GEOTECHNICAL CALCULATION COVER SHEET

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

400 N 34th St, Suite 100; Seattle, WA 98103

CALC. NO:

JOB NO: 21-1-21361-611

PROJECT: Cleveland Innerbelt CCG1

SHEETS: 4 (not including cover)

CLIENT: HNTB / Walsh

SUBMITTAL NO.: 0

TITLE:
Required Rock Socket Length Based on O-Cell Test

PURPOSE AND OBJECTIVE:
Revise rock socket length based on unit side and base resistances determined from the results of the O-Cell test as reported by LoadTest in their revised report dated May 4, 2012.

SUMMARY AND CONCLUSIONS:
Required rock socket length is 8.3 feet and is controlled by minimum depth stipulated in the RFP of 1.5D (where D is the diameter of the shaft). Estimated shaft settlements under Service limit loads is approximately 1/2 to 1 inch.

SIGN OFF

REV. NO.	ORIGINATOR Name/Date	TECHNICAL REVIEW Name/Date	PRINCIPAL REVIEW Name/Date
1	Gerard Buechel / 5-9-2012	David Vara / 5-9-2012	Bill Perkins / 5-10-2012

Rev. No	Revision Description	Revision Date

Strength Limit - 6905 kips ✓; Service Limit - 5270 kips ✓

Design - side - 17 ksf; 170 ksf tip ⇒ 22' ✓

April 10 CT values - 17 ksf; 220 ksf tip ⇒ 18' ✓

Using 4 CT - 17 ksf; 370 ksf tip ⇒ 8.25' (combination) (1.5ϕ) ✓

Rock Socket - 5.5' ϕ ✓

RF = 0.7 per AASHTO for strength. ✓

Load Test Results

Transducer A - 3.8 inches
Transducer B+C - 5.3 to 5.5 inches

Plate ϕ - 42 inches ⇒ 5% = 2.1 inches ✓
Shaft ϕ - 66 inches ✓
Plate ϕ + 2V; 1BH = 42+8 = 50 x 0.05 = 2.5 inches ✓

shear $2\sqrt{f'_c}$ ⇒ 18 ksf

Average ϕ = 42+4 = 46" ⇒ π(46/12) = 12.0 ft

Shear Surface = 12 ft x 8/12 = 8 ft²

shear = 18 x 8 = 144 kips

FOR A 1H:1V SHEAR SURFACE: per Dave Vana

R_2 = 21"
R_1 = 29"

$A = \pi(R_1+R_2)\sqrt{(R_1-R_2)^2+h^2}$

$A = \pi(29"+21")\sqrt{(29"-21")^2+8^2} = 1,777\ in^2 = 12.3\ ft^2$

12.3(18) = 221 kips

Conclusion - At nominal loads, concrete sheared

8-cell

Strength Limit Design

6905/0.7 = 9864 kips → Required Nominal Resist. ✓

Base @ 2.5" deflection = 370 ksf ✓

End Bearing Creep Limit → O.C – 4300 k @ 1.95" displacement ✓
(Figure D-1 pg 56/82)

Side Shear Creep Limit → O.C. – 3900 k @ 0.73" displacement ✓
(Figure D-2 pg 57/82)

Side Resistance = 17 ksf. ✓

5.5' ϕ → Area 23.7 ft² ✓ Perimeter 17.3 ft. ✓

Base Resistance = 23.7(370) = 8769 kips ✓

Required Nominal = 8769 – 9864 = 1095 kips ✓

Required Embedment = 1095/(17 ksf · 17.3 ft)
= 3.7 ft ✓

Required min Embed = 1.5(5.5) = 8.25' ✓

Mobilized Base Resistance =

Side Resis = 8.25'(17.3 ft)(17 ksf) = 2426 kips ✓

9864 – 2426 kips = 7438 kips / 23.7 = 314 ksf ✓

At 314 ksf, Settlement is 1.9 inch ✓
314 × π(25²)/144 = 4300, O.C Force is 4300 k ✓

– Note Load transferred to soil that is required per Design Criteria –
2,400 k Figure 5 of 8
[illegible] OK

– Recheck Mobilized Base:

9864 – 2426 – 2400 = 5038 kips / 23.7 = 212 ksf ✓
(Figure 7 of 8) about 1.2" deflection

Check Service Limit State

Service Limit is 5270 kips ✓

With minimum Embed – 8.25' (17.3') × 17 ksf

= 2426 kips ✓

Mobilized Base = 5270 – 2426

= 2844 kips = 120 ksf ✓

23.7 ft²

Settlement at 120 ksf ⇒ 0.75 inch

(Note this is governing soil contribution) ✓

Force in O-cell ⇒ 120 k/ft² × π (25. in)² × ft²/144 in²

⇒ 1635 kips. ✓

Also see Fig 1 of 8 at 0.75 – Force in O.C. ~ 1600 k ✓

At this Force; Side Resistance Mobilized in Soil is about 800 kips (Figure 5 of 8). ✓

True Base Resistance:

5270 – 2426 k – 800 k = 2044 k ✓

2044 / 23.7 k = 86 ksf Settlement is about 0.5 inch ✓

	Excluding Soil	With Soil
Side –	2426 k ✓	3226 k ✓
Base –	2844 k ✓ (120 ksf)	2044 k ✓ (86 ksf)
	5270 k ✓	5270 k ✓

Both Forces in Base + Side are less than the creep limits see page 2. ✓

Conclusions

- OK to use minimum embedment - 8.3' ✓
- Nominal Required shaft Resistance - 9864 K ✓
- Service Limit State Resistance - 5270 K ✓

Shaft Design

	(kips) Excluding 5.0:1	(kips) Including 5.0:1
Strength		
Side	✓2426 (17 KSF)	✓4826 (17 KSF + 5.0:1)
Base	✓7438 (314 KSF)	✓5038 (212 KSF)
	✓9864 ✓	✓9864 ✓
Estimated Settlement	✓2.0 inch	✓1.2 inch.
Service		
Side	✓2426 (17 KSF)	✓3226 (17 + 5.0:1)
Base	✓2844 (120 KSF)	✓2044 (86 KSF)
	✓5270 ✓	✓5270 ✓
Estimated Settlement	✓0.7 inch	✓0.5 inch

- Service Limit Settlement less than Creep Limit shaft will not creep. ✓

Check Settlement Using Old version of Report - Figure 7 of 8 For Service Limit

Base Resistance	120 KSF	86 KSF
	✓1.4 inch ✓	✓0.9 inch

Tall HWTB Service Limit Settlement 0.7 to 1.0 inch ✓