CONCRETE SLAB ON GRADE ANALYSIS

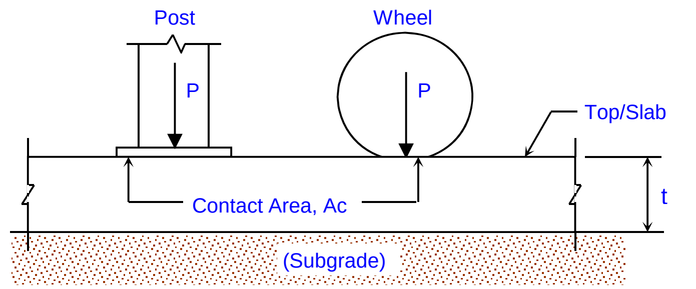
For Slab Subjected to Interior Concentrated Post or Wheel Loading

Assuming ACI-360 "Type B" Design - Reinforced for Shrinkage and Temperature Only

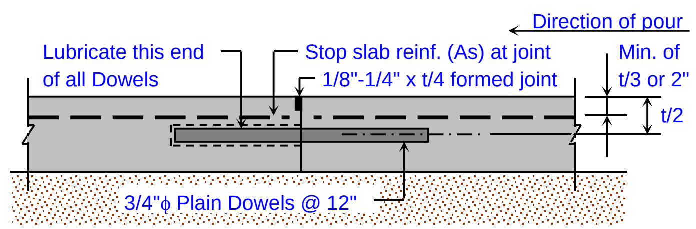
Job Name:	Sunset Farms, Inc. Feed Pad	Subject:	JLG G9-43A Telehandler		
Job Number:	14774000	Originator:	JRH	Checker:	

Input Data:

Slab Thickness, t =	8.000	in.
Concrete Strength, f'_c =	4000	psi
Conc. Unit Weight, w_c =	150	pcf
Reinforcing Yield, f_y =	60000	psi
Subgrade Modulus, k =	200	pci
Concentrated Load, P =	8550.00	lbs.
Contact Area, A_c =	54.00	in.^2
Factor of Safety, FS =	2.00	
Dowel Bar Dia., d_b =	1.000	in.
Dowel Bar Spacing, s =	15.000	in.
Const. Joint Width, z =	0.1250	in.
Joint Spacing, L =	125.000	ft.
Temperature Range, ΔT =	80.00	deg.
Increase for 2nd Wheel, i =	0	%



Concrete Slab on Grade



Typical Construction Joint for Load Transfer

Results:

Check Slab Flexural Stress: (assuming unreinforced slab with interior load condition)

Effective Load Radius, a =	4.146	in.	a = SQRT(A_c/π)
Modulus of Elasticity, E_c =	3834254	psi	E_c = 33*w_c^1.5*SQRT(f 'c)
Modulus of Rupture, MR =	569.21	psi	MR = 9*SQRT(f 'c)
Cracking Moment, M_r =	6.07	ft-k/ft.	M_r = MR*(12*t^2/6)/12000 (per 1' = 12" width)
Poisson's Ratio, μ =	0.15		μ = 0.15 (assumed for concrete)
Radius of Stiffness, L_r =	30.245	in.	L_r = (E_c*t^3/(12*(1-μ^2)*k))^0.25
Equivalent Radius, b =	4.166	in.	b = SQRT(1.6*a^2+t^2)-0.675*t , for a < 1.724*t
1 Load: $fb1_{(actual)}$ =	190.60	psi	$fb1_{(actual)}$ = 3*P*(1+μ)/(2*π*t^2)*(LN(L_r/b)+0.6159) (Ref. 1)
2 Loads: $fb2_{(actual)}$ =	N.A.	psi	$fb2_{(actual)}$ = N.A.
$Fb_{(allow)}$ =	284.60	psi	$Fb_{(allow)}$ = MR/FS **Fb(allow) >= fb(actual), O.K.**

Note: Effect of a 2nd load was not considered.

Check Slab Bearing Stress: (assuming working stress) (Ref. 4)

$fp_{(actual)}$ =	158.33	psi	$fp_{(actual)}$ = P/A_c
$Fp_{(allow)}$ =	2390.68	psi	Fp(allow) = 4.2*MR **Fp(allow) >= fp(actual), O.K.**

Check Slab Punching Shear Stress: (assuming working stress) (Ref. 4)

b_o =	29.394	in.	b_o = 4*SQRT(A_c) (assumed shear perimeter)
$fv_{(actual)}$ =	17.41	psi	$fv_{(actual)}$ = P/(t*(b_o+4*t))
$Fv_{(allow)}$ =	153.69	psi	$Fv_{(allow)}$ = 0.27*MR **Fv(allow) >= fv(actual), O.K.**

Shrinkage and Temperature Reinf.: (assuming subgrade drag method) (Ref. 3)

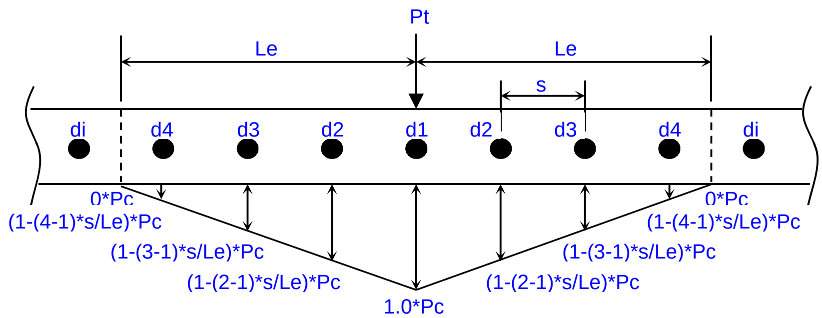
Friction Factor, F =	1.50		F = 1.5 (assumed friction factor between subgrade and slab)
Slab Weight, W =	100.00	psf	W = w_c*(t/12)
Reinf. Allow. Stress, f_s =	45000	psi	f_s = 0.75*fy
A_s =	0.208	in.^2/ft.	A_s = F*L*W/(2*fs)

(continued)

Determine Estimated Crack Width: (assuming no use of stabilized or granular subbase)

Slab-base Frict. Adjust., C =	1.00		C = 1.0 (assumed value for no subbase)
Thermal Expansion, α =	0.0000055	in./in./deg	α = 5.5x10^(-6) (assumed thermal expansion coefficient)
Shrinkage Coefficient, ε =	0.00035	in./in.	ε = 3.5x10^(-4) (assumed coefficient of shrinkage)
Est. Crack Width, ΔL =	1.1850	in.	ΔL = C*L*12*(α*ΔT+ε)

Check Bearing Stress on Dowels at Construction Joints with Load Transfer: (Ref. 2)



Assumed Load Transfer Distribution for Dowels at Construction Joint

L_e =	30.245	in.	L_e = 1.0*L_r = applicable dist. each side of critical dowel
Effective Dowels, N_e =	2.02	bars	N_e = 1.0+2*Σ(1-d(n-1)*s/L_e) (where: n = dowel #)
Joint Load, P_t =	4275.00	lbs.	P_t = 0.50*P (assumed load transferred across joint)
Critical Dowel Load, P_c =	2111.82	lbs.	P_c = P_t/N_e
Mod. of Dowel Suppt., k_c =	1500000	psi	k_c = 1.5x10^6 (assumed for concrete)
Mod. of Elasticity, E_b =	29000000	psi	E_b = 29x10^6 (assumed for steel dowels)
Inertia/Dowel Bar, I_b =	0.0491	in.^4	I_b = π*d_b^4/64
Relative Bar Stiffness, β =	0.716		β = (k_c*d_b/(4*E_b*I_b))^(1/4)
$f_{d(actual)}$ =	3161.38	psi	$f_{d(actual)}$ = k_c*(P_c*(2+β*z)/(4*$\beta^{3*}E_b$*I_b))
$F_{d(allow)}$ =	4000.00	psi	$F_{d(allow)}$ = (4-d_b)/3*f '$_c$ **Fd(allow) >= fd(actual), O.K.**

References:

1. "Load Testing of Instumented Pavement Sections - Improved Techniques for Appling the Finite Element Method to Strain Predition in PCC Pavement Structures" - by University of Minnesota, Department of Civil Engineering (submitted to MN/DOT, March 24, 2002)
2. "Dowel Bar Opimization: Phases I and II - Final Report" - by Max L. Porter (Iowa State University, 2001)
3. "Design of Slabs on Grade" - ACI 360R-92 - by American Concrete Institute (from ACI Manual of Concrete Practice, 1999)
4. "Slab Thickness Design for Industrial Concrete Floors on Grade" (IS195.01D) - by Robert G. Packard (Portland Cement Association, 1976)

Comments: