

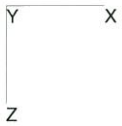
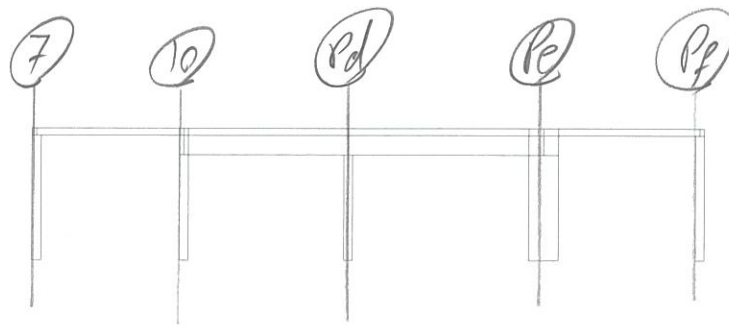
Alexandra Park

Item 7

Ground Floor Slab Design

Ground floor slab design

Along GL P12x



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File: E:\Projects\13015-Alexandra Park\Structural\Design\Gmd-900-P12x.slb

Project: Alex Park

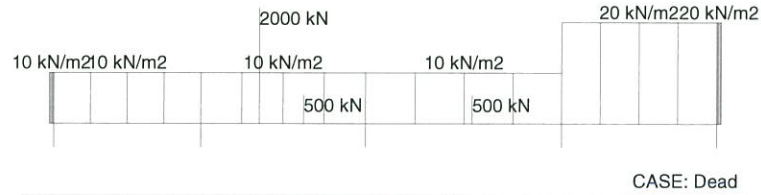
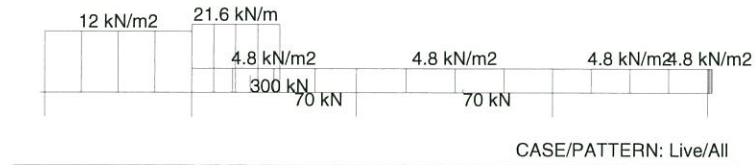
Frame: Gmd-900-p12x

Engineer: Houman

Code: CSA A23.3-04

Date: 01/22/15

Time: 11:04:58



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File: E:\Projects\13015-Alexandra Park\Structural\Design\Grnd-900-P12x.slb

Project: Alex Park

Frame: Grnd-900-p12x

Engineer: Houman

Code: CSA A23.3-04

Date: 01/22/15

Time: 11:15:10

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A Computer Program for Analysis, Design, and Investigation of
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[1] INPUT ECHO

General Information

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=====
File name: E:\Projects\13015-Alexandra Park\Structural\Design\Grnd-900-P12x.slb
Project: Alex Park
Frame: Grnd-900-p12x
Engineer: Houman
Code: CSA A23.3-04
Reinforcement Database: CSA G30.18
Mode: Design
Number of supports = 5 + Left cantilever + Right cantilever
Floor System: One-Way/Beam
  
```

Live load pattern ratio = 100%
 Deflections are based on cracked section properties.
 In negative moment regions, Ig and Mcr DO NOT include flange/slab contribution (if available)
 Long-term deflections are calculated for load duration of 60 months.
 0% of live load is sustained.
 Compression reinforcement calculations NOT selected.
 Default incremental rebar design selected.
 Combined M-V-T reinforcement design NOT selected.
 Moment redistribution NOT selected.
 Effective flange width calculations NOT selected.
 Rigid beam-column joint NOT selected.
 Torsion analysis and design NOT selected.

Material Properties

```

=====
          Slabs|Beams      Columns
          -----
wc      =      2402.8      2402.8 kg/m3
f'c     =      45      35 MPa
Ec      =      31005      28214 MPa
fr      =      2.0125      1.7748 MPa
Precast concrete construction is not selected.

fy      =      413.69 MPa, Bars are not epoxy-coated
fyt     =      413.69 MPa
Es      =      199950 MPa
  
```

Reinforcement Database

```

=====
Units: Db (mm), Ab (mm^2), Wb (kg/m)

```

Size	Db	Ab	Wb	Size	Db	Ab	Wb
#10	11	100	1	#15	16	200	2
#20	20	300	2	#25	25	500	4
#30	30	700	5	#35	36	1000	8
#45	44	1500	12	#55	56	2500	20

Span Data

=====

Slabs

Units: L1, wL, wR (m); t, Hmin (mm)

Span	Loc	L1	t	wL	wR	Hmin	
1	Int	0.150	250	1.500	1.500	0	LC
2	Int	5.000	250	1.500	1.500	199	
3	Int	5.600	250	1.500	1.500	0	
4	Int	6.650	250	1.500	1.500	0	
5	Int	5.300	250	1.500	1.500	197	
6	Int	0.150	250	1.500	1.500	0	RC

Ribs and Longitudinal Beams

Units: b, h, Sp (mm)

Span	Ribs			Beams		Span
	b	h	Sp	b	h	Hmin
1	0	0	0	0	0	---
2	0	0	0	0	0	---
3	0	0	0	3000	900	257
4	0	0	0	3000	900	291
5	0	0	0	0	0	---
6	0	0	0	0	0	---

Support Data

=====

Columns

Units: c1a, c2a, c1b, c2b (mm); Ha, Hb (m)

Supp	c1a	c2a	Ha	c1b	c2b	Hb	Red%
1	0	0	0.000	300	3000	4.500	15
2	0	0	0.000	300	3000	4.500	100
3	0	0	0.000	300	1000	4.500	100
4	0	0	0.000	1000	300	4.500	100
5	0	0	0.000	300	3000	4.500	15

Transverse Beams

Units: b, h, Ecc (mm)

Supp	b	h	Ecc
1	0	0	0
2	300	900	0
3	0	0	0
4	1000	900	0
5	0	0	0

Boundary Conditions

Units: Kz (kN/mm); Kry (kN-mm/rad)

Supp	Spring Kz	Spring Kry	Far End A	Far End B
1	0	0	Fixed	Fixed
2	0	0	Fixed	Fixed
3	0	0	Fixed	Fixed
4	0	0	Fixed	Fixed
5	0	0	Fixed	Fixed

Load Data

=====

Load Cases and Combinations

Case Type	SELF DEAD	Dead DEAD	Live LIVE
U1	1.400	1.400	0.000
U2	1.250	1.250	1.500

Area Loads

Units: Wa (kN/m2)

Case/Patt	Span	Wa
SELF	1	5.89
	2	5.89
	3	5.89
	4	5.89
	5	5.89
	6	5.89
Dead	1	10.00
	2	10.00
	3	10.00
	4	10.00
	5	20.00
	6	20.00

Live	2	12.00
	3	4.80
	4	4.80
	5	4.80
	6	4.80
Live/Odd	3	4.80
	5	4.80
Live/Even	2	12.00
	4	4.80
	6	4.80
Live/S1	2	12.00
Live/S2	2	12.00
	3	4.80
Live/S3	3	4.80
	4	4.80
Live/S4	4	4.80
	5	4.80
Live/S5	5	4.80
	6	4.80

Line Loads

Units: Wa, Wb (kN/m), La, Lb (m)

Case/Patt	Span	Wa	La	Wb	Lb
SELF	3	45.95	0.000	45.95	5.600
	4	45.95	0.000	45.95	6.650
Live	3	21.60	0.000	21.60	3.000
Live/Odd	3	21.60	0.000	21.60	3.000
Live/S2	3	21.60	0.000	21.60	3.000
Live/S3	3	21.60	0.000	21.60	3.000

Point Forces

Units: Wa (kN), La (m)

Case/Patt	Span	Wa	La
Dead	3	2000.00	2.000
	3	500.00	3.500
	4	500.00	3.600
Live	3	300.00	2.000
	3	70.00	3.500
	4	70.00	3.600
Live/Odd	3	300.00	2.000
	3	70.00	3.500
Live/Even	4	70.00	3.600
Live/S2	3	300.00	2.000
	3	70.00	3.500
Live/S3	3	300.00	2.000
	3	70.00	3.500
	4	70.00	3.600
Live/S4	4	70.00	3.600

Reinforcement Criteria

Slabs and Ribs

	Top bars		Bottom bars	
	Min	Max	Min	Max
Bar Size	#20	#25	#20	#25
Bar spacing	25	457	25	457 mm
Reinf ratio	0.14	5.00	0.14	5.00 %
Cover	35		25	mm

There is NOT more than 300 mm of concrete below top bars.

Beams

	Top bars		Bottom bars		Stirrups	
	Min	Max	Min	Max	Min	Max
Bar Size	#25	#35	#25	#35	#10	#10
Bar spacing	25	457	25	457	152	457 mm
Reinf ratio	0.14	5.00	0.14	5.00 %		
Cover	35		25	mm		
Layer dist.	25		25	mm		
No. of legs					6	6
Side cover					25	mm
1st StIRRUP					76	mm

There is NOT more than 300 mm of concrete below top bars.

```

          000000      0      0
          00      00      00      00
000000      000000      00      00      000000      00
00      0      00      00      00      0      00      00
00      00      00      000      00      000000      000000
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0      00      00      00      00      00      00      00
000000      00      000000      000      000000      000000      (TM)

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spSlab v3.60 (TM)

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Reinforced Concrete Beams, One-way and Two-way Slab Systems
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[2] DESIGN RESULTS

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Top Reinforcement

Units: Width (m), Mmax (kNm), Xmax (m), As (mm ²), Sp (mm)									
Span Zone	Width	Mmax	Xmax	AsMin	AsMax	AsReq	SpProv	Bars	
1 Left	3.00	0.00	0.000	1500	21302	0	375	8-#25	*3 *5
Midspan	3.00	0.00	0.000	1500	21302	0	375	8-#25	*3 *5
Right	3.00	0.00	0.000	1500	21302	0	375	8-#25	*3 *5
2 Left	3.00	8.40	0.150	1500	21302	118	375	8-#25	*3 *5
Midspan	3.00	5.57	3.205	1500	21302	78	375	8-#25	*3 *5
Right	3.00	382.44	4.850	1500	21302	5799	170	18-#25	
3 Left	3.00	254.44	0.150	8756	89712	851	170	18-#25	*3
Midspan	3.00	0.00	2.800	0	89712	0	0	---	
Right	3.00	2162.73	5.450	8756	89712	7379	170	18-#25	*3
4 Left	3.00	2318.17	0.150	8756	89712	7923	170	18-#25	*3
Midspan	3.00	475.15	2.250	8756	89712	1593	170	18-#25	*3
Right	3.00	250.95	6.150	8756	89712	839	170	18-#25	*3
5 Left	3.00	318.42	0.500	1500	21302	4761	170	18-#25	
Midspan	3.00	0.00	2.825	0	21602	0	0	---	
Right	3.00	14.79	5.150	1500	21602	205	429	7-#20	*3 *5
6 Left	3.00	0.00	0.150	1500	21602	0	429	7-#20	*3 *5
Midspan	3.00	0.00	0.150	1500	21602	0	429	7-#20	*3 *5
Right	3.00	0.00	0.150	1500	21602	0	429	7-#20	*3 *5

NOTES:

- *3 - Design governed by minimum reinforcement.
*5 - Number of bars governed by maximum allowable spacing.

Top Bar Details

Units: Length (m)									
Span	Left				Continuous		Right		
	Bars	Length	Bars	Length	Bars	Length	Bars	Length	Bars
1	---		---		8-#25	0.15	---		---
2	---		---		8-#25	5.00	5-#25	1.70	5-#25
3	18-#25	1.15	---		---		18-#25	2.05	---
4	---		---		18-#25	6.65	---		---
5	9-#25	2.06	9-#25	1.43	---		5-#20	1.68	2-#20
6	---		---		7-#20	0.15	---		---

Bottom Reinforcement

Design shown on dwg

25e258T 25e250T ✓

25e189T 25e180T ✓

25e315T 25e250T ✓

=====

Units: Width (m), Mmax (kNm), Xmax (m), As (mm ²), Sp (mm)								
Span	Width	Mmax	Xmax	AsMin	AsMax	AsReq	SpProv	Bars
1	3.00	0.00	0.075	0	22654	0	0	---
2	3.00	151.77	1.866	1500	22654	2055	429	7-#20
3	3.00	3783.63	2.016	8756	90764	12977	116	26-#25
4	3.00	732.75	3.600	8756	90764	2434	170	18-#25 *3
5	3.00	175.67	3.379	1500	22654	2389	375	8-#20
6	3.00	0.00	0.075	0	22654	0	0	---

NOTES:

*3 - Design governed by minimum reinforcement.

Bottom Bar Details

=====

Units: Start (m), Length (m)

Span	Long Bars			Short Bars		
	Bars	Start	Length	Bars	Start	Length
1	---			---		
2	5-#20	0.00	5.00	2-#20	0.00	3.15
3	18-#25	0.00	5.60	8-#25	0.00	3.98
4	18-#25	0.00	6.65	---		
5	5-#20	0.00	5.30	3-#20	1.83	3.47
6	---			---		

Flexural Capacity

=====

Units: x (m), As (mm²), PhiMn (kNm)

Span	x	AsTop	AsBot	PhiMn-	PhiMn+
1	0.000	4000	0	-270.28	0.00
	0.075	4000	0	-270.28	0.00
	0.150	4000	0	-270.28	0.00
2	0.000	4000	2100	-270.28	154.98
	0.150	4000	2100	-270.28	154.98
	1.795	4000	2100	-270.28	154.98
	2.500	4000	2100	-270.28	154.98
	2.672	4000	2100	-270.28	154.98
	3.149	4000	1500	-270.28	111.51
	3.205	4000	1500	-270.28	111.51
	3.299	4000	1500	-270.28	111.51
	3.777	6500	1500	-424.57	111.51
	3.909	6500	1500	-424.57	111.51
	4.388	9000	1500	-567.61	111.51
	4.850	9000	1500	-567.61	111.51
	5.000	9000	1500	-567.61	111.51
3	0.000	9000	13000	-2624.68	3790.10
	0.150	9000	13000	-2624.68	3790.10
	0.852	9000	13000	-2624.68	3790.10
	1.152	0	13000	0.00	3790.10
	2.005	0	13000	0.00	3790.10
	2.800	0	13000	0.00	3790.10
	3.042	0	13000	0.00	3790.10
	3.553	0	10823	0.00	3176.73
	3.595	627	10642	-187.69	3125.36
	3.981	6323	9000	-1859.33	2656.33
	4.162	9000	9000	-2624.68	2656.33
	5.450	9000	9000	-2624.68	2656.33
	5.600	9000	9000	-2624.68	2656.33
4	0.000	9000	9000	-2624.68	2656.33
	0.150	9000	9000	-2624.68	2656.33
	2.250	9000	9000	-2624.68	2656.33
	3.325	9000	9000	-2624.68	2656.33
	4.050	9000	9000	-2624.68	2656.33
	6.150	9000	9000	-2624.68	2656.33
	6.650	9000	9000	-2624.68	2656.33
5	0.000	9000	1500	-567.61	111.51
	0.500	9000	1500	-567.61	111.51
	1.038	9000	1500	-567.61	111.51
	1.431	4500	1500	-302.04	111.51
	1.664	4500	1500	-302.04	111.51
	1.834	2558	1500	-176.16	111.51

Design

shown on dwg

20e435B

20e250B ✓

30e161B

35e200B ✓

20e365B

30e200B ✓

15e251B

15e250B ✓

2.057	0	1914	0.00	141.60
2.127	0	2045	0.00	151.00
2.319	0	2400	0.00	176.47
2.650	0	2400	0.00	176.47
3.523	0	2400	0.00	176.47
3.615	0	2400	0.00	176.47
3.915	1500	2400	-106.23	176.47
4.219	1500	2400	-106.23	176.47
4.519	2100	2400	-147.59	176.47
5.150	2100	2400	-147.59	176.47
5.300	2100	2400	-147.59	176.47

6	0.000	2100	0	-147.59	0.00
	0.075	2100	0	-147.59	0.00
	0.150	2100	0	-147.59	0.00

Longitudinal Beam Shear Reinforcement Required

Units: dv (mm), Start, End, Xu (m), PhiVc, Vmax, Vu (kN), Av/s (mm^2/mm)									
Span	dv	PhiVc	Vmax	Start	End	Vu	Xu	Av/s	
1	--- No beam ---								
2	--- No beam ---								
3	767.2	1806.34	16829.57	0.226	1.859	2157.93	0.917	2.919	
				1.859	2.800	1996.92	1.859	2.919	
				2.800	3.741	2039.05	3.741	2.919	
				3.741	5.374	2169.56	4.683	2.919	
4	767.2	1806.34	16829.57	0.226	2.034	978.86	0.917	2.919	
				2.034	3.150	824.09	2.034	2.919	
				3.150	4.266	669.33	3.150	2.919	
				4.266	6.074	433.30	5.383	2.919	
5	--- No beam ---								
6	--- No beam ---								

Longitudinal Beam Shear Reinforcement Details

Units: spacing & distance (mm).									
Span Size Stirrups (2 legs each unless otherwise noted)									
1	--- No beam ---								
2	--- No beam ---								
3	#10 27 @ 198 [6L]								
4	#10 31 @ 195 [6L]								
5	--- No beam ---								
6	--- No beam ---								

Beam Shear Capacity

Units: dv, Sp (mm), Start, End, Xu (m), PhiVc, PhiVn, Vu (kN), Av/s (mm^2/mm)									
Span	dv	PhiVc	Start	End	Av/s	Sp	PhiVn	Vu	Xu
1	--- No beam ---								
2	--- No beam ---								
3	767.2	1806.34	0.000	0.226	-----	-----	2973.88	2157.93	0.917
			0.226	5.374	3.031	198	2973.88	2169.56	4.683
			5.374	5.600	-----	-----	2973.88	2169.56	4.683
4	767.2	1806.34	0.000	0.226	-----	-----	2992.24	978.86	0.917
			0.226	6.074	3.078	195	2992.24	978.86	0.917
			6.074	6.650	-----	-----	2992.24	433.30	5.383
5	--- No beam ---								
6	--- No beam ---								

Slab Shear Capacity

Units: b, dv (mm), Xu (m), PhiVc, Vu(kN)							
Span	b	dv	Beta	Vratio	PhiVc	Vu	Xu
1	3000	182	0.210	1.000	500.40	0.00	0.00
2	3000	182	0.210	1.000	500.40	326.17	4.67
3	--- Not checked ---						
4	--- Not checked ---						
5	3000	182	0.210	1.000	500.40	319.85	0.68
6	3000	185	0.210	1.000	507.44	0.00	0.00

Deflections

=====
Section properties

Units: Ig, Icr, Ie (mm^4), Mcr, Mmax (kNm)

Span	Ie, avg		Zone	Ig	Icr	Mcr	Load Level			
	Dead	Dead+Live					Dead		Dead+Live	
							Mmax	Ie	Mmax	Ie
1	3.9063e+009	3.9063e+009	Right	3.9063e+009	7.2394e+008	62.89	-0.54	3.9063e+009	-0.54	3.9063e+009
2	3.5358e+009	1.6059e+009	Left	3.9063e+009	7.2394e+008	62.89	-12.87	3.9063e+009	-26.35	3.9063e+009
			Midspan	3.9063e+009	4.7993e+008	62.89	56.50	3.9063e+009	107.73	1.1616e+009

3	6.9496e+010	6.7459e+010	Right	3.9063e+009	1.3600e+009	62.89	-202.15	1.4367e+009	-323.31	1.3788e+009
			Left	1.8225e+011	3.1916e+010	815.06	-302.49	1.8225e+011	-436.69	1.8225e+011
			Midspan	1.8225e+011	4.4756e+010	815.06	2482.27	4.9623e+010	2849.79	4.7973e+010
4	1.6241e+011	1.6150e+011	Right	1.8225e+011	3.1916e+010	815.06	-1667.29	4.9479e+010	-1909.71	4.3604e+010
			Left	1.8225e+011	3.1916e+010	815.06	-1651.88	4.9975e+010	-1891.97	4.3935e+010
			Midspan	1.8225e+011	3.2721e+010	815.06	404.57	1.8225e+011	457.67	1.8225e+011
5	1.5693e+009	1.4080e+009	Right	1.8225e+011	3.1916e+010	815.06	-327.59	1.8225e+011	-385.63	1.8225e+011
			Left	3.9063e+009	1.3600e+009	62.89	-327.54	1.3780e+009	-387.89	1.3709e+009
			Midspan	3.9063e+009	5.3865e+008	62.89	113.64	1.1095e+009	134.81	8.8056e+008
6	3.9063e+009	3.9063e+009	Right	3.9063e+009	4.3362e+008	62.89	-30.95	3.9063e+009	-36.74	3.9063e+009
			Left	3.9063e+009	4.3362e+008	62.89	-0.87	3.9063e+009	-1.04	3.9063e+009

Maximum Instantaneous Deflections

Units: D (mm)

Span	Ddead	Dlive	Dtotal
1	-0.04	-0.26	-0.30
2	-0.67	2.71	2.78
3	2.17	0.42	2.59
4	-0.30	-0.06	-0.37
5	3.68	1.09	4.77
6	-0.35	-0.09	-0.44

Maximum Long-term Deflections

Time dependant factor for sustained loads = 2.000

Units: D (mm)

Span	Dsust	Lambda	Dcs	Dcs+lu	Dcs+l	Dtotal
1	-0.04	2.000	-0.08	-0.34	-0.34	-0.38
2	0.07	2.000	0.14	2.85	2.85	2.93
3	2.17	2.000	4.34	4.76	4.76	6.94
4	-0.30	2.000	-0.60	-0.67	-0.67	-0.97
5	3.68	2.000	7.35	8.44	8.44	12.12
6	-0.35	2.000	-0.70	-0.79	-0.79	-1.14

Material Takeoff

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Reinforcement in the Direction of Analysis

Top Bars:	1063.0 kg	<=>	46.52 kg/m	<=>	15.506 kg/m^2
Bottom Bars:	1151.1 kg	<=>	50.38 kg/m	<=>	16.793 kg/m^2
Stirrups:	1035.4 kg	<=>	45.31 kg/m	<=>	15.104 kg/m^2
Total Steel:	3249.4 kg	<=>	142.21 kg/m	<=>	47.403 kg/m^2
Concrete:	43.6 m^3	<=>	1.91 m^3/m	<=>	0.635 m^3/m^2