Input

Company					
Project				Project #	
Subject	38-T-201				
Name	Chandra	Date	2/21/2008	Sheet Number	1
Checked by		Check Date		Total Sheets	1

LOADING CONDITIONS

Note: Calculations are per *ACI 318-05* Appendix D.

N_u and V_u were factored using factors from ACI 318-05?	Section 9.2	
Factored tensile load (kips) = N_u =	used 1.5 load factor	116.865
Factored shear load (kips) = V_u =	perpendicular to edge	10.5
Is there a built-up grout pad?		Yes

ANCHOR DATA, EMBEDMENT, AND THICKNESS OF MEMBER

Anchor material type =	A307-Type C, Fu = 58
Nominal anchor diameter (in.) =	2 1/2
Effective anchor embedment depth (in.) = hef	46.00 = hef
Thickness of member in which anchor is anchored, (in.) = h	51.00 = h
Number of anchors in tension = n(tension) =	1
Number of anchors in shear = n(shear) =	2

CONCRETE FAILURE AREAS

Do you want to manually input the value of A_n? No

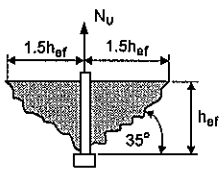
A_n = 7402.0

Note: Units for A_n and A_v are sq. in. A_n= 2497.21605

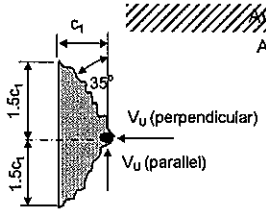
Do you want to manually input the value of A_v? No

A_v = 0

A_v= 1631.28905



Breakout cone for tension



Breakout cone for shear

DESIGN CONSIDERATIONS

Ductility required?	Tension	No	Shear: No
Intermediate or high seismic risk?		No	
Specified concrete strength (psi) = f'_c =		5000	
Cracking modification factor, Ψ_7	1.4 - Located in region where there isn't cracking at service loads (ft < fr)		
Adequate supplementary reinf. provided to resist tension loads in anchors?		No	
Adequate reinforcement provided to resist shear loads in anchors?		No	

ECCENTRICITY

Eccentricity of tensile force on group of tensile anchors (in.)

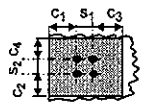
e_N' = 0 (0=single anchor)

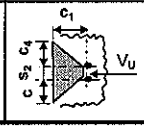
Eccentricity of shear force on group of anchors (in.)

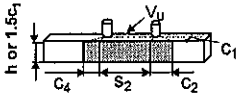
(Note e_v' must be less than s perpendicular to shear) e_V'= 0

EDGE DISTANCES AND SPACING

TENSION				SHEAR	
Edge Distance, in.		Spacing, in.		Edge Distance, in.	Spacing, in.
c_1 = 14.71	c_3 = 69.00	s_1 = 0.0		c_1 = 14.71	s_2 = 29.8
c_2 = 14.9	c_4 = 14.9	s_2 = 29.8		c_2 = 29.8	
				c_4 = 29.8	
c_1 = minimum edge distance				c_1 = edge distance in direction of V_n (perp.)	
c_2 = least edge distance perpendicular to c_1				c_2 = least edge distance perpendicular to c_1	







SUMMARY OF RESULTS

DUCTILITY	INTERACTION OF TENSILE AND SHEAR FORCES	RESULTS
	ϕN_n = 130.1 kips >= Nu = 116.9 kips	
	ϕV_n = 92.2 kips >= Vu = 10.5 kips	
	$N_u/(\phi N_n) + V_u/(\phi V_n)$ = 0.90 + 0.11 = 1.01 <=1.2	ANCHOR OK !
		130.10

Tensile load - service (N) =	77.91	kip	n =	no of bolts = 32	ANCHORS HAVE ONLY ONE CONC EDGE
Factored Tensile load (Nu) = 1.5*N =	116.865	kip	W =	Face/Face of Octagon Pedestal = 27.76 ft	Min Embedment length = (12d) in
Shear - service = Vs	7	kip	BCD =	25.3 ft	Min Embedment length =(Sleeve+6d) in
Factored Shear 1.5*(Vs)	10.5	kip			

Tension

C1= 0.5(W-BCD)*12 = 14.71 in

C2= C4 = (Pi)*BCD/n = 29.83 in = S2

Conservatively use half the distance

Shear PIP Appendix-page A-6

C1 = 1.03W/2-BCD/2 = 19.70 in

C2=C4 = [(1.03W/2)^2-(BCD/2)^ 79.83

Very conservative use

SUBJECT: VESSEL No 38-T-201
Anchor Rod design

BY: Chandra Date: 03/06/08
Chk By: _____ Date: ____

Define Units kipft := kip·ft

A) Concrete Pedestal Size

Diameter (BCD) - D — D := 25.313ft — Pile = 18in Dia Auger -CIP

Anchor Bolt dia =d — d := 2.75in — Flour Dwg: 6"x24" sleeve

Bolt Sleeve Dia = ds — ds := 6in

Bolt Sleeve Length = Ls — Ls := 24in

Face to Face Pedestal = (FF)

FF1 := D + 8in — FF1 = 25.98·ft

FF2 := D + 8·d — FF2 = 27.146·ft (ASTM 307 Type C Anchor Rod)

FF3 := D + ds + 6in — FF3 = 26.313·ft

FF := max(FF1, FF2, FF3) — FF = 27.146·ft

Use Min Face to Face Pedestal Size of 27.5 feet min

B) Determine Max Tension on Anchor Rod

2-3/4 in Anchor Rod - ASTM A 307 Grade C - Galvanized/ with Sleeve (6x24)"

Moment of Intertia of Anchor Bolts

No of Anchor Bolts n := 32 — $I := \frac{n \cdot D^2}{8}$ — $I = 2.56 \times 10^3 \cdot ft^2$

Allowable loads

Fy := 36ksi Fu := 60ksi — Fv := 0.17·Fu — Fv = 10.2·ksi — $A1 := \frac{\pi \cdot d^2}{4}$

Ft := 0.33Fu — Ft = 19.8·ksi

Area of Bolt = A1 — A1 = 5.94·in² — Use Ft := 15ksi [redacted]

Conservative

Ftallow := Ft·A1 — Ftallow = 89.094·kip

Fvallow := 0.17·Fu·A1 — Fvallow = 60.584·kip

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Anchor Rod design

BY: Chandra Date: 03/06/08
Chk By: _____ Date: ____

Erection Case

Errection wt - Vertical load- Per

$Per := 1054kip$ Errection wt

Errection Moment - Me

$Me := 22448kipft$ Use Seismic Base Moment

Moment arm = Xm $\quad Xm := \frac{D}{2}$ $\quad Xm = 12.656 \cdot ft$

$Ftmax1 := \frac{Per}{n} + \frac{Me \cdot Xm}{I}$ $\quad Ftmax1 = 143.79 \cdot kip$ (Compression)

$Ftmin1 := \frac{Per}{n} - \frac{Me \cdot Xm}{I}$ $\quad Ftmin1 = -77.915 \cdot kip$ (Tension)

Errection Shear - Fes

$Fes := 183kip$ Seismic shear

$Fvmax := \frac{Fes}{n}$ $\quad Fvmax = 5.719 \cdot kip$

$IR := \frac{-Ftmin1}{Ftallow} + \frac{Fvmax}{Fvallow}$ $\quad IR = 0.969$

Operating Case

Operating wt - Vertical load - Pop

$Pop := 2194kip$ Operating wt

Operating Moment Mo

$Mo := 26967kipft$ Use Seismic moment

$Ftmax2 := \frac{Pop}{n} + \frac{Mo \cdot Xm}{I}$ $\quad Ftmax2 = 201.73 \cdot kip$ (Compression)

$Ftmin2 := \frac{Pop}{n} - \frac{Mo \cdot Xm}{I}$ $\quad Ftmin2 = -64.605 \cdot kip$ (Tension)

Operating Shear - Fos

$Fos := 226kip$ Seismic shear

$Fvmax := \frac{Fos}{n}$ $\quad Fvmax = 7.063 \cdot kip$ (Lateral)

$IR := \frac{-Ftmin2}{Ftallow} + \frac{Fvmax}{Fvallow}$ $\quad IR = 0.842$

SUBJECT: VESSEL No 38-T-201
Anchor Rod design

BY: Chandra Date: 03/06/08
Chk By: _____Date: ____

C) Anchor Rod Design: Embedment length

Reference PIP STE05121 /2003

ACI 318 /05 Appendix D

Wind Loads and Anchor Bolt Design for Petro Chemical Facilities - ASCE Task Committee on wind induced forces & task committee on Anchor bolt Design

Design Criteria:

Min Embedment length do = Anchor rod dia ds = Sleeve dia Ls = Sleeve length

$do := d$ $d = 2.75 \cdot in$ $ds := 6in$ $Ls = 24 \cdot in$

a) L1=12 do $L1 := 12 \cdot d$ $L1 = 33 \cdot in$

b) L2=Ls + 6do $L2 := Ls + 6 \cdot do$ $L2 = 40.5 \cdot in$

Min Edge distance

a) 4do
b) 4do+0.5(ds-do)

Min Bolt spacing

a) 8do

Check Transfer of Tension Force - From Anchor Rod to Pedestal Rebar

Max Tension Tmax (use load factor of 1.5) $Tmax := (1.5) \cdot -min(Ftmin1, Ftmin2)$

$Tmax = 116.872 \cdot kip$

Rebar yield = fy $fy := 60ksi$

Area of rebar required to sufficient to transfer the tension = Ast

$$Ast := \frac{Tmax}{(0.9 \cdot fy)} \qquad Ast = 2.164 \cdot in^2$$

Select			Nos Bar reqired	Use
#9: $dp9 := 1.128in$	$Ap9 := \left(\frac{22}{7}\right) \cdot \frac{(dp9)^2}{4}$	$Ap9 = 1 \cdot in^2$	$n9 := \frac{Ast}{Ap9}$ $n9 = 2.165$	$n9 := 3$
#8: $dp8 := 1.0in$	$Ap8 := \left(\frac{22}{7}\right) \cdot \frac{(dp8)^2}{4}$	$Ap8 = 0.786 \cdot in^2$	$n8 := \frac{Ast}{Ap8}$ $n8 = 2.755$	$n8 := 3$
#7: $dp7 := 0.875in$	$Ap7 := \left(\frac{22}{7}\right) \cdot \frac{(dp7)^2}{4}$	$Ap7 = 0.602 \cdot in^2$	$n7 := \frac{Ast}{Ap7}$ $n7 = 3.598$	$n7 := 4$

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Anchor Rod design

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Chk By: _____Date: ____

Select smaller dia bars with smaller developement lengths for vertical reinforcemet in the pedestal. USE # 7 bars

USE 4 # 7 bars to transfer the tension in the Anchor into the pedestal

Note

1) The # 7 bars must be developed within the pedestal - See cad sketch - OK

From Cad sketch Use 4.25 ft Pedestal With # 7 Rebar for vertical reinforcement

Min Embedment length of Anchor = Le1

$Le1 := 3.84ft$ $Le1 = 46.08 \cdot in$

Min embedment Le

$Le := max(L1, L2, Le1)$ $Le = 46.08 \cdot in$

2) Check Anchor rod embedment length Per ACI 318- Appendix D -See Spread Sheet - OK

Use Min required embedment length from cad sketch (Le1) and check for compliance with Appendix D OK

3) Total Length odf Anchor Rod

Anchor Rod Total Length = L L = Projection(p) + Embedment(Lm) + bottom plate(lm)

Projection = p = Grout(1")+Skirt ht (Hs)+ (2x nuts)+1"

Grout thk = Gr $Gr := 1in$

Skirt ht Hs $Hs := 20.25in$

Nut thk = nt $nt := d$

$p := (Gr + Hs + 2 \cdot d + 1in)$ $d = 2.75 \cdot in$

$p = 27.75 \cdot in$

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Chk By: _____ Date: ____

Bottom length Lb= nut+1"

$Lb := d + 1in$ $Lb = 3.75 \cdot in$

Anchor rod Total length - Lb

$Lbolt := p + Le + Lb$ $Lbolt = 77.58 \cdot in$

USE $p := 28in$

$Le := 46.in$

$Lb := 4.0in$

$Lbolt := p + Le + Lb$

$Lbolt = 78 \cdot in$

USE 6'-6" = 78" ANCHOR ROD