

STRUCTUREPOINT - spColumn v6.50

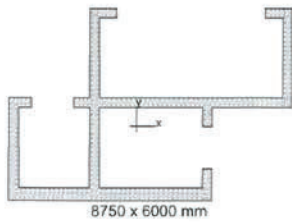
Licensed to: Dynamic Engineering Consultants Co., Ltd., License ID: 68794-1062303-4-2667D-XXXXX
C:\193018\GCDT\SPcolumn\10-09-63(C1 building)\SP(shear wall)\P6-L2.col

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9/18/2020

11:18 AM

6.2. MM at P=38760 [kN]



General Information

Project	---
Column	---
Engineer	---
Code	ACI 318-14
Bar Set	ASTM A615
Units	Metric
Run Option	Investigation
Run Axis	Biaxial
Slenderness	Not Considered
Column Type	Structural
Capacity Method	Critical capacity

Materials

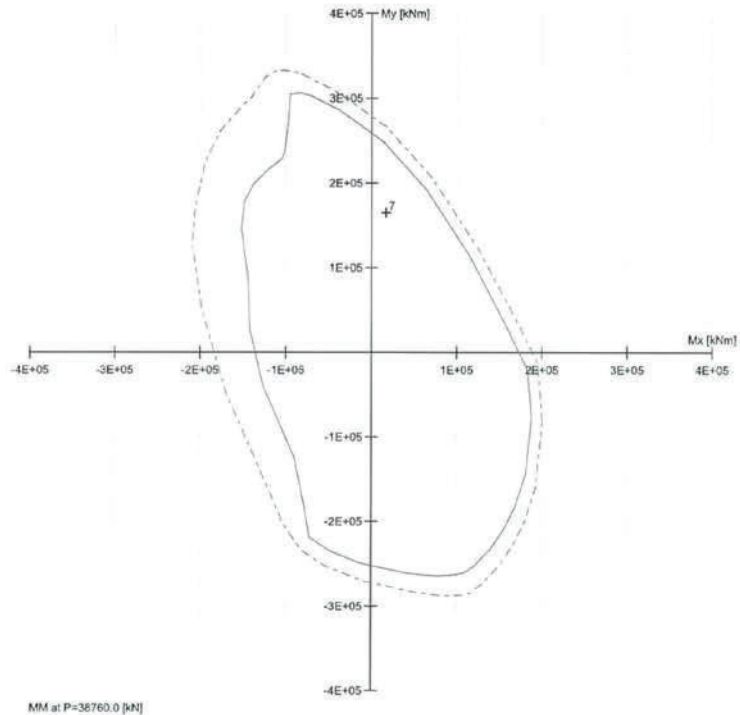
f'_c	35 MPa
E_s	27805.6 MPa
f_y	400 MPa
E_s	200000 MPa

Section

Type	Irregular
A_g	8.6825e+006 mm ²
I_x	2.8376e+013 mm ⁴
I_y	6.17429e+013 mm ⁴

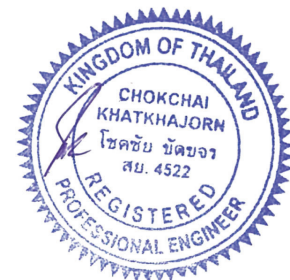
Reinforcement

Pattern	Irregular
Bar layout	---
Cover to	---
Clear cover	---
Bars	---
Confinement type	Tied
Total steel area, A_s	135020 mm ²
Rho	1.56 %
Min. clear spacing	18 mm



No.	P_u kN	M_{ux} kNm	M_{uy} kNm	ϕP_u kN	ϕM_{ux} kNm	ϕM_{uy} kNm	Capacity Ratio
7	38760.0	16890.0	164790.0	15864.75	19662.69	191842.20	0.83

Max. Capacity Ratio: 0.83





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C

3. รายการคำนวณพื้นที่คอนกรีต อัดแรงภายหลัง





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

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พัฒนาพื้นที่ส่วนขยาย ศูนย์ราชการ พื้นที่โซน **C** อาคารทิศตะวันตก **W**

2-8



1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Fy (Main bars)	4.00 T/cm 2
F'c for BEAMS/SLABS	320.00 Kg/cm 2	Fy (Shear reinforcement)	4.00 T/cm 2
F'ci for BEAMS/SLABS	280.00 Kg/cm 2	Minimum Cover at TOP	1.50 cm
For COLUMNS/WALLS	240.00 Kg/cm 2	Minimum Cover at BOTTOM	1.50 cm
Ec for BEAMS/SLABS	257.00 T/cm 2	Post-tensioning	
For COLUMNS/WALLS	257.00 T/cm 2	SYSTEM	BONDED
CREEP factor	2.00	Fpu	19.00 T/cm 2
CONCRETE WEIGHT	NORMAL	Fse	10.80 T/cm 2
UNIT WEIGHT	2400.00 Kg/m 3	Strand area	0.990 cm 2
Tension stress limits / (f'c)1/2		Min CGS from TOP	4.20 cm
At Top	1.590	Min CGS from BOT for interior spans	5.60 cm
At Bottom	1.590	Min CGS from BOT for exterior spans	5.60 cm
Compression stress limits / f'c		Min average precompression	10.00 Kg/cm 2
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (f'c)1/2		Analysis and design options	
At Top	0.795	Structural system - Equiv Frame	TWO-WAY
At Bottom	0.795	Moments reduced to face of support	YES
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	DESIGN CODE SELECTED	ACI-318 (1999)
Reinforcement			

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	cm	cm	cm	cm	cm	cm	cm		
C	1	2.00	840.00	23.00					0.00	0.50	0.50
1	1	8.00	840.00	23.00					0.00	0.50	0.50
2	1	8.00	840.00	23.00					0.00	0.50	0.50
3	1	8.00	840.00	23.00					0.00	0.50	0.50
C	1	2.00	840.00	23.00					0.00	0.50	0.50

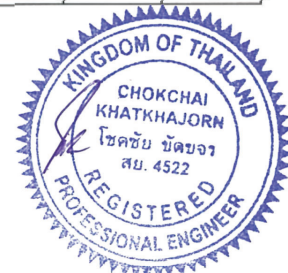
2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	cm	m	cm	cm			m	cm	cm		
1	100.0	3.0	80.0	100.0	100	(1)	3.0	80.0	100.0	100	(1)
2	100.0	3.0	80.0	100.0	100	(1)	3.0	80.0	100.0	100	(1)
3	100.0	3.0	80.0	100.0	100	(1)	3.0	80.0	100.0	100	(1)
4	100.0	3.0	80.0	100.0	100	(1)	3.0	80.0	100.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			T/m2	T/m	T/m	m	m	m	T	T-m
CANT	LL	U	0.300							
CANT	SDL	U	0.370							
1	LL	U	0.300							
1	SDL	U	0.370							
2	LL	U	0.300							
2	SDL	U	0.370							



3	LL	U	0.300							
3	SDL	U	0.370							
CANT	LL	U	0.300							
CANT	SDL	U	0.370							

NOTE: SELFWEIGHT INCLUSION REQUIRED (SW= SELF WEIGHT Computed from geometry input and treated as dead loading. Unit selfweight $W = 2400.0 \text{ Kg/m}^3$)

NOTE: LIVE LOADING is SKIPPED with a skip factor of 0.75

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			T/m	T/m	T	T-m	m	m	m	%
CL	LL	U	2.520							0.000
CL	SDL	U	3.108							
CL	SW	U	4.637							
1	LL	U	2.520							0.000
1	SDL	U	3.108							
1	SW	U	4.637							
2	LL	U	2.520							0.000
2	SDL	U	3.108							
2	SW	U	4.637							
3	LL	U	2.520							0.000
3	SDL	U	3.108							
3	SW	U	4.637							
CR	LL	U	2.520							0.000
CR	SDL	U	3.108							
CR	SW	U	4.637							

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	I	Yb	Yt
	cm ²	cm ⁴	cm	cm
CANT	19320.00	0.85E+06	11.50	11.50
1	19320.00	0.85E+06	11.50	11.50
2	19320.00	0.85E+06	11.50	11.50
3	19320.00	0.85E+06	11.50	11.50
CANT	19320.00	0.85E+06	11.50	11.50

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		T-m	T-m	T-m	T	T
CANT	SW	-----	-----	-9.27	-----	9.27
1	SW	-20.38	13.37	-27.08	-17.71	19.38
2	SW	-25.59	11.55	-25.50	-18.56	18.54
3	SW	-27.18	13.37	-20.26	-19.41	17.68
CANT	SW	-9.27	-----	-----	-9.27	-----
CANT	SDL	-----	-----	-6.22	-----	6.22
1	SDL	-13.66	8.96	-18.15	-11.87	12.99
2	SDL	-17.15	7.74	-17.10	-12.44	12.42
3	SDL	-18.22	8.96	-13.58	-13.01	11.85
CANT	SDL	-6.22	-----	-----	-6.22	-----
CANT	XL	-----	-----	0.00	-----	0.00



1	XL	0.00	0.00	0.00	0.00	0.00
2	XL	0.00	0.00	0.00	0.00	0.00
3	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		T	T-m	T-m
1	SW	26.98	-5.74	-5.36
2	SW	37.94	0.77	0.72
3	SW	37.95	-0.87	-0.81
4	SW	26.96	5.68	5.30
1	SDL	18.09	-3.85	-3.59
2	SDL	25.43	0.52	0.48
3	SDL	25.44	-0.58	-0.54
4	SDL	18.07	3.81	3.56
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	T-m	T-m	T-m	T-m	T-m	T-m	T	T
CL	-----	-----	-----	-----	-5.04	-----	-----	5.04
1	-11.07	-0.13	7.26	-1.18	-14.72	-1.85	-9.62	10.54
2	-13.91	-1.56	6.36	-1.66	-13.86	-1.58	-10.09	10.07
3	-14.77	-1.84	7.27	-1.17	-11.01	-0.14	-10.55	9.61
CR	-5.04	-----	-----	-----	-----	-----	-5.04	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	15.28	4.69	2.52	-5.64	2.35	-5.26
2	21.68	9.65	4.94	-4.52	4.61	-4.22
3	21.68	9.63	4.49	-4.97	4.20	-4.64
4	15.26	4.70	5.60	-2.51	5.23	-2.35

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		T-m	T-m	T-m
CANT	SW	-----	-----	-5.22
1	SW	-12.10	13.37	-17.97
2	SW	-16.89	11.55	-16.82
3	SW	-18.05	13.37	-12.00
CANT	SW	-5.22	-----	-----
CANT	SDL	-----	-----	-3.50
1	SDL	-8.11	8.96	-12.04
2	SDL	-11.32	7.74	-11.27
3	SDL	-12.10	8.97	-8.04
CANT	SDL	-3.50	-----	-----



CANT	XL	-----	-----	0.00
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-2.84	-----
1	-6.58	-0.26	7.26	-1.18	-9.76	-1.75
2	-9.18	-1.56	6.36	-1.66	-9.14	-1.58
3	-9.81	-1.74	7.27	-1.17	-6.52	-0.27
CR	-2.84	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

Tendon B

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---



7.2 Selected Post-Tensioning Forces and Tendon Drapes

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	99.000	-11.20	---	---	-4.20	5.24	3.543	46
1	104.194	-4.20	---	-17.40	-4.20	5.39	1.719	22
2	109.521	-4.20	---	-17.40	-4.20	5.67	1.807	23
3	107.952	-4.20	---	-17.40	-4.20	5.59	1.781	23
CR	101.897	-4.20	---	---	-11.20	5.40	3.650	47

Tendon B

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	91.021	-11.20	---	---	-4.20	4.76	3.215	42
1	96.186	-4.20	---	-17.40	-4.20	4.98	1.587	20
2	97.604	-4.20	---	-17.40	-4.20	5.05	1.610	21
3	92.824	-4.20	---	-17.40	-4.20	4.80	1.532	20
CR	88.112	-4.20	---	---	-11.20	4.66	3.152	41

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	T	kg/cm2	

CL	190.021	10	88
1	200.38	10.37	42
2	207.125	10.72	44
3	200.776	10.39	43
CR	190.009	10.06	88

Approximate weight of strand: 383.2 Kg

7.3 Tendon Extents and Stressing Conditions

Type	Num	Force	Left End	Right End	From	To	Extension
A	9	11.79	Dead	Live	CL	CR	---
B	8	11.82	Live	Dead	CL	CR	0.00

7.4 Required Minimum Post-Tensioning Forces

Based on Stress Conditions Based on Minimum P/A

Type	Left	Center	Right	Left	Center	Right
	T	T	T	T	T	T
CL	----	----	0.00	----	----	193.20
1	53.28	94.58	170.81	193.20	193.20	193.20
2	149.85	51.26	148.61	193.20	193.20	193.20
3	172.40	94.78	51.15	193.20	193.20	193.20
CR	0.00	----	----	193.20	----	----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2
CL	----	----	----	----	----	----	----	----	----	-9.16	----	-14.42
1	7.77	-1.11	----	-28.04	----	-36.31	15.57	----	23.64	----	----	-44.68
2	20.05	----	----	-41.47	----	-31.05	9.60	-1.23	19.83	----	----	-41.29
3	23.83	----	----	-44.90	----	-36.33	15.54	----	7.42	-1.38	----	-27.71
CR	----	-9.24	----	-14.35	----	----	----	----	----	----	----	----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	T-m	T-m	T-m	T	T
CL	----	----	8.18	----	10.14
1	13.53	-10.38	14.47	-0.13	-0.13
2	14.61	-10.60	14.60	0.00	0.00
3	14.51	-10.40	13.55	0.14	0.14
CR	8.23	----	----	10.20	----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	T	T-m	T-m
1	0.135	0.742	0.693
2	-0.137	0.072	0.067
3	-0.135	-0.042	-0.039
4	0.137	-0.707	-0.660

Note: Moments are reported at face of support

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)



Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-17.02	-----
1	-37.98	-27.24	45.58	31.23	-56.17	-42.55
2	-52.45	-39.50	40.43	26.79	-52.31	-39.46
3	-56.49	-42.77	45.54	31.19	-37.71	-27.08
CR	-17.02	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	89.21	71.21	-8.41	-22.27	-7.85	-20.79
2	125.44	104.99	10.27	-5.82	9.59	-5.43
3	125.47	104.98	5.57	-10.51	5.20	-9.81
4	89.12	71.16	22.10	8.31	20.63	7.76

8.3 Secondary Moments

Span	Left	Midspan	Right
	T-m	T-m	T-m
1	1.50	1.97	2.45
2	2.64	2.60	2.55
3	2.40	1.92	1.44

Note: Moments are reported at face of support

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	cm2	cm2	cm2	cm2	cm2
1	TOP	7.50	8.00	14.54	14.54	0.00	0.00	0.00
2	TOP	0.00	0.50	7.61	7.61	0.00	0.00	0.00
2	TOP	7.50	8.00	7.61	7.61	0.00	0.00	0.00
3	TOP	0.00	0.50	14.57	14.57	0.00	0.00	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	cm2
1	1	TOP	4.90	2	8	6.20	10.20
2	2	TOP	4.90	2	8	6.20	10.20
1	3	TOP	5.70	1	8	4.60	5.10
2	4	TOP	5.70	1	8	4.60	5.10

10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
1	1	TOP	4.90	2	8	3.10
1	3	TOP	5.70	1	8	2.30
2	1	TOP	0.00	2	8	3.10
2	2	TOP	4.90	2	8	3.10
2	3	TOP	0.00	1	8	2.30



2	4	TOP	5.70	1	8	2.30
3	2	TOP	0.00	2	8	3.10
3	4	TOP	0.00	1	8	2.30

13 - PUNCHING SHEAR REINFORCEMENT

13.1 Critical Section Geometry

Column	Layer	Cond.	a	d	b1	b2
			cm	cm	cm	cm
1	1	1	9.48	18.96	118.96	98.96
2	1	1	9.48	18.96	118.96	98.96
3	1	1	9.48	18.96	118.96	98.96
4	1	1	9.48	18.96	118.96	98.96

13.2 Critical Section Stresses

Label	Layer	Cond.	Factored shear	Factored moment	Stress due to shear	Stress due to moment	Total stress	Allowable stress	Stress ratio
			T	T-m	T/cm ²	T/cm ²	T/cm ²	T/cm ²	
1	1	1	-88.16	+34.79	0.01	0.005	0.015	0.016	0.982
2	1	1	-123.65	-5.00	0.01	0.001	0.016	0.016	0.991
3	1	1	-123.68	+5.56	0.01	0.001	0.016	0.016	0.996
4	1	1	-88.07	-34.47	0.01	0.005	0.015	0.016	0.977

13.3 Punching Shear Reinforcement

Reinforcement option: Stirrups

Bar Size: 5

Col.	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs
	cm		cm		cm		cm		cm	
1										
2										
3										
4										

Dist. = Distance measured from the face of support

Note: Columns with --- have not been checked for punching shear.

Note: Columns with *** have exceeded the maximum allowable shear stress.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	cm	cm	cm	cm	cm	cm	cm	cm
CL	0.0	-0.1	-0.1	-0.4(497)	-0.1(2999)	0.0(****)	-0.4(497)	-0.5(426)
1	0.3	0.1	0.3	0.8(1023)	0.1(5349)	0.0(****)	0.8(1023)	0.9(860)
2	0.2	0.0	0.1	0.4(1813)	0.1(5700)	0.0(****)	0.4(1813)	0.6(1375)
3	0.3	0.1	0.3	0.8(1021)	0.1(5355)	0.0(****)	0.8(1021)	0.9(859)
CR	0.0	-0.1	-0.1	-0.4(487)	-0.1(2976)	0.0(****)	-0.4(487)	-0.5(418)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

15 - FRICTION, ELONGATION AND LONG TERM LOSSES

15.1 Input Parameters

Parameter	Value	Parameter	Value
Type of Strand	Low Relaxation	Coefficient of Angular Friction (meu)	0.17000 1/rad
Age of Concrete at Stressing	3 days	Coefficient of Wobble Friction (K)	0.00160 rad/m
Ec at Stressing	238.00 T/cm ²	Ratio of Jacking Stress	0.75
Average Relative Humidity	80.00 percent	Anchor Set	6.00 mm



Volume to Surface Ratio of Members	11.50 cm	Tendon A Stressing Method	Right side
Es of Strand	2030.00 T/cm2	Tendon B Stressing Method	Left side

15.2 Long-term Losses

Tendon	Span	Left	Center	Right
		T/cm2	T/cm2	T/cm2
TENDON A	CL	0.42	0.42	0.42
TENDON A	1	0.36	0.37	0.39
TENDON A	2	0.39	0.46	0.43
TENDON A	3	0.42	0.42	0.39
TENDON A	CR	0.46	0.45	0.44
TENDON B	CL	0.45	0.45	0.44
TENDON B	1	0.38	0.41	0.42
TENDON B	2	0.43	0.46	0.40
TENDON B	3	0.39	0.38	0.36
TENDON B	CR	0.43	0.42	0.42

15.3 Calculated Stresses After Friction and Long-term Losses

Tendon	Span	Stress Left FL Only	Stress Center FL Only	Stress Right FL Only	Stress Left FL+LTL	Stress Center FL+LTL	Stress Right FL+LTL
		T/cm2	T/cm2	T/cm2	T/cm2	T/cm2	T/cm2
TENDON A	CL	11.45	11.53	11.78	11.03	11.11	11.36
TENDON A	1	11.78	12.08	12.45	11.43	11.71	12.06
TENDON A	2	12.45	12.76	12.87	12.06	12.30	12.46
TENDON A	3	12.87	12.54	12.17	12.46	12.13	11.78
TENDON A	CR	12.17	11.89	11.77	11.71	11.44	11.34
TENDON B	CL	11.85	11.94	12.05	11.40	11.49	11.60
TENDON B	1	12.05	12.58	12.92	11.67	12.16	12.50
TENDON B	2	12.92	12.79	12.48	12.50	12.33	12.08
TENDON B	3	12.48	12.11	11.81	12.09	11.73	11.45
TENDON B	CR	11.81	11.55	11.45	11.38	11.12	11.02

15.6 Summary

Tendon	Force	Ext. Left	Start Span	End Span	Ext. Right	Elong. Left	Elong Right	Anchor Left	Anchor Right	Max Stress ratio
	T					cm	cm			
TENDON A	11.60	0.00	CL	5	0.00	0.00	17.05	0.60	0.62	0.68
TENDON B	11.63	0.00	CL	5	0.00	17.10	-0.00	0.62	0.60	0.69

16 - Unbalanced Moment Reinforcement

16.1 Unbalanced Moment Reinforcement - No Redistribution

Joint	Gamma Left	Gamma Right	Width Left	Width Right	Moment Left Neg	Moment Left Pos	Moment Right Neg	Moment Right Pos	As Top	As Bot	n Bar Top	n Bar Bot
			m	m	T-m	T-m	T-m	T-m	cm2	cm2		
1	0.58	0.58	1.49	1.49	0.00	0.00	-20.96	0.00	0.00	0.00	0	0
2	0.58	0.58	1.49	1.49	-3.71	0.00	0.00	0.00	0.00	0.00	0	0
3	0.58	0.58	1.49	1.49	0.00	0.00	-4.18	0.00	0.00	0.00	0	0
4	0.58	0.58	1.49	1.49	-20.69	0.00	0.00	0.00	0.00	0.00	0	0





พัฒนาพื้นที่ส่วนขยาย ศูนย์ราชการ พื้นที่โซน C อาคารทิศตะวันตก W

2-5



1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Fy (Main bars)	4.00 T/cm 2
F'c for BEAMS/SLABS	320.00 Kg/cm 2	Fy (Shear reinforcement)	4.00 T/cm 2
F'ci for BEAMS/SLABS	280.00 Kg/cm 2	Minimum Cover at TOP	1.50 cm
For COLUMNS/WALLS	240.00 Kg/cm 2	Minimum Cover at BOTTOM	1.50 cm
Ec for BEAMS/SLABS	257.00 T/cm 2	Post-tensioning	
For COLUMNS/WALLS	257.00 T/cm 2	SYSTEM	BONDED
CREEP factor	2.00	Fpu	19.00 T/cm 2
CONCRETE WEIGHT	NORMAL	Fse	10.80 T/cm 2
UNIT WEIGHT	2400.00 Kg/m 3	Strand area	0.990 cm 2
Tension stress limits / (f'c)1/2		Min CGS from TOP	4.20 cm
At Top	1.590	Min CGS from BOT for interior spans	5.60 cm
At Bottom	1.590	Min CGS from BOT for exterior spans	5.60 cm
Compression stress limits / f'c		Min average precompression	10.00 Kg/cm 2
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (f'c)1/2		Analysis and design options	
At Top	0.795	Structural system - Equiv Frame	TWO-WAY
At Bottom	0.795	Moments reduced to face of support	YES
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	DESIGN CODE SELECTED	ACI-318 (1999)
Reinforcement			

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	cm	cm	cm	cm	cm	cm	cm		
C	1	2.00	100.00	23.00					0.00	4.20	4.20
1	1	8.00	100.00	23.00					0.00	4.20	4.20
2	1	8.00	100.00	23.00					0.00	4.20	4.20
3	1	8.00	100.00	23.00					0.00	4.20	4.20
4	1	8.00	100.00	23.00					0.00	0.40	4.20
5	1	8.00	100.00	23.00					0.00	0.40	4.20
6	1	8.00	100.00	23.00					0.00	0.40	4.20
7	1	8.00	100.00	23.00					0.00	4.20	4.20
C	1	2.00	100.00	23.00					0.00	4.20	4.20

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	cm	m	cm	cm			m	cm	cm		
1	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
2	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
3	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
4	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
5	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
6	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
7	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
8	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen



Span	Class	Type	W	P1	P2	A	B	C	F	M
			T/m ²	T/m	T/m	m	m	m	T	T-m
CANT	LL	U	0.300							
CANT	SDL	U	0.370							
1	LL	U	0.300							
1	SDL	U	0.370							
2	LL	U	0.300							
2	SDL	U	0.370							
3	LL	U	0.300							
3	SDL	U	0.370							
4	LL	U	0.300							
4	SDL	U	0.370							
5	LL	U	0.300							
5	SDL	U	0.370							
6	LL	U	0.300							
6	SDL	U	0.370							
7	LL	U	0.300							
7	SDL	U	0.370							
CANT	LL	U	0.300							
CANT	SDL	U	0.370							

NOTE: SELFWEIGHT INCLUSION REQUIRED (SW= SELF WEIGHT Computed from geometry input and treated as dead loading. Unit selfweight $W = 2400.0 \text{ Kg/m}^3$)

NOTE: LIVE LOADING is SKIPPED with a skip factor of 0.75

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			T/m	T/m	T	T-m	m	m	m	%
CL	LL	U	2.520							0.000
CL	SDL	U	3.108							
CL	SW	U	4.637							
1	LL	U	2.520							0.000
1	SDL	U	3.108							
1	SW	U	4.637							
2	LL	U	2.520							0.000
2	SDL	U	3.108							
2	SW	U	4.637							
3	LL	U	2.520							0.000
3	SDL	U	3.108							
3	SW	U	4.637							
4	LL	U	1.380							0.000
4	SDL	U	1.702							
4	SW	U	2.539							
5	LL	U	1.380							0.000
5	SDL	U	1.702							
5	SW	U	2.539							
6	LL	U	1.380							0.000
6	SDL	U	1.702							
6	SW	U	2.539							
7	LL	U	2.520							0.000
7	SDL	U	3.108							
7	SW	U	4.637							
CR	LL	U	2.520							0.000
CR	SDL	U	3.108							
CR	SW	U	4.637							

4 - CALCULATED SECTION PROPERTIES



4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	I	Yb	Yt
	cm ²	cm ⁴	cm	cm
CANT	19320.00	0.85E+06	11.50	11.50
1	19320.00	0.85E+06	11.50	11.50
2	19320.00	0.85E+06	11.50	11.50
3	19320.00	0.85E+06	11.50	11.50
4	10580.00	0.47E+06	11.50	11.50
5	10580.00	0.47E+06	11.50	11.50
6	10580.00	0.47E+06	11.50	11.50
7	19320.00	0.85E+06	11.50	11.50
CANT	19320.00	0.85E+06	11.50	11.50

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		T-m	T-m	T-m	T	T
CANT	SW	-----	-----	-9.27	-----	9.27
1	SW	-18.47	14.22	-27.29	-17.44	19.65
2	SW	-25.75	11.72	-25.01	-18.64	18.46
3	SW	-25.92	13.19	-21.89	-19.05	18.04
4	SW	-15.58	6.11	-12.83	-10.50	9.81
5	SW	-13.71	6.62	-13.68	-10.16	10.15
6	SW	-12.55	5.96	-16.16	-9.71	10.61
7	SW	-24.41	15.19	-19.39	-19.17	17.92
CANT	SW	-9.27	-----	-----	-9.27	-----
CANT	SDL	-----	-----	-6.22	-----	6.22
1	SDL	-12.38	9.53	-18.29	-11.69	13.17
2	SDL	-17.26	7.85	-16.76	-12.49	12.37
3	SDL	-17.38	8.84	-14.67	-12.77	12.09
4	SDL	-10.44	4.09	-8.60	-7.04	6.58
5	SDL	-9.19	4.44	-9.17	-6.81	6.81
6	SDL	-8.41	4.00	-10.83	-6.51	7.11
7	SDL	-16.36	10.18	-13.00	-12.85	12.01
CANT	SDL	-6.22	-----	-----	-6.22	-----
CANT	XL	-----	-----	0.00	-----	0.00
1	XL	0.00	0.00	0.00	0.00	0.00
2	XL	0.00	0.00	0.00	0.00	0.00
3	XL	0.00	0.00	0.00	0.00	0.00
4	XL	0.00	0.00	0.00	0.00	0.00
5	XL	0.00	0.00	0.00	0.00	0.00
6	XL	0.00	0.00	0.00	0.00	0.00
7	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		T	T-m	T-m
1	SW	26.72	-4.75	-4.44
2	SW	38.29	0.80	0.75
3	SW	37.51	-0.47	-0.44
4	SW	28.54	3.26	3.04
5	SW	19.97	-0.46	-0.43
6	SW	19.86	0.59	0.55
7	SW	29.78	-4.27	-3.99



8	SW	27.19	5.23	4.89
1	SDL	17.91	-3.19	-2.97
2	SDL	25.67	0.54	0.50
3	SDL	25.14	-0.32	-0.30
4	SDL	19.13	2.18	2.04
5	SDL	13.39	-0.31	-0.28
6	SDL	13.31	0.39	0.37
7	SDL	19.96	-2.86	-2.67
8	SDL	18.23	3.51	3.28
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00
5	XL	0.00	0.00	0.00
6	XL	0.00	0.00	0.00
7	XL	0.00	0.00	0.00
8	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	T-m	T-m	T-m	T-m	T-m	T-m	T	T
CL	-----	-----	-----	-----	-5.04	-----	-----	5.04
1	-10.04	-0.47	7.73	-1.63	-14.83	-2.24	-9.48	10.68
2	-13.99	-2.22	6.97	-2.20	-13.59	-1.86	-10.13	10.03
3	-14.09	-2.29	7.17	-1.57	-11.89	-0.24	-10.35	9.81
4	-8.47	-1.48	3.32	-0.60	-6.97	0.63	-5.71	5.33
5	-7.45	-0.16	3.60	-0.19	-7.44	-0.15	-5.52	5.52
6	-6.82	0.66	3.24	-0.62	-8.78	-1.77	-5.27	5.77
7	-13.27	-0.90	8.26	-1.01	-10.54	-1.07	-10.42	9.74
CR	-5.04	-----	-----	-----	-----	-----	-5.04	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	15.26	4.65	2.28	-4.86	2.13	-4.54
2	22.12	9.49	4.11	-3.67	3.83	-3.43
3	21.78	9.48	3.64	-3.90	3.40	-3.64
4	16.48	4.86	4.72	-2.95	4.41	-2.75
5	11.44	5.09	3.90	-4.15	3.65	-3.88
6	11.41	5.02	4.17	-3.85	3.90	-3.60
7	16.67	5.22	2.57	-4.89	2.40	-4.57
8	15.12	5.06	4.71	-1.87	4.40	-1.75

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		T-m	T-m	T-m
CANT	SW	-----	-----	-5.93
1	SW	-11.86	14.22	-19.80
2	SW	-18.66	11.72	-18.00
3	SW	-18.67	13.19	-15.04
4	SW	-11.59	6.11	-9.11
5	SW	-9.85	6.62	-9.82



6	SW	-8.87	5.96	-12.12
7	SW	-17.11	15.19	-12.60
CANT	SW	-5.93	-----	-----
CANT	SDL	-----	-----	-3.98
1	SDL	-7.95	9.53	-13.27
2	SDL	-12.51	7.85	-12.07
3	SDL	-12.52	8.84	-10.08
4	SDL	-7.76	4.09	-6.10
5	SDL	-6.60	4.44	-6.59
6	SDL	-5.95	4.00	-8.12
7	SDL	-11.47	10.18	-8.44
CANT	SDL	-3.98	-----	-----
CANT	XL	-----	-----	0.00
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00
5	XL	0.00	0.00	0.00
6	XL	0.00	0.00	0.00
7	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-3.23	-----
1	-6.45	-0.59	7.73	-1.63	-10.76	-2.16
2	-10.14	-2.21	6.97	-2.20	-9.78	-1.88
3	-10.15	-2.20	7.17	-1.57	-8.17	-0.38
4	-6.30	-1.38	3.32	-0.60	-4.95	0.50
5	-5.35	-0.16	3.60	-0.19	-5.34	-0.15
6	-4.82	0.53	3.24	-0.62	-6.59	-1.65
7	-9.30	-0.91	8.26	-1.01	-6.85	-1.06
CR	-3.23	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
4	1	0.100	0.500	0.100	---
5	1	0.100	0.500	0.100	---
6	1	0.100	0.500	0.100	---
7	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

Tendon B

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.100	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
4	1	0.100	0.500	0.100	---



5	1	0.100	0.500	0.100	---
6	1	0.100	0.500	0.100	---
7	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

Tendon C

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.100	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
4	1	0.100	0.500	0.100	---
5	1	0.100	0.500	0.100	---
6	1	0.100	0.500	0.100	---
7	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drapes

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	113.641	-11.20	---	---	-4.20	5.93	4.010	52
1	120.089	-4.20	---	-17.40	-4.20	6.22	1.981	26
2	121.833	-4.20	---	-17.40	-4.20	6.31	2.010	26
3	115.893	-4.20	---	-17.40	-4.20	6.00	1.912	25
4	108.518	-4.20	---	-17.40	-4.20	10.26	1.791	42
5	114.159	-4.20	---	-17.40	-4.20	10.79	1.884	44
6	120.054	-4.20	---	-17.40	-4.20	11.35	1.981	47
7	119.947	-4.20	---	-17.40	-4.20	6.21	1.979	26
CR	113.113	-4.20	---	---	-11.20	5.99	4.048	52

Tendon B

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	79.178	-11.20	---	---	-4.20	4.19	2.834	37
1	83.890	-4.20	---	-17.40	-4.20	4.34	1.384	18
2	85.062	-4.20	---	-17.40	-4.20	4.40	1.404	18
3	80.916	-4.20	---	-17.40	-4.20	4.19	1.335	17
4	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
5	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
6	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
7	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
CR	0.000	-4.20	---	---	-11.50	0.00	0.000	0

Tendon C

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	0.000	-11.50	---	---	-4.20	0.00	0.000	0
1	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
2	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
3	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
4	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
5	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
6	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
7	83.900	-4.20	---	-17.40	-4.20	4.34	1.384	18
CR	79.116	-4.20	---	---	-11.20	4.19	2.835	37

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
------	-------	-----------	------------------



	T	kg/cm2	
CL	192.819	10.12	89
1	203.979	10.56	44
2	206.895	10.71	44
3	196.809	10.19	42
4	108.518	10.26	42
5	114.159	10.79	44
6	120.054	11.35	47
7	203.847	10.55	44
CR	192.229	10.18	89

Approximate weight of strand: 698.3 Kg

7.3 Tendon Extents and Stressing Conditions

Type	Num	Force	Left End	Right End	From	To	Extension
A	10	11.70	Live	Live	CL	CR	---
B	7	11.83	Live	Dead	CL	3	0.15
C	7	11.81	Dead	Live	7	CR	0.20

7.4 Required Minimum Post-Tensioning Forces

Based on Stress Conditions

Based on Minimum P/A

Type	Left	Center	Right	Left	Center	Right
	T	T	T	T	T	T
CL	----	----	0.00	----	----	193.20
1	47.30	113.65	203.61	193.20	193.20	193.20
2	182.75	60.55	167.48	193.20	193.20	193.20
3	180.47	88.98	112.72	193.20	193.20	193.20
4	140.56	21.18	74.48	105.80	105.80	105.80
5	90.57	34.75	91.83	105.80	105.80	105.80
6	67.81	17.45	154.65	105.80	105.80	105.80
7	156.24	135.01	61.39	193.20	193.20	193.20
CR	0.00	----	----	193.20	----	----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2
CL	----	----	----	----	----	----	----	----	----	----	----	----
1	6.07	-2.63	----	-26.60	----	-38.39	17.28	----	27.76	----	-9.27	-15.15
2	24.27	----	----	-46.08	----	-31.98	10.57	-1.82	22.93	----	----	-44.03
3	25.26	----	----	-46.12	----	-35.51	15.13	----	16.65	----	----	-36.65
4	16.01	----	----	-52.07	----	-28.76	8.24	-1.43	18.07	----	----	-39.02
5	22.40	----	----	-43.61	----	-32.48	10.90	----	21.61	----	----	-43.68
6	13.67	----	----	-35.97	----	-27.05	4.35	-5.17	15.30	-0.93	----	-54.73
7	20.98	----	----	-42.47	----	-40.89	19.79	----	7.93	-1.31	----	-28.43
CR	----	-9.32	----	-15.06	----	----	----	----	----	----	----	----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	T-m	T-m	T-m	T	T
CL	----	----	9.35	----	10.95
1	14.15	-10.86	15.29	-0.16	-0.16
2	15.26	-10.79	15.06	0.03	0.03
3	14.91	-10.45	13.56	0.19	0.19
4	11.85	-6.02	8.58	-0.28	-0.28
5	8.41	-5.85	8.51	-0.01	-0.01
6	9.57	-6.83	12.63	0.37	0.37



7	14.38	-11.16	14.42	-0.01	-0.01
CR	9.40	-----	-----	11.01	-----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	T	T-m	T-m
1	0.158	0.601	0.561
2	-0.186	-0.034	-0.032
3	-0.160	-0.066	-0.062
4	0.464	-0.865	-0.808
5	-0.263	-0.128	-0.119
6	-0.386	0.642	0.600
7	0.378	1.073	1.002
8	-0.005	-0.731	-0.683

Note: Moments are reported at face of support

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)

Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-19.36	-----
1	-37.46	-27.51	48.18	32.26	-62.23	-47.60
2	-58.53	-45.04	41.51	25.91	-56.58	-43.14
3	-58.99	-45.47	44.29	29.44	-48.48	-35.23
4	-38.85	-30.50	19.93	13.26	-28.65	-19.38
5	-31.19	-22.36	22.57	16.14	-31.02	-22.20
6	-26.80	-17.70	20.24	13.67	-40.09	-31.71
7	-54.45	-40.18	50.95	35.20	-39.69	-29.85
CR	-19.36	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	88.58	70.55	-6.64	-18.78	-6.20	-17.54
2	126.96	105.50	8.82	-4.40	8.23	-4.11
3	124.58	103.67	5.02	-7.80	4.69	-7.28
4	95.22	75.46	14.78	1.74	13.80	1.63
5	65.89	55.10	5.44	-8.25	5.08	-7.70
6	65.45	54.58	9.11	-4.54	8.51	-4.24
7	98.35	78.89	-4.53	-17.23	-4.24	-16.09
8	89.29	72.18	19.52	8.33	18.23	7.77

8.3 Secondary Moments

Span	Left	Midspan	Right
	T-m	T-m	T-m
1	1.23	1.79	2.36
2	2.35	2.25	2.15
3	1.93	1.26	0.58
4	-1.05	0.01	1.06
5	0.94	0.98	1.03
6	2.13	0.79	-0.55
7	1.37	1.39	1.41



Note: Moments are reported at face of support

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	cm2	cm2	cm2	cm2	cm2
1	TOP	7.60	8.00	21.77	21.77	0.00	0.00	0.00
2	TOP	0.00	0.00	12.52	12.52	0.00	0.00	0.00
2	TOP	0.40	0.40	14.57	14.57	0.00	0.00	0.00
2	TOP	7.60	8.00	12.52	12.52	0.00	0.00	0.00
3	TOP	0.00	0.00	12.52	12.52	0.00	0.00	0.00
3	TOP	0.40	0.40	16.32	16.32	0.00	0.00	0.00
5	TOP	0.00	0.00	2.12	2.12	0.00	0.00	0.00
5	TOP	0.40	0.40	3.61	3.61	0.00	0.00	0.00
5	TOP	7.60	8.00	3.61	3.61	0.00	0.00	0.00
7	TOP	0.00	0.00	5.49	5.49	0.00	0.00	0.00
7	TOP	0.40	0.40	9.77	9.77	0.00	0.00	0.00
1	BOT	3.20	4.00	3.16	3.16	0.00	0.00	0.00
7	BOT	3.60	4.80	7.46	7.46	0.00	0.00	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	cm2
1	1	TOP	4.90	3	8	6.20	15.30
2	2	TOP	4.90	2	8	6.20	10.20
4	3	TOP	4.90	1	8	6.20	5.10
5	4	TOP	4.90	1	8	6.20	5.10
6	5	TOP	4.90	1	8	6.20	5.10
1	6	TOP	5.70	2	8	4.60	10.20
2	7	TOP	5.70	2	8	4.60	10.20
6	8	TOP	5.70	1	8	4.60	5.10
CL	9	BOT	0.00	4	5	60.00	8.00

10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
1	1	TOP	4.90	3	8	3.10
1	6	TOP	5.70	2	8	2.30
2	1	TOP	0.00	3	8	3.10
2	2	TOP	4.90	2	8	3.10
2	6	TOP	0.00	2	8	2.30
2	7	TOP	5.70	2	8	2.30
3	2	TOP	0.00	2	8	3.10
3	7	TOP	0.00	2	8	2.30
4	3	TOP	4.90	1	8	3.10
5	3	TOP	0.00	1	8	3.10
5	4	TOP	4.90	1	8	3.10
6	4	TOP	0.00	1	8	3.10
6	5	TOP	4.90	1	8	3.10
6	8	TOP	5.70	1	8	2.30
7	5	TOP	0.00	1	8	3.10
7	8	TOP	0.00	1	8	2.30
CL	9	BOT	0.00	4	5	2.00



1	9	BOT	0.00	4	5	8.00
2	9	BOT	0.00	4	5	8.00
3	9	BOT	0.00	4	5	8.00
4	9	BOT	0.00	4	5	8.00
5	9	BOT	0.00	4	5	8.00
6	9	BOT	0.00	4	5	8.00
7	9	BOT	0.00	4	5	8.00
CR	9	BOT	0.00	4	5	2.00

13 - PUNCHING SHEAR REINFORCEMENT

13.1 Critical Section Geometry

Column	Layer	Cond.	a	d	b1	b2
			cm	cm	cm	cm
1	1	1	9.48	18.96	98.96	58.96
2	1	1	9.48	18.96	98.96	58.96
3	1	1	9.48	18.96	98.96	58.96
4	1	1	9.48	18.96	98.96	58.96
5	1	1	9.48	18.96	98.96	58.96
6	1	1	9.48	18.96	98.96	58.96
7	1	1	9.48	18.96	98.96	58.96
8	1	1	9.48	18.96	98.96	58.96

13.2 Critical Section Stresses

Label	Layer	Cond.	Factored shear	Factored moment	Stress due to shear	Stress due to moment	Total stress	Allowable stress	Stress ratio
			T	T-m	T/cm ²	T/cm ²	T/cm ²	T/cm ²	
1	1	1	-87.31	+28.83	0.01	0.008	0.022	0.017	1.331
2	1	1	-124.72	-4.96	0.02	0.001	0.022	0.017	1.313
3	1	1	-122.19	+3.11	0.02	0.001	0.021	0.017	1.265
4	1	1	-93.59	-18.91	0.02	0.005	0.021	0.018	1.167
5	1	1	-52.94	+12.54	0.01	0.003	0.012	0.017	0.724
6	1	1	-52.56	-14.18	0.01	0.004	0.013	0.017	0.740
7	1	1	-97.53	+24.84	0.02	0.007	0.023	0.018	1.271
8	1	1	-88.70	-31.60	0.01	0.008	0.023	0.017	1.388

13.3 Punching Shear Reinforcement

Reinforcement option: Stirrups

Bar Size: 5

Col.	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs
	cm		cm		cm		cm		cm	
1	9.5	9	19.0	11						
2	9.5	9	19.0	11						
3	9.5	9	19.0	11						
4	9.5	9								
5										
6										
7	9.5	9								
8	9.5	9	19.0	11						

Dist. = Distance measured from the face of support

Note: Columns with --- have not been checked for punching shear.

Note: Columns with *** have exceeded the maximum allowable shear stress.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
------	----	-------	-----------	-----------------	----	---	-----------	-------



	cm	cm	cm	cm	cm	cm	cm	cm
CL	-0.1	-0.1	-0.2	-0.6(351)	-0.1(2074)	0.0(****)	-0.6(351)	-0.7(300)
1	0.3	0.1	0.3	0.9(891)	0.2(4483)	0.0(****)	0.9(891)	1.1(744)
2	0.2	0.0	0.1	0.4(1789)	0.2(4931)	0.0(****)	0.4(1789)	0.6(1313)
3	0.3	0.1	0.2	0.7(1105)	0.2(4967)	0.0(****)	0.7(1105)	0.9(904)
4	0.2	0.0	0.1	0.3(2390)	0.1(6997)	0.0(****)	0.3(2390)	0.4(1795)
5	0.2	0.0	0.2	0.5(1501)	0.1(6895)	0.0(****)	0.5(1501)	0.6(1233)
6	0.2	-0.1	0.1	0.2(3620)	0.1(7168)	0.0(****)	0.2(3620)	0.3(2467)
7	0.3	0.1	0.3	1.0(774)	0.2(4502)	0.0(****)	1.0(774)	1.2(661)
CR	-0.1	-0.1	-0.2	-0.6(320)	-0.1(2136)	0.0(****)	-0.6(320)	-0.7(278)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

15 - FRICTION, ELONGATION AND LONG TERM LOSSES

15.1 Input Parameters

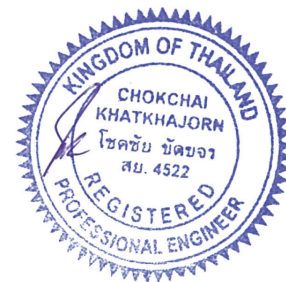
Parameter	Value	Parameter	Value
Type of Strand	Low Relaxation	Coefficient of Wobble Friction (K)	0.00160 rad/m
Age of Concrete at Stressing	3 days	Ratio of Jacking Stress	0.75
Ec at Stressing	238.00 T/cm ²	Anchor Set	6.00 mm
Average Relative Humidity	80.00 percent	Tendon_A Stressing Method	Both sides
Volume to Surface Ratio of Members	11.50 cm	Tendon_B Stressing Method	Left side
Es of Strand	2030.00 T/cm ²	Tendon_C Stressing Method	Right side
Coefficient of Angular Friction (meu)	0.17000 1/rad		

15.2 Long-term Losses

Tendon	Span	Left T/cm ²	Center T/cm ²	Right T/cm ²
TENDON A	CL	0.46	0.46	0.47
TENDON A	1	0.40	0.43	0.42
TENDON A	2	0.43	0.48	0.40
TENDON A	3	0.39	0.40	0.36
TENDON A	4	0.44	0.52	0.50
TENDON A	5	0.50	0.57	0.55
TENDON A	6	0.59	0.65	0.55
TENDON A	7	0.43	0.41	0.40
TENDON A	CR	0.49	0.46	0.45
TENDON B	CL	0.45	0.46	0.49
TENDON B	1	0.41	0.42	0.42
TENDON B	2	0.43	0.48	0.40
TENDON B	3	0.39	0.40	0.36
TENDON B	4	0.34	0.00	0.00
TENDON B	5	0.00	0.00	0.00
TENDON B	6	0.00	0.00	0.00
TENDON B	7	0.00	0.00	0.00
TENDON B	CR	0.00	0.00	0.00
TENDON C	CL	0.00	0.00	0.00
TENDON C	1	0.00	0.00	0.00
TENDON C	2	0.00	0.00	0.00
TENDON C	3	0.00	0.00	0.00
TENDON C	4	0.00	0.00	0.00
TENDON C	5	0.00	0.00	0.00
TENDON C	6	0.00	0.00	0.43
TENDON C	7	0.43	0.41	0.40
TENDON C	CR	0.49	0.46	0.45

15.3 Calculated Stresses After Friction and Long-term Losses

Tendon	Span	Stress Left FL Only T/cm ²	Stress Center FL Only T/cm ²	Stress Right FL Only T/cm ²	Stress Left FL+LTL T/cm ²	Stress Center FL+LTL T/cm ²	Stress Right FL+LTL T/cm ²



TENDON A	CL	11.85	11.94	12.05	11.38	11.48	11.57
TENDON A	1	12.05	12.58	12.92	11.65	12.14	12.50
TENDON A	2	12.92	12.79	12.48	12.49	12.31	12.08
TENDON A	3	12.48	12.11	11.81	12.08	11.71	11.45
TENDON A	4	11.81	11.47	11.78	11.37	10.95	11.27
TENDON A	5	11.78	12.08	12.45	11.28	11.52	11.90
TENDON A	6	12.45	12.76	12.87	11.86	12.11	12.33
TENDON A	7	12.87	12.54	12.17	12.45	12.13	11.77
TENDON A	CR	12.17	11.89	11.77	11.68	11.43	11.33
TENDON B	CL	11.77	11.89	12.17	11.33	11.43	11.68
TENDON B	1	12.17	12.54	12.87	11.76	12.12	12.46
TENDON B	2	12.87	12.76	12.45	12.46	12.28	12.05
TENDON B	3	12.45	12.08	11.78	12.05	11.69	11.43
TENDON B	4	11.78	0.00	0.00	11.43	0.00	0.00
TENDON B	5	0.00	0.00	0.00	0.00	0.00	0.00
TENDON B	6	0.00	0.00	0.00	0.00	0.00	0.00
TENDON B	7	0.00	0.00	0.00	0.00	0.00	0.00
TENDON B	CR	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	CL	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	1	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	2	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	3	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	4	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	5	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	6	0.00	0.00	12.87	0.00	0.00	12.46
TENDON C	7	12.87	12.54	12.17	12.45	12.13	11.77
TENDON C	CR	12.17	11.89	11.77	11.68	11.43	11.33

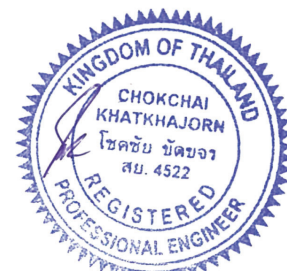
15.6 Summary

Tendon	Force	Ext. Left	Start Span	End Span	Ext. Right	Elong. Left	Elong Right	Anchor Left	Anchor Right	Max Stress ratio
	T					cm	cm			
TENDON A	11.64	0.00	CL	9	0.00	33.57	2.87	0.62	0.62	0.69
TENDON B	11.72	0.00	CL	4	0.15	16.61	-0.00	0.62	0.61	0.68
TENDON_C	11.70	0.20	8	CR	0.00	0.00	7.14	0.68	0.62	0.68

16 - Unbalanced Moment Reinforcement

16.1 Unbalanced Moment Reinforcement - No Redistribution

Joint	Gamma Left	Gamma Right	Width Left	Width Right	Moment Left Neg	Moment Left Pos	Moment Right Neg	Moment Right Pos	As Top	As Bot	n Bar Top	n Bar Bot
			m	m	T-m	T-m	T-m	T-m	cm2	cm2		
1	0.54	0.54	1.09	1.09	0.00	0.00	-18.10	0.00	0.00	0.00	0	0
2	0.54	0.54	1.09	1.09	-3.70	0.00	0.00	0.00	0.00	0.00	0	0
3	0.54	0.54	1.09	1.09	0.00	0.00	-2.41	0.00	0.00	0.00	0	0
4	0.54	0.54	1.09	1.09	-9.63	0.00	0.00	0.00	0.00	0.00	0	0
5	0.54	0.54	1.09	1.09	0.00	0.00	-2.98	0.00	0.00	0.00	0	0
6	0.54	0.54	1.09	1.09	-4.50	0.00	0.00	0.00	0.00	0.00	0	0
7	0.54	0.54	1.09	1.09	0.00	0.00	-14.36	0.00	0.00	0.00	0	0
8	0.54	0.54	1.09	1.09	-20.32	0.00	0.00	0.00	0.00	0.00	0	0





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C



พัฒนาพื้นที่ส่วนขยาย ศูนย์ราชการ พื้นที่โซน **C** อาคารทิศตะวันตก **W**

2-2



1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Fy (Main bars)	4.00 T/cm 2
F'c for BEAMS/SLABS	320.00 Kg/cm 2	Fy (Shear reinforcement)	4.00 T/cm 2
F'ci for BEAMS/SLABS	280.00 Kg/cm 2	Minimum Cover at TOP	1.50 cm
For COLUMNS/WALLS	240.00 Kg/cm 2	Minimum Cover at BOTTOM	1.50 cm
Ec for BEAMS/SLABS	257.00 T/cm 2	Post-tensioning	
For COLUMNS/WALLS	257.00 T/cm 2	SYSTEM	BONDED
CREEP factor	2.00	Fpu	19.00 T/cm 2
CONCRETE WEIGHT	NORMAL	Fse	10.80 T/cm 2
UNIT WEIGHT	2400.00 Kg/m 3	Strand area	0.990 cm 2
Tension stress limits / (f'c)1/2		Min CGS from TOP	4.20 cm
At Top	1.590	Min CGS from BOT for interior spans	5.60 cm
At Bottom	1.590	Min CGS from BOT for exterior spans	5.60 cm
Compression stress limits / f'c		Min average precompression	10.00 Kg/cm 2
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (f'c)1/2		Analysis and design options	
At Top	0.795	Structural system - Equiv Frame	TWO-WAY
At Bottom	0.795	Moments reduced to face of support	YES
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	DESIGN CODE SELECTED	ACI-318 (1999)
Reinforcement			

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	cm	cm	cm	cm	cm	cm	cm		
C	2	2.00	680.00	23.00	680.00	23.00			0.00	0.50	0.50
2	2	8.00	280.00	35.00	680.00	23.00			0.00	0.50	0.50
3	2	8.00	280.00	35.00	680.00	23.00			0.00	0.50	0.50
4	2	8.00	280.00	35.00	680.00	23.00			0.00	0.50	0.50
6	2	8.00	680.00	23.00	680.00	23.00			0.00	0.50	0.50
C	2	2.00	680.00	23.00	680.00	23.00			0.00	0.50	0.50

2.2 Detailed Data for Nonuniform Spans

Span	Seg.	Form	Left Dist.	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
			m	cm	cm	cm	cm	cm	cm	cm		
1	1	2	0.00	680.00	23.00	680.00	23.00			0.00	0.50	0.50
1	2	2	0.40	680.00	23.00	680.00	23.00			0.00	0.50	0.50
1	3	2	6.60	280.00	35.00	680.00	23.00			0.00	0.50	0.50
1	4	2	7.60	280.00	35.00	680.00	23.00			0.00	0.50	0.50
5	1	2	0.00	280.00	35.00	680.00	23.00			0.00	0.50	0.50
5	2	2	0.40	280.00	35.00	680.00	23.00			0.00	0.50	0.50
5	3	2	1.40	680.00	23.00	680.00	23.00			0.00	0.50	0.50
5	4	2	7.60	680.00	23.00	680.00	23.00			0.00	0.50	0.50

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	cm	m	cm	cm			m	cm	cm		
1	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
2	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)



3	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
4	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
5	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
6	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)
7	80.0	3.0	40.0	80.0	100	(1)	3.0	40.0	80.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			T/m2	T/m	T/m	m	m	m	T	T-m
CANT	LL	U	0.300							
CANT	SDL	U	0.370							
1	LL	U	0.300							
1	SDL	U	0.370							
2	LL	U	0.300							
2	SDL	U	0.370							
2	SDL	C				7.200			11.000	
3	LL	U	0.300							
3	SDL	U	0.370							
3	SDL	C				1.850			11.000	
3	SDL	C				6.700			11.000	
4	LL	U	0.300							
4	SDL	U	0.370							
4	SDL	C				4.530			11.000	
5	LL	U	0.300							
5	SDL	U	0.370							
6	LL	U	0.300							
6	SDL	U	0.370							
CANT	LL	U	0.300							
CANT	SDL	U	0.370							

NOTE: SELFWEIGHT INCLUSION REQUIRED (SW= SELF WEIGHT Computed from geometry input and treated as dead loading. Unit selfweight $W = 2400.0 \text{ Kg/m}^3$)

NOTE: LIVE LOADING is SKIPPED with a skip factor of 0.75

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			T/m	T/m	T	T-m	m	m	m	%
CL	LL	U	2.040							0.000
CL	SDL	U	2.516							
CL	SW	U	3.754							
1	LL	P	2.040				0.000	8.000		0.000
1	SDL	P	2.516				0.000	8.000		
1	SW	P	3.754				0.000	6.600		
1	SW	P	4.560				6.600	8.000		
2	LL	U	2.040							0.000
2	SDL	U	2.516							
2	SDL	C			11.000		7.200			
2	SW	U	4.560							
3	LL	U	2.040							0.000
3	SDL	U	2.516							
3	SDL	C			11.000		1.850			
3	SDL	C			11.000		6.700			
3	SW	U	4.560							
4	LL	U	2.040							0.000
4	SDL	U	2.516							



4	SDL	C			11.000		4.530			
4	SW	U	4.560							
5	LL	P	2.040				0.000	8.000		0.000
5	SDL	P	2.516				0.000	8.000		
5	SW	P	4.560				0.000	1.400		
5	SW	P	3.754				1.400	8.000		
6	LL	U	2.040							0.000
6	SDL	U	2.516							
6	SW	U	3.754							
CR	LL	U	2.040							0.000
CR	SDL	U	2.516							
CR	SW	U	3.754							

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	I	Yb	Yt
	cm ²	cm ⁴	cm	cm
CANT	15640.00	0.69E+06	11.50	11.50
1	---	---	---	---
2	19000.00	0.16E+07	20.41	14.59
3	19000.00	0.16E+07	20.41	14.59
4	19000.00	0.16E+07	20.41	14.59
5	---	---	---	---
6	15640.00	0.69E+06	11.50	11.50
CANT	15640.00	0.69E+06	11.50	11.50

4.2 Section Properties for Non-Uniform Spans

Span	Segment	Area	I	Yb	Yt
		cm ²	cm ⁴	cm	cm
1	1	15640.00	0.78E+06	11.50	11.50
1	2	15640.00	0.69E+06	11.50	11.50
1	3	19000.00	0.16E+07	20.41	14.59
1	4	19000.00	0.18E+07	20.41	14.59
5	1	19000.00	0.18E+07	20.41	14.59
5	2	19000.00	0.16E+07	20.41	14.59
5	3	15640.00	0.69E+06	11.50	11.50
5	4	15640.00	0.78E+06	11.50	11.50

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		T-m	T-m	T-m	T	T
CANT	SW	----	----	-7.51	----	7.51
1	SW	-14.45	9.26	-27.88	-13.43	17.72
2	SW	-25.75	11.57	-24.08	-18.45	18.03
3	SW	-24.39	12.00	-24.57	-18.22	18.26
4	SW	-24.46	11.84	-24.81	-18.20	18.28
5	SW	-25.30	8.20	-19.15	-16.81	14.34
6	SW	-21.35	11.20	-16.31	-15.64	14.38
CANT	SW	-7.51	----	----	-7.51	----
CANT	SDL	----	----	-5.03	----	5.03
1	SDL	-9.83	6.34	-17.73	-9.08	11.05
2	SDL	-14.88	6.00	-22.18	-10.25	20.88



3	SDL	-25.93	10.82	-27.34	-20.13	22.00
4	SDL	-25.49	15.15	-22.63	-15.19	15.93
5	SDL	-18.16	4.97	-12.17	-10.81	9.32
6	SDL	-14.10	7.57	-11.01	-10.45	9.68
CANT	SDL	-5.03	-----	-----	-5.03	-----
CANT	XL	-----	-----	0.00	-----	0.00
1	XL	0.00	0.00	0.00	0.00	0.00
2	XL	0.00	0.00	0.00	0.00	0.00
3	XL	0.00	0.00	0.00	0.00	0.00
4	XL	0.00	0.00	0.00	0.00	0.00
5	XL	0.00	0.00	0.00	0.00	0.00
6	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		T	T-m	T-m
1	SW	20.94	-3.59	-3.35
2	SW	36.17	1.14	0.99
3	SW	36.25	-0.17	-0.14
4	SW	36.46	0.06	0.05
5	SW	35.10	-0.26	-0.23
6	SW	29.99	-1.14	-1.06
7	SW	21.89	4.55	4.25
1	SDL	14.11	-2.48	-2.32
2	SDL	21.30	1.53	1.33
3	SDL	41.01	-2.01	-1.74
4	SDL	37.19	0.99	0.86
5	SDL	26.75	2.40	2.08
6	SDL	19.77	-1.00	-0.93
7	SDL	14.71	3.09	2.89
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00
5	XL	0.00	0.00	0.00
6	XL	0.00	0.00	0.00
7	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	T-m	T-m	T-m	T-m	T-m	T-m	T	T
CL	-----	-----	-----	-----	-4.08	-----	-----	4.08
1	-7.96	-0.44	5.13	-0.79	-14.42	-0.85	-7.35	8.97
2	-12.22	-2.58	5.60	-1.88	-10.51	-0.78	-8.37	7.95
3	-10.85	-1.23	5.64	-1.57	-10.95	-1.24	-8.15	8.17
4	-10.72	-0.95	5.68	-1.85	-11.71	-2.16	-8.04	8.28
5	-13.01	-0.16	4.55	-1.10	-10.53	-1.81	-8.47	7.85
6	-11.64	-1.32	6.07	-0.91	-8.85	-0.26	-8.51	7.81
CR	-4.08	-----	-----	-----	-----	-----	-4.08	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	11.81	3.96	1.81	-3.81	1.69	-3.56



2	18.28	7.51	5.05	-3.87	4.37	-3.35
3	17.72	7.14	3.71	-3.89	3.22	-3.37
4	17.80	7.27	3.88	-3.76	3.36	-3.25
5	18.14	7.12	4.21	-4.91	3.65	-4.26
6	17.06	7.31	3.10	-3.68	2.90	-3.44
7	12.33	3.86	4.40	-1.93	4.11	-1.80

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		T-m	T-m	T-m
CANT	SW	-----	-----	-4.80
1	SW	-9.37	9.26	-21.15
2	SW	-18.73	11.57	-17.23
3	SW	-17.47	12.00	-17.63
4	SW	-17.55	11.84	-17.86
5	SW	-18.94	8.20	-13.71
6	SW	-15.39	11.20	-10.86
CANT	SW	-4.80	-----	-----
CANT	SDL	-----	-----	-3.22
1	SDL	-6.41	6.34	-13.52
2	SDL	-10.98	6.00	-14.03
3	SDL	-18.08	10.82	-18.74
4	SDL	-19.62	15.15	-16.46
5	SDL	-14.03	4.97	-8.64
6	SDL	-10.12	7.57	-7.34
CANT	SDL	-3.22	-----	-----
CANT	XL	-----	-----	0.00
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00
5	XL	0.00	0.00	0.00
6	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-2.61	-----
1	-5.18	-0.47	5.13	-0.79	-11.00	-0.84
2	-9.03	-2.49	5.60	-1.88	-7.49	-0.87
3	-7.75	-1.23	5.64	-1.57	-7.84	-1.24
4	-7.66	-1.01	5.68	-1.85	-8.56	-2.10
5	-9.79	-0.24	4.55	-1.10	-7.55	-1.73
6	-8.40	-1.27	6.07	-0.91	-5.89	-0.33
CR	-2.61	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---



1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
4	1	0.100	0.500	0.100	---
5	1	0.100	0.500	0.100	---
6	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

Tendon B

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.100	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
4	1	0.100	0.500	0.100	---
5	1	0.100	0.500	0.100	---
6	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drapes

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	157.771	-11.50	---	---	-4.20	10.11	5.769	92
1	166.064	-4.20	---	-17.40	-4.20	10.62	2.740	43
2	164.835	-4.20	---	-29.40	-4.20	8.68	5.192	61
3	151.266	-4.20	---	-29.40	-4.20	7.96	4.765	48
4	156.255	-4.20	---	-29.40	-4.20	8.22	4.922	58
5	168.182	-4.20	---	-17.40	-4.20	10.75	2.775	43
6	165.845	-4.20	---	-17.40	-4.20	10.60	2.736	44
CR	157.024	-4.20	---	---	-11.50	10.22	5.833	93

Tendon B

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	33.642	-11.50	---	---	-4.20	2.19	1.250	20
1	35.505	-4.20	---	-17.40	-4.20	2.27	0.586	9
2	35.265	-4.20	---	-29.40	-4.20	1.86	1.111	13
3	32.326	-4.20	---	-29.40	-4.20	1.70	1.018	10
4	29.321	-4.20	---	-29.40	-4.20	1.54	0.924	11
5	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
6	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
CR	0.000	-4.20	---	---	-11.50	0.00	0.000	0

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	T	kg/cm2	
CL	191.413	12.3	112
1	201.569	12.89	52
2	200.1	10.54	74
3	183.592	9.66	58
4	185.576	9.76	69
5	168.182	10.75	43
6	165.845	10.6	44
CR	157.024	10.22	93

Approximate weight of strand: 662.1 Kg

7.3 Tendon Extents and Stressing Conditions



Type	Num	Force	Left End	Right End	From	To	Extension
A	14	11.58	Live	Live	CL	CR	---
B	3	11.07	Live	Dead	CL	4	0.20

7.4 Required Minimum Post-Tensioning Forces

Based on Stress Conditions

Based on Minimum P/A

Type	Left	Center	Right	Left	Center	Right
	T	T	T	T	T	T
CL	----	----	0.00	----	----	156.40
1	37.13	43.58	83.37	156.40	156.40	190.00
2	42.93	8.29	40.10	190.00	190.00	190.00
3	64.25	46.98	67.46	190.00	190.00	190.00
4	70.14	75.03	65.28	190.00	190.00	190.00
5	68.83	7.77	121.10	190.00	156.40	156.40
6	153.28	84.97	63.13	156.40	156.40	156.40
CR	0.00	----	----	156.40	----	----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2
CL	----	----	----	----	----	----	----	----	----	----	----	----
1	0.56	-8.09	----	-25.61	----	-31.94	6.17	-3.70	8.17	-2.01	----	-37.37
2	----	-8.44	----	-26.15	----	-13.02	----	-16.73	----	-7.10	----	-24.33
3	5.54	-1.64	----	-31.82	----	-19.49	4.07	-5.26	7.61	----	----	-33.37
4	7.52	----	----	-33.55	----	-22.51	8.05	-1.69	6.76	-1.16	----	-33.58
5	8.26	-0.80	----	-35.99	----	-27.14	5.63	-3.80	19.62	----	----	-41.48
6	25.54	----	----	-47.17	----	-37.28	16.08	----	10.23	----	----	-30.83
CR	----	-9.15	----	-15.36	----	----	----	----	----	----	----	----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	T-m	T-m	T-m	T	T
CL	----	----	8.98	----	11.23
1	13.12	-9.31	25.15	-0.79	-0.79
2	26.99	-20.47	27.87	-0.12	-0.12
3	26.47	-17.84	25.75	0.10	0.10
4	26.33	-18.91	24.70	0.23	0.23
5	22.82	-7.89	11.59	0.45	0.45
6	12.12	-8.85	11.78	0.05	0.05
CR	7.47	----	----	9.33	----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	T	T-m	T-m
1	0.791	0.048	0.045
2	-0.670	1.430	1.239
3	-0.222	-0.864	-0.749
4	-0.126	0.396	0.343
5	-0.221	-1.450	-1.257
6	0.401	0.367	0.343
7	0.046	-0.617	-0.576

Note: Moments are reported at face of support



8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)

Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	----	----	----	----	-15.67	----
1	-30.49	-22.49	33.83	23.77	-61.13	-43.86
2	-47.81	-36.69	43.69	30.98	-46.49	-35.24
3	-54.51	-43.42	49.86	37.60	-56.03	-44.82
4	-56.22	-44.91	55.48	42.68	-55.37	-44.39
5	-58.55	-42.32	28.80	19.20	-43.10	-33.20
6	-48.45	-36.33	37.98	26.11	-34.28	-24.82
CR	-15.67	----	----	----	----	----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	69.94	56.60	-5.38	-14.94	-5.02	-13.95
2	110.86	92.56	13.75	-1.40	11.91	-1.21
3	138.07	120.09	2.40	-10.54	2.08	-9.13
4	133.24	115.33	8.46	-4.52	7.33	-3.92
5	117.21	98.48	8.70	-6.82	7.54	-5.91
6	99.07	82.49	2.65	-8.88	2.47	-8.29
7	72.25	57.85	17.56	6.80	16.40	6.36

8.3 Secondary Moments

Span	Left	Midspan	Right
	T-m	T-m	T-m
1	0.41	3.26	6.11
2	9.14	9.58	10.01
3	8.44	8.33	8.22
4	8.85	8.04	7.22
5	4.25	2.64	1.03
6	1.54	1.38	1.21

Note: Moments are reported at face of support

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	cm2	cm2	cm2	cm2	cm2
5	TOP	7.60	8.00	5.04	5.04	0.00	0.00	0.00
6	TOP	0.00	0.00	10.68	10.68	0.00	0.00	0.00
6	TOP	0.40	0.40	12.59	12.59	0.00	0.00	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	cm2
5	1	TOP	4.90	2	8	6.20	10.20
5	2	TOP	5.70	1	8	4.60	5.10



10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
5	1	TOP	4.90	2	8	3.10
5	2	TOP	5.70	1	8	2.30
6	1	TOP	0.00	2	8	3.10
6	2	TOP	0.00	1	8	2.30

13 - PUNCHING SHEAR REINFORCEMENT

13.1 Critical Section Geometry

Column	Layer	Cond.	a	d	b1	b2
			cm	cm	cm	cm
1	1	1	9.48	18.96	98.96	58.96
2	1	1	15.48	30.96	110.96	70.96
3	1	1	15.48	30.96	110.96	70.96
4	1	1	15.48	30.96	110.96	70.96
5	1	1	15.48	30.96	110.96	70.96
6	1	1	9.48	18.96	98.96	58.96
7	1	1	9.48	18.96	98.96	58.96

13.2 Critical Section Stresses

Label	Layer	Cond.	Factored shear	Factored moment	Stress due to shear	Stress due to moment	Total stress	Allowable stress	Stress ratio
			T	T-m	T/cm2	T/cm2	T/cm2	T/cm2	
1	1	1	-69.31	+22.94	0.01	0.006	0.018	0.017	1.024
2	1	1	-109.27	-13.40	0.01	0.002	0.011	0.017	0.669
3	1	1	-135.37	+7.87	0.01	0.001	0.013	0.017	0.776
4	1	1	-130.47	-3.86	0.01	0.000	0.012	0.017	0.728
5	1	1	-114.84	-0.64	0.01	0.000	0.010	0.017	0.615
6	1	1	-97.86	+6.97	0.02	0.002	0.018	0.017	1.077
7	1	1	-71.50	-27.61	0.01	0.007	0.019	0.017	1.152

13.3 Punching Shear Reinforcement

Reinforcement option: Stirrups

Bar Size: 5

Col.	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs
	cm		cm		cm		cm		cm	
1	9.5	9								
2										
3										
4										
5										
6	9.5	9								
7	9.5	9								

Dist. = Distance measured from the face of support

Note: Columns with --- have not been checked for punching shear.

Note: Columns with *** have exceeded the maximum allowable shear stress.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	cm	cm	cm	cm	cm	cm	cm	cm
CL	0.0	-0.1	-0.1	-0.4(486)	-0.1(3241)	0.0(****)	-0.4(486)	-0.5(422)
1	0.2	0.0	0.2	0.5(1455)	0.1(6465)	0.0(****)	0.5(1455)	0.7(1188)



2	0.1	-0.1	0.0	-0.1(6706)	0.0(21564)	0.0(****)	-0.1(6706)	-0.2(5115)
3	0.1	0.0	0.1	0.2(3264)	0.1(11289)	0.0(****)	0.2(3264)	0.3(2541)
4	0.1	-0.1	0.1	0.2(3774)	0.1(11159)	0.0(****)	0.2(3774)	0.3(2829)
5	0.2	0.0	0.1	0.3(2785)	0.1(6798)	0.0(****)	0.3(2785)	0.4(1977)
6	0.3	0.1	0.3	0.8(969)	0.2(5197)	0.0(****)	0.8(969)	1.0(818)
CR	-0.1	-0.1	-0.1	-0.4(460)	-0.1(2818)	0.0(****)	-0.4(460)	-0.5(395)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

15 - FRICTION, ELONGATION AND LONG TERM LOSSES

15.1 Input Parameters

Parameter	Value	Parameter	Value
Type of Strand	Low Relaxation	Coefficient of Angular Friction (meu)	0.17000 1/rad
Age of Concrete at Stressing	3 days	Coefficient of Wobble Friction (K)	0.00160 rad/m
Ec at Stressing	238.00 T/cm2	Ratio of Jacking Stress	0.75
Average Relative Humidity	80.00 percent	Anchor Set	6.00 mm
Volume to Surface Ratio of Members	11.50 cm	Tendon_A Stressing Method	Both sides
Es of Strand	2030.00 T/cm2	Tendon_B Stressing Method	Left side

15.2 Long-term Losses

Tendon	Span	Left T/cm2	Center T/cm2	Right T/cm2
TENDON A	CL	0.54	0.55	0.65
TENDON A	1	0.57	0.58	0.57
TENDON A	2	0.63	0.68	0.59
TENDON A	3	0.55	0.54	0.50
TENDON A	4	0.51	0.59	0.58
TENDON A	5	0.56	0.62	0.57
TENDON A	6	0.54	0.58	0.57
TENDON A	CR	0.67	0.55	0.53
TENDON B	CL	0.53	0.55	0.65
TENDON B	1	0.58	0.58	0.57
TENDON B	2	0.63	0.68	0.58
TENDON B	3	0.55	0.54	0.50
TENDON B	4	0.51	0.56	0.50
TENDON B	5	0.48	0.00	0.00
TENDON B	6	0.00	0.00	0.00
TENDON_B	CR	0.00	0.00	0.00



15.3 Calculated Stresses After Friction and Long-term Losses

Tendon	Span	Stress Left FL Only T/cm2	Stress Center FL Only T/cm2	Stress Right FL Only T/cm2	Stress Left FL+LTL T/cm2	Stress Center FL+LTL T/cm2	Stress Right FL+LTL T/cm2
TENDON A	CL	11.81	11.92	12.03	11.27	11.37	11.39
TENDON A	1	12.03	12.57	12.91	11.47	11.98	12.32
TENDON A	2	12.91	12.55	12.03	12.28	11.87	11.45
TENDON A	3	12.03	11.44	11.36	11.47	10.90	10.86
TENDON A	4	11.36	11.86	12.44	10.85	11.25	11.85
TENDON A	5	12.44	12.75	12.86	11.87	12.12	12.30
TENDON A	6	12.86	12.53	12.16	12.32	11.96	11.59
TENDON A	CR	12.16	11.88	11.75	11.50	11.31	11.22
TENDON B	CL	11.74	11.87	12.16	11.21	11.31	11.50
TENDON B	1	12.16	12.53	12.86	11.58	11.95	12.28
TENDON B	2	12.86	12.52	12.00	12.24	11.86	11.42
TENDON B	3	12.00	11.41	10.94	11.44	10.87	10.44
TENDON B	4	10.94	10.40	9.97	10.43	9.84	9.46
TENDON B	5	9.97	0.00	0.00	9.49	0.00	0.00
TENDON B	6	0.00	0.00	0.00	0.00	0.00	0.00
TENDON_B	CR	0.00	0.00	0.00	0.00	0.00	0.00

15.6 Summary

Tendon	Force	Ext. Left	Start Span	End Span	Ext. Right	Elong. Left	Elong Right	Anchor Left	Anchor Right	Max Stress ratio
	T					cm	cm			
TENDON A	11.50	0.00	CL	8	0.00	28.03	3.41	0.62	0.62	0.69
TENDON B	11.01	0.00	CL	5	0.20	20.46	-0.00	0.62	0.51	0.68

16 - Unbalanced Moment Reinforcement

16.1 Unbalanced Moment Reinforcement - No Redistribution

Joint	Gamma Left	Gamma Right	Width Left	Width Right	Moment Left Neg	Moment Left Pos	Moment Right Neg	Moment Right Pos	As Top	As Bot	n Bar Top	n Bar Bot
			m	m	T-m	T-m	T-m	T-m	cm2	cm2		
1	0.54	0.54	1.09	1.09	0.00	0.00	-14.82	0.00	0.00	0.00	0	0
2	0.55	0.55	1.45	1.45	-13.33	0.00	0.00	0.00	0.00	0.00	0	0
3	0.55	0.55	1.45	1.45	0.00	0.00	-8.18	0.00	0.00	0.00	0	0
4	0.55	0.55	1.45	1.45	0.00	0.00	-0.19	0.00	0.00	0.00	0	0
5	0.55	0.55	1.45	1.45	-2.07	0.00	-3.18	0.00	0.00	0.00	0	0
6	0.54	0.54	1.09	1.09	0.00	0.00	-5.35	0.00	0.00	0.00	0	0
7	0.54	0.54	1.09	1.09	-18.61	0.00	0.00	0.00	0.00	0.00	0	0





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C



พัฒนาพื้นที่ส่วนขยาย ศูนย์ราชการ พื้นที่ โซน **C** อาคารทิศตะวันตก **W**

2-E



1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Fy (Main bars)	4.00 T/cm 2
F'c for BEAMS/SLABS	320.00 Kg/cm 2	Fy (Shear reinforcement)	4.00 T/cm 2
F'ci for BEAMS/SLABS	280.00 Kg/cm 2	Minimum Cover at TOP	1.50 cm
For COLUMNS/WALLS	240.00 Kg/cm 2	Minimum Cover at BOTTOM	1.50 cm
Ec for BEAMS/SLABS	257.00 T/cm 2	Post-tensioning	
For COLUMNS/WALLS	257.00 T/cm 2	SYSTEM	BONDED
CREEP factor	2.00	Fpu	19.00 T/cm 2
CONCRETE WEIGHT	NORMAL	Fse	10.80 T/cm 2
UNIT WEIGHT	2400.00 Kg/m 3	Strand area	0.990 cm 2
Tension stress limits / (f'c)1/2		Min CGS from TOP	4.20 cm
At Top	1.590	Min CGS from BOT for interior spans	5.60 cm
At Bottom	1.590	Min CGS from BOT for exterior spans	5.60 cm
Compression stress limits / f'c		Min average precompression	10.00 Kg/cm 2
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (f'c)1/2		Analysis and design options	
At Top	0.795	Structural system - Equiv Frame	TWO-WAY
At Bottom	0.795	Moments reduced to face of support	YES
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	DESIGN CODE SELECTED	ACI-318 (1999)
Reinforcement			

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

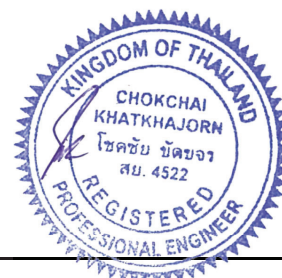
Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	cm	cm	cm	cm	cm	cm	cm		
C	1	2.80	800.00	23.00					0.00	0.50	0.50
1	1	8.40	800.00	23.00					0.00	0.50	0.50
2	1	8.40	800.00	23.00					0.00	0.50	0.50
3	1	8.40	800.00	23.00					0.00	0.50	0.50
5	2	8.40	300.00	35.00	800.00	23.00			0.00	0.50	0.50

2.2 Detailed Data for Nonuniform Spans

Span	Seg.	Form	Left Dist.	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
			m	cm	cm	cm	cm	cm	cm	cm		
4	1	2	0.00	800.00	23.00	800.00	23.00			0.00	0.50	0.50
4	2	2	0.40	800.00	23.00	800.00	23.00			0.00	0.50	0.50
4	3	2	7.00	300.00	35.00	800.00	23.00			0.00	0.50	0.50
4	4	2	8.00	300.00	35.00	800.00	23.00			0.00	0.50	0.50
CR	1	2	0.00	300.00	35.00	800.00	23.00			0.00	0.50	0.50
CR	2	2	0.40	300.00	35.00	800.00	23.00			0.00	0.50	0.50
CR	3	2	1.40	800.00	23.00	800.00	23.00			0.00	0.50	0.50

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	cm	m	cm	cm			m	cm	cm		
1	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
2	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
3	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
4	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)



5	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
6	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

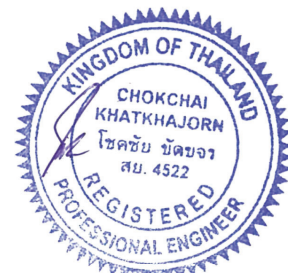
Span	Class	Type	W	P1	P2	A	B	C	F	M
			T/m2	T/m	T/m	m	m	m	T	T-m
CANT	LL	U	0.300							
CANT	SDL	U	0.370							
1	LL	U	0.300							
1	SDL	U	0.370							
2	LL	U	0.300							
2	SDL	U	0.370							
3	LL	U	0.300							
3	SDL	U	0.370							
4	LL	U	0.300							
4	SDL	U	0.370							
5	LL	U	0.300							
5	LL	L		10.000		0.950	2.500			
5	SDL	U	0.370							
CANT	LL	U	0.300							
CANT	SDL	U	0.370							

NOTE: SELFWEIGHT INCLUSION REQUIRED (SW= SELF WEIGHT Computed from geometry input and treated as dead loading. Unit selfweight W = 2400.0 Kg/m³)

NOTE: LIVE LOADING is SKIPPED with a skip factor of 0.75

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			T/m	T/m	T	T-m	m	m	m	%
CL	LL	U	2.400							0.000
CL	SDL	U	2.960							
CL	SW	U	4.416							
1	LL	U	2.400							0.000
1	SDL	U	2.960							
1	SW	U	4.416							
2	LL	U	2.400							0.000
2	SDL	U	2.960							
2	SW	U	4.416							
3	LL	U	2.400							0.000
3	SDL	U	2.960							
3	SW	U	4.416							
4	LL	P	2.400				0.000	8.400		0.000
4	SDL	P	2.960				0.000	8.400		
4	SW	P	4.416				0.000	7.000		
4	SW	P	5.280				7.000	8.400		
5	LL	U	2.400							0.000
5	LL	P	10.000				0.950	2.500		0.000
5	SDL	U	2.960							
5	SW	U	5.280							
CR	LL	P	2.400				0.000	2.800		0.000
CR	SDL	P	2.960				0.000	2.800		
CR	SW	P	5.280				0.000	1.400		
CR	SW	P	4.416				1.400	2.800		



4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	I	Yb	Yt
	cm ²	cm ⁴	cm	cm
CANT	18400.00	0.81E+06	11.50	11.50
1	18400.00	0.81E+06	11.50	11.50
2	18400.00	0.81E+06	11.50	11.50
3	18400.00	0.81E+06	11.50	11.50
4	---	---	---	---
5	22000.00	0.18E+07	20.64	14.36
CANT	---	---	---	---

4.2 Section Properties for Non-Uniform Spans

Span	Segment	Area	I	Yb	Yt
		cm ²	cm ⁴	cm	cm
4	1	18400.00	0.11E+07	11.50	11.50
4	2	18400.00	0.81E+06	11.50	11.50
4	3	22000.00	0.18E+07	20.64	14.36
4	4	22000.00	0.23E+07	20.64	14.36
CR	1	22000.00	0.18E+07	20.64	14.36
CR	2	22000.00	0.18E+07	20.64	14.36
CR	3	18400.00	0.81E+06	11.50	11.50

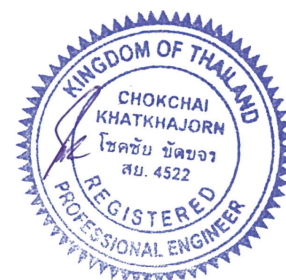
5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		T-m	T-m	T-m	T	T
CANT	SW	---	---	-17.31	---	12.36
1	SW	-23.56	13.35	-27.63	-18.06	19.03
2	SW	-26.80	12.36	-26.38	-18.60	18.50
3	SW	-26.67	12.70	-25.82	-18.65	18.45
4	SW	-24.40	10.73	-32.89	-17.64	20.67
5	SW	-33.73	16.27	-26.87	-22.99	21.36
CANT	SW	-18.16	---	---	-13.57	---
CANT	SDL	---	---	-11.60	---	8.29
1	SDL	-15.79	8.95	-18.52	-12.11	12.76
2	SDL	-17.96	8.29	-17.67	-12.47	12.40
3	SDL	-17.85	8.49	-17.38	-12.49	12.38
4	SDL	-16.58	7.36	-20.92	-11.91	12.95
5	SDL	-19.58	8.70	-15.24	-12.95	11.92
CANT	SDL	-11.60	---	---	-8.29	---
CANT	XL	---	---	0.00	---	0.00
1	XL	0.00	0.00	0.00	0.00	0.00
2	XL	0.00	0.00	0.00	0.00	0.00
3	XL	0.00	0.00	0.00	0.00	0.00
4	XL	0.00	0.00	0.00	0.00	0.00
5	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	---	---	0.00	---

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		T	T-m	T-m
1	SW	30.43	-3.23	-3.02



2	SW	37.63	0.43	0.40
3	SW	37.15	-0.15	-0.14
4	SW	36.08	0.73	0.69
5	SW	43.66	-0.45	-0.39
6	SW	34.93	4.67	4.04
1	SDL	20.40	-2.17	-2.02
2	SDL	25.22	0.29	0.27
3	SDL	24.89	-0.09	-0.08
4	SDL	24.29	0.41	0.39
5	SDL	25.90	0.72	0.62
6	SDL	20.20	1.95	1.69
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00
5	XL	0.00	0.00	0.00
6	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	T-m	T-m	T-m	T-m	T-m	T-m	T	T
CL	-----	-----	-----	-----	-9.41	-----	-----	6.72
1	-12.81	-1.13	7.26	-1.57	-15.01	-1.58	-9.82	10.34
2	-14.54	-1.70	6.81	-1.78	-14.38	-1.44	-10.10	10.06
3	-14.64	-1.72	7.00	-1.64	-13.69	-0.94	-10.19	9.97
4	-12.19	-0.95	5.88	-2.12	-20.12	-2.93	-9.14	11.02
5	-28.60	-2.62	11.76	-2.09	-16.95	-0.91	-23.78	11.88
CR	-9.41	-----	-----	-----	-----	-----	-6.72	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	17.17	6.58	4.09	-5.85	3.82	-5.46
2	21.74	9.39	5.13	-4.89	4.79	-4.56
3	21.68	9.36	4.93	-5.06	4.60	-4.72
4	21.02	8.20	5.22	-4.45	4.88	-4.15
5	36.28	10.13	6.34	-10.89	5.50	-9.43
6	19.49	6.34	8.43	-4.39	7.31	-3.81

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		T-m	T-m	T-m
CANT	SW	-----	-----	-12.72
1	SW	-16.69	13.35	-20.37
2	SW	-19.71	12.36	-19.34
3	SW	-19.57	12.70	-18.79
4	SW	-17.70	10.73	-25.05
5	SW	-24.95	16.27	-18.75
CANT	SW	-13.15	-----	-----
CANT	SDL	-----	-----	-8.52
1	SDL	-11.19	8.95	-13.66
2	SDL	-13.21	8.29	-12.95



3	SDL	-13.09	8.49	-12.66
4	SDL	-12.05	7.36	-15.98
5	SDL	-14.64	8.70	-10.71
CANT	SDL	-8.52	-----	-----
CANT	XL	-----	-----	0.00
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00
5	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-6.91	-----
1	-9.07	-1.17	7.26	-1.57	-11.07	-1.56
2	-10.70	-1.68	6.81	-1.78	-10.55	-1.46
3	-10.75	-1.68	7.00	-1.64	-9.90	-0.98
4	-8.73	-1.04	5.88	-2.12	-15.90	-2.85
5	-19.28	-2.55	11.76	-2.10	-12.39	-1.02
CR	-6.91	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
4	1	0.100	0.500	0.100	---
5	1	0.100	0.500	0.100	---
CR	1	0.000	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drape

Tendon A

Span	Force T	CGS Left cm	CGS C1 cm	CGS C2 cm	CGS Right cm	P/A kg/cm2	Wbal T/-	WBal (%DL)
CL	207.790	-11.20	---	---	-4.20	11.39	3.743	51
1	217.198	-4.20	---	-17.40	-4.20	11.80	3.251	44
2	218.488	-4.20	---	-17.40	-4.20	11.87	3.270	44
3	207.660	-4.20	---	-17.40	-4.20	11.29	3.108	42
4	211.032	-4.20	---	-17.40	-4.20	11.47	3.158	42
5	214.180	-4.20	---	-29.40	-4.20	9.74	6.119	74
CR	201.981	-4.20	---	---	-11.20	11.07	3.637	47

All Tendons

Span	Force T	Total P/A kg/cm2	Total WBal (%DL)
CL	207.79	11.39	51
1	217.198	11.8	44
2	218.488	11.87	44
3	207.66	11.29	42
4	211.032	11.47	42



5	214.18	9.74	74
CR	201.981	11.07	47

Approximate weight of strand: 679.9 Kg

7.3 Tendon Extents and Stressing Conditions

Type	Num	Force	Left End	Right End	From	To	Extension
A	18	11.83	Live	Live	CL	CR	---

7.4 Required Minimum Post-Tensioning Forces

Type	Based on Stress Conditions			Based on Minimum P/A		
	Left	Center	Right	Left	Center	Right
	T	T	T	T	T	T
CL	----	----	87.12	----	----	184.00
1	150.21	105.14	221.39	184.00	184.00	184.00
2	210.06	82.62	200.00	184.00	184.00	184.00
3	206.30	90.69	190.47	184.00	184.00	184.00
4	171.10	46.92	123.20	184.00	184.00	220.00
5	121.74	84.03	35.13	220.00	220.00	220.00
CR	0.00	----	----	184.00	----	----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2
CL	----	----	----	----	----	----	----	----	12.39	----	----	-35.11
1	18.85	----	----	-41.72	----	-37.71	14.10	----	28.40	----	----	-52.49
2	26.31	----	----	-50.60	----	-34.95	11.20	-0.97	26.09	----	----	-49.41
3	27.43	----	----	-50.54	----	-36.13	13.56	----	26.09	----	----	-48.41
4	22.88	----	----	-45.44	----	-32.01	9.07	-2.28	15.22	----	----	-45.77
5	13.35	-2.24	----	-43.28	----	-20.97	6.41	-9.69	2.54	-7.48	----	-26.21
CR	0.19	-5.40	----	-22.80	----	----	----	----	----	----	----	----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	T-m	T-m	T-m	T	T
CL	----	----	11.41	----	8.98
1	15.60	-11.29	16.57	-0.13	-0.13
2	16.50	-11.18	16.21	0.04	0.04
3	15.91	-10.67	15.08	0.11	0.11
4	14.38	-9.48	25.97	-0.72	-0.72
5	30.13	-22.83	27.26	0.38	0.38
CR	16.92	----	----	8.73	----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	T	T-m	T-m
1	0.128	0.798	0.746
2	-0.166	-0.054	-0.051
3	-0.073	-0.159	-0.148
4	0.828	-0.475	-0.443
5	-1.096	2.788	2.416
6	0.378	-4.743	-4.110

Note: Moments are reported at face of support



8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)

Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-41.49	-----
1	-52.86	-39.43	45.64	30.64	-63.89	-47.73
2	-61.77	-46.45	42.84	28.24	-60.92	-45.46
3	-62.11	-46.69	43.38	28.69	-59.14	-43.97
4	-55.40	-42.34	39.14	25.52	-77.93	-55.75
5	-76.32	-47.88	65.38	41.83	-53.30	-33.97
CR	-42.10	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	100.48	82.48	0.18	-16.70	0.17	-15.59
2	124.78	103.78	9.68	-7.35	9.03	-6.87
3	123.64	102.70	7.88	-9.10	7.36	-8.50
4	121.08	99.29	10.01	-6.43	9.35	-6.00
5	157.96	113.51	13.95	-15.35	12.09	-13.29
6	110.69	88.34	18.86	-2.95	16.34	-2.55

8.3 Secondary Moments

Span	Left	Midspan	Right
	T-m	T-m	T-m
1	1.60	2.08	2.57
2	2.50	2.36	2.22
3	1.89	1.81	1.72
4	1.08	3.81	6.54
5	11.88	10.44	9.00

Note: Moments are reported at face of support



10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	cm2	cm2	cm2	cm2	cm2
1	TOP	7.98	8.40	19.87	19.87	0.00	0.00	0.00
2	TOP	0.00	0.42	16.66	16.66	0.00	0.00	0.00
2	TOP	7.98	8.40	14.83	14.83	0.00	0.00	0.00
3	TOP	0.00	0.42	17.32	17.32	0.00	0.00	0.00
3	TOP	7.98	8.40	12.70	12.70	0.00	0.00	0.00
4	TOP	0.00	0.42	5.37	5.37	0.00	0.00	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	cm2
1	1	TOP	5.16	2	8	6.48	10.20
2	2	TOP	5.16	2	8	6.48	10.20

3	3	TOP	5.16	2	8	6.48	10.20
1	4	TOP	6.00	2	8	4.80	10.20
2	5	TOP	6.00	2	8	4.80	10.20
3	6	TOP	6.00	1	8	4.80	5.10

10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
1	1	TOP	5.16	2	8	3.24
1	4	TOP	6.00	2	8	2.40
2	1	TOP	0.00	2	8	3.24
2	2	TOP	5.16	2	8	3.24
2	4	TOP	0.00	2	8	2.40
2	5	TOP	6.00	2	8	2.40
3	2	TOP	0.00	2	8	3.24
3	3	TOP	5.16	2	8	3.24
3	5	TOP	0.00	2	8	2.40
3	6	TOP	6.00	1	8	2.40
4	3	TOP	0.00	2	8	3.24
4	6	TOP	0.00	1	8	2.40



13 - PUNCHING SHEAR REINFORCEMENT

13.1 Critical Section Geometry

Column	Layer	Cond.	a	d	b1	b2
			cm	cm	cm	cm
1	1	1	9.48	18.96	98.96	118.96
2	1	1	9.48	18.96	98.96	118.96
3	1	1	9.48	18.96	98.96	118.96
4	1	1	9.48	18.96	98.96	118.96
5	1	1	15.48	30.96	110.96	130.96
6	1	1	15.48	30.96	110.96	130.96

13.2 Critical Section Stresses

Label	Layer	Cond.	Factored shear	Factored moment	Stress due to shear	Stress due to moment	Total stress	Allowable stress	Stress ratio
			T	T-m	T/cm2	T/cm2	T/cm2	T/cm2	
1	1	1	-99.39	+18.88	0.01	0.002	0.015	0.016	0.909
2	1	1	-122.58	-2.62	0.01	0.000	0.015	0.016	0.940
3	1	1	-121.30	+1.40	0.01	0.000	0.015	0.016	0.927
4	1	1	-117.75	-4.75	0.01	0.001	0.015	0.016	0.934
5	1	1	-155.45	+8.52	0.01	0.001	0.011	0.017	0.657
6	1	1	-109.18	-21.25	0.01	0.001	0.009	0.016	0.526

13.3 Punching Shear Reinforcement

Reinforcement option: Stirrups

Bar Size: 5

Col.	Dist	N_Legs	Dist	N_Legs	Dist	N_Legs	Dist	N_Legs	Dist	N_Legs
	cm		cm		cm		cm		cm	
1										
2										
3										
4										
5										
6										

Dist. = Distance measured from the face of support

Note: Columns with --- have not been checked for punching shear.

Note: Columns with *** have exceeded the maximum allowable shear stress.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	cm	cm	cm	cm	cm	cm	cm	cm
CL	0.1	0.0	0.0	0.1(5551)	0.1(1922)	0.0(****)	0.1(5551)	0.2(1428)
1	0.3	0.1	0.3	0.8(1092)	0.2(4587)	0.0(****)	0.8(1092)	1.0(882)
2	0.2	0.0	0.2	0.6(1453)	0.2(4820)	0.0(****)	0.6(1453)	0.8(1116)
3	0.3	0.1	0.2	0.7(1247)	0.2(4733)	0.0(****)	0.7(1247)	0.9(986)
4	0.2	0.0	0.2	0.5(1622)	0.1(5850)	0.0(****)	0.5(1622)	0.7(1270)
5	0.2	-0.1	0.0	0.1(10841)	0.1(5712)	0.0(****)	0.1(10841)	0.2(3915)
CR	0.0	0.0	0.0	0.0(47837)	0.1(3710)	0.0(****)	0.0(47837)	0.1(3443)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

15 - FRICTION, ELONGATION AND LONG TERM LOSSES

15.1 Input Parameters

Parameter	Value	Parameter	Value
Type of Strand	Low Relaxation	Coefficient of Angular Friction (meu)	0.17000 1/rad
Age of Concrete at Stressing	3 days	Coefficient of Wobble Friction (K)	0.00160 rad/m
Ec at Stressing	238.00 T/cm2	Ratio of Jacking Stress	0.75
Average Relative Humidity	80.00 percent	Anchor Set	6.00 mm
Volume to Surface Ratio of Members	11.50 cm	Tendon_A Stressing Method	Both sides
Es of Strand	2030.00 T/cm2		

15.2 Long-term Losses

Tendon	Span	Left T/cm2	Center T/cm2	Right T/cm2
TENDON A	CL	0.58	0.60	0.58
TENDON A	1	0.57	0.63	0.60
TENDON A	2	0.62	0.64	0.57
TENDON A	3	0.55	0.58	0.51
TENDON A	4	0.52	0.61	0.60
TENDON A	5	0.66	0.72	0.62
TENDON A	CR	0.59	0.58	0.56

15.3 Calculated Stresses After Friction and Long-term Losses

Tendon	Span	Stress Left FL Only T/cm2	Stress Center FL Only T/cm2	Stress Right FL Only T/cm2	Stress Left FL+LTL T/cm2	Stress Center FL+LTL T/cm2	Stress Right FL+LTL T/cm2
TENDON A	CL	12.15	12.24	12.33	11.57	11.64	11.74
TENDON A	1	12.33	12.80	13.14	11.76	12.18	12.53
TENDON A	2	13.14	12.88	12.58	12.52	12.24	12.01
TENDON A	3	12.58	12.22	12.13	12.02	11.64	11.62
TENDON A	4	12.13	12.43	12.82	11.61	11.82	12.21
TENDON A	5	12.82	12.71	12.00	12.17	11.99	11.39
TENDON A	CR	12.00	11.91	11.81	11.41	11.33	11.25

15.6 Summary

Tendon	Force	Ext. Left	Start Span	End Span	Ext. Right	Elong. Left	Elong Right	Anchor Left	Anchor Right	Max Stress ratio
	T					cm	cm			
TENDON A	11.73	0.00	CL	7	0.00	28.07	1.38	0.64	0.62	0.69

16 - Unbalanced Moment Reinforcement





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C

16.1 Unbalanced Moment Reinforcement - No Redistribution

Joint	Gamma Left	Gamma Right	Width Left	Width Right	Moment Left Neg	Moment Left Pos	Moment Right Neg	Moment Right Pos	As Top	As Bot	n Bar Top	n Bar Bot
			m	m	T-m	T-m	T-m	T-m	cm2	cm2		
1	0.62	0.62	1.69	1.69	0.00	0.00	-11.37	0.00	0.00	0.00	0	0
2	0.62	0.62	1.69	1.69	-2.12	0.00	0.00	0.00	0.00	0.00	0	0
3	0.62	0.62	1.69	1.69	0.00	0.00	-1.22	0.00	0.00	0.00	0	0
4	0.62	0.62	1.69	1.69	-3.73	0.00	0.00	0.00	0.00	0.00	0	0
5	0.62	0.62	2.05	2.05	-7.87	0.00	0.00	0.00	0.00	0.00	0	0
6	0.62	0.62	2.05	2.05	-11.21	0.00	0.00	0.00	0.00	0.00	0	0





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C



พัฒนาพื้นที่ส่วนขยาย ศูนย์ราชการ พื้นที่โซน C อาคารทิศตะวันตก W

2-G



1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Fy (Main bars)	4.00 T/cm 2
F'c for BEAMS/SLABS	320.00 Kg/cm 2	Fy (Shear reinforcement)	4.00 T/cm 2
F'ci for BEAMS/SLABS	280.00 Kg/cm 2	Minimum Cover at TOP	1.50 cm
For COLUMNS/WALLS	240.00 Kg/cm 2	Minimum Cover at BOTTOM	1.50 cm
Ec for BEAMS/SLABS	257.00 T/cm 2	Post-tensioning	
For COLUMNS/WALLS	257.00 T/cm 2	SYSTEM	BONDED
CREEP factor	2.00	Fpu	19.00 T/cm 2
CONCRETE WEIGHT	NORMAL	Fse	10.80 T/cm 2
UNIT WEIGHT	2400.00 Kg/m 3	Strand area	0.990 cm 2
Tension stress limits / (fc)1/2		Min CGS from TOP	4.20 cm
At Top	1.590	Min CGS from BOT for interior spans	5.60 cm
At Bottom	1.590	Min CGS from BOT for exterior spans	5.60 cm
Compression stress limits / fc		Min average precompression	10.00 Kg/cm 2
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (fc)1/2		Analysis and design options	
At Top	0.795	Structural system - Equiv Frame	TWO-WAY
At Bottom	0.795	Moments reduced to face of support	YES
Compression stress limits (initial) / fc		Moment Redistribution	NO
At all locations	0.600	DESIGN CODE SELECTED	ACI-318 (1999)
Reinforcement			

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	cm	cm	cm	cm	cm	cm	cm		
1	1	8.40	800.00	23.00					0.00	0.50	0.50
C	1	2.50	800.00	23.00					0.00	0.50	0.50

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	cm	m	cm	cm			m	cm	cm		
1	0.0	3.0	0.0	0.0	100	(2)	3.0	0.0	0.0	100	(2)
2	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)

3 - INPUT APPLIED LOADING

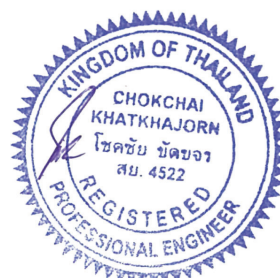
3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			T/m2	T/m	T/m	m	m	m	T	T-m
1	LL	U	0.300							
1	SDL	U	0.370							
CANT	LL	U	0.300							
CANT	SDL	U	0.370							

NOTE: SELFWEIGHT INCLUSION REQUIRED (SW= SELF WEIGHT Computed from geometry input and treated as dead loading. Unit selfweight W = 2400.0 Kg/m³

NOTE: LIVE LOADING is SKIPPED with a skip factor of 0.75

3.2 Compiled loads



Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			T/m	T/m	T	T-m	m	m	m	%
1	LL	U	2.400							0.000
1	SDL	U	2.960							
1	SW	U	4.416							
CR	LL	U	2.400							0.000
CR	SDL	U	2.960							
CR	SW	U	4.416							

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	I	Yb	Yt
	cm ²	cm ⁴	cm	cm
1	18400.00	0.81E+06	11.50	11.50
CANT	18400.00	0.81E+06	11.50	11.50

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		T-m	T-m	T-m	T	T
1	SW	0.00	22.42	-33.06	-14.61	22.48
CANT	SW	-13.80	-----	-----	-11.04	-----
1	SDL	0.00	15.03	-22.16	-9.79	15.07
CANT	SDL	-9.25	-----	-----	-7.40	-----
1	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		T	T-m	T-m
1	SW	14.61	0.00	0.00
2	SW	33.52	9.96	9.30
1	SDL	9.79	0.00	0.00
2	SDL	22.47	6.67	6.23
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	T-m	T-m	T-m	T-m	T-m	T-m	T	T
1	0.00	0.00	12.19	-0.75	-17.96	-1.50	-7.94	12.22
CR	-7.50	-----	-----	-----	-----	-----	-6.00	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	8.18	-0.24	0.00	0.00	0.00	0.00
2	18.22	6.24	8.25	-2.84	7.71	-2.65



6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		T-m	T-m	T-m
1	SW	0.00	22.42	-24.42
CANT	SW	-9.74	-----	-----
1	SDL	0.00	15.03	-16.37
CANT	SDL	-6.53	-----	-----
1	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
1	0.00	0.00	12.19	-0.75	-13.27	-1.43
CR	-5.29	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
1	1	0.100	0.500	0.100	---
CR	1	0.000	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drape

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
1	391.798	-11.50	---	-17.40	-4.50	21.29	4.176	57
CR	374.394	-4.50	---	---	-11.50	20.20	8.328	113

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	T	kg/cm2	
1	391.798	21.29	57
CR	374.394	20.2	113

Approximate weight of strand: 305.2 Kg

7.3 Tendon Extents and Stressing Conditions

Type	Num	Force	Left End	Right End	From	To	Extension
A	33	11.73	Dead	Live	1	CR	---

7.4 Required Minimum Post-Tensioning Forces

Based on Stress Conditions

Based on Minimum P/A

Type	Left	Center	Right	Left	Center	Right
	T	T	T	T	T	T
1	0.00	326.02	287.90	184.00	184.00	184.00
CR	17.08	-----	-----	184.00	-----	-----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1



Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2
1	-----	-21.62	-----	-21.62	-----	-62.57	19.98	-----	13.52	-5.30	-----	-54.50
CR	-----	-23.29	-----	-24.84	-----	-----	-----	-----	-----	-----	-----	-----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	T-m	T-m	T-m	T	T
1	0.00	-20.52	30.07	-0.62	-0.62
CR	18.36	-----	-----	17.49	-----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	T	T-m	T-m
1	0.617	0.000	0.000
2	-0.617	-3.407	-3.181

Note: Moments are reported at face of support

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)

Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
1	0.00	0.00	76.45	54.45	-73.39	-53.27
CR	-31.77	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	48.69	34.38	0.00	0.00	0.00	0.00
2	108.74	88.38	33.91	15.05	31.66	14.05

8.3 Secondary Moments

Span	Left	Midspan	Right
	T-m	T-m	T-m
1	0.00	3.29	6.27

Note: Moments are reported at face of support

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.2 Provided Rebar

13 - PUNCHING SHEAR REINFORCEMENT

13.1 Critical Section Geometry



Column	Layer	Cond.	a	d	b1	b2
			cm	cm	cm	cm
1	1	2	9.48	18.96	9.48	18.96
2	1	1	9.48	18.96	98.96	118.96

13.2 Critical Section Stresses

Label	Layer	Cond.	Factored shear	Factored moment	Stress due to shear	Stress due to moment	Total stress	Allowable stress	Stress ratio
			T	T-m	T/cm2	T/cm2	T/cm2	T/cm2	
1	1	2	-48.44	-0.00	0.07	0.015	0.082	0.008	10.215
2	1	1	-108.58	-56.24	0.01	0.007	0.021	0.018	1.126

13.3 Punching Shear Reinforcement

Reinforcement option: Stirrups

Bar Size: 5

Col.	Dist	N_Legs	Dist	N_Legs	Dist	N_Legs	Dist	N_Legs	Dist	N_Legs
	cm		cm		cm		cm		cm	
1	***	***								
2	9.5	12								

Dist. = Distance measured from the face of support

Note: Columns with --- have not been checked for punching shear.

Note: Columns with *** have exceeded the maximum allowable shear stress.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	cm	cm	cm	cm	cm	cm	cm	cm
1	0.7	0.1	0.6	1.8(471)	0.4(2256)	0.0(****)	1.8(471)	2.2(390)
CR	-0.1	-0.2	-0.3	-0.9(265)	-0.1(1832)	0.0(****)	-0.9(265)	-1.1(231)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

15 - FRICTION, ELONGATION AND LONG TERM LOSSES

15.1 Input Parameters

Parameter	Value	Parameter	Value
Type of Strand	Low Relaxation	Coefficient of Angular Friction (meu)	0.17000 1/rad
Age of Concrete at Stressing	3 days	Coefficient of Wobble Friction (K)	0.00160 rad/m
Ec at Stressing	238.00 T/cm2	Ratio of Jacking Stress	0.75
Average Relative Humidity	80.00 percent	Anchor Set	6.00 mm
Volume to Surface Ratio of Members	11.50 cm	Tendon A Stressing Method	Right side
Es of Strand	2030.00 T/cm2		

15.2 Long-term Losses

Tendon	Span	Left	Center	Right
		T/cm2	T/cm2	T/cm2
TENDON A	1	0.85	0.82	0.85
TENDON A	CR	0.97	0.79	0.76

15.3 Calculated Stresses After Friction and Long-term Losses

Tendon	Span	Stress Left FL Only	Stress Center FL Only	Stress Right FL Only	Stress Left FL+LTL	Stress Center FL+LTL	Stress Right FL+LTL
		T/cm2	T/cm2	T/cm2	T/cm2	T/cm2	T/cm2
TENDON A	1	12.98	12.77	12.29	12.13	11.96	11.45
TENDON A	CR	12.29	12.20	12.11	11.31	11.41	11.35

15.6 Summary





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C

Tendon	Force	Ext. Left	Start Span	End Span	Ext. Right	Elong. Left	Elong Right	Anchor Left	Anchor Right	Max Stress ratio
	T					cm	cm			
TENDON_A	11.54	0.00	1	CR	0.00	0.00	6.78	0.68	0.64	0.68

16 - Unbalanced Moment Reinforcement

16.1 Unbalanced Moment Reinforcement - No Redistribution

Joint	Gamma Left	Gamma Right	Width Left	Width Right	Moment Left Neg	Moment Left Pos	Moment Right Neg	Moment Right Pos	As Top	As Bot	n Bar Top	n Bar Bot
			m	m	T-m	T-m	T-m	T-m	cm2	cm2		
1	0.00	0.60	0.00	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0	0
2	0.62	0.62	1.69	1.69	-41.62	0.00	0.00	0.00	0.00	0.00	0	0





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C



พัฒนาพื้นที่ส่วนขยาย ศูนย์ราชการ พื้นที่โซน C อาคารทิศตะวันตก W

2-J



1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Fy (Main bars)	4.00 T/cm 2
F'c for BEAMS/SLABS	320.00 Kg/cm 2	Fy (Shear reinforcement)	4.00 T/cm 2
F'ci for BEAMS/SLABS	280.00 Kg/cm 2	Minimum Cover at TOP	1.50 cm
For COLUMNS/WALLS	240.00 Kg/cm 2	Minimum Cover at BOTTOM	1.50 cm
Ec for BEAMS/SLABS	257.00 T/cm 2	Post-tensioning	
For COLUMNS/WALLS	257.00 T/cm 2	SYSTEM	BONDED
CREEP factor	2.00	Fpu	19.00 T/cm 2
CONCRETE WEIGHT	NORMAL	Fse	10.80 T/cm 2
UNIT WEIGHT	2400.00 Kg/m 3	Strand area	0.990 cm 2
Tension stress limits / (f'c)1/2		Min CGS from TOP	4.20 cm
At Top	1.590	Min CGS from BOT for interior spans	5.60 cm
At Bottom	1.590	Min CGS from BOT for exterior spans	5.60 cm
Compression stress limits / f'c		Min average precompression	10.00 Kg/cm 2
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (f'c)1/2		Analysis and design options	
At Top	0.795	Structural system - Equiv Frame	TWO-WAY
At Bottom	0.795	Moments reduced to face of support	YES
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	DESIGN CODE SELECTED	ACI-318 (1999)
Reinforcement			

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	cm	cm	cm	cm	cm	cm	cm		
C	1	2.80	450.00	23.00					0.00	0.50	0.50
1	1	8.40	450.00	23.00					0.00	0.50	0.50
2	1	8.40	450.00	23.00					0.00	0.50	0.50
3	1	8.40	450.00	23.00					0.00	0.50	0.50
C	1	0.40	450.00	23.00					0.00	0.50	0.50

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	cm	m	cm	cm			m	cm	cm		
1	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
2	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
3	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
4	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			T/m2	T/m	T/m	m	m	m	T	T-m
CANT	LL	U	0.300							
CANT	SDL	U	0.370							
1	LL	U	0.300							
1	SDL	U	0.370							
2	LL	U	0.300							
2	SDL	U	0.370							

3	LL	U	0.300							
3	SDL	U	0.370							
CANT	LL	U	0.300							
CANT	SDL	U	0.370							

NOTE: SELFWEIGHT INCLUSION REQUIRED (SW= SELF WEIGHT Computed from geometry input and treated as dead loading. Unit selfweight $W = 2400.0 \text{ Kg/m}^3$)

NOTE: LIVE LOADING is SKIPPED with a skip factor of 0.75

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			T/m	T/m	T	T-m	m	m	m	%
CL	LL	U	1.350							0.000
CL	SDL	U	1.665							
CL	SW	U	2.484							
1	LL	U	1.350							0.000
1	SDL	U	1.665							
1	SW	U	2.484							
2	LL	U	1.350							0.000
2	SDL	U	1.665							
2	SW	U	2.484							
3	LL	U	1.350							0.000
3	SDL	U	1.665							
3	SW	U	2.484							
CR	LL	U	1.350							0.000
CR	SDL	U	1.665							
CR	SW	U	2.484							

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	I	Yb	Yt
	cm ²	cm ⁴	cm	cm
CANT	10350.00	0.46E+06	11.50	11.50
1	10350.00	0.46E+06	11.50	11.50
2	10350.00	0.46E+06	11.50	11.50
3	10350.00	0.46E+06	11.50	11.50
CANT	10350.00	0.46E+06	11.50	11.50



5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		T-m	T-m	T-m	T	T
CANT	SW	-----	-----	-9.74	-----	6.96
1	SW	-14.49	6.98	-15.36	-10.33	10.54
2	SW	-15.07	6.80	-15.15	-10.42	10.44
3	SW	-15.88	7.25	-13.43	-10.72	10.14
CANT	SW	-0.20	-----	-----	-0.99	-----
CANT	SDL	-----	-----	-6.53	-----	4.66
1	SDL	-9.71	4.68	-10.30	-6.92	7.06
2	SDL	-10.10	4.56	-10.16	-6.99	7.00
3	SDL	-10.65	4.86	-9.00	-7.19	6.80
CANT	SDL	-0.13	-----	-----	-0.67	-----
CANT	XL	-----	-----	0.00	-----	0.00

1	XL	0.00	0.00	0.00	0.00	0.00
2	XL	0.00	0.00	0.00	0.00	0.00
3	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	----	----	0.00	----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		T	T-m	T-m
1	SW	17.28	-2.46	-2.29
2	SW	20.96	0.15	0.14
3	SW	21.17	-0.38	-0.35
4	SW	11.13	6.84	6.39
1	SDL	11.59	-1.65	-1.54
2	SDL	14.05	0.10	0.10
3	SDL	14.19	-0.25	-0.24
4	SDL	7.46	4.59	4.28
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	T-m	T-m	T-m	T-m	T-m	T-m	T	T
CL	----	----	----	----	-5.29	----	----	3.78
1	-7.87	-0.13	3.79	-0.28	-8.35	-0.40	-5.61	5.73
2	-8.19	-0.31	3.69	-0.34	-8.24	-0.34	-5.66	5.68
3	-8.63	-0.61	3.94	-0.17	-7.30	0.30	-5.83	5.51
CR	-0.11	----	----	----	----	----	-0.54	----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	9.55	3.73	2.65	-3.98	2.47	-3.72
2	11.66	5.55	3.79	-3.71	3.54	-3.46
3	11.67	5.66	3.58	-3.79	3.35	-3.54
4	6.20	0.39	3.98	-0.26	3.72	-0.25

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		T-m	T-m	T-m
CANT	SW	----	----	-7.15
1	SW	-10.56	6.98	-11.35
2	SW	-11.10	6.80	-11.18
3	SW	-11.79	7.25	-9.57
CANT	SW	0.00	----	----
CANT	SDL	----	----	-4.80
1	SDL	-7.08	4.68	-7.61
2	SDL	-7.44	4.56	-7.49
3	SDL	-7.90	4.86	-6.41
CANT	SDL	0.00	----	----



CANT	XL	-----	-----	0.00
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-3.89	-----
1	-5.74	-0.14	3.80	-0.28	-6.17	-0.38
2	-6.03	-0.31	3.69	-0.34	-6.07	-0.34
3	-6.41	-0.56	3.94	-0.17	-5.20	0.26
CR	0.00	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
CR	1	0.000	---	---	---

Tendon B

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---



7.2 Selected Post-Tensioning Forces and Tendon Drapes

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	69.753	-11.20	---	---	-4.20	6.84	1.265	30
1	73.140	-4.20	---	-17.40	-4.20	7.07	1.095	26
2	73.604	-4.20	---	-17.40	-4.20	7.11	1.102	27
3	70.105	-4.20	---	-17.40	-11.20	6.77	0.771	19
CR	68.453	-11.20	---	---	-11.20	6.62	0.000	0

Tendon B

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	68.934	-11.20	---	---	-4.20	6.82	1.261	30
1	72.036	-4.20	---	-17.40	-4.20	6.96	1.078	26
2	75.832	-4.20	---	-17.40	-4.20	7.33	1.135	27
3	72.815	-4.20	---	-17.40	-11.20	7.04	0.801	19
CR	71.042	-11.20	---	---	-11.20	6.87	0.000	0

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	T	kg/cm2	

CL	138.687	13.66	60
1	145.176	14.03	52
2	149.436	14.44	54
3	142.92	13.81	38
CR	139.495	13.49	0

Approximate weight of strand: 274.2 Kg

7.3 Tendon Extents and Stressing Conditions

Type	Num	Force	Left End	Right End	From	To	Extension
A	6	11.98	Live	Dead	CL	CR	---
B	6	12.14	Dead	Live	CL	CR	0.00

7.4 Required Minimum Post-Tensioning Forces

Based on Stress Conditions				Based on Minimum P/A		
Type	Left	Center	Right	Left	Center	Right
	T	T	T	T	T	T
CL	-----	-----	48.77	-----	-----	103.50
1	104.92	47.20	121.89	103.50	103.50	103.50
2	115.47	42.44	117.73	103.50	103.50	103.50
3	143.71	62.89	118.96	103.50	103.50	103.50
CR	0.00	-----	-----	103.50	-----	-----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2
CL	-----	-----	-----	-----	-----	-----	-----	-----	7.00	-2.80	-----	-34.04
1	17.82	-----	-----	-45.17	-----	-34.68	6.62	-3.65	20.77	-----	-----	-49.51
2	18.58	-----	-----	-47.46	-----	-33.42	4.54	-5.61	20.05	-----	-----	-48.43
3	27.84	-----	-----	-56.06	-----	-40.75	13.13	-----	24.09	-----	-----	-51.09
CR	-----	-14.53	-----	-12.42	-----	-----	-----	-----	-----	-----	-----	-----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	T-m	T-m	T-m	T	T
CL	-----	-----	7.70	-----	6.06
1	10.88	-7.26	11.18	-0.04	-0.04
2	11.47	-7.51	11.16	0.04	0.04
3	9.46	-5.37	6.27	-0.84	-0.84
CR	0.42	-----	-----	0.00	-----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	T	T-m	T-m
1	0.040	0.727	0.679
2	-0.081	0.162	0.151
3	0.878	-1.065	-0.995
4	-0.837	-3.408	-3.182

Note: Moments are reported at face of support

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)



Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-23.34	-----
1	-33.02	-23.51	24.35	17.42	-35.30	-25.47
2	-34.17	-24.45	24.01	17.16	-34.83	-25.07
3	-38.57	-28.64	26.74	19.75	-24.97	-15.69
CR	0.00	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	56.68	46.80	-0.52	-11.79	-0.48	-11.01
2	68.75	58.37	6.96	-5.78	6.50	-5.40
3	70.22	60.00	4.15	-8.39	3.87	-7.83
4	35.74	25.86	19.36	12.14	18.08	11.34

8.3 Secondary Moments

Span	Left	Midspan	Right
	T-m	T-m	T-m
1	1.42	1.58	1.73
2	2.04	1.84	1.64
3	-0.11	3.07	6.26

Note: Moments are reported at face of support

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	cm2	cm2	cm2	cm2	cm2
1	TOP	8.00	8.40	1.68	1.68	0.00	0.00	0.00
3	TOP	0.00	0.42	6.93	6.93	0.00	0.00	0.00
3	TOP	7.98	8.40	10.72	10.72	0.00	0.00	0.00

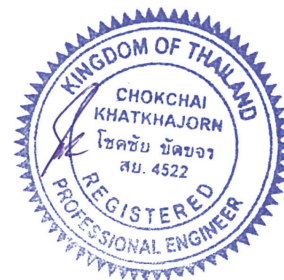
10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	cm2
1	1	TOP	5.16	1	8	6.48	5.10
2	2	TOP	5.16	1	8	6.48	5.10
3	3	TOP	5.16	2	8	3.64	10.20
2	4	TOP	6.00	1	8	4.80	5.10
3	5	TOP	6.00	1	8	2.80	5.10

10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
1	1	TOP	5.16	1	8	3.24
2	1	TOP	0.00	1	8	3.24
2	2	TOP	5.16	1	8	3.24
2	4	TOP	6.00	1	8	2.40
3	2	TOP	0.00	1	8	3.24



3	3	TOP	5.16	2	8	3.24
3	4	TOP	0.00	1	8	2.40
3	5	TOP	6.00	1	8	2.40
CR	3	TOP	0.00	2	8	0.40
CR	5	TOP	0.00	1	8	0.40

13 - PUNCHING SHEAR REINFORCEMENT

13.1 Critical Section Geometry

Column	Layer	Cond.	a cm	d cm	b1 cm	b2 cm
1	1	1	9.48	18.96	98.96	118.96
2	1	1	9.48	18.96	98.96	118.96
3	1	1	9.48	18.96	98.96	118.96
4	1	2	9.48	18.96	89.48	118.96

13.2 Critical Section Stresses

Label	Layer	Cond.	Factored shear T	Factored moment T-m	Stress due to shear T/cm2	Stress due to moment T/cm2	Total stress T/cm2	Allowable stress T/cm2	Stress ratio
1	1	1	-56.43	+14.10	0.01	0.002	0.009	0.017	0.525
2	1	1	-68.29	-1.27	0.01	0.000	0.008	0.017	0.504
3	1	1	-69.95	+4.44	0.01	0.001	0.009	0.017	0.543
4	1	2	-35.49	-36.57	0.01	0.006	0.012	0.016	0.750

13.3 Punching Shear Reinforcement

Reinforcement option: Stirrups

Bar Size: 5

Col.	Dist cm	N Legs	Dist cm	N Legs	Dist cm	N Legs	Dist cm	N Legs	Dist cm	N Legs
1										
2										
3										
4										

Dist. = Distance measured from the face of support

Note: Columns with --- have not been checked for punching shear.

Note: Columns with *** have exceeded the maximum allowable shear stress.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	cm	cm	cm	cm	cm	cm	cm	cm
CL	0.2	0.0	0.1	0.2(1340)	0.1(2990)	0.0(****)	0.2(1340)	0.3(925)
1	0.3	0.0	0.2	0.5(1652)	0.1(6238)	0.0(****)	0.5(1652)	0.6(1306)
2	0.2	0.0	0.1	0.4(2057)	0.1(6608)	0.0(****)	0.4(2057)	0.5(1569)
3	0.3	0.1	0.3	0.8(1058)	0.1(5868)	0.0(****)	0.8(1058)	0.9(897)
CR	0.0	0.0	0.0	0.0(1278)	0.0(37389)	0.0(****)	0.0(1278)	0.0(1236)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

15 - FRICTION, ELONGATION AND LONG TERM LOSSES

15.1 Input Parameters

Parameter	Value	Parameter	Value
Type of Strand	Low Relaxation	Coefficient of Angular Friction (meu)	0.17000 1/rad
Age of Concrete at Stressing	3 days	Coefficient of Wobble Friction (K)	0.00160 rad/m



Ec at Stressing	238.00 T/cm ²	Ratio of Jacking Stress	0.75
Average Relative Humidity	80.00 percent	Anchor Set	6.00 mm
Volume to Surface Ratio of Members	11.50 cm	Tendon A Stressing Method	Left side
Es of Strand	2030.00 T/cm ²	Tendon B Stressing Method	Right side

15.2 Long-term Losses

Tendon	Span	Left	Center	Right
		T/cm ²	T/cm ²	T/cm ²
TENDON A	CL	0.49	0.50	0.40
TENDON A	1	0.40	0.48	0.45
TENDON A	2	0.46	0.49	0.42
TENDON A	3	0.40	0.41	0.49
TENDON A	CR	0.49	0.49	0.49
TENDON B	CL	0.49	0.49	0.39
TENDON B	1	0.40	0.47	0.44
TENDON B	2	0.45	0.52	0.45
TENDON B	3	0.44	0.44	0.51
TENDON B	CR	0.52	0.52	0.52

15.3 Calculated Stresses After Friction and Long-term Losses

Tendon	Span	Stress Left FL Only	Stress Center FL Only	Stress Right FL Only	Stress Left FL+LTL	Stress Center FL+LTL	Stress Right FL+LTL
		T/cm ²	T/cm ²	T/cm ²	T/cm ²	T/cm ²	T/cm ²
TENDON A	CL	12.15	12.24	12.33	11.66	11.74	11.94
TENDON A	1	12.33	12.80	13.14	11.95	12.32	12.68
TENDON A	2	13.14	12.88	12.58	12.68	12.40	12.16
TENDON A	3	12.58	12.22	12.03	12.16	11.81	11.54
TENDON A	CR	12.03	12.01	12.01	11.54	11.52	11.52
TENDON B	CL	12.01	12.09	12.29	11.52	11.60	11.90
TENDON B	1	12.29	12.60	12.97	11.91	12.13	12.52
TENDON B	2	12.97	13.29	13.04	12.52	12.77	12.59
TENDON B	3	13.04	12.70	12.48	12.60	12.26	11.96
TENDON B	CR	12.48	12.47	12.47	11.96	11.96	11.95

15.6 Summary

Tendon	Force	Ext. Left	Start Span	End Span	Ext. Right	Elong. Left	Elong Right	Anchor Left	Anchor Right	Max Stress ratio
	T					cm	cm			
TENDON A	11.83	0.00	CL	5	0.00	17.63	-0.00	0.64	0.63	0.69
TENDON B	12.00	0.00	CL	5	0.00	0.00	17.87	0.63	0.66	0.70

16 - Unbalanced Moment Reinforcement

16.1 Unbalanced Moment Reinforcement - No Redistribution

Joint	Gamma Left	Gamma Right	Width Left	Width Right	Moment Left Neg	Moment Left Pos	Moment Right Neg	Moment Right Pos	As Top	As Bot	n Bar Top	n Bar Bot
			m	m	T-m	T-m	T-m	T-m	cm ²	cm ²		
1	0.62	0.62	1.69	1.69	0.00	0.00	-9.68	0.00	0.00	0.00	0	0
2	0.62	0.62	1.69	1.69	-1.12	0.00	0.00	0.00	0.00	0.00	0	0
3	0.62	0.62	1.69	1.69	0.00	0.00	-3.74	0.00	0.00	0.00	0	0
4	0.62	0.62	1.69	1.69	-24.97	0.00	0.00	0.00	0.00	0.00	0	0





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง
(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)
(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C



รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C



พัฒนาพื้นที่ส่วนขยาย ศูนย์ราชการ พื้นที่โซน C อาคารทิศตะวันตก W
4-D



1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Fy (Main bars)	4.00 T/cm ²
F'c for BEAMS/SLABS	320.00 Kg/cm ²	Fy (Shear reinforcement)	4.00 T/cm ²
F'ci for BEAMS/SLABS	280.00 Kg/cm ²	Minimum Cover at TOP	1.50 cm
For COLUMNS/WALLS	240.00 Kg/cm ²	Minimum Cover at BOTTOM	1.50 cm
Ec for BEAMS/SLABS	257.00 T/cm ²	Post-tensioning	
For COLUMNS/WALLS	257.00 T/cm ²	SYSTEM	BONDED
CREEP factor	2.00	Fpu	19.00 T/cm ²
CONCRETE WEIGHT	NORMAL	Fse	10.80 T/cm ²
UNIT WEIGHT	2400.00 Kg/m ³	Strand area	0.990 cm ²
Tension stress limits / (f'c) ^{1/2}		Min CGS from TOP	4.20 cm
At Top	1.590	Min CGS from BOT for interior spans	5.60 cm
At Bottom	1.590	Min CGS from BOT for exterior spans	5.60 cm
Compression stress limits / f'c		Min average precompression	10.00 Kg/cm ²
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (f'c) ^{1/2}		Analysis and design options	
At Top	0.795	Structural system - Equiv Frame	TWO-WAY
At Bottom	0.795	Moments reduced to face of support	YES
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	DESIGN CODE SELECTED	ACI-318 (1999)
Reinforcement			

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

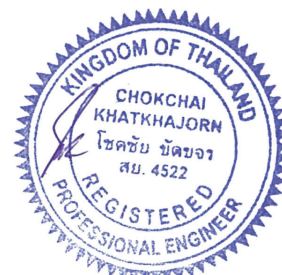
Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	cm	cm	cm	cm	cm	cm	cm		
C	2	4.00	300.00	35.00	800.00	23.00			0.00	0.50	0.50
1	2	8.40	300.00	35.00	800.00	23.00			0.00	0.50	0.50
3	2	8.40	800.00	23.00	800.00	23.00			0.00	0.50	0.50
4	2	8.40	800.00	23.00	800.00	23.00			0.00	0.50	0.50
C	2	0.40	800.00	23.00	800.00	23.00			0.00	0.50	0.50

2.2 Detailed Data for Nonuniform Spans

Span	Seg.	Form	Left Dist.	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
			m	cm	cm	cm	cm	cm	cm	cm		
2	1	2	0.00	300.00	35.00	800.00	23.00			0.00	0.50	0.50
2	2	2	0.40	300.00	35.00	800.00	23.00			0.00	0.50	0.50
2	3	2	1.50	800.00	23.00	800.00	23.00			0.00	0.50	0.50
2	4	2	8.00	800.00	23.00	800.00	23.00			0.00	0.50	0.50

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	cm	m	cm	cm			m	cm	cm		
1	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
2	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
3	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
4	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
5	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)



3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			T/m ²	T/m	T/m	m	m	m	T	T-m
CANT	LL	U	0.300							
CANT	SDL	U	0.370							
1	LL	U	0.300							
1	SDL	U	0.370							
2	LL	U	0.300							
2	SDL	U	0.370							
3	LL	U	0.300							
3	SDL	U	0.370							
4	LL	U	1.000							
4	SDL	U	0.370							
CANT	LL	U	1.000							
CANT	SDL	U	0.370							

NOTE: SELFWEIGHT INCLUSION REQUIRED (SW= SELF WEIGHT Computed from geometry input and treated as dead loading. Unit selfweight W = 2400.0 Kg/m³)

NOTE: LIVE LOADING is SKIPPED with a skip factor of 0.75

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			T/m	T/m	T	T-m	m	m	m	%
CL	LL	U	2.400							0.000
CL	SDL	U	2.960							
CL	SW	U	5.280							
1	LL	U	2.400							0.000
1	SDL	U	2.960							
1	SW	U	5.280							
2	LL	P	2.400				0.000	8.400		0.000
2	SDL	P	2.960				0.000	8.400		
2	SW	P	5.280				0.000	1.500		
2	SW	P	4.416				1.500	8.400		
3	LL	U	2.400							0.000
3	SDL	U	2.960							
3	SW	U	4.416							
4	LL	U	8.000							0.000
4	SDL	U	2.960							
4	SW	U	4.416							
CR	LL	U	8.000							0.000
CR	SDL	U	2.960							
CR	SW	U	4.416							

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	I	Yb	Yt
	cm ²	cm ⁴	cm	cm
CANT	22000.00	0.18E+07	20.64	14.36
1	22000.00	0.18E+07	20.64	14.36
2	---	---	---	---
3	18400.00	0.81E+06	11.50	11.50
4	18400.00	0.81E+06	11.50	11.50
CANT	18400.00	0.81E+06	11.50	11.50



4.2 Section Properties for Non-Uniform Spans

Span	Segment	Area	I	Yb	Yt
		cm ²	cm ⁴	cm	cm
2	1	22000.00	0.23E+07	20.64	14.36
2	2	22000.00	0.18E+07	20.64	14.36
2	3	18400.00	0.81E+06	11.50	11.50
2	4	18400.00	0.11E+07	11.50	11.50

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

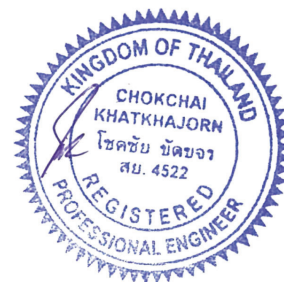
Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		T-m	T-m	T-m	T	T
CANT	SW	-----	-----	-42.24	-----	21.12
1	SW	-35.09	13.64	-30.76	-22.69	21.66
2	SW	-32.92	10.77	-24.40	-20.74	17.65
3	SW	-25.41	12.36	-27.78	-18.26	18.83
4	SW	-29.93	14.90	-18.16	-19.95	17.15
CANT	SW	-0.35	-----	-----	-1.77	-----
CANT	SDL	-----	-----	-23.68	-----	11.84
1	SDL	-19.36	7.37	-18.11	-12.58	12.28
2	SDL	-21.00	7.34	-16.52	-12.97	11.90
3	SDL	-17.08	8.27	-18.60	-12.25	12.61
4	SDL	-20.06	9.99	-12.18	-13.37	11.49
CANT	SDL	-0.24	-----	-----	-1.18	-----
CANT	XL	-----	-----	0.00	-----	0.00
1	XL	0.00	0.00	0.00	0.00	0.00
2	XL	0.00	0.00	0.00	0.00	0.00
3	XL	0.00	0.00	0.00	0.00	0.00
4	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		T	T-m	T-m
1	SW	43.81	3.83	3.32
2	SW	42.40	-1.16	-1.00
3	SW	35.91	-0.52	-0.48
4	SW	38.78	-1.12	-1.04
5	SW	18.91	9.21	8.60
1	SDL	24.42	2.32	2.01
2	SDL	25.25	-1.55	-1.34
3	SDL	24.15	-0.29	-0.27
4	SDL	25.98	-0.76	-0.71
5	SDL	12.68	6.17	5.77
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00
5	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
------	-----------------	-----------------	--------------------	--------------------	------------------	------------------	------------	-------------



	T-m	T-m	T-m	T-m	T-m	T-m	T	T
CL	----	----	----	----	-19.20	----	----	9.60
1	-15.61	-3.35	7.38	-2.95	-14.93	-1.71	-10.16	10.00
2	-17.75	-0.61	6.25	-1.40	-12.08	-0.98	-10.76	9.40
3	-11.95	1.94	6.70	-3.75	-24.56	-8.12	-8.34	11.82
4	-46.20	-2.47	29.49	-0.95	-35.93	0.95	-34.82	32.38
CR	-0.64	----	----	----	----	----	-3.20	----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	20.68	8.93	7.90	-5.97	6.84	-5.17
2	22.86	9.07	5.74	-7.25	4.97	-6.28
3	20.95	6.76	5.83	-4.72	5.45	-4.40
4	47.33	9.99	4.46	-15.65	4.17	-14.62
5	36.20	2.60	19.23	-0.98	17.96	-0.92

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		T-m	T-m	T-m
CANT	SW	----	----	-34.21
1	SW	-26.44	13.64	-22.52
2	SW	-25.05	10.77	-17.70
3	SW	-18.45	12.36	-20.60
4	SW	-22.31	14.90	-11.66
CANT	SW	0.00	----	----
CANT	SDL	----	----	-19.18
1	SDL	-14.56	7.37	-13.44
2	SDL	-16.06	7.34	-12.00
3	SDL	-12.42	8.27	-13.79
4	SDL	-14.95	9.99	-7.82
CANT	SDL	0.00	----	----
CANT	XL	----	----	0.00
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00
CANT	XL	0.00	----	----



6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	----	----	----	----	-15.55	----
1	-11.74	-3.31	7.38	-2.95	-11.13	-1.80
2	-13.64	-0.68	6.25	-1.40	-8.51	-0.98
3	-8.89	1.41	6.70	-3.75	-20.03	-5.42
4	-32.91	-2.32	29.49	-0.95	-23.62	0.77
CR	0.00	----	----	----	----	----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
4	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

Tendon B

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.000	0.000	0.000	---
2	1	0.000	0.000	0.000	---
3	1	0.000	0.000	0.000	---
4	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

Tendon C

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.100	---
1	1	0.100	0.500	0.100	---
2	1	0.000	0.000	0.000	---
3	1	0.100	0.500	0.100	---
4	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drapes

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	218.112	-14.20	---	---	-4.20	10.10	2.778	34
1	228.689	-4.20	---	-29.40	-4.20	10.39	6.534	79
2	225.389	-4.20	---	-17.40	-4.20	12.25	3.373	45
3	237.078	-4.20	---	-17.40	-4.20	12.88	3.548	48
4	228.209	-4.20	---	-17.40	-11.20	12.40	2.510	34
CR	223.249	-11.20	---	---	-11.20	12.14	0.000	0

Tendon B

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	146.426	-14.20	---	---	-4.20	6.67	1.835	22
1	0.001	-4.20	---	-29.40	-4.20	6.52	NaN	*****
2	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	*****
3	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	*****
4	0.000	-4.20	---	-17.40	-11.00	0.00	0.000	0
CR	0.000	-11.00	---	---	-11.50	0.00	0.000	0

Tendon C

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	0.000	-14.40	---	---	-4.20	0.00	0.000	0
1	0.000	-4.20	---	-29.40	-4.20	0.00	0.000	0
2	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	*****
3	0.000	-4.20	---	-17.40	-4.20	0.00	0.000	0
4	262.380	-4.20	---	-17.40	-11.20	14.26	2.886	39
CR	256.637	-11.20	---	---	-11.20	13.95	0.000	0

All Tendons



Span	Force	Total P/A	Total WBal (%DL)
	T	kg/cm2	
CL	364.538	16.77	56
1	228.69	16.91	79
2	225.389	12.25	45
3	237.078	12.88	48
4	490.589	26.66	73
CR	479.886	26.09	0

Approximate weight of strand: 901.2 Kg

7.3 Tendon Extents and Stressing Conditions

Type	Num	Force	Left End	Right End	From	To	Extension
A	19	12.05	Live	Live	CL	CR	---
B	11	0.00	Live	Dead	CL	1	0.20
C	22	11.91	Dead	Live	4	CR	0.20

7.4 Required Minimum Post-Tensioning Forces

Type	Based on Stress Conditions			Based on Minimum P/A		
	Left	Center	Right	Left	Center	Right
	T	T	T	T	T	T
CL	---	---	242.58	---	---	220.00
1	79.65	25.41	55.87	220.00	220.00	220.00
2	94.92	49.75	159.70	220.00	184.00	184.00
3	162.21	73.10	354.44	184.00	184.00	184.00
4	486.16	424.53	314.32	184.00	184.00	184.00
CR	0.00	---	---	184.00	---	---

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top	Left Top	Left Bot	Left Bot	Center Top	Center Top	Center Bot	Center Bot	Right Top	Right Top	Right Bot	Right Bot
	Max-T	Max-C	Max-T	Max-C	Max-T	Max-C	Max-T	Max-C	Max-T	Max-C	Max-T	Max-C
	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2
CL	---	---	---	---	---	---	---	---	14.37	---	---	-61.36
1	3.02	-6.48	---	-28.95	---	-12.15	---	-19.87	---	-10.32	---	-23.41
2	6.44	-4.59	---	-34.38	---	-31.38	6.89	-3.97	17.03	---	---	-42.09
3	16.32	---	---	-41.61	---	-31.12	5.35	-9.46	7.80	-20.60	---	-62.65
4	26.43	-20.23	---	-80.77	---	-74.20	20.87	-22.29	11.20	-23.37	---	-63.40
CR	---	-28.11	---	-24.03	---	---	---	---	---	---	---	---

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	T-m	T-m	T-m	T	T
CL	---	---	30.50	---	16.61
1	36.52	-26.22	35.88	4.39	4.39
2	34.03	-10.87	17.36	0.04	0.04
3	19.33	-14.46	29.57	1.03	1.03
4	32.36	-20.85	16.78	-2.26	-2.26
CR	1.44	---	---	0.00	---

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	T	T-m	T-m
1	-4.390	1.764	1.528
2	4.346	-2.199	-1.905
3	-0.985	1.273	1.189



4	3.293	1.411	1.318
5	-2.264	-9.117	-8.513

Note: Moments are reported at face of support

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)

Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-101.18	-----
1	-75.82	-61.49	26.81	9.24	-101.10	-85.24
2	-116.54	-94.51	18.18	5.16	-55.88	-43.07
3	-54.21	-36.70	40.47	22.71	-85.90	-61.07
4	-108.59	-56.59	93.10	41.35	-50.70	-9.25
CR	0.00	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	126.29	106.32	23.79	0.22	20.61	0.19
2	137.92	114.47	3.76	-18.31	3.26	-15.87
3	118.71	94.58	10.06	-7.88	9.39	-7.35
4	174.42	110.95	6.38	-27.81	5.95	-25.98
5	103.50	46.38	45.11	10.75	42.13	10.04

8.3 Secondary Moments

Span	Left	Midspan	Right
	T-m	T-m	T-m
1	1.54	-15.15	-31.83
2	-35.80	-17.81	0.17
3	4.11	0.21	-3.70
4	-0.48	8.12	16.72

Note: Moments are reported at face of support

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	cm2	cm2	cm2	cm2	cm2
2	TOP	0.42	0.42	22.78	22.78	0.00	0.00	0.00
2	TOP	1.68	2.10	27.92	27.92	0.00	0.00	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	cm2
1	1	TOP	5.16	3	8	6.48	15.30
1	2	TOP	6.00	3	8	4.80	15.30

10.2.2 Total Strip Steel Disposition



Span	ID	Location	From	Quantity	Size	Length
			m			m
1	1	TOP	5.16	3	8	3.24
1	2	TOP	6.00	3	8	2.40
2	1	TOP	0.00	3	8	3.24
2	2	TOP	0.00	3	8	2.40

13 - PUNCHING SHEAR REINFORCEMENT

13.1 Critical Section Geometry

Column	Layer	Cond.	a	d	b1	b2
			cm	cm	cm	cm
1	1	1	15.48	30.96	110.96	130.96
2	1	1	15.48	30.96	110.96	130.96
3	1	1	9.48	18.96	98.96	118.96
4	1	1	9.48	18.96	98.96	118.96
5	1	2	9.48	18.96	89.48	118.96

13.2 Critical Section Stresses

Label	Layer	Cond.	Factored shear	Factored moment	Stress due to shear	Stress due to moment	Total stress	Allowable stress	Stress ratio
			T	T-m	T/cm ²	T/cm ²	T/cm ²	T/cm ²	
1	1	1	-124.72	-25.44	0.01	0.002	0.010	0.018	0.543
2	1	1	-139.11	+15.97	0.01	0.001	0.010	0.017	0.616
3	1	1	-108.48	-3.94	0.01	0.001	0.014	0.016	0.838
4	1	1	-173.25	+39.12	0.02	0.005	0.026	0.020	1.302
5	1	2	-102.45	-84.02	0.02	0.012	0.030	0.016	1.901

13.3 Punching Shear Reinforcement

Reinforcement option: Stirrups

Bar Size: 5

Col.	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs
	cm		cm		cm		cm		cm	
1										
2										
3										
4	***	***								
5	***	***								

Dist. = Distance measured from the face of support

Note: Columns with --- have not been checked for punching shear.

Note: Columns with *** have exceeded the maximum allowable shear stress.

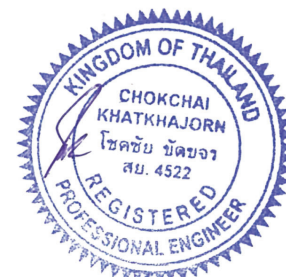
14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	cm	cm	cm	cm	cm	cm	cm	cm
CL	0.5	0.1	0.4	1.2(335)	0.2(1679)	0.0(****)	1.2(335)	1.4(279)
1	0.1	-0.1	-0.1	-0.2(3685)	-0.1(14734)	0.0(****)	-0.2(3685)	-0.3(2951)
2	0.2	0.0	0.1	0.4(1926)	0.2(5458)	0.0(****)	0.4(1926)	0.6(1423)
3	0.2	-0.1	0.1	0.3(2573)	0.2(4924)	0.0(****)	0.3(2573)	0.5(1699)
4	0.4	-0.1	0.1	0.4(1960)	0.7(1131)	0.0(****)	0.4(1960)	1.1(730)
CR	0.0	0.0	0.0	-0.1(593)	-0.1(664)	0.0(****)	-0.1(593)	-0.1(313)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

15 - FRICTION, ELONGATION AND LONG TERM LOSSES



15.1 Input Parameters

Parameter	Value	Parameter	Value
Type of Strand	Low Relaxation	Coefficient of Wobble Friction (K)	0.00160 rad/m
Age of Concrete at Stressing	3 days	Ratio of Jacking Stress	0.75
Ec at Stressing	238.00 T/cm ²	Anchor Set	6.00 mm
Average Relative Humidity	80.00 percent	Tendon A Stressing Method	Both sides
Volume to Surface Ratio of Members	11.50 cm	Tendon B Stressing Method	Left side
Es of Strand	2030.00 T/cm ²	Tendon C Stressing Method	Right side
Coefficient of Angular Friction (meu)	0.17000 1/rad		

15.2 Long-term Losses

Tendon	Span	Left T/cm ²	Center T/cm ²	Right T/cm ²
TENDON A	CL	0.73	0.71	0.54
TENDON A	1	0.63	0.71	0.50
TENDON A	2	0.43	0.45	0.41
TENDON A	3	0.43	0.48	0.44
TENDON A	4	0.42	0.47	0.53
TENDON A	CR	0.53	0.53	0.77
TENDON B	CL	0.51	0.51	0.36
TENDON B	1	0.55	0.73	0.50
TENDON B	2	0.47	0.00	0.00
TENDON B	3	0.00	0.00	0.00
TENDON B	4	0.00	0.00	0.00
TENDON B	CR	0.00	0.00	0.00
TENDON C	CL	0.00	0.00	0.00
TENDON C	1	0.00	0.00	0.00
TENDON C	2	0.00	0.00	0.00
TENDON C	3	0.00	0.00	0.31
TENDON C	4	0.35	0.40	0.45
TENDON C	CR	0.45	0.45	0.56



15.3 Calculated Stresses After Friction and Long-term Losses

Tendon	Span	Stress Left FL Only T/cm ²	Stress Center FL Only T/cm ²	Stress Right FL Only T/cm ²	Stress Left FL+LTL T/cm ²	Stress Center FL+LTL T/cm ²	Stress Right FL+LTL T/cm ²
TENDON A	CL	14.25	14.15	14.05	13.51	13.44	13.51
TENDON A	1	14.05	10.85	0.00	13.31	10.13	0.00
TENDON A	2	0.00	0.00	0.01	0.00	0.00	0.00
TENDON A	3	0.01	0.01	7.51	0.00	0.00	7.04
TENDON A	4	7.51	7.66	8.60	7.08	7.19	8.07
TENDON A	CR	8.60	8.75	14.09	8.07	8.22	13.32
TENDON B	CL	11.40	11.50	11.60	10.89	10.99	11.24
TENDON B	1	11.60	11.60	0.01	11.05	10.88	0.00
TENDON B	2	0.01	0.00	0.00	0.00	0.00	0.00
TENDON B	3	0.00	0.00	0.00	0.00	0.00	0.00
TENDON B	4	0.00	0.00	0.00	0.00	0.00	0.00
TENDON B	CR	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	CL	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	1	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	2	0.00	0.00	0.00	0.00	0.00	0.00
TENDON C	3	0.00	0.00	0.01	0.00	0.00	0.00
TENDON C	4	0.01	0.01	0.01	0.00	0.00	0.00
TENDON C	CR	0.01	0.01	11.40	0.00	0.00	10.84

15.6 Summary

Tendon	Force	Ext. Left	Start Span	End Span	Ext. Right	Elong. Left	Elong Right	Anchor Left	Anchor Right	Max Stress ratio
--------	-------	-----------	------------	----------	------------	-------------	-------------	-------------	--------------	------------------

TENDON_A	5.92	0.00	CL	6	0.00	522599999999999995000000.00	335200000000000000.00	0.75	0.74	0.75
TENDON_B	7.55	0.00	CL	2	0.20	0.10	-0.00	0.60	0.00	0.61
TENDON_C	0.37	0.20	5	CR	0.00	0.00	-0.10	0.00	0.60	0.60

16 - Unbalanced Moment Reinforcement

16.1 Unbalanced Moment Reinforcement - No Redistribution

Joint	Gamma Left	Gamma Right	Width Left	Width Right	Moment Left Neg	Moment Left Pos	Moment Right Neg	Moment Right Pos	As Top	As Bot	n Bar Top	n Bar Bot
			m	m	T-m	T-m	T-m	T-m	cm2	cm2	0	0
1	0.62	0.62	2.05	2.05	-25.36	0.00	0.00	0.00	0.00	0.00	0	0
2	0.62	0.62	2.05	2.05	0.00	0.00	-15.44	0.00	0.00	0.00	0	0
3	0.62	0.62	1.69	1.69	-6.37	0.00	0.00	0.00	0.00	0.00	0	0
4	0.62	0.62	1.69	1.69	-4.48	0.00	-22.69	0.00	0.00	0.00	0	0
5	0.62	0.62	1.69	1.69	-50.70	0.00	0.00	0.00	0.00	10.85	0	6





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C



พัฒนาพื้นที่ส่วนขยาย ศูนย์ราชการ พื้นที่โซน C อาคารทิศตะวันตก W
4-K



1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Fy (Main bars)	4.00 T/cm 2
F'c for BEAMS/SLABS	320.00 Kg/cm 2	Fy (Shear reinforcement)	4.00 T/cm 2
F'ci for BEAMS/SLABS	280.00 Kg/cm 2	Minimum Cover at TOP	1.50 cm
For COLUMNS/WALLS	240.00 Kg/cm 2	Minimum Cover at BOTTOM	1.50 cm
Ec for BEAMS/SLABS	257.00 T/cm 2	Post-tensioning	
For COLUMNS/WALLS	257.00 T/cm 2	SYSTEM	BONDED
CREEP factor	2.00	Fpu	19.00 T/cm 2
CONCRETE WEIGHT	NORMAL	Fse	10.80 T/cm 2
UNIT WEIGHT	2400.00 Kg/m 3	Strand area	0.990 cm 2
Tension stress limits / (f'c)1/2		Min CGS from TOP	4.20 cm
At Top	1.590	Min CGS from BOT for interior spans	5.60 cm
At Bottom	1.590	Min CGS from BOT for exterior spans	5.60 cm
Compression stress limits / f'c		Min average precompression	10.00 Kg/cm 2
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (f'c)1/2		Analysis and design options	
At Top	0.795	Structural system - Equiv Frame	TWO-WAY
At Bottom	0.795	Moments reduced to face of support	YES
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	DESIGN CODE SELECTED	ACI-318 (1999)
Reinforcement			

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	cm	cm	cm	cm	cm	cm	cm		
C	1	2.95	100.00	23.00					0.00	2.95	4.00
1	1	8.40	100.00	23.00					0.00	2.95	4.00
2	1	8.40	100.00	23.00					0.00	2.95	4.00
3	1	8.40	100.00	23.00					0.00	2.95	4.00
C	1	2.95	100.00	23.00					0.00	2.95	4.00

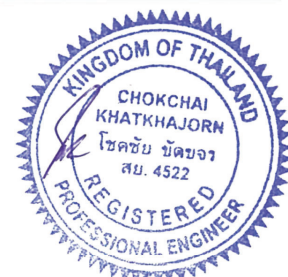
2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	cm	m	cm	cm			m	cm	cm		
1	50.0	3.0	50.0	50.0	100	(1)	3.0	50.0	50.0	100	(1)
2	50.0	3.0	50.0	50.0	100	(1)	3.0	50.0	50.0	100	(1)
3	50.0	3.0	50.0	50.0	100	(1)	3.0	50.0	50.0	100	(1)
4	50.0	3.0	50.0	50.0	100	(1)	3.0	50.0	50.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			T/m2	T/m	T/m	m	m	m	T	T-m
CANT	LL	U	0.300							
CANT	SDL	U	0.370							
1	LL	U	0.300							
1	SDL	U	0.370							
2	LL	U	0.300							
2	SDL	U	0.370							



3	LL	U	0.300							
3	SDL	U	0.370							
CANT	LL	U	0.300							
CANT	SDL	U	0.370							

NOTE: SELFWEIGHT INCLUSION REQUIRED (SW= SELF WEIGHT Computed from geometry input and treated as dead loading. Unit selfweight $W = 2400.0 \text{ Kg/m}^3$

NOTE: LIVE LOADING is SKIPPED with a skip factor of 0.75

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			T/m	T/m	T	T-m	m	m	m	%
CL	LL	U	2.085							0.000
CL	SDL	U	2.572							
CL	SW	U	3.836							
1	LL	U	2.085							0.000
1	SDL	U	2.572							
1	SW	U	3.836							
2	LL	U	2.085							0.000
2	SDL	U	2.572							
2	SW	U	3.836							
3	LL	U	2.085							0.000
3	SDL	U	2.572							
3	SW	U	3.836							
CR	LL	U	2.085							0.000
CR	SDL	U	2.572							
CR	SW	U	3.836							

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	I	Yb	Yt
	cm ²	cm ⁴	cm	cm
CANT	15985.00	0.70E+06	11.50	11.50
1	15985.00	0.70E+06	11.50	11.50
2	15985.00	0.70E+06	11.50	11.50
3	15985.00	0.70E+06	11.50	11.50
CANT	15985.00	0.70E+06	11.50	11.50



5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		T-m	T-m	T-m	T	T
CANT	SW	----	----	-16.69	----	11.32
1	SW	-19.89	12.05	-23.68	-15.66	16.56
2	SW	-23.03	10.80	-23.03	-16.11	16.11
3	SW	-23.68	12.05	-19.89	-16.56	15.66
CANT	SW	-16.69	----	----	-11.32	----
CANT	SDL	----	----	-11.19	----	7.59
1	SDL	-13.33	8.08	-15.87	-10.50	11.10
2	SDL	-15.44	7.24	-15.44	-10.80	10.80
3	SDL	-15.87	8.08	-13.33	-11.10	10.50
CANT	SDL	-11.19	----	----	-7.59	----
CANT	XL	----	----	0.00	----	0.00

1	XL	0.00	0.00	0.00	0.00	0.00
2	XL	0.00	0.00	0.00	0.00	0.00
3	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		T	T-m	T-m
1	SW	26.98	-1.66	-1.55
2	SW	32.68	0.33	0.31
3	SW	32.68	-0.33	-0.31
4	SW	26.98	1.66	1.55
1	SDL	18.08	-1.11	-1.04
2	SDL	21.90	0.22	0.21
3	SDL	21.90	-0.22	-0.21
4	SDL	18.08	1.11	1.04
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
4	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	T-m	T-m	T-m	T-m	T-m	T-m	T	T
CL	-----	-----	-----	-----	-9.07	-----	-----	6.15
1	-10.81	-2.20	7.17	-2.26	-12.87	-1.59	-8.51	9.00
2	-12.52	-2.05	6.80	-2.40	-12.52	-2.05	-8.76	8.76
3	-12.87	-1.59	7.17	-2.26	-10.81	-2.20	-9.00	8.51
CR	-9.07	-----	-----	-----	-----	-----	-6.15	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	15.36	6.13	3.17	-4.07	2.96	-3.80
2	19.52	7.69	3.41	-3.23	3.18	-3.01
3	19.52	7.69	3.23	-3.41	3.01	-3.18
4	15.36	6.13	4.07	-3.17	3.80	-2.96

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		T-m	T-m	T-m
CANT	SW	-----	-----	-13.98
1	SW	-16.10	12.05	-19.66
2	SW	-19.12	10.80	-19.13
3	SW	-19.66	12.05	-16.10
CANT	SW	-13.98	-----	-----
CANT	SDL	-----	-----	-9.37
1	SDL	-10.79	8.08	-13.18
2	SDL	-12.82	7.24	-12.82
3	SDL	-13.18	8.08	-10.79
CANT	SDL	-9.37	-----	-----



CANT	XL	-----	-----	0.00
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00
3	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-7.60	-----
1	-8.75	-2.20	7.17	-2.26	-10.68	-1.61
2	-10.39	-2.05	6.80	-2.40	-10.39	-2.05
3	-10.68	-1.61	7.17	-2.26	-8.75	-2.20
CR	-7.60	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

Tendon B

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.100	---
1	1	0.100	0.500	0.100	---
2	1	0.100	0.500	0.100	---
3	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drapes

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	111.273	-11.50	---	---	-4.20	7.13	1.913	30
1	116.355	-4.20	---	-17.40	-4.20	7.28	1.741	27
2	122.299	-4.20	---	-17.40	-4.20	7.65	1.830	29
3	121.821	-4.20	---	-17.40	-4.20	7.62	1.823	28
CR	116.061	-4.20	---	---	-11.50	7.44	1.997	31

Tendon B

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	116.097	-11.50	---	---	-4.20	7.45	1.997	31
1	121.922	-4.20	---	-17.40	-4.20	7.63	1.825	28
2	122.299	-4.20	---	-17.40	-4.20	7.65	1.830	29
3	116.254	-4.20	---	-17.40	-4.20	7.27	1.740	27
CR	111.152	-4.20	---	---	-11.50	7.13	1.913	30

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	T	kg/cm2	



CL	227.37	14.58	61
1	238.277	14.91	55
2	244.598	15.3	58
3	238.075	14.89	55
CR	227.213	14.57	61

Approximate weight of strand: 499.0 Kg

7.3 Tendon Extents and Stressing Conditions

Type	Num	Force	Left End	Right End	From	To	Extension
A	10	11.89	Dead	Live	CL	CR	---
B	10	11.89	Live	Dead	CL	CR	0.00

7.4 Required Minimum Post-Tensioning Forces

Based on Stress Conditions

Based on Minimum P/A

Type	Left	Center	Right	Left	Center	Right
	T	T	T	T	T	T
CL	----	----	134.92	----	----	159.85
1	160.50	107.82	225.02	159.85	159.85	159.85
2	215.38	82.01	215.50	159.85	159.85	159.85
3	225.06	107.84	160.54	159.85	159.85	159.85
CR	135.31	----	----	159.85	----	----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2
CL	----	----	----	----	----	----	----	----	12.85	----	----	-41.66
1	14.99	----	----	-44.16	----	-38.77	8.96	-6.42	24.87	----	----	-55.39
2	22.79	----	----	-53.49	----	-35.04	4.43	-10.59	22.82	----	----	-53.51
3	24.90	----	----	-55.40	----	-38.78	9.00	-6.38	15.01	----	----	-44.18
CR	12.79	----	----	-41.73	----	----	----	----	----	----	----	----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	T-m	T-m	T-m	T	T
CL	----	----	14.25	----	10.56
1	17.52	-12.67	18.93	-0.18	-0.18
2	18.96	-12.76	18.95	0.00	0.00
3	18.92	-12.66	17.51	0.18	0.18
CR	14.25	----	----	10.55	----

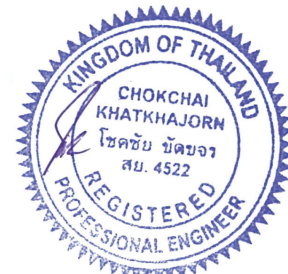
Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	T	T-m	T-m
1	0.179	0.525	0.490
2	-0.180	0.000	0.000
3	-0.178	-0.004	-0.004
4	0.179	-0.521	-0.487

Note: Moments are reported at face of support

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)



Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-45.61	-----
1	-51.46	-40.33	42.13	26.11	-61.66	-46.24
2	-59.86	-45.68	39.35	23.70	-59.88	-45.69
3	-61.67	-46.25	42.12	26.10	-51.47	-40.34
CR	-45.61	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	89.38	73.69	2.05	-10.27	1.92	-9.59
2	109.42	89.30	6.57	-4.70	6.14	-4.39
3	109.42	89.31	4.70	-6.57	4.39	-6.14
4	89.37	73.69	10.28	-2.05	9.60	-1.91

8.3 Secondary Moments

Span	Left	Midspan	Right
	T-m	T-m	T-m
1	1.06	1.77	2.47
2	2.52	2.52	2.52
3	2.46	1.76	1.05

Note: Moments are reported at face of support

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	cm2	cm2	cm2	cm2	cm2
1	TOP	8.15	8.40	6.24	6.24	0.00	0.00	0.00
2	TOP	0.25	0.25	3.81	3.81	0.00	0.00	0.00
2	TOP	8.15	8.40	3.81	3.81	0.00	0.00	0.00
3	TOP	0.00	0.25	6.24	6.24	0.00	0.00	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	cm2
1	1	TOP	5.16	1	8	6.48	5.10
2	2	TOP	5.16	1	8	6.48	5.10
1	3	TOP	6.00	1	8	4.80	5.10
2	4	TOP	6.00	1	8	4.80	5.10

10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
1	1	TOP	5.16	1	8	3.24
1	3	TOP	6.00	1	8	2.40
2	1	TOP	0.00	1	8	3.24
2	2	TOP	5.16	1	8	3.24
2	3	TOP	0.00	1	8	2.40



2	4	TOP	6.00	1	8	2.40
3	2	TOP	0.00	1	8	3.24
3	4	TOP	0.00	1	8	2.40

13 - PUNCHING SHEAR REINFORCEMENT

13.1 Critical Section Geometry

Column	Layer	Cond.	a	d	b1	b2
			cm	cm	cm	cm
1	1	1	9.48	18.96	68.96	68.96
2	1	1	9.48	18.96	68.96	68.96
3	1	1	9.48	18.96	68.96	68.96
4	1	1	9.48	18.96	68.96	68.96

13.2 Critical Section Stresses

Label	Layer	Cond.	Factored shear	Factored moment	Stress due to shear	Stress due to moment	Total stress	Allowable stress	Stress ratio
			T	T-m	T/cm ²	T/cm ²	T/cm ²	T/cm ²	
1	1	1	-88.20	+9.42	0.02	0.003	0.020	0.018	1.119
2	1	1	-106.41	-2.11	0.02	0.001	0.021	0.018	1.168
3	1	1	-106.41	+2.11	0.02	0.001	0.021	0.018	1.168
4	1	1	-88.20	-9.44	0.02	0.003	0.020	0.018	1.119

13.3 Punching Shear Reinforcement

Reinforcement option: Stirrups

Bar Size: 5

Col.	Dist	N_Legs	Dist	N_Legs	Dist	N_Legs	Dist	N_Legs	Dist	N_Legs
	cm		cm		cm		cm		cm	
1	9.5	8								
2	9.5	8								
3	9.5	8								
4	9.5	8								

Dist. = Distance measured from the face of support

Note: Columns with --- have not been checked for punching shear.

Note: Columns with *** have exceeded the maximum allowable shear stress.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	cm	cm	cm	cm	cm	cm	cm	cm
CL	0.1	-0.1	0.0	-0.1(4340)	0.2(1262)	0.0(****)	-0.1(4340)	0.2(1355)
1	0.3	0.0	0.2	0.7(1274)	0.2(3556)	0.0(****)	0.7(1274)	0.9(939)
2	0.2	0.0	0.1	0.4(2289)	0.2(3844)	0.0(****)	0.4(2289)	0.6(1435)
3	0.3	0.0	0.2	0.7(1272)	0.2(3556)	0.0(****)	0.7(1272)	0.9(937)
CR	0.1	-0.1	0.0	-0.1(4324)	0.2(1262)	0.0(****)	-0.1(4324)	0.2(1359)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

15 - FRICTION, ELONGATION AND LONG TERM LOSSES

15.1 Input Parameters

Parameter	Value	Parameter	Value
Type of Strand	Low Relaxation	Coefficient of Angular Friction (meu)	0.17000 1/rad
Age of Concrete at Stressing	3 days	Coefficient of Wobble Friction (K)	0.00160 rad/m
Ec at Stressing	238.00 T/cm ²	Ratio of Jacking Stress	0.75
Average Relative Humidity	80.00 percent	Anchor Set	6.00 mm



Volume to Surface Ratio of Members	11.50 cm	Tendon A Stressing Method	Right side
Es of Strand	2030.00 T/cm ²	Tendon B Stressing Method	Left side

15.2 Long-term Losses

Tendon	Span	Left	Center	Right
		T/cm ²	T/cm ²	T/cm ²
TENDON A	CL	0.47	0.46	0.36
TENDON A	1	0.37	0.43	0.41
TENDON A	2	0.42	0.51	0.46
TENDON A	3	0.45	0.49	0.41
TENDON A	CR	0.41	0.50	0.50
TENDON B	CL	0.50	0.50	0.41
TENDON B	1	0.41	0.48	0.45
TENDON B	2	0.46	0.51	0.42
TENDON B	3	0.41	0.45	0.38
TENDON B	CR	0.37	0.46	0.48

15.3 Calculated Stresses After Friction and Long-term Losses

Tendon	Span	Stress Left FL Only	Stress Center FL Only	Stress Right FL Only	Stress Left FL+LTL	Stress Center FL+LTL	Stress Right FL+LTL
		T/cm ²	T/cm ²	T/cm ²	T/cm ²	T/cm ²	T/cm ²
TENDON A	CL	11.62	11.70	11.90	11.15	11.23	11.54
TENDON A	1	11.90	12.20	12.55	11.53	11.76	12.14
TENDON A	2	12.55	12.86	13.14	12.14	12.36	12.67
TENDON A	3	13.14	12.80	12.45	12.67	12.31	12.04
TENDON A	CR	12.45	12.23	12.13	12.04	11.72	11.63
TENDON B	CL	12.13	12.23	12.45	11.63	11.72	12.04
TENDON B	1	12.45	12.80	13.14	12.04	12.33	12.68
TENDON B	2	13.14	12.86	12.55	12.67	12.36	12.13
TENDON B	3	12.55	12.20	11.90	12.13	11.74	11.53
TENDON B	CR	11.90	11.69	11.60	11.53	11.22	11.13

15.6 Summary

Tendon	Force	Ext. Left	Start Span	End Span	Ext. Right	Elong. Left	Elong Right	Anchor Left	Anchor Right	Max Stress ratio
	T					cm	cm			
TENDON A	11.76	0.00	CL	5	0.00	0.00	19.16	0.61	0.64	0.69
TENDON B	11.76	0.00	CL	5	0.00	19.16	-0.00	0.64	0.61	0.69

16 - Unbalanced Moment Reinforcement

16.1 Unbalanced Moment Reinforcement - No Redistribution

Joint	Gamma Left	Gamma Right	Width Left	Width Right	Moment Left Neg	Moment Left Pos	Moment Right Neg	Moment Right Pos	As Top	As Bot	n Bar Top	n Bar Bot
			m	m	T-m	T-m	T-m	T-m	cm ²	cm ²		
1	0.60	0.60	1.19	1.19	0.00	0.00	-7.64	0.00	0.00	0.00	0	0
2	0.60	0.60	1.19	1.19	-1.80	0.00	0.00	0.00	0.00	0.00	0	0
3	0.60	0.60	1.19	1.19	0.00	0.00	-1.79	0.00	0.00	0.00	0	0
4	0.60	0.60	1.19	1.19	-7.65	0.00	0.00	0.00	0.00	0.00	0	0





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C



พัฒนาพื้นที่ส่วนขยาย ศูนย์ราชการ พื้นที่ โซน **C** อาคารทิศตะวันตก **W**
4-12/13



1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Fy (Main bars)	4.00 T/cm 2
F'c for BEAMS/SLABS	320.00 Kg/cm 2	Fy (Shear reinforcement)	4.00 T/cm 2
F'ci for BEAMS/SLABS	280.00 Kg/cm 2	Minimum Cover at TOP	1.50 cm
For COLUMNS/WALLS	240.00 Kg/cm 2	Minimum Cover at BOTTOM	1.50 cm
Ec for BEAMS/SLABS	257.00 T/cm 2	Post-tensioning	
For COLUMNS/WALLS	257.00 T/cm 2	SYSTEM	BONDED
CREEP factor	2.00	Fpu	19.00 T/cm 2
CONCRETE WEIGHT	NORMAL	Fse	10.80 T/cm 2
UNIT WEIGHT	2400.00 Kg/m 3	Strand area	0.990 cm 2
Tension stress limits / (f'c)1/2		Min CGS from TOP	4.20 cm
At Top	1.590	Min CGS from BOT for interior spans	5.60 cm
At Bottom	1.590	Min CGS from BOT for exterior spans	5.60 cm
Compression stress limits / f'c		Min average precompression	10.00 Kg/cm 2
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (f'c)1/2		Analysis and design options	
At Top	0.795	Structural system - Equiv Frame	TWO-WAY
At Bottom	0.795	Moments reduced to face of support	YES
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	DESIGN CODE SELECTED	ACI-318 (1999)
Reinforcement			

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	cm	cm	cm	cm	cm	cm	cm		
C	2	3.60	300.00	35.00	640.00	23.00			0.00	0.50	0.50
1	2	11.60	300.00	35.00	640.00	23.00			0.00	0.50	0.50
C	2	3.00	300.00	35.00	640.00	23.00			0.00	0.50	0.50

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	cm	m	cm	cm			m	cm	cm		
1	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)
2	80.0	3.0	100.0	80.0	100	(1)	3.0	100.0	80.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			T/m2	T/m	T/m	m	m	m	T	T-m
CANT	LL	U	0.700							
CANT	SDL	U	0.370							
1	LL	U	0.700							
1	SDL	U	0.370							
CANT	LL	U	0.700							
CANT	SDL	U	0.370							

NOTE: SELFWEIGHT INCLUSION REQUIRED (SW= SELF WEIGHT Computed from geometry input and treated as dead loading. Unit selfweight W = 2400.0 Kg/m³)



NOTE: LIVE LOADING is SKIPPED with a skip factor of 0.75

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			T/m	T/m	T	T-m	m	m	m	%
CL	LL	U	4.480							0.000
CL	SDL	U	2.368							
CL	SW	U	4.397							
1	LL	U	4.480							0.000
1	SDL	U	2.368							
1	SW	U	4.397							
CR	LL	U	4.480							0.000
CR	SDL	U	2.368							
CR	SW	U	4.397							

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	I	Yb	Yt
	cm ²	cm ⁴	cm	cm
CANT	18320.00	0.16E+07	20.06	14.94
1	18320.00	0.16E+07	20.06	14.94
CANT	18320.00	0.16E+07	20.06	14.94

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

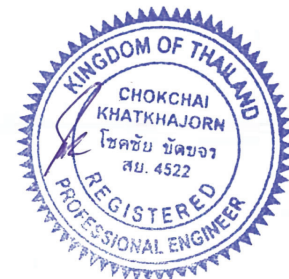
Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		T-m	T-m	T-m	T	T
CANT	SW	-----	-----	-28.49	-----	15.83
1	SW	-48.55	26.62	-46.12	-25.71	25.29
CANT	SW	-19.79	-----	-----	-13.19	-----
CANT	SDL	-----	-----	-15.34	-----	8.52
1	SDL	-26.15	14.34	-24.84	-13.85	13.62
CANT	SDL	-10.66	-----	-----	-7.10	-----
CANT	XL	-----	-----	0.00	-----	0.00
1	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		T	T-m	T-m
1	SW	41.54	-10.75	-9.31
2	SW	38.48	14.11	12.23
1	SDL	22.37	-5.79	-5.02
2	SDL	20.73	7.60	6.58
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	T-m	T-m	T-m	T-m	T-m	T-m	T	T
CL	-----	-----	-----	-----	-29.03	-----	-----	16.13



1	-49.47	-2.96	27.12	-2.04	-47.00	-1.11	-26.20	25.77
CR	-20.16	-----	-----	-----	-----	-----	-13.44	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	42.81	16.34	13.44	-24.39	11.64	-21.13
2	39.91	13.23	24.39	-10.01	21.13	-8.67

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		T-m	T-m	T-m
CANT	SW	-----	-----	-22.51
1	SW	-38.62	26.62	-36.36
CANT	SW	-14.86	-----	-----
CANT	SDL	-----	-----	-12.12
1	SDL	-20.80	14.34	-19.58
CANT	SDL	-8.00	-----	-----
CANT	XL	-----	-----	0.00
1	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-22.94	-----
1	-39.35	-2.90	27.12	-2.04	-37.05	-1.17
CR	-15.14	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

Tendon B

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
CR	1	0.000	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drapes

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	155.260	-14.90	---	---	-4.20	8.72	2.636	39
1	159.353	-4.20	---	-29.40	-4.20	8.70	2.387	35
CR	148.625	-4.20	---	---	-14.90	8.32	3.622	54



Tendon B

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	174.270	-14.94	---	---	-4.20	9.67	2.935	43
1	185.965	-4.20	---	-29.40	-4.20	10.15	2.786	41
CR	179.723	-4.20	---	---	-14.94	10.04	4.390	65

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	T	kg/cm2	
CL	329.53	18.39	82
1	345.318	18.85	76
CR	328.348	18.36	119

Approximate weight of strand: 417.8 Kg

7.3 Tendon Extents and Stressing Conditions

Type	Num	Force	Left End	Right End	From	To	Extension
A	13	12.01	Dead	Live	CL	CR	---
B	15	12.11	Live	Dead	CL	CR	0.00

7.4 Required Minimum Post-Tensioning Forces

Based on Stress Conditions

Based on Minimum P/A

Type	Left	Center	Right	Left	Center	Right
	T	T	T	T	T	T
CL	---	---	191.76	---	---	183.20
1	337.25	312.64	309.97	183.20	183.20	183.20
CR	57.00	---	---	183.20	---	---

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2	kg/cm2
CL	---	---	---	---	---	---	---	---	9.27	-12.45	---	-55.01
1	28.41	-8.85	---	-81.30	---	-49.54	22.37	-14.70	22.86	-12.21	---	-74.05
CR	---	-22.12	---	-31.88	---	---	---	---	---	---	---	---

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	T-m	T-m	T-m	T	T
CL	---	---	28.59	---	17.83
1	49.31	-35.65	49.29	0.00	0.00
CR	27.14	---	---	20.83	---

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	T	T-m	T-m
1	-0.001	8.151	7.062
2	0.001	-8.170	-7.079

Note: Moments are reported at face of support

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE



8.1 Factored Design Moments (Not Redistributed)

Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-87.48	-----
1	-134.87	-72.91	118.68	69.11	-126.05	-65.06
CR	-57.75	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	162.25	117.25	7.85	-56.47	6.79	-48.92
2	150.74	105.39	63.69	5.21	55.18	4.52

8.3 Secondary Moments

Span	Left	Midspan	Right
	T-m	T-m	T-m
1	15.21	15.23	15.25

Note: Moments are reported at face of support

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	cm2	cm2	cm2	cm2	cm2
1	TOP	0.00	0.40	9.38	9.38	0.00	0.00	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	cm2
CL	1	TOP	0.00	1	8	7.96	5.10
CL	2	TOP	1.50	1	8	5.30	5.10

10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
CL	1	TOP	0.00	1	8	3.60
CL	2	TOP	1.50	1	8	2.10
1	1	TOP	0.00	1	8	4.36
1	2	TOP	0.00	1	8	3.20

13 - PUNCHING SHEAR REINFORCEMENT

13.1 Critical Section Geometry

Column	Layer	Cond.	a	d	b1	b2
			cm	cm	cm	cm
1	1	1	15.48	30.96	110.96	130.96
2	1	1	15.48	30.96	110.96	130.96

13.2 Critical Section Stresses



Label	Layer	Cond.	Factored shear	Factored moment	Stress due to shear	Stress due to moment	Total stress	Allowable stress	Stress ratio
			T	T-m	T/cm2	T/cm2	T/cm2	T/cm2	
1	1	1	-161.43	+62.74	0.01	0.004	0.015	0.019	0.790
2	1	1	-149.54	-87.09	0.01	0.006	0.016	0.019	0.830

13.3 Punching Shear Reinforcement

Reinforcement option: Stirrups

Bar Size: 5

Col.	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs
	cm		cm		cm		cm		cm	
1										
2										

Dist. = Distance measured from the face of support

Note: Columns with --- have not been checked for punching shear.

Note: Columns with *** have exceeded the maximum allowable shear stress.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	cm	cm	cm	cm	cm	cm	cm	cm
CL	0.1	-0.1	0.0	-0.1(5347)	-0.2(1807)	0.0(****)	-0.1(5347)	-0.3(1350)
1	0.6	-0.1	0.2	0.5(2166)	0.6(1946)	0.0(****)	0.5(2166)	1.1(1026)
CR	0.0	-0.1	-0.2	-0.5(657)	-0.2(1780)	0.0(****)	-0.5(657)	-0.6(480)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

15 - FRICTION, ELONGATION AND LONG TERM LOSSES

15.1 Input Parameters

Parameter	Value	Parameter	Value
Type of Strand	Low Relaxation	Coefficient of Angular Friction (meu)	0.17000 1/rad
Age of Concrete at Stressing	3 days	Coefficient of Wobble Friction (K)	0.00160 rad/m
Ec at Stressing	238.00 T/cm2	Ratio of Jacking Stress	0.75
Average Relative Humidity	80.00 percent	Anchor Set	6.00 mm
Volume to Surface Ratio of Members	11.50 cm	Tendon A Stressing Method	Right side
Es of Strand	2030.00 T/cm2	Tendon B Stressing Method	Left side

15.2 Long-term Losses

Tendon	Span	Left	Center	Right
		T/cm2	T/cm2	T/cm2
TENDON A	CL	0.55	0.56	0.46
TENDON A	1	0.45	0.44	0.41
TENDON A	CR	0.52	0.52	0.51
TENDON B	CL	0.53	0.53	0.44
TENDON B	1	0.42	0.46	0.46
TENDON B	CR	0.56	0.56	0.56



15.3 Calculated Stresses After Friction and Long-term Losses

Tendon	Span	Stress Left FL Only	Stress Center FL Only	Stress Right FL Only	Stress Left FL+LTL	Stress Center FL+LTL	Stress Right FL+LTL
		T/cm2	T/cm2	T/cm2	T/cm2	T/cm2	T/cm2
TENDON A	CL	12.52	12.62	12.88	11.97	12.06	12.42
TENDON A	1	12.88	12.84	12.35	12.45	12.41	11.95
TENDON A	CR	12.35	12.06	11.93	11.83	11.54	11.43
TENDON B	CL	12.16	12.26	12.38	11.63	11.73	11.93
TENDON B	1	12.38	13.01	12.96	11.96	12.54	12.50

TENDON B	CR	12.96	12.65	12.55	12.39	12.10	11.99
----------	----	-------	-------	-------	-------	-------	-------

15.6 Summary

Tendon	Force	Ext. Left	Start Span	End Span	Ext. Right	Elong. Left	Elong Right	Anchor Left	Anchor Right	Max Stress ratio
	T					cm	cm			
TENDON A	11.86	0.00	CL	3	0.00	0.00	11.36	0.66	0.63	0.69
TENDON B	11.97	0.00	CL	3	0.00	11.46	-0.00	0.64	0.66	0.69

16 - Unbalanced Moment Reinforcement

16.1 Unbalanced Moment Reinforcement - No Redistribution

Joint	Gamma Left	Gamma Right	Width Left	Width Right	Moment Left Neg	Moment Left Pos	Moment Right Neg	Moment Right Pos	As Top	As Bot	n Bar Top	n Bar Bot
			m	m	T-m	T-m	T-m	T-m	cm2	cm2		
1	0.62	0.62	2.05	2.05	0.00	0.00	-47.39	0.00	0.00	0.00	0	0
2	0.62	0.62	2.05	2.05	-68.30	0.00	0.00	0.00	0.00	0.00	0	0





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C



พัฒนาพื้นที่ส่วนขยาย ศูนย์ราชการ พื้นที่ โซน **C** อาคารทิศตะวันตก **W**
4-8



1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Fy (Main bars)	4.00 T/cm 2
F'c for BEAMS/SLABS	320.00 Kg/cm 2	Fy (Shear reinforcement)	4.00 T/cm 2
F'ci for BEAMS/SLABS	280.00 Kg/cm 2	Minimum Cover at TOP	1.50 cm
For COLUMNS/WALLS	240.00 Kg/cm 2	Minimum Cover at BOTTOM	1.50 cm
Ec for BEAMS/SLABS	257.00 T/cm 2	Post-tensioning	
For COLUMNS/WALLS	257.00 T/cm 2	SYSTEM	BONDED
CREEP factor	2.00	Fpu	19.00 T/cm 2
CONCRETE WEIGHT	NORMAL	Fse	10.80 T/cm 2
UNIT WEIGHT	2400.00 Kg/m 3	Strand area	0.990 cm 2
Tension stress limits / (f'c)1/2		Min CGS from TOP	4.20 cm
At Top	1.590	Min CGS from BOT for interior spans	5.60 cm
At Bottom	1.590	Min CGS from BOT for exterior spans	5.60 cm
Compression stress limits / f'c		Min average precompression	10.00 Kg/cm 2
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (f'c)1/2		Analysis and design options	
At Top	0.795	Structural system - Equiv Frame	TWO-WAY
At Bottom	0.795	Moments reduced to face of support	YES
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	DESIGN CODE SELECTED	ACI-318 (1999)
Reinforcement			

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	cm	cm	cm	cm	cm	cm	cm		
C	1	2.50	840.00	23.00					0.00	0.50	0.50
1	1	8.00	840.00	23.00					0.00	0.50	0.50
C	1	0.50	840.00	23.00					0.00	0.50	0.50

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	cm	m	cm	cm			m	cm	cm		
1	100.0	3.0	80.0	100.0	100	(1)	3.0	80.0	100.0	100	(1)
2	100.0	3.0	80.0	100.0	100	(1)	3.0	80.0	100.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			T/m2	T/m	T/m	m	m	m	T	T-m
CANT	LL	U	0.300							
CANT	SDL	U	0.370							
1	LL	U	0.300							
1	SDL	U	0.370							
CANT	LL	U	0.300							
CANT	SDL	U	0.370							

NOTE: SELFWEIGHT INCLUSION REQUIRED (SW= SELF WEIGHT Computed from geometry input and treated as dead loading. Unit selfweight W = 2400.0 Kg/m³)



NOTE: LIVE LOADING is SKIPPED with a skip factor of 0.75

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			T/m	T/m	T	T-m	m	m	m	%
CL	LL	U	2.520							0.000
CL	SDL	U	3.108							
CL	SW	U	4.637							
1	LL	U	2.520							0.000
1	SDL	U	3.108							
1	SW	U	4.637							
CR	LL	U	2.520							0.000
CR	SDL	U	3.108							
CR	SW	U	4.637							

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	I	Yb	Yt
	cm ²	cm ⁴	cm	cm
CANT	19320.00	0.85E+06	11.50	11.50
1	19320.00	0.85E+06	11.50	11.50
CANT	19320.00	0.85E+06	11.50	11.50

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		T-m	T-m	T-m	T	T
CANT	SW	-----	-----	-14.49	-----	11.59
1	SW	-24.85	15.22	-18.90	-19.29	17.80
CANT	SW	-0.58	-----	-----	-2.32	-----
CANT	SDL	-----	-----	-9.71	-----	7.77
1	SDL	-16.65	10.20	-12.67	-12.93	11.93
CANT	SDL	-0.39	-----	-----	-1.55	-----
CANT	XL	-----	-----	0.00	-----	0.00
1	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		T	T-m	T-m
1	SW	30.88	-5.36	-5.00
2	SW	20.12	9.47	8.85
1	SDL	20.70	-3.59	-3.35
2	SDL	13.49	6.35	5.93
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00



5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	T-m	T-m	T-m	T-m	T-m	T-m	T	T
CL	-----	-----	-----	-----	-7.88	-----	-----	6.30

1	-13.50	-1.76	8.27	-0.58	-10.27	0.61	-10.48	9.68
CR	-0.31	-----	-----	-----	-----	-----	-1.26	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	16.80	6.70	2.86	-5.77	2.67	-5.39
2	11.35	0.86	5.73	-0.58	5.35	-0.55

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		T-m	T-m	T-m
CANT	SW	-----	-----	-9.27
1	SW	-15.78	15.22	-10.58
CANT	SW	0.00	-----	-----
CANT	SDL	-----	-----	-6.22
1	SDL	-10.58	10.20	-7.09
CANT	SDL	0.00	-----	-----
CANT	XL	-----	-----	0.00
1	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	-----	-----	-----	-----	-5.04	-----
1	-8.58	-1.61	8.27	-0.58	-5.75	0.46
CR	0.00	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
CL	1	---	---	0.000	---
1	1	0.100	0.500	0.100	---
CR	1	0.100	---	---	---

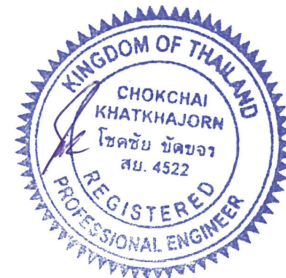
7.2 Selected Post-Tensioning Forces and Tendon Drape

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	T	cm	cm	cm	cm	kg/cm2	T/-	
CL	195.479	-11.20	---	---	-4.20	10.18	4.405	57
1	203.649	-4.20	---	-17.40	-11.20	10.54	2.469	32
CR	198.990	-11.20	---	---	-11.20	10.30	0.000	0

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	T	kg/cm2	
CL	195.479	10.18	57



1	203.649	10.54	32
CR	198.99	10.3	0

Approximate weight of strand: 158.6 Kg

7.3 Tendon Extents and Stressing Conditions

Type	Num	Force	Left End	Right End	From	To	Extension
A	17	11.78	Live	Live	CL	CR	---

7.4 Required Minimum Post-Tensioning Forces

Type	Based on Stress Conditions			Based on Minimum P/A		
	Left	Center	Right	Left	Center	Right
	T	T	T	T	T	T
CL	----	----	0.00	----	----	193.20
1	134.28	157.66	33.41	193.20	193.20	193.20
CR	0.00	----	----	193.20	----	----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²	kg/cm ²
CL	----	----	----	----	----	----	----	----	4.88	-1.93	----	-25.18
1	19.27	----	----	-39.98	----	-44.55	23.47	----	12.65	----	----	-33.30
CR	----	-11.10	----	-9.49	----	----	----	----	----	----	----	----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

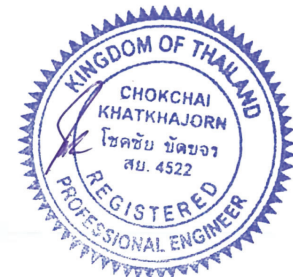
Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	T-m	T-m	T-m	T	T
CL	----	----	9.40	----	8.81
1	13.00	-8.51	6.40	-0.94	-0.94
CR	0.60	----	----	0.00	----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	T	T-m	T-m
1	0.935	0.142	0.133
2	-0.935	-3.753	-3.504

Note: Moments are reported at face of support



8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)

Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	T-m	T-m	T-m	T-m	T-m	T-m
CL	----	----	----	----	-30.25	----
1	-50.77	-38.94	53.42	38.37	-27.69	-17.13
CR	0.00	----	----	----	----	----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	T	T	T-m	T-m	T-m	T-m
1	101.71	84.53	-7.53	-22.19	-7.03	-20.72

2	65.41	47.59	28.14	17.41	26.28	16.25
---	-------	-------	-------	-------	-------	-------

8.3 Secondary Moments

Span	Left	Midspan	Right
	T-m	T-m	T-m
1	0.71	3.77	6.82

Note: Moments are reported at face of support

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	cm2	cm2	cm2	cm2	cm2
1	TOP	0.40	0.50	5.49	5.49	0.00	0.00	0.00
1	BOT	3.20	5.20	11.32	11.32	0.00	0.00	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	cm2
CL	1	TOP	0.00	1	8	5.60	5.10
CL	2	TOP	0.95	1	8	3.86	5.10
CL	3	BOT	0.00	6	5	11.00	12.00

10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
CL	1	TOP	0.00	1	8	2.50
CL	2	TOP	0.95	1	8	1.55
1	1	TOP	0.00	1	8	3.10
1	2	TOP	0.00	1	8	2.31
CL	3	BOT	0.00	6	5	2.50
1	3	BOT	0.00	6	5	8.00
CR	3	BOT	0.00	6	5	0.50

13 - PUNCHING SHEAR REINFORCEMENT

13.1 Critical Section Geometry

Column	Layer	Cond.	a	d	b1	b2
			cm	cm	cm	cm
1	1	1	9.48	18.96	118.96	98.96
2	1	2	9.48	18.96	109.48	98.96

13.2 Critical Section Stresses

Label	Layer	Cond.	Factored shear	Factored moment	Stress due to shear	Stress due to moment	Total stress	Allowable stress	Stress ratio
			T	T-m	T/cm2	T/cm2	T/cm2	T/cm2	
1	1	1	-101.61	+33.52	0.01	0.004	0.017	0.016	1.072
2	1	2	-64.76	-52.51	0.01	0.007	0.018	0.015	1.184

13.3 Punching Shear Reinforcement

Reinforcement option: Stirrups

Bar Size: 5



Col.	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs	Dist	N Legs
	cm		cm		cm		cm		cm	
1	9.5	12								
2	9.5	9	19.0	10						

Dist. = Distance measured from the face of support

Note: Columns with --- have not been checked for punching shear.

Note: Columns with *** have exceeded the maximum allowable shear stress.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	cm	cm	cm	cm	cm	cm	cm	cm
CL	0.0	-0.1	-0.1	-0.3(786)	-0.1(3140)	0.0(****)	-0.3(786)	-0.4(629)
1	0.3	0.2	0.4	1.2(684)	0.2(4481)	0.0(****)	1.2(684)	1.3(593)
CR	0.0	0.0	0.0	-0.1(344)	0.0(2455)	0.0(****)	-0.1(344)	-0.2(302)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

15 - FRICTION, ELONGATION AND LONG TERM LOSSES

15.1 Input Parameters

Parameter	Value	Parameter	Value
Type of Strand	Low Relaxation	Coefficient of Angular Friction (meu)	0.17000 1/rad
Age of Concrete at Stressing	3 days	Coefficient of Wobble Friction (K)	0.00160 rad/m
Ec at Stressing	238.00 T/cm2	Ratio of Jacking Stress	0.75
Average Relative Humidity	80.00 percent	Anchor Set	6.00 mm
Volume to Surface Ratio of Members	11.50 cm	Tendon A Stressing Method	Both sides
Es of Strand	2030.00 T/cm2		

15.2 Long-term Losses

Tendon	Span	Left	Center	Right
		T/cm2	T/cm2	T/cm2
TENDON A	CL	0.56	0.57	0.59
TENDON A	1	0.51	0.54	0.59
TENDON A	CR	0.59	0.59	0.59

15.3 Calculated Stresses After Friction and Long-term Losses

Tendon	Span	Stress Left FL Only	Stress Center FL Only	Stress Right FL Only	Stress Left FL+LTL	Stress Center FL+LTL	Stress Right FL+LTL
		T/cm2	T/cm2	T/cm2	T/cm2	T/cm2	T/cm2
TENDON A	CL	12.07	12.16	12.25	11.51	11.58	11.67
TENDON A	1	12.25	12.63	12.41	11.75	12.09	11.81
TENDON A	CR	12.41	12.40	12.40	11.81	11.80	11.80

15.6 Summary

Tendon	Force	Ext. Left	Start Span	End Span	Ext. Right	Elong. Left	Elong Right	Anchor Left	Anchor Right	Max Stress ratio
	T					cm	cm			
TENDON A	11.68	0.00	CL	3	0.00	6.83	0.09	0.64	0.65	0.67

16 - Unbalanced Moment Reinforcement

16.1 Unbalanced Moment Reinforcement - No Redistribution

Joint	Gamma Left	Gamma Right	Width Left	Width Right	Moment Left Neg	Moment Left Pos	Moment Right Neg	Moment Right Pos	As Top	As Bot	n Bar Top	n Bar Bot
-------	------------	-------------	------------	-------------	-----------------	-----------------	------------------	------------------	--------	--------	-----------	-----------





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

(สัญญาก่อสร้างอาคารทิศตะวันตก Final Detailed Design)

(ส่วนงานโครงสร้าง งานสถาปัตยกรรม และงานระบบหลัก)

โครงการพัฒนาพื้นที่ส่วนขยายศูนย์ราชการเฉลิมพระเกียรติ ๘๐ พรรษา ๕ ธันวาคม ๒๕๕๐ พื้นที่โซน C

			m	m	T-m	T-m	T-m	T-m	cm2	cm2		
1	0.58	0.58	1.49	1.49	0.00	0.00	-20.52	0.00	0.00	0.00	0	0
2	0.58	0.58	1.49	1.49	-27.69	0.00	0.00	0.00	0.00	0.00	0	0





รายงานการออกแบบ Design Note รายการคำนวณงานโครงสร้าง

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4. รายการคำนวณพื้นค.ส.ล.



DYNAMIC ENGINEERING CONSULTANT CO., LTD.

ONE WAY SLAB

(Ultimate Stress Design method in accordance with ACI 318)

Job No. : 193018

Rev. : 0

Initial : CKJ

Date : 6-Jan-21

Slab No. : S-1

Project : อาคารด้านทิศตะวันตก

filename : 1 Slab

Concrete Strength $f_c' = 350$ [kg/cm²]
 f_y SD = 4000 [kg/cm²]
 f_y RD = 2400 [kg/cm²]
 Clear span Length $L_n = 340$ [cm]
 Load $LL = 800$ [kg/m]

Type of Slab

Simple Support

Reinforcement Steel

DB12

Thick of Slab $DL = 360$ [kg/m]
 $h = 15$ [cm]
 $W_u = 1864$ [kg/m]
 Moment $- Mu_L = 898$ [kg-m]
 $+ Mu_m = 2693$ [kg-m]
 $- Mu_R = 898$ [kg-m]
 Shear $V_{ur} = 3644$ [kg]

$K = 0.80$

$\phi = 0.90$

$\rho = 0.0360$

$\rho_{max} = 0.0270$

$d = 5.8$ [cm]

$d < h$ OK

Check Shear

Existing Unit Shear $v_c = 3.17$ [kg/cm²]

Allowable Shear unit $v_{all} = 8.92$ [kg/cm²]

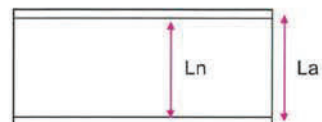
$v_c < v_{all}$ OK

$a_{try} = 0.9108$ [cm]

$As = 6.774$ [cm²]

$a = 0.9108$ [cm]

$j d = 14.54$ [cm]



$$\begin{aligned} Mu &= 1/24 W_u L_n^2 & Mu &= 1/9 W_u L_n^2 \\ Mu &= 1/14 W_u L_n^2 & Mu &= 1/14 W_u L_n^2 \\ V_{ur} &= 1.15 W_u L_n / 2 \end{aligned}$$

Check Deflection

$\Delta_{all} = 0.94$ [cm]

$\rho f_y = 13.7 < 35$ [kg/cm²]

$I = 28125$ [cm⁴]

$E_c = 284116$ [kg/cm²]

$\Delta = 0.41$ [cm] $< \Delta_{all}$ OK

LL = 40 % and Coefficient = 2

$\Delta_{Time} = 0.3 < \Delta_{all}$ OK

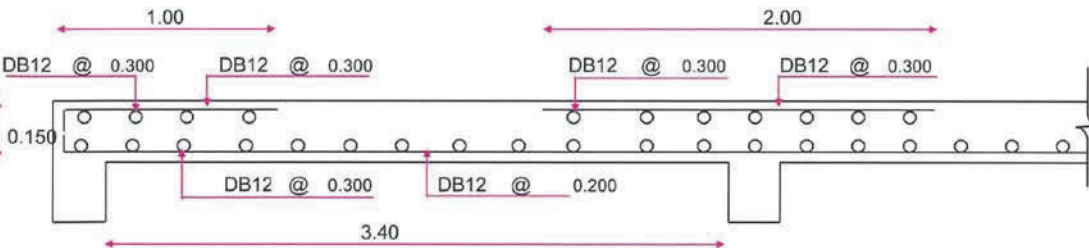
Moment arm

$M_u / \phi f_y j d$ $- Mu_L$ $As_L = 1.71$ [cm²]

$+ Mu_m$ $As_m = 5.14$ [cm²]

$- Mu_R$ $As_R = 1.71$ [cm²]

Minimum Steel $As_{min} = 3.00$ [cm²]



One Way Slab (0.15)



DYNAMIC ENGINEERING CONSULTANT CO., LTD.

TWO WAY SLAB

(Ultimate Stress Design method in accordance with ACI 318)

(Method 2)

Slab No. **FS-1**

Project : **อาคารด้านทิศตะวันตก**

Job No. : **193018**

Rev. : **0**

Initial : **CKJ**

Date : **6-Jan-21**

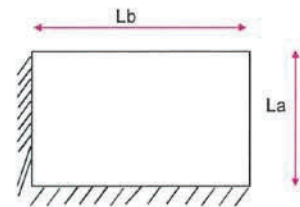
Filename : **Slab S**

Concrete Strength	f_c'	=	350	[kg/cm ²]
	f_y SD	=	4000	[kg/cm ²]
	f_y RD	=	2400	[kg/cm ²]
Thick of Slab	h	=	27.5	[cm]
Clear span Length	L_a	=	800	[cm]
	L_b	=	840	[cm]
Live Load	LL	=	1500	[kg/m ²]
Finishing Load	FL	=	120	[kg/m ²]

4 Siden Continuous

DB16

	DL	=	660	[kg/m]
	k	=	0.80	
	ϕ bend	=	0.90	
	ϕ Shear	=	0.85	
Cover (Short Side)	C_c	=	4.0	[cm]
Depth of Slab	d	=	23.5	[cm]
	W_u	=	3642	[kg/m]
	L_b/L_a	=	1.05	OK
	m	=	0.952	
Shear	V_u S	=	9712	[kg/m]
	V_u L	=	10163	[kg/m]
	V_c all	=	16856	[kg/m]
	V_u L	<	V_c all	OK



Check h	ρ	=	0.0360	
	ρ_{max}	=	0.0270	
Required d	=	10.8	[cm]	
	d	<	23.5	OK
	a try	=	2	[cm]
	As	=	11.392	[cm ²]
	a	=	1.5317	[cm]
Moment arm	j d	=	22.73	[cm]

Short Span

Moment	- Continue M_u	=	9324	[kg-m]
	- Not Cont. M_u	=	0	[kg-m]
	+ Middle M_u m	=	6604	[kg-m]

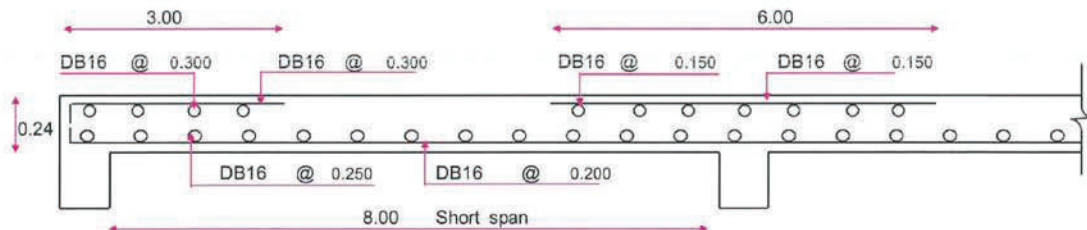
$M_u / \phi f_y j d$

$As1$	=	11.39	[cm ²]	6 DB16 @ 0.150	OK
$As2$	=	0.00	[cm ²]	1 DB16 @ 0.300	OK
$As3$	=	8.07	[cm ²]	5 DB16 @ 0.200	OK

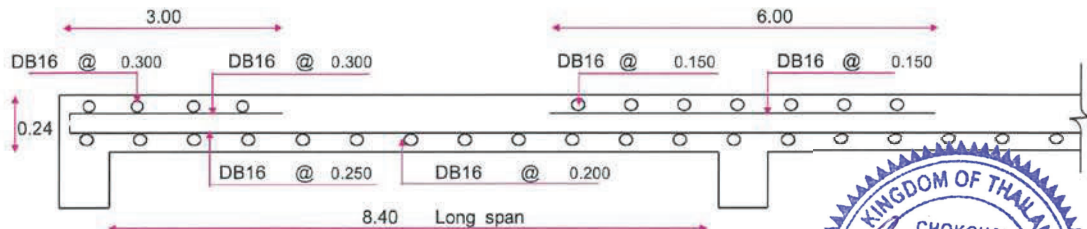
Long Span

Moment	- Continue M_u	=	8857	[kg-m]
	- Not Cont. M_u	=	0	[kg-m]
	+ Middle M_u m	=	5827	[kg-m]
Minimum Steel				

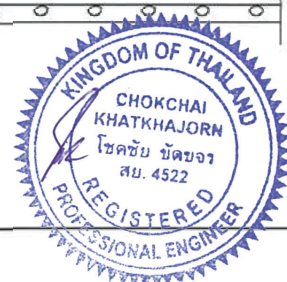
$As4$	=	10.82	[cm ²]	6 DB16 @ 0.150	OK
$As5$	=	0.00	[cm ²]	1 DB16 @ 0.300	OK
$As6$	=	7.12	[cm ²]	4 DB16 @ 0.250	OK
As min	=	5.50	[cm ²]	3 DB16 @ 0.300	OK



Two Way Slab (0.28)



Two Way Slab (0.28)



DYNAMIC ENGINEERING CONSULTANT CO., LTD.

ONE WAY SLAB

(Ultimate Stress Design method in accordance with ACI 318)

Job No. : 193018

Rev. : 0

Initial : CKJ

Date : 6-Jan-21

Slab No. : GUS-1

Project : อาคารทิศตะวันตก

filename : Slab

Concrete Strength $f_c' = 350$ [kg/cm²]
 f_y SD = 4000 [kg/cm²]
 f_y RD = 2400 [kg/cm²]
 Clear span Length $L_n = 200$ [cm]
 Load $LL = 1000$ [kg/m]

Type of Slab

Cantilever

Reinforcement Steel

DB12

Thick of Slab $DL = 480$ [kg/m]
 $h = 20$ [cm]
 $W_u = 2372$ [kg/m]
 Moment $- Mu_L = 4744$ [kg-m]
 $+ Mu_m = 0$ [kg-m]
 $- Mu_R = 0$ [kg-m]
 Shear $V_{ur} = 2728$ [kg]
 $K = 0.80$
 $\phi = 0.90$
 $\rho = 0.0360$
 $\rho_{max} = 0.0270$
 $d = 7.7$ [cm] ($M_u / \phi \rho f_y d b^2 (1 - 0.59 \rho f_y / f_c')^{0.5}$)

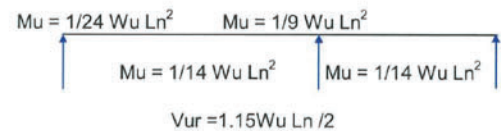
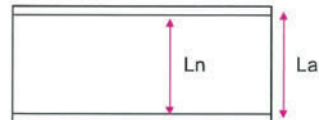
$d < h$ OK

Check Shear

Existing Unit Shear $v_c = 1.65$ [kg/cm²]
 Allowable Shear unit $v_{all} = 8.92$ [kg/cm²]
 $v_c < v_{all}$ OK
 $a_{try} = 1.1112$ [cm]
 $As = 8.265$ [cm²]
 $a = 1.1112$ [cm]
 $j d = 19.44$ [cm]

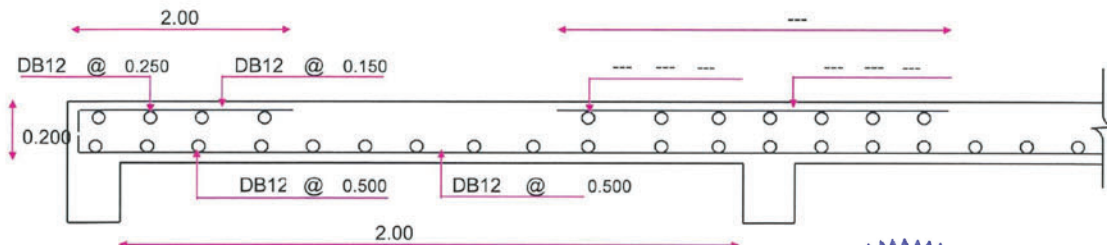
Check Deflection

$\Delta_{all} = 0.56$ [cm]
 $\rho f_y = 13.6 < 35$ [kg/cm²]
 $I = 66667$ [cm⁴]
 $E_c = 284116$ [kg/cm²]
 $\Delta = 0.03$ [cm] $< \Delta_{all}$ OK
 $LL = 40\%$ and Coefficient = 2
 $\Delta_{Time} = 0.02 < \Delta_{all}$ OK

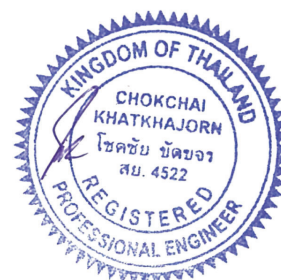


Moment arm

$M_u / \phi f_y j$
 $- Mu_L$ $As_L = 6.78$ [cm²] 6 DB12 @ 0.150 OK
 $+ Mu_m$ $As_m = 0.00$ [cm²] 1 DB12 @ 0.500 OK
 $- Mu_R$ $As_R = 0.00$ [cm²] 1 --- --- OK
 Minimum Steel $As_{min} = 4.00$ [cm²] 4 DB12 @ 0.250 OK



One Way Slab (0.2)



DYNAMIC ENGINEERING CONSULTANT CO., LTD.

ONE WAY SLAB

(Ultimate Stress Design method in accordance with ACI 318)

Job No. : 193018

Rev. : 0

Initial : CKJ

Date : 6-Jan-21

Slab No. : DS-1

Project : อาคารทิศตะวันตก

filename : Slab

Concrete Strength $f_c' = 350$ [kg/cm²]
 f_y SD = 4000 [kg/cm²]
 f_y RD = 2400 [kg/cm²]
 Clear span Length $L_n = 340$ [cm]
 Load $LL = 800$ [kg/m]

Type of Slab

Simple Support

Reinforcement Steel

DB12

Thick of Slab $DL = 480$ [kg/m]
 $h = 20$ [cm]
 Moment $W_u = 2032$ [kg/m]
 $- Mu_L = 979$ [kg-m]
 $+ Mu_m = 2936$ [kg-m]
 $- Mu_R = 979$ [kg-m]
 Shear $V_{ur} = 3973$ [kg]
 $K = 0.80$
 $\phi = 0.90$
 $\rho = 0.0360$
 $\rho_{max} = 0.0270$
 $d = 6.1$ [cm] ($M_u / \phi \rho f_y d b^2 (1 - 0.59 \rho f_y / f_c')^{0.5}$)

$d < h$ OK

Sheck Shear

Existing Unit Shear $v_c = 2.41$ [kg/cm²]
 Allowable Shear unit $v_{all} = 8.92$ [kg/cm²]
 $v_c < v_{all}$ OK

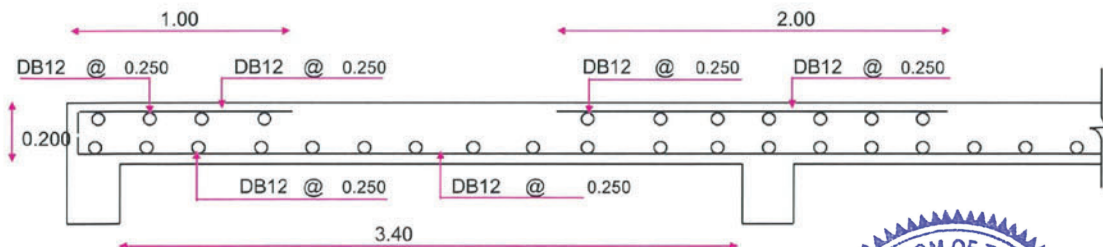
$a_{try} = 0.6786$ [cm]
 $As = 5.047$ [cm²]
 $a = 0.6786$ [cm]
 $j d = 19.66$ [cm]

Check Deflection

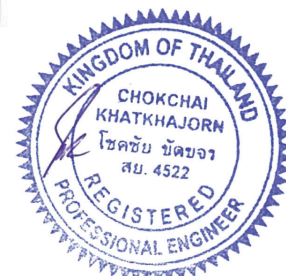
$\Delta_{all} = 0.94$ [cm]
 $\rho f_y = 8.3 < 35$ [kg/cm²]
 $I = 66667$ [cm⁴]
 $E_c = 284116$ [kg/cm²]
 $\Delta = 0.19$ [cm] $< \Delta_{all}$ OK
 $LL = 40\%$ and Coefficient = 2
 $\Delta_{Time} = 0.15 < \Delta_{all}$ OK

Moment arm

$M_u / \phi f_y j d$
 $- Mu_L As_L = 1.38$ [cm²] 2 DB12 @ 0.250 OK
 $+ Mu_m As_m = 4.15$ [cm²] 4 DB12 @ 0.250 OK
 $- Mu_R As_R = 1.38$ [cm²] 2 DB12 @ 0.250 OK
 Minimum Steel $As_{min} = 4.00$ [cm²] 4 DB12 @ 0.250 OK



One Way Slab (0.2)



DYNAMIC ENGINEERING CONSULTANT CO., LTD.

ONE WAY SLAB

(Ultimate Stress Design method in accordance with ACI 318)

Job No. : 193018

Rev. : 0

Initial : CKJ

Date : 6-Jan-21

Slab No. : LS-1

Project : อาคารทิศตะวันตก

filename : Slab

Concrete Strength $f_c' = 350$ [kg/cm²]
 f_y SD = 4000 [kg/cm²]
 f_y RD = 2400 [kg/cm²]
 Clear span Length $L_n = 350$ [cm]
 Load $LL = 2000$ [kg/m]

Type of Slab

Simple Support

Reinforcement Steel

DB12

Thick of Slab $DL = 480$ [kg/m]
 $h = 20$ [cm]
 $W_u = 4072$ [kg/m]
 Moment $- Mu_L = 2078$ [kg-m]
 $+ Mu_m = 6235$ [kg-m]
 $- Mu_R = 2078$ [kg-m]
 Shear $V_{ur} = 8195$ [kg]
 $K = 0.80$
 $\phi = 0.90$
 $\rho = 0.0360$
 $\rho_{max} = 0.0270$
 $d = 8.9$ [cm] ($M_u / \phi \rho f_y d b^2 (1 - 0.59 \rho f_y / f_c')^{0.5}$)

$d < h$ OK

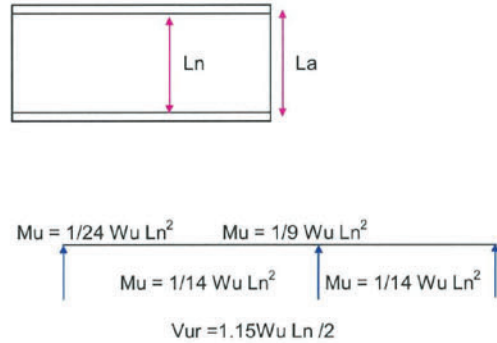
Shear

Existing Unit Shear $v_c = 4.97$ [kg/cm²]
 Allowable Shear unit $v_{all} = 8.92$ [kg/cm²]
 $v_c < v_{all}$ OK

$a_{try} = 1.4775$ [cm]
 $A_s = 10.989$ [cm²]
 $a = 1.4775$ [cm]
 $j d = 19.26$ [cm]

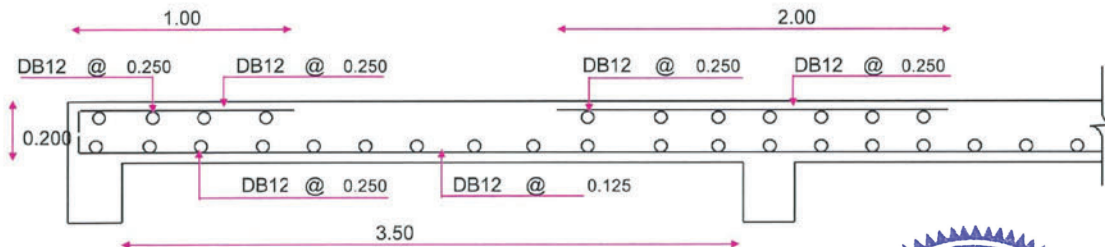
Check Deflection

$\Delta_{all} = 0.97$ [cm]
 $\rho f_y = 18.0 < 35$ [kg/cm²]
 $I = 66667$ [cm⁴]
 $E_c = 284116$ [kg/cm²]
 $\Delta = 0.42$ [cm] $< \Delta_{all}$ OK
 $LL = 40\%$ and Coefficient = 2
 $\Delta_{Time} = 0.26 < \Delta_{all}$ OK



Moment arm

$M_u / \phi f_y j d$
 $- Mu_L$ $A_s L = 3.00$ [cm²] 3 DB12 @ 0.250 OK
 $+ Mu_m$ $A_s m = 8.99$ [cm²] 8 DB12 @ 0.125 OK
 $- Mu_R$ $A_s R = 3.00$ [cm²] 3 DB12 @ 0.250 OK
 Minimum Steel $A_{s min} = 4.00$ [cm²] 4 DB12 @ 0.250 OK



One Way Slab (0.2)



DYNAMIC ENGINEERING CONSULTANT CO., LTD.

TWO WAY SLAB

(Ultimate Stress Design method in accordance with ACI 318)

(Method 2)

Slab No. **WS-1**

Project : **อาคารด้านทิศตะวันตก**

Job No. : **193018**

Rev. : **0**

Initial : **CKJ**

Date : **6-Jan-21**

Filename : **Slab S**

Concrete Strength	f_c'	=	350	[kg/cm ²]
	f_y SD	=	4000	[kg/cm ²]
	f_y RD	=	2400	[kg/cm ²]
Thick of Slab	h	=	20	[cm]
Clear span Length	L_a	=	300	[cm]
	L_b	=	410	[cm]
Live Load	LL	=	2000	[kg/m ²]
Finishing Load	FL	=	120	[kg/m ²]

0 Siden Continuous

DB12

DL	=	480	[kg / m]
k	=	0.80	
ϕ bend	=	0.90	
ϕ Shear	=	0.85	

Cover (Short Side)	C_c	=	5.0	[cm]
Depth of Slab	d	=	15.0	[cm]
	W_u	=	4240	[kg / m]
	L_b/L_a	=	1.37	OK
	m	=	0.732	

Shear	V_u S	=	4240	[kg / m]
	V_u L	=	5225	[kg / m]
	V_c all	=	9692	[kg / m]
	V_u L	<	V_c all	OK

Short Span

Moment	- Continue	M_u	=	0	[kg-m]
	- Not Cont.	M_u	=	0	[kg-m]
	+ Middle	M_u m	=	0	[kg-m]

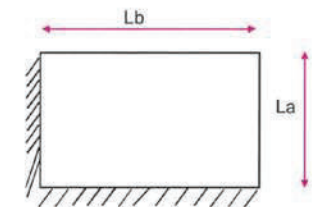
$M_u / \phi f_y j d$

As_1	=	0.00	[cm ²]	1 DB12	@	0.250	OK
As_2	=	0.00	[cm ²]	1 DB12	@	0.250	OK
As_3	=	0.00	[cm ²]	1 DB12	@	0.250	OK

Long Span

Moment	- Continue M_u	=	0	[kg-m]
	- Not Cont. M_u	=	1259	[kg-m]
	+ Middle M_u m	=	1908	[kg-m]
Minimum Steel				

As_4	=	0.00	[cm ²]	1 DB12	@	0.250	OK
As_5	=	2.37	[cm ²]	3 DB12	@	0.250	OK
As_6	=	3.59	[cm ²]	4 DB12	@	0.250	OK
As min	=	4.00	[cm ²]	4 DB12	@	0.250	OK



Check h/p = 0.0360

p_{max} = 0.0270

Required d = 4.9 [cm]

$(M_u / \phi p f_y d b^2 (1 - 0.59 p f_y / f_c'))^{0.5}$

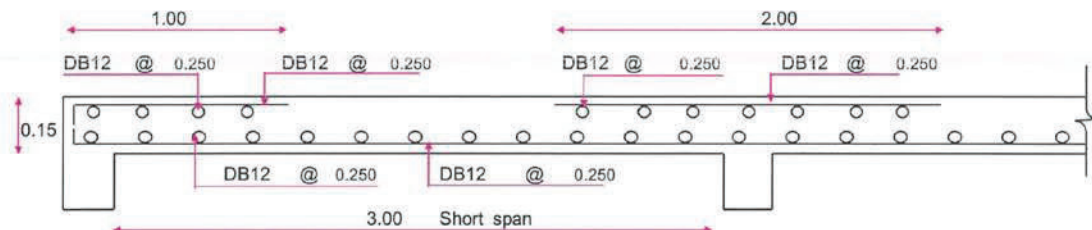
d < 15.0 OK

a try = 0 [cm]

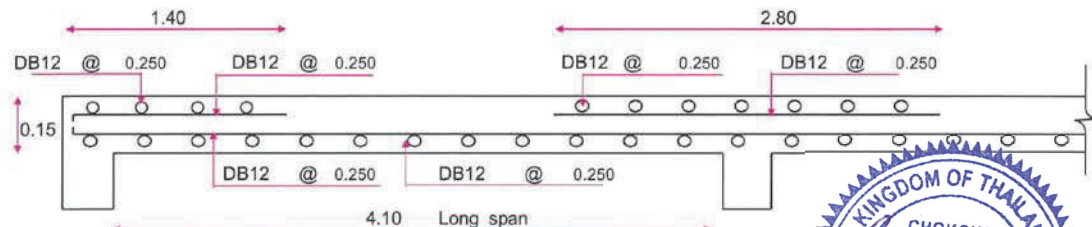
As = 3.591 [cm²]

a = 0.4828 [cm]

Moment arm $j d$ = 14.76 [cm]



Two Way Slab (0.20)



Two Way Slab (0.20)

