| Pole ID | MAP-1, 35' | MAP-2, 45' | MAP-3, 55' | MAP-4, 10' |
|---|---|---|---|---|
| Boring ID | B-101 | B-102 | B-103 | B-104 |

**Check Steel Requirements for Torsional Load:**

$$P_H = \pi(D - 2C - d_{TIE}) \quad A_O = 0.85\frac{\pi(D - 2C - d_{TIE})^2}{4} \quad A_T = \frac{\pi d_{TIE}^{\ 2}}{4} \quad S_{MAX} = \frac{\phi_{TOR}\, 2A_O A_t f_y}{T_U} \quad S \le S_{MAX}$$

$$\phi T_n = \frac{\phi_{TOR} 2A_O A_T f_y}{S_{MAX}} \quad T_U = LF_{CONC}T \quad \phi T_n \ge T_U \quad A_{TOR} = \frac{A_T}{S_{MAX}}P_H \quad \rho_{TOR} = \frac{A_{TOR}}{A_g}$$

$$\rho_{TOT} = \rho_B + \rho_{TOR} \quad \rho_F(\min) = smaller\ of\ \frac{3\sqrt{f'_C}}{f_Y}\ or\ \rho_{TOT}\left(\frac{4}{3}\right) \quad \rho_C(\min) = 1.0\%\left(\frac{1}{2}\right) = 0.005$$

$$V = \left(\frac{\pi D^2}{4}L\right)\Big/27 + 1 \quad \rho_{REQ} = \text{Greater of } \rho_F(\min)\ or\ \rho_C(\min) \quad \rho = \rho_B$$

| | | | | |
|---|---|---|---|---|
| Concrete Strength Reduction Factor = $\phi_{TOR}$ | 0.85 | 0.85 | 0.85 | 0.85 |
| Perimeter of Centerline of Tie Bar (in) = $P_H$ | 92.7 | 92.7 | 92.7 | 92.7 |
| Area of Inside Shear Flow (in^2) = $A_0$ | 581.0 | 581.0 | 581.0 | 581.0 |
| Area of Tie Bar (in^2) = $A_T$ | 0.196 | 0.196 | 0.196 | 0.196 |
| Maximum Tie Bar Spacing (in) = $S_{MAX}$ | 21.8 | 12.6 | 9.4 | 119.0 |
| Tie Bar Spacing Provided (in) = $S$ | **12** | **12** | **9** | **12** |
| Concrete Design Strength (in-lbs) = $\phi T_n$ | 534674 | 923426 | 1235504 | 97750 |
| Concrete Design Strength (ft-lbs) = $\phi T_n$ | 44556 | 76952 | 102959 | 8146 |
| Concrete Required Strength (ft-lbs) = $T_U$ | 44556 | 76952 | 102959 | 8146 |
| Concrete Required Strength (in-lbs) = $T_U$ | 534674 | 923426 | 1235504 | 97750 |
| Area of Longitudinal Steel for Torsion (in^2) = $A_{TOR}$ | 0.836 | 1.444 | 1.932 | 0.153 |
| Longitudinal Reinforcement Ratio for Torsion = $\rho_{TOR}$ | 0.0008 | 0.0014 | 0.0019 | 0.0002 |
| Total Longitudinal Reinforcement Ratio = $\rho_{TOT}$ | 0.0027 | 0.0039 | 0.0055 | 0.0012 |
| Minimum Flexural Reinforcement Ratio = $\rho_F(\min)$ | 0.0030 | 0.0030 | 0.0030 | 0.0016 |
| Longitudinal Reinforcement Ratio Provided = $\rho$ | 0.0062 | 0.0062 | 0.0062 | 0.0062 |
| | **OK** | **OK** | **OK** | **OK** |
| Concrete Volume (Cu.Yd.) = $V$ | 3 | 4 | 4 | 3 |