CHAPTER V
CONCLUSION

5.1 Roof

The purlin to be used here is steel C125x50x20x2 with a length of 4 meters. The truss is to be made of WF 300x150x6.5x9 steel. Each member of the truss is connected by dual bolt connection. The concrete ring barrier and steel truss are connected by means of four anchors.

5.2 Beam

The first main beam has cross sectional dimensions of 350x600 mm, and the second main beam with cross sectional dimensions of 600x650 mm, with a standard length of 8 meters. The secondary beam has cross sectional dimensions of 350x400mm, with a standard length of 4 meters. The strength of the steel reinforcement used is 400 MPa while the compressive strength of the concrete used is 30 MPa. There is a 40 mm concrete cap.

For the first main beam, the support reinforcement is 7D25 at the top, 4D13 in the center, 5D25 at the bottom, and 4D10-100 at the confinement. On the field section, the top reinforcement is 3 D25, middle reinforcement is 4D13, bottom reinforcement is 3D25, and confinement is 3D13-100. It has a 135° hook with a 150 mm length. For the second main beam, the support reinforcement is 5D25 at the top, 4D13 in the center, 5D25 at the bottom, and 3D13-100 at the confinement. Top reinforcement is 3 D25, middle reinforcement is 4D13, bottom reinforcement is 3D25, and confinement is 3D13-100. It uses a 135° hook with a 150 mm length. Lastly, the secondary beam has top reinforcement of 2D25, middle reinforcement of 4D13, and bottom reinforcement of 2D25, all along the beam. The transversal reinforcement used is 2D13, with spacing of 75mm on the support section an 100mm on the field section.

5.3 Tie Beam

The tie beam will use reinforced concrete 300x400 mm2. The concrete cover is 30 mm. The strength of steel is 420 MPa while that of concrete is 30 MPa. 3D16 is the confinement reinforcement, 2D16 is the bottom reinforcement, and 2D16 is the top reinforcement. 3D16 is the confinement, 2D16 is the bottom reinforcement, and 3D16 is the top reinforcement at span. 75 mm is the hook length when 135° bending is used.

5.4 Column

There are two column types used in the Bengkulu Youth Center. The first column type has cross-sectional dimensions of 800x800 mm with fc' 30 MPa and fy 420 MPa. The concrete cover is 40 mm. 16D25 is the longitudinal reinforcement, 4D13-100 is the confinement at support, and 2D13-150 is the confinement at span. The second column type has cross sectional dimensions of 1000x1000 mm, with longitudinal reinforcement of 24D25 inside 40mm concrete cover. 13mm stirrups with 100 mm spacing is used throughout the column, with 4 legs on the support section and 2 legs on the field section. For both types, the hook will be made with a cross tie, with one 90-degree bent and the other 135-degree bent.

5.5 Beam-Column Joint

The longitudinal reinforcement is continuation of column rebar 7D25, the confinement is 4D13-100, the development length is 360 mm, and the hook length is 300 mm.

5.6 Slab

Generally, the slabs used have dimensions of 4000x4000 mm, with fc' 25 Mpa and fy 400 MPa reinforcement. The thickness is 14 cm for the floor slabs, and 15 cm for the roof slabs. The reinforcement for short span is D10-250, long span is D10-250, short support is D10-250, and long support is D10-250.

5.7 Stairs

The stairs and bordes slab will use reinforced concrete with fc' 25 MPa and fy 370 MPa. The stairs have 24 total steps, a width of 2 meters, a length of 2.88 meters, a slope of 28.0724 degrees, an optrede of 0.16 meters, antrede of 0.3 meters, and a thickness of 0.15 meters. The bordes dimensions are 160 mm in thickness and 2 m in breadth. D13-250 is the main reinforcement at the stair support, and D8-100 is the shrinkage reinforcement. D8-100 is the major reinforcement at the stair span, and D8-150 is the shrinkage reinforcement. D8-100 and D8-100 serve as the reinforcement for bordes at support and span, respectively.

5.8 Foundation

The foundation that is chosen for this design is bore pile foundation at a depth of 8 meters where no liquefaction occurs. The foundation can support weight up to 6800 kN and moment 4499.83 kNm at this depth. Two bore pile configurations are chosen, one for each column type. The pile cap measures 2.7 by 1.3 meters and 2.3 by 2.3 meters respectively. Four piles with a diameter of 0.5 m are needed in the first configuration, and two with a diameter of 0.35 m are needed in the second configuration in order to support the lateral loads. It is determined that the pile group's efficiency and settlement are safe. The reinforcement for the pile cap type 1 is 13D20 at the top short span, 13D10 at the bottom short span, 13D20 at the top long span, and 13D10 at the bottom long span. Pile longitudinal reinforcement is provided by spiral 75D16. The reinforcement for the pile cap type 2 is 7D16 at the top short span, 7D8 at the bottom short span, D13-200 at the top long span, and D13-200 at the bottom long span. Pile longitudinal reinforcement is provided by spiral 50D16.

5.9 Cost and Time Management

The total worker that is required in this project is 120 workers. The duration of the work is 231 days. The total cost is Rp 28,927,692,100.98. From the known area of building 5056.0 m^2, it can be estimated that the price per m^2 is Rp 5,721,458.09.

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INFRASTRUCTURE DESIGN AND PLANNING OF YOUTH CENTER IN BENGKULU CITY

Final Project Report
Appendix
As one of the requirements to obtain Bachelor's degree in

Universitas Atma Jaya Yogyakarta

By:

ALVIN PIRES	**201317977**
RICHARDO HADINATA DJOENARKO	**201317980**
VINAYAK MUNESH PANJABI	**201318351**

INTERNATIONAL CIVIL ENGINEERING PROGRAM
DEPARTMENT OF CIVIL ENGINEERING
FACULTY OF ENGINEERING
UNIVERSITAS ATMA JAYA YOGYAKARTA
YOGYAKARTA

VALIDATION

Final Project Report

INFRASTRUCTURE DESIGN AND PLANNING OF YOUTH CENTER IN BENGKULU CITY

By:

FOTO 4x6 (Warna & Terbaru)	FOTO 4x6 (Warna & Terbaru)	FOTO 4x6 (Warna & Terbaru)
Alvin Pires 201317977	Richardo Hadinata Djoenarko 201317980	Vinayak Munesh Panjabi 201318351

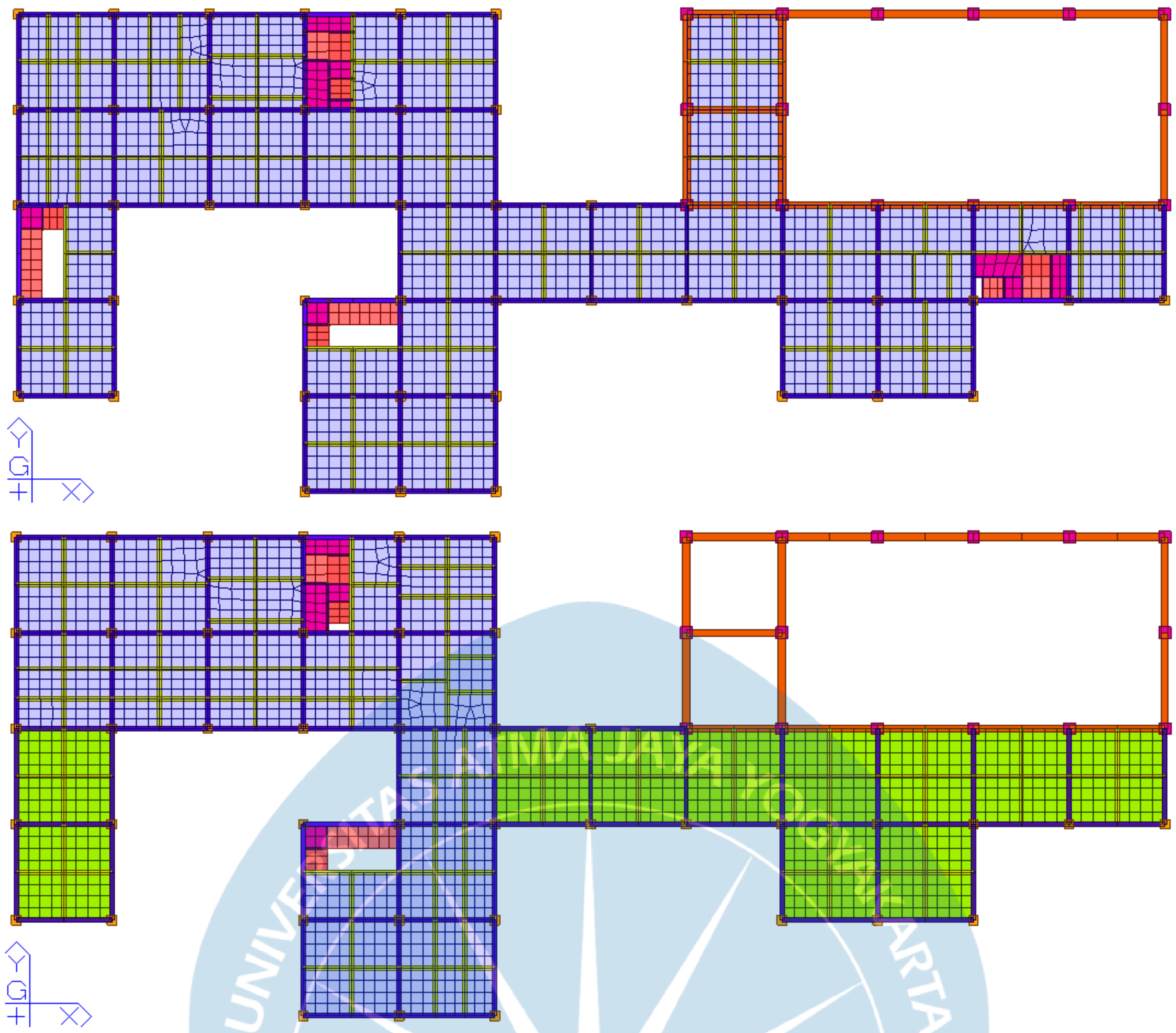
Has been examined and approved by:

Name		Signature	Date
Leader	: ……………………………..	………………	………………
Secretary	: ……………………………..	………………	………………
Member	: ……………………………..	………………	………………

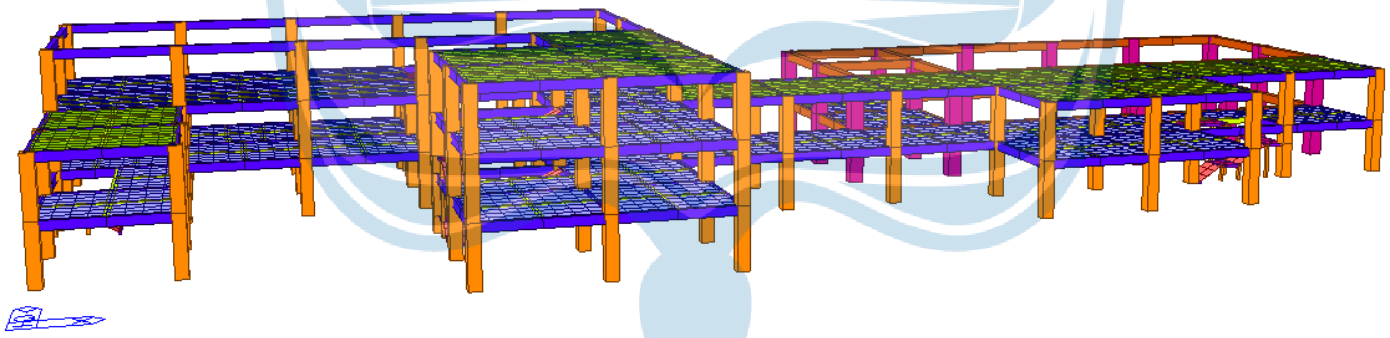
TABLE OF APPENDIX

A. MIDAS GEN STRUCTURAL MODELLING

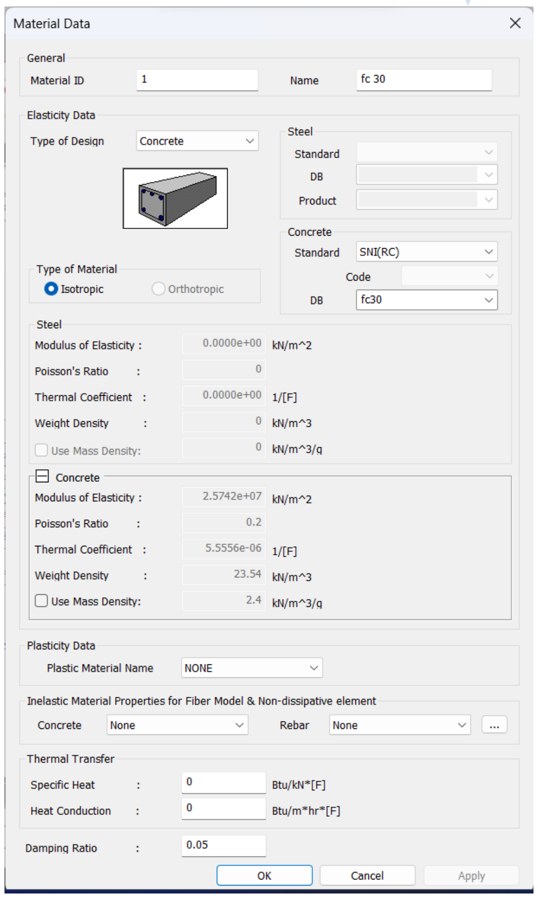
A.1 Ground Floor, Second-Fourth Floor Model

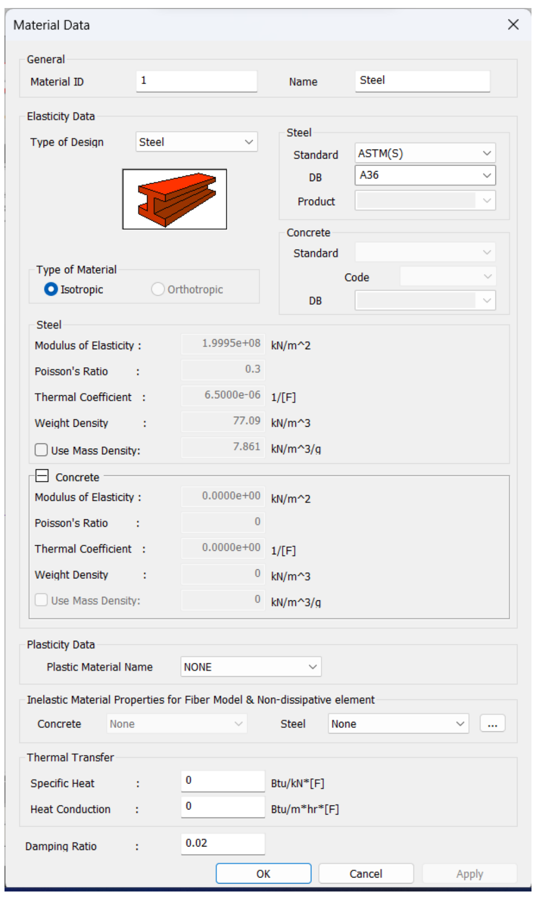


A.2 Structure Model View



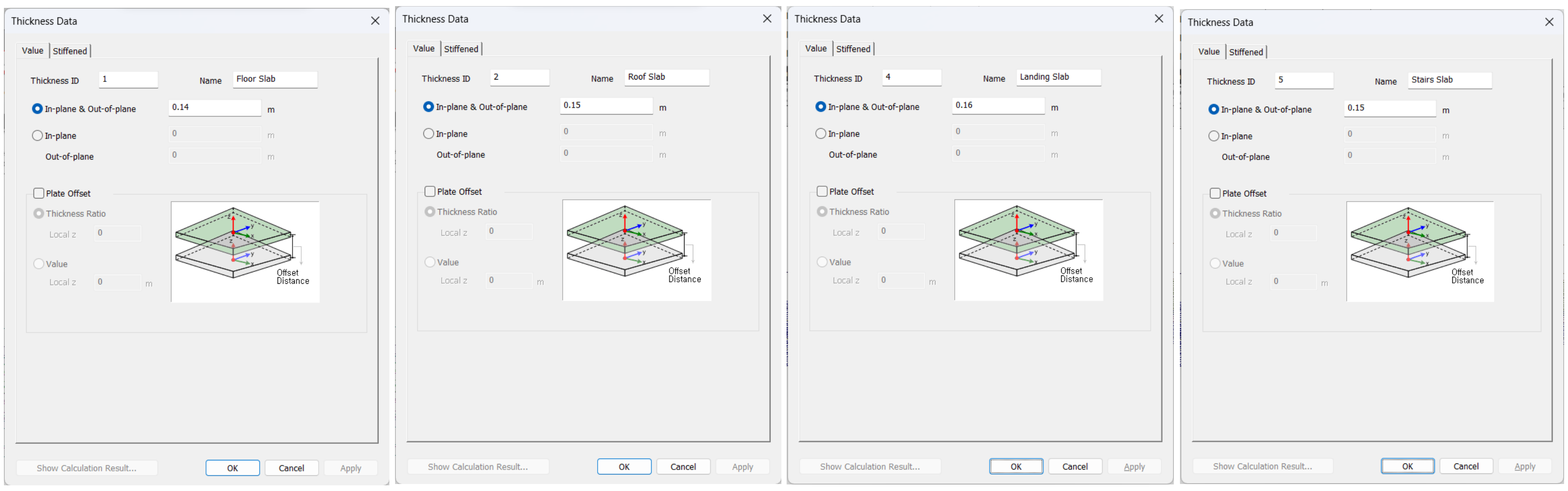
A.3 Material Properties for Concrete and Steel



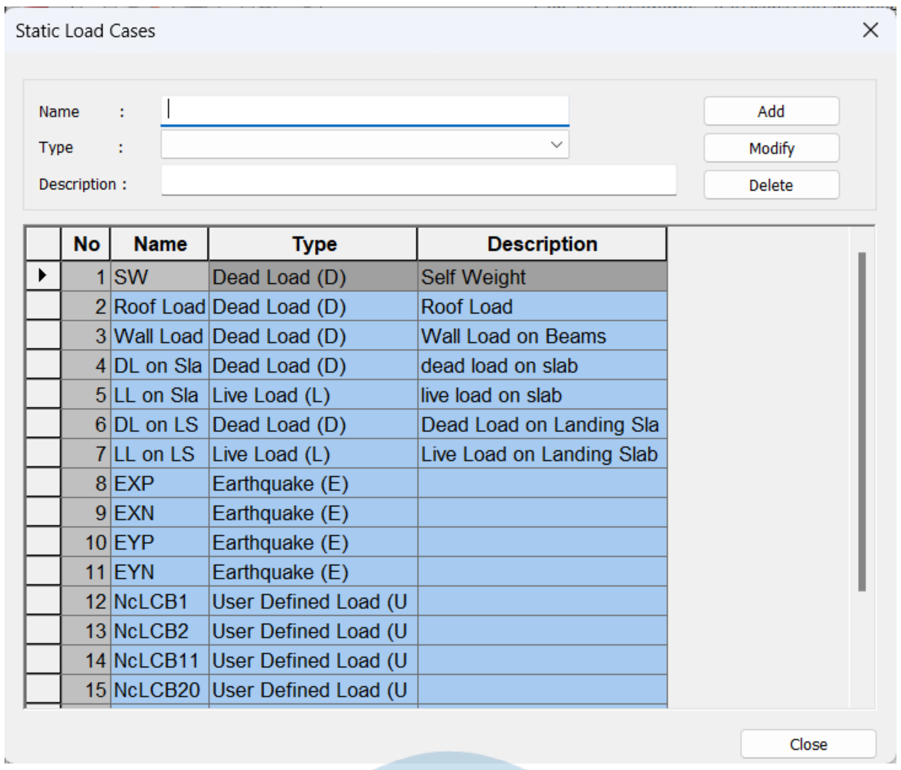


A.4 Beam and Column Properties

A.5 Slab Properties

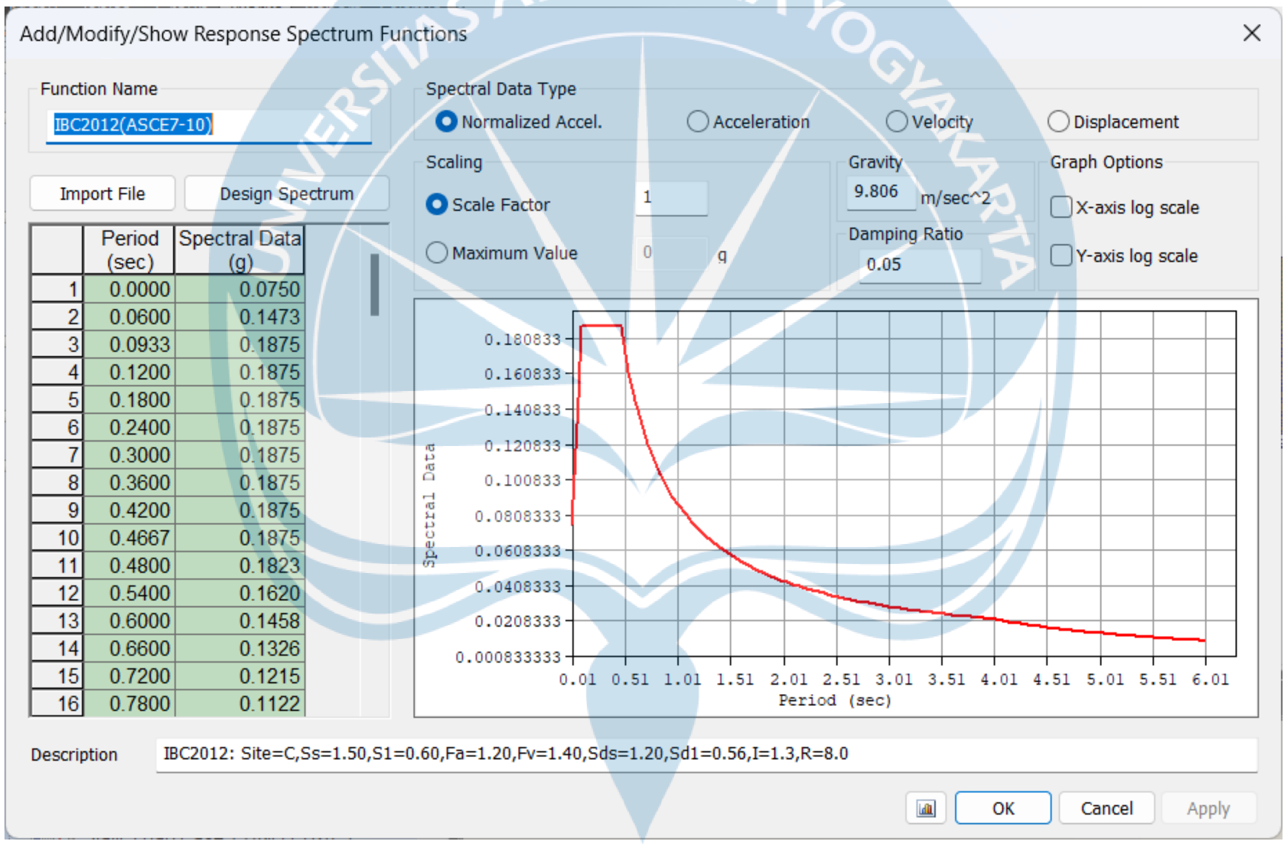


A.6 Load Cases



No	Name	Type	Description
1	SW	Dead Load (D)	Self Weight
2	Roof Load	Dead Load (D)	Roof Load
3	Wall Load	Dead Load (D)	Wall Load on Beams
4	DL on Sla	Dead Load (D)	dead load on slab
5	LL on Sla	Live Load (L)	live load on slab
6	DL on LS	Dead Load (D)	Dead Load on Landing Sla
7	LL on LS	Live Load (L)	Live Load on Landing Slab
8	EXP	Earthquake (E)	
9	EXN	Earthquake (E)	
10	EYP	Earthquake (E)	
11	EYN	Earthquake (E)	
12	NcLCB1	User Defined Load (U	
13	NcLCB2	User Defined Load (U	
14	NcLCB11	User Defined Load (U	
15	NcLCB20	User Defined Load (U	

A.7 Response Spectrum



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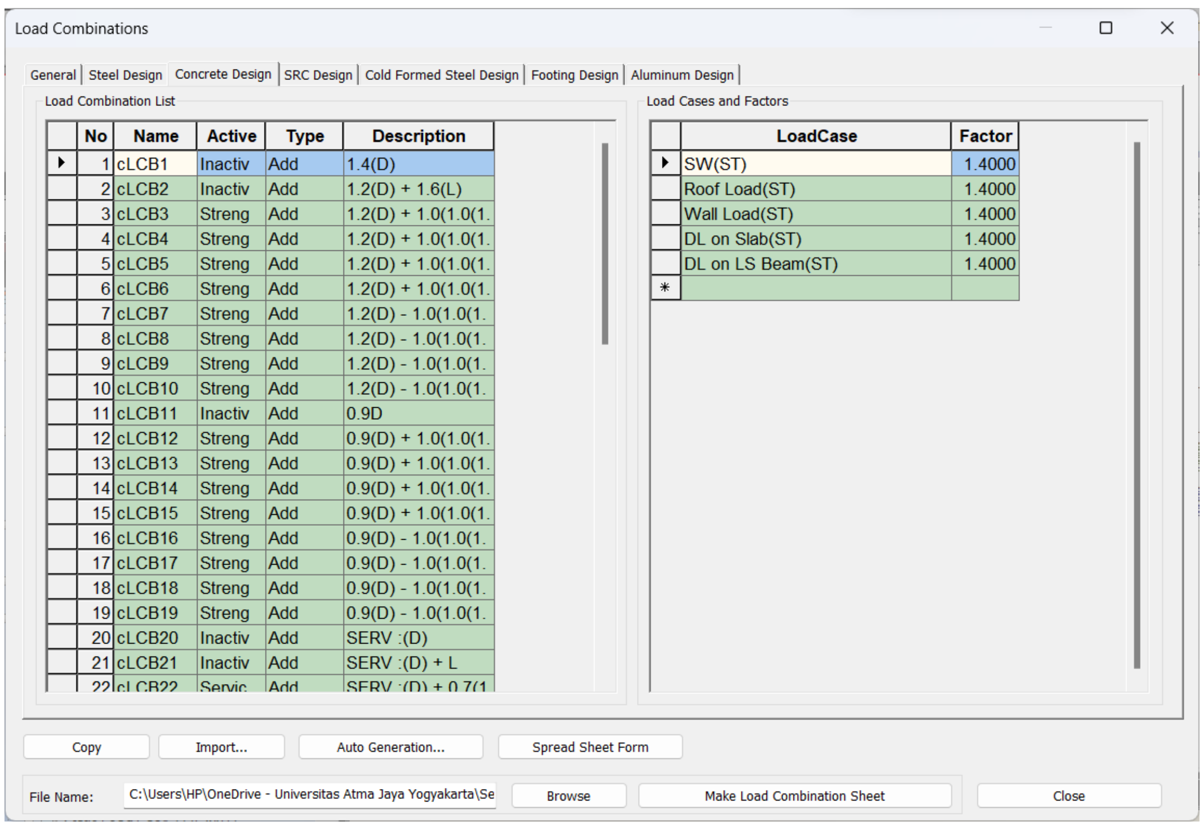
3	0.0933	0.1875
4	0.1200	0.1875
5	0.1800	0.1875
6	0.2400	0.1875
7	0.3000	0.1875
8	0.3600	0.1875
9	0.4200	0.1875
10	0.4667	0.1875
11	0.4800	0.1823
12	0.5400	0.1620
13	0.6000	0.1458
14	0.6600	0.1326
15	0.7200	0.1215
16	0.7800	0.1122

A.8 Load Combinations



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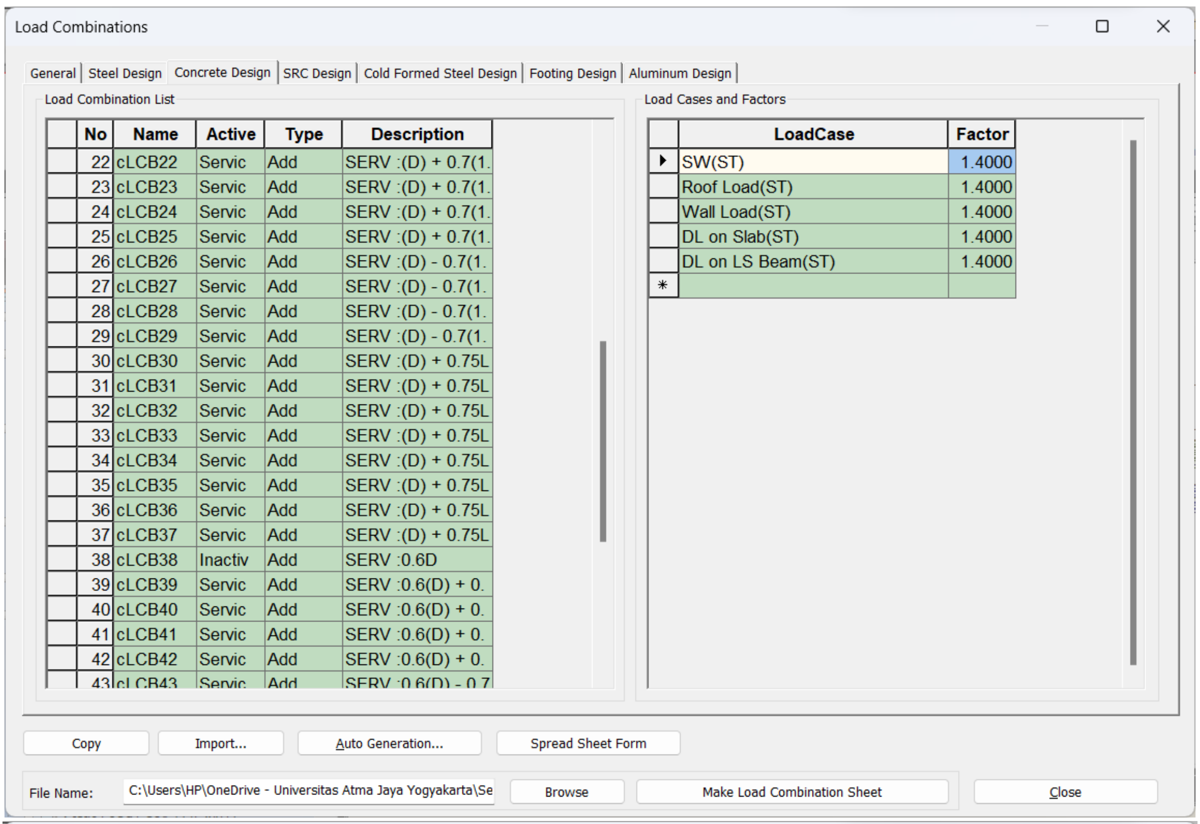
2	cLCB2	Inactiv	Add	1.2(D) + 1.6(L)
3	cLCB3	Streng	Add	1.2(D) + 1.0(1.0(1.
4	cLCB4	Streng	Add	1.2(D) + 1.0(1.0(1.
5	cLCB5	Streng	Add	1.2(D) + 1.0(1.0(1.
6	cLCB6	Streng	Add	1.2(D) + 1.0(1.0(1.
7	cLCB7	Streng	Add	1.2(D) - 1.0(1.0(1.
8	cLCB8	Streng	Add	1.2(D) - 1.0(1.0(1.
9	cLCB9	Streng	Add	1.2(D) - 1.0(1.0(1.
10	cLCB10	Streng	Add	1.2(D) - 1.0(1.0(1.
11	cLCB11	Inactiv	Add	0.9D
12	cLCB12	Streng	Add	0.9(D) + 1.0(1.0(1.
13	cLCB13	Streng	Add	0.9(D) + 1.0(1.0(1.
14	cLCB14	Streng	Add	0.9(D) + 1.0(1.0(1.
15	cLCB15	Streng	Add	0.9(D) + 1.0(1.0(1.
16	cLCB16	Streng	Add	0.9(D) - 1.0(1.0(1.
17	cLCB17	Streng	Add	0.9(D) - 1.0(1.0(1.
18	cLCB18	Streng	Add	0.9(D) - 1.0(1.0(1.
19	cLCB19	Streng	Add	0.9(D) - 1.0(1.0(1.
20	cLCB20	Inactiv	Add	SERV :(D)
21	cLCB21	Inactiv	Add	SERV :(D) + L
22	cLCB22	Servic	Add	SERV :(D) + 0.7(1

LoadCase	Factor
SW(ST)	1.4000
Roof Load(ST)	1.4000
Wall Load(ST)	1.4000
DL on Slab(ST)	1.4000
DL on LS Beam(ST)	1.4000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General | Steel Design | Concrete Design | SRC Design | Cold Formed Steel Design | Footing Design | Aluminum Design
Load Combination List
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23 | cLCB23 | Servic | Add | SERV :(D) + 0.7(1.
24 | cLCB24 | Servic | Add | SERV :(D) + 0.7(1.
25 | cLCB25 | Servic | Add | SERV :(D) + 0.7(1.
26 | cLCB26 | Servic | Add | SERV :(D) - 0.7(1.
27 | cLCB27 | Servic | Add | SERV :(D) - 0.7(1.
28 | cLCB28 | Servic | Add | SERV :(D) - 0.7(1.
29 | cLCB29 | Servic | Add | SERV :(D) - 0.7(1.
30 | cLCB30 | Servic | Add | SERV :(D) + 0.75L
31 | cLCB31 | Servic | Add | SERV :(D) + 0.75L
32 | cLCB32 | Servic | Add | SERV :(D) + 0.75L
33 | cLCB33 | Servic | Add | SERV :(D) + 0.75L
34 | cLCB34 | Servic | Add | SERV :(D) + 0.75L
35 | cLCB35 | Servic | Add | SERV :(D) + 0.75L
36 | cLCB36 | Servic | Add | SERV :(D) + 0.75L
37 | cLCB37 | Servic | Add | SERV :(D) + 0.75L
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39 | cLCB39 | Servic | Add | SERV :0.6(D) + 0.
40 | cLCB40 | Servic | Add | SERV :0.6(D) + 0.
41 | cLCB41 | Servic | Add | SERV :0.6(D) + 0.
42 | cLCB42 | Servic | Add | SERV :0.6(D) + 0.
43 | cLCB43 | Servic | Add | SERV :0.6(D) - 0.7
Load Cases and Factors
LoadCase | Factor
SW(ST) | 1.4000
Roof Load(ST) | 1.4000
Wall Load(ST) | 1.4000
DL on Slab(ST) | 1.4000
DL on LS Beam(ST) | 1.4000
Copy
Import...
Auto Generation...
Spread Sheet Form
File Name:
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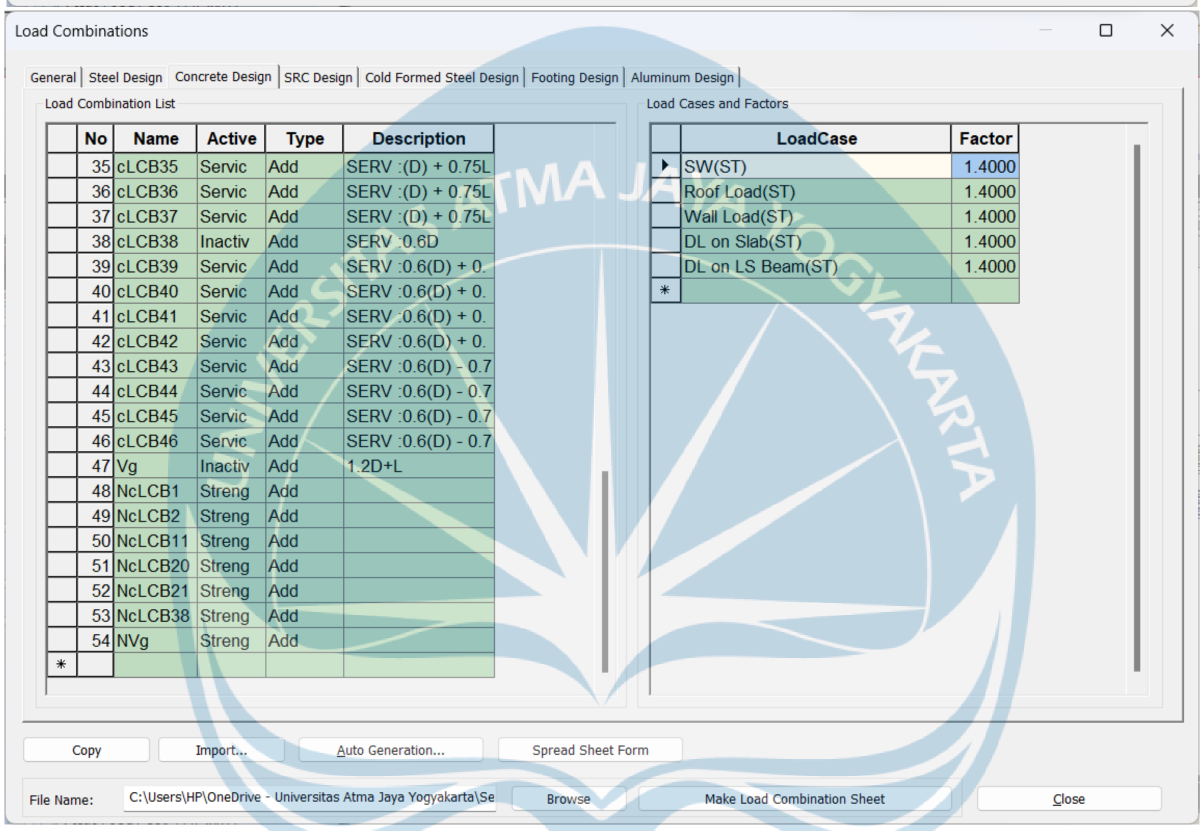
Browse
Make Load Combination Sheet
Close


Load Combinations
General | Steel Design | Concrete Design | SRC Design | Cold Formed Steel Design | Footing Design | Aluminum Design
Load Combination List
No | Name | Active | Type | Description
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36 | cLCB36 | Servic | Add | SERV :(D) + 0.75L
37 | cLCB37 | Servic | Add | SERV :(D) + 0.75L
38 | cLCB38 | Inactiv | Add | SERV :0.6D
39 | cLCB39 | Servic | Add | SERV :0.6(D) + 0.
40 | cLCB40 | Servic | Add | SERV :0.6(D) + 0.
41 | cLCB41 | Servic | Add | SERV :0.6(D) + 0.
42 | cLCB42 | Servic | Add | SERV :0.6(D) + 0.
43 | cLCB43 | Servic | Add | SERV :0.6(D) - 0.7
44 | cLCB44 | Servic | Add | SERV :0.6(D) - 0.7
45 | cLCB45 | Servic | Add | SERV :0.6(D) - 0.7
46 | cLCB46 | Servic | Add | SERV :0.6(D) - 0.7
47 | Vg | Inactiv | Add | 1.2D+L
48 | NcLCB1 | Streng | Add
49 | NcLCB2 | Streng | Add
50 | NcLCB11 | Streng | Add
51 | NcLCB20 | Streng | Add
52 | NcLCB21 | Streng | Add
53 | NcLCB38 | Streng | Add
54 | NVg | Streng | Add
Load Cases and Factors
LoadCase | Factor
SW(ST) | 1.4000
Roof Load(ST) | 1.4000
Wall Load(ST) | 1.4000
DL on Slab(ST) | 1.4000
DL on LS Beam(ST) | 1.4000
Copy
Import...
Auto Generation...
Spread Sheet Form
File Name:
C:\Users\HP\OneDrive - Universitas Atma Jaya Yogyakarta\Se
Browse
Make Load Combination Sheet
Close

APPENDIX B

B. SUPER STRUCTURE APPENDIX

B.1 Purlin Type A Design

Purlin Dimension		
Description	Value	Unit
Purlin Type	C125x50x20x2	
H	125	mm
B	50	mm
C	20	mm
t	2	mm
L	4	m

Purlin Dimension		
Description	Value	Unit
Purlin Type	C125x50x20x2	
H	125	mm
B	50	mm
C	20	mm
t	2	mm
L	4	m

Steel Properties			
Description	Value	Unit	Note
Purlin weight	3.95	kg/m	
Ix	1200000.00	mm4	Inertia of x
Iy	180000.00	mm4	Inertia of y
Sx	19300.00	mm3	elastic section modulus of x
Sy	5500.00	mm3	elastic section modulus of y
A	504.00	mm2	Gross Area
Fy	240.00	mpa	Yield Strength
Fu	370.00	mpa	Rupture Strength
rx	48.90	mm	radius of gyration of x
ry	19.10	mm	radius of gyration of y
Cx	16.90	mm	Centroid of x
xo	41.50	mm	Shear Center of x
xy	0.00	mm	Shear Center of y
J	6720000.00	mm4	Torsional Constant
Cw	675000000.00	mm6	Warping Constant
E	200000.00	mpa	Modulus of Elasticity
Lb	2000	mm	Unbraced Length due to Sag Rod
Zx	22874.63813	mm3	Plastic section modulus of y
Zy	7564.791813	mm3	Plastic section modulus of x
			According to Segui

Steel Properties			
Description	Value	Unit	Note
Purlin weight	3.95	kg/m	
Ix	1200000.00	mm4	Inertia of x
Iy	180000.00	mm4	Inertia of y
Sx	19300.00	mm3	elastic section modulus of x
Sy	5500.00	mm3	elastic section modulus of y
A	504.00	mm2	Gross Area
Fy	240.00	mpa	Yield Strength
Fu	370.00	mpa	Rupture Strength
rx	48.90	mm	radius of gyration of x
ry	19.10	mm	radius of gyration of y
Cx	16.90	mm	Centroid of x
xo	41.50	mm	Shear Center of x
xy	0.00	mm	Shear Center of y
J	6720000.00	mm4	Torsional Constant
Cw	675000000.00	mm6	Warping Constant
E	200000.00	mpa	Modulus of Elasticity
Lb	2000.00	mm	Unbraced Length due to Sag Rod
Zx	22874.64	mm3	Plastic section modulus of y
Zy	7564.79	mm3	Plastic section modulus of x
			According to Segui

Tributary Area			
Description	Value	Unit	Note
Tributary Length (Lt)	1.25	m	
Top Purlin	5	m2	(Lt)*L
Middle Purlin	10	m2	2*(Lt)*L
Bottom Purlin	5	m2	(Lt)*L
α	21	°	Truss Angle

Tributary Area			
Description	Value	Unit	Note
Tributary Length (Lt)	1.25	m	
Top Purlin	5	m2	(Lt)*L
Middle Purlin	10	m2	2*(Lt)*L
Bottom Purlin	5	m2	(Lt)*L
α	21	°	Truss Angle

Loading			
Top Purlin and Bottom Purlin			
Description	Value	Unit	Note
Roof Weight	13	kg/m2	Bitumen
Ceiling Weight	18	kg/m2	
Roof (ADL)	0.6500	kN	Roof Weight*Tributary
Ceiling (ADL)	0.9000	kN	Ceiling Weight*Tributary
Purlin (DL)	0.1580	kN	Purlin Weight*Length
Total Dead Load	1.7080	kN	Roof+Ceiling+Purlin
Live Load (LL)	1	kN	SNI
indward Wind Load (W	-0.203	kN/m2	(+)comes to roof (-) goes off roof
eeward Wind Load (W	-0.322	kN/m2	(+)comes to roof (-) goes off roof
indward Wind Load (W	-1.0160	kN	(Wt)*Tributary
eeward Wind Load (W	-1.6116	kN	(Wh)*Tributary
Take Wind Load (WL)	-1.6116	kN	Max from Wt and Wh
at x direction			
Sin α	0.35836795		
DL	0.612092458	kN	
LL	0.35836795	kN	
WL	-0.577535788	kN	
Moment			
DL	0.306046229	kNm	
LL	0.179183975	kNm	
WL	-0.288767894	kNm	
Load Combination			
1.4D	0.8569	kN	SNI
1.2D + 0.5Lr	0.9137	kN	
1.2D+1.6Lr+0.5W	1.0191	kN	
1.2D + W +0.5Lr	0.3362	kN	
0.9D + W	-0.0267	kN	
Maximum	1.0191	kN	
Moment Combination			
1.4D	0.4285	kNm	SNI
1.2D + 0.5Lr	0.4568	kNm	
1.2D+1.6Lr+0.5W	0.4484	kNm	
1.2D + W +0.5Lr	0.1681	kNm	
0.9D + W	-0.0133	kNm	
Maximum	0.4568	kNm	
at y direction			
Cos α	0.999985734		
DL	1.707975634	kN	
LL	0.999985734	kN	
WL	-1.611549106	kN	
Moment			
DL	0.853987817	kNm	
LL	0.499992867	kNm	
WL	-0.805774553	kNm	
Load Combination			
1.4D	2.3912	kN	SNI
1.2D + 0.5Lr	2.5496	kN	
1.2D+1.6Lr+0.5W	2.8438	kN	
1.2D + W +0.5Lr	0.9380	kN	
0.9D + W	-0.0744	kN	
Maximum	2.8438	kN	
Moment Combination			
1.4D	1.1956	kNm	SNI
1.2D + 0.5Lr	1.2748	kNm	
1.2D+1.6Lr+0.5W	1.2511	kNm	
1.2D + W +0.5Lr	0.4690	kNm	
0.9D + W	-0.0372	kNm	
Maximum	1.2748	kNm	

Loading			
Middle Purlin			
Description	Value	Unit	Note
Roof Weight	13	kg/m2	Bitumen
Ceiling Weight	18	kg/m2	
Roof (ADL)	1.3000	kN	Roof Weight*Tributary
Ceiling (ADL)	1.8000	kN	Ceiling Weight*Tributary
Purlin (DL)	0.1580	kN	Purlin Weight*Length
Total Dead Load	3.2580	kN	Roof+Ceiling+Purlin
Live Load (LL)	1	kN	SNI
Windward Wind Load (W	-0.203	kN/m2	(+)comes to roof (-) goes off roof
Leeward Wind Load (W	-0.322	kN/m2	(+)comes to roof (-) goes off roof
Windward Wind Load (W	-2.0320	kN	(Wt)*Tributary
Leeward Wind Load (W	-3.2231	kN	(Wh)*Tributary
Take Wind Load (WL)	-3.2231	kN	Max from Wt and Wh
at x direction			
Sin α	0.35836795		
DL	1.16756278	kN	
LL	0.35836795	kN	
WL	-1.155071575	kN	
Moment			
DL	0.58378139	kNm	
LL	0.179183975	kNm	
WL	-0.577535788	kNm	
Load Combination			
1.4D	1.6346	kN	SNI
1.2D + 0.5Lr	1.5803	kN	
1.2D+1.6Lr+0.5W	1.3969	kN	
1.2D + W +0.5Lr	0.4252	kN	
0.9D + W	-0.1043	kN	
Maximum	1.6346	kN	
Moment Combination			
1.4D	0.8173	kNm	SNI
1.2D + 0.5Lr	0.7901	kNm	
1.2D+1.6Lr+0.5W	0.5817	kNm	
1.2D + W +0.5Lr	0.2126	kNm	
0.9D + W	-0.0521	kNm	
Maximum	0.8173	kNm	
at y direction			
Cos α	0.999948094		
DL	3.257830889	kN	
LL	0.999948094	kN	
WL	-3.22297689	kN	
Moment			
DL	1.628915444	kNm	
LL	0.499974047	kNm	
WL	-1.611488445	kNm	
Load Combination			
1.4D	4.5610	kN	SNI
1.2D + 0.5Lr	4.4094	kN	
1.2D+1.6Lr+0.5W	3.8978	kN	
1.2D + W +0.5Lr	1.1864	kN	
0.9D + W	-0.2909	kN	
Maximum	4.5610	kN	
Moment Combination			
1.4D	2.2805	kNm	SNI
1.2D + 0.5Lr	2.2047	kNm	
1.2D+1.6Lr+0.5W	1.6231	kNm	
1.2D + W +0.5Lr	0.5932	kNm	
0.9D + W	-0.1455	kNm	
Maximum	2.2805	kNm	

Dimension Calculation			
Centroid of Half Area of Top from Neutral X Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange	92	61.5	5658
Web	125	31.25	3906.25
Lip	40	52.5	2100
Total	257		11664.25
y'	45.3862		
Plastic Modulus Section Zx			
Description	Value	Unit	Note
a	90.77237354	mm	2*y'
Zx	22874.63813	mm3	(A/2)*a
Centroid of Half Area of Top from Neutral Y Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange left	62.2	15.55	967.21
Flange Right	62.2	15.55	967.21
Lip Left	40	32.1	1284
Lip Right	40	32.1	1284
Total	204.4		3218.42
y1	15.7457		
Centroid of Half Area of Bottom from Neutral Y Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange Left	33.8	8.45	285.61
Flange Right	33.8	8.45	285.61
Web	242	15.9	3847.8
Total	309.6		4419.02
y1	14.2733		
Description	Value	Unit	Note
a	30.0190	mm	y1+y2
Zy	7564.791813	mm3	(A/2)*a

Profile Checking (Compact/Non Compact) for Y direction			
	λ	λp	λr
Flange	25	10.9697	28.86751346
Web	62.5	108.542	164.5448267
Conclusion			
Flange	non-compact		
Web	compact		
This section is non-compact			
h0	123		
rts	23.89821231		
c	1.004290795		
(J.c)/(Sx.h0)	2.8429311		
E/0.7Fy	1190.47619		
0.7Fy/E	0.00084		
Lb	2000	mm	
Lp	970.4103325	mm	
Lr	132287.5391	mm	
Cb	1.3		
Lb/rts	83.68826816		
Fcr	14443.70982	N/mm2	
Mp	5489913.152	Mpa	
Moment Design Calculation			
Description	Mn	Unit	Note
-	-		
Inelastic LTB	7113979.033	Nmm	
he flange is non-compa	3728060.753	Nmm	
Take φMn	3.355254678	kNm	0.9*smallest Mn
Mu	1.274781814	kNm	φMn>Mu Safe

Dimension Calculation			
Centroid of Half Area of Top from Neutral X Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange	92	61.5	5658
Web	125	31.25	3906.25
Lip	40	52.5	2100
Total	257		11664.25
y'	45.3862		
Plastic Modulus Section Zx			
Description	Value	Unit	Note
a	90.77237354	mm	2*y'
Zx	22874.63813	mm3	(A/2)*a
Centroid of Half Area of Top from Neutral Y Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange left	62.2	15.55	967.21
Flange Right	62.2	15.55	967.21
Lip Left	40	32.1	1284
Lip Right	40	32.1	1284
Total	204.4		3218.42
y1	15.7457		
Centroid of Half Area of Bottom from Neutral Y Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange Left	33.8	8.45	285.61
Flange Right	33.8	8.45	285.61
Web	242	15.9	3847.8
Total	309.6		4419.02
y1	14.2733		
Description	Value	Unit	Note
a	30.0190	mm	y1+y2
Zy	7564.791813	mm3	(A/2)*a

Profile Checking (Compact/Non Compact) for Y direction			
	λ	λ_p	λ_r
Flange	25	10.96965511	28.86751346
Web	62.5	108.5418506	164.5448267
Conclusion			
Flange	non-compact		
Web	compact		
This section is non-compact			
h0	123		
rts	23.89821231		
c	1.004290795		
(J.c)/(Sx.h0)	2.8429311		
E/0.7Fy	1190.47619		
0.7Fy/E	0.00084		
Lb	2000	mm	
Lp	970.4103325	mm	
Lr	132287.5391	mm	
Cb	1.3		
Lb/rts	83.68826816		
Fcr	14443.70982	N/mm2	
Mp	5489913.152	Mpa	
Moment Design Calculation			
Description	Mn	Unit	Note
-	-		
Inelastic LTB	7113979.033	Nmm	
The flange is non-compa	3728060.753	Nmm	
Take φMn	3.355254678	kNm	0.9*smallest Mn
Mu	2.280481622	kNm	φMn>Mu Safe

Profile Checking (Compact/Non Compact) for X direction			
	λ	λp	λr
Flange	25	10.9697	28.86751346
Web	62.5	108.542	164.5448267
Conclusion			
Flange	non-compact		
Web	compact		
This section is non-compact			
h0	123		
rts	71.93494402		
c	2.593067681		
(J.c)/(Sy.h0)	9.97610368		
E/0.7Fy	1190.47619		
0.7Fy/E	0.00084		
Lb	2000	mm	
Lp	2484.453678	mm	
Lr	745917.3565	mm	
Cb	1.3		
Lb/rts	27.80289923		
Fcr	81483.84158	N/mm2	
Mp	1815550.035	Mpa	
Moment Design Calculation			
Description	Mn	Unit	Note
-	-		
No LTB	1815550.035	Nmm	
he flange is non-compa	1116653.316	Nmm	
Take φMn	1.004987984	kNm	0.9*smallest Mn
Mu	0.456847462	kNm	φMn>Mu Safe

Shear Design Calculation			
h/tw	62.5	(a)	
kv	5.34		
1.1*√(kv/Fy)	73.37915235	(b)	
Conclusion	(a)<=(b)		
Cv1	1	atio of critical web stress to shear yield stres	
φv	0.9	resistance factor	
Ωv	1.67		
Aw	250	mm2	H*t
Vn	36000	N	0.6Fy.Aw.Cv1
φVn	32.4	kN	
Vu	0.637390907	kN	φVn>Vu Safe

Deflection at Y direction			
w	0.710943346	kN/m	
δmax	9.874213134	mm	Safe
δallowed	25.5	mm	1 inch

Deflection at X direction			
w	0.254782944	kN/m	
δmax	11.77663384	mm	Safe
δallowed	25.5	mm	1 inch

Sag Rod Calculation			
T	1.019131775	kN	
Ab req	4.896729249	mm2	
Diam. Req	2.496939991	mm	
Use Thread Rod diam	10	mm	
Ab	78.53981634	mm2	
Tie Rod at Ridge			
P	1.019146314	kN	
Ab req	4.896799106	mm2	
Diam. Req	2.496957802	mm	
Use Thread Rod diam	10	mm	SNI 1729-2015 J3.4
Ab	78.53981634	mm2	

Profile Checking (Compact/Non Compact) for X direction			
	λ	λ_p	λ_r
Flange	25	10.96965511	28.86751346
Web	62.5	108.5418506	164.5448267
Conclusion			
Flange	non-compact		
Web	compact		
This section is non-compact			
h0	123		
rts	71.93494402		
c	2.593067681		
(J.c)/(Sy.h0)	9.97610368		
E/0.7Fy	1190.47619		
0.7Fy/E	0.00084		
Lb	2000	mm	
Lp	2484.453678	mm	
Lr	745917.3565	mm	
Cb	1.3		
Lb/rts	27.80289923		
Fcr	81483.84158	N/mm2	
Mp	1815550.035	Mpa	
Moment Design Calculation			
Description	Mn	Unit	Note
-	-		
No LTB	1815550.035	Nmm	
The flange is non-compa	1116653.316	Nmm	
Take φMn	1.004987984	kNm	0.9*smallest Mn
Mu	0.817293946	kNm	φMn>Mu Safe

Shear Design Calculation			
h/tw	62.5	(a)	
kv	5.34		
1.1*√(kv/Fy)	73.37915235	(b)	
Conclusion	(a)<=(b)		
Cv1	1	ratio of critical web stress to shear yield stress	
φv	0.9	resistance factor	
Ωv	1.67		
Aw	250	mm2	H*t
Vn	36000	N	0.6Fy.Aw.Cv1
φVn	32.4	kN	
Vu	1.140240811	kN	φVn>Vu Safe

Deflection at Y direction			
w	1.140240811	kN/m	
δmax	15.83667793	mm	Safe
δallowed	25.5	mm	1 inch

Deflection at X direction			
w	0.408646973	kN/m	
δmax	18.88857119	mm	Safe
δallowed	25.5	mm	1 inch

Sag Rod Calculation			
T	1.634587891	kN	
Ab req	7.853875755	mm2	
Diam. Req	3.162256345	mm	
Use Thread Rod diam	10	mm	
Ab	78.53981634	mm2	
Tie Rod at Ridge			
P	1.634672742	kN	
Ab req	7.854283443	mm2	
Diam. Req	3.162338419	mm	
Use Thread Rod diam	10	mm	SNI 1729-2015 J3.4
Ab	78.53981634	mm2	

B.2 Purlin Type B Design

Purlin Dimension		
Description	Value	Unit
Purlin Type	C125x50x20x2	
H	125	mm
B	50	mm
C	20	mm
t	2	mm
L	7.6	m

Purlin Dimension		
Description	Value	Unit
Purlin Type	C125x50x20x2	
H	125	mm
B	50	mm
C	20	mm
t	2	mm
L	7	m

Steel Properties			
Description	Value	Unit	Note
Purlin weight	3.95	kg/m	
Ix	1370000.00	mm4	Inertia of x
Iy	206000.00	mm4	Inertia of y
Sx	19300.00	mm3	elastic section modulus of x
Sy	5500.00	mm3	elastic section modulus of y
A	504.00	mm2	Gross Area
Fy	240.00	mpa	Yield Strength
Fu	370.00	mpa	Rupture Strength
rx	48.90	mm	radius of gyration of x
ry	19.10	mm	radius of gyration of y
Cx	16.90	mm	Centroid of x
xo	41.50	mm	Shear Center of x
xy	0.00	mm	Shear Center of y
J	6720000.00	mm4	Torsional Constant
Cw	675000000.00	mm6	Warping Constant
E	200000.00	mpa	Modulus of Elasticity
Lb	3800	mm	Unbraced Length due to Sag Rod
Zx	22874.63813	mm3	Plastic section modulus of y
Zy	7564.791813	mm3	Plastic section modulus of x
			According to Segui

Tributary Area			
Description	Value	Unit	Note
Tributary Length (Lt)	1.25	m	
Top Purlin	4.75	m2	(Lt)*L
Middle Purlin	9.5	m2	2*(Lt)*L
Bottom Purlin	4.75	m2	(Lt)*L
α	21	°	Truss Angle

Loading			
Top Purlin and Bottom Purlin			
Description	Value	Unit	Note
Roof Weight	4	kg/m2	Bitumen
Ceiling Weight	0	kg/m2	
Roof (ADL)	0.1900	kN	Roof Weight*Tributary
Ceiling (ADL)	0.0000	kN	Ceiling Weight*Tributary
Purlin (DL)	0.3002	kN	Purlin Weight*Length
Total Dead Load	0.4902	kN	Roof+Ceiling+Purlin
Live Load (LL)	1	kN	SNI
Windward Wind Load (Wt)	-0.203	kN/m2	(+)comes to roof (-) goes off roof
Leeward Wind Load (Wh)	-0.322	kN/m2	(+)comes to roof (-) goes off roof
Windward Wind Load (Wt)	-0.9652	kN	(Wt)*Tributary
Leeward Wind Load (Wh)	-1.5310	kN	(Wh)*Tributary
Take Wind Load (WL)	-1.5310	kN	Max from Wt and Wh
at x direction			
Sin α	0.35836795		
DL	0.175671969	kN	
LL	0.35836795	kN	
WL	-0.548658998	kN	
Moment			
DL	0.16688837	kNm	
LL	0.340449552	kNm	
WL	-0.521226048	kNm	
Load Combination			
1.4D	0.2459	kN	SNI
1.2D + 0.5Lr	0.3900	kN	
1.2D+1.6Lr+0.5W	0.5099	kN	
1.2D + W +0.5Lr	-0.1587	kN	
0.9D + W	-0.3906	kN	
Maximum	0.5099	kN	
Moment Combination			
1.4D	0.2336	kNm	SNI
1.2D + 0.5Lr	0.3705	kNm	
1.2D+1.6Lr+0.5W	0.4510	kNm	
1.2D + W +0.5Lr	-0.1507	kNm	
0.9D + W	-0.3710	kNm	
Maximum	0.4510	kNm	
at y direction			
Cos α	0.999995758		
DL	0.490197921	kN	
LL	0.999995758	kN	
WL	-1.530986997	kN	
Moment			
DL	0.465688025	kNm	
LL	0.94999597	kNm	
WL	-1.454437647	kNm	
Load Combination			
1.4D	0.6863	kN	SNI
1.2D + 0.5Lr	1.0882	kN	
1.2D+1.6Lr+0.5W	1.4227	kN	
1.2D + W +0.5Lr	-0.4428	kN	
0.9D + W	-1.0898	kN	
Maximum	1.4227	kN	
Moment Combination			
1.4D	0.6520	kNm	SNI
1.2D + 0.5Lr	1.0338	kNm	
1.2D+1.6Lr+0.5W	1.2585	kNm	
1.2D + W +0.5Lr	-0.4206	kNm	
0.9D + W	-1.0353	kNm	
Maximum	1.2585	kNm	

Steel Properties			
Description	Value	Unit	Note
Purlin weight	3.95	kg/m	
Ix	1370000.00	mm4	Inertia of x
Iy	206000.00	mm4	Inertia of y
Sx	19300.00	mm3	elastic section modulus of x
Sy	5500.00	mm3	elastic section modulus of y
A	504.00	mm2	Gross Area
Fy	240.00	mpa	Yield Strength
Fu	370.00	mpa	Rupture Strength
rx	48.90	mm	radius of gyration of x
ry	19.10	mm	radius of gyration of y
Cx	16.90	mm	Centroid of x
xo	41.50	mm	Shear Center of x
xy	0.00	mm	Shear Center of y
J	6720000.00	mm4	Torsional Constant
Cw	675000000.00	mm6	Warping Constant
E	200000.00	mpa	Modulus of Elasticity
Lb	3800.00	mm	Unbraced Length due to Sag Rod
Zx	22874.64	mm3	Plastic section modulus of y
Zy	7564.79	mm3	Plastic section modulus of x
			According to Segui

Tributary Area			
Description	Value	Unit	Note
Tributary Length (Lt)	1.25	m	
Top Purlin	4.75	m2	(Lt)*L
Middle Purlin	9.5	m2	2*(Lt)*L
Bottom Purlin	4.75	m2	(Lt)*L
α	21	°	Truss Angle

Loading			
Middle Purlin			
Description	Value	Unit	Note
Roof Weight	4	kg/m2	Bitumen
Ceiling Weight	0	kg/m2	
Roof (ADL)	0.3800	kN	Roof Weight*Tributary
Ceiling (ADL)	0.0000	kN	Ceiling Weight*Tributary
Purlin (DL)	0.2765	kN	Purlin Weight*Length
Total Dead Load	0.6565	kN	Roof+Ceiling+Purlin
Live Load (LL)	1	kN	SNI
Windward Wind Load (Wt)	-0.203	kN/m2	(+)comes to roof (-) goes off roof
Leeward Wind Load (Wh)	-0.322	kN/m2	(+)comes to roof (-) goes off roof
Windward Wind Load (Wt)	-1.9304	kN	(Wt)*Tributary
Leeward Wind Load (Wh)	-3.0620	kN	(Wh)*Tributary
Take Wind Load (WL)	-3.0620	kN	Max from Wt and Wh
at x direction			
Sin α	0.35836795		
DL	0.235268559	kN	
LL	0.35836795	kN	
WL	-1.097317996	kN	
Moment			
DL	0.223505131	kNm	
LL	0.340449552	kNm	
WL	-1.042452097	kNm	
Load Combination			
1.4D	0.3294	kN	SNI
1.2D + 0.5Lr	0.4615	kN	
1.2D+1.6Lr+0.5W	0.3071	kN	
1.2D + W +0.5Lr	-0.6358	kN	
0.9D + W	-0.8856	kN	
Maximum	0.4615	kN	
Moment Combination			
1.4D	0.3129	kNm	SNI
1.2D + 0.5Lr	0.4384	kNm	
1.2D+1.6Lr+0.5W	0.2470	kNm	
1.2D + W +0.5Lr	-0.6040	kNm	
0.9D + W	-0.8413	kNm	
Maximum	0.4384	kNm	
at y direction			
Cos α	0.999992391		
DL	0.656495005	kN	
LL	0.999992391	kN	
WL	-3.061963685	kN	
Moment			
DL	0.623670255	kNm	
LL	0.949992772	kNm	
WL	-2.908865501	kNm	
Load Combination			
1.4D	0.9191	kN	SNI
1.2D + 0.5Lr	1.2878	kN	
1.2D+1.6Lr+0.5W	0.8568	kN	
1.2D + W +0.5Lr	-1.7742	kN	
0.9D + W	-2.4711	kN	
Maximum	1.2878	kN	
Moment Combination			
1.4D	0.8731	kNm	SNI
1.2D + 0.5Lr	1.2234	kNm	
1.2D+1.6Lr+0.5W	0.6892	kNm	
1.2D + W +0.5Lr	-1.6855	kNm	
0.9D + W	-2.3476	kNm	
Maximum	1.2234	kNm	

Dimension Calculation			
Centroid of Half Area of Top from Neutral X Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange	92	61.5	5658
Web	125	31.25	3906.25
Lip	40	52.5	2100
Total	257		11664.25
y'	45.3862		
Plastic Modulus Section Zx			
Description	Value	Unit	Note
a	90.77237354	mm	2*y'
Zx	22874.63813	mm3	(A/2)*a
Centroid of Half Area of Top from Neutral Y Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange left	62.2	15.55	967.21
Flange Right	62.2	15.55	967.21
Lip Left	40	32.1	1284
Lip Right	40	32.1	1284
Total	204.4		3218.42
y1	15.7457		
Centroid of Half Area of Bottom from Neutral Y Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange Left	33.8	8.45	285.61
Flange Right	33.8	8.45	285.61
Web	242	15.9	3847.8
Total	309.6		4419.02
y1	14.2733		
Description	Value	Unit	Note
a	30.0190	mm	y1+y2
Zy	7564.791813	mm3	(A/2)*a

Profile Checking (Compact/Non Compact) for Y direction			
	λ	λp	λr
Flange	25	10.9697	28.86751346
Web	62.5	108.542	164.5448267
Conclusion			
Flange	non-compact		
Web	compact		
This section is non-compact			
h0	123		
rts	24.71804359		
c	1.074377339		
(J.c)/(Sx.h0)	3.041331024		
E/0.7Fy	1190.47619		
0.7Fy/E	0.00084		
Lb	3800	mm	
Lp	970.4103325	mm	
Lr	141519.5018	mm	
Cb	1.3		
Lb/rts	153.7338498		
Fcr	8130.578839	N/mm2	
Mp	5489913.152	Mpa	
Moment Design Calculation			
Description	Mn	Unit	Note
-	-		
Inelastic LTB	7078064.931	Nmm	
The flange is non-compact	3728060.753	Nmm	
Take φMn	3.355254678	kNm	0.9*smallest Mn
Mu	1.258462753	kNm	φMn>Mu Safe

Profile Checking (Compact/Non Compact) for X direction			
	λ	λp	λr
Flange	25	10.9697	28.86751346
Web	62.5	108.542	164.5448267
Conclusion			
Flange	non-compact		
Web	compact		
This section is non-compact			
h0	123		
rts	74.35749323		
c	2.770661774		
(J.c)/(Sy.h0)	10.67230705		
E/0.7Fy	1190.47619		
0.7Fy/E	0.00084		
Lb	3800	mm	
Lp	2484.453678	mm	
Lr	797488.1187	mm	
Cb	1.3		
Lb/rts	51.10446621		
Fcr	45823.74214	N/mm2	
Mp	1815550.035	Mpa	
Moment Design Calculation			
Description	Mn	Unit	Note
-	-		
Inelastic LTB	2358297.145	Nmm	
The flange is non-compact	1116653.316	Nmm	
Take φMn	1.004987984	kNm	0.9*smallest Mn
Mu	0.45099463	kNm	φMn>Mu Safe

Dimension Calculation			
Centroid of Half Area of Top from Neutral X Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange	92	61.5	5658
Web	125	31.25	3906.25
Lip	40	52.5	2100
Total	257		11664.25
y'	45.3862		
Plastic Modulus Section Zx			
Description	Value	Unit	Note
a	90.77237354	mm	2*y'
Zx	22874.63813	mm3	(A/2)*a
Centroid of Half Area of Top from Neutral Y Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange left	62.2	15.55	967.21
Flange Right	62.2	15.55	967.21
Lip Left	40	32.1	1284
Lip Right	40	32.1	1284
Total	204.4		3218.42
y1	15.7457		
Centroid of Half Area of Bottom from Neutral Y Axis Reference			
	A (mm2)	y (mm)	Ay (mm3)
Flange Left	33.8	8.45	285.61
Flange Right	33.8	8.45	285.61
Web	242	15.9	3847.8
Total	309.6		4419.02
y1	14.2733		
Description	Value	Unit	Note
a	30.0190	mm	y1+y2
Zy	7564.791813	mm3	(A/2)*a

Profile Checking (Compact/Non Compact) for Y direction			
	λ	λ_p	λ_r
Flange	25	10.96965511	28.86751346
Web	62.5	108.5418506	164.5448267
Conclusion			
Flange	non-compact		
Web	compact		
This section is non-compact			
h0	123		
rts	24.71804359		
c	1.074377339		
(J.c)/(Sx.h0)	3.041331024		
E/0.7Fy	1190.47619		
0.7Fy/E	0.00084		
Lb	3800	mm	
Lp	970.4103325	mm	
Lr	141519.5018	mm	
Cb	1.3		
Lb/rts	153.7338498		
Fcr	8130.578839	N/mm2	
Mp	5489913.152	Mpa	
Moment Design Calculation			
Description	Mn	Unit	Note
-	-		
Inelastic LTB	7078064.931	Nmm	
The flange is non-compact	3728060.753	Nmm	
Take φMn	3.355254678	kNm	0.9*smallest Mn
Mu	1.223400692	kNm	φMn>Mu Safe

Profile Checking (Compact/Non Compact) for X direction			
	λ	λ_p	λ_r
Flange	25	10.96965511	28.86751346
Web	62.5	108.5418506	164.5448267
Conclusion			
Flange	non-compact		
Web	compact		
This section is non-compact			
h0	123		
rts	74.35749323		
c	2.770661774		
(J.c)/(Sy.h0)	10.67230705		
E/0.7Fy	1190.47619		
0.7Fy/E	0.00084		
Lb	3800	mm	
Lp	2484.453678	mm	
Lr	797488.1187	mm	
Cb	1.3		
Lb/rts	51.10446621		
Fcr	45823.74214	N/mm2	
Mp	1815550.035	Mpa	
Moment Design Calculation			
Description	Mn	Unit	Note
-	-		
Inelastic LTB	2358297.145	Nmm	
The flange is non-compact	1116653.316	Nmm	
Take φMn	1.004987984	kNm	0.9*smallest Mn
Mu	0.438430933	kNm	φMn>Mu Safe

Shear Design Calculation			
h/tw	62.5	(a)	
kv	5.34		
1.1*√(kv/Fy)	73.37915235	(b)	
Conclusion	(a)<=(b)		
Cv1	1	atio of critical web stress to shear yield stres	
φv	0.9	resistance factor	
Ωv	1.67		
Aw	250	mm2	H*t
Vn	36000	N	0.6Fy.Aw.Cv1
φVn	32.4	kN	
Vu	0.629231377	kN	φVn>Vu Safe

Deflection at Y direction			
w	0.187202266	kN/m	
δmax	29.67930227	mm	Safe
δallowed	42.22222222	mm	1 inch

Deflection at X direction			
w	0.067087577	kN/m	
δmax	35.3112112	mm	Safe
δallowed	42.22222222	mm	1 inch

Sag Rod Calculation			
T	0.5099	kN	
Ab req	2.449804602	mm2	
Diam. Req	1.766122333	mm	
Use Thread Rod diam	10	mm	
Ab	78.53981634	mm2	
Tie Rod at Ridge			
P	0.509867746	kN	
Ab req	2.449814994	mm2	
Diam. Req	1.766126079	mm	
Use Thread Rod diam	10	mm	SNI 1729-2015 J3.4
Ab	78.53981634	mm2	

Shear Design Calculation			
h/tw	62.5	(a)	
kv	5.34		
1.1*√(kv/Fy)	73.37915235	(b)	
Conclusion	(a)<=(b)		
Cv1	1	ratio of critical web stress to shear yield stress	
φv	0.9	resistance factor	
Ωv	1.67		
Aw	250	mm2	H*t
Vn	36000	N	0.6Fy.Aw.Cv1
φVn	32.4	kN	
Vu	0.611700346	kN	φVn>Vu Safe

Deflection at Y direction			
w	0.183970029	kN/m	
δmax	20.99072571	mm	Safe
δallowed	38.88888889	mm	1 inch

Deflection at X direction			
w	0.065929464	kN/m	
δmax	24.97398481	mm	Safe
δallowed	38.88888889	mm	1 inch

Sag Rod Calculation			
T	0.461506245	kN	
Ab req	2.217447425	mm2	
Diam. Req	1.68028026	mm	
Use Thread Rod diam	10	mm	
Ab	78.53981634	mm2	
Tie Rod at Ridge			
P	0.461509757	kN	
Ab req	2.217464297	mm2	
Diam. Req	1.680286652	mm	
Use Thread Rod diam	10	mm	SNI 1729-2015 J3.4
Ab	78.53981634	mm2	

B.3 Wind Load Calculation

Parameter	Value	Unit	SNI 1727:2020
Building Width, B	16.0	m	
Building Length, L	96.0	m	
Wall Height	12.0	m	
Soil to Roof Height	15.1	m	
Effective Height, h	13.6	m	
L/B	6.00		
h/L	0.14		
Roof Angle, θ	21.0	°	
Roof Type	Pitched		
Base Wind Velocity, V	32.00	m/s	Chapter 26.5.1
Coefficient Factor of Wind Direction, Kd	0.95		Table 26.6.1
Exposure Category	B		Chapter 26.7
Coefficient Factor of Topography, Kzt	1.00		Table 26.6.1
Coefficient Factor of Wind Blow, G	0.85		Chapter 26.11
Coefficient of Internal Pressure, (GCpi)	0.18		Table 26.13-1
α	7		Table 26.9.1
Zg	365.76	m	Table 26.9.1
Zmin	9.14	m	Table 26.9.1
Coefficient Exposure of Velocity Pressure, Kz	0.78		Table 27.3.1
Velocity pressure, q_z	467.9577	N/m2	Equation 27.3-1

Coefficient of External Pressure, Cp*		
Wall Surface	Cp*	Figure 27.4-1
Wall side of windward	0.80	
Wall side of leeward	-0.20	
Edge wall	-0.70	
Roof Surface	Cp*	
Windward side	-0.30	
Leeward side	-0.60	

Roof Pressure			
Roof Wind, Windward	-203	N/mm2	Chapter 27.4.2 & Equation 27.4.1
Roof Wind, Leeward	-322	N/mm2	Chapter 27.4.2 & Equation 27.4.1

B.4 Truss Type A Design

Profile Properties

WF 300 x 150 x 6.5 x 9			
300	150	6.5	9
30	15	0.65	0.9
Steel Type	A36		
Fy	250	Mpa	
Fu	400	Mpa	
Ag	4678	mm2	
b	150	mm	
h	300	mm	
t1	6.5	mm	
t2	9	mm	
E	200000	Mpa	
rx	12.4	cm	
ry	3.29	cm	
dbolt	16.00	mm	
dhole	18	mm	SNI 1729-2020 Table J3.3M
nbolt at edge for 1 column	1		
Cx	24.6	mm	

Load Recap on Truss		
SDLmid	3.26	kN
SDLcorner	1.71	kN
L	1.00	kN
Wmid	-3.22	kN
Wcorner	-1.61	kN

Output from MIDAS

Member	Axial Force (kN)	Combination
1	0.858	1.4D
2	-44.746	1.4D
3	-44.746	1.4D
4	0.858	1.4D
Maximum	44.746	

Joints	Displacement (mm)	Combination
J1	0	1.4D
J2	0	1.4D
J3	-0.001035	1.4D
J4	-0.000029	1.4D
J5	-0.000029	1.4D
Maximum	0.001035	
Check <1 inch (25.5 mm)	Safe	

Check for Tension Member			
Pu max	44.746	kN	
L	8000	mm	
K	1		
Slenderness	243.1610942		KL/r
	KL/r<300 OK		
An	4678	mm2	
Ue	1		SNI 1729-2019 Table D3.1
Ae	4678	mm2	An*Ue
Yield Strenth ϕPn	1052.55	kN	0.9*Fy*Ag
	Safe		
Rupture Strenth φPn	1403.4	kN	0.75*Fu*Ae
	Safe		

Check for Compression Member

Member	Axial Force (kN)	Length (mm)	KL/r	4.71*sqrt(E/Fy)	Fe	Fcr	φPn	Note
1	0.858	1000	30.40	133.2189	2136.5917	238.0515	1002.24424	Safe
2	44.746	8569	260.46	133.2189	29.09787349	25.51884	107.439399	Safe
3	44.746	8569	260.46	133.2189	29.09787349	25.51884	107.439399	Safe
4	0.858	1000	30.40	133.2189	2136.5917	238.0515	1002.24424	Safe

Check if Slender		
λ	23.07692308	
λr	12.72792206	SNI 1279-2019 Table B4.1.a
ıder. Local Buckling Stress must be calculates		

ılculate Local Buckling Stress as in Segui Ex 4.4

B.5 Truss Type B Design

Profile Properties

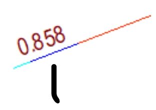
WF 300 x 150 x 6.5 x 9			
Steel Type	A36		
Fy	250	Mpa	
Fu	400	Mpa	
Ag	4678	mm2	
b	150	mm	
h	300	mm	
t1	6.5	mm	
t2	9	mm	
E	200000	Mpa	
rx	12.4	cm	
ry	3.29	cm	
dbolt	16.00	mm	
dhole	18	mm	SNI 1729-2020 Table J3.3M
nbolt at edge for 1 column	1		
Cx	24.6	mm	

Load Recap on Truss		
SDLmid	3.26	kN
SDLcorner	1.71	kN
L	1.00	kN
Wmid	-3.22	kN
Wcorner	-1.61	kN

Output from ETABS

Member	Axial Force (kN)	Combination
1	0.858	1.4D
2	-17.134	1.4D
3	-12.097	1.4D
4	-17.134	1.4D
5	0.858	1.4D
Maximum	17.134	

Joints	Displacement (mm)	Combination
J1	0	
J2	0	1.4D
J3	-0.02949	1.4D
J4	-0.02949	1.4D
J5	-0.339473	1.4D
J6	-0.339473	1.4D
J7	0	1.4D
Maximum	0.339473	
Check <1 inch (25.5 mm)	Safe	



Check for Tension Member			
Pu max	17.134	kN	
L	8000	mm	
K	1		
Slenderness	243.1610942		KL/r
	KL/r<300 OK		
An	4678	mm2	Ag-n*dh*t*2 (2 for double angle)
Ue	1		SNI 1729-2019 Table D3.1
Ae	4678	mm2	An*Ue
Yield Strenth ϕPn	1052.55	kN	0.9*Fy*Ag
	Safe		
Rupture Strenth φPn	1403.4	kN	0.75*Fu*Ae
	Safe		

Check for Compression Member								
Member	Axial Force (kN)	Length (mm)	KL/r	4.71*sqrt(E/Fy)	Fe	Fcr	φPn	Note
1	0.858	1000	30.40	133.2189176	2136.59	238.05146	1002.244	Safe
2	17.134	3789.9	115.19	133.2189176	148.753	123.72107	520.8905	Safe
3	12.097	8923.6	271.23	133.2189176	26.8313	23.53103	99.07034	Safe
4	17.134	3789.9	115.19	133.2189176	148.753	123.72107	520.8905	Safe
5	0.858	1000	30.40	133.2189176	2136.59	238.05146	1002.244	Safe

Check if Slender		
λ	23.07692308	
λr	12.72792206	SNI 1279-2019 Table B4.1.a
λ>λr Slender. Local Buckling Stress must be calculates		

If Slender Calculate Local Buckling Stress as in Segui Ex 4.4

B.6 Truss Type C Design

Profile Properties			
WF 300 x 150 x 6.5 x 9			
Steel Type	A36		
Fy	250	Mpa	
Fu	400	Mpa	
Ag	4678	mm2	
b	150	mm	
h	300	mm	
t1	6.5	mm	
t2	9	mm	
E	200000	Mpa	
rx	12.4	cm	
ry	3.29	cm	
dbolt	16.00	mm	
dhole	18	mm	SNI 1729-2020 Table J3.3M
nbolt at edge for 1 column	1		
Cx	24.6	mm	

Load Recap on Truss		
SDLmid	3.26	kN
SDLcorner	1.71	kN
L	1.00	kN
Wmid	-3.22	kN
Wcorner	-1.61	kN

Output from ETABS

Member	Axial Force (kN)	Combination
1	0.858	1.4D
2	2.547	1.4D
3	-3.107	1.4D
Maximum	3.107	

Joints	Displacement (mm)	Combination
J1	0	
J2	0	1.4D
J3	-0.02949	1.4D
J4	0	1.4D
Maximum	0.02949	
Check <1 inch (25.5 mm)	Safe	

Check for Tension Member			
Pu max	3.107	kN	
L	8000	mm	
K	1		
Slenderness	243.1610942		KL/r
	KL/r<300 OK		
An	4678	mm2	Ag-n*dh*t*2 (2 for double angle)
Ue	1		SNI 1729-2019 Table D3.1
Ae	4678	mm2	An*Ue
Yield Strenth ϕPn	1052.55	kN	0.9*Fy*Ag
	Safe		
Rupture Strenth φPn	1403.4	kN	0.75*Fu*Ae
	Safe		

Check for Compression Member								
Member	Axial Force (kN)	Length (mm)	KL/r	4.71*sqrt(E/Fy)	Fe	Fcr	φPn	Note
1	0.858	1000	30.40	133.2189176	2136.59	238.0515	1002.244	Safe
2	2.547	4784.5	145.43	133.2189176	93.3358	81.85553	344.6281	Safe
3	3.107	4784.5	26.58	133.2189176	2793.84	240.8099	1013.858	Safe

Check if Slender		
λ	23.07692308	
λr	12.72792206	SNI 1279-2019 Table B4.1.a
λ>λr Slender. Local Buckling Stress must be calculates		

If Slender Calculate Local Buckling Stress as in Segui Ex 4.4

B.7 Bolt and Weld Connections

Steel Profile			
Profile WF	A36		
fy	250	MPa	
fu	400	MPa	
Profile End-plate	BJ37		
fy	240		
fu	370	MPa	
End-plate thickness, t	10	mm	
fyp	240	MPa	
fup	370	MPa	
End plate depth, d	310	mm	
End plate depth, b	160	mm	
End-plate amount, m	1		
Bolt			
Type	Group A	A325	
Bolt diameter, db	20	mm	
fyb	240	MPa	
fub	370	MPa	
Bolt type			
Fnv	372	MPa	
Bolt amount (n)	8		
Bolt amount in 1 row (n1)	2		
Bolt diameter with hole, dbh	22	mm	
Ab	380.1327	mm2	

Weld Connection			
E70XX			Segui Page 511: Example 8.8
F_{EXX}	70	ksi	
	482.6330105	Mpa	
b	300	mm	
d	132	mm	
2b	600	mm	
2d	264	mm	
A	864	mm	A = 2b + 2d
Sx	45408	mm2	Sx = bd + d^2/3
ft	737.7554616	N/mm	ft = Mu/Sx
fv	22.56944444	N/mm	fv = Vu/A
fr	738.1006035	N/mm	fr = ftotal = sqrt(fv^2+ft^2)
	0.841771875	mm	
Fnw	289.5798063	N/mm2	
ϕRn	243.7601365	N/mm	ϕRn = 0.75*0707*D/16*Fnw
D	3.027979119		
w	5	mm	
Use w = 5 mm for weld connection			

g	100		
s	63.24555	mm	1/2*sqrt(bp*g)
pfi	70	mm	
check pfi<s	Not Ok		

Mu	33.5	kNm	
V	19.5	kN	
T	51300	N	
C			
Shear on each bolt, Ruv	2437.5		V/n
ϕf	0.75		
Ab	380.13	mm2	
Shear strength, Vd=ϕf*Vn	106057	N	ϕf*Fnv*Ab
Check Vd>Ruv	Safe		
Bearing Strength, Rd	146520	N	ϕf*2.4*dbh*tp*fu
Check Rd>Ruv	Safe		
Tension Strength, Rnt	79115.12	N	ϕf*0.75*fu*Ab
Check Rnt>Ruv	Safe		
µ	0.3		coefficient of static friction for class A
Du	1.13		ratio of mean actual bolt pretension to minimum pretension
hf	1		1 filler=1.0, 2 fillers=0.85
Tb	91		Table J3.1M
ns	1		number of shear plane
Slip critical, Rns	246792	N	φ*µ*Du*hf*Tb*ns*nb (Eq. J3.4)
Check Rns>V	Safe		
ΣT	410400		
neutral axis, a	10.6875	mm	ΣT/(fy*b)
d1	74.31		
d2	144.31	mm	
d3	214.31	mm	
d4			
fMn	2193075	Nmm	fy*a^2*b/2
Td1	7624206	Nmm	
Td2	14806206	Nmm	
Td3	21988206	Nmm	
Td4	0	Nmm	
Mn	41950524	Nmm	
	41.95052	kNm	
ϕMn	37.75547	kNm	
Check ϕMn>Mu	Safe		

30.849

B.8 Anchor Design

Base Plate			BJ37
dp	350	mm	
bp	200	mm	
Ap	70000	mm2	
tp	10	mm	
fy	240	Mpa	
fu	370	MPa	
Stiffness Plate			
ls	150	mm	
ts	8	mm	

Type	Steel Headed Stud			
Dmin	25	mm	>2.5*t(member)	SNI 1729:2015 Section I8.1
Actual D	25.5	mm		
Lmin	100	mm	>4*D	SNI 1729:2015 Section I8.2
Actual L	204	mm	h/d>8 =>h=8*D	29:2015 Section I8.3 when subjected to shear and

Load			
Rz	36.85	kN	Reaction Z-direction
Rx	53.25	kN	Reaction X-direction

Shear Strength			
Asa	490.8738521	mm2	
fc'	30	Mpa	
Ec	25742.9602	Mpa	4700*sqrt(fc')
Rg	1		
Rp	1		
Fu	448	Mpa	Minimum fu (65 ksi)
0.5*Asa*sqrt(fc'*Ec)	215689.8821	N	
Rg*Rp*Asa*Fu	219911.4858	N	
Qnv	215.6898821	kN	SNI 1729:2015 Eq I8.1
φ	0.65		
φQnv	140.1984234	kN	φQnv>Rx Safe

Failure due to Compression on Concrete			
fc'	30		
Ac	105000	mm2	
Pc	2677.5	kN	SNI 2847:2019 Table 17.3.1.1
φ	0.65		
φPc	1740.375	kN	φPc>Rz Safe

Failure due to Shear on Concrete			
ha = 1.5ca1	150	mm	SNI 2847:2019 Sec 17.5.2.4
ca1	100	mm	
ca2	45	mm	
maximum s	300	mm	SNI 2847:2019 Sec 17.2.1.1
take s	200	mm	
hef	204	mm	SNI 2847:2019 Fig R2.2
Concrete spalling			
Asa	490.8738521		
Fu	448	Mpa	
Vsa	219911.4858	N	
φ	0.65		SNI 2847:2019 Sec 17.3.3
φVsa	142.9424657	kN	

Concrete pryout			
kcp	2		SNI 2847:2019 Sec 17.5.3.1
Ψec,N	1		SNI 2847:2019 Sec 17.4.2.4
Ψed,N	0.798039216		SNI 2847:2019 Sec 17.4.2.5
Ψc,N	1.25		SNI 2847:2019 Sec 17.4.2.6
Ψcp,N	1		SNI 2847:2019 Sec 17.4.2.7 (Cast in type)
Anc	333906	mm2	SNI 2847:2019 Fig R17.4.2.1b
Anco	395352	mm2	SNI 2847:2019 Fig R17.4.2.1a
kc	10		
λ	1	normal	SNI 2847:2019 Sec 17.2.6 & 19.2.4
fc'	30	Mpa	
Nb	159590.0749	N	SNI 2847:2019 Eq. 17.4.2.2
Ncpg	134456.0682	N	Ncpg=Ncbg SNI 2847:2019 Sec 17.5.3.1b
Vcpg	268912.1365	N	
ϕ	0.75		SNI 2847:2019 Sec 17.3.3 Cond. A
ϕVcpg	201.6841024	kN	

Concrete breakout			
Ψec,V	1		SNI 2847:2019 Sec. 17.5.2.5
Ψed,V	1		SNI 2847:2019 Sec. 17.5.2.6
Ψc,V	1.4		SNI 2847:2019 Sec. 17.5.2.7
Ψh,V	1		SNI 2847:2019 Sec. 17.5.2.8
Avc	75000	mm2	Case 3 Fig R17.5.2.1.b
Avco	45000	mm2	
L	204	mm	anchor length
D	25.5	mm	anchor diameter
fc'	30	Mpa	
ca1	100	mm	
λ	1	normal	SNI 2847:2019 Sec 17.2.6 & 19.2.4
Vb1	25153.58929		SNI 2847:2019 Eq. 17.5.2.2a
Vb2	20265.73463		SNI 2847:2019 Eq. 17.5.2.2b
Take Vb	20265.73463		
Vcb	47.28671413	kN	SNI 2847:2019 Eq 17.5.2.1.b
ϕ	0.75		SNI 2847:2019 Sec 17.3.3 Cond. A
ϕVcb	35.4650356	kN	
Recap Shear Strength			
φVsa	142.9424657	kN	
ϕVcpg	201.6841024	kN	
ϕVcb	35.4650356	kN	
Smallest ϕV	35.4650356	kN	
n anchor	1.501478826		
n use	2	1 side	
	4	2 sides	

B.9 Beam B1

Material and Cross Section Properties					
Beam Length, L			Input	mm	8000
Beam Width, b			Input	mm	350
Beam Height, h			Input	mm	600
Support Length	21.5.3.1	18.6.4.1	2 * h	mm	1200
Longitudinal Reinforcement Diameter, d_b			Input	mm	25
Additional Reinforcement Diameter, d_{bt}			Input	mm	13
Stirrups Diameter, d_s			Input	mm	10
Concrete Cover, c_c			Input	mm	40
Effective Beam Height, d			$h - c_c - d_s - d_b/2$	mm	537.5
Concrete Compressive Strength, f_c'			Input	MPa	30
Longitudinal Reinf. Yield Strength, f_y			Input	MPa	420
Stirrups Yield Strength, f_{yv}			Input	MPa	420
β_1	10.2.7.3	Tabel 22.2.2.4.3	0.65 <= 0.85 - 0.05 * (fc' - 28) / 7 <= 0.85		0.8357
Column Length, c_1			Input (Beam width perpendicular side)	mm	800
Column Width, c_2			Input (Beam width parallel side)	mm	800
L_n			$L - c_1$	mm	7200
λ			Assume not using lightweight concrete		1
Internal Forces					
$M_{u,support}$ (-)			Input	kN-m	-563.58
$M_{u,support}$ (+)			Input	kN-m	365.2
$M_{u,field}$ (-)			Input	kN-m	-170.32
$M_{u,field}$ (+)			Input	kN-m	116.11
Pu			Input	kN	558.39
Forces and Geometry Requirements					
Axial Force Requirement	21.5.1.1	Not advised. See R18.6.1 and 18.6.4.7	Pu <= 0.1 A_g f_c' ?		OK
Effective Height Requirement	21.5.1.2	18.6.2.1	L_n >= 4d ?		OK
Width Requirement 1	21.5.1.3	18.6.2.1	b >= min(0.3h, 250 mm) ?		OK
Width Requirement 2	21.5.1.4	18.6.2.1	b <= c_2 + 2 * min (c_2, 0.75 c_1) ?		OK

Flexural Reinforcement					
Negative Support					
Number of Negative Support Reinforcement, n			Input		7
d_b				mm	25
Net Distance Between Reinforcements			$(b - 2 c_c - 2 d_s - n * d_b) / (n - 1)$	mm	12.500
Net Distance Check	7.6.1	25.2.1	Jarak Bersih >= d_b dan 25 mm?		NO
Number of Layers					2
As use			$n * \pi/4 * d_b^2$	mm^2	3436.117
$As_{min,1}$	10.5.1	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	613.335
$As_{min,2}$	10.5.1, 21.5.2.1	9.6.1.2	$1.4 / (4 * f_y) * b * d$	mm^2	627.083
As min Check			As use >= As min ?		OK
ρ			As / (b * d)		1.83%
$\rho_{max,1}$	B.10.3	Tidak ada	$0.75\ \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{max,2}$	21.5.2.1	18.6.3.1	2.5%		2.50%
As max Check			$\rho <= \rho$ max ?		OK
a	10.2.7.1	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	161.700
M_n	10.2.7.1	22.2.2.4.1	As * fy * (d - a/2)	kN-m	659.023
c	10.2.7.1	22.2.2.4.1	$a / \beta 1$	mm	193.487
ε_s	10.2.2, 10.2.3	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.005
ϕ	S9.3.2	Tabel 21.2.2	$0.65 <= 0.65 + (\varepsilon s - 0.002) / 0.003 * 0.25 <= 0.9$		0.900
ϕM_n			ϕ * Mn	kN-m	593.121
$M_{u,support}$ (-)				kN-m	563.580
Capacity Check			$\phi M_n > M_{u\ ?}$		OK
As Req			Mu / [fy * (d - a/2)]	mm^2	2938.479
Positive Support					
n			Input		5
d_b				mm	25
Net Distance Between Reinforcements			$(b - 2 c_c - 2 d_s - n * d_b) / (n - 1)$	mm	31.250
Net Distance Check	7.6.1	25.2.1	Jarak Bersih >= d_b dan 25 mm?		YES
Number of Layers					2
As use			$n * \pi/4 * d_b^2$	mm^2	2454.369
$As_{min,1}$	10.5.1	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	613.335
$As_{min,2}$	10.5.1, 21.5.2.1	9.6.1.2	1.4 / (4 * fy) * b * d	mm^2	627.083
$As_{min,4}$	21.5.2.2	18.6.3.2	0.5 * As Negative Support	mm^2	1718.058
As min Check			As use >= As min ?		OK
ρ			As / (b * d)		1.30%
$\rho_{max,1}$	B.10.3		$0.75\ \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{max,2}$	21.5.2.1	18.6.3.1	2.5%		2.50%
As max Check			$\rho <= \rho$ max ?		OK
a	10.2.7.1	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	115.500
M_n	10.2.7.1	22.2.2.4.1	As * fy * (d - a/2)	kN-m	494.543
c	10.2.7.1	22.2.2.4.1	$a / \beta 1$	mm	138.205
ε_s	10.2.2, 10.2.3	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.009
ϕ	S9.3.2	Tabel 21.2.2	$0.65 <= 0.65 + (\varepsilon s - 0.002) / 0.003 * 0.25 <= 0.9$		0.900
ϕM_n			ϕ * Mn	kN-m	445.089
M_u				kN-m	365.200
Cek $\phi M_n > M_u$			$\phi M_n > M_{u\ ?}$		OK
As Req			Mu / [fy * (d - a/2)]	mm^2	1812.451

Negative Field					
n			Input		3
d_b				mm	25
Net Distance Between Reinforcements			$(b - 2 c_c - 2 d_s - n * d_b) / (n - 1)$	mm	87.500
Net Distance Check	7.6.1	25.2.1	Net Distance >= d_b and 25 mm?		YES
Number of Layers					2
As use			$n * \pi/4 * d_b^2$	mm^2	1472.622
$As_{min,1}$	10.5.1	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	613.335
$As_{min,2}$	10.5.1, 21.5.2.1	9.6.1.2	1.4 / (4 * fy) * b * d	mm^2	627.083
$As_{min,4}$	21.5.2.2	18.6.3.2	0.25 * As Negative Support	mm^2	859.029
As min Check			As use >= As min ?		OK
ρ			As / (b * d)		0.78%
$\rho_{max,1}$	B.10.3		$0.75 \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{max,2}$	21.5.2.1	18.6.3.1	2.5%		2.50%
As max Check			ρ <= ρ max ?		OK
a	10.2.7.1	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	69.300
M_n	10.2.7.1	22.2.2.4.1	As * fy * (d - a/2)	kN-m	311.013
c	10.2.7.1	22.2.2.4.1	a / β1	mm	82.923
ε_s	10.2.2, 10.2.3	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.016
ϕ	S9.3.2	Tabel 21.2.2	0.65 <= 0.65 + (εs - 0.002) / 0.003 * 0.25 <= 0.9		0.900
ϕM_n			ϕ * Mn	kN-m	279.912
M_u				kN-m	170.320
Cek $\phi M_n > M_u$			$\phi M_n > M_u$?		OK
As Req			Mu / [fy * (d - a/2)]	mm^2	806.451
Positive Field					
n			Input		3
d_b				mm	25
Net Distance Between Reinforcements			$(b - 2 c_c - 2 d_s - n * d_b) / (n - 1)$	mm	87.500
Net Distance Check	7.6.1	25.2.1	Net Distance >= d_b dan 25 mm?		YES
Number of Layers					2
As use			$n * \pi/4 * d_b^2$	mm^2	1472.622
$As_{min,1}$	10.5.1	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	613.335
$As_{min,2}$	10.5.1, 21.5.2.1	9.6.1.2	1.4 / (4 * fy) * b * d	mm^2	627.083
$As_{min,4}$	21.5.2.2	18.6.3.2	0.25 * As Negative Support	mm^2	859.029
As min Check			As use >= As min ?		OK
ρ			As / (b * d)		0.78%
$\rho_{max,1}$	B.10.3		$0.75 \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{max,2}$	21.5.2.1	18.6.3.1	2.5%		2.50%
As max Check			ρ <= ρ max ?		OK
a	10.2.7.1	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	69.300
M_n	10.2.7.1	22.2.2.4.1	As * fy * (d - a/2)	kN-m	311.013
c	10.2.7.1	22.2.2.4.1	a / β1	mm	82.923
ε_s	10.2.2, 10.2.3	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.016
ϕ	S9.3.2	Tabel 21.2.2	0.65 <= 0.65 + (εs - 0.002) / 0.003 * 0.25 <= 0.9		0.900
ϕM_n			ϕ * Mn	kN-m	279.912
M_u				kN-m	116.110
Cek $\phi M_n > M_u$			$\phi M_n > M_u$?		OK
As Req			Mu / [fy * (d - a/2)]	mm^2	549.771

Internal Forces					
$V_{u,support}$			Input	kN	320.72
$V_{u,field}$			Input	kN	309
Support					
Design Force					
Vg,Support	S21.5.4	R18.6.5	Input [Combination 1.2 D + L]	kN	245
As+ Support			From Flexible Design Sheet	mm^2	2454.369
As- Support			From Flexible Design Sheet	mm^2	3436.117
a_{pr}^{+}			1.25 a (Positive Support)	mm	144.375
a_{pr}^{-}			1.25 a (Negative Support)	mm	202.125
M_{pr}^{+}	S21.5.4	R18.6.5	A_s^{+} * (1.25 f_y) * (d - a_{pr}^{+}/2)	N mm	599575783
M_{pr}^{-}	S21.5.4	R18.6.5	A_s^{-} * (1.25 f_y) * (d - a_{pr}^{-}/2)	N mm	787316833
V_{sway} or V_{pr}	21.5.4.1	18.6.5.1	(M_{pr}^{+} + M_{pr}^{-}) / L_n	N	192624
V_e	21.5.4.1	18.6.5.1	$V_g + V_{pr}$	N	437624
Beam Shear Resistance					
V_{pr}				N	192624
1/2 V_e				N	218812
Pu				N	558390
Ag fc' / 20				N	315000
V_c Considered?	21.5.4.2	18.6.5.2	V_c = 0 **if** V_{pr} >= 1/2 V_e **and** P_u < A_g f_c' / 20		Yes
V_c				N	175169
Shear Reinforcement					
Number of Legs			Input		4
Av			n *π/4 *d_s^2	mm^2	314.159
Spacing			Input	mm	100
Max Spacing 1	21.5.3.2	18.6.4.4	d / 4	mm	134.38
Max Spacing 2	21.5.3.2	18.6.4.4	6 d_b	mm	150.00
Max Spacing 3	21.5.3.2	18.6.4.4	150 mm	mm	150.00
Spacing Check					OK
V_s	11.4.7.2	22.5.10.5.3	A_v * f_{yv} * d / s	N	709215
V_s Limit	11.4.7.9	22.5.1.2	0.66 * (f_c')$^{0.5}$ * b * d	N	680066
ϕ	9.3.2.3	12.5.3.2, 21.2.4			0.75
V_n			$V_c + V_s$	N	855235
V_u				N	437624
$\phi V_n / V_u$					1.466
Capacity Check			$\phi V_n / V_u$ >= 1 ?		OK
Field					
Shear Reinforcement					
Number of Legs			Input		3
Av			n *π/4 *d_s^2	mm^2	235.619
Spacing			Input	mm	100
Max Spacing	21.5.3.4	18.6.4.6	d / 2	mm	268.75
Spacing Check					OK
V_s	11.4.7.2	22.5.10.5.3	A_v * f_{yv} * d / s	N	531911
V_s Limit	11.4.7.9	22.5.1.2	0.66 * (f_c')$^{0.5}$ * b * d	N	680066
V_c	11.2.1.1	22.5.5.1	0.17 * (f_c')$^{0.5}$ * b * d	N	175169
ϕ	9.3.2.3	12.5.3.2, 21.2.4			0.75
V_n			$V_c + V_s$		707079
V_u				N	309000
$\phi V_n / V_u$					1.716
Capacity Check			$\phi V_n / V_u$ >= 1 ?		OK

Section Geometry Parameter for Torsion Calculations					
A_{cp}			b * h	mm^2	210000
P_{cp}			2 * (b + h)	mm	1900
x_o			b - $2c_c$ - d_s	mm	260
y_o			h - $2c_c$ - d_s	mm	510
A_{oh}		R22.7.6.1.1	x_o * y_o	mm^2	132600
A_o	11.5.3.6	22.7.6.1.1	0.85 A_{oh}	mm^2	112710
P_h		22.7.6.1	2 * (x_o + y_o)	mm	1540
Internal Forces					
T_u			Input	kN m	26.49
Torsion Reinforcement Requirements Check					
T_{cr}			0.33 * $(f_c')^{0.5}$ * $A_{cp}{}^2$ / P_{cp}	N mm	41952665
ϕ	9.3.2.3	Tabel 21.2.1			0.75
ϕ T_{cr} / 4				N mm	7866125
Needs Torsion Reinforcement?	11.5.1	Tabel 22.7.4.1	T_u > ϕ T_{cr} / 4 ?		Yes
The calculations below must be checked					
Section Dimensions Adequacy Check					
Torsion Type			Certain Static = Equilibrium, Uncertain Static = Compatibility		Compatibility
T_u Use	11.5.2.2	22.7.3.2, 22.7.5	ϕ T_{cr} or T_u	N mm	26490000
V_u			From Shear Design Sheet	N	437624
V_c	11.2.1.1	22.5.5.1	0.17 * $(f_c')^{0.5}$ * b * d	N	175169
Ultimate Shear Stress + Torsion	11.5.3.1	22.7.7.1	{ [V_u / b*d]^2 + [T_u P_h / (1.7 $A_{oh}{}^2$)]^2 }$^{0.5}$	MPa	2.697
Concrete Stress Capacity	11.5.3.1	22.7.7.1	ϕ * { [V_c / (b * d)] + 0.66 * $(f_c')^{0.5}$ }	MPa	3.410
Section Dimensions Check	11.5.3.1	22.7.7.1	Left Section <= Right Section?		OK
Other General Parameters					
f_y / f_{yt}			Torsion Reinforcement Steel Yield Strength = Flexible and Shear Reinforcement Steel Yield Strengths		1
θ	11.5.3.6	22.7.6.1.2	θ is taken for non-prestressed structure component beam	°	45
Torsion Stirrups Calculations					
n Support leg			From Shear Design Sheet		4
n Field leg			From Shear Design Sheet		3
s Support			From Shear Design Sheet	mm	100
s Field			From Shear Design Sheet	mm	100
s max 1	11.5.6.1	9.7.6.3.3	P_h / 8	mm	193
s max 2	11.5.6.1	9.7.6.3.3	300 mm	mm	300
Support Spacing Check			s Support >= s max ?		OK
Field Spacing Check			s Field >= s max ?		OK
Av+t / s Support Use			n *π/4 *$d_s{}^2$ / s	mm^2/mm	3.142
Av+t / s Support Use			n *π/4 *$d_s{}^2$ / s	mm^2/mm	2.356
A_t / s	11.5.3.6	22.7.6.1	T_u / (2 * ϕ * A_o * f_{yv})	mm^2/mm	0.373
Av / s Support Req			(Vu Support / φ - Vc) / (fyv * d)	mm^2/mm	1.809
Av / s Field Req			(Vu Field / φ - Vc) / (fyv * d)	mm^2/mm	1.049
Av+t / s Support Req	11.5.5.2	R9.5.4.3	2 * A_t / s + A_v / s		2.555
Av+t / s Field Req	11.5.5.2	R9.5.4.3	2 * A_t / s + A_v / s		1.795
A_{v+t} / s min 1	11.5.5.2	9.6.4.2	0.062 * $(f_c')^{0.5}$ * b / f_{yv}		0.283
A_{v+t} / s min 2	11.5.5.2	9.6.4.2	0.35 * b / f_{yv}		0.292
Support Shear + Torsion Check			Av+t / s Use >= Av+t / s Req and min ?		OK
Field Shear + Torsion Check			Av+t / s Use >= Av+t / s Req and min ?		OK
Torsion Longitudinal Calculations					
db or dbt				mm	13
d_b, min	11.5.6.2	9.7.5.2	0.042 s	mm	4.2
Cek d_b			d_b >= d_b min ?		OK
As Req Top Support			From Shear Design Sheet	mm^2	2938.479
As Req Bottom Support			From Shear Design Sheet	mm^2	1812.451
As Req Top Field			From Shear Design Sheet	mm^2	806.451
As Req Bottom Field			From Shear Design Sheet	mm^2	549.771
A_l	11.5.3.7	22.7.6.1	A_t / s * P_h	mm^2	574.513
A_l min	11.5.5.3	9.6.4.3	0.42 * $(f_c')^{0.5}$ * A_{cp} / f_y - (A_t/s) * P_h	mm^2	575.705
As + Al Req Support				mm^2	5326.635
As + Al Req Field				mm^2	1931.926
Top Support n			From Flexible Design Sheet		7
Middle Support n			Input (Multiples of 2 Advised)		4
Bottom Support n			From Flexible Design Sheet		5
Vertical Support n			2 + n Tengah / 2		4
Top Field n			From Flexible Design Sheet		3
Middle Field n			Input (Multiples of 2 Advised)		4
Bottom Field n			From Flexible Design Sheet		3
Vertical Field n			2 + n Middle / 2		4
Horizontal Support Spacing			(b - $2c_c$ - $2d_s$ - d_b) / [min(n atas, n bawah) - 1]	mm	56
Vertical Support Spacing			(h - 2cc - 2ds - db) / (n Vertical - 1)	mm	158
Horizontal Field Spacing			(b - $2c_c$ - $2d_s$ - d_b) / [min(n atas, n bawah) - 1]	mm	113
Vertical Field Spacing			(h - 2cc - 2ds - db) / (n Vertical - 1)	mm	158
Field Longitudinal Reinforcement Spacing Check	11.5.6.2		Spacing >= 300 mm ?		OK
Support Longitudinal Reinforcement Spacing Check	11.5.6.2		Spacing >= 300 mm ?		OK
As + Al Use Support				mm^2	6421.415
As + Al Use Field				mm^2	3476.172
Support Flexibility + Torsion Check			As + Al Use >= As + Al Req ?		OK
Field Flexibility + Torsion Check			As + Al Use >= As + Al Req ?		OK

Conclusion	
Forces and Geometry Requirements	OK
Flexural Capacity	OK
Shear Capacity	OK
Torsion Capacity	OK
Longitudinal Reinforcement	
Top Support Longitudinal	7 D25
Middle Support Longitudinal	4 D13
Bottom Support Longitudinal	5 D25
Top Field Longitudinal	3 D25
Middle Field Longitudinal	4 D13
Bottom Field Longitudinal	3 D25
Stirrups	
Support Stirrups	4D10-100
Field Stirrups	3D10-100

B.10 Beam B2

Parameter	SNI 2847:2019	Equation	Unit	Value
Beam Length, L		Input	mm	8000
Beam Width, b		Input	mm	600
Beam Height, h		Input	mm	650
Support Length	18.6.4.1	2 * h	mm	1300
Longitudinal Reinforcement Diameter, d_b		Input	mm	25
Additional Reinforcement Diameter, d_{bt}		Input	mm	13
Stirrups Diameter, d_s		Input	mm	13
Concrete Cover, c_c		Input	mm	40
Effective Beam Height, d		$h - c_c - d_s - d_b/2$	mm	584.5
Concrete Compressive Strength, f_c'		Input	MPa	30
Longitudinal Reinf. Yield Strength, f_y		Input	MPa	420
Stirrups Yield Strength, f_{yv}		Input	MPa	420
β_1	Table 22.2.2.4.3	0.65 <= 0.85 - 0.05 * (fc' - 28) / 7 <= 0.85		0.8357
Column Length, c_1		Input (Beam width perpendicular side)	mm	1000
Column Width, c_2		Input (Beam width parallel side)	mm	1000
L_n		$L - c_1$	mm	7000
λ		Assume not using lightweight concrete		1

Parameter	Unit	Value
Ultimate Moment $M_{u,support}$ (-)	kN-m	-461.05
Ultimate Moment $M_{u,support}$ (+)	kN-m	332.28
Ultimate Moment $M_{u,field}$ (-)	kN-m	-183.63
Ultimate Moment $M_{u,field}$ (+)	kN-m	88.56
Ultimate Axial Force, Pu	kN	238.32

Parameter	SNI 2847:2019	Equation	Value	Note
Axial Force Requirement	Not advised. See R18.6.1 and 18.6.4.7	Pu <= 0.1 A_g f_c' ?	Pu=238.32 kN < 0.1Agfc=1170 kN	OK
Effective Height Requirement	18.6.2.1	L_n >= 4d ?	Ln = 7000 mm > 4d = 2338 mm	OK
Width Requirement 1	18.6.2.1	b >= min(0.3h, 250 mm) ?	b=600 mm > 0.3h=195 mm, 250 mm	OK
Width Requirement 2	18.6.2.1	b <= c_2 + 2 * min (c_2, 0.75 c_1) ?	b=600 mm < 2500 mm	OK

Parameter	SNI 2847:2019	Equation	Unit	Value
Number of Negative Support Reinforcement, n		Input		5
d_b			mm	25
Net Distance Between Reinforcements		$(b - 2\ c_c - 2\ d_s - n * d_b) / (n - 1)$	mm	92.250
Net Distance Check	25.2.1	Jarak Bersih >= d_b dan 25 mm?		IYA
Number of Layers				1
As use		$n * \pi/4 * d_b^2$	mm^2	2454.369
$As_{min,1}$	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	1143.371
$As_{min,2}$	9.6.1.2	$1.4 / (4 * f_y) * b * d$	mm^2	1169.000
As min Check		As use >= As min ?		OK
ρ		As / (b * d)		0.70%
$\rho_{max,1}$	Tidak ada	$0.75\ \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{max,2}$	18.6.3.1	2.5%		2.50%
As max Check		ρ <= ρ max ?		OK
a	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	67.375
M_n	22.2.2.4.1	As * fy * (d - a/2)	kN-m	567.797
c	22.2.2.4.1	a / β1	mm	80.619
ε_s	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.019
ϕ	Tabel 21.2.2	0.65 <= 0.65 + (εs - 0.002) / 0.003 * 0.25 <= 0.9		0.900
ϕM_n		ϕ * Mn	kN-m	511.017
$M_{u,support}$ (-)			kN-m	461.050
Capacity Check		$\phi M_n > M_u$?		OK
As Req		Mu / [fy * (d - a/2)]	mm^2	1992.943
Parameter	**SNI 2847:2019**	**Equation**	**Unit**	**Value**
n		Input		5
d_b			mm	25
Net Distance Between Reinforcements		$(b - 2\ c_c - 2\ d_s - n * d_b) / (n - 1)$	mm	92.250
Net Distance Check	25.2.1	Jarak Bersih >= d_b dan 25 mm?		IYA
Number of Layers				1
As use		$n * \pi/4 * d_b^2$	mm^2	2454.369
$As_{min,1}$	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	1143.371
$As_{min,2}$	9.6.1.2	1.4 / (4 * fy) * b * d	mm^2	1169.000
$As_{min,4}$	18.6.3.2	0.5 * As Negative Support	mm^2	1227.185
As min Check		As use >= As min ?		OK
ρ		As / (b * d)		0.70%
$\rho_{max,1}$		$0.75\ \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{max,2}$	18.6.3.1	2.5%		2.50%
As max Check		ρ <= ρ max ?		OK
a	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	67.375
M_n	22.2.2.4.1	As * fy * (d - a/2)	kN-m	567.797
c	22.2.2.4.1	a / β1	mm	80.619
ε_s	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.019
ϕ	Tabel 21.2.2	0.65 <= 0.65 + (εs - 0.002) / 0.003 * 0.25 <= 0.9		0.900
ϕM_n		ϕ * Mn	kN-m	511.017
M_u			kN-m	332.280
Cek $\phi M_n > M_u$		$\phi M_n > M_u$?		OK
As Req		Mu / [fy * (d - a/2)]	mm^2	1436.320
Parameter	**SNI 2847:2019**	**Equation**	**Unit**	**Value**
n		Input		3
d_b			mm	25
Net Distance Between Reinforcements		$(b - 2\ c_c - 2\ d_s - n * d_b) / (n - 1)$	mm	209.500
Net Distance Check	25.2.1	Net Distance >= d_b and 25 mm?		IYA
Number of Layers				1
As use		$n * \pi/4 * d_b^2$	mm^2	1472.622
$As_{min,1}$	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	1143.371
$As_{min,2}$	9.6.1.2	1.4 / (4 * fy) * b * d	mm^2	1169.000
$As_{min,4}$	18.6.3.2	0.25 * As Negative Support	mm^2	613.592
As min Check		As use >= As min ?		OK
ρ		As / (b * d)		0.42%
$\rho_{max,1}$		$0.75\ \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{max,2}$	18.6.3.1	2.5%		2.50%
As max Check		ρ <= ρ max ?		OK
a	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	40.425
M_n	22.2.2.4.1	As * fy * (d - a/2)	kN-m	349.012
c	22.2.2.4.1	a / β1	mm	48.372
ε_s	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.033
ϕ	Tabel 21.2.2	0.65 <= 0.65 + (εs - 0.002) / 0.003 * 0.25 <= 0.9		0.900
ϕM_n		ϕ * Mn	kN-m	314.111
M_u			kN-m	183.630
Cek $\phi M_n > M_u$		$\phi M_n > M_u$?		OK
As Req		Mu / [fy * (d - a/2)]	mm^2	774.808
Parameter	**SNI 2847:2019**	**Equation**	**Unit**	**Value**
n		Input		3
d_b			mm	25
Net Distance Between Reinforcements		$(b - 2\ c_c - 2\ d_s - n * d_b) / (n - 1)$	mm	209.500
Net Distance Check	25.2.1	Net Distance >= d_b dan 25 mm?		IYA
Number of Layers				1
As use		$n * \pi/4 * d_b^2$	mm^2	1472.622
$As_{min,1}$	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	1143.371
$As_{min,2}$	9.6.1.2	1.4 / (4 * fy) * b * d	mm^2	1169.000
$As_{min,4}$	18.6.3.2	0.25 * As Negative Support	mm^2	613.592
As min Check		As use >= As min ?		OK
ρ		As / (b * d)		0.42%
$\rho_{max,1}$		$0.75\ \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{max,2}$	18.6.3.1	2.5%		2.50%
As max Check		ρ <= ρ max ?		OK
a	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	40.425
M_n	22.2.2.4.1	As * fy * (d - a/2)	kN-m	349.012
c	22.2.2.4.1	a / β1	mm	48.372
ε_s	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.033
ϕ	Tabel 21.2.2	0.65 <= 0.65 + (εs - 0.002) / 0.003 * 0.25 <= 0.9		0.900
ϕM_n		ϕ * Mn	kN-m	314.111
M_u			kN-m	88.560
Cek $\phi M_n > M_u$		$\phi M_n > M_u$?		OK
As Req		Mu / [fy * (d - a/2)]	mm^2	373.670

Internal Forces

Parameter	Unit	Value
$V_{u,support}$	kN	212.45
$V_{u,field}$	kN	187.68

Support

Parameter	SNI 2847:2019	Equation	Unit	Value
Vg,Support	R18.6.5	Input [Combination 1.2 D + L]	kN	171.44
As+ Support		Steel Area at Positive Support	mm^2	2454.369
As- Support		Steel Area at Negative Support	mm^2	2454.369
a_{pr}^+		1.25 a (Positive Support)	mm	84.219
a_{pr}^-		1.25 a (Negative Support)	mm	84.219
M_{pr}^+	R18.6.5	A_s^+ * (1.25 f_y) * (d - a_{pr}^+/2)	N mm	698894237
M_{pr}^-	R18.6.5	A_s^- * (1.25 f_y) * (d - a_{pr}^-/2)	N mm	698894237
V_{sway} or V_{pr}	18.6.5.1	(M_{pr}^+ + M_{pr}^-) / L_n	N	199684
V_e	18.6.5.1	V_g + V_{pr}	N	371124
V_{pr}			N	199684
1/2 V_e			N	185562
Pu			N	238320
Ag fc' / 20			N	585000
V_c Considered?	18.6.5.2	V_c = 0 **if** V_{pr} >= 1/2 V_e **and** P_u < A_g f_c' / 20		Tidak
V_c			N	0
Number of Legs		Input		3
Av		n *π/4 *d_s^2	mm^2	398.197
Spacing		Input	mm	100
Max Spacing 1	18.6.4.4	d / 4	mm	146.13
Max Spacing 2	18.6.4.4	6 d_b	mm	150.00
Max Spacing 3	18.6.4.4	150 mm	mm	150.00
Spacing Check				OK
V_s	22.5.10.5.3	A_v * f_{yv} * d / s	N	977533
V_s Limit	22.5.1.2	0.66 * (f_c')$^{0.5}$ * b * d	N	1267770
ϕ	12.5.3.2, 21.2.4			0.75
V_n		V_c + V_s	N	977533
V_u			N	371124
ϕV_n / V_u				1.975
Capacity Check		ϕV_n / V_u >= 1 ?		OK

Field

Parameter	SNI 2847:2019	Equation	Unit	Value
Number of Legs		Input		3
Av		n *π/4 *d_s^2	mm^2	398.197
Spacing		Input	mm	100
Max Spacing	18.6.4.6	d / 2	mm	292.25
Spacing Check				OK
V_s	22.5.10.5.3	A_v * f_{yv} * d / s	N	977533
V_s Limit	22.5.1.2	0.66 * (f_c')$^{0.5}$ * b * d	N	1267770
V_c	22.5.5.1	0.17 * (f_c')$^{0.5}$ * b * d	N	326547
ϕ	12.5.3.2, 21.2.4			0.75
V_n		V_c + V_s		1304080
V_u			N	187680
ϕV_n / V_u				5.211
Capacity Check		ϕV_n / V_u >= 1 ?		OK

Section Geometry Parameter for Torsion Calculations

Parameter	SNI 2847:2019	Equation	Unit	Value
A_{cp}		b * h	mm^2	390000
P_{cp}		2 * (b + h)	mm	2500
x_o		$b - 2c_c - d_s$	mm	507
y_o		$h - 2c_c - d_s$	mm	557
A_{oh}	R22.7.6.1.1	$x_o * y_o$	mm^2	282399
A_o	22.7.6.1.1	$0.85\ A_{oh}$	mm^2	240039
P_h	22.7.6.1	$2 * (x_o + y_o)$	mm	2128
Internal Torsion Force, T_u		Input	kN m	74.85
Cracking Torsion, T_{cr}		$0.33 * (f_c')^{0.5} * A_{cp}{}^2 / P_{cp}$	N mm	109967353
ϕ	Tabel 21.2.1			0.75
$\phi\ T_{cr} / 4$			N mm	20618879
Needs Torsion Reinforcement?	Tabel 22.7.4.1	$T_u > \phi\ T_{cr} / 4$?		Yes
The calculations below must be checked				

Section Dimensions Adequacy Check

Parameter	SNI 2847:2019	Equation	Unit	Value
Torsion Type		Certain Static = Equilibrium, Uncertain Static = Compatibility		Compatibility
T_u Use	22.7.3.2, 22.7.5	$\phi\ T_{cr}$ or T_u	N mm	74850000
V_u		From Shear Design Sheet	N	371124
V_c	22.5.5.1	$0.17 * (f_c')^{0.5} * b * d$	N	326547
Ultimate Shear Stress + Torsion	22.7.7.1	$\{ [V_u / b*d]^2 + [T_u P_h / (1.7 A_{oh}{}^2)]^2 \}^{0.5}$	MPa	1.581
Concrete Stress Capacity	22.7.7.1	$\phi * \{ [V_c / (b * d)] + 0.66 * (f_c')^{0.5} \}$	MPa	3.410
Section Dimensions Check	22.7.7.1	Left Section <= Right Section?		OK
f_y / f_{yt}		Torsion Reinforcement Steel Yield Strength = Flexible and Shear Reinforcement Steel Yield Strengths		1
θ	22.7.6.1.2	θ is taken for non-prestressed structure component beam	°	45
n Support leg		From Shear Design		3
n Field leg		From Shear Design		3
s Support		From Shear Design	mm	100
s Field		From Shear Design	mm	100
s max 1	9.7.6.3.3	$P_h / 8$	mm	266
s max 2	9.7.6.3.3	300 mm	mm	300
Support Spacing Check		s Support >= s max ?		OK
Field Spacing Check		s Field >= s max ?		OK
Av+t / s Support Use		$n * \pi/4 * d_s{}^2 / s$	mm^2/mm	3.982
Av+t / s Support Use		$n * \pi/4 * d_s{}^2 / s$	mm^2/mm	3.982
A_t / s	22.7.6.1	$T_u / (2 * \phi * A_o * f_{yv})$	mm^2/mm	0.495
Av / s Support Req		(Vu Support / φ - Vc) / (fyv * d)	mm^2/mm	2.016
Av / s Field Req		(Vu Field / φ - Vc) / (fyv * d)	mm^2/mm	-0.311
Av+t / s Support Req	R9.5.4.3	$2 * A_t / s + A_v / s$		3.006
Av+t / s Field Req	R9.5.4.3	$2 * A_t / s + A_v / s$		0.679
A_{v+t} / s min 1	9.6.4.2	$0.062 * (f_c')^{0.5} * b / f_{yv}$		0.485
A_{v+t} / s min 2	9.6.4.2	$0.35 * b / f_{yv}$		0.500
Support Shear + Torsion Check		Av+t / s Use >= Av+t / s Req and min ?		OK
Field Shear + Torsion Check		Av+t / s Use >= Av+t / s Req and min ?		OK

Torsion Longitudinal Calculations

Parameter	SNI 2847:2019	Equation	Unit	Value
db or dbt			mm	13
d_b, min	9.7.5.2	0.042 s	mm	4.2
Cek d_b		$d_b >= d_b$ min ?		OK
As Req Top Support		From Shear Design	mm^2	1992.943
As Req Bottom Support		From Shear Design	mm^2	1436.320
As Req Top Field		From Shear Design	mm^2	774.808
As Req Top Field		From Shear Design	mm^2	373.670
A_l	22.7.6.1	$A_t / s * P_h$	mm^2	1053.273
A_l min	9.6.4.3	$0.42 * (f_c')^{0.5} * A_{cp} / f_y - (A_t/s) * P_h$	mm^2	1082.845
As + Al Req Support			mm^2	4512.108
As + Al Req Field			mm^2	2231.323
Top Support n		From Flexible Design Sheet		5
Middle Support n		Input (Multiples of 2 Advised)		4
Bottom Support n		From Flexible Design Sheet		5
Vertical Support n		2 + n Tengah / 2		4
Top Field n		From Flexible Design Sheet		3
Middle Field n		Input (Multiples of 2 Advised)		4
Bottom Field n		From Flexible Design Sheet		3
Vertical Field n		2 + n Middle / 2		4
Horizontal Support Spacing		$(b - 2c_c - 2d_s - d_b)$ / [min(n atas, n bawah) - 1]	mm	117
Vertical Support Spacing		(h - 2cc - 2ds - db) / (n Vertical - 1)	mm	173
Horizontal Field Spacing		$(b - 2c_c - 2d_s - d_b)$ / [min(n atas, n bawah) - 1]	mm	235
Vertical Field Spacing		(h - 2cc - 2ds - db) / (n Vertical - 1)	mm	173
Field Longitudinal Reinforcement Spacing Check		Spacing >= 300 mm ?		OK
Support Longitudinal Reinforcement Spacing Check		Spacing >= 300 mm ?		OK
As + Al Use Support			mm^2	5439.668
As + Al Use Field			mm^2	3476.172
Support Flexibility + Torsion Check		As + Al Use >= As + Al Req ?		OK
Field Flexibility + Torsion Check		As + Al Use >= As + Al Req ?		OK

Longitudinal Reinforcement	
Top Support Longitudinal	5 D25
Middle Support Longitudinal	4 D13
Bottom Support Longitudinal	5 D25
Top Field Longitudinal	3 D25
Middle Field Longitudinal	4 D13
Bottom Field Longitudinal	3 D25
Stirrups	
Support Stirrups	3D13-100
Field Stirrups	3D13-100

B.11 Secondary Beam B3

Material and Cross Section Properties					
Beam Length, L			Input	mm	8000
Beam Width, b			Input	mm	350
Beam Height, h			Input	mm	400
Support Length	21.5.3.1	18.6.4.1	2 * h	mm	800
ongitudinal Reinforcement Diameter, d_b			Input	mm	25
Additional Reinforcement Diameter, d_{bt}			Input	mm	13
Stirrups Diameter, d_s			Input	mm	13
Concrete Cover, c_c			Input	mm	40
Effective Beam Height, d			$h - c_c - d_s - d_b/2$	mm	334.5
Concrete Compressive Strength, f_c'			Input	MPa	30
Longitudinal Reinf. Yield Strength, f_y			Input	MPa	420
Stirrups Yield Strength, f_{yv}			Input	MPa	420
β_1	10.2.7.3	Tabel 22.2.2.4.3	0.65 <= 0.85 - 0.05 * (fc' - 28) / 7 <= 0.85		0.8357
Column Length, c_1			Input (Beam width perpendicular side)	mm	350
Column Width, c_2			Input (Beam width parallel side)	mm	350
L_n			$L - c_1$	mm	7650
λ			Assume not using lightweight concrete		1

Internal Forces					
$M_{u,support}$ (-)			Input	kN-m	0
$M_{u,support}$ (+)			Input	kN-m	0
$M_{u,field}$ (-)			Input	kN-m	0
$M_{u,field}$ (+)			Input	kN-m	17.26
Pu			Input	kN	239.07
Forces and Geometry Requirements					
Axial Force Requirement	21.5.1.1	Not advised. See R18.6.1 and 18.6.4.7	Pu <= 0.1 A_g f_c' ?		OK
Effective Height Requirement	21.5.1.2	18.6.2.1	L_n >= 4d ?		OK
Width Requirement 1	21.5.1.3	18.6.2.1	b >= min(0.3h, 250 mm) ?		OK
Width Requirement 2	21.5.1.4	18.6.2.1	b <= c_2 + 2 * min (c_2, 0.75 c_1) ?		OK

Flexural Reinforcement					
Negative Support					
ber of Negative Support Reinforcement, n			Input		2
d_b				mm	25
Net Distance Between Reinforcements			$(b - 2\ c_c - 2\ d_s - n * d_b) / (n - 1)$	mm	194.000
Net Distance Check	7.6.1	25.2.1	Jarak Bersih >= d_b dan 25 mm?		IYA
Number of Layers					1
As use			$n * \pi/4 * d_b^2$	mm^2	981.748
$As_{\ min,1}$	10.5.1	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	381.694
$As_{\ min,2}$	10.5.1, 21.5.2.1	9.6.1.2	$1.4 / (4 * f_y) * b * d$	mm^2	390.250
As min Check			As use >= As min ?		OK
ρ			As / (b * d)		0.84%
$\rho_{\ max,1}$	B.10.3	Tidak ada	$0.75\ \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{\ max,2}$	21.5.2.1	18.6.3.1	2.5%		2.50%
As max Check			ρ <= ρ max ?		OK
a	10.2.7.1	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	46.200
M_n	10.2.7.1	22.2.2.4.1	As * fy * (d - a/2)	kN-m	128.401
c	10.2.7.1	22.2.2.4.1	a / β1	mm	55.282
ε_s	10.2.2, 10.2.3	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.015
ϕ	S9.3.2	Tabel 21.2.2	0.65 <= 0.65 + (εs - 0.002) / 0.003 * 0.25 <= 0.9		0.900
ϕM_n			ϕ * Mn	kN-m	115.561
$M_{u,support}$ (-)				kN-m	0.000
Capacity Check			$\phi M_n > M_{u\ ?}$		OK
As Req			Mu / [fy * (d - a/2)]	mm^2	0.000
Positive Support					
n			Input		2
d_b				mm	25
Net Distance Between Reinforcements			$(b - 2\ c_c - 2\ d_s - n * d_b) / (n - 1)$	mm	194.000
Net Distance Check	7.6.1	25.2.1	Jarak Bersih >= d_b dan 25 mm?		IYA
Number of Layers					1
As use			$n * \pi/4 * d_b^2$	mm^2	981.748
$As_{\ min,1}$	10.5.1	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	381.694
$As_{\ min,2}$	10.5.1, 21.5.2.1	9.6.1.2	1.4 / (4 * fy) * b * d	mm^2	390.250
$As_{\ min,4}$	21.5.2.2	18.6.3.2	0.5 * As Negative Support	mm^2	490.874
As min Check			As use >= As min ?		OK
ρ			As / (b * d)		0.84%
$\rho_{\ max,1}$	B.10.3		$0.75\ \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{\ max,2}$	21.5.2.1	18.6.3.1	2.5%		2.50%
As max Check			ρ <= ρ max ?		OK
a	10.2.7.1	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	46.200
M_n	10.2.7.1	22.2.2.4.1	As * fy * (d - a/2)	kN-m	128.401
c	10.2.7.1	22.2.2.4.1	a / β1	mm	55.282
ε_s	10.2.2, 10.2.3	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.015
ϕ	S9.3.2	Tabel 21.2.2	0.65 <= 0.65 + (εs - 0.002) / 0.003 * 0.25 <= 0.9		0.900
ϕM_n			ϕ * Mn	kN-m	115.561
M_u				kN-m	0.000
Cek $\phi M_n > M_u$			$\phi M_n > M_{u\ ?}$		OK
As Req			Mu / [fy * (d - a/2)]	mm^2	0.000

Negative Field					
n			Input		2
d_b				mm	25
Net Distance Between Reinforcements			$(b - 2 c_c - 2 d_s - n * d_b) / (n - 1)$	mm	194.000
Net Distance Check	7.6.1	25.2.1	Net Distance >= d_b and 25 mm?		IYA
Number of Layers					1
As use			$n * \pi/4 * d_b^2$	mm^2	981.748
$As_{min,1}$	10.5.1	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	381.694
$As_{min,2}$	10.5.1, 21.5.2.1	9.6.1.2	1.4 / (4 * fy) * b * d	mm^2	390.250
$As_{min,4}$	21.5.2.2	18.6.3.2	0.25 * As Negative Support	mm^2	245.437
As min Check			As use >= As min ?		OK
ρ			As / (b * d)		0.84%
$\rho_{max,1}$	B.10.3		$0.75 \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{max,2}$	21.5.2.1	18.6.3.1	2.5%		2.50%
As max Check			ρ <= ρ max ?		OK
a	10.2.7.1	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	46.200
M_n	10.2.7.1	22.2.2.4.1	As * fy * (d - a/2)	kN-m	128.401
c	10.2.7.1	22.2.2.4.1	a / β1	mm	55.282
ε_s	10.2.2, 10.2.3	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.015
ϕ	S9.3.2	Tabel 21.2.2	0.65 <= 0.65 + (εs - 0.002) / 0.003 * 0.25 <= 0.9		0.900
ϕM_n			ϕ * Mn	kN-m	115.561
M_u				kN-m	0.000
Cek $\phi M_n > M_u$			$\phi M_n > M_u$?		OK
As Req			Mu / [fy * (d - a/2)]	mm^2	0.000
Positive Field					
n			Input		2
d_b				mm	25
Net Distance Between Reinforcements			$(b - 2 c_c - 2 d_s - n * d_b) / (n - 1)$	mm	194.000
Net Distance Check	7.6.1	25.2.1	Net Distance >= d_b dan 25 mm?		IYA
Number of Layers					1
As use			$n * \pi/4 * d_b^2$	mm^2	981.748
$As_{min,1}$	10.5.1	9.6.1.2	$(f_c')^{0.5} / (4 * f_y) * b * d$	mm^2	381.694
$As_{min,2}$	10.5.1, 21.5.2.1	9.6.1.2	1.4 / (4 * fy) * b * d	mm^2	390.250
$As_{min,4}$	21.5.2.2	18.6.3.2	0.25 * As Negative Support	mm^2	245.437
As min Check			As use >= As min ?		OK
ρ			As / (b * d)		0.84%
$\rho_{max,1}$	B.10.3		$0.75 \rho_b = 0.75 * 0.85 * \beta_1 * f_c' / f_y * (600/(600 + f_y))$		2.24%
$\rho_{max,2}$	21.5.2.1	18.6.3.1	2.5%		2.50%
As max Check			ρ <= ρ max ?		OK
a	10.2.7.1	22.2.2.4.1	As * fy / (0.85 * fc' * b)	mm	46.200
M_n	10.2.7.1	22.2.2.4.1	As * fy * (d - a/2)	kN-m	128.401
c	10.2.7.1	22.2.2.4.1	a / β1	mm	55.282
ε_s	10.2.2, 10.2.3	22.2.1.2, 22.2.2.1	(d - c) / c * 0.003		0.015
ϕ	S9.3.2	Tabel 21.2.2	0.65 <= 0.65 + (εs - 0.002) / 0.003 * 0.25 <= 0.9		0.900
ϕM_n			ϕ * Mn	kN-m	115.561
M_u				kN-m	17.260
Cek $\phi M_n > M_u$			$\phi M_n > M_u$?		OK
As Req			Mu / [fy * (d - a/2)]	mm^2	131.969

Internal Forces					
$V_{u,support}$			Input	kN	17.26
$V_{u,field}$			Input	kN	8.63
Support					
Design Force					
Vg,Support	S21.5.4	R18.6.5	Input [Combination 1.2 D + L]	kN	14.79
As+ Support			From Flexible Design Sheet	mm^2	981.748
As- Support			From Flexible Design Sheet	mm^2	981.748
a_{pr}^{+}			1.25 a (Positive Support)	mm	57.750
a_{pr}^{-}			1.25 a (Negative Support)	mm	57.750
M_{pr}^{+}	S21.5.4	R18.6.5	A_s^{+} * (1.25 f_y) * (d - a_{pr}^{+}/2)	N mm	157524522
M_{pr}^{-}	S21.5.4	R18.6.5	A_s^{-} * (1.25 f_y) * (d - a_{pr}^{-}/2)	N mm	157524522
V_{sway} or V_{pr}	21.5.4.1	18.6.5.1	(M_{pr}^{+} + M_{pr}^{-}) / L_n	N	41183
V_e	21.5.4.1	18.6.5.1	V_g + V_{pr}	N	55973
Beam Shear Resistance					
V_{pr}				N	41183
1/2 V_e				N	27986
Pu				N	239070
Ag fc' / 20				N	210000
V_c Considered?	21.5.4.2	18.6.5.2	V_c = 0 if V_{pr} >= 1/2 V_e and P_u < A_g f_c' / 20		Yes
V_c				N	109012
Shear Reinforcement					
Number of Legs			Input		2
Av			n *π/4 *d_s^2	mm^2	265.465
Spacing			Input	mm	75
Max Spacing 1	21.5.3.2	18.6.4.4	d / 4	mm	83.63
Max Spacing 2	21.5.3.2	18.6.4.4	6 d_b	mm	150.00
Max Spacing 3	21.5.3.2	18.6.4.4	150 mm	mm	150.00
Spacing Check					OK
V_s	11.4.7.2	22.5.10.5.3	A_v * f_{yv} * d / s	N	497268
V_s Limit	11.4.7.9	22.5.1.2	0.66 * $(f_c')^{0.5}$ * b * d	N	423222
ϕ	9.3.2.3	12.5.3.2, 21.2.4			0.75
V_n			V_c + V_s	N	532234
V_u				N	55973
ϕV_n / V_u					7.132
Capacity Check			ϕV_n / V_u >= 1 ?		OK
Field					
Shear Reinforcement					
Number of Legs			Input		2
Av			n *π/4 *d_s^2	mm^2	265.465
Spacing			Input	mm	100
Max Spacing	21.5.3.4	18.6.4.6	d / 2	mm	167.25
Spacing Check					OK
V_s	11.4.7.2	22.5.10.5.3	A_v * f_{yv} * d / s	N	372951
V_s Limit	11.4.7.9	22.5.1.2	0.66 * $(f_c')^{0.5}$ * b * d	N	423222
V_c	11.2.1.1	22.5.5.1	0.17 * $(f_c')^{0.5}$ * b * d	N	109012
ϕ	9.3.2.3	12.5.3.2, 21.2.4			0.75
V_n			V_c + V_s		481963
V_u				N	8630
ϕV_n / V_u					41.886
Capacity Check			ϕV_n / V_u >= 1 ?		OK

Internal Forces					
T_u			Input	kN m	12.4
Torsion Reinforcement Requirements Check					
T_{cr}			$0.33 * (f_c')^{0.5} * A_{cp}{}^2 / P_{cp}$	N mm	23617797
ϕ	9.3.2.3	Tabel 21.2.1			0.75
$\phi\ T_{cr} / 4$				N mm	4428337
Needs Torsion Reinforcement?	11.5.1	Tabel 22.7.4.1	$T_u > \phi\ T_{cr} / 4$?		Yes
The calculations below must be checked					
Pengecekan Kecukupan Dimensi Penampang					
Torsion Type			Certain Static = Equilibrium, Uncertain Static = Compatibility		Kompatibilitas
T_u Use	11.5.2.2	22.7.3.2, 22.7.5	$\phi\ T_{cr}$ or T_u	N mm	12400000
V_u			From Shear Design Sheet	N	55973
V_c	11.2.1.1	22.5.5.1	$0.17 * (f_c')^{0.5} * b * d$	N	109012
Ultimate Shear Stress + Torsion	11.5.3.1	22.7.7.1	$\{ [V_u / b*d]^2 + [T_u\ P_h / (1.7\ A_{oh}{}^2)]^2 \}^{0.5}$	MPa	1.406
Concrete Stress Capacity	11.5.3.1	22.7.7.1	$\phi * \{ [V_c / (b * d)] + 0.66 * (f_c')^{0.5} \}$	MPa	3.410
Section Dimensions Check	11.5.3.1	22.7.7.1	Left Section <= Right Section?		OK
Other General Parameters					
f_y / f_{yt}			Torsion Reinforcement Steel Yield Strength = Flexible and Shear Reinforcement Steel Yield Strengths		1
θ	11.5.3.6	22.7.6.1.2	θ is taken for non-prestressed structure component beam	°	45
Torsion Stirrups Calculations					
n Support leg			From Shear Design Sheet		2
n Field leg			From Shear Design Sheet		2
s Support			From Shear Design Sheet	mm	75
s Field			From Shear Design Sheet	mm	100
s max 1	11.5.6.1	9.7.6.3.3	$P_h / 8$	mm	141
s max 2	11.5.6.1	9.7.6.3.3	300 mm	mm	300
Support Spacing Check			s Support >= s max ?		OK
Field Spacing Check			s Field >= s max ?		OK
Av+t / s Support Use			$n * \pi/4 * d_s{}^2 / s$	mm^2/mm	3.540
Av+t / s Support Use			$n * \pi/4 * d_s{}^2 / s$	mm^2/mm	2.655
A_t / s	11.5.3.6	22.7.6.1	$T_u / (2 * \phi * A_o * f_{yv})$	mm^2/mm	0.293
Av / s Support Req			(Vu Support / φ - Vc) / (fyv * d)	mm^2/mm	-0.245
Av / s Field Req			(Vu Field / φ - Vc) / (fyv * d)	mm^2/mm	-0.694
Av+t / s Support Req	11.5.5.2	R9.5.4.3	$2 * A_t / s + A_v / s$		0.342
Av+t / s Field Req	11.5.5.2	R9.5.4.3	$2 * A_t / s + A_v / s$		-0.107
A_{v+t} / s min 1	11.5.5.2	9.6.4.2	$0.062 * (f_c')^{0.5} * b / f_{yv}$		0.283
A_{v+t} / s min 2	11.5.5.2	9.6.4.2	$0.35 * b / f_{yv}$		0.292
Support Shear + Torsion Check			Av+t / s Use >= Av+t / s Req and min ?		OK
Field Shear + Torsion Check			Av+t / s Use >= Av+t / s Req and min ?		OK
Torsion Longitudinal Calculations					
db or dbt				mm	13
d_b, min	11.5.6.2	9.7.5.2	0.042 s	mm	4.2
Cek d_b			$d_b >= d_b$ min ?		OK
As Req Top Support			From Shear Design Sheet	mm^2	0.000
As Req Bottom Support			From Shear Design Sheet	mm^2	0.000
As Req Top Field			From Shear Design Sheet	mm^2	0.000
As Req Top Field			From Shear Design Sheet	mm^2	131.969
A_l	11.5.3.7	22.7.6.1	$A_t / s * P_h$	mm^2	331.055
A_l min	11.5.5.3	9.6.4.3	$0.42 * (f_c')^{0.5} * A_{cp} / f_y - (A_t/s) * P_h$	mm^2	435.757
As + Al Req Support				mm^2	435.757
As + Al Req Field				mm^2	567.726
Top Support n			From Flexible Design Sheet		2
Middle Support n			Input (Multiples of 2 Advised)		4
Bottom Support n			From Flexible Design Sheet		2
Vertical Support n			2 + n Tengah / 2		4
Top Field n			From Flexible Design Sheet		2
Middle Field n			Input (Multiples of 2 Advised)		4
Bottom Field n			From Flexible Design Sheet		2
Vertical Field n			2 + n Middle / 2		4
Horizontal Support Spacing			$(b - 2c_c - 2d_s - d_b)$ / [min(n atas, n bawah) - 1]	mm	219
Vertical Support Spacing			(h - 2cc - 2ds - db) / (n Vertical - 1)	mm	90
Horizontal Field Spacing			$(b - 2c_c - 2d_s - d_b)$ / [min(n atas, n bawah) - 1]	mm	219
Vertical Field Spacing			(h - 2cc - 2ds - db) / (n Vertical - 1)	mm	90
ield Longitudinal Reinforcement Spacing Chec	11.5.6.2		Spacing >= 300 mm ?		OK
pport Longitudinal Reinforcement Spacing Che	11.5.6.2		Spacing >= 300 mm ?		OK
As + Al Use Support				mm^2	2494.425
As + Al Use Field				mm^2	2494.425
Support Flexibility + Torsion Check			As + Al Use >= As + Al Req ?		OK
Field Flexibility + Torsion Check			As + Al Use >= As + Al Req ?		OK

B.12 Column K1

Axial - Flexural			
Condition	**P (kN)**	**M2 (kN-m)**	**M3 (kN-m)**
P max	84.350	0.000	0.000
P min	-2685.770	-9.390	56.460
M2 Max	-247.460	472.190	194.810
M2 Min	-1026.590	-446.620	-107.820
M3 Max	-392.120	188.370	498.370
M3 Min	-441.850	-189.560	-683.700

Shear	
Support	
V2 (kN)	-681.420
V3 (kN)	-266.550
Field	
V2 (kN)	-143.400
V3 (kN)	-213.910

Parameter	Reference Codes		Equation	Unit	Value
	SNI 2847:2013	SNI 2847:2019			
Material and Section Properties					
Column Length/Height, L			Input	mm	4000
Column Short Side, b			Input	mm	800
Column Long Side, h			Input	mm	800
Longitudinal Reinf. Diameter, d_b			Input	mm	25
Stirrup Diameter, d_s			Input	mm	13
Concrete Cover, c_c			Input	mm	40
Concrete Compressive Strength, f_c'			Input	MPa	30
Longitudinal Reinf. Yield Strength, f_y			Input	MPa	420
Stirrup Yield Strength, f_{yv}			Input	MPa	420
Beam Height, h_b			Input	mm	600
L_n			L - hb	mm	3400
Forces and Geometry Requirements					
Axial Force Requirement	21.6.1	Not required. Read R18.7.1	Pu > 0.1 A_g f_c' ?		OK
Shortest Side Requirement	21.6.1.1	18.7.2.1	b >= 300 mm ?		OK
Section Dimension Ratio Requirement	21.6.1.2	18.7.2.1	b/h >= 0.4 ?		OK
Internal Forces in Axial-Flexural Check (Using PCA Column, SP Column, CSI Column, or others)					
Number of Reinforcements, n			Input		16
Longitudinal Reinf. Area, A_s			$n * \pi/4 * d_b^2$	mm^2	7854.0
Reinforcement Ratio, ρ			As / (b * h)		1.23%
ρ_{min} and ρ_{max} Check	21.6.3.1	18.7.4.1	1% <= ρ <= 6%		OK
Strong Column - Weak Beam (SCWB) Check					
Column Nominal Moment, M_{nc}			Input (M_n from P_{max} dan P_{min} condition)	kN m	1190.444444
M_n^- Beam Support			Input	kN m	659.023
M_n^+ Beam Support			Input	kN m	494.543
SCWB Check	21.6.2.2	18.7.3.2	$2 * M_{nc} >= 1.2 * (M_n^- + M_n^+)$		OK

Plastic Hinge Zone Length					
l_{o1}	21.6.4.1	18.7.5.1	h	mm	800.0
l_{o2}	21.6.4.1	18.7.5.1	L_n / 6	mm	566.7
l_{o3}	21.6.4.1	18.7.5.1	450 mm	mm	450
l_o	21.6.4.1	18.7.5.1	Max (l_{o1}; l_{o2}; l_{o3})	mm	800.0
Plastic/Support Hinge Zone Transversal Reinforcement					
Number of Short Side Legs, n1			Input		4
Number of Long Side Legs, n2			Input		4
Spacing, s			Input	mm	100
Largest Leg Spacing, $x_{i\ max}$	S21.6.4.2	R18.7.5.2	Input	mm	300
A_{sh} 1			n *π/4 *d_s^2	mm^2	530.929
A_{sh} 2			n *π/4 *d_s^2	mm^2	530.929
A_{sh} / s, 1				mm^2 / mm	5.309
A_{sh} / s, 2				mm^2 / mm	5.309
Plastic Hinge Zone Confinement					
Concrete Core Section Width, b_c	S21.6.4.2	R18.7.5.2	b - $2c_c$	mm	720
Concrete Core Section Length, h_c	S21.6.4.2	R18.7.5.2	h - $2c_c$	mm	720
Column Section Area, A_g			b * h	mm^2	640000
Concrete Core Section Area, A_{ch}			b_c * h_c	mm^2	518400
Short Side/Minor Axis					
A_{sh}/s min, 1	21.6.4.4	18.7.5.4	0.3 (b_c * f_c' / f_{yv}) * (A_g / A_{ch} - 1)	mm^2	3.619
A_{sh}/s min, 2	21.6.4.4	18.7.5.4	0.09 * b_c * f_c' / f_{yv}	mm^2	4.629
Cek A_{sh}/s 1			A_{sh}/s 1 >= Ash/s min ?		OK
Long Side/Major Axis					
A_{sh}/s min, 1	21.6.4.4	18.7.5.4	0.3 (h_c * f_c' / f_{yv}) * (A_g / A_{ch} - 1)	mm^2	3.619
A_{sh}/s min, 2	21.6.4.4	18.7.5.4	0.09 * h_c * f_c' / f_{yv}	mm^2	4.629
Cek A_{sh}/s 2			A_{sh}/s 2 >= Ash/s min ?		OK
Spacing Check					
$s_{max,1}$	21.6.4.3	18.7.5.3	b / 4	mm	200
$s_{max,2}$	21.6.4.3	18.7.5.3	6 * d_b	mm	150
h_x	21.6.4.3	18.7.5.3	$x_{i\ max}$	mm	300
$s_{max,3}$ = s_o	21.6.4.3	18.7.5.3	100 <= 100 + (350 - hx) / 3 <= 150	mm	116.667
s_{max}	21.6.4.3	18.7.5.3	Min (s_{max1}, s_{max2}, s_{max3})	mm	116.667
Spacing Check					OK
Plastic Hinge Zone Shear Strength					
Design Shear Force (Needs input from PCA Column, SP Column, CSI Column, or others with f_{pr} = 1.25 f_y)					
Column M_{pr}			Input, (largest value)	kN m	2065.465
$V_{u\ 1}$	S21.5.4	18.7.6.1	2 * M_{pr} Column / Ln	N	1214979
Shear Force Result of Structural Analysis					
Vu 2, Minor Axis			From Internal Forces Sheet	N	681420
Vu 2, Major Axis			From Internal Forces Sheet	N	266550
Minor Axis Concrete Shear Resistance					
V_u			Max (V_{u1}, V_{u2})	N	1214979
ϕ	9.3.2.3	Tabel 21.2.1			0.75
V_c	11.2.1.2	22.5.6.1	0.17 (1 + N_u/(14 A_g)] $(f_c')^{0.5}$ h d; d = b - c_c - d_s - d_b / 2	N	547131
Vs Req	11.1.1	22.5.10.1	V_u / ϕ - V_c	N	1072842
As/s Req	11.4.7.2	22.5.10.5.3	V_s / (f_{yv} * d); d = b - c_c - d_s - d_b / 2	mm^2 / mm	3.4777
A_s/s Min 1	-	10.6.2.2	0.062 $(f_c')^{0.5}$ h / f_{yv}	mm^2 / mm	0.6468
A_s/s Min 2	-	10.6.2.2	0.35 h / f_{yv}	mm^2 / mm	0.6667
A_s/s Check			Ash/s 1 >= Max (As/s Req, As/s Min) ?		OK
Major Axis Concrete Shear Resistance					
V_u			Max (V_{u1}, V_{u2})	N	1214979
ϕ	9.3.2.3	Tabel 21.2.1			0.75
V_c	11.2.1.2	22.5.6.1	0.17 (1 + N_u/(14 A_g)] $(f_c')^{0.5}$ b d; d = h - c_c - d_s - d_b / 2	N	547131
Vs Req	11.1.1	22.5.10.1	V_u / ϕ - V_c	N	1072842
As/s Req	11.4.7.2	22.5.10.5.3	V_s / (f_{yv} * d); d = h - c_c - d_s - d_b / 2	mm^2 / mm	3.4777
A_s/s Min 1	-	10.6.2.2	0.062 $(f_c')^{0.5}$ b / f_{yv}	mm^2 / mm	0.6468
A_s/s Min 2	-	10.6.2.2	0.35 b / f_{yv}	mm^2 / mm	0.6667
A_s/s Check			Ash/s 2 >= Max (As/s Req, As/s Min) ?		OK

Out of Plastic/Support Hinnge Zone Transversal Reinforcement					
Number of Short Side Legs, n1			Input		2
Number of Long Side Legs, n2			Input		2
Spacing, s			Input	mm	150
Av Minor Axis			$n * \pi/4 * d_s^2$	mm^2	265.465
Av Major Axis			$n * \pi/4 * d_s^2$	mm^2	265.465
Out of Plastic/Support Hinge Zone Confinement					
Max Spacing 1	21.6.4.5	18.7.5.5	$6\ d_b$	mm	150.0
Max Spacing 2	21.6.4.5	18.7.5.5	150 mm	mm	150.0
Spacing Check			Spacing <= Max Spacing ?		OK
Out of Plastic Hinge Zone Shear Strength					
Minor Axis Concrete Shear Resistance					
V_u			From Internal Forces Sheet	N	143400
ϕ	9.3.2.3	Tabel 21.2.1			0.75
V_c	11.2.1.2	22.5.6.1	$0.17\ (1 + N_u/(14\ A_g))\ (f_c')^{0.5}\ h\ d;\ d = b - c_c - d_s - d_b / 2$	N	547131
Vs Req	11.1.1	22.5.10.1	$Max\ (V_u/\phi - V_c; 0)$		0
Av/s Req	11.4.7.2	22.5.10.5.3	$V_s / (f_{yv} * d);\ d = b - c_c - d_s - d_b / 2$		0.000000000000
A_s/s Min 1	-	10.6.2.2	$0.062\ (f_c')^{0.5}\ b / f_{yv}$	mm^2 / mm	0.0000
A_s/s Min 2	-	10.6.2.2	$0.35\ b / f_{yv}$	mm^2 / mm	0.0000
A_s/s Check			Av/s >= Av/s Req ?		OK
Major Axis Concrete Shear Resistance					
V_u			From Internal Forces Sheet	N	213910
ϕ	9.3.2.3	Tabel 21.2.1			0.75
V_c	11.2.1.2	22.5.6.1	$0.17\ (1 + N_u/(14\ A_g))\ (f_c')^{0.5}\ b\ d;\ d = h - c_c - d_s - d_b / 2$	N	547131
Vs Req	11.1.1	22.5.10.1	$Max\ (V_u/\phi - V_c; 0)$		0
Av/s Req	11.4.7.2	22.5.10.5.3	$V_s / (f_{yv} * d);\ d = h - c_c - d_s - d_b / 2$		0.0000
A_s/s Min 1	-	10.6.2.2	$0.062\ (f_c')^{0.5}\ b / f_{yv}$	mm^2 / mm	0.0000
A_s/s Min 2	-	10.6.2.2	$0.35\ b / f_{yv}$	mm^2 / mm	0.0000
Cek A_s/s			Av/s >= Av/s Req ?		OK

Conclusion	
Forces and Geometry Requirements	OK
Flexural Capacity	OK
Shear Capacity	OK
Longitudinal Reinforcement	
Longitudinal	16 D25
Transversal/Stirrup Reinforcement at Support	
Minor Axis	4D13-100
Major Axis	4D13-100
Transversal/Stirrup Reinforcement at Span	
Minor Axis	2D13-150
Major Axis	2D13-150

B.13 Column K2

Axial - Flexural			
Condition	P (kN)	M2 (kN-m)	M3 (kN-m)
P max	-21.190	134.590	47.370
P min	-1383.180	-37.820	200.580
M2 Max	-435.410	472.520	133.120
M2 Min	-519.130	-1484.890	-97.590
M3 Max	-1258.380	315.760	690.200
M3 Min	-722.280	-147.450	-448.360

Shear	
Support	
V2 (kN)	-143.730
V3 (kN)	-213.890
Field	
V2 (kN)	-143.730
V3 (kN)	-213.890

Parameter	Reference Codes		Equation	Unit	Value
	SNI 2847:2013	SNI 2847:2019			
Material and Section Properties					
Column Length/Height, L			Input	mm	4000
Column Short Side, b			Input	mm	1000
Column Long Side, h			Input	mm	1000
Longitudinal Reinf. Diameter, d_b			Input	mm	25
Stirrup Diameter, d_s			Input	mm	13
Concrete Cover, c_c			Input	mm	40
Concrete Compressive Strength, f_c'			Input	MPa	30
Longitudinal Reinf. Yield Strength, f_y			Input	MPa	420
Stirrup Yield Strength, f_{yv}			Input	MPa	420
Beam Height, h_b			Input	mm	650
L_n			L - hb	mm	3350
Forces and Geometry Requirements					
Axial Force Requirement	21.6.1	Not required. Read R18.7.1	Pu > 0.1 A_g f_c' ?		NOT CONSIDERED
Shortest Side Requirement	21.6.1.1	18.7.2.1	b >= 300 mm ?		OK
Section Dimension Ratio Requiremen	21.6.1.2	18.7.2.1	b/h >= 0.4 ?		OK
Internal Forces in Axial-Flexural Check (Using PCA Column, SP Column, CSI Column, or others)					
Number of Reinforcements, n			Input		24
Longitudinal Reinf. Area, A_s			n *π/4 *d_b^2	mm^2	11781.0
Reinforcement Ratio, ρ			As / (b * h)		1.18%
ρ_{min} and ρ_{max} Check	21.6.3.1	18.7.4.1	1% <= ρ <= 6%		OK
Strong Column - Weak Beam (SCWB) Check					
Column Nominal Moment, M_{nc}			Input (M_n from P_{max} dan P_{min} condition)	kN m	1914.967
M_n^- Beam Support			Input	kN m	567.797
M_n^+ Beam Support			Input	kN m	459.794
SCWB Check	21.6.2.2	18.7.3.2	2 * M_{nc} >= 1.2 * (M_n^- + M_n^+)		OK

Plastic Joint Zone Length					
l_{o1}	21.6.4.1	18.7.5.1	h	mm	1000.0
l_{o2}	21.6.4.1	18.7.5.1	L_n / 6	mm	558.3
l_{o3}	21.6.4.1	18.7.5.1	450 mm	mm	450
l_o	21.6.4.1	18.7.5.1	Max (l_{o1}; l_{o2}; l_{o3})	mm	1000.0
Plastic/Support Joint Zone Transversal Reinforcement					
Number of Short Side Legs, n1			Input		6
Number of Long Side Legs, n2			Input		6
Spacing, s			Input	mm	100
Largest Leg Spacing, $x_{i\,max}$	S21.6.4.2	R18.7.5.2	Input	mm	300
A_{sh} 1			$n * \pi/4 * d_s^2$	mm^2	796.394
A_{sh} 2			$n * \pi/4 * d_s^2$	mm^2	796.394
A_{sh} / s, 1				mm^2 / mm	7.964
A_{sh} / s, 2				mm^2 / mm	7.964
Plastic Joint Zone Confinement					
Concrete Core Section Width, b_c	S21.6.4.2	R18.7.5.2	b - $2c_c$	mm	920
Concrete Core Section Length, h_c	S21.6.4.2	R18.7.5.2	h - $2c_c$	mm	920
Column Section Area, A_g			b * h	mm^2	1000000
Concrete Core Section Area, A_{ch}			$b_c * h_c$	mm^2	846400
Short Side/Minor Axis					
A_{sh}/s min, 1	21.6.4.4	18.7.5.4	$0.3\ (b_c * f_c' / f_{yv}) * (A_g / A_{ch} - 1)$	mm^2	3.757
A_{sh}/s min, 2	21.6.4.4	18.7.5.4	$0.09 * b_c * f_c' / f_{yv}$	mm^2	6.210
Cek A_{sh}/s 1			A_{sh}/s 1 >= Ash/s min ?		OK
Long Side/Major Axis					
A_{sh}/s min, 1	21.6.4.4	18.7.5.4	$0.3\ (h_c * f_c' / f_{yv}) * (A_g / A_{ch} - 1)$	mm^2	3.757
A_{sh}/s min, 2	21.6.4.4	18.7.5.4	$0.09 * h_c * f_c' / f_{yv}$	mm^2	6.210
Cek A_{sh}/s 2			A_{sh}/s 2 >= Ash/s min ?		OK
Spacing Check					
$s_{max,1}$	21.6.4.3	18.7.5.3	b / 4	mm	250
$s_{max,2}$	21.6.4.3	18.7.5.3	6 * d_b	mm	150
h_x	21.6.4.3	18.7.5.3	$x_{i\,max}$	mm	300
$s_{max,3} = s_o$	21.6.4.3	18.7.5.3	100 <= 100 + (350 - hx) / 3 <= 150	mm	116.667
s_{max}	21.6.4.3	18.7.5.3	Min (s_{max1}, s_{max2}, s_{max3})	mm	116.667
Spacing Check					OK
Plastic Joint Zone Shear Strength					
Design Shear Force (Needs input from PCA Column, SP Column, CSI Column, or others with $f_{pr} = 1.25\ f_y$)					
Column M_{pr}			Input, (largest value)	kN m	2816.589
$V_{u\,1}$	S21.5.4	18.7.6.1	2 * M_{pr} Column / Ln	N	1681546
Shear Force Result of Structural Analysis					
Vu 2, Minor Axis			From Internal Forces Sheet	N	143730
Vu 2, Major Axis			From Internal Forces Sheet	N	213890
Minor Axis Concrete Shear Resistance					
V_u			Max (V_{u1}, V_{u2})	N	1681546
ϕ	9.3.2.3	Tabel 21.2.1			0.75
V_c	11.2.1.2	22.5.6.1	$0.17\ (1 + N_u/(14\ A_g))\ (f_c')^{0.5}\ h\ d$; $d = b - c_c - d_s - d_b / 2$	N	870139
Vs Req	11.1.1	22.5.10.1	$V_u / \phi - V_c$	N	1371921
As/s Req	11.4.7.2	22.5.10.5.3	$V_s / (f_{yv} * d)$; $d = b - c_c - d_s - d_b / 2$	mm^2 / mm	3.6702
A_s/s Min 1	-	10.6.2.2	$0.062\ (f_c')^{0.5}\ h / f_{yv}$	mm^2 / mm	0.8490
A_s/s Min 2	-	10.6.2.2	$0.35\ h / f_{yv}$	mm^2 / mm	0.8750
A_s/s Check			Ash/s 1 >= Max (As/s Req, As/s Min) ?		OK
Major Axis Concrete Shear Resistance					
V_u			Max (V_{u1}, V_{u2})	N	1681546
ϕ	9.3.2.3	Tabel 21.2.1			0.75
V_c	11.2.1.2	22.5.6.1	$0.17\ (1 + N_u/(14\ A_g))\ (f_c')^{0.5}\ b\ d$; $d = h - c_c - d_s - d_b / 2$	N	870139
Vs Req	11.1.1	22.5.10.1	$V_u / \phi - V_c$	N	1371921
As/s Req	11.4.7.2	22.5.10.5.3	$V_s / (f_{yv} * d)$; $d = h - c_c - d_s - d_b / 2$	mm^2 / mm	3.6702
A_s/s Min 1	-	10.6.2.2	$0.062\ (f_c')^{0.5}\ b / f_{yv}$	mm^2 / mm	0.8490
A_s/s Min 2	-	10.6.2.2	$0.35\ b / f_{yv}$	mm^2 / mm	0.8750
A_s/s Check			Ash/s 2 >= Max (As/s Req, As/s Min) ?		OK

Out of Plastic/Support Joint Zone Transversal Reinforcement					
Number of Short Side Legs, n1			Input		2
Number of Long Side Legs, n2			Input		2
Spacing, s			Input	mm	150
Av Minor Axis			$n * \pi/4 * d_s^2$	mm^2	265.465
Av Major Axis			$n * \pi/4 * d_s^2$	mm^2	265.465
Out of Plastic/Support Joint Zone Confinement					
Max Spacing 1	21.6.4.5	18.7.5.5	$6\ d_b$	mm	150.0
Max Spacing 2	21.6.4.5	18.7.5.5	150 mm	mm	150.0
Spacing Check			Spasi <= Spasi Max ?		OK
Out of Plastic Joint Zone Shear Strength					
Minor Axis Concrete Shear Resistance					
V_u			From Internal Forces Sheet	N	143730
ϕ	9.3.2.3	Tabel 21.2.1			0.75
V_c	11.2.1.2	22.5.6.1	$0.17 (1 + N_u/(14 A_g)] (f_c')^{0.5} h d; d = b - c_c - d_s - d_b / 2$	N	870139
Vs Req	11.1.1	22.5.10.1	$Max (V_u/\phi - V_c; 0)$		0
Av/s Req	11.4.7.2	22.5.10.5.3	$V_s / (f_{yv} * d); d = b - c_c - d_s - d_b / 2$		0.0000
A_s/s Min 1	-	10.6.2.2	$0.062 (f_c')^{0.5} b / f_{yv}$	mm^2 / mm	0.0000
A_s/s Min 2	-	10.6.2.2	$0.35 b / f_{yv}$	mm^2 / mm	0.0000
A_s/s Check			Av/s >= Av/s Req ?		OK
Major Axis Concrete Shear Resistance					
V_u			From Internal Forces Sheet	N	213890
ϕ	9.3.2.3	Tabel 21.2.1			0.75
V_c	11.2.1.2	22.5.6.1	$0.17 (1 + N_u/(14 A_g)] (f_c')^{0.5} b d; d = h - c_c - d_s - d_b / 2$	N	870139
Vs Req	11.1.1	22.5.10.1	$Max (V_u/\phi - V_c; 0)$		0
Av/s Req	11.4.7.2	22.5.10.5.3	$V_s / (f_{yv} * d); d = h - c_c - d_s - d_b / 2$		0.0000
A_s/s Min 1	-	10.6.2.2	$0.062 (f_c')^{0.5} b / f_{yv}$	mm^2 / mm	0.0000
A_s/s Min 2	-	10.6.2.2	$0.35 b / f_{yv}$	mm^2 / mm	0.0000
Cek A_s/s			Av/s >= Av/s Req ?		OK

B.14 Slab

B.14.1 Slab A3

Dimension

Lx = Short Span			
bw	400	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	4000	mm	
hw	550	mm	web height or beam height
ht	690	mm	total depth = hf+hw
ln x	3600	mm	
Type	Exterior		

Ly = Long Span			
bw	400	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	550	mm	web height or beam height
ht	690	mm	total depth = hf+hw
ln y	3600	mm	
Type	Exterior		

ly/lx	1
Slab Type	Two Way Slab

Properties		
Concrete Unit Weight	25	kN/m3
fy	400	mpa
conc cover	20	mm
D shrinkage	8	mm
f'c	30	mpa
Dlx	10	mm
Dly	10	mm
Dtx	10	mm
Dty	10	mm

Load				
Live Load	4.79	kN	4.79	kN/m2
Self Weight	3.5	kN/m2	3.5	kN/m2
Reinforced				
Ceramic	0.2	kN/m2	0.2	
Ceiling	0.18	kN/m2	0.18	
Total DL	3.88	kN/m2	3.88	kN/m2
Comb Load 1.2D + 1.6L	12.32	kN/m2		

Center of Gravity and Inertia

Lx	Interior	
A1	220000	mm2
A2	210000	mm2
y1	275	mm
y2	620	mm
Be1	1500	mm
Be2	1520	mm
Be used	1500	mm
y	443.4883721	mm
Ib	18677100775	mm4

Ly	Interior	
A1	220000	mm2
A2	210000	mm2
y1	275	mm
y2	620	mm
Be1	1500	mm
Be2	1520	mm
Be used	1500	mm
y	443.4883721	mm
Ib	18677100775	mm4

Inertia of Slab

ip1	914666666.7	mm4
ip2	914666666.7	mm4

ip1	914666666.7	mm4
ip2	914666666.7	mm4

$\alpha 1$	17.0871	
$\alpha 2$	17.0871	
αfm	17.0871	
beta	1.0000	
min h value	86.8571	mm

OK slab thickness>h min

$\alpha 1$	17.0871	
$\alpha 1$	17.0871	
αfm	17.0871	
beta	1.0000	
min h value	86.8571	mm

OK slab thickness>h min

Moment Calculation

mlx	0.1971	x	21	4.13952	kNm
mly	0.1971	x	21	4.13952	kNm
mtx	0.1971	x	52	10.25024	kNm
mty	0.1971	x	52	10.25024	kNm

Shear Stregth

Vu	38.2536	kN
	38253.6	N
dx	666	mm
ØVc	186039.4439	N
	186.0394	kN

OK ØVc>Vu

Coefficient of Flexural Resistance

dy	658	mm
klx	0.0259	
kly	0.0266	
ktx	0.0642	
kty	0.0658	

Reinforcement Ratio

β_1	0.8357	2019 table 22.2.2.4.3
plx	0.000065	
ply	0.000066	
ptx	0.000161	
pty	0.000165	
pmaks	0.022564	
biggest p	0.000165	

OK

Area of Steel

b	1000	mm
Ag	140000	
Asreqlx	43.1851	mm2
Asreqly	43.7107	mm2
Asreqtx	107.0151	mm2
Asreqty	108.3195	mm2

Asuselx	280	mm2
Asusely	280	mm2
Asusetx	280	mm2
Asusety	280	mm2
Asmin short span	280	mm2
Asmin long span	280	mm2

Moment Strength

alx	10.98039216	mm
Mnx	73977098.04	Nmm
0.9Mn	66579388.24	Nmm
	66.57938824	kNm
>	4.1395	kNm

Safe

aly	10.98039216	mm
Mny	73081098.04	Nmm
0.9Mn	65772988.24	Nmm
	65.77298824	kNm
>	4.1395	kNm

Safe

aty	10.98039216	mm
Mny	73081098.04	Nmm
0.9Mn	65772988.24	Nmm
	65.77298824	kNm
>	10.2502	kNm

Safe

atx	10.98039216	mm
Mnx	73977098.04	Nmm
0.9Mn	66579388.24	Nmm
	66.57938824	kNm
>	10.2502	kNm

Safe

Spacings

slx	280.4993441	mm
sly	280.4993441	mm
stx	280.4993441	mm
sty	280.4993441	mm

Max spacing				
3h	420	or	450	mm

Use

Dlx	D10-	250
Dly	D10-	250
Dtx	D10-	250
Dty	D10-	250

Shrinkage reinforcement field and support		
As	50.26548246	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	179.5195802	mm
spacing use, s use	175	mm

B.14.2 Slab B2

Dimension

Lx = Short Span			
bw	400	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	4000	mm	
hw	550	mm	web height or beam height
ht	690	mm	total depth = hf+hw
ln x	3600	mm	
Type	Interior		

Ly = Long Span			
bw	400	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	550	mm	web height or beam height
ht	690	mm	total depth = hf+hw
ln y	3600	mm	
Type	Interior		

ly/lx	1
Slab Type	Two Way Slab

Properties		
Concrete Unit Weight	25	kN
fy	400	mpa
conc cover	20	mm
D shrinkage	8	mm
f'c	30	mpa
Dlx	10	mm
Dly	10	mm
Dtx	10	mm
Dty	10	mm

Load		
Live Load	4.79	kN
Self Weight	3.5	kN/m2
Reinforced		
Ceramic	0.2	kN/m2
Ceiling	0.18	kN/m2
Total DL	3.88	kN/m2
Comb Load 1.2D + 1.6L	12.32	kN/m2

Center of Gravity and Inertia

Lx	Interior	
A1	220000	mm2
A2	210000	mm2
y1	275	mm
y2	620	mm
Be1	1500	mm
Be2	1520	mm
Be used	1500	mm
y	443.4883721	mm
Ib	18677100775	mm4

Ly	Interior	
A1	220000	mm2
A2	210000	mm2
y1	275	mm
y2	620	mm
Be1	1500	mm
Be2	1520	mm
Be used	1500	mm
y	443.4883721	mm
Ib	18677100775	mm4

Inertia of Slab

ip1	914666666.7	mm4
ip2	914666666.7	mm4

ip1	914666666.7	mm4
ip2	914666666.7	mm4

$\alpha 1$	20.4196	
$\alpha 2$	20.4196	
αfm	20.4196	
beta	1.0000	
min h value	86.8571	mm

OK slab thickness>h min

$\alpha 1$	20.4196	
$\alpha 1$	20.4196	
αfm	20.4196	
beta	1.0000	
min h value	86.8571	mm

OK slab thickness>h min

Moment Calculation

mlx	0.1971	x	21	4.13952	kNm
mly	0.1971	x	21	4.13952	kNm
mtx	0.1971	x	52	10.25024	kNm
mty	0.1971	x	52	10.25024	kNm

Shear Stregth

Vu	38.2536	kN
	38253.6	N
dx	666	mm
ØVc	186039.4439	N
	186.0394	kN

OK ØVc>Vu

Coefficient of Flexural Resistance

dy	658	mm
klx	0.0259	
kly	0.0266	
ktx	0.0642	
kty	0.0658	

Reinforcement Ratio

β_1	0.8357	2019 table 22.2.2.4.3
plx	0.000065	
ply	0.000066	
ptx	0.000161	
pty	0.000165	
pmaks	0.022564	
biggest p	0.000165	

OK

Area of Steel

b	1000	mm
Ag	140000	
Asreqlx	43.1851	mm2
Asreqly	43.7107	mm2
Asreqtx	107.0151	mm2
Asreqty	108.3195	mm2

Asuselx	280	mm2
Asusely	280	mm2
Asusetx	280	mm2
Asusety	280	mm2
Asmin short span	280	mm2
Asmin long span	280	mm2

Moment Strength

alx	10.98039216	mm
Mnx	73977098.04	Nmm
0.9Mn	66579388.24	Nmm
	66.57938824	kNm
>	4.1395	kNm

Safe

aly	10.98039216	mm
Mny	73081098.04	Nmm
0.9Mn	65772988.24	Nmm
	65.77298824	kNm
>	4.1395	kNm

Safe

aty	10.98039216	mm
Mny	73081098.04	Nmm
0.9Mn	65772988.24	Nmm
	65.77298824	kNm
>	10.2502	kNm

Safe

atx	10.98039216	mm
Mnx	73977098.04	Nmm
0.9Mn	66579388.24	Nmm
	66.57938824	kNm
>	10.2502	kNm

Safe

Spacings

slx	280.4993441	mm
sly	280.4993441	mm
stx	280.4993441	mm
sty	280.4993441	mm

Max spacing				
3h	420	or	450	mm

Use

Dlx	D10-	250
Dly	D10-	250
Dtx	D10-	250
Dty	D10-	250

Shrinkage reinforcement field and support		
As	50.26548246	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	179.5195802	mm
spacing use, s use	175	mm

B.14.3 Slab H1

Dimension

Lx = Short Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln x	3500	mm	
Type	Exterior		

Ly = Long Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln y	3500	mm	
Type	Exterior		

ly/lx	1
Slab Type	Two Way Slab

Properties		
Concrete Unit Weight	25	kN
fy	400	mpa
conc cover	20	mm
D shrinkage	8	mm
f'c	30	mpa
Dlx	10	mm
Dly	10	mm
Dtx	10	mm
Dty	10	mm

Load		
Live Load	4.79	kN
Self Weight	3.5	kN/m2
Reinforced		
Ceramic	0.2	kN/m2
Ceiling	0.18	kN/m2
Total DL	3.88	kN/m2
Comb Load 1.2D + 1.6L	12.32	kN/m2

Center of Gravity and Inertia

Lx	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Ly	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Inertia of Slab

ip1	914666666.7	mm4
ip2	914666666.7	mm4

ip1	914666666.7	mm4
ip2	914666666.7	mm4

$\alpha 1$	30.1541	
$\alpha 2$	30.1541	
αfm	30.1541	
beta	1.0000	
min h value	84.4444	mm

OK slab thickness>h min

$\alpha 1$	30.1541	
$\alpha 1$	30.1541	
αfm	30.1541	
beta	1.0000	
min h value	84.4444	mm

OK slab thickness>h min

Moment Calculation

mlx	0.1971	x	21	4.13952	kNm
mly	0.1971	x	21	4.13952	kNm
mtx	0.1971	x	52	10.25024	kNm
mty	0.1971	x	52	10.25024	kNm

Shear Stregth

Vu	40.16628	kN
	40166.28	N
dx	766	mm
ØVc	267466.6179	N
	267.4666	kN

OK ØVc>Vu

Coefficient of Flexural Resistance

dy	758	mm
klx	0.0157	
kly	0.0160	
ktx	0.0388	
kty	0.0396	

Reinforcement Ratio

β_1	0.8357	2019 table 22.2.2.4.3
plx	0.000039	
ply	0.000040	
ptx	0.000097	
pty	0.000099	
pmaks	0.022564	
biggest p	0.000099	

OK

Area of Steel

b	1000	mm
Ag	140000	
Asreqlx	30.0319	mm2
Asreqly	30.3490	mm2
Asreqtx	74.3984	mm2
Asreqty	75.1848	mm2

Asuselx	280	mm2
Asusely	280	mm2
Asusetx	280	mm2
Asusety	280	mm2
Asmin short span	280	mm2
Asmin long span	280	mm2

Moment Strength

alx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	4.1395	kNm

Safe

aly	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	4.1395	kNm

Safe

aty	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	10.2502	kNm

Safe

atx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	10.2502	kNm

Safe

Spacings

slx	280.4993441	mm
sly	280.4993441	mm
stx	280.4993441	mm
sty	280.4993441	mm

Max spacing				
3h	420	or	450	mm

Use

Dlx	D10-	250
Dly	D10-	250
Dtx	D10-	250
Dty	D10-	250

Shrinkage reinforcement field and support		
As	50.26548246	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	179.5195802	mm
spacing use, s use	175	mm

B.14.4 Slab I3

Dimension

Lx = Short Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln x	3500	mm	
Type	Interior		

Ly = Long Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln y	3500	mm	
Type	Interior		

ly/lx	1
Slab Type	Two Way Slab

Properties		
Concrete Unit Weight	25	kN
fy	400	mpa
conc cover	20	mm
D shrinkage	8	mm
f'c	30	mpa
Dlx	10	mm
Dly	10	mm
Dtx	10	mm
Dty	10	mm

Load		
Live Load	4.79	kN
Self Weight	3.5	kN/m2
Reinforced		
Ceramic	0.2	kN/m2
Ceiling	0.18	kN/m2
Total DL	3.88	kN/m2
Comb Load 1.2D + 1.6L	12.32	kN/m2

Center of Gravity and Inertia

Lx	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Ly	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Inertia of Slab

ip1	914666666.7	mm4
ip2	914666666.7	mm4

ip1	914666666.7	mm4
ip2	914666666.7	mm4

$\alpha 1$	37.1727	
$\alpha 2$	37.1727	
αfm	37.1727	
beta	1.0000	
min h value	84.4444	mm

OK slab thickness>h min

$\alpha 1$	37.1727	
$\alpha 1$	37.1727	
αfm	37.1727	
beta	1.0000	
min h value	84.4444	mm

OK slab thickness>h min

Moment Calculation

mlx	0.1971	x	21	4.13952	kNm
mly	0.1971	x	21	4.13952	kNm
mtx	0.1971	x	52	10.25024	kNm
mty	0.1971	x	52	10.25024	kNm

Shear Stregth

Vu	40.16628	kN
	40166.28	N
dx	766	mm
ØVc	267466.6179	N
	267.4666	kN

OK ØVc>Vu

Coefficient of Flexural Resistance

dy	758	mm
klx	0.0157	
kly	0.0160	
ktx	0.0388	
kty	0.0396	

Reinforcement Ratio

β_1	0.8357	2019 table 22.2.2.4.3
plx	0.000039	
ply	0.000040	
ptx	0.000097	
pty	0.000099	
pmaks	0.022564	
biggest p	0.000099	

OK

Area of Steel

b	1000	mm
Ag	140000	
Asreqlx	30.0319	mm2
Asreqly	30.3490	mm2
Asreqtx	74.3984	mm2
Asreqty	75.1848	mm2

Asuselx	280	mm2
Asusely	280	mm2
Asusetx	280	mm2
Asusety	280	mm2
Asmin short span	280	mm2
Asmin long span	280	mm2

Moment Strength

alx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	4.1395	kNm

Safe

aly	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	4.1395	kNm

Safe

aty	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	10.2502	kNm

Safe

atx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	10.2502	kNm

Safe

Spacings

slx	280.4993441	mm
sly	280.4993441	mm
stx	280.4993441	mm
sty	280.4993441	mm

Max spacing				
3h	420	or	450	mm

Use

Dlx	D10-	250
Dly	D10-	250
Dtx	D10-	250
Dty	D10-	250

Shrinkage reinforcement field and support		
As	50.26548246	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	179.5195802	mm
spacing use, s use	175	mm

B.14.5 Slab A1

Dimension

Lx = Short Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	2500	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln x	2000	mm	
Type	Interior		

Ly = Long Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln y	3500	mm	
Type	Interior		

ly/lx	1.6
Slab Type	Two Way Slab

Properties		
Concrete Unit Weight	25	kN
fy	400	mpa
conc cover	20	mm
D shrinkage	8	mm
f'c	30	mpa
Dlx	10	mm
Dly	10	mm
Dtx	10	mm
Dty	10	mm

Load		
Live Load	4.79	kN
Self Weight	3.5	kN/m2
Reinforced		
Ceramic	0.2	kN/m2
Ceiling	0.18	kN/m2
Total DL	3.88	kN/m2
Comb Load 1.2D + 1.6L	12.32	kN/m2

Center of Gravity and Inertia

Lx	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Ly	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Inertia of Slab

ip1	914666666.7	mm4
ip2	571666666.7	mm4

ip1	571666666.7	mm4
ip2	914666666.7	mm4

$\alpha 1$	37.1727	
$\alpha 2$	59.4764	
αfm	48.3246	
beta	0.5714	
min h value	52.7778	mm

OK slab thickness>h min

$\alpha 1$	59.4764	
$\alpha 1$	37.1727	
αfm	48.3246	
beta	0.5714	
min h value	92.3611	mm

OK slab thickness>h min

Moment Calculation

mlx	0.0770	x	45	3.465	kNm
mly	0.1971	x	21	4.13952	kNm
mtx	0.0770	x	94	7.238	kNm
mty	0.1971	x	64	12.61568	kNm

Shear Stregth

Vu	22.95216	kN
	22952.16	N
dx	766	mm
ØVc	267466.6179	N
	267.4666	kN

OK ØVc>Vu

Coefficient of Flexural Resistance

dy	758	mm
klx	0.0131	
kly	0.0160	
ktx	0.0274	
kty	0.0488	

Reinforcement Ratio

β_1	0.8357	2019 table 22.2.2.4.3
plx	0.000033	
ply	0.000040	
ptx	0.000069	
pty	0.000122	
pmaks	0.022564	
biggest p	0.000122	

OK

Area of Steel

b	1000	mm
Ag	140000	
Asreqlx	25.1370	mm2
Asreqly	30.3490	mm2
Asreqtx	52.5232	mm2
Asreqty	92.5518	mm2

Asuselx	280	mm2
Asusely	280	mm2
Asusetx	280	mm2
Asusety	280	mm2
Asmin short span	280	mm2
Asmin long span	280	mm2

Moment Strength

alx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	3.4650	kNm

Safe

aly	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	4.1395	kNm

Safe

aty	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	12.6157	kNm

Safe

atx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	12.6157	kNm

Safe

Spacings

slx	280.4993441	mm
sly	280.4993441	mm
stx	280.4993441	mm
sty	280.4993441	mm

Max spacing				
3h	420	or	450	mm

Use

Dlx	D10-	250
Dly	D10-	250
Dtx	D10-	250
Dty	D10-	250

Shrinkage reinforcement field and support		
As	50.26548246	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	179.5195802	mm
spacing use, s use	175	mm

B.14.6 Slab B1

Dimension

Lx = Short Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	3000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln x	2500	mm	
Type	Interior		

Ly = Long Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln y	3500	mm	
Type	Interior		

ly/lx	1.333333333
Slab Type	Two Way Slab

Properties		
Concrete Unit Weight	25	kN
fy	400	mpa
conc cover	20	mm
D shrinkage	8	mm
f'c	30	mpa
Dlx	10	mm
Dly	10	mm
Dtx	10	mm
Dty	10	mm

Load		
Live Load	4.79	kN
Self Weight	3.5	kN/m2
Reinforced		
Ceramic	0.2	kN/m2
Ceiling	0.18	kN/m2
Total DL	3.88	kN/m2
Comb Load 1.2D + 1.6L	12.32	kN/m2

Center of Gravity and Inertia

Lx	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Ly	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Inertia of Slab

ip1	914666666.7	mm4
ip2	686000000	mm4

ip1	686000000	mm4
ip2	914666666.7	mm4

$\alpha 1$	37.1727	
$\alpha 2$	49.5637	
αfm	43.3682	
beta	0.7143	
min h value	63.9731	mm

OK slab thickness>h min

$\alpha 1$	49.5637	
$\alpha 1$	37.1727	
αfm	43.3682	
beta	0.7143	
min h value	89.5623	mm

OK slab thickness>h min

Moment Calculation

mlx	0.1109	x	34.33333333	3.80688	kNm
mly	0.1971	x	21	4.13952	kNm
mtx	0.1109	x	75.33333333	8.35296	kNm
mty	0.1971	x	58.66666667	11.56437333	kNm

Shear Stregth

Vu	28.6902	kN
	28690.2	N
dx	766	mm
ØVc	267466.6179	N
	267.4666	kN

OK ØVc>Vu

Coefficient of Flexural Resistance

dy	758	mm
klx	0.0144	
kly	0.0160	
ktx	0.0316	
kty	0.0447	

Reinforcement Ratio

β_1	0.8357	2019 table 22.2.2.4.3
plx	0.000036	
ply	0.000040	
ptx	0.000079	
pty	0.000112	
pmaks	0.022564	
biggest p	0.000112	

OK

Area of Steel

b	1000	mm
Ag	140000	
Asreqlx	27.6179	mm2
Asreqly	30.3490	mm2
Asreqtx	60.6190	mm2
Asreqty	84.8324	mm2

Asuselx	280	mm2
Asusely	280	mm2
Asusetx	280	mm2
Asusety	280	mm2
Asmin short span	280	mm2
Asmin long span	280	mm2

Moment Strength

alx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	3.8069	kNm

Safe

aly	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	4.1395	kNm

Safe

aty	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	11.5644	kNm

Safe

atx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	11.5644	kNm

Safe

Spacings

slx	280.4993441	mm
sly	280.4993441	mm
stx	280.4993441	mm
sty	280.4993441	mm

Max spacing				
3h	420	or	450	mm

Use

Dlx	D10-	250
Dly	D10-	250
Dtx	D10-	250
Dty	D10-	250

Shrinkage reinforcement field and support		
As	50.26548246	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	179.5195802	mm
spacing use, s use	175	mm

B.14.7 Slab L3

Dimension

Lx = Short Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	1000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln x	500	mm	
Type	Interior		

Ly = Long Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln y	3500	mm	
Type	Interior		

ly/lx	4
Slab Type	One Way Slab

Properties		
Concrete Unit Weight	25	kN/m3
fy	400	mpa
conc cover	20	mm
D reinforcement	10	mm
D shrinkage	10	mm
f'c	30	mpa
λ	1	
β	0.835714286	

Load			
Live Load	19.16	kN/m	4.79
Self Weight	14	kN/m	
Reinforced			
Ceramic	0.8	kN/m	
Ceiling	0.72	kN/m	
Total DL	15.52	kN/m	
Comb Load 1.2D + 1.6L	49.28	kN/m	

Slab width, b	1000	mm	assumption
Effective depth, d	115	mm	
s			
Ag	140000	mm2	

Minimum thickness		
Type	Simple Support	
h min	50	mm
h use	140	mm

Ultimate Load			
Moment (+), Mu	0.77	kNm	Table 6.5.2
Moment (-), Mu	1.232	kNm	
Shear, Vu	12.32	kN	Table 6.5.4

$\emptyset Vc$	80.30981999	kN	Eq 22.5.5.1
Check $\emptyset Vc$>Vu	OK		

Flexural Resistance Coefficient	
k (field)	0.064692292
k (support)	0.103507666

Reinforcement Ratio Field	
	0.002540179
ρ	0.000161936
Check	OK

Reinforcement Ratio Support	
	0.004067396
ρ	0.000259296
ρmax	0.019179643
Check	OK

Required Flexural Strength Field		
Asreq	18.62268629	mm2
Asmin	280	mm2
As use	280	mm2

Required Flexural Strength Support		
Asreq	29.81909714	mm2
Asmin	280	mm2
As use	280	mm2

Moment Strength Field		
c	5.255572314	mm
al	2.196078431	mm
Mn	12.63403922	kNm
0.9Mn	11.37063529	kNm
Check 0.9Mn>Mu	OK	

Moment Strength Support		
c	5.255572314	mm
al	2.196078431	mm
Mn	12.63403922	kNm
0.9Mn	11.37063529	kNm
Check 0.9Mn>Mu	OK	

Maximum Spacing Support					
s	280.4993441	mm			
smax	420	mm	or	450	mm
	275	mm			

Maximum Spacing Field					
s	280.4993441	mm			
smax	420	mm	or	450	mm
	275	mm			

Shrinkage reinforcement field and support		
As	78.53981634	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	280.4993441	mm
spacing use, s use	275	mm

Recap		
Flexural Reinforcement	Field	D10-275
	Support	D10-275
Shrinkage Reinforcement	Field and Support	D10-275

B.14.8 Slab F2 (Third Story)

Dimension

Lx = Short Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	2000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln x	1500	mm	
Type	Interior		

Ly = Long Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln y	3500	mm	
Type	Interior		

ly/lx	2
Slab Type	Two Way Slab

Properties		
Concrete Unit Weight	25	kN
fy	400	mpa
conc cover	20	mm
D shrinkage	8	mm
f'c	30	mpa
Dlx	10	mm
Dly	10	mm
Dtx	10	mm
Dty	10	mm

Load		
Live Load	4.79	kN
Self Weight	3.5	kN/m2
Reinforced		
Ceramic	0.2	kN/m2
Ceiling	0.18	kN/m2
Total DL	3.88	kN/m2
Comb Load 1.2D + 1.6L	12.32	kN/m2

Center of Gravity and Inertia

Lx	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Ly	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Inertia of Slab

ip1	914666666.7	mm4
ip2	457333333.3	mm4

ip1	457333333.3	mm4
ip2	914666666.7	mm4

$\alpha 1$	37.1727	
$\alpha 2$	74.3455	
αfm	55.7591	
beta	0.4286	
min h value	40.8602	mm

OK slab thickness>h min

$\alpha 1$	74.3455	
$\alpha 1$	37.1727	
αfm	55.7591	
beta	0.4286	
min h value	95.3405	mm

OK slab thickness>h min

Moment Calculation

mlx	0.0493	x	61	3.00608	kNm
mly	0.1971	x	21	4.13952	kNm
mtx	0.0493	x	122	6.01216	kNm
mty	0.1971	x	72	14.19264	kNm

Shear Stregth

Vu	17.21412	kN
	17214.12	N
dx	766	mm
ØVc	267466.6179	N
	267.4666	kN

OK ØVc>Vu

Coefficient of Flexural Resistance

dy	758	mm
klx	0.0114	
kly	0.0160	
ktx	0.0228	
kty	0.0549	

Reinforcement Ratio

β_1	0.8357	2019 table 22.2.2.4.3
plx	0.000028	
ply	0.000040	
ptx	0.000057	
pty	0.000137	
pmaks	0.022564	
biggest p	0.000137	

OK

Area of Steel

b	1000	mm
Ag	140000	
Asreqlx	21.8070	mm2
Asreqly	30.3490	mm2
Asreqtx	43.6238	mm2
Asreqty	104.1333	mm2

Asuselx	280	mm2
Asusely	280	mm2
Asusetx	280	mm2
Asusety	280	mm2
Asmin short span	280	mm2
Asmin long span	280	mm2

Moment Strength

alx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	3.0061	kNm

Safe

aly	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	4.1395	kNm

Safe

aty	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	14.1926	kNm

Safe

atx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	14.1926	kNm

Safe

Spacings

slx	280.4993441	mm
sly	280.4993441	mm
stx	280.4993441	mm
sty	280.4993441	mm

Max spacing				
3h	420	or	450	mm

Use

Dlx	D10-	250
Dly	D10-	250
Dtx	D10-	250
Dty	D10-	250

Shrinkage reinforcement field and support		
As	50.26548246	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	179.5195802	mm
spacing use, s use	175	mm

B.14.9 Slab C1

Dimension

Lx = Short Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	3500	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln x	3000	mm	
Type	Interior		

Ly = Long Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln y	3500	mm	
Type	Interior		

ly/lx	1.142857143
Slab Type	Two Way Slab

Properties		
Concrete Unit Weight	25	kN
fy	400	mpa
conc cover	20	mm
D shrinkage	8	mm
f'c	30	mpa
Dlx	10	mm
Dly	10	mm
Dtx	10	mm
Dty	10	mm

Load		
Live Load	4.79	kN
Self Weight	3.5	kN/m2
Reinforced		
Ceramic	0.2	kN/m2
Ceiling	0.18	kN/m2
Total DL	3.88	kN/m2
Comb Load 1.2D + 1.6L	12.32	kN/m2

Center of Gravity and Inertia

Lx	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Ly	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Inertia of Slab

ip1	914666666.7	mm4
ip2	800333333.3	mm4

ip1	800333333.3	mm4
ip2	914666666.7	mm4

$\alpha 1$	37.1727	
$\alpha 2$	42.4831	
αfm	39.8279	
beta	0.8571	
min h value	74.5098	mm

OK slab thickness>h min

$\alpha 1$	42.4831	
$\alpha 1$	37.1727	
αfm	39.8279	
beta	0.8571	
min h value	86.9281	mm

OK slab thickness>h min

Moment Calculation

mlx	0.1509	x	26.71428571	4.03172	kNm
mly	0.1971	x	21	4.13952	kNm
mtx	0.1509	x	62	9.35704	kNm
mty	0.1971	x	54.85714286	10.81344	kNm

Shear Stregth

Vu	34.42824	kN
	34428.24	N
dx	766	mm
ØVc	267466.6179	N
	267.4666	kN

OK ØVc>Vu

Coefficient of Flexural Resistance

dy	758	mm
klx	0.0153	
kly	0.0160	
ktx	0.0354	
kty	0.0418	

Reinforcement Ratio

β_1	0.8357	2019 table 22.2.2.4.3
plx	0.000038	
ply	0.000040	
ptx	0.000089	
pty	0.000105	
pmaks	0.022564	
biggest p	0.000105	

OK

Area of Steel

b	1000	mm
Ag	140000	
Asreqlx	29.2495	mm2
Asreqly	30.3490	mm2
Asreqtx	67.9109	mm2
Asreqty	79.3193	mm2

Asuselx	280	mm2
Asusely	280	mm2
Asusetx	280	mm2
Asusety	280	mm2
Asmin short span	280	mm2
Asmin long span	280	mm2

Moment Strength

alx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	4.0317	kNm

Safe

aly	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	4.1395	kNm

Safe

aty	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	10.8134	kNm

Safe

atx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	10.8134	kNm

Safe

Spacings

slx	280.4993441	mm
sly	280.4993441	mm
stx	280.4993441	mm
sty	280.4993441	mm

Max spacing				
3h	420	or	450	mm

Use

Dlx	D10-	250
Dly	D10-	250
Dtx	D10-	250
Dty	D10-	250

Shrinkage reinforcement field and support		
As	50.26548246	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	179.5195802	mm
spacing use, s use	175	mm

B.14.10 Exterior Roof Slab

Dimension

Lx = Short Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln x	3500	mm	
Type	Exterior		

Ly = Long Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln y	3500	mm	
Type	Exterior		

ly/lx	1
Slab Type	Two Way Slab

Properties		
Concrete Unit Weight	25	kN
fy	400	mpa
conc cover	20	mm
D shrinkage	8	mm
f'c	30	mpa
Dlx	10	mm
Dly	10	mm
Dtx	10	mm
Dty	10	mm

d_h = tambahan kedalaman air pada atap yang tidak melendut di atas lubang masuk sistem drainase sekunder pada aliran desainnya (yakni, kepala hidraulik), dalam in. (mm)

d_s = kedalaman air pada atap yang tidak melendut meningkat ke lubang masuk sistem drainase sekunder apabila sistem drainase primer tertutup (yakni, tinggi statis), dalam in. (mm)

R = beban air hujan pada atap yang tidak melendut, dalam lb/ft² (kN/m²). Apabila istilah "atap yang tidak melendut" digunakan, lendutan dari beban (termasuk beban mati) tidak perlu diperhitungkan ketika menentukan jumlah air hujan pada atap.

$$R = 0,0098\,(d_s + d_h)$$

0.12

Load		
Live Load	1.92	kN
Self Weight	3.5	kN/m2
Rain Load	0.5	kN/m2
Ceramic	0.2	kN/m2
Ceiling	0.18	kN/m2
Total DL	4.38	kN/m2
Comb Load 1.2D + 1.6L	8.328	kN/m2

Kategori Curah Hujan		
Rendah	0 - 10	mm
Menengah	10 - 30	mm
Tinggi	30 - 50	mm
Sangat Tinggi	>50	mm

ϒw	1000	kg/m3
ds	40	mm
dh	10	mm

Center of Gravity and Inertia

Lx	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Ly	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Inertia of Slab

ip1	914666666.7	mm4
ip2	914666666.7	mm4

ip1	914666666.7	mm4
ip2	914666666.7	mm4

$\alpha 1$	30.1541	
$\alpha 2$	30.1541	
αfm	30.1541	
beta	1.0000	
min h value	84.4444	mm

OK slab thickness>h min

$\alpha 1$	30.1541	
$\alpha 1$	30.1541	
αfm	30.1541	
beta	1.0000	
min h value	84.4444	mm

OK slab thickness>h min

Moment Calculation

mlx	0.1332	x	21	2.798208	kNm
mly	0.1332	x	21	2.798208	kNm
mtx	0.1332	x	52	6.928896	kNm
mty	0.1332	x	52	6.928896	kNm

Shear Stregth

Vu	27.151362	kN
	27151.362	N
dx	766	mm
∅Vc	267466.6179	N
	267.4666	kN

OK ∅Vc>Vu

Coefficient of Flexural Resistance

dy	758	mm
klx	0.0106	
kly	0.0108	
ktx	0.0262	
kty	0.0268	

Reinforcement Ratio

β_1	0.8357	2019 table 22.2.2.4.3
plx	0.000026	
ply	0.000027	
ptx	0.000066	
pty	0.000067	
pmaks	0.022564	
biggest p	0.000067	

OK

Area of Steel

b	1000	mm
Ag	140000	
Asreqlx	20.2987	mm2
Asreqly	20.5131	mm2
Asreqtx	50.2790	mm2
Asreqty	50.8102	mm2

Asuselx	280	mm2
Asusely	280	mm2
Asusetx	280	mm2
Asusety	280	mm2
Asmin short span	280	mm2
Asmin long span	280	mm2

Moment Strength

alx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	2.7982	kNm

Safe

aly	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	2.7982	kNm

Safe

aty	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	6.9289	kNm

Safe

atx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	6.9289	kNm

Safe

Spacings

slx	280.4993441	mm
sly	280.4993441	mm
stx	280.4993441	mm
sty	280.4993441	mm

Max spacing				
3h	420	or	450	mm

Use

Dlx	D10-	250
Dly	D10-	250
Dtx	D10-	250
Dty	D10-	250

Shrinkage reinforcement field and support		
As	50.26548246	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	179.5195802	mm
spacing use, s use	175	mm

B.14.11 Interior Roof Slab

Dimension

Lx = Short Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
lx	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln x	3500	mm	
Type	Interior		

Ly = Long Span			
bw	500	mm	beam width
hf	140	mm	flange depth or slab thickness
ly	4000	mm	
hw	650	mm	web height or beam height
ht	790	mm	total depth = hf+hw
ln y	3500	mm	
Type	Interior		

ly/lx	1
Slab Type	Two Way Slab

Properties		
Concrete Unit Weight	25	kN
fy	400	mpa
conc cover	20	mm
D shrinkage	8	mm
f'c	30	mpa
Dlx	10	mm
Dly	10	mm
Dtx	10	mm
Dty	10	mm

Load		
Live Load	1.92	kN
Self Weight	3.5	kN/m2
Rain Load	0.5	kN/m2
Ceramic	0.2	kN/m2
Ceiling	0.18	kN/m2
Total DL	4.38	kN/m2
Comb Load 1.2D + 1.6L	8.328	kN/m2

Center of Gravity and Inertia

Lx	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Ly	Interior	
A1	325000	mm2
A2	252000	mm2
y1	325	mm
y2	720	mm
Be1	1800	mm
Be2	1620	mm
Be used	1620	mm
y	497.5129983	mm
Ib	34000664486	mm4

Inertia of Slab

ip1	914666666.7	mm4
ip2	914666666.7	mm4

$\alpha 1$	37.1727	
$\alpha 2$	37.1727	
αfm	37.1727	
beta	1.0000	
min h value	84.4444	mm

OK slab thickness>h min

ip1	914666666.7	mm4
ip2	914666666.7	mm4

$\alpha 1$	37.1727	
$\alpha 1$	37.1727	
αfm	37.1727	
beta	1.0000	
min h value	84.4444	mm

OK slab thickness>h min

Moment Calculation

mlx	0.1332	x	21	2.798208	kNm
mly	0.1332	x	21	2.798208	kNm
mtx	0.1332	x	52	6.928896	kNm
mty	0.1332	x	52	6.928896	kNm

Shear Stregth

Vu	27.151362	kN
	27151.362	N
dx	766	mm
ØVc	267466.6179	N
	267.4666	kN

OK ØVc>Vu

Coefficient of Flexural Resistance

dy	758	mm
klx	0.0106	
kly	0.0108	
ktx	0.0262	
kty	0.0268	

Reinforcement Ratio

β_1	0.8357	2019 table 22.2.2.4.3
plx	0.000026	
ply	0.000027	
ptx	0.000066	
pty	0.000067	
pmaks	0.022564	
biggest p	0.000067	

OK

Area of Steel

b	1000	mm
Ag	140000	
Asreqlx	20.2987	mm2
Asreqly	20.5131	mm2
Asreqtx	50.2790	mm2
Asreqty	50.8102	mm2

Asuselx	280	mm2
Asusely	280	mm2
Asusetx	280	mm2
Asusety	280	mm2
Asmin short span	280	mm2
Asmin long span	280	mm2

Moment Strength

alx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	2.7982	kNm

Safe

aly	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	2.7982	kNm

Safe

aty	8.784313725	mm
Mny	84404078.43	Nmm
0.9Mn	75963670.59	Nmm
	75.96367059	kNm
>	6.9289	kNm

Safe

atx	8.784313725	mm
Mnx	85300078.43	Nmm
0.9Mn	76770070.59	Nmm
	76.77007059	kNm
>	6.9289	kNm

Safe

Spacings

slx	280.4993441	mm
sly	280.4993441	mm
stx	280.4993441	mm
sty	280.4993441	mm

Max spacing				
3h	420	or	450	mm

Use

Dlx	D10-	250
Dly	D10-	250
Dtx	D10-	250
Dty	D10-	250

Shrinkage reinforcement field and support		
As	50.26548246	mm2
Asmin	280	mm2
As use	280	mm2
spacing, s	179.5195802	mm
spacing use, s use	175	mm

B.15 Stairs Design

Stair Properties		
Hlt	4	m
w stair	2	m
w Landing Slab	2	m
Optrede (OP)	0.16	m
Antrede (An)	0.3	m
Number of stair (Ntg)	24	stairs
Stair length (Ltg)	2.88	m
Stair slope (α)	28.07248694	°
Thickness of stair slab, ts	0.15	m
Equivalent thickness of stair (tt)	0.070588235	m
Total equivalent of stair (t')	0.25	m
Weight of concrete (wc)	24	kN/m3
Weight of tile (wt)	21	kN/m3
Weight of cement (wcm)	14.1264	kN/m3
Tiles thickness (ttl)	0.05	m
Plaster Thickness (tp)	0.03	m
Railing length (lr)	2.88	m
Railing unit weight (wr)	0.09375157	kN/m
Railing glass ver (agl)	2.88	m
Weight of railing glass (wgl)	0.08	kN/m2
Stair Loading		
Dead Load		
Slab weight	6	kN/m2
Tiles and specific weight	1.05	kN/m2
Railing weight	0.32415157	kN/m
qD	7.37415157	kN/m
Live Load		
qL	4.79	kN/m2

Landing Slab Properties			
Landing Slab long span (Ly)	=	2	m
Landing Slab short span (Lx)	=	2	m
Landing Slab thickness (hb)	=	160	mm
d reinforcement support (dbs)	=	13	mm
d reinforcement span (dbf)	=	13	mm
d distribution/shrinkage (dsh)	=	8	mm
concrete cover (cc)	=	40	mm
d	hb-cc-1/2*db =	113.5	mm
Fc	=	30	MPa
Fy main	=	400	MPa
Fy distribution	=	400	MPa
Es	=	200000	MPa
Light brick Unit Weight	=	650	kg/m3
		6.3765	kN/m3
β	=	0.83571429	
ϵty main	Fy main/Es =	0.002	
ϵty main	Fy distr/Es =	0.002	
Landing Slab Loading			
Dead Load			
Slab weight	ts*wc =	3.6	kN/m2
Tiles and Plaster Weight	ttl*wt+tp*wcm =	1.473792	kN/m2
Total Dead Load (qD)		5.073792	kN/m2
Wall Height	=	0.96	m
Wall Thickness	=	0.15	m
Wall Weight	=	0.918216	kN/m
Live Load	=	4.79	kN/m2
Total			
Landing Slab Internal Force			
Vu	Modeling Software =	38.79	kN
Mu support	Modeling Software =	26.7	kNm
Mu span	=	1.36	kNm

Landing Slab Support Reinforcement			
Rn	Mu/(0.9*bw*d^2) =	2.30291034	MPa
ρmin	=	0.0018	
ρneed	0.85*fc/fy*(1-sqrt(1-2*Rn/(0.85*fc))) =	0.00604376	
ρmax	0.85*fc*beta/fy*(600/(600+fy)) =	0.03196607	
ρuse	=	0.00604376	
As min	0.002Ag or max(0.0018*420/fy*Ag,0.0014Ag)	302.4	mm2
As need	ρ*b*d =	685.967059	mm2
As		685.967059	mm2
spacing, s	pi()/4*dbs^2*b/(As) =	193.496594	mm
spacing, s	=	175	mm
As use	pi()/4*db^2*b/s =	758.470226	mm2
c	As*fy/(0.85*fc*β*b) =	14.2364112	mm
a	β*c =	11.8975722	mm
Mn	As*fy*(d-a/2) =	32629757.4	Nmm
εt	0.003/c*(d-c) =	0.02091754	
ϕ	Table 21.2.2 SNI 2847	0.9	
ϕMn	=	29366781.7	Nmm
	=	29.3667817	kNm
Check ϕMn>Mu		Safe	
Landing Slab span Reinforcement			
Rn	Mu/(0.9*bw*d^2) =	0.1173018	MPa
ρmin	=	0.0018	
ρneed	0.85*fc/fy*(1-sqrt(1-2*Rn/(0.85*fc))) =	0.00029393	
ρmax	0.85*fc*beta/fy*(600/(600+fy)) =	0.03196607	
ρuse	=	0.0018	
As min	0.002Ag or max(0.0018*420/fy*Ag,0.0014Ag)	302.4	mm2
As need	ρ*b*d =	204.3	mm2
As	=	302.4	mm2
spacing, s	pi()/4*dbf^2*b/(As) =	438.929529	mm
spacing, s	=	425	mm
As use	pi()/4*dbf^2*b/s =	312.31127	mm2
c	As*fy/(0.85*fc*β*b) =	5.86205165	mm
a	β*c =	4.89900031	mm
Mn	As*fy*(d-a/2) =	13872929	Nmm
εt	0.003/c*(d-c) =	0.05508547	
ϕ	Table 21.2.2 SNI 2847	0.9	
ϕMn	=	12485636.1	Nmm
	=	12.4856361	kNm
Check ϕMn>Mu		Safe	

Distribution/Shrinkage Bar Reinforcement			
ρmin	Table 7.6.1.1 SNI =	0.002	
As min	ρ*b*h =	302.4	mm2
spacing, s	pi()/4*dsh^2*b/(As min) =	166.221834	mm
spacing, s	=	150	mm
As use	pi()/4*dsh^2*b/s =	335.103216	mm2
Landing Slab Beam			
b	=	200	mm
h	=	200	mm
Ag	b*h =	40000	mm2
Fc	=	30	MPa
Ec	4700*sqrt(fc) =	25742.9602	MPa
Fy	=	420	MPa
Es	=	200000	MPa
ety	fy/Es =	0.0021	
db support	=	19	mm
db span	=	19	mm
dv	=	8	mm
cc	=	40	mm
d	=	142.5	mm
β	=	0.83571429	
λ	=	1	
Beam Load			
Tile and Plester		1.473792	kN/m
Wall Weight	=	0.918216	kN/m
Live Load	=	4.79	kN/m2
Total Live	=	9.58	kN/m
Internal Load			
Mu Support	=	26.7	kNm
Mu Span	=	13.36	kNm
Vu support	=	38.79	kN
Vu span	=	19.49	kN
Flexural Reinforcement			
Support			
Rn	Mu/(0.9*bw*d^2) =	7.30481174	MPa
ρmin	=	0.002	
ρneed	0.85*fc/fy*(1-sqrt(1-2*Rn/(0.85*fc))) =	0.02103697	
ρmax	0.85*fc*beta/fy*(600/(600+fy)) =	0.02984694	
ρuse	=	0.02103697	
As min	0.002Ag or max(0.0018*420/fy*Ag,0.0014Ag)	72	mm2
As need	ρ*b*d =	599.553738	mm2
As	=	599.553738	mm2
nb	As/(pi()/4*db^2) =	2.11461365	
		4	
As use	nb*pi()/4*db^2 =	1134.11495	mm2
c	As*fy/(0.85*fc*β*b) =	111.757934	mm
a	β*c =	93.3977016	mm
Mn	As*fy*(d-a/2) =	45632796.4	Nmm
εt	0.003/c*(d-c) =	0.00082523	
ϕ	Table 21.2.2 SNI 2847	0.65	
ϕMn	=	29661317.7	Nmm
	=	29.6613177	kNm
Check ϕMn>Mu		Safe	
Span			
Rn	Mu/(0.9*bw*d^2) =	3.65514175	MPa
ρmin	=	0.002	
ρneed	0.85*fc/fy*(1-sqrt(1-2*Rn/(0.85*fc))) =	0.00943597	
ρmax	0.85*fc*beta/fy*(600/(600+fy)) =	0.02984694	
ρuse	=	0.00943597	
As min	0.002Ag or max(0.0018*420/fy*Ag,0.0014Ag)	72	mm2
As need	ρ*b*d =	268.925101	mm2
As	=	268.925101	mm2
nb	As/(pi()/4*db^2) =	0.94849328	
		4	
As use	nb*pi()/4*db^2 =	1134.11495	mm2
c	As*fy/(0.85*fc*β*b) =	111.757934	mm
a	β*c =	93.3977016	mm
Mn	As*fy*(d-a/2) =	45632796.4	Nmm
εt	0.003/c*(d-c) =	0.00082523	
ϕ	Table 21.2.2 SNI 2847	0.65	
ϕMn	=	29661317.7	Nmm
	=	29.6613177	kNm
Check ϕMn>Mu		Safe	

Shear Reinforcement Support			
ρw	As/(bw*d) =	0.03979351	
a)	(0.16*λ*sqrt(fc)+17*ρw*Vu*d/Mu)*bw*d =	28967.5865	N
b)	(0.16*λ*sqrt(fc)+17*ρw)*bw*d =	44256.1027	N
c)	0.29*λ*sqrt(fc)*bw*d =	45269.2694	N
Vc	min(a),b),c)) =	28967.5865	N
		28.9675865	kN
ϕVc	0.75*Vc =	21.7256899	kN
Check ϕVc>Vu	=	Not OK	
Vs	Vu-Vc =	9.82241346	kN
		9822.41346	N
n legs	=	2	
s	n*Av*fy*d/Vs =	612.555995	mm
		600	mm
Vs use	n*Av*fy*d/s =	10027.9638	N
Vc+Vs	=	38995.5503	N
ϕ(Vc+Vs)	0.75*(Vc+Vs) =	29246.6627	N
		29.2466627	kN
Only if ϕVc>Vu --> use practical shear reinforcement			
min spacing, s			
SNI 18.6.4.4 b)	6*db =	114	mm
SNI 18.6.4.4 c)	150 mm	150	mm
		100	mm
Shear Reinforcement use		D8-100 mm	
Shear Reinforcement Span			
ρw	As/(bw*d) =	0.03979351	
a)	(0.16*λ*sqrt(fc)+17*ρw*Vu*d/Mu)*bw*d =	28984.135	N
b)	(0.16*λ*sqrt(fc)+17*ρw)*bw*d =	44256.1027	N
c)	0.29*λ*sqrt(fc)*bw*d =	45269.2694	N
Vc	min(a),b),c)) =	28984.135	N
		28.984135	kN
ϕVc	0.75*Vc =	21.7381013	kN
Check ϕVc>Vu	=	OK Vs=0	
Vs	Vu-Vc =	0	kN
		0	N
n legs	=	2	
s	n*Av*fy*d/Vs =	#DIV/0!	mm
		#DIV/0!	mm
Vs use	n*Av*fy*d/s =	#DIV/0!	N
Vc+Vs	=	#DIV/0!	N
ϕ(Vc+Vs)	0.75*(Vc+Vs) =	#DIV/0!	N
		#DIV/0!	kN
Only if ϕVc>Vu --> use practical shear reinforcement			
min spacing, s			
SNI 18.6.4.4 b)	6*db =	114	mm
SNI 18.6.4.4 c)	150 mm	150	mm
		100	mm
Shear Reinforcement use		D8-100 mm	

Support Reinforcement			
Mu	=	26.7	kNm
Vu	=	38.79	kN
db		16	mm
b		1000	mm
h		230.588235	mm
d	h-cc-dv-1/2db	174.588235	mm
Rn	Mu/(0.9*bw*d^2) =	0.97328225	MPa
ρneed	0.85*fc/fy*(1-sqrt(1-2*Rn/(0.85*fc))) =	0.00236334	
ρmax	0.85*fc*beta/fy*(600/(600+fy)) =	0.02984694	
As min	0.002Ag or max(0.0018*420/fy*Ag,0.0014Ag)	415.058824	mm2
As need	ρ*b*d	412.610614	mm2
Spacing	1000*0.25*π*db^2/As	487.29219	mm
Suse		450	mm
As use	1000*0.25*π*db^2/S	446.804289	mm2
c	As*fy/(0.85*fc*β*b) =	8.80579593	mm
a	β*c =	7.35912946	mm
Mn	As*fy*(d-a/2) =	32072345.3	Nmm
ϵt	0.003/c*(d-c) =	0.05647954	
ϕ	Table 21.2.2 SNI 2847	0.9	
ϕMn	=	28865110.8	Nmm
	=	28.8651108	kNm
Check ϕMn>Mu		Safe	
Check the shear force			
Vc	1/6*sqrt(fc)*bw*d =	159376.525	N
ϕ Vc	0.75*Vc =	119532.393	N
		119.532393	kN
Check		safe	
Shrinkage Reinforcement			
D		8	mm
ρmin	Table 7.6.1.1 SNI =	0.002	
As min	ρ*b*h =	435.811765	mm2
s	pi()/4*dsh^2*b/(As min) =	115.337599	mm
S used	=	100	mm
As use	pi()/4*dsh^2*b/s =	502.654825	mm2

Span Reinforcement			
Mu	=	13.36	kNm
Vu	=	19.49	kN
db		12	mm
b		1000	mm
h	tt+Optrade	230.588235	mm
d	h-cc-dv-1/2db	176.588235	mm
Rn	Mu/(0.9*bw*d^2) =	0.47603668	kN/m2
ρneed	0.85*fc/fy*(1-sqrt(1-2*Rn/(0.85*fc))) =	0.0011442	
ρmax	0.85*fc*beta/fy*(600/(600+fy)) =	0.02984694	
As min	0.002Ag or max(0.0018*420/fy*Ag,0.0014Ag)	415.058824	mm2
As need	ρ*b*d	202.052665	mm2
Spacing	1000*0.25*π*db^2/As	559.741865	mm
S use		550	mm
As use	1000*0.25*π*db^2/S	205.631519	mm2
c	As*fy/(0.85*fc*β*b) =	4.05266745	mm
a	β*c =	3.38687208	mm
Mn	As*fy*(d-a/2) =	14932100.5	Nmm
εt	0.003/c*(d-c) =	0.1262395	
ϕ	Table 21.2.2 SNI 2847	0.9	
ϕMn	=	13438890.4	Nmm
	=	13.4388904	kNm
Check ϕMn>Mu		Safe	
Check the shear force			
Vc	1/6*sqrt(fc)*bw*d =	161202.266	kN
ϕ Vc	0.75*Vc =	120901.7	kN
Check		safe	
Shrinkage Reinforcement			
D		8	mm
ρmin	Table 7.6.1.1 SNI =	0.002	
As min	ρ*b*h =	435.811765	mm2
S	pi()/4*dsh^2*b/(As min) =	115.337599	mm
S used	=	100	mm
As use	pi()/4*dsh^2*b/s =	502.654825	mm2

APPENDIX C

C. SUB-STRUCTURE APPENDIX

C.1 Soil Investigation Data

SOIL MECHANIC LABORATORY
CIVIL ENGINEERING PROGRAM
FACULTY OF ENGINEERING, UAJY
44 BABARSARI STREET, YOGYAKARTA 55281
Tel: +62-274-487711 ext. 1055
Fax: +62-274-487748

Boring Number:

BH-1

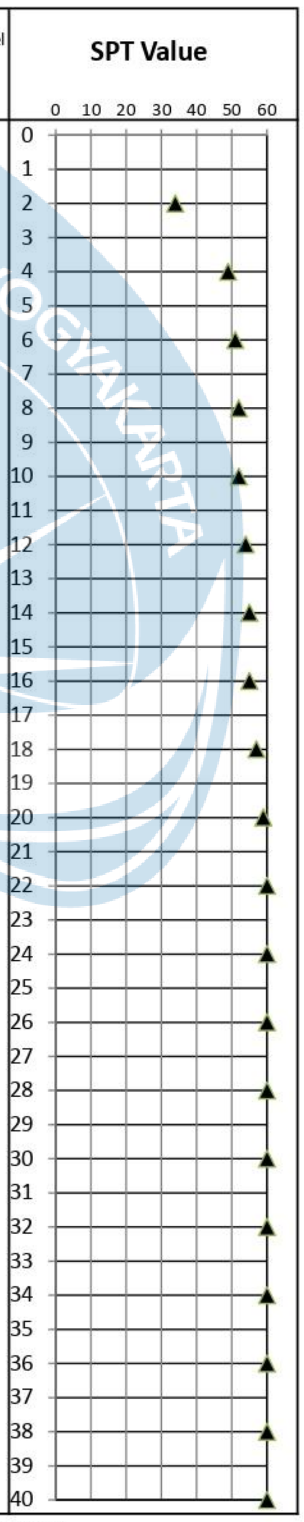
BOR LOG

CLIENT: YUSUF GOENAWAN
PROJECT CONTRACT NUMBER: 027/LMKT/FT.UAJY/11/2018
PROJECT TITLE :
PROJECT LOCATION :

DATE STARTED:
DATE COMPLETED :
DRILLING CONTRACTOR: SOIL MECH. LAB. UAJY
DRILLING METHOD: ROTARY SPINDLE, SKID MOUNTED TYPE
LOGGED BY: RIYANTO, CS.
CHECKED BY: SOIL MECH. LAB, UAJY

GROUND ELEVATION : + 1,50 m from road level
HOLE SIZE : 7.295cm
GROUND WATER LEVEL : - 15,00 m from ground level
WEATHER CONDITION : FINE
ESTIMATED SEASONAL HIGH : -

Depth (m)	Graph Log	Material Description (field observations)	Contact Depth (m)	Sample Number	Blow Counts (N Value)				Water Level Elevation (m)
					N_1	N_2	N_3	N_V	
1									
2					8	12	22	34	
3									
4					12	19	30	49	
5									
6					12	21	30	51	
7									
8					14	22	30	52	
9									
10		Pasir kasar (coklat)	18,5		14	21	31	52	
11									
12					14	23	31	54	
13									
14					16	24	31	55	
15				I					15.00
16					16	23	32	55	
17									
18					17	24	33	57	
19									
20					17	24	35	59	
21									
22					19	23	37	60	
23									
24					19	25	35	60	
25									
26					18	24	36	60	
27									
28					19	26	34	60	
29									
30		Pasir kasar padat (coklat)	21,5		19	25	35	60	
31									
32					20	27	33	60	
33									
34					20	23	37	60	
35									
36					22	25	35	60	
37									
38					22	25	35	60	
39									
40					22	28	32	60	



Catatan: Pada pengamatan di lapangan, lanau bisa tampak seperti pasir halus atau pasir sangat halus

Laboratorium Mekanika Tanah
UNIVERSITAS ATMA JAYA YOGYAKARTA
Fakultas Teknik - Program Studi Teknik Sipil
Jl. Babarsari No. 44 Yogyakarta 55281 Indonesia
Telp. +62-274-565411 ext. 2052, Fax. +62-274-487748

REKAP HASIL PENGUJIAN TANAH

Proyek :
Lokasi :
Tanggal :

Titik	Kedalaman (m)	Kadar Air (%)	Berat Jenis (G)	γ_b (gr/cm^3)	γ_k (gr/cm^3)	Pengujian Geser Langsung	
						c (kg/cm^2)	θ°
BH 1	15,00	31,18	2,69	1,63	1,24	0,00	26,55
BH 2		29,34	2,65	1,63	1,26	0,00	25,97

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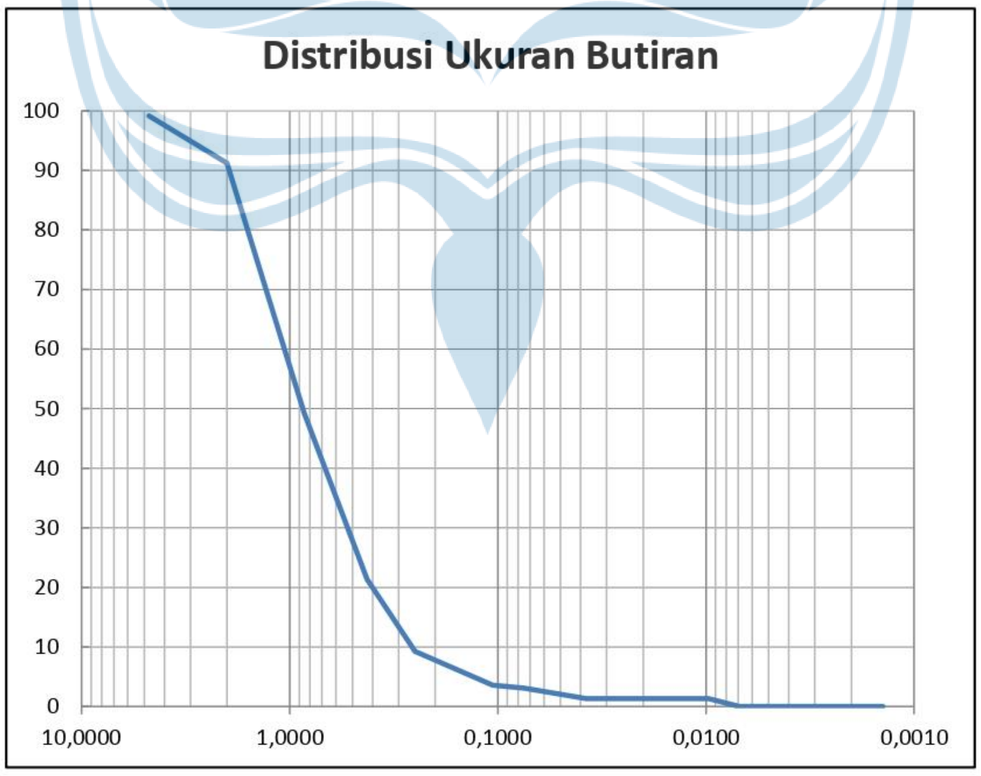
ANALISA BUTIRAN

Proyek :
Lokasi :
Tanggal :

Titik : BH 1
Kedalaman: 15



No. Sieve	Ukuran Butiran (mm)	Berat Tertahan	Berat Lolos	Prosen Lolos
4	4,750	0,83	99,17	99,17
10	2,000	7,96	91,21	91,21
20	0,850	42,01	49,20	49,20
40	0,425	27,87	21,33	21,33
60	0,250	12,08	9,25	9,25
140	0,106	5,69	3,56	3,56
200	0,075	0,45	3,11	3,11
Pan		3,11		

C.2 Liquefaction Analysis

Location	Depth	w (%)	G	γb (kN/m3)	γd (kN/m3)	c	f
BH1	15.00	31.18%	2.69	16.3	12.4	0	26.55
BH2	15.00	29.34%	2.65	16.3	12.6	0	25.97

First Correction

$$N_{60} = \frac{1}{0,6} E_f C_b C_s C_r N \qquad (2.7)$$

dengan,
- N_{60} = N-SPT telah dikoreksi
- E_f = efisiensi pemukul (**Tabel 2.3**).
- C_b = koreksi diameter lubang bor (**Tabel 2.4**)
- C_s = koreksi oleh tipe tabung *sampler* SPT (**Tabel 2.4**)
- C_r = koreksi untuk panjang batang bor (**Tabel 2.4**)
- N = nilai N-SPT hasil uji di lapangan.

Ef	China/Donat/Cathead	0.50
Cb	72.95 mm	1.00
Cs	standard	1.00
Cr	40 m	1.00

Depth Correction

Pasir kasar normal konsolidasi

$$C_N = \frac{3}{2 + \frac{\sigma'_v}{\sigma_r}}$$

$$N'_{60} = C_N N_{60}$$

General Data

γw	9.81	kN/m3	D	3	m
B	2	m			
max P 1	2626.3	kN	max q 1	1167.2	kN/m2
max P 2	1889.1	kN	max q 2	839.61	kN/m2

Depth	Depth Interval	Nv	N60	γb (kN/m3)	γd (kN/m3)	γsat (kN/m3)	γ' (kN/m3)	σ total (kN/m2)	σ'v (kN/m2)	CN	N'60	a max	g (m/s2)	NCEER Method											
														rd	FC (%)	α	β	$(N1)_{60cs}$	CSR	CRR	FS	Note	Fi	Wi	LPI
2	2	34	28.33	16.3				32.6	32.6	1.29	36.54	1.5000	9.8100	0.9867	3.11	0.00	1.00	36.54	0.10	0.1709	1.74	safe	0.00	9.00	0.00
4	2	49	40.83	16.3				65.2	65.2	1.13	46.19	1.5000	9.8100	0.9726	3.11	0.00	1.00	46.19	0.10	0.0279	0.29	not safe	0.71	8.00	11.39
6	2	51	42.50	16.3				97.8	97.8	1.01	42.81	1.5000	9.8100	0.9577	3.11	0.00	1.00	42.81	0.10	0.0622	0.65	not safe	0.35	7.00	4.85
8	2	52	43.33	16.3				130.4	130.4	0.91	39.35	1.5000	9.8100	0.9372	3.11	0.00	1.00	39.35	0.09	0.1169	1.25	safe	0.00	6.00	0.00
10	2	52	43.33	16.3				163	163	0.83	35.81	1.5000	9.8100	0.9049	3.11	0.00	1.00	35.81	0.09	0.1853	2.06	safe	0.00	5.00	0.00
12	2	54	45.00	16.3				195.6	195.6	0.76	34.13	1.5000	9.8100	0.8565	3.11	0.00	1.00	34.13	0.09	0.2177	2.56	safe	0.00	4.00	0.00
14	2	55	45.83	16.3				228.2	228.2	0.70	32.11	1.5000	9.8100	0.7943	3.11	0.00	1.00	32.11	0.08	0.2520	3.19	safe	0.00	3.00	0.00
16	2	55	45.83		12.4	17.6	7.8	262.1	252.3	0.66	30.40	1.5000	9.8100	0.7276	3.11	0.00	1.00	30.40	0.08	0.2751	3.66	safe	0.00	2.00	0.00
18	2	57	47.50		12.4	17.6	7.8	297.3	267.87	0.64	30.46	1.5000	9.8100	0.6671	3.11	0.00	1.00	30.46	0.07	0.2744	3.73	safe	0.00	1.00	0.00
20	2	59	49.17		12.4	17.6	7.8	332.5	283.45	0.62	30.51	1.5000	9.8100	0.6180	3.11	0.00	1.00	30.51	0.07	0.2738	3.80	safe	0.00	0.00	0.00
22	2	60	50.00		12.4	17.6	7.8	367.7	299.03	0.60	30.06	1.5000	9.8100	0.5807	3.11	0.00	1.00	30.06	0.07	0.2789	3.93	safe	Total LPI		16.24
24	2	60	50.00		12.4	17.6	7.8	402.9	314.61	0.58	29.15	1.5000	9.8100	0.5527	3.11	0.00	1.00	29.15	0.07	0.2875	4.09	safe			
26	2	60	50.00		12.4	17.6	7.8	438.1	330.19	0.57	28.29	1.5000	9.8100	0.5315	3.11	0.00	1.00	28.29	0.07	0.2937	4.19	safe			
28	2	60	50.00		12.4	17.6	7.8	473.3	345.77	0.55	27.48	1.5000	9.8100	0.5149	3.11	0.00	1.00	27.48	0.07	0.2977	4.25	safe			
30	2	60	50.00		12.4	17.6	7.8	508.5	361.36	0.53	26.72	1.5000	9.8100	0.5015	3.11	0.00	1.00	26.72	0.07	0.2998	4.27	safe			
32	2	60	50.00		12.4	17.6	7.8	543.7	376.94	0.52	26.00	1.5000	9.8100	0.4901	3.11	0.00	1.00	26.00	0.07	0.3003	4.27	safe			
34	2	60	50.00		12.4	17.6	7.8	578.9	392.52	0.51	25.32	1.5000	9.8100	0.4802	3.11	0.00	1.00	25.32	0.07	0.2996	4.26	safe			
36	2	60	50.00		12.4	17.6	7.8	614.1	408.1	0.49	24.67	1.5000	9.8100	0.4713	3.11	0.00	1.00	24.67	0.07	0.2979	4.23	safe			
38	2	60	50.00		12.4	17.6	7.8	649.3	423.68	0.48	24.05	1.5000	9.8100	0.4632	3.11	0.00	1.00	24.05	0.07	0.2953	4.19	safe			
40	2	60	50.00		12.4	17.6	7.8	684.5	439.26	0.47	23.46	1.5000	9.8100	0.4557	3.11	0.00	1.00	23.46	0.07	0.2921	4.14	safe			

Depth	Depth Interval	Nv	N60	γb (kN/m3)	γd (kN/m3)	γsat (kN/m3)	γ' (kN/m3)	σ total (kN/m2)	σ'v (kN/m2)	CN	N'60	a max	g (m/s2)	Simplified Method												
														α	β	rd	τ av	CSR	CN	N*CN	CRR	FS	Note	Fi	Wi	LPI
2	2	34	28.33	16.3				32.6	32.6	1.29	36.54	1.5000	9.8100	-0.077	0.009	0.934	3.027	0.093	1.401	39.703	0.496	5.338	**safe**	0.000	9.000	0.000
4	2	49	40.83	16.3				65.2	65.2	1.13	46.19	1.5000	9.8100	-0.197	0.022	0.840	5.442	0.083	1.169	47.753	0.600	7.189	**safe**	0.000	8.000	0.000
6	2	51	42.50	16.3				97.8	97.8	1.01	42.81	1.5000	9.8100	-0.341	0.038	0.739	7.184	0.073	1.034	43.940	0.551	7.495	**safe**	0.000	7.000	0.000
8	2	52	43.33	16.3				130.4	130.4	0.91	39.35	1.5000	9.8100	-0.504	0.057	0.639	8.286	0.064	0.938	40.633	0.508	7.989	**safe**	0.000	6.000	0.000
10	2	52	43.33	16.3				163	163	0.83	35.81	1.5000	9.8100	-0.682	0.076	0.546	8.842	0.054	0.863	37.399	0.466	8.586	**safe**	0.000	5.000	0.000
12	2	54	45.00	16.3				195.6	195.6	0.76	34.13	1.5000	9.8100	-0.869	0.097	0.462	8.980	0.046	0.802	36.094	0.449	9.776	**safe**	0.000	4.000	0.000
14	2	55	45.83	16.3				228.2	228.2	0.70	32.11	1.5000	9.8100	-1.061	0.118	0.389	8.833	0.039	0.751	34.400	0.427	11.028	**safe**	0.000	3.000	0.000
16	2	55	45.83		12.4	17.6	7.8	262.1	252.3	0.66	30.40	1.5000	9.8100	-1.251	0.138	0.329	8.242	0.033	0.717	32.862	0.407	12.456	**safe**	0.000	2.000	0.000
18	2	57	47.50		12.4	17.6	7.8	297.3	267.871	0.64	30.46	1.5000	9.8100	-1.434	0.158	0.279	7.429	0.028	0.697	33.105	0.410	14.786	**safe**	0.000	1.000	0.000
20	2	59	49.17		12.4	17.6	7.8	332.5	283.452	0.62	30.51	1.5000	9.8100	-1.605	0.176	0.239	6.745	0.024	0.678	33.337	0.413	17.359	**safe**	0.000	0.000	0.000
22	2	60	50.00		12.4	17.6	7.8	367.7	299.032	0.60	30.06	1.5000	9.8100	-1.759	0.191	0.209	6.198	0.021	0.660	33.007	0.409	19.723	**safe**			**0.000**
24	2	60	50.00		12.4	17.6	7.8	402.9	314.613	0.58	29.15	1.5000	9.8100	-1.891	0.204	0.185	5.789	0.018	0.643	32.158	0.398	21.619	**safe**			
26	2	60	50.00		12.4	17.6	7.8	438.1	330.194	0.57	28.29	1.5000	9.8100	-1.998	0.214	0.168	5.516	0.017	0.627	31.350	0.387	23.187	**safe**			
28	2	60	50.00		12.4	17.6	7.8	473.3	345.774	0.55	27.48	1.5000	9.8100	-2.076	0.221	0.156	5.377	0.016	0.612	30.579	0.377	24.263	**safe**			
30	2	60	50.00		12.4	17.6	7.8	508.5	361.355	0.53	26.72	1.5000	9.8100	-2.123	0.224	0.150	5.376	0.015	0.597	29.842	0.368	24.718	**safe**			
32	2	60	50.00		12.4	17.6	7.8	543.7	376.936	0.52	26.00	1.5000	9.8100	-2.138	0.223	0.147	5.520	0.015	0.583	29.136	0.359	24.485	**safe**			
34	2	60	50.00		12.4	17.6	7.8	578.9	392.516	0.51	25.32	1.5000	9.8100	-2.120	0.219	0.149	5.825	0.015	0.569	28.459	0.350	23.571	**safe**			
36	2	60	50.00		12.4	17.6	7.8	614.1	408.097	0.49	24.67	1.5000	9.8100	-2.070	0.211	0.156	6.315	0.015	0.556	27.808	0.341	22.060	**safe**			
38	2	60	50.00		12.4	17.6	7.8	649.3	423.678	0.48	24.05	1.5000	9.8100	-1.990	0.199	0.167	7.027	0.017	0.544	27.181	0.333	20.093	**safe**			
40	2	60	50.00		12.4	17.6	7.8	684.5	439.258	0.47	23.46	1.5000	9.8100	-1.881	0.185	0.183	8.009	0.018	0.532	26.577	0.325	17.848	**safe**			

Depth	Depth Interval	Nv	N60	γb (kN/m3)	γd (kN/m3)	γsat (kN/m3)	γ' (kN/m3)	σ total (kN/m2)	σ'v (kN/m2)	CN	N'60	a max	g (m/s2)	Idriss and Boulanger Method														
														α	β	rd	Δ(N1)60	(N1)60cs	Cσ	Kσ	MSF	CSR	CRR	FS	Note	Fi	Wi	LPI
2	2	34	28.33	16.3				32.6	32.6	1.29	36.54	1.5000	9.8100	-0.077	0.009	0.934	0.000	36.543	0.287	1.100	1.000	0.084	1.565	18.538	**safe**	0.000	9.000	0.000
4	2	49	40.83	16.3				65.2	65.2	1.13	46.19	1.5000	9.8100	-0.197	0.022	0.840	0.000	46.192	0.300	1.100	1.000	0.076	57.381	756.364	**safe**	0.000	8.000	0.000
6	2	51	42.50	16.3				97.8	97.8	1.01	42.81	1.5000	9.8100	-0.341	0.038	0.739	0.000	42.814	0.300	1.007	1.000	0.073	11.632	159.423	**safe**	0.000	7.000	0.000
8	2	52	43.33	16.3				130.4	130.4	0.91	39.35	1.5000	9.8100	-0.504	0.057	0.639	0.000	39.346	0.300	0.920	1.000	0.069	3.360	48.672	**safe**	0.000	6.000	0.000
10	2	52	43.33	16.3				163	163	0.83	35.81	1.5000	9.8100	-0.682	0.076	0.546	0.000	35.813	0.275	0.866	1.000	0.063	1.321	21.083	**safe**	0.000	5.000	0.000
12	2	54	45.00	16.3				195.6	195.6	0.76	34.13	1.5000	9.8100	-0.869	0.097	0.462	0.000	34.125	0.250	0.832	1.000	0.055	0.931	16.880	**safe**	0.000	4.000	0.000
14	2	55	45.83	16.3				228.2	228.2	0.70	32.11	1.5000	9.8100	-1.061	0.118	0.389	0.000	32.111	0.225	0.815	1.000	0.048	0.656	13.798	**safe**	0.000	3.000	0.000
16	2	55	45.83		12.4	17.6	7.8	262.1	252.3	0.66	30.40	1.5000	9.8100	-1.251	0.138	0.329	0.000	30.401	0.207	0.809	1.000	0.042	0.511	12.183	**safe**	0.000	2.000	0.000
18	2	57	47.50		12.4	17.6	7.8	297.3	267.871	0.64	30.46	1.5000	9.8100	-1.434	0.158	0.279	0.000	30.457	0.207	0.796	1.000	0.039	0.515	13.318	**safe**	0.000	1.000	0.000
20	2	59	49.17		12.4	17.6	7.8	332.5	283.452	0.62	30.51	1.5000	9.8100	-1.605	0.176	0.239	0.000	30.510	0.208	0.784	1.000	0.036	0.519	14.562	**safe**	0.000	0.000	0.000
22	2	60	50.00		12.4	17.6	7.8	367.7	299.032	0.60	30.06	1.5000	9.8100	-1.759	0.191	0.209	0.000	30.058	0.203	0.777	1.000	0.033	0.489	14.904	**safe**			**0.000**
24	2	60	50.00		12.4	17.6	7.8	402.9	314.613	0.58	29.15	1.5000	9.8100	-1.891	0.204	0.185	0.000	29.148	0.195	0.777	1.000	0.030	0.436	14.389	**safe**			
26	2	60	50.00		12.4	17.6	7.8	438.1	330.194	0.57	28.29	1.5000	9.8100	-1.998	0.214	0.168	0.000	28.292	0.187	0.776	1.000	0.029	0.396	13.865	**safe**			
28	2	60	50.00		12.4	17.6	7.8	473.3	345.774	0.55	27.48	1.5000	9.8100	-2.076	0.221	0.156	0.000	27.484	0.181	0.776	1.000	0.027	0.364	13.250	**safe**			
30	2	60	50.00		12.4	17.6	7.8	508.5	361.355	0.53	26.72	1.5000	9.8100	-2.123	0.224	0.150	0.000	26.721	0.175	0.775	1.000	0.027	0.337	12.495	**safe**			
32	2	60	50.00		12.4	17.6	7.8	543.7	376.936	0.52	26.00	1.5000	9.8100	-2.138	0.223	0.147	0.000	25.999	0.170	0.775	1.000	0.027	0.316	11.586	**safe**			
34	2	60	50.00		12.4	17.6	7.8	578.9	392.516	0.51	25.32	1.5000	9.8100	-2.120	0.219	0.149	0.000	25.316	0.165	0.775	1.000	0.028	0.298	10.538	**safe**			
36	2	60	50.00		12.4	17.6	7.8	614.1	408.097	0.49	24.67	1.5000	9.8100	-2.070	0.211	0.156	0.000	24.667	0.160	0.774	1.000	0.030	0.282	9.391	**safe**			
38	2	60	50.00		12.4	17.6	7.8	649.3	423.678	0.48	24.05	1.5000	9.8100	-1.990	0.199	0.167	0.000	24.051	0.156	0.774	1.000	0.033	0.269	8.200	**safe**			
40	2	60	50.00		12.4	17.6	7.8	684.5	439.258	0.47	23.46	1.5000	9.8100	-1.881	0.185	0.183	0.000	23.465	0.153	0.774	1.000	0.037	0.258	7.023	**safe**			

C.3 Type 1 Foundation Bearing Capacity

Location	Depth	w (%)	G	γb (kN/m3)	γd (kN/m3)	c	f
BH1	15.00	31.18%	2.69	16.3	12.4	0	26.55

First Correction

$$N_{60} = \frac{1}{0{,}6} E_f C_b C_s C_r N \quad (2.7)$$

dengan,
- N_{60} = N-SPT telah dikoreksi
- E_f = efisiensi pemukul (**Tabel 2.3**).
- C_b = koreksi diameter lubang bor (**Tabel 2.4**)
- C_s = koreksi oleh tipe tabung *sampler* SPT (**Tabel 2.4**)
- C_r = koreksi untuk panjang batang bor (**Tabel 2.4**)
- N = nilai N-SPT hasil uji di lapangan.

Ef	China/Donat/Cathead	0.50
Cb	72.95 mm	1.00
Cs	standard	1.00
Cr	40 m	1.00

Depth Correction

Pasir kasar normal konsolidasi

$$C_N = \frac{3}{2 + \frac{\sigma'_v}{\sigma_r}}$$

$$N'_{60} = C_N N_{60}$$

Foundation Data

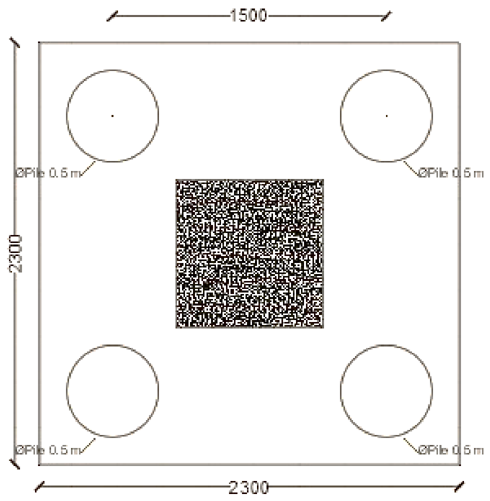
Type:	**Deep Foundation**	
Long Piles, fixed head		
d	0.5	m
A pile	0.19635	m2

Column K1

B	0.8	m
H	0.8	m
L (length)	8	m
A col	0.64	m2

General Data

γw	9.81	kN/m3
B	2	m
max P	2626.29	kN
D	3	m
SF	3	
y conc	24	kn/m3
f'c	30	MPa
Stress	13375.58	kN/m2
Stress + ca	13399.58	kN/m3
σr	100	kpa
Perimeter	1.570796	m



Depth	Depth Interval	Nv	N60	γb (kN/m3)	γd (kN/m3)	γsat (kN/m3)	γ' (kN/m3)	σ'v (kN/m2)	CN	N'60	rd	FC %	α	β	$(N1)_{60cs}$
2	2	34	28.33	16.3				32.60	1.2898	36.54	0.9867	3.11	0.0000	1.0000	2.0000
4	2	49	40.83	16.3				65.20	1.1312	46.19	0.9726	3.11	0.0000	1.0000	4.0000
6	2	51	42.50	16.3				97.80	1.0074	42.81	0.9577	3.11	0.0000	1.0000	6.0000
8	2	52	43.33	16.3				130.40	0.9080	39.35	0.9372	3.11	0.0000	1.0000	8.0000
10	2	52	43.33	16.3				163.00	0.8264	35.81	0.9049	3.11	0.0000	1.0000	10.0000
12	2	54	45.00	16.3				195.60	0.7583	34.13	0.8565	3.11	0.0000	1.0000	12.0000
14	2	55	45.83	16.3				228.20	0.7006	32.11	0.7943	3.11	0.0000	1.0000	14.0000
16	2	55	45.83		12.4	17.6	7.8	252.29	0.6633	30.40	0.7276	3.11	0.0000	1.0000	16.0000
18	2	57	47.50		12.4	17.6	7.8	267.87	0.6412	30.46	0.6671	3.11	0.0000	1.0000	18.0000
20	2	59	49.17		12.4	17.6	7.8	283.45	0.6205	30.51	0.6180	3.11	0.0000	1.0000	20.0000
22	2	60	50.00		12.4	17.6	7.8	299.03	0.6012	30.06	0.5807	3.11	0.0000	1.0000	22.0000
24	2	60	50.00		12.4	17.6	7.8	314.61	0.5830	29.15	0.5527	3.11	0.0000	1.0000	24.0000
26	2	60	50.00		12.4	17.6	7.8	330.19	0.5658	28.29	0.5315	3.11	0.0000	1.0000	26.0000
28	2	60	50.00		12.4	17.6	7.8	345.77	0.5497	27.48	0.5149	3.11	0.0000	1.0000	28.0000
30	2	60	50.00		12.4	17.6	7.8	361.36	0.5344	26.72	0.5015	3.11	0.0000	1.0000	30.0000
32	2	60	50.00		12.4	17.6	7.8	376.94	0.5200	26.00	0.4901	3.11	0.0000	1.0000	32.0000
34	2	60	50.00		12.4	17.6	7.8	392.52	0.5063	25.32	0.4802	3.11	0.0000	1.0000	34.0000
36	2	60	50.00		12.4	17.6	7.8	408.10	0.4933	24.67	0.4713	3.11	0.0000	1.0000	36.0000
38	2	60	50.00		12.4	17.6	7.8	423.68	0.4810	24.05	0.4632	3.11	0.0000	1.0000	38.0000
40	2	60	50.00		12.4	17.6	7.8	439.26	0.4693	23.46	0.4557	3.11	0.0000	1.0000	40.0000

Bearing Capacity of 1 Pile
Meyerhof Method

Depth	Depth Interval	4D	10D	L+4D	L-10D	N60	qp (tip stress)	upper limit qp (kN)	qp used (kN)	QP	Average N60	fav (kN/m2)	Qs (kN)	Qult (kN)	Qall (kN)	Q all (kN/m2)	Req. Piles
2	2.0000	2	5	4	#NUM!	41.50	6640.00	16600.00	6640	1303.76	22.31667	44.63	0	1303.8	434.59	2213.333	7
4	2.0000	2	5	6	#NUM!	44.67	14293.33	17866.67	14293.33	2806.49	25.44167	50.88	0	2806.5	935.50	4764.444	3
6	2.0000	2	5	8	2	46.50	22320.00	18600.00	18600	3652.10	26.76	53.52	0	3652.1	1217.37	6200	3
8	2.0000	2	5	10	4	51.00	32640.00	20400.00	20400	4005.53	27.53	55.05	0	4005.5	1335.18	6800	2
10	2.0000	2	5	12	6	52.25	41800.00	20900.00	20900	4103.71	27.98	55.97	0	4103.7	1367.90	6966.667	2
12	2.0000	2	5	14	8	53.25	51120.00	21300.00	21300	4182.25	28.43	56.86	0	4182.2	1394.08	7100	2
14	2.0000	2	5	16	10	54.00	60480.00	21600.00	21600	4241.15	28.80	57.61	0	4241.2	1413.72	7200	2
16	2.0000	2	5	18	12	55.25	70720.00	22100.00	22100	4339.32	29.94	59.88	1916.16	6255.5	2085.16	10619.64	2
18	2.0000	2	5	20	14	56.50	81360.00	22600.00	22600	4437.50	31.04	62.08	2234.70	6672.2	2224.07	11327.08	2
20	2.0000	2	5	22	16	57.75	92400.00	23100.00	23100	4535.67	32.10	64.21	2568.31	7104.0	2368.00	12060.1	2
22	2.0000	2	5	24	18	59.00	103840.00	23600.00	23600	4633.85	33.10	66.20	2912.64	7546.5	2515.50	12811.31	2
24	2.0000	2	5	26	20	59.75	114720.00	23900.00	23900	4692.75	33.99	67.98	3262.82	7955.6	2651.86	13505.8	1
26	2.0000	2	5	28	22	60.00	124800.00	24000.00	24000	4712.39	34.79	69.58	3617.99	8330.4	2776.79	14142.08	1
28	2.0000	2	5	30	24	60.00	134400.00	24000.00	24000	4712.39	35.51	71.03	3977.42	8689.8	2896.60	14752.28	1
30	2.0000	2	5	32	26	60.00	144000.00	24000.00	24000	4712.39	36.17	72.34	4340.55	9052.9	3017.64	15368.74	1
32	2.0000	2	5	34	28	60.00	153600.00	24000.00	24000	4712.39	36.77	73.54	4706.88	9419.3	3139.75	15990.64	1
34	2.0000	2	5	36	30	60.00	163200.00	24000.00	24000	4712.39	37.32	74.65	5076.01	9788.4	3262.80	16617.3	1
36	2.0000	2	5	38	32	60.00	172800.00	24000.00	24000	4712.39	37.83	75.66	5447.62	10160.0	3386.67	17248.16	1
38	2.0000	2	5	40	34	60.00	182400.00	24000.00	24000	4712.39	38.30	76.60	5821.41	10533.8	3511.26	17882.72	1
40	2.0000	2	5	42	36	60.00	192000.00	24000.00	24000	4712.39	38.73	77.46	6197.14	10909.5	3636.51	18520.58	1

Pile Efficiency

minimum distance between piles as to as	Circumference of piles	1.6	m	2.0
	2.5D	1.25	m	
Pile Group	B	0.5	m	
	L	2	m	
	n	2		
	m	1		
	n'	1		
	s	1.5	m	
	d	0.5	m	

Brom's Method

Load from Column Earthquake, DL, LL combination from MIDAS

n column: 1

Vy (shear)*n column: 754.633 kN

My: 755.461 kNm

Lateral Strength of Pile

Depth	Depth Interval (m)	Kp	Hu (kN)	Hu/SF (kN)	Note	Mmax (Knm)	Mmax/SF	Note	x=f/sqrt(Hu)	Hu	Hu allowed=Hu/SF	H/Hu all	n Pile required
2	2.000	1.618	158.20	52.73	not safe	210.93	70.31	not safe	0.160	586.177	195.392	3.862	4.000
4	2.000	1.618	632.79	210.93	not safe	1687.44	562.48	not safe	0.113	738.537	246.179	3.065	4.000
6	2.000	1.618	1423.78	474.59	not safe	5695.10	1898.37	safe	0.092	845.414	281.805	2.678	3.000
8	2.000	1.618	2531.16	843.72	safe	13499.50	4499.83	safe	0.080	930.498	310.166	2.433	3.000
10	2.000	1.618	3954.93	1318.31	safe	26366.21	8788.74	safe	0.071	1002.349	334.116	2.259	3.000
12	2.000	1.618	5695.10	1898.37	safe	45560.81	15186.94	safe	0.065	1065.155	355.052	2.125	3.000
14	2.000	1.618	7751.67	2583.89	safe	72348.88	24116.29	safe	0.060	1121.317	373.772	2.019	3.000
16	2.000	1.618	10124.62	3374.87	safe	107995.99	35998.66	safe	0.057	1159.462	386.487	1.953	2.000
18	2.000	1.618	12813.98	4271.33	safe	153767.73	51255.91	safe	0.056	1182.855	394.285	1.914	2.000
20	2.000	1.618	15819.73	5273.24	safe	210929.68	70309.89	safe	0.054	1205.358	401.786	1.878	2.000
22	2.000	1.618	19141.87	6380.62	safe	280747.40	93582.47	safe	0.053	1227.051	409.017	1.845	2.000
24	2.000	1.618	22780.41	7593.47	safe	364486.48	121495.49	safe	0.051	1248.002	416.001	1.814	2.000
26	2.000	1.618	26735.34	8911.78	safe	463412.50	154470.83	safe	0.050	1268.273	422.758	1.785	2.000
28	2.000	1.618	31006.66	10335.55	safe	578791.03	192930.34	safe	0.049	1287.915	429.305	1.758	2.000
30	2.000	1.618	35594.38	11864.79	safe	711887.66	237295.89	safe	0.048	1306.976	435.659	1.732	2.000
32	2.000	1.618	40498.50	13499.50	safe	863967.96	287989.32	safe	0.047	1325.497	441.832	1.708	2.000
34	2.000	1.618	45719.01	15239.67	safe	1036297.50	345432.50	safe	0.046	1343.514	447.838	1.685	2.000
36	2.000	1.618	51255.91	17085.30	safe	1230141.88	410047.29	safe	0.045	1361.061	453.687	1.663	2.000
38	2.000	1.618	57109.21	19036.40	safe	1446766.66	482255.55	safe	0.044	1378.166	459.389	1.643	2.000
40	2.000	1.618	63278.90	21092.97	safe	1687437.42	562479.14	safe	0.044	1394.857	464.952	1.623	2.000

Pile Group Efficiency according Converse-Labarre Formula

Depth (m)	Depth Interval (m)	Θ = arctan (d/s)	Eg	Qg	Note (Qg>Qu=Safe)
2	2.0000	0.333333	1	869.174	Safe
4	2.0000	0.333333	1	1870.993	Safe
6	2.0000	0.333333	1	2434.734	Safe
8	2.0000	0.333333	1	2670.354	Safe
10	2.0000	0.333333	1	2735.804	Safe
12	2.0000	0.333333	1	2788.163	Safe
14	2.0000	0.333333	1	2827.433	Safe
16	2.0000	0.333333	1	4170.323	Safe
18	2.0000	0.333333	1	4448.133	Safe
20	2.0000	0.333333	1	4735.992	Safe
22	2.0000	0.333333	1	5030.991	Safe
24	2.0000	0.333333	1	5303.717	Safe
26	2.0000	0.333333	1	5553.584	Safe
28	2.0000	0.333333	1	5793.207	Safe
30	2.0000	0.333333	1	6035.29	Safe
32	2.0000	0.333333	1	6279.51	Safe
34	2.0000	0.333333	1	6525.6	Safe
36	2.0000	0.333333	1	6773.337	Safe
38	2.0000	0.333333	1	7022.529	Safe
40	2.0000	0.333333	1	7273.017	Safe

Settlement of Single Pile		
Ec	2.6E+07	kN/m2
μ_s	0.3	
I_{wp}	0.88	
S allowable	25.4	mm

Depth	α	I_{ws}	s1 (mm)	s2 (mm)	s3 (mm)	S	Note
2	0.5	2.70000	1.03916	0.25979	0.03989	0.0614171	Safe
4	0.5	2.98995	2.07833	0.25979	0.02209	0.1228343	Safe
6	0.5	3.21244	3.11749	0.25979	0.01582	0.1842514	Safe
8	0.5	3.40000	4.15666	0.25979	0.01256	0.2456685	Safe
10	0.5	3.56525	5.19582	0.25979	0.01054	0.3070856	Safe
12	0.5	3.71464	6.23498	0.25979	0.00915	0.3685028	Safe
14	0.5	3.85203	7.27415	0.25979	0.00813	0.4299199	Safe
16	0.5	3.97990	8.31331	0.25979	0.00735	0.491337	Safe
18	0.5	4.10000	9.35248	0.25979	0.00673	0.5527542	Safe
20	0.5	4.21359	10.3916	0.25979	0.00623	0.6141713	Safe
22	0.5	4.32164	11.4308	0.25979	0.0058	0.6755884	Safe
24	0.5	4.42487	12.47	0.25979	0.00545	0.7370055	Safe
26	0.5	4.52389	13.5091	0.25979	0.00514	0.7984227	Safe
28	0.5	4.61916	14.5483	0.25979	0.00488	0.8598398	Safe
30	0.5	4.71109	15.5875	0.25979	0.00464	0.9212569	Safe
32	0.5	4.80000	16.6266	0.25979	0.00443	0.9826741	Safe
34	0.5	4.88617	17.6658	0.25979	0.00425	1.0440912	Safe
36	0.5	4.96985	18.705	0.25979	0.00408	1.1055083	Safe
38	0.5	5.05123	19.7441	0.25979	0.00393	1.1669254	Safe
40	0.5	5.13050	20.7833	0.25979	0.00379	1.2283426	Safe

Settlement of Group Pile		
B edge	0	m
L edge	0	m
Bg	0.5	m
Lg	2	m
Allowable s	50	mm

Vesic (1969)

Depth	Sg (mm)	Note
2	0.06142	Safe
4	0.12283	Safe
6	0.18425	Safe
8	0.24567	Safe
10	0.30709	Safe
12	0.3685	Safe
14	0.42992	Safe
16	0.49134	Safe
18	0.55275	Safe
20	0.61417	Safe
22	0.67559	Safe
24	0.73701	Safe
26	0.79842	Safe
28	0.85984	Safe
30	0.92126	Safe
32	0.98267	Safe
34	1.04409	Safe
36	1.10551	Safe
38	1.16693	Safe
40	1.22834	Safe

C.4 Type 2 Foundation Bearing Capacity

Location	Depth	w (%)	G	γb (kN/m3)	γd (kN/m3)	c	f
BH1	15.00	31.18%	2.69	16.3	12.4	0	26.55

First Correction

$$N_{60} = \frac{1}{0,6} E_f C_b C_s C_r N \qquad (2.7)$$

dengan,
- N_{60} = N-SPT telah dikoreksi
- E_f = efisiensi pemukul (**Tabel 2.3**).
- C_b = koreksi diameter lubang bor (**Tabel 2.4**)
- C_s = koreksi oleh tipe tabung *sampler* SPT (**Tabel 2.4**)
- C_r = koreksi untuk panjang batang bor (**Tabel 2.4**)
- N = nilai N-SPT hasil uji di lapangan.

Ef	China/Donat/Cathead	0.50
Cb	72.95 mm	1.00
Cs	standard	1.00
Cr	40 m	1.00

Depth Correction

Pasir kasar normal konsolidasi

$$C_N = \frac{3}{2 + \frac{\sigma'_v}{\sigma_r}}$$

$$N'_{60} = C_N N_{60}$$

Foundation Data

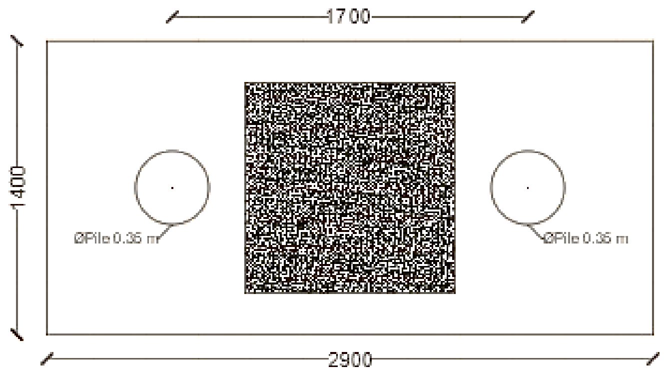
Type:	Deep Foundation	
Long Piles, fixed head		
d	0.35	m
A pile	0.096211	m2

Column K2

B	1	m
H	1	m
L (length)	8	m
A col	1	m2

General Data

γw	9.81	kN/m3
B	2	m
max P	1274.96	kN
D	3	m
SF	3	
y conc	24	kn/m3
f'c	30	MPa
Stress	13251.67	kN/m2
Stress + ca	13275.67	kN/m3
σr	100	kpa
Perimeter	1.099557	m



Depth	Depth Interval	Nv	N60	γb (kN/m3)	γd (kN/m3)	γsat (kN/m3)	γ' (kN/m3)	σ'v (kN/m2)	CN	N'60	rd	FC %	α	β	$(N1)_{60cs}$
2	2	34	28.33	16.3				32.60	1.2898	36.54	0.9867	3.11	0.0000	1.0000	2.0000
4	2	49	40.83	16.3				65.20	1.1312	46.19	0.9726	3.11	0.0000	1.0000	4.0000
6	2	51	42.50	16.3				97.80	1.0074	42.81	0.9577	3.11	0.0000	1.0000	6.0000
8	2	52	43.33	16.3				130.40	0.9080	39.35	0.9372	3.11	0.0000	1.0000	8.0000
10	2	52	43.33	16.3				163.00	0.8264	35.81	0.9049	3.11	0.0000	1.0000	10.0000
12	2	54	45.00	16.3				195.60	0.7583	34.13	0.8565	3.11	0.0000	1.0000	12.0000
14	2	55	45.83	16.3				228.20	0.7006	32.11	0.7943	3.11	0.0000	1.0000	14.0000
16	2	55	45.83		12.4	17.6	7.8	252.29	0.6633	30.40	0.7276	3.11	0.0000	1.0000	16.0000
18	2	57	47.50		12.4	17.6	7.8	267.87	0.6412	30.46	0.6671	3.11	0.0000	1.0000	18.0000
20	2	59	49.17		12.4	17.6	7.8	283.45	0.6205	30.51	0.6180	3.11	0.0000	1.0000	20.0000
22	2	60	50.00		12.4	17.6	7.8	299.03	0.6012	30.06	0.5807	3.11	0.0000	1.0000	22.0000
24	2	60	50.00		12.4	17.6	7.8	314.61	0.5830	29.15	0.5527	3.11	0.0000	1.0000	24.0000
26	2	60	50.00		12.4	17.6	7.8	330.19	0.5658	28.29	0.5315	3.11	0.0000	1.0000	26.0000
28	2	60	50.00		12.4	17.6	7.8	345.77	0.5497	27.48	0.5149	3.11	0.0000	1.0000	28.0000
30	2	60	50.00		12.4	17.6	7.8	361.36	0.5344	26.72	0.5015	3.11	0.0000	1.0000	30.0000
32	2	60	50.00		12.4	17.6	7.8	376.94	0.5200	26.00	0.4901	3.11	0.0000	1.0000	32.0000
34	2	60	50.00		12.4	17.6	7.8	392.52	0.5063	25.32	0.4802	3.11	0.0000	1.0000	34.0000
36	2	60	50.00		12.4	17.6	7.8	408.10	0.4933	24.67	0.4713	3.11	0.0000	1.0000	36.0000
38	2	60	50.00		12.4	17.6	7.8	423.68	0.4810	24.05	0.4632	3.11	0.0000	1.0000	38.0000
40	2	60	50.00		12.4	17.6	7.8	439.26	0.4693	23.46	0.4557	3.11	0.0000	1.0000	40.0000

Bearing Capacity of 1 Pile
Meyerhof Method

Depth	Depth Interval	4D	10D	L+4D	L-10D	N60	qp (tip stress)	upper limit qp (kN)	qp used (kN)	QP	Average N60	fav (kN/m2)	Qs (kN)	Qult (kN)	Qall (kN)	Q all (kN/m2)	Req. Piles
2	2.0000	1.4	3.5	3.4	#NUM!	41.5	9485.714	16600	9485.714	912.6327	22.31667	44.63	0	912.6	304.21	3161.905	5
4	2.0000	1.4	3.5	5.4	0	44.66666667	20419.05	17866.67	17866.67	1718.975	25.44167	50.88	0	1719.0	572.99	5955.556	3
6	2.0000	1.4	3.5	7.4	2	46.5	31885.71	18600	18600	1789.53	26.76	53.52	0	1789.5	596.51	6200	3
8	2.0000	1.4	3.5	9.4	4	51	46628.57	20400	20400	1962.71	27.53	55.05	0	1962.7	654.24	6800	2
10	2.0000	1.4	3.5	11.4	6	52.25	59714.29	20900	20900	2010.816	27.98	55.97	0	2010.8	670.27	6966.667	2
12	2.0000	1.4	3.5	13.4	8	53.25	73028.57	21300	21300	2049.3	28.43	56.86	0	2049.3	683.10	7100	2
14	2.0000	1.4	3.5	15.4	10	54	86400	21600	21600	2078.164	28.80	57.61	0	2078.2	692.72	7200	2
16	2.0000	1.4	3.5	17.4	12	55.25	101028.6	22100	22100	2126.269	29.94	59.88	1341.31	3467.6	1155.86	12013.77	2
18	2.0000	1.4	3.5	19.4	14	56.5	116228.6	22600	22600	2174.375	31.04	62.08	1564.29	3738.7	1246.22	12952.97	2
20	2.0000	1.4	3.5	21.4	16	57.75	132000	23100	23100	2222.48	32.10	64.21	1797.82	4020.3	1340.10	13928.72	1
22	2.0000	1.4	3.5	23.4	18	59	148342.9	23600	23600	2270.586	33.10	66.20	2038.85	4309.4	1436.48	14930.45	1
24	2.0000	1.4	3.5	25.4	20	59.75	163885.7	23900	23900	2299.449	33.99	67.98	2283.97	4583.4	1527.81	15879.72	1
26	2.0000	1.4	3.5	27.4	22	60	178285.7	24000	24000	2309.071	34.79	69.58	2532.59	4841.7	1613.89	16774.41	1
28	2.0000	1.4	3.5	29.4	24	60	192000	24000	24000	2309.071	35.51	71.03	2784.20	5093.3	1697.76	17646.12	1
30	2.0000	1.4	3.5	31.4	26	60	205714.3	24000	24000	2309.071	36.17	72.34	3038.38	5347.5	1782.48	18526.77	1
32	2.0000	1.4	3.5	33.4	28	60	219428.6	24000	24000	2309.071	36.77	73.54	3294.81	5603.9	1867.96	19415.2	1
34	2.0000	1.4	3.5	35.4	30	60	233142.9	24000	24000	2309.071	37.32	74.65	3553.21	5862.3	1954.09	20310.43	1
36	2.0000	1.4	3.5	37.4	32	60	246857.1	24000	24000	2309.071	37.83	75.66	3813.33	6122.4	2040.80	21211.66	1
38	2.0000	1.4	3.5	39.4	34	60	260571.4	24000	24000	2309.071	38.30	76.60	4074.98	6384.1	2128.02	22118.18	1
40	2.0000	1.4	3.5	41.4	36	60	274285.7	24000	24000	2309.071	38.73	77.46	4338.00	6647.1	2215.69	23029.41	1

Pile Efficiency

minimum distance between piles as to as	Circumference of piles	1.1	m	2.0
	2.5D	0.875	m	
Pile Group	B	0.35	m	
	L	2	m	
	n	2		
	m	2		
	n'	1		
	s	1.05	m	
	d	0.35	m	

Brom's Method

Load from Column Earthquake, DL, LL combination from MIDAS

n column: 1

Vy (shear)*n column: 231.132 kN

My: 525.761 kNm

Lateral Strength of Pile

Depth	Depth Interval (m)	Kp	Hu (kN)	Hu/SF (kN)	Note	Mmax (Knm)	Mmax/SF	Note	x=f/sqrt(Hu)	Hu	Hu allowed=Hu/SF	H/Hu all	n Pile required
2	2.000	1.618	110.74	36.91	not safe	147.65	49.22	not safe	0.191	408.739	136.246	1.696	2.000
4	2.000	1.618	442.95	147.65	not safe	1181.21	393.74	safe	0.135	514.978	171.659	1.346	2.000
6	2.000	1.618	996.64	332.21	safe	3986.57	1328.86	safe	0.110	589.503	196.501	1.176	2.000
8	2.000	1.618	1771.81	590.60	safe	9449.65	3149.88	safe	0.095	648.832	216.277	1.069	2.000
10	2.000	1.618	2768.45	922.82	safe	18456.35	6152.12	safe	0.085	698.933	232.978	0.992	1.000
12	2.000	1.618	3986.57	1328.86	safe	31892.57	10630.86	safe	0.078	742.727	247.576	0.934	1.000
14	2.000	1.618	5426.17	1808.72	safe	50644.22	16881.41	safe	0.072	781.889	260.630	0.887	1.000
16	2.000	1.618	7087.24	2362.41	safe	75597.20	25199.07	safe	0.069	808.488	269.496	0.858	1.000
18	2.000	1.618	8969.78	2989.93	safe	107637.41	35879.14	safe	0.067	824.800	274.933	0.841	1.000
20	2.000	1.618	11073.81	3691.27	safe	147650.77	49216.92	safe	0.065	840.491	280.164	0.825	1.000
22	2.000	1.618	13399.31	4466.44	safe	196523.18	65507.73	safe	0.063	855.617	285.206	0.810	1.000
24	2.000	1.618	15946.28	5315.43	safe	255140.54	85046.85	safe	0.061	870.226	290.075	0.797	1.000
26	2.000	1.618	18714.74	6238.25	safe	324388.75	108129.58	safe	0.060	884.361	294.787	0.784	1.000
28	2.000	1.618	21704.66	7234.89	safe	405153.72	135051.24	safe	0.059	898.057	299.352	0.772	1.000
30	2.000	1.618	24916.07	8305.36	safe	498321.36	166107.12	safe	0.057	911.349	303.783	0.761	1.000
32	2.000	1.618	28348.95	9449.65	safe	604777.57	201592.52	safe	0.056	924.263	308.088	0.750	1.000
34	2.000	1.618	32003.31	10667.77	safe	725408.25	241802.75	safe	0.055	936.826	312.275	0.740	1.000
36	2.000	1.618	35879.14	11959.71	safe	861099.31	287033.10	safe	0.054	949.061	316.354	0.731	1.000
38	2.000	1.618	39976.45	13325.48	safe	1012736.66	337578.89	safe	0.053	960.989	320.330	0.722	1.000
40	2.000	1.618	44295.23	14765.08	safe	1181206.19	393735.40	safe	0.052	972.628	324.209	0.713	1.000

Pile Group Efficiency according Converse-Labarre Formula

Depth (m)	Depth Interval (m)	Θ = arctan (d/s)	Eg	Qg (kN)	Note (Qg>Qu=Safe)
2	2.0000	1.05	0.997083	606.6472	Safe
4	2.0000	1.05	0.997083	1142.641	Safe
6	2.0000	1.05	0.997083	1189.54	Safe
8	2.0000	1.05	0.997083	1304.657	Safe
10	2.0000	1.05	0.997083	1336.634	Safe
12	2.0000	1.05	0.997083	1362.215	Safe
14	2.0000	1.05	0.997083	1381.401	Safe
16	2.0000	1.05	0.997083	2304.978	Safe
18	2.0000	1.05	0.997083	2485.174	Safe
20	2.0000	1.05	0.997083	2672.383	Safe
22	2.0000	1.05	0.997083	2864.575	Safe
24	2.0000	1.05	0.997083	3046.704	Safe
26	2.0000	1.05	0.997083	3218.36	Safe
28	2.0000	1.05	0.997083	3385.607	Safe
30	2.0000	1.05	0.997083	3554.57	Safe
32	2.0000	1.05	0.997083	3725.026	Safe
34	2.0000	1.05	0.997083	3896.787	Safe
36	2.0000	1.05	0.997083	4069.697	Safe
38	2.0000	1.05	0.997083	4243.623	Safe
40	2.0000	1.05	0.997083	4418.452	Safe

Settlement of Single Pile		
Ec	2.6E+07	kN/m2
μ_s	0.3	
I_{wp}	0.88	
S allowab	25.4	mm

Depth	α	I_{ws}	s1 (mm)	s2 (mm)	s3 (mm)	S	Note
2	0.5	2.83666	1.02954	0.14428	0.02035	1.194164176	Safe
4	0.5	3.18322	2.05907	0.14428	0.01142	2.214770928	Safe
6	0.5	3.44914	3.08861	0.14428	0.00825	3.241138706	Safe
8	0.5	3.67332	4.11815	0.14428	0.00659	4.269016489	Safe
10	0.5	3.87083	5.14769	0.14428	0.00555	5.297519887	Safe
12	0.5	4.04939	6.17722	0.14428	0.00484	6.32634533	Safe
14	0.5	4.21359	7.20676	0.14428	0.00432	7.355359501	Safe
16	0.5	4.36643	8.2363	0.14428	0.00392	8.38449431	Safe
18	0.5	4.50998	9.26584	0.14428	0.00359	9.413711198	Safe
20	0.5	4.64575	10.2954	0.14428	0.00333	10.44298663	Safe
22	0.5	4.77489	11.3249	0.14428	0.00311	11.47230538	Safe
24	0.5	4.89828	12.3544	0.14428	0.00293	12.50165715	Safe
26	0.5	5.01662	13.384	0.14428	0.00277	13.53103471	Safe
28	0.5	5.13050	14.4135	0.14428	0.00263	14.56043282	Safe
30	0.5	5.24037	15.4431	0.14428	0.00251	15.58984761	Safe
32	0.5	5.34664	16.4726	0.14428	0.0024	16.61927611	Safe
34	0.5	5.44964	17.5021	0.14428	0.0023	17.64871606	Safe
36	0.5	5.54965	18.5317	0.14428	0.00221	18.67816565	Safe
38	0.5	5.64692	19.5612	0.14428	0.00213	19.70762346	Safe
40	0.5	5.74166	20.5907	0.14428	0.00206	20.73708834	Safe

Settlement of Group Pile		
B edge	0	m
L edge	0	m
Bg	0.35	m
Lg	2	m
Allowable	35	mm

Vesic (1969)

Depth	Sg (mm)	Note	Coef. SGR
2	1.19416	Safe	27,299
4	2.21477	Safe	29,439
6	3.24114	Safe	30,175
8	4.26902	Safe	30,546
10	5.29752	Safe	30,769
12	6.32635	Safe	30,918
14	7.35536	Safe	31,025
16	8.38449	Safe	30,090
18	9.41371	Safe	28,455
20	10.443	Safe	27,143
22	11.4723	Safe	26,066
24	12.5017	Safe	25,166
26	13.531	Safe	24,403
28	14.5604	Safe	23,748
30	15.5898	Safe	23,179
32	16.6193	Safe	22,681
34	17.6487	Safe	22,241
36	18.6782	Safe	21,849
38	19.7076	Safe	21,498
40	20.7371	Safe	21,182

C.4 Differential Settlement

Biggest Column Axial Force Different					
	C61	C88	C35	C57	Unit
	2410.458	1887.728	1680.11	1647.964	kN
	C73	C7	C9	C127	
	70.40912	113.4872	160.9612	162.0898	kN
Δ	2340.049	1774.24	1519.149	1485.874	kN
Δmax	2340.049	kN			

Input to P to S1 and S2

Depth	8	
s1 (mm)	s2 (mm)	Δs (mm)
0.245669	3.148629	2.902961

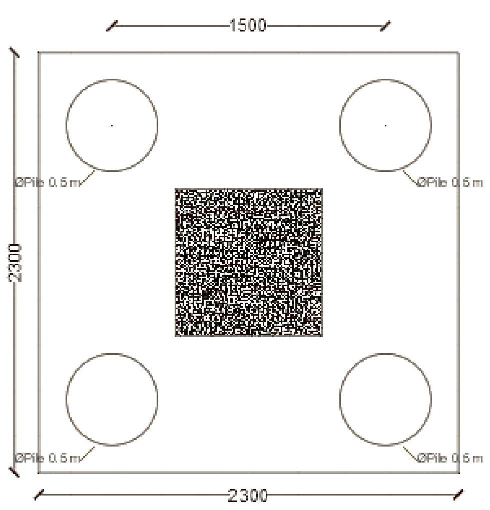
C61	
Depth	Sg (mm)
2	0.06142
4	0.12283
6	0.18425
8	0.24567
10	0.30709
12	0.3685
14	0.42992
16	0.49134
18	0.55275
20	0.61417
22	0.67559
24	0.73701
26	0.79842
28	0.85984
30	0.92126
32	0.98267
34	1.04409
36	1.10551
38	1.16693
40	1.22834

C73	
Depth	Sg (mm)
2	0.92583
4	1.66051
6	2.40349
8	3.14863
10	3.89466
12	4.64115
14	5.3879
16	6.13483
18	6.88187
20	7.629
22	8.37618
24	9.12341
26	9.87068
28	10.618
30	11.3653
32	12.1126
34	12.86
36	13.6073
38	14.3547
40	15.1021

C.5 Type 1 Foundation Design

Type 1

Foundation Data		
Type:	**Deep Foundation**	
Long Piles, fixed head		
d	0.5	m
A pile	0.19635	m2
Column K1		
B	0.8	m
H	0.8	m
L (length)	8	m
A col	0.64	m2
Piles Data		
Cap L	2300	mm
Cap B	2300	mm
Cap h	800	mm
Cc	60	mm
d rebar	20	mm
A rebar	314.1593	mm2
d stirrup	13	mm
A stirrup	132.7323	mm2
n of piles	4	piles
max P	2626.288	kN
fy	400	Mpa



101.568
2727.856

Pile Cap Reinforcement

Factored Load			
Vu	656.5721	kN	
d	720	mm	(effective height)
2 way shear around column			
bo	2883.2	mm	
λ	1		
βc	1		
Vc1	5798799	N	
αs	40		
Vc2	11314239	N	
Vc3	3752164	N	
Vc used	3752164	N	
ΦVn	2814123	N	**SAFE**
2 way shear around piles			
bo	2120.5	mm	
Vc1	4264829	N	
Vc2	10814947	N	
Vc3	2759595	N	
Vc used	2759595	N	
ΦVn	2069696	N	**SAFE**

Bending moment design Lx

n	2		(number of piles in critical section)
dist.	750	mm	(x axis dist. From pile to column)
Mu	984.8582	kNm	
Rn	0.91778		
ρ req	0.00234		
As req	3870.561	mm2	
As min	3312.000	mm2	
As use	3870.561	mm2	
n rebars	13		
s	171.5385	mm	
s use	150	mm	
bot. reinf.	**13D20**		
top reinf.	**13D10**		50% of bottom reinforcement
l hook bot.	**400**		20db
l hook top	**200**		50% of bottom hook length
One way shear			
d	727	mm	
w	250	mm	dist. From face of column to pile
Vu	656572	N	
ρw	0		
Vc1	1465355	N	
Vc2	1465355	N	
Vc3	2655956	N	
Vc used	1465355	N	
ΦVc	1099016	N	
ΦVs	-442444		**SAFE** (ΦVc > Vu)

$$\rho_{perlu} = \frac{0,85 f_c'}{f_y}\left[1-\sqrt{1-\frac{2R_n}{0,85 f_c'}}\right]$$

If **d > w**, then the critical location where shear is checked is taken at the face of support.

V_c		
Paling kecil di antara a), b), dan c):	$\left[0,16\lambda\sqrt{f_c'}+17\rho_w\frac{V_u d}{M_u}\right]b_w d$[1]	a)
	$\left[0,16\lambda\sqrt{f_c'}+17\rho_w\right]b_w d$	b)
	$0,29\lambda\sqrt{f_c'}b_w d$	c)

[1] M_u dan V_u terjadi secara serentak pada penampang.

Pile Reinforcement

Ast begin	2%	
φ	0.75	
α	0.85	
cover	60	mm
Rebar Calculation		
Ag	196349.5	mm2
D	500	mm
D use	500	mm
Ag use	196349.5	mm2
Ast	3926.991	mm2
ΦPn	4698.865	kN
d reinf.	25	mm
A reinf.	490.8739	mm2
n reinf.	8	
n use	8	
Rebar	**8D25**	

rounddown to get gross area less than calculated

For spiral columns (φ = 0.75)

$$\phi P_n(max) = 0.85\phi[0.85f_c'(A_g - A_{st}) + f_y A_{st}] \quad \text{(ACI Equation 22.4.2.1b}^8\text{)}$$

For tied columns (φ = 0.65)

$$\phi P_n(max) = 0.80\phi[0.85f_c'(A_g - A_{st}) + f_y A_{st}] \quad \text{(ACI Equation 22.4.2.1a}^9\text{)}$$

Spiral Calculation

Ast	3926.991	mm2	
Dc	380	mm	diameter inside cover
Ac	113411.5	mm2	area inside cover
ρs min	0.024681		min spiral ratio
Ds	16	mm	diameter of spiral
As	201.0619	mm2	area of spiral steel
s	82.13978	mm	spiral pitch
s use	75	mm	
Spiral	**75D16**		
Main Bar Spacing			
CC	1014.734	mm	clear circumference
spacing	126.8418	mm	
Cutting Length			
L	8	m	
n	106.6667		number of turns
C	1.14354	m	circumference of the helical stirrup
s	75		spiral pitch
L spiral	122.2396	m	spiral length=n*sqrt(c^2+P^2)
L limit	12		bar length limit
Cut length	10.18664		
	10	turns	

$$\text{Minimum } \rho_s = (0.45)\left(\frac{A_g}{A_c}-1\right)\frac{f_c'}{f_y}$$

$$\rho_s = \frac{4a_s(D_c - d_b)}{sD_c^2}$$

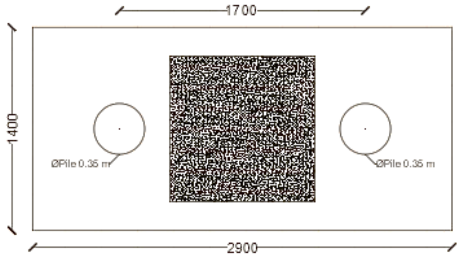
Recap

Pile Cap	Lx Bottom	13D20	mm
	Lx Top	13D10	mm
	Ly Bottom	13D20	mm
	Ly Top	13D10	mm
Pile	Longitudinal	8D25	mm
	Spiral	75D16	mm
	Cutting Length	10	turns

C.6 Type 2 Foundation Design

Type 2

Foundation Data		
Type:	**Deep Foundation**	
Long Piles, fixed head		
d	0.35	m
A pile	0.096211	m2
Column K2		
B	1	m
H	1	m
L (length)	8	m
A col	1	m2
Piles Data		
Cap L	1400	mm
Cap B	2900	mm
Cap h	700	mm
Cc	60	mm
d rebar	16	mm
A rebar	201.0619	mm2
d stirrup	13	mm
A stirrup	132.7323	mm2
n of piles	2	piles
max P	1274.96	kN
fy	400	Mpa



Pile Cap Reinforcement

Factored Load			
Vu	637.4801	kN	
d	624	mm	(effective height)
2 way shear around column			
bo	2500	mm	
λ	1		
βc	1		
Vc1	4357681	N	
αs	40		
Vc2	8498947	N	
Vc3	2819676	N	
Vc used	2819676	N	
ΦVn	2114757	N	**SAFE**
2 way shear around piles			
bo	2024.35	mm	
Vc1	3528588	N	
Vc2	8229086	N	
Vc3	2283204	N	
Vc used	2283204	N	
ΦVn	1712403	N	**SAFE**

Bending moment design Lx

n	1	
dist.	850	mm
Mu	541.8581	kNm
Rn	0.53318	
ρ req	0.00135	
As req	1176.906	mm2
As min	1320.247	mm2
As use	1320.247	mm2
n rebars	7	
s	190.2857	mm
s use	150	mm
bot. reinf.	**7D16**	
top reinf.	**7D8**	
l hook bot.	**320**	
l hook top	**160**	

One way shear

d	627	mm
d+c/2	1127	mm
Vu	472283	N
ρw	7E-05	
Vc1	1340473	N
Vc2	1814491	N
Vc3	1394293	N
Vc used	1340473	N
ΦVc	1005355	N
ΦVs	-533072	
legs	3	
Av	126.75	mm2
Avmin/s	0.6125	mm2/mm
s	206.9388	mm
s used	200	mm
Stirrups	**D13-200**	

Pile Reinforcement

Ast begin	2%	
φ	0.75	
α	0.85	
cover	60	mm

For spiral columns ($\phi = 0.75$)

$$\phi P_n(\max) = 0.85\phi[0.85 f'_c(A_g - A_{st}) + f_y A_{st}] \quad \text{(ACI Equation 22.4.2.1b)}$$

For tied columns ($\phi = 0.65$)

$$\phi P_n(\max) = 0.80\phi[0.85 f'_c(A_g - A_{st}) + f_y A_{st}] \quad \text{(ACI Equation 22.4.2.1a)}$$

Rebar Calculation			
Ag	96211.28	mm2	
D	350	mm	rounddown to get gross area less than calculated
D use	350	mm	
Ag use	96211.28	mm2	
Ast	1924.226	mm2	
ΦPn	2302.444	kN	
d reinf.	20	mm	
A reinf.	314.1593	mm2	
n reinf.	6.125		
n use	7		
Rebar	**7D20**		

Spiral Calculation

Ast	2199.115	mm2	
Dc	230	mm	diameter inside cover
Ac	41547.56	mm2	area inside cover
ρs min	0.044405		min spiral ratio
Ds	16	mm	diameter of spiral
As	201.0619	mm2	area of spiral steel
s	73.26906	mm	spiral pitch
s use	50	mm	
Spiral	**50D16**		
Main Bar Spacing			
CC	559.2035	mm	clear circumference
spacing	79.88621	mm	
Cutting Length			
L	8	m	
n	160		number of turns
C	0.672301	m	circumference of the helical stirrup
s	50		spiral pitch
L spiral	107.8652	m	spiral length=n*sqrt(c^2+P^2)
L limit	12		bar length limit
Cut length	8.988767		
	8	turns	

$$\text{Minimum } \rho_s = 0.45\left(\frac{A_g}{A_c} - 1\right)\frac{f'_c}{f_y}$$

$$\rho_s = \frac{4a_s(D_c - d_b)}{sD_c^2}$$

Recap

Pile Cap	Lx Bottom	7D16	mm
	Lx Top	7D8	mm
	Ly Bottom	D13-200	mm
	Ly Top	D13-200	mm
Pile	Longitudinal	7D20	mm
	Spiral	50D16	mm
	Cutting Length	8	turns

APPENDIX D

D. COST AND TIME MANAGEMENT APPENDIX

D.1 Work Unit Cost Analysis

1 m2 Land Clearing

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost (Rp)
A	**WORKERS**					
	Worker	L.01	OH	0.01	100,000.00	1,000.00
	Foreman	L.04	OH	0.00	175,000.00	175.00
				TOTAL LABOR COST		1,175.00
B	**MATERIALS**					
						-
				TOTAL MATERIALS COST		-
C	**TOOLS**					
						-
				TOTAL TOOLS COST		-
D	Total (A+B+C)					1,175.00
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	117.50
F	**Work Unit Cost (D+E)**					**1,292.50**

1 m2 Metal Fence Installation

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost (Rp)
A	WORKERS					
	Worker	L.01		0.042	100,000.00	4,200.00
	Blacksmith	L.02		0.004	130,000.00	520.00
	Head Worker	L.03		0.002	175,000.00	350.00
	Foreman	L.04		0.042	175,000.00	7,350.00
				TOTAL LABOR COST		**12,420.00**
B	MATERIALS					
	Steel Wiremesh		Sheets	0.1434	13,700.00	1,964.58
				TOTAL MATERIALS COST		**13,700.00**
C	TOOLS					
						-
				TOTAL TOOLS COST		**-**
D	Total (A+B+C)					26,120.00
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	**2,612.00**
F	Work Unit Cost (D+E)					**28,732.00**

1 m' Bouwplank Measurement and Installation

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost (Rp)
A	**WORKERS**					
	Worker	L.01	OH	0.1	100,000.00	10,000.00
	Woodworker	L.02	OH	0.1	130,000.00	13,000.00
	Head Worker	L.03	OH	0.01	175,000.00	1,750.00
	Foreman	L.04	OH	0.005	175,000.00	875.00
				TOTAL LABOR COST		25,625.00
B	**MATERIALS**					
	Kalba Wood 5/7		m^3	0.012	1,900,000.00	22,800.00
	Nails 2”-3”		Kg	0.02	21,200.00	424.00
	Kalba Wood Board		m^3	0.007	2,222,000.00	15,554.00
				TOTAL MATERIALS COST		38,778.00
C	**TOOLS**					
				TOTAL TOOLS COST		-
D	Total (A+B+C)					64,403.00
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	6,440.30
F	**Work Unit Cost (D+E)**					**70,843.30**

1 m2 Scaffolding Installation

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost

						(Rp)
A	WORKERS					
	Worker	L.01	OH	0.25	100,000.00	25,000.00
	Woodworker	L.02	OH	0.017	130,000.00	2,210.00
	Head Worker	L.03	OH	0.002	175,000.00	350.00
	Foreman	L.04	OH	0.013	175,000.00	2,275.00
				TOTAL LABOR COST		29,835.00
B	MATERIALS					
	Bamboo (6-8/600 cm Diameter)		pcs	1.25	20,800.00	26,000.00
				TOTAL MATERIALS COST		26,000.00
C	TOOLS					
						-
				TOTAL TOOLS COST		-
D	Total (A+B+C)					55,835.00
E	Overhead & Profit (Maximum 15 %)			2.50%	x D	1,395.88
F	Work Unit Cost (D+E)					**57,230.88**

1 m3 of 1m Depth Excavation for Regular Soil

No	Description	Code	Unit	Coefficient	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker	L.01	OH	0.750	100,000.00	75,000.00
	Foreman	L.04	OH	0.025	175,000.00	4,375.00
				TOTAL LABOR COST		79,375.00
B	MATERIALS					-
						-
				TOTAL MATERIALS COST		-
C	TOOLS					-
	Excavator		hour	0.0104	553,850.00	5,740.12
	Dump Truck		hour	0.0380	154,900.00	5,880.02
						-
				TOTAL TOOLS COST		11,620.14
D	Total (A+B+C)					90,995.14
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	9,099.51
F	Work Unit Cost (D+E)					**100,094.66**

1 m3 Sandstone filling

No	Description	Code	Unit	Coefficient	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker	L.01	OH	0.30	100,000.00	30,000.00
	Foreman	L.04	OH	0.01	175,000.00	1,750.00
				TOTAL LABOR COST		31,750.00
B	MATERIALS					
	Sandstone			1.2	190,200.00	228,240.00
				TOTAL MATERIALS COST		228,240.00
C	TOOLS					
	Excavator		hour	0.0104	553,850.00	5,740.12
	Dump Truck		hour	0.0380	154,900.00	5,880.02
	Vibro Roller		hour	0.013333333	500449.58	6,672.66
				TOTAL TOOLS COST		18,292.80
D	Total (A+B+C)					278,282.80
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	27,828.28
F	Work Unit Cost (D+E)					**306,111.08**

Creation of 1 m3 K-100 Lean Concrete

No	Description	Code	Unit	Coefficient	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker	L.01	OH	1.20	100,000.00	120,000.00
	Bricklayer	L.02	OH	0.20	140,000.00	28,000.00
	Head Worker	L.03	OH	0.02	175,000.00	3,500.00

	Foreman	L.04	OH	0.06	175,000.00	10,500.00
				TOTAL LABOR COST		162,000.00
B	MATERIALS					
	Portland Cement		Kg	230	1,350.00	310,500.00
	Concrete Sand		Kg	893	157.14	140,328.57
	2/3 cm Crushed Stone		Kg	1027	191.33	196,499.33
	Water		Ltr	200	35.00	7,000.00
				TOTAL MATERIALS COST		654,327.90
C	TOOLS					
						-
				TOTAL TOOLS COST		-
D	Total (A+B+C)					816,327.90
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	81,632.79
F	Work Unit Cost (D+E)					**897,960.70**

1 m3 of Land Refilling

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost (Rp)
A	WORKERS					
	Worker	L.01	OH	0.50	100,000.00	50,000.00
	Foreman	L.04	OH	0.05	175,000.00	8,750.00
				TOTAL LABOR COST		58,750.00
B	MATERIALS					
						-
				TOTAL MATERIALS COST		-
C	TOOLS					
	Excavator		hour	0.0104	553,850.00	5,740.12
	Dump Truck		hour	0.0380	154,900.00	5,880.02
	Vibro Roller		hour	0.013333333	500449.58	6,672.66
				TOTAL TOOLS COST		18,292.80
D	Total (A+B+C)					77,042.80
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	7,704.28
F	Work Unit Cost (D+E)					**84,747.08**

1 m3 of Disposal Movement 30 meters Away

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost (Rp)
A	WORKERS					
	Worker	L.01	OH	0.330	100,000.00	33,000.00
	Foreman	L.04	OH	0.010	175,000.00	1,750.00
				TOTAL LABOR COST		34,750.00
B	MATERIALS					
						-
				TOTAL MATERIALS COST		-
C	TOOLS					
	Excavator		hour	0.0104	553,850.00	5,740.12
	Dump Truck		hour	0.0380	154,900.00	5,880.02
				TOTAL TOOLS COST		11,620.14
D	Total (A+B+C)					46,370.14
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	4,637.01
F	Work Unit Cost (D+E)					**51,007.16**

Installation of 1 m2 2x Use Column Formwork

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost (Rp)
A	WORKERS					
	Worker	L.01	OH	0.66	100,000.00	66,000.00
	Woodworker	L.02	OH	0.33	130,000.00	42,900.00
	Head Worker	L.03	OH	0.033	175,000.00	5,775.00
	Foreman	L.04	OH	0.033	175,000.00	5,775.00
				TOTAL LABOR COST		120,450.00
B	MATERIALS					
	Nails 2”-3”		kg	0.4	21,200.00	8,480.00

	Formwork Oil		Liter	0.2	22,100.00	4,420.00
	Kalba Wood		m^3	0.009	1,900,000.00	17,100.00
	Formwork Multiplex 9mm		Lbr	0.175	100,000.00	17,500.00
	Bamboo (6-8/600 cm Diameter)		pcs	0.65	20,800.00	13,520.00
				TOTAL MATERIALS COST		61,020.00
C	TOOLS					
	Crane 25 ton		hour	0.0047840	750,000.00	3,587.96
				TOTAL TOOLS COST		3,587.96
D	Total (A+B+C)					185,057.96
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	18,505.80
F	Work Unit Cost (D+E)					**203,563.76**

Installation of 1 m2 Beam Formwork

No	Description	Code	Unit	Coefficient	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker	L.01	OH	0.66	100,000.00	66,000.00
	Woodworker	L.02	OH	0.33	130,000.00	42,900.00
	Head Worker	L.03	OH	0.033	175,000.00	5,775.00
	Foreman	L.04	OH	0.033	175,000.00	5,775.00
				TOTAL LABOR COST		120,450.00
B	MATERIALS					
	Nails 2”-3”		kg	0.4	21,200.00	8,480.00
	Formwork Oil		Liter	0.2	22,100.00	4,420.00
	Kalba Wood		m^3	0.018	1,900,000.00	34,200.00
	Formwork Multiplex 9mm		Lbr	0.35	100,000.00	35,000.00
	Bamboo (6-8/600 cm Diameter)		pcs	1.3	20,800.00	27,040.00
				TOTAL MATERIALS COST		109,140.00
C	TOOLS					
	Crane 25 ton		hour	0.0047840	750,000.00	3,587.96
				TOTAL TOOLS COST		3,587.96
D	Total (A+B+C)					233,177.96
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	23,317.80
F	Work Unit Cost (D+E)					**256,495.76**

Installation of 1 m2 Floor and Stairs Slabs Formwork

No	Description	Code	Unit	Coefficient	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker	L.01	OH	0.66	100,000.00	66,000.00
	Woodworker	L.02	OH	0.33	130,000.00	42,900.00
	Head Worker	L.03	OH	0.033	175,000.00	5,775.00
	Foreman	L.04	OH	0.033	175,000.00	5,775.00
				TOTAL LABOR COST		120,450.00
B	MATERIALS					
	Nails 2”-3”		kg	0.4	21,200.00	8,480.00
	Formwork Oil		Liter	0.2	22,100.00	4,420.00
	Kalba Wood		m^3	0.015	1,900,000.00	28,500.00
	Formwork Multiplex 9mm		Sheets	0.35	100,000.00	35,000.00
	Bamboo (6-8/600 cm Diameter)		pcs	3	20,800.00	62,400.00
				TOTAL MATERIALS COST		138,800.00
C	TOOLS					
	Crane 25 ton		hour	0.0047840	750,000.00	3,587.96
				TOTAL TOOLS COST		3,587.96
D	Total (A+B+C)					262,837.96
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	**26,283.80**
F	Work Unit Cost (D+E)					289,121.76

1 kg Reinforcement with Plain or Threaded Rebars

No	Description	Code	Unit	Coefficient	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker	L.01	OH	0.00700	100,000.00	700.00

	Blacksmith	L.02	OH	0.00700	130,000.00	910.00
	Head Worker	L.03	OH	0.00070	175,000.00	122.50
	Foreman	L.04	OH	0.00040	175,000.00	70.00
				TOTAL LABOR COST		1,802.50
B	MATERIALS					
	Plain Steel Rebar		kg	1.050	12,200.00	12,810.00
	Concrete Metal Wire		kg	0.015	20,500.00	307.50
				TOTAL MATERIALS COST		13,117.50
C	TOOLS					
				TOTAL TOOLS COST		
D	Total (A+B+C)					14,920.00
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	1,492.00
F	Work Unit Cost (D+E)					**16,412.00**

Mixing and Casting of 1 m3 fc'30 MPa Concrete

No	Description	Code	Unit	Coefficient	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker	L.01	OH	1.000	100,000.00	100,000.00
	Bricklayer	L.02	OH	0.250	140,000.00	35,000.00
	Head Worker	L.03	OH	0.025	175,000.00	4,375.00
	Foreman	L.04	OH	0.100	175,000.00	17,500.00
				TOTAL LABOR COST		156,875.00
B	MATERIALS					
	Portland Cement		Kg	428	1,350.00	577,800.00
	Concrete Sand		Kg	741	157.14	116,442.86
	2/3 cm Crushed Stone		Kg	930	191.33	177,940.00
	Water		Ltr	195	35.00	6,825.00
				TOTAL MATERIALS COST		879,007.86
C	TOOLS					
	Vibrator Ø head 2.5 cm length of flexible shaft 2.0 m		hour	0.1	700,000.00	70,000.00
	Mix Truck 0.3 m3		hour	0.0671	850,000.00	57,003.97
	Concrete Pump		hour	0.0426	200,000.00	8,520.00
				TOTAL TOOLS COST		135,523.97
D	Total (A+B+C)					1,171,406.83
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	117,140.68
F	Work Unit Cost (D+E)					**1,288,547.51**

Borepile Drilling for 1 m'

No	**Details**	**Code**	**Unit**	**Coefficient**	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker		hour	0.0099	100,000.00	1,188.00
	Blacksmith		hour	0.005	120,000.00	500.00
	Foreman		hour	0.0017	175,000.00	255.00
				WORKERS TOTAL COST		1,943.00
B	MATERIALS					
	Bentonite Slurry		m3	1.05	120,000.00	126,000.00
				MATERIALS TOTAL COST		126,000.00
C	TOOLS					
	Drilling Machine Diameter 600mm		hour	0.0017	216,000.00	367.20
	Helping tool		Ls	1	5,000.00	5,000.00
				TOOLS TOTAL COST		367.20
D	Sum (A+B+C)					128,310.20
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	3,207.76
F	Unit Price (D+E)					131,517.96

Installation of 1 m2 15 cm Thick Light Bricks

No	Description	Code	Unit	Coefficient	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker	L.01	OH	0.60	100,000.00	60,000.00

	Bricklayer	L.02	OH	0.20	140,000.00	28,000.00
	Head Worker	L.03	OH	0.02	175,000.00	3,500.00
	Foreman	L.04	OH	0.03	175,000.00	5,250.00
				TOTAL LABOR COST		96,750.00
B	MATERIALS					
	Light Bricks		m3	0.15	650,000.00	97,500.00
	MU-382 Light Brick Adhesive		sacks	0.1575	130,000.00	20,475.00
	Helping Tool		Ls	1	5,000.00	5,000.00
				TOTAL MATERIALS COST		122,975.00
C	TOOLS					
						-
				TOTAL TOOLS COST		-
D	Total (A+B+C)					219,725.00
E	Overhead & Profit (Maximum 15 %)					21,972.50
F	Work Unit Cost (D+E)					**241,697.50**

1 m2 Plastering with 15 mm Thickness

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost (Rp)
A	WORKERS					
	Worker	L.01	OH	0.3	100,000.00	30,000.00
	Bricklayer	L.03	OH	0.15	140,000.00	21,000.00
	Head Worker	L.03	OH	0.015	175,000.00	2,625.00
	Foreman	L.04	OH	0.015	175,000.00	2,625.00
				TOTAL LABOR COST		56,250.00
B	MATERIALS					
	Portland Cement		Kg	4.416	1,350.00	5,961.60
	Tide Sand		m^3	0.027	217,500.00	5,872.50
				TOTAL MATERIALS COST		11,834.10
C	TOOLS					
						-
				TOTAL TOOLS COST		-
D	Total (A+B+C)					68,084.10
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	6,808.41
F	Work Unit Cost (D+E)					**74,892.51**

1 m2 of Interior Walls Painting

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost (Rp)
A	WORKERS					
	Worker	L.01	OH	0.020	100,000.00	2,000.00
	Painter	L.02	OH	0.063	120,000.00	7,560.00
	Head Worker	L.03	OH	0.0063	175,000.00	1,102.50
	Foreman	L.04	OH	0.003	175,000.00	525.00
				TOTAL LABOR COST		11,187.50
B	MATERIALS					
	Catylac Interior Base Paint		Kg	0.10	26,600.00	2,660.00
	Catylac Interior Coat Paint		Kg	0.39	28,100.00	10,959.00
				TOTAL MATERIALS COST		13,619.00
C	TOOLS					
						-
				TOTAL TOOLS COST		-
D	Total (A+B+C)					24,806.50
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	2,480.65
F	Work Unit Cost (D+E)					**27,287.15**

1 m2 of Exterior Walls Painting

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost (Rp)
A	WORKERS					
	Worker	L.01	OH	0.02	100,000.00	2,000.00
	Painter	L.02	OH	0.063	120,000.00	7,560.00
	Head Worker	L.03	OH	0.0063	175,000.00	1,102.50
	Foreman	L.04	OH	0.003	175,000.00	525.00
				TOTAL LABOR COST		11,187.50

B	MATERIALS					
	Catylac Exterior Base Paint		Kg	0.1	33,300.00	3,330.00
	Catylac Exterior Coat Paint		Kg	0.39	45,000.00	17,550.00
				TOTAL MATERIALS COST		20,880.00
C	TOOLS					
						-
				TOTAL TOOLS COST		-
D	Total (A+B+C)					32,067.50
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	3,206.75
F	Work Unit Cost (D+E)					**35,274.25**

Pointing for 1 m2 Wall

No	**Details**	**Code**	**Unit**	**Coefficient**	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Pekerja		OH	0.1	120,000.00	12,000.00
	Mandor		OH	0.01	150,000.00	1,500.00
				WORKERS TOTAL COST		13,500.00
B	MATERIALS					
	Instant Pointing Cement		kg	3.25	1,100.00	3,575.00
				MATERIALS TOTAL COST		3,575.00
C	TOOLS					
				TOOLS TOTAL COST		
D	Total (A+B+C)					17,075.00
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	426.88
F	Work Unit Cost (D+E)					17,501.88

Installation of 1 m2 Ceiling

No	Description	Code	Unit	Coefficient	Unit Cost (Rp)	Total Cost (Rp)
A	WORKERS					
	Worker	L.01	OH	0.0656	100,000.00	6,560.00
	Painter	L.02	OH	0.0066	120,000.00	792.00
	Head Worker	L.03	OH	0.0438	175,000.00	7,665.00
	Foreman	L.04	OH	0.0022	175,000.00	385.00
				TOTAL LABOR COST		15,402.00
B	MATERIALS					
	Gypsum Compound		kg	0.7977	3,300.00	2,632.41
	Textile Tape		roll	0.02	6,500.00	130.00
				TOTAL MATERIALS COST		2,762.41
C	TOOLS					
						-
				TOTAL TOOLS COST		-
D	Total (A+B+C)					18,164.41
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	1,816.44
F	Work Unit Cost (D+E)					**19,980.85**

Trasraam for 1 m2 Walls

No	**Details**	**Code**	**Unit**	**Coefficient**	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker		OH	0.3	100,000.00	30,000.00
	Foreman		OH	0.015	120,000.00	1,800.00
	Bricklayer		OH	0.1	175,000.00	17,500.00
	Head Worker		OH	0.01	175,000.00	1,750.00
				WORKERS TOTAL COST		51,050.00
B	MATERIALS					
	Portland Cement		kg	8.64	1,100.00	9,504.00
	Sand		m3	0.00308	208,000.00	640.64
				MATERIALS TOTAL COST		10,144.64
C	TOOLS					
				TOOLS TOTAL COST		

D	Total (A+B+C)					61,194.64
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	1,529.87
F	Work Unit Cost (D+E)					62,724.51

Ceramic Work for 1 m2 Floors (Homogenous Tiles)

No	Description	Code	Unit	Coefficient	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker	L.01	OH	0.7	100,000.00	70,000.00
	Bricklayer	L.02	OH	0.35	140,000.00	49,000.00
	Head Worker	L.03	OH	0.035	175,000.00	6,125.00
	Foreman	L.04	OH	0.035	175,000.00	6,125.00
				TOTAL LABOR COST		131,250.00
B	MATERIALS					
	NIRO 60x60 cm Homogenous tiles		Pcs	3	51,600.00	154,800.00
	Portland Cement		Kg	8.19	1,350.00	11,056.50
	Tide Sand		M3	0.045	217,500.00	9,787.50
	Color Cement		Kg	0.3	19,800.00	5,940.00
				TOTAL MATERIALS COST		181,584.00
C	TOOLS					
						-
				TOTAL TOOLS COST		-
D	Total (A+B+C)					312,834.00
E	Overhead & Profit (Maximum 15 %)			2.50%	x D	7,820.85
F	Work Unit Cost (D+E)					**320,654.85**

Installation of 5 mm Thick Glass Walls

No	Description	Code	Unit	Coefficient	**Unit Cost (Rp)**	**Total Cost (Rp)**
A	WORKERS					
	Worker	L.01	OH	0.015	100,000.00	1,500.00
	Woodworker	L.02	OH	0.15	130,000.00	19,500.00
	Head Worker	L.03	OH	0.015	175,000.00	2,625.00
	Foreman	L.04	OH	0.0008	175,000.00	140.00
				TOTAL LABOR COST		23,765.00
B	MATERIALS					
	5 mm Thick Glass Pane		m^2	1.1	120,000.00	132,000.00
	Sealant		Kg	0.05	40,000.00	2,000.00
				TOTAL MATERIALS COST		134,000.00
C	TOOLS					
						-
				TOTAL TOOLS COST		-
D	Total (A+B+C)					157,765.00
E	Overhead & Profit (Maximum 15 %)			10.00%	x D	15,776.50
F	Work Unit Cost (D+E)					173,541.50

D.2 Work Breakdown Structure, Specifications, and Bill of Quantities

No.	Work	Dimension	Type	Volume	unit	Unit Price (Rp)	Total Price (Rp)
A	**Preparation Work**						
1	Land Clearing	40x96		3977	m2	Rp 1,292.50	Rp 5,140,272.50
2	Fence	40+96+40+96	Steel Wiremesh Fence	276	m	Rp 28,732.00	Rp 7,930,032.00
3	Bouwplank	40+96+40+97		276	m	Rp 70,843.30	Rp 19,552,750.80
4	Creating Keet Board			1	pcs	Rp 10,000,000.00	Rp 10,000,000.00
5	Construction of Worker Barracks			1	pcs	Rp 8,000,000.00	Rp 8,000,000.00
6	Creation of Contractor Site Office			1	pcs	Rp 12,000,000.00	Rp 12,000,000.00
7	Creation of Site Office Supervisor and Owner			1	pcs	Rp 12,000,000.00	Rp 12,000,000.00
8	Creation of Project Supervisor and Owner Nameplates			1	pcs	Rp 500,000.00	Rp 500,000.00
9	Water Supply			1	pcs	Rp 10,000,000.00	Rp 10,000,000.00
10	Electricity Provision			1	pcs	Rp 12,000,000.00	Rp 12,000,000.00
11	Project Administration			1	pcs	Rp 3,500,000.00	Rp 3,500,000.00
12	Equipment Mobilization and Demobilization			1	pcs	Rp 20,000,000.00	Rp 20,000,000.00
13	Provision of Occupational Health and Safety (K3)			1	pcs	Rp 8,000,000.00	Rp 8,000,000.00
14	Provision of Health Protocols			1	pcs	Rp 5,000,000.00	Rp 5,000,000.00
15	Scaffolding			3312	m2	Rp 57,230.88	Rp 189,548,658.00
B	**Land Work**						
1	Excavation	40x96		3977	m3	Rp 100,094.66	Rp 398,076,453.43
2	Sandstone Fill	40x96x0.1		397.7	m3	Rp 306,111.08	Rp 121,740,378.43
3	Lean Concrete	40x96x0.1		397.7	m3	Rp 897,960.70	Rp 357,118,968.50
4	Landfill	40x96x0.8		2965.536466	m3	Rp 84,747.08	Rp 251,320,570.42
5	Disposal Movement	40x96x0.1		3977	m3	Rp 51,007.16	Rp 202,855,465.93
C	**Concrete Structure Work**						
1	Borepile Drilling	3.14x0.25x0.5x0.5x8	Bentonite:water = 5.4%	1568	m'	Rp 131,517.96	Rp 206,220,153.44
2	Borepile L=8m type 1	3.14x0.25x0.5x0.5x8					
	Reinforcement		8D25	53677.73601	kg	Rp 16,412.00	Rp 880,959,003.34
	Concrete Cast		Concrete f'c 30 MPa	240.5373471	m3	Rp 1,288,547.51	Rp 309,943,799.18
3	Borepile L=8m type 2	3.14x0.25x0.35x0.35x8					
	Reinforcement		7D20	6588.745178	kg	Rp 16,412.00	Rp 108,134,485.86
	Concrete Cast		Concrete f'c 30 MPa	21.51096304	m3	Rp 1,288,547.51	Rp 27,717,897.82
4	Pile Cap 1	2.3x2.3x0.8					
	Formwork			309.12	m2	Rp 289,121.76	Rp 89,373,318.22
	Reinforcement		13D20 & 13D10	9762.255698	kg	Rp 16,412.00	Rp 160,218,140.51
	Concrete Cast		Concrete f'c 30 MPa	176.5004005	m3	Rp 1,288,547.51	Rp 227,429,151.28
5	Pile Cap 2	1.4x2.9x0.7					
	Formwork			84.28	m2	Rp 289,121.76	Rp 24,367,181.87
	Reinforcement			1792.686776	kg	Rp 16,412.00	Rp 29,421,575.36
	Concrete Cast		Concrete f'c 30 MPa	39.5631332	m3	Rp 1,288,547.51	Rp 50,978,976.70
6	Sloof (Type 1)						
	Formwork			494.34	m2	Rp 256,495.76	Rp 126,796,113.63
	Reinforcement		Top Support 3D16	3468.941173	kg	Rp 16,412.00	Rp 56,932,262.53

			Bottom Support 2D16				
			Top Span 2D16				
			Bottom Span 2D16				
			Support Stirrups 1D10-150				
			Span Stirrups 1D10-150				
	Concrete Cast		Concrete f'c 30 MPa	53.48609667	m3	Rp 1,288,547.51	Rp 68,919,376.57
7	Sloof (Type 2)	0.4x0.4					
	Formwork			20.9088	m2	Rp 256,495.76	Rp 5,363,018.53
	Reinforcement		Top Support 4D16	430.6786121	kg	Rp 16,412.00	Rp 7,068,297.38
			Bottom Support 3D16				
			Top Span 3D16				
			Bottom Span 3D16				
			Support Stirrups 1D10-150				
			Span Stirrups 1D10-150				
	Concrete Cast		Concrete f'c 30 MPa	6.281136483	m3	Rp 1,288,547.51	Rp 8,093,542.76
8	Column Type 1						
	Formwork			1420.800	m2	Rp 203,563.76	Rp 289,223,389.16
	Reinforcement		Longitudinal 16D25	24564.135	kg	Rp 16,412.00	Rp 403,146,579.90
			Support Stirrup 4D13-100				
			Span Stirrup 2D13-150				
	Concrete Cast		Concrete f'c 30 MPa	281.031	m3	Rp 1,288,547.51	Rp 362,121,550.98
9	Column Type 2	1x1x4					
	Formwork			448	m2	Rp 203,563.76	Rp 91,196,564.15
	Reinforcement		Longitudinal 24D25	9182.507182	kg	Rp 16,412.00	Rp 150,703,307.87
			Support Stirrup 6D13-100				
			Span Stirrup 2D13-150				
	Concrete Cast		Concrete f'c 30 MPa	110.8302539	m3	Rp 1,288,547.51	Rp 142,810,047.42
10	Beam 1	0.35x0.65x8					
	Formwork			2219.6	m2	Rp 256,495.76	Rp 569,317,987.25
	Reinforcement		Top Support 7D25	58720.46742	kg	Rp 16,412.00	Rp 963,720,311.24
			Middle Support 4D13				
			Bottom Support 5D25				
			Top Span 3D25				
			Middle Span 4D13				
			Bottom Span 3D25				
			Support Stirrups 4D10-100				
			Span Stirrups 3D10-100				
	Concrete Cast		Concrete f'c 30 MPa	293.2396857	m3	Rp 1,288,547.51	Rp 377,853,266.21
11	Beam 2	0.6x0.65x8					
	Formwork			668.8	m2	Rp 256,495.76	Rp 171,544,363.79
	Reinforcement		Top Support 5D25	13193.8051	kg	Rp 16,412.00	Rp 216,536,729.32
			Middle Support 4D13				
			Bottom Support 5D25				
			Top Span 3D25				
			Middle Span 4D13				
			Bottom Span 3D25				

			Support Stirrups 3D13-100				
			Span Stirrups 3D10-100				
	Concrete Cast		Concrete f'c 30 MPa	135.5992605	m3	Rp 1,288,547.51	Rp 174,726,089.19
12	Secondary Beam	0.35x0.4x8					
	Formwork			1559.4	m2	Rp 256,495.76	Rp 399,979,486.99
	Reinforcement		Top Support 2D25	29377.91601	kg	Rp 16,412.00	Rp 482,150,357.48
			Middle Support 4D13				
			Bottom Support 2D25				
			Top Span 2D25				
			Middle Span 4D13				
			Bottom Span 2D25				
			Support Stirrups 2D13-75				
			Span Stirrups 2D13-100				
	Concrete Cast		Concrete f'c 30 MPa	186.0975903	m3	Rp 1,288,547.51	Rp 239,795,586.24
13	Landing Beams	0.15x0.15x2					
	Formwork			54	m2	Rp 289,121.76	Rp 15,612,575.00
	Reinforcement		4D19 and 8D100	1163.03645	kg	Rp 16,412.00	Rp 19,087,754.22
	Concrete Cast		Concrete f'c 30 MPa	2.55184249	m3	Rp 1,288,547.51	Rp 3,288,170.28
14	Slab Type A (Standard)	4x4x0.14					
	Formwork			2368	m2	Rp 289,121.76	Rp 684,640,325.93
	Reinforcement		D10-250	23359.37501	kg	Rp 16,412.00	Rp 383,374,062.63
	Concrete Cast		Concrete f'c 30 MPa	328.5442834	m3	Rp 1,288,547.51	Rp 423,344,917.67
15	Slab Type B (Toilet Floor Slab)	4x3.5x0.14					
	Formwork			168	m2	Rp 289,121.76	Rp 48,572,455.56
	Reinforcement		D10-250	1672.049858	kg	Rp 16,412.00	Rp 27,441,682.27
	Concrete Cast		Concrete f'c 30 MPa	23.30700002	m3	Rp 1,288,547.51	Rp 30,032,176.79
16	Slab Type C (Toilet Floor Slab 2)	4x1x0.14					
	Formwork			24	m2	Rp 289,121.76	Rp 6,938,922.22
	Reinforcement		D10-275	457.3587705	kg	Rp 16,412.00	Rp 7,506,172.14
	Concrete Cast		Concrete f'c 30 MPa	3.301737736	m3	Rp 1,288,547.51	Rp 4,254,445.93
17	Slab Type D	4x2.5x0.14					
	Formwork			440	m2	Rp 289,121.76	Rp 127,213,574.07
	Reinforcement		D10-250	4828.722156	kg	Rp 16,412.00	Rp 79,248,988.03
	Concrete Cast		Concrete f'c 30 MPa	60.98487616	m3	Rp 1,288,547.51	Rp 78,581,910.20
18	Slab Type E	4x3x0.14					
	Formwork			312	m2	Rp 289,121.76	Rp 90,205,988.89
	Reinforcement		D10-250	3205.995303	kg	Rp 16,412.00	Rp 52,616,794.91
	Concrete Cast		Concrete f'c 30 MPa	43.27159296	m3	Rp 1,288,547.51	Rp 55,757,503.27
19	Slab Type F	4x2x0.14					
	Formwork			16	m2	Rp 289,121.76	Rp 4,625,948.15
	Reinforcement		D10-250	197.2920186	kg	Rp 16,412.00	Rp 3,237,956.61
	Concrete Cast		Concrete f'c 30 MPa	2.214867259	m3	Rp 1,288,547.51	Rp 2,853,961.69
20	Roof Slab	4x4x0.15					
	Formwork			1632	m2	Rp 289,121.76	Rp 471,846,711.11
	Reinforcement		D10-250	14635.48066	kg	Rp 16,412.00	Rp 240,197,508.52
	Concrete Cast		Concrete f'c 30 MPa	242.9356076	m3	Rp 1,288,547.51	Rp 313,034,071.71

21	Stairs						
	Formwork			15.45105362	m2	Rp 289,121.76	Rp 4,467,235.81
	Reinforcement			1976.444271	kg	Rp 16,412.00	Rp 32,437,403.38
	Concrete Cast		Concrete f'c 30 MPa	7.002512642	m3	Rp 1,288,547.51	Rp 9,023,070.21
	Mezzanine (Bordes)		t=0.15 m				
22	Formwork			15.84	m2	Rp 289,121.76	Rp 4,579,688.67
	Reinforcement			21.11594638	kg	Rp 16,412.00	Rp 346,554.91
	Concrete Cast		Concrete f'c 30 MPa	1.92	m3	Rp 1,288,547.51	Rp 2,474,011.22
D	**Roof Work**						
1	Roof Work for 1m2	(16x40) + (16x40)		1518.2	m2	Rp 290,000.00	Rp 440,278,000.00
E	**Wall**						
1	Brick Masonry		Light Bricks SNI Standard	2886.16	m2	Rp 241,697.50	Rp 697,577,656.60
2	Glass Wall Installation		2 layers of 5 mm thick glass	4606.88	m2	Rp 173,541.50	Rp 799,484,865.52
3	Plastering			2886.16	m2	Rp 74,892.51	Rp 216,151,766.66
4	Trasraam			2886.16	m2	Rp 62,724.51	Rp 181,032,960.24
5	Pointing		25 kg:9 litre water t=2 mm	2886.16	m2	Rp 17,501.88	Rp 50,513,211.55
6	Painting Interior			2886.16	m2	Rp 27,287.15	Rp 78,755,080.84
7	Painting Exterior			2886.16	m2	Rp 35,274.25	Rp 101,807,129.38
F	**Facade for 1m-pcs**						
1	Façade		Wooden lattice	3200	m-pcs	Rp 600,000.00	Rp 1,920,000,000.00
2	Glass Window		Curved Glass Window	284.48	m-pcs	Rp 1,500,000.00	Rp 426,720,000.00
G	**Floor**						
1	Ceramic	3500		5696	m2	Rp 320,654.85	Rp 1,826,450,025.60
H	**Ceiling**						
1	Ceiling Installation			2304	m2	Rp 19,980.85	Rp 46,035,880.70
2	Ceiling Painting			2304	m2	Rp 27,287.15	Rp 62,869,593.60
I	**Electricity**						
1	Installation of Switch Points and Sockets	80		827	pcs	Rp 378,829.00	Rp 313,291,583.00
2	Socket Installation	24		696	pcs	Rp 118,250.00	Rp 82,302,000.00
3	Single Switch Installation	20		40	pcs	Rp 118,250.00	Rp 4,730,000.00
4	Dual Switch Installation	34		91	pcs	Rp 123,750.00	Rp 11,261,250.00
5	Light Fixtures Installation	72		380	pcs	Rp 380,820.00	Rp 144,711,600.00
6	Downlight Installation	45		32	pcs	Rp 130,776.00	Rp 4,184,832.00
7	Fatro Light Installation	16		32	pcs	Rp 94,331.00	Rp 3,018,592.00
8	Fitting Light Installation	72		316	pcs	Rp 56,023.00	Rp 17,703,268.00
9	NYM 3x2.5 Cable Installation	220		1500	m'	Rp 27,583.00	Rp 41,374,500.00
10	Installation of MCB Box and MCB	1		2	sets	Rp 2,000,000.00	Rp 4,000,000.00
11	Installation of Air Conditioning			64	units	Rp 3,000,000.00	Rp 192,000,000.00

J	**Clean Water Utility System**						
1	Water Torn	5		5	pcs	Rp 1,123,000.00	Rp 5,615,000.00
2	Septic Tank	5		5	pcs	Rp 11,935,220.52	Rp 59,676,102.60
3	Roof Tank	5		5	pcs	Rp 18,000,000.00	Rp 90,000,000.00
4	PVC Pipe Installation	1000		1000	m	Rp 15,427.00	Rp 15,427,000.00
5	Galvalume Gutter	5		5	pcs	Rp 18,000,000.00	Rp 90,000,000.00
6	Floor Drain	98		98	pcs	Rp 232,000.00	Rp 22,736,000.00
7	4M Water Well	10		10	m	Rp 1,127,000.00	Rp 11,270,000.00
8	Seating Closet	56		56	m	Rp 2,617,120.00	Rp 146,558,720.00
9	Water Sink	42		42	m	Rp 1,491,267.00	Rp 62,633,214.00
7	Shower	10		10	m	Rp 909,900.00	Rp 9,099,000.00
K	**Fire Suppresion System**						
1	Hydrant Box Indoor	15	Type B	15	pcs	Rp 5,125,000.00	Rp 76,875,000.00
2	Hydrant Pillar Outdoor	10	Type C	10	pcs	Rp 2,250,000.00	Rp 22,500,000.00
3	Smoke Detector	50	Total Fire	50	pcs	Rp 425,000.00	Rp 21,250,000.00
4	Fire alarm	72	Total Fire	72	pcs	Rp 675,000.00	Rp 48,600,000.00
5	Sprinkler Head	72	Total Fire	72	pcs	Rp 175,000.00	Rp 12,600,000.00
L	**Wood**						
1	Door	30	Wood	60	pcs	Rp 3,797,277.00	Rp 227,836,620.00
2	Door Hinge	60	Door Hinge	120	pcs	Rp 36,000.00	Rp 4,320,000.00
3	Floor Hinge	30	Floor Hinge	60	pcs	Rp 1,395,000.00	Rp 83,700,000.00
4	Patchfiting	30	Patchfiting	60	pcs	Rp 495,000.00	Rp 29,700,000.00
5	Key Slot	30	Key Slot	60	pcs	Rp 297,000.00	Rp 17,820,000.00
6	Window	40	Wood	80	pcs	Rp 1,339,167.00	Rp 107,133,360.00
7	Window Casement	40	Casement	80	pcs	Rp 32,000.00	Rp 2,560,000.00
8	Glass	40	Glass	80	pcs	Rp 382,500.00	Rp 30,600,000.00
9	Window Seal	40	Rubber	80	pcs	Rp 36,500.00	Rp 2,920,000.00
10	Wooden Grid	200	Glass	400	m	Rp 654,000.00	Rp 261,600,000.00
M	**Other Architectural Works**						
1	Balcony Glass	8x2x0.05		144	m2	Rp 173,541.50	Rp 24,989,976.00
2	Balcony Railings	300		316	m	Rp 505,000.00	Rp 159,580,000.00
3	GRC Type 1	40		2606.16	m2	Rp 770,159.00	Rp 2,007,157,579.44
4	GRC Kawung (batik)	300		420	m2	Rp 8,072,528.00	Rp 3,390,461,760.00
5	Stairs Railing	15.45105362		94.68	m2	Rp 586,621.00	Rp 55,541,276.28
6	Entrance Gate	40		40	m2	Rp 2,319,651.00	Rp 92,786,040.00
7	Steel Fence	300		300	m2	Rp 537,276.00	Rp 161,182,800.00
8	Bitumen Roof	1518.2		1518.2	m2	Rp 371,784.00	Rp 564,442,468.80
9	WPC wood railing			1000	m2	Rp 1,000,000.00	Rp 1,000,000,000.00
10	Rooftop Painting	8x8x17		1088	m2	Rp 35,274.25	Rp 38,378,384.00
						ΣSUM	**Rp 28,927,692,100.98**
						Unit Cost / m2	**Rp 5,721,458.09**

D.3 Heavy Equipment Coefficient

Asumption				
Work Hours		Tk	7.00	hour
Material Expanding Factors		Fk	1.20	-
Materials Weight Volume		D	1.60	Ton/M3
Works Procedure				
Soil is excavated by excavator				
Excavator put soil to Dump Truck				
Dump Truck throws soil to the dump site with distance		L	2.00	Km
Workers clear the area				
Materials, Equipments, and Powers				
MATERIAL				
No materials are need				
TOOL				
EXCAVATOR		(E10)		
Bucket Capacity		V	0.93	M3
Bucket Factor		Fb	1.00	-
Tool Efficiency Factor		Fa	0.83	-
Cycle Time = T1 + T2		Ts1	0.40	minute
- Excavating, loading and rotating		T1	0.30	minute
- etc.		T2	0.10	minute
Production Capacity/Hour	= (V x Fb x Fa x 60)/(Ts1 x Fk)	Q1	96.49	M3
Coefficient Equipment/M3	= 1 : Q1	-	**0.0104**	**Hour**
DUMP TRUCK		(E08)		
Tub Capacity		V	11.20	ton
Tools Efficiency Factor		Fa	0.83	-
Average velocity of Loaded Truck		v1	30.00	Km/hour
Average velocity of Emptied Truck		v2	50.00	Km/hour
Cycle Time :		Ts2		
- Muat	= (V x 60)/ D x Q1 x Fk	T1	3.63	minute
b. Loading Duration	= (L : v1) x 60	T2	4.00	minute
c. Empty Duration	= (L : v2) x 60	T3	2.40	minute
d. Etc		T4	1.00	minute
			11.03	minute
Production Capacity/Hour =	V x Fa x 60	Q2	26.34	M3
	D x Fk x Ts2			
Coefficient Equipment/M3	**= 1 : Q2**	-	**0.0380**	**hour**
Vibro Roller				
Drum Width		W1	2.2	m
Forward/Backward Velocity		V	1.5	km/hour
Compaction Thickness		H	0.2	m
Total Track per layer		N	6	
Work Efficiency		E	0.75	Good
Effective Width	= W1	W	2	m
Production/hour	= (W x V x H x 1 x E) / N	Q5	75	m3/hour
Equipment Coefficient/m3	=1/Q5		**0.0133**	**hour**

Bore Pile Diameter 600mm

ASSUMPTIONS				
Using Tools (Mechanical Way)				
Beton berdasarkan analisa item pekerjaan ybs				
Baja tulangan berdasarkan analisa item ybs				
Average distance		L	5	KM
Woek hours		Tk	8	hour
Borepile Length		p	8	M

Borepile Diameter		Uk	0.5	M
Reinforcement Requirements		Mb	150	Kg/M3
WORK METHODOLOGY				
Boring with Boring Machine				
Soil Disposal				
Casing Insertion				
Reinforcement Installation				
Concrete Casting				
USE OF MATERIALS, TOOLS, AND WORKFORCE				
MATERIALS				
K-250 Concrete	= {1/4 Phi x (Uk)^2) x 1m	(EI-715)	**0.2827**	M3
Steel Reinforcement	= {EI-716 x Mb}	(EI-731)	**42.4115**	Kg
Casing	= Phi x Uk		**1.885**	M2
TOOLS				
Bore Pile Machine		(E33)		
Capacity		V1	2,000.00	M'
Efficiency Factor		Fa	0.83	-
Cycle Time		Ts1	165	minute
Productivity per hour	V1 x Fa x 60	Q1	603.64	M1
	Ts1			
Tool Coefficient / m'	= 1 : Q1	(E33)	**0.0017**	**hour**
Concrete Pump		(E30)		
Capacity		V1	8	M3
Efficiency Factor		Fa	0.83	-
Cycle Time		Ts2	60	
Productivity per hour	V2 x Fa x 60	Q2	6.64	M3/hour
	Ts2	Q2	23.48	M'/hour
Tool Coefficient / m'	= 1 : Q2	(E30)	**0.0426**	**hour**
HELPING TOOLS				
Required helping tools			Lumpsum	

Concrete Truck Mixer

Drum Capacity		Cp=V	7	m3
Machine Power		Pw	220	Hp
Efficiency Factor		Fa	1.2	
Distance		L	5	km
Debit of Concrete		Q1	25	m3/h
Kecepatan rata-rata isi	(15-25) km/hour	v1	20	km/h
Kecepatan rata-rata kosong	(25-35) km/hour	v2	30	km/h
Lama waktu mengisi	(V/Q)*60	T1	16.8	minute
Lama waktu mengangkut	(L/v1)*60	T2	9	minute
Lama waktu kembali	(L/v2)*60	T3	6	minute
Lama waktu menumpahkan	2 minute	T4	2	minute
Waktu siklus pencampuran	Total Tn	Ts	33.8	minute
Productivity Capacity/hour	(V*Fa*60)/Ts	Q2	14.9112	m3
Coefficient	1/Q		0.07	hour

Crane Floor 1				

Capacity		V1	24.00	m2
Tool Efficiency Factor		Fa	0.75	-
Operation Traffic		L	300	m
Average Speed		v1	5	m/s
Height of Elevation		h	4	m
Elevation Speed		v2	0.4	m/s
Cycle Time				
a. Traffic Time		T1	60	s
b. Speeding up and Slowing Down		T2	10	s
c. Loading Tying Time		T3	120	s
d. Elevating Time		T4	10	s
e. Mid Air Waiting Time		T5	10	s
f. Unloading Time		T6	90	s
g. De-elevating Time		T7	10	s
		Ts1	310	s
Productivity Capacity/hour	V1 x Fa x 3600	Q1	209.032	m2
	Ts1			
Coefficient	= 1 : Q1	(E33)	**0.00478**	**hour**

Crane Floor 2				
Capacity		V1	24.00	m2
Tool Efficiency Factor		Fa	0.75	-
Operation Traffic		L	300	m
Average Speed		v1	5	m/s
Height of Elevation		h	8	m
Elevation Speed		v2	0.4	m/s
Cycle Time				
a. Traffic Time		T1	60	s
b. Speeding up and Slowing Down		T2	10	s
c. Loading Tying Time		T3	120	s
d. Elevating Time		T4	20	s
e. Mid Air Waiting Time		T5	10	s
f. Unloading Time		T6	90	s
g. De-elevating Time		T7	20	s
		Ts1	330	s
Productivity Capacity/hour	V1 x Fa x 3600	Q1	196.364	m2
	Ts1			
Coefficient	= 1 : Q1	(E33)	**0.00509**	**hour**

Crane Floor 3				
Capacity		V1	24.00	m2
Tool Efficiency Factor		Fa	0.75	-
Operation Traffic		L	300	m
Average Speed		v1	5	m/s
Height of Elevation		h	12	m
Elevation Speed		v2	0.4	m/s
Cycle Time				
a. Traffic Time		T1	60	s
b. Speeding up and Slowing Down		T2	10	s
c. Loading Tying Time		T3	120	s
d. Elevating Time		T4	30	s
e. Mid Air Waiting Time		T5	10	s
f. Unloading Time		T6	90	s
g. De-elevating Time		T7	30	s
		Ts1	350	s
Productivity Capacity/hour	V1 x Fa x 3600	Q1	185.143	m2
	Ts1			
Coefficient	= 1 : Q1	(E33)	**0.0054**	**hour**

D.4 Scheduling and Task Dependencies

Task Name	Duration	Start	Finish	Predecessors
PROJECT TOTAL	**231 days**	**Mon 1/01/24**	**Mon 18/11/24**	
Land Clearing	4 days	Mon 1/01/24	Thu 4/01/24	
Fence	1 day	Fri 5/01/24	Fri 5/01/24	2
Site Preparation	3 days	Fri 5/01/24	Tue 9/01/24	3SS
Bouwplank	3 days	Fri 5/01/24	Tue 9/01/24	4SS
Excavation	2 days	Wed 10/01/24	Fri 12/01/24	3,5
Disposal Movement	2 days	Wed 10/01/24	Thu 11/01/24	6SS
Borepile Drilling	3 days	Fri 12/01/24	Tue 16/01/24	7
Borepile Reinforcement Steel	11 days	Wed 17/01/24	Wed 31/01/24	8
Borepile Concrete Cast L=8m	1 day	Wed 17/01/24	Wed 17/01/24	9SS
Sandstone Fill	1 day	Thu 18/01/24	Thu 18/01/24	10
Lean Concrete	2 days	Fri 19/01/24	Tue 30/01/24	11
Land Fill	2 days	Wed 31/01/24	Thu 1/02/24	12
Pile Cap Steel Reinforcement	5 days	Fri 2/02/24	Thu 8/02/24	13
Column 1st Floor Steel Reinforcement	3 days	Mon 5/02/24	Fri 9/02/24	14SS+1 day
Tie Beam Steel Reinforcement	3 days	Mon 12/02/24	Wed 14/02/24	15
Pile Cap Formwork	2 days	Thu 15/02/24	Fri 16/02/24	16
Tie Beam Formwork	3 days	Thu 15/02/24	Mon 19/02/24	17SS
Pile Cap Concrete Cast	2 days	Tue 20/02/24	Thu 22/02/24	18
Tie Beam Concrete Cast	1 day	Tue 20/02/24	Tue 20/02/24	19SS
Formwork Column 1st Floor	4 days	Fri 23/02/24	Wed 28/02/24	20,19
Column 1st Floor Concrete Cast	1 day	Thu 29/02/24	Mon 4/03/24	21
2nd floor Scaffolding & Shoring	3 days	Thu 29/02/24	Mon 4/03/24	22FF
Formwork Beam 2nd Floor	8 days	Tue 5/03/24	Thu 14/03/24	22,23
Beam 2nd Floor Steel Reinforcement	9 days	Fri 15/03/24	Wed 27/03/24	24
Beam 2nd Floor Concrete Cast	2 days	Thu 28/03/24	Fri 29/03/24	25
Formwork Slab 2nd Floor	9 days	Wed 6/03/24	Mon 18/03/24	24SS+1 day
Slab 2nd Floor Steel Reinforcement	4 days	Tue 19/03/24	Fri 22/03/24	27
Slab 2nd Floor Concrete Cast	3 days	Mon 25/03/24	Wed 27/03/24	28
Formwork Landing Beam 1st Floor	1 day	Tue 5/03/24	Tue 5/03/24	22
Landing Beam 1st Floor Steel Reinforcement	1 day	Wed 6/03/24	Wed 6/03/24	30
Landing Beam 1st Floor Concrete Cast	1 day	Thu 7/03/24	Thu 7/03/24	31
Formwork Landing Slabs (Bordes) 1st Floor	1 day	Fri 8/03/24	Fri 8/03/24	32
Landing Slabs (Bordes) 1st Floor Steel Reinforcement	1 day	Mon 11/03/24	Mon 11/03/24	33
Landing Slabs (Bordes) 1st Floor Concrete Cast	1 day	Tue 12/03/24	Tue 12/03/24	34
Formwork Stairs 1st Floor	1 day	Fri 8/03/24	Fri 8/03/24	32
Stairs 1st Floor Steel Reinforcement	1 day	Mon 11/03/24	Mon 11/03/24	36
Stairs 1st Floor Concrete Cast	1 day	Tue 12/03/24	Tue 12/03/24	37
Column 2nd Floor Steel Reinforcement	3 days	Thu 28/03/24	Mon 1/04/24	29
Formwork Column 2nd Floor	4 days	Tue 2/04/24	Fri 5/04/24	39
Column 2nd Floor Concrete Cast	5 days	Mon 8/04/24	Fri 12/04/24	40
3rd floor Scaffolding & Shoring	3 days	Wed 10/04/24	Fri 12/04/24	41FF
Formwork Beam 3rd Floor	8 days	Mon 15/04/24	Wed 24/04/24	41,42
Beam 3rd Floor Steel Reinforcement	9 days	Thu 25/04/24	Tue 7/05/24	43
Beam 3rd Floor Concrete Cast	2 days	Wed 8/05/24	Thu 9/05/24	44
Formwork Slab 3rd Floor	14 days	Tue 16/04/24	Fri 3/05/24	43SS+1 day
Slab 3rd Floor Steel Reinforcement	12 days	Mon 6/05/24	Tue 21/05/24	46
Slab 3rd Floor Concrete Cast	7 days	Wed 22/05/24	Thu 30/05/24	47,45SS+1 day
Formwork Landing Beam 2nd Floor	1 day	Mon 15/04/24	Mon 15/04/24	41
Landing Beam 2nd Floor Steel Reinforcement	1 day	Tue 16/04/24	Tue 16/04/24	49

Landing Beam 2nd Floor Concrete Cast	1 day	Wed 17/04/24	Wed 17/04/24	50
Formwork Landing Slabs (Bordes) 2nd Floor	1 day	Thu 18/04/24	Thu 18/04/24	51
Landing Slabs (Bordes) 2nd Floor Steel Reinforcement	1 day	Fri 19/04/24	Fri 19/04/24	52
Landing Slabs (Bordes) 2nd Floor Concrete Cast	1 day	Mon 22/04/24	Mon 22/04/24	53
Formwork Stairs 2nd Floor	1 day	Wed 17/04/24	Wed 17/04/24	50
Stairs 2nd Floor Steel Reinforcement	1 day	Thu 18/04/24	Thu 18/04/24	55
Stairs 2nd Floor Concrete Cast	1 day	Fri 19/04/24	Fri 19/04/24	56
Column 3rd Floor Steel Reinforcement	2 days	Fri 10/05/24	Mon 13/05/24	45
Formwork Column 3rd Floor	2 days	Tue 14/05/24	Wed 15/05/24	58
Column 3rd Floor Concrete Cast	2 days	Thu 16/05/24	Fri 17/05/24	59
4th floor Scaffolding & Shoring	15 days	Mon 29/04/24	Fri 17/05/24	60FF
Formwork Beam 4th Floor	15 days	Mon 20/05/24	Fri 7/06/24	60,61
Beam 4th Floor Steel Reinforcement	4 days	Mon 10/06/24	Thu 13/06/24	62
Beam 4th Floor Concrete Cast	1 day	Fri 14/06/24	Fri 14/06/24	63
Formwork Slab 4th Floor	14 days	Tue 21/05/24	Fri 7/06/24	62SS+1 day
Slab 4th Floor Steel Reinforcement	3 days	Mon 10/06/24	Wed 12/06/24	65
Slab 4th Floor Concrete Cast	2 days	Mon 17/06/24	Tue 18/06/24	66,64SS+1 day
Roof Installation	16 days	Wed 19/06/24	Wed 10/07/24	67
Ceiling Installation	12 days	Thu 11/07/24	Fri 26/07/24	68
Light Brick Masonry Floor 1	11 days	Mon 1/04/24	Mon 15/04/24	26
Plastering Floor 1	17 days	Tue 16/04/24	Wed 8/05/24	70
Trasraam Floor 1	17 days	Thu 9/05/24	Fri 31/05/24	71
Light Brick Masonry Floor 2	10 days	Fri 10/05/24	Thu 23/05/24	45
Plastering Floor 2	15 days	Fri 24/05/24	Thu 13/06/24	73
Trasraam Floor 2	15 days	Fri 14/06/24	Thu 4/07/24	74
Light Brick Masonry Floor 3	9 days	Mon 17/06/24	Thu 27/06/24	64
Plastering Floor 3	13 days	Fri 28/06/24	Tue 16/07/24	76
Trasraam Floor 3	13 days	Wed 17/07/24	Fri 2/08/24	77
Pointing	29 days	Mon 5/08/24	Thu 12/09/24	72,75,78
Glass Wall Installation Floor 1	6 days	Mon 5/08/24	Mon 12/08/24	79SS
Glass Wall Installation Floor 2	20 days	Mon 5/08/24	Fri 30/08/24	79SS
Glass Wall Installation Floor 3	4 days	Mon 5/08/24	Thu 8/08/24	79SS
Ceiling Painting	7 days	Mon 29/07/24	Tue 6/08/24	69
Painting Interior	19 days	Fri 13/09/24	Wed 9/10/24	79
Painting Exterior	19 days	Fri 13/09/24	Wed 9/10/24	84SS
Rooftop Painting	7 days	Fri 13/09/24	Mon 23/09/24	84SS
Façade Work	10 days	Thu 10/10/24	Wed 23/10/24	85,84
Floor Work Story 1	28 days	Thu 10/10/24	Mon 18/11/24	84
Floor Work Story 2	28 days	Thu 10/10/24	Mon 18/11/24	88SS,35,38
Floor Work Story 3	12 days	Thu 10/10/24	Fri 25/10/24	88SS,54,57,48
Electrical Components	3 days	Thu 10/10/24	Mon 14/10/24	85
Clean Water Utility System	3 days	Tue 15/10/24	Thu 17/10/24	91
Fire Suppresion System	2 days	Thu 10/10/24	Fri 11/10/24	85
Wood Work	3 days	Thu 10/10/24	Mon 14/10/24	85
Balcony Work	3 days	Thu 10/10/24	Mon 14/10/24	85
GRC Work	7 days	Thu 10/10/24	Fri 18/10/24	85
Stairs Railing Installation	1 day	Thu 10/10/24	Thu 10/10/24	85
Fence and Gate Installation	3 days	Wed 19/06/24	Fri 21/06/24	67
Bitumen Roof Cover Installation	4 days	Thu 11/07/24	Tue 16/07/24	68
WPC Wood Installation	2 days	Thu 10/10/24	Fri 11/10/24	85
Finish	0 days	Mon 18/11/24	Mon 18/11/24	87,88,89,90,91,92,93,94,95,96,97,98,99,100,69,82,86,83,84,85,80,81

Work Activity	Cost	1	2	3	4	5	6	7	8	9	10
Land Clearing	Rp5,140,273	Rp5,140,273									
Fence	Rp7,930,032	Rp7,930,032									
Site Preparation	Rp101,000,000	Rp33,666,667	Rp67,333,333								
Bouwplank	Rp19,552,751	Rp6,543,584	Rp13,009,167								
Excavation	Rp398,076,453		Rp398,076,453								
Disposal Movement	Rp202,855,466		Rp202,855,466								
Borepile Drilling	Rp206,220,153		Rp69,232,051	Rp136,988,102							
Borepile Reinforcement Steel	Rp989,093,490			Rp269,851,970	Rp449,525,950	Rp269,715,570					
Borepile Concrete Cast L=8m	Rp337,661,697			Rp337,661,697							
Sandstone Fill	Rp121,740,378			Rp121,740,378							
Lean Concrete	Rp357,118,968			Rp46,451,371	Rp222,576,855	Rp88,090,742					
Land Fill	Rp251,320,570					Rp251,320,570					
Pile Cap Steel Reinforcement	Rp189,639,715					Rp38,003,485	Rp151,636,230				
Column 1st Floor Steel Reinforcement	Rp217,287,596						Rp217,287,596				
Tie Beam Steel Reinforcement	Rp64,000,560							Rp64,000,560			
Pile Cap Formwork	Rp113,740,500							Rp113,740,500			
Tie Beam Formwork	Rp132,159,132							Rp88,726,653	Rp43,432,479		
Pile Cap Concrete Cast	Rp278,408,128								Rp278,408,128		
Tie Beam Concrete Cast	Rp77,012,919								Rp77,012,919		
Formwork Column 1st Floor	Rp184,242,601								Rp46,080,150	Rp138,162,451	
Column 1st Floor Concrete Cast	Rp207,109,751									Rp187,058,307	Rp20,051,444
2nd floor Scaffolding & Shoring	Rp66,578,736									Rp44,385,824	Rp22,192,912
Formwork Beam 2nd Floor	Rp444,538,370										Rp222,295,185
Beam 2nd Floor Steel Reinforcement	Rp677,284,862										
Beam 2nd Floor Concrete Cast	Rp320,965,027										
Formwork Slab 2nd Floor	Rp495,565,053										Rp165,227,351
Slab 2nd Floor Steel Reinforcement	Rp286,756,816										
Slab 2nd Floor Concrete Cast	Rp303,223,188										
Formwork Landing Beam 1st Floor	Rp10,115,347										Rp10,115,347
Landing Beam 1st Floor Steel Reinforcement	Rp164,016,967										Rp164,016,967
Landing Beam 1st Floor Concrete Cast	Rp2,415,424										Rp2,415,424
Formwork Landing Slabs 1st Floor	Rp3,258,396										Rp3,258,396
Landing Slabs 1st Floor Steel Reinforcement	Rp219,382										
Landing Slabs 1st Floor Concrete Cast	Rp1,522,209										
Formwork Stairs 1st Floor	Rp4,215,497										Rp4,215,497
Stairs 1st Floor Steel Reinforcement	Rp20,539,647										
Stairs 1st Floor Concrete Cast	Rp5,897,381										
Column 2nd Floor Steel Reinforcement	Rp216,373,051										
Formwork Column 2nd Floor	Rp169,136,601										
Column 2nd Floor Concrete Cast	Rp223,809,751										
3rd floor Scaffolding & Shoring	Rp63,182,886										
Formwork Beam 3rd Floor	Rp427,052,139										
Beam 3rd Floor Steel Reinforcement	Rp679,558,440										
Beam 3rd Floor Concrete Cast	Rp320,965,027										
Formwork Slab 3rd Floor	Rp650,228,488										
Slab 3rd Floor Steel Reinforcement	Rp422,275,635										
Slab 3rd Floor Concrete Cast	Rp652,444,080										
Formwork Landing Beam 2nd Floor	Rp4,119,483										
Landing Beam 2nd Floor Steel Reinforcement	Rp5,784,109										
Landing Beam 2nd Floor Concrete Cast	Rp1,452,706										
Formwork Landing Slabs 2nd Floor	Rp1,321,292										
Landing Slabs 2nd Floor Steel Reinforcement	Rp127,174										
Landing Slabs 2nd Floor Concrete Cast	Rp951,802										
Formwork Stairs 2nd Floor	Rp1,251,738										
Stairs 2nd Floor Steel Reinforcement	Rp11,897,757										
Stairs 2nd Floor Concrete Cast	Rp3,125,689										
Column 3rd Floor Steel Reinforcement	Rp120,189,241										
Formwork Column 3rd Floor	Rp27,040,752										
Column 3rd Floor Concrete Cast	Rp74,012,096										
4th floor Scaffolding & Shoring	Rp87,182,885										
Formwork Beam 4th Floor	Rp269,251,328										
Beam 4th Floor Steel Reinforcement	Rp305,564,096										
Beam 4th Floor Concrete Cast	Rp150,444,886										
Formwork Slab 4th Floor	Rp303,862,960										
Slab 4th Floor Steel Reinforcement	Rp103,678,468										
Slab 4th Floor Concrete Cast	-Rp44,520,109										
Roof Installation	Rp440,278,000										
Ceiling Installation	Rp13,636,328										
Light Brick Masonry Floor 1	Rp265,702,719										
Plastering Floor 1	Rp52,726,922										
Trasraam Floor 1	Rp23,221,348										
Light Brick Masonry Floor 2	Rp250,247,919										
Plastering Floor 2	Rp47,189,100										
Trasraam Floor 2	Rp22,591,348										
Light Brick Masonry Floor 3	Rp181,627,019										
Plastering Floor 3	Rp40,304,880										
Trasraam Floor 3	Rp18,842,457										
Pointing	Rp50,513,213										
Glass Wall Installation Floor 1	Rp160,258,660										
Glass Wall Installation Floor 2	Rp235,114,660										
Glass Wall Installation Floor 3	Rp37,147,333										
Ceiling Painting	Rp62,869,594										
Painting Interior	Rp78,755,080										
Painting Exterior	Rp101,807,130										
Rooftop Painting	Rp28,177,441										
Façade Work	Rp1,920,000,000										
Floor Work Story 1	Rp14,230,400										
Floor Work Story 2	Rp14,230,400										
Floor Work Story 3	Rp8,230,000										
Electrical Components	Rp818,577,625										
Clean Water Utility System	Rp513,015,037										
Fire Suppresion System	Rp181,825,000										
Wood Work	Rp769,189,980										
Balcony Work	Rp184,569,976										
GRC Work	Rp5,397,619,339										
Stairs Railing Installation	Rp55,541,276										
Fence and Gate Installation	Rp253,968,840										
Bitumen Roof Cover Installation	Rp564,442,470										
WPC Wood Installation	Rp1,000,000,000										
Total Cost	**Rp26,326,639,380**										

11	12	13	14	15	16	17	18	19	20	21	22	23
Rp222,243,185												
Rp75,386,140	Rp376,186,701	Rp225,712,021										
		Rp320,965,027										
Rp275,281,418	Rp55,056,284											
	Rp286,756,816											
		Rp303,223,188										
Rp219,382												
Rp1,522,209												
Rp20,539,647												
Rp5,897,381												
		Rp144,265,234	Rp72,107,817									
			Rp169,136,601									
				Rp223,809,751								
				Rp63,182,886								
					Rp266,927,087	Rp160,125,052						
						Rp151,128,720	Rp377,449,800	Rp150,979,920				
								Rp320,965,027				
					Rp185,844,568	Rp232,191,960	Rp232,191,960					
								Rp180,727,198	Rp172,534,598	Rp69,013,839		
										Rp406,844,979	Rp245,599,101	
					Rp4,119,483							
					Rp5,784,109							
					Rp1,452,706							
					Rp1,321,292							
					Rp127,174							
						Rp951,802						
					Rp1,251,738							
					Rp11,897,757							
					Rp3,125,689							
								Rp60,111,154	Rp60,078,087			
									Rp27,040,752			
									Rp74,012,096			
							Rp53,834,543	Rp16,674,171	Rp16,674,171			
										Rp90,813,998	Rp89,218,665	Rp89,218,665
										Rp87,893,412	Rp107,984,774	Rp107,984,774
			Rp120,899,963	Rp120,668,963	Rp24,133,793							
					Rp12,497,335	Rp15,472,918	Rp15,472,918	Rp9,283,751				
								Rp6,331,928	Rp5,979,782	Rp5,454,819	Rp5,454,819	
								Rp25,213,792	Rp125,018,959	Rp100,015,168		
										Rp3,243,940	Rp15,694,700	Rp15,694,700

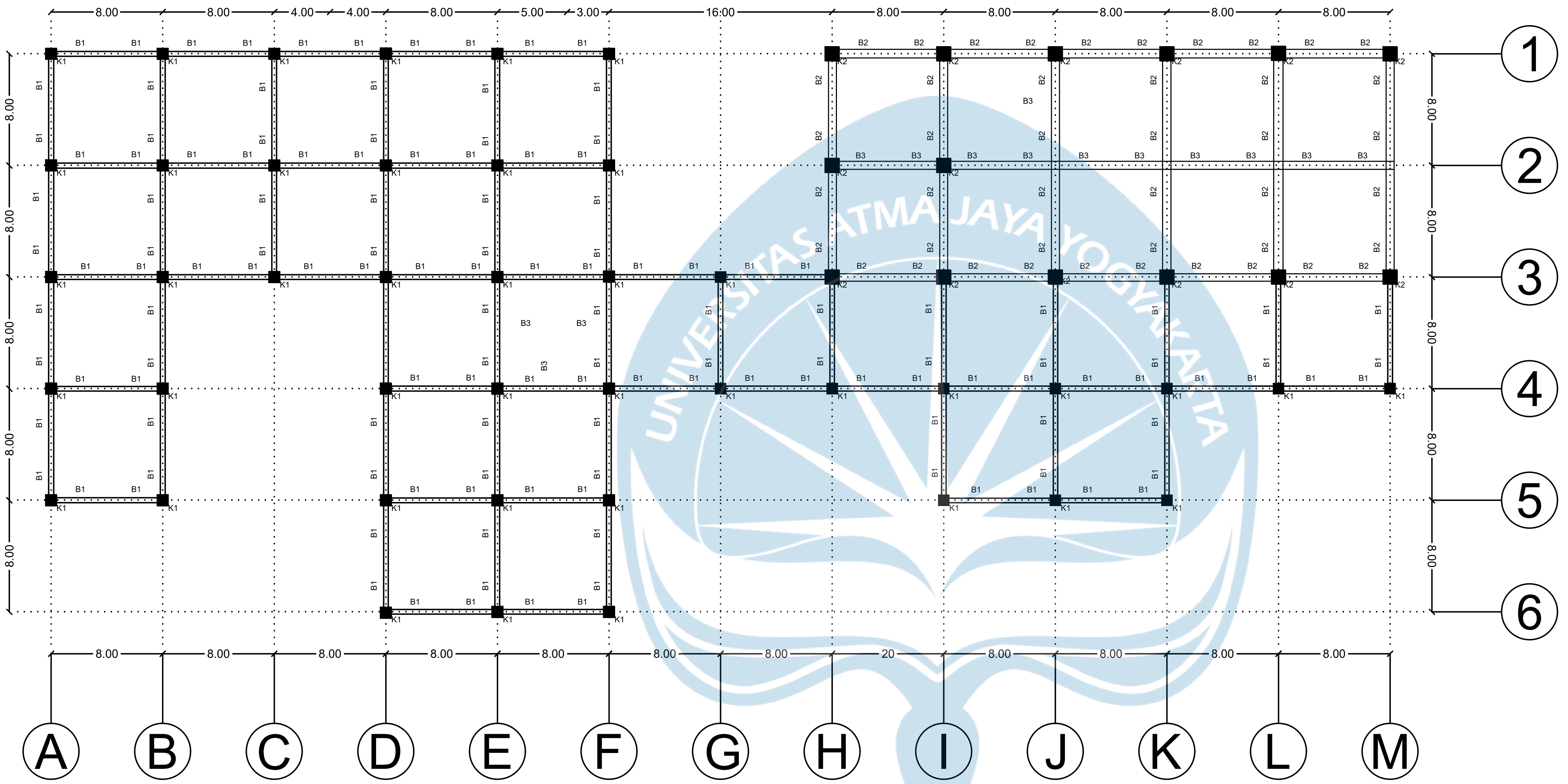
24	25	26	27	28	29	30	31	32	33	34	35	36
Rp305,564,096												
Rp150,444,886												
Rp103,678,468												
	-Rp44,520,109											
	Rp82,552,125	Rp137,586,875	Rp137,586,875	Rp82,552,125								
				Rp2,632,444	Rp5,706,109	Rp5,297,775						
Rp12,555,760												
Rp4,119,426	Rp7,722,092	Rp5,972,128	Rp4,777,702									
	Rp109,681,677	Rp71,945,342										
		Rp3,184,375	Rp15,466,877	Rp15,466,877	Rp6,186,751							
					Rp7,944,413	Rp5,449,022	Rp5,449,022					
								Rp8,779,577	Rp8,779,577	Rp8,779,577	Rp8,779,577	Rp8,779,577
								Rp133,808,883	Rp26,449,777			
								Rp60,728,665	Rp58,128,665	Rp58,128,665	Rp58,128,665	
								Rp37,147,333				
							Rp45,186,853	Rp17,682,741				
	Rp253,968,840											
				Rp282,221,235	Rp282,221,235							

37	38	39	40	41	42	43	44	45	46	47
Rp6,615,328										
Rp4,685,004	Rp20,575,021	Rp20,575,021	Rp20,575,021	Rp12,345,013						
Rp5,898,270	Rp26,641,350	Rp26,641,350	Rp26,641,350	Rp15,984,810						
Rp4,205,349	Rp19,976,743	Rp3,995,349								
				Rp384,000,000	Rp960,000,000	Rp576,000,000				
				Rp3,880,000	Rp2,350,000	Rp2,000,000	Rp2,000,000	Rp2,000,000	Rp2,000,000	Rp400
				Rp3,880,000	Rp2,350,000	Rp2,000,000	Rp2,000,000	Rp2,000,000	Rp2,000,000	Rp400
				Rp3,880,000	Rp2,350,000	Rp2,000,000				
				Rp545,718,417	Rp272,859,208					
					Rp513,015,037					
				Rp181,825,000						
				Rp512,793,320	Rp256,396,660					
				Rp123,046,651	Rp61,523,325					
				Rp1,542,176,954	Rp3,855,442,385					
				Rp55,541,276						
				Rp1,000,000,000						

D.5 S-Curve

Work Activity	Weight	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Land Clearing	0.02%	0.02%																																															
Fence	0.03%	0.03%																																															
Site Preparation	0.38%	0.13%	0.26%																																												
Bouwplank	0.07%	0.02%	0.05%																																												
Excavation	1.51%		1.51%																																												
Disposal Movement	0.77%		0.77%																																												
Borepile Drilling	0.78%		0.26%	0.52%																																											
Borepile Reinforcement Steel	3.76%			1.03%	1.71%	1.02%																																									
Borepile Concrete Cast L=8m	1.28%			1.28%																																											
Sandstone Fill	0.46%			0.46%																																											
Lean Concrete	1.36%			0.18%	0.85%	0.33%																																									
Land Fill	0.95%					0.95%																																									
Pile Cap Steel Reinforcement	0.72%					0.14%	0.58%																																								
Column 1st Floor Steel Reinforcement	0.83%						0.83%																																								
Tie Beam Steel Reinforcement	0.24%							0.24%																																							
Pile Cap Formwork	0.43%							0.43%																																							
Tie Beam Formwork	0.50%							0.34%	0.16%																																						
Pile Cap Concrete Cast	1.06%								1.06%																																						
Tie Beam Concrete Cast	0.29%								0.29%																																						
Formwork Column 1st Floor	0.70%								0.18%	0.52%																																					
Column 1st Floor Concrete Cast	0.79%									0.71%	0.08%																																				
2nd floor Scaffolding & Shoring	0.25%									0.17%	0.08%																																				
Formwork Beam 2nd Floor	1.69%										0.84%	0.84%																																			
Beam 2nd Floor Steel Reinforcement	2.57%											0.29%	1.43%	0.86%																																	
Beam 2nd Floor Concrete Cast	1.22%													1.22%																																	
Formwork Slab 2nd Floor	1.88%										0.63%	1.05%	0.21%																																		
Slab 2nd Floor Steel Reinforcement	1.09%												1.09%																																		
Slab 2nd Floor Concrete Cast	1.15%													1.15%																																	
Formwork Landing Beam 1st Floor	0.04%										0.04%																																				
Landing Beam 1st Floor Steel Reinforcement	0.62%										0.62%																																				
Landing Beam 1st Floor Concrete Cast	0.01%										0.01%																																				
Formwork Landing Slabs (Bordes) 1st Floor	0.01%										0.01%																																				
Landing Slabs (Bordes) 1st Floor Steel Reinforcement	0.00%											0.00%																																			
Landing Slabs (Bordes) 1st Floor Concrete Cast	0.01%											0.01%																																			
Formwork Stairs 1st Floor	0.02%										0.02%																																				
Stairs 1st Floor Steel Reinforcement	0.08%											0.08%																																			
Stairs 1st Floor Concrete Cast	0.02%											0.02%																																			
Column 2nd Floor Steel Reinforcement	0.82%													0.55%	0.27%																																
Formwork Column 2nd Floor	0.64%														0.64%																																
Column 2nd Floor Concrete Cast	0.85%															0.85%																															
3rd floor Scaffolding & Shoring	0.24%															0.24%																															
Formwork Beam 3rd Floor	1.62%																1.01%	0.61%																													
Beam 3rd Floor Steel Reinforcement	2.58%																	0.57%	1.43%	0.57%																											
Beam 3rd Floor Concrete Cast	1.22%																			1.22%																											
Formwork Slab 3rd Floor	2.47%																0.71%	0.88%	0.88%																												
Slab 3rd Floor Steel Reinforcement	1.60%																			0.69%	0.66%	0.26%																									
Slab 3rd Floor Concrete Cast	2.48%																					1.55%	0.93%																								
Formwork Landing Beam 2nd Floor	0.02%																0.02%																														
Landing Beam 2nd Floor Steel Reinforcement	0.02%																0.02%																														
Landing Beam 2nd Floor Concrete Cast	0.01%																0.01%																														
Formwork Landing Slabs (Bordes) 2nd Floor	0.01%																0.01%																														
Landing Slabs (Bordes) 2nd Floor Steel Reinforcement	0.00%																0.00%																														
Landing Slabs (Bordes) 2nd Floor Concrete Cast	0.00%																	0.00%																													
Formwork Stairs 2nd Floor	0.00%																0.00%																														
Stairs 2nd Floor Steel Reinforcement	0.05%																0.05%																														
Stairs 2nd Floor Concrete Cast	0.01%																0.01%																														
Column 3rd Floor Steel Reinforcement	0.46%																			0.23%	0.23%																										
Formwork Column 3rd Floor	0.10%																				0.10%																										
Column 3rd Floor Concrete Cast	0.28%																				0.28%																										
4th floor Scaffolding & Shoring	0.33%																		0.20%	0.06%	0.06%																										
Formwork Beam 4th Floor	1.02%																					0.34%	0.34%	0.34%																							
Beam 4th Floor Steel Reinforcement	1.16%																								1.16%																						
Beam 4th Floor Concrete Cast	0.57%																								0.57%																						
Formwork Slab 4th Floor	1.15%																					0.33%	0.41%	0.41%																							
Slab 4th Floor Steel Reinforcement	0.39%																								0.39%																						
Slab 4th Floor Concrete Cast	-0.17%																									-0.17%																					
Roof Installation	1.67%																									0.31%	0.52%	0.52%	0.31%																		
Ceiling Installation	0.05%																												0.01%	0.02%	0.02%																
Light Brick Masonry Floor 1	1.01%														0.46%	0.46%	0.09%																														
Plastering Floor 1	0.20%																0.05%	0.06%	0.06%	0.04%																											
Trasraam Floor 1	0.09%																			0.02%	0.02%	0.02%	0.02%																								
Light Brick Masonry Floor 2	0.95%																			0.10%	0.47%	0.38%																									
Plastering Floor 2	0.18%																					0.01%	0.06%	0.06%	0.05%																						
Trasraam Floor 2	0.09%																								0.02%	0.03%	0.02%	0.02%																			
Light Brick Masonry Floor 3	0.69%																									0.42%	0.27%																				
Plastering Floor 3	0.15%																										0.01%	0.06%	0.06%	0.02%																	
Trasraam Floor 3	0.07%																													0.03%	0.02%	0.02%															
Pointing	0.19%																																0.03%	0.03%	0.03%	0.03%	0.03%	0.03%									
Glass Wall Installation Floor 1	0.61%																																0.51%	0.10%													
Glass Wall Installation Floor 2	0.89%																																0.23%	0.22%	0.22%	0.22%											
Glass Wall Installation Floor 3	0.14%																																0.14%														
Ceiling Painting	0.24%																															0.17%	0.07%														
Painting Interior	0.30%																																					0.02%	0.08%	0.08%	0.08%	0.05%					
Painting Exterior	0.39%																																					0.02%	0.10%	0.10%	0.10%	0.06%					
Rooftop Painting	0.11%																																					0.02%	0.08%	0.02%							
Façade Work	7.29%																																									1.46%	3.65%	2.19%			
Floor Work Story 1	0.05%																																									0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%
Floor Work Story 2	0.05%																																									0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%
Floor Work Story 3	0.03%																																									0.01%	0.01%	0.01%			
Electrical Components	3.11%																																									2.07%	1.04%				
Clean Water Utility System	1.95%																																										1.95%				
Fire Suppression System	0.69%																																									0.69%					
Wood Work	2.92%																																									1.95%	0.97%				
Balcony Work	0.70%																																									0.47%	0.23%				
GRC Work	20.50%																																									5.86%	14.64%				
Stairs Railing Installation	0.21%																																									0.21%					
Fence and Gate Installation	0.96%																									0.96%																					
Bitumen Roof Cover Installation	2.14%																												1.07%	1.07%																	
WPC Wood Installation	3.80%																																									3.80%					
Weight Per Week	100.00%	0.20%	2.85%	3.47%	2.55%	2.46%	1.40%	1.01%	1.69%	1.40%	2.33%	2.28%	2.73%	3.78%	1.38%	1.55%	1.97%	2.13%	2.58%	2.93%	1.83%	2.90%	1.76%	0.81%	2.19%	1.56%	0.83%	0.60%	1.45%	1.15%	0.04%	0.19%	0.98%	0.35%	0.25%	0.25%	0.03%	0.08%	0.26%	0.19%	0.18%	16.66%	22.51%	2.21%	0.02%	0.02%	0.02%	0.00%
Weight Cummulative		0.20%	3.05%	6.52%	9.07%	11.53%	12.93%	13.94%	15.63%	17.04%	19.37%	21.65%	24.38%	28.16%	29.53%	31.08%	33.05%	35.18%	37.76%	40.68%	42.51%	45.41%	47.17%	47.98%	50.17%	51.72%	52.56%	53.15%	54.61%	55.76%	55.80%	55.99%	56.97%	57.32%	57.58%	57.83%	57.87%	57.95%	58.20%	58.40%	58.58%	75.23%	97.74%	99.95%	99.97%	99.98%	100.00%	100.00%

AutoCAD Construction Drawings



DETAILS:	
B1:	Beam 350 x 600
B2:	Beam 600 x 650
B3:	Beam 350 x 400

DETAILS:
K1:Column 1000 x 1000
K2:Column 800 x 800

Beam and Column Plan View 1st Story

Scale 1:400

UNIVERSITAS ATMA JAYA YOGYAKARTA

Final Project and Infrastructure Design

Date Friday, 22nd March 2023

Title

Beam & Column Plan View (1st Floor)

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

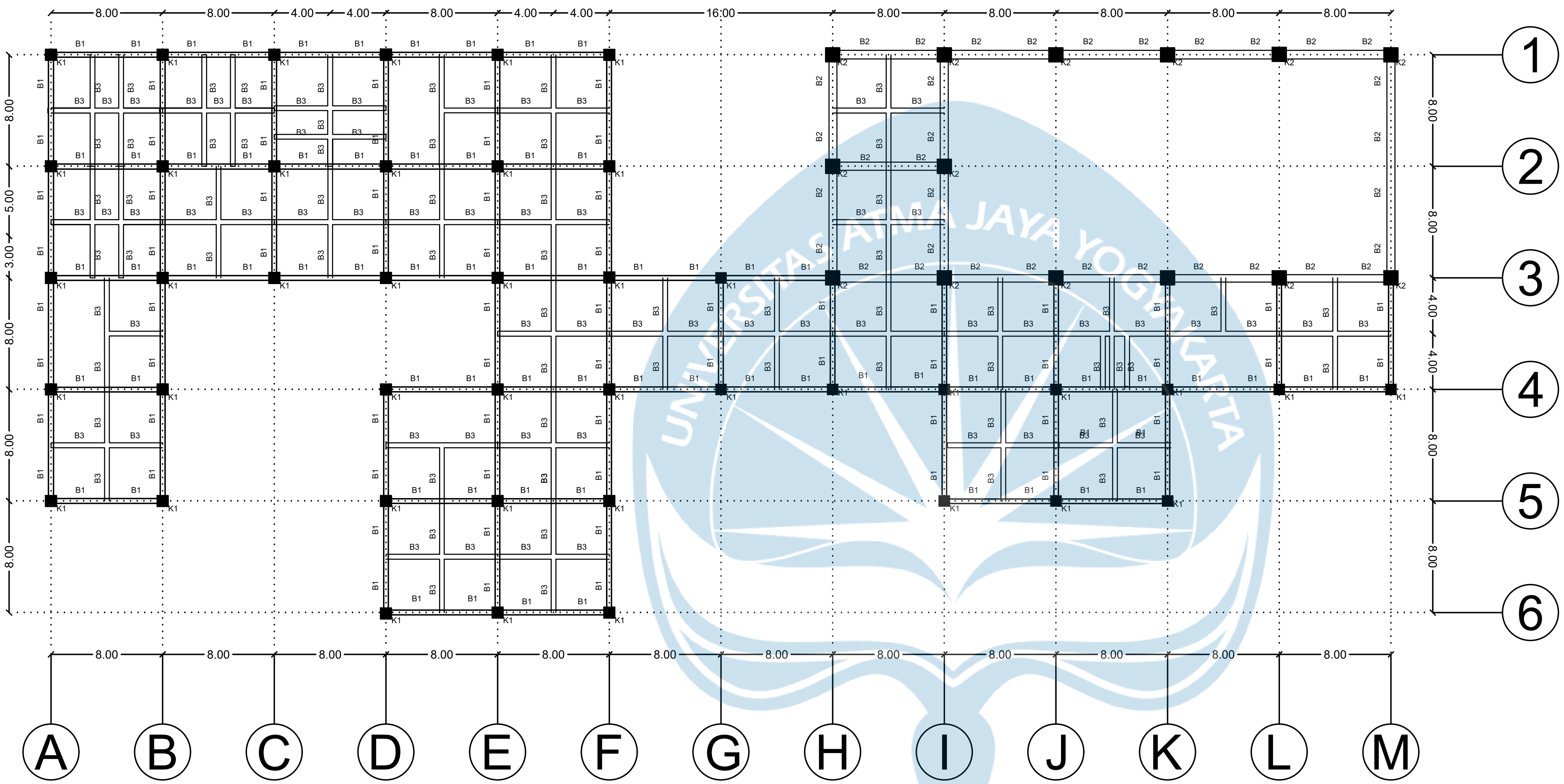
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:400 in m

Page

1



DETAILS:	
B1:	Beam 350 x 600
B2:	Beam 600 x 650
B3:	Beam 350 x 400

DETAILS:
K1:Column 1000 x 1000
K2:Column 800 x 800

Beam and Column Plan View 2nd Story

Scale 1:400

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Beam & Column Plan View (2nd Floor)

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

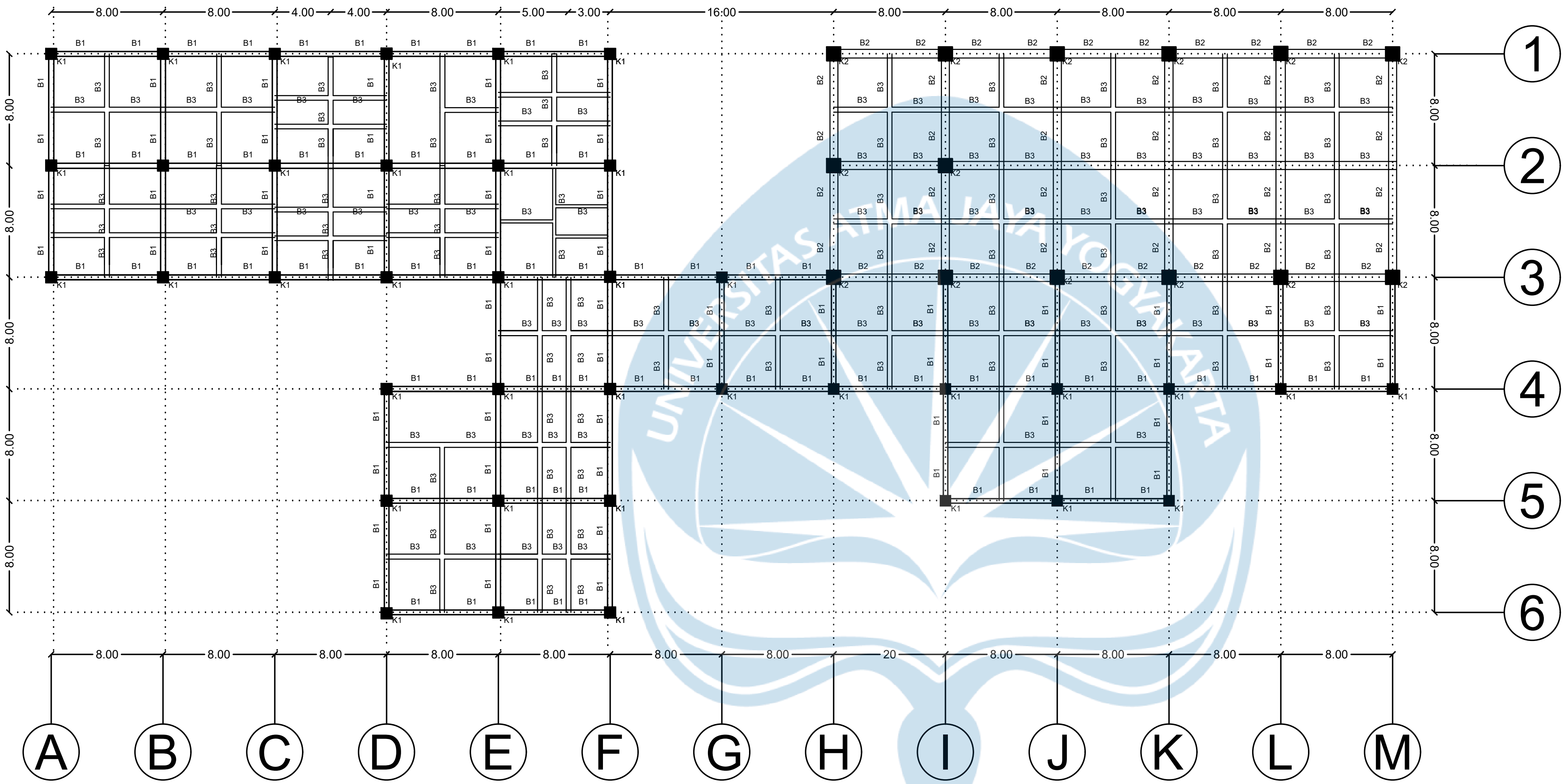
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:400 in m

Page

1



DETAILS:	
B1:	Beam 350 x 600
B2:	Beam 600 x 650
B3:	Beam 350 x 400

DETAILS:
K1:Column 1000 x 1000
K2:Column 800 x 800

Beam and Column Plan View 3rd Story

Scale 1:400

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Beam & Column Plan View (1st Floor)

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

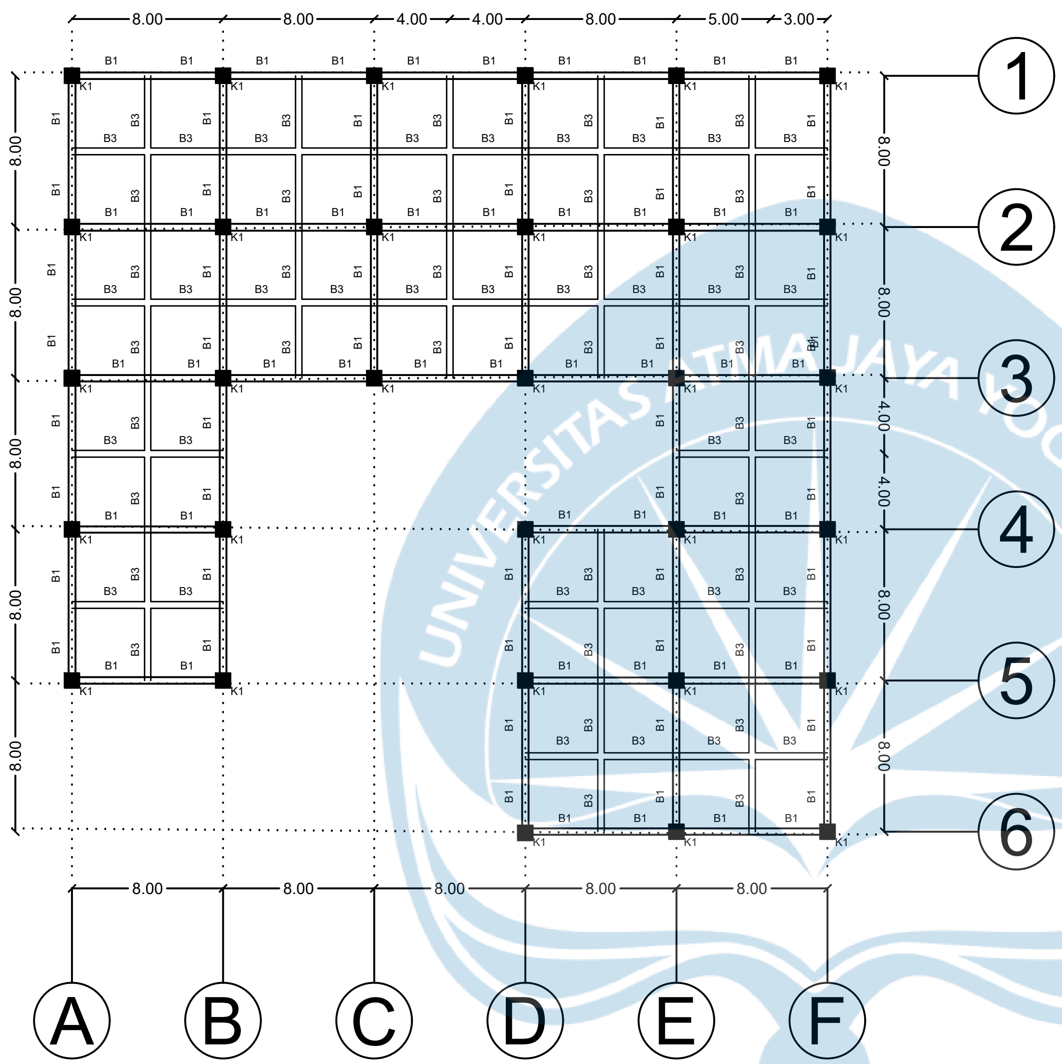
Agreed by

Johan Ardianto, S.T, M.T
Lecturer

Scale

1:400 in m

Page



DETAILS:	
B1:	Beam 350 x 600
B2:	Beam 600 x 650
B3:	Beam 350 x 400

DETAILS:
K1:Column 1000 x 1000
K2:Column 800 x 800

Beam and Column Plan View 4th Story

Scale 1:400

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Beam & Column Plan View (3rd Floor)

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

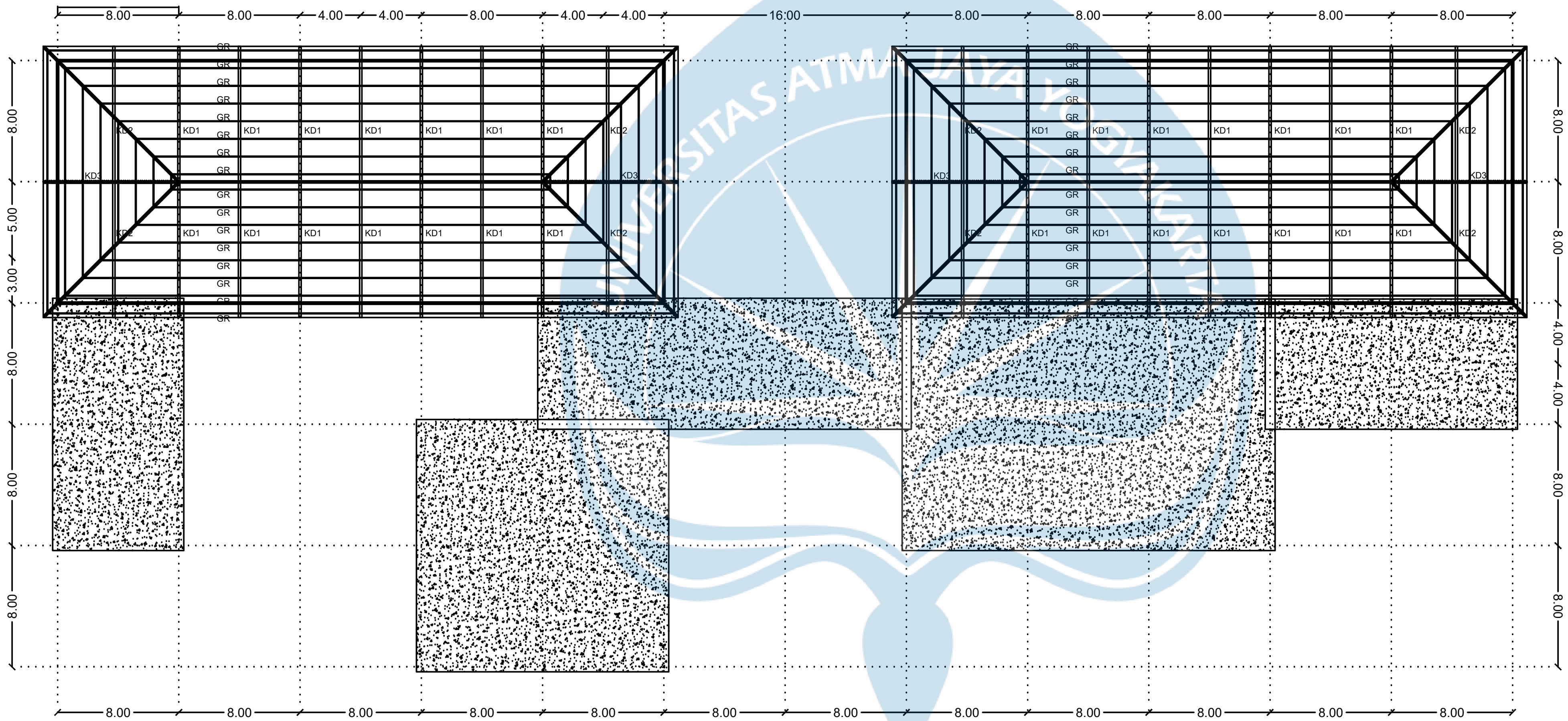
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:400 in m

Page

1



Roof Plan View

Scale 1:400

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Roof Plan View

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

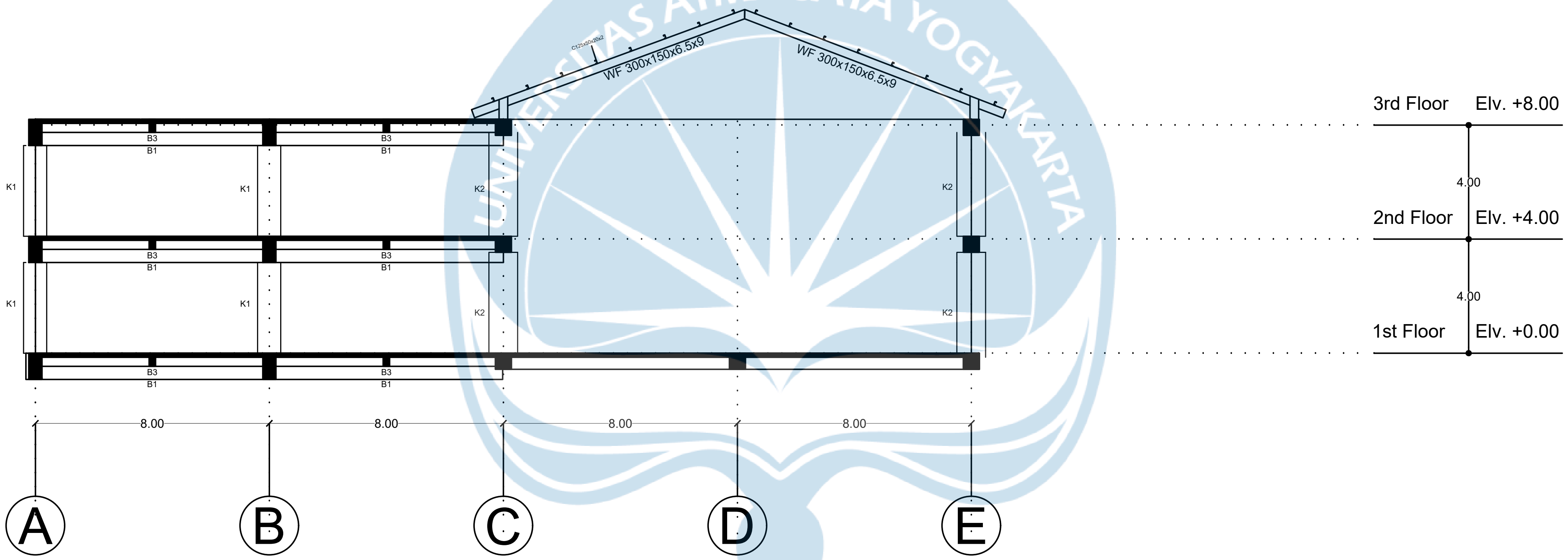
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:200 in m

Page

1



Section C-C

Scale 1:200

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Section C-C

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

Johan Ardianto, S.T, M.T
Lecturer

Scale

1:200 in m

Page

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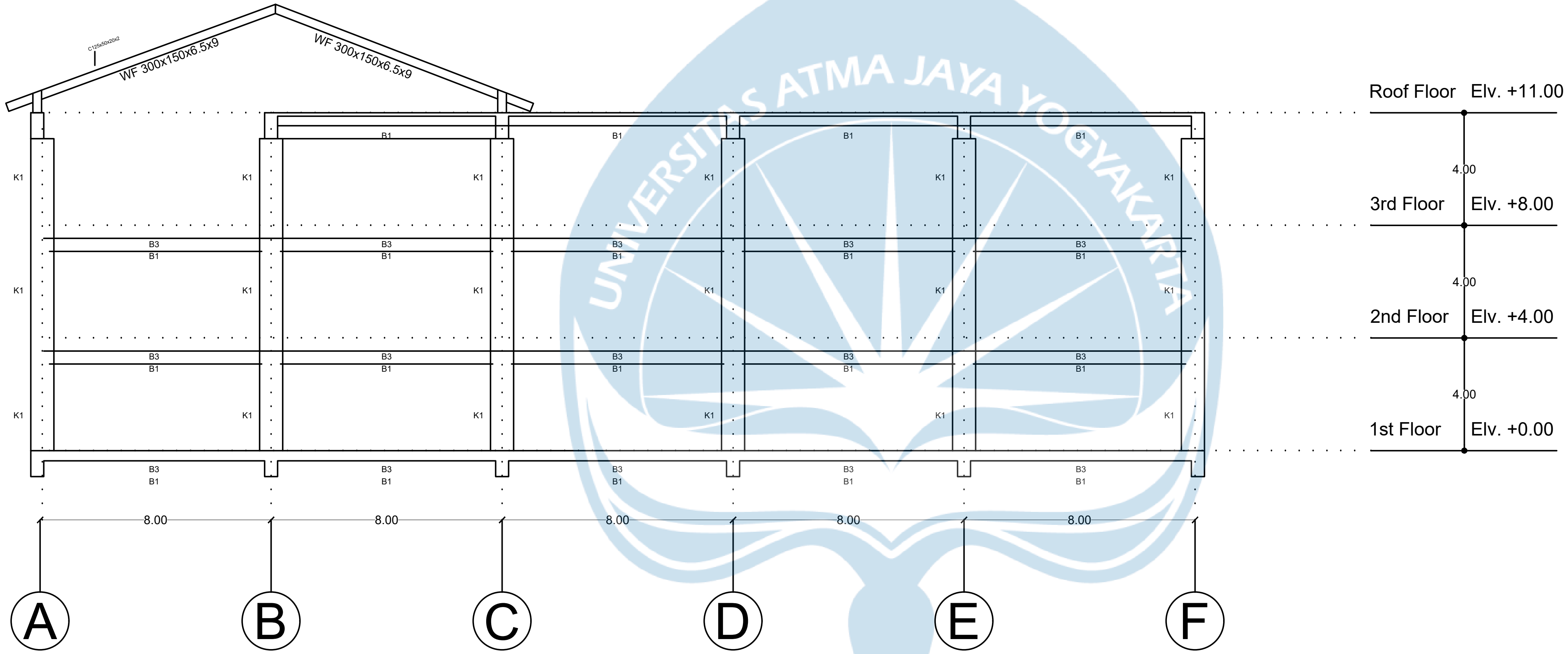


Section B-B

Scale 1:200

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Section B-B

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

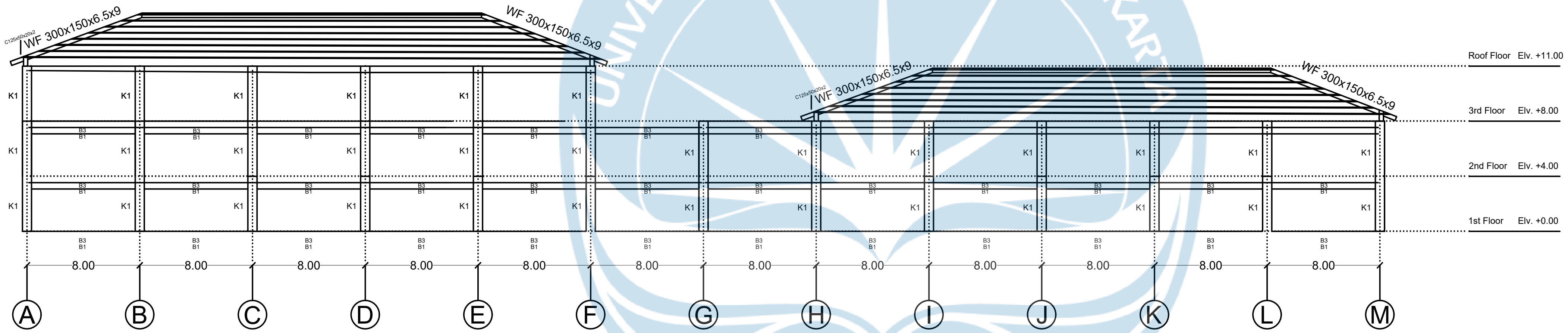
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:200 in m

Page

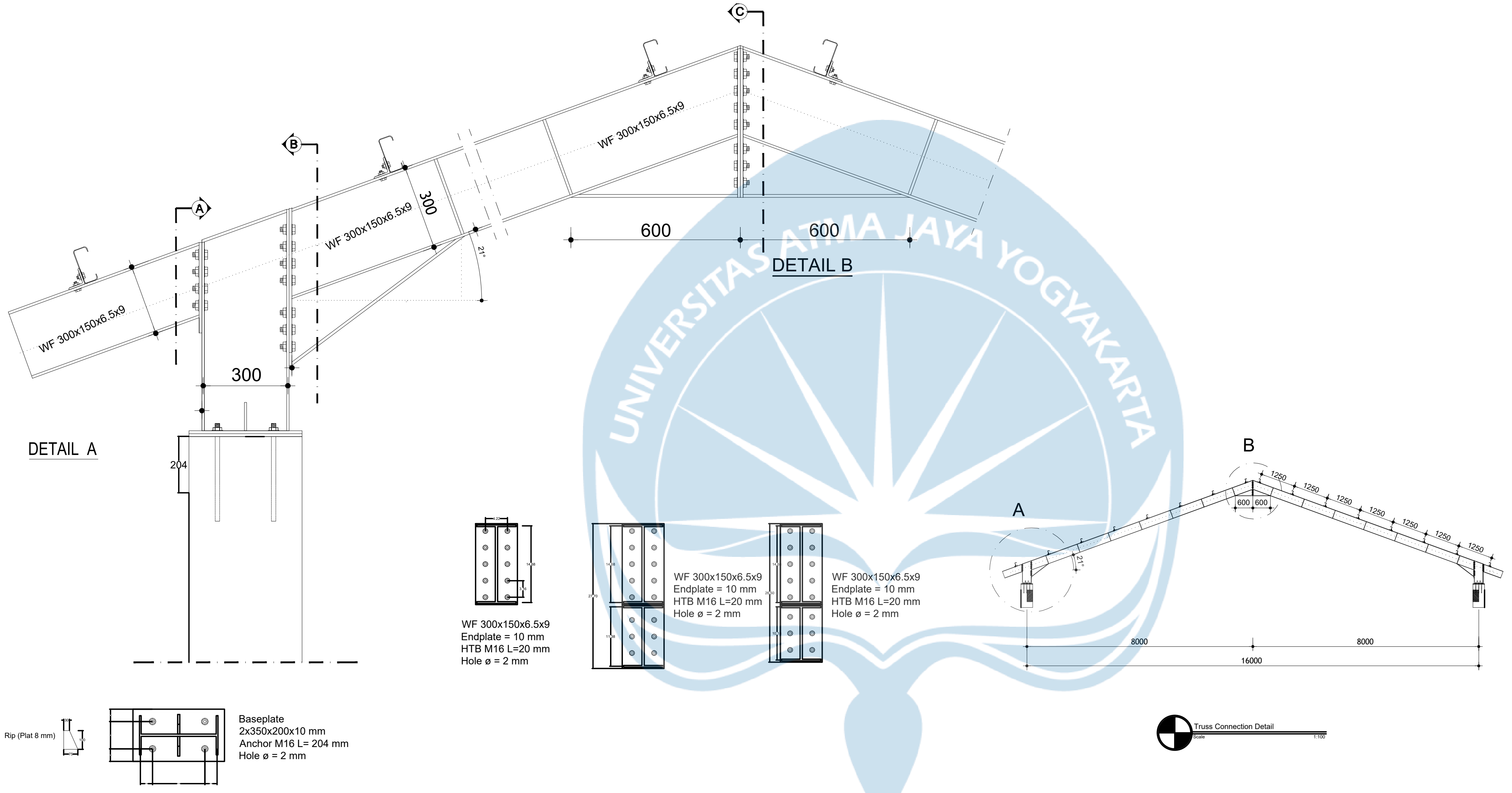
1



Section A-A

Scale 1:400

Final Project and Infrastructure Design	
Date	Friday, 22nd March 2023
Title	
Section A-A	
Drawer	
GROUP 1: Alvin Pires (201317977) Richardo Hadinata Djoenarko (201317980) Vinayak Munesh Panjabi (201318351)	
Checked by	
Johan Ardianto, S.T, M.T Lecturer	
Agreed by	
Johan Ardianto, S.T, M.T Lecturer	
Scale	
1:400 in m	
Page	
1	



Detail Truss Connection for Type 1 (KD1)

Scale 1:100

Final Project and Infrastructure Design

Date: Friday, 22nd March 2023

Title: Detail Truss Connection

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

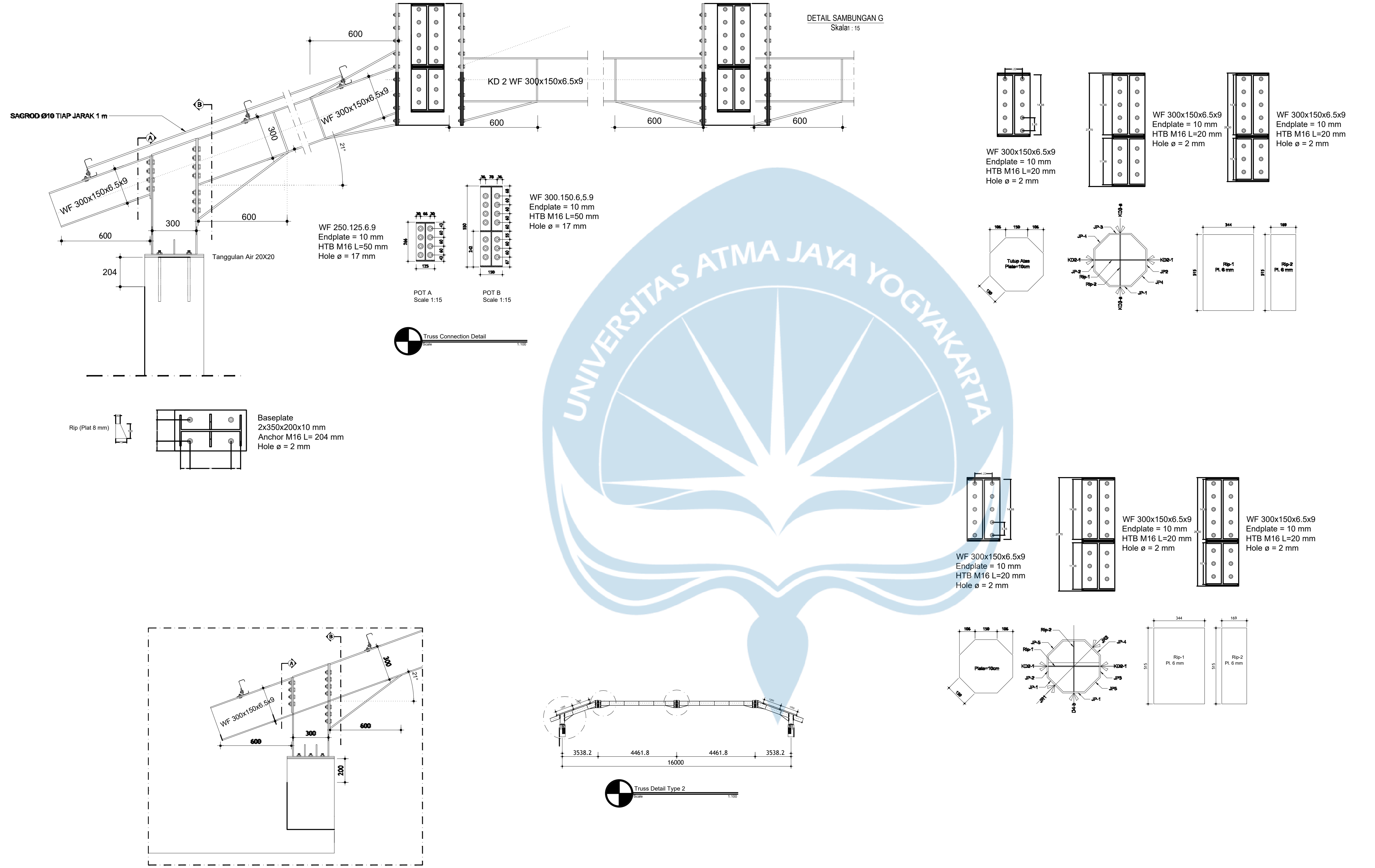
Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

Johan Ardianto, S.T, M.T
Lecturer

Scale: 1:100 in mm



Detail Truss Connection for Type 2 (KD2)
Scale 1:100

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Detail Truss Connection

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

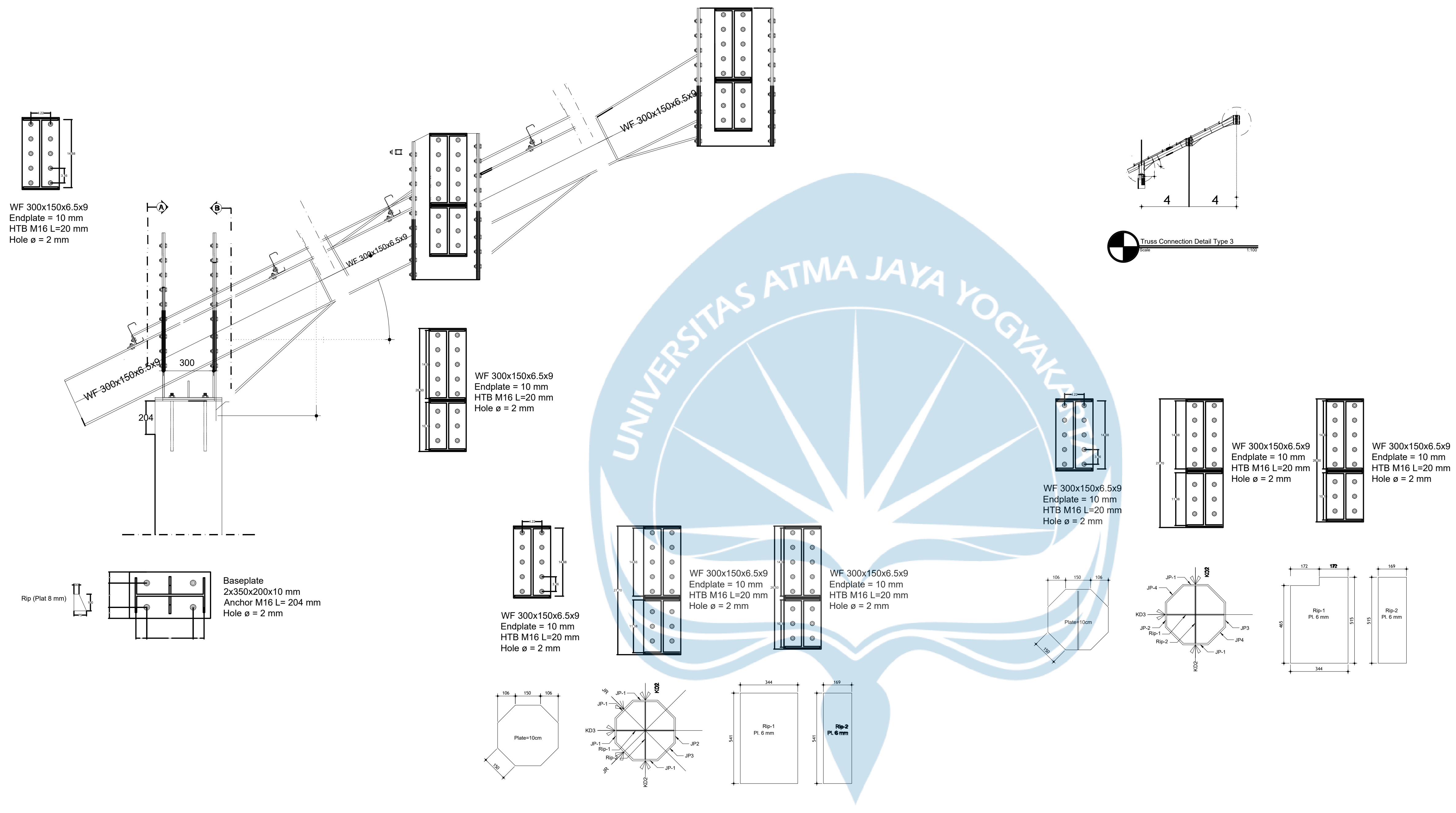
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:100 in mm

Page

1



Detail Truss Connection for Type 3 (KD3)

Scale 1:100

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Detail Truss Connection

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

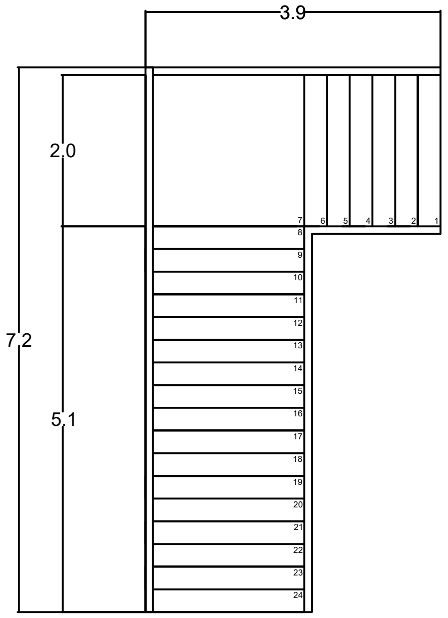
Johan Ardianto, S.T, M.T
Lecturer

Scale

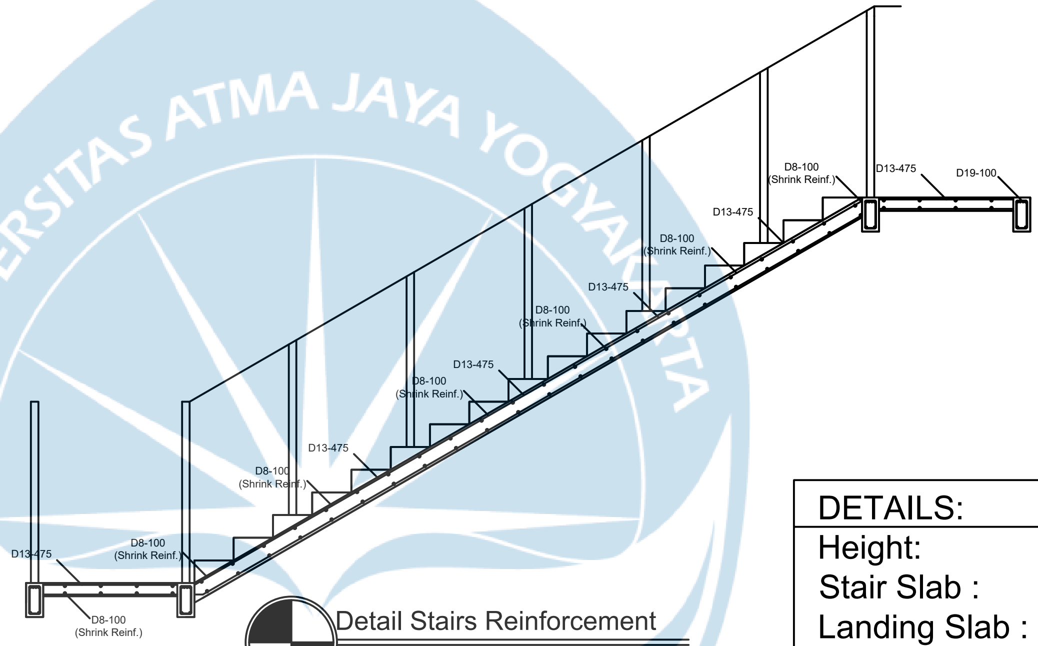
1:100 in mm

Page

1



Section A-A Main Stairs
Scale 1:100



Detail Stairs Reinforcement
Scale 1:100

DETAILS:	
Height:	4m
Stair Slab :	2m
Landing Slab :	2m
Stair Length :	2.88m

Type 1 Stairs Detail

Scale 1:100

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Detail Stairs

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

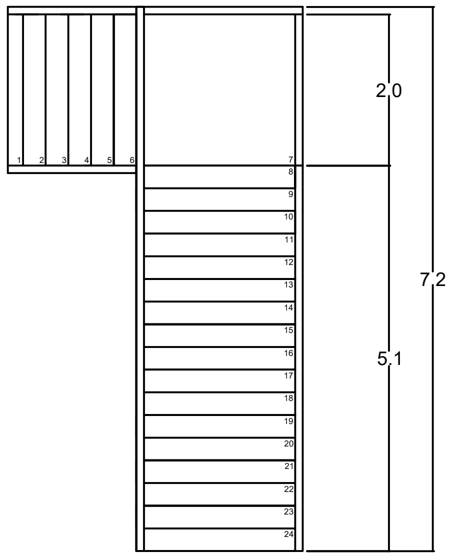
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:200 in m

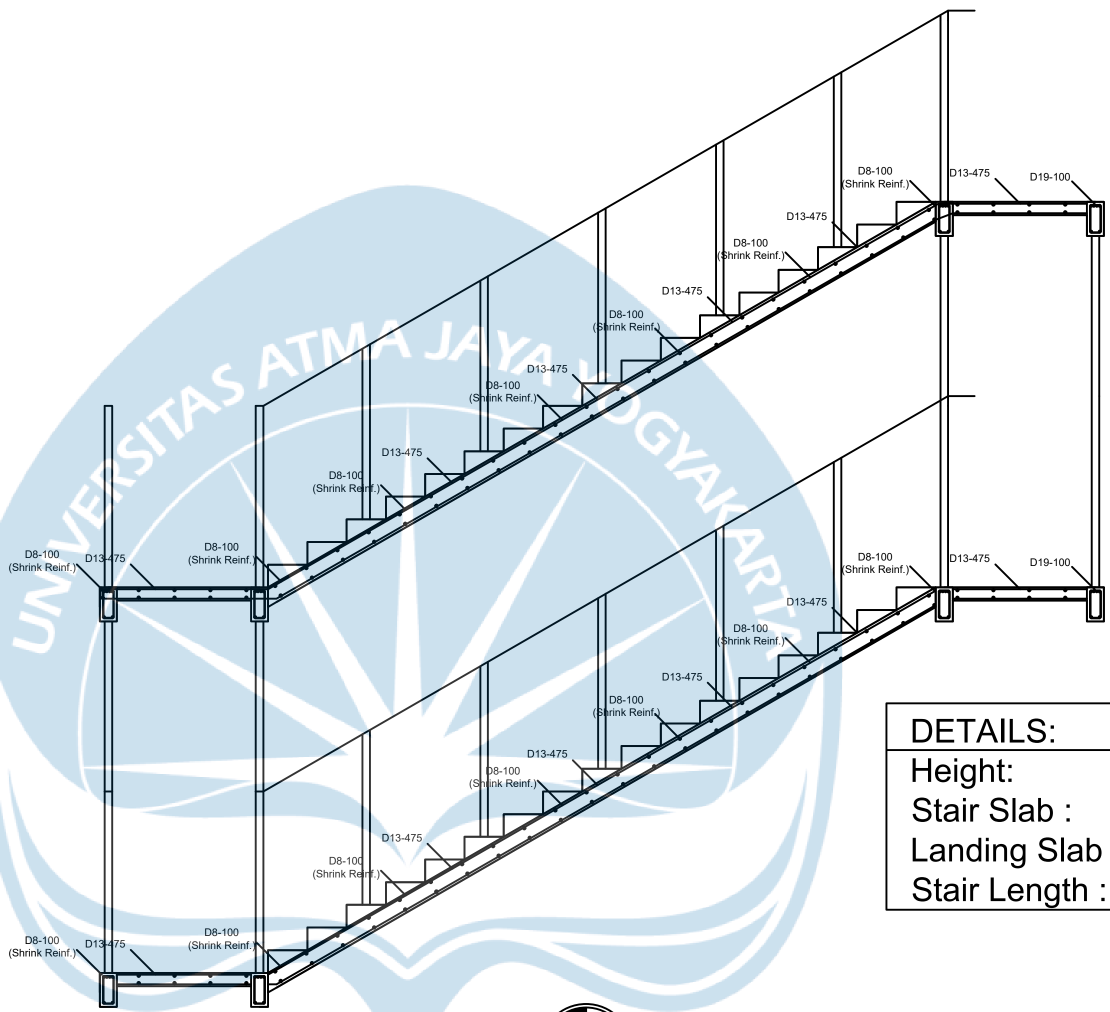
Page

1



Section A-A Main Stairs

Scale 1:100



DETAILS:	
Height:	4m
Stair Slab :	2m
Landing Slab :	2m
Stair Length :	2.88m

Detail Stairs Reinforcement

Scale 1:100

Type 2 Stairs Detail

Scale 1:100

UNIVERSITAS ATMA JAYA YOGYAKARTA

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Detail Stairs

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

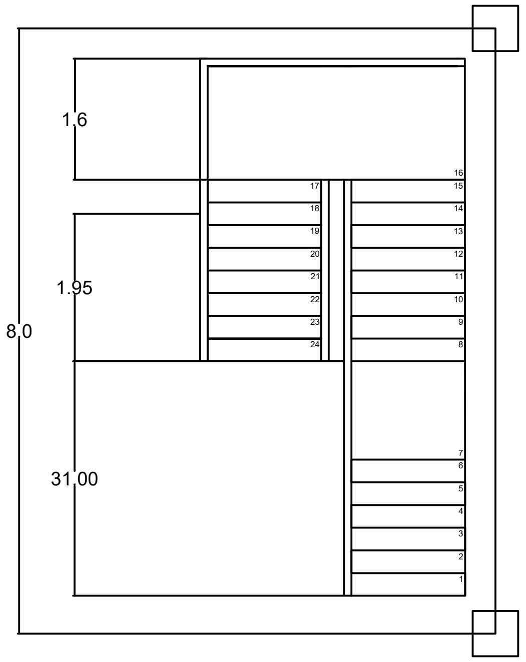
Johan Ardianto, S.T, M.T
Lecturer

Scale

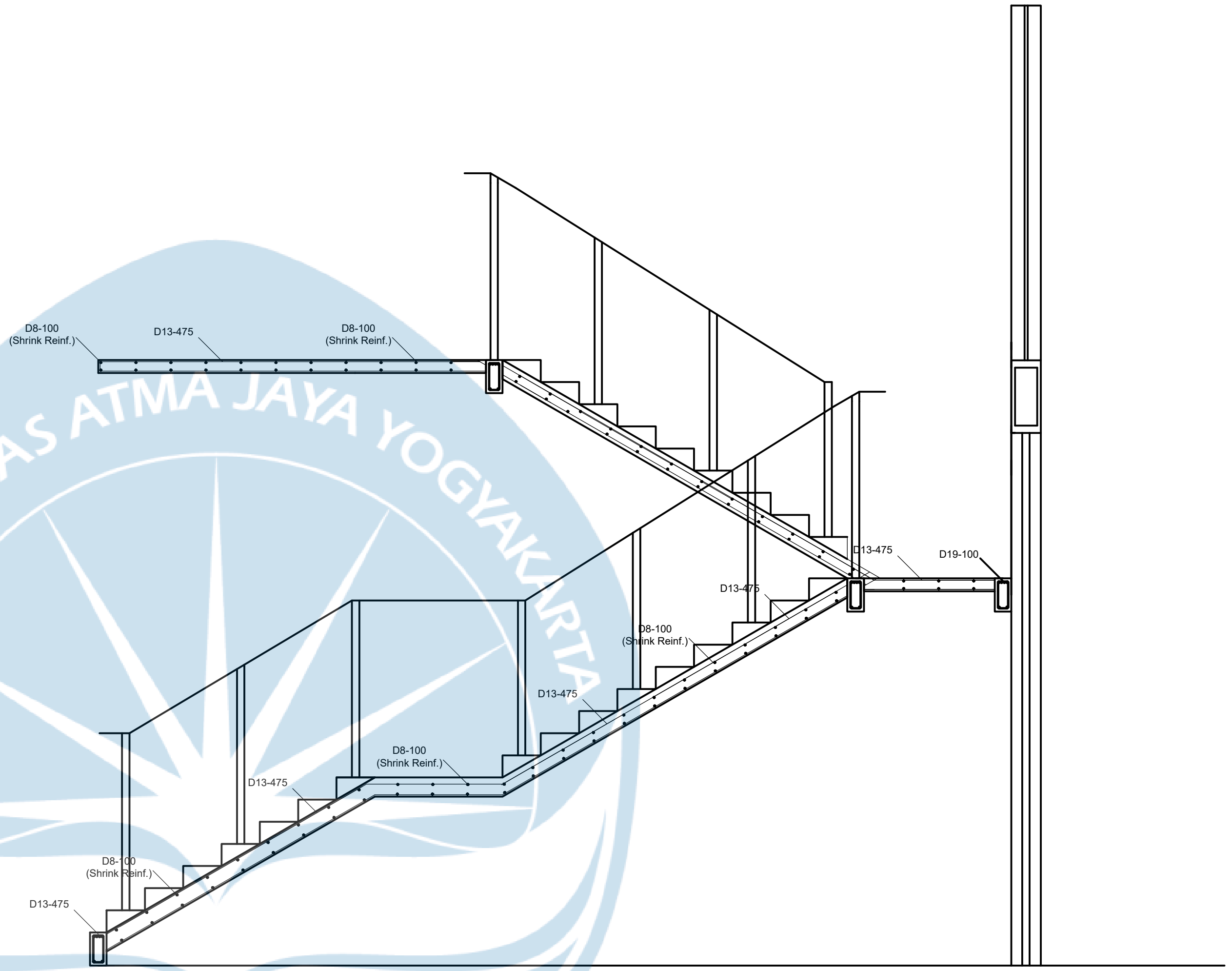
1:200 in m

Page

1



Section B-B Main Stairs
Scale 1:100



Detail Stairs Reinforcement
Scale 1:100

DETAILS:	
Height:	4m
Stair Slab :	2m
Landing Slab :	2m
Stair Length :	2.88m

Type 3 Stairs Detail

Scale 1:100

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Detail Stairs

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

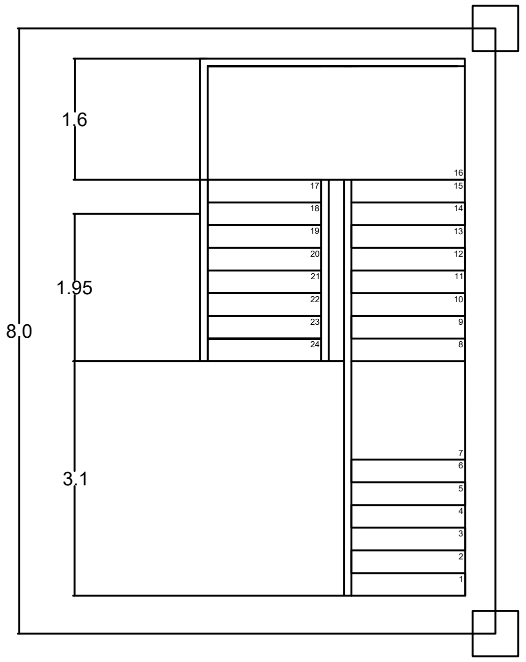
Johan Ardianto, S.T, M.T
Lecturer

Scale

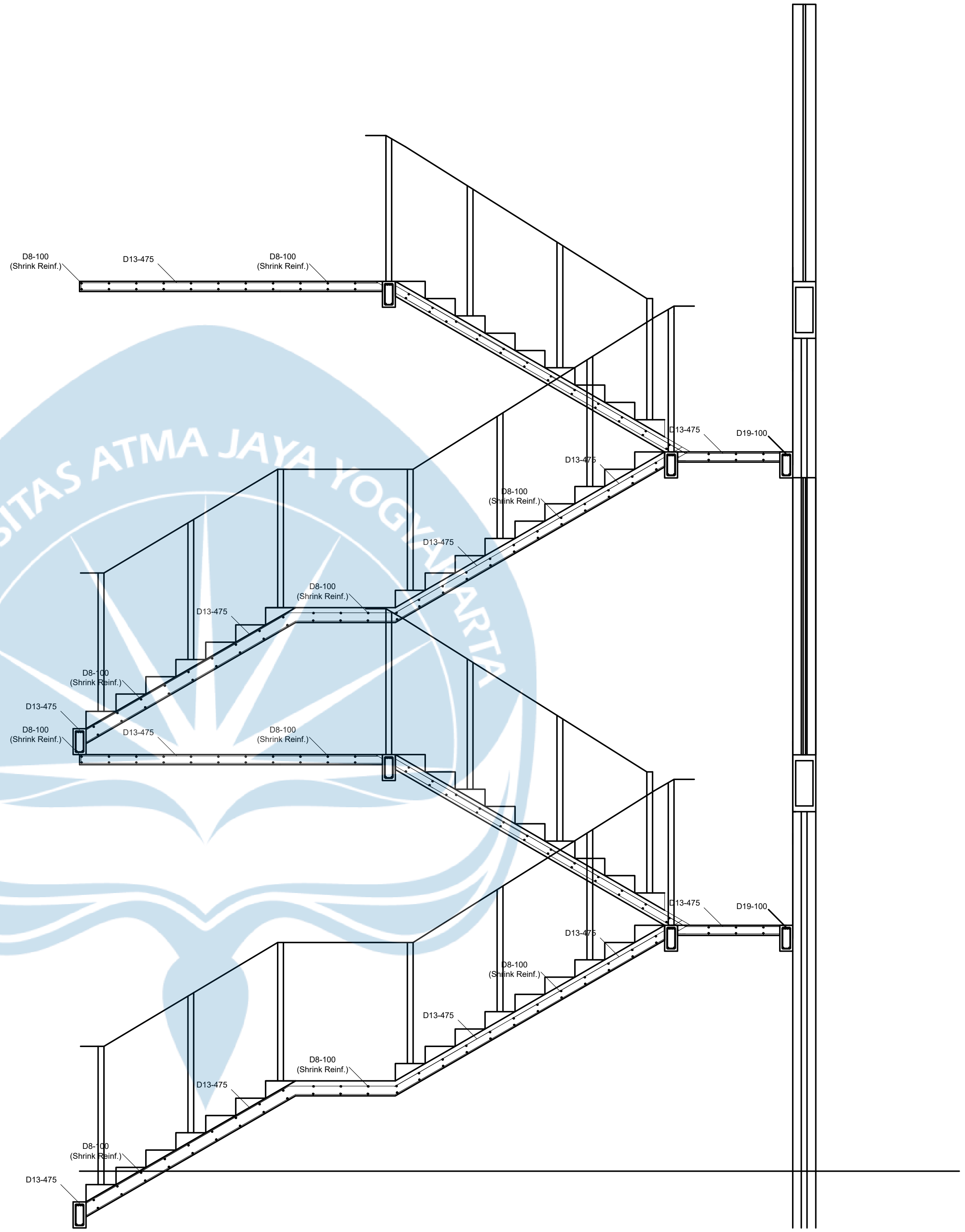
1:200 in m

Page

1



Section B-A Main Stairs
Scale 1:100



Detail Stairs Reinforcement
Scale 1:100

DETAILS:	
Height:	4m
Stair Slab :	2m
Landing Slab :	2m
Stair Length :	2.88m

Type 4 Stairs Detail

Scale 1:100

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Detail Stairs

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

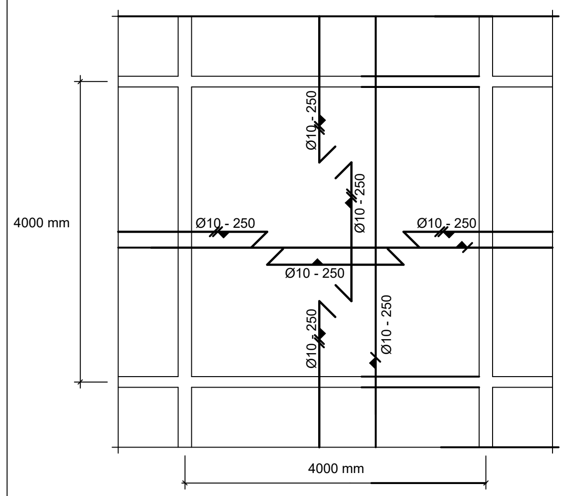
Johan Ardianto, S.T, M.T
Lecturer

Scale

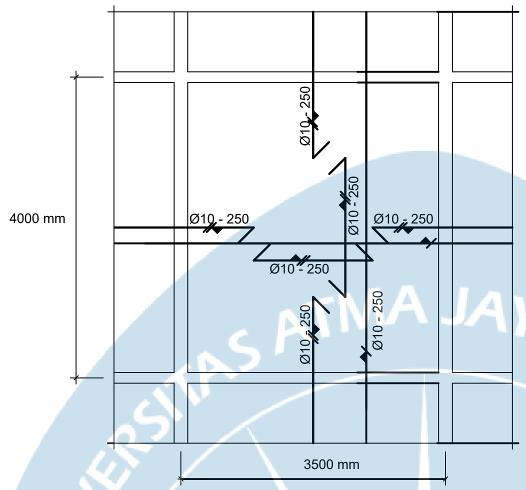
1:200 in m

Page

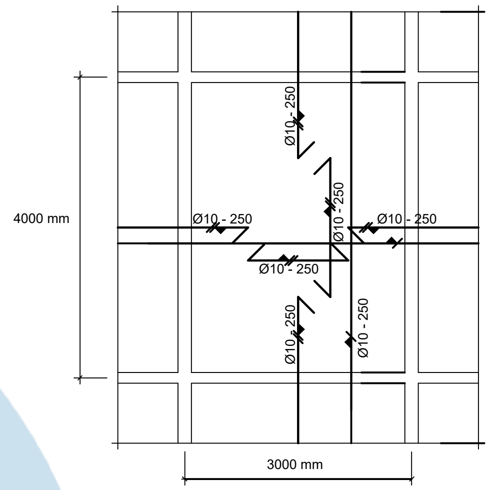
S1 FLOOR SLAB
H = 140 MM



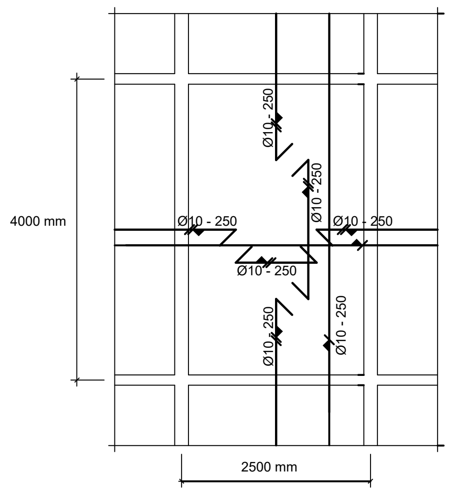
S2 TOILET FLOOR SLAB 1
H = 140 MM



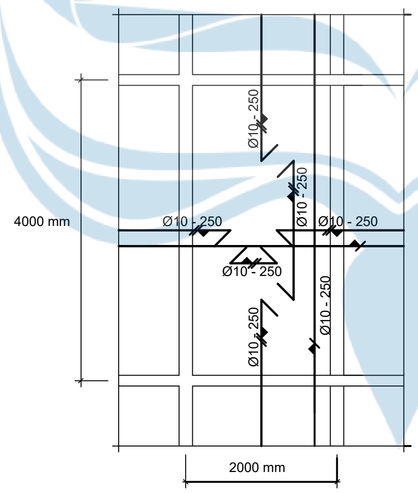
S3 MUSIC STUDIO FLOOR SLAB 2
H = 140 MM



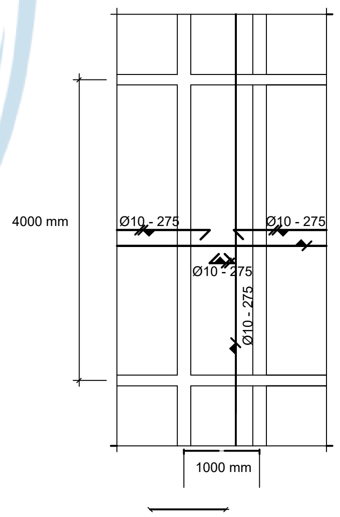
S4 MUSIC STUDIO FLOOR SLAB 1
H = 140 MM



S5 FLOOR SLAB ADDITIONAL TYPE
H = 140 MM

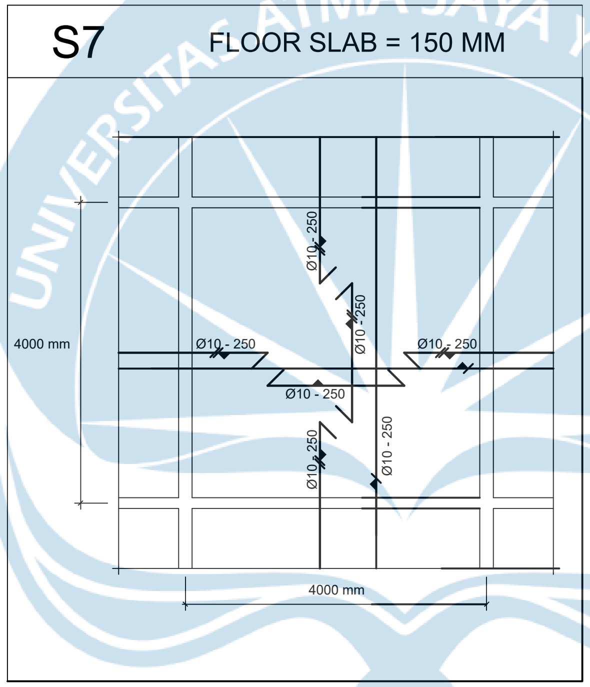


S6 TOILET FLOOR SLAB 2
H = 140 MM



Floor Slab Detail
Scale 1:85

Final Project and Infrastructure Design	
Date	Friday, 22nd March 2023
Title	Detail Reinforced Slab
Drawer	GROUP 1: Alvin Pires (201317977), Richardo Hadinata Djoenarko (201317980), Vinayak Munesh Panjabi (201318351)
Checked by	Johan Ardianto, S.T, M.T (Lecturer)
Agreed by	Johan Ardianto, S.T, M.T (Lecturer)
Scale	1:100 in mm
Page	1



Roof Slab Detail

Scale 1:85

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Detail Reinforced Slab

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

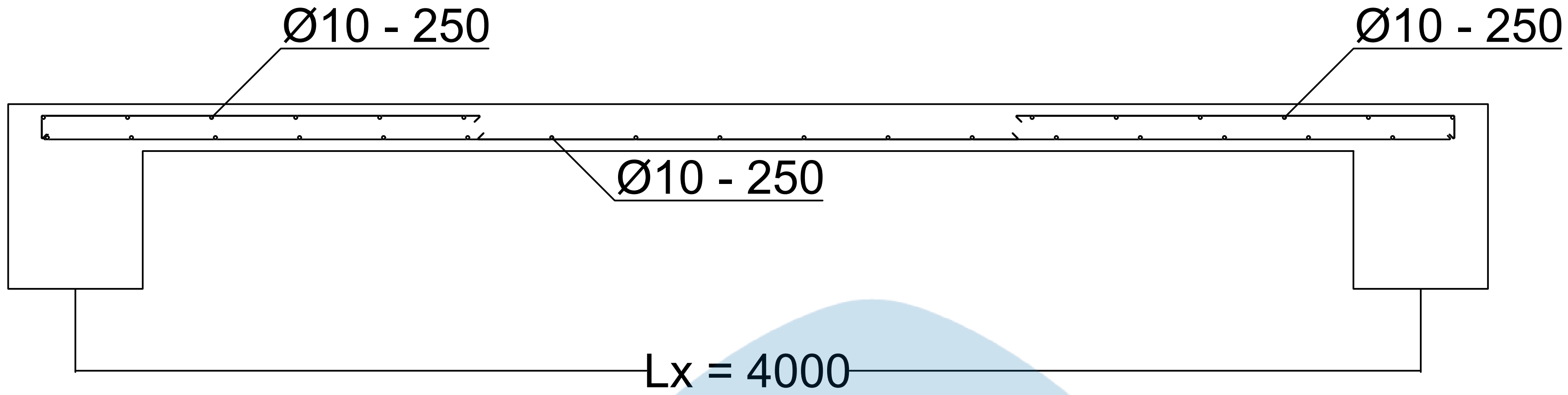
Johan Ardianto, S.T, M.T
Lecturer

Scale

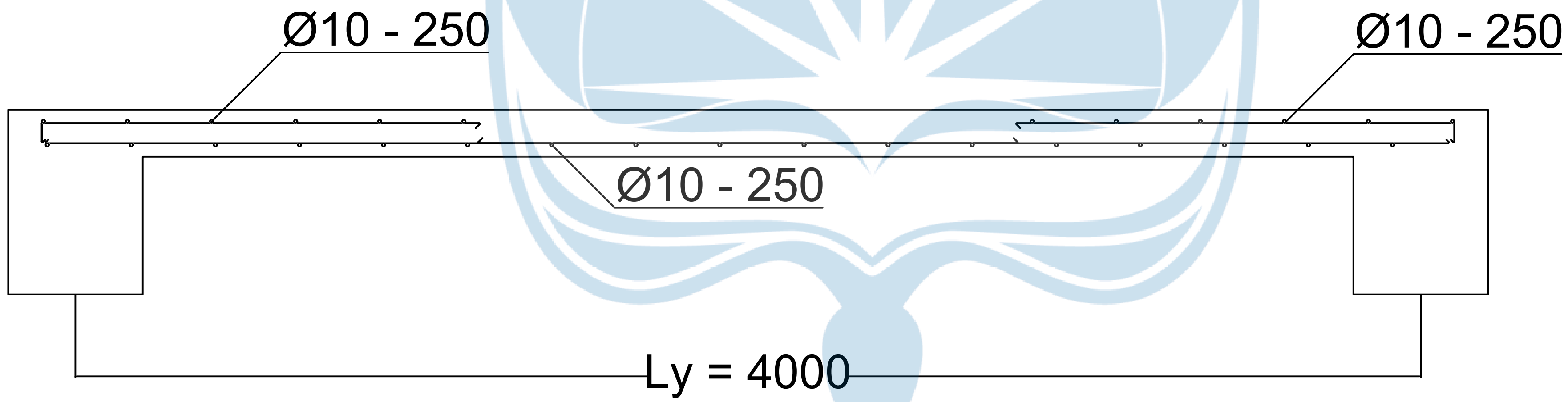
1:100 in mm

Page

1



Slab (4x4) m Cross-Section X Direction
Scale 1:20



Slab (4x4) m Cross-Section Y Direction
Scale 1:20

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Slab (4x4) m Cross Section View

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

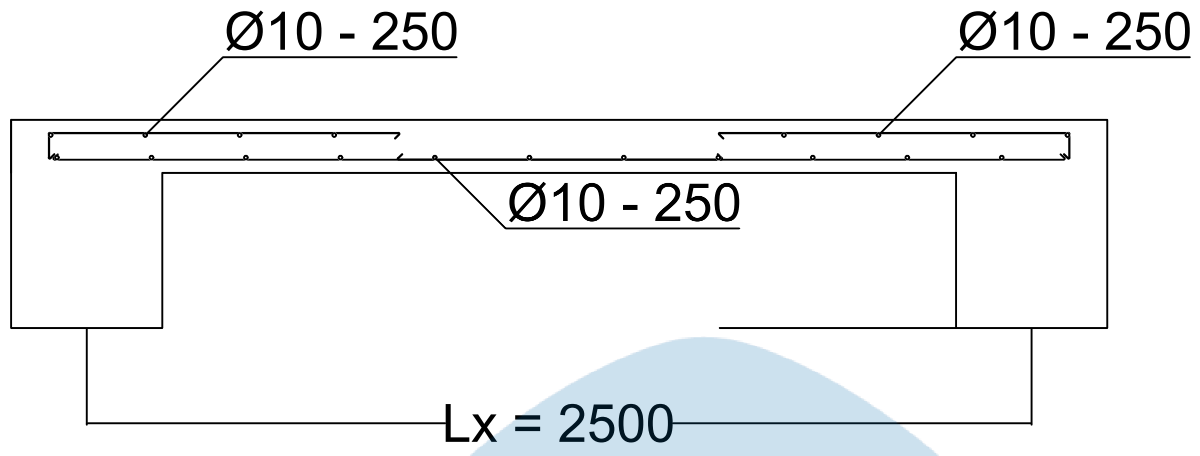
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:20 in mm

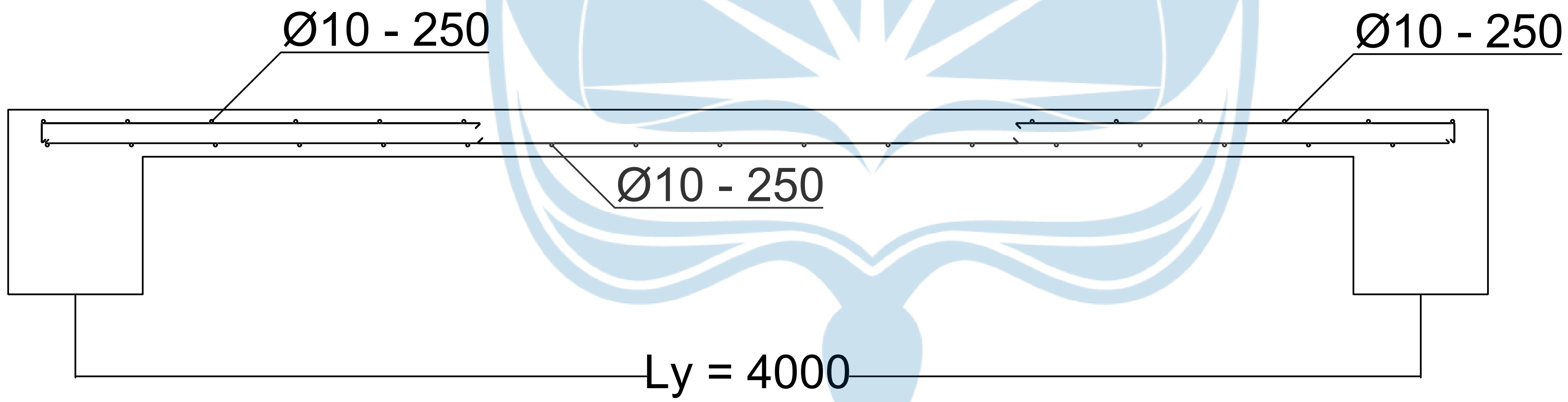
Page

1



Slab (2.5x4) m Cross-Section X Direction

Scale 1:20



Slab (2.5x4) m Cross-Section Y Direction

Scale 1:20

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Slab (2.5x4) m Cross Section View

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

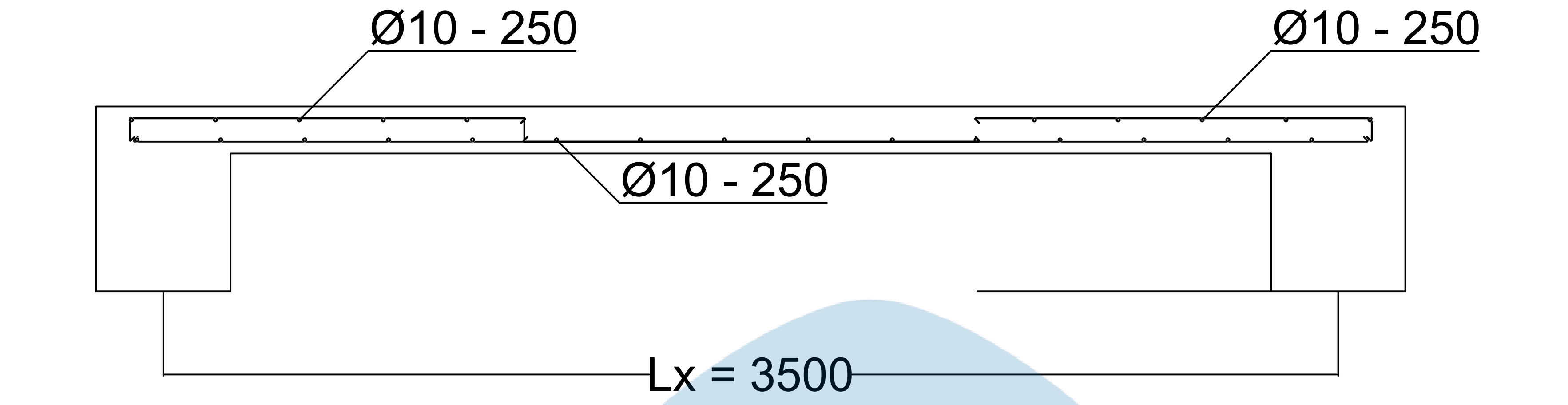
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:20 in mm

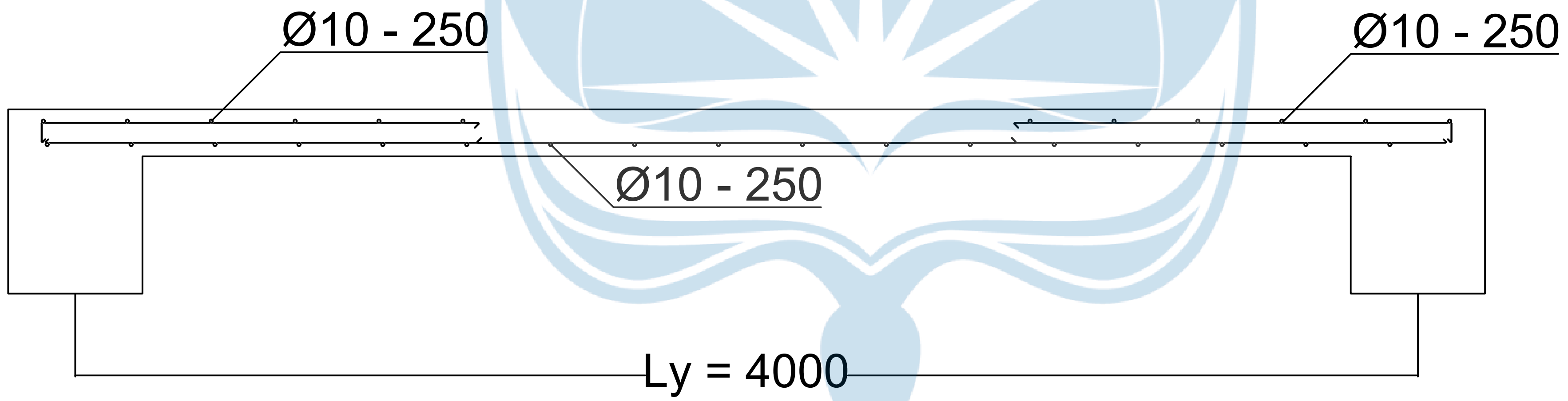
Page

1



Slab (3.5x4) m Cross-Section X Direction

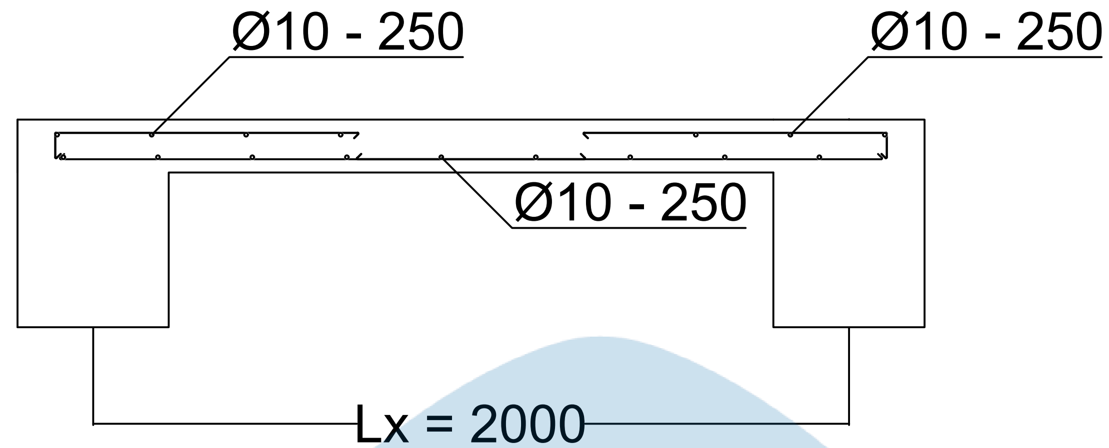
Scale 1:20



Slab (3.5x4) m Cross-Section Y Direction

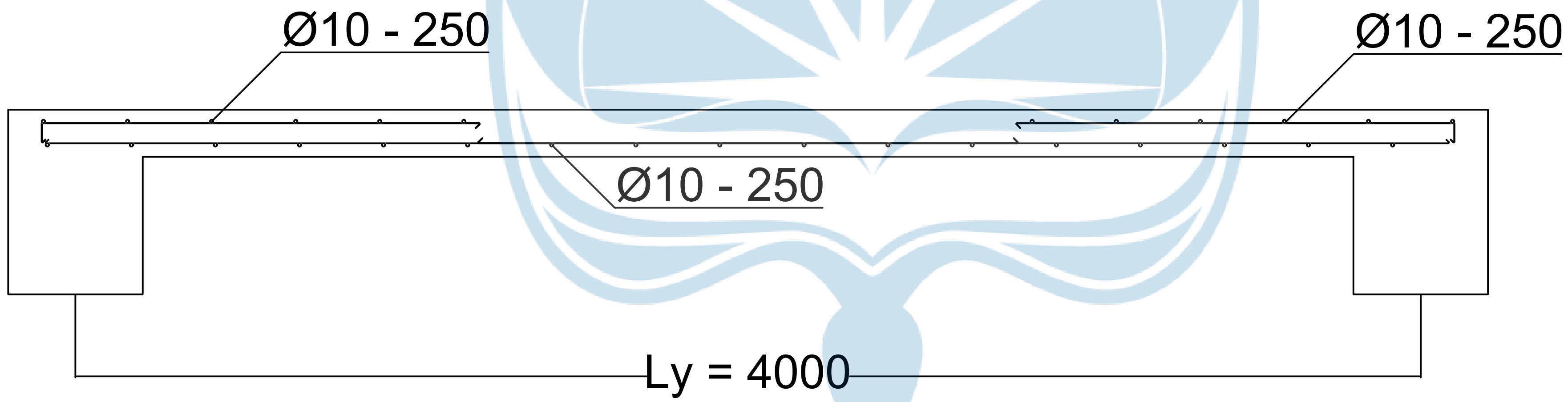
Scale 1:20

Final Project and Infrastructure Design	
Date	Friday, 22nd March 2023
Title	
Slab (3.5x4) m Cross Section View	
Drawer	
GROUP 1: Alvin Pires (201317977) Richardo Hadinata Djoenarko (201317980) Vinayak Munesh Panjabi (201318351)	
Checked by	
Johan Ardianto, S.T, M.T Lecturer	
Agreed by	
Johan Ardianto, S.T, M.T Lecturer	
Scale	
1:20 in mm	
Page	
1	



Slab (2x4) m Cross-Section X Direction

Scale 1:20



Slab (2x4) m Cross-Section Y Direction

Scale 1:20

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Slab (2x4) m Cross Section View

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

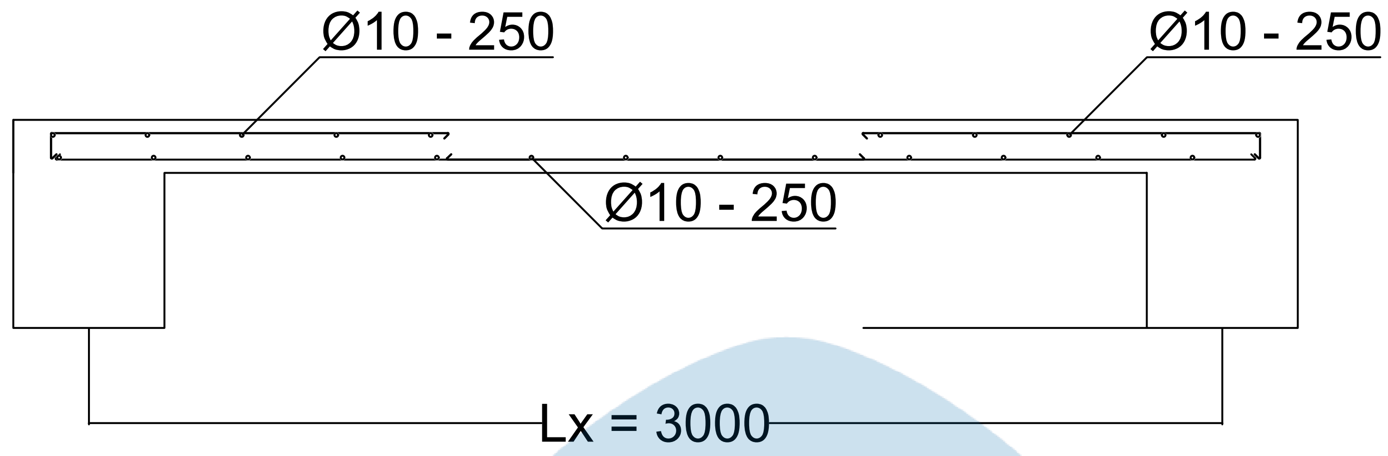
Johan Ardianto, S.T, M.T
Lecturer

Scale

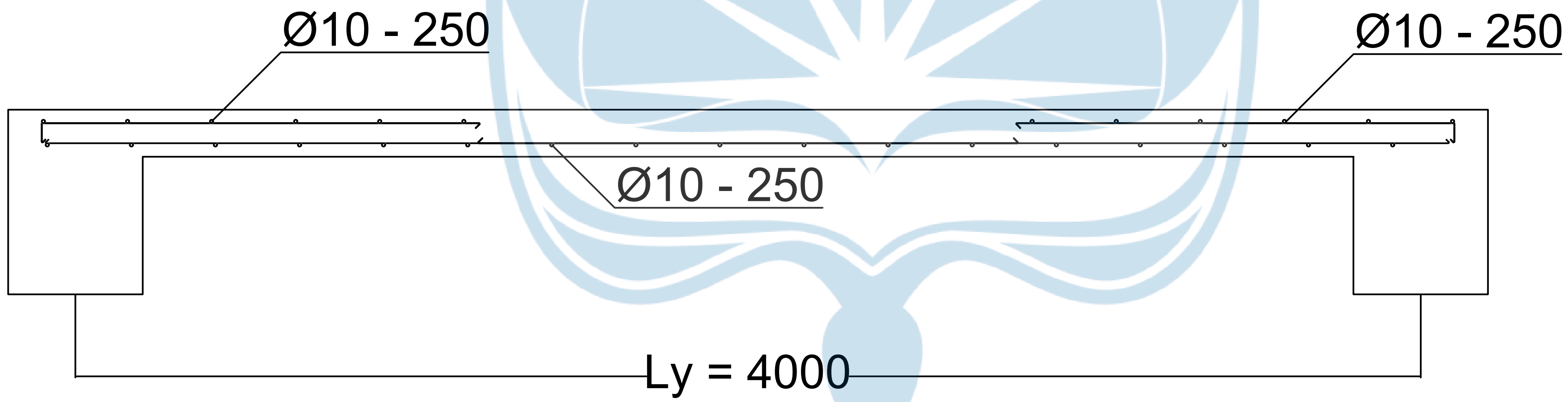
1:20 in mm

Page

1



Slab (3x4) m Cross-Section X Direction
Scale 1:20



Slab (3x4) m Cross-Section Y Direction
Scale 1:20

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Slab (3x4) m Cross Section View

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

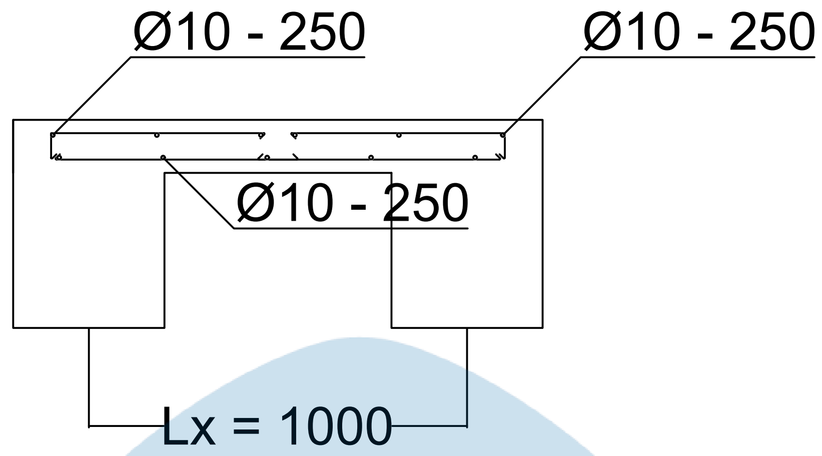
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:20 in mm

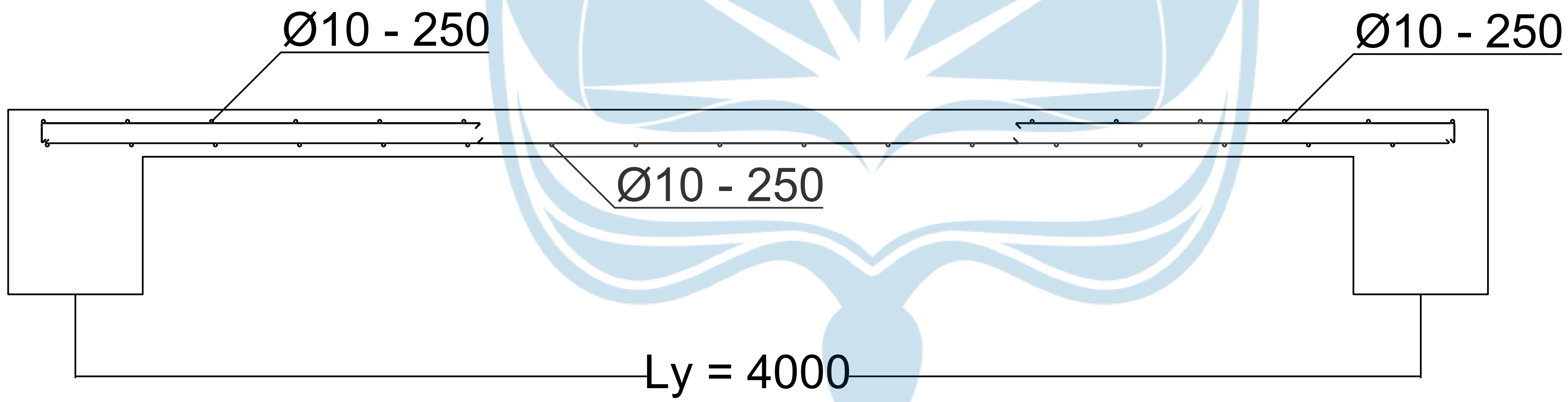
Page

1



Slab (1x4) m Cross-Section X Direction

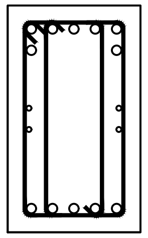
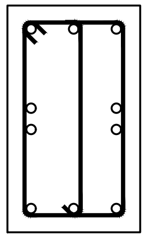
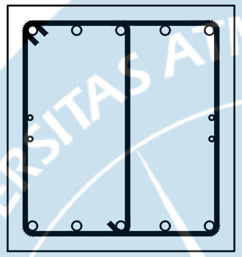
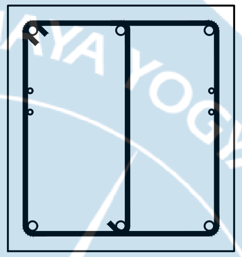
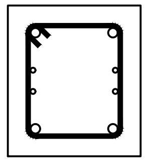
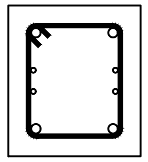
Scale 1:20



Slab (1x4) m Cross-Section Y Direction

Scale 1:20

Final Project and Infrastructure Design	
Date	Friday, 22nd March 2023
Title	
Slab (1x4) m Cross Section View	
Drawer	
GROUP 1: Alvin Pires (201317977) Richardo Hadinata Djoenarko (201317980) Vinayak Munesh Panjabi (201318351)	
Checked by	
Johan Ardianto, S.T, M.T Lecturer	
Agreed by	
Johan Ardianto, S.T, M.T Lecturer	
Scale	
1:20 in mm	
Page	
1	

BEAM DIMENSION AND REINFORCEMENT						
CODE	B1		B2		B3	
POTITION	SUPPORT	FIELD	SUPPORT	FIELD	SUPPORT	FIELD
SHAPE						
DIMENSION	350 X 600	350 X 600	600 X 650	600 X 650	350 X 400	350 X 400
REINFORCEMENT						
TOP	7 D 25	3 D 25	5 D 25	3 D 25	2 D 25	2 D 25
MIDDLE	4 D 13	4 D 25	4 D 13	4 D 13	4 D 13	4 D 13
BOTTOM	5 D 25	3 D 25	5 D 25	3 D 25	2 D 25	2 D 25
STIRRUPS	4D 10-100	3D 10-142.86	3D 13-100	3D 13-142.86	2D 13-75	2D 13-100

Beam & Column Detail

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Beam Detail

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

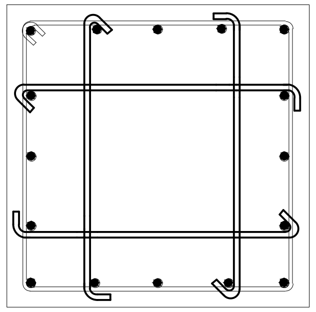
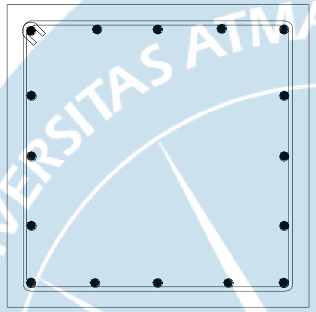
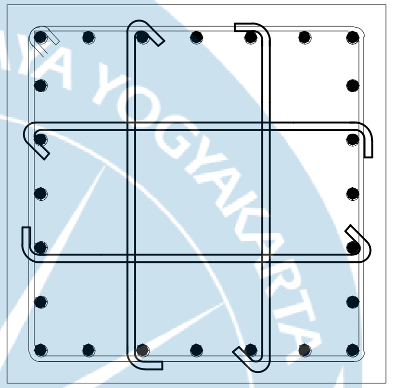
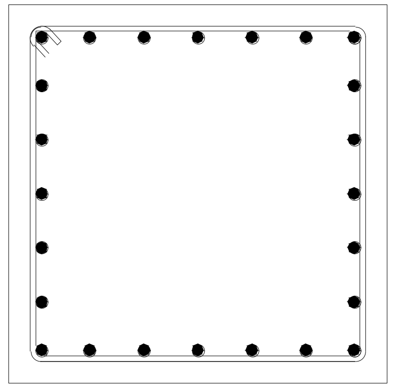
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:20 in mm

Page

1

COLUMN DIMENSION AND REINFORCEMENT				
CODE	K1		K2	
POTITION	SUPPORT	FIELD	SUPPORT	FIELD
SHAPE				
DIMENSION	800 X 800	800 X 800	1000 X 1000	1000 X 1000
REINFORCEMENT	16 D 25	16 D 25	24 D 25	24 D 25
STIRRUPS	SUPPORT	SPAN	SUPPORT	SPAN
MJOR AXIS	4D 13-100	2D 13-100	4D 13-100	2D 13-100
MINOR AXIS	4D 13-100	2D 13-100	4D 13-100	2D 13-100

Beam & Column Detail

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Column Detail

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

Johan Ardianto, S.T, M.T
Lecturer

Scale

1:20 in mm

Page

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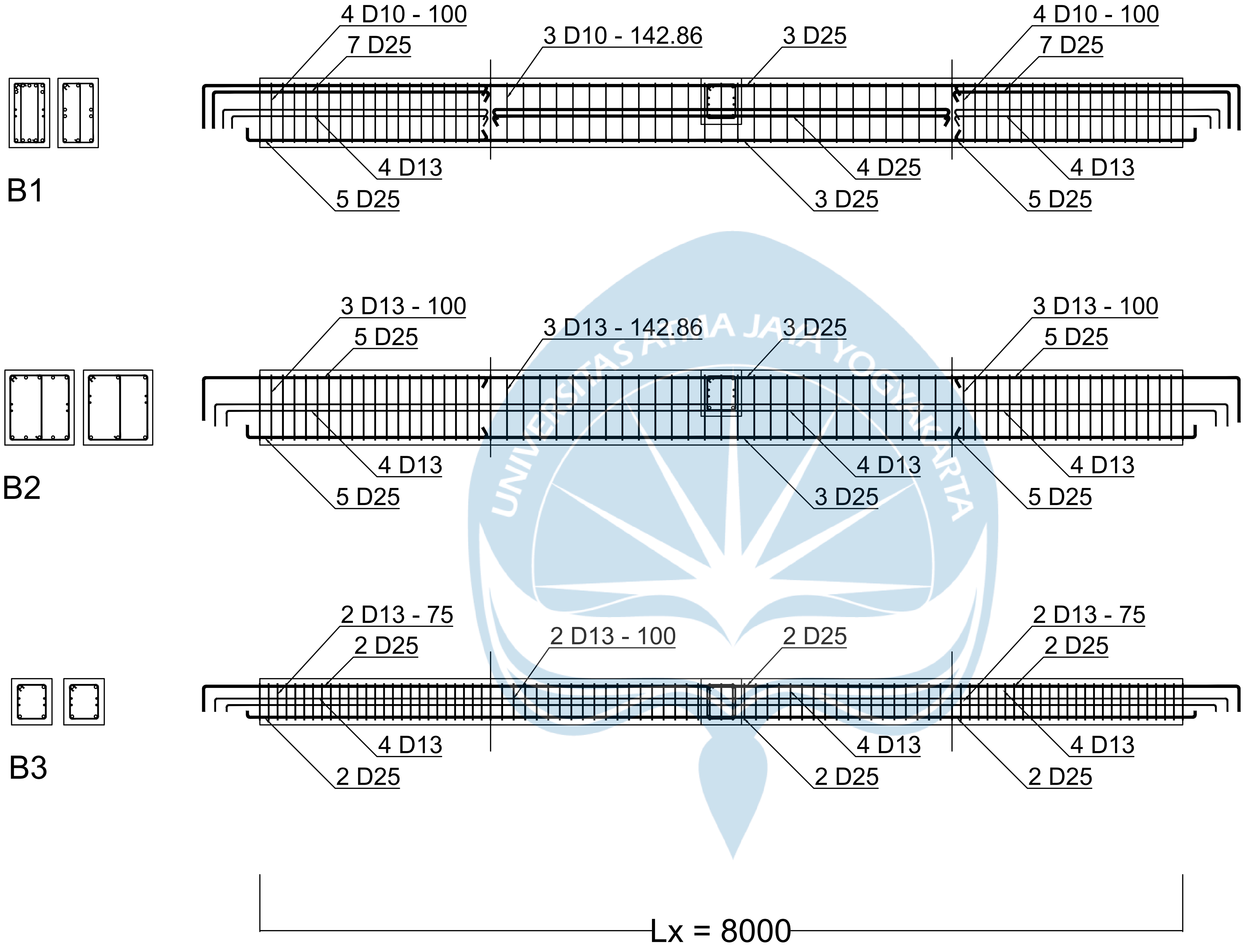

Beam Cross Section Detail

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Beam Cross Section Detail

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

Johan Ardianto, S.T, M.T
Lecturer

Scale

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Page

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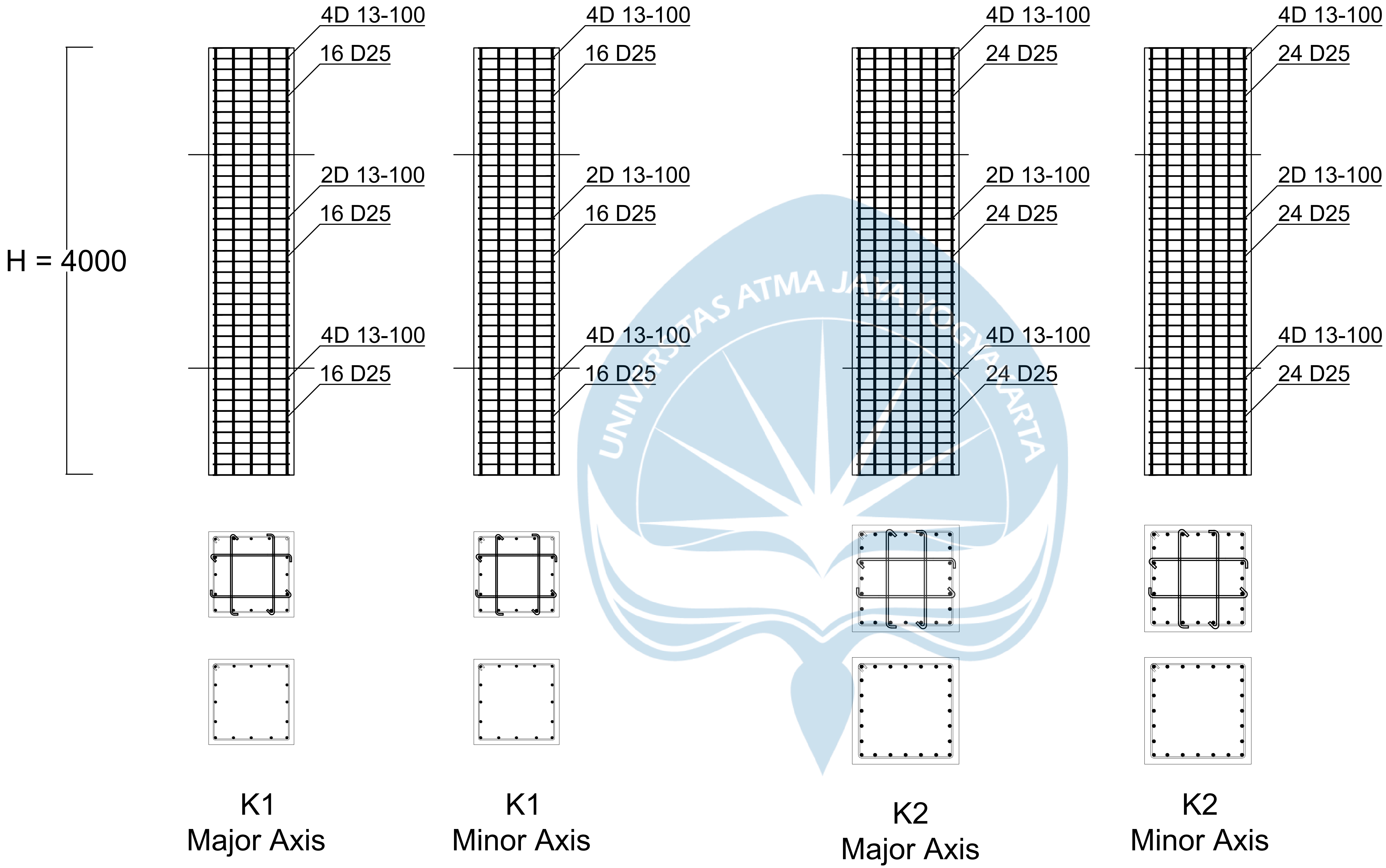

Column Cross Section Detail

Final Project and Infrastructure Design

Date	Friday, 22nd March 2023

Title

Column Cross Section Detail

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

Johan Ardianto, S.T, M.T
Lecturer

Scale

1:40 in mm

Page

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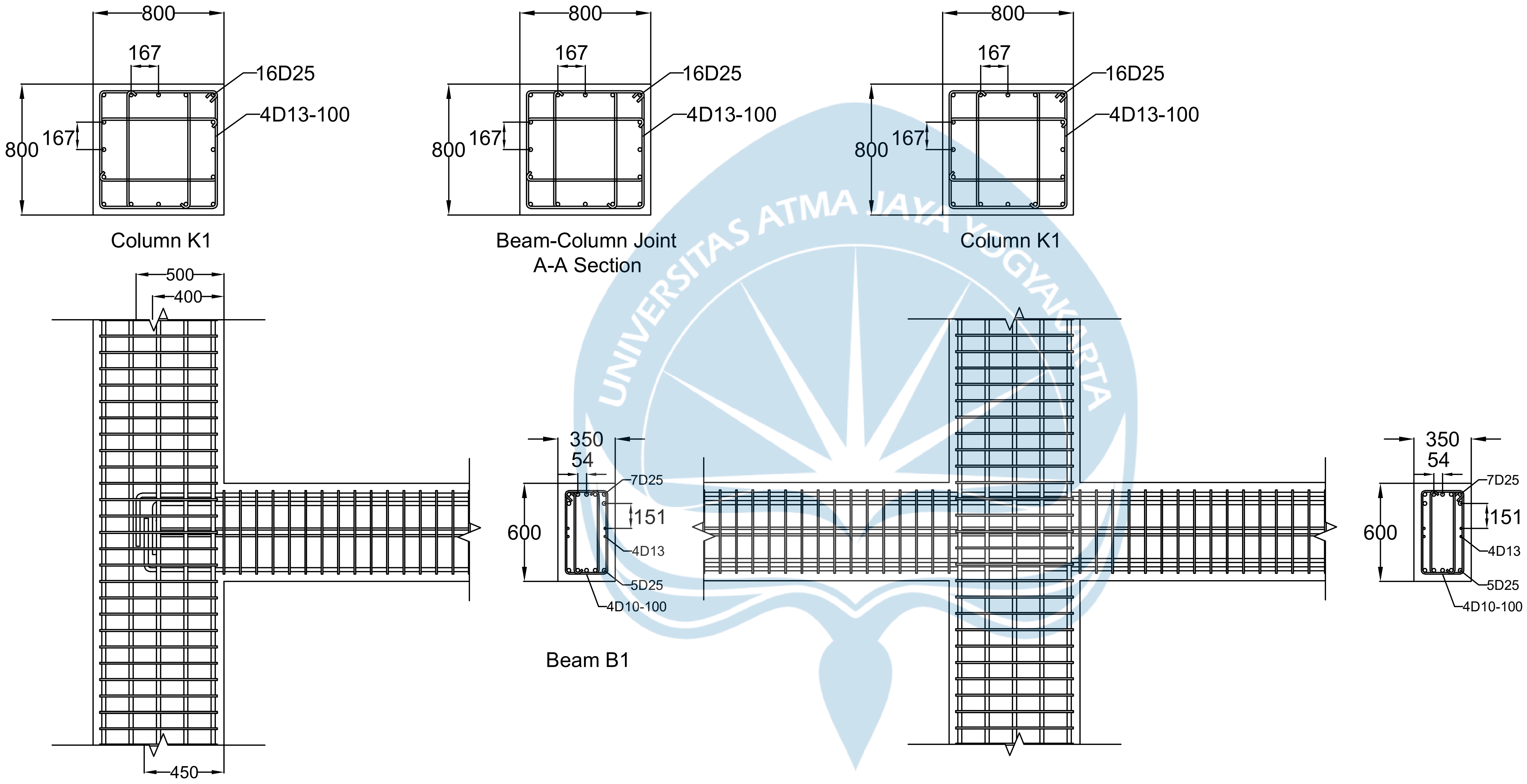

Beam B1 and Column K1 Joint

Scale 1:30

Final Project and Infrastructure Design

Date	Friday, 24th October 2023

Title

Type 1 Beam and Type 1 Column Joint

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T., M.Eng.
Lecturer

Agreed by

Johan Ardianto, S.T., M.Eng.
Lecturer

Scale

1:30 in mm

Page

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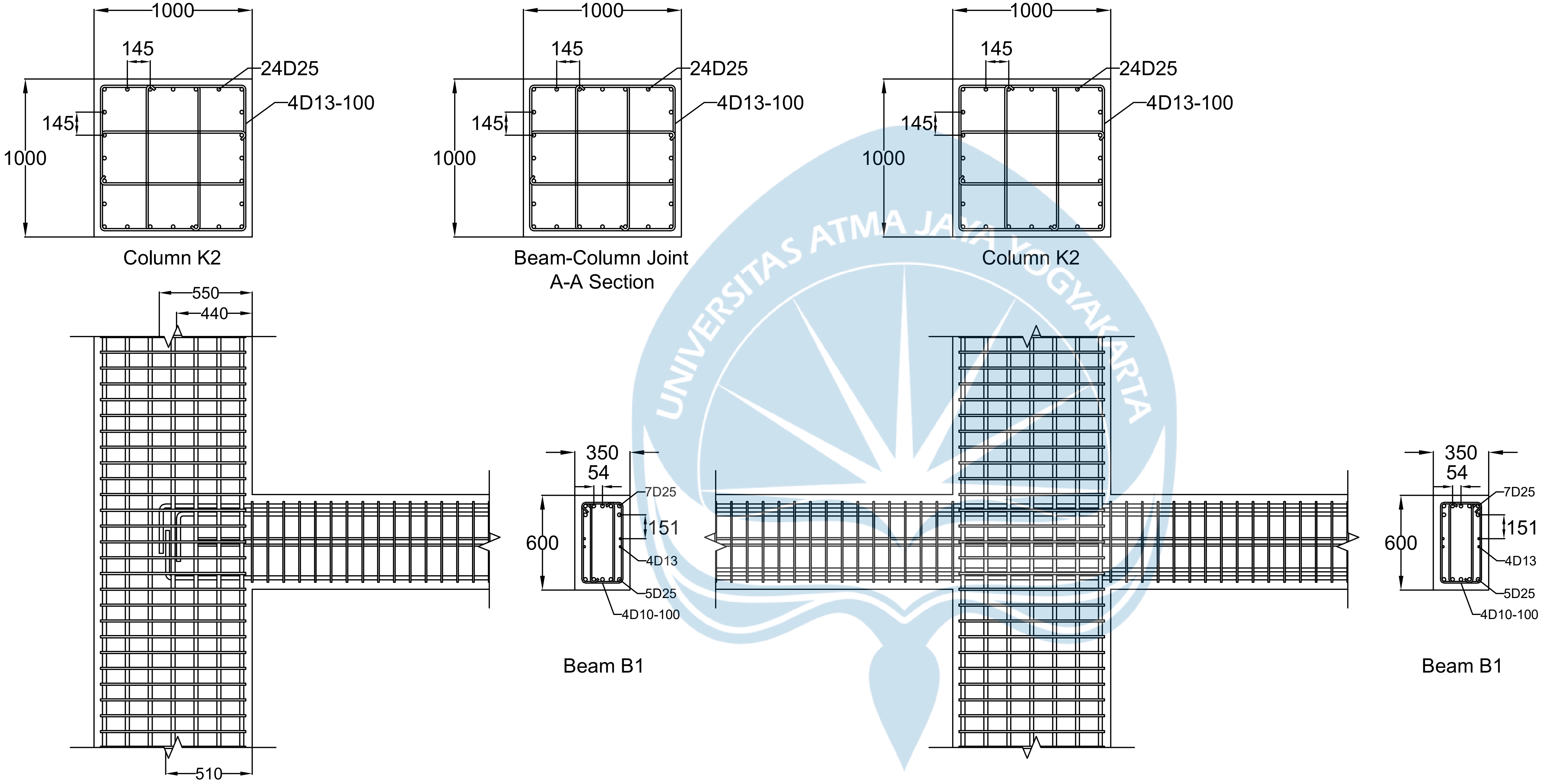

Beam B1 and Column K2 Joint

Scale 1:30

Final Project and Infrastructure Design	
Date	Friday, 24th October 2023
Title	
Type 1 Beam and Type 2 Column Joint	
Drawer	
GROUP 1: Alvin Pires (201317977) Richardo Hadinata Djoenarko (201317980) Vinayak Munesh Panjabi (201318351)	
Checked by	
Johan Ardianto, S.T., M.Eng. Lecturer	
Agreed by	
Johan Ardianto, S.T., M.Eng. Lecturer	
Scale	
1:30 in mm	
Page	
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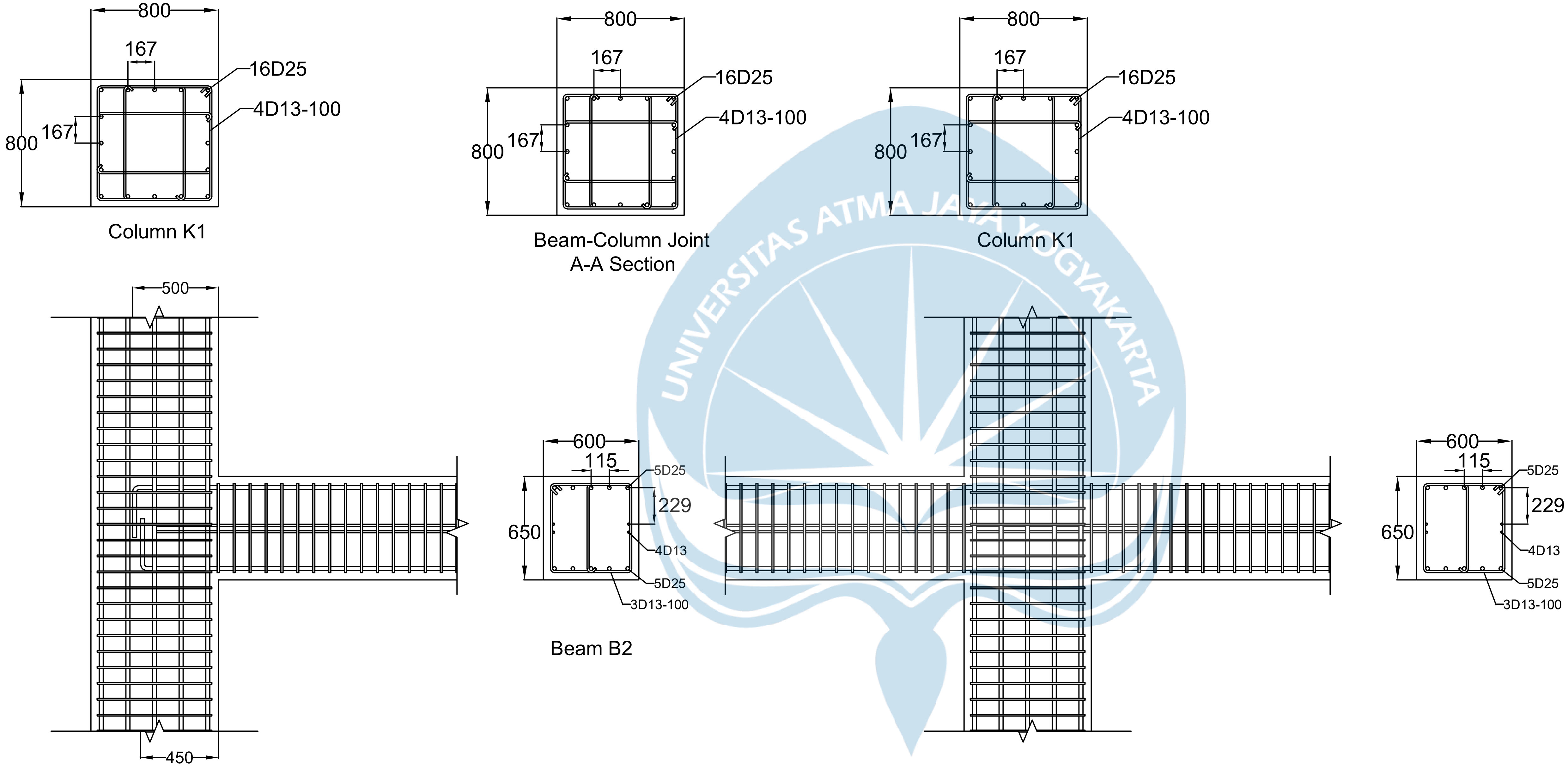

Beam B2 and Column K1 Joint

Scale 1:30

Final Project and Infrastructure Design	
Date	Friday, 24th October 2023
Title	
Type 2 Beam and Type 1 Column Joint	
Drawer	
GROUP 1: Alvin Pires (201317977) Richardo Hadinata Djoenarko (201317980) Vinayak Munesh Panjabi (201318351)	
Checked by	
Johan Ardianto, S.T., M.Eng. Lecturer	
Agreed by	
Johan Ardianto, S.T., M.Eng. Lecturer	
Scale	
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Page	
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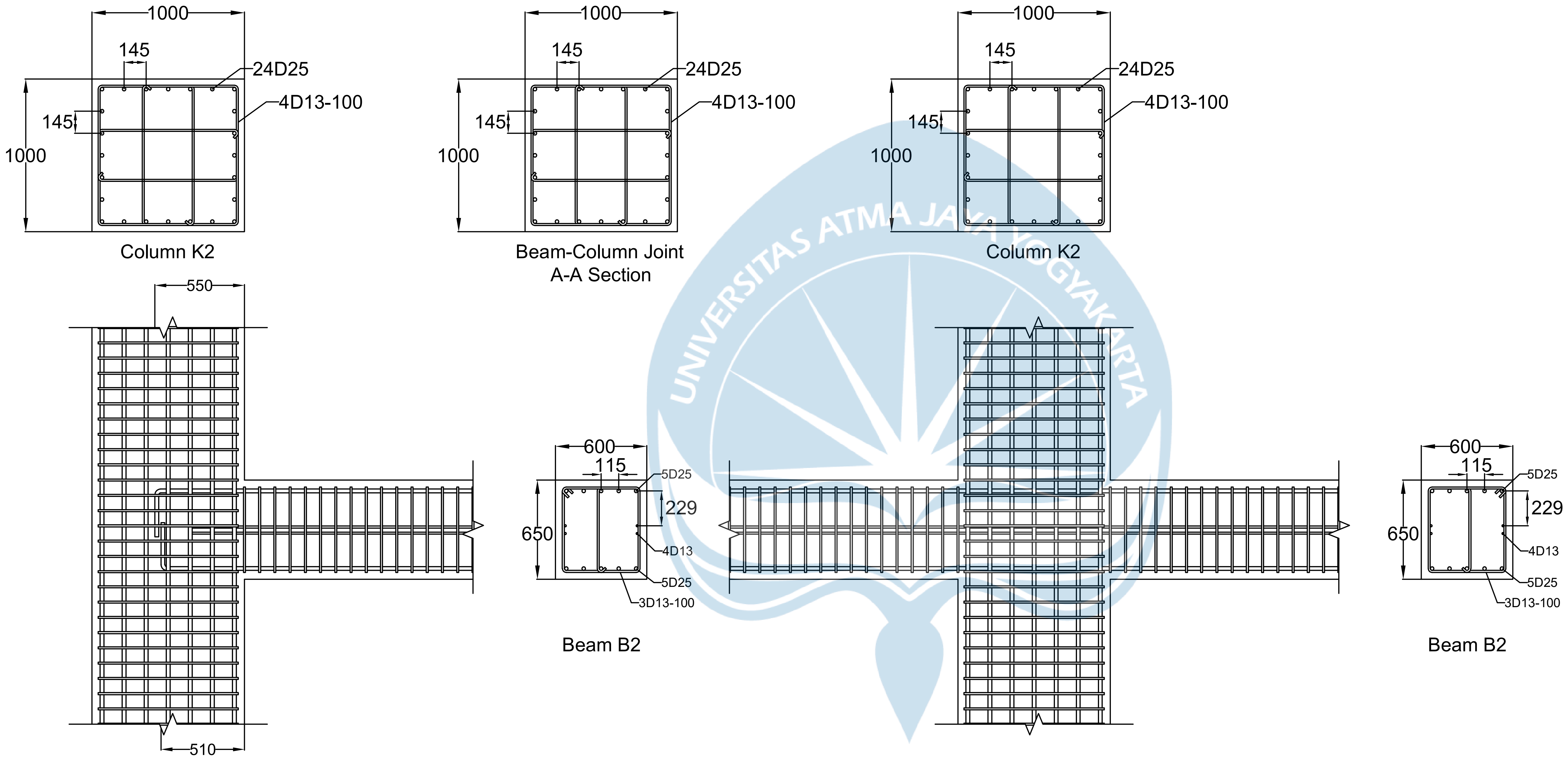


Beam B2 and Column K2 Joint

Scale 1:30

Final Project and Infrastructure Design

Date	Friday, 24th October 2023

Title

Type 2 Beam and Type 2 Column Joint

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T., M.Eng.
Lecturer

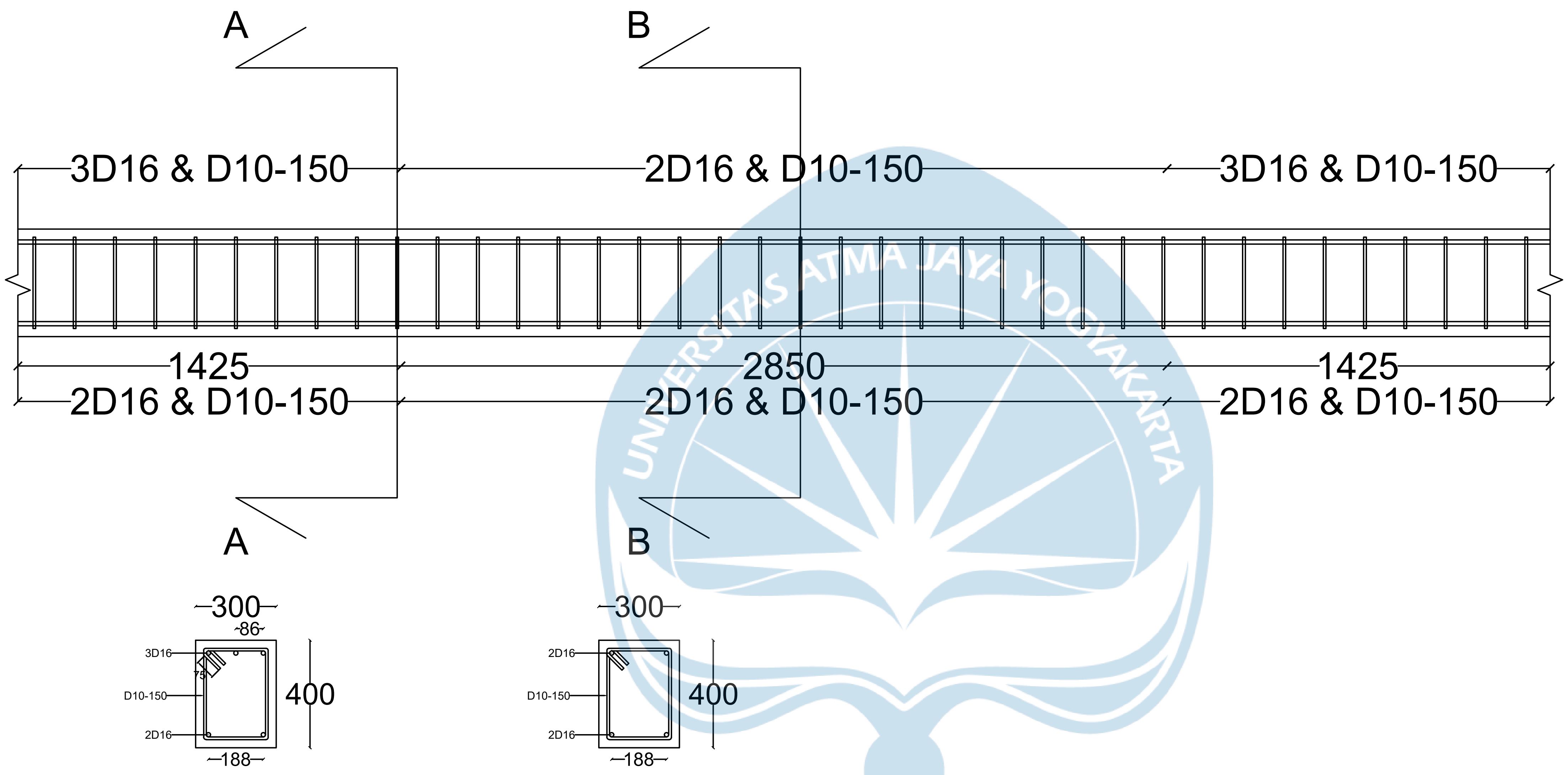
Agreed by

Johan Ardianto, S.T., M.Eng.
Lecturer

Scale

1:30 in mm

Page



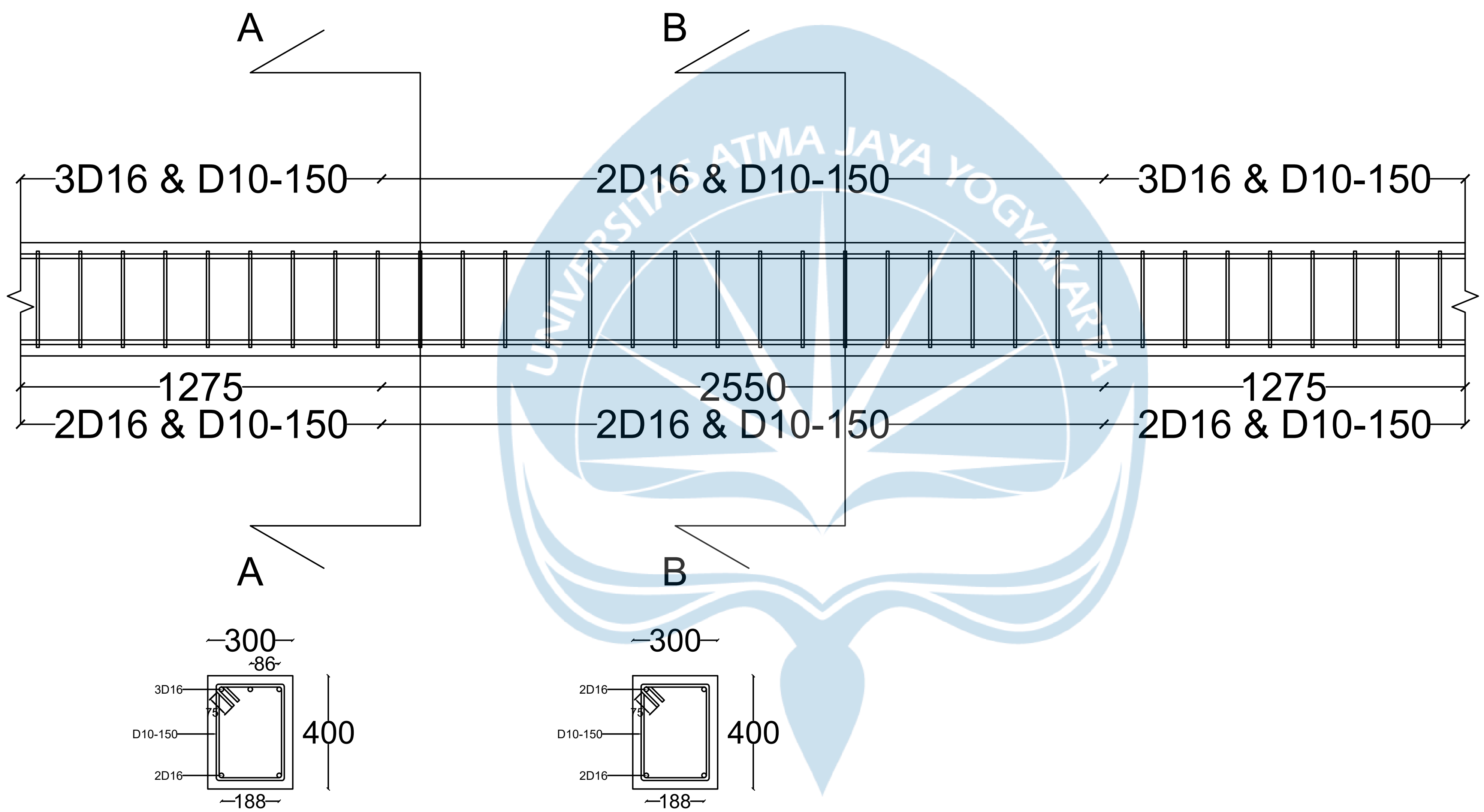
Tie Beam Support Section A-A

Tie Beam Support Section B-B

Tie Beam Cross Section Detail

Scale 1:20

Final Project and Infrastructure Design	
Date	Friday, 24th October 2023
Title	
Tie Beam Type 1	
Drawer	
GROUP 1: Alvin Pires (201317977) Richardo Hadinata Djoenarko (201317980) Vinayak Munesh Panjabi (201318351)	
Checked by	
Johan Ardianto, S.T, M.T Lecturer	
Agreed by	
Johan Ardianto, S.T, M.T Lecturer	
Scale	
1:20 in m	
Page	
1	



Tie Beam Support Section A-A

Tie Beam Support Section B-B

Tie Beam Cross Section Detail

Scale 1:20

Final Project and Infrastructure Design

Date Friday, 24th October 2023

Title

Tie Beam Type 2

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

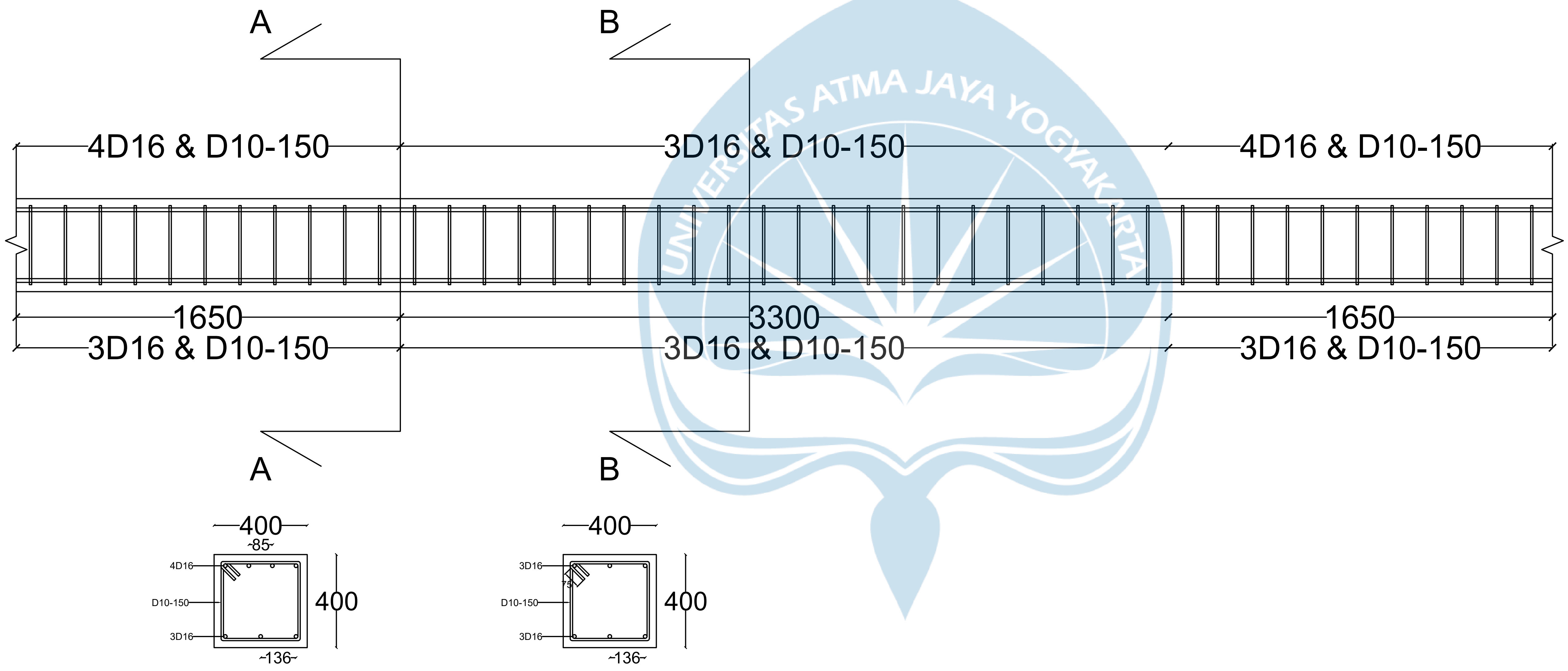
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:20 in m

Page

1



Tie Beam Support Section A-A

Tie Beam Support Section B-B

Tie Beam Cross Section Detail

Scale 1:20

Final Project and Infrastructure Design

Date	Friday, 24th October 2023

Title

Tie Beam Type 3

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

Johan Ardianto, S.T, M.T
Lecturer

Agreed by

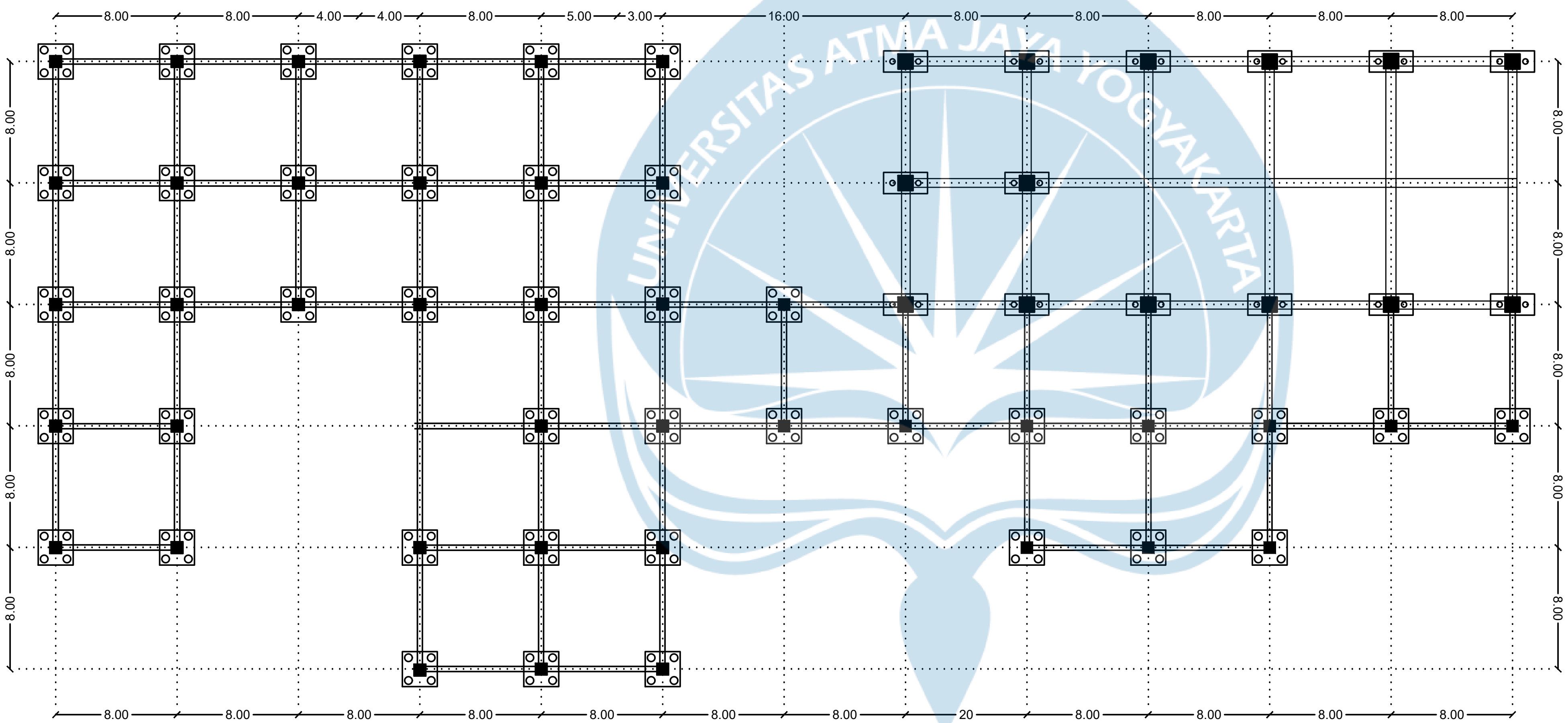
Johan Ardianto, S.T, M.T
Lecturer

Scale

1:20 in m

Page

1



Location of Pile Installation

Scale 1:400

Final Project and Infrastructure Design

Date	Friday, 24th October 2023

Title

Pile Configuration

Drawer

GROUP 1:

Alvin Pires
(201317977)
Richardo Hadinata Djoenarko
(201317980)
Vinayak Munesh Panjabi
(201318351)

Checked by

William Wijaya, S.T., M.Eng.
Lecturer

Agreed by

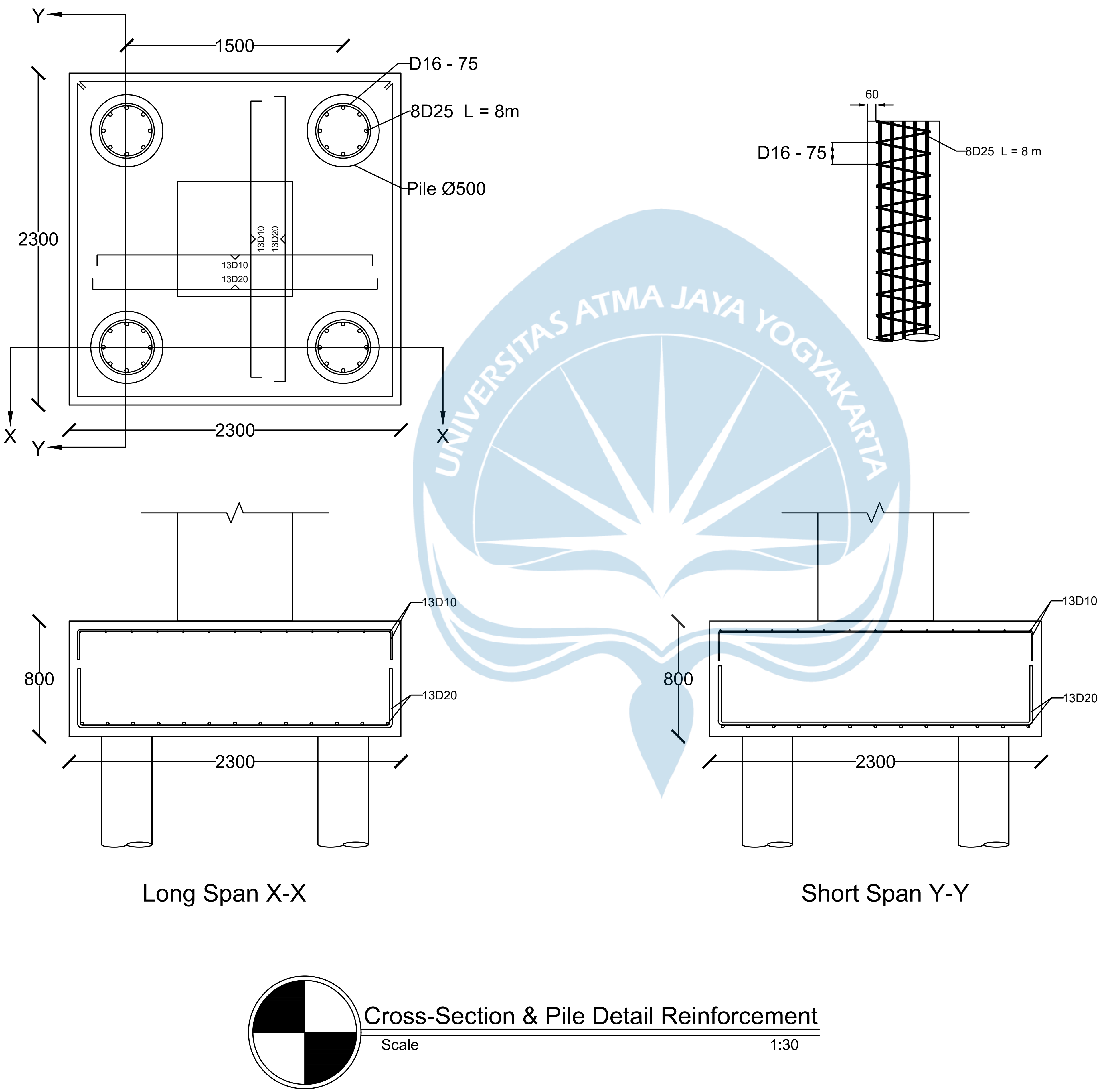
William Wijaya, S.T., M.Eng.
Lecturer

Scale

1:400 in m

Page

1



Final Project and Infrastructure Design

Date	Friday, 24th October 2023

Title

Borepile Type 1

Drawer

GROUP 1:

Alvin Pires (201317977)
Richardo Hadinata Djoenarko (201317980)
Vinayak Munesh Panjabi (201318351)

Checked by

William Wijaya, S.T., M.Eng.
Lecturer

Agreed by

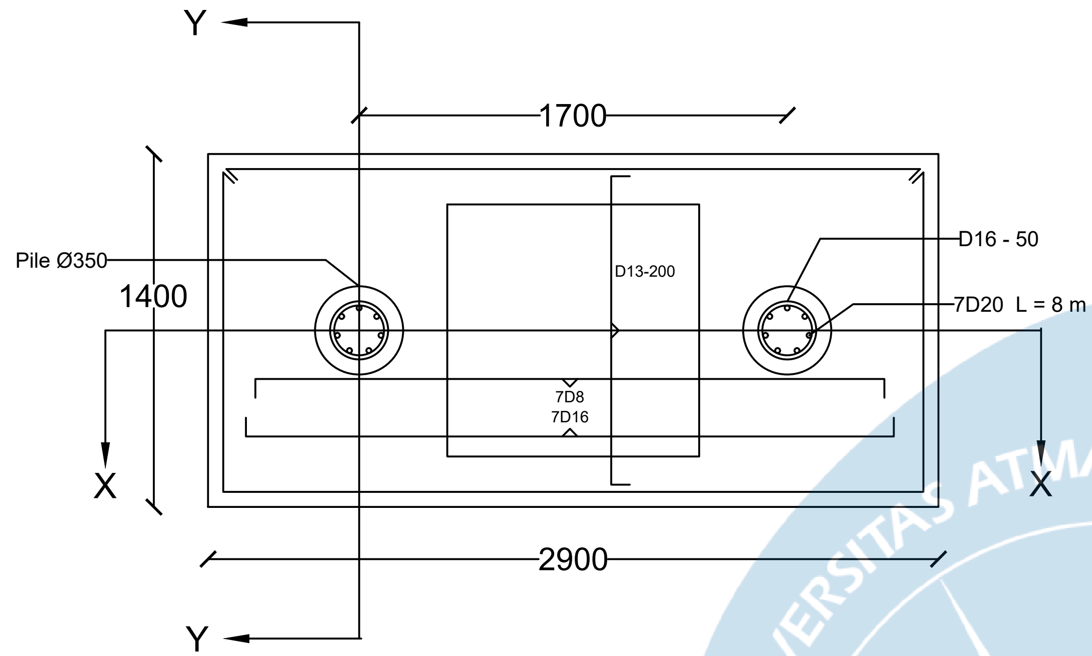
William Wijaya, S.T., M.Eng.
Lecturer

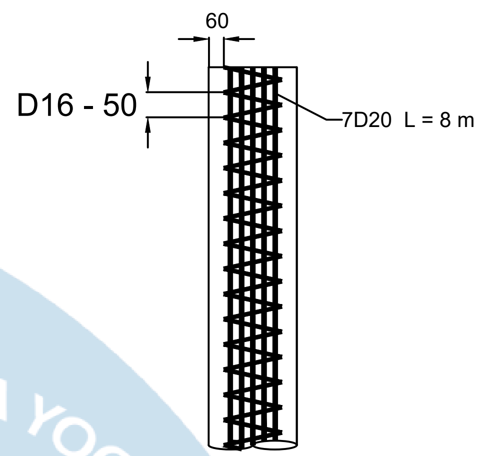
Scale

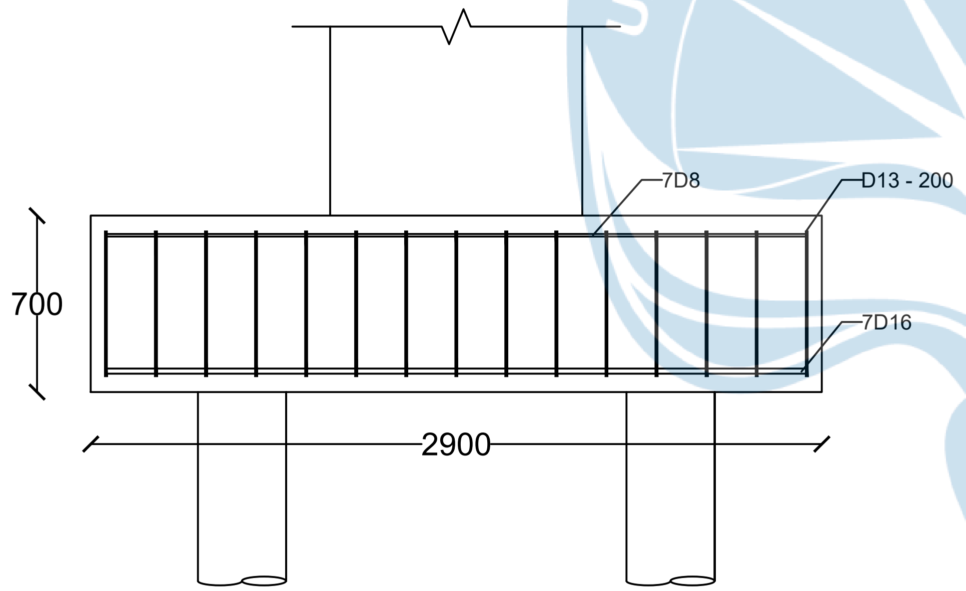
1:30 in mm

Page

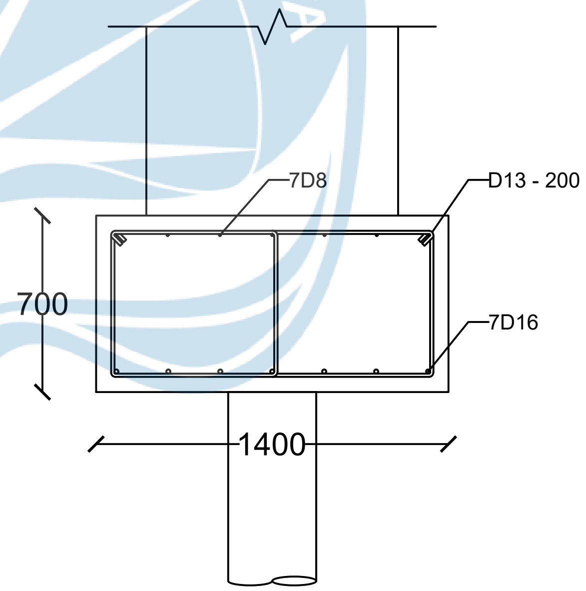
1







Long Span X-X



Short Span Y-Y

Cross-Section & Pile Detail Reinforcement

Scale 1:30

Final Project and Infrastructure Design	
Date	Friday, 24th October 2023
Title	Borepile Type 2
Drawer	GROUP 1: Alvin Pires (201317977) Richardo Hadinata Djoenarko (201317980) Vinayak Munesh Panjabi (201318351)
Checked by	William Wijaya, S.T., M.Eng. Lecturer
Agreed by	William Wijaya, S.T., M.Eng. Lecturer
Scale	1:30 in mm
Page	1