ACDC PRECAST COVERED SECTION REACH 4

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT _____ PAGE ____ OF ____

DETAIL _____ COMPUTED _____ DATE ____

_____ CHECKED BY _____ DATE ____

ACDC

Reach #4 Area

Pre-Cast Box Beam

Analysis

ALDC – Reach 4

Covered Sections

Pre-Cast Box Beams

1.) All areas of the covered sections must include HS-20 live load as specified by the COE.
All allowable earthen fills on the following pages include the HS-20 Live Load as approved by the LA-COE from the T-PBC computer print outs.

2.) The L.A.-COE recommends that the 4' diameter - 5' high circular planters be spaced at least 20' apart.
Engineering recommends a 30' planter spacing when place over the ALDC box.
Engineering would like the landscape Architect to investigate possible root damage to the pre-cast boxes.
Overturning of the trees due to wind loading should also be considered.

3.) Earth mound up to 5' high will not be allowed in the section 7(b) area, which includes most of the Biltmore parking area.

4.) The following pages show the allowable fills for the different sections at each station
(Note: there are two Section 7s
Section 7a and Section 7b)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ALDC PAGE ____ OF ____

DETAIL Reach 4 COMPUTED ____ DATE ____

Pre-Cast Box Beams CHECKED BY ____ DATE ____

Method of calculation of allowable fill over ALDC covered box.

from T-PBC computer printouts approved by the LA-CDE.

Service load moments

Live Load HS-20 used on all sections

Dead Load - Includes MDL of Girder + MDL of fill

$M_{DL\,fill} = M_{Total\,DL} - M_{DL\,Girder}$

$\left(M = \frac{w l^2}{8}\right)$ Uniform load $(w) = \frac{(8)(M_{DL\,fill})}{(l^2)}$

$\boxed{\text{Depth of fill}} = \frac{\text{Uniform load } (w)}{(.14\ \text{lb/ft soil weight})(8'\text{ wide beam})}$

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC PAGE 1 OF

DETAIL Biltmore Area COMPUTED CGW DATE

Pre-Cast Box Beams CHECKED BY DATE

Covered Channel Sections
in the
Reach #4 ACDC
Allowable Fill

NOTE: Each section includes HS-20 load

NOTE: For information purposes only, COE has responsibility

Covered Section # 7(a)

Allowable Fill — 3'-10

Sta. 975+51.70 to Sta 973+50
Sta. 967+00 to Sta 963+49.11
Sta. 930+00 to Sta. 929+00

Covered Section # 7(b)

Allowable Fill — 2'-0

Sta 944+67 to Sta 930+00
Sta 929+00 to Sta 922+37
Sta 921+16.50 to Sta 919+00
Sta 909+28 to Sta 904+00

Covered Section # 8

Allowable Fill — 9'-0

Sta 919+00 to Sta 911+40

Covered Section # 9

Allowable Fill — 4'-10

Sta 922+37 to Sta 921+16.50
Sta 911+40 to Sta 909+28

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC PAGE ____ OF ____

DETAIL Reach 4 COMPUTED ____ DATE ____

Pre-Cast Box Beams CHECKED BY ____ DATE ____

Covered Section #6

Allowable Fill — 5'-2

Sta 904+00 to 897+00

Covered Section #10

Allowable Fill — 1'-5

Sta 973+50 to Sta 967+00

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ALDC PAGE 2 OF

DETAIL Biltmore Area COMPUTED CEW DATE

Pre-Cast Box Beams CHECKED BY DATE

Areas where the existing ground line seems to show a backfill in excess of the Pre-Cast Box Beam Section indicated for that area.

1) Sta 944+00 to Sta 942+50
Existing ground line indicates a backfill of about 4'-0, while Section 7(b) has a backfill capacity of 2'-1.

2) Sta 922+37 +
Existing ground line indicates a backfill of about 3'-0, while Section 7(b) has a backfill capacity of 2'-1.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ALDC PAGE 3 OF

DETAIL Biltmore Area COMPUTED CGW DATE

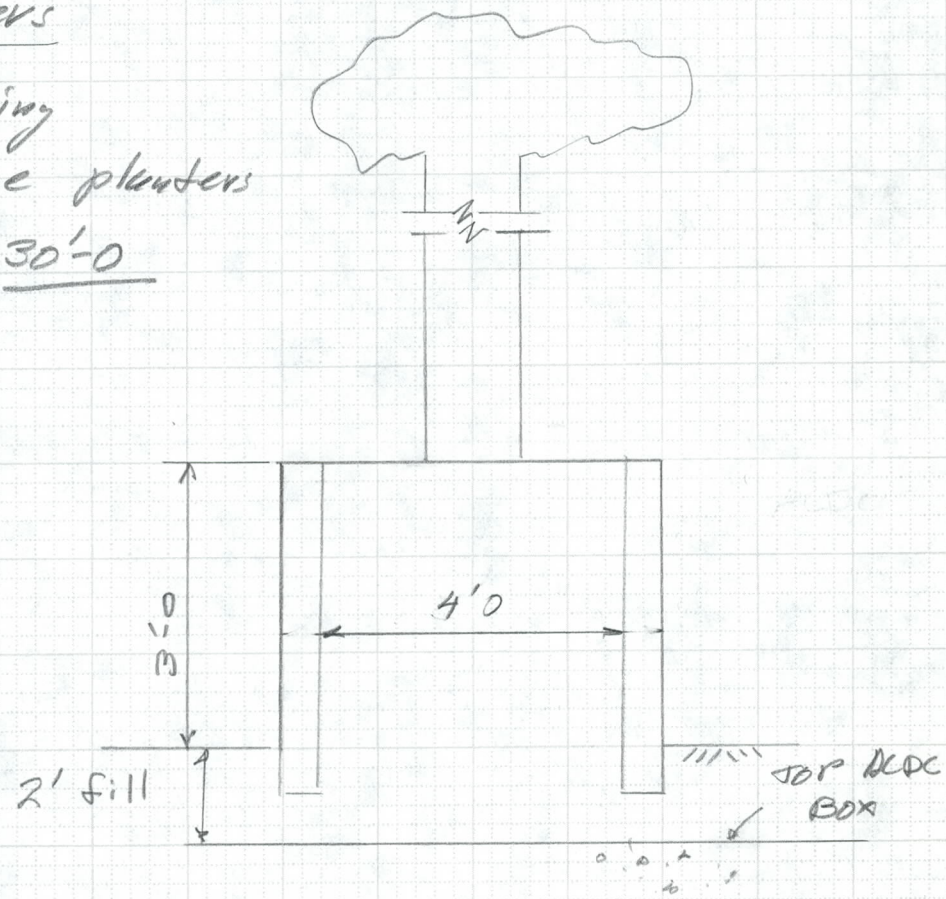
Pre-Cast Box Culverts CHECKED BY DATE

COE says NO!

~~Section 7 (b)~~
~~Maximum backfill height with no Live Load is 4'-0.~~

Tree Planters

Minimum spacing between tree planters should be 30'-0



6910-153 4-90

MARICOPA COUNTY FLOOD CONTROL DISTRICT

INTEROFFICE MEMORANDUM

SUBJECT:EQUIPMENT LOADS ON THE ACDC COVERED BOX AT THE BILTMORE

TO:FRED FULLER FROM C G WAINWRIGHT DATE:JULY 11,1994
VIA:ED RALEIGH

THIS ANALYSIS IS FOR SMALL EXCAVATIONS OF THE FILL AREA OVER THE ACDC COVERED BOX SECTIONS, SUCH AS THE REMOVAL OF FILL FOR THE BILTMORE HOTEL'S NEW CONFERENCE CENTER.

THIS ANALYSIS IS FOR TRACKED VEHICLES, SUCH AS CATERPILLAR DOZERS, AND WHEELED VEHICLES, SUCH AS SCRAPERS AND LOADERS.

THE LIVE LOAD FOR THE ORIGINAL DESIGN CALLED FOR THE PRESTRESSED BOX GIRDERS TO CARRY; THEIR OWN WEIGHT, THE FILL HEIGHT FOR THE LOCAL AREA, AND THE HS-20-44 TRUCK LOADING. THE TRUCK LOADING CONSISTS OF 3 SEMI-TRUCKS PARKED SIDE-BY-SIDE WITH THEIR COMBINED 6 WHEELS ALL ON THE SAME GIRDER. EACH OF THE 6 TRUCK WHEELS WOULD HAVE A LOAD OF 16,000 LBS.

THE MOMENT INDUCED INTO THE BOX GIRDER FROM AN INDIVIDUAL PIECE OF CONSTRUCTION EQUIPMENT SHOULD NOT GREATLY EXCEED THE MOMENT PRODUCED BY ONE HS-20 TRUCK, SINCE MORE THAN ONE PIECE OF EQUIPMENT COULD BE ON THE SAME GIRDER AT THE SAME TIME.

TRACKED VEHICLES:
TRACKED VEHICLES SHOULD NOT EXCEED 40,000 LBS TOTAL WEIGHT, WHICH IS A LITTLE MORE THAN A D-5 CATERPILLAR TRACTOR.

WHEELED VEHICLES:
WHEELED VEHICLES SHOULD NOT HAVE AN AXIAL LOADING IN EXCESS OF 32,000 LBS, WHICH IS THE SAME AS AN HS-20 TRUCK LOADING. THIS LOADING IS SLIGHTLY GREATER THAN A CATERPILLAR 613C SCRAPER.

FILL LOADINGS:
FILL LOADINGS OVER 3.7 FT ABOVE THE DESIGN FILL, USUALLY 2 FT, WOULD EXCEED THE ALLOWABLE DESIGN LIVE LOAD MOMENT CAPACITY OF THE BOX GIRDER LID. THIS COULD INCLUDE THE EQUIPMENT USED TO PLACE THE FILL.
THE ACDC COVER BOX TO THE EAST OF THE BILTMORE GOLF COURSE WAS DESIGNED FOR A HIGH FILL, WHILE THE ACDC BOX IN THE BILTMORE AREA WAS DESIGN FOR ONLY A 2 FOOT FILL HEIGHT IN MOST AREAS.

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2711
LOS ANGELES, CALIFORNIA 90053-2325

FLOOD CONTROL DISTRICT
RECEIVED
MAY 23 1991

	ENG	P & PM
		HYDRO
		LMGT
		FILE

REMARKS

May 17, 1991

REPLY TO
ATTENTION OF

Office of the Chief
Design Branch

Mr. John Rodriguez, P.E., Chief
Planning and Project Management Division
Flood Control District of Maricopa County
3335 West Durango Street
Phoenix, Arizona 85009

Dear Mr. Rodriguez:

Reference is made to letter of transmittal dated May 13, 1991, signed by Jan Staedicke, subject: Arizona Canal Diversion Channel (ACDC) Reach 4; Biltmore Hotel.

This letter expands on our letter of May 1, 1991, same subject. We have reviewed the data which you provided relative to design depths of fill for the various reaches of the covered channel in the vicinity of the Biltmore Hotel and agree that depths greater than 2 feet are allowable between certain stations.

The 2-foot criteria still holds except for those reaches identified below which are designed to carry a deeper fill:

Covered Section No.	Allowable Fill	Stations
7a	4'-0"	929+00 to 930+00
7b	2'-0"	Other reaches
8	10'-0"	911+40 to 919+00
9	5'-0"	921+16 to 922+37

The above criteria can be used in the design of landscape mounds through the area.

If you have any questions, please feel free to call me or Mr. Ford (213/894-5530) of my staff.

Sincerely,

Robert E. Koplin, PE
Chief, Engineering Division

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC - Biltmore Constr PAGE 1 OF 5

DETAIL Max Moments on ACDC Box from a D-5 cat COMPUTED CGG DATE 2/94

CHECKED BY _____ DATE _____

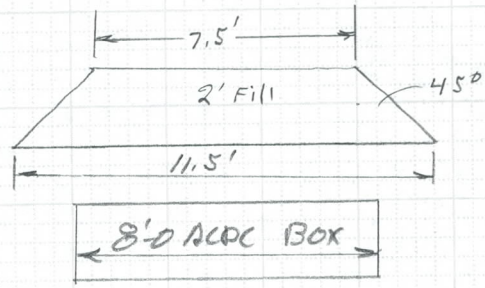
D-5 Cat

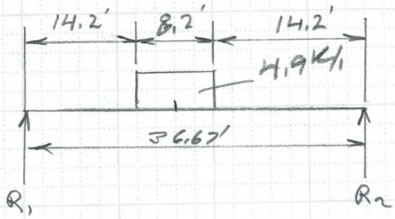
Weight 35,000 lb
Blade 5,000 lb
40,000 lb = 40 Kips

Tread Contact

Length 7.5'
Width 7.5'

Tread Width





$R_1 = \frac{D\text{-}5\ cat}{2} = \frac{40^k}{2} = 20^k$

Impact say 10% = 1.10

$w = \frac{40^k}{8.2'} = 4.9^{k/1}$

$Mom\ Max = R_1\left(a + \frac{R_1}{2w}\right)$

$= (20^k)\left[14.2' + \frac{20^k}{(2)(4.9^{k/1})}\right]$

$Mom\ Max = 286^{k\text{-}1}$

Reduction for overlapping Tread width on 2' Fill

$R = \frac{8.0}{11.5} = 0.70$

$Max\ Mom\ from\ D\text{-}5\ cat = \overset{M}{(286^{1\text{-}k})}\overset{R}{(0.70)}\overset{I}{(1.10)}$

$= 220^{1\text{-}k} < 264^{1\text{-}k}$

One HS-20-44 Truck Load

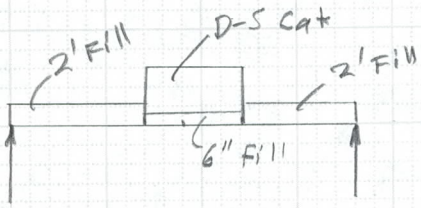
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ALDC - Biltmore Constr PAGE 2 OF 5

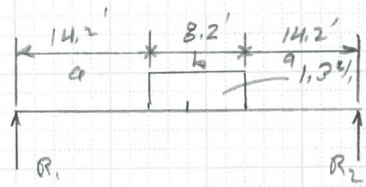
DETAIL Max Moment on COMPUTED CAW DATE 2/94

ALDC Box from a D-5 Cat CHECKED BY _____ DATE _____

D-5 Cat (With 1.5' of fill removed leaving only 6" of fill on Box Girder where tractor is located)



Moment loss from removal of 1.5' of fill



$w = (110\,lb/ft^3)(1.5')(8') = 1.3^{k/'}$

$R_1 = (1.3^{k/'})(8.2')/(2) = 5.3^{k}$

$M_{om} = R_1\left(a + \frac{R_1}{2w}\right) = (5.3^k)\left[(14.2') + \frac{(5.3^k)}{(2)(1.3^{k/'})}\right]$

$M_{om} = 77^{'-k}$ Add Moment Capacity from removal of fill.

Mom from D-5 – No reduction for distribution of Load thru the fill.
Add 10% for impact

from Page 1

$$\text{Mom Max} = \overset{M}{(286^{'-k})}\,\overset{I}{(1.10)} - \overset{f}{(77)}$$

$$\text{Mom Max} = 238^{'-k} \approx 264^{'-k}$$ from one HS-20-44 Truck.

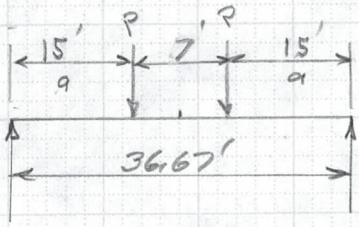
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

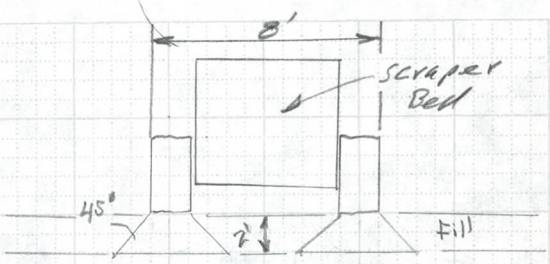
PROJECT ACDC – Biltmore Constr PAGE 3 OF 5

DETAIL Max Moment on COMPUTED CGW DATE 2/94

ACDC Girders for Scraper CHECKED BY _____ DATE _____

Max Scraper Axial Loading





Assumed Scraper Dim.

Max Mom = Pa = P(15')

Mom Max Allowable = 467'-k

467'-k = P(15')

P = 31^k wheel loading

62^k (31 ton) Axial Loading Max Allowable

Limit the Scraper Axial Load to 16 ton (32^k).
Include 10% for Impact

Mom 17ton Axial Load = Pa = (16^kip)(15')(1.10)

Mom from 17ton Axial Load = 264'-k = 264'-k (from One HS-20 Truck)

Limit wheel vehicles to 32,000 lb/axle

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC - Biltmore Constr PAGE 4 OF 5

DETAIL Max Moment on COMPUTED CLG DATE 7/44

ACDC Girder from Live Load CHECKED BY _____ DATE _____

Allowable Max Moment from Live Load

from Girder Design sheets for ACDC Box Girder with 2' of fill (Sandt Section 7(b))

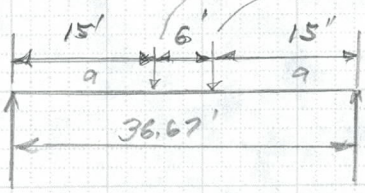
Live Load Allowed = 2.776 k/ft

Moment Allowed = $\frac{wl^2}{8}$ = $(2.776\ k/ft)(36.67)^2/8$

Max Mom Allowed = 467 k-ft for Live Load

Loading from One HS-20-44 Truck

16k Truck Wheel Loading



M = Pa

M = (16k)(15')(1.10)

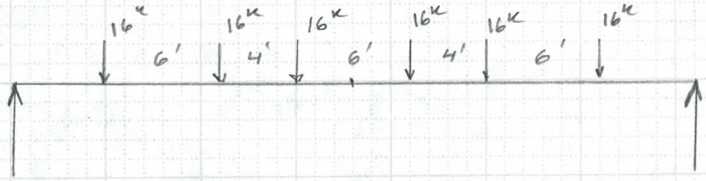
10% Impact at low speed

Mom = 264 1-k (from one HS-20 Truck)

Use for permit purposes

Loading from 3 HS-20-44 Trucks

Reduction factor
3 Truck = 0.9



Max Mom Live Load = ΣPa = [(16k)(15') + (16k)(11') + (16k)(5')](.9)

= [240 1-k + 176 1-k + 80 1-k](.9)

Max LL Mom = 446 1-k (from 3 HS-20 Trucks)

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC- Biltmore Cowstr PAGE 5 OF 5

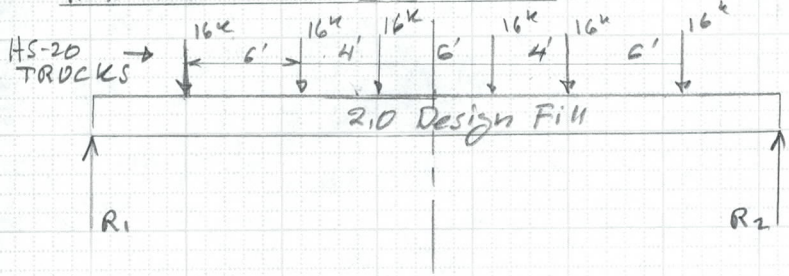
DETAIL fill equal to COMPUTED CGG DATE 7/94

HS-20 Loading CHECKED BY _____ DATE _____

Fill equivalent to HS-20 Truck Loading

HS-20 Design Truck Loading is 3 Trucks parked side by side.

Max HS-20 LL + 2' Fill DL



DL Box Girder = 1.388 k/'

DL Design Fill (2') = 2.400 k/'

LL HS-20-44 Trucks (3)

$M_{DL} = (1.3)\frac{wl^2}{8}$

$M_{DL} = \frac{(1.3)(1.388^{k/'} + 2.400^{k/'})(36.67')^2}{(8)}$

$M_{DL} = 828^{'-k}$

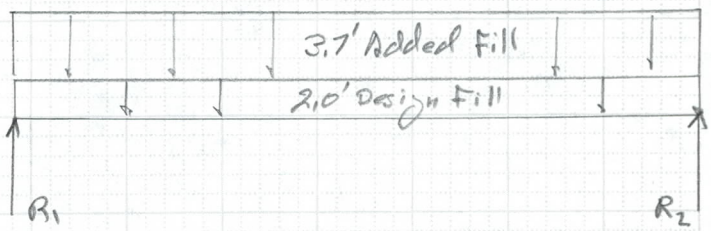
$M_{LL} = (2.17)(\Sigma Pa)(.9)$

$= (2.17)[(16^k)(15') + (16^k)(11') + (16^k)(5')](.9)$

$M_{LL} = 969^{'-k}$

$\Sigma M = M_{DL} + M_{LL} = 1797^{'-k}$

Max Fill no LL



DL Box Girder = 1.388 k/'

DL Design Fill (2') = 2.400 k/'

DL Added Fill (3.7') =

(3.7')(8')(1.50 k/'/ft³) = 4.40 k/'

$M_{DL} = (1.3)\frac{wl^2}{8}$

$M_{DL} = \frac{(1.3)(1.388^{k/'} + 2.40^{k/'} + 4.40^{k/'})(36.67')^2}{(8)}$

$M_{DL} = 1789^{'-k}$

(No Live Load only fill.)

Any fill over 3.7' over the top of the design fill, will exceed the allowable stresses for the ACDC Box Cover.

Track-Type Tractors | Specifications

MODEL	D5H LGP Series II	
Flywheel Power	97 kW	130 hp
Operating Weight*		
(Power Shift)	16 057 kg	35,400 lb
(Direct Drive)	16 103 kg	35,500 lb
Engine Model	3304	
Rated Engine RPM	2200	
No. of Cylinders	4	
Bore	121 mm	4.75″
Stroke	152 mm	6″
Displacement	7 L	425 in³
Track Rollers (Each Side)	8	
Width of Standard Track Shoe	860 mm	34″
Length of Track on Ground	3.12 m	10′3″
Ground Contact Area (W/Std. Shoe)	5.37 m²	8320 in²
Track Gauge	2.16 m	7′1″
GENERAL DIMENSIONS:		
Height (Stripped Top)**	2.30 m	7′6.5″
Height (To Top of ROPS Canopy)	3.12 m	10′3″
Height (To Top of ROPS)	—	
Height (To Top of Cab ROPS)	3.18 m	10′5″
Overall Length (With P Blade)	5.30 m	17′6.3″
(Without Blade)	4.13 m	13′7″
Overall Length (With S Blade)	—	
(Without Blade)	—	
Width (Over Trunnion)	3.26 m	10′8.4″
Width (W/O Trunnion — Std. Shoe)	3.02 m	9′11″
Ground Clearance	529 mm	20.8″
Blade Types and Widths:		
Straight	3.65 m	12′0″
Angle	—	
Semi-U	—	
"P" Straight	3.66 m	11′11.9″
Power Angle & Tilt	3.98 m	13′0.1″
Fuel Tank Refill Capacity	246 L	65 U.S. gal

Wheel Tractor-Scrapers | Specifications • Elevating Scrapers

MODEL	613C Series II	
Flywheel Power	131 kW	175 hp
Approx. Operating Weight (Empty)◄	15 264 kg	33,650 lb
Scraper Capacity — Heaped	8.4 m³	11 yd³
Rated Load	11 975 kg	26,400 lb
Weight Distribution — Empty		
Drive	63%	
Rear	37%	
Weight Distribution — Loaded		
Drive	49%	
Rear	51%	
Engine Model	3116	
Rated Engine RPM	2300	
Displacement	6.6 L	403 in³
Top Speed (Loaded)	35.1 km/h	21.8 mph
Non-Stop Turning Circle	8.9 m	29′4″
Tires — Standard		
Tractor	23.5R25	
Scraper	23.5R25	
Width of Cut	2.35 m	7′8.5″
Maximum Depth of Cut	160 mm	6.3″
Elevator Flight Spacing	419 mm	16.5″
Number of Flights	15	
Maximum Floor Opening	1.14 m	3′9″
Maximum Depth of Spread	370 mm	14.6″
Fuel Tank Refill Capacity	250 L	66 U.S. gal
GENERAL DIMENSIONS:		
Height to Top of Scraper	3.06 m	10′0″
Wheelbase	6.26 m	20′6.5″
Overall Length	10.0 m	32′9″
Overall Width	2.44 m	8′0″
Shipping Width	2.44 m	8′0″
(Draft Arms on Inside of Bowl)	—	
Scraper Tread	1.80 m	5′11″
Tractor Tread	1.80 m	5′11″

<----------PRESTRESSED CONCRETE MEMBER DESIGN SUMMARY----------SHEET NO. 18/

JOB I.D. : ACDC CHANNEL COVER FOR SUNDT-SECTION 7(b)
DATE : 2/13/91; DESIGNED BY:NTS CHECKED BY: JOB NO. 7068
SECTION NAME: 96BG27 7(b)

<----------SPAN= 36.667 FT---------->

PRECAST X-SECTION LOADS:
SELF WEIGHT.....= 1.388 KIP/FT
SUPERIMPOSED DEAD LOAD..= 2.400 KIP/FT
P = 1.094K @ 18.333 FT FROM LE
SUPERIMPOSED LIVE LOAD..= 2.776 KIP/FT

SDL= 300.00 PSF SLL= 347.00 PSF % OF LL SUSTAINED= 0.00%

<--------SECTION PROPERTIES--------><----------SERVICE LOAD MOMENTS---------->

	PLAIN		COMPOSITE	
A =	1332.00	IN.^2	=**********	IN.^2
I =	131598.00	IN.^4	=**********	IN.^4
H =	27.00	IN.	=**********	IN.
YB=	13.50	IN.	=**********	IN.
YT=	13.50	IN.	=**********	IN.
SB=	9748.00	IN.^3	=**********	IN.^3
ST=	9748.00	IN.^3	=**********	IN.^3
WT=	1387.50	PLF	=**********	PLF

PRECAST SECTION:
D.L.= 646.6 K-FT AT 18.3 FT FROM LE
L.L.= 466.5 K-FT AT 18.3 FT FROM LE

Std. Pull

<----------

CONCRETE DATA:
BEAM:
WT = 150 PCF
FCI = 4.00 KSI
F'C = 5.00 KSI

STRAND DATA: PULL= 0.75 FPU=270 KSI LOW-RELAXATION
DIA.= 0.500 IN.;AREA PER STRAND= 0.1531 IN.^2 } 1/2" ϕ
NO. = 26 ;TOTAL AREA = 3.9806 IN.^2

AASHTO LOSSES; INITIAL= 4.30%; FINAL= 15.40%
PI= 806 KIPS; PO= 771 KIPS; PE= 682 KIPS
ECCENTRICITY DATA: NUMBER OF HARP POINTS= 0 ← Straight Pull
ECCENTRICITY AT ENDS = 10.50, 10.50 IN.
<----------

<----------
ULTIMATE MOMENT AT CRITICAL SECTION: (1.30 DL + 2.17 LL)
* CRITICAL MOMENT = 1852.9 KIP-FT 18.3 FT FROM LEFT END
RESISTING MOMENT= 1942.0 KIP-FT * E.O.R. Shows 1872 K
<----------

<----------
TRANSFER STRESSES:
CRITICAL TENSILE AT TOP 3.7 FT FROM LT END= 0.148 KSI; ALLOW= 0.190 KSI
CRITICAL COMPRESSIVE AT BOT 3.7 FT FROM LT END= 1.307 KSI; ALLOW= 2.400 KSI
SERVICE STRESSES:
CRITICAL TENSILE AT BOT 18.3 FT FROM LT END= 0.124 KSI; ALLOW= 0.424 KSI
CRITICAL COMPRESSIVE AT TOP 18.3 FT FROM LT END= 1.148 KSI; ALLOW= 2.000 KSI
<----------

<----------
DESIGN CAMBER IN INCHES: +/- 1/2 INCH TOLERANCE

DIST FROM LE(FT)	ESTIMATED AT RELEASE	<---ESTIMATED AT ERECTION---> SELF WEIGHT	NON-COMP. D.L.	TDL + 0%PERM.LL	<---ESTIMATED LONG TIME---> WITH TDL ONLY	WITH TDL + 0%PERM.LL	TDL + 0%PERM.LL 100%INST.LL
18.33	0.273	0.485	0.309	0.309	0.150	0.150	-0.049

<----------

<----------
SHEAR STIRRUPS: WITH A(V)= 0.800 IN.^2 & FY = 60.0 KSI

MEASURED FROM LEFT END	MEASURED FROM RIGHT END
1 AT 2 IN.	1 AT 2 IN.
2 AT 12 IN.	2 AT 12 IN.
9 AT 18 IN.	9 AT 18 IN.

USE #4 Stirrups in Pairs. 2 of 48" | 24" 48"
Spacing per E.O.R. Dwg.
<----------

<----------
CGS AT ENDS= 3.000 , 3.000 IN. **
<----------

<----------
REACTIONS IN KIPS= (WSD) 120.88 , 120.88 ; (USD) 201.42 , 201.42
<----------

<----------
DESIGN COMPLETED

** E.O.R. Shows 192.78 K

CORPS OF ENGINEERS, U. S. ARMY
LOS ANGELES DISTRICT
APPROVED
SUBJECTED TO CORRECTION NOTED IN RED
(EXCEPT FOR ERRORS & OMISSIONS)

MAR 0 9 1991

AUTHORIZED REPRESENTATIVE OF
THE CONTRACTING OFFICER

MARICOPA COUNTY FLOOD CONTROL DISTRICT

INTEROFFICE MEMORANDUM

SUBJECT:EQUIPMENT LOADS ON THE ACDC COVERED BOX AT THE BILTMORE

TO:FRED FULLER FROM C G WAINWRIGHT DATE:JULY 11,1994
VIA:ED RALEIGH

THIS ANALYSIS IS FOR SMALL EXCAVATIONS OF THE FILL AREA OVER THE ACDC COVERED BOX SECTIONS, SUCH AS THE REMOVAL OF FILL FOR THE BILTMORE HOTEL'S NEW CONFERENCE CENTER.

THIS ANALYSIS IS FOR TRACKED VEHICLES, SUCH AS CATERPILLAR DOZERS, AND WHEELED VEHICLES, SUCH AS SCRAPERS AND LOADERS.

THE LIVE LOAD FOR THE ORIGINAL DESIGN CALLED FOR THE PRESTRESSED BOX GIRDERS TO CARRY; THEIR OWN WEIGHT, THE FILL HEIGHT FOR THE LOCAL AREA, AND THE HS-20-44 TRUCK LOADING. THE TRUCK LOADING CONSISTS OF 3 SEMI-TRUCKS PARKED SIDE-BY-SIDE WITH THEIR COMBINED 6 WHEELS ALL ON THE SAME GIRDER. EACH OF THE 6 TRUCK WHEELS WOULD HAVE A LOAD OF 16,000 LBS.

THE MOMENT INDUCED INTO THE BOX GIRDER FROM AN INDIVIDUAL PIECE OF CONSTRUCTION EQUIPMENT SHOULD NOT GREATLY EXCEED THE MOMENT PRODUCED BY ONE HS-20 TRUCK, SINCE MORE THAN ONE PIECE OF EQUIPMENT COULD BE ON THE SAME GIRDER AT THE SAME TIME.

TRACKED VEHICLES:
TRACKED VEHICLES SHOULD NOT EXCEED 40,000 LBS TOTAL WEIGHT, WHICH IS A LITTLE MORE THAN A D-5 CATERPILLAR TRACTOR.

WHEELED VEHICLES:
WHEELED VEHICLES SHOULD NOT HAVE AN AXIAL LOADING IN EXCESS OF 32,000 LBS, WHICH IS THE SAME AS AN HS-20 TRUCK LOADING. THIS LOADING IS SLIGHTLY GREATER THAN A CATERPILLAR 613C SCRAPER.

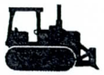
FILL LOADINGS:
FILL LOADINGS OVER 3.7 FT ABOVE THE DESIGN FILL, USUALLY 2 FT, WOULD EXCEED THE ALLOWABLE DESIGN LIVE LOAD MOMENT CAPACITY OF THE BOX GIRDER LID. THIS COULD INCLUDE THE EQUIPMENT USED TO PLACE THE FILL.

MODEL	D5H Series II	D5H XL Series II	D5H LGP Series II	D6D
Flywheel Power	89 kW **120 hp**	97 kW **130 hp**	97 kW **130 hp**	104 kW **140 hp**
Operating Weight*				
(Power Shift)	13 224 kg **29,200 lb**	13 982 kg **30,830 lb**	16 057 kg **35,400 lb**	14 610 kg **32,210 lb**
(Direct Drive)	13 303 kg **29,300 lb**	—	16 103 kg **35,500 lb**	—
Engine Model	**3304**	**3304**	**3304**	**3306**
Rated Engine RPM	**2200**	**2200**	**2200**	**1900**
No. of Cylinders	**4**	**4**	**4**	**6**
Bore	121 mm **4.75″**	121 mm **4.75″**	121 mm **4.75″**	121 mm **4.75″**
Stroke	152 mm **6″**	152 mm **6″**	152 mm **6″**	152 mm **6″**
Displacement	7 L **425 in³**	7 L **425 in³**	7 L **425 in³**	10.5 L **638 in³**
Track Rollers (Each Side)	**6**	**7**	**8**	**6**
Width of Standard Track Shoe	510 mm **20″**	600 mm **24″**	860 mm **34″**	508 mm **20″**
Length of Track on Ground	2.31 m **7′6″**	2.48 m **8′2″**	3.12 m **10′3″**	2.37 m **7′9″**
Ground Contact Area (W/Std. Shoe)	2.35 m² **3646 in²**	3.03 m² **4689 in²**	5.37 m² **8320 in²**	2.40 m² **3730 in²**
Track Gauge	1.80 m **5′9″**	1.89 m **6′2″**	2.16 m **7′1″**	1.88 m **6′2″**
GENERAL DIMENSIONS:				
Height (Stripped Top)**	2.13 m **6′11.8″**	2.13 m **6′11.8″**	2.30 m **7′6.5″**	2.10 m **6′11″**
Height (To Top of ROPS Canopy)	—	—	3.12 m **10′3″**	—
Height (To Top of ROPS)	2.98 m **9′10″**	3.01 m **9′10.6″**	—	3.20 m **10′5″**
Height (To Top of Cab ROPS)	—	—	3.18 m **10′5″**	—
Overall Length (With P Blade)	—	—	5.30 m **17′6.3″**	—
(Without Blade)	—	—	4.13 m **13′7″**	—
Overall Length (With S Blade)	4.53 m **14′11″**	4.60 m **15′1″**	—	5.00 m **16′4″**
(Without Blade)	3.60 m **11′10″**	3.60 m **11′10″**	—	3.94 m **12′9″**
Width (Over Trunnion)	2.54 m **8′4″**	2.63 m **8′7″**	3.26 m **10′8.4″**	—
Width (W/O Trunnion — Std. Shoe)	2.31 m **7′7″**	2.49 m **8′2″**	3.02 m **9′11″**	2.39 m **7′10″**
Ground Clearance	390 mm **15.4″**	415 mm **16.3″**	529 mm **20.8″**	310 mm **12.2″**
Blade Types and Widths:				
Straight	2.95 m **9′8.2″**	—	3.65 m **12′0″**	3.20 m **10′6″**
Angle	—	—	—	3.90 m **12′9″**
Semi-U	—	3.16 m **10′5″**	—	—
"P" Straight	—	—	3.66 m **11′11.9″**	—
Power Angle & Tilt	3.27 m **10′9″**	3.27 m **10′9″**	3.98 m **13′0.1″**	—
Fuel Tank Refill Capacity	246 L **65 U.S. gal**	246 L **65 U.S. gal**	246 L **65 U.S. gal**	295 L **78 U.S. gal**

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluids, straight dozer with tilt (PAT on D5H) rigid drawbar, front towing device, engine enclosures and suspension seat.
— D6D equipped with 560 mm (**122″**) track.
**Height (stripped top) — without ROPS canopy, exhaust, pre-cleaner, seat back or other easily removed encumbrances.

MODEL	D6D LGP	D6E	D6H Series II	D6H XL Series II
Flywheel Power	104 kW **140 hp**	116 kW **155 hp**	123 kW **165 hp**	130 kW **175 hp**
Operating Weight*				
(Power Shift)	17 373 kg **38,300 lb**	14 960 kg **32,987 lb**	17 761 kg **39,075 lb**	18 966 kg **41,811 lb**
(Direct Drive)	—	—	17 765 kg **39,170 lb**	—
(Power Shift Differential Steer)	—	—	17 838 kg **39,325 lb**	19 080 kg **42,063 lb**
Engine Model	**3306**	**3306**	**3306**	**3306**
Rated Engine RPM	**1900**	**1900**	**1900**	**1900**
No. of Cylinders	**6**	**6**	**6**	**6**
Bore	121 mm **4.75″**	121 mm **4.75″**	121 mm **4.75″**	121 mm **4.75′**
Stroke	152 mm **6″**	152 mm **6″**	152 mm **6″**	152 mm **6″**
Displacement	10.5 L **638 in³**	10.5 L **638 in³**	10.5 L **638 in³**	10.5 L **638 in³**
Track Rollers (Each Side)	**7**	**7**	**6**	**7**
Width of Standard Track Shoe	910 mm **36″**	508 mm **20″**	560 mm **22″**	560 mm **22″**
Length of Track on Ground	2.87 m **9′5″**	2.67 m **8′9″**	2.63 m **8′7.5″**	2.84 m **9′3″**
Ground Contact Area (W/Std. Shoe)	5.25 m² **8136 in²**	2.72 m² **4216 in²**	2.94 m² **4564 in²**	3.18 m² **4923 in²**
Track Gauge	2.11 m **6′9″**	1.88 m **6′2″**	1.88 m **6′2″**	1.88 m **6′2″**
GENERAL DIMENSIONS:				
Height (Stripped Top)**	2.05 m **6′8″**	2.10 m **6′11″**	2.26 m **7′5″**	2.26 m **7′5″**
Height (To Top of ROPS Canopy)	2.92 m **9′7.5″**	—	—	—
Height (To Top of ROPS)	—	3.20 m **10′5″**	3.12 m **10′3″**	3.12 m **10′3″**
Height (To Top of Cab ROPS)	—	—	3.12 m **10′3″**	3.12 m **10′3″**
Overall Length (With S Blade)	5.16 m **16′11″**	5.00 m **16′4″**	5.11 m **16′9″**	—
(Without Blade)	3.94 m **12′11″**	3.94 m **12′9″**	4.06 m **13′4″**	4.06 m **13′4″**
Width (Over Trunnions)	—	—	2.64 m **8′8″**	2.64 m **8′8″**
Width (W/O Trunnion — Std. Shoe)	—	2.39 m **7′10″**	2.44 m **8′0″**	2.44 m **8′0″**
Width (With Standard Shoe)	3.02 m **9′11″**	—	—	—
Ground Clearance	310 mm **12.2″**	310 mm **12.2″**	376 mm **14.8″**	377 mm **14.8″**
Blade Types and Widths:				
Straight	3.71 m **12′2″**	3.20 m **10′6″**	3.35 m **11′0″**	—
Angle	—	3.90 m **12′9″**	—	—
Angle Straight	—	—	4.16 m **13′7.8″**	4.16 m **13′8″**
Full Angle	—	—	3.78 m **12′4.7″**	3.78 m **12′5″**
Semi-U	—	3.20 m **10′6″**	3.26 m **10′8″**	3.26 m **10′8″**
Fuel Tank Refill Capacity	295 L **78 U.S. gal**	295 L **78 U.S. gal**	397 L **105 U.S. gal**	397 L **105 U.S. gal**

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluids, straight dozer with tilt, rigid drawbar, front towing device, engine enclosures and suspension seat.
— D6H Series II with extended undercarriage: length of track on ground 2.78 m (**9′1.5″**), ground contact area 3.11 m² (**4804 in²**).
**Height (stripped top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.



MODEL	D5H Series II		D5H XL Series II		D5H LGP Series II		D6D	
Flywheel Power	89 kW	**120 hp**	97 kW	**130 hp**	97 kW	**130 hp**	104 kW	**140 hp**
Operating Weight*								
(Power Shift)	13 224 kg	**29,200 lb**	13 982 kg	**30,830 lb**	16 057 kg	**35,400 lb**	14 610 kg	**32,210 lb**
(Direct Drive)	13 303 kg	**29,300 lb**	—		16 103 kg	**35,500 lb**	—	
Engine Model	**3304**		**3304**		**3304**		**3306**	
Rated Engine RPM	**2200**		**2200**		**2200**		**1900**	
No. of Cylinders	**4**		**4**		**4**		**6**	
Bore	121 mm	**4.75″**	121 mm	**4.75″**	121 mm	**4.75″**	121 mm	**4.75″**
Stroke	152 mm	**6″**	152 mm	**6″**	152 mm	**6″**	152 mm	**6″**
Displacement	7 L	**425 in³**	7 L	**425 in³**	7 L	**425 in³**	10.5 L	**638 in³**
Track Rollers (Each Side)	**6**		**7**		**8**		**6**	
Width of Standard Track Shoe	510 mm	**20″**	600 mm	**24″**	860 mm	**34″**	508 mm	**20″**
Length of Track on Ground	2.31 m	**7′6″**	2.48 m	**8′2″**	3.12 m	**10′3″**	2.37 m	**7′9″**
Ground Contact Area (W/Std. Shoe)	2.35 m²	**3646 in²**	3.03 m²	**4689 in²**	5.37 m²	**8320 in²**	2.40 m²	**3730 in²**
Track Gauge	1.80 m	**5′9″**	1.89 m	**6′2″**	2.16 m	**7′1″**	1.88 m	**6′2″**
GENERAL DIMENSIONS:								
Height (Stripped Top)**	2.13 m	**6′11.8″**	2.13 m	**6′11.8″**	2.30 m	**7′6.5″**	2.10 m	**6′11″**
Height (To Top of ROPS Canopy)	—		—		3.12 m	**10′3″**	—	
Height (To Top of ROPS)	2.98 m	**9′10″**	3.01 m	**9′10.6″**	—		3.20 m	**10′5″**
Height (To Top of Cab ROPS)	—		—		3.18 m	**10′5″**	—	
Overall Length (With P Blade)	—		—		5.30 m	**17′6.3″**	—	
(Without Blade)	—		—		4.13 m	**13′7″**	—	
Overall Length (With S Blade)	4.53 m	**14′11″**	4.60 m	**15′1″**	—		5.00 m	**16′4″**
(Without Blade)	3.60 m	**11′10″**	3.60 m	**11′10″**	—		3.94 m	**12′9″**
Width (Over Trunnion)	2.54 m	**8′4″**	2.63 m	**8′7″**	3.26 m	**10′8.4″**	—	
Width (W/O Trunnion — Std. Shoe)	2.31 m	**7′7″**	2.49 m	**8′2″**	3.02 m	**9′11″**	2.39 m	**7′10″**
Ground Clearance	390 mm	**15.4″**	415 mm	**16.3″**	529 mm	**20.8″**	310 mm	**12.2″**
Blade Types and Widths:								
Straight	2.95 m	**9′8.2″**	—		3.65 m	**12′0″**	3.20 m	**10′6″**
Angle	—		—		—		3.90 m	**12′9″**
Semi-U	—		3.16 m	**10′5″**	—		—	
"P" Straight	—		—		3.66 m	**11′11.9″**	—	
Power Angle & Tilt	3.27 m	**10′9″**	3.27 m	**10′9″**	3.98 m	**13′0.1″**	—	
Fuel Tank Refill Capacity	246 L	**65 U.S. gal**	246 L	**65 U.S. gal**	246 L	**65 U.S. gal**	295 L	**78 U.S. gal**

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluids, straight dozer with tilt (PAT on D5H) rigid drawbar, front towing device, engine enclosures and suspension seat.
— D6D equipped with 560 mm (**122″**) track.
**Height (stripped top) — without ROPS canopy, exhaust, pre-cleaner, seat back or other easily removed encumbrances.

MODEL	D6D LGP		D6E		D6H Series II		D6H XL Series II	
Flywheel Power	104 kW	**140 hp**	116 kW	**155 hp**	123 kW	**165 hp**	130 kW	**175 hp**
Operating Weight*								
(Power Shift)	17 373 kg	**38,300 lb**	14 960 kg	**32,987 lb**	17 761 kg	**39,075 lb**	18 966 kg	**41,811 lb**
(Direct Drive)	—		—		17 765 kg	**39,170 lb**	—	
(Power Shift Differential Steer)	—		—		17 838 kg	**39,325 lb**	19 080 kg	**42,063 lb**
Engine Model	**3306**		**3306**		**3306**		**3306**	
Rated Engine RPM	**1900**		**1900**		**1900**		**1900**	
No. of Cylinders	**6**		**6**		**6**		**6**	
Bore	121 mm	**4.75″**	121 mm	**4.75″**	121 mm	**4.75″**	121 mm	**4.75′**
Stroke	152 mm	**6″**	152 mm	**6″**	152 mm	**6″**	152 mm	**6″**
Displacement	10.5 L	**638 in³**	10.5 L	**638 in³**	10.5 L	**638 in³**	10.5 L	**638 in³**
Track Rollers (Each Side)	**7**		**7**		**6**		**7**	
Width of Standard Track Shoe	910 mm	**36″**	508 mm	**20″**	560 mm	**22″**	560 mm	**22″**
Length of Track on Ground	2.87 m	**9′5″**	2.67 m	**8′9″**	2.63 m	**8′7.5″**	2.84 m	**9′3″**
Ground Contact Area (W/Std. Shoe)	5.25 m²	**8136 in²**	2.72 m²	**4216 in²**	2.94 m²	**4564 in²**	3.18 m²	**4923 in²**
Track Gauge	2.11 m	**6′9″**	1.88 m	**6′2″**	1.88 m	**6′2″**	1.88 m	**6′2″**
GENERAL DIMENSIONS:								
Height (Stripped Top)**	2.05 m	**6′8″**	2.10 m	**6′11″**	2.26 m	**7′5″**	2.26 m	**7′5″**
Height (To Top of ROPS Canopy)	2.92 m	**9′7.5″**	—		—		—	
Height (To Top of ROPS)	—		3.20 m	**10′5″**	3.12 m	**10′3″**	3.12 m	**10′3″**
Height (To Top of Cab ROPS)	—		—		3.12 m	**10′3″**	3.12 m	**10′3″**
Overall Length (With S Blade)	5.16 m	**16′11″**	5.00 m	**16′4″**	5.11 m	**16′9″**	—	
(Without Blade)	3.94 m	**12′11″**	3.94 m	**12′9″**	4.06 m	**13′4″**	4.06 m	**13′4″**
Width (Over Trunnions)	—		—		2.64 m	**8′8″**	2.64 m	**8′8″**
Width (W/O Trunnion — Std. Shoe)	—		2.39 m	**7′10″**	2.44 m	**8′0″**	2.44 m	**8′0″**
Width (With Standard Shoe)	3.02 m	**9′11″**	—		—		—	
Ground Clearance	310 mm	**12.2″**	310 mm	**12.2″**	376 mm	**14.8″**	377 mm	**14.8″**
Blade Types and Widths:								
Straight	3.71 m	**12′2″**	3.20 m	**10′6″**	3.35 m	**11′0″**	—	
Angle	—		3.90 m	**12′9″**	—		—	
Angle Straight	—		—		4.16 m	**13′7.8″**	4.16 m	**13′8″**
Full Angle	—		—		3.78 m	**12′4.7″**	3.78 m	**12′5″**
Semi-U	—		3.20 m	**10′6″**	3.26 m	**10′8″**	3.26 m	**10′8″**
Fuel Tank Refill Capacity	295 L	**78 U.S. gal**	295 L	**78 U.S. gal**	397 L	**105 U.S. gal**	397 L	**105 U.S. gal**

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluids, straight dozer with tilt, rigid drawbar, front towing device, engine enclosures and suspension seat.
— D6H Series II with extended undercarriage: length of track on ground 2.78 m (**9′1.5″**), ground contact area 3.11 m² (**4804 in²**).
**Height (stripped top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.

MODEL	D6H XR Series II		D6H LGP Series II		D7G		D7H Series II	
Flywheel Power	130 kW	**175 hp**	127 kW	**170 hp**	149 kW	**200 hp**	160 kW	**215 hp**
Operating Weight*								
(Power Shift)	18 684 kg	**41,192 lb**	19 814 kg	**43,590 lb**	20 666 kg	**45,560 lb**	24 694 kg	**54,401 lb**
(Direct Drive)	—		19 989 kg	**43,976 lb**	20 510 kg	**45,218 lb**	—	
(Power Shift Differential Steer)	18 799 kg	**41,444 lb**	—		—		24 993 kg	**55,100 lb**
Engine Model	**3306**		**3306**		**3306**		**3306**	
Rated Engine RPM	**1900**		**1900**		**2000**		**2100**	
No. of Cylinders	**6**		**6**		**6**		**6**	
Bore	121 mm	**4.75″**	121 mm	**4.75″**	121 mm	**4.75″**	121 mm	**4.75″**
Stroke	152 mm	**6″**	152 mm	**6″**	152 mm	**6″**	152 mm	**6″**
Displacement	10.5 L	**638 in³**	10.5 L	**638 in³**	10.5 L	**638 in³**	10.5 L	**638 in³**
Track Rollers (Each Side)	**7**		**8**		**6**		**7**	
Width of Standard Track Shoe	560 mm	**22″**	915 mm	**36″**	508 mm	**20″**	560 mm	**22″**
Length of Track on Ground	2.77 m	**9′1″**	3.27 m	**10′8.5″**	2.70 m	**8′11″**	2.90 m	**9′6″**
Ground Contact Area (W/Std. Shoe)	3.11 m²	**4815 in²**	5.97 m²	**9254 in²**	2.76 m²	**4280 in²**	3.24 m²	**5016 in²**
Track Gauge	1.88 m	**6′2″**	2.23 m	**7′3″**	1.98 m	**6′5″**	1.98 m	**6′6″**
GENERAL DIMENSIONS:								
Height (Stripped Top)**	2.26 m	**7′5″**	2.32 m	**7′7″**	2.27 m	**7′5″**	2.44 m	**8′0″**
Height (To Top of ROPS)	3.12 m	**10′3″**	3.16 m	**10′5″**	3.20 m	**10′6″**	3.33 m	**10′11″**
Height (To Top of Cab ROPS)	3.12 m	**10′3″**	3.16 m	**10′5″**	—		3.42	**11′3″**
Height (To Top of ROPS Canopy)	—		3.16 m	**10′5″**	—		—	
Overall Length (With P Blade)	—		5.18 m	**17′0″**	—		—	
(Without Blade)	—		4.49 m	**14′9″**	—		—	
Overall Length (With S Blade)	5.26 m	**17′3″**	—		5.28 m	**17′4″**	6.03 m	**19′9″**
(Without Blade)	4.21 m	**13′10″**	—		4.19 m	**13′9″**	4.73 m	**15′6″**
Width (Over Trunnion)	2.64 m	**8′8″**	3.43 m	**11′3″**	—		2.86 m	**9′5″**
Width (W/O Trunnion — Std. Shoe)	2.44 m	**8′0″**	3.14 m	**10′3.6″**	2.55 m	**8′5″**	2.54 m	**8′4″**
Ground Clearance	377 mm	**14.8″**	382 mm	**15″**	347 mm	**13.7″**	406 mm	**16″**
Blade Types and Widths:								
Straight	3.36 m	**11′0″**	3.99 m	**13′1″**	3.66 m	**12′0″**	3.91 m	**12′10″**
Angle	—		—		4.27 m	**14′0″**	—	
Angle Straight	4.16 m	**13′8″**	—		—		4.49 m	**14′9″**
Full Angle	3.78 m	**12′5″**	—		—		4.08 m	**13′5″**
Universal	—		—		3.81 m	**12′6″**	3.98 m	**13′1″**
Semi-U	3.26 m	**10′8″**	—		—		3.68 m	**12′1″**
Fuel Tank Refill Capacity	397 L	**105 U.S. gal**	337 L	**89 U.S. gal**	435 L	**115 U.S. gal**	479 L	**127 U.S. gal**

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluid, straight dozer with tilt, horn, back-up alarm, retrieval hitch and front pull hook.
— D7G includes end track guiding guards.
**Height (stripped top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.

MODEL	D7H XR Series II		D7H LGP Series II		D8N		D8N LGP	
Flywheel Power	160 kW	**215 hp**	171 kW	**230 hp**	212 kW	**285 hp**	212 kW	**285 hp**
Operating Weight*								
(Power Shift)	24 920 kg	**54,939 lb**	26 839 kg	**59,169 lb**	36 842 kg	**81,222 lb**	36 746 kg	**81,025 lb**
(Power Shift Differential Steer)	25 219 kg	**55,598 lb**	27 139 kg	**59,831 lb**	—		—	
Engine Model	**3306**		**3306**		**3406**		**3406**	
Rated Engine RPM	**2100**		**2100**		**2100**		**2100**	
No. of Cylinders	**6**		**6**		**6**		**6**	
Bore	121 mm	**4.75″**	121 mm	**4.75″**	137 mm	**5.4″**	137 mm	**5.4″**
Stroke	152 mm	**6″**	152 mm	**6″**	165 mm	**6.5″**	165 mm	**6.5″**
Displacement	10.5 L	**638 in³**	10.5 L	**638 in³**	14.6 L	**893 in³**	14.6 L	**893 in³**
Track Rollers (Each Side)	**8**		**7**		**8**		**8**	
Width of Standard Track Shoe	560 mm	**22″**	914 mm	**36″**	560 mm	**22″**	965 mm	**38″**
Length of Track on Ground	3.06 m	**10′0.8″**	3.17 m	**10′5.4″**	3.21 m	**10′6″**	3.20 m	**10′6″**
Ground Contact Area (W/Std. Shoe)	3.43 m²	**5315 in²**	5.82 m²	**9029 in²**	3.6 m²	**5565 in²**	6.2 m²	**9576 in²**
Track Gauge	1.98 m	**6′6″**	2.23 m	**7′3″**	2.08 m	**6′10″**	2.34 m	**7′8″**
GENERAL DIMENSIONS:								
Height (Stripped Top)**	2.44 m	**8′0″**	2.55 m	**8′4″**	2.59 m	**8′6″**	2.59 m	**8′6″**
Height (To Top of ROPS)	3.33 m	**10′11″**	—		3.43 m	**11′3″**	3.43 m	**11′3″**
Height (To Top of ROPS Canopy)	—		3.42 m	**11′2.6″**	—		—	
Height (To Top of Cab ROPS)	3.42 m	**11′3″**	3.50 m	**11′6″**	—		—	
Overall Length (With P Blade)	—		5.54 m	**18′2″**	—		—	
(Without Blade)	—		4.62 m	**15′2″**	—		—	
Overall Length (With S Blade)	6.03 mm	**19′9″**	—		6.24 m	**20′6″**	6.24 m	**20′6″**
(Without Blade)	4.73 m	**15′6″**	—		4.93 m	**16′2″**	4.93 m	**16′2″**
Width (Over Trunnion)	2.86 m	**9′5″**	3.37 m	**11′1″**	3.05 m	**10′**	—	
Width (W/O Trunnion — Std. Shoe)	2.54 m	**8′1″**	3.15 m	**10′4″**	2.7 m	**8′10″**	—	
Width (With Standard Shoe)	—		—		—		3.37 m	**11′1″**
Ground Clearance	406 mm	**16″**	488 mm	**19.2″**	528 mm	**20.8″**	536 mm	**21″**
Blade Types and Widths:								
Straight	3.91 m	**12′10″**	4.49 m	**14′9″**	—		—	
Angle Straight	4.49 m	**14′9″**	—		4.96 m	**16′3″**	—	
Full Angle	4.08 m	**13′5″**	—		—		—	
Universal	3.98 m	**13′1″**	—		4.26 m	**14′0″**	3.94 m	**12′11″**
Semi-U	3.68 m	**12′1″**	—		3.94 m	**12′11″**	—	
Fuel Tank Refill Capacity	479 L	**127 U.S. gal**	479 L	**127 U.S. gal**	488 L	**129 U.S. gal**	488 L	**129 U.S. gal**

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluid, straight dozer with tilt, horn, back-up alarm, retrieval hitch and front pull hook.
— D8N equipped with track guides, 635 mm (**24″**) MS shoes, single shank ripper and SU blade.
**Height (stripped top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.
Note: D8N LGP is offered as a custom product.

MODEL	D6E WDA		D6H WDA Series II		D7H WDA Series II	
Flywheel Power	116 kW	**155 hp**	123 kW	**165 hp**	160 kW	**215 hp**
Operating Weight (PS)*	14 960 kg	**32,987 lb**	18 191 kg	**40,104 lb**	24 948 kg	**55,000 lb**
Engine Model	**3306**		**3306**		**3306**	
Rated Engine RPM	**1900**		**1800**		**2100**	
No. of Cylinders	**6**		**6**		**6**	
Bore	121 mm	**4.75″**	121 mm	**4.75″**	121 mm	**4.75″**
Stroke	152 mm	**6″**	152 mm	**6″**	152 mm	**6″**
Displacement	10.5 L	**638 in³**	10.5 L	**638 in³**	10.5 L	**638 in³**
Track Rollers (Each Side)	**7**		**6**		**7**	
Width of Standard Track Shoe	560 mm	**22″**	560 mm	**22″**	560 mm	**22″**
Length of Track on Ground	2.63 m	**8′9″**	2.62 m	**8′7.5″**	2.90 m	**9′6″**
Ground Contact Area (W/Std. Shoe)	2.98 m²	**4619 in²**	2.94 m²	**4564 in²**	3.24 m²	**5016 in²**
Track Gauge	1.88 m	**6′2″**	1.88 m	**6′2″**	1.98 m	**6′5″**
GENERAL DIMENSIONS:						
Height (Stripped Top)**	2.10 m	**6′11″**	2.26 m	**7′5″**	2.44 m	**8′0″**
Height (To Top of Cab ROPS)	3.20 m	**10′5″**	3.11 m	**10′2.25″**	3.42 m	**11′3″**
Overall Length (S Blade)	5.00 m	**16′4″**	5.01 m	**16′5″**	5.56 m	**18′3″**
(W/O Blade)	3.94 m	**12′9″**	—		—	
Width (Over Trunnion)	—		2.64 m	**8′8″**	2.87 m	**9′5″**
(W/O Trunnion)	2.39 m	**7′10″**	—		2.54 m	**8′4″**
Ground Clearance	—		377 mm	**14.8″**	406 mm	**16″**
Blade Types and Widths:						
Straight	3.2 m	**10′6″**	3.2 m	**10′6″**	3.81 m	**12′6″**
Semi-Universal	—		3.24 m	**10′7.5″**	3.66 m	**12′0″**
Universal	—		—		3.96 m	**13′0″**
Fuel Tank Refill Capacity	295 L	**78 U.S. gal**	337 L	**89 U.S. gal**	488 L	**129 U.S. gal**

* D6H Series II Operating Weight includes lubricants, coolant, full fuel tank, hydraulic controls, 6SU/tilt, 610 mm (24″) trash rack, 560 mm (22″) shoes, ROPS canopy, engine enclosure, extreme service crankcase guard, fuel tank guard, hydraulic cooler, prescreener, six lights, hinged HD radiator guard, lower radiator guarding, final drive seal guards, idler seal guards, engine compartment guarding, tilt cylinder guards.
D7H Series II Operating Weight includes lubricants, coolant, full fuel tank, hydraulic controls, 7SU/tilt, 610 mm (24″) trash rack, 610 mm (24″) shoes, ROPS canopy, engine enclosure, extreme service crankcase guard, fuel tank guard, hydraulic cooler, prescreener, six lights, hinged HD radiator guard, lower radiator guarding, final drive seal guards, idler seal guards, engine compartment guarding, tilt cylinder guards.
** Height with ROPS canopy, exhaust pipe, seat or all easily removed encumbrances. Add 71.1 mm (2.8″) for grouser tips on D7H Series II.

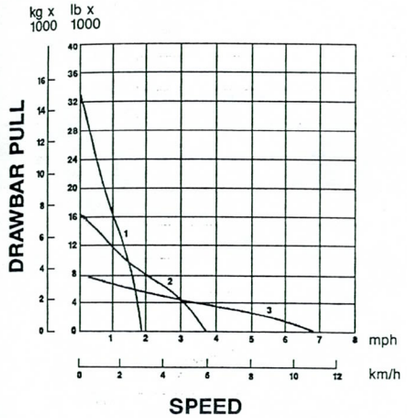
MODEL	D8N WDA		D9N WDA	
Flywheel Power	212 kW	**285 hp**	276 kW	**370 hp**
Operating Weight (PS)*	34 645 kg	**76,375 lb**	46 815 kg	**103,209 lb**
Engine Model	**3406**		**3408**	
Rated Engine RPM	**2100**		**1900**	
No. of Cylinders	**6**		**8**	
Bore	137 mm	**5.4″**	137 mm	**5.4″**
Stroke	165 mm	**6.5″**	152 mm	**6″**
Displacement	14.6 L	**893 in³**	18 L	**1099 in³**
Track Rollers (Each Side)	**8**		**8**	
Width of Standard Track Shoe	560 mm	**22″**	610 mm	**24″**
Length of Track on Ground	3.21 m	**10′6.5″**	3.47 m	**11′4.8″**
Ground Contact Area (W/Std. Shoe)	3.59 m²	**5553 in²**	4.24 m²	**6571 in²**
Track Gauge	2.08 m	**6′8″**	2.25 m	**7′4.6″**
GENERAL DIMENSIONS:				
Height (Stripped Top)**	2.59 m	**8′6″**	2.93 m	**9′7.3″**
Height (To Top of Cab ROPS)	3.42 m	**11′3″**	3.91 m	**12′9.8″**
Overall Length (S Blade)	6.24 m	**20′6″**	6.87 m	**22′6.4″**
(W/O Blade)	4.88 m	**16′2″**	5.17 m	**16′11.5″**
Width (Over Trunnion)	2.94 m	**9′8″**	3.25 m	**10′8″**
(W/O Trunnion)***	—	—	—	—
Ground Clearance	536 mm	**21.1″**	505 mm	**19.9″**
Blade Types and Widths:				
Straight	3.94 m	**12′11″**	4.32 m	**14′1.9″**
Universal	4.26 m	**14′0″**	4.66 m	**15′3.4″**
Fuel Tank Refill Capacity	481 L	**127 U.S. gal**	792 L	**209 U.S. gal**

*D8N Operating Weight includes lubricants, coolant, full fuel tank, hydraulic controls, 8S with 762 mm (30″) trash rack, 660 mm (26″) shoes, and ROPS — FOPS canopy. Also included are special radiator core and ejector fan, drawbar, engine enclosures, fuel tank guard, extreme service crankcase guard, HD hinged radiator guard, higher prescreener, front & rear striker bars and operator.
D9N Operating Weight includes lubricants, coolant, full fuel tank, hydraulic controls, 9SU with 914 mm (36″) trash rack, 685 mm (27″) shoes, and ROPS — FOPS canopy. Also included are special radiator core and ejector fan, fuel tank guards, engine enclosures, extreme service crankcase guard, HD hinged radiator guard, higher prescreener, front & rear striker bars and operator.
**Height with ROPS canopy, exhaust pipe, seat or all easily removed encumbrances.
***D8N-660 mm (26″) track shoes.
D9N-685 mm (27″) track shoes.

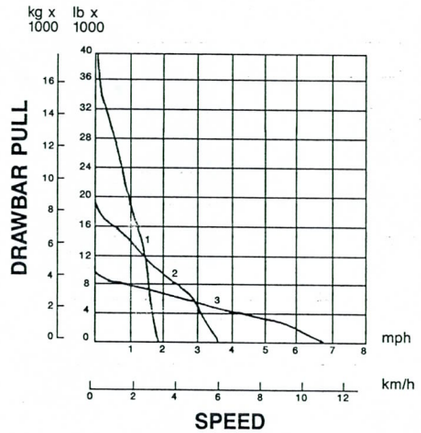
MODEL	D9N		D10N		D11N	
Flywheel Power	276 kW	**370 hp**	388 kW	**520 hp**	574 kW	**770 hp**
Operating Weight*	42 816 kg	**94,196 lb**	59 792 kg	**131,817 lb**	97 454 kg	**214,847 lb**
Engine Model		**3408**		**3412**		**3508**
Rated Engine RPM		**1900**		**1900**		**1800**
No. of Cylinders		**8**		**12**		**8**
Bore	137 mm	**5.4″**	137 mm	**5.4″**	170 mm	**6.69″**
Stroke	152 mm	**6″**	152 mm	**6″**	190 mm	**7.48″**
Displacement	18 L	**1099 in³**	27 L	**1649 in³**	34.5 L	**2105 in³**
Track Rollers (Each Side)		**8**		**8**		**8**
Width of Standard Track Shoe	610 mm	**24″**	610 mm	**24″**	710 mm	**28″**
Length of Track on Ground	3.47 m	**11′4.8″**	3.87 m	**12′8.5″**	4.44 m	**14′7″**
Ground Contact Area (W/Std. Shoe)	4.24 m²	**6571 in²**	4.73 m²	**7326 in²**	6.31 m²	**9781 in²**
Track Gauge	2.25 m	**7′4.6″**	2.55 m	**8′4″**	2.89 m	**9′6″**
GENERAL DIMENSIONS:						
Height (Stripped Top)**	2.93 m	**9′7.3″►**	3.197 m	**10′5.9″**	3.50 m	**11′6″►**
Height (To Top of ROPS Canopy)	3.91 m	**12′9.8″►**		—		—
Height (To Top of ROPS)		—	4.24 m	**13′11″►**	4.56 m	**14′11″►**
Overall Length (With SU Blade)	6.87 m	**22′6.4″**	7.76 m	**25′5″**	8.39 m	**27′6″**
(Without Blade)	5.17 m	**16′11.5″**	5.59 m	**18′3.9″**	6.16 m	**20′3″**
Width (Over Trunnions)	3.25 m	**10′8″**	3.72 m	**12′2.2″**		—
Width (W/O Trunnions — Std. Shoe)	2.89 m	**9′5.9″**	3.30 m	**10′9.8″**	3.78 m	**12′5″**
Ground Clearance	505 mm	**19.9″■**	615 mm	**24.2″■**	623 mm	**24.5″■**
Blade Types and Widths:						
Straight		—		—		—
Angle Straight/Angled		—		—		—
Universal	4.66 m	**15′3.4″**	5.26 m	**17′3″**	6.35 m	**20′10″**
Semi-U	4.32 m	**14′1.9″**	4.86 m	**15′11″**	5.60 m	**18′4″**
"P" Straight/Angled		—		—		—
Fuel Tank Refill Capacity	731 L	**193 U.S. gal**	974 L	**257 U.S. gal**	1471 L	**388 U.S. gal**

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluids, semi universal with tilt, back-up alarm, seat belts, lights, rigid drawbar and front towing device.
— D9N-D11N include track guides.
— D11N equipped with 813 mm (32″) extreme service track shoes.
— D11N includes 11U Dual Tilt Bulldozer, single shank ripper and ROPS cab.
**Height (stripped top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.
►Dimensions to flat of shoe. For dimensions to grouser tips add 84 mm (3.3″) for D9N, add 93 mm (3.7″) for D10N and 101 mm (4″) for D11N.
■SAE J1234

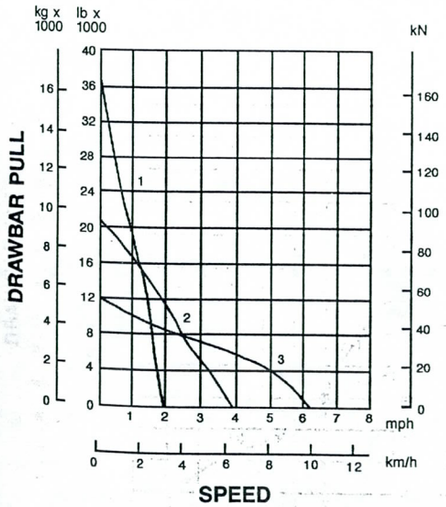
D3C Series II & D3C LGP Series II



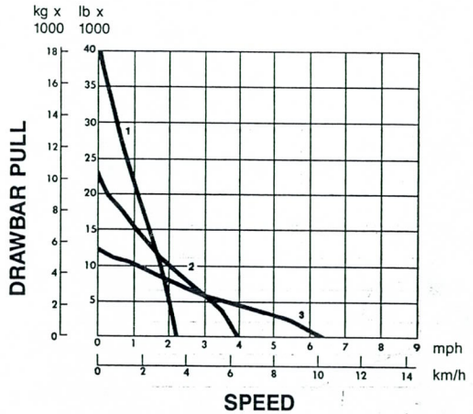
D4C Series II & D4C LGP Series II



D5C D5C LGP



D4H Series II



KEY:
1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear

MODEL	613C Series II		615C Series II		623E		633E	
Flywheel Power	131 kW	**175 hp**	197.5 kW	**265 hp**	272 kW	**365 hp**	354 kW	**475 hp**
Approx. Operating Weight (Empty)◄	15 264 kg	**33,650 lb**	25 605 kg	**56,450 lb**	33 700 kg	**74,300 lb**	50 805 kg	**112,000 lb**
Scraper Capacity — Heaped	8.4 m^3	**11 yd^3**	13 m^3	**17 yd^3**	17.6 m^3	**23 yd^3**	26 m^3	**34 yd^3**
Rated Load	11 975 kg	**26,400 lb**	18 506 kg	**40,800 lb**	24 950 kg	**55,000 lb**	37 195 kg	**82,000 lb**
Weight Distribution — Empty								
Drive	**63%**		**66%**		**65%**		**64%**	
Rear	**37%**		**34%**		**35%**		**36%**	
Weight Distribution — Loaded								
Drive	**49%**		**51%**		**52%**		**51%**	
Rear	**51%**		**49%**		**48%**		**49%**	
Engine Model	**3116**		**3306**		**3406**		**3408**	
Rated Engine RPM	**2300**		**2200**		**1900**		**2000**	
Displacement	6.6 L	**403 in^3**	10.5 L	**638 in^3**	14.6 L	**893 in^3**	18.0 L	**1099 in^3**
Top Speed (Loaded)	35.1 km/h	**21.8 mph**	44.4 km/h	**27.6 mph**	48 km/h	**30 mph**	53.0 km/h	**32.9 mph**
Non-Stop Turning Circle	8.9 m	**29′4″**	9.63 m	**31′7″**	10.9 m	**35′8″**	13.16 m	**43′2″**
Tires — Standard								
Tractor	**23.5R25**		**29.5R25**		**29.5-29, 34 PR (E-2)**		**37.25R35, 30 PR (E-3)**	
Scraper	**23.5R25**		**29.5R25**		**29.5-29, 34 PR (E-2)**		**37.25R35, 30 PR (E-3)**	
Width of Cut	2.35 m	**7′8.5″**	2.89 m	**9′6″**	3.5 m	**11′6″**	3.5 m	**11′6″**
Maximum Depth of Cut	160 mm	**6.3″**	414 mm	**16.3″**	330 mm	**13″**	431 mm	**17.0″**
Elevator Flight Spacing	419 mm	**16.5″**	419 mm	**16.5″**	520 mm	**20.5″**	619 mm	**24″**
Number of Flights	**15**		**18**		**15**		**14**	
Maximum Floor Opening	1.14 m	**3′9″**	1.181 m	**3′10.5″**	1.53 m	**5′**	1.22 m	**4′0″**
Maximum Depth of Spread	370 mm	**14.6″**	399 mm	**15.7″**	390 mm	**15.4″**	500 mm	**19.6″**
Fuel Tank Refill Capacity	250 L	**66 U.S. gal**	399 L	**105 U.S. gal**	570 L	**150 U.S. gal**	814 L	**215 U.S. gal**
GENERAL DIMENSIONS:								
Height to Top of Scraper	3.06 m	**10′0″**	3.589 m	**11′9″**	3.94 m	**12′11″**	4.72 m	**15′6″**
Wheelbase	6.26 m	**20′6.5″**	6.995 m	**22′11″**	7.97 m	**26′2″**	8.89 m	**29′2″**
Overall Length	10.0 m	**32′9″**	11.6 m	**38′1″**	12.61 m	**41′4″**	14.48 m	**47′6″**
Overall Width	2.44 m	**8′0″**	3.05 m	**10′0″**	3.55 m	**11′8″**	3.94 m	**12′11″**
Shipping Width	2.44 m	**8′0″**	3.05 m	**10′0″**	3.55 m	**11′8″**	3.94 m	**12′11″**
(Draft Arms on Inside of Bowl)	—		—		—		—	
Scraper Tread	1.80 m	**5′11″**	2.12 m	**6′9″**	2.18 m	**7′2″**	2.5 m	**8′1″**
Tractor Tread	1.80 m	**5′11″**	2.12 m	**6′9″**	2.21 m	**6′9″**	2.5 m	**8′1″**

◄Operating weight includes coolants, lubricants, ROPS canopy, full fuel tank and operator.

MODEL	621E		631E Series II		651E	
Flywheel Power: Tractor	272 kW	**365 hp**	366 kW	**490 hp**	443 kW	**594 hp**
Approx. Operating Weight (Empty) ◄	36 175 kg	**79,750 lb**	45 980 kg	**101,370 lb**	66 575 kg	**146,770 lb**
Scraper Capacity (Heaped)	15.96 m^3	**21 yd^3**	23.7 m^3	**31 yd^3**	33.6 m^3	**44 yd^3**
Rated Load	21 775 kg	**48,000 lb**	34 020 kg	**75,000 lb**	47 175 kg	**104,000 lb**
Approx. Operating Weight (Loaded)	57 950 kg	**127,750 lb**	80 000 kg	**176,370 lb**	113 750 kg	**250,770 lb**
AUGER ATTACHMENT						
Auger Diameter	1320 mm	**52″**	1524 mm	**60″**	1676 mm	**66″**
Auger RPM	**Variable 55 to 35 RPM**		**Variable 55 to 35 RPM**		**Variable 55 to 35 RPM**	
Auger Power	149 kW	**200 hp**	201 kW	**270 hp**	354 kW	**475 hp**
Hydraulic Flow	273 L/min	**72 gpm**	378 L/min	**100 gpm**	549 L/min	**145 gpm**
Cooling Flow	—	—	—	—	132 L/min	**35 gpm**
System Pressure	41 370 kPa	**6000 psi**	37 895 kPa	**5500 psi**	41 370 kPa	**5700 psi**
Auger Control	**electronic**		**electronic**		**electronic**	

◄Operating weight includes standard machine, coolant, lubricants, full fuel tank and operator.

The auger scraper is a self-loading system that offers an alternative to conventional, push-pull or elevating scrapers. An independent hydrostatic system powers the auger which is located near the center of the bowl. The rotating auger lifts and evenly distributes over 50% of the material that flows over the scraper cutting edge. This action reduces the cutting edge resistance allowing the wheel tractor-scraper to continue moving through the cut and quickly obtain full rated loads.

Advantages:

- Self-load in equal or less time
- Requires shorter cut distance
- Complete material ejection (angled ejector pushes material)
- Increased tire life
- Broader material appetite
- Better material retention on haul road (closed apron instead of open elevator)

MODEL	621E		631E Series II		651E	
Flywheel Power	246 kW	**330 hp**	336 kW	**450 hp**	410 kW	**550 hp**
Approx. Operating Weight (Empty)◄	30 480 kg	**67,195 lb**	43 945 kg	**96,880 lb**	60 950 kg	**134,370 lb**
Scraper Capacity —						
Struck	10.7 m^3	**14 yd^3**	16.1 m^3	**21 yd^3**	24.5 m^3	**32 yd^3**
Heaped	15.3 m^3	**20 yd^3**	23.7 m^3	**31 yd^3**	33.6 m^3	**44 yd^3**
Rated Load	21 775 kg	**48,000 lb**	34 020 kg	**75,000 lb**	47 175 kg	**104,000 lb**
Weight Distribution — Empty						
Drive	**68%**		**67%**		**66%**	
Rear	**32%**		**33%**		**34%**	
Weight Distribution — Loaded						
Drive	**53%**		**53%**		**53%**	
Rear	**47%**		**47%**		**47%**	
Engine Model	**3406**		**3408**		**3412**	
Rated Engine RPM	**1900**		**2000**		**1900**	
Displacement	14.6 L	**893 in^3**	18.0 L	**1099 in^3**	27.0 L	**1649 in^3**
Top Speed (Loaded)	51 km/h	**32 mph**	53 km/h	**33 mph**	53 km/h	**33 mph**
Non-Stop Turning Circle	10.9 m	**35′8″**	12.2 m	**40′1″**	13.6 m	**44′7″**
With ROPS Restriction	—		—		14.5 m	**47′7″**
Tires — Tractor Drive	**33.25-29, 26 PR (E-3)**		**37.25-35, 30 PR (E-3)**		**37.5R39 Radial★★(E-3)**	
Scraper	**33.25-29, 26 PR (E-3)**		**37.25-35, 30 PR (E-3)**		**37.5R39 Radial★★(E-3)**	
Width of Cut	3.02 m	**9′11″**	3.49 m	**11′6″**	3.85 m	**12′8″**
Maximum Depth of Cut	333 mm	**13.1″**	437 mm	**17.2″**	660 mm	**26″**
Maximum Depth of Spread	522 mm	**20.6″**	480 mm	**18.9″**	533 mm	**21″**
Fuel Tank Refill Capacity	530 L	**140 U.S. gal**	738 L	**195 U.S. gal**	954 L	**252 U.S. gal**
GENERAL DIMENSIONS:						
Height to Top of Scraper	3.71 m	**12′2″**	4.29 m	**14′1″**	4.71 m	**15′5″**
Wheelbase	7.72 m	**25′4″**	8.77 m	**28′9″**	9.92 m	**32′7″**
Overall Length	12.93 m	**42′5″**	14.28 m	**46′10″**	16.14 m	**52′11″**
Overall Width	3.47 m	**11′4″**	3.94 m	**12′11″**	4.35 m	**14′4″**
Shipping Width (Draft Arm on Inside of Bowl)	—		3.64 m	**11′11″**	3.91 m	**12′10″**
Scraper Tread	2.18 m	**7′2″**	2.46 m	**8′1″**	2.85 m	**9′4″**
Tractor Tread	2.21 m	**7′3″**	2.46 m	**8′1″**	2.64 m	**8′8″**

◄Operating weight includes standard machine, coolant, lubricants, full fuel tank, and operator.

MODEL	627E		637E Series II		657E	
Flywheel Power: Tractor	246.2 kW	**330 hp**	336 kW	**450 hp**	410 kW	**550 hp**
Scraper	168 kW	**225 hp**	187 kW	**250 hp**	298 kW	**400 hp**
Approx. Operating Weight (Empty)◄	35 160 kg	**77,510 lb**	50 845 kg	**112,090 lb**	68 860 kg	**151,810 lb**
Scraper Capacity: Struck	10.7 m^3	**14 yd^3**	16.1 m^3	**21 yd^3**	24.5 m^3	**32 yd^3**
Heaped	15.3 m^3	**20 yd^3**	23.7 m^3	**31 yd^3**	33.6 m^3	**44 yd^3**
Rated Load	21 775 kg	**48,000 lb**	34 020 kg	**75,000 lb**	47 175 kg	**104,000 lb**
Weight Distribution — Empty: Front	**59%**		**59%**		**60%**	
Rear	**41%**		**41%**		**40%**	
Weight Distribution — Loaded: Front	**48%**		**49%**		**51%**	
Rear	**52%**		**51%**		**49%**	
Engine Model: Tractor	**3406**		**3408**		**3412**	
Scraper	**3306**		**3306**		**3408**	
Rated Engine RPM: Tractor	**1900**		**2000**		**1900**	
Scraper	**2200**		**2200**		**1900**	
Displacement: Tractor	14.6 L	**893 in^3**	18.0 L	**1099 in^3**	27.0 L	**1649 in^3**
Scraper	10.5 L	**638 in^3**	10.5 L	**638 in^3**	18.0 L	**1099 in^3**
Top Speed (Loaded)	51.3 km/h	**32 mph**	53 km/h	**33 mph**	53 km/h	**33 mph**
Non-Stop Turning Circle	10.9 m	**35′9″**	12.2 m	**40′1″**	13.6 m	**44′8″**
With ROPS Restriction	—		—		14.5 m	**47′7″**
Tires — Tractor Drive	**33.25-29, 26 PR (E-3)**		**37.25-35, 30 PR (E-3)**		**37.5R39 Radial★★(E-3)**	
Scraper	**33.25-29, 26 PR (E-3)**		**37.25-35, 30 PR (E-3)**		**37.5R39 Radial★★(E-3)**	
Width of Cut	3.02 m	**9′11″**	3.51 m	**11′6″**	3.85 m	**12′8″**
Maximum Depth of Cut	333 mm	**13.1″**	437 mm	**17″**	660 mm	**26″**
Maximum Depth of Spread	522 mm	**20.6″**	480 mm	**18′8″**	533 mm	**21″**
Fuel Tank Refill Capacity: Tractor	—		—		—	
Scraper	992 L	**262 U.S. gal**	1200 L	**317 U.S. gal**	1597 L	**422 U.S. gal**
GENERAL DIMENSIONS:						
Height to Top of Scraper	3.71 m	**12′2″**	4.29 m	**14′1″**	4.71 m	**15′5″**
Wheelbase	7.72 m	**25′4″**	8.77 m	**28′9″**	9.92 m	**32′7″**
Overall Length	12.93 m	**42′5″**	14.28 m	**46′10″**	16.2 m	**53′0″**
Overall Width	3.47 m	**11′4″**	3.94 m	**12′11″**	4.35 m	**14′4″**
Shipping Width (Draft Arm on Inside of Bowl)	—		3.64 m	**11′11″**	3.91 m	**12′10″**
Scraper Tread	2.18 m	**7′2″**	2.46 m	**8′1″**	2.85 m	**9′4″**
Tractor Tread	2.21 m	**7′3″**	2.46 m	**8′1″**	2.64 m	**8′8″**
PUSH-PULL GENERAL DIMENSIONS:						
Operating Weight (Empty)◄	36 620 kg	**80,735 lb**	52 385 kg	**115,490 lb**	72 640 kg	**160,140 lb**
Overall Length	15.2 m	**49′7″**	16.49 m	**54′1″**		
Weight Distribution — Empty: Front	**60%**		**60%**		**60%**	
Rear	**40%**		**40%**		**40%**	
Weight Distribution — Loaded: Front	**49%**		**50%**		**51%**	
Rear	**51%**		**50%**		**49%**	

◄Operating weight includes standard machine, coolant, lubricants, full fuel tank, and operator.

MODEL	627E		637E Series II		657E	
Flywheel Power: Tractor	246 kW	**330 hp**	336 kW	**450 hp**	410 kW	**550 hp**
Scraper	168 kW	**225 hp**	187 kW	**250 hp**	298 kW	**400 hp**
Approx. Operating Weight (Empty) ◄	40 385 kg	**89,035 lb**	54 540 kg	**120,235 lb**	75 875 kg	**167,270 lb**
Scraper Capacity (Heaped)	15.96 m^3	**21 yd^3**	23.7 m^3	**31 yd^3**	33.6 m^3	**44 yd^3**
Rated Load	21 775 kg	**48,000 lb**	34 020 kg	**75,000 lb**	47 175 kg	**104,000 lb**
Approx. Operating Weight (Loaded)	62 160 kg	**137,035 lb**	88 560 kg	**195,235 lb**	123 050 kg	**271,270 lb**
AUGER ATTACHMENT						
Auger Diameter	1320 mm	**52″**	1524 mm	**60″**	1676 mm	**66″**
Auger RPM	**Variable 55 to 35 RPM**		**Variable 55 to 35 RPM**		**Variable 55 to 35 RPM**	
Auger Power	149 kW	**200 HP**	201 kW	**270 HP**	354 kW	**475 HP**
Hydraulic Flow	273 L/min	**72 gpm**	378 L/min	**100 gpm**	549 L/min	**145 gpm**
Cooling Flow	—	—	—	—	132 L/min	**35 gpm**
System Pressure	41 370 kPa	**6000 psi**	37 923 kPa	**5500 psi**	41 340 kPa	**5700 psi**
Auger Control	**electronic**		**electronic**		**electronic**	

◄Operating weight includes standard machine, coolant, lubricants, full fuel tank and operator.

The auger scraper is a self-loading system that offers an alternative to conventional, push-pull or elevating scrapers. A independent hydrostatic system powers the auger which is located near the center of the bowl. The rotating auger lifts a evenly distributes over 50% of the material that flows over the scraper cutting edge. This action reduces the cutting ed resistance allowing the wheel tractor-scraper to continue moving through the cut and quickly obtain full rated loads.

Advantages:

- Self-load in equal or less time
- Requires shorter cut distance
- Complete material ejection (angled ejector pushes material)
- Increased tire life
- Broader material appetite
- Better material retention on haul road (closed apron instead of open elevator)

TIRE OPTIONS			613C Series II		615C Series II		621E 623E 627E		631E Series II 633E 637E Series II		651E 657E	
			Tr.	Sc.	Tr.	Sc.	Tr.	Sc.	Tr.	Sc.	Tr.	Sc.
18.00-25	16 PR	E2	•	•								
23.5-25	16 PR	E2	•	•								
"	"	E3	•	•								
23.5R25	★		• 1	•								
26.5-25	26 PR	E2			•	•						
26.5R25	★	E2			•	•						
29.5-25	22 PR	E2			•	•						
"	"	E3			•	•						
29.5R25	★	E2			• 2	•						
29.5R25	★ ★	E2			•	•						
29.5-29	34 PR	E2					• 4	•				
"	"	E3					•	•				
29.5R29	★ ★	E2					•	•				
"	"	E3					•	•				
33.25-29	26 PR	E3					• 5	•				
33.25R29	★ ★	E2					• 6	•				
"	"	E3					• 6	•				
33.25R35	★ ★	E2							•	•		
"	"	E3							•	•		
37.25-35	30 PR	(E-3)							• 7	•		
37.25R35	★ ★	E2							• 8	•		
37.5-39	44 PR	E3									•	•
37.5-39	52 PR	E3									•	•
37.5-39	★ ★	E3									•	•
37.5R39	★ ★	E3									• 9	•
40.5/75R39	★ ★	E3									•	•

KEY

1. Standard on 613C Series II.
2. Standard on 615C Series II.
4. Standard on 623E. Not available on 621E and 627E.
5. Standard on 621E and 627E. Not available on 623E.
6. Not available on 623E.
7. Standard on 631E Series II and 637E Series II.
8. Standard on 633E.
9. Standard on 651E and 657E.

<----------PRESTRESSED CONCRETE MEMBER DESIGN SUMMARY----------SHEET NO. 18/

JOB I.D. : ACDC CHANNEL COVER FOR SUNDT-SECTION 7(b)
DATE : 2/13/91; DESIGNED BY:NTS CHECKED BY: JOB NO. 7068
SECTION NAME: 96BG27 7(b)

<----------SPAN= 36.667 FT---------->

PRECAST X-SECTION LOADS:
SELF WEIGHT.....= 1.388 KIP/FT
SUPERIMPOSED DEAD LOAD..= 2.400 KIP/FT
P = 1.094K @ 18.333 FT FROM LE (midspan)
SUPERIMPOSED LIVE LOAD..= 2.776 KIP/FT

SDL= 300.00 PSF SLL= 347.00 PSF % OF LL SUSTAINED= 0.00%

<----------SERVICE LOAD MOMENTS---------->

<----------SECTION PROPERTIES----------><----------PRECAST SECTION:

	PLAIN		COMPOSITE	
A =	1332.00	IN.^2	**********	IN.^2
I =	131598.00	IN.^4	**********	IN.^4
H =	27.00	IN.	**********	IN.
YB=	13.50	IN	**********	IN.
YT=	13.50	IN.	**********	IN.
SB=	9748.00	IN.^3	**********	IN.^3
ST=	9748.00	IN.^3	**********	IN.^3
WT=	1387.50	PLF	**********	PLF

D.L.= 646.6 K-FT AT 18.3 FT FROM LE
L.L.= 466.5 K-FT AT 18.3 FT FROM LE

Std. Pull

<----------

CONCRETE DATA:
BEAM:
WT = 150 PCF
FCI = 4.00 KSI
F'C = 5.00 KSI

STRAND DATA: PULL= 0.75 FPU=270 KSI LOW-RELAXATION
DIA.= 0.500 IN.; AREA PER STRAND= 0.1531 IN.^2 } 1/2" φ
NO. = 26 ; TOTAL AREA = 3.9806 IN.^2

AASHTO LOSSES: INITIAL= 4.30%; FINAL= 15.40%
PI= 806 KIPS; PO= 771 KIPS; PE= 682 KIPS ← Straight Pull
ECCENTRICITY DATA: NUMBER OF HARP POINTS= 0
ECCENTRICITY AT ENDS = 10.50, 10.50 IN.
---------->

<----------
ULTIMATE MOMENT AT CRITICAL SECTION: (1.30 DL + 2.17 LL)
CRITICAL MOMENT = 1852.9 KIP-FT 18.3 FT FROM LEFT END
* RESISTING MOMENT= 1942.0 KIP-FT * E.O.R. Shows 1872 K ---------->

<----------
TRANSFER STRESSES:
CRITICAL TENSILE AT TOP 3.7 FT FROM LT END= 0.148 KSI; ALLOW= 0.190 KSI
CRITICAL COMPRESSIVE AT BOT 3.7 FT FROM LT END= 1.307 KSI; ALLOW= 2.400 KSI
SERVICE STRESSES:
CRITICAL TENSILE AT BOT 18.3 FT FROM LT END= 0.124 KSI; ALLOW= 0.424 KSI
CRITICAL COMPRESSIVE AT TOP 18.3 FT FROM LT END= 1.148 KSI; ALLOW= 2.000 KSI
---------->

<----------
DESIGN CAMBER IN INCHES: +/- 1/2 INCH TOLERANCE

DIST FROM LE(FT)	ESTIMATED AT RELEASE	<---ESTIMATED AT ERECTION---> SELF WEIGHT	NON-COMP. D.L.	TDL + 0%PERM.LL	<---ESTIMATED LONG TIME---> WITH TDL ONLY	WITH TDL + 0%PERM.LL	TDL + 0%PERM.LL 100%INST.LL
18.33	0.273	0.485	0.309	0.309	0.150	0.150	-0.049

---------->

<----------
SHEAR STIRRUPS: WITH A(V)= 0.800 IN.^2 & FY = 60.0 KSI

MEASURED FROM LEFT END	MEASURED FROM RIGHT END
1 AT 2 IN.	1 AT 2 IN.
2 AT 12 IN.	2 AT 12 IN.
9 AT 18 IN.	9 AT 18 IN.

USE #4 Stirrups in Pairs. Spacing per E.O.R. Dwg. ---------->

<----------
CGS AT ENDS= 3.000 , 3.000 IN. ** ---------->

<----------
REACTIONS IN KIPS= (WSD) 120.88 , 120.88 ; (USD) 201.42 , 201.42 ---------->

<----------
DESIGN COMPLETED

** E.O.R. Shows 192.78 K

CORPS OF ENGINEERS, U. S. ARMY
LOS ANGELES DISTRICT
APPROVED
SUBJECTED TO CORRECTION NOTED IN RED
(EXCEPT FOR ERRORS & OMISSIONS)

MAR 0 9 1991

AUTHORIZED REPRESENTATIVE OF
THE CONTRACTING OFFICER

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC - Pre - Cont - Covered Sec PAGE 4 OF ____

DETAIL Summary COMPUTED ____ DATE ____

Allowable Fill Height CHECKED BY ____ DATE ____

Covered Sections — Allowable Fill Height

Sec. 6

T-PAC 5.2' ✓ | In-House 5.6' | USE 5.1'

(4'-9")

904+60 → 897+00

Sec. 7(a)

T-PAC 3.9' ✓ | In-House 4.0' | USE 3.9'

(3'-10")

975+50 → 973+50, 967+00 → 963+50, COE 4.0'

Sec. 7(b)

T-PAC 2.2' ✓ | In-House 2.5' | Use 2.1

(1'-9")

944+67 → 930+00, 928+00 → 922+37, 921+16.50 → 919+00, 909+28 → 904+00 COE 2.0'

Sec. 8

T-PAC 9.0' ✓ | In-House 9.1' | Use 9.0'

(8'-4")

919+00 → 911+40, COE 10.0'

Sec 9

T-PAC 4.8' ✓ | In-House 4.8' | Use 4.8'

(3'-9")

922+37 → 921+16.50, 911+40 → 909+28 COE 5.0'

Sec 10

T-PAC 1.4' ✓ | In-House 1.1' | Use 1.0'

(1'-5")

973+50 → 967+00,

Tapered Sections appear to meet the numbers shown above.

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ALDC - Pre-Cast - Covered Sec PAGE 5 OF

DETAIL T-PAC calcs COMPUTED DATE

Excess DL Allowable CHECKED BY DATE

Analysis of T-PAC computer results

Sec. 6

$DLM = 1505^{1-k}$ $M_{girder} = \frac{wl^2}{8} = \frac{(1.45)(40.7)^2}{(8)} = 300^{1-k}$

$EDLM = 1505 - 300 = 1205^{1-k}$

$w = \frac{8M}{l^2} = \frac{(8)(1205)}{(40.7)^2} = 5.82^{k/'}$ $h = \frac{w}{\gamma W} = \frac{5.82}{(1.14)(8)} = 5.2'$

$\boxed{h = 5.2'}$

Sec. 7a.

$DLM = 969^{1-k}$ $M_{girder} = \frac{wl^2}{8} = \frac{(1.39)(36.7)^2}{(8)} = 234^{1-k}$

$EDLM = 969 - 234 = 735^{1-k}$

$w = \frac{(8)(735)}{(36.7)^2} = 4.37^{k/'}$ $h = \frac{4.37}{(1.14)(8)} = 3.9'$

$\boxed{h = 3.9'}$

Sec. 7b.

$DLM = 647^{1-k}$ $M_{girder} = \frac{wl^2}{8} = \frac{(1.39)(36.7)^2}{(8)} = 234^{1-k}$

$EDLM = 647 - 234 = 413^{1-k}$

$w = \frac{(8)(413)}{(36.7)^2} = 2.45^{k/'}$ $h = \frac{2.45}{(1.14)(8)} = 2.2'$

$\boxed{h = 2.2'}$

Sec. 8

$DLM = 1950^{1-k}$ $M_{girder} = \frac{wl^2}{8} = \frac{(1.45)(36.7)^2}{(8)} = 244^{1-k}$

$EDLM = 1950 - 244 = 1706^{1-k}$

$w = \frac{(8)(1706)}{(36.7)^2} = 10.1^{k/'}$ $h = \frac{10.1}{(1.14)(8)} = 9.0'$

$\boxed{h = 9.0'}$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ALDC - Pre-Const - Covered Sec PAGE 6 OF ____

DETAIL T-PAC Calcs COMPUTED ____ DATE ____

Excess DL Allowable CHECKED BY ____ DATE ____

Analysis of T-PAC computer results - cont'd

Sec. 9

DLM = 1131'-k Moinder = $\frac{(1.34)(36.7)^2}{(8)}$ = 234'-k

EDLM = 1131 - 234 = 897'-k

$w = \frac{(8)(897)}{(36.7)^2} = 5.33$ $h = \frac{5.33}{(.114)(8)} = 4.8'$

$\boxed{h = 4.8'}$

Sec. 10

DLM = 489'-k Moinder = $\frac{(1.31)(36.7)^2}{(8)}$ = 220'-k

EDLM = 489 - 220 = 269'-k

$w = \frac{(8)(269)}{(36.7)^2} = 1.60$ $h = \frac{1.60}{(.114)(8)} = 1.4'$

$\boxed{h = 1.4'}$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC PAGE 7 OF

DETAIL COMPUTED CLW DATE

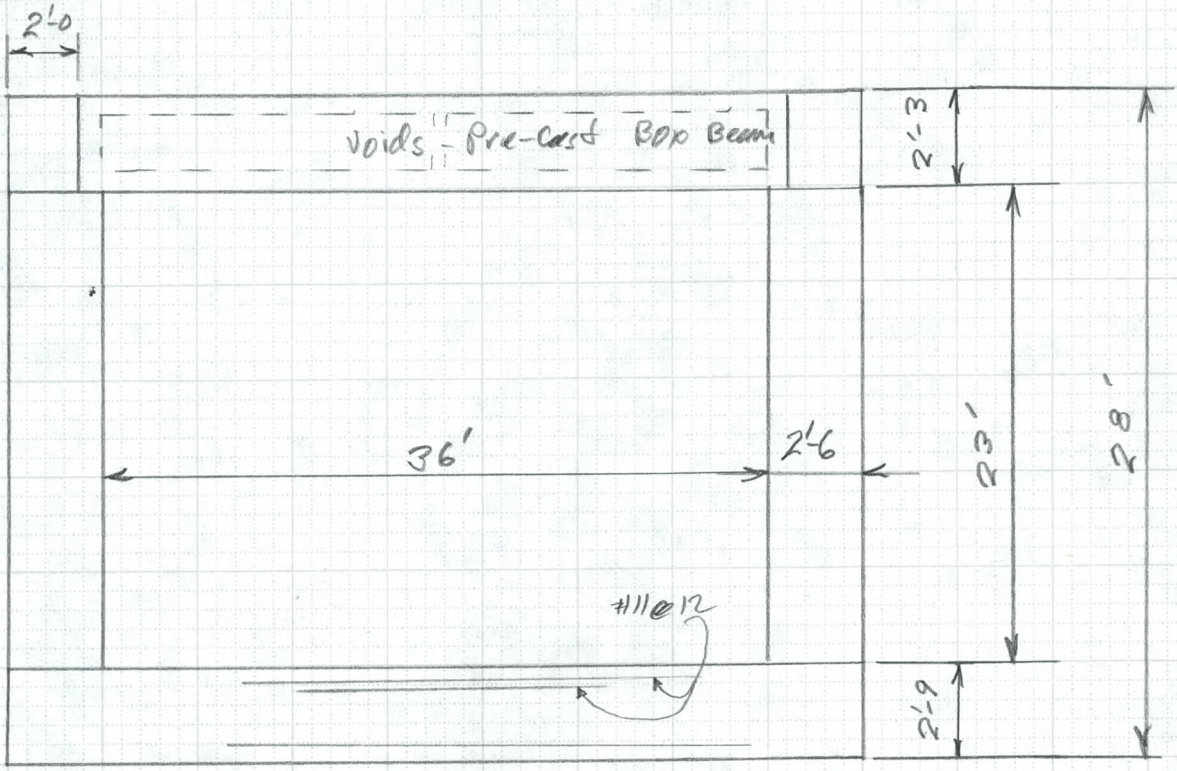
Biltmore Uplift Check CHECKED BY DATE

Covered Section #7

Sheet 59 of 91

	W	H	Tr	Tw	Ts	H bar	J bar	K bar
NO. 7	36	23	2-2	2-6	2'-9	#6@12	#11@12	#11@12

(2-3) precast



Wt of Box / Lin ft (2)(2ft)(2.25ft)(.15 k/ft) = 1.35 k/ft

Pre-Cast Pre Cast Box Beam wt = (1.388 k/ft)(37 ft)/(8ft) = 6.42

Top Walls = (2)(2.5 ft)(23 ft)(.15 k/ft³) = 17.25

Floor = (2.75 ft)(41 ft)(.15 k/ft³) = 16.91

ΣW = 41.93 k Pre-Cast

CIP

Top = (2.17 ft)(41 ft)(.15 k/ft³) = 13.35 k/ft

Wall = 17.25

Floor = 16.91

47.51 k/ft CIP

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC PAGE 8 OF

DETAIL COMPUTED DATE

Biltmore Uplift Check CHECKED BY DATE

Ground Water Height above Bottom adequate to produce uplift

Cast-in-Place Top

Water Displaced = Wt of Box

$(H)(41\,ft)(1\,ft)(.0624\,k/ft^3) = 47.51^k$

$H = 18.6^{ft}$

Pre-Cast Top

$(H)(41\,ft)(1\,ft)(.0624\,k/ft^3) = 41.93^k$

$H = 16.4^{ft}$

Ground water level 4 ft above box bottom as per Paul Linzen ∴ Uplift is no problem

Pre-Cast Top w/ 2' of fill

$2'\,Fill = (2\,ft)(41\,ft)(.12\,k/ft) = 9.84^k$

$SW = 41.93 + 9.84 = 51.77^k$

$(H)(41)(1)(.0624) = 51.35^k$

$H = 20.2^{ft}$

Fill required if water @ top of Box

$(28)(41)(1)(.0624) = 41.93 + (H)(41)(1)(0.120)$

Fill Height required = 6^{ft}

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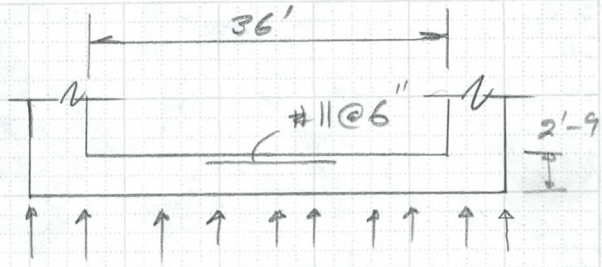
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC PAGE 9 OF

DETAIL Biltmore Uplift Check COMPUTED DATE

CHECKED BY DATE

Uplift Floor will accept



Max Mom Uniform Loaded Beam
fixed at both ends $= \frac{wl^2}{12} = M$

$M_{Beam} = \frac{1}{1.3} A_s f_y (d - a/2)$

$= \left(\frac{1}{1.3}\right)(2)\frac{(1.56 in^2)(60\ k/in^2)}{(12\ in/ft)}\left(30 - \frac{4.6}{2}\right)$

$a = \frac{A_s f_y}{.85 f'_c b}$

$= \frac{(2)(1.56)(60)}{(.85)(4)(12)}$

$a = 4.6$

$M = 332'^{-k}$ capacity of Floor Beam

$w = \frac{12M}{l^2} = \frac{(12)(332'^{-k})}{(36')^2} = 3.1^{k/'}$

$(H')(1')(.0624\ k/ft^3) = 3.1^{k/'}$

$H = 49.7'$ Floor Beam ok

6910-153 4-90

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ADOL - Pre-Cast - Covered Sec PAGE 10 OF

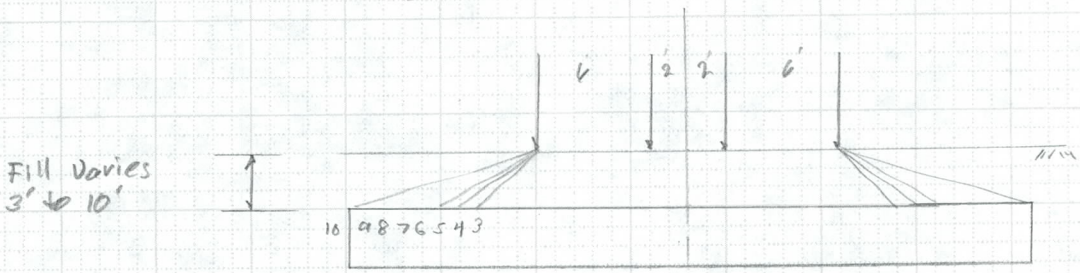
DETAIL 36' Span LL Mom COMPUTED DATE

Excess DL Allowable CHECKED BY DATE

LL Uniform Loads for fill depth > 3'

$$M = R_1\left(a + \frac{R_1}{2w}\right)$$

2-Trucks 100%
$I = 1.0$



$$M_3 = (32)(1.0)\left(7 + \frac{(32)}{(2)(2.9)}\right) \qquad M_{10} = (32)(1.0)\left(0 + \frac{(32)}{(2)(1.78)}\right)$$

$M_3 = 400^{1\text{-}k}$ $\qquad M_{10} = 288^{1\text{-}k}$

Uniform LL Moms incl Transverse reduction

2-Trucks

3'	$400^{1\text{-}k}$		7'	$218^{1\text{-}k}$
4	384		8	182
5	335		9	155
6	268		10	132

3-Trucks 90%
$I = 1.0$

Assume uniform load over entire span

$$w = \frac{\Sigma P}{L} = \frac{(6)(16)}{(36)} = 2.67^{k/ft}$$

$$M = \frac{wl^2}{8}(.9) = \frac{(2.67)(36)^2(.9)}{(8)} = 389^{1\text{-}k}$$

LL Moments

3-Trucks

3'	$389^{1\text{-}k}$		7	$253^{1\text{-}k}$
4	389		8	222
5	354		9	198
6	296		10	179

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

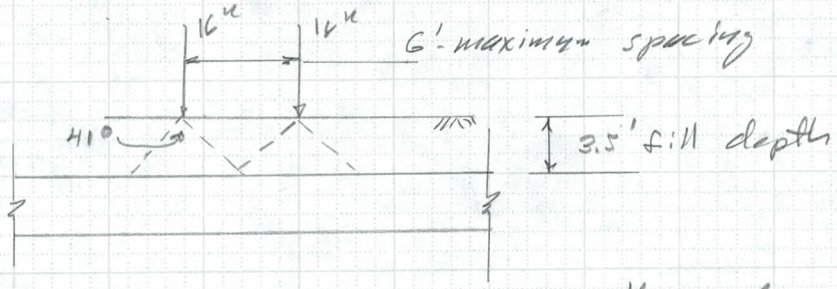
PROJECT AL DL - Pre-Cast - Covered Sec PAGE 11 OF

DETAIL 36' Span LL Moments COMPUTED DATE

Excess DL Allowable CHECKED BY DATE

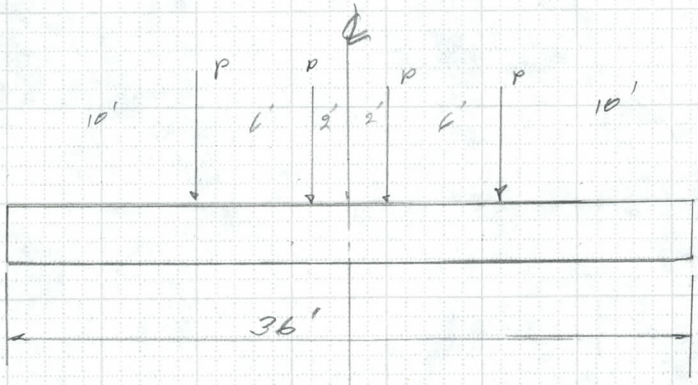
Live Load Moments 36' span

For fill depths under 3½' use point loads
For fill depths over 3½' use uniform load



Using a 41° distribution, fills above 3½ produce a uniform load (6.4.2) AASHTO Live Load on fill.

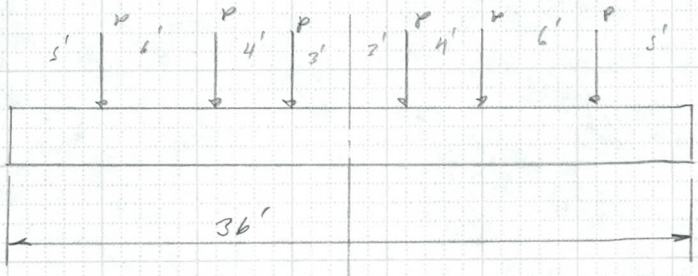
Point Loads Under 3' fill



2-Trucks 100%
I = 1.3

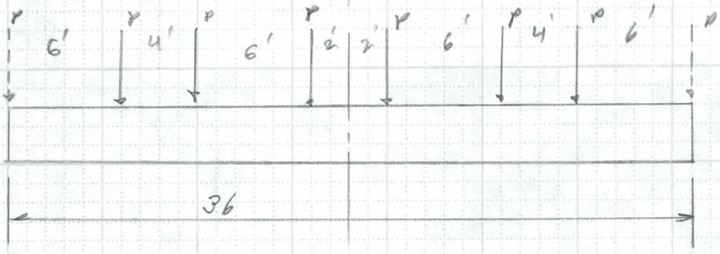
$M = \Sigma Pa$
$= (1.3)(16)(10+16)$
$M = 540'^{-k}$

Fill	M	I
0→1	580	I=1.3
1→2	535	I=1.2
2→3	490	I=1.1



3-Trucks 90%
I = 1.3

$M = \Sigma Pa(.9)$
$= (1.3)(16)(5+11+15)(.9)$
$M = 580'^{-k}$



4-Trucks 75%
I = 1.3

$M = \Sigma Pa(.75)$
$= (1.3)(16)(6+10+16)(.75)$
$M = 499'^{-k}$

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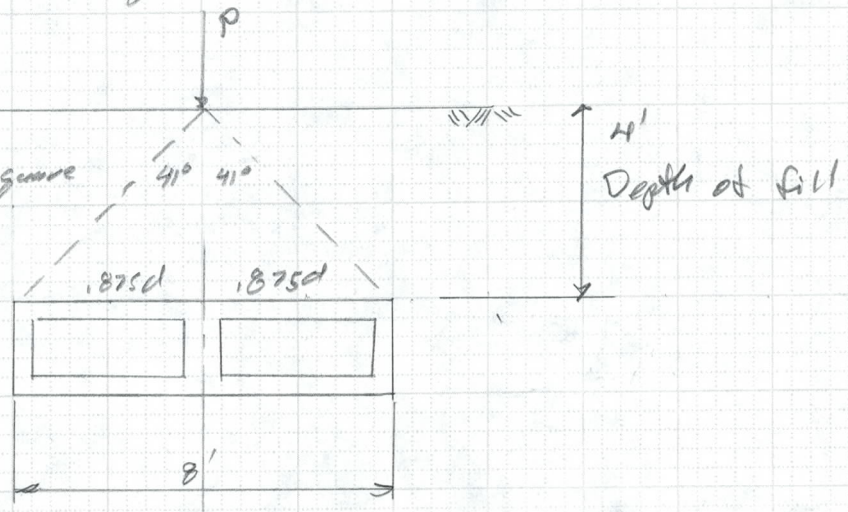
Impact Reduction due to depth of fill (3.8.2.3)

I = 1.3 0 → 1'
I = 1.2 1' → 2'
I = 1.1 2' → 3'
I = 1.0 > 3' fill depth

Transverse reducing of LL due to depth of fill

6.4.2
Distribution equals a square 13/4 on a side.



Dept of fill	% of LL carried by 8' beam
0 → 4'	100%
5	91
6	76
7	65
8	57
9	51
10	46

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	Part. Size & Gradation			
	Approx. Size Range (mm.)		Approx. D_{10} (mm.)	Approx. Range Unif. Coef., C_u
	D_{max}	D_{min}		
Granular Materials				
1. Uniform Materials				
a. Equal spheres (theoretical values)	—	—	—	1.0
b. Standard Ottawa SAND	0.84	0.59	0.67	1.1
c. Clean, uniform SAND (fine or medium)	—	—	—	1.2 to 2.0
d. Uniform, inorganic SILT	0.05	0.005	0.012	1.2 to 2.0
2. Well-graded Materials				
a. Silty SAND	2.0	0.005	0.02	5 to 10
b. Clean, fine to coarse SAND	2.0	0.05	0.09	4 to 6
c. Micaceous SAND	—	—	—	—
d. Silty SAND & GRAVEL	100	0.005	0.02	15 to 300
Mixed Soils				
1. Sandy or silty CLAY	2.0	0.001	0.003	10 to 30
2. Skip-graded silty CLAY with stones or rk. frag.	250	0.001	—	—
3. Well-graded GRAVEL, SAND, SILT & CLAY mixture	250	0.001	0.002	25 to 1000
Clay Soils				
1. CLAY (30 to 50% clay sizes)	0.05	0.5μ	0.001	—
2. Colloidal CLAY (-0.002 mm. ≥ 50%)	0.01	10Å	—	—
Organic Soils				
1. Organic SILT	—	—	—	—
2. Organic CLAY (30 to 50% clay sizes)	—	—	—	—

* Granular materials may reach e_{max} when dry or only slightly moist. Clays can reach e_{max} only when fully saturated.

† Granular materials reach minimum unit wet weight when at e_{max} and with hygroscopic moisture only. Clays reach minimum unit wet weight when fully saturated at e_{max}. The unit submerged weight of any saturated soil is the unit wet weight minus the unit weight of water.

FIG. 2–9. Typical value

concentration or packing of the solids in a given mass of soil. Thus it is common to describe certain soils as having high or low density, depending on whether the particles are closely or loosely packed. It is evident that among other things, soil density is an index of compressibility, the loosely packed soils being far more compressible than those with greater density. Soil d[illegible]y, as defined above, is measured in terms of weight of solids in

Voids*					Unit Weight† (lb./cu.ft)						
Void Ratio			Porosity (%)		Dry Wt., γ_{dry}			Wet Wt., γ_{wet}		Sub. Wt., γ_{sub}	
e_{max} (loose)	e_{cr}	e_{min} (dense)	n_{max} (loose)	n_{min} (dense)	Min. (loose)	100% Mod. AASHO	Max. (dense)	Min. (loose)	Max. (dense)	Min. (loose)	Max. (dense)
0.92	—	0.35	47.6	26.0	—	—	—	—	—	—	—
0.80	0.75	0.50	44	33	92	—	110	93	131	57	69
1.0	0.80	0.40	50	29	83	115	118	84	136	52	73
1.1	—	0.40	52	29	80	—	118	81	136	51	73
0.90	—	0.30	47	23	87	122	127	88	142	54	79
0.95	0.70	0.20	49	17	85	132	138	86	148	53	86
1.2	—	0.40	55	29	76	—	120	77	138	48	76
0.85	—	0.14	46	12	89	—	146‡	90	155‡	56	92
1.8	—	0.25	64	20	60	130	135	100	147	38	85
1.0	—	0.20	50	17	84	—	140	115	151	53	89
0.70	—	0.13	41	11	100	140	148§	125	156§	62	94
2.4	—	0.50	71	33	50	105	112	94	133	31	71
12	—	0.60	92	37	13	90	106	71	128	8	66
3.0	—	0.55	75	35	40	—	110	87	131	25	69
4.4	—	0.70	81	41	30	—	100	81	125	18	62

‡ Applicable for very compact glacial till. Unusually high unit weight values for tills are sometimes due not only to an extremely compact condition but to unusually high specific gravity values.

§ Applicable for hardpan.

GENERAL NOTE: Tabulation is based on $G = 2.65$ for granular soil, $G = 2.7$ for clays, and $G = 2.6$ for organic soils.

soil index properties.

a given soil mass or in terms of relative volumes of voids and solids in the mass.

2–11. Volumetric Basis. The total volume of a mass of soil may b[illegible] considered the sum of the volume of the voids and volume of solid matter or

$$V_t = V_v + V_s \tag{2–6}$$

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Section 6
CULVERTS

6.1 CULVERT LOCATION, LENGTH, AND WATERWAY OPENINGS

Recommendations on culvert location, length, and waterway openings are given in the AASHTO *Guide on Hydraulic Design of Culverts*.

6.2 DEAD LOADS

Vertical and horizontal earth pressures on culverts may be computed by recognized or appropriately documented analytical techniques based on the principles of soil mechanics and soil structure interaction, or design pressures shall be calculated as being the result of an equivalent fluid weight as follows.

6.2.1 Culvert in trench, or culvert untrenched on yielding foundation

A. Rigid culverts except reinforced concrete boxes:
   (1) For vertical earth pressure—120 pcf
       For lateral earth pressure— 30 pcf
   (2) For vertical earth pressure—120 pcf
       For lateral earth pressure— 120 pcf

B. Reinforced concrete boxes:
   (1) For vertical earth pressure—120 pcf
       For lateral earth pressure— 30 pcf
   (2) For vertical earth pressure—120 pcf
       For lateral earth pressure— 60 pcf

C. Flexible Culverts:
   For vertical earth pressure—120 pcf
   For lateral earth pressure— 120 pcf

6.2.2 Culvert untrenched on unyielding foundation

A special analysis is required.

6.3 FOOTINGS

Footings for culverts shall be carried to an elevation sufficient to secure a firm foundation, or a heavy reinforced floor shall be used to distribute the pressure over the entire horizontal area of the structure. In any location subject to erosion, aprons or cut-off walls shall be used at both ends of the culvert and, where necessary, the entire floor area between the wing walls shall be paved. Baffle walls or struts across the unpaved bottom of a culvert barrel shall not be used where the stream bed is subject to erosion. When conditions require, culvert footings shall be reinforced longitudinally.

6.4 DISTRIBUTION OF WHEEL LOADS THROUGH EARTH FILLS

6.4.1 When the depth of fill is 2 feet or more, concentrated loads shall be considered as uniformly distributed over a square with sides equal to 1 3/4 times the depth of fill.

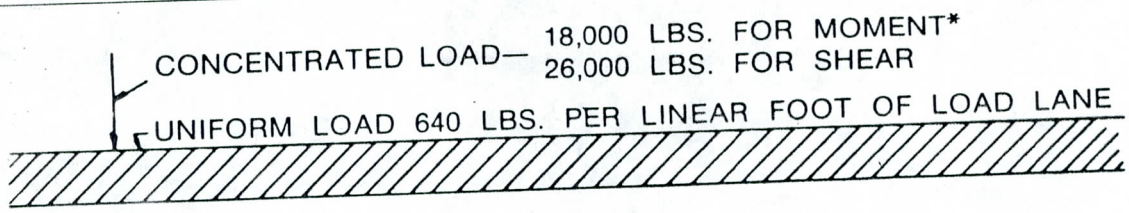
6.4.2 When such areas from several concentrations overlap, the total load shall be uniformly distributed over the area defined by the outside limits of the individual areas, but the total width of distribution shall not exceed the total width of the supporting slab. For single spans, the effect of live load may be neglected when the depth of fill is more than 8 feet and exceeds the span length; for multiple spans it may be neglected when the depth of fill exceeds the distance between faces of end supports or abutments. When the depth of fill is less than 2 feet the wheel load shall be distributed as in slabs with concentrated loads. When the calculated live load and impact moment in concrete slabs, based on the distribution of the wheel load through earth fills, exceeds the live load and impact moment calculated according to Article 3.24, the later moment shall be used.

6.5 DISTRIBUTION REINFORCEMENT

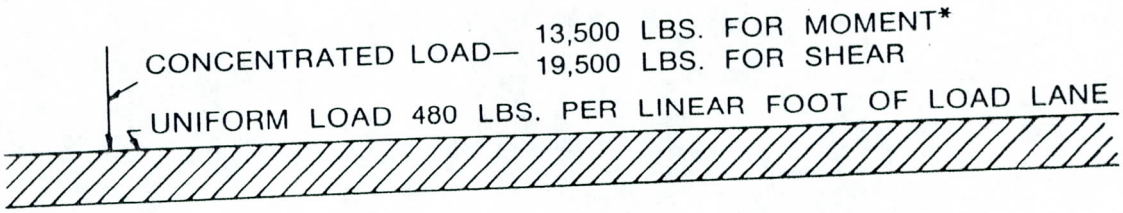
Where the depth of fill exceeds 2 feet, reinforcement to provide for the lateral distribution of concentrated loads is not required.

6.6 DESIGN

For culvert design guidelines see Section 17.



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.

(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′ 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.

3.10 CENTRIFUGAL FORCES

3.10.1 Structures on curves shall be designed for a horizontal radial force equal to the following percentage of the live load, without impact, in all traffic lanes:

$$C = 0.00117\, S^2\, D = \frac{6.68\, S^2}{R} \qquad (3\text{-}2)$$

where
C = the centrifugal force in percent of the live load, without impact;
S = the design speed in miles per hour;

D = the degree of curve;
R = the radius of the curve in feet.

3.10.2 The effects of superelevation shall be taken into account.

3.10.3 The centrifugal force shall be applied 6 feet above the roadway surface, measured along the centerline of the roadway. The design speed shall be determined with regard to the amount of superelevation provided in the roadway. The traffic lanes shall be loaded in accordance with the provisions of Article 3.7 with one standard truck on each design traffic lane placed in position for maximum loading.

3.10.4 Lane loads shall not be used in the computation of centrifugal forces.

3.10.5 When a reinforced concrete floor slab or a steel grid deck is keyed to or attached to its supporting members, it may be assumed that the deck resists, within its plane, the shear resulting from the centrifugal forces acting on the live load.

3.11 APPLICATION OF LIVE LOAD

3.11.1 Traffic Lane Units

In computing stresses, each 10-foot lane load or single standard truck shall be considered as a unit, and fractions of load lane widths or trucks shall not be used.

3.11.2 Number and Position of Traffic Lane Units

The number and position of the lane load or truck loads shall be as specified in Article 3.7 and, whether lane or truck loads, shall be such as to produce maximum stress, subject to the reduction specified in Article 3.12.

3.11.3 Lane Loads on Continuous Spans

For the determination of maximum negative moment in the design of continuous spans, the lane load shown in Figure 3.7.6B shall be modified by the addition of a second, equal weight concentrated load placed in one other span in the series in such position to produce the maximum effect. For maximum positive moment, only one concentrated load shall be used per lane, combined with as many spans loaded uniformly as are required to produce maximum moment.

3.11.4 Loading for Maximum Stress

3.11.4.1 On both simple and continuous spans, the type of loading, whether lane load or truck load, to be used shall be the loading which produces the maximum stress. The moment and shear tables given in Appendix A show which type of loading controls for simple spans.

3.11.4.2 For continuous spans, the lane loading shall be continuous or discontinuous; only one standard H or HS truck per lane shall be considered on the structure.

3.12 REDUCTION IN LOAD INTENSITY

3.12.1 Where maximum stresses are produced in any member by loading a number of traffic lanes simultaneously, the following percentages of the live loads shall be used in view of the improbability of coincident maximum loading:

	Percent
One or two lanes	100
Three lanes	90
Four lanes or more	75

3.12.2 The reduction in intensity of loads on transverse members such as floor beams shall be determined as in the case of main trusses or girders, using the number of traffic lanes across the width of roadway that must be loaded to produce maximum stresses in the floor beam.

3.13 ELECTRIC RAILWAY LOADS

If highway bridges carry electric railway traffic, the railway loads shall be determined from the class of traffic which the bridge may be expected to carry. The possibility that the bridge may be required to carry railroad freight cars shall be given consideration.

3.14 SIDEWALK, CURB, AND RAILING LOADING

3.14.1 Sidewalk Loading

3.14.1.1 Sidewalk floors, stringers and their immediate supports shall be designed for a live load of 85 pounds per square foot of sidewalk area. Girders, trusses, arches, and other members shall be designed for the following sidewalk live loads:

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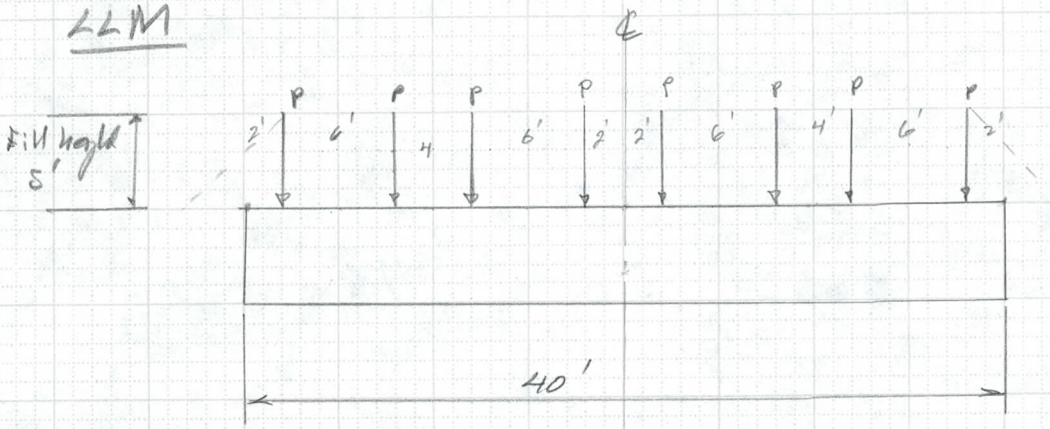
Sec 6 Span 40'

LLM

Load Reduction



4-Trucks - 75%

$M = \Sigma Pa\,(.8)(.75)$

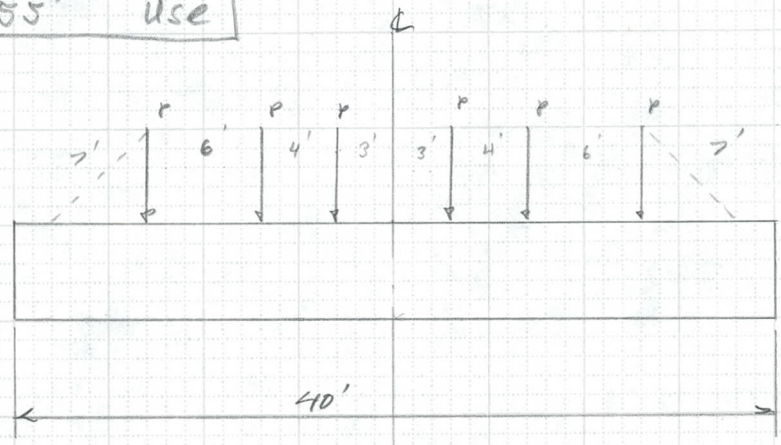
$= 16(2+8+12+18)(.75)(.8)$

$M = 384^{1-k}$ (no fill distribution)

fill depth > 3' therefore the live loads would act as a uniform load

$$M = \frac{wl^2}{8}(.8)(.75) = \frac{(6)(16)}{(40)}\frac{(40)^2}{(8)}(.8)(.75) + \frac{(2)(16)}{(40)}\frac{(40)^2}{(8)}(.8)(.75)\left(\frac{7}{10}\right)$$

$\boxed{M = 355^{1-k} \text{ use}}$



3-Trucks - 90%

$M = \Sigma Pa\,(.8)(.9)$

$= (16)(7+13+17)(.8)(.9)$

$M = 426^{1-k}$ (no fill distribution)

EQ010 Uniform Load

$$M = \frac{wl^2}{8}(.8)(.9) = \frac{(6)(16)}{(40)}\frac{(40)^2}{(8)}(.8)(.9) = 346^{1-k}$$

Reduction due to cover depth of 5'

$= .80\,M$

Impact = 1.0 > 3' depth

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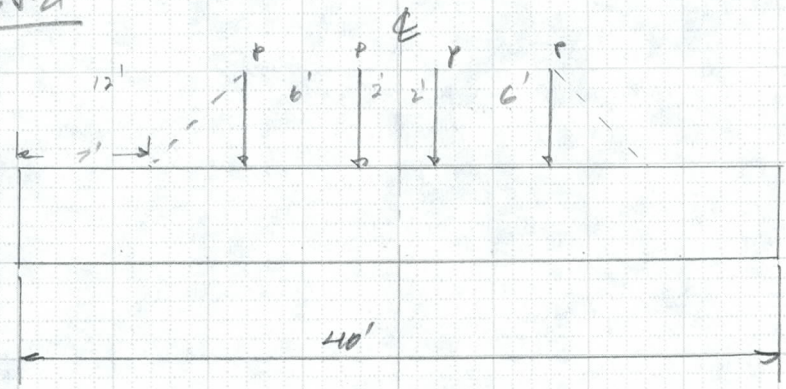
Sec 6 span 40

LLM cont'd

2-Trucks - 100%



$M = \Sigma Pa\,(1.8)$

$= 16(12+18)(1.8)$

$M = 384'^{-k}$ (no fill distribution)

Equiv Uniform load due to 5' fill

Steel Book $M = R_1\left(a + \frac{R_1}{2w}\right)(1.8)$

$w = \frac{(4)(16)}{(40-14)} = 2.46^{k/'}$

$M = (32^k)\left(7 + \frac{(32^k)}{(2)(2.46)}\right)(1.8)$

$R_1 = \frac{(4)(16)}{(2)} = 32^k$

$M = 346'^{-k}$

$a = 7'$

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Sec 6 span 40'

LLM = 355'-k (1.0 Impact, Fill > 3')

from T-PAC computer print out

A = 1392 in²

I = 187,262 in⁴

h = 31 in

Y_{T+B} = 15.50 in

S_{T+B} = 12,081 in³

W_T = 1.45 k/ft

DLM = 1505 k-'

LLM = 354 k-'

A'_s = 4.90 in² f'_c = 5 ksi

strands = 32

P_f = 838 k

d = 31 - 3 = 28 in

e = 15.5 - 3 = 12.5

Ultimate Moment Capacity

$$\phi M_u = \phi\left[A_s f'_{su} d\left(1 - 0.6\rho \frac{f'_{su}}{f'_c}\right)\right]$$

$$\rho = \frac{A'_s}{bd} = \frac{(4.90)}{(95.5)(28)} = .00183$$

$$f'_{su} = f_s\left(1 - \frac{.5\rho f_s}{f'_c}\right)$$

$$= (270)\left(1 - (.5)\frac{(.00183)(270)}{5}\right)$$

$$f'_{su} = 256.7$$

$$= \left(\frac{1.0}{12}\right)\left[(4.90)(256.7)(28)\left(1 - \frac{(0.6)(.00183)(256.7)}{(5)}\right)\right]$$

$\phi M_u = 2769'-k$

Ultimate Moment Maximum Extra DL

$$M_{ult} = 1.3(M_{DL}) + 2.17(M_{LL})$$

$$2769 = 1.3(\Sigma DL) + \frac{(1.3)(1.45)(40)^2}{(8)} + (2.17)(355)$$

$$2769 = 1.3(\Sigma DL) + 377 + 770$$

$\Sigma DL = 1248'-k$

$$M = \frac{wl^2}{8} \qquad w = \frac{8M}{l^2} = \frac{(8)(1248)}{(40)^2} = 6.24^{k}/_{1}$$

$$h = \frac{w}{\gamma W} = \frac{6.24}{(.14)(8)} = 5.6'$$

$\boxed{\text{Fill Allowed } 5.6 \text{ ft}}$

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Sec 6 contd span 40'

Applied Loads Check $f_c = P/A \pm \frac{Pe}{S} \pm M/S$

$f'_c = 5$ ksi, $f_c = 2$ ksi

Mid Span w/o Extra Fill $M_{girder} = (1.45)(40)^2/8 = 290'^{-k}$

TOP

$$f_c = \frac{\overset{.60}{838}}{1392} - \frac{(\overset{.87}{838})(12.5)}{(12,081)} + \frac{(\overset{DL\ .29}{290} + \overset{LL\ .35}{355})(12)}{(12,081)} =$$

w/o LL
+0.02 ksi < 2 ok
w/LL
+0.35 ksi < 2 ok

BOTT

$$f_c = .60 + .87 - (.29 + .35) =$$

w/o LL
+1.18 ksi < 2 ok
w/LL
+0.83 ksi < 2 ok

END

TOP $f_c = .60 - .87 = -0.27$ ksi < 0.424 ok

BOTT $f_c = .60 + .87 = +1.47$ ksi < 2 ok

Check with Extra Dead Load

$EDLM = 1248'^{-k}$ $f = \frac{(1248)(12)}{(12,081)} = 1.24$ ksi

Mid Span

TOP $f_c = .60 - .87 + (\overset{DL}{.29 + 1.24} + \overset{LL}{.35}) =$

w/o LL
+1.26 ksi < 2.0 ksi ok
w/LL
+1.61 ksi < 2.0 ok

BOTT $f_c = .60 + .87 - (\overset{DL}{.29 + 1.24} + \overset{LL}{.35}) =$

w/o LL
-0.06 ksi < 0.424 ok
w/LL
-0.410 ksi < 0.424 ok

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Sec. 7a span 36'

LLM = 389'-k (No Impact, Fill > 3.0') (3.8.2.3)

from T-PAC computer print out

A = 1332 in²	S_{bot} = 9748 in³	A^*_s = 4.29 in²	e = 13.5 - 3 = 10.5 in
I = 131,598 in⁴	DLM = 969'-k	Strands = 28	f'c = 5 ksi
H = 27 in	LLM = 324'-k	P_f = 736k	
Y_{bot} = 13.50 in	W_t = 1.39 k/ft	d = 27-3 = 24 in	

Ultimate Moment Capacity

$$\phi M_n = \phi\left[A_s f^*_{su} d\left(1 - 0.6\rho \frac{f^*_{su}}{f'c}\right)\right]$$

$$\rho = \frac{A^*_s}{bd} = \frac{4.29}{(91.5)(24)} = .00187$$

$$= \left(\frac{1.0}{12}\right)\left[(4.29)(256.4)(24)\left(1 - \frac{(0.6)(.00187)(256.4)}{(5)}\right)\right]$$

$$f^*_{su} = f_s\left(1 - .5\rho \frac{f_s}{f'c}\right)$$

$$= (270)\left(1 - \frac{(.5)(.00187)(270)}{(5)}\right)$$

$$f^*_{su} = 256.4$$

$$\phi M_n = 2073'^{-k}$$

Ultimate Moment Maximum Extra DL

$$M_{ult} = 1.3(M_{DL}) + 2.17(M_{LL})$$

$$2073 = 1.3(EDL) + (1.3)(1.39)(36)^2/(8) + (2.17)(389)$$

$$2073 = 1.3(EDL) + 293 + 844$$

$$EDL = 720'^{-k}$$

$$M = \frac{wl^2}{8} \qquad w = \frac{8M}{l^2} = \frac{(8)(720)}{(36)^2} = 4.444, \qquad h = \frac{w}{\gamma W} = \frac{4.44}{(.14)(8)} = 4.0$$

Fill Allowed h = 4.0 ft

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Sec 7a cont'd

Applied Loads Check $f_c = P/A \pm Pe/S \pm \Sigma M/S$

Mid Span W/O Extra fill $M_{girder} = (1.35)(36)^2/8 = 225'^{-k}$

Top $f_c = \frac{736}{1332}$ (.55) $- \frac{(736)(10.5)}{(9748)}$ (.79) $+ \frac{(225 + 389)(12)}{(9748)}$ (.28 DL, .48 LL) = W/O LL

+0.04 ksi < 2.0 ok

W/LL

+0.55 ksi < 2.0 ok

Bott $f_c = .55 + .79 - (.28 + .48) =$ W/O LL

+1.06 ksi < 2.0 ksi ok

W/LL

+0.55 ksi < 2.0 ok

END

Top $f_c = .55 - .79 = -0.24$ ksi < 0.424 ksi ok

Bott $f_c = .55 + .79 = +1.34$ ksi < 2.0 ksi ok

Check with Extra Dead Load

$\Sigma DLM = 720'^{-k}$ $f = \frac{(720)(12)}{(9748)} = 0.88$ ksi

Mid Span

Top $f_c = 0.55 - 0.79 + (.28 + .88 + .48) =$ W/O LL

+0.87 ksi < 2.0 ok

W/LL

+1.38 ksi < 2.0 ok

Bott $f_c = 0.55 + 0.79 - (.28 + .88 + .48) =$ W/O LL

+0.23 ksi < 2.0 ok

W/LL

-0.30 ksi < 0.424 ksi ok

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PROJECT ALDC - Pre-Cast - Covered Sec PAGE 23 OF

DETAIL Sect 7b COMPUTED DATE

Excess DL Allowable CHECKED BY DATE

Sec 7b Span 36'

LLM = 490 '-k (1.1 Impact, Fill 2'+)

from T-PAL computer print out

A = 1332 in² Wt = 1.39 k/ft As = 3.98 in² e = 13.5-3 = 10.5 in

I = 131,558 in⁴ DLM = 647 '-k Strands = 26 f'c = 5 ksi

h = 27 in LLM = 467 '-k Pf = 682 k

y_{bot} = 13.5 in S_{bot} = 9,748 in³ d = 27-3 = 24 in

Ultimate Moment Capacity

$$\phi M_n = \phi\left[A_s f^*_{su} d\left(1 - \frac{0.6\rho f^*_{su}}{f'_c}\right)\right]$$

$$\rho = \frac{A^*_s}{bd} = \frac{3.98}{(95.5)(24)}$$

$$\rho = .00174$$

$$f^*_{su} = f_s\left(1 - \frac{.5\rho f_s}{f'_c}\right)$$

$$= 270\left(1 - \frac{(.5)(.00174)(270)}{(5)}\right)$$

$$f^*_{su} = 257.3$$

$$= \left(\frac{1.0}{12}\right)\left[(3.98)(257.3)(24)\left(1 - \frac{(0.6)(.00174)(257.3)}{(5)}\right)\right]$$

$$\phi M_n = 1938\ '-k$$

Ultimate Moment Maximum Extra DL

$$M_{ult} = 1.3(M_{DL}) + 2.17(M_{LL})$$

$$1938 = 1.3(EDL) + (1.3)(1.39)(36)^2/(8) + (2.17)(490)$$

$$1938 = 1.3(EDL) + 293 + 1063$$

$$EDL = 448\ '-k$$

$$M = \frac{w\ell^2}{8} \qquad w = \frac{8M}{\ell^2} = \frac{(8)(448)}{(36)^2} = 2.77\ k/ft \qquad h = \frac{w}{\gamma W} = \frac{2.77}{(.14)(8)} = 2.5'$$

$$\boxed{\text{Fill Allowed } h = 2.5 \text{ ft}}$$

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Sec 7b cont'd

Applied Loads check $f_c = P/A \pm \frac{Pe}{S} \pm \Sigma \frac{M}{S}$

Mid Span W/O Extra fill $M_{girder} = (1.39)(36)^2/(8) = 225^{1-k}$

TOP $f_c = \frac{682}{1332} - \frac{(682)(10.5)}{(9748)} + \frac{(225 + 490)(12)}{(9748)} =$ (.51, .73, .28 DL, .60 LL)

W/O LL $+0.06$ ksi < 2.0 ksi OK

W/LL $= +0.62$ ksi < 2.0 OK

BOTT $f_c = 0.51 + 0.73 - (.28 + .60) =$

W/O LL $+0.96$ ksi < 2.0 OK

W/LL $+0.40$ ksi < 2.0 OK

END

TOP $f_c = 0.51 - 0.73 = -0.22$ ksi < 0.424 ksi OK

BOTT $f_c = 0.51 + 0.73 = +1.23$ ksi < 2.0 ksi OK

Check with Extra Dead Load

$\Sigma \Delta M = 448^{1-k}$ $f = \frac{(448)(12)}{(9748)} = 0.55$ ksi

Mid Span

TOP $f_c = 0.51 - 0.73 + (.28 + .55 + .60) =$ (DL, LL)

W/O LL $+0.68$ ksi < 2.0 OK

W/LL $+1.21$ ksi < 2.0 OK

BOTT $f_c = 0.51 + 0.73 - (.28 + .55 + .60) =$ (DL, LL)

W/O LL $+0.34$ ksi < 2.0 OK

W/LL -0.19 ksi < 0.424 ksi OK

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC - Pre Cast - Covered Sec PAGE 25 OF ____

DETAIL Sect 7b (NO LL) COMPUTED ____ DATE ____

Excess DL Allowable CHECKED BY ____ DATE ____

Sec. 7(b) Cont'd Span 36'

Fill Allowable with no LL.

$\phi M_n = 1938^{1-k}$

Ultimate Moment Extra DL

$M_{ult} = 1.3(M_{Girder} + M_{Extra\ DL})$

$1938^{1-k} = 293^{1-k} + 1.3(EDL)$

$EDL = 1265$

$w = \frac{8M}{l^2} = \frac{(8)(1265)}{(36.7)^2} = 7.51^{k/'}$ $h = \frac{w}{\gamma W} = \frac{7.51}{(.14)(8)} = 6.70'$

~~Fill Allowed NO LL = 6.7'~~ NG

Check Applied Loads

$EDL = 1265$ $f = \frac{(1265)(12)}{(9748)} = 1.56$ ksi

TOP $f_c = 0.51 - 0.73 + (.28 + 1.56) =$ w/o LL $+1.62$ ksi < 2.0 OK

BOTT $f_c = 0.51 + 0.73 - (.28 + 1.56) =$ w/o LL -0.60 ksi > 0.424 NG

Reduce DL Mom 0.600 ksi $- 0.424 = 0.176$ ksi

Reduce DLM $= (f)(S) = \frac{(0.176)(9748)}{(12)} = -143^{1-k}$

$DLM = 1265 - 143 = 1122^{1-k}$

$w = \frac{(8)(M)}{l^2} = \frac{(8)(1122)}{(36.7)^2} = 6.7^{k/'}$ $h = \frac{(6.7)}{(.14)(8')} = 6.0'$

Fill Allowed No Live Load = 6.0'

Use 4'-0

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PROJECT ALDC - Pre-Cast - Covered Sec PAGE 26 OF

DETAIL Sec 8 COMPUTED DATE

Excess DL Allowable CHECKED BY DATE

Sec. 8 - Span 36'

LLM = 223 $^{1-k}$ (No Impact) (Fill > 3') (3.8.2.3)

0 → 1'-0	I = 30%
1'-0 → 2'-0	I = 20%
2'-0 → 3'-0	I = 10%
> 3'-0	I = 0

Reduction due to fill height
assume 41° projection of LL
for 9' fill LL = 51% reduction

from T-PAC print out

A = 1392 in²

I = 187,262 in⁴

H = 31 in

Y_{Bot} = 15.50 in

S_{Bot} = 12,081 in³

W_t = 1.45 k/ft

DLM = 1950 $^{1-k}$

LLM = 136 $^{1-k}$

A^*_s = 5.51 in²

strands = 36

P_f = 951 ^{k}

d = 31 − 3.22 = 27.78 in

c = 15.5 − 3.22 = 12.28 in

f'c = 5 ksi

Ultimate Moment Capacity

$$\phi M_n = \phi\left[A_s f^*_{su} d\left(1 - 0.6\rho\frac{f^*_{su}}{f'c}\right)\right]$$

$$= \left(\frac{1.0}{12}\right)\left[(5.51)(255)(28)\left(1 - \frac{(0.6)(.00206)(255)}{(5)}\right)\right]$$

$$\phi M_n = 3072^{1-k}$$

$$\rho = \frac{A^*_s}{bd} = \frac{5.51}{(95.5)(28)}$$

ρ = .00206

$$f^*_{su} = f_s\left(1 - \frac{.5\rho f_s}{f'c}\right)$$

$$= (270)\left(1 - \frac{(.5)(.00206)(270)}{(5)}\right)$$

f^*_{su} = 255

Ultimate Moment Maximum Extra DL

$$M_{ult} = 1.3(M_{DL}) + 2.17(M_{LL})$$

$$3072 = (1.3)(EDL) + \frac{(1.3)(1.45)(36)^2}{(8)} + (2.17)(223)$$

EDL = 1756 $^{1-k}$

$$M = \frac{wl^2}{8} \qquad w = \frac{8M}{l^2} = \frac{(8)(1756)}{(36)^2} = 10.8\ k/l \qquad h = \frac{w}{\gamma W} = \frac{10.8}{(.14)(8)} = 9.7'$$

Fill Allowed ~~h = 9.7 ft~~ Applied Load Check h = 9.1 ft

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PROJECT ALPC - Pre-Cast - Covered Sec PAGE 27 OF

DETAIL Sect 8 COMPUTED DATE

Excess DL Allowable CHECKED BY DATE

Sec 8 cont'd

Applied Loads check $f_c = P/A \pm Pe/S \pm ZM/S$

$f'_c = 5{,}000$ psi, $f_c = (.4)(f'_c) = 2{,}000$ psi

Mid Span W/O Extra fill $M_{Girder\ DL} = \frac{(1.45)(36)^2}{(8)} = 235^{1-k}$

TOP $f_c = \frac{\overset{.68}{951^k}}{1392\ in} - \frac{(951)(12.5)}{(12{,}081)} + \frac{(\overset{DL\ .23}{235} + \overset{LL\ .22}{223})(12)}{(12{,}081)} =$ W/O LL $-0.07 < 0.424$ ksi ok

W/LL $= +0.14 < 2.0$ ksi ok

BOT $f_c = .68 + .98 - (.23 + .22) =$ W/O LL $+1.43$ ksi < 2.0 ksi ok

W/LL $+1.22$ ksi < 2.0 ksi ok

END

TOP $f_c = .68 - .98 = -0.30$ ksi < -0.424 ksi ok

BOT $f_c = .68 + .98 = +1.66$ ksi < 2.0 ksi ok

Check with Extra Dead Load

$EDLM = 1756^{1-k}$ $f = \frac{(1756)(12)}{(12{,}081)} = 1.74$ ksi

Mid Span

TOP $f_c = .68 - .98 + (\overset{DL}{.23 + 1.74} + \overset{LL}{.22}) =$ W/O LL $+1.69 < 2.0$ ksi ok

W/LL $= +1.90 < 2.0$ ksi ok

BOT $f_c = .68 + .98 - (\overset{DL}{.23 + 1.74} + \overset{LL}{.22}) =$ W/O LL $-0.33 < 0.424$ ksi ok

W/LL $= -0.530 > 0.424$ NG

Lower Allowable fill

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Sec 8 cont'd

Applied Load Check cont'd

BOT

$f_c = -0.424 = .68 + .98 - (.23 + x + .22)$

$x = 1.64$

$f = \frac{M(12)}{S}$ $\quad 1.64 = \frac{M(12)}{12.081}$ $\quad M = 1651'^{-k}$

$w = \frac{8M}{\ell^2} = \frac{(8)(1651)}{(36)^2} = 10.2^{k/'}$

$h = \frac{w}{\gamma W} = \frac{(10.2^{k/'})}{(1.14)(8)} = 9.1'$

$\boxed{\text{Fill Allowed } h = 9.1'}$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ALDC - Pre-Cast - Covered Sec PAGE 29 OF ____

DETAIL Seat 9 COMPUTED ____ DATE ____

Excess DL Allowable CHECKED BY ____ DATE ____

Sec 9 Span 36'

$LLM = 354^{1-k}$ (No Impact, Fill > 3')

Reduction due to fill height assume 41° projection of LL for 5' fill

from T-PBC computer print out

$A = 1332 \text{ in}^2$ $S_{B+T} = 9{,}748 \text{ in}^3$ $A^*s = 4.59 \text{ in}^2$

$I = 131{,}598 \text{ in}^4$ $w_t = 1.39 \text{ k/ft}$ Strands = 30

$H = 27 \text{ in}$ $DLM = 1131^{1-k}$ $P_f = 786^k$

$Y_{B+T} = 13.50 \text{ in}$ $LLM = 309^{1-k}$ $d = 27 - 3 = 24 \text{ in}$

$e = 13.50 - 3 = 10.50 \text{ in}$

$f'c = 5 \text{ ksi}$

Ultimate Moment Capacity

$$\phi M_n = \phi\left[A_s f^*_{su} d\left(1 - 0.6\rho\frac{f^*_{su}}{f'c}\right)\right]$$

$$\rho = \frac{A^*_s}{bd} = \frac{4.59}{(95.5)(24)}$$

$$= \frac{(1.0)}{(12)}\left[(4.59)(255.4)(24)\left(1 - \frac{(.6)(.0020)(255.4)}{(5)}\right)\right]$$

$\rho = .0020$

$$f^*_{su} = f_s\left(1 - .5\frac{\rho f_s}{f'c}\right)$$

$$= (270)\left(1 - \frac{(.5)(.0020)(270)}{(5)}\right)$$

$f^*_{su} = 255.4$

$\phi M_n = 2201^{1-k}$

Ultimate Moment Maximum Extra DL

$M_{ult} = 1.3(M_{DL}) + 2.17(M_{LL})$

$2201 = 1.3(EDL) + \overset{293}{(1.3)(1.39)(36)^2/(8)} + \overset{768}{(2.17)(354^{1-k})}$

$EDL = 877^{1-k}$

$M = \frac{wl^2}{8}$ $w = \frac{8M}{l^2} = \frac{(8)(877)}{(36)^2} = 5.41 \text{ k/l}$ $h = \frac{w}{\gamma W} = \frac{5.41}{(.14)(8)} = 4.8'$

$\boxed{\text{Fill Allowed } h = 4.8 \text{ ft}}$

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PROJECT ACDC - Pre-Cast Covered Sec PAGE 30 OF

DETAIL Sect 9 COMPUTED DATE

Excess DL Allowable CHECKED BY DATE

Sec 9 cont'd

Applied Loads check $f_c = P/A \pm Pe/S \pm M/S$

Mid span W/O Extra fill $M_{girder} = (1.39)(36)^2/(8) = 225^{1-k}$

TOP $f_c = \frac{786}{1332} - \frac{(786)(10.5)}{(9748)} + \frac{(225 + 354)(12)}{(9,748)} =$ (0.59, 0.85, .28 DL, .44 LL)

W/O LL
+0.02 ksi < 2.0 ksi OK

W/LL
= +0.43 ksi < 2.0 ksi OK

BOTT $f_c = 0.59 + 0.85 - (.28 + .44) =$ (DL, LL)

W/O LL
+1.16 ksi < 2.0 ksi OK

W/LL
+0.75 ksi < 2.0 OK

END

TOP $f_c = 0.59 - 0.85 = -0.26$ ksi < 0.424 ksi OK

BOTT $f_c = 0.59 + 0.85 = +1.44$ ksi < 2.0 ksi OK

Check with Extra Dead Load

$\Sigma DLM = 877^{1-k}$ $f = \frac{(877)(12)}{(9748)} = 1.08$ ksi

Mid Span

TOP $f_c = 0.59 - 0.85 + (0.28 + 1.08 + 0.44) =$ (DL, LL)

W/O LL
+1.15 ksi < 2.0 ksi OK

W/LL
= +1.56 ksi < 2.0 OK

BOTT $f_c = 0.59 + 0.85 - (0.28 + 1.08 + 0.44) =$

W/O LL
+0.03 ksi < 2.0 ksi OK

W/LL
= -0.360 ksi < -0.424 ksi OK

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ADOT - Pre-Cast - Covered Sec PAGE 31 OF ____

DETAIL Sect 10 COMPUTED ____ DATE ____

Excess DL Allowable CHECKED BY ____ DATE ____

Sec. 10 - Span 36'

LLM = 580 '-k (1.3 Impact) (6" cover pavement only)

from T-PAC print out

A = 1257.0 in²
I = 76,946
H = 22 in
y_{BOT} = 11 in

S_{BOT} = 6995 in³
W_t = 1.309 k/ft
DLM = 489 '-k
LLM = 493 '-k

A^*_s = 4.90 in²
Strands = 32
P_f = 815 k
d = 22-3 = 19 in
e = 11-3 = 8 in
f'c = 5 ksi

Ultimate Moment Capacity

$$\phi M_n = \phi \left[A_s f^*_{su} d \left(1 - 0.6\rho \frac{f^*_{su}}{f'c}\right)\right]$$

$$= \frac{(1.0)}{(12)}\left[(4.9)(250.3)(19)\left(1-\frac{(0.6)(.00270)(250.3)}{(5)}\right)\right]$$

ϕM_n = 1784 '-k

$\rho = A^*_s / bd$

$= \frac{4.9}{(95.5)(19)}$

ρ = .00270

$f^*_{su} = f_s\left(1 - \frac{.5\rho f_s}{f'c}\right)$

$= 270\left(1 - \frac{(1.5)(.00270)(270)}{(5)}\right)$

f^*_{su} = 250.3

Ultimate Moment Maximum Extra DL

$M_{ult} = (1.3)(M_{DL}) + (2.17)(M_{LL})$

$1784'^{-k} = (1.3)(EDL) + (1.3)\left(\frac{1.309)(36)^2}{(8)}\right) + (2.17)(580'^{-k})$

$1784 = (1.3)(EDL) + 276 + 1258$

EDL = 192 '-k

$M = \frac{w\ell^2}{8}$ $\quad w = \frac{8M}{\ell^2} = \frac{(8)(192'^{-k})}{(36')^2} = 1.19$ k/'

$w = \gamma W h$ $\quad h = \frac{w}{\gamma W} = \frac{1.19\ k/'}{(.14\ k/ft^3)(8')} = 1.1'$

$\boxed{\text{Fill Allowed } h = 1.1 \text{ ft}}$

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ACDC - Pre-Cast - Covered Sec PAGE 32 OF

DETAIL Sect 10 COMPUTED DATE

Excess DL Allowable CHECKED BY DATE

Sec 10 cont'd

Applied Loads check $f_c = P/A \pm \frac{Pe}{S} \pm \frac{\Sigma M}{S}$

$f'_c = 5{,}000$ psi $f_c = (.4)(f'_c) = 2{,}000$ psi

Mid Span W/O Extra Fill $M_{G\,DL} = \frac{(1{,}309)(36)^2}{8} = 212^{1-k}$

Top $f_c = \frac{815^k}{1257\ in^2} - \frac{(815^k)(11-3\ in)}{(6995\ in^3)} + \frac{(212^{1-k} + 580^{1-k})(12\ in/ft)}{(6995)}$ (.65) (.93) (.36) DL (.99) LL

= W/O LL +0.08 < 2.0 ksi ok

W/LL = +1.01 ksi < 2.0 ksi ok

BOTT $f_c = .65 + .93 - (.36 + .99) =$ W/O LL +1.22 ksi < 2.00 ksi ok

W/LL = +0.29 < 2.00 ksi ok

END

TOP $f_c = 0.65 - 0.93 = -0.28$ ksi < -0.424 ksi ok

BOTT $f_c = 0.65 + 0.93 = +1.58$ ksi < +2.0 ksi ok

Check With Extra Dead Load

$\Sigma DLM = 192^{1-k}$ $f = \frac{(192)(12)}{(6995)} = .33$ ksi

Mid Span

TOP $f_c = .65 - .93 + (.36 + .33 + .99) =$ (DL, LL) W/O LL +0.41 ksi < 2.0 ksi ok

W/LL = +1.40 ksi < 2.0 ksi ok

BOTT $f_c = .65 + .93 - (.36 + .33 + .99) =$ (DL, LL) W/O LL +0.89 ksi < 2.0 ksi ok

W/LL -0.100 ksi < -0.424 ksi ok

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT ALDL - Pre-Cast-Covered Sec PAGE 33 OF ____

DETAIL Tapered Sec Check COMPUTED ____ DATE ____

Allowable fill height CHECKED BY ____ DATE ____

Tapered Section Check

Sec 7.b Straight Section Fill Height = 2.1'

Section Varies from 6.46' to 7.88' Avg = 7.17'

$w = (7.17)(2.1)(.14^{k}/ft^3) = 2.1^{k/'}$

$M_{(Fill)} = wl^2/8 = (2.1^{k/'})(36.67)^2/(8) = 353'^{-k}$ (Tapered Fill)

$M_{(Girder)} = wl^2/8 = (1.27^{k/'})(36.67)^2/(8) = \underline{212'^{-k}}$ (Tapered Girder)

DL Tapered Mom req'd = $565'^{-k} < 576'^{-k}$ ok

(By Sec) T-PBC Sh. 22 Tapered Sec DL Mom Capacity = 576 ok

Sec. 9 Straight Section Fill Height = 4.8'

Section Varies from 7.58' to 7.98' Avg = 7.78'

$w = (7.78')(4.8')(.14^{k}/ft^3) = 5.2^{k/'}$

$M_{(Fill + Girder)} = \Sigma \frac{wl^2}{8} = (5.2 + 1.35)(36.67)^2/(8) = 1101'^{-k}$

DL Tapered Mom Req'd = $1101'^{-k} \geq 1098'^{-k}$ ok

(By Sec) T-PBC Sh. 28 Tapered Sec DL Mom Capacity = $1098'^{-k}$

Sec. 8 Straight Section Fill Height = 9.0'

Section Varies from 7.02' to 7.98' Avg = 7.5'

$w = (7.5')(9.0')(.14^{k}/ft^3) = 9.45^{k/'}$

$M_{(Fill + Girder)} = \Sigma \frac{wl^2}{8} = (9.45 + 1.38)(36.67)^2/(8) = 1820'^{-k}$

DL Tapered Mom Req'd = $1820'^{-k} < 1824'^{-k}$ ok

(By Sec) T-PBC Sh. 33 Tapered Sec DL Mom Capacity = $1824'^{-k}$

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Sec 10 cont'd span 36'

Assuming Two Trucks on Beam

LLM = 498'-k (Impact 1.2, fill > 1.0 ft)

Ultimate Moment Capacity

$\phi M_n = 1784'^{-k}$

Ultimate Moment Extra Dead Load

$M_{ult} = 1.3(M_{DL}) + 2.17(M_{LL})$

$1784 = 1.3(EDL) + \frac{(1.3)(1.304)(36)^2}{(8)} + (2.17)(498)$

$1784 = 1.3(EDL) + 276 + 1081$

$EDL = 328'^{-k}$

$w = \frac{(8)(328)}{(36)^2} = 2.02^{k/'}$ $h = \frac{(2.02^{k/'})}{(.14^{k/ft^3})(8)} = 1.8'$

$\boxed{\text{Fill Allowed } h = 1.8' \text{ with Two Trucks}}$

Check with Extra Dead Load

$EDLM = 328'^{-k}$ $f = \frac{(328)(12)}{(6995)} = 0.56$

Mid Span

Top $f_c = .65$