CALCULATION COVER SHEET

MWH

PROJECT TITLE:	GE SECTION 27 CLOSEOUT PLAN
PROJECT NO:	1005667
CALCULATION TITLE:	Mine Shaft Cap Reinforced Concrete Calculation

	NAME	DATE
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CHECKED BY:	John Hamm	2/6/09
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REVISIONS				
DATE	**PURPOSE**	**PREPARED BY**	**CHECKED BY**	**REVIEWED BY**
2/26/09	Editorial and additional calc. reviews.	Stefano Truschke	John Hamm	John Hamm

1 Purpose

The purpose of this calculation is to determine the Live and Dead Load that the typical vent and shaft plug detail can support according to ACI 318-05.

2 Assumptions

- Concrete Weight = 150 pcf
- Concrete Strength = 4ksi
- Reinforcement Strength, Fy=60ksi
- Soil Backfill Unit Weight = 120 pcf
- Assume that soil is free draining away from structure
- Assume a live load 2-ft soil surcharge (equipment load) of 240 psf
- Assume that steel plate and polyurethane foam do not contribute to load distribution.

3 Load

Assuming a Live Load of 240 psf and a Soil Cover of 3.0-ft which is a Live Load, Soil of 360 psf, the selected slab thickness of 12-inch is selected. This results in a 150 psf Dead Load, Concrete.

Factored Load

$$P_U = 1.6L + 1.2D$$

$$P_U = 1.6 * 100\,psf + 1.2 * 150\,psf$$

$$P_U = 1.140ksf$$

Using the Timoshenko Circular Plates Table, M=3wR^2/16, Pinned Condition. Use an additional 6-inch to account for uncertainties in actual diameter.

$$M = \frac{3wR^2}{16}$$

$$M = \frac{3 * 1.140ksf * 6.5^2}{16}$$

$$M = 9.03k - ft / ft$$

4 Concrete Design

Designed Moment = 9.03 k-ft
Assumed thickness, tb = 10-inch
Design width, b = 12-inch
Assumed Rebar, No. 5 bar
Minimum Clear Cover = 1.5-inch for concrete exposed to earth or weather
Reduction Factor, $\phi = 0.90$
Effective depth, d = tb – Cc – Db/2 = 8.0-inch, round down to the nearest 0.5-inch for construction tolerance

$$As,_{req} = \frac{M_u}{\phi f_y 0.875d}$$

$$As,_{req} = \frac{9.03k - ft * 12in / ft}{0.90 * 60ksi * 0.875 * 8.0in}$$

$$As,_{req} = 0.29in^2$$

$$a = \frac{A_s f_y}{0.85 f'_c b}$$

$$a = \frac{0.29 * 60}{0.85 * 4 * 12}$$

$$a = 0.42$$

$$As,_{req} = \frac{M_u}{\phi f_y \left(d - \frac{a}{2} \right)}$$

$$As,_{req} = \frac{9.03k - ft * 12in / ft}{0.90 * 60ksi * \left(10.00in - \frac{0.338in}{2} \right)}$$

$$As,_{req} = 0.26in^2$$

Minimum Steel Requirement

$$As_{\min 1b} = \max \left(\frac{3\sqrt{f_c, psi} * b * d}{f_y}, \frac{200, psi * b * d}{f_y} \right)$$

$$As_{\min 1b} = 0.317in^2$$

$$As_{\min 2b} = \frac{4}{3} As_{reqb}$$

$$As_{\min 2b} = \frac{4}{3} * 0.204in^2$$

$$As_{\min 2b} = 0.35in^2$$

Therefore, the minimum steel required is 0.317 in^2/ft. Using No. 5 rebar at 12-inch spacing, Each Way (EW) for the bottom steel fulfills this requirement.

Shrinkage and Temperature Steel, ACI 7.12.2.1
As, min = 0.0018*b*d/2
As, min = 0.0018*12*12/2
As, min =0.013in^2
The minimum top steel should be #4 @ 12-inch EW.

5 Conclusion

For the 12-ft diameter shaft with 3.0-ft maximum soil cover, a concrete slab 12-inch thick with #5 @ 12-inch EW should be used for the bottom slab steel. The minimum steel required for the top of slab for shrinkage and temperature steel is #4 @12-inch EW. This design will support a maximum Live Load of 240 psf and a Soil Load of 3-ft of 120 pcf soil, 360 psf.