DESIGN COMPUTATIONS FOR

VAOT bf 013-4(47)
28' x 8' Archcon with Anchor Wingwalls
Duxbury, VT

Comments were made in the previous submittal regarding rebar spacing, clearr cover, number of layes, and amount provided compared to the fabrication plans. A revised sheet was not included herein but needs to be in order to verify the calculations and fabrication plans are coordinated.

NO CHANGES.
SEE EXPLINATIONS.

PREPARED FOR:

Michie Corporation
PO Box 870
Henniker, New Hampshire 03242

STATE OF VERMONT
DARYL D. BURNS
No. 9031
Structural I
LICENSED PROFESSIONAL ENGINEER

7-28-16

Vermont Agency of Transportation
RECEIVED
CK'D BY TYLIN OK'D BY KMH
July 29, 2016
RESUBMIT Yes Rejected
BY Kristin Higgins DATE 08/01/2016

T·Y·LIN INTERNATIONAL
The stamped documents are hereby:
____ Approved
____ Approved as noted
__X__ Revise and resubmit

See transmittal for additional information as applicable.

This review is for general conformance with design concept only. Any deviation from the plans or specifications not clearly noted by the Contractor has not been reviewed. Review by the Engineer shall not relieve the Contractor of the contractual responsibility for any errors or deviation from the contract requirements.

Josh Olund 08/01/2016
Reviewer Date

PREPARED BY:

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28x8under8c4MOD.out

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*** WELCOME TO CANDE-2013(version 3/1/2013) ***

MASTER CONTROL AND PIPE-TYPE DATA FOR PROBLEM #  1

      USER TITLE: 28x8_u8.6_c4

      EXECUTION MODE ..................   ANALYS
      SOLUTION LEVEL ..................  #2 AUTO
      METHODOLOGY (LRFD OR SERVICE) ...     LRFD
      NUMBER OF PIPE-ELEMENT GROUPS ....       1
      MAXIMUM ITERATIONS PER STEP ......      50

      CULVERT PIPE-TYPE ............... CONCRETE
      CANNED MESH CODE # ..............        3
      NUMBER OF BEAM ELEMENTS .........       19

      CONCRETE MATERIAL PROPERTIES ARE AS FOLLOWS
           COMPRESSION STRENGTH (psi)..........      6500.000
           ELASTIC YOUNGS MODULUS (psi)........   4595487.000
           POISSON RATIO ......................         0.170
           CONCRETE DENSITY (pcf) .............       150.000
           INITIAL TENSILE CRACKING STRAIN.....      0.000010
           INITIAL COMPRESSION YIELD STRAIN....      0.000687
           INITIAL COMPRESSION CRUSH STRAIN ...      0.002000
           SHEAR STRENGTH MODEL (NSHEAR) # ...          1
           (VARIABLE STRENGTH MODEL PRINTED IN OUTPUT)
           CONCRETE CRACK-WIDTH MODEL NAME.....   HEGER-McGRATH
           (DRIVEN BY TENSILE STRAIN IN STEEL)

      STEEL REINFORCEMENT MATERIAL PROPERTIES
           TYPE OF STEEL CAGES (RSHAPE) .......     ARBIT
           STEEL YIELD STRENGTH (psi)..........     60000.000
           STEEL ELASTIC MODULUS (psi).........  29000000.000
```

LOAD CASE 4 CONTROLS.

LOAD CASE 4 INPUT PRESENTED.

ONLY BOUNDARY CONDITIONS + RESULTS ARE PRESENTED FOR LOAD CASE 1, 2, 3.

CHANGED DWGS TO SHOW 6500

~~6,000 psi~~

A2 & A3 CANDE BARS LAY IN THE SAME PLANE... DRAWN SEPRATE SO YOU CAN SEE 'EM. 1 MAT SPACED 4" C/C IS CONSERVATIVE.

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STEEL POISSON RATIO 0.300000

CANDE DEFAULT. CAN'T CHANGE.

STEEL YIELDING STRAIN 0.001883

0.0021

NONLINEAR MODELING CODE (1,2,3) 3

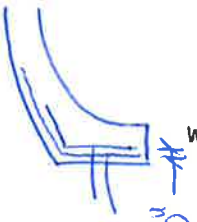
A4 & A5 BARS @ 10" C/C ARE NOT IN TENSION AREAS.

STEEL-BASED CRACKWIDTH PREDICTION PARAMETERS

REBAR SPACING INNER ROW (SLI), (in)	5.00
REBAR SPACING OUTER ROW (SLO), (in)	4.00
NUMBER OF STEEL LAYERS FOR INNER CAGE	1
NUMBER OF STEEL LAYERS FOR OUTER CAGE	1
HEGER-MCGRATH CODE NUMBER FOR STEEL TYPE..	3

5" and 10" spacings used in plans

it appears there are two layers used in the plans (A2 and A3 bars)



0.088 in plans - ok

1.5" + ½ BAR ϕ

2" + ½ BAR ϕ

WALL THICKNESS, REBAR AREAS AND COVER DEPTHS

WALL-THICK	INNER-REBAR	OUTER-REBAR	INNER-COVER	OUTER COVER
10.0000	0.0770	0.0200	2.0000	2.5000
10.0000	0.0770	0.0200	2.0000	2.5000
10.0000	0.0770	0.0200	2.0000	2.5000
10.0000	0.0770	0.0200	2.0000	2.5000
10.0000	0.0770	0.0200	2.0000	2.5000
10.0000	0.0770	0.0200	2.0000	2.5000
10.0000	0.0770	0.0200	2.0000	2.5000
10.0630	0.0770	0.0200	2.0000	2.5000
10.0630	0.0770	0.0880	2.0000	2.5000
10.6880	0.0200	0.0880	2.0000	2.5000
12.3750	0.0400	0.1300	2.0000	2.5000
15.2500	0.0400	0.1300	2.0000	2.5000
19.2500	0.0400	0.1300	2.0000	2.5000
27.0000	0.0400	0.1300	2.0000	2.5000
19.8130	0.0400	0.1300	2.0000	2.5000
15.4380	0.0400	0.1300	2.0000	2.5000
12.8750	0.0400	0.1300	2.0000	2.5000
12.0000	0.0400	0.1300	2.0000	2.5000
12.0000	0.0400	0.0880	2.0000	2.5000
12.0000	0.0400	0.0880	2.0000	2.5000

COVER IS TO CENTER OF REBAR IN CANDE. THESE ARE CONSERVATIVE.

CHANGED DWG.

0.031 in plans

0.15 in plans - ok

CHANGED DWG.

LRFD RESISTANCE FACTORS FOR STRENGTH-LIMIT STATES AND CRACK-WIDTH LIMIT AT SERVICE LOAD

YIELDING OF REINFORCEMENT STEEL	0.950
CRUSHING OF CONCRETE OUTER FIBER.....	0.750
SHEARING FAILURE OF CONCRETE	0.900
SPLITTING OF CONCRETE IN RADIAL TENSION	0.900
ALLOWABLE CRACKWIDTH SERVICE LOAD (inch)....	0.010

LARGE DEFORMATION/BUCKLING CODE, IBUCK = 0
IBUCK=0, MEANS SMALL DEFORMATION THEORY FOR GROUP AND NO BUCKLING PREDICTION.

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CONFINED MOD.= 0.3356E+07
LATERAL COEFF.= 0.2048E+00

PROPERTIES FOR MATERIAL  3    ********ML95

     DENSITY =     0.14000E+03

CONTROLS FOR DUNCAN SOIL MODEL
WITH SELIG HYPERBOLIC BULK MODULUS FORMULATION

      LRFD STRESS CONTROL..........        0

      ENTERING ELEMENT RATIO.......      0.5000

HYPERBOLIC STRESS-STRAIN PARAMETERS

      SOIL CLASSIFICATION ............ML95

      COHESION INTERCEPT  C ..........      4.0000

      FRICTION ANGLE  PHIO (DEG)......     34.0000

      10-FOLD REDUCTION IN PHIO(DEG)..      0.0000

      SCALED MODULUS NUMBER  ZK ......    440.0000

      MODULUS EXPONENT  ZN ...........      0.4000

      FAILURE RATIO  RF ..............      0.9500

      INIT. BULK MODULUS NUMBER BI....     48.3000

      ULT. VOLUMETRIC STRAIN EU ......      0.0600
```

Is AASHTO 3.11.7 considered by the software?

LAT PRESSURE/SOIL STRUCTURE INTERACTION BY CANDE.

INTERFACE ELEMENT MATERIAL-GROUP PROPERTIES

MAT. NO.	NORMAL-ANGLE	COEF-FRICTION	TENSILE-RUPTURE	INITIAL-GAP
1	90.00	0.40000	50.00000	0.00000
2	88.03	0.40000	50.00000	0.00000
3	86.14	0.40000	50.00000	0.00000
4	84.24	0.40000	50.00000	0.00000
5	82.35	0.40000	50.00000	0.00000
6	80.45	0.40000	50.00000	0.00000
7	78.56	0.40000	50.00000	0.00000
8	76.66	0.40000	50.00000	0.00000
9	74.77	0.40000	50.00000	0.00000
10	72.87	0.40000	50.00000	0.00000
11	70.97	0.40000	50.00000	0.00000
12	69.08	0.40000	50.00000	0.00000
13	67.18	0.40000	50.00000	0.00000
14	66.55	0.40000	50.00000	0.00000
15	11.42	0.40000	50.00000	0.00000
16	7.38	0.40000	50.00000	0.00000

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JOB	2016.059.009		
DESCIPTION	28x8u8		
SHEET NO	OF	SCALE	
CALCULATED BY	rja	DATE	7/5/2016
CHECKED BY		DATE	

Final Condition with Live Load Effects - Sum Forces and Moments About "Heel"

Toe Width	1	ft	Backfill Soil (phi)	32	deg
Wall Width	12	in			
Stem Width	2.25	ft			
Heel Width	5	ft			
Footing Width	8.25	ft			
Stem Height	3.51	ft			
Footing Thickness	2.5	ft			
Fill Height	8.6	ft			
Structure Height	8.83	ft			

Soil Weight 140 pcf

Ka = 2 <<< ENGAGING PASSIVE PRESSURE AGAINST STEM AND FOOTING

Limit States

Factor	Str-1a	Str-1b	Str IV	Serv
DC	1.25	0.90	1.50	1.00
DW	1.50	0.65	1.50	1.00
EH	0.90	0.90	0.90	1.00
EV	1.35	1.00	1.35	1.00
LL	1.75	1.75	0.00	1.00
LS	0.00	0.00	0.00	1.00

Resistance Factors

Sliding	0.9
Bearing	0.45
Moment	0.9
Shear	0.9

Suggest investigating LS or providing reason not to

Factored Bearing Resistance 15.5ksf

Note: Downward and inward forces are positive

	Dir	Factor	Force		Arm ft		Str-1a F kips	Str-1a M k-ft	Str-1b F kips	Str-1b M k-ft	Str IV F kips	Str IV M k-ft	Service F kips	Service M k-ft
Structure Reaction	V	DC	3.18	x	6.13	=	3.98	24.35	2.86	17.53	4.77	29.22	3.18	19.48
	V	DW	0	x	6.13	=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	V	EH	0.35	x	6.13	=	0.32	1.93	0.32	1.93	0.32	1.93	0.35	2.14
	V	EV	24.03	x	6.13	=	32.44	198.70	24.03	147.2	32.44	198.70	24.03	147.18
	V	LL	4.55	x	6.13	=	7.96	48.77	7.96	48.77	0.00	0.00	4.55	27.87
	H	DC	-1.5	x	6.01	=	-1.88	-11.27	-1.35	-8.11	-2.25	-13.52	-1.50	-9.02
	H	DW	0	x	6.01	=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	H	EH	0.12	x	6.01	=	0.11	0.65	0.11	0.65	0.11	0.65	0.12	0.72
	H	EV	-10.7	x	6.01	=	-14.47	-86.98	-10.72	-64.43	-14.47	-86.98	-10.72	-64.43
	H	LL	-2.71	x	6.01	=	-4.74	-28.50	-4.74	-28.50	0.00	0.00	-2.71	-16.29
	H	LS	0	x	6.01	=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Soil Above Heel	V	EV	14.66	x	2.50	=	19.79	49.47	14.66	36.65	19.79	49.47	14.66	36.65
Soil Above Stem	V	EV	1.53	x	5.31	=	2.06	10.94	1.53	8.10	2.06	10.94	1.53	8.10
EH from Soil Above	H	EH	29.33	x	3.01	=	26.40	79.33	26.40	79.33	26.40	79.33	29.33	88.14
EH on Stem FTG	H	EH	5.057	x	2.00	=	4.55	9.12	4.55	9.12	4.55	9.12	5.06	10.13
Stem Weight	V	DC	1.185	x	6.13	=	1.48	9.07	1.07	6.53	1.78	10.88	1.18	7.26
Ftg Weight	V	DC	3.094	x	4.13	=	3.87	15.95	2.78	11.49	4.64	19.14	3.09	12.76
Totals								321.52		266.23		308.87		270.70

	Str-1a	Str-1b	Str IV	Service
Total Vertical	71.89	55.20	65.79	52.57
Net Horizontal	9.97	14.24	14.34	19.58
Resultant Loacation	4.47 ft	4.82 ft	4.69 ft	5.15 ft
Eccentricity	-0.35 ft	-0.70 ft	-0.57 ft	-1.02 ft
bf'	7.55 ft	6.85 ft	7.11 ft	6.20 ft
Bearing Pressure	9.52 ksf	8.05 ksf	9.25 ksf	8.48 ksf
Eccentricity within middle half	YES	YES	YES	YES
Sliding Resistance	32.34 kips	24.84 kips	29.60 kips	23.65

revise for footing on bedrock (typ)

CHECKING FOOTING ROTATING TWARDS BACKFILL DUE TO ARCH THRUST. CONSERVATIVE TO NOT USE BENEFITIAL EFFECT OF LLS.