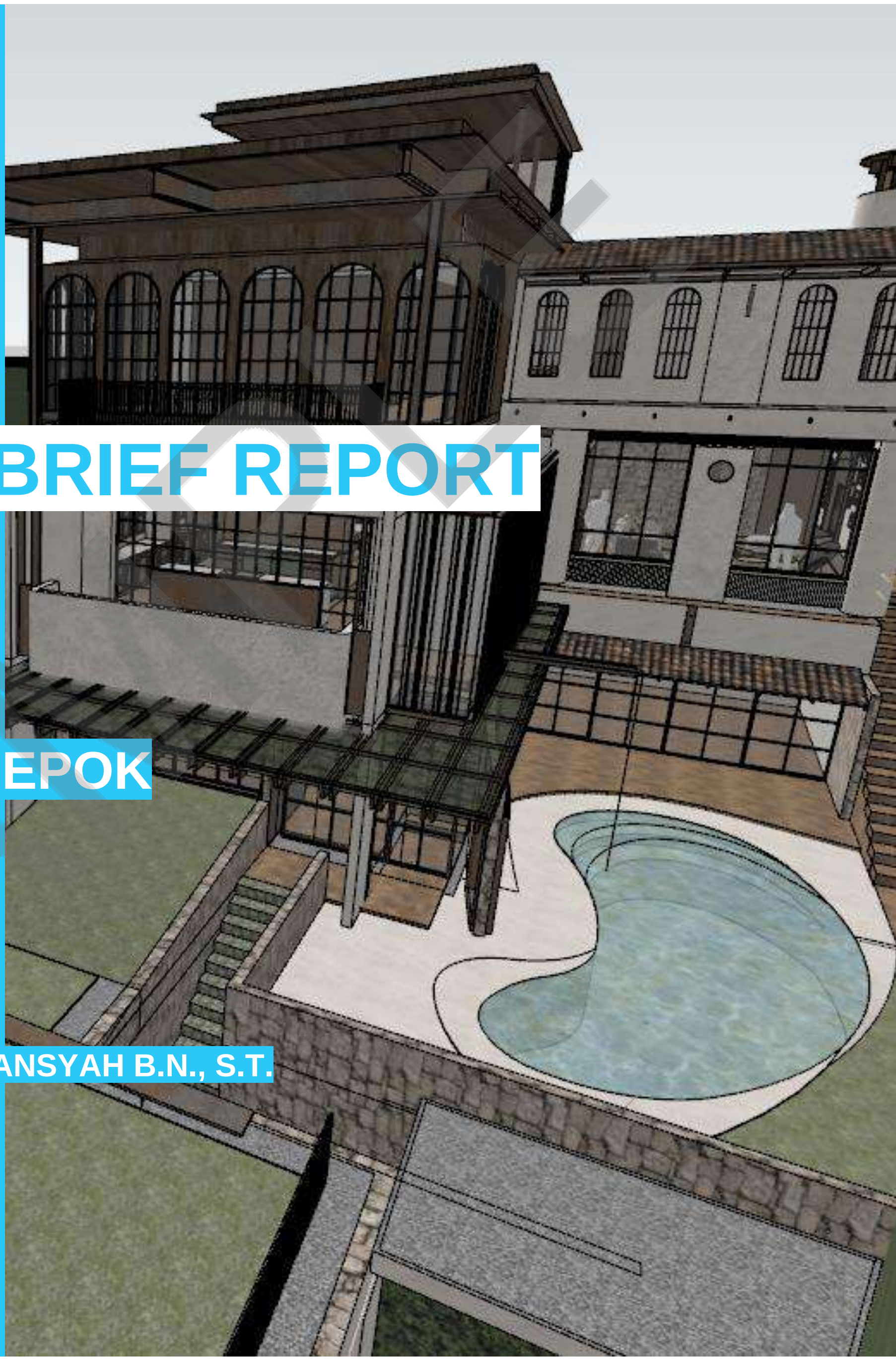
PADMA STRUKTUR



STRUCTURE BRIEF REPORT

PROJECT
LAKEHOUSE
CINERE ESTATE, DEPOK

BY: ZHAFRAN AL HAFIZH RAIHANSYAH B.N., S.T.

SEPTEMBER 2022

PREPARED FOR

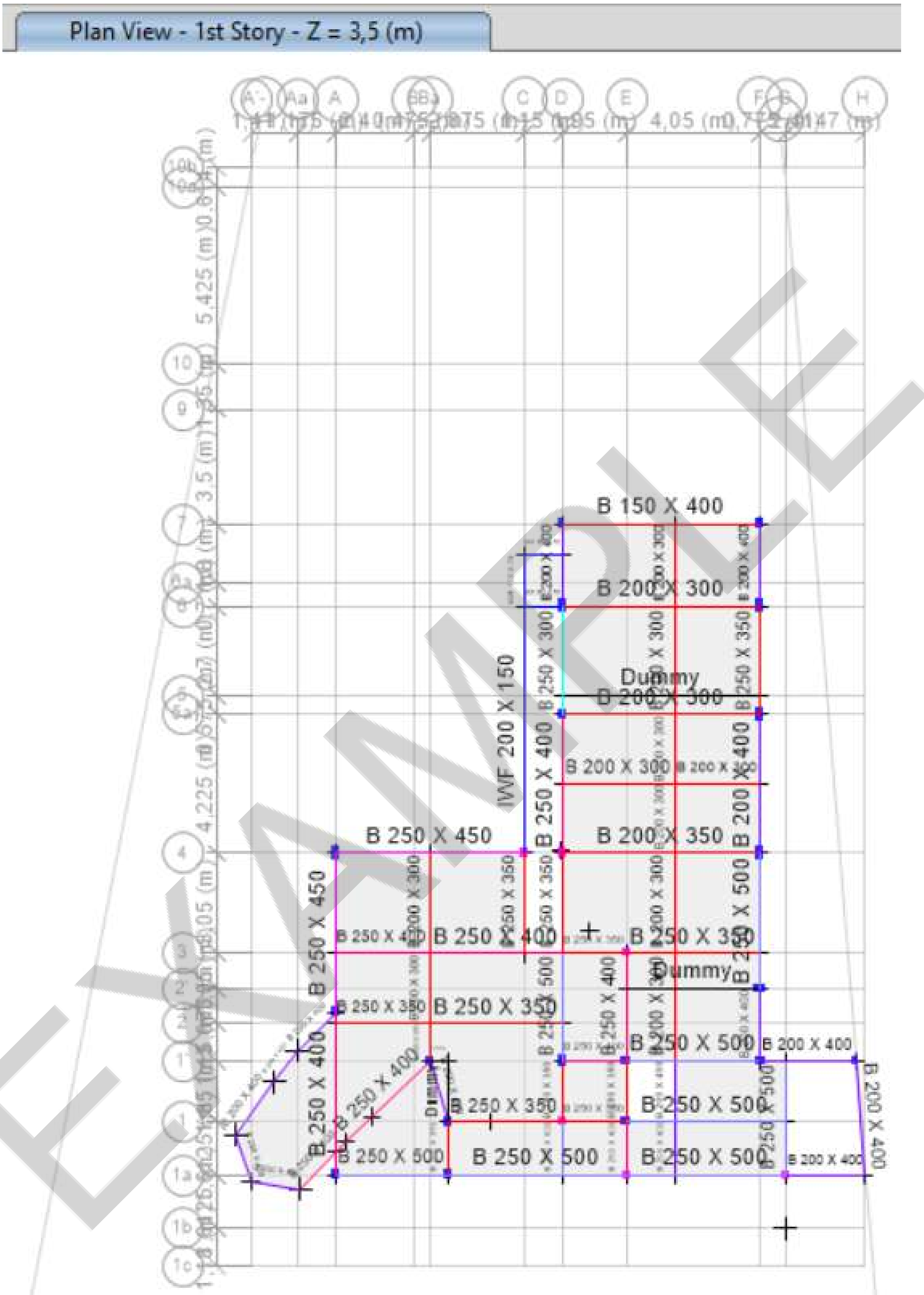
TABLE OF CONTENTS

CHAPTER I PROJECT DESCRIPTION

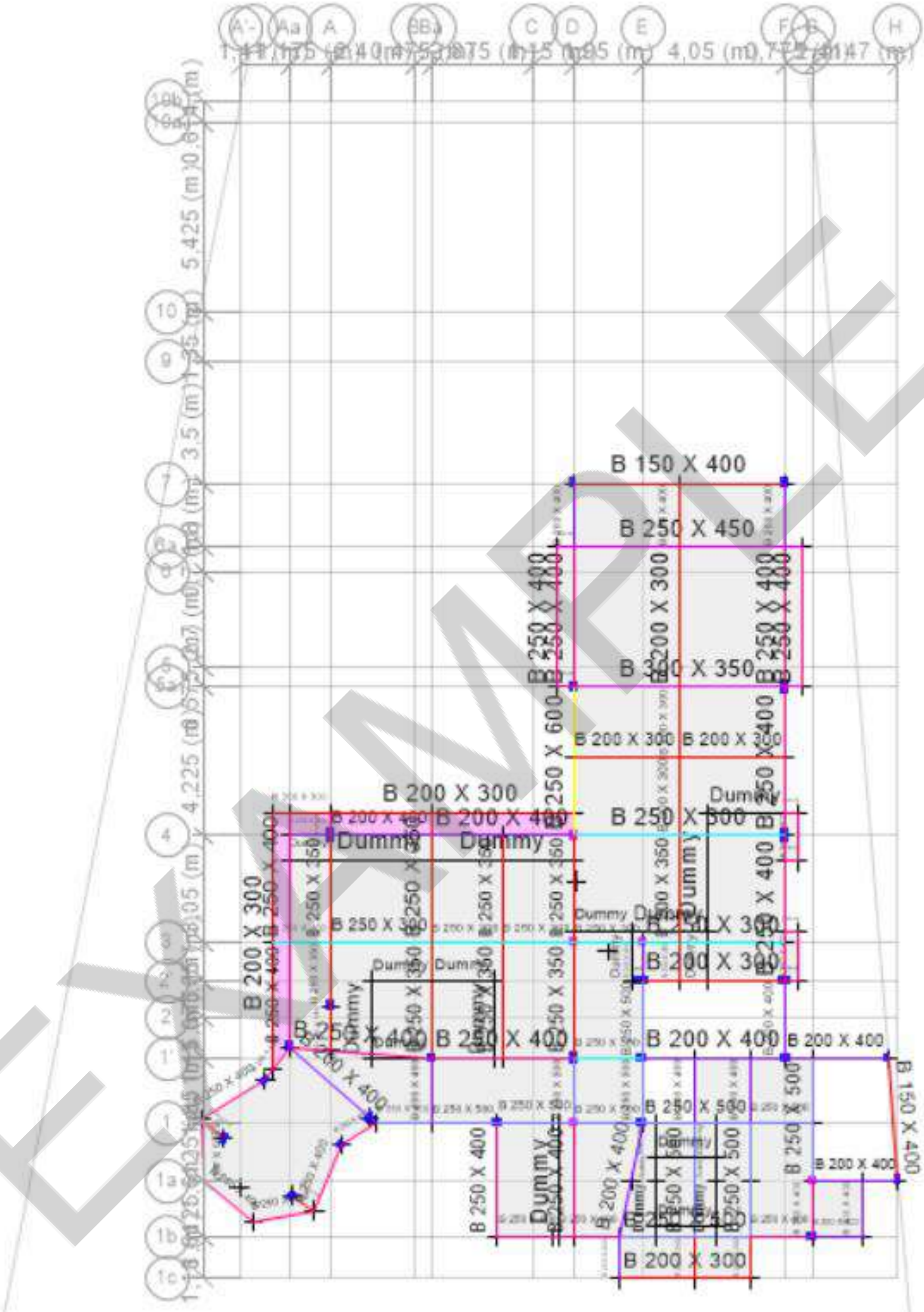
This project is a residential building project, which has a land area of ±594.77m² and a building area of ±988.91m². This project is located in the Cinere Estate Block A Housing Complex, Cinere District, Depok City. According to the client's request, this residential structure will consist of concrete beams and columns, along with a concrete roof and floor slab. For the rooftop, steel beams and columns will be used. The foundation will use a bored pile or driven piles.

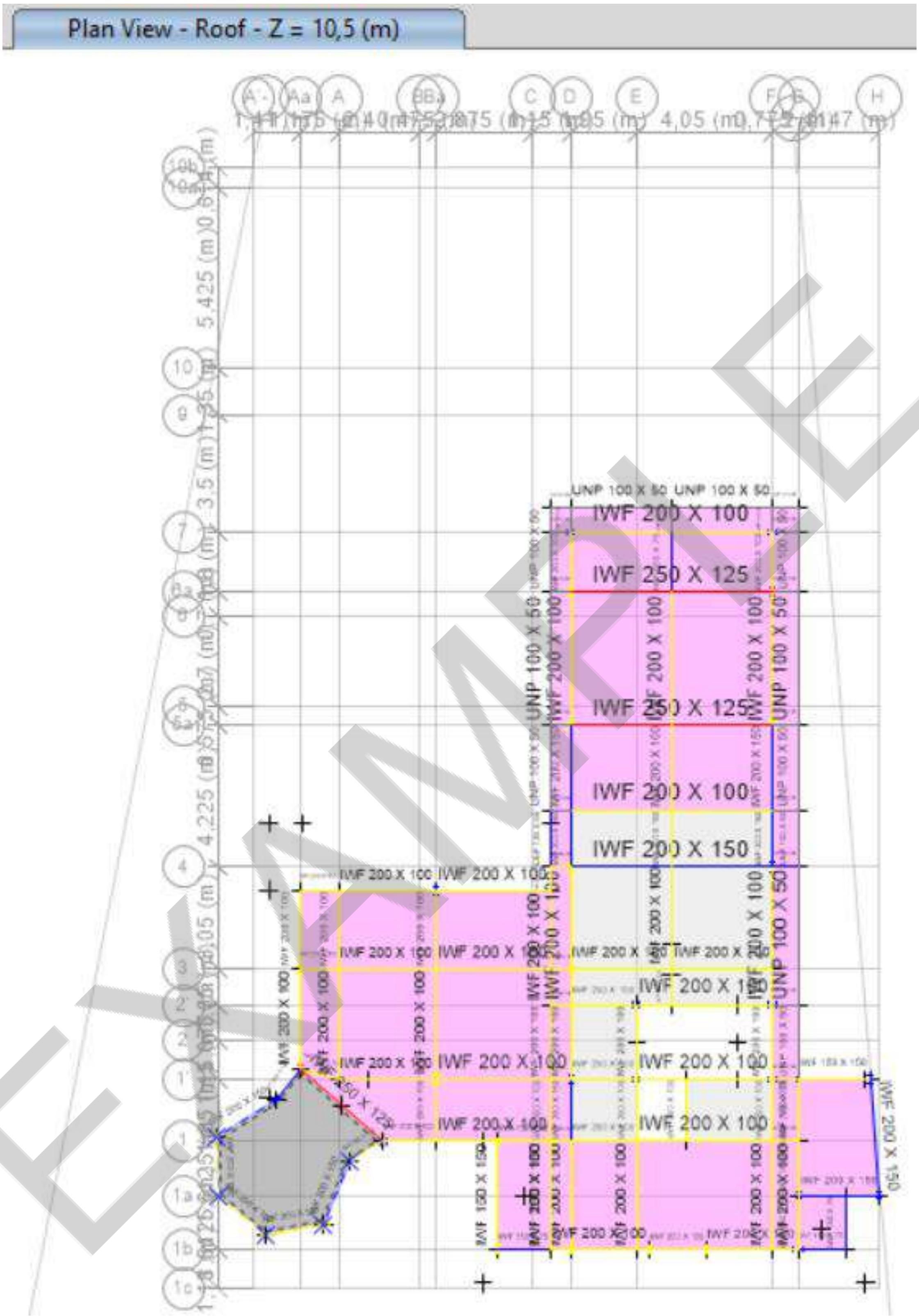
CHAPTER II PLAN LAYOUT WITH BEAM & COLUMN DIMENSIONS

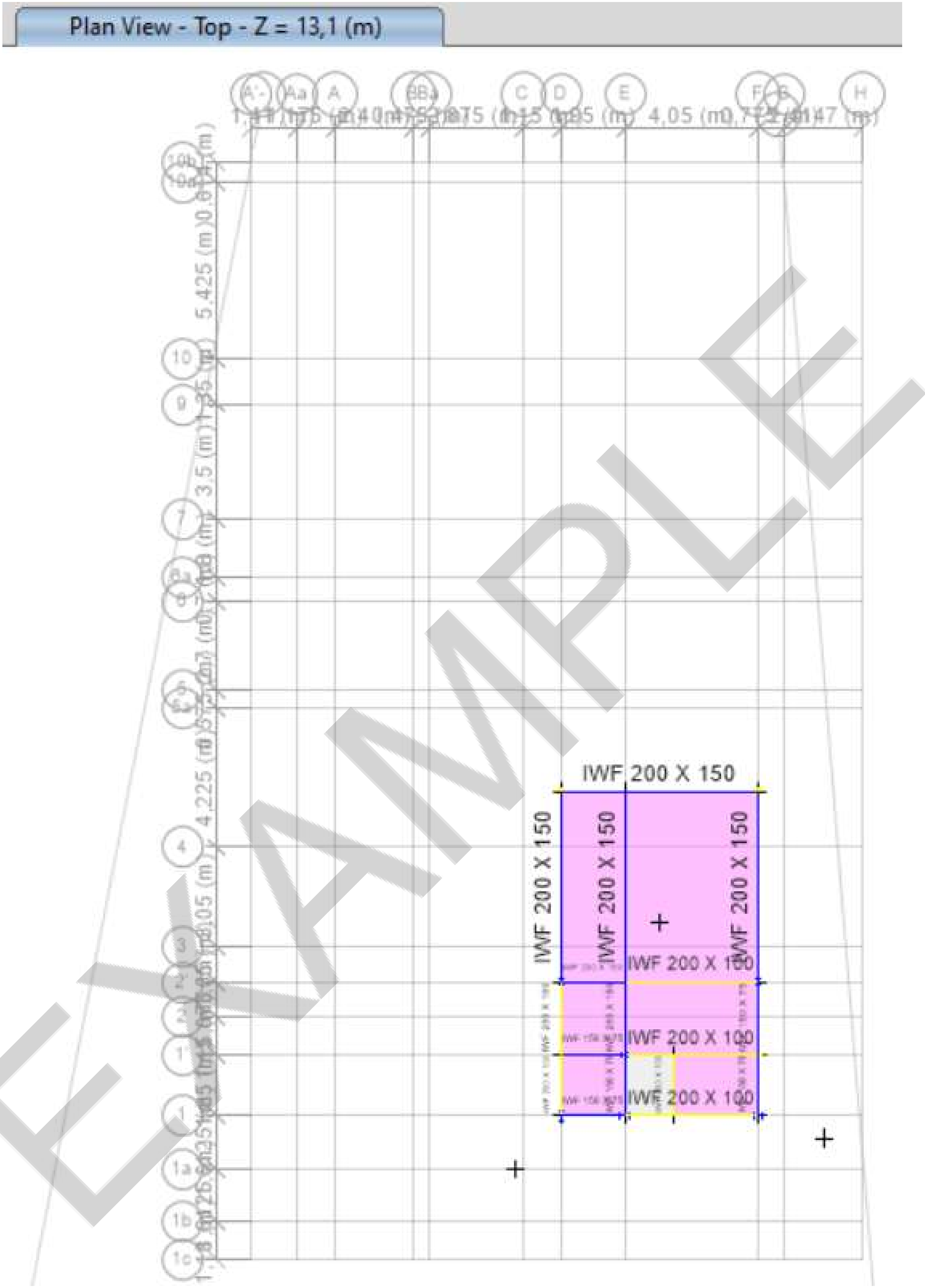
II.1 Main Building + Tower

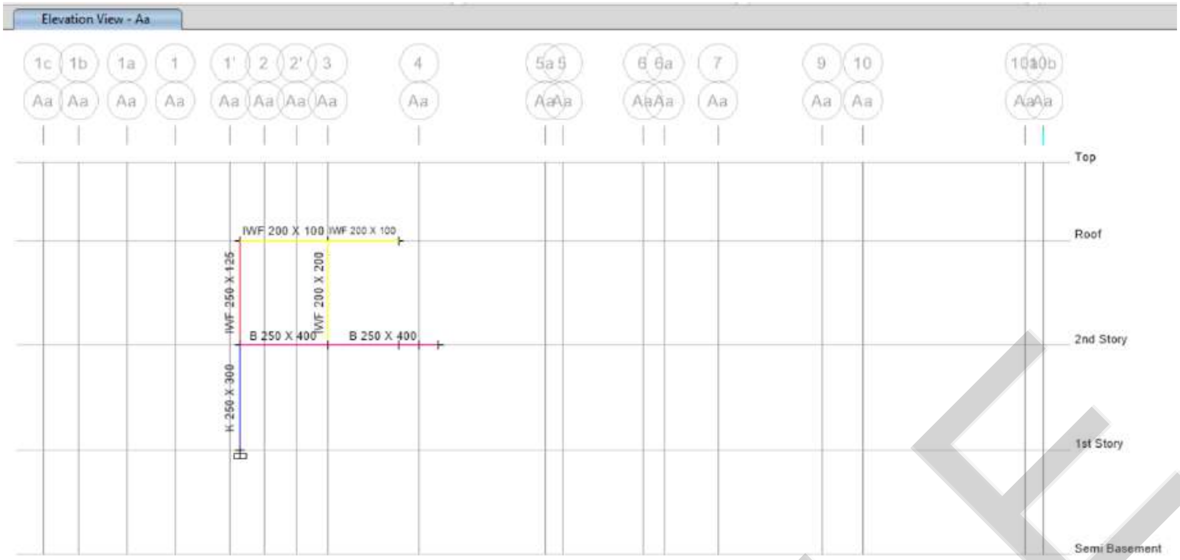

Plan View - 1st Story - Z = 3,5 (m)
B 150 X 400
B 200 X 300
Dummy
B 250 X 450
B 250 X 400
B 250 X 350
B 200 X 350
IWF 200 X 150
B 250 X 500
B 200 X 400
EXAMPLE

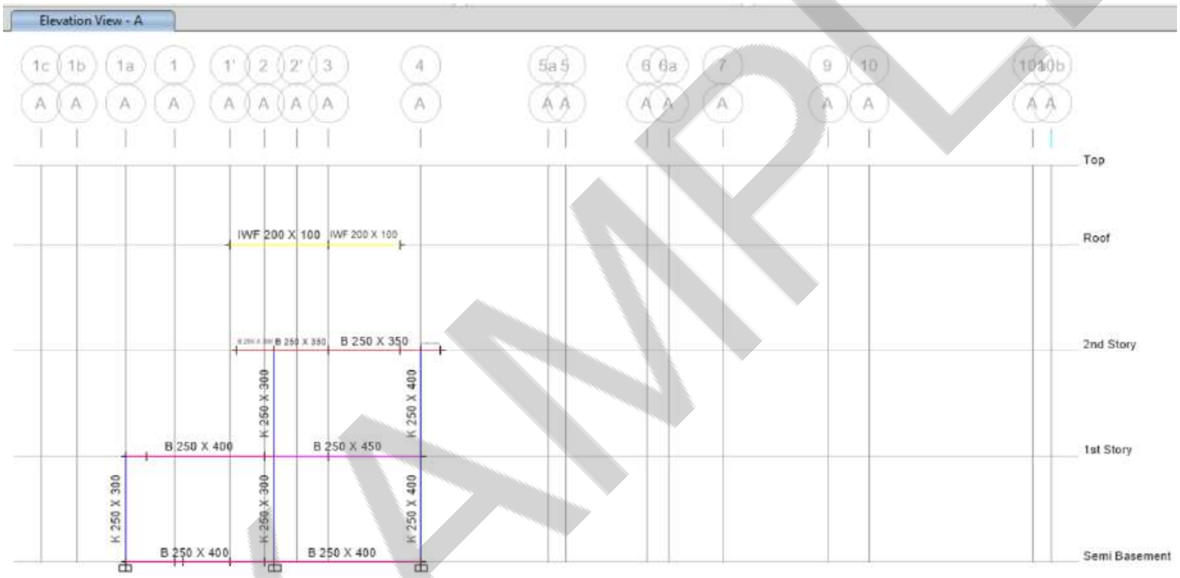
Plan View - 2nd Story - Z = 7 (m)

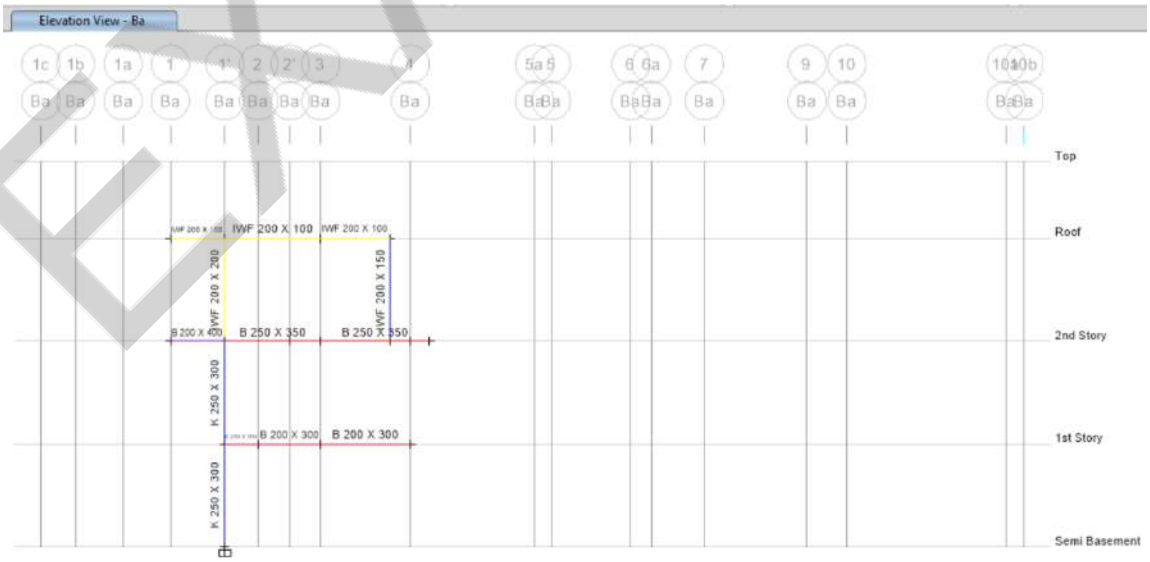


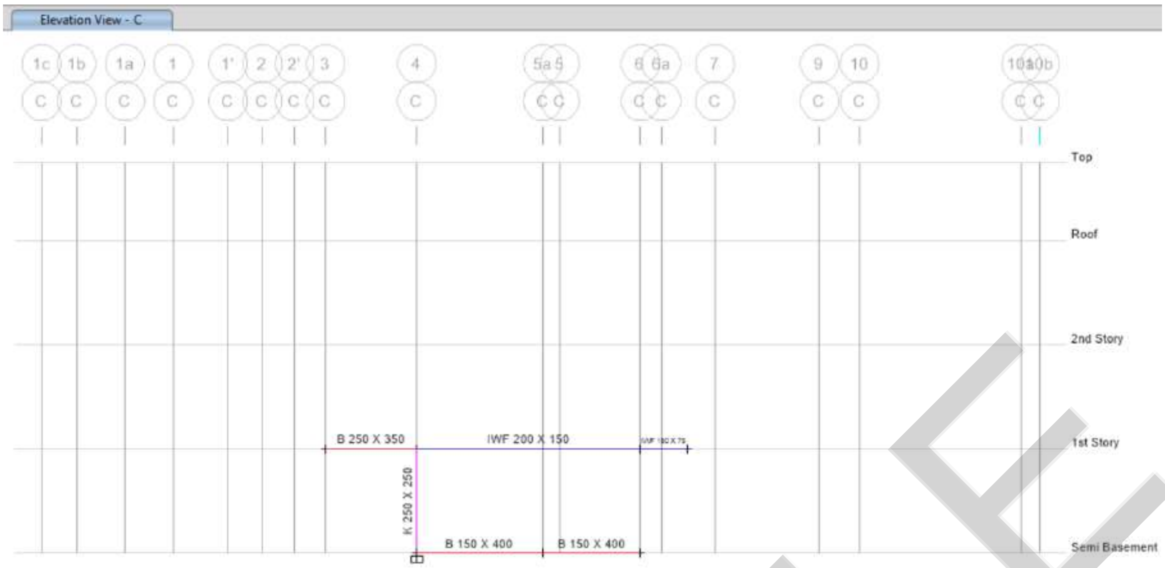

Plan View - Roof - Z = 10,5 (m)
UNP 100 X 50
IWF 200 X 100
IWF 250 X 125
IWF 250 X 125
IWF 200 X 100
IWF 200 X 150
IWF 200 X 100
IWF 200 X 100
IWF 200 X 100
IWF 200 X 100
IWF 200 X 150


Plan View - Top - Z = 13,1 (m)
IWF 200 X 150
IWF 200 X 100
EXAMPLE


Elevation View - Aa
1c
1b
1a
1
1'
2
2'
3
4
5a
5
6
6a
7
9
10
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 100
IWF 200 X 100
IWF 250 X 125
IWF 200 X 200
B 250 X 400
B 250 X 400
K 250 X 300

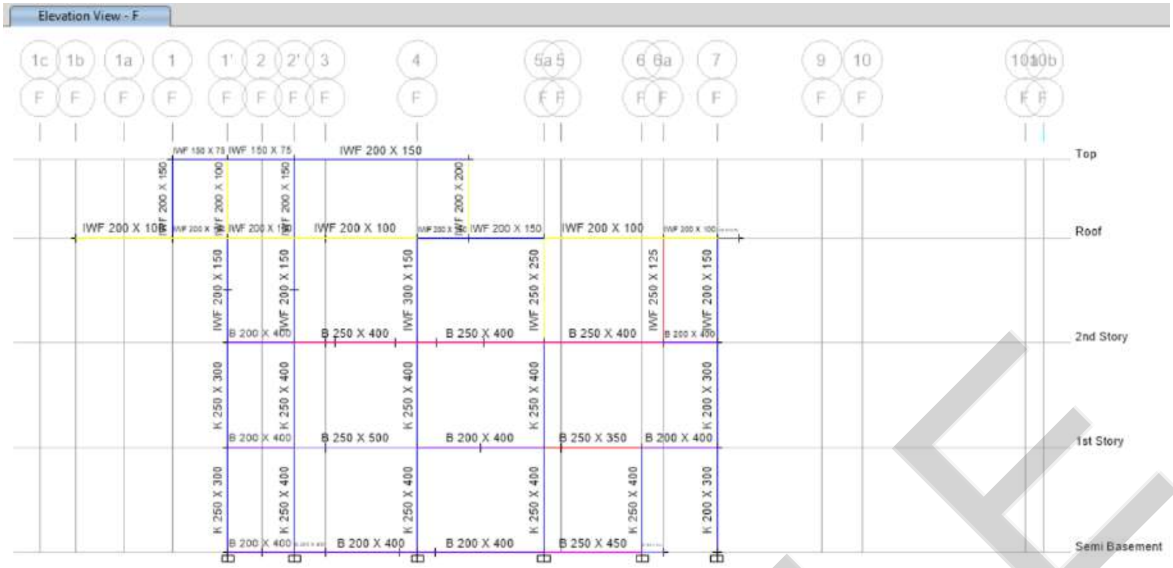

Elevation View - A
1c
1b
1a
1
1'
2
2'
3
4
5a
5
6
6a
7
9
10
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 100
IWF 200 X 100
B 250 X 350
B 250 X 350
K 250 X 300
K 250 X 400
B 250 X 400
B 250 X 450
K 250 X 300
K 250 X 300
K 250 X 400
B 250 X 400
B 250 X 400

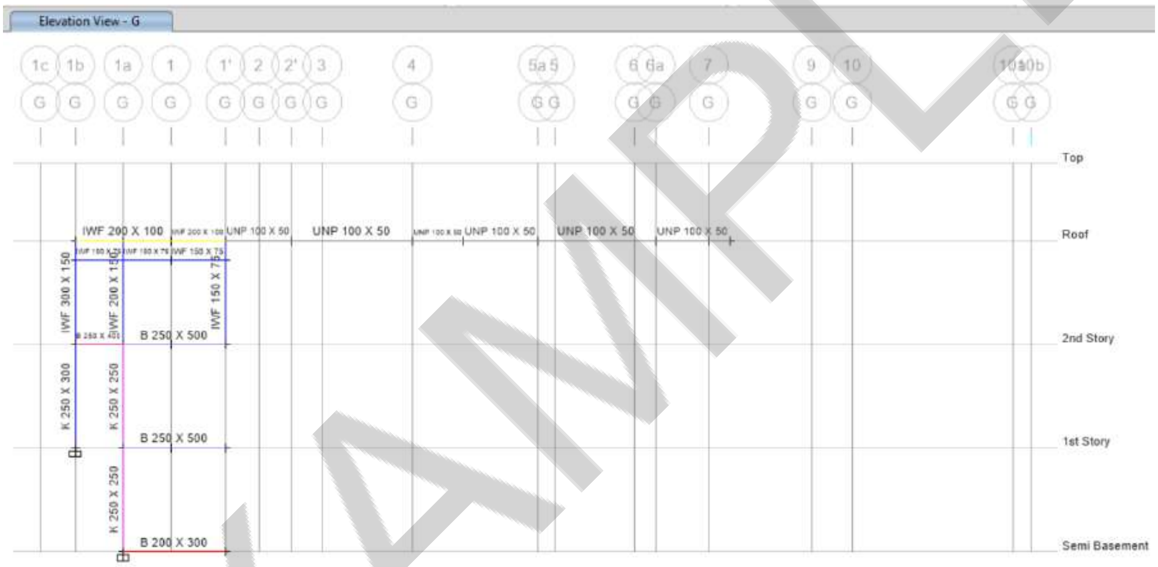

Elevation View - Ba
1c
1b
1a
1
1'
2
2'
3
4
5a
5
6
6a
7
9
10
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 100
IWF 200 X 100
IWF 200 X 200
IWF 200 X 150
B 200 X 400
B 250 X 350
B 250 X 350
K 250 X 300
B 200 X 300
B 200 X 300
K 250 X 300

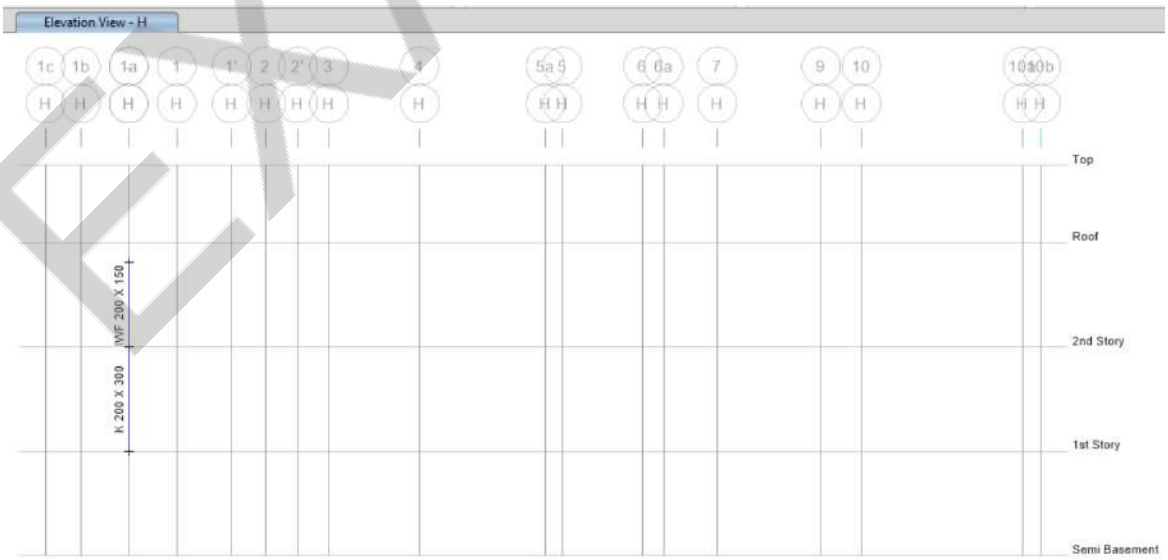

Elevation View - C
Top
Roof
2nd Story
1st Story
Semi Basement
B 250 X 350
IWF 200 X 150
K 250 X 250
B 150 X 400
B 150 X 400

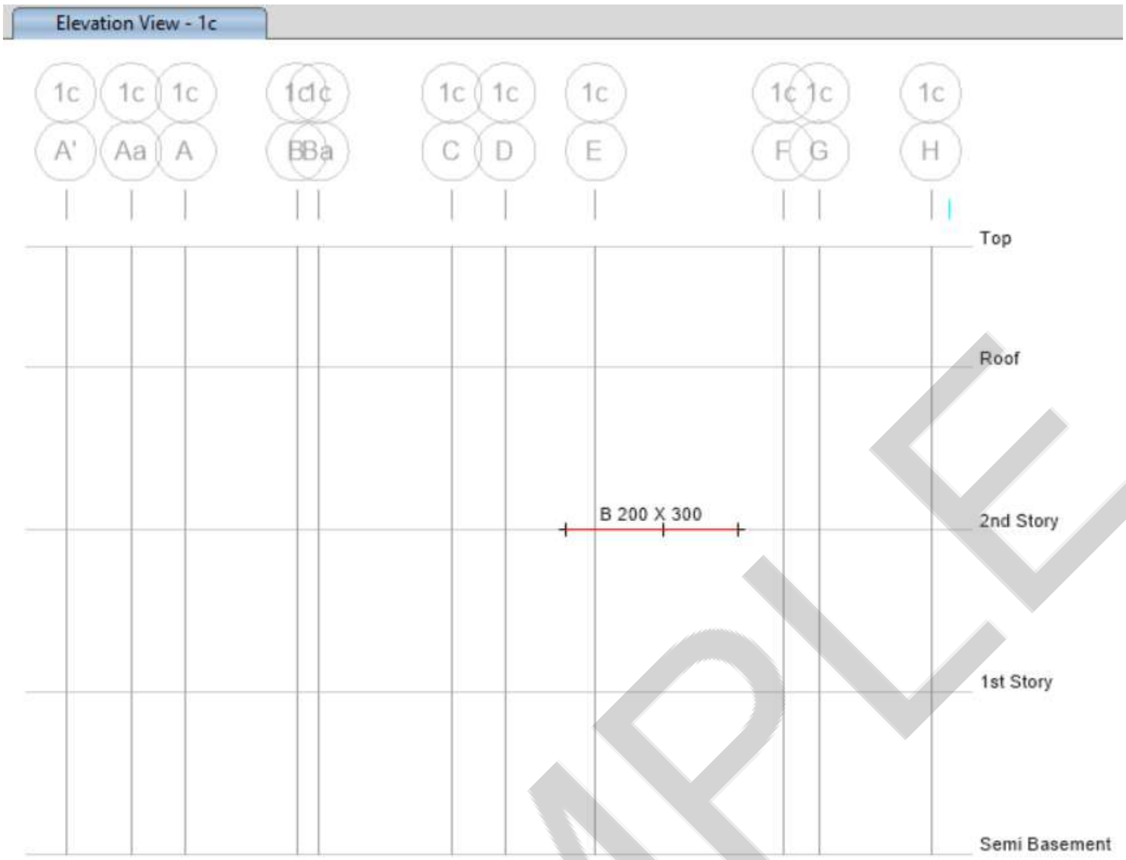

Elevation View - D
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 150
IWF 200 X 100
IWF 200 X 150
IWF 200 X 100
B 250 X 400
B 250 X 350
B 250 X 350
B 250 X 600
B 250 X 400
B 250 X 500
B 250 X 350
B 250 X 400
B 250 X 300
B 200 X 400
B 200 X 400
B 150 X 400
B 150 X 400

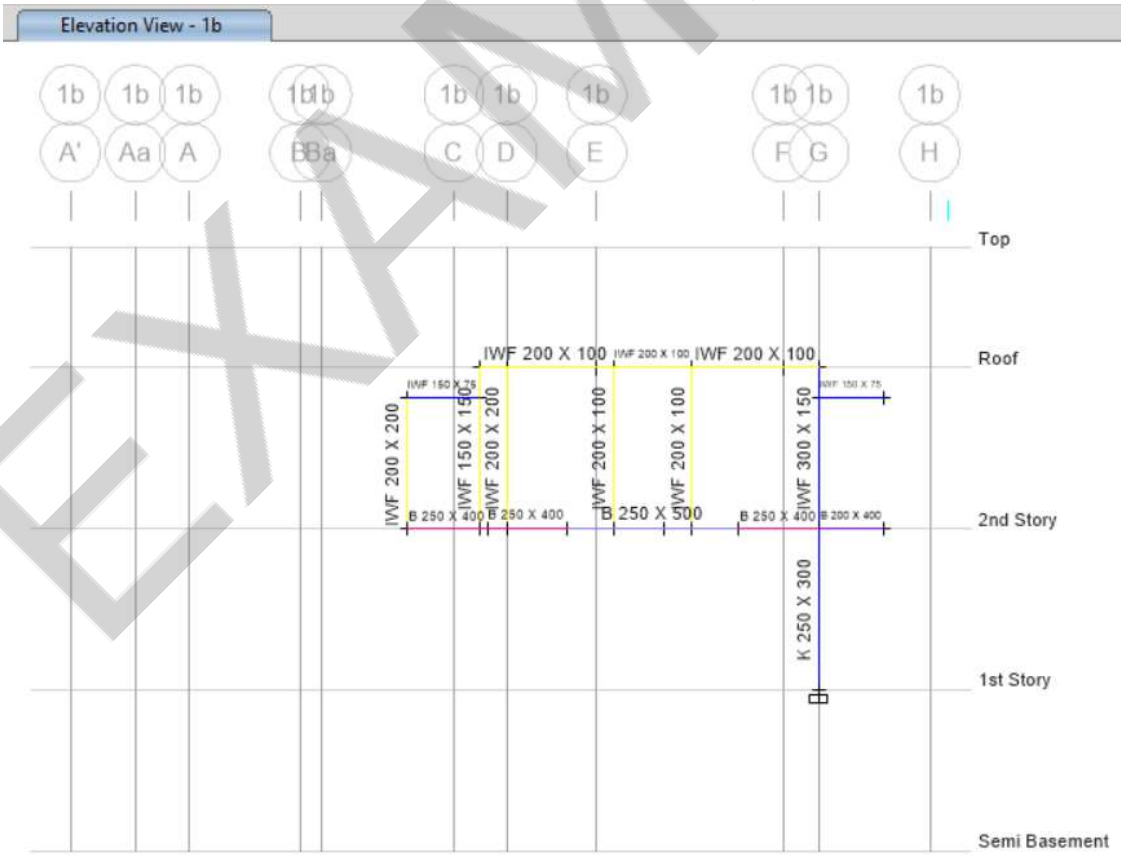

Elevation View - E
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 150
IWF 200 X 100
B 250 X 400
B 200 X 400
B 250 X 500
B 250 X 500

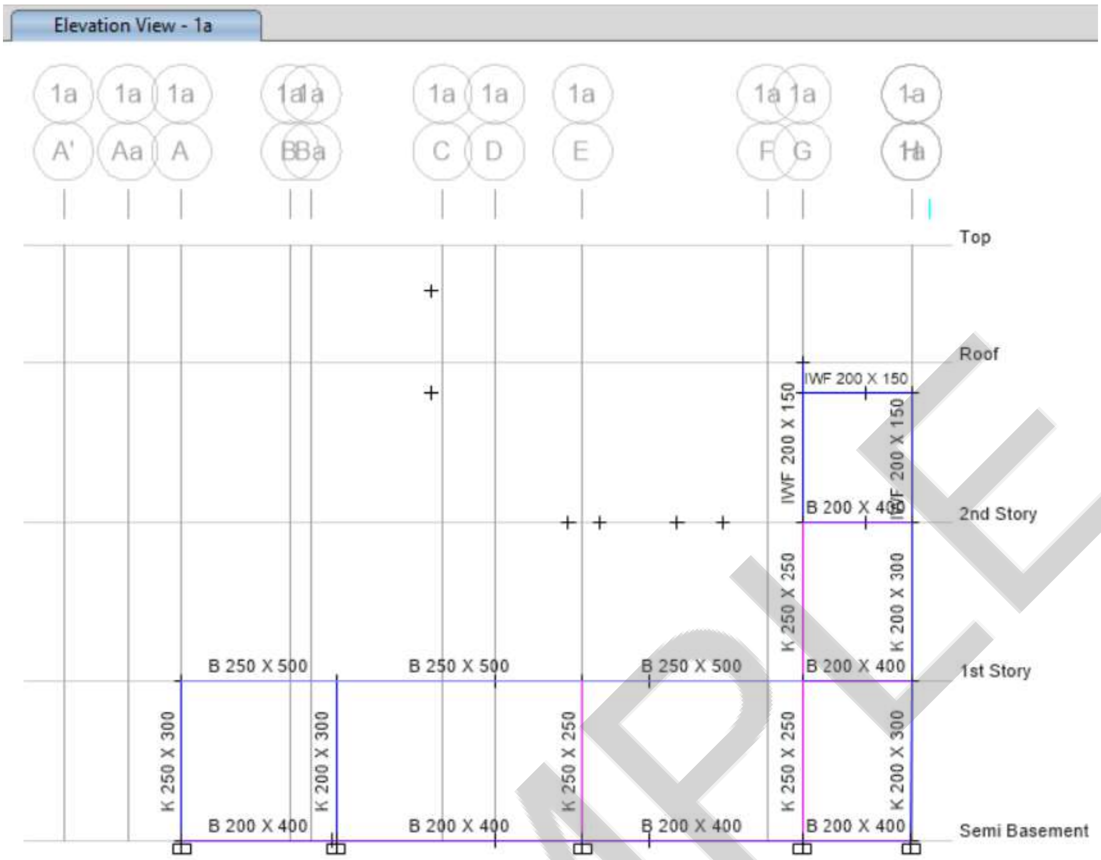

Elevation View - F
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 150
IWF 200 X 100
IWF 200 X 150
B 200 X 400
B 250 X 400
B 250 X 400
B 250 X 400
B 250 X 500
B 200 X 400
B 250 X 350
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400
B 250 X 450

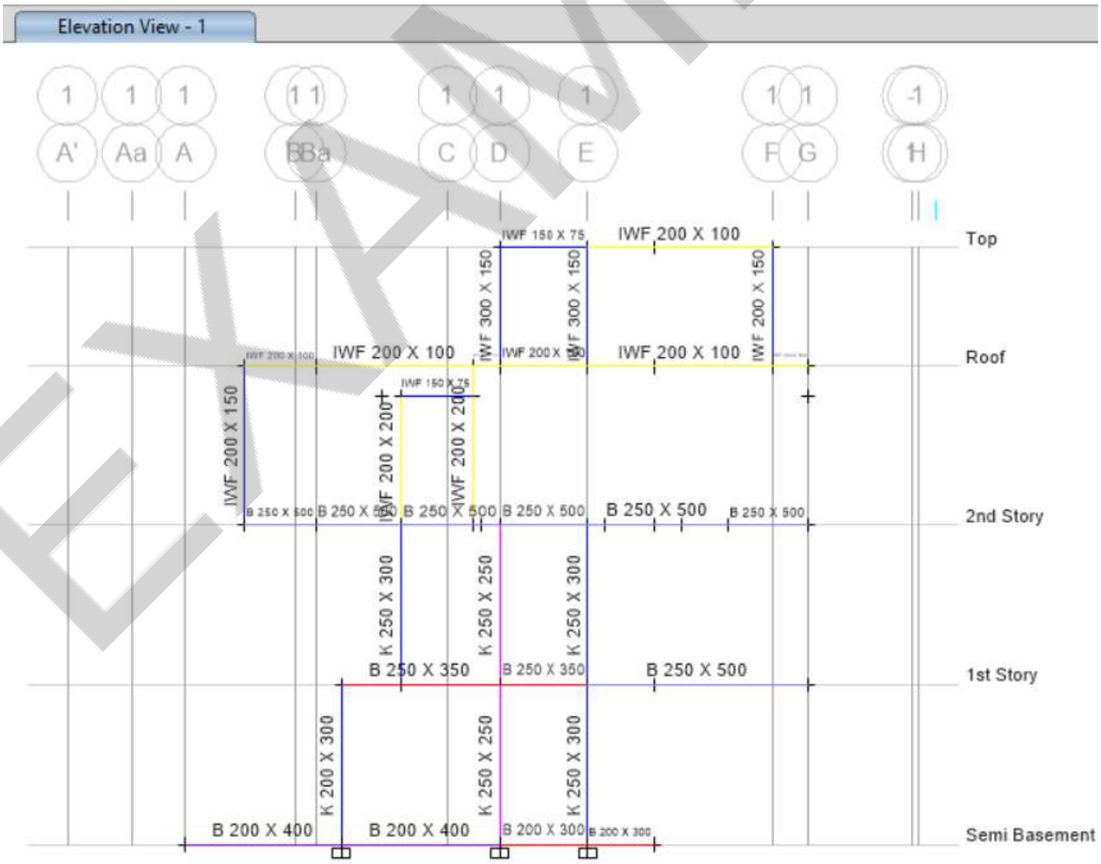

Elevation View - G
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 100
UNP 100 X 50
UNP 100 X 50
UNP 100 X 50
UNP 100 X 50
IWF 300 X 150
B 250 X 500
K 250 X 300
B 250 X 500
B 200 X 300

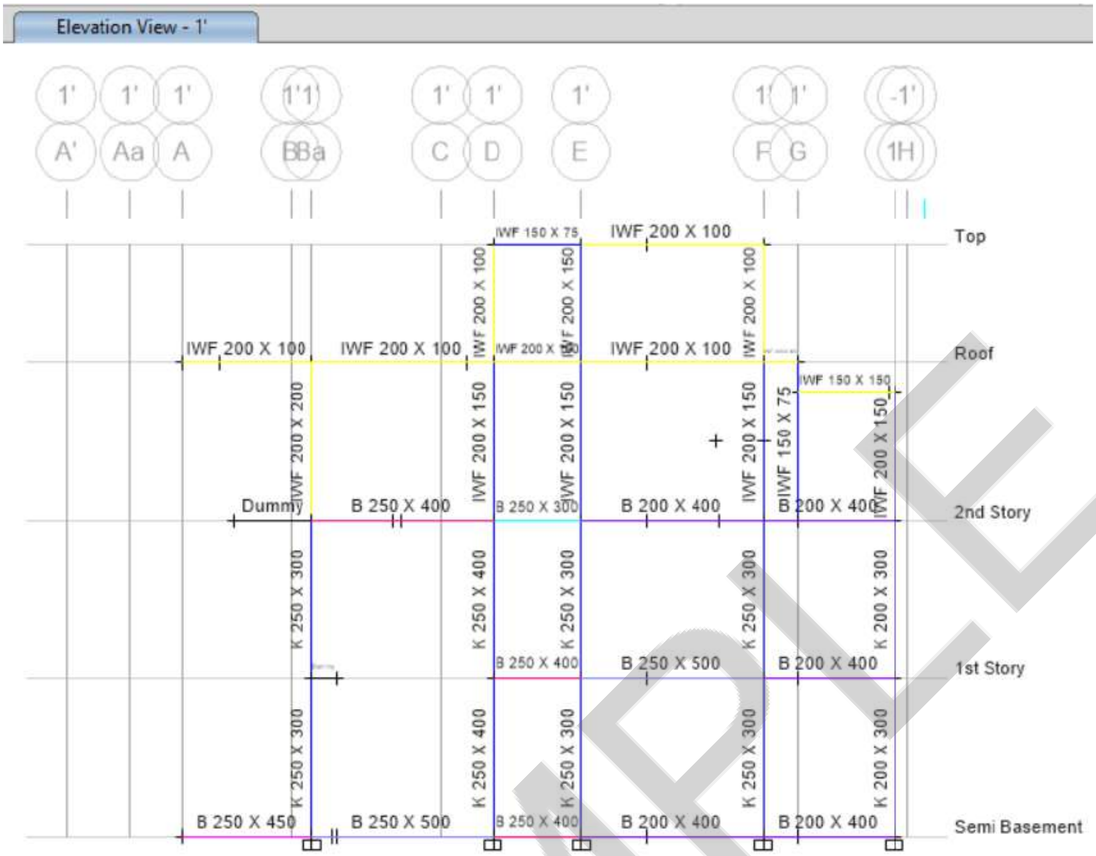

Elevation View - H
Top
Roof
2nd Story
1st Story
Semi Basement
K 200 X 300

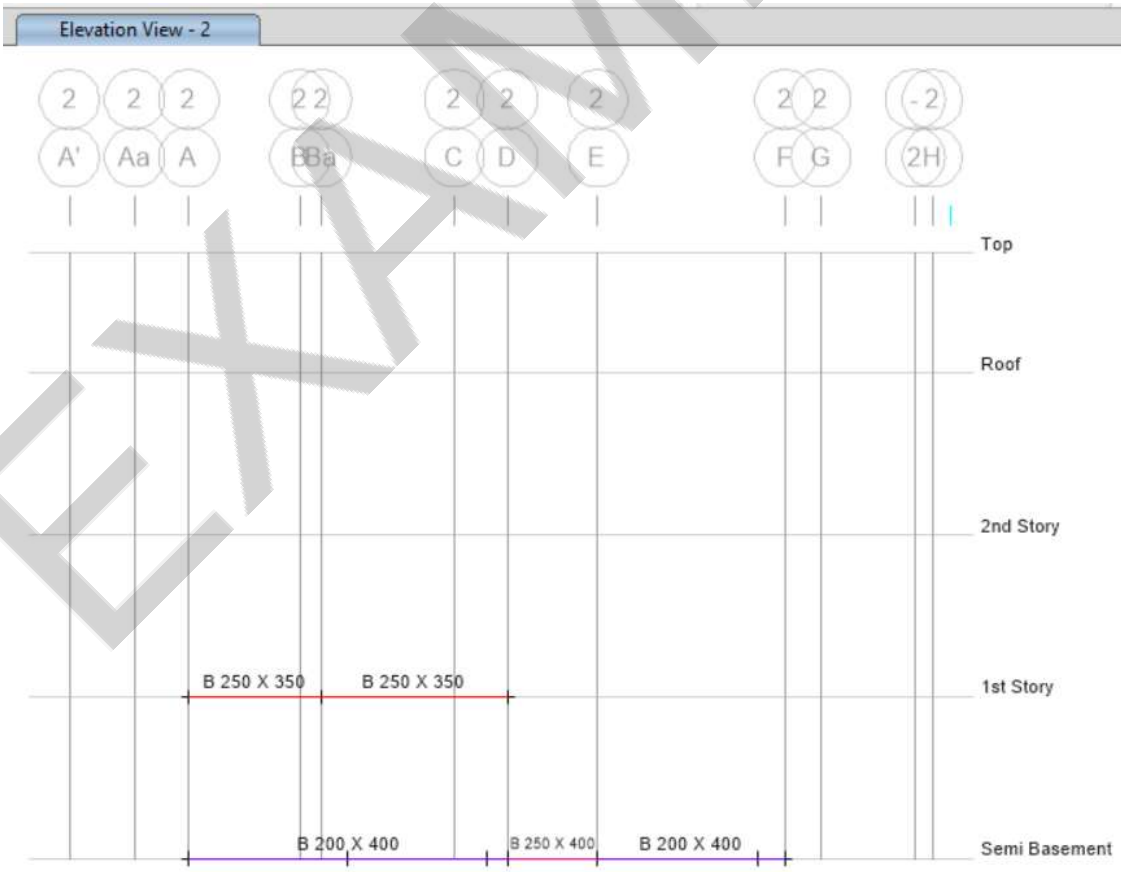

Elevation View - 1c
1c
A'
Aa
A
B
Ba
C
D
E
F
G
H
Top
Roof
2nd Story
1st Story
Semi Basement
B 200 X 300


Elevation View - 1b
1b
A'
Aa
A
B
Ba
C
D
E
F
G
H
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 100
IWF 200 X 100
IWF 200 X 200
IWF 150 X 150
IWF 200 X 200
IWF 200 X 100
IWF 200 X 100
IWF 300 X 150
B 250 X 400
B 250 X 400
B 250 X 500
B 250 X 400
K 250 X 300

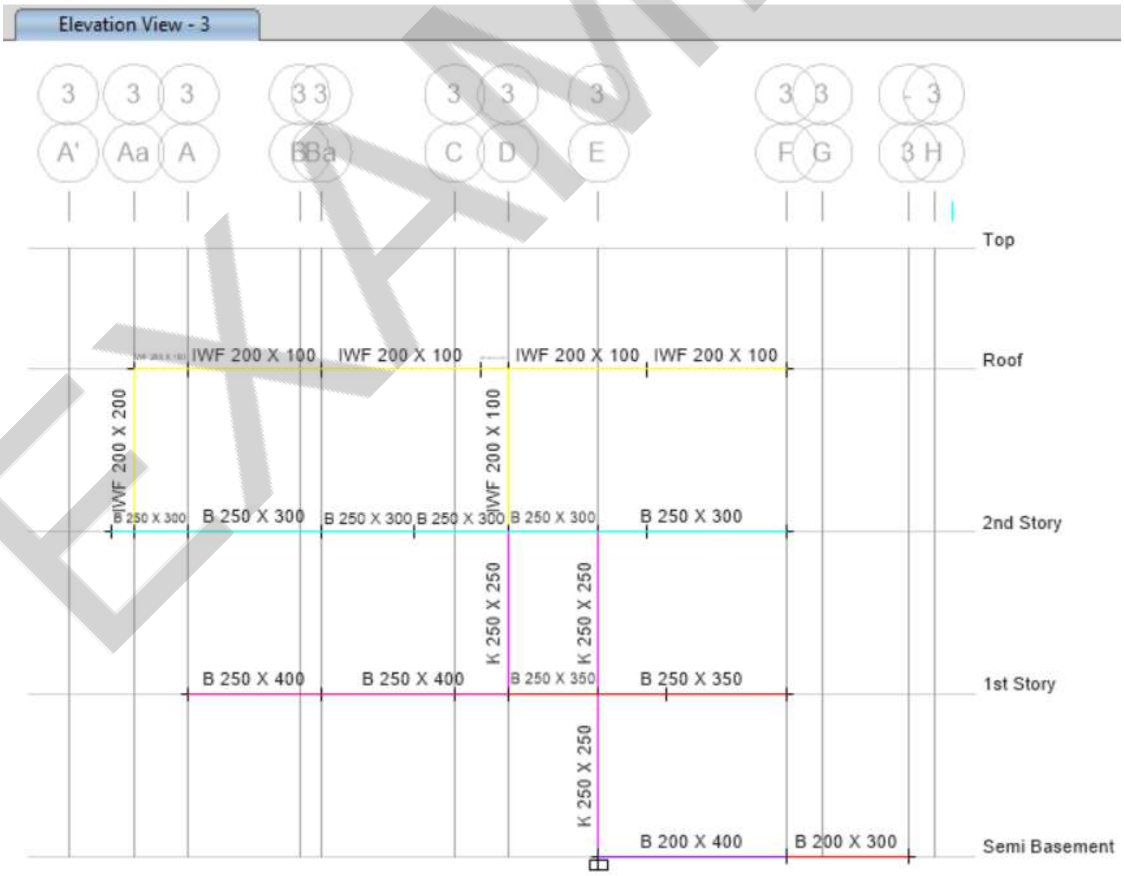

Elevation View - 1a
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 150
IWF 200 X 150
IWF 200 X 150
B 200 X 400
K 250 X 250
K 200 X 300
B 250 X 500
B 250 X 500
B 250 X 500
B 200 X 400
K 250 X 300
K 200 X 300
K 250 X 250
K 250 X 250
K 200 X 300
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400

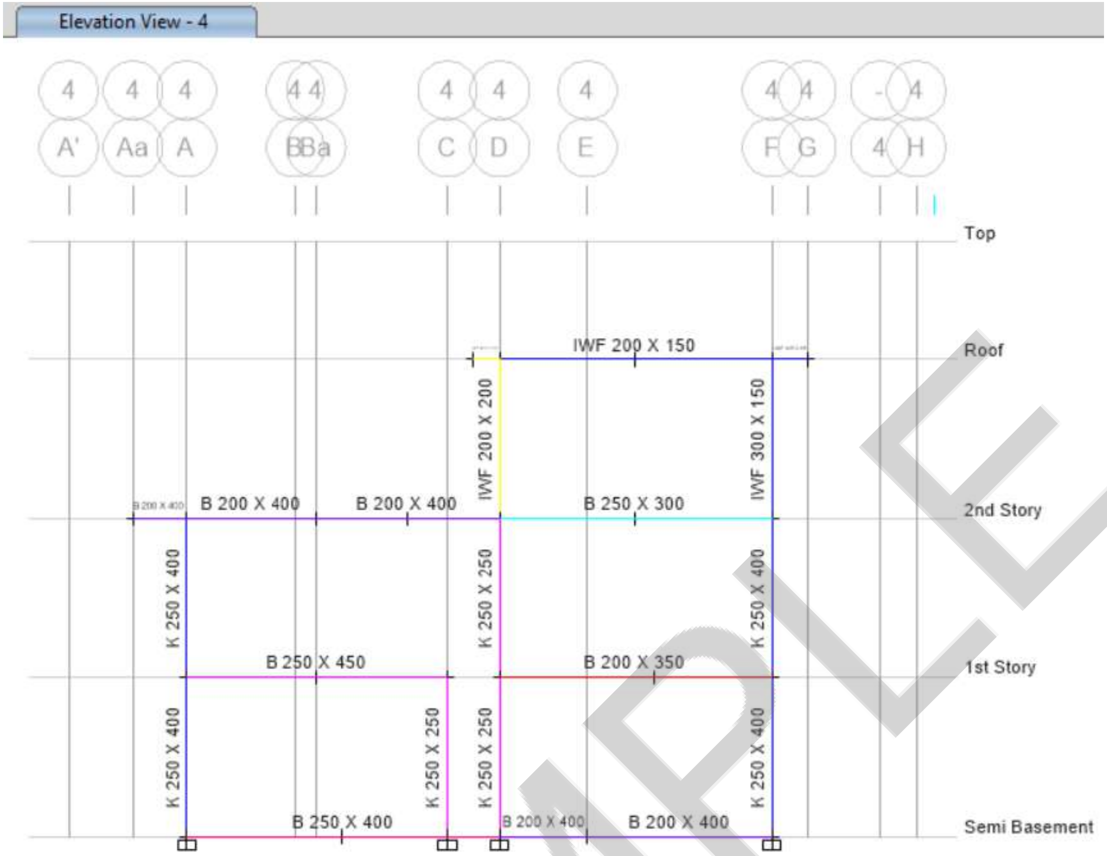

Elevation View - 1
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 150 X 75
IWF 200 X 100
IWF 300 X 150
IWF 300 X 150
IWF 200 X 150
IWF 200 X 100
IWF 200 X 100
IWF 200 X 150
IWF 150 X 75
IWF 200 X 200
IWF 200 X 200
B 250 X 500
B 250 X 500
B 250 X 500
B 250 X 500
K 250 X 300
K 250 X 250
K 250 X 300
B 250 X 350
B 250 X 350
B 250 X 500
K 200 X 300
K 250 X 250
K 250 X 300
B 200 X 400
B 200 X 400
B 200 X 300

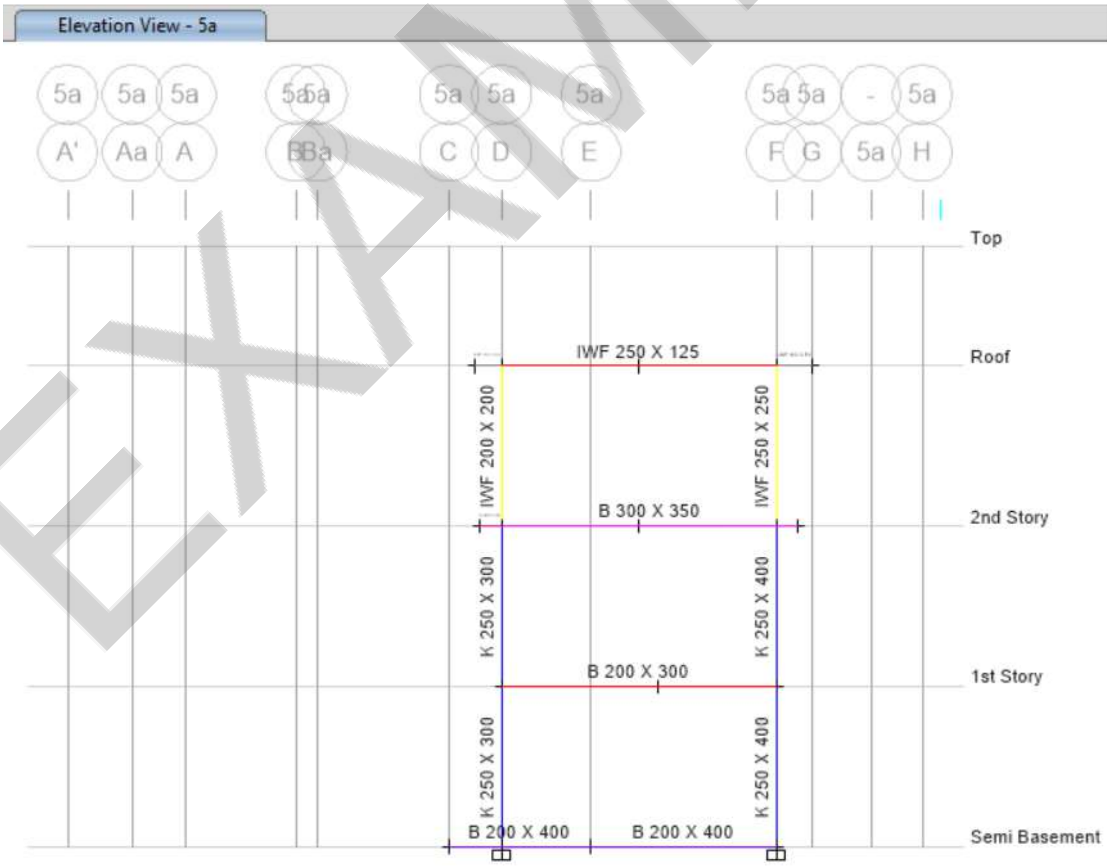

Elevation View - 1'
1' 1' 1' 1'1' 1' 1' 1' 1' 1' -1'
A' Aa A BBa C D E F G 1H
IWF 150 X 75
IWF 200 X 100
Top
IWF 200 X 100
IWF 200 X 100
IWF 200 X 100
IWF 200 X 100
IWF 200 X 150
Roof
IWF 150 X 150
IWF 200 X 200
IWF 200 X 150
IWF 200 X 150
IWF 200 X 150
IWF 150 X 75
IWF 200 X 150
Dummy
B 250 X 400
B 250 X 300
B 200 X 400
B 200 X 400
2nd Story
K 250 X 300
K 250 X 400
K 250 X 300
K 250 X 300
K 200 X 300
B 250 X 400
B 250 X 500
B 200 X 400
1st Story
K 250 X 300
K 250 X 400
K 250 X 300
K 250 X 300
K 200 X 300
B 250 X 450
B 250 X 500
B 250 X 400
B 200 X 400
B 200 X 400
Semi Basement

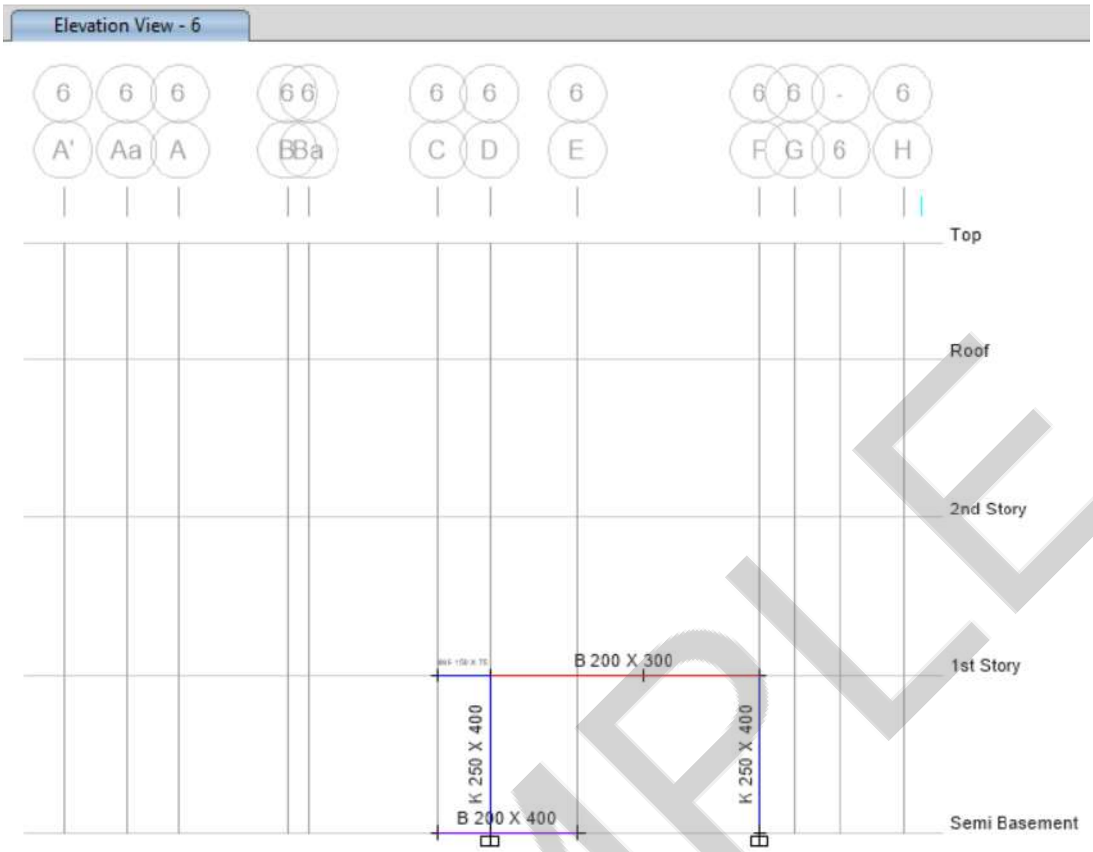

Elevation View - 2
2 2 2 2 2 2 2 2 2 2 -2
A' Aa A BBa C D E F G 2H
Top
Roof
2nd Story
B 250 X 350
B 250 X 350
1st Story
B 200 X 400
B 250 X 400
B 200 X 400
Semi Basement

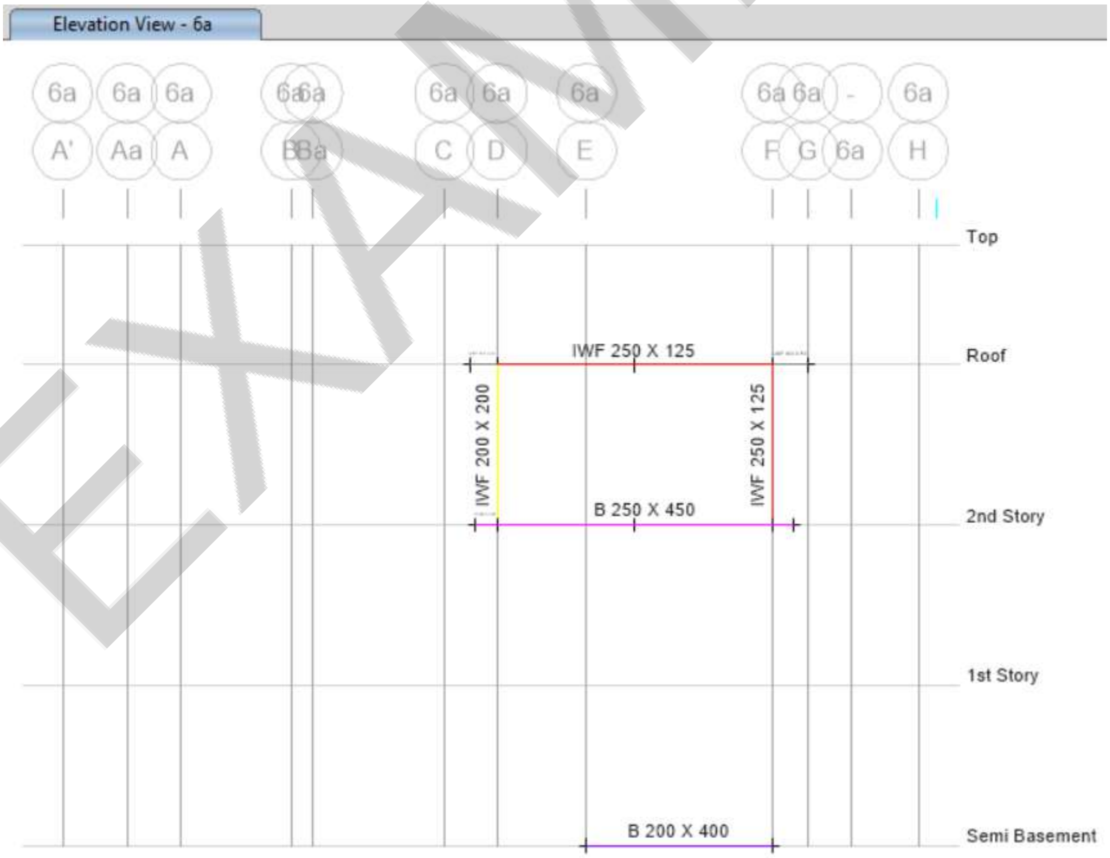

Elevation View - 2'
IWF 200 X 150
IWF 200 X 100
IWF 200 X 150
IWF 200 X 100
IWF 200 X 150
IWF 200 X 100
IWF 200 X 150
IWF 200 X 150
Dummy
Dummy
B 200 X 300
K 250 X 400
K 250 X 400
Dummy
K 250 X 400
B 200 X 300
Top
Roof
2nd Story
1st Story
Semi Basement

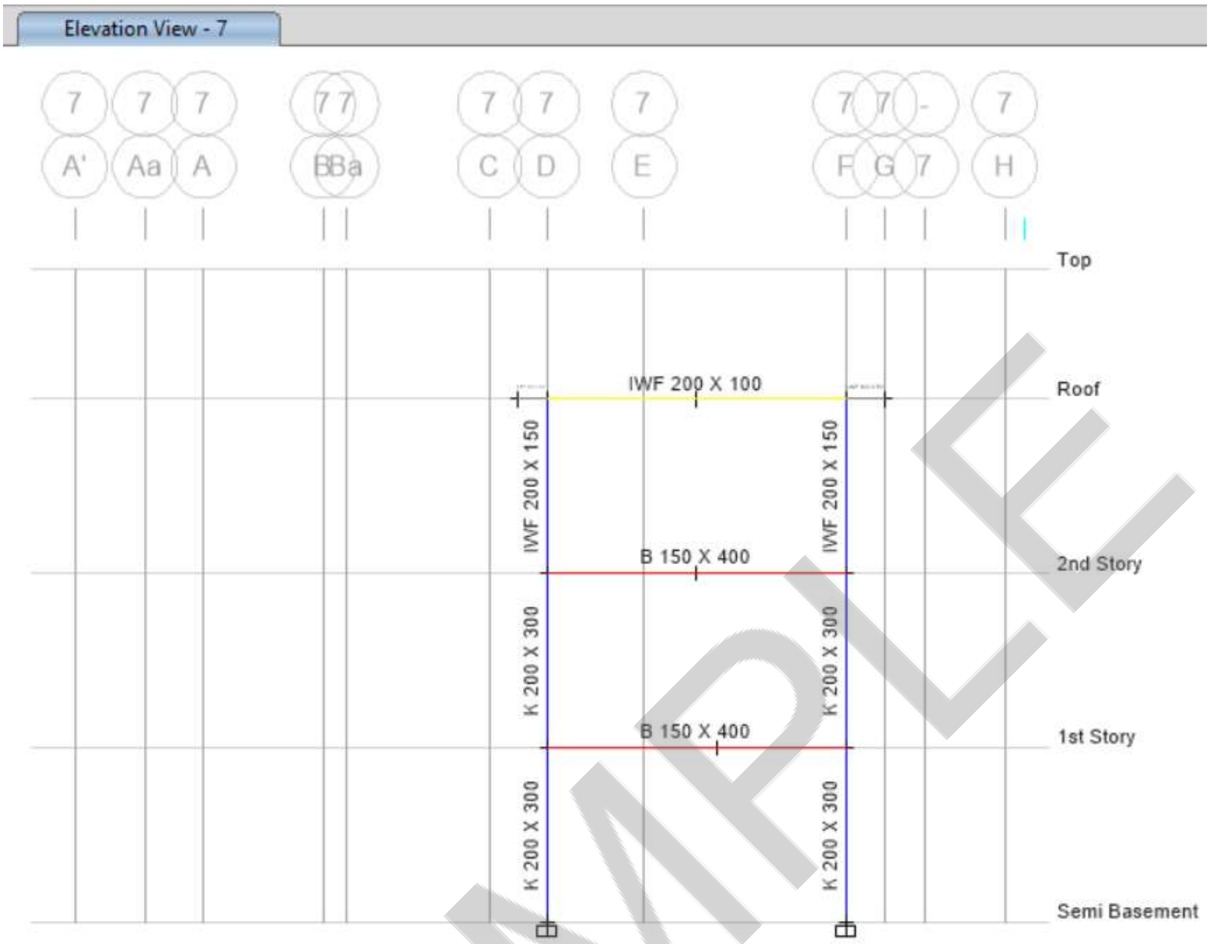

Elevation View - 3
IWF 200 X 100
IWF 200 X 100
IWF 200 X 100
IWF 200 X 100
IWF 200 X 200
IWF 200 X 100
B 250 X 300
B 250 X 300
B 250 X 300
B 250 X 300
B 250 X 300
B 250 X 300
K 250 X 250
K 250 X 250
B 250 X 400
B 250 X 400
B 250 X 350
B 250 X 350
K 250 X 250
B 200 X 400
B 200 X 300
Top
Roof
2nd Story
1st Story
Semi Basement

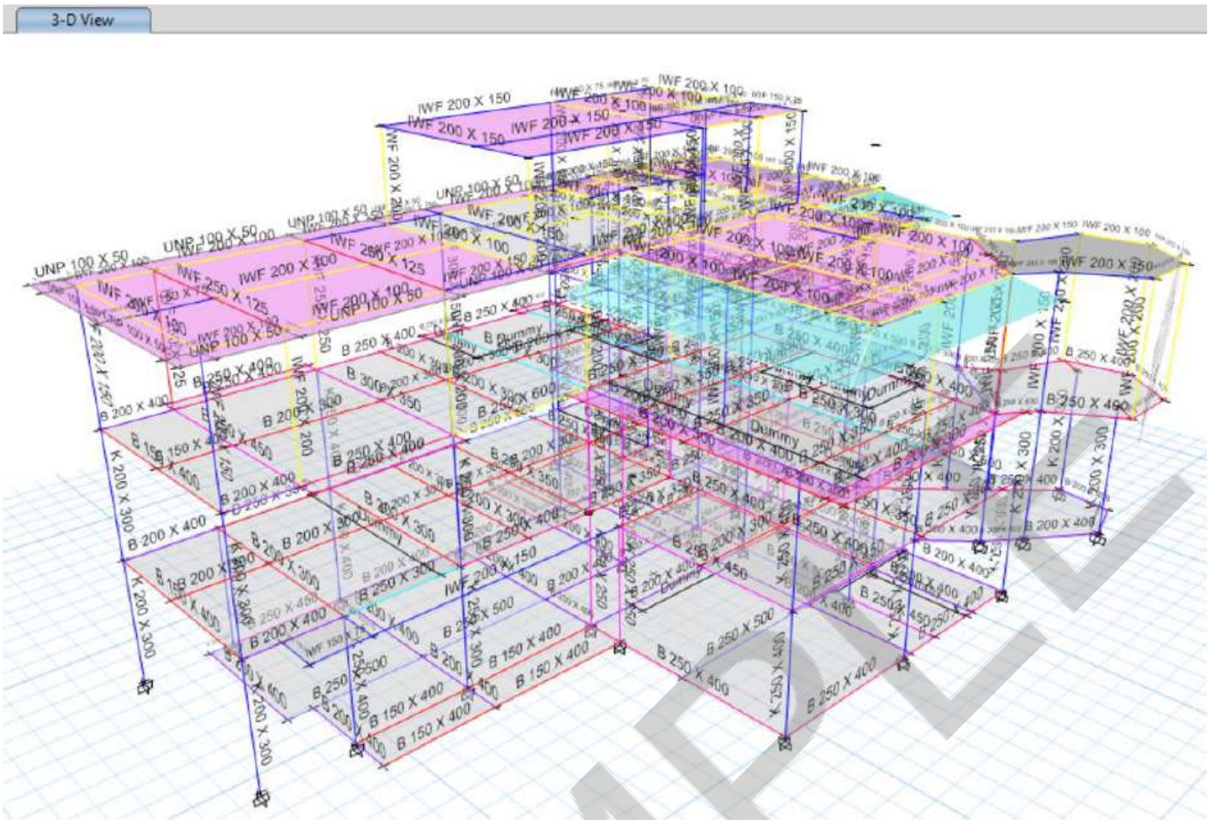

Elevation View - 4
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 150
IWF 200 X 200
IWF 300 X 150
B 200 X 400
B 200 X 400
B 250 X 300
K 250 X 400
K 250 X 250
K 250 X 400
B 250 X 450
B 200 X 350
K 250 X 400
K 250 X 250
K 250 X 250
K 250 X 400
B 250 X 400
B 200 X 400
B 200 X 400

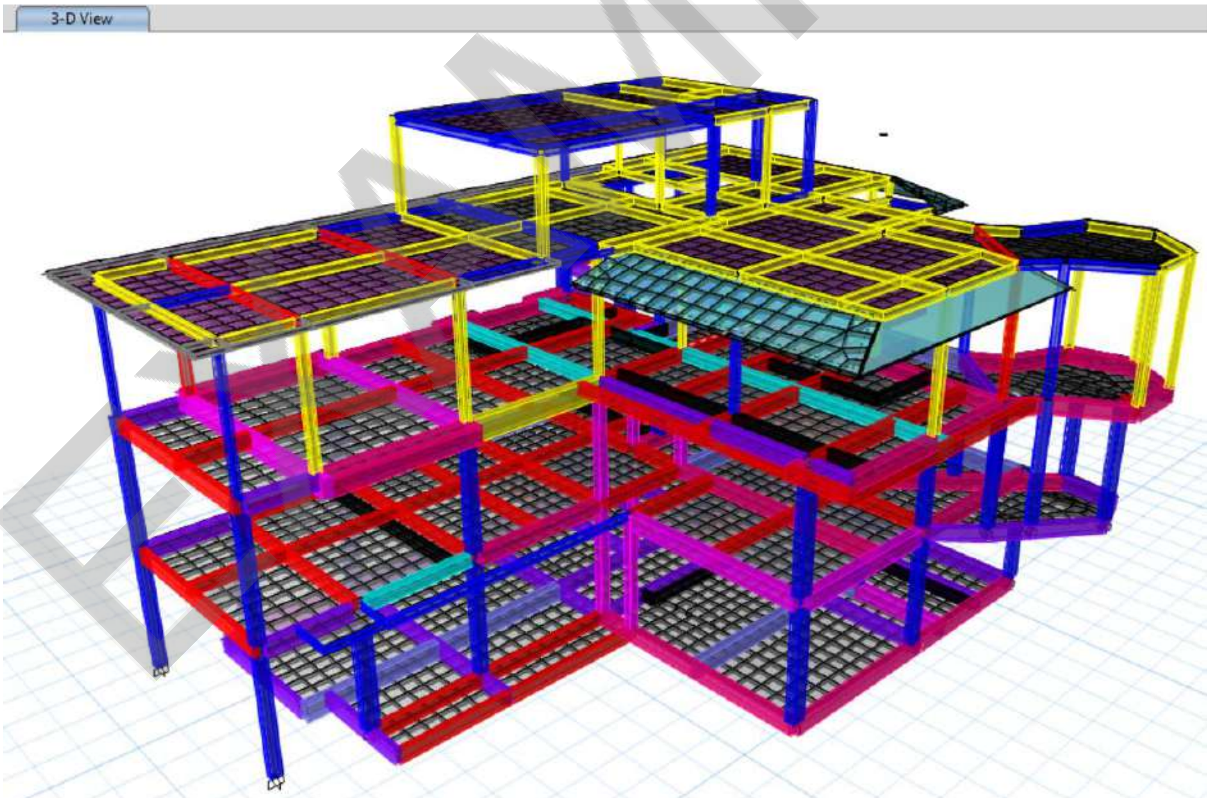

Elevation View - 5a
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 250 X 125
IWF 200 X 200
IWF 250 X 250
B 300 X 350
K 250 X 300
K 250 X 400
B 200 X 300
K 250 X 300
K 250 X 400
B 200 X 400
B 200 X 400


Elevation View - 6
6
A'
Aa
A
B
Ba
C
D
E
F
G
H
Top
Roof
2nd Story
1st Story
Semi Basement
B 200 X 300
K 250 X 400
K 250 X 400
B 200 X 400

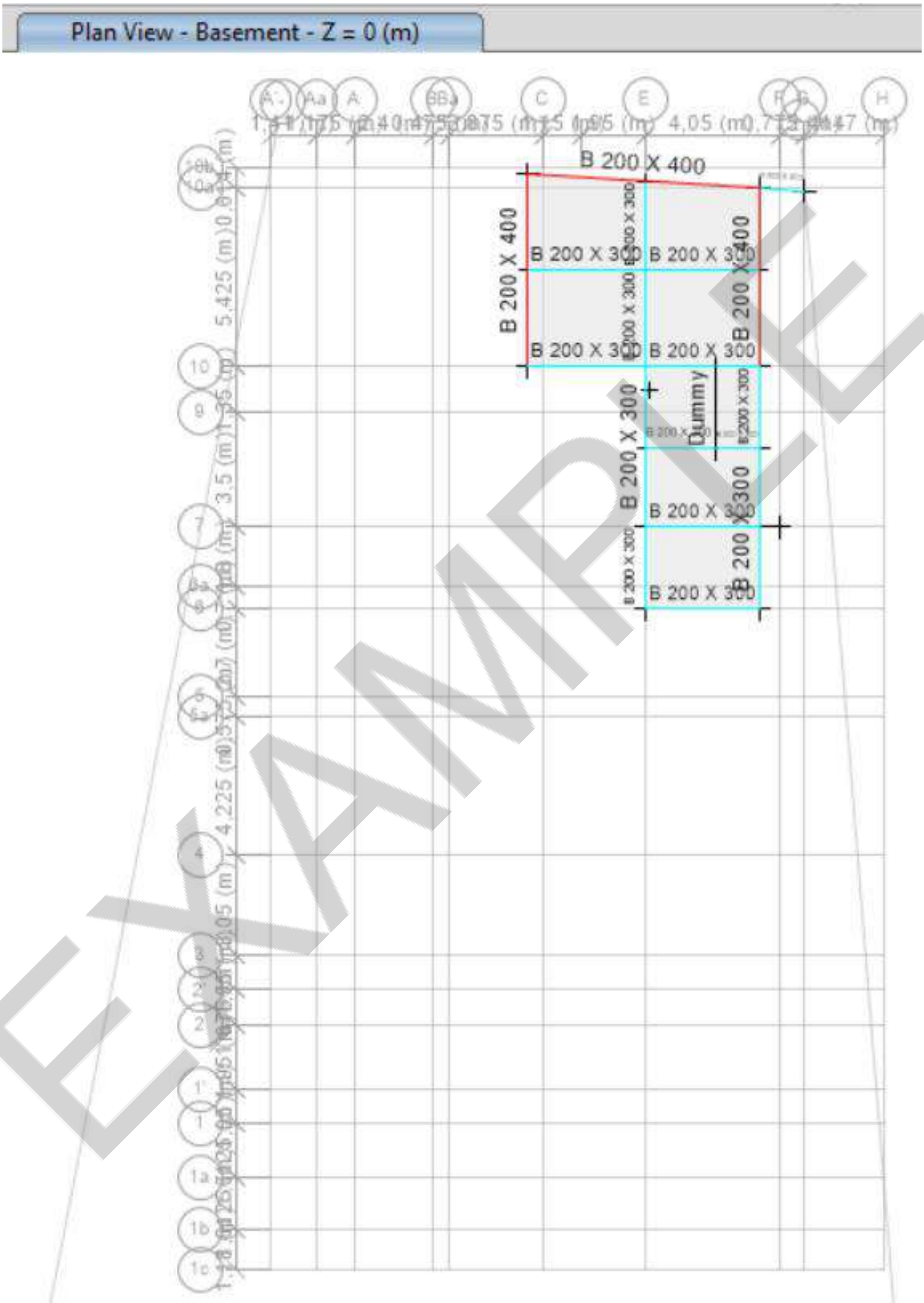

Elevation View - 6a
6a
A'
Aa
A
B
Ba
C
D
E
F
G
H
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 250 X 125
IWF 200 X 200
IWF 250 X 125
B 250 X 450
B 200 X 400

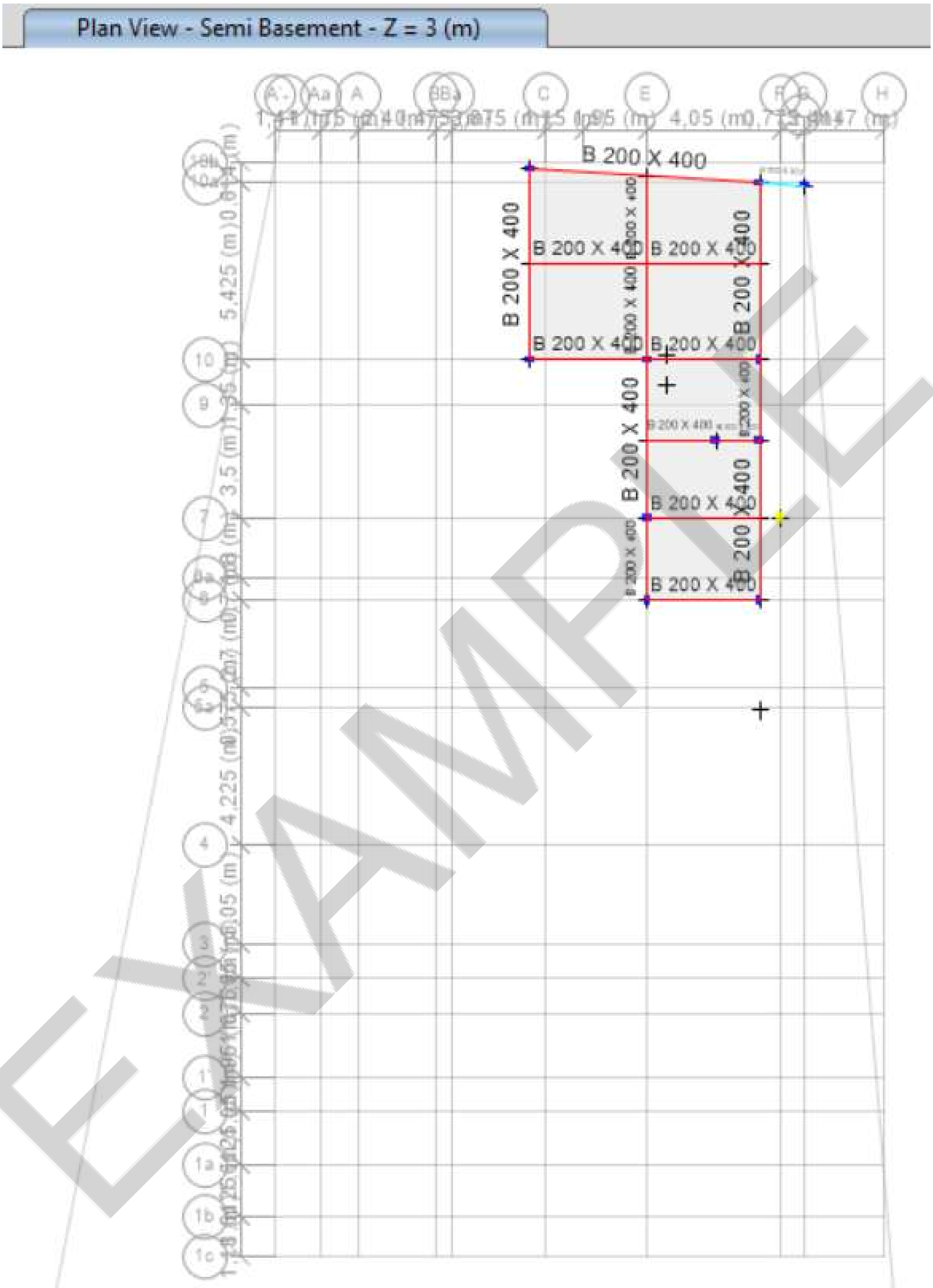

Elevation View - 7
7
A'
Aa
A
BBa
C
D
E
F
G
H
Top
Roof
2nd Story
1st Story
Semi Basement
IWF 200 X 100
IWF 200 X 150
IWF 200 X 150
B 150 X 400
B 150 X 400
K 200 X 300
K 200 X 300
K 200 X 300
K 200 X 300

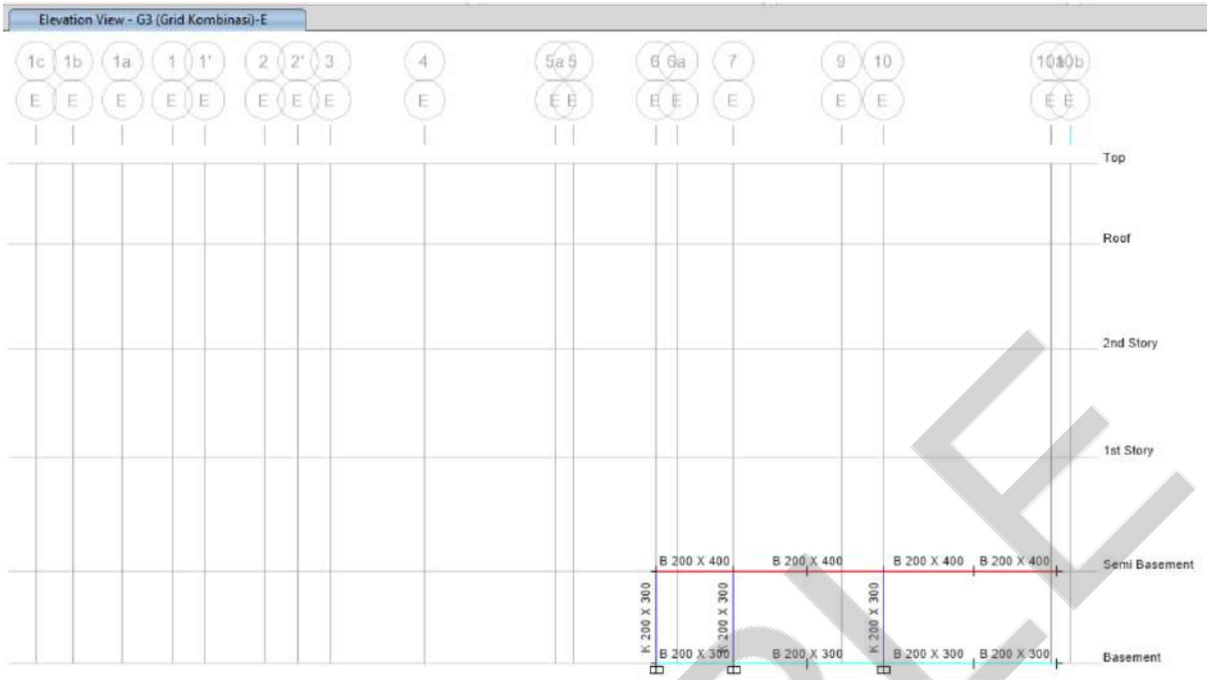

3-D View

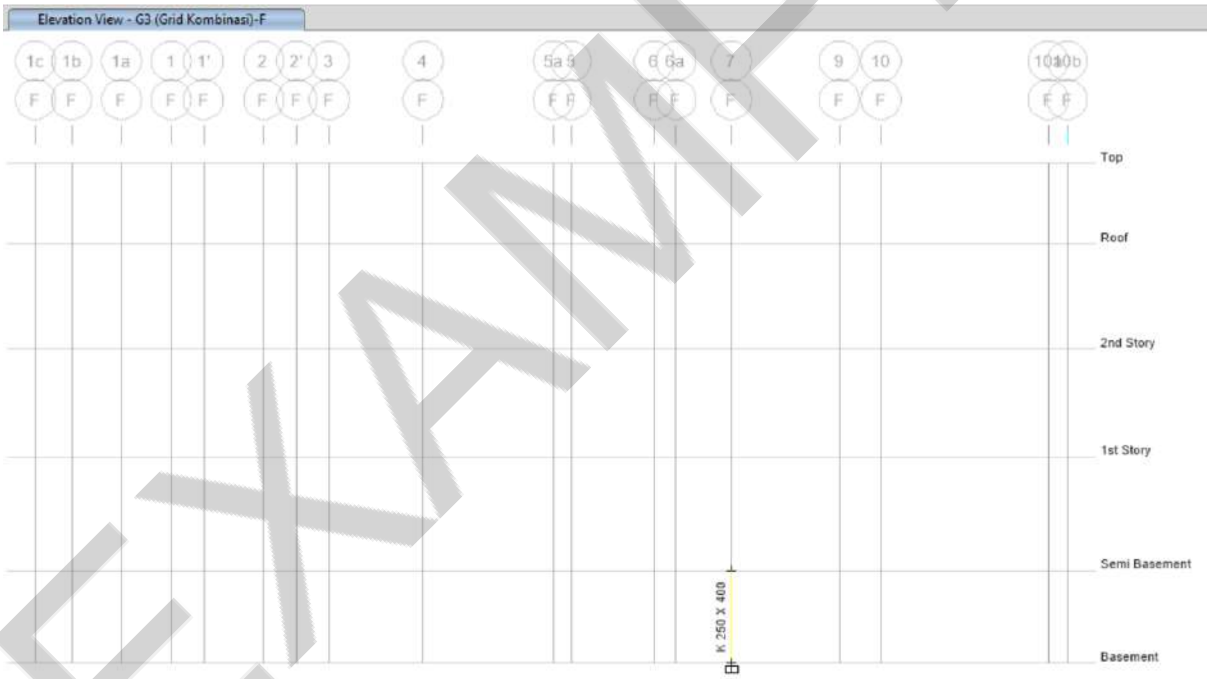

3-D View

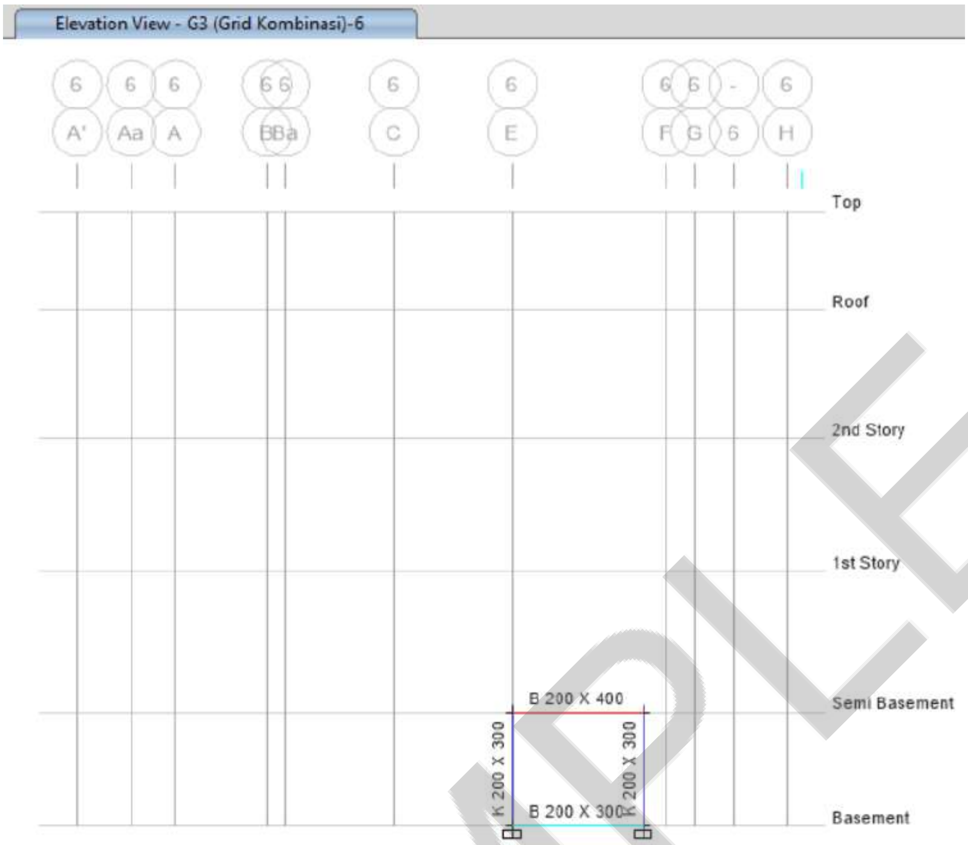
II.2 Basement

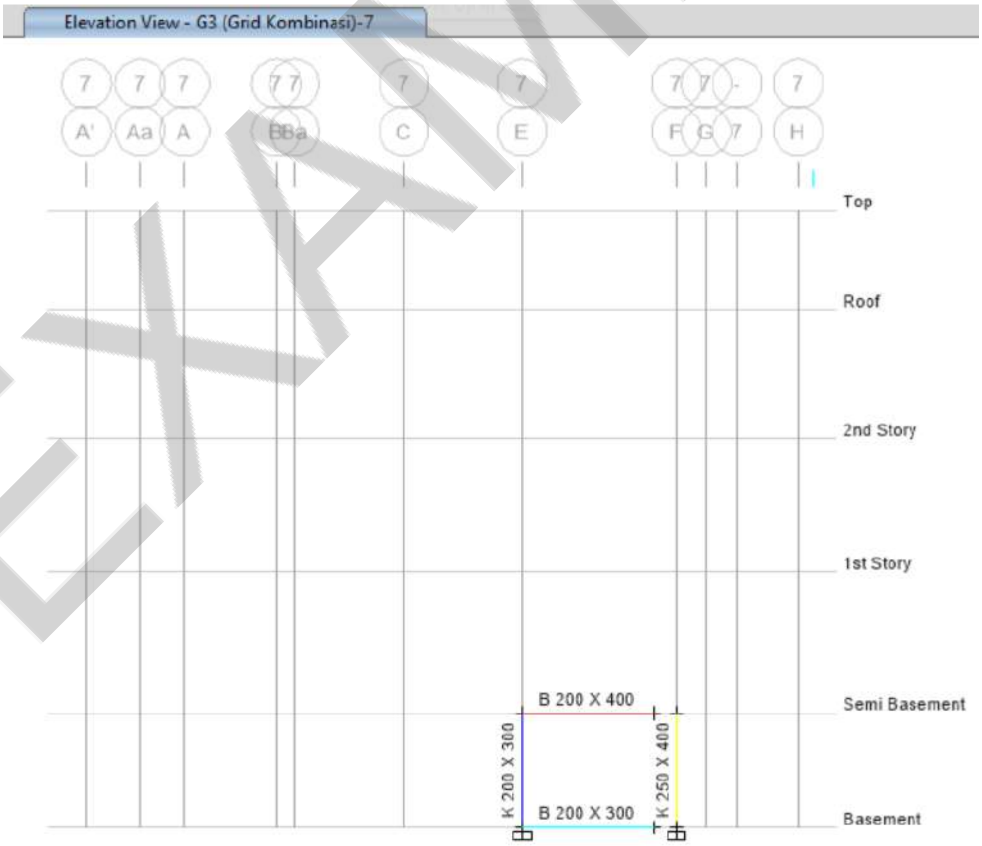



Plan View - Semi Basement - Z = 3 (m)
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400
B 200 X 400


Elevation View - G3 (Grid Kombinasi)-E
1c 1b 1a 1 1' 2 2' 3 4 5a 5 6 6a 7 9 10 10a 10b
Top
Roof
2nd Story
1st Story
Semi Basement
Basement
B 200 X 400
B 200 X 300
K 200 X 300


Elevation View - G3 (Grid Kombinasi)-F
1c 1b 1a 1 1' 2 2' 3 4 5a 5 6 6a 7 9 10 10a 10b
Top
Roof
2nd Story
1st Story
Semi Basement
Basement
K 250 X 400

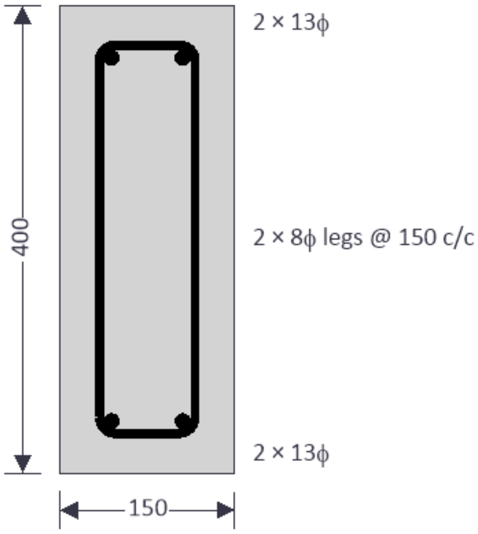
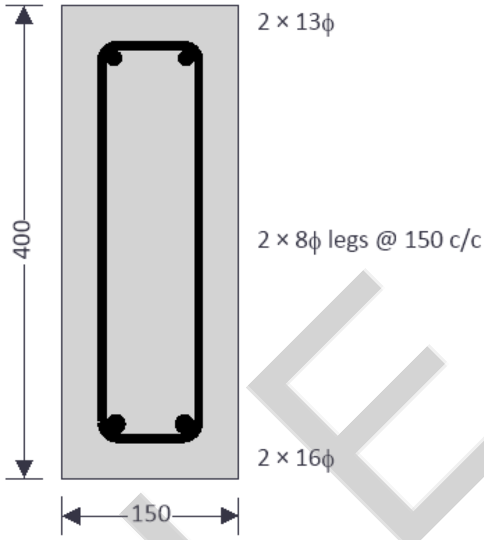

Elevation View - G3 (Grid Kombinasi)-6
Top
Roof
2nd Story
1st Story
Semi Basement
Basement
B 200 X 400
B 200 X 300
K 200 X 300
K 200 X 300

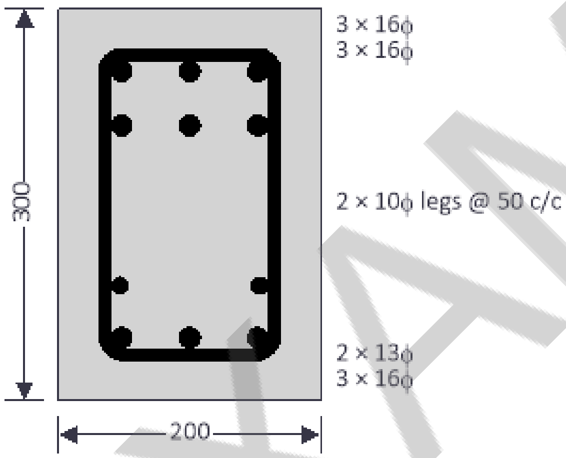
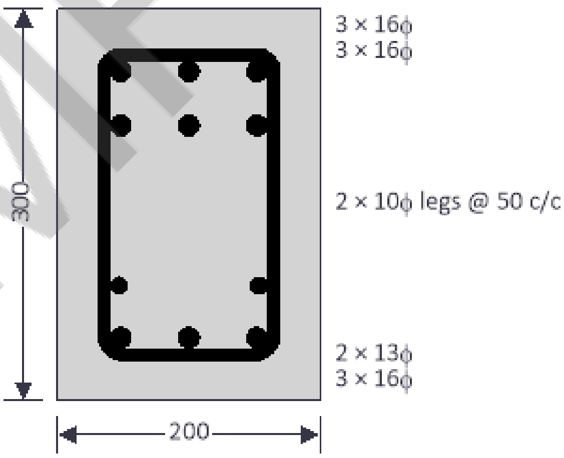

Elevation View - G3 (Grid Kombinasi)-7
Top
Roof
2nd Story
1st Story
Semi Basement
Basement
B 200 X 400
B 200 X 300
K 200 X 300
K 250 X 400

CHAPTER III BEAM, COLUMN, PLATE & FOUNDATION DETAILING

III.1 Beam Detailing

	TABLE: Element Forces -Concrete Beams				
	Sections	**V2MAX**	**V2MIN**	**M3MAX**	**M3MIN**
		kN	kN	kN-m	kN-m
CB1	B 150 X 400_END	40,1529	-40,0617	23,6663	-30,4726
	B 150 X 400_MID	22,3375	-25,5507	42,8453	-2,6098
CB2	B 200 X 300_END	94,8009	-120,833	55,0611	-72,6634
	B 200 X 300_MID	73,8766	-120,527	58,6021	-16,4384
CB3	B 200 X 350_END	68,5333	-53,9273	23,146	-54,0781
	B 200 X 350_MID	34,4803	-23,2888	48,6842	-17,6293
CB4	B 200 X 400_END	100,8021	-106,596	120,9644	-138,855
	B 200 X 400_MID	94,7068	-112,195	81,0524	-137,388
CB5	B 250 X 300_END	69,0989	-84,3718	34,6638	-91,6095
	B 250 X 300_MID	52,6738	-79,8924	49,7563	-31,8836
CB6	B 250 X 350_END	85,3191	-113,78	80,5209	-124,653
	B 250 X 350_MID	67,0454	-106,091	89,5221	-73,0106
CB7	B 250 X 400_END	124,0276	-117,399	102,2825	-194,56
	B 250 X 400_MID	108,3016	-84,0001	68,0547	-101,596
CB8	B 250 X 450_END	63,1292	-74,8916	54,0606	-60,6576
	B 250 X 450_MID	34,1345	-50,7852	81,9111	-5,6484
CB9	B 250 X 500_END	157,6768	-205,27	88,0506	-178,247
	B 250 X 500_MID	55,7596	-147,372	116,6681	-146,758
CB10	B 250 X 600_END	70,3849	-69,91	0,0151	-97,5201
	B 250 X 600_MID	42,6191	-23,7243	2,2985	-22,1338
CB11	B 300 X 350_END	104,3612	-94,8384	38,308	-96,1657
	B 300 X 350_MID	68,6049	-49,936	98,3003	-0,9335

B 150 X 400_END	B 150 X 400_MID
	

B 200 X 300_END	B 200 X 300_MID
	

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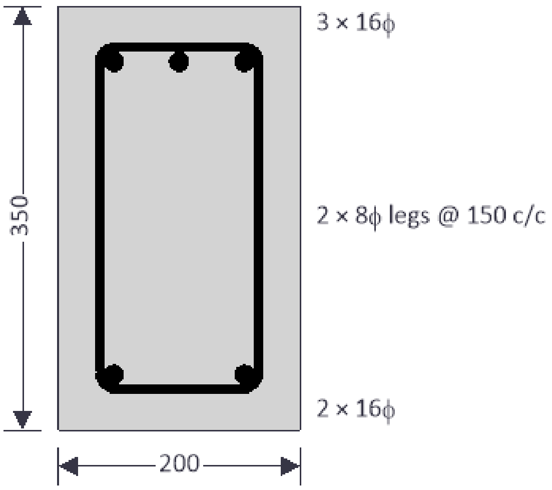

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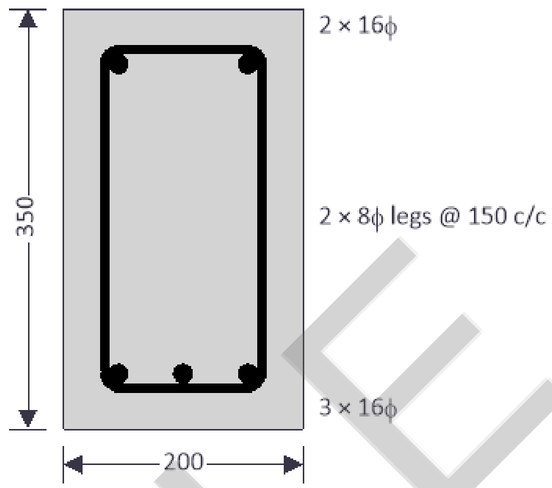

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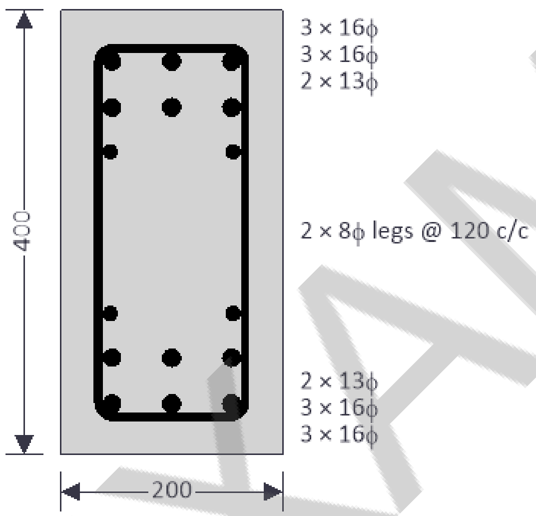

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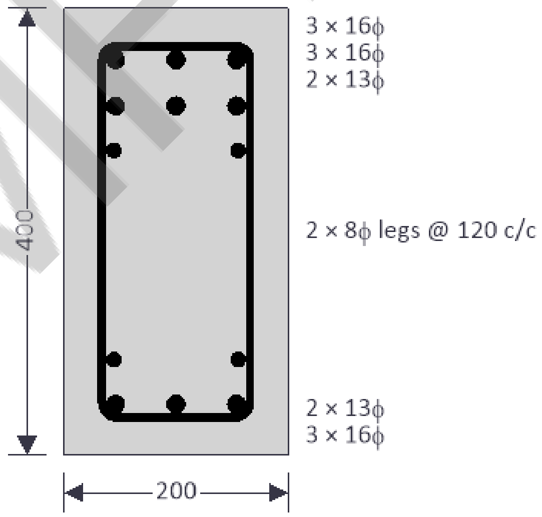

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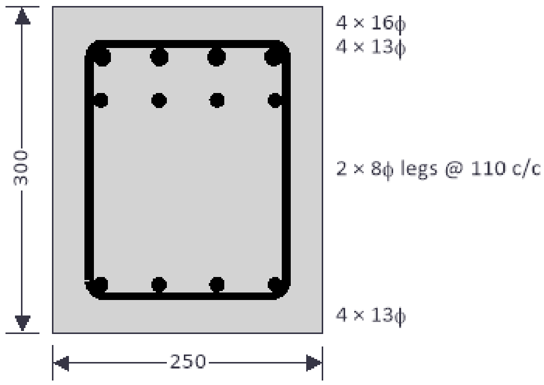	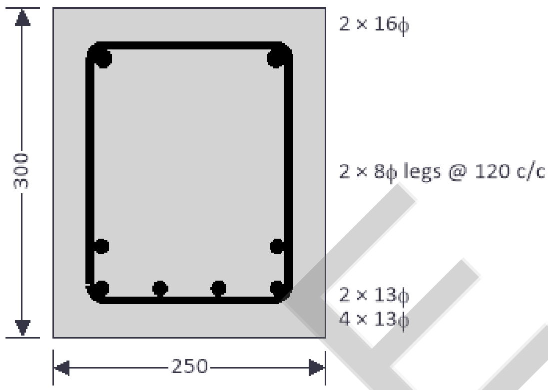

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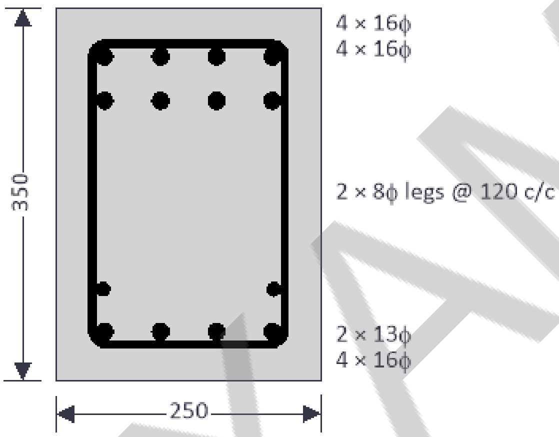	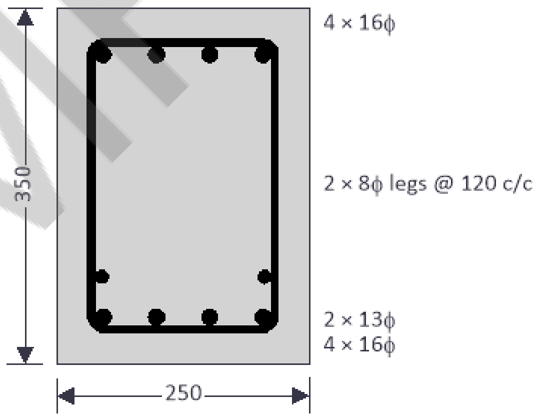

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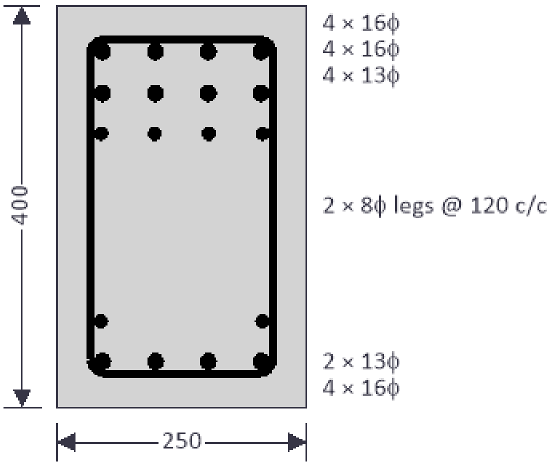

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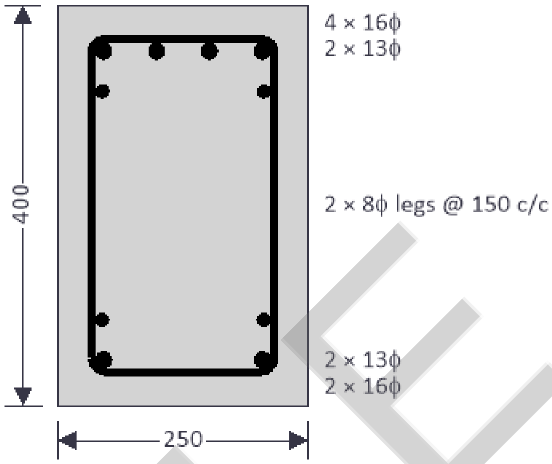

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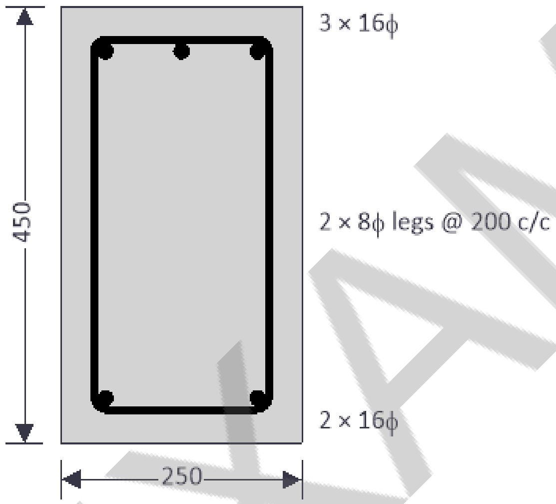

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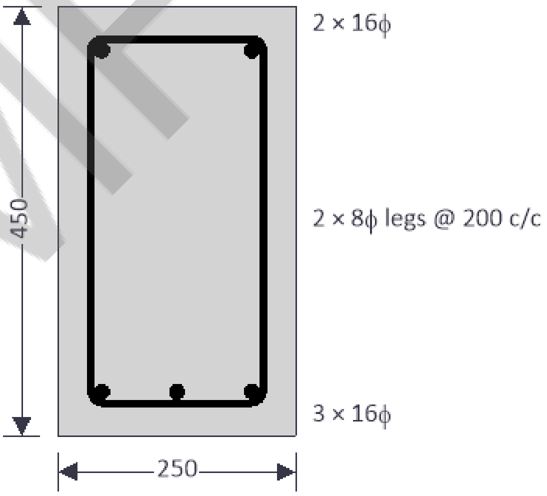

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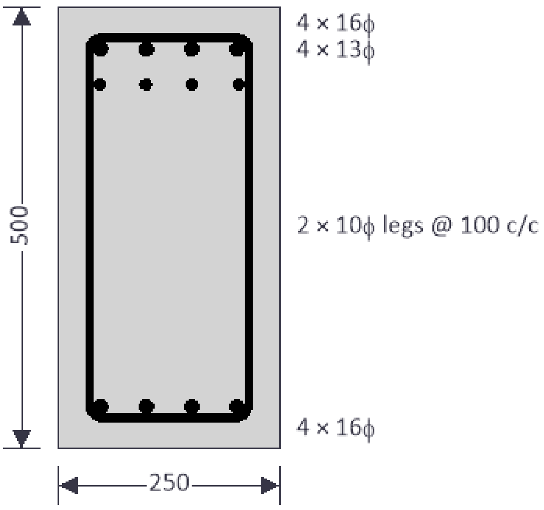
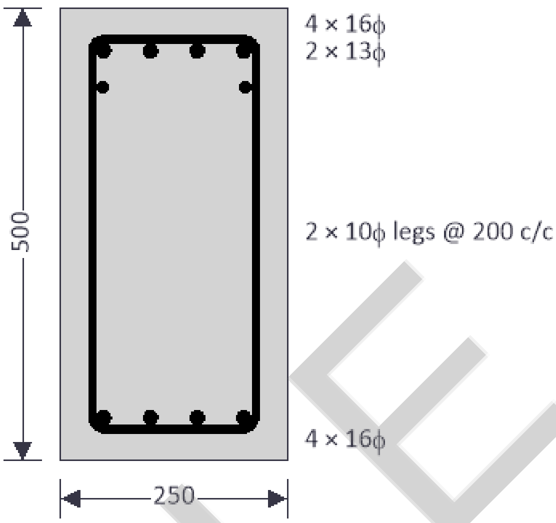
<tr><td>
</td><td>
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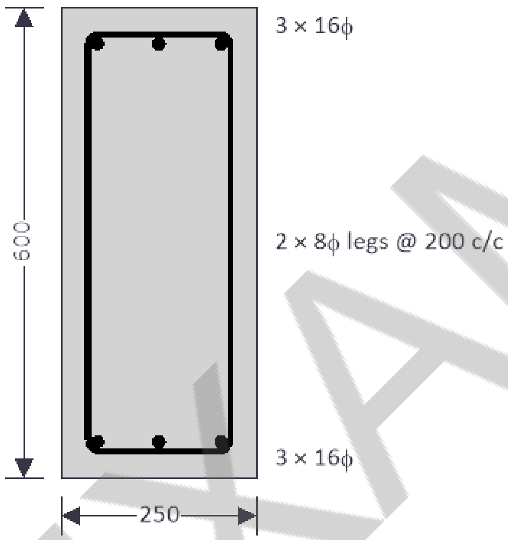
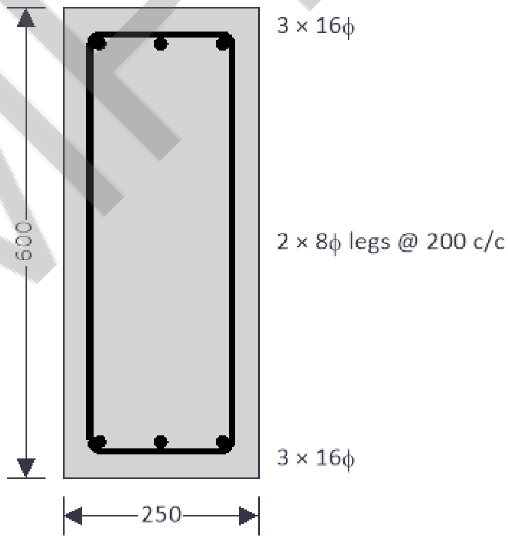
<tr><td>
</td><td>
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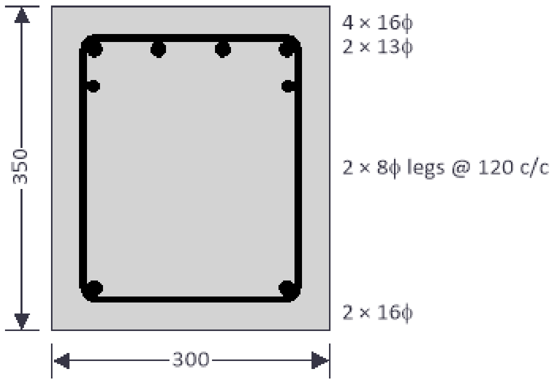
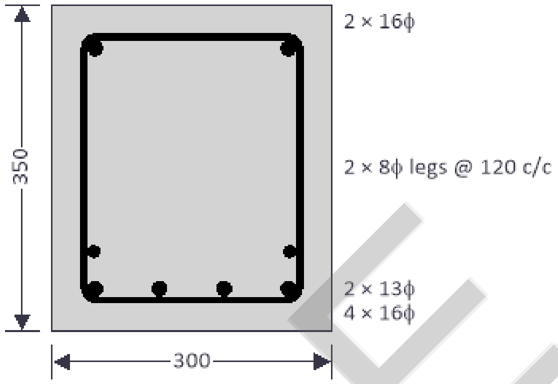
	

NOTE :

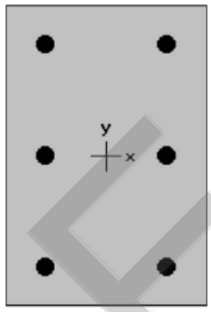
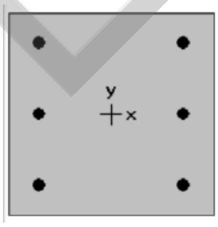
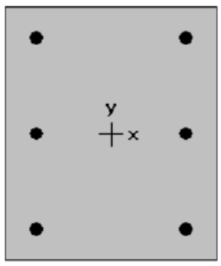
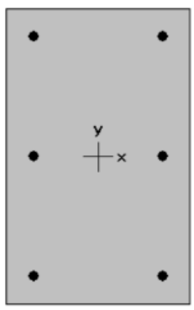
- All information on the **main reinforcement** and **stirrups** on the drawings, must be in accordance with the installation in the field.
- Reinforcement for tie beams uses the same reinforcement with the same beam dimensions
- Both beams and columns are designed using **K300** concrete quality. If you want to use quality below K300, please consult first.
- The quality of threaded reinforcement uses **BJTD 40** and the quality of plain reinforcement uses **BJTP 30**.

	TABLE: Element Forces -Concrete Beams				
	Sections	**V2MAX**	**V2MIN**	**M3MAX**	**M3MIN**
		kN	kN	kN-m	kN-m
SB1	IWF 150 X 150_END	29,8742	-109,98	31,6568	-36,6742
	IWF 150 X 150_MID	27,4558	-0,0859	18,0609	-13,3597
SB2	IWF 150 X 75_END	33,9632	-14,2827	11,1413	-19,3237
	IWF 150 X 75_MID	15,8467	-13,8821	7,1831	-3,2869
SB3	IWF 200 X 100_END	67,2812	-49,994	34,2518	-43,0684
	IWF 200 X 100_MID	66,9835	-49,7502	21,4976	-21,3176
SB4	IWF 200 X 150_END	63,6779	-125,724	43,4576	-51,4439
	IWF 200 X 150_MID	59,5698	-62,887	56,1228	-33,3643
SB5	IWF 250 X 125_END	52,8035	-46,4171	30,1755	-48,6152
	IWF 250 X 125_MID	34,767	-35,5939	64,1121	-1,6156
SB6	UNP 100 X 50_END	10,3875	-11,401	5,1927	-6,6618
	UNP 100 X 50_MID	10,1675	-11,0359	2,7943	-3,7282
SB7	UNP 125 X 65_END	0,0123	-14,545	3,2343	3,2343
	UNP 125 X 65_MID	0,0123	-14,0051	0,1438	-9,0893

NOTE :

- Both beams and columns are designed using **BJ 37** steel quality.

III.2 Column Detailing

	CONCRETE						
	TABLE: Element Forces - Columns						
	Story	**Sections**	**P**	**M2**	**M3**	**Reinforcement Needs**	**ρ**
			kN	kN-m	kN-m		%
CC1	2nd Story	K 200 X 300	2,8643	-0,2819	-0,0279		2,84
	1st Story	K 200 X 300	-264,525	7,0009	-1,3558		
	2nd Story	K 200 X 300	-193,254	21,072	19,181		
	2nd Story	K 200 X 300	-185,646	-17,2693	17,738		
	2nd Story	K 200 X 300	-193,254	21,072	19,181		
	2nd Story	K 200 X 300	-188,001	-13,9819	-38,5715	6 D19 / Ø10 - 90	
CC2	2nd Story	K 250 X 250	0,2231	0,0633	-0,0718		1,91
	1st Story	K 250 X 250	-731,466	2,6346	-12,0554		
	2nd Story	K 250 X 250	-128,515	14,0134	11,8867		
	1st Story	K 250 X 250	-123,131	-22,7359	-19,4346		
	2nd Story	K 250 X 250	-80,4253	-6,8238	37,5421		
	2nd Story	K 250 X 250	-74,8649	2,8259	-31,5368	6 D16 / Ø10 - 70	
CC3	2nd Story	K 250 X 300	7,0195	-7,6021	5,6972		1,59
	1st Story	K 250 X 300	-660,408	-5,9354	5,8559		
	2nd Story	K 250 X 300	-406,115	59,2733	-1,9017		
	2nd Story	K 250 X 300	-399,972	-36,4805	8,1784		
	2nd Story	K 250 X 300	-233,38	-8,1448	24,7912		
	2nd Story	K 250 X 300	-304,619	3,3885	-25,1529	6 D16 / Ø10 - 95	
CC4	1st Story	K 250 X 400	0,4911	0,0035	0,0248		1,19
	1st Story	K 250 X 400	-600,081	-22,7126	6,8969		
	1st Story	K 250 X 400	-114,036	49,5522	-4,3927		
	2nd Story	K 250 X 400	-409,644	-59,0318	-6,3349		
	2nd Story	K 250 X 400	-272,842	39,6603	37,8172		
	2nd Story	K 250 X 400	-270,351	-8,5607	-55,8138	6 D16 / Ø10 - 140	

	STEEL				
	TABLE: Element Forces - Columns				
	Story	Sections	P	M2	M3
			kN	kN-m	kN-m
SC1	Roof	IWF 150 X 150	0,1587	0,0119	-0,1016
	Roof	IWF 150 X 150	-81,591	11,0944	-11,6175
	Roof	IWF 150 X 150	-71,9384	12,7666	7,9649
	Roof	IWF 150 X 150	-59,6079	-10,5774	-8,2473
	Roof	IWF 150 X 150	-71,9384	12,7666	7,9649
	Roof	IWF 150 X 150	-81,591	11,0944	-11,6175
SC2	Roof	IWF 150 X 75	0,1394	-0,0004	-0,0079
	Roof	IWF 150 X 75	-38,0122	0,1068	-2,5696
	Roof	IWF 150 X 75	-28,4767	1,1537	6,8763
	Roof	IWF 150 X 75	-28,4021	-0,6397	-0,9752
	Roof	IWF 150 X 75	-28,4767	1,1537	6,8763
	Roof	IWF 150 X 75	-30,9923	0,1222	-2,576
SC3	Roof	IWF 200 X 100	69,7881	1,1377	-5,6545
	Top	IWF 200 X 100	-123,873	-3,3393	-2,119
	Top	IWF 200 X 100	-123,267	3,85	4,9917
	Top	IWF 200 X 100	-123,873	-3,3393	-2,119
	Roof	IWF 200 X 100	63,442	-1,2973	18,0194
	Top	IWF 200 X 100	-32,8958	-1,0696	-14,0431
SC4	Roof	IWF 200 X 150	17,3855	-1,7816	29,2074
	Roof	IWF 200 X 150	-195,245	-3,8586	-3,8808
	Top	IWF 200 X 150	-46,945	9,6206	23,022
	Top	IWF 200 X 150	-47,8176	-6,5357	-14,3994
	Top	IWF 200 X 150	-20,1641	4,0934	42,8065
	Roof	IWF 200 X 150	-16,0158	-0,0994	-36,0785

SC5	Roof	IWF 200 X 200	19,5319	7,1848	-33,7542
	Roof	IWF 200 X 200	-205,153	3,9817	-13,3338
	Top	IWF 200 X 200	-49,1846	32,1348	-15,169
	Top	IWF 200 X 200	-47,7708	-32,1865	-9,3934
	Roof	IWF 200 X 200	16,1851	-7,8021	74,8227
	Roof	IWF 200 X 200	-29,2043	-1,0609	-34,7369
SC6	Roof	IWF 250 X 125	2,8473	-0,467	0,7985
	Roof	IWF 250 X 125	-79,9422	1,7186	-25,3557
	Top	IWF 250 X 125	-33,0513	6,0331	-5,8563
	Top	IWF 250 X 125	-34,188	-4,8418	4,9338
	Roof	IWF 250 X 125	-73,4135	-2,4914	25,2524
	Roof	IWF 250 X 125	-74,5676	1,6728	-25,8434
SC7	Roof	IWF 250 X 250	0,1135	0,0125	0,408
	Roof	IWF 250 X 250	-125,12	-40,4982	-44,7267
	Roof	IWF 250 X 250	-122,342	44,6697	3,516
	Roof	IWF 250 X 250	-125,12	-40,4982	-44,7267
	Roof	IWF 250 X 250	-13,9164	4,4806	5,3015
	Roof	IWF 250 X 250	-107,114	-40,3951	-44,8513
SC8	Top	IWF 300 X 150	2,6869	-7,8827	-10,9562
	Roof	IWF 300 X 150	-150,542	-3,9181	45,7381
	Top	IWF 300 X 150	-16,2926	12,3919	-34,4735
	Roof	IWF 300 X 150	-142,09	-9,2785	-26,6215
	Roof	IWF 300 X 150	-140,46	-3,9099	46,5171
	Roof	IWF 300 X 150	-129,406	3,91	-79,9335

NOTE:

- All information on the **main reinforcement** and **stirrups** on the drawings, must be in accordance with the installation in the field.
- Reinforcement for tie beams uses the same reinforcement with the same beam dimensions
- Both beams and columns are designed using **K300** concrete quality. If you want to use quality below K300, please consult first.
- The quality of threaded reinforcement uses **BJTD 40** and the quality of plain reinforcement uses **BJTP 30**.
- Both steel beams and steel columns are designed using **BJ 37** steel quality.

III.3 Slab Detailing

Detailing for slab with 120 mm of thickness:

SLAB DESIGNER	**PROJECT**	**Lakehouse Cinere Depok**			
	REV		**DATE**		
One Way Slab	**ENGINEER**	Zhafran Al Hafizh R.B.N., S.T.	**BEAM ID**		

INPUT CALCULATION DATA

Properties Material

f_c'	Compressive strength of concrete	:	25	MPa
f_y	Yield stress of bending reinf	:	400	MPa
f_{yt}	Yield stress of shear reinf	:	240	MPa

Strength of Cross-Sectional Plans

M_u^+	Mid moment	:	21,892	kNm
M_u^-	End moment	:	30,047	kNm
V_u	Shear force	:	396,41	kN

Reinforcement Diameter

D	Longitudinal reinf diameter	:	13	mm
Ø	Shear reinf diameter	:	10	mm
d'	Clean concrete cover	:	30	mm

Slab Dimension

b	Slab width	:	1000	mm
h	Slab height	:	120	mm

Strength Reduction Factors

ϕ	Bending reduction factor	:	0,9
ϕ	Shear reduction fac	:	0,75

CALCULATION OF CONCRETE CROSS-SECTION

β	Concrete tension form factor		:	0,85	
	◦ if $f_c' \leq 30$ MPa	: 0,85			
	◦ if $f_c' > 30$ MPa	: $0.85 - 0.05\,(f_c' - 30)/7$			
ρ_b	Balanced reinforcement ratio	$= \beta\ 0.85\ f_c' / fy\ 600 / (600 + fy)$	:	0,0271	
R_{max}	Max moment resistance factor	$= 0.75\ \rho_b\ f_y\ (1 - 0.375\ \rho_b\ f_y / (0.85\ f_c'))$	:	6,5736	
	Max reinforcement number per row	$= (b - 2\ d' - 2\ P) / (25 + D)$	:	24	pieces

CALCULATION OF POSITIVE REINFORCEMENT (MID)

M_n	Plan nominal moment	$= M_u^+ / \phi$	:	24,324	kNm
d	Effective height of cross section	$= h - d' - P - 0.5\ D$	:	73,5	mm
R_n	Moment resistance factor	$= M_n\ 10^6 / (b\ d^2)$	:	4,5027	
	Check the moment resistance factor against the maximum value:	R_n	<	R_{max}	**OK!**
ρ_{min}	Minimum rebar ratio	$= \sqrt{f_c'} / (4 * f_y)$ atau $1.4 / f_y$	:	0,0035	
ρ	Required rebar ratio	$= 0.85\ f_c' / f_y\ (1 - \sqrt{(1 - 2\ R_n / (0.85\ f_c'))})$	:	0,0128	
	Check the minimum reinforcement ratio requirement:	ρ_{min}	<	ρ	**OK!**
A_s	Required area of reinforcement	$= \rho\ b\ d$	:	940,67	mm^2
n	The required amount of reinforcement		:	8	pieces

CALCULATION OF NEGATIVE REINFORCEMENT (END)						
M_n	Plan nominal moment	$= M_u^+ / \phi$		:	33,386	kNm
d	Effective height of cross section	= h - d' - P - 0.5 D		:	73,5	mm
R_n	Moment resistance factor	$= M_n \, 10^6 / (b \, d^2)$		:	6,1799	
	Check the moment resistance factor against the maximum value:		R_n	<	R_{max}	**OK!**
ρ_{min}	Minimum rebar ratio	= 0.25%		:	0,0035	
ρ	Required rebar ratio	$= 0.85 \, f_c' / f_y \, (1 - \sqrt{(1 - 2 \, R_n / (0.85 \, f_c'))})$		:	0,0188	
	Check the minimum reinforcement ratio requirement:		ρ_{min}	<	ρ	**OK!**
A_s	Required area of reinforcement	= ρ b d		:	1379,1	mm^2
n	The required amount of reinforcement			:	11	pieces

CALCULATION OF SHEAR REINFORCEMENT					
V_c	Shear strength of concrete	$= (\sqrt{f_c'}) / 6 * (b \, d \, 10^{-3}$	:	61,25	kN
$\phi \, V_c$	Concrete shear resistance	$= \phi \, V_c$	:	45,938	kN
		Required shear reinforcement!			
$\phi \, V_s$	Shear resistance of shear reinf	$= V_u - \phi \, V_c$	:	350,47	kN
V_s	Shear strength of shear reinf	$= V_u / \phi$	:	467,29	kN
n	Number of legs used		:	2	pieces
A_v	Shear reinforcement area	$= n \, \pi \, Ø^2 / 4$	:	157,08	mm^2
s	Required shear reinf distance	$= A_v \, f_{yt} \, d / (V_s \, 10^3)$	:	5,9297	mm
s_{max}	Maximum shear reinf distance	= d / 2 atau 250 mm	:	36,75	mm

REINFORCEMENT RESUME				
Mid reinforcement (positive)	**D13**	-	**125**	mm
End reinforcement (negative)	**D13**	-	**100**	mm

As for the rooftop and top story, bondek slab will be used. The detailing for the bondek slab is in the shop drawing.

Detailing for slab with 150 mm of thickness (for water tank at the tower roof):

SLAB DESIGNER	**PROJECT**	**Lakehouse Cinere Depok (for Water Tank)**			
	REV		**DATE**		
One Way Slab	**ENGINEER**	Zhafran Al Hafizh R.B.N., S.T.	**BEAM ID**		

INPUT CALCULATION DATA

Properties Material					***Strength of Cross-Sectional Plans***				
f_c'	Compressive strength of concret	:	25	MPa	M_u^+	Mid moment	:	8,046	kNm
f_y	Yield stress of bending reinf	:	400	MPa	M_u^-	End moment	:	28,781	kNm
f_{yt}	Yield stress of shear reinf	:	240	MPa	V_u	Shear force	:	96,641	kN
Reinforcement Diameter					***Slab Dimension***				
D	Longitudinal reinf diameter	:	13	mm	b	Slab width	:	1000	mm
Ø	Shear reinf diameter	:	10	mm	h	Slab height	:	150	mm
d'	Clean concrete cover	:	40	mm					
Strength Reduction Factors									
ϕ	Bending reduction factor	:	0,9		ϕ	Shear reduction fac	:	0,75	

CALCULATION OF CONCRETE CROSS-SECTION

β	Concrete tension form factor		:	0,85	
	◦ if $f_c' \leq 30$ MPa	: 0,85			
	◦ if $f_c' > 30$ MPa	: 0.85 - 0.05 (f_c' - 30)/7			
ρ_b	Balanced reinforcement ratio	= β 0.85 f_c' / fy 600 / (600 + fy)	:	0,0271	
R_{max}	Max moment resistance factor	= 0.75 ρ_b f_y (1 - 0.375 ρ_b f_y / (0.85 f_c'))	:	6,5736	
	Max reinforcement number per ro	= (b - 2 d' - 2 P) / (25 + D)	:	23	pieces

CALCULATION OF POSITIVE REINFORCEMENT (MID)

M_n	Plan nominal moment	= M_u^+ / ϕ	:	8,94	kNm
d	Effective height of cross section	= h - d' - P - 0.5 D	:	93,5	mm
R_n	Moment resistance factor	= M_n 10^6 / (b d^2)	:	1,0226	
	Check the moment resistance factor against the maximum value:	R_n	<	R_{max}	**OK!**
ρ_{min}	Minimum rebar ratio	= √ f_c' / (4 * f_y) atau 1.4 / f_y	:	0,0035	
ρ	Required rebar ratio	= 0.85 f_c' / f_y (1 - √ (1 - 2 R_n / (0.85 f_c')))	:	0,0026	
	Check the minimum reinforcement ratio requirement:	ρ_{min}	>	ρ	**CEK!**
A_s	Required area of reinforcement	= ρ b d	:	327,25	mm^2
n	The required amount of reinforcement		:	3	pieces

CALCULATION OF NEGATIVE REINFORCEMENT (END)

M_n	Plan nominal moment	$= M_u^+ / \phi$	:	31,979	kNm
d	Effective height of cross section	= h - d' - P - 0.5 D	:	93,5	mm
R_n	Moment resistance factor	$= M_n\ 10^6 / (b\ d^2)$	:	3,658	
	Check the moment resistance factor against the maximum value:	R_n	<	R_{max}	**OK!**
ρ_{min}	Minimum rebar ratio	= 0.25%	:	0,0035	
ρ	Required rebar ratio	$= 0.85\ f_c' / f_y\ (1 - \sqrt{(1 - 2\ R_n / (0.85\ f_c'))})$	:	0,0101	
	Check the minimum reinforcement ratio requirement:	ρ_{min}	<	ρ	**OK!**
A_s	Required area of reinforcement	$= \rho\ b\ d$	:	944,93	mm^2
n	The required amount of reinforcement		:	8	pieces

CALCULATION OF SHEAR REINFORCEMENT

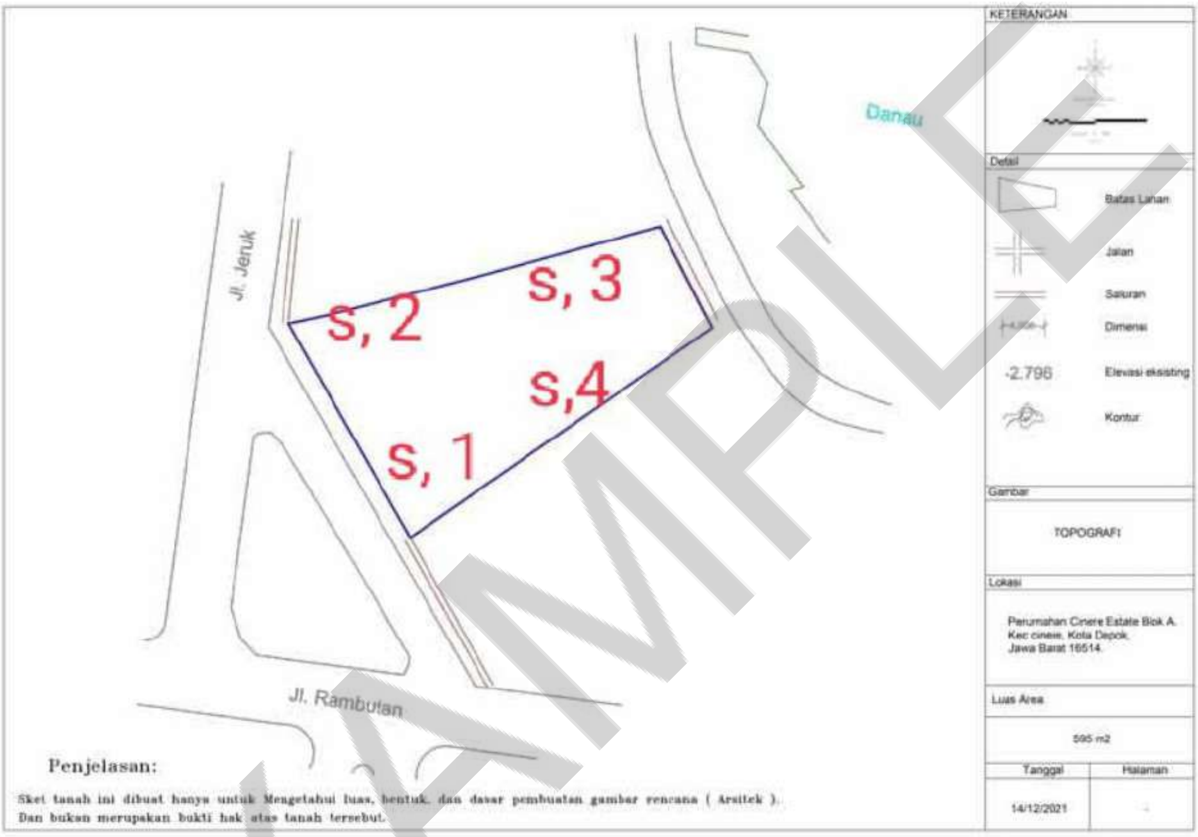
V_c	Shear strength of concrete	$= (\sqrt{f_c'}) / 6 * (b\ d\ 10^{-3}$	:	77,917	kN
$\phi\ V_c$	Concrete shear resistance	$= \phi\ V_c$	:	58,438	kN
		Required shear reinforcement!			
$\phi\ V_s$	Shear resistance of shear reinf	$= V_u - \phi\ V_c$	:	38,204	kN
V_s	Shear strength of shear reinf	$= V_u / \phi$	:	50,938	kN
n	Number of legs used		:	2	pieces
A_v	Shear reinforcement area	$= n\ \pi\ Ø^2 / 4$	:	157,08	mm^2
s	Required shear reinf distance	$= A_v\ f_{yt}\ d / (V_s\ 10^3)$	:	69,199	mm
s_{max}	Maximum shear reinf distance	= d / 2 atau 250 mm	:	46,75	mm

REINFORCEMENT RESUME

Mid reinforcement (positive)	**D13**	-	**500**	mm →	**200 mm**
End reinforcement (negative)	**D13**	-	**125**	mm	

III.4 Foundation Detailing

Based on the results of the soil investigation conducted by PT Wenays Jaya Semesta, the location of the house plan has the optimum soil bearing capacity at a depth of > 10 m at 4 Cone Penetration Test (CPT) test points. Also this location is on a slope area with a height difference of ±6.5 m.

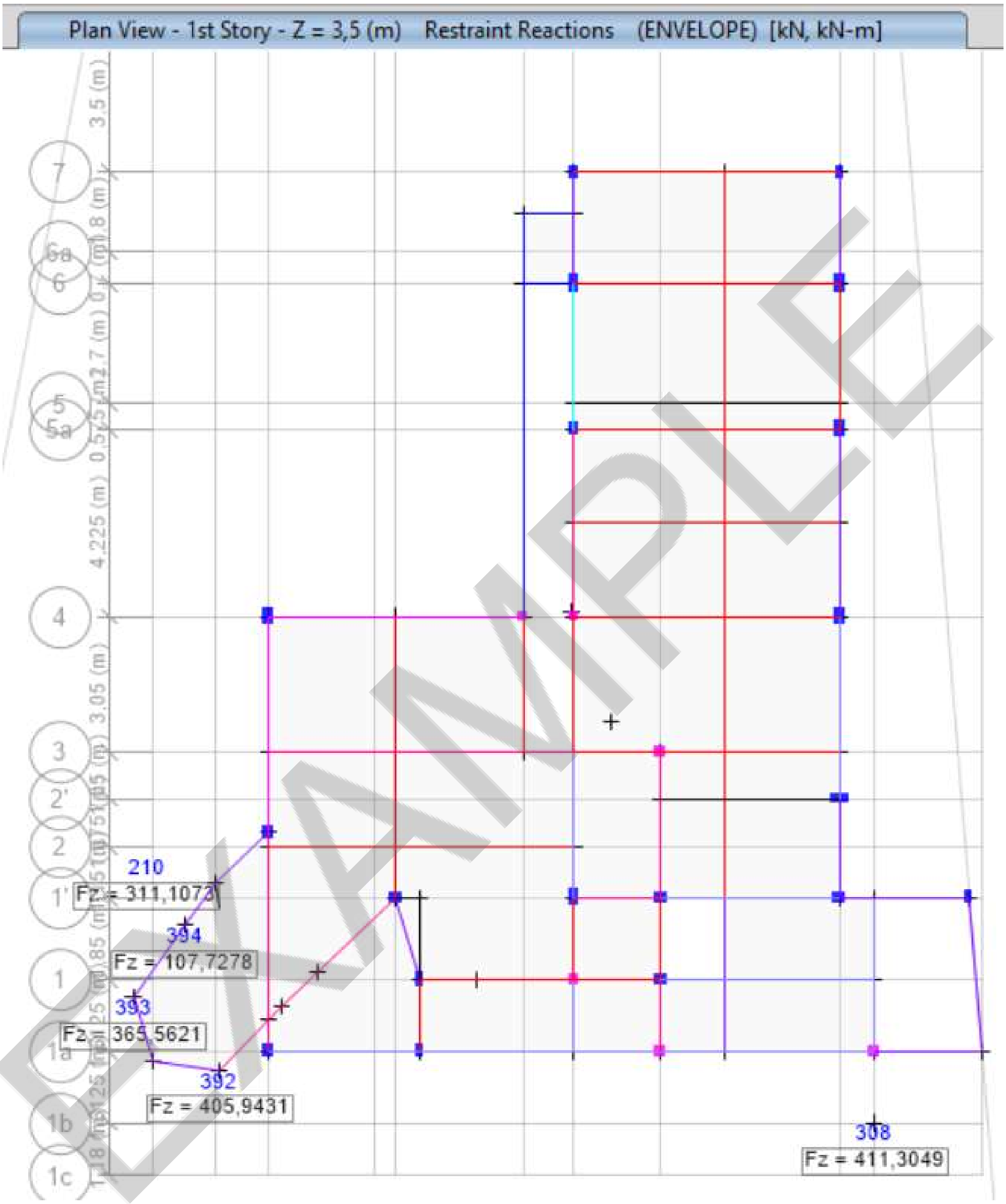


Titik Sondir	Kedalaman Pengujian Sondir	Nilai Tahanan Konus (qc)
S-1	16.6	250 kg/cm^2
S-2	15.2	250 kg/cm^2
S-3	11.6	250 kg/cm^2
S-4	12.4	250 kg/cm^2

Source: Soil Investigation Report for Lakehouse

Therefore, the foundation that will be used is the deep foundation in the form of a concrete pile foundation. The depth of the foundation will adjust to the results of the tests that have been carried out. The foundation in the area around points S-1 and S-2 will have more depth than points S-3 and S-4.

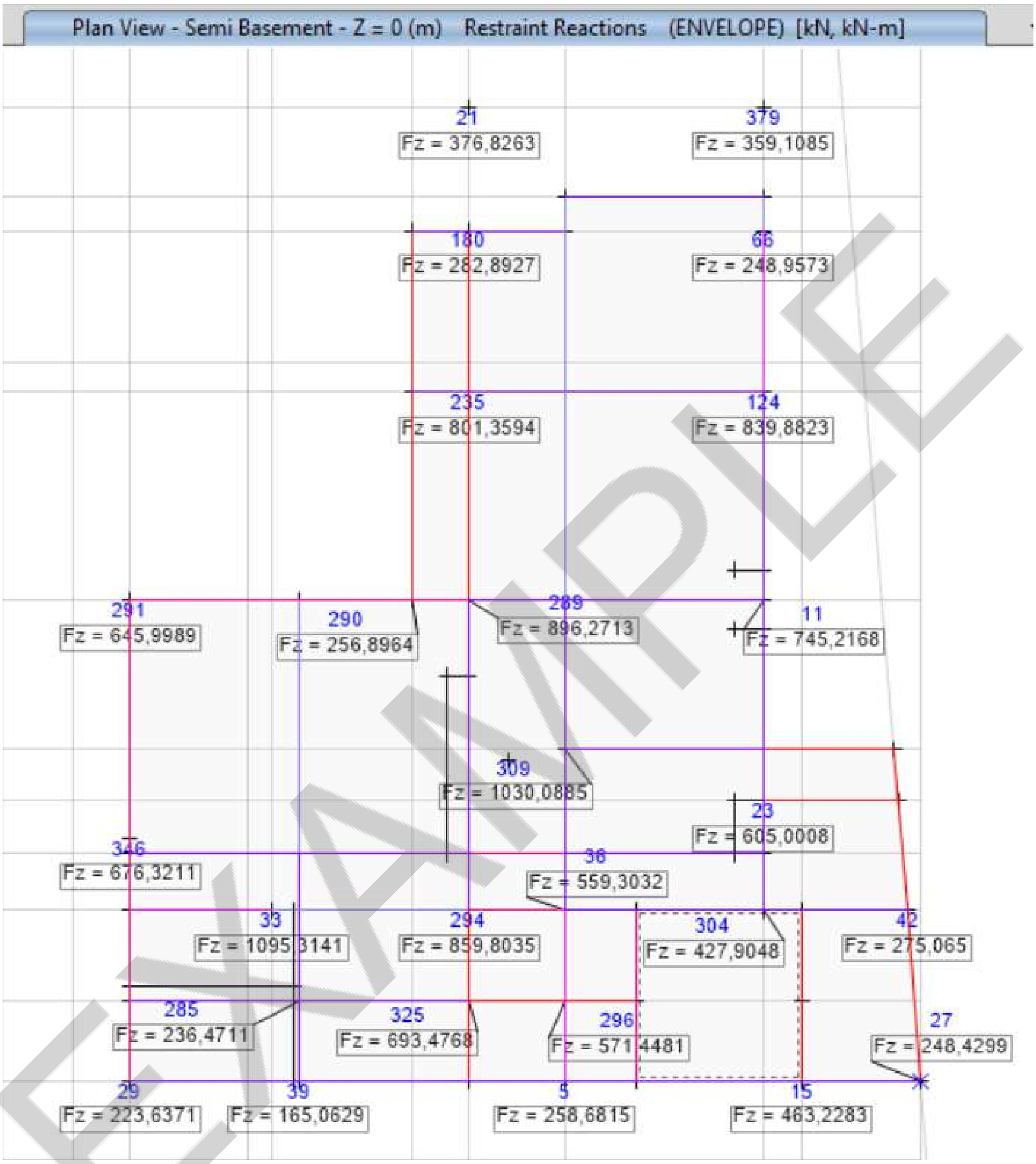
- Main Building + Tower – 1st Story



Story	Unique Name	Column Location	Output Case	FX	FY	FZ	MX	MY	MZ
1st Story	308	S2	Comb3	-11,9568	2,0682	311,1855	-3,023	-11,9131	-0,0419
1st Story	392	S2	Comb1	-4,0789	-18,1239	307,6878	56,5706	-18,6296	-0,0465
1st Story	393	S2	Comb1	-5,2215	1,2118	225,2492	-14,0414	-15,197	0,0269
1st Story	210	S2	Comb1	29,3262	5,4111	278,35	-5,5837	-10,1404	-0,7582
1st Story	394	S2	Comb1	-0,8935	2,6494	91,8754	-6,6828	2,3445	-0,0277

								Pile Cap			
Story	Foundation type	Qall (ton)	n asli	n Pile	Depth (Ref.) [m]	Depth (In Field) [m	Diameter Pile (m)	Thickness (m)	b (m)	h (m)	nd (m)
1st Story	Bored Ø 400 mm	46,6	0,851	1	15	15	0,4	0,5	1,2	1,2	0,4
1st Story	Fondasi Telapak	43,8	-	-	1	1	-	0,3	2,0	2,0	-
1st Story	Fondasi Telapak	43,8	-	-	1	1	-	0,3	2,0	2,0	-
1st Story	Fondasi Telapak	43,8	-	-	1	1	-	0,3	2,0	2,0	-
1st Story	Fondasi Telapak	43,8	-	-	1	1	-	0,3	1,0	1,0	-

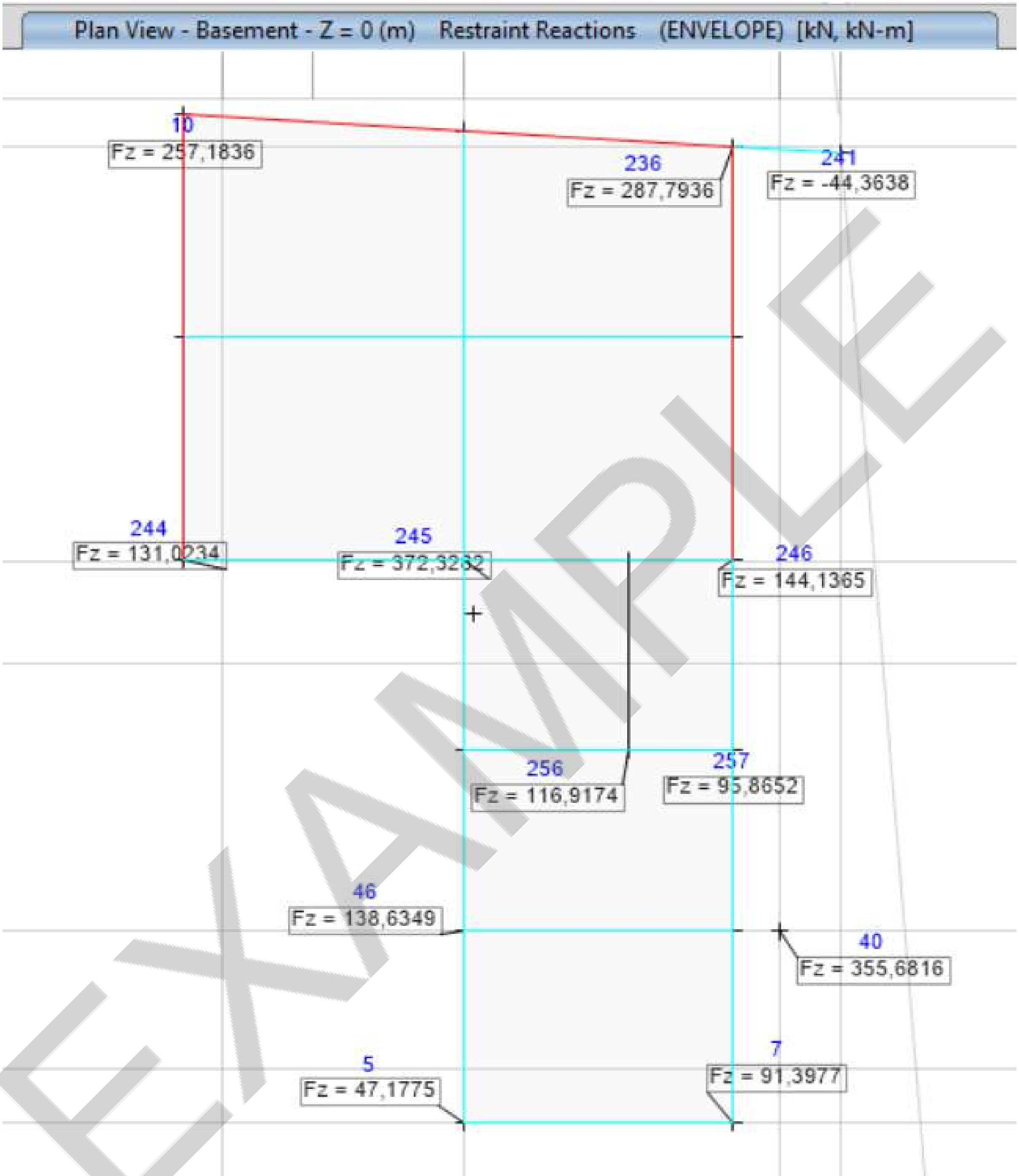
- Main Building – Semi Basement



Story	Unique Name	Column Location	Output Case	FX	FY	FZ	MX	MY	MZ
Semi Basement	289	S4	Comb2	10,3586	-2,2417	890,0404	-84,0889	-85,5642	-0,0064
Semi Basement	309	S4	Comb2	-1,8649	-3,527	851,7993	40,9616	-38,3082	-0,0064
Semi Basement	294	S2	Comb2	-2,285	14,9215	675,4341	94,0351	55,5178	-0,0147
Semi Basement	346	S2	Comb2	4,2446	0,2462	555,9735	-3,7913	-39,7663	-0,009
Semi Basement	285	S2	Comb3	6,2576	1,8481	237,0632	-10,449	42,2437	-0,005
Semi Basement	291	S4	Comb2	11,4117	-7,1588	526,2188	-49,716	-69,7793	-0,0147
Semi Basement	11	S4	Comb2	-12,5257	0,4165	660,8799	-28,4303	88,8545	-0,0147
Semi Basement	235	S4	Comb2	16,3877	-2,8076	775,1473	22,1016	-79,074	-0,009
Semi Basement	15	S1	Comb1	-1,0144	2,2461	425,8538	14,4798	43,4979	-0,0055
Semi Basement	23	S1	Comb2	-4,354	1,6673	485,2763	54,7444	-41,809	-0,0147
Semi Basement	124	S4	Comb2	-19,6345	-5,7969	738,4516	28,7816	108,4764	-0,0147
Semi Basement	36	S1	Comb1	3,3478	2,2907	447,1935	20,9608	4,3721	-0,0078
Semi Basement	33	S2	Comb2	-5,0713	5,1326	957,3416	64,119	-79,2707	-0,009
Semi Basement	180	S4	Comb2	23,6401	-1,228	272,7707	-20,0081	-71,3456	-0,0147
Semi Basement	42	S1	Comb1	-0,6976	-1,8986	159,8663	45,5391	2,4067	0,059
Semi Basement	304	S1	Comb1	-2,759	-0,923	398,1033	0,5776	-3,0628	-0,0078
Semi Basement	21	S4	Comb2	5,9843	1,2099	264,5251	-1,3558	7,0009	-0,0054
Semi Basement	27	S1	Comb1	-0,5287	1,838	84,5116	-1,8943	-0,3989	0,1068
Semi Basement	5	S1	Comb1	-0,0429	1,2803	234,2676	-1,6757	-5,619	-0,0055
Semi Basement	29	S2	Comb1	0,4593	11,2427	200,3619	44,1446	-0,3701	-0,0078
Semi Basement	39	S2	Comb2	0,672	1,3656	157,6277	-1,6011	-40,1449	-0,0054
Semi Basement	290	S2	Comb2	-10,2693	-12,0489	240,9234	-17,5287	84,5935	-0,0064
Semi Basement	379 -> 40	S4	Comb2	-6,4519	1,5726	246,9975	-1,7459	-7,4603	-0,0054
Semi Basement	325	S2	Comb3	-4,0361	-0,9679	562,4507	-21,6642	-4,2922	-0,0058
Semi Basement	296	S2	Comb1	2,5527	0,2262	471,5533	-0,5515	-13,4407	-0,0078
Semi Basement	66	S4	Comb2	-25,502	-2,3685	234,0281	11,5796	24,4693	-0,0147

									Pile Cap			
Story	Unique Name	Foundation type	Qall (ton)	n asli	n Pile	Depth (Ref.) [m]	Depth (In Field) [m	Diameter Pile (m)	Thickness (m)	b (m)	h (m)	nd (m)
Semi Basement	289	Bored Ø 400 mm	43,8	2,589	3	12	8,5	0,4	0,5	1,9	1,9	1,2
Semi Basement	309	Bored Ø 400 mm	43,8	2,478	3	12	8,5	0,4	0,5	1,9	1,9	1,2
Semi Basement	294	Bored Ø 400 mm	46,6	1,847	2	15	11,5	0,4	0,5	1,5	0,8	0,8
Semi Basement	346	Bored Ø 400 mm	46,6	1,52	2	15	11,5	0,4	0,5	1,5	0,8	0,8
Semi Basement	285	Bored Ø 400 mm	46,6	0,648	1	15	11,5	0,4	0,5	1,2	1,2	0,4
Semi Basement	291	Bored Ø 400 mm	43,8	1,531	2	12	8,5	0,4	0,5	1,5	0,8	0,8
Semi Basement	11	Bored Ø 400 mm	43,8	1,923	2	12	8,5	0,4	0,5	1,5	0,8	0,8
Semi Basement	235	Bored Ø 400 mm	43,8	2,255	3	12	8,5	0,4	0,5	1,9	1,9	1,2
Semi Basement	15	Retaining Wall										
Semi Basement	23	Bored Ø 500 mm	35,2	1,757	2	15	11,5	0,5	0,5	1,8	1,0	1
Semi Basement	124	Bored Ø 400 mm	43,8	2,148	3	12	8,5	0,4	0,5	1,9	1,9	1,2
Semi Basement	36	Bored Ø 500 mm	35,2	1,619	2	15	11,5	0,5	0,5	1,8	1,0	1
Semi Basement	33	Bored Ø 400 mm	46,6	2,618	3	15	11,5	0,4	0,5	1,9	1,9	1,2
Semi Basement	180	Bored Ø 400 mm	43,8	0,794	1	12	8,5	0,4	0,5	1,2	1,2	0,4
Semi Basement	42	Bored Ø 500 mm	35,2	0,579	1	15	11,5	0,5	0,5	1,5	1,5	0,5
Semi Basement	304	Bored Ø 500 mm	35,2	1,441	2	15	11,5	0,5	0,5	1,8	1,0	1
Semi Basement	21	Bored Ø 400 mm	43,8	0,77	1	12	8,5	0,4	0,5	1,2	1,2	0,4
Semi Basement	27	Retaining Wall										
Semi Basement	5	Retaining Wall										
Semi Basement	29	Retaining Wall										
Semi Basement	39	Retaining Wall										
Semi Basement	290	Bored Ø 400 mm	46,6	0,659	1	15	11,5	0,4	0,5	1,2	1,2	0,4
Semi Basement	379 -> 40	**Continue to joint 40 Basement**										
Semi Basement	325	Bored Ø 400 mm	46,6	1,538	2	15	11,5	0,4	0,5	1,5	0,8	0,8
Semi Basement	296	Bored Ø 400 mm	46,6	1,289	2	15	11,5	0,4	0,5	1,5	0,8	0,8
Semi Basement	66	Bored Ø 400 mm	43,8	0,681	1	12	8,5	0,4	0,5	1,2	1,2	0,4
Gabungan	-	Bored Ø 400 mm	43,8	3,29	4	12	8,5	0,4	0,5	2,3	2,3	1,6

- Basement


Plan View - Basement - Z = 0 (m) Restraint Reactions (ENVELOPE) [kN, kN-m]
10
Fz = 257,1836
236
Fz = 287,7936
241
Fz = -44,3638
244
Fz = 131,0234
245
Fz = 372,3262
246
Fz = 144,1365
256
Fz = 116,9174
257
Fz = 95,8652
46
Fz = 138,6349
40
Fz = 355,6816
5
Fz = 47,1775
7
Fz = 91,3977

Story	Unique Name	Column Location	Output Case	FX	FY	FZ	MX	MY	MZ
Basement	241	S4	Comb3	0,9928	-1,343	-44,3638	0	0	0
	241			opsi ke 2					
Basement	244	S3	Comb3	0,8314	14,6428	131,0234	46,011	-4,9479	0,1306
Basement	245	S4	Comb3	-0,8008	11,961	372,3282	35,2642	-2,7358	0,1306
Basement	246	S4	Comb3	-5,9788	7,5157	144,1365	24,4952	-2,8582	0,1306
Basement	257	S4	Comb3	-3,9513	-4,9158	95,8652	-12,6875	-1,4473	0,1306
Basement	5	S4	Comb1	2,3198	-0,758	47,176	3,1153	1,5723	0,1306
Basement	7	S4	Comb1	-3,7797	8,7242	91,3977	10,5061	-3,2126	0,1306
Basement	46	S4	Comb3	10,182	-2,968	138,6349	29,535	-15,0796	0,1306
Basement	10	S3	Comb3	30,5477	-18,853	257,1836	-56,6296	-49,7925	0,2613
Basement	236	S4	Comb3	-28,4503	-10,7283	287,7936	-27,9188	48,4621	0,1306
Basement	256	S4	Comb3	-1,9128	-3,2775	116,9174	3,9063	17,677	0,1306
Basement	40	S4	Comb2	0	0	355,6816	0	0	0

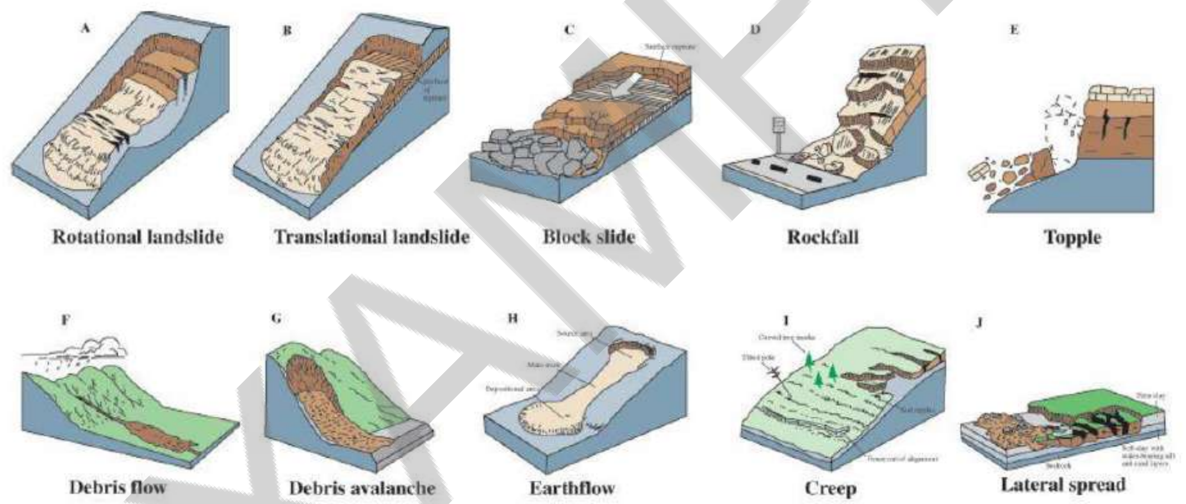
Story	Foundation type	Qall (ton)	n asli	n Pile	Depth (Ref.) [m]	Depth (In Field) [m]	Diameter Pile (m)	Thickness (m)	b (m)	h (m)	nd (m)
Basement	Fondasi Telapak		-	-	1	1	-	0,5	1,0	1,0	-
	Bored Ø 300 mm	7	0,808	1	5	2	0,3	0,5	0,9	0,9	0,3
Basement	Bored Ø 400 mm	40,6	0,411	1	11	8	0,4	0,5	1,2	1,2	0,4
Basement	Bored Ø 300 mm	26,8	1,77	2	12	9	0,3	0,5	1,2	0,6	0,6
Basement	Bored Ø 300 mm	26,8	0,685	1	12	9	0,3	0,5	0,9	0,9	0,3
Basement	Bored Ø 300 mm	26,8	0,456	1	12	9	0,3	0,5	0,9	0,9	0,3
Basement	Retaining Wall										
Basement	Retaining Wall										
Basement	Bored Ø 300 mm	26,8	0,659	1	12	9	0,3	0,5	0,9	0,9	0,3
Basement	Bored Ø 400 mm	40,6	0,807	1	11	8	0,4	0,5	1,2	1,2	0,4
Basement	Bored Ø 300 mm	26,8	1,368	2	12	9	0,3	0,5	1,2	0,6	0,6
Basement	Bored Ø 300 mm	26,8	0,556	1	12	9	0,3	0,5	0,9	0,9	0,3
Basement	Bored Ø 300 mm	26,8	1,691	2	10	6,5	0,3	0,5	1,2	0,6	0,6

CHAPTER IV RETAINING WALL DESIGN & SLOPE STABILITY ANALYSIS

Retaining Wall is one method that can be used in geotechnical engineering as an additional structure for slope reinforcement and underground walls. In designing Retaining Wall, a wall needs to be strong to withstand overturning, sliding and the bearing capacity of the Retaining Wall structure itself (bearing capacity).

Retaining Wall design using Geo Structural Analysis Cantilever Wall software.

Because the structure will be built on a slope area or sloping land, it is necessary to carry out a slope stability analysis to ensure that the subgrade at the project site can accept the structural load without failure/slipping on the subgrade that supports the building. Several types of slope failure are shown in the illustration below:

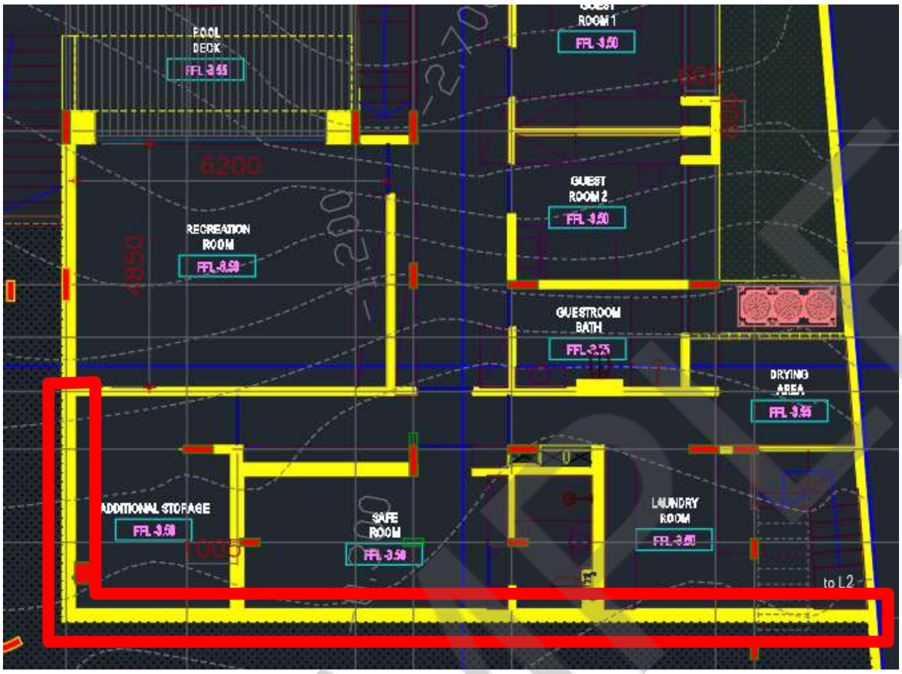


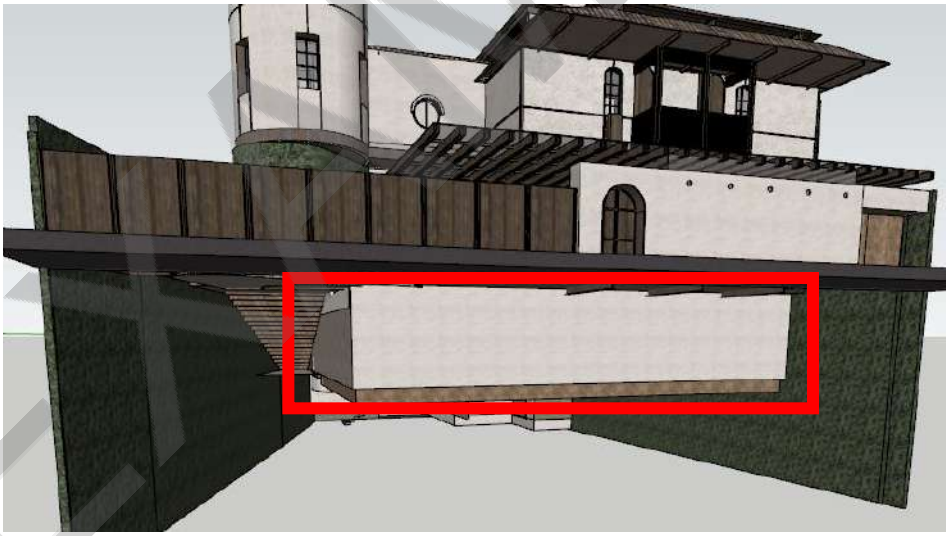
Slope stability is determined from the value of the Safety Factor (SF). The value of SF is the ratio of the forces that push and hold the soil in the slope. The greater the SF value, the safer the slope will be. Geotechnical engineering needs to be done in order to stabilize the slope if the slope is considered unsafe if it is loaded.

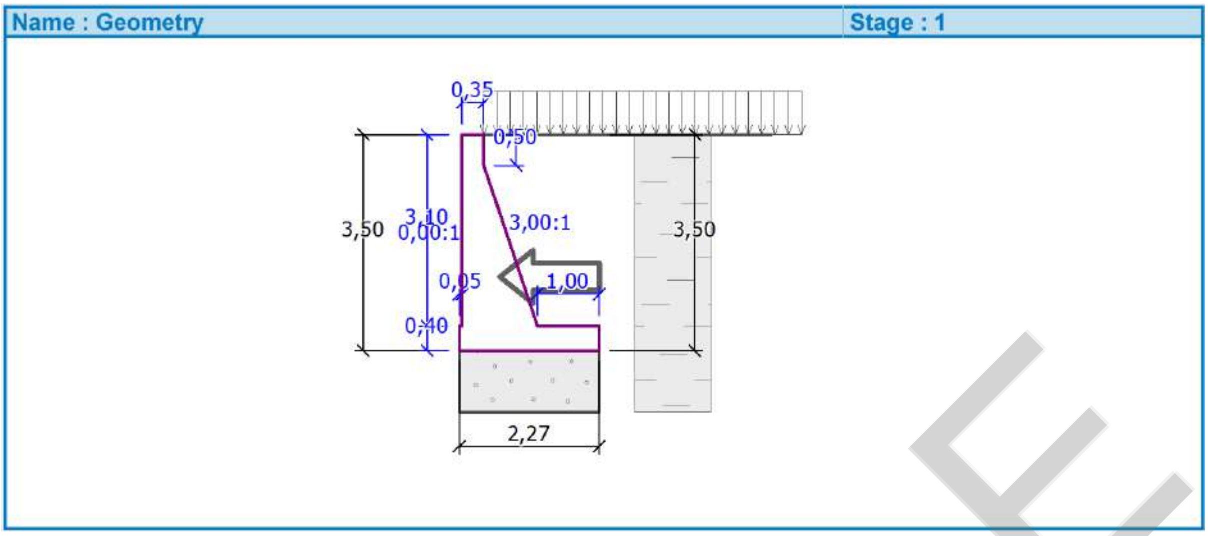
Slope stability analysis was carried out with the help of Geo Structural Analysis Slope Stability software.

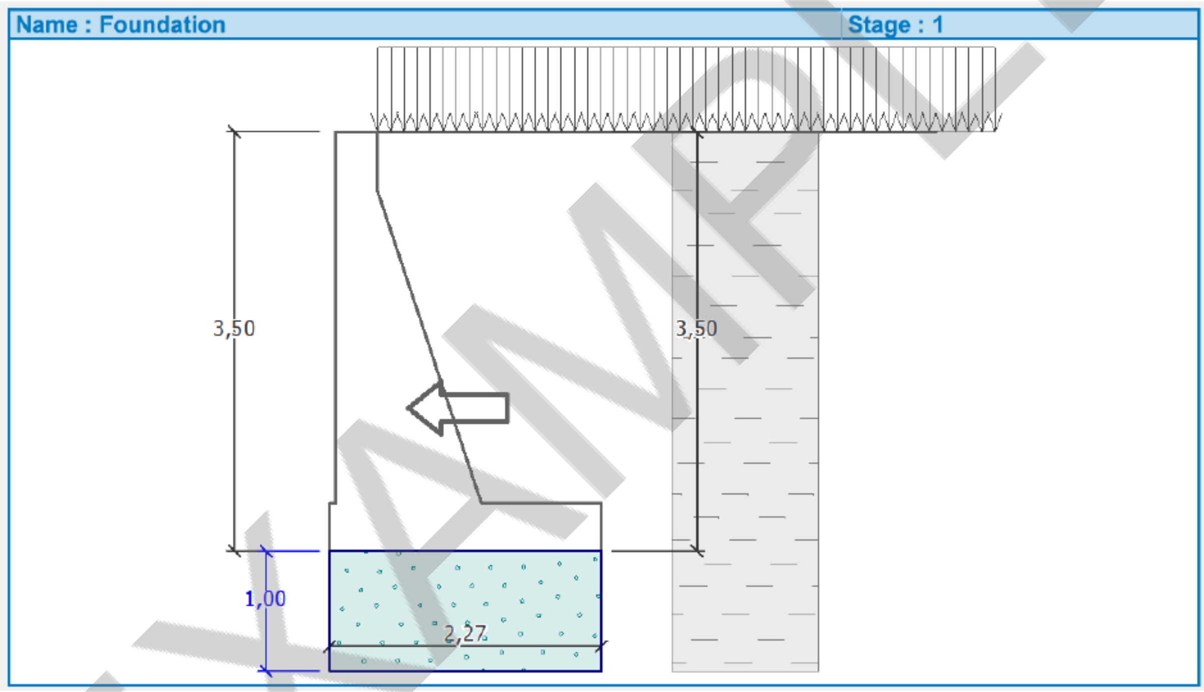
IV.1 Retaining Wall 1

The wall that will be replaced with a retaining wall is the wall around the semi-basement story as shown in the image below:

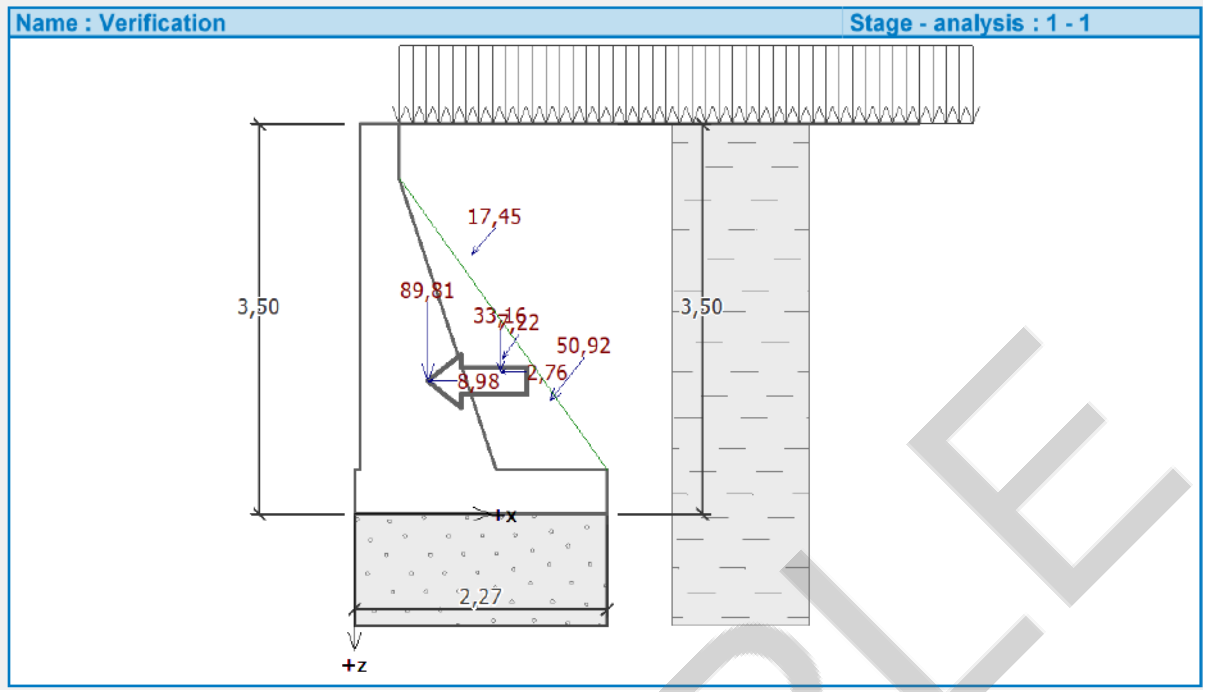








The foundation of the retaining wall will use a layer of well graded sand and gravel with a thickness of 1 m. The aim is to strengthen the footing of the retaining wall due to poor soil conditions.



Verification of complete wall

Check for overturning stability

Resisting moment M_{res} = 193,38 kNm/m
Overturning moment M_{ovr} = 79,44 kNm/m

Safety factor = 2,43 > 1,50
Wall for overturning is SATISFACTORY

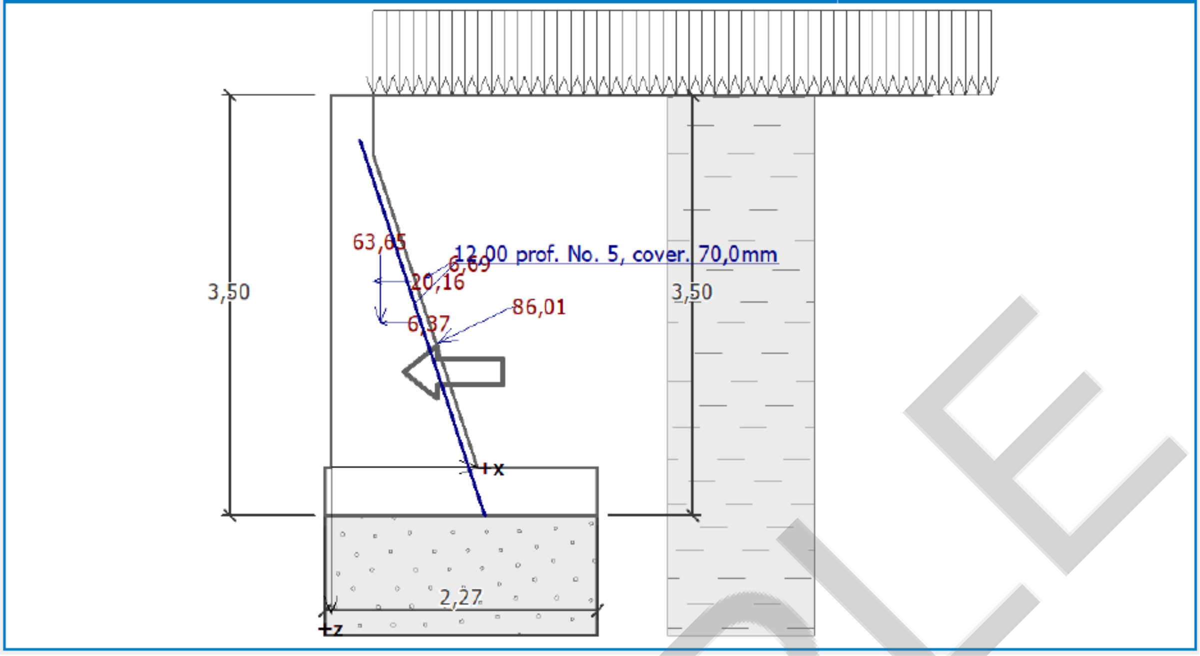
Check for slip

Resisting horizontal force H_{res} = 134,42 kN/m
Active horizontal force H_{act} = 59,30 kN/m

Safety factor = 2,27 > 1,50
Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Name : Dimensioning	Stage - analysis : 1 - 1



Wall stem check

Reinforcement and dimensions of the cross-section

Bar number	=	5
Number of bars	=	12
Reinforcement cover	=	30,0 mm
Cross-section width	=	1,00 m
Cross-section depth	=	1,22 m

Reinforcement ratio	ρ	=	0,20 %	>	0,04 %	=	ρ_{min}
Position of neutral axis	c	=	0,05 m	<	0,50 m	=	c_{max}
Ultimate shear force	ϕV_n	=	733,81 kN	>	109,78 kN	=	V_u
Ultimate moment	ϕM_n	=	988,43 kNm	>	129,69 kNm	=	M_u

Cross-section is SATISFACTORY.

Back wall jump check

Reinforcement and dimensions of the cross-section

Bar number	=	5
Number of bars	=	12
Reinforcement cover	=	30,0 mm
Cross-section width	=	1,00 m
Cross-section depth	=	0,40 m

Reinforcement ratio	ρ	=	0,66 %	>	0,34 %	=	ρ_{min}
Position of neutral axis	c	=	0,05 m	<	0,16 m	=	c_{max}
Ultimate shear force	ϕV_n	=	225,48 kN	>	82,81 kN	=	V_u
Ultimate moment	ϕM_n	=	290,47 kNm	>	27,54 kNm	=	M_u

Cross-section is SATISFACTORY.

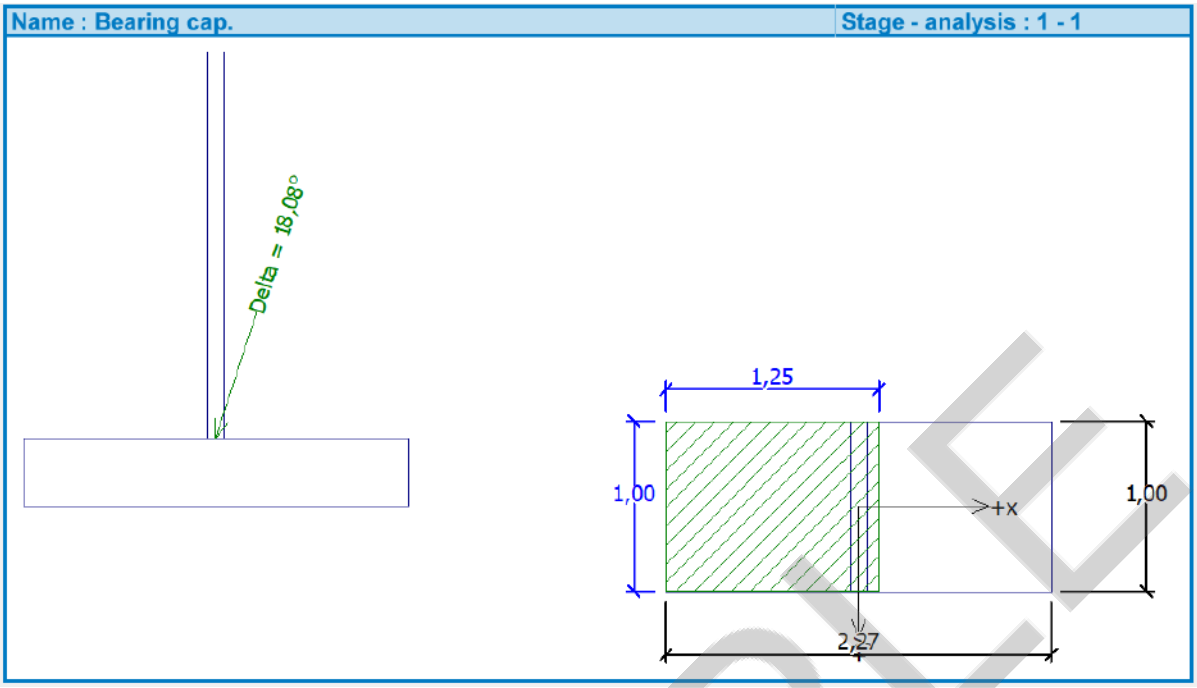
Wall check at the construction joint 0,10 m from the wall crest

Reinforcement and dimensions of the cross-section

Bar number	=	5
Number of bars	=	12
Reinforcement cover	=	30,0 mm
Cross-section width	=	1,00 m
Cross-section depth	=	0,35 m

Reinforcement ratio	ρ	=	0,76 %	>	0,34 %	=	ρ_{min}
Position of neutral axis	c	=	0,05 m	<	0,13 m	=	c_{max}
Ultimate shear force	ϕV_n	=	194,34 kN	>	0,41 kN	=	V_u
Ultimate moment	ϕM_n	=	247,72 kNm	>	0,02 kNm	=	M_u

Cross-section is SATISFACTORY.



Verification of spread footing bearing capacity
Vertical bearing capacity check
Shape of contact stress : rectangle
Most severe load case No. 1. (LC 1)

Design bearing capacity of found.soil R_d = 294,91 kPa
Extreme contact stress σ = 144,81 kPa

Factor of safety = 2,04 > 2,00
Bearing capacity in the vertical direction is SATISFACTORY

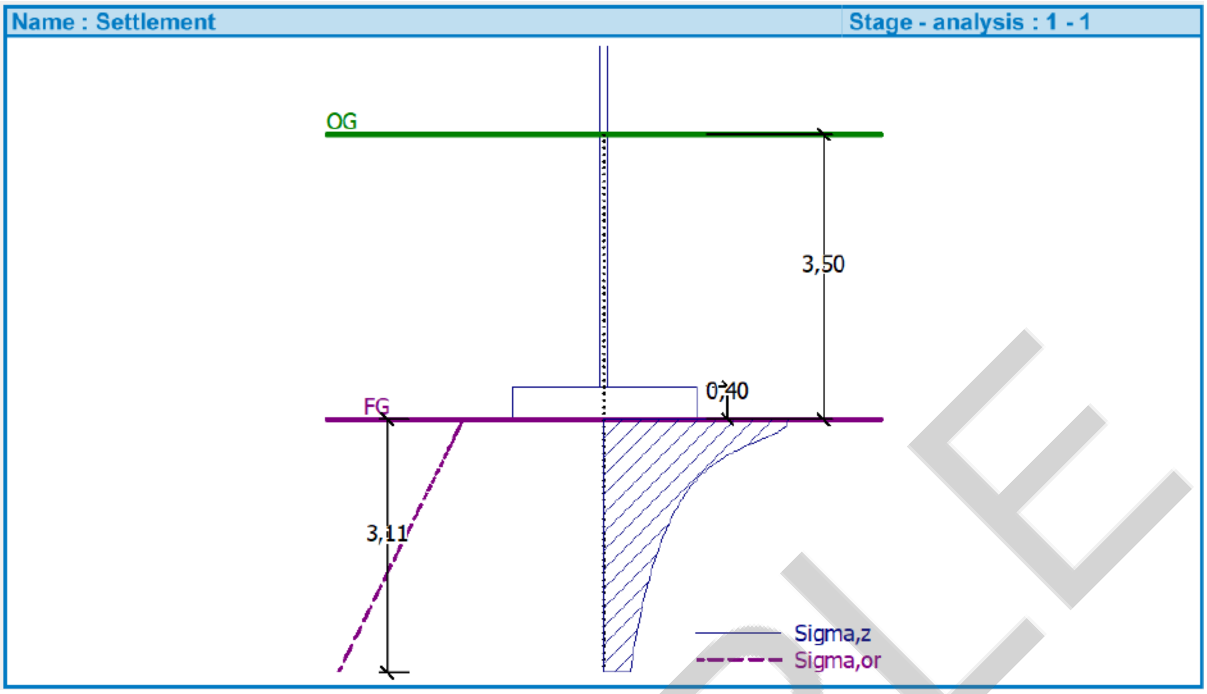
Verification of load eccentricity
Max. excentricity in direction of base length e_x = 0,223<0,333
Max. eccentricity in direction of base width e_y = 0,000<0,333
Max. overall eccentricity e_t = 0,223<0,333
Eccentricity of load is SATISFACTORY

Horizontal bearing capacity check
Most severe load case No. 1. (LC 1)

Horizontal bearing capacity R_{dh} = 134,42 kN
Extreme horizontal force H = 59,30 kN

Factor of safety = 2,27 > 1,50
Bearing capacity in the horizontal direction is SATISFACTORY

Bearing capacity of foundation is SATISFACTORY



Settlement and rotation of foundation - results

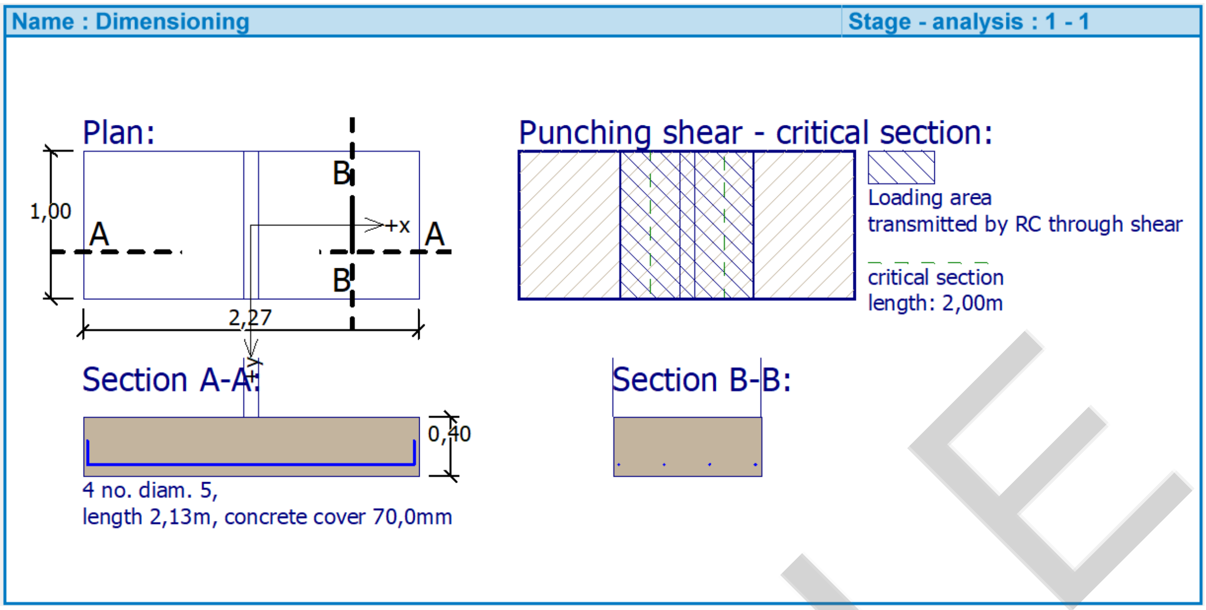
Foundation stiffness:
Average modulus of deformation E_{def} = 25,09 MPa
Foundation in the longitudinal direction is rigid (k=5,18)
Foundation in the direction of width is rigid (k=60,36)

Verification of load eccentricity

Max. excentricity in direction of base length	e_x =	0,223<0,333
Max. eccentricity in direction of base width	e_y =	0,000<0,333
Max. overall eccentricity	e_t =	0,223<0,333

Eccentricity of load is SATISFACTORY

Overall settlement and rotation of foundation:
Foundation settlement = 5,8 mm
Depth of influence zone = 3,11 m
Rot. in direction of width = 4,179 (tan*1000); (7,7E-02 °)

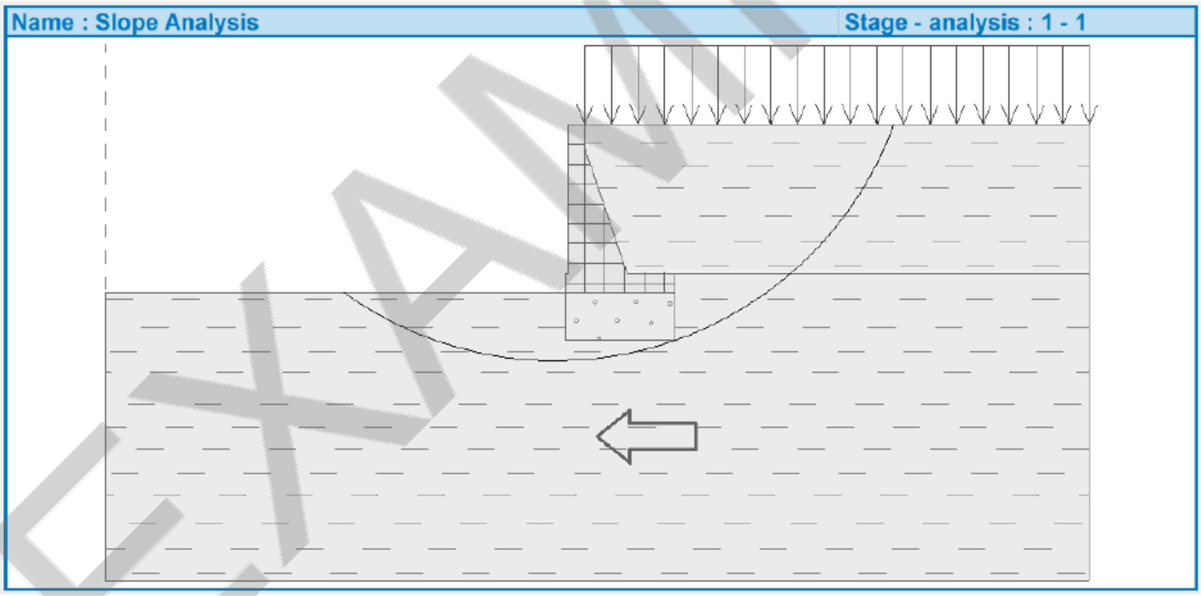


Reinforcement verification of reinforced concrete foundation

Verification of longitudinal reinforcement of foundation in the direction of x

Reinforcement ratio	ρ	=	0,22 %	>	0,19 %	=	ρ_{min}
Position of neutral axis	c	=	0,02 m	<	0,16 m	=	c_{max}
Ultimate moment	ϕM_n	=	101,07 kNm	>	80,59 kNm	=	M_u

Cross-section is SATISFACTORY.



Slope stability verification (Bishop)

Sum of active forces : F_a = 228,28 kN/m
Sum of passive forces : F_p = 436,54 kN/m

Sliding moment : M_a = 1714,38 kNm/m
Resisting moment : M_p = 3278,40 kNm/m
Factor of safety = 1,91 > 1,50
Slope stability ACCEPTABLE

Slope stability verification (Fellenius / Petterson)

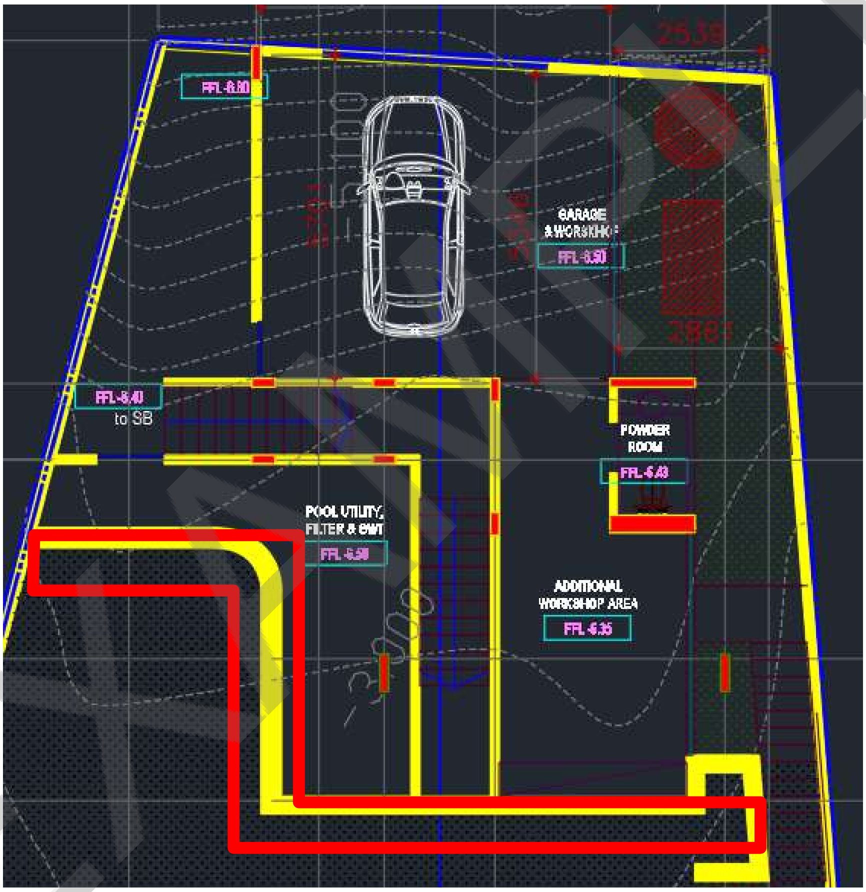
Sum of active forces : F_a = 218,48 kN/m

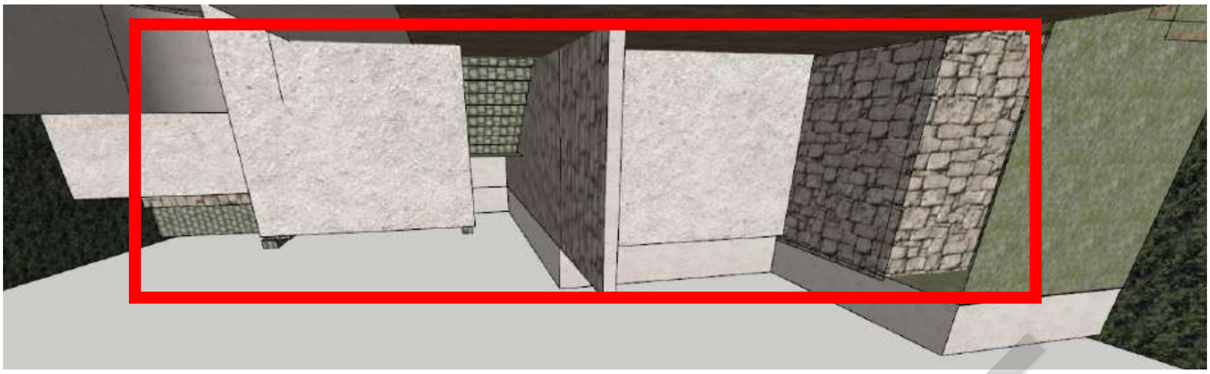
Sum of passive forces : F_p = 384,32 kN/m
Sliding moment : M_a = 1448,50 kNm/m
Resisting moment : M_p = 2548,03 kNm/m
Factor of safety = 1,76 > 1,50
Slope stability ACCEPTABLE

Slope stability verification (Spencer)
Factor of safety = 1,91 > 1,50
Slope stability ACCEPTABLE

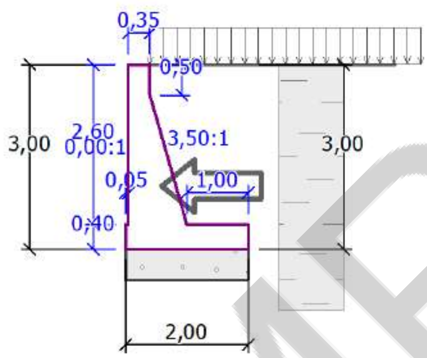
IV.2 Retaining Wall 2

The second wall that will be replaced with a retaining wall is the wall around the basement floor as shown in the picture below

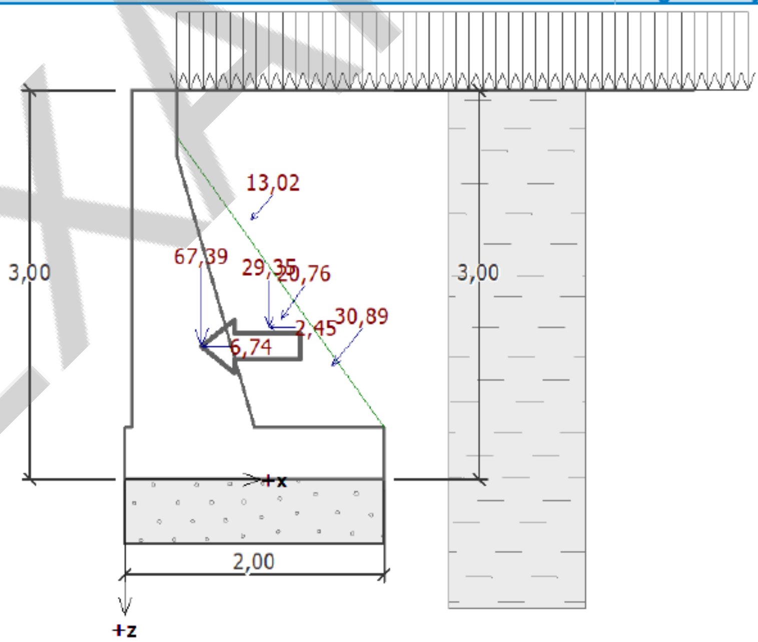




Name : Geometry	Stage : 1



Name : Verification	Stage - analysis : 1 - 1



Verification of complete wall

Check for overturning stability

Resisting moment	M_{res}	=	141,01	kNm/m
Overturning moment	M_{ovr}	=	58,35	kNm/m

Safety factor = 2,42 > 1,50

Wall for overturning is SATISFACTORY

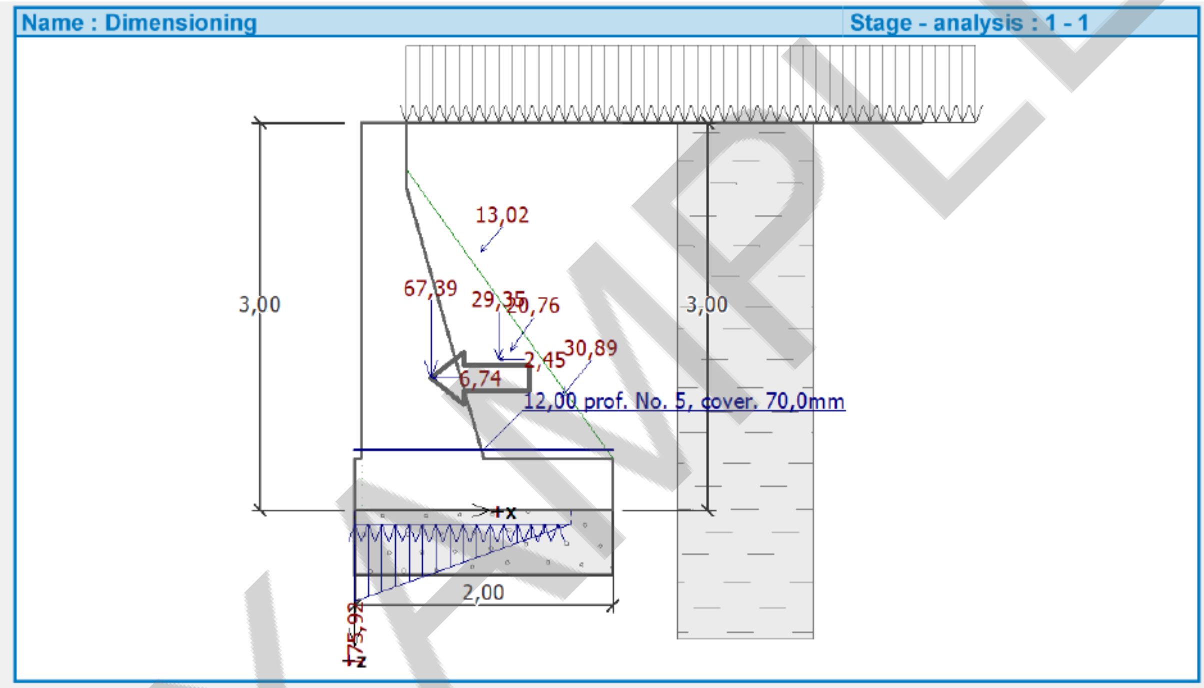
Check for slip

Resisting horizontal force	H_{res}	=	109,28	kN/m
Active horizontal force	H_{act}	=	48,93	kN/m

Safety factor = 2,23 > 1,50

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY



Wall stem check

Reinforcement and dimensions of the cross-section

Bar number	=	5	
Number of bars	=	12	
Reinforcement cover	=	30,0	mm
Cross-section width	=	1,00	m
Cross-section depth	=	0,95	m

Reinforcement ratio	ρ	=	0,26	%	>	0,04	%	=	ρ_{min}
Position of neutral axis	c	=	0,05	m	<	0,39	m	=	c_{max}
Ultimate shear force	ϕV_n	=	567,78	kN	>	90,28	kN	=	V_u
Ultimate moment	ϕM_n	=	760,46	kNm	>	92,28	kNm	=	M_u

Cross-section is SATISFACTORY.

Wall check at the construction joint 0,10 m from the wall crest

Reinforcement and dimensions of the cross-section

Bar number	=	5	
Number of bars	=	12	
Reinforcement cover	=	30,0	mm

Cross-section width	= 1,00 m						
Cross-section depth	= 0,35 m						
Reinforcement ratio	ρ	=	0,76 %	>	0,34 %	=	ρ_{min}
Position of neutral axis	c	=	0,05 m	<	0,13 m	=	c_{max}
Ultimate shear force	ϕV_n	=	194,34 kN	>	0,88 kN	=	V_u
Ultimate moment	ϕM_n	=	247,72 kNm	>	0,04 kNm	=	M_u

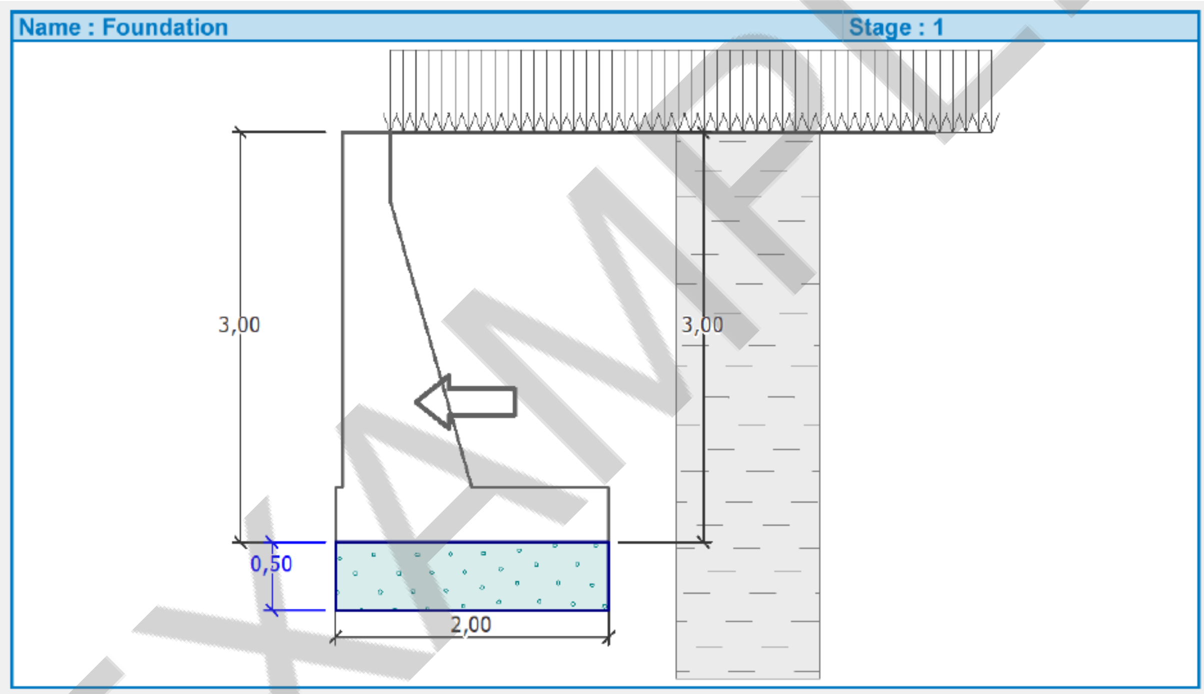
Cross-section is SATISFACTORY.

Back wall jump check

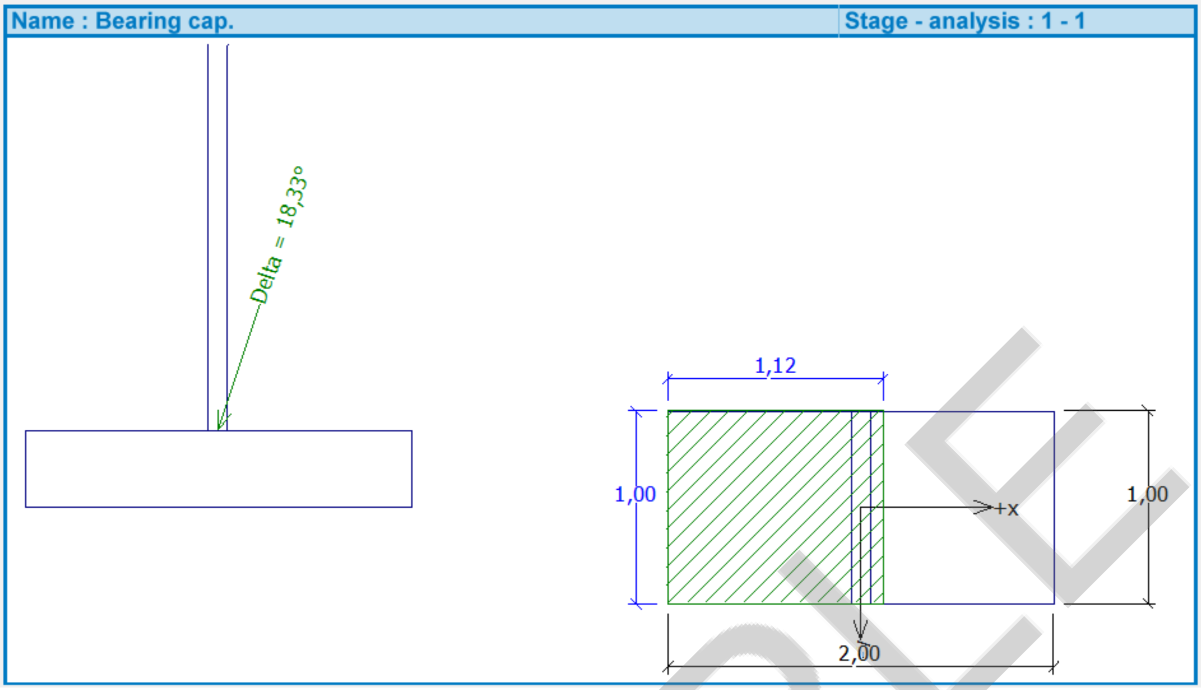
Reinforcement and dimensions of the cross-section

Bar number	= 5						
Number of bars	= 12						
Reinforcement cover	= 30,0 mm						
Cross-section width	= 1,00 m						
Cross-section depth	= 0,40 m						
Reinforcement ratio	ρ	=	0,66 %	>	0,34 %	=	ρ_{min}
Position of neutral axis	c	=	0,05 m	<	0,16 m	=	c_{max}
Ultimate shear force	ϕV_n	=	225,48 kN	>	66,97 kN	=	V_u
Ultimate moment	ϕM_n	=	290,47 kNm	>	25,61 kNm	=	M_u

Cross-section is SATISFACTORY.



The foundation of the retaining wall will use a layer of well graded sand and gravel with a thickness of 0,5 m. The aim is to strengthen the footing of the retaining wall due to poor soil conditions.



Verification of spread footing bearing capacity
Vertical bearing capacity check
Shape of contact stress : rectangle
Most severe load case No. 1. (LC 1)

Design bearing capacity of found.soil	R_d	=	287,08 kPa
Extreme contact stress	σ	=	131,94 kPa

Factor of safety = 2,18 > 2,00
Bearing capacity in the vertical direction is SATISFACTORY

Verification of load eccentricity

Max. excentricity in direction of base length	e_x	=	0,220<0,333
Max. eccentricity in direction of base width	e_y	=	0,000<0,333
Max. overall eccentricity	e_t	=	0,220<0,333

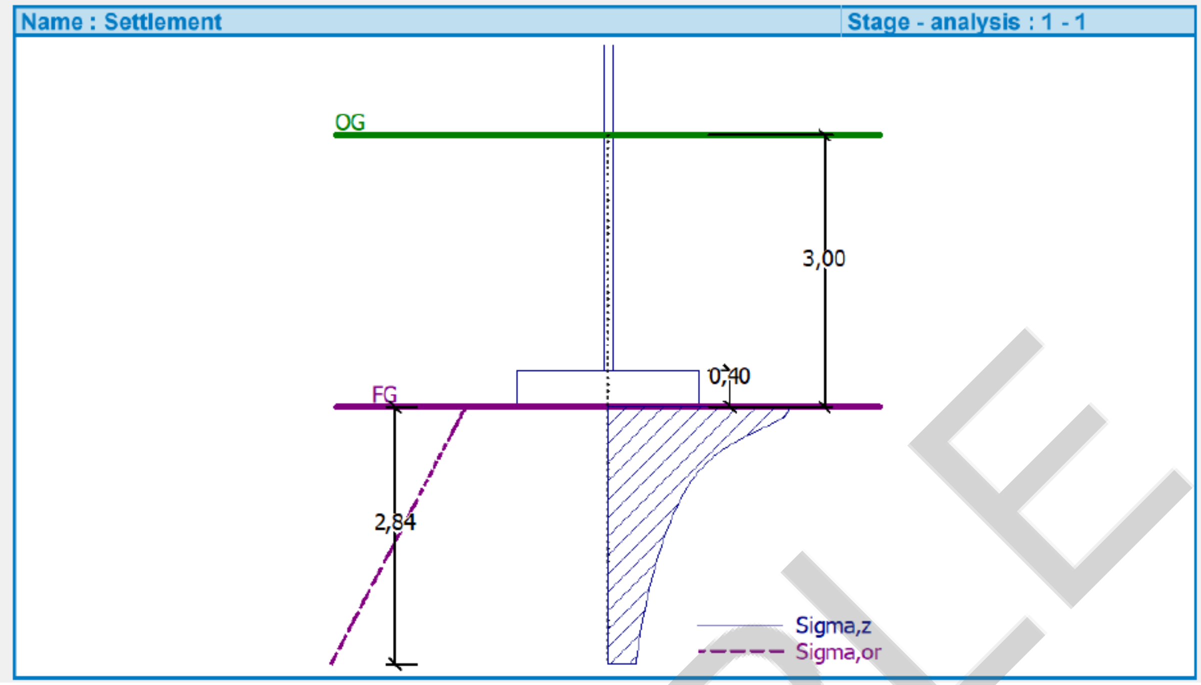
Eccentricity of load is SATISFACTORY

Horizontal bearing capacity check
Most severe load case No. 1. (LC 1)

Horizontal bearing capacity	R_{dh}	=	109,28 kN
Extreme horizontal force	H	=	48,93 kN

Factor of safety = 2,23 > 1,50
Bearing capacity in the horizontal direction is SATISFACTORY

Bearing capacity of foundation is SATISFACTORY



Settlement and rotation of foundation - results

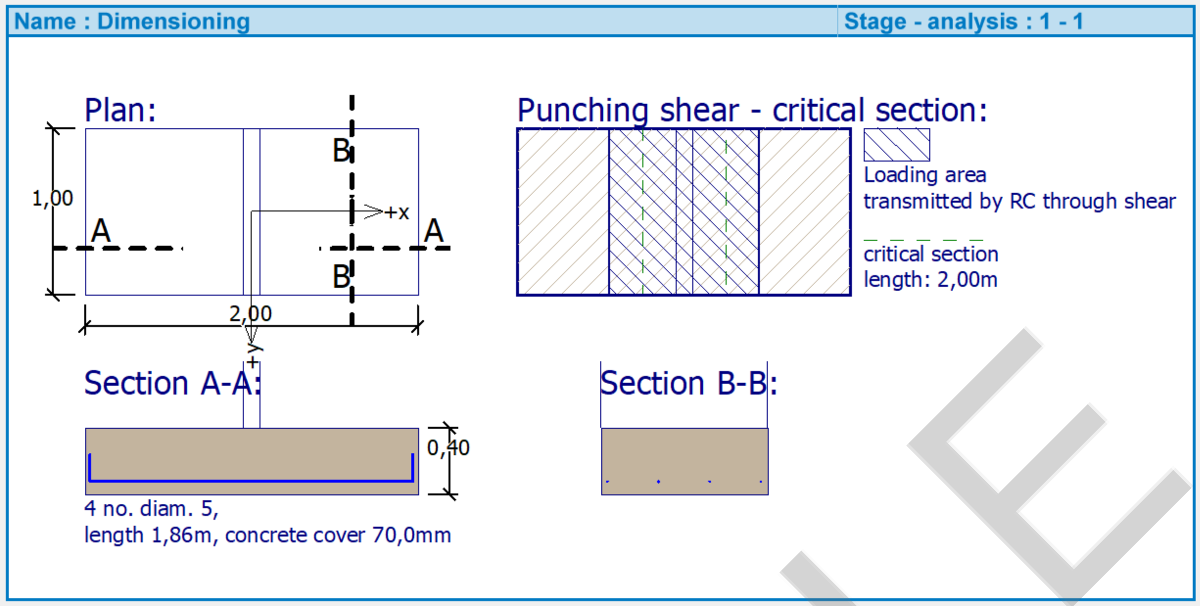
Foundation stiffness:
Average modulus of deformation E_{def} = 26,23 MPa
Foundation in the longitudinal direction is rigid (k=7,22)
Foundation in the direction of width is rigid (k=57,74)

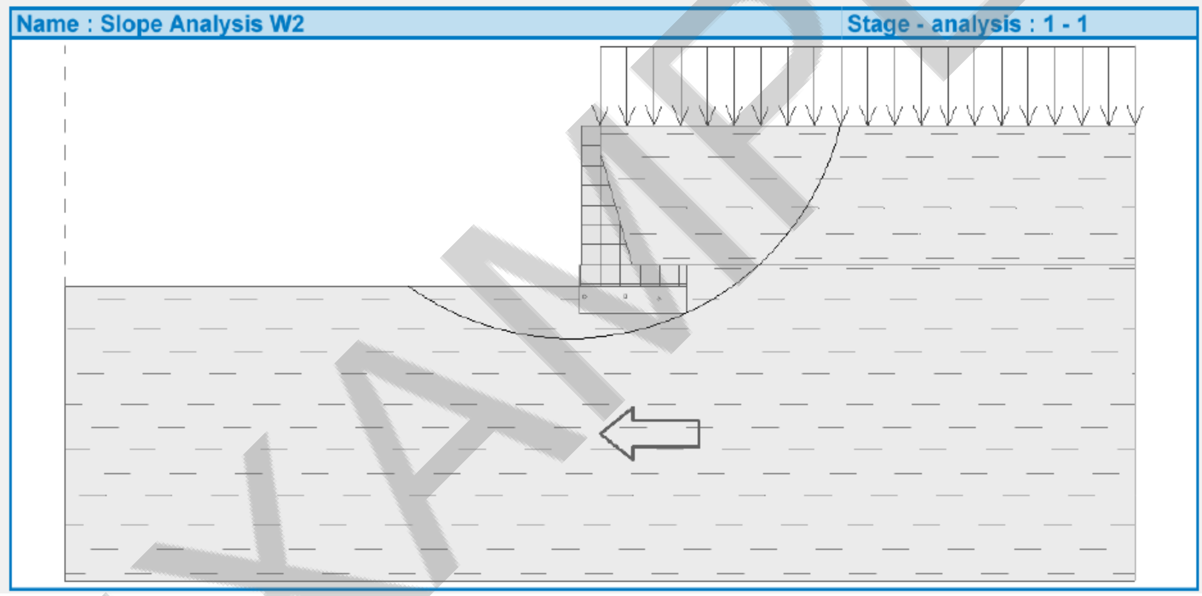
Verification of load eccentricity

Max. excentricity in direction of base length	e_x =	0,211<0,333
Max. eccentricity in direction of base width	e_y =	0,000<0,333
Max. overall eccentricity	e_t =	0,211<0,333

Eccentricity of load is SATISFACTORY

Overall settlement and rotation of foundation:
Foundation settlement = 4,5 mm
Depth of influence zone = 2,84 m
Rot. in direction of width = 3,524 (tan*1000); (7,4E-02 °)





Slope stability verification (Bishop)

Sum of active forces : F_a = 159,83 kN/m
Sum of passive forces : F_p = 294,16 kN/m
Sliding moment : M_a = 847,08 kNm/m
Resisting moment : M_p = 1559,07 kNm/m
Factor of safety = 1,84 > 1,50
Slope stability ACCEPTABLE

Slope stability verification (Fellenius / Petterson)

Sum of active forces : F_a = 158,54 kN/m
Sum of passive forces : F_p = 270,87 kN/m
Sliding moment : M_a = 822,85 kNm/m
Resisting moment : M_p = 1405,82 kNm/m
Factor of safety = 1,71 > 1,50
Slope stability ACCEPTABLE

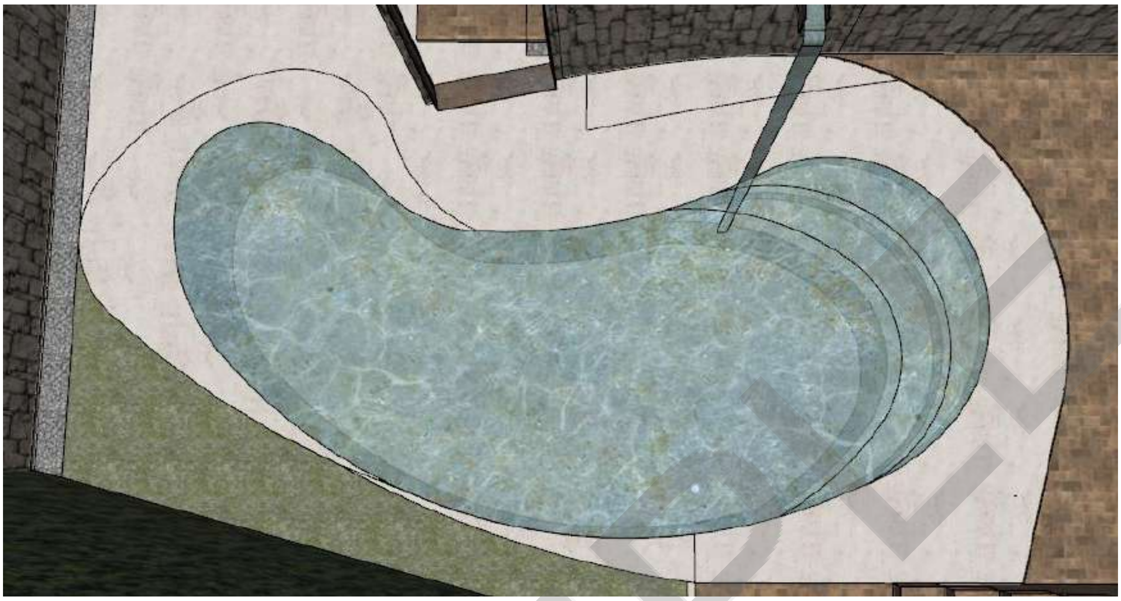
Slope stability verification (Spencer)
Factor of safety = 1,83 > 1,50
Slope stability ACCEPTABLE

Slope stability verification (Morgenstern-Price)
Factor of safety = 2,03 > 1,50
Slope stability ACCEPTABLE

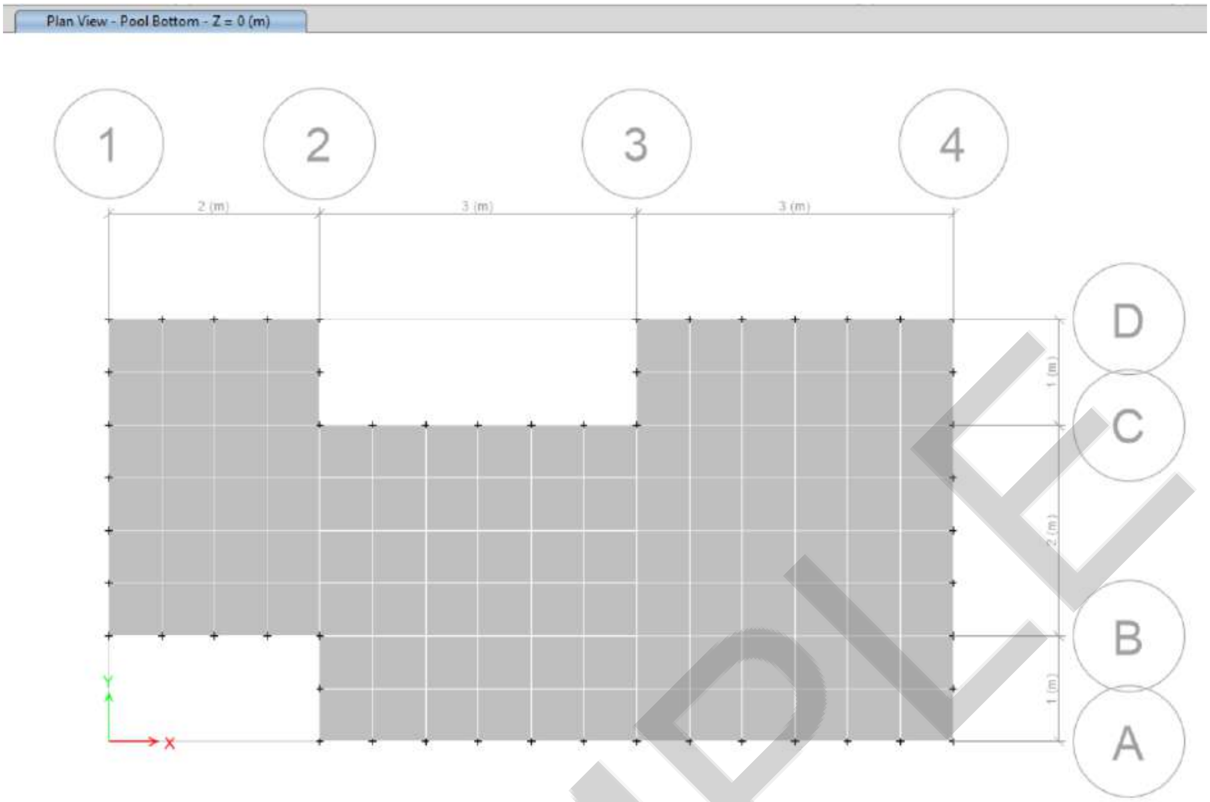
Slope stability verification (Janbu)
Factor of safety = 2,03 > 1,50
Slope stability ACCEPTABLE

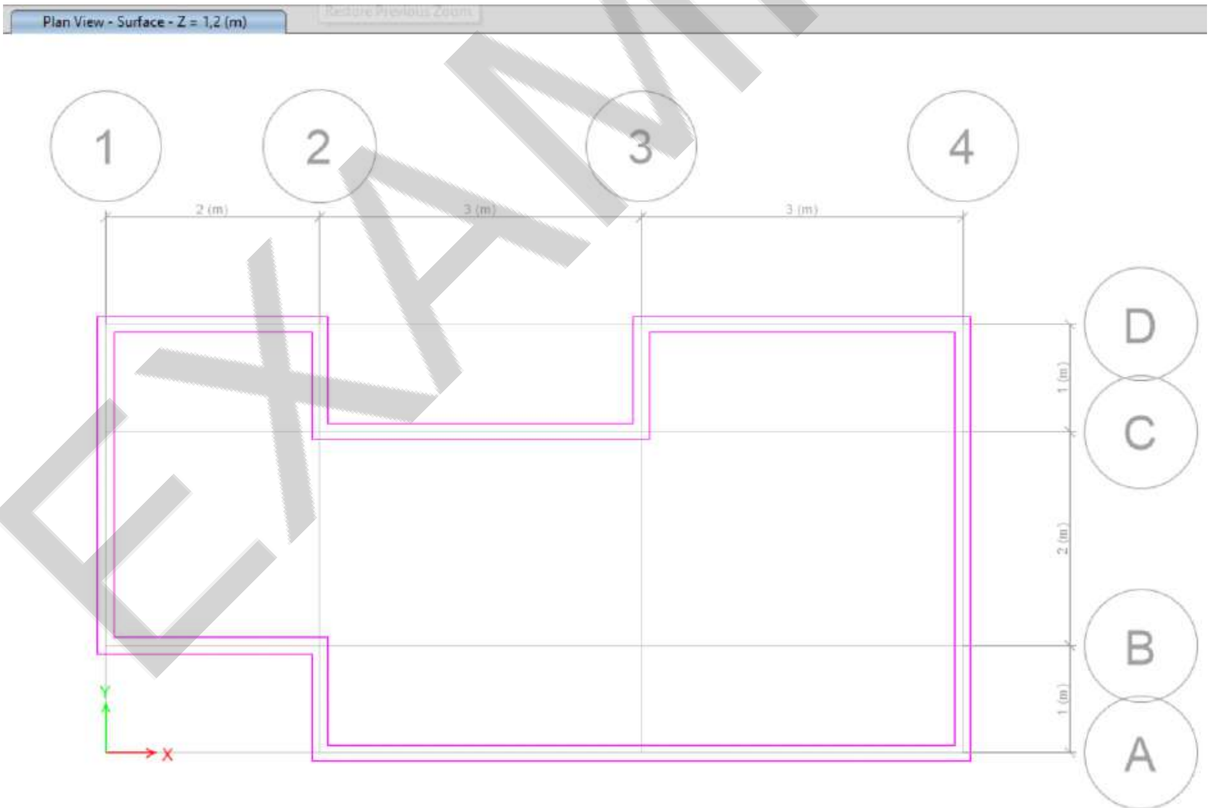
CHAPTER V SWIMMING POOL DETAILING

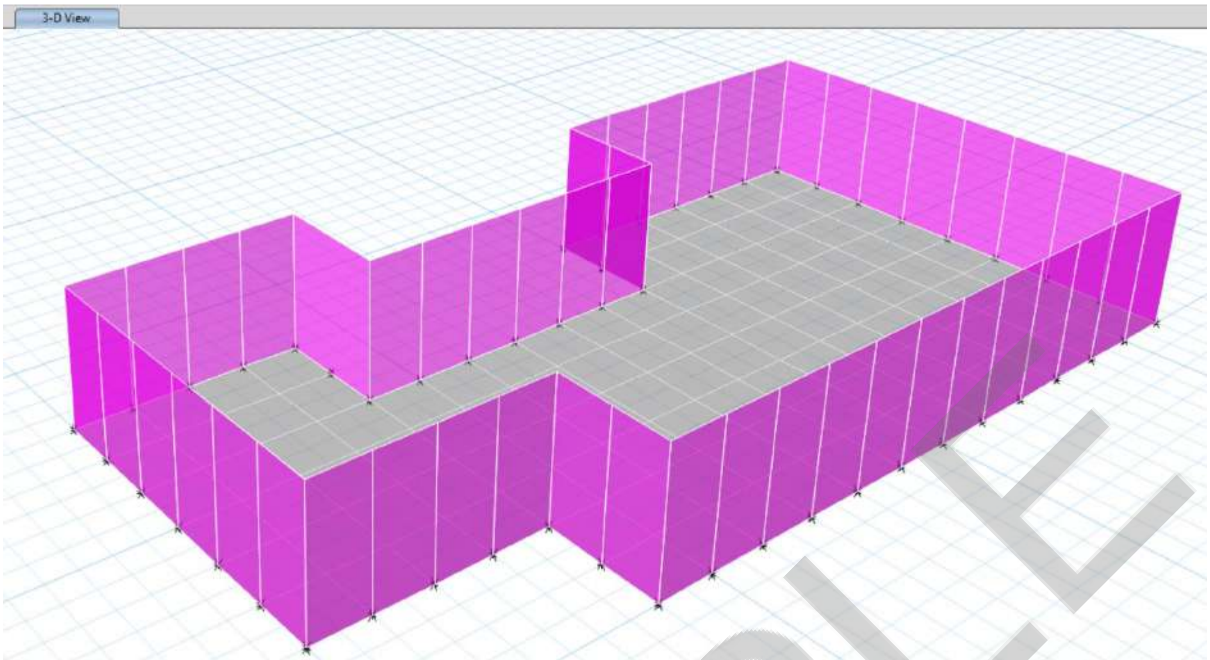
Below is a picture of a real swimming pool design for lakehouse:

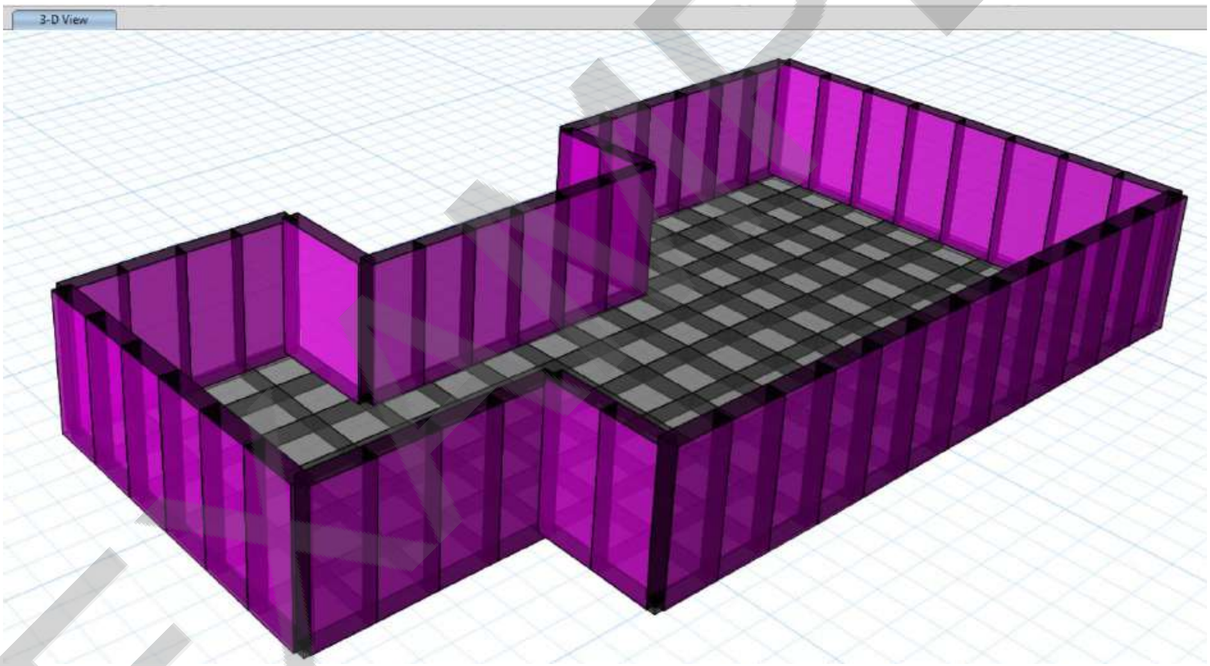


For easier analysis, the swimming pool will be made simpler with a more rigid shape as in the picture below:


Plan View - Pool Bottom - Z = 0 (m)
1
2
3
4
2 (m)
3 (m)
3 (m)
D
C
B
A
1 (m)
2 (m)
1 (m)
Y
X


Plan View - Surface - Z = 1,2 (m)
1
2
3
4
2 (m)
3 (m)
3 (m)
D
C
B
A
1 (m)
2 (m)
1 (m)
Y
X





The walls and floors of the swimming pool will structurally use reinforced concrete materials, and wire mesh will be used for the reinforcement.

SLAB DESIGNER	**PROJECT**	Lakehouse Depok - Swimming Pool Floor Slab		
	REV		**DATE**	
One Way Slab	**ENGINEER**	Zhafran Al Hafizh R.B.N., S.T.	**BEAM ID**	

INPUT CALCULATION DATA

Properties Material					***Strength of Cross-Sectional Plans***				
f_c'	Compressive strength of concret	:	25	MPa	M_u^+	Mid moment	:	10,841	kNm
f_y	Yield stress of bending reinf	:	420	MPa	M_u^-	End moment	:	13,207	kNm
f_{yt}	Yield stress of shear reinf	:	390	MPa	V_u	Shear force	:	21,444	kN
Reinforcement Diameter					***Dimensi Pelat***				
D	Longitudinal reinf diameter	:	10	mm	b	Slab width	:	1000	mm
Ø	Shear reinf diameter	:	8	mm	h	Slab height	:	150	mm
d'	Clean concrete cover	:	70	mm					
Strength Reduction Factors									
ϕ	Bending reduction factor	:	0,9		ϕ	Shear reduction fac	:	0,75	

CALCULATION OF CONCRETE CROSS-SECTION

β	Concrete tension form factor		:	0,85	
	◦ if $f_c' \leq 30$ MPa	: 0,85			
	◦ if $f_c' > 30$ MPa	: 0.85 - 0.05 (f_c' - 30)/7			
ρ_b	Balanced reinforcement ratio	= β 0.85 f_c' / fy 600 / (600 + fy)	:	0,0253	
R_{max}	Max moment resistance factor	= 0.75 ρ_b f_y (1 - 0.375 ρ_b f_y / (0.85 f_c'))	:	6,4746	
	Max reinforcement number per ro	= (b - 2 d' - 2 P) / (25 + D)	:	24	pieces

CALCULATION OF POSITIVE REINFORCEMENT (MID)

M_n	Plan nominal moment	= M_u^+ / ϕ	:	12,046	kNm
d	Effective height of cross section	= h - d' - P - 0.5 D	:	67	mm
R_n	Moment resistance factor	= M_n 10^6 / (b d^2)	:	2,6833	
	Check the moment resistance factor against the maximum value:	R_n	<	R_{max}	**OK!**
ρ_{min}	Minimum rebar ratio	= √ f_c' / (4 * f_y) atau 1.4 / f_y	:	0,0033	
ρ	Required rebar ratio	= 0.85 f_c' / f_y (1 - √ (1 - 2 R_n / (0.85 f_c')))	:	0,0069	
	Check the minimum reinforcement ratio requirement:	ρ_{min}	<	ρ	**OK!**
A_s	Required area of reinforcement	= ρ b d	:	459,15	mm^2
n	The required amount of reinforcement		:	6	pieces

CALCULATION OF NEGATIVE REINFORCEMENT (END)					
M_n	Plan nominal moment	$= M_u^+ / \phi$	:	14,674	kNm
d	Effective height of cross section	= h - d' - P - 0.5 D	:	67	mm
R_n	Moment resistance factor	$= M_n\ 10^6 / (b\ d^2)$	:	3,269	
	Check the moment resistance factor against the maximum value:	R_n	<	R_{max}	**OK!**
ρ_{min}	Minimum rebar ratio	= 0.25%	:	0,0033	
ρ	Required rebar ratio	$= 0.85\ f_c' / f_y\ (1 - \sqrt{(1 - 2\ R_n / (0.85\ f_c'))})$	:	0,0085	
	Check the minimum reinforcement ratio requirement:	ρ_{min}	<	ρ	**OK!**
A_s	Required area of reinforcement	= ρ b d	:	569,28	mm^2
n	The required amount of reinforcement		:	8	pieces

CALCULATION OF SHEAR REINFORCEMENT					
V_c	Shear strength of concrete	$= (\sqrt{f_c'}) / 6 * (b\ d\ 10^{-3}$	:	55,833	kN
$\phi\ V_c$	Concrete shear resistance	$= \phi\ V_c$	:	41,875	kN
		Required shear reinforcement!			
$\phi\ V_s$	Shear resistance of shear reinf	$= V_u - \phi\ V_c$	:	0	kN
V_s	Shear strength of shear reinf	$= V_u / \phi$	:	0	kN
n	Number of legs used		:	2	pieces
A_v	Shear reinforcement area	$= n\ \pi\ \varnothing^2 / 4$	:	100,53	mm^2
s	Required shear reinf distance	$= A_v\ f_{yt}\ d / (V_s\ 10^3)$	:	0	mm
s_{max}	Maximum shear reinf distance	= d / 2 atau 250 mm	:	33,5	mm

REINFORCEMENT RESUME				
Mid reinforcement (positive)	**M10**	**-**	**200**	mm
End reinforcement (negative)	**M10**	**-**	**125**	mm

SLAB DESIGNER	PROJECT	Lakehouse Depok - Swimming Pool Wall		
	REV		DATE	
One Way Slab	ENGINEER	Zhafran Al Hafizh R.B.N., S.T.	BEAM ID	

INPUT CALCULATION DATA

Properties Material					***Strength of Cross-Sectional Plans***				
f_c'	Compressive strength of concret	:	25	MPa	M_u^+	Mid moment	:	5,504	kNm
f_y	Yield stress of bending reinf	:	390	MPa	M_u^-	End moment	:	6,704	kNm
f_{yt}	Yield stress of shear reinf	:	390	MPa	V_u	Shear force	:	43,913	kN
Reinforcement Diameter					***Dimensi Pelat***				
D	Longitudinal reinf diameter	:	8	mm	b	Slab width	:	1000	mm
Ø	Shear reinf diameter	:	8	mm	h	Slab height	:	150	mm
d'	Clean concrete cover	:	70	mm					
Strength Reduction Factors									
ϕ	Bending reduction factor	:	0,9		ϕ	Shear reduction fac	:	0,75	

CALCULATION OF CONCRETE CROSS-SECTION

β	Concrete tension form factor		:	0,85	
	◦ if $f_c' \leq 30$ MPa	: 0,85			
	◦ if $f_c' > 30$ MPa	: 0.85 - 0.05 (f_c' - 30)/7			
ρ_b	Balanced reinforcement ratio	= β 0.85 f_c' / fy 600 / (600 + fy)	:	0,0281	
R_{max}	Max moment resistance factor	= 0.75 ρ_b f_y (1 - 0.375 ρ_b f_y / (0.85 f_c'))	:	6,6242	
	Max reinforcement number per ro	= (b - 2 d' - 2 P) / (25 + D)	:	25	pieces

CALCULATION OF POSITIVE REINFORCEMENT (MID)

M_n	Plan nominal moment	= M_u^+ / ϕ	:	6,1156	kNm
d	Effective height of cross section	= h - d' - P - 0.5 D	:	68	mm
R_n	Moment resistance factor	= M_n 10^6 / (b d^2)	:	1,3226	
	Check the moment resistance factor against the maximum value:	R_n	<	R_{max}	**OK!**
ρ_{min}	Minimum rebar ratio	= √ f_c' / (4 * f_y) atau 1.4 / f_y	:	0,0036	
ρ	Required rebar ratio	= 0.85 f_c' / f_y (1 - √ (1 - 2 R_n / (0.85 f_c')))	:	0,0035	
	Check the minimum reinforcement ratio requirement:	ρ_{min}	>	ρ	**CEK!**
A_s	Required area of reinforcement	= ρ b d	:	244,1	mm^2
n	The required amount of reinforcement		:	5	pieces

CALCULATION OF NEGATIVE REINFORCEMENT (END)					
M_n	Plan nominal moment	$= M_u^+ / \phi$	:	7,4489	kNm
d	Effective height of cross section	= h - d' - P - 0.5 D	:	68	mm
R_n	Moment resistance factor	$= M_n\, 10^6 / (b\, d^2)$	:	1,6109	
	Check the moment resistance factor against the maximum value:	R_n	<	R_{max}	**OK!**
ρ_{min}	Minimum rebar ratio	= 0.25%	:	0,0036	
ρ	Required rebar ratio	$= 0.85\, f_c' / f_y\, (1 - \sqrt{(1 - 2\, R_n / (0.85\, f_c'))})$	:	0,0043	
	Check the minimum reinforcement ratio requirement:	ρ_{min}	<	ρ	**OK!**
A_s	Required area of reinforcement	= ρ b d	:	292,42	mm^2
n	The required amount of reinforcement		:	6	pieces

CALCULATION OF SHEAR REINFORCEMENT					
V_c	Shear strength of concrete	$= (\sqrt{f_c'}) / 6 * (b\, d\, 10^{-3}$	:	56,667	kN
$\phi\, V_c$	Concrete shear resistance	$= \phi\, V_c$	:	42,5	kN
		Required shear reinforcement!			
$\phi\, V_s$	Shear resistance of shear reinf	$= V_u - \phi\, V_c$	:	1,413	kN
V_s	Shear strength of shear reinf	$= V_u / \phi$	:	1,884	kN
n	Number of legs used		:	2	pieces
A_v	Shear reinforcement area	$= n\, \pi\, Ø^2 / 4$	:	100,53	mm^2
s	Required shear reinf distance	$= A_v\, f_{yt}\, d / (V_s\, 10^3)$	:	1415,1	mm
s_{max}	Maximum shear reinf distance	= d / 2 atau 250 mm	:	34	mm

REINFORCEMENT RESUME						
Mid reinforcement (positive)	**M8**	**-**	**250**	mm	**~ 200 mm**
End reinforcement (negative)	**M8**	**-**	**200**	mm	