

WINGHAVEN - BOX CULVERT @ WINGHAVEN DRIVE
100YEAR / 24 HOUR DESIGN STORM

Subarea descr.	Tc or Tt	Time (hrs)
	Tc	0.39

Quick TR-55 Ver.5.46 S/N:
Executed: 13:22:14 04-29-1998

WINGHAVEN - BOX CULVERT @ WINGHAVEN DRIVE
100YEAR / 24 HOUR DESIGN STORM

RUNOFF CURVE NUMBER SUMMARY

Subarea Description	Area (acres)	CN (weighted)
	1220.97	80

Quick TR-55 Ver.5.46 S/N:
Executed: 13:22:14 04-29-1998

WINGHAVEN - BOX CULVERT @ WINGHAVEN DRIVE
100YEAR / 24 HOUR DESIGN STORM

RUNOFF CURVE NUMBER DATA

Composite Area:

SURFACE DESCRIPTION	AREA (acres)	CN	
GRASS (GOLF COURSE)	164.74	61	
PAVED (SINGLE FAMILY RES.)	647.42	75	
PAVED (MULTI-FAMILY RES.)	47.08	85	
PAVED (COMMERCIAL)	361.73	98	
COMPOSITE AREA --->	1220.97	80.3	(80)

Quick TR-55 Version: 5.46 S/N:

)))))) GRAPHICAL PEAK DISCHARGE METHOD ((((((

WINGHAVEN - BOX CULVERT @ WINGHAVEN DRIVE
100YEAR / 24 HOUR DESIGN STORM

CALCULATED
DISK FILE: WH-POST .GPD

Drainage Area	(acres)	1220.9--->	1.9077 sq.mi.
Runoff Curve Number	(CN)	80	
Time of Concentration,Tc	(hrs)	.39	
Rainfall Distribution	(Type)	II	
Pond and Swamp Areas	(%)	--->	0.0 acres

	Storm #1	Storm #2	Storm #3
Frequency (years)	100		
Rainfall, P, 24-hr (in)	7.2		
Initial Abstraction, Ia (in)	0.500	0.500	0.500
Ia/p Ratio	0.069	0.000	0.000
Unit Discharge, * qu (csm/in)	599	0	0
Runoff, Q (in)	4.88	0.00	0.00
Pond & Swamp Adjustment Factor	1.00	1.00	1.00
PEAK DISCHARGE, qp (cfs)	5574	0	0

Summary of Computations for qu

Ia/p	#1	0.100	0.000	0.000
C0	#1	2.553	0.000	0.000
C1	#1	-0.615	0.000	0.000
C2	#1	-0.164	0.000	0.000
qu (csm)	#1	598.886	0.000	0.000
Ia/p	#2	0.100	0.000	0.000
C0	#2	2.553	0.000	0.000
C1	#2	-0.615	0.000	0.000
C2	#2	-0.164	0.000	0.000
qu (csm)	#2	598.886	0.000	0.000
* qu (csm)		599	0	0

* Interpolated for computed Ia/p ratio (between Ia/p #1 & Ia/p #2)
If computed Ia/p exceeds Ia/p limits, bounding limit for Ia/p is used.

$$\log(qu) = C0 + (C1 * \log(Tc)) + (C2 * (\log(Tc))^2)$$

qp (cfs) = qu(csm) * Area(sq.mi.) * Q(in.) * (Pond & Swamp Adj.)

BOX CULVERT DESIGN

JVS 17 JUL 98

18 July 98

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OM
OM                      CULVERT BR#A300
OM                      file: A306LRF1.pol
OM                      Date: 17Jul98
OM                      Hydraulic Design
OM                      Double Box Culvert (No Haunch)
OM                      2-Cell Box  8'Wx  7'H
OM                      Load Factor Design
OM                      Rigid Frame Method
OM                      Top and Bot Slab Different
OM                      Exterior and Interior Wall Different
OM
OM                      Minumum Fill Ht Condition (1.0 Ft)
OM
STDLOD      2, 0, 0, 0, 0
SWPRES      1, 2, 60, 15, 62.4
BOXDIM      1, 2,  8,  7, 1, 10
SLBTHK      1, 10.5, 10.0, 7, 7, 1111
H&SKEW      1, 90, 90, 0, 0, 0
REEBAR      18, 9, 1, 11, 4, .016
CONCOV      2, 3, 2, 1.5, .5, .5
MATPRP      120, 60, 24, 3, 0, 0
PRTCTL      1, 1, 1, 0
F&HCTL      1, 1, 1
DESCTL      1, 0, 1, 0, 0, 9
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CONSTANT DATA

STANDARD LIVE LOAD			- DESIGN METHOD -			- PRINT CONTROL		
TRUCK CODE	OMIT L.L.	STRESS O-FILL	OVERLD AXLE	- SERVICE LOAD	LOAD FACTOR	- 10th Pt MOMENT	INFL LINE	LOC. NEG MOMENT
HS20	NO	NO	0.	NO	YES	YES	YES	1.00

MATERIAL PROPERTIES					- THICKNESS	
SOIL WEIGHT	STEEL Fy	STEEL Fs	CONCRETE STRENGTH	CONCRETE SHEAR	CON.SHEAR W/ STIRRUP	- INCREMENTS SLAB	WALL
120.	60000.	24000.	3000.	0.	0.	0.50	0.50

CONCRETE COVER			- DESIGN	- PRINT	- REINFORCING			
EXTERIOR		INTERIOR	- SAME	- BAR	- BAR SPACING		BAR SIZE	
TOP SLAB	BOT SLAB	WALL	(ALL)	- THICKNESS - SLAB WALL	- TABLE -	MAX	MIN	MAX	MIN
2.00	3.00	2.00	1.50	NO NO	YES	18.0	9.0	11	4

CRACK PARAMETER Z = 98.0
MODULAR RATIO N = 9.0

SUPERIMPOSED DEAD LOADS							- SPECIAL LIVE LOADS		
UNIFORM LOAD	CONCENTRATED LOAD						- WHEEL LOAD	FILL HEIGHT	OVERSTRESS FACTOR
	WT.	X1	WT.	X2	WT.	X3			
0.000	0.00	0.0	0.00	0.0	0.00	0.0	0.000	0.000	1.00

DATA FOR STRUCTURE NUMBER 1

CULVERT TYPE	- SPAN - LENGTH	- CLEAR - HEIGHT	- DESIGN - FILL	- CENTERLINE - LENGTH	- SKEW - LEFT	- SKEW - RIGHT	- FLOOR TYPE
DOUBLE	8.00	7.00	1.00	10.00	90	90	FULL

SLAB THICKNESSES				- LIVE	- SOIL		- WATER
TOP SLAB	BOT. SLAB	EXT. WALL	INT. WALL	- LOAD SURCHARGE	- PRESSURE MAX	MIN	- PRESSURE
10.50F	10.00F	7.00F	7.00F	2.00	60.0	15.0	62.4

TOP HAUNCH HEIGHT	BOTTOM HAUNCH HEIGHT	- RIGID OR FLEXIBLE	- CHECK MILITARY	- BAR SPACING INCREMENT
0.0	0.0	RIGID	NO	1 INCH

BOTH HEADWALLS ELIMINATED.

***** LOAD FACTOR DESIGN *****
***** STRESSES AT CRITICAL SECTIONS *****

*** MAXIMUM REINFORCEMENT RATIO (As/bd) = .016

MEMBER NUMBER = 1
MEMBER THICKNESS = 7.00
EXTERIOR WAL

	-MOMENT-	-AXIAL FORCE-	-SHEAR-	-Po-	-Mu-	-Mbal-	-Pbal-	-STEEL AREA-	-SHEAR STRESS-	-ALL.- MOM.	-ALL.- SHEAR
LT	-11.1*	7.8	3.4	179.9	10.2	13.0	27.7	0.67	79.2	11.0	109.5
MID	1.6	1.3	1.8	163.5	3.7	12.0	53.5	0.17	36.5	3.9	109.5
MID-	-3.6	5.7	1.8	165.1	4.0	11.0	45.4	0.21	40.6	4.9	109.5
RT	-5.5	3.8	2.0	168.3	5.5	12.0	41.6	0.29	46.1	6.1	109.5

MEMBER NUMBER = 2
MEMBER THICKNESS = 10.50
TOP SLAB

	-MOMENT-	-AXIAL FORCE-	-SHEAR-	-Po-	-Mu-	-Mbal-	-Pbal-	-STEEL AREA-	-SHEAR STRESS-	-ALL.- MOM.	-ALL.- SHEAR
LT	-5.4	2.1	8.3	245.2	8.8	31.0	91.8	0.25	101.7	9.3	110.6
MID	16.8*	-0.2	4.5	253.6	16.8	35.0	87.6	0.54	52.1	16.7	109.5
RT	-19.5	-2.2	9.0	260.8	21.2	35.0	72.0	0.71	110.6*	20.8	109.5

MEMBER NUMBER = 3
MEMBER THICKNESS = 7.00
INTERIOR WAL

	-MOMENT-	-AXIAL FORCE-	-SHEAR-	-Po-	-Mu-	-Mbal-	-Pbal-	-STEEL AREA-	-SHEAR STRESS-	-ALL.- MOM.	-ALL.- SHEAR
LT	-1.3	7.4	0.5	163.5	3.7	10.0	46.8	0.17	12.5	4.7	109.5
MID	0.9	11.2	0.5	163.5	3.7	10.0	46.8	0.17	12.5	5.2	109.5
RT	-3.0	8.8	0.5	164.1	4.0	11.0	46.2	0.18	12.5	5.3	109.5

MEMBER NUMBER = 4
MEMBER THICKNESS = 10.00
BOTTOM SLAB

	-MOMENT-	-AXIAL FORCE-	-SHEAR-	-Po-	-Mu-	-Mbal-	-Pbal-	-STEEL AREA-	-SHEAR STRESS-	-ALL.- MOM.	-ALL.- SHEAR
LT	-10.7	1.8	6.1	239.5	10.7	26.0	65.2	0.50	92.5	11.1	109.5
MID	10.3	-0.8	1.1	237.0	11.3	30.0	88.0	0.34	13.1	11.1	109.5
RT	-14.8	1.6	5.0	246.1	14.8	27.0	56.9	0.67	75.8	15.2	109.5

A CORNER BAR(T)				A CORNER BAR(B)				A TSLAB+		A TSLAB-	
H	V	SZ	SPG	H	V	SZ	SPG	SZ	SPG	SZ	SPG
30	25	5	9.0	55	48	8	9.0	7	9.0	8	9.0

A BSLAB+		A BSLAB-		B EXTIN		B EXTOUT		B INTWL		C1
SZ	SPG	SZ	SPG	SZ	SPG	SZ	SPG	SZ	SPG	BARS
6	9.0	8	9.0	5	12.0	5	9.0	5	12.0	69

** THE HEIGHT OF C.H.C.U. ** BOTTOM SLAB = 3.50 IN
TOP SLAB = 4.75 IN

** T.SLAB	* B.SLAB	* WALL	* INWALL	*** VOLUME	*** STEEL **
IN	IN	IN	IN	CY/FT	LB/FT
10.50	10.00	7.00	7.00	1.577	377

** REINFORCING STEEL BAR SCHEDULE **

LOCATN	BAR	NO.	SZ	TYP	LNGTH	WT.	H LEG	V LEG
TOP SLAB POSV MAIN	A100	14	7	STR	17- 4	496		
BOT SLAB POSV MAIN	A200	14	6	STR	17- 4	364		
TOP SLAB NEGV MAIN	A300	14	8	STR	17- 4	648		
BOT SLAB NEGV MAIN	A400	14	8	STR	17- 4	648		
CORNER (TOP)	A1	28	5	6	4- 7	134	2- 6	2- 1
CORNER (BOTTOM)	A2	28	8	6	8- 7	642	4- 7	4- 0
EXTWALL IN	B1	20	5	STR	8- 2	170		
EXTWALL OUT	B2	28	5	STR	6- 4	185		
INTWALL	B3	10	5	STR	8- 2	85		
LONGTD (1)	C1	69	4	STR	9- 8	446		
					TOTAL	3818		

***** SPLICE LENGTHS CHART *****

BAR	SIZE	SPLICE LENGTH
A200	6	2- 3
A400	8	3-11
B1	5	1- 8
B3	5	1- 8
C1	4	2- 2

** MOMENT * AXIAL FORCE * SHEAR FOR LOAD FACTOR DESIGN AT TENTH POINT **

M-PT	+MOMENT	-MOMENT	+A.F.	-A.F.	+SHEAR	-SHEAR
1- 0	2.417	-12.993	3.124	7.796	4.038	-1.517
1- 1	1.299	-9.347	2.711	7.796	3.424	-1.247
1- 2	1.193	-6.975	2.261	7.291	2.858	-1.009
1- 3	1.530	-5.204	2.003	7.291	2.340	-0.804
1- 4	1.560	-3.591	1.337	5.693	1.870	-0.632
1- 5	1.449	-2.438	8.788	5.630	1.753	-0.796
1- 6	2.685	-2.612	7.080	4.441	1.860	-1.169
1- 7	4.116	-2.826	6.533	4.060	1.935	-1.495
1- 8	5.385	-3.161	5.785	3.905	1.977	-1.772
1- 9	7.641	-4.710	4.982	3.834	1.987	-2.001
1-10	9.913	-6.396	4.982	3.834	1.964	-2.182
2- 0	9.913	-6.396	0.332	2.142	9.365	-1.116
2- 1	13.118	-3.362	0.287	2.134	8.414	-2.671
2- 2	15.219	-1.978	-0.010	1.845	7.441	-3.812
2- 3	16.165	-1.655	-0.400	1.537	6.460	-4.953
2- 4	16.752	-2.518	-0.228	-0.126	5.482	-6.090
2- 5	16.750	-4.513	-0.014	-0.164	4.520	-5.570
2- 6	15.691	-6.799	0.142	-0.491	3.586	-6.520
2- 7	13.958	-9.687	2.142	-2.878	2.692	-7.435
2- 8	11.611	-13.048	2.182	-2.878	1.850	-8.305
2- 9	8.682	-16.548	2.165	-2.878	1.072	-9.116
2-10	5.412	-20.968	2.089	-1.884	0.371	-9.857
3- 0	1.551	-1.551	11.150	7.351	0.527	-0.527
3- 1	1.073	-1.073	11.150	7.351	0.527	-0.527
3- 2	0.582	-0.582	10.742	10.003	0.527	-0.527
3- 3	0.170	-0.170	7.112	6.101	0.527	-0.527
3- 4	0.370	-0.370	9.404	8.394	0.527	-0.527
3- 5	0.845	-0.845	11.232	9.172	0.527	-0.527
3- 6	1.345	-1.345	10.894	8.919	0.527	-0.527
3- 7	1.824	-1.824	10.894	8.919	0.527	-0.527
3- 8	2.302	-2.302	10.894	8.919	0.527	-0.527
3- 9	2.781	-2.781	10.894	8.919	0.527	-0.527
3-10	3.288	-3.288	10.528	8.648	0.527	-0.527
4- 0	2.417	-12.993	-1.629	1.811	7.389	1.123
4- 1	4.583	-6.282	-1.629	1.811	6.093	0.826
4- 2	5.856	-0.683	-1.635	1.793	4.798	0.529
4- 3	6.447	0.172	-1.505	1.876	3.502	-0.221
4- 4	8.691	0.677	-0.817	3.959	2.207	-1.018
4- 5	10.297	0.927	-0.817	4.952	1.068	-1.814
4- 6	11.015	0.534	-1.310	4.952	0.272	-2.610
4- 7	10.647	-1.670	0.281	3.148	-0.452	-3.407
4- 8	9.562	-5.820	1.787	1.642	-0.749	-4.203
4- 9	7.378	-10.881	1.787	1.642	-1.046	-4.999
4-10	4.082	-16.839	1.787	1.642	-1.344	-5.795

***** INFLUENCE LINES FOR MOMENT *****

***** MEMBER NO. 1 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
100	-0.51	-0.41	-0.31	-0.22	-0.12	-0.02	0.08	0.17	0.27	0.37	0.46
105	-0.45	-0.37	-0.29	-0.21	-0.13	-0.05	0.03	0.10	0.18	0.26	0.34
110	-0.39	-0.33	-0.27	-0.20	-0.14	-0.08	-0.02	0.04	0.11	0.17	0.23
115	-0.33	-0.29	-0.24	-0.19	-0.15	-0.10	-0.05	-0.01	0.04	0.09	0.13
120	-0.28	-0.25	-0.21	-0.18	-0.15	-0.12	-0.09	-0.05	-0.02	0.01	0.04
125	-0.22	-0.20	-0.18	-0.17	-0.15	-0.13	-0.11	-0.09	-0.07	-0.06	-0.04
130	-0.17	-0.16	-0.16	-0.15	-0.14	-0.14	-0.13	-0.12	-0.12	-0.11	-0.11
135	-0.12	-0.12	-0.13	-0.13	-0.14	-0.14	-0.15	-0.15	-0.16	-0.16	-0.17
140	-0.07	-0.08	-0.10	-0.11	-0.13	-0.14	-0.16	-0.17	-0.19	-0.20	-0.22
145	-0.02	-0.04	-0.07	-0.09	-0.12	-0.14	-0.16	-0.19	-0.21	-0.24	-0.26
150	0.02	-0.01	-0.04	-0.07	-0.10	-0.14	-0.17	-0.20	-0.23	-0.26	-0.30
155	0.06	0.02	-0.01	-0.05	-0.09	-0.13	-0.17	-0.21	-0.25	-0.28	-0.32
160	0.10	0.05	0.01	-0.03	-0.08	-0.12	-0.17	-0.21	-0.25	-0.30	-0.34
165	0.13	0.08	0.03	-0.01	-0.06	-0.11	-0.16	-0.21	-0.26	-0.31	-0.35
170	0.16	0.11	0.05	0.00	-0.05	-0.10	-0.15	-0.20	-0.26	-0.31	-0.36
175	0.18	0.13	0.07	0.02	-0.04	-0.09	-0.14	-0.20	-0.25	-0.31	-0.36
180	0.20	0.14	0.09	0.03	-0.02	-0.08	-0.13	-0.19	-0.24	-0.30	-0.35
185	0.21	0.15	0.10	0.04	-0.01	-0.07	-0.12	-0.18	-0.23	-0.29	-0.34
190	0.21	0.16	0.11	0.05	0.00	-0.05	-0.11	-0.16	-0.22	-0.27	-0.32
195	0.21	0.16	0.11	0.06	0.01	-0.04	-0.09	-0.15	-0.20	-0.25	-0.30
200	0.20	0.16	0.11	0.06	0.01	-0.03	-0.08	-0.13	-0.18	-0.22	-0.27
205	0.19	0.15	0.10	0.06	0.02	-0.03	-0.07	-0.11	-0.16	-0.20	-0.24
210	0.18	0.14	0.10	0.06	0.02	-0.02	-0.06	-0.10	-0.14	-0.17	-0.21
215	0.16	0.12	0.09	0.05	0.02	-0.01	-0.05	-0.08	-0.11	-0.15	-0.18
220	0.13	0.11	0.08	0.05	0.02	-0.01	-0.04	-0.07	-0.09	-0.12	-0.15
225	0.11	0.09	0.06	0.04	0.02	0.00	-0.03	-0.05	-0.07	-0.10	-0.12
230	0.08	0.07	0.05	0.03	0.01	0.00	-0.02	-0.04	-0.05	-0.07	-0.09
235	0.05	0.04	0.03	0.02	0.01	0.00	-0.01	-0.02	-0.03	-0.04	-0.05
240	0.02	0.02	0.01	0.01	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02
245	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
250	-0.05	-0.04	-0.03	-0.02	-0.01	0.00	0.01	0.02	0.03	0.04	0.05
255	-0.09	-0.07	-0.05	-0.03	-0.02	0.00	0.02	0.03	0.05	0.07	0.08
260	-0.13	-0.10	-0.08	-0.05	-0.03	0.00	0.02	0.05	0.07	0.10	0.12
265	-0.17	-0.14	-0.10	-0.07	-0.04	0.00	0.03	0.06	0.09	0.13	0.16
270	-0.21	-0.17	-0.13	-0.09	-0.05	-0.01	0.03	0.08	0.12	0.16	0.20
275	-0.26	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24
280	-0.30	-0.25	-0.19	-0.13	-0.07	-0.01	0.05	0.11	0.16	0.22	0.28
285	-0.35	-0.29	-0.22	-0.15	-0.08	-0.02	0.05	0.12	0.19	0.26	0.32
290	-0.40	-0.33	-0.25	-0.17	-0.10	-0.02	0.06	0.14	0.21	0.29	0.37
295	-0.46	-0.37	-0.28	-0.20	-0.11	-0.02	0.07	0.15	0.24	0.33	0.41
300	-0.51	-0.41	-0.31	-0.22	-0.12	-0.02	0.07	0.17	0.27	0.36	0.46

***** MEMBER NO. 2 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
100	0.46	0.33	0.19	0.06	-0.08	-0.21	-0.35	-0.49	-0.62	-0.76	-0.89
105	0.34	0.60	0.43	0.26	0.09	-0.07	-0.24	-0.41	-0.58	-0.75	-0.92
110	0.23	0.89	0.68	0.48	0.28	0.07	-0.13	-0.33	-0.54	-0.74	-0.94
115	0.13	0.75	0.94	0.71	0.47	0.23	-0.01	-0.25	-0.48	-0.72	-0.96
120	0.04	0.63	1.21	0.94	0.67	0.40	0.12	-0.15	-0.42	-0.70	-0.97
125	-0.04	0.51	1.06	1.19	0.88	0.57	0.26	-0.05	-0.35	-0.66	-0.97
130	-0.11	0.41	0.92	1.44	1.10	0.75	0.41	0.07	-0.28	-0.62	-0.96
135	-0.17	0.31	0.79	1.27	1.32	0.95	0.57	0.19	-0.19	-0.57	-0.94
140	-0.22	0.23	0.67	1.12	1.56	1.15	0.74	0.32	-0.09	-0.50	-0.92

145	-0.26	0.15	0.56	0.97	1.38	1.36	0.92	0.47	0.02	-0.43	-0.88
150	-0.30	0.08	0.46	0.83	1.21	1.59	1.10	0.62	0.14	-0.34	-0.82
155	-0.32	0.02	0.36	0.71	1.05	1.39	1.31	0.79	0.28	-0.24	-0.76
160	-0.34	-0.03	0.28	0.59	0.90	1.21	1.52	0.97	0.42	-0.13	-0.67
165	-0.35	-0.08	0.20	0.48	0.76	1.04	1.31	1.16	0.58	0.00	-0.58
170	-0.36	-0.11	0.13	0.38	0.63	0.88	1.12	1.37	0.76	0.15	-0.46
175	-0.36	-0.14	0.08	0.29	0.51	0.73	0.95	1.16	0.95	0.31	-0.33
180	-0.35	-0.16	0.03	0.21	0.40	0.59	0.78	0.97	1.16	0.49	-0.18
185	-0.34	-0.18	-0.02	0.14	0.31	0.47	0.63	0.79	0.95	0.69	-0.01
190	-0.32	-0.19	-0.05	0.09	0.22	0.36	0.49	0.63	0.77	0.90	0.18
195	-0.30	-0.19	-0.08	0.04	0.15	0.26	0.37	0.48	0.60	0.71	0.39
200	-0.27	-0.18	-0.09	0.00	0.09	0.18	0.27	0.36	0.45	0.54	0.63
205	-0.24	-0.17	-0.10	-0.04	0.03	0.10	0.17	0.24	0.31	0.38	0.45
210	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29
215	-0.18	-0.15	-0.12	-0.08	-0.05	-0.02	0.01	0.05	0.08	0.11	0.14
220	-0.15	-0.14	-0.12	-0.10	-0.09	-0.07	-0.05	-0.04	-0.02	-0.01	0.01
225	-0.12	-0.12	-0.12	-0.12	-0.12	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11
230	-0.09	-0.10	-0.11	-0.13	-0.14	-0.15	-0.17	-0.18	-0.19	-0.20	-0.22
235	-0.05	-0.08	-0.11	-0.13	-0.16	-0.18	-0.21	-0.24	-0.26	-0.29	-0.31
240	-0.02	-0.06	-0.10	-0.13	-0.17	-0.21	-0.25	-0.29	-0.32	-0.36	-0.40
245	0.01	-0.04	-0.08	-0.13	-0.18	-0.23	-0.28	-0.33	-0.38	-0.43	-0.47
250	0.05	-0.01	-0.07	-0.13	-0.19	-0.25	-0.31	-0.36	-0.42	-0.48	-0.54
255	0.08	0.02	-0.05	-0.12	-0.19	-0.26	-0.33	-0.39	-0.46	-0.53	-0.60
260	0.12	0.04	-0.03	-0.11	-0.19	-0.26	-0.34	-0.42	-0.50	-0.57	-0.65
265	0.16	0.07	-0.01	-0.10	-0.18	-0.27	-0.35	-0.44	-0.53	-0.61	-0.70
270	0.20	0.11	0.01	-0.08	-0.17	-0.27	-0.36	-0.45	-0.55	-0.64	-0.74
275	0.24	0.14	0.04	-0.06	-0.16	-0.26	-0.37	-0.47	-0.57	-0.67	-0.77
280	0.28	0.17	0.06	-0.04	-0.15	-0.26	-0.37	-0.47	-0.58	-0.69	-0.80
285	0.32	0.21	0.09	-0.02	-0.14	-0.25	-0.37	-0.48	-0.60	-0.71	-0.82
290	0.37	0.25	0.12	0.00	-0.12	-0.24	-0.36	-0.48	-0.61	-0.73	-0.85
295	0.41	0.28	0.16	0.03	-0.10	-0.23	-0.36	-0.49	-0.61	-0.74	-0.87
300	0.46	0.32	0.19	0.05	-0.08	-0.22	-0.35	-0.49	-0.62	-0.76	-0.89

***** MEMBER NO. 3 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
105	-0.03	-0.02	-0.01	-0.01	0.00	0.01	0.02	0.03	0.03	0.04	0.05
110	-0.06	-0.04	-0.03	-0.01	0.00	0.02	0.03	0.05	0.06	0.08	0.09
115	-0.08	-0.06	-0.04	-0.01	0.01	0.03	0.05	0.07	0.09	0.11	0.13
120	-0.10	-0.07	-0.04	-0.02	0.01	0.04	0.06	0.09	0.12	0.14	0.17
125	-0.11	-0.08	-0.05	-0.02	0.01	0.05	0.08	0.11	0.14	0.17	0.20
130	-0.12	-0.09	-0.05	-0.02	0.02	0.05	0.09	0.12	0.16	0.19	0.23
135	-0.13	-0.09	-0.05	-0.02	0.02	0.06	0.10	0.14	0.17	0.21	0.25
140	-0.13	-0.09	-0.05	-0.01	0.03	0.07	0.11	0.15	0.19	0.22	0.26
145	-0.14	-0.09	-0.05	-0.01	0.03	0.07	0.11	0.15	0.19	0.23	0.28
150	-0.13	-0.09	-0.05	-0.01	0.03	0.07	0.12	0.16	0.20	0.24	0.28
155	-0.13	-0.09	-0.05	-0.01	0.03	0.08	0.12	0.16	0.20	0.24	0.28
160	-0.12	-0.08	-0.04	0.00	0.04	0.08	0.12	0.16	0.20	0.24	0.28
165	-0.11	-0.08	-0.04	0.00	0.04	0.07	0.11	0.15	0.19	0.23	0.26
170	-0.10	-0.07	-0.03	0.00	0.04	0.07	0.11	0.14	0.18	0.21	0.25
175	-0.09	-0.06	-0.03	0.00	0.03	0.07	0.10	0.13	0.16	0.19	0.22
180	-0.07	-0.05	-0.02	0.00	0.03	0.06	0.08	0.11	0.14	0.16	0.19
185	-0.06	-0.04	-0.02	0.01	0.03	0.05	0.07	0.09	0.11	0.13	0.15
190	-0.04	-0.03	-0.01	0.00	0.02	0.03	0.05	0.06	0.08	0.09	0.11
195	-0.02	-0.01	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.05	0.06
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
205	0.02	0.01	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05	-0.06
210	0.04	0.03	0.01	0.00	-0.02	-0.03	-0.05	-0.06	-0.08	-0.09	-0.11
215	0.06	0.04	0.02	-0.01	-0.03	-0.05	-0.07	-0.09	-0.11	-0.13	-0.15
220	0.07	0.05	0.02	0.00	-0.03	-0.06	-0.08	-0.11	-0.14	-0.16	-0.19
225	0.09	0.06	0.03	0.00	-0.03	-0.07	-0.10	-0.13	-0.16	-0.19	-0.22
230	0.10	0.07	0.03	0.00	-0.04	-0.07	-0.11	-0.14	-0.18	-0.21	-0.25
235	0.11	0.08	0.04	0.00	-0.04	-0.07	-0.11	-0.15	-0.19	-0.23	-0.26
240	0.12	0.08	0.04	0.00	-0.04	-0.08	-0.12	-0.16	-0.20	-0.24	-0.28

245	0.13	0.09	0.05	0.01	-0.03	-0.08	-0.12	-0.16	-0.20	-0.24	-0.28
250	0.13	0.09	0.05	0.01	-0.03	-0.07	-0.12	-0.16	-0.20	-0.24	-0.28
255	0.14	0.09	0.05	0.01	-0.03	-0.07	-0.11	-0.15	-0.19	-0.23	-0.28
260	0.13	0.09	0.05	0.01	-0.03	-0.07	-0.11	-0.15	-0.19	-0.22	-0.26
265	0.13	0.09	0.05	0.02	-0.02	-0.06	-0.10	-0.14	-0.17	-0.21	-0.25
270	0.12	0.09	0.05	0.02	-0.02	-0.05	-0.09	-0.12	-0.16	-0.19	-0.23
275	0.11	0.08	0.05	0.02	-0.01	-0.05	-0.08	-0.11	-0.14	-0.17	-0.20
280	0.10	0.07	0.04	0.02	-0.01	-0.04	-0.06	-0.09	-0.12	-0.14	-0.17
285	0.08	0.06	0.04	0.01	-0.01	-0.03	-0.05	-0.07	-0.09	-0.11	-0.13
290	0.06	0.04	0.03	0.01	0.00	-0.02	-0.03	-0.05	-0.06	-0.08	-0.09
295	0.03	0.02	0.01	0.01	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05
300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

***** MEMBER NO. 4 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
100	0.51	0.23	0.00	-0.18	-0.33	-0.43	-0.48	-0.50	-0.47	-0.40	-0.29
105	0.45	0.19	-0.03	-0.20	-0.34	-0.42	-0.47	-0.47	-0.43	-0.35	-0.22
110	0.39	0.14	-0.06	-0.22	-0.34	-0.42	-0.45	-0.44	-0.39	-0.29	-0.15
115	0.33	0.10	-0.09	-0.24	-0.35	-0.41	-0.43	-0.40	-0.34	-0.23	-0.08
120	0.28	0.06	-0.12	-0.26	-0.35	-0.40	-0.40	-0.37	-0.29	-0.16	0.00
125	0.22	0.02	-0.15	-0.27	-0.35	-0.38	-0.38	-0.33	-0.23	-0.10	0.08
130	0.17	-0.02	-0.18	-0.28	-0.35	-0.37	-0.35	-0.28	-0.18	-0.03	0.17
135	0.12	-0.06	-0.20	-0.29	-0.34	-0.35	-0.32	-0.24	-0.12	0.04	0.25
140	0.07	-0.10	-0.22	-0.30	-0.34	-0.33	-0.29	-0.19	-0.06	0.12	0.34
145	0.02	-0.13	-0.24	-0.31	-0.33	-0.32	-0.25	-0.15	0.00	0.19	0.42
150	-0.02	-0.16	-0.26	-0.32	-0.33	-0.30	-0.22	-0.10	0.06	0.26	0.50
155	-0.06	-0.19	-0.28	-0.32	-0.32	-0.28	-0.19	-0.06	0.11	0.33	0.58
160	-0.10	-0.22	-0.29	-0.32	-0.31	-0.26	-0.16	-0.02	0.17	0.39	0.66
165	-0.13	-0.24	-0.30	-0.32	-0.30	-0.23	-0.13	0.02	0.22	0.45	0.73
170	-0.16	-0.26	-0.31	-0.32	-0.29	-0.21	-0.10	0.06	0.27	0.51	0.80
175	-0.18	-0.27	-0.32	-0.32	-0.28	-0.20	-0.07	0.10	0.31	0.57	0.86
180	-0.20	-0.28	-0.32	-0.31	-0.27	-0.18	-0.04	0.13	0.35	0.61	0.92
185	-0.21	-0.29	-0.32	-0.31	-0.26	-0.16	-0.02	0.16	0.39	0.65	0.96
190	-0.21	-0.29	-0.31	-0.30	-0.24	-0.14	0.00	0.18	0.41	0.69	1.00
195	-0.21	-0.28	-0.31	-0.29	-0.23	-0.13	0.02	0.20	0.44	0.71	1.03
200	-0.20	-0.27	-0.30	-0.28	-0.22	-0.12	0.03	0.22	0.45	0.73	1.04
205	-0.19	-0.26	-0.29	-0.27	-0.21	-0.11	0.04	0.23	0.46	0.73	1.05
210	-0.18	-0.25	-0.28	-0.26	-0.20	-0.10	0.04	0.22	0.45	0.73	1.04
215	-0.16	-0.23	-0.26	-0.25	-0.20	-0.10	0.04	0.22	0.44	0.71	1.02
220	-0.13	-0.21	-0.25	-0.25	-0.20	-0.11	0.03	0.20	0.42	0.69	0.99
225	-0.11	-0.20	-0.24	-0.24	-0.20	-0.12	0.01	0.18	0.40	0.65	0.95
230	-0.08	-0.18	-0.23	-0.24	-0.20	-0.13	-0.01	0.16	0.36	0.61	0.90
235	-0.05	-0.16	-0.22	-0.23	-0.21	-0.14	-0.03	0.13	0.32	0.56	0.85
240	-0.02	-0.13	-0.20	-0.23	-0.21	-0.16	-0.05	0.09	0.28	0.51	0.78
245	0.01	-0.11	-0.19	-0.23	-0.22	-0.17	-0.08	0.05	0.23	0.45	0.71
250	0.05	-0.09	-0.18	-0.23	-0.23	-0.19	-0.11	0.01	0.18	0.39	0.64
255	0.09	-0.06	-0.16	-0.22	-0.24	-0.22	-0.15	-0.04	0.12	0.32	0.56
260	0.13	-0.03	-0.15	-0.22	-0.25	-0.24	-0.18	-0.08	0.06	0.24	0.47
265	0.17	0.00	-0.13	-0.22	-0.26	-0.26	-0.22	-0.13	-0.01	0.17	0.38
270	0.21	0.03	-0.12	-0.22	-0.27	-0.29	-0.26	-0.19	-0.07	0.09	0.29
275	0.26	0.06	-0.10	-0.21	-0.28	-0.31	-0.30	-0.24	-0.14	0.01	0.19
280	0.30	0.09	-0.08	-0.21	-0.29	-0.34	-0.34	-0.29	-0.20	-0.08	0.10
285	0.35	0.13	-0.06	-0.20	-0.30	-0.36	-0.37	-0.34	-0.27	-0.16	0.00
290	0.40	0.16	-0.04	-0.20	-0.31	-0.38	-0.41	-0.40	-0.34	-0.24	-0.10
295	0.46	0.20	-0.02	-0.19	-0.32	-0.41	-0.45	-0.45	-0.41	-0.32	-0.19
300	0.51	0.24	0.01	-0.18	-0.33	-0.43	-0.48	-0.50	-0.47	-0.40	-0.29

***** INFLUENCE LINES FOR SHEAR AND AXIAL FORCE *****

***** MEMBER NO. 1 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	A.F.
100	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	-0.84
105	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	-0.80
110	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	-0.76
115	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	-0.72
120	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.68
125	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-0.64
130	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-0.60
135	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.56
140	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.52
145	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.48
150	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.44
155	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.40
160	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.36
165	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.32
170	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.29
175	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.25
180	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.22
185	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.19
190	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.16
195	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.13
200	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.10
205	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.08
210	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.06
215	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
220	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.02
225	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	0.00
230	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	0.02
235	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.03
240	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.04
245	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
250	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
255	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.08
260	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.09
265	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.10
270	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.11
275	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.12
280	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.13
285	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.13
290	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.14
295	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.15
300	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.16

***** MEMBER NO. 2 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	A.F.
100	0.84	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	0.12
105	0.80	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	0.10
110	0.76	0.76	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24	0.08
115	0.72	0.72	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	0.06
120	0.68	0.68	0.68	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	0.04
125	0.64	0.64	0.64	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36	0.02
130	0.60	0.60	0.60	0.60	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	0.01
135	0.56	0.56	0.56	0.56	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.01
140	0.52	0.52	0.52	0.52	0.52	-0.48	-0.48	-0.48	-0.48	-0.48	-0.48	-0.02

145	0.48	0.48	0.48	0.48	0.48	-0.52	-0.52	-0.52	-0.52	-0.52	-0.52	-0.03
150	0.44	0.44	0.44	0.44	0.44	0.44	-0.56	-0.56	-0.56	-0.56	-0.56	-0.04
155	0.40	0.40	0.40	0.40	0.40	0.40	-0.60	-0.60	-0.60	-0.60	-0.60	-0.05
160	0.36	0.36	0.36	0.36	0.36	0.36	0.36	-0.64	-0.64	-0.64	-0.64	-0.06
165	0.32	0.32	0.32	0.32	0.32	0.32	0.32	-0.68	-0.68	-0.68	-0.68	-0.06
170	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	-0.71	-0.71	-0.71	-0.07
175	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	-0.75	-0.75	-0.75	-0.07
180	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	-0.78	-0.78	-0.07
185	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	-0.81	-0.81	-0.07
190	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	-0.84	-0.07
195	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	-0.87	-0.07
200	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	-0.06
205	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	-0.06
210	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	-0.05
215	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.04
220	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-0.04
225	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.03
230	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
235	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.01
240	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.01
245	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	0.00
250	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	0.01
255	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	0.02
260	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	0.03
265	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	0.04
270	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	0.05
275	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	0.06
280	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	0.07
285	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	0.09
290	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	0.10
295	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	0.11
300	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	0.12

***** MEMBER NO. 3 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	A.F.
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.31
105	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-0.35
110	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-0.38
115	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.41
120	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.44
125	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.48
130	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.51
135	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.54
140	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.57
145	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.60
150	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.63
155	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.66
160	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.68
165	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.71
170	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.73
175	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.75
180	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.76
185	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.77
190	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-0.78
195	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-0.79
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.79
205	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.79
210	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.78
215	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.77
220	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.76
225	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.75
230	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.73
235	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.71
240	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.68

245	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.66
250	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.63
255	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.60
260	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.57
265	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.54
270	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.51
275	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.48
280	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.44
285	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.41
290	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.38
295	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.35
300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.31

***** MEMBER NO. 4 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	A.F.
100	-0.34	-0.29	-0.24	-0.19	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	-0.12
105	-0.33	-0.28	-0.23	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	-0.10
110	-0.31	-0.26	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	-0.08
115	-0.30	-0.25	-0.20	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	-0.06
120	-0.28	-0.23	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	-0.04
125	-0.27	-0.22	-0.17	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	-0.02
130	-0.25	-0.20	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	0.25	-0.01
135	-0.23	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	0.01
140	-0.22	-0.17	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	0.28	0.02
145	-0.20	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.03
150	-0.19	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	0.21	0.26	0.31	0.04
155	-0.17	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	0.28	0.33	0.05
160	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.06
165	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.06
170	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	0.21	0.26	0.31	0.36	0.07
175	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	0.32	0.37	0.07
180	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	0.28	0.33	0.38	0.07
185	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.07
190	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.07
195	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.07
200	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.06
205	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.06
210	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.05
215	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.04
220	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	0.28	0.33	0.38	0.04
225	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	0.32	0.37	0.03
230	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	0.32	0.37	0.02
235	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	0.21	0.26	0.31	0.36	0.01
240	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.01
245	-0.17	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	0.28	0.33	0.00
250	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	0.32	-0.01
255	-0.20	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	0.25	0.30	-0.02
260	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	-0.03
265	-0.23	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	-0.04
270	-0.24	-0.19	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	0.21	0.26	-0.05
275	-0.26	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	-0.06
280	-0.27	-0.22	-0.17	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	-0.07
285	-0.29	-0.24	-0.19	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	0.21	-0.09
290	-0.31	-0.26	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	-0.10
295	-0.33	-0.28	-0.23	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	-0.11
300	-0.34	-0.29	-0.24	-0.19	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	-0.12

JW 17JUL98

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OM
OM                      CULVERT BR#A300
OM                      file: A306LRF7.pol
OM                      Date: 17ul98
OM                      Hydraulic Design
OM                      Double Box Culvert (No Haunch)
OM                      2-Cell Box  8'Wx  7'H
OM                      Load Factor Design
OM                      Rigid Frame Method
OM                      Top and Bot Slab Different
OM                      Exterior and Interior Wall Different
OM
OM                      Maximum Fill Ht Condition (7.0 Ft)
OM
STDLOD      2, 0, 0, 0, 0
SWPRES      1, 2, 60, 15, 62.4
BOXDIM      1, 2,  8,  7, 7, 10
SLBTHK      1, 10.5, 10.0, 7, 7, 1111
H&SKEW      1, 90, 90, 0, 0, 0
REEBAR      18, 9, 1, 11, 4, .016
CONCOV      2, 3, 2, 1.5, .5, .5
MATPRP      120, 60, 24, 3, 0, 0
PRTCTL      1, 1, 1, 0
F&HCTL      1, 1, 1
DESCTL      1, 0, 1, 0, 0, 9
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BL
18 July 98

CONSTANT DATA

STANDARD LIVE LOAD				-	DESIGN METHOD		-	PRINT CONTROL		
TRUCK CODE	OMIT L.L.	STRESS O-FILL	OVERLD AXLE	-	SERVICE LOAD	LOAD FACTOR	-	10th Pt MOMENT	INFL LINE	LOC. NEG MOMENT
HS20	NO	NO	0.		NO	YES		YES	YES	1.00

MATERIAL PROPERTIES						-	THICKNESS INCREMENTS	
SOIL WEIGHT	STEEL Fy	STEEL Fs	CONCRETE STRENGTH	CONCRETE SHEAR	CON.SHEAR W/ STIRRUP	-	SLAB	WALL
120.	60000.	24000.	3000.	0.	0.		0.50	0.50

CONCRETE COVER				-	DESIGN	-	PRINT	-	REINFORCING			
EXTERIOR			INTERIOR	-	SAME	-	BAR	-	BAR SPACING		BAR SIZE	
TOP SLAB	BOT SLAB	WALL	(ALL)	-	THICKNESS SLAB	WALL	TABLE	-	MAX	MIN	MAX	MIN
2.00	3.00	2.00	1.50		NO	NO	YES		18.0	9.0	11	4

CRACK PARAMETER Z = 98.0
MODULAR RATIO N = 9.0

SUPERIMPOSED DEAD LOADS							-	SPECIAL LIVE LOADS		
UNIFORM	CONCENTRATED LOAD						-	WHEEL	FILL	OVERSTRESS
LOAD	WT.	X1	WT.	X2	WT.	X3	-	LOAD	HEIGHT	FACTOR
0.000	0.00	0.0	0.00	0.0	0.00	0.0		0.000	0.000	1.00

DATA FOR STRUCTURE NUMBER 1

CULVERT TYPE	- SPAN - LENGTH	- CLEAR - HEIGHT	- DESIGN - FILL	- CENTERLINE - LENGTH	- SKEW - LEFT	- SKEW - RIGHT	- FLOOR TYPE
DOUBLE	8.00	7.00	7.00	10.00	90	90	FULL

SLAB THICKNESSES				-	LIVE	-	SOIL		-	WATER
TOP SLAB	BOT. SLAB	EXT. WALL	INT. WALL	-	LOAD SURCHARGE	-	PRESSURE MAX	MIN	-	PRESSURE
10.50F	10.00F	7.00F	7.00F		2.00		60.0	15.0		62.4

TOP HAUNCH HEIGHT	BOTTOM HAUNCH HEIGHT	-	RIGID OR FLEXIBLE	-	CHECK MILITARY	-	BAR SPACING INCREMENT
0.0	0.0		RIGID		NO		1 INCH

BOTH HEADWALLS ELIMINATED.

***** LOAD FACTOR DESIGN *****
***** STRESSES AT CRITICAL SECTIONS *****

*** MAXIMUM REINFORCEMENT RATIO (As/bd) = .016

MEMBER NUMBER = 1
MEMBER THICKNESS = 7.00
EXTERIOR WAL

	-MOMENT-	-AXIAL FORCE-	-SHEAR-	-Po-	-Mu-	-Mbal-	-Pbal-	-STEEL AREA-	-SHEAR STRESS-	-ALL.- MOM.	-ALL.- SHEAR
LT	-5.2	5.6	3.5	167.6	5.2	12.0	42.4	0.31	82.1	6.1	123.2
MID	2.1	4.5	0.4	163.5	3.7	12.0	53.5	0.17	8.7	4.4	118.3
MID-	-1.9	5.3	0.4	163.5	3.3	11.0	47.4	0.17	9.7	4.1	118.4
RT	-4.7	5.6	2.9	166.4	4.7	11.0	43.8	0.38	68.1	5.5	122.1

MEMBER NUMBER = 2
MEMBER THICKNESS = 10.50
TOP SLAB

	-MOMENT-	-AXIAL FORCE-	-SHEAR-	-Po-	-Mu-	-Mbal-	-Pbal-	-STEEL AREA-	-SHEAR STRESS-	-ALL.- MOM.	-ALL.- SHEAR
LT	-4.7	3.5	5.0	245.2	8.8	31.0	91.8	0.25	61.5	9.6	125.9
MID	8.4	0.1	0.1	245.2	9.4	32.0	98.4	0.25	1.5	9.4	117.3
RT	-12.6*	-0.1	6.9	249.8	12.6	32.0	85.9	0.37	84.8	12.6	123.6

MEMBER NUMBER = 3
MEMBER THICKNESS = 7.00
INTERIOR WAL

	-MOMENT-	-AXIAL FORCE-	-SHEAR-	-Po-	-Mu-	-Mbal-	-Pbal-	-STEEL AREA-	-SHEAR STRESS-	-ALL.- MOM.	-ALL.- SHEAR
LT	-1.1	12.9	0.1	163.5	3.7	10.0	46.8	0.17	3.5	5.4	117.9
MID	1.1	12.9	0.1	163.5	3.7	10.0	46.8	0.17	3.5	5.4	117.9
RT	-1.3	15.2	0.1	163.5	3.7	10.0	46.8	0.17	2.9	5.7	117.7

MEMBER NUMBER = 4
MEMBER THICKNESS = 10.00
BOTTOM SLAB

	-MOMENT-	-AXIAL FORCE-	-SHEAR-	-Po-	-Mu-	-Mbal-	-Pbal-	-STEEL AREA-	-SHEAR STRESS-	-ALL.- MOM.	-ALL.- SHEAR
LT	-5.2	4.1	5.2	233.7	6.9	25.0	72.5	0.33	78.9	8.0	124.9
MID	8.2	-0.3	0.3	233.5	8.4	29.0	92.4	0.24	3.1	8.3	117.5
RT	-12.7*	-0.3	7.2	242.6	12.7	26.0	61.2	0.47	108.4	12.6	125.7

A CORNER BAR(T)				A CORNER BAR(B)				A TSLAB+		A TSLAB-	
H	V	SZ	SPG	H	V	SZ	SPG	SZ	SPG	SZ	SPG
30	25	5	9.0	30	23	5	9.0	5	9.0	6	9.0

A BSLAB+		A BSLAB-		B EXTIN		B EXTOUT		B INTWL		C1
SZ	SPG	SZ	SPG	SZ	SPG	SZ	SPG	SZ	SPG	BARS
5	9.0	7	9.0	5	12.0	5	9.0	5	12.0	69

** THE HEIGHT OF C.H.C.U. ** BOTTOM SLAB = 3.75 IN
TOP SLAB = 5.25 IN

** T.SLAB *	B.SLAB *	WALL *	INWALL ***	VOLUME ***	STEEL **
IN	IN	IN	IN	CY/FT	LB/FT
10.50	10.00	7.00	7.00	1.577	253

** REINFORCING STEEL BAR SCHEDULE **

LOCATN	BAR	NO.	SZ	TYP	LNGTH	WT.	H LEG	V LEG
TOP SLAB POSV MAIN	A100	14	5	STR	17- 4	253		
BOT SLAB POSV MAIN	A200	14	5	STR	17- 4	253		
TOP SLAB NEGV MAIN	A300	14	6	STR	17- 4	364		
BOT SLAB NEGV MAIN	A400	14	7	STR	17- 4	496		
CORNER (TOP)	A1	28	5	6	4- 7	134	2- 6	2- 1
CORNER (BOTTOM)	A2	28	5	6	4- 5	129	2- 6	1-11
EXTWALL IN	B1	20	5	STR	8- 2	170		
EXTWALL OUT	B2	28	5	STR	6- 4	185		
INTWALL	B3	10	5	STR	8- 2	85		
LONGTD (1)	C1	69	4	STR	9- 8	446		
					TOTAL	2515		

***** SPLICE LENGTHS CHART *****

BAR	SIZE	SPLICE LENGTH
A200	5	1- 8
A400	7	3- 0
B1	5	1- 8
B3	5	1- 8
C1	4	2- 2

** MOMENT * AXIAL FORCE * SHEAR FOR LOAD FACTOR DESIGN AT TENTH POINT **

M-PT	+MOMENT	-MOMENT	+A.F.	-A.F.	+SHEAR	-SHEAR
1- 0	-0.828	-6.863	4.551	5.558	4.538	-0.542
1- 1	-1.178	-3.688	4.551	5.558	3.556	-0.364
1- 2	-0.379	-2.291	5.322	4.953	2.623	-0.218
1- 3	1.041	-2.127	5.066	5.087	1.737	-0.105
1- 4	1.886	-1.920	4.492	5.271	0.900	-0.025
1- 5	2.124	-1.722	4.492	5.432	0.420	-0.286
1- 6	1.762	-1.627	4.492	5.469	0.435	-1.027
1- 7	0.893	-1.587	5.558	5.140	0.418	-1.720
1- 8	-0.330	-1.648	5.342	5.356	0.368	-2.365
1- 9	-0.279	-3.523	4.787	5.605	0.286	-2.961
1-10	-0.097	-6.068	4.787	5.605	0.171	-3.510
2- 0	-0.097	-6.068	-0.171	3.510	6.411	3.676
2- 1	3.442	-1.900	-0.149	3.479	5.170	2.709
2- 2	6.077	0.951	-0.069	3.377	3.875	1.743
2- 3	7.765	2.703	0.049	3.304	2.601	0.733
2- 4	8.415	3.616	0.118	3.304	1.352	-0.649
2- 5	7.904	3.700	0.118	3.304	0.129	-2.031
2- 6	6.229	2.902	0.171	3.131	-1.069	-3.247
2- 7	3.747	0.174	3.494	-0.153	-2.241	-4.494
2- 8	0.479	-3.732	3.510	-0.153	-3.241	-5.770
2- 9	-3.843	-8.565	3.311	-0.133	-4.208	-7.074
2-10	-7.870	-14.717	3.311	-0.079	-5.174	-8.389
3- 0	0.318	-0.368	15.205	12.857	0.146	-0.123
3- 1	0.222	-0.253	15.205	12.857	0.146	-0.123
3- 2	0.125	-0.139	15.205	12.857	0.146	-0.123
3- 3	0.028	-0.029	15.205	11.900	0.146	-0.123
3- 4	0.090	-0.068	14.400	13.661	0.146	-0.123
3- 5	0.205	-0.165	12.857	15.205	0.146	-0.123
3- 6	0.319	-0.262	12.857	15.205	0.146	-0.123
3- 7	0.434	-0.358	12.857	15.205	0.146	-0.123
3- 8	0.548	-0.455	12.857	15.205	0.146	-0.123
3- 9	0.663	-0.552	12.857	15.205	0.146	-0.123
3-10	0.777	-0.648	12.857	15.205	0.146	-0.123
4- 0	-0.828	-6.863	-0.146	4.147	6.623	4.390
4- 1	3.014	-2.080	-0.174	4.147	5.190	3.290
4- 2	5.700	1.137	-0.343	4.187	3.757	2.189
4- 3	7.508	3.206	-0.343	4.357	2.345	1.076
4- 4	8.177	4.330	-0.343	4.408	1.021	-0.284
4- 5	7.651	4.510	-0.343	4.429	-0.256	-1.644
4- 6	5.905	3.745	-0.343	4.429	-1.442	-3.004
4- 7	3.232	1.511	2.667	1.338	-2.542	-4.365
4- 8	0.187	-2.803	4.172	-0.156	-3.643	-5.733
4- 9	-3.838	-8.298	4.172	-0.200	-4.744	-7.143
4-10	-8.763	-14.960	4.172	-0.343	-5.844	-8.565

***** INFLUENCE LINES FOR MOMENT *****

***** MEMBER NO. 1 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
100	-0.51	-0.41	-0.31	-0.22	-0.12	-0.02	0.08	0.17	0.27	0.37	0.46
105	-0.45	-0.37	-0.29	-0.21	-0.13	-0.05	0.03	0.10	0.18	0.26	0.34
110	-0.39	-0.33	-0.27	-0.20	-0.14	-0.08	-0.02	0.04	0.11	0.17	0.23
115	-0.33	-0.29	-0.24	-0.19	-0.15	-0.10	-0.05	-0.01	0.04	0.09	0.13
120	-0.28	-0.25	-0.21	-0.18	-0.15	-0.12	-0.09	-0.05	-0.02	0.01	0.04
125	-0.22	-0.20	-0.18	-0.17	-0.15	-0.13	-0.11	-0.09	-0.07	-0.06	-0.04
130	-0.17	-0.16	-0.16	-0.15	-0.14	-0.14	-0.13	-0.12	-0.12	-0.11	-0.11
135	-0.12	-0.12	-0.13	-0.13	-0.14	-0.14	-0.15	-0.15	-0.16	-0.16	-0.17
140	-0.07	-0.08	-0.10	-0.11	-0.13	-0.14	-0.16	-0.17	-0.19	-0.20	-0.22
145	-0.02	-0.04	-0.07	-0.09	-0.12	-0.14	-0.16	-0.19	-0.21	-0.24	-0.26
150	0.02	-0.01	-0.04	-0.07	-0.10	-0.14	-0.17	-0.20	-0.23	-0.26	-0.30
155	0.06	0.02	-0.01	-0.05	-0.09	-0.13	-0.17	-0.21	-0.25	-0.28	-0.32
160	0.10	0.05	0.01	-0.03	-0.08	-0.12	-0.17	-0.21	-0.25	-0.30	-0.34
165	0.13	0.08	0.03	-0.01	-0.06	-0.11	-0.16	-0.21	-0.26	-0.31	-0.35
170	0.16	0.11	0.05	0.00	-0.05	-0.10	-0.15	-0.20	-0.26	-0.31	-0.36
175	0.18	0.13	0.07	0.02	-0.04	-0.09	-0.14	-0.20	-0.25	-0.31	-0.36
180	0.20	0.14	0.09	0.03	-0.02	-0.08	-0.13	-0.19	-0.24	-0.30	-0.35
185	0.21	0.15	0.10	0.04	-0.01	-0.07	-0.12	-0.18	-0.23	-0.29	-0.34
190	0.21	0.16	0.11	0.05	0.00	-0.05	-0.11	-0.16	-0.22	-0.27	-0.32
195	0.21	0.16	0.11	0.06	0.01	-0.04	-0.09	-0.15	-0.20	-0.25	-0.30
200	0.20	0.16	0.11	0.06	0.01	-0.03	-0.08	-0.13	-0.18	-0.22	-0.27
205	0.19	0.15	0.10	0.06	0.02	-0.03	-0.07	-0.11	-0.16	-0.20	-0.24
210	0.18	0.14	0.10	0.06	0.02	-0.02	-0.06	-0.10	-0.14	-0.17	-0.21
215	0.16	0.12	0.09	0.05	0.02	-0.01	-0.05	-0.08	-0.11	-0.15	-0.18
220	0.13	0.11	0.08	0.05	0.02	-0.01	-0.04	-0.07	-0.09	-0.12	-0.15
225	0.11	0.09	0.06	0.04	0.02	0.00	-0.03	-0.05	-0.07	-0.10	-0.12
230	0.08	0.07	0.05	0.03	0.01	0.00	-0.02	-0.04	-0.05	-0.07	-0.09
235	0.05	0.04	0.03	0.02	0.01	0.00	-0.01	-0.02	-0.03	-0.04	-0.05
240	0.02	0.02	0.01	0.01	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02
245	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
250	-0.05	-0.04	-0.03	-0.02	-0.01	0.00	0.01	0.02	0.03	0.04	0.05
255	-0.09	-0.07	-0.05	-0.03	-0.02	0.00	0.02	0.03	0.05	0.07	0.08
260	-0.13	-0.10	-0.08	-0.05	-0.03	0.00	0.02	0.05	0.07	0.10	0.12
265	-0.17	-0.14	-0.10	-0.07	-0.04	0.00	0.03	0.06	0.09	0.13	0.16
270	-0.21	-0.17	-0.13	-0.09	-0.05	-0.01	0.03	0.08	0.12	0.16	0.20
275	-0.26	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24
280	-0.30	-0.25	-0.19	-0.13	-0.07	-0.01	0.05	0.11	0.16	0.22	0.28
285	-0.35	-0.29	-0.22	-0.15	-0.08	-0.02	0.05	0.12	0.19	0.26	0.32
290	-0.40	-0.33	-0.25	-0.17	-0.10	-0.02	0.06	0.14	0.21	0.29	0.37
295	-0.46	-0.37	-0.28	-0.20	-0.11	-0.02	0.07	0.15	0.24	0.33	0.41
300	-0.51	-0.41	-0.31	-0.22	-0.12	-0.02	0.07	0.17	0.27	0.36	0.46

***** MEMBER NO. 2 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
100	0.46	0.33	0.19	0.06	-0.08	-0.21	-0.35	-0.49	-0.62	-0.76	-0.89
105	0.34	0.60	0.43	0.26	0.09	-0.07	-0.24	-0.41	-0.58	-0.75	-0.92
110	0.23	0.89	0.68	0.48	0.28	0.07	-0.13	-0.33	-0.54	-0.74	-0.94
115	0.13	0.75	0.94	0.71	0.47	0.23	-0.01	-0.25	-0.48	-0.72	-0.96
120	0.04	0.63	1.21	0.94	0.67	0.40	0.12	-0.15	-0.42	-0.70	-0.97
125	-0.04	0.51	1.06	1.19	0.88	0.57	0.26	-0.05	-0.35	-0.66	-0.97
130	-0.11	0.41	0.92	1.44	1.10	0.75	0.41	0.07	-0.28	-0.62	-0.96
135	-0.17	0.31	0.79	1.27	1.32	0.95	0.57	0.19	-0.19	-0.57	-0.94
140	-0.22	0.23	0.67	1.12	1.56	1.15	0.74	0.32	-0.09	-0.50	-0.92

145	-0.26	0.15	0.56	0.97	1.38	1.36	0.92	0.47	0.02	-0.43	-0.88
150	-0.30	0.08	0.46	0.83	1.21	1.59	1.10	0.62	0.14	-0.34	-0.82
155	-0.32	0.02	0.36	0.71	1.05	1.39	1.31	0.79	0.28	-0.24	-0.76
160	-0.34	-0.03	0.28	0.59	0.90	1.21	1.52	0.97	0.42	-0.13	-0.67
165	-0.35	-0.08	0.20	0.48	0.76	1.04	1.31	1.16	0.58	0.00	-0.58
170	-0.36	-0.11	0.13	0.38	0.63	0.88	1.12	1.37	0.76	0.15	-0.46
175	-0.36	-0.14	0.08	0.29	0.51	0.73	0.95	1.16	0.95	0.31	-0.33
180	-0.35	-0.16	0.03	0.21	0.40	0.59	0.78	0.97	1.16	0.49	-0.18
185	-0.34	-0.18	-0.02	0.14	0.31	0.47	0.63	0.79	0.95	0.69	-0.01
190	-0.32	-0.19	-0.05	0.09	0.22	0.36	0.49	0.63	0.77	0.90	0.18
195	-0.30	-0.19	-0.08	0.04	0.15	0.26	0.37	0.48	0.60	0.71	0.39
200	-0.27	-0.18	-0.09	0.00	0.09	0.18	0.27	0.36	0.45	0.54	0.63
205	-0.24	-0.17	-0.10	-0.04	0.03	0.10	0.17	0.24	0.31	0.38	0.45
210	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29
215	-0.18	-0.15	-0.12	-0.08	-0.05	-0.02	0.01	0.05	0.08	0.11	0.14
220	-0.15	-0.14	-0.12	-0.10	-0.09	-0.07	-0.05	-0.04	-0.02	-0.01	0.01
225	-0.12	-0.12	-0.12	-0.12	-0.12	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11
230	-0.09	-0.10	-0.11	-0.13	-0.14	-0.15	-0.17	-0.18	-0.19	-0.20	-0.22
235	-0.05	-0.08	-0.11	-0.13	-0.16	-0.18	-0.21	-0.24	-0.26	-0.29	-0.31
240	-0.02	-0.06	-0.10	-0.13	-0.17	-0.21	-0.25	-0.29	-0.32	-0.36	-0.40
245	0.01	-0.04	-0.08	-0.13	-0.18	-0.23	-0.28	-0.33	-0.38	-0.43	-0.47
250	0.05	-0.01	-0.07	-0.13	-0.19	-0.25	-0.31	-0.36	-0.42	-0.48	-0.54
255	0.08	0.02	-0.05	-0.12	-0.19	-0.26	-0.33	-0.39	-0.46	-0.53	-0.60
260	0.12	0.04	-0.03	-0.11	-0.19	-0.26	-0.34	-0.42	-0.50	-0.57	-0.65
265	0.16	0.07	-0.01	-0.10	-0.18	-0.27	-0.35	-0.44	-0.53	-0.61	-0.70
270	0.20	0.11	0.01	-0.08	-0.17	-0.27	-0.36	-0.45	-0.55	-0.64	-0.74
275	0.24	0.14	0.04	-0.06	-0.16	-0.26	-0.37	-0.47	-0.57	-0.67	-0.77
280	0.28	0.17	0.06	-0.04	-0.15	-0.26	-0.37	-0.47	-0.58	-0.69	-0.80
285	0.32	0.21	0.09	-0.02	-0.14	-0.25	-0.37	-0.48	-0.60	-0.71	-0.82
290	0.37	0.25	0.12	0.00	-0.12	-0.24	-0.36	-0.48	-0.61	-0.73	-0.85
295	0.41	0.28	0.16	0.03	-0.10	-0.23	-0.36	-0.49	-0.61	-0.74	-0.87
300	0.46	0.32	0.19	0.05	-0.08	-0.22	-0.35	-0.49	-0.62	-0.76	-0.89

***** MEMBER NO. 3 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
105	-0.03	-0.02	-0.01	-0.01	0.00	0.01	0.02	0.03	0.03	0.04	0.05
110	-0.06	-0.04	-0.03	-0.01	0.00	0.02	0.03	0.05	0.06	0.08	0.09
115	-0.08	-0.06	-0.04	-0.01	0.01	0.03	0.05	0.07	0.09	0.11	0.13
120	-0.10	-0.07	-0.04	-0.02	0.01	0.04	0.06	0.09	0.12	0.14	0.17
125	-0.11	-0.08	-0.05	-0.02	0.01	0.05	0.08	0.11	0.14	0.17	0.20
130	-0.12	-0.09	-0.05	-0.02	0.02	0.05	0.09	0.12	0.16	0.19	0.23
135	-0.13	-0.09	-0.05	-0.02	0.02	0.06	0.10	0.14	0.17	0.21	0.25
140	-0.13	-0.09	-0.05	-0.01	0.03	0.07	0.11	0.15	0.19	0.22	0.26
145	-0.14	-0.09	-0.05	-0.01	0.03	0.07	0.11	0.15	0.19	0.23	0.28
150	-0.13	-0.09	-0.05	-0.01	0.03	0.07	0.12	0.16	0.20	0.24	0.28
155	-0.13	-0.09	-0.05	-0.01	0.03	0.08	0.12	0.16	0.20	0.24	0.28
160	-0.12	-0.08	-0.04	0.00	0.04	0.08	0.12	0.16	0.20	0.24	0.28
165	-0.11	-0.08	-0.04	0.00	0.04	0.07	0.11	0.15	0.19	0.23	0.26
170	-0.10	-0.07	-0.03	0.00	0.04	0.07	0.11	0.14	0.18	0.21	0.25
175	-0.09	-0.06	-0.03	0.00	0.03	0.07	0.10	0.13	0.16	0.19	0.22
180	-0.07	-0.05	-0.02	0.00	0.03	0.06	0.08	0.11	0.14	0.16	0.19
185	-0.06	-0.04	-0.02	0.01	0.03	0.05	0.07	0.09	0.11	0.13	0.15
190	-0.04	-0.03	-0.01	0.00	0.02	0.03	0.05	0.06	0.08	0.09	0.11
195	-0.02	-0.01	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.05	0.06
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
205	0.02	0.01	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05	-0.06
210	0.04	0.03	0.01	0.00	-0.02	-0.03	-0.05	-0.06	-0.08	-0.09	-0.11
215	0.06	0.04	0.02	-0.01	-0.03	-0.05	-0.07	-0.09	-0.11	-0.13	-0.15
220	0.07	0.05	0.02	0.00	-0.03	-0.06	-0.08	-0.11	-0.14	-0.16	-0.19
225	0.09	0.06	0.03	0.00	-0.03	-0.07	-0.10	-0.13	-0.16	-0.19	-0.22
230	0.10	0.07	0.03	0.00	-0.04	-0.07	-0.11	-0.14	-0.18	-0.21	-0.25
235	0.11	0.08	0.04	0.00	-0.04	-0.07	-0.11	-0.15	-0.19	-0.23	-0.26
240	0.12	0.08	0.04	0.00	-0.04	-0.08	-0.12	-0.16	-0.20	-0.24	-0.28

245	0.13	0.09	0.05	0.01	-0.03	-0.08	-0.12	-0.16	-0.20	-0.24	-0.28
250	0.13	0.09	0.05	0.01	-0.03	-0.07	-0.12	-0.16	-0.20	-0.24	-0.28
255	0.14	0.09	0.05	0.01	-0.03	-0.07	-0.11	-0.15	-0.19	-0.23	-0.28
260	0.13	0.09	0.05	0.01	-0.03	-0.07	-0.11	-0.15	-0.19	-0.22	-0.26
265	0.13	0.09	0.05	0.02	-0.02	-0.06	-0.10	-0.14	-0.17	-0.21	-0.25
270	0.12	0.09	0.05	0.02	-0.02	-0.05	-0.09	-0.12	-0.16	-0.19	-0.23
275	0.11	0.08	0.05	0.02	-0.01	-0.05	-0.08	-0.11	-0.14	-0.17	-0.20
280	0.10	0.07	0.04	0.02	-0.01	-0.04	-0.06	-0.09	-0.12	-0.14	-0.17
285	0.08	0.06	0.04	0.01	-0.01	-0.03	-0.05	-0.07	-0.09	-0.11	-0.13
290	0.06	0.04	0.03	0.01	0.00	-0.02	-0.03	-0.05	-0.06	-0.08	-0.09
295	0.03	0.02	0.01	0.01	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05
300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

***** MEMBER NO. 4 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
100	0.51	0.23	0.00	-0.18	-0.33	-0.43	-0.48	-0.50	-0.47	-0.40	-0.29
105	0.45	0.19	-0.03	-0.20	-0.34	-0.42	-0.47	-0.47	-0.43	-0.35	-0.22
110	0.39	0.14	-0.06	-0.22	-0.34	-0.42	-0.45	-0.44	-0.39	-0.29	-0.15
115	0.33	0.10	-0.09	-0.24	-0.35	-0.41	-0.43	-0.40	-0.34	-0.23	-0.08
120	0.28	0.06	-0.12	-0.26	-0.35	-0.40	-0.40	-0.37	-0.29	-0.16	0.00
125	0.22	0.02	-0.15	-0.27	-0.35	-0.38	-0.38	-0.33	-0.23	-0.10	0.08
130	0.17	-0.02	-0.18	-0.28	-0.35	-0.37	-0.35	-0.28	-0.18	-0.03	0.17
135	0.12	-0.06	-0.20	-0.29	-0.34	-0.35	-0.32	-0.24	-0.12	0.04	0.25
140	0.07	-0.10	-0.22	-0.30	-0.34	-0.33	-0.29	-0.19	-0.06	0.12	0.34
145	0.02	-0.13	-0.24	-0.31	-0.33	-0.32	-0.25	-0.15	0.00	0.19	0.42
150	-0.02	-0.16	-0.26	-0.32	-0.33	-0.30	-0.22	-0.10	0.06	0.26	0.50
155	-0.06	-0.19	-0.28	-0.32	-0.32	-0.28	-0.19	-0.06	0.11	0.33	0.58
160	-0.10	-0.22	-0.29	-0.32	-0.31	-0.26	-0.16	-0.02	0.17	0.39	0.66
165	-0.13	-0.24	-0.30	-0.32	-0.30	-0.23	-0.13	0.02	0.22	0.45	0.73
170	-0.16	-0.26	-0.31	-0.32	-0.29	-0.21	-0.10	0.06	0.27	0.51	0.80
175	-0.18	-0.27	-0.32	-0.32	-0.28	-0.20	-0.07	0.10	0.31	0.57	0.86
180	-0.20	-0.28	-0.32	-0.31	-0.27	-0.18	-0.04	0.13	0.35	0.61	0.92
185	-0.21	-0.29	-0.32	-0.31	-0.26	-0.16	-0.02	0.16	0.39	0.65	0.96
190	-0.21	-0.29	-0.31	-0.30	-0.24	-0.14	0.00	0.18	0.41	0.69	1.00
195	-0.21	-0.28	-0.31	-0.29	-0.23	-0.13	0.02	0.20	0.44	0.71	1.03
200	-0.20	-0.27	-0.30	-0.28	-0.22	-0.12	0.03	0.22	0.45	0.73	1.04
205	-0.19	-0.26	-0.29	-0.27	-0.21	-0.11	0.04	0.23	0.46	0.73	1.05
210	-0.18	-0.25	-0.28	-0.26	-0.20	-0.10	0.04	0.22	0.45	0.73	1.04
215	-0.16	-0.23	-0.26	-0.25	-0.20	-0.10	0.04	0.22	0.44	0.71	1.02
220	-0.13	-0.21	-0.25	-0.25	-0.20	-0.11	0.03	0.20	0.42	0.69	0.99
225	-0.11	-0.20	-0.24	-0.24	-0.20	-0.12	0.01	0.18	0.40	0.65	0.95
230	-0.08	-0.18	-0.23	-0.24	-0.20	-0.13	-0.01	0.16	0.36	0.61	0.90
235	-0.05	-0.16	-0.22	-0.23	-0.21	-0.14	-0.03	0.13	0.32	0.56	0.85
240	-0.02	-0.13	-0.20	-0.23	-0.21	-0.16	-0.05	0.09	0.28	0.51	0.78
245	0.01	-0.11	-0.19	-0.23	-0.22	-0.17	-0.08	0.05	0.23	0.45	0.71
250	0.05	-0.09	-0.18	-0.23	-0.23	-0.19	-0.11	0.01	0.18	0.39	0.64
255	0.09	-0.06	-0.16	-0.22	-0.24	-0.22	-0.15	-0.04	0.12	0.32	0.56
260	0.13	-0.03	-0.15	-0.22	-0.25	-0.24	-0.18	-0.08	0.06	0.24	0.47
265	0.17	0.00	-0.13	-0.22	-0.26	-0.26	-0.22	-0.13	-0.01	0.17	0.38
270	0.21	0.03	-0.12	-0.22	-0.27	-0.29	-0.26	-0.19	-0.07	0.09	0.29
275	0.26	0.06	-0.10	-0.21	-0.28	-0.31	-0.30	-0.24	-0.14	0.01	0.19
280	0.30	0.09	-0.08	-0.21	-0.29	-0.34	-0.34	-0.29	-0.20	-0.08	0.10
285	0.35	0.13	-0.06	-0.20	-0.30	-0.36	-0.37	-0.34	-0.27	-0.16	0.00
290	0.40	0.16	-0.04	-0.20	-0.31	-0.38	-0.41	-0.40	-0.34	-0.24	-0.10
295	0.46	0.20	-0.02	-0.19	-0.32	-0.41	-0.45	-0.45	-0.41	-0.32	-0.19
300	0.51	0.24	0.01	-0.18	-0.33	-0.43	-0.48	-0.50	-0.47	-0.40	-0.29

***** INFLUENCE LINES FOR SHEAR AND AXIAL FORCE *****

***** MEMBER NO. 1 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	A.F.
100	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	-0.84
105	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	-0.80
110	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	-0.76
115	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	-0.72
120	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.68
125	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-0.64
130	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-0.60
135	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.56
140	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.52
145	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.48
150	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.44
155	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.40
160	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.36
165	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.32
170	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.29
175	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.25
180	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.22
185	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.19
190	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.16
195	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.13
200	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.10
205	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.08
210	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.06
215	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
220	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.02
225	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	0.00
230	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	0.02
235	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.03
240	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.04
245	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
250	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
255	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.08
260	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.09
265	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.10
270	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.11
275	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.12
280	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.13
285	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.13
290	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.14
295	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.15
300	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.16

***** MEMBER NO. 2 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	A.F.
100	0.84	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	0.12
105	0.80	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	0.10
110	0.76	0.76	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24	-0.24	0.08
115	0.72	0.72	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	0.06
120	0.68	0.68	0.68	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32	0.04
125	0.64	0.64	0.64	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36	-0.36	0.02
130	0.60	0.60	0.60	0.60	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	0.01
135	0.56	0.56	0.56	0.56	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.44	-0.01
140	0.52	0.52	0.52	0.52	0.52	-0.48	-0.48	-0.48	-0.48	-0.48	-0.48	-0.02

145	0.48	0.48	0.48	0.48	0.48	-0.52	-0.52	-0.52	-0.52	-0.52	-0.52	-0.03
150	0.44	0.44	0.44	0.44	0.44	0.44	-0.56	-0.56	-0.56	-0.56	-0.56	-0.04
155	0.40	0.40	0.40	0.40	0.40	0.40	-0.60	-0.60	-0.60	-0.60	-0.60	-0.05
160	0.36	0.36	0.36	0.36	0.36	0.36	0.36	-0.64	-0.64	-0.64	-0.64	-0.06
165	0.32	0.32	0.32	0.32	0.32	0.32	0.32	-0.68	-0.68	-0.68	-0.68	-0.06
170	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	-0.71	-0.71	-0.71	-0.07
175	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	-0.75	-0.75	-0.75	-0.07
180	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	-0.78	-0.78	-0.07
185	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	-0.81	-0.81	-0.07
190	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	-0.84	-0.07
195	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	-0.87	-0.07
200	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	-0.06
205	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	-0.06
210	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	-0.05
215	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.04
220	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-0.04
225	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.03
230	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
235	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.01
240	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.01
245	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	0.00
250	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	0.01
255	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	0.02
260	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	0.03
265	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	0.04
270	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	0.05
275	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	0.06
280	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	0.07
285	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	0.09
290	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	0.10
295	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	0.11
300	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	0.12

***** MEMBER NO. 3 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	A.F.
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.31
105	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-0.35
110	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-0.38
115	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.41
120	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.44
125	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.48
130	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.51
135	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.54
140	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.57
145	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.60
150	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.63
155	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.66
160	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.68
165	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-0.71
170	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.73
175	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-0.75
180	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.76
185	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	-0.77
190	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-0.78
195	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-0.79
200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.79
205	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.79
210	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.78
215	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.77
220	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.76
225	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.75
230	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.73
235	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.71
240	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.68

245	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.66
250	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.63
255	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.60
260	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.57
265	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.54
270	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.51
275	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.48
280	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.44
285	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.41
290	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.38
295	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.35
300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.31

***** MEMBER NO. 4 *****

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	A.F.
100	-0.34	-0.29	-0.24	-0.19	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	-0.12
105	-0.33	-0.28	-0.23	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	-0.10
110	-0.31	-0.26	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	-0.08
115	-0.30	-0.25	-0.20	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	-0.06
120	-0.28	-0.23	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	-0.04
125	-0.27	-0.22	-0.17	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	-0.02
130	-0.25	-0.20	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	0.25	-0.01
135	-0.23	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	0.01
140	-0.22	-0.17	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	0.28	0.02
145	-0.20	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.03
150	-0.19	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	0.21	0.26	0.31	0.04
155	-0.17	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	0.28	0.33	0.05
160	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.06
165	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.06
170	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	0.21	0.26	0.31	0.36	0.07
175	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	0.32	0.37	0.07
180	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	0.28	0.33	0.38	0.07
185	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.07
190	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.07
195	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.07
200	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.06
205	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.06
210	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.05
215	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.39	0.04
220	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	0.28	0.33	0.38	0.04
225	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	0.32	0.37	0.03
230	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	0.32	0.37	0.02
235	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	0.21	0.26	0.31	0.36	0.01
240	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	0.34	0.01
245	-0.17	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	0.28	0.33	0.00
250	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	0.32	-0.01
255	-0.20	-0.15	-0.10	-0.05	0.00	0.05	0.10	0.15	0.20	0.25	0.30	-0.02
260	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	0.29	-0.03
265	-0.23	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	0.22	0.27	-0.04
270	-0.24	-0.19	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	0.21	0.26	-0.05
275	-0.26	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	0.24	-0.06
280	-0.27	-0.22	-0.17	-0.12	-0.07	-0.02	0.03	0.08	0.13	0.18	0.23	-0.07
285	-0.29	-0.24	-0.19	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	0.21	-0.09
290	-0.31	-0.26	-0.21	-0.16	-0.11	-0.06	-0.01	0.04	0.09	0.14	0.19	-0.10
295	-0.33	-0.28	-0.23	-0.18	-0.13	-0.08	-0.03	0.02	0.07	0.12	0.17	-0.11
300	-0.34	-0.29	-0.24	-0.19	-0.14	-0.09	-0.04	0.01	0.06	0.11	0.16	-0.12

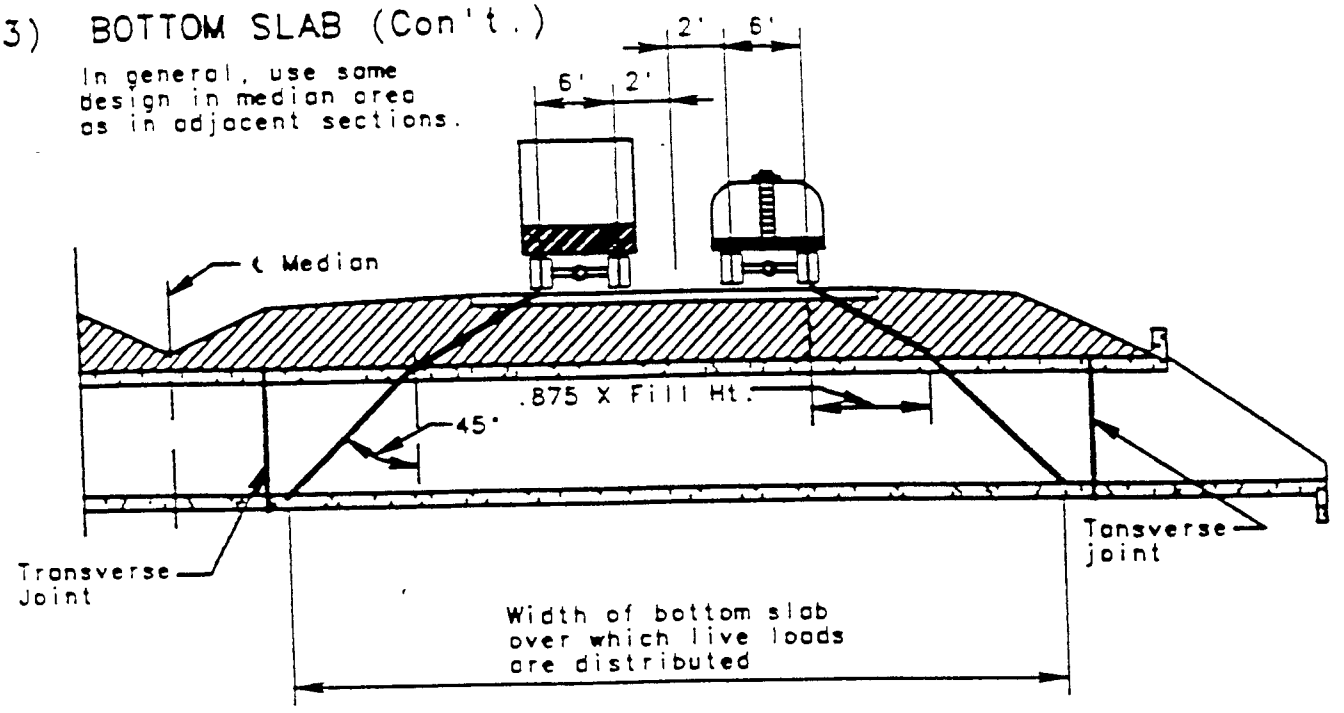
KSW 14 JULY 98

WINGHAVEN BEARING PRESSURES (MAX FILL) (MIN FILL)

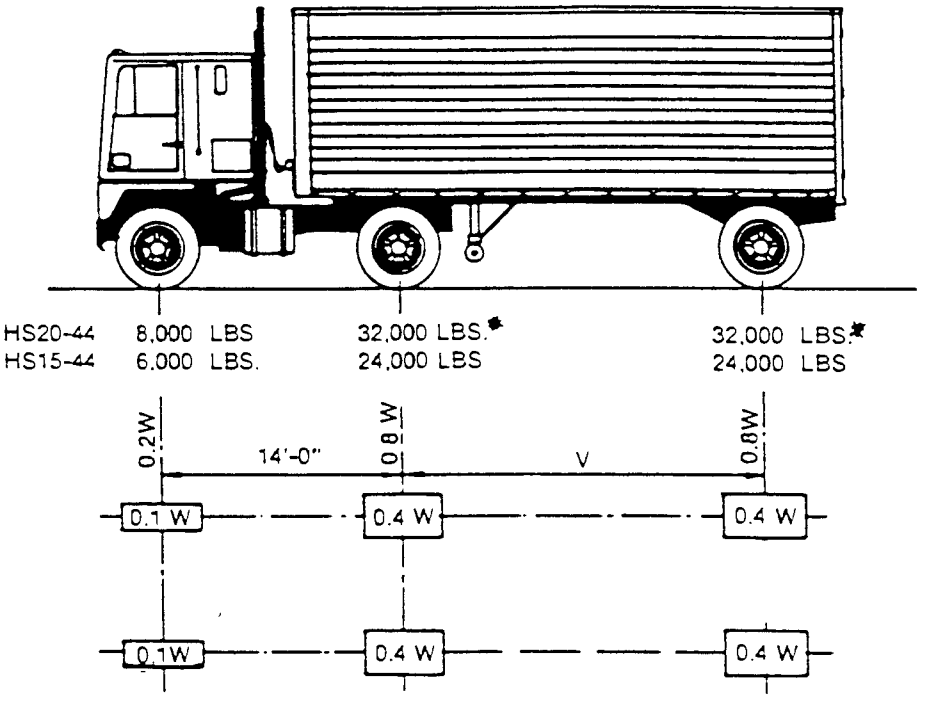
BRIDGE #	A3210012 1 CELL	A3210013 1 CELL	A3210014 4 CELL	A3210015 5 CELL	A3210016 2 CELL	A3210012 1 CELL	A3210013 1 CELL	A3210014 4 CELL	A3210015 5 CELL	A3210016 2 CELL
CULVERTP 13-Jul-98										
LIVE LOAD TWO HS20 AXLE	64000	64000	64000	64000	64000	64000	64000	64000	64000	64000
LBS PER SQ FT	57	57	44	31	43	92	92	60	47	96
LANE LOAD	64	64	64	64	64	64	64	64	64	64
FILL HEIGHT (FT)	5	5	4	6	8	1	1	1	1	1
CULVERT DIMENSIONS										
NUMBER OF CELLS N =	1	1	4	5	2	1	1	4	5	2
OPENING WIDTH (FT) S =	10	10	12	12	8	10	10	12	12	8
OPENING HEIGHT (FT) H =	7	7	10	12	7	7	7	10	12	7
TOP SLAB THICK (IN) D1 =	11.5	11.5	11.5	11.5	10.5	11.5	11.5	11.5	11.5	10.5
BOTTOM SLAB THICK (IN) D2 =	11	11	12.5	11.5	9.5	11	11	12.5	11.5	9.5
EXTERIOR WALL THICK (IN) T =	8	8	8	8.5	7	8	8	8	8.5	7
INTERIOR WALL THICK (IN)TI =	0	0	8	7	6	0	0	8	7	6
TOTAL WIDTH(IN) C =	136	136	616	765	212	136	136	616	765	212
TOTAL WIDTH(FT) C =	11.333	11.333	51.333	63.750	17.667	11.333	11.333	51.333	63.750	17.667
WEIGHT PER FT OF LENGTH										
LIVE LOAD	64	64	64	64	64	92	92	64	64	96
FILL	600	600	480	720	960	120	120	120	120	120
CULVERT	405	405	397	393	349	405	405	397	393	349
TOTAL LBS PER SQ FT	1069	1069	941	1177	1373	617	617	581	577	565

3) BOTTOM SLAB (Con't.)

In general, use same design in median area as in adjacent sections.



LOADING CONDITION – INTERIOR SECTION OF BOXES WITH TRANSVERSE JOINTS



W = COMBINED WEIGHT ON THE FIRST TWO AXLES WHICH IS THE SAME AS FOR THE CORRESPONDING H. TRUCK.

V = VARIABLE SPACING — 14 FEET TO 30 FEET INCLUSIVE. SPACING TO BE USED IS THAT WHICH PRODUCES MAXIMUM STRESSES.

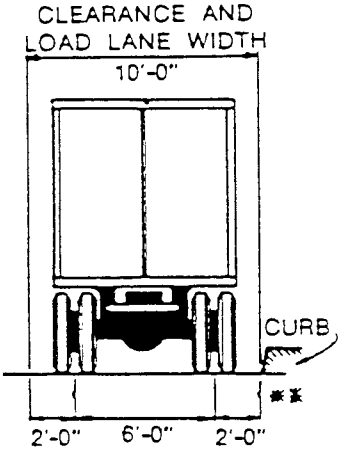
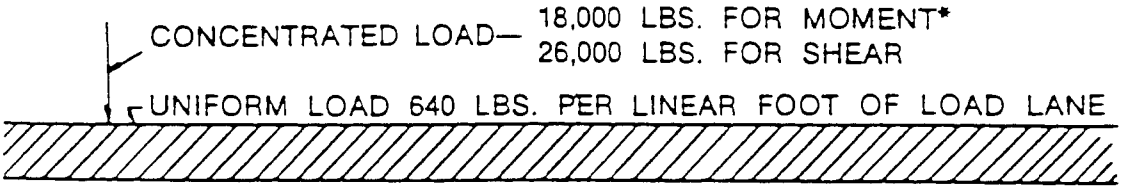


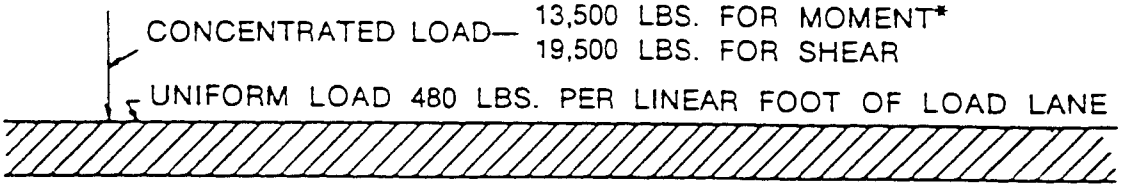
FIGURE 3.7.7A. Standard HS Trucks

*In the design of timber floors and orthotropic steel decks (excluding transverse beams) for H 20 loading, one axle load of 24,000 pounds or two axle loads of 16,000 pounds each, spaced 4 feet apart may be used, whichever produces the greater stress, instead of the 32,000-pound axle shown.

**For slab design, the center line of wheels shall be assumed to be 1 foot from face of curb. (See Article 3.24.2.)



H20-44 LOADING
HS20-44 LOADING



H15-44 LOADING
HS15-44 LOADING

FIGURE 3.7.6B. Lane Loading

*For the loading of continuous spans involving lane loading refer to Article 3.11.3 which provides for an additional concentrated load

L = length in feet of the portion of the span that is loaded to produce the maximum stress in the member.

3.8.2.2 For uniformity of application, in this formula, the loaded length, L, shall be as follows:

(a) For roadway floors: the design span length.
(b) For transverse members, such as floor beams: the span length of member center to center of supports.
(c) For computing truck load moments: the span length, or for cantilever arms the length from the moment center to the farthermost axle.
(d) For shear due to truck loads: the length of the loaded portion of span from the point under consideration to the far reaction; except, for cantilever arms, use a 30 percent impact factor.
(e) For continuous spans: the length of span under consideration for positive moment, and the average of two adjacent loaded spans for negative moment.

3.8.2.3 For culverts with cover

0′0″ to 1′-0″ inc. I = 30%
1′-1″ to 2′-0″ inc. I = 20%
2′-1″ to 2′-11″ inc. I = 10%

3.9 LONGITUDINAL FORCES

Provision shall be made for the effect of a longitudinal force of 5 percent of the live load in all lanes carrying traffic headed in the same direction. All lanes shall be loaded for bridges likely to become one directional in the future. The load used, without impact, shall be the lane load plus the concentrated load for moment specified in Article 3.7, with reduction for multiple-loaded lanes as specified in Article 3.12. The center of gravity of the longitudinal force shall be assumed to be located 6 feet above the floor slab and to be transmitted to the substructure through the superstructure.

WYOMING DEPARTMENT OF TRANSPORTATION
Program for the Design of Reinforced Concrete Box Culverts

BRASS - CULVERT

Version 1

User Manual
January, 1995

BRASS-CULVERT	COMMAND DESCRIPTION
COMMAND NAME	STDLOD
PURPOSE	STDLOD defines the standard truck loads to be used.

5 COMMAND PARAMETERS

Truck Code (1-8)	Enter the code for the desired truck load to be applied. The codes are: 1) HS 25 2) HS 20 3) H 20 4) HS 15 5) H 15 6) HS 10 7) H 10 8) Special Live Load Only 9) No Live Load Special live loads are defined with the SPLLOD command.
Check Military Load (0,1)	When HS 25 or HS 20 truck loading is specified, the standard military load in two adjacent lanes will be checked if specified here. Enter 1 to check military load as a separate load case, else enter 0.
Neglect Live Load (0,1)	Live load may be neglected for single culverts if fill depth is more than 8 feet and exceeds barrel span length. For multiple culverts, it may be neglected if fill depth exceeds the distance between end supports or abutments. (See AASHTO 6.4.2.) Enter 1 to neglect live load according to AASHTO 6.4.2. Enter 0 to use live load regardless of fill height.
Stress at Zero Fill (0,1)	Enter 1 for stress check at zero fill (top of top slab) to be performed, else enter 0.
Overload Axle Weight, kip	Enter the axle weight for the overload standard truck, kips.

EXAMPLE

To define an HS 25 truck load to be applied to the culvert with live load distribution based on AASHTO 6.4.2, no stress check at zero fill or overload truck effects to be calculated, and military load will not be checked as a separate load case, code:

```
STDLOD 1, 0, 0, 0, 0
```

FIGURES

NOTES

BRASS-CULVERT	COMMAND DESCRIPTION
COMMAND NAME	SWPRES
PURPOSE	SWPRES defines soil and water pressure parameters.

5 COMMAND PARAMETERS

1	Structure Number (1-10)	Enter the reference number for the culvert to be described by the following data. Culverts must be numbered sequentially beginning with 1, 2, 3 ...etc.
2	Live Load Surcharge, ft.	Enter the depth of surcharge to be used for calculating the effects of lateral earth pressure. Surcharge load is applied as a uniform load on the exterior walls and is calculated as the depth of surcharge times the maximum or minimum soil pressure as applicable.
45	Maximum Soil Pressure, pcf	Enter the maximum soil equivalent fluid pressure for lateral earth pressure calculations. Standard maximum is 30 pcf by AASHTO 6.2.1.
15	Minimum Soil Pressure, pcf	Enter the minimum soil equivalent fluid pressure for lateral earth pressure calculations. A minimum of 15 pcf is used for checking positive moments unless otherwise defined.
62.4	Water Pressure, pcf	Enter the unit weight of water (62.4 pcf standard). Enter 0 for no water pressure to be considered. When considered, BRASS-CULVERT uses full height of water and no water as two loading cases.

EXAMPLE

For standard values:

SWPRES 1, 2.0, 30.0, 15.0, 62.4

FIGURES

NOTES

BRASS-CULVERT	COMMAND DESCRIPTION

COMMAND NAME	BOXDIM
PURPOSE	BOXDIM defines the geometry of the box culvert.

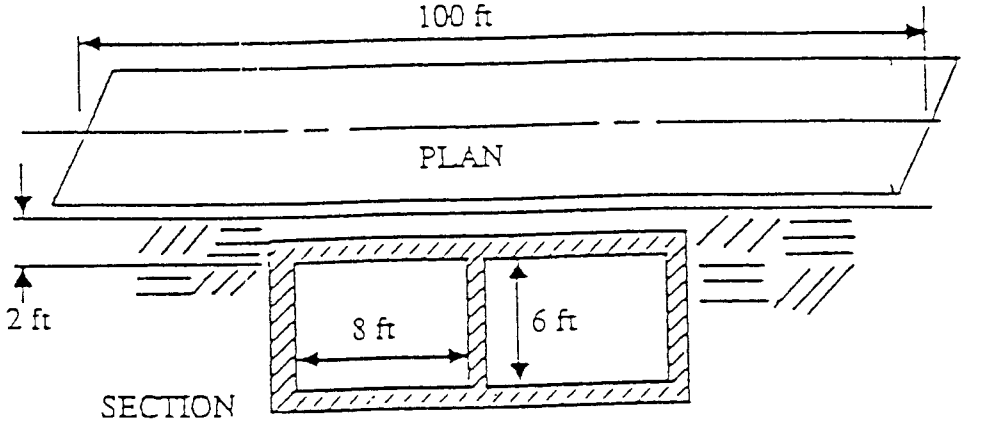
6 COMMAND PARAMETERS

1	Structure Number (1-10)	Enter the reference number for the culvert to be described by the following data. Culverts must be numbered sequentially beginning with 1, 2, 3 ...etc.
1, 1, 2, 4, 5	Number of Barrels (1-4)	Enter the number of barrels for the culvert, four maximum.
10, 10, 8, 12, 12	Clear Span, ft.	Enter the clear span of the barrels, feet. All barrels have the same span.
7, 3, 7, 10, 12	Clear Height, ft.	Enter the clear height of the barrels, feet. All barrels have the same height.
4, 10, 8, 8, 6	Design Fill, ft.	Enter the depth of fill to be used for design. Fill is measured from the bottom of the top slab to the top of fill, feet. Live loads will be applied to the top of this fill.
30, 105, 108, 150, 78	Centerline Length, ft.	Enter the length of the culvert along its centerline, feet.

EXAMPLE

BOXDIM 1, 2, 8, 6, 2, 100

FIGURES



NOTES

BRASS-CULVERT	COMMAND DESCRIPTION

COMMAND NAME	SLBTHK
PURPOSE	SLBTHK defines the thickness for the top and bottom slabs, and the exterior and interior walls.

6 COMMAND PARAMETERS

1	Structure Number (1-10)	Enter the reference number for the culvert to be defined by the following data. Culverts must be numbered sequentially beginning with 1, 2, 3 ...etc.
6	Top Slab Thickness, in.	Enter the thickness for the top slab. Unless this value is specified as fixed value (see below), BRASS-CULVERT uses this value as minimum thickness.
6	Bottom Slab Thickness, in.	Enter the thickness for the bottom slab. Unless this value is specified as fixed value (see below), BRASS-CULVERT uses this value as minimum thickness.
6	Exterior Wall Thickness, in.	Enter the thickness for the exterior wall. Unless this value is specified as fixed value (see below), BRASS-CULVERT uses this value as minimum thickness.
6	Interior Wall Thickness, in.	Enter the thickness for the interior wall. Unless this value is specified as fixed value (see below), BRASS-CULVERT uses this value as minimum thickness.
0000	Fixed Thickness Code (0 - 1111)	BRASS-CULVERT will use the thicknesses defined above as minimum values unless otherwise specified here. Each digit of the code is for the top slab, bottom slab, exterior walls, and interior walls respectively. Enter 1 to fix the thickness, else enter 0. For example to fix the top slab and exterior wall thicknesses only, enter a code of 1010.

EXAMPLE

For a culvert with a fixed slab and wall thickness of 7 inches, code:

SLBTHK 1, 7, 7, 7, 7, 1111

For a culvert with a fixed top slab of 8 inches and fixed exterior walls of 10 inches, bottom slab and interior wall thicknesses are used as minimum values, code:

SLBTHK 1, 8, 8, 10, 10, 1010

For a culvert with no fixed thicknesses and it is desired for the program to set the thicknesses as required, code:

SLBTHK 1, 0, 0, 0, 0, 0000

FIGURES

NOTES

BRASS-CULVERT	COMMAND DESCRIPTION
COMMAND NAME	H&SKEW
PURPOSE	H&SKEW defines haunches and end skews.

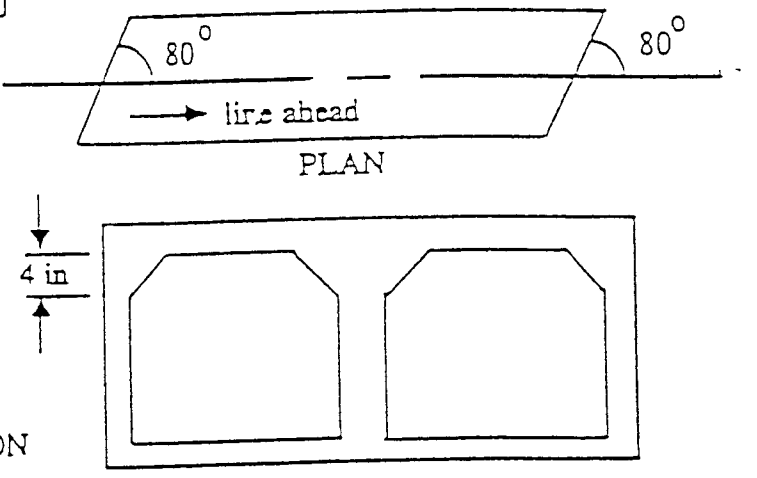
6 COMMAND PARAMETERS

1	Structure Number (1-10)	Enter the reference number for the culvert to be described by the following data. Culverts must be numbered sequentially beginning with 1, 2, 3 ...etc.
90	Skew Angle Left, deg.	Enter the skew angle at the left end of the culvert, degrees. See Note.
90	Skew Angle Right, deg.	Enter the skew angle at the right end of the culvert, degrees. See Note.
0	Top Haunch Height, in.	Enter the height of the top haunch, inches. Enter 0 for no top haunch.
0	Bottom Haunch Height, in.	Enter the height of the bottom haunch, inches. Enter 0 for no bottom haunch.
0	Haunches by AASHTO 0 or 1	Enter 1 for haunches to be considered in effective span length calculations, as per AASHTO Section 8.8, else enter 0.

EXAMPLE

H&SKEW 80, 80, 4, 0, 1

FIGURES



NOTES

Skew angles are measured from line ahead to skew as shown above. Positive angles only.

BRASS-CULVERT	COMMAND DESCRIPTION
COMMAND NAME	REEBAR
PURPOSE	REEBAR defines allowable bar sizes and spacings, and maximum steel ratio.

6 COMMAND PARAMETERS

12	Maximum Bar Spacing, in. Default = 12	Enter the maximum allowable bar spacing.
9	Minimum Bar Spacing, in. Default = 12	Enter the minimum allowable bar spacing.
1	Bar Spacing Increment (0,1)	Steel design bar spacings will be rounded to the increment defined here. Enter 1 to round spacings to 1 inch increments, or enter 0 to round bar spacings to ½ inch increments.
11	Maximum Bar Size (#) Default = 11	Enter the maximum bar size to be used in design.
4	Minimum Bar Size (#) Default = 4	Enter the minimum bar size to be used in design.
.016	Maximum Steel Ratio Default = 0.012	Enter the maximum ratio of area of steel to area for concrete (A_s / bd) in decimal form.

$$\rho_{MAX} = .75\,\rho_b = \frac{.85(.85)3000}{60000}\left(\frac{87000}{87000+60000}\right)$$

$$= .016$$

EXAMPLE

For a culvert with a maximum bar spacing of 12 inches, a minimum bar spacing of 4 inches, bar spacing increments of ½ inch, a maximum bar size of #11, a minimum bar size of #4, and a maximum reinforcement ratio of 0.012, code:

REEBAR 12, 4, 0, 4, 0.012

11

12 0.016

FIGURES

NOTES

BRASS-CULVERT	COMMAND DESCRIPTION
COMMAND NAME	CONCOV
PURPOSE	CONCOV defines the depth of concrete cover for reinforcement and the slab thickness round off increment.

6 COMMAND PARAMETERS

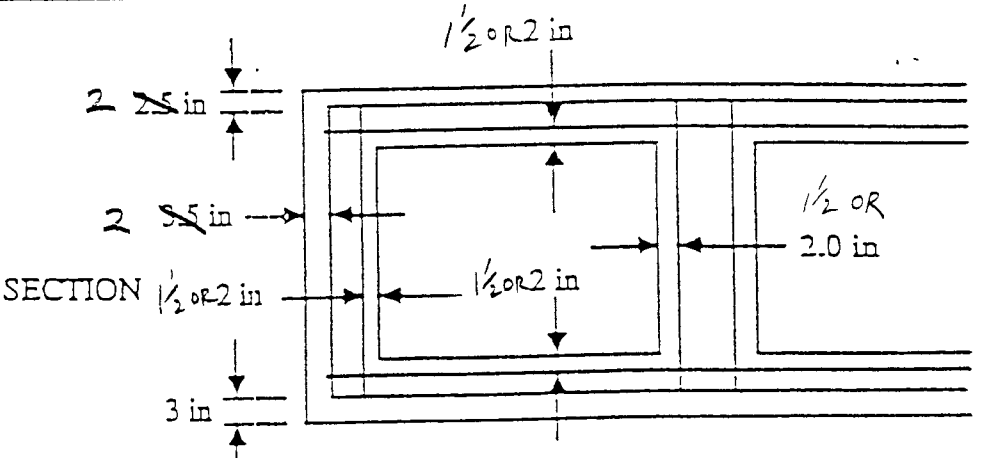
2	Exterior Top Slab, in.	Enter the distance from the face of steel bars to the face of concrete for the top steel of the top slab, inches. See Note.
3	Exterior Bottom Slab, in.	Enter the distance from the face of steel bars to the face of concrete for the bottom steel of the bottom slab, inches. See Note.
2	Exterior Wall, in.	Enter the distance from the face of steel bars to the exterior face of the exterior walls, inches. See Note.
HYDR GULF 2, 2	Interior Cover, in.	Enter the distance from the face of steel bars to the face of concrete for the interior faces of slabs and walls, inches. See Note. NOTE: Default values are 3 inches for bottom slab cover and 2 inches for all other covers.
1/2	Slab Thickness Increment, in.	BRASS-CULVERT "rounds up" slab thickness to the nearest increment defined. Default values are ½ inch.
1/2	Wall Thickness Increment, in.	BRASS-CULVERT "rounds up" wall thickness to the nearest increment defined. Default values are ½ inch.

EXAMPLE

CONCOV ~~2.5~~ 2.0, 3.0, ~~3.5~~ 2.0, 0.5, 0.5

HYDR → 1.5
ONLY

FIGURES



NOTES

All covers are measured from the outer face of steel to face of slab.

BRASS-CULVERT	COMMAND DESCRIPTION
COMMAND NAME	MATPRP
PURPOSE	MATPRP defines material properties for steel and concrete.

6 COMMAND PARAMETERS

120	Soil Unit Weight, pcf	Enter the unit weight of the soil fill in pounds per cubic foot. BRASS-CULVERT uses 100% of soil weight for both rigid and flexible box designs.
60	Reinforcing Yield, Fy, ksi	Enter the yield strength for steel reinforcement, ksi.
24	Allowable Steel Stress, ksi	Enter the allowable steel stress, ksi.
3	Concrete Strength, ksi	Enter the 28 day compressive strength for concrete, ksi.
0	Allowable Concrete Shear, ksi	Enter the allowable concrete shear stress, ksi. Enter 0 for BRASS-CULVERT to calculate the concrete shear strength according to AASHTO 8.16.
0	Allowable Concrete Shear, with Stirrups, ksi	Enter the allowable concrete shear stress when stirrups are used. Enter 0 for no stirrups.

EXAMPLE

For a culvert with a soil unit weight of 120 pcf, 40 ksi reinforcing steel, an allowable steel stress of 20 ksi, a concrete strength of 3000 psi, and to have the program calculate the allowable concrete shear stress, code:

MATPRP 120, 40, 20, 3, 0, 0
60 24

FIGURES

NOTES

COMMAND NAME	PRTCTL
PURPOSE	PRTCTL controls the output produced.

4 COMMAND PARAMETERS

0	1	Bar Schedule (0,1) — Enter 1 for printing the bar schedule, else enter 0.
0	1	Tenth Point Actions (0,1) — Enter 1 for printing moments, shears, and axial forces at tenth points, else enter 0. These are factored actions for ultimate strength design.
0	1	Influence Lines (0,1) — Enter 1 for printing live load influence line ordinates at tenth points, else enter 0.
0	0	Debug Printout (0,1) — This parameter is to be used for debugging purposes only. Enter 1 for special printout of dead load, soil pressure, and live load moments and shears, else enter 0. These are unfactored actions for ultimate strength design.
	↑	
	FINAL RUN	

EXAMPLE

To print the bar schedule, tenth point actions, and influence line ordinates, code:

```
PRTCTL 1, 1, 1, 0
       0 0 0
```

FIGURES

NOTES

BRASS-CULVERT	COMMAND DESCRIPTION
COMMAND NAME	F&HCTL
PURPOSE	F&HCTL defines floor type and headwall configuration.

3 COMMAND PARAMETERS

Structure Number (1-10)	Enter the reference number for the culvert to be described by the following data. Culverts must be numbered sequentially beginning with 1, 2, 3 ...etc.
Floor Type (1,2,3)	Enter 1 for full floor. Enter 2 for no floor with fixed end supports. Enter 3 for no floor with pinned end supports.
Headwall Steel (0-3)	Enter 0 to generate headwall steel as per North Carolina standard. Enter 1 to suppress headwall steel generation. Enter 2 to generate left headwall steel only. Enter 3 to generate right headwall steel only.

EXAMPLE

To suppress a full floor and headwall steel design, code:

F&HCTL 1, 1, ✗
2

FIGURES

NOTES

BRASS-CULVERT	COMMAND DESCRIPTION

COMMAND NAME	DESCTL
PURPOSE	DESCTL defines design control parameters.

6 COMMAND PARAMETERS

Design Method (0,1)	Enter 0 for service load design method, or enter 1 for load factor design method.
Rigid or Flexible (0,1)	Enter 0 for rigid box culvert design, else enter 1 for flexible box culvert design.
Design Negative Moment Position (0.0 - 1.0)	The position of design negative moment is defined by a value from zero to one where 0.0 represents the centerline of the wall or slab, 0.5 represents half way between center of the wall or slab and face of the wall or slab, and 1.0 represents the face of the wall or slab.
Design Same Slabs (0,1)	Enter 1 for BRASS-CULVERT to design the same thicknesses and steel for top and bottom slabs, else enter 0. See Note.
Design Same Walls (0,1)	Enter 1 for BRASS-CULVERT to design the same exterior and interior wall thicknesses, else enter 0. See Note.
Modular Ratio (N) Default = 9	Enter the ratio of the modules of elasticity of steel to that of concrete.

QUANTITIES

Kuhlmann *design* Group | BRIDGE NO. A3210016 | 7/20/98 8:53 AM A300QUAN.XLS

HEM 7-20-98
JVS 20JUL98

CONCRETE QUANTITIES

DESCRIPTION	QUANT.	WIDTH	LENGTH	DEPTH	FACTOR	TOTAL (CU. FT.)	TOTAL (CU. YD.)
TOP SLAB	1.00	17.75	123.46	0.88	1.00	1917.46	71.02
EXTERIOR WALL	2.00	0.58	123.46	7.00	1.00	1008.24	37.34
INTERIOR WALL	1.00	0.58	123.46	7.00	1.00	504.12	18.67
BOTTOM SLAB	1.00	17.75	180.00	0.83	1.00	2662.50	98.61
BOTTOM SLAB TRIANGLE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEADWALL	2.00	21.36	1.50	0.50	1.00	32.05	1 19
CUT OFF WALL DOWNSTREAM	1.00	20.41	0.83	2.17	1.00	36.84	1.36
CUT OFF WALL UPSTREAM	1.00	20.41	0.83	1.17	1.00	19.84	0.73
INT WING DOWNSTREAM	1.00	0.58	28.27	7.88	1.00	129 87	4 81
INT. WING DOWNSTREAM DEDUCT	1.00	0.58	28.02	6.88	-0.50	-56.19	-2.08
EXT. WING DOWNSTREAM	2.00	0.58	28.10	7.88	1.00	258.21	9 56
EXT. WING DOWNSTREAM DEDUCT	2.00	0.58	27.85	6.88	-0.50	-111.71	-4.14
INT. WING UPSTREAM	1.00	0.58	28.27	7.88	1.00	129.87	4.81
INT. WING UPSTREAM DEDUCT	1.00	0.58	28.02	6.88	-0.50	-56.19	-2.08
EXT. WING UPSTREAM	2.00	0.58	28.27	7.88	1.00	259.74	9.62
EXT. WING UPSTREAM DEDUCT	2.00	0.58	28.02	6.88	-0.50	-112.38	-4.16
						6622.28	245.27
EXCAVATION	1.00	20.75	180.00	15.71	1.00	58670.63	2172.99

SPECIFICATIONS

See Plan Sheets