美特鋁質有限公司
MIDI ALUMINIUM FABRICATOR LTD.

工程指示 / 要求簡箋 ENGINEER INSTRUCTIONS(E.I.)

工程指示編號:	EI- 4588	修改版本:	-
	HK- /		
工程編號:	J 857	工程名稱:	NKIL6552
收件人:	Maggie Lor	發件人:	Nero HO
工程項目:	幕牆吊運架測試	日期:	14/04/2022

☐ 原合約工程包	☐ 原合約工程加 / 減賬 QT-	☐ 新工程報價 QT-

信件批核號碼/圖紙參考編號:	批核模具圖紙編號:
客戶指示附件:	管理內部批簽署:

☐ 初步鋁料 B.M.	☐ 加工拆圖，然後生產	☐ 尺寸表
☐ 正式鋁料 B.M.	☐ 技術上資料／指示	☐ 報價
☐ 配件 B.M.	☐ 樣辦或貨品說明書	☐ 分判合約
☑ 其他: 測試		

內容:
請安排LAB驗吊運架
附頁施工圖
最重單元件重700Kg

完成上列要求日期: 28/04/2022

國內

☐ 生產技術總監	☐ 連附件	☐ 技術部	☐ 連附件	☐ 生產部	☐ 連附件
☐ 採購部	☐ 連附件	☐ 生產統籌部	☐ 連附件	☐ 報關組	☐ 連附件
☐ 質檢部	☐ 連附件	☐ 會計部	☐ 連附件	☐ 機械設計部	☐ 連附件
☐ 其他:					

香港

☐ 行政部	☐ 連附件	☐ 會計部	☐ 連附件	☐ 統籌部	☐ 連附件	☐ 工程部	☐ 連附件
☑ 採購部	☑ 連附件	☐ QS部	☐ 連附件	☐ 地盤管理	☐ 連附件	☐ 維修部	☐ 連附件

*發件人簽署： (signed)	*組別成員批核簽署： (signed)
傳遞編號： /	項目經理簽署：

PROJECT : PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

SHOP DRAWING

OF

12/F AND 22F MONORAIL

(1ST SUBMISSION)

SUBMISSION	DATE	COMMENTS RECEIPT DATE			REMARK
		Architect	Consultant	Main Contractor	
1st.	22/03/2022				

浩揚機器設備有限公司

HO YEUNG MACHINERY & EQUIPMENT LTD.

NO.	DRAWING NO.	REV.	DRAWING TITLE	REMARK	NO.	DRAWING NO.	REV.	DRAWING TITLE	REMARK
1	MR/COVER	–	COVER	–	51				
2	MR/DL001	–	DRAWING LIST FOR MONORAIL	–	52				
3	MR/AN001	–	GENERAL NOTES	–	53				
4	MR/PL01	–	PLAN FOR MONORAIL	–	54				
5	MR/PL02	–	PLAN FOR MONORAIL	–	55				
6	MR/PL03	–	PLAN FOR MONORAIL	–	56				
7	MR/PL01A	–	PLAN FOR MONORAIL	–	57				
8	MR/PL01B	–	PLAN FOR MONORAIL	–	58				
9	MR/PL01C	–	PLAN FOR MONORAIL	–	59				
10	MR/PL01D	–	PLAN FOR MONORAIL		60				
11	MR/PL01E	–	PLAN FOR MONORAIL		61				
12	MR/PL01F	–	PLAN FOR MONORAIL		62				
13	MR/PL02A	–	PLAN FOR MONORAIL		63				
14	MR/PL02D	–	PLAN FOR MONORAIL		64				
15	MR/PL02C	–	PLAN FOR MONORAIL		65				
16	MR/PL02D	–	PLAN FOR MONORAIL		66				
17	MR/PL03A	–	PLAN FOR MONORAIL		67				
18	MR/PL03B	–	PLAN FOR MONORAIL		68				
19	MR/PL03C	–	PLAN FOR MONORAIL		69				
20	MR/S101	–	SECTION FOR MONORAIL		70				
21	MR/D101	–	DETAIL FOR MONORAIL		71				
22	MR/D102	–	DETAIL FOR MONORAIL		72				
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50					100				

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

NOTE :

CLIENT :

MARBLE EDGE INVESTMENT LTD.

ARCHITECT:

RONALD LU & PARTNERS
ARCHITECTS | PLANNERS | INTERIOR DESIGNERS

STRUCTURAL ENGINEER :

CMA C M WONG & ASSOCIATES LTD

MAIN CONTRACTOR :

裕民建築有限公司

浩揚機器設備有限公司
HO YEUNG MACHINERY & EQUIPMENT LTD.

PROJECT TITLE :

PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

DRAWING TITLE :

DRAWING LIST FOR MONORAIL

DRAWN : BIN	DATE : 18/02/2022
DESIGNED : AMEN	SCALE : 1:2
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/DL001	REV : –

A1

GENERAL NOTES

I, MAIN MATERIALS AND MECHANICAL PROPERTIES:

1. STRUCTURAL STEEL TO BE GRADE S275 TO BS EN 10025: 2004 & BS EN 10210 (FOR HOLLOW) STRUCTURAL STEEL MATERIAL SHALL BE CLASS 1 AS STATED IN CL.3.1.1 OF CODE OF PRACTICE FOR THE STRUCTURAL USE OF STEEL 2011.

YIELD STRENGTH	Ys= 275 MPa
TENSILE STRENGTH	Us= 430 MPa
DESIGN STRENGTH (FOR THICKNESS<=16mm)	py= 275 MPa
DESIGN STRENGTH (FOR 16mm<THICKNESS<=40mm)	py= 265 MPa
MODULUS OF ELASTICITY	Es= 205000 MPa

2. ALL SCREW, THROUGH BOLT OR BOLT TO BE GRADE 4.6 TO BS 3692 & BD 4190

DESIGN TENSILE STRENGTH	pt= 195 MPa
DESIGN SHEAR STRENGTH	ps= 160 MPa

3. ALL SCREW, THROUGH BOLT OR BOLT TO BE GRADE 8.8 TO BS 3692 & BD 4190

DESIGN TENSILE STRENGTH	pt= 450 MPa
DESIGN SHEAR STRENGTH	ps= 375 MPa

II, DESIGN CODES AND STANDARDS

1). HONG KONG "CODE OF PRACTICE FOR THE STRUCTURAL USE OF STEEL" – 2011
2). HONG KONG "CODE OF PRACTICE FOR THE STRUCTURAL USE OF CONCRETE" – 2013
3). CODE OF PRACTICE FOR DEAD & IMPOSED LOAD 2011

III, DESIGN CRITERIA:

1. DESIGN LIVE LOAD

BASIC GONDOLA : 500kg

1a. GONDOLA WITH 2M FOR CONSERVATIVE 283.4KG
2a. WORKING LABOURS WITH 2x75KG= 150KG
3a. TWO WORKER HAND TOOLS AND MATERIAL FOR 30KGx2=60KG
} = 500kg

BASIC MATERIAL HOISTING : 1000kg

2. DESIGN WIND LOAD

ACCORDING TO THE TECHNICAL SPECIFICATION OF THE CONTRACT DOCUMENT, THE DESIGN BASIC WIND PRESSURE WILL BE IN ACCORDANCE WITH 'CODE OF PRACTICE ON WIND EFFECTS 2004 – TABLE 1',

HEIGHT ABOVE SITE-GROUND LEVEL $H_s := 100$ m

THE BASIC WIND PRESSURE IS: $q_s = 2.86$kPa

THE WIND PRESSURE COEFFICIENT, $C_p := 2$

FOR TEMPORARY WORK, $Y_s := 0.7$

THEREFORE, DESIGN WIND PRESSURE : $w_p := q_s \times C_p \times Y_s$, $w_p = 4.0$kPa

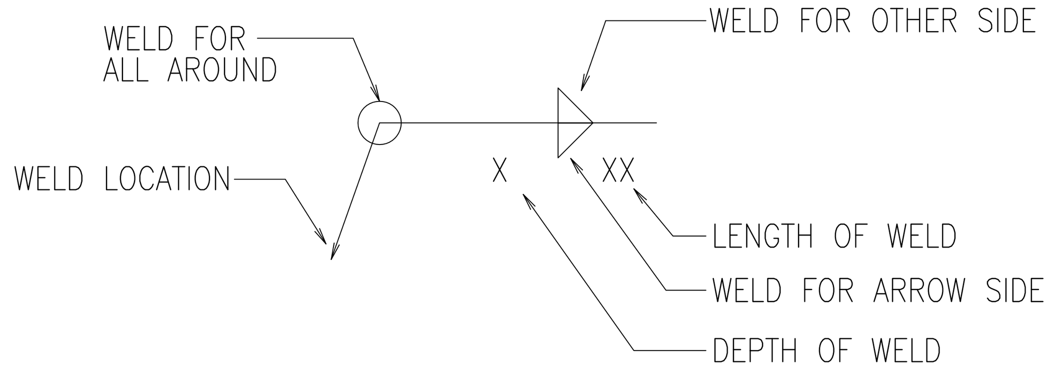
IV, FABRICATION & INSTALLATION

1). ALL DIMENSIONS SHOWN ON SHOP DRAWING TO BE READ IN MILLIMETER (mm), EXCEPT THE FLOOR LEVEL MARK TO BE READ IN METER (m)

2). WELDING FOR STRUCTURAL STEEL:

a.) ALL WELDING SHALL COMPLY WITH BS EN 1011
b.) SITE WELD SURFACES TO BE PROTECTED BY ZINC CHROMATE
c.) DESIGN WELD STRENGTH: pw=220 MPa

WELD SYMBOL :

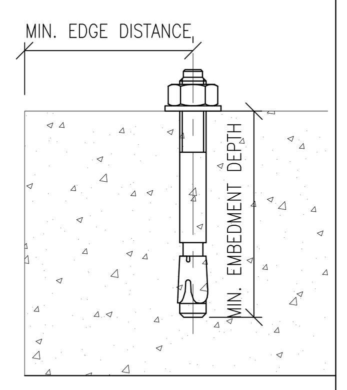


3). HILTI ANCHOR BOLT:

INSTALLATION SHALL BE IN STRICT ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTIONS

INFLUENCE OF CONCRETE STRENGTH (fb) : $\sqrt{\frac{35Mpa}{25Mpa}}$ =1.18

ANCHOR BOLT (HILTI)(CRACKED CONC.)	HST3 M12
EFFECTIVE EMBEDMENT DEPTH (mm)	70
RECOMMENDED TENSILE LOAD (kN)	11.8
TENSILE TEST LOAD (1.5 x T.L.xfb)(kN)	10.05
RECOMMENDED SHEAR LOAD (kN)	6.7
MIN. SPACING (mm)	50
MIN. EDGE DISTANCE (mm)	140



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REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

NOTE :

CLIENT :
MARBLE EDGE INVESTMENT LTD.

ARCHITECT:
RONALD LU & PARTNERS
ARCHITECTS | PLANNERS | INTERIOR DESIGNERS

STRUCTURAL ENGINEER :
CMA C M WONG & ASSOCIATES LTD

MAIN CONTRACTOR :
裕民建築有限公司

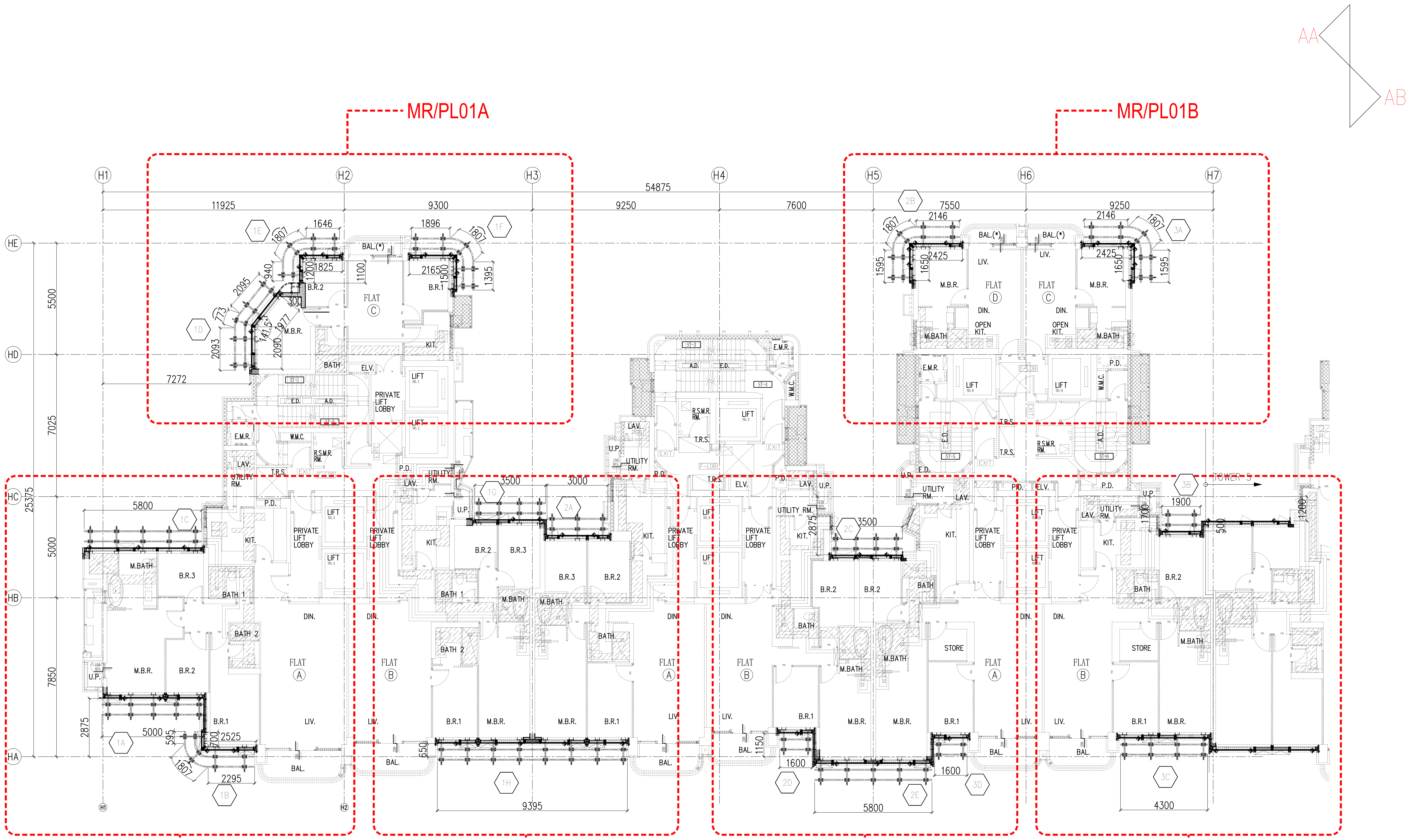
浩揚機器設備有限公司
HO YEUNG MACHINERY & EQUIPMENT LTD.

PROJECT TITLE :
PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

DRAWING TITLE :
GENERAL NOTES

DRAWN : BIN	DATE : 18/02/2022
DESIGNED : AMEN	SCALE : 1:2
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/AN001	REV : –

A1



01 TOWER 1, 2 AND 3 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

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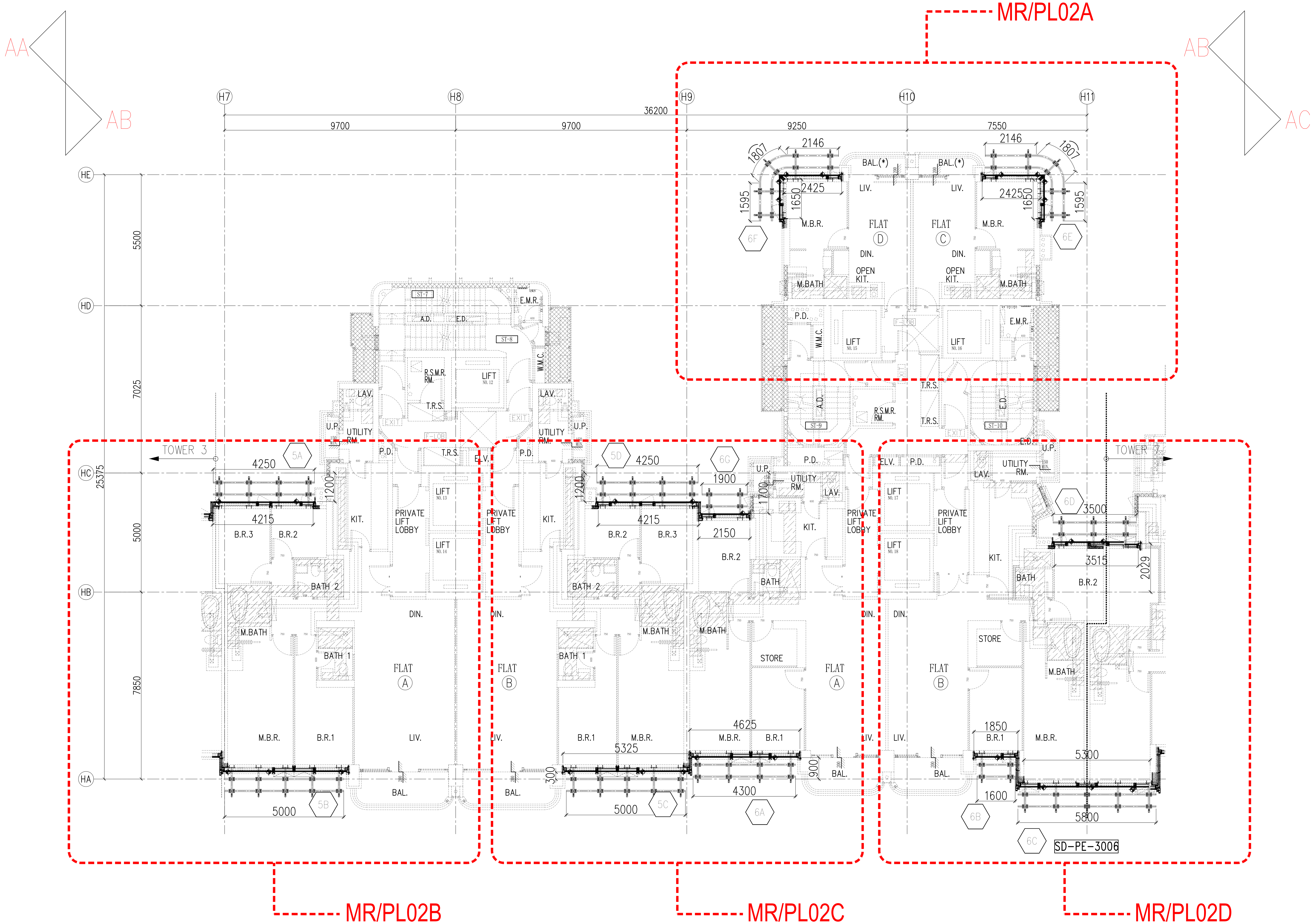
HO YEUNG MACHINERY & EQUIPMENT LTD.

PROJECT TITLE :
PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

DRAWING TITLE :
12F FLOOR PLAN FOR MONORAIL (AA)

DRAWN : BIN
DATE : 21/03/2022
DESIGNED : AMEN
SCALE : 1:100
CHECKED : DY
PROJECT NO.: –
DRAWING NO.: MR/PL01
REV : –

A1



01 TOWER 5 AND 6 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

NOTE :

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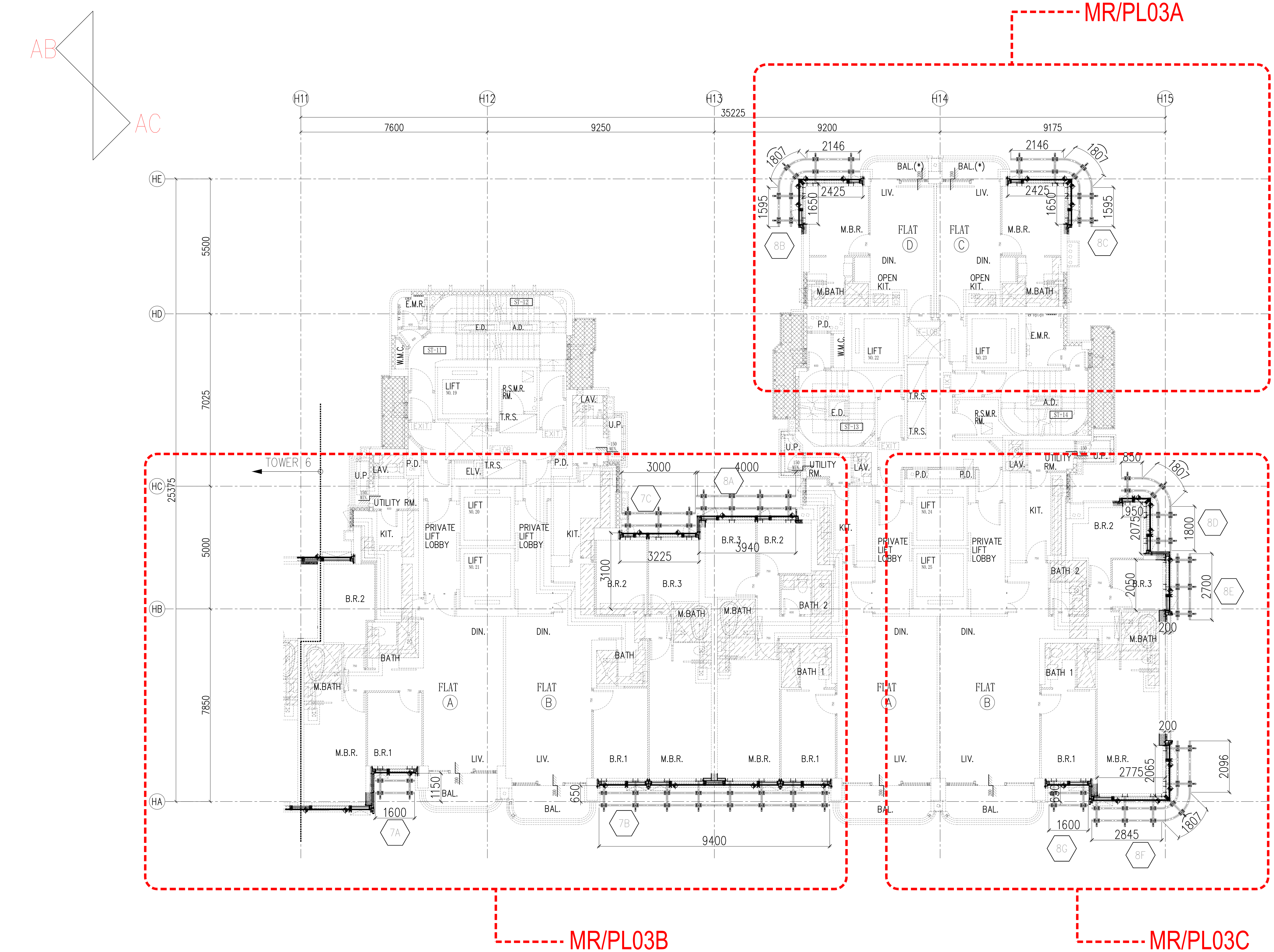
HO YEUNG MACHINERY & EQUIPMENT LTD.

PROJECT TITLE : PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

DRAWING TITLE : 12F FLOOR PLAN FOR MONORAIL (AB)

DRAWN : BIN	DATE : 21/03/2022
DESIGNED : AMEN	SCALE : 1:80
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/PL02	REV : –



01
TOWER 7 AND 8 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

NOTE :

CLIENT :
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ARCHITECT:
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ARCHITECTS | PLANNERS | INTERIOR DESIGNERS

STRUCTURAL ENGINEER :
CMA C M WONG & ASSOCIATES LTD

MAIN CONTRACTOR :
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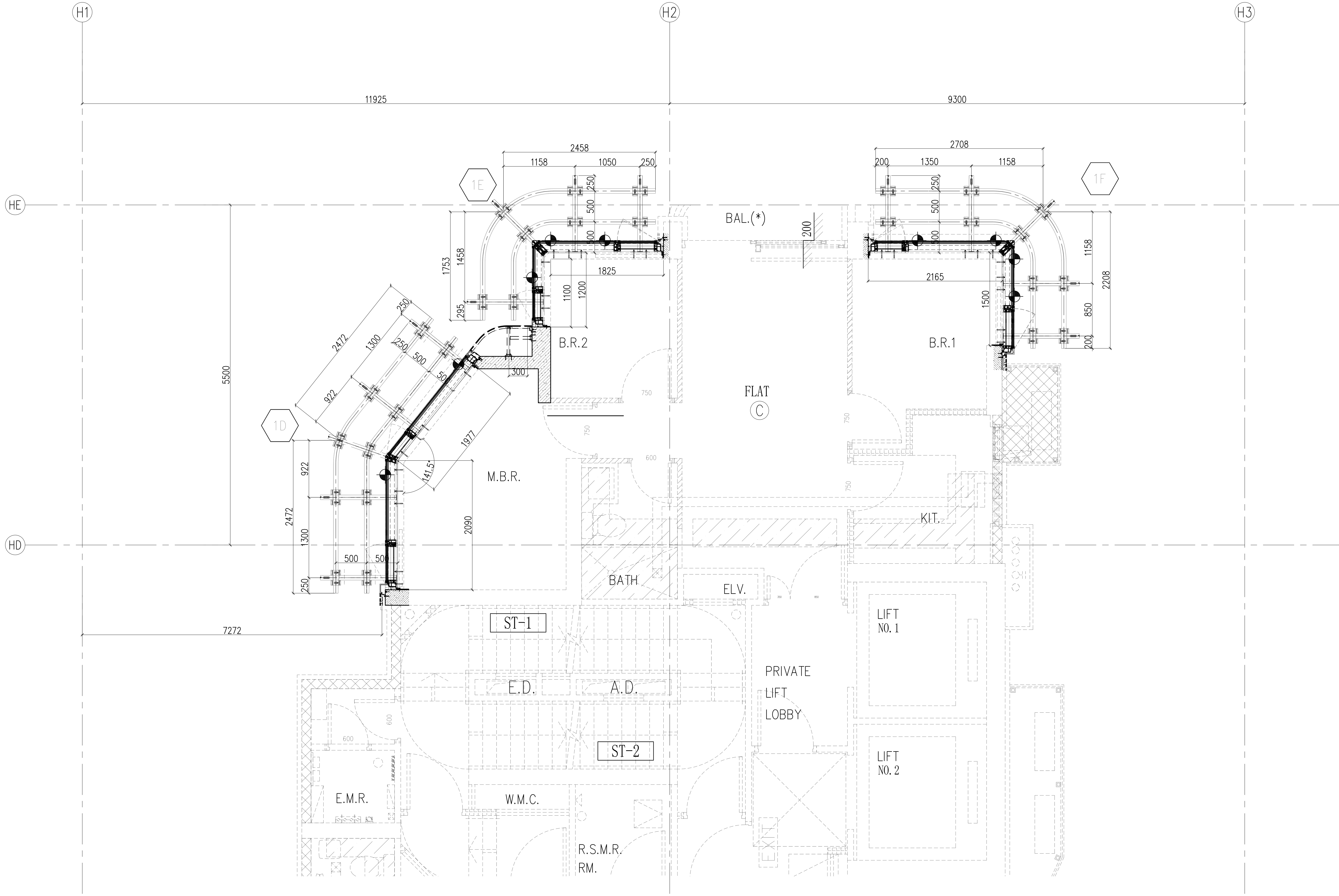
PROJECT TITLE :
PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

DRAWING TITLE :
12F FLOOR PLAN FOR MONORAIL (AC)

DRAWN : BIN
DATE : 21/03/2022
DESIGNED : AMEN
SCALE : 1:80
CHECKED : DY
PROJECT NO.: –
DRAWING NO.: MR/PL03
REV : –



01
—
TOWER 1, 2 AND 3 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

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PROJECT TITLE :
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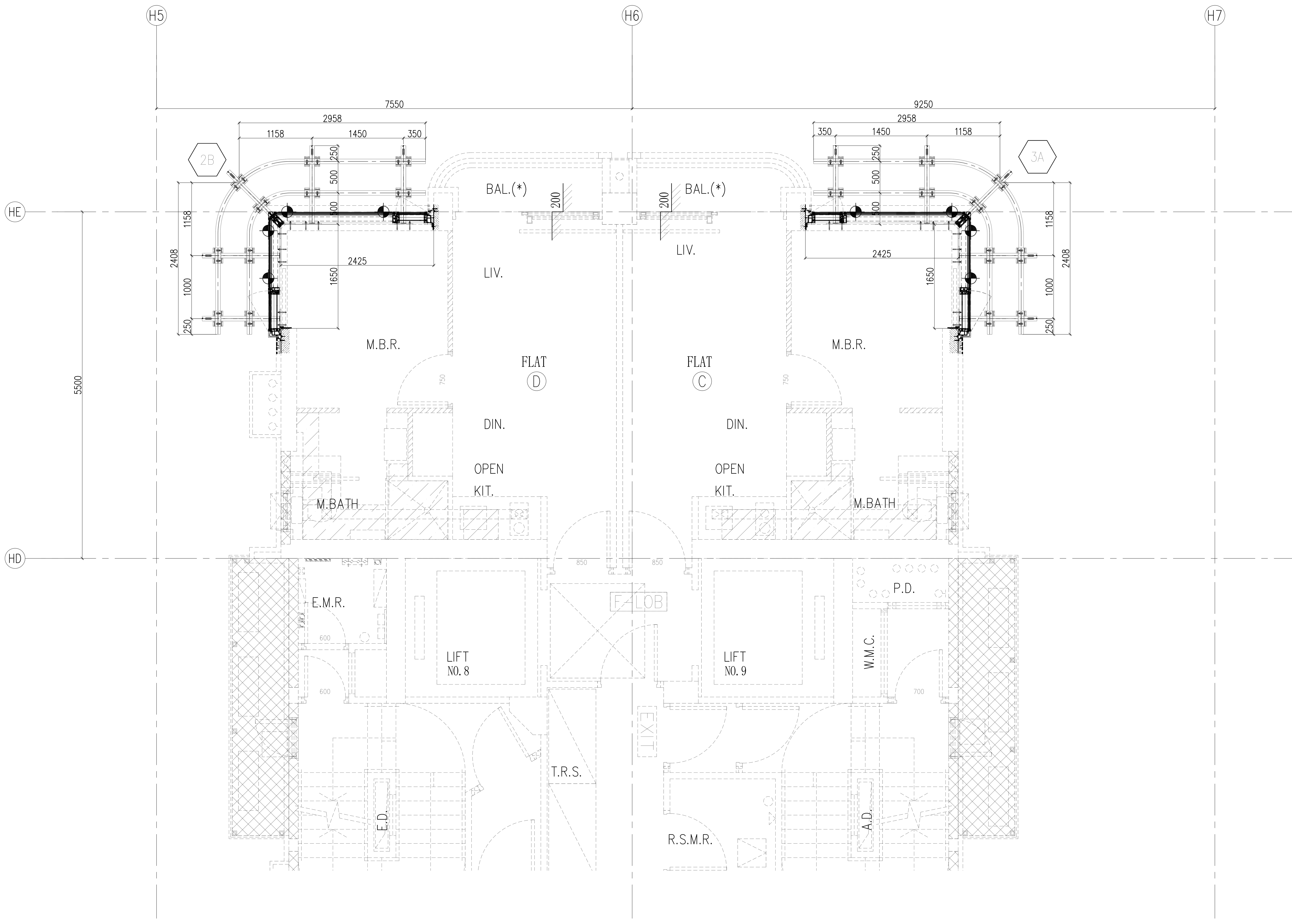
DRAWING TITLE :
12F FLOOR PLAN
FOR MONORAIL (AA)

DRAWN : BIN	DATE : 21/03/2022
DESIGNED : AMEN	SCALE : 1:100
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/PL01A	REV : –

A1



02 TOWER 1, 2 AND 3 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

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PROJECT TITLE :
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DRAWING TITLE :
12F FLOOR PLAN FOR MONORAIL (AA)

DRAWN :	BIN	DATE :	21/03/2022
DESIGNED :	AMEN	SCALE :	1:100
CHECKED :	DY	PROJECT NO.:	–
DRAWING NO.:	MR/PL01B	REV :	–

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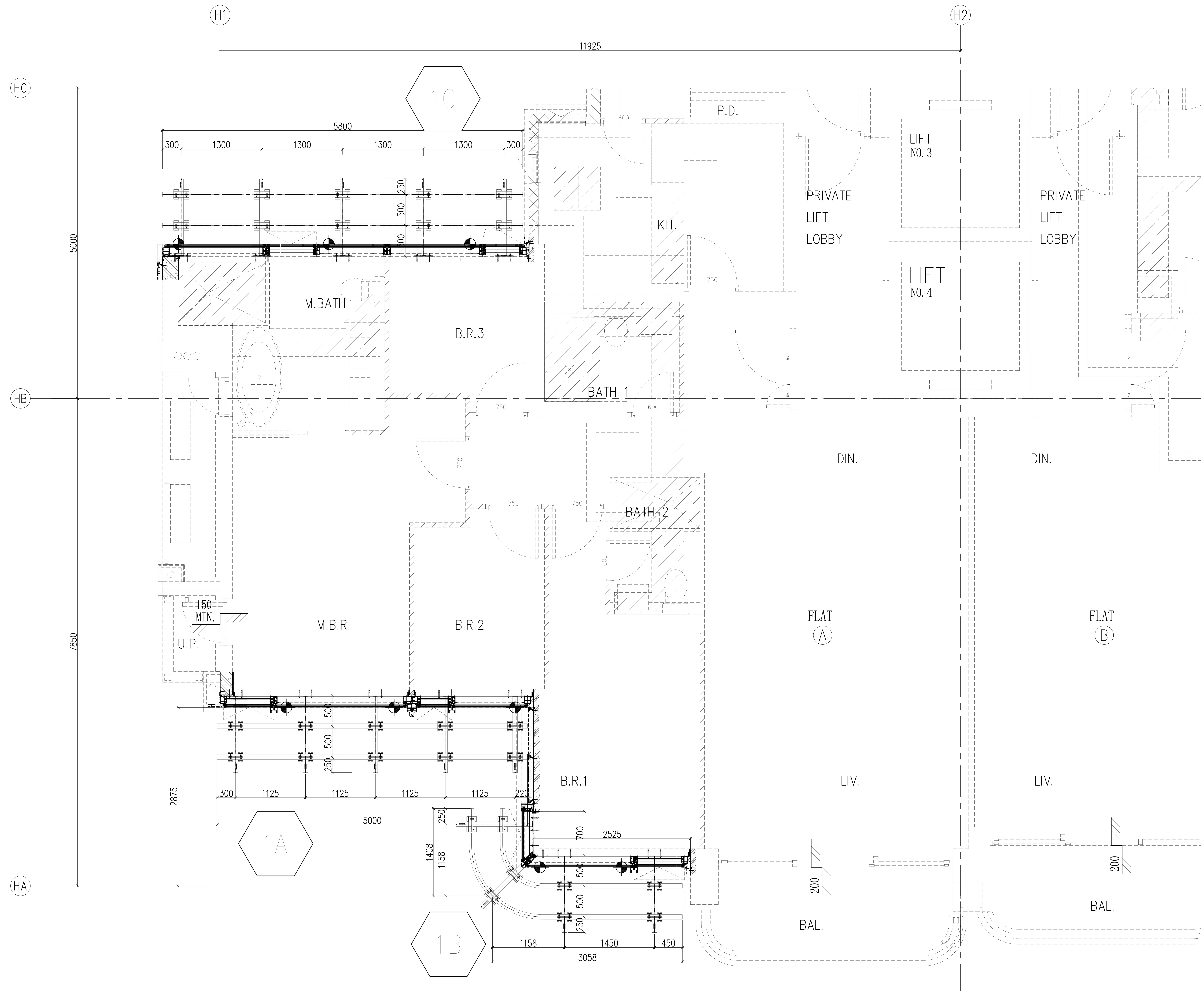

03
–
TOWER 1, 2 AND 3 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

NOTE :

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MAIN CONTRACTOR :
裕民建築有限公司

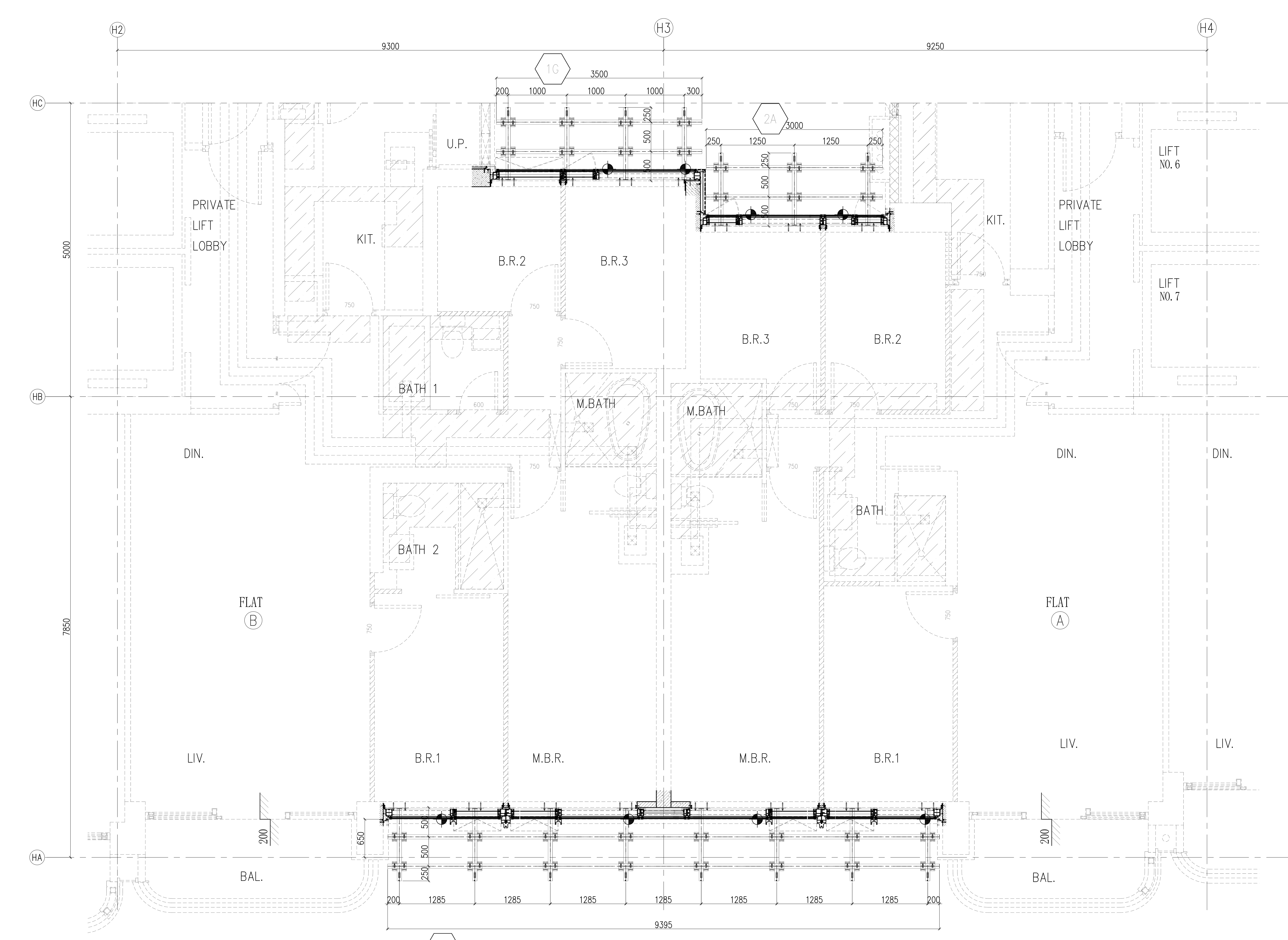
浩揚機器設備有限公司
HO YEUNG MACHINERY & EQUIPMENT LTD.

PROJECT TITLE :
PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

DRAWING TITLE :
12F FLOOR PLAN FOR MONORAIL (AA)

DRAWN : BIN	DATE : 21/03/2022
DESIGNED : AMEN	SCALE : 1:100
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/PL01C	REV : –

A1



04
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TOWER 1, 2 AND 3 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN)

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

NOTE :

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ARCHITECT:
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STRUCTURAL ENGINEER :
CMA C M WONG & ASSOCIATES LTD

MAIN CONTRACTOR :
裕民建築有限公司

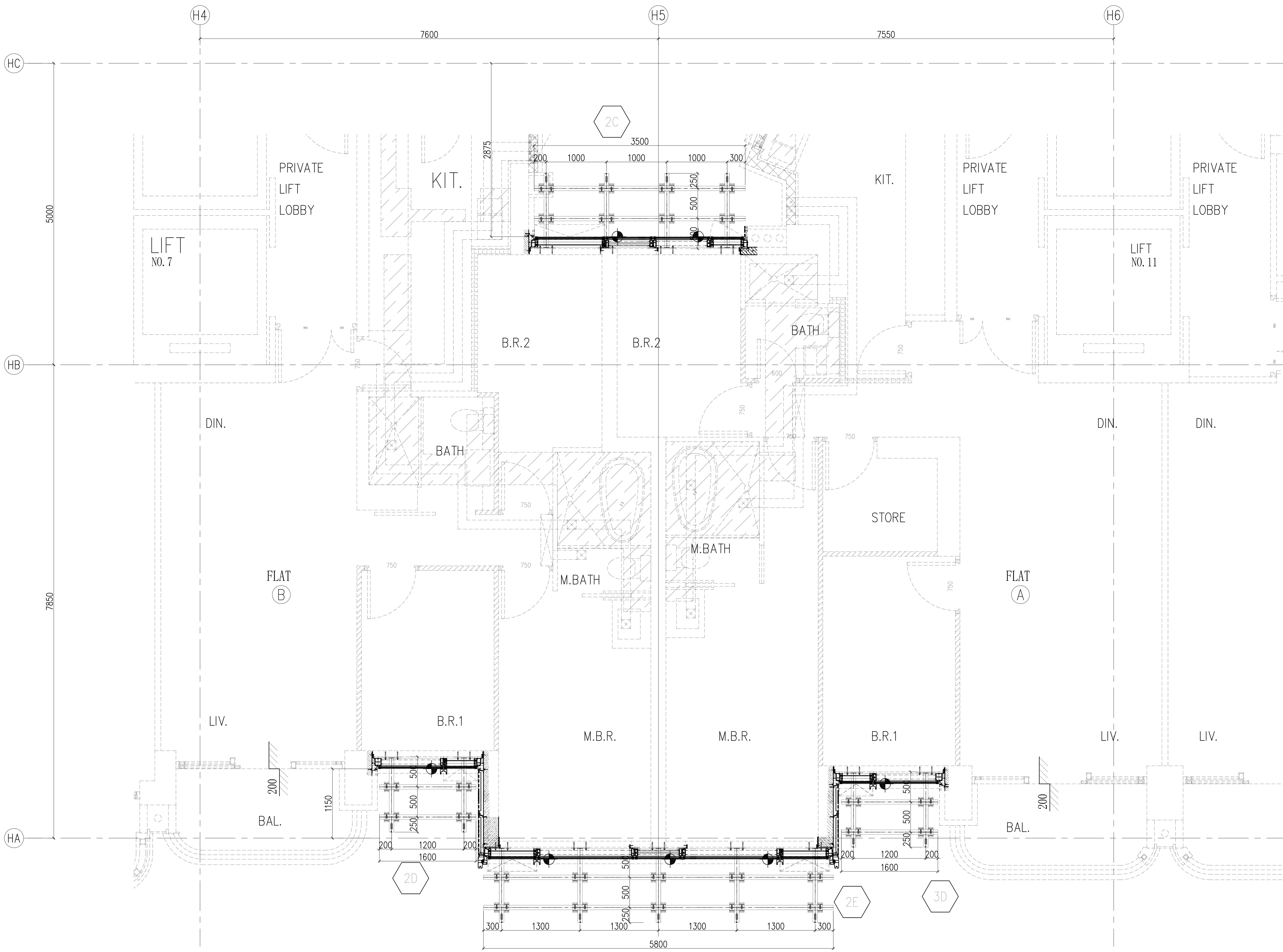
浩揚機器設備有限公司
HO YEUNG MACHINERY & EQUIPMENT LTD.

PROJECT TITLE :
PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

DRAWING TITLE :
12F FLOOR PLAN FOR MONORAIL (AA)

DRAWN : BIN	DATE : 21/03/2022
DESIGNED : AMEN	SCALE : 1:100
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/PL01D	REV : –

A1



05
—
TOWER 1, 2 AND 3 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
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MAIN CONTRACTOR :
裕民建築有限公司

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HO YEUNG MACHINERY & EQUIPMENT LTD.

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PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

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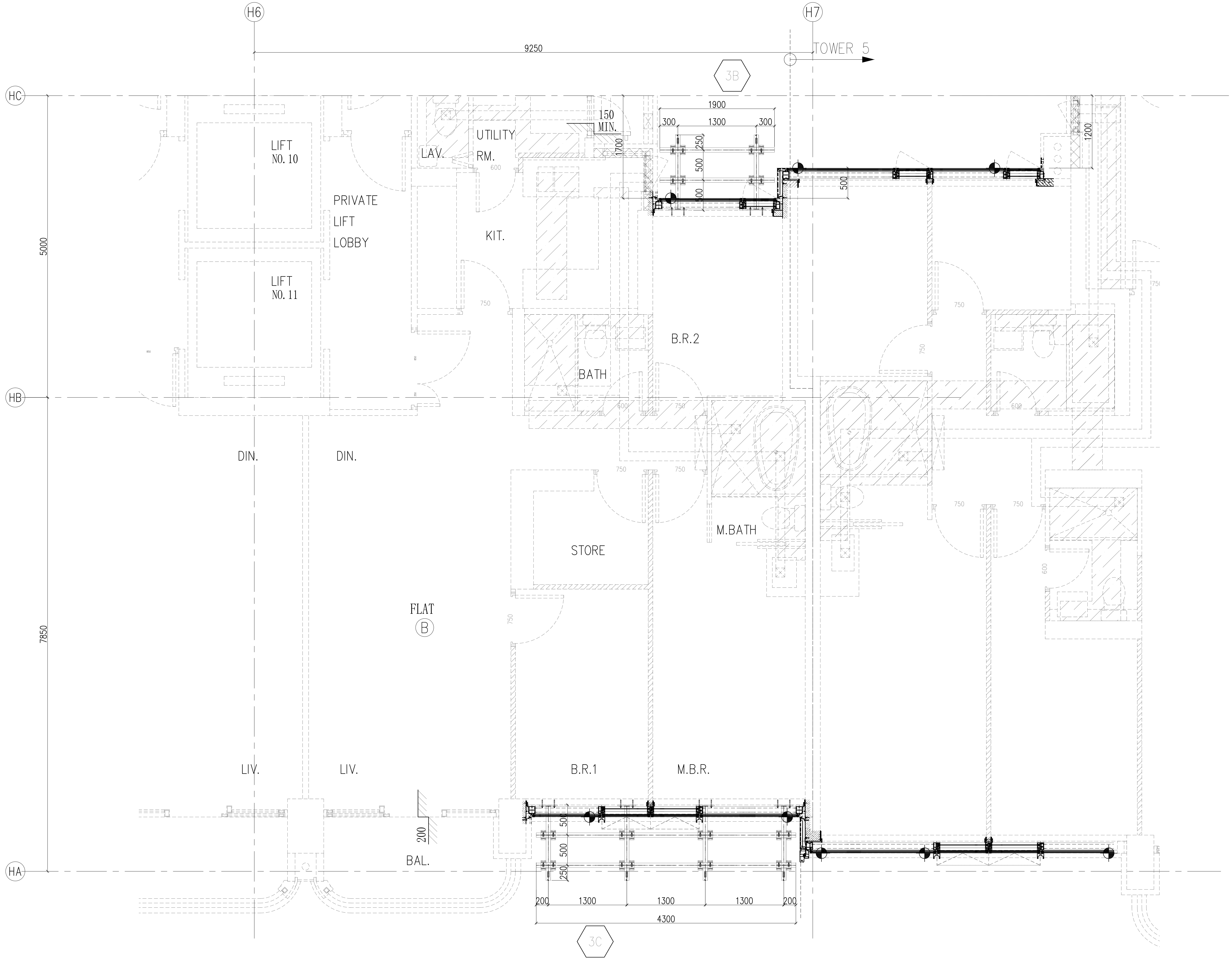
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/PL01E	REV : –

A1



06
–

TOWER 1, 2 AND 3 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

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REV	AMENDMENTS	BY	DATE
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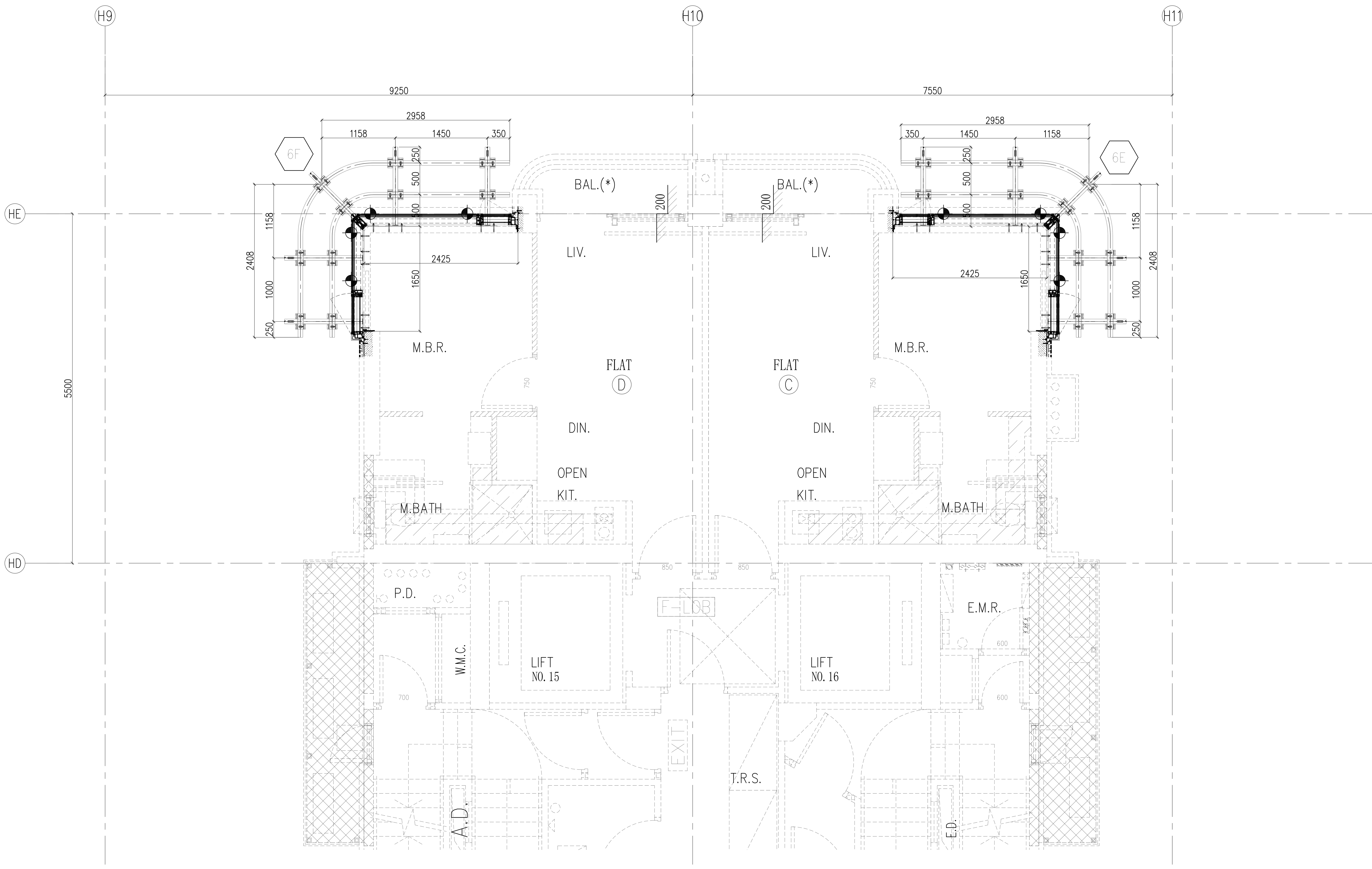
DRAWING NO.: MR/PL01F	REV : –

A1



01
–
TOWER 5 AND 6 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
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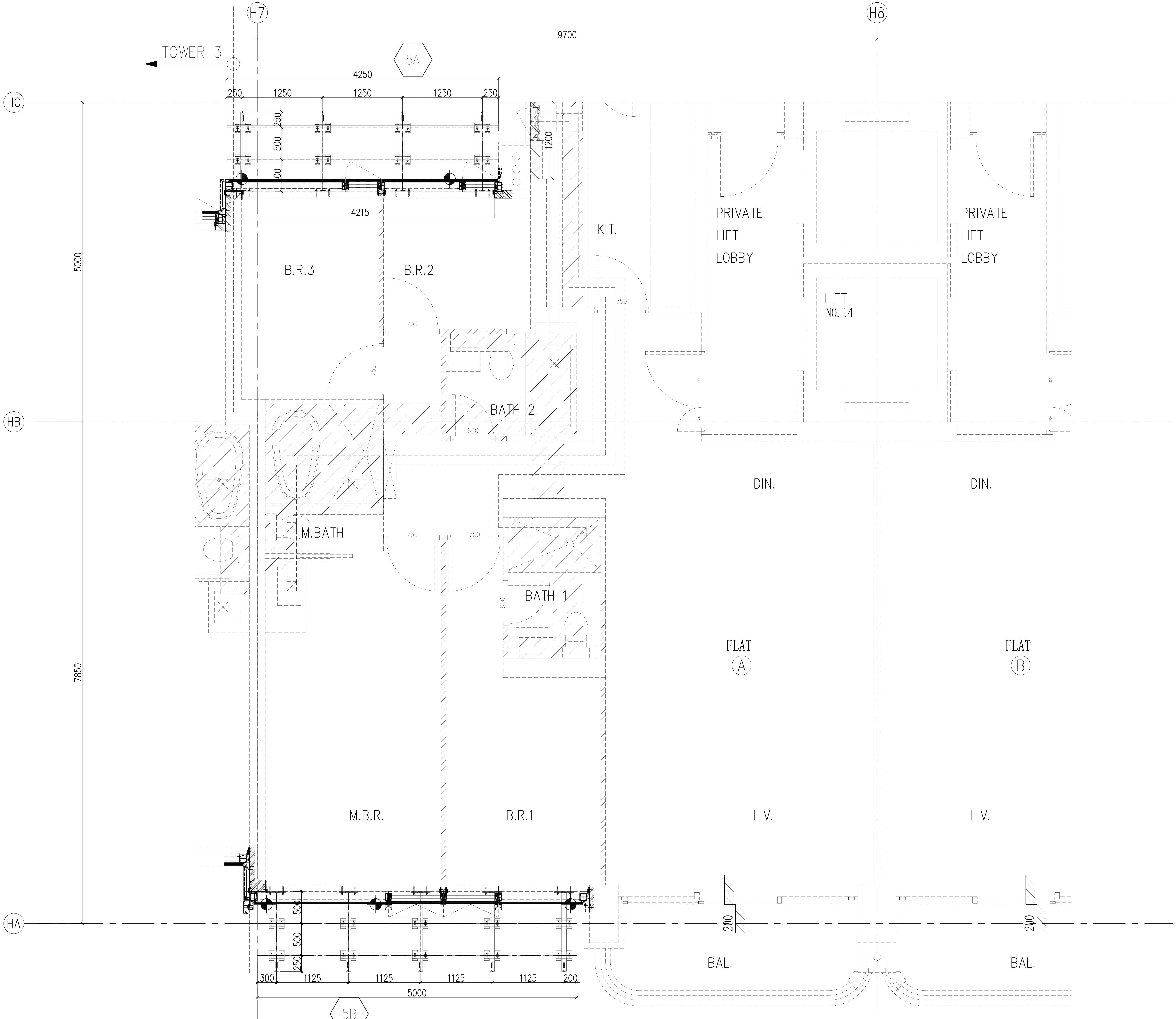
DEVELOPMENT AT
NEW KOWLOON INLAND LOT.
NO.6552

DRAWING TITLE :
12F FLOOR PLAN
FOR MONORAIL (AB)

DRAWN : BIN
DATE : 21/03/2022
DESIGNED : AMEN
SCALE : 1:80
CHECKED : DY
PROJECT NO.: –
DRAWING NO.: MR/PL02A
REV : –



02
–
TOWER 5 AND 6 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

NOTE :

CLIENT :
MARBLE EDGE INVESTMENT LTD.

ARCHITECT:
RONALD LU & PARTNERS
ARCHITECTS | PLANNERS | INTERIOR DESIGNERS

STRUCTURAL ENGINEER :
C M WONG & ASSOCIATES LTD

MAIN CONTRACTOR :
裕民建築有限公司

浩揚機器設備有限公司
HO YEUNG MACHINERY & EQUIPMENT LTD.

PROJECT TITLE :
PROPOSED RESIDENTIAL
DEVELOPMENT AT
NEW KOWLOON INLAND LOT.
NO.6552

DRAWING TITLE :
12F FLOOR PLAN
FOR MONORAIL (AB)

DRAWN : BIN	DATE : 21/03/2022
DESIGNED : AMEN	SCALE : 1:80
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/PL02B	REV : –

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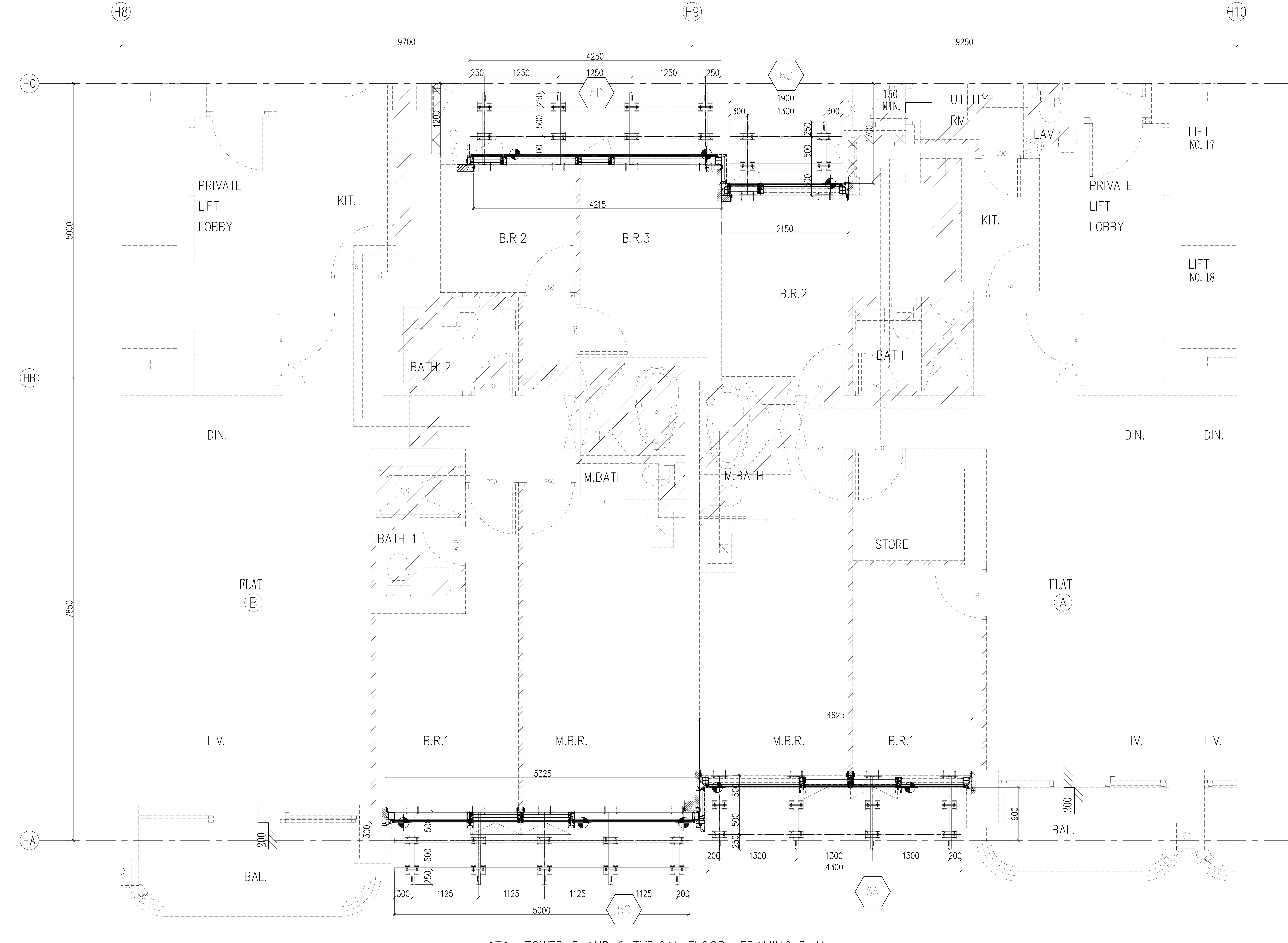

03 TOWER 5 AND 6 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN)

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

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DRAWN : BIN
DATE : 21/03/2022
DESIGNED : AMEN
SCALE : 1:80
CHECKED : DY
PROJECT NO.: –
DRAWING NO.: MR/PL02C
REV : –

04
TOWER 5 AND 6 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

NOTE :

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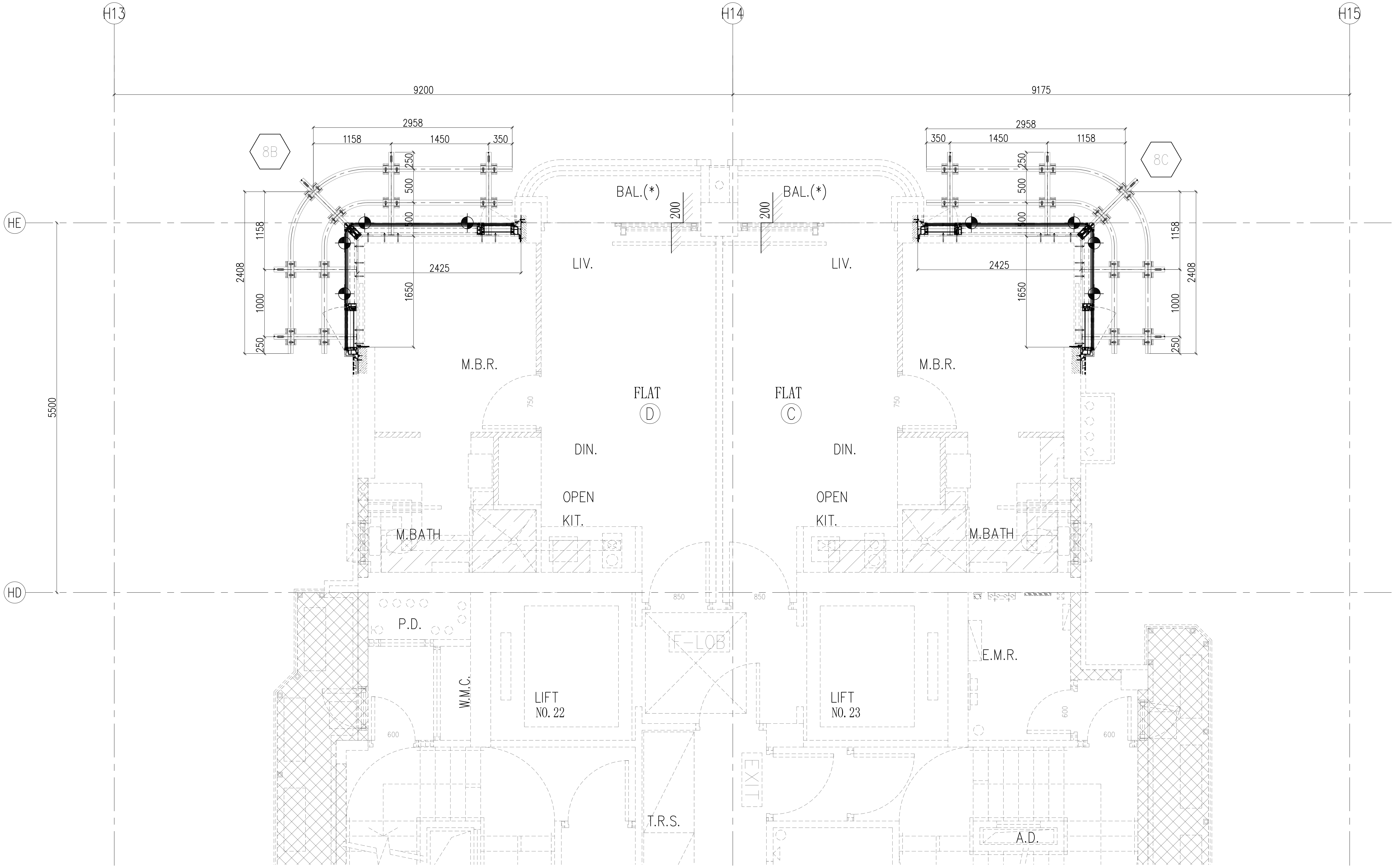

01
—
TOWER 7 AND 8 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

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DRAWING TITLE :
12F FLOOR PLAN
FOR MONORAIL (AC)

DRAWN : BIN	DATE : 21/03/2022
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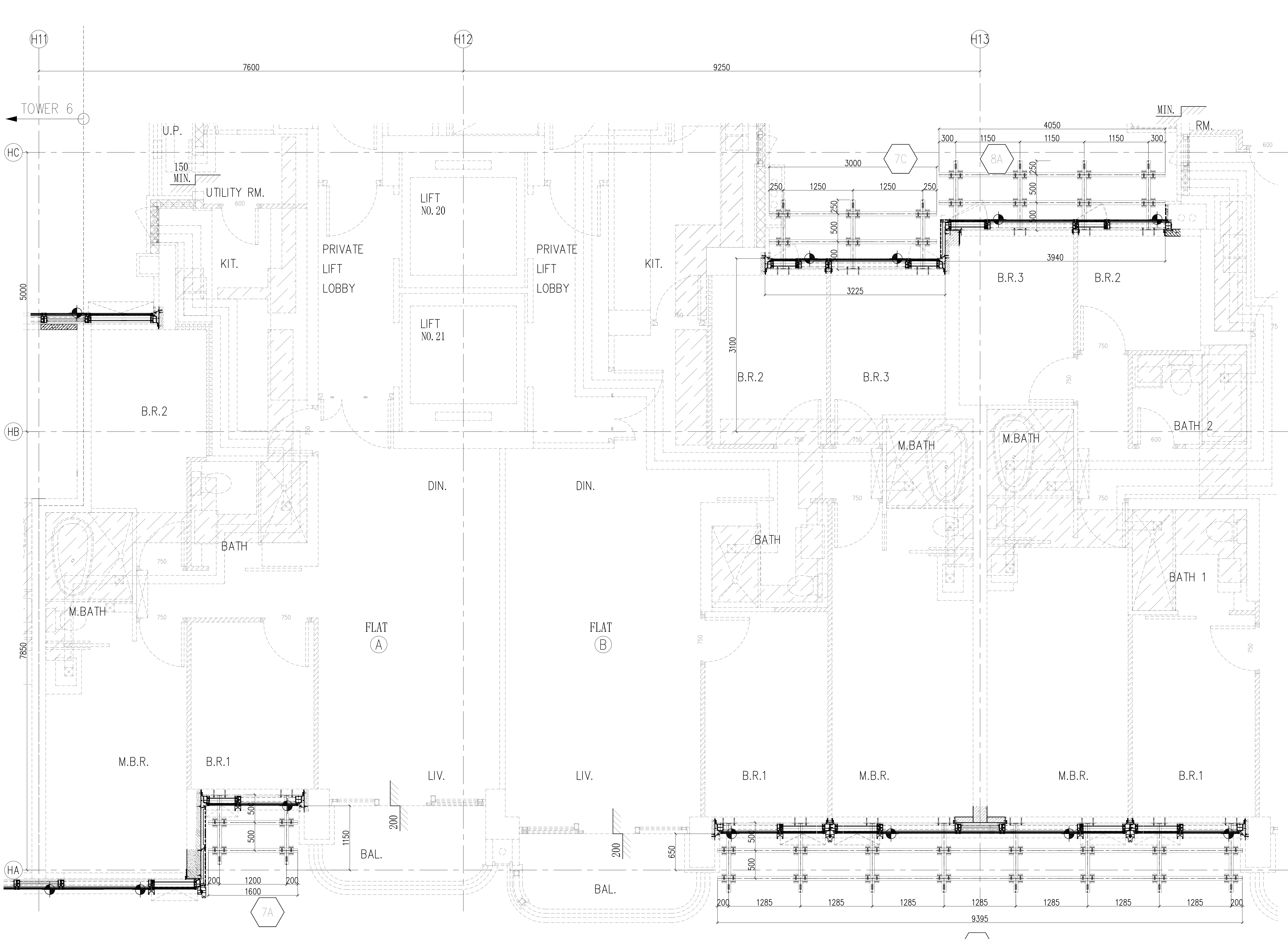

02 TOWER 7 AND 8 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN)

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

NOTE :

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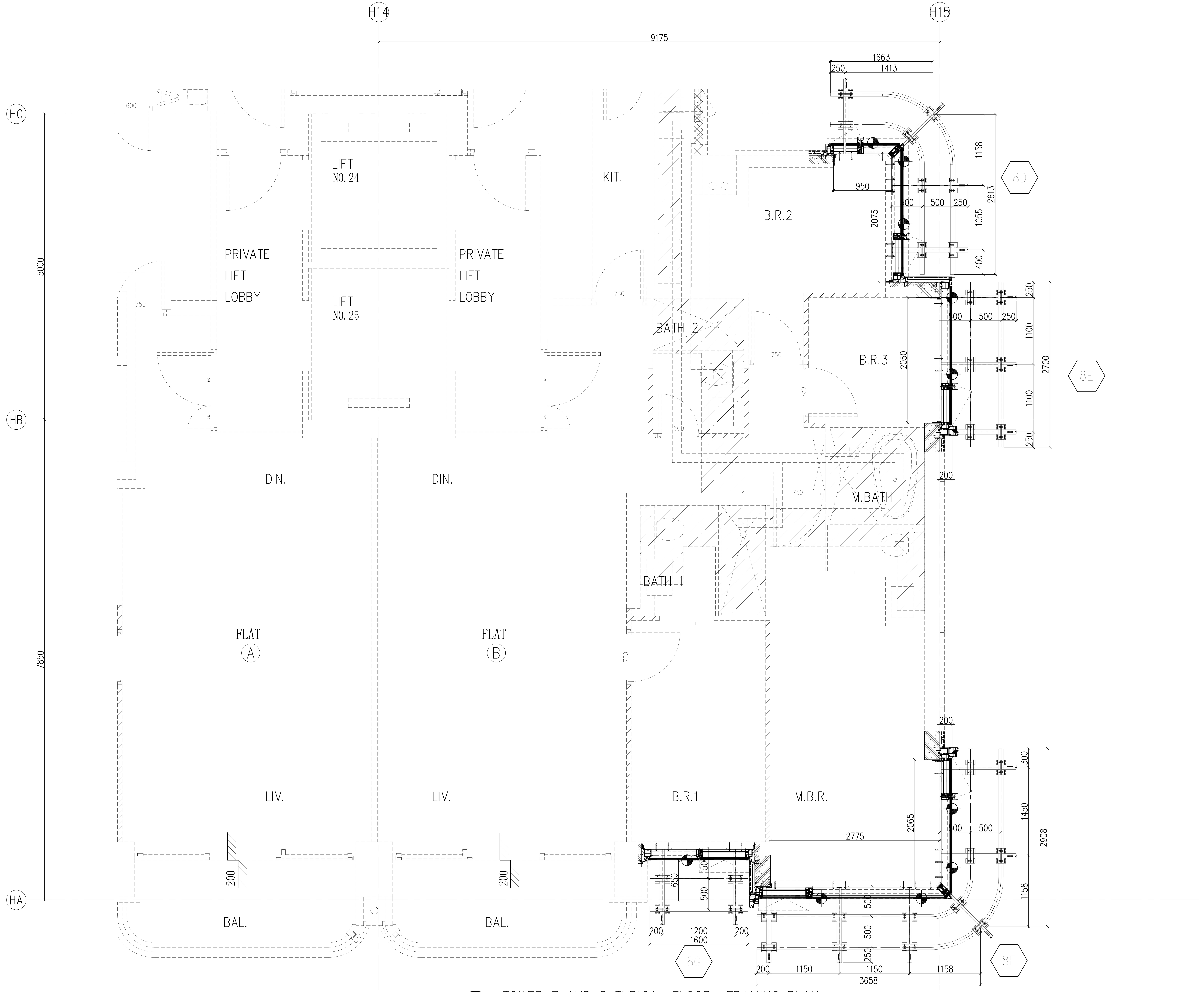

03
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TOWER 7 AND 8 TYPICAL FLOOR FRAMING PLAN
(12/F AND 22/F PLAN

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	21/03/2022

NOTE :

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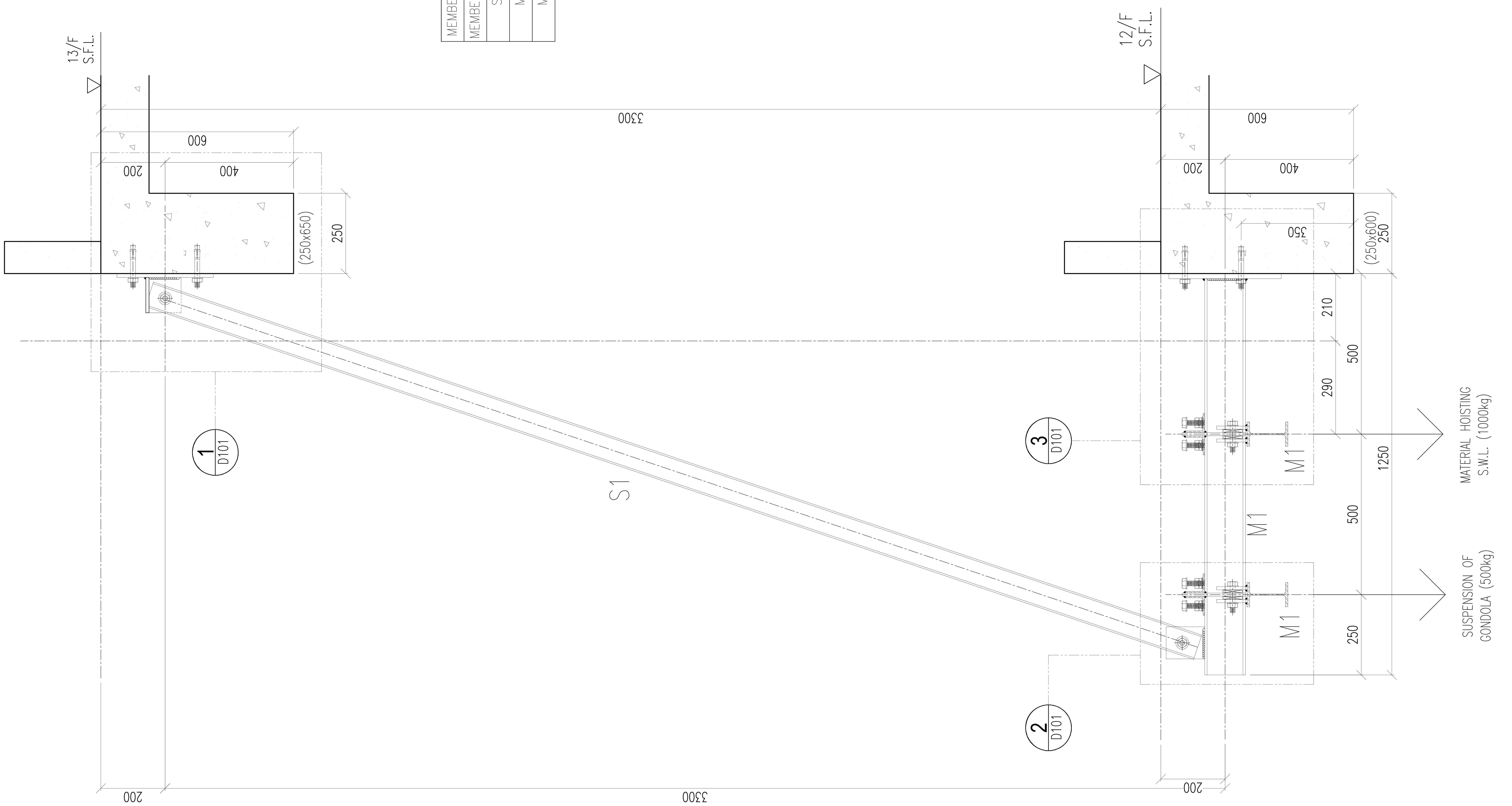
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/PL03C	REV : –

A1

MEMBER SCHEDULE	
MEMBER MARK	DESCRIPTION
S1	80x40x7kg/m GMS CHANNEL
M1	140x80x14kg/m GMS U BEAM
M2	140x80x14kg/m GMS U BEAM



1 SECTION FOR 3300mm HEIGH FLOOR

SCALE 1 : 15

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	18/02/2022

NOTE :

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PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

DRAWING TITLE :

SECTION FOR MONORAIL

DRAWN : BIN	DATE : 18/02/2022
DESIGNED : AMEN	SCALE : 1:15
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/S101	REV : –

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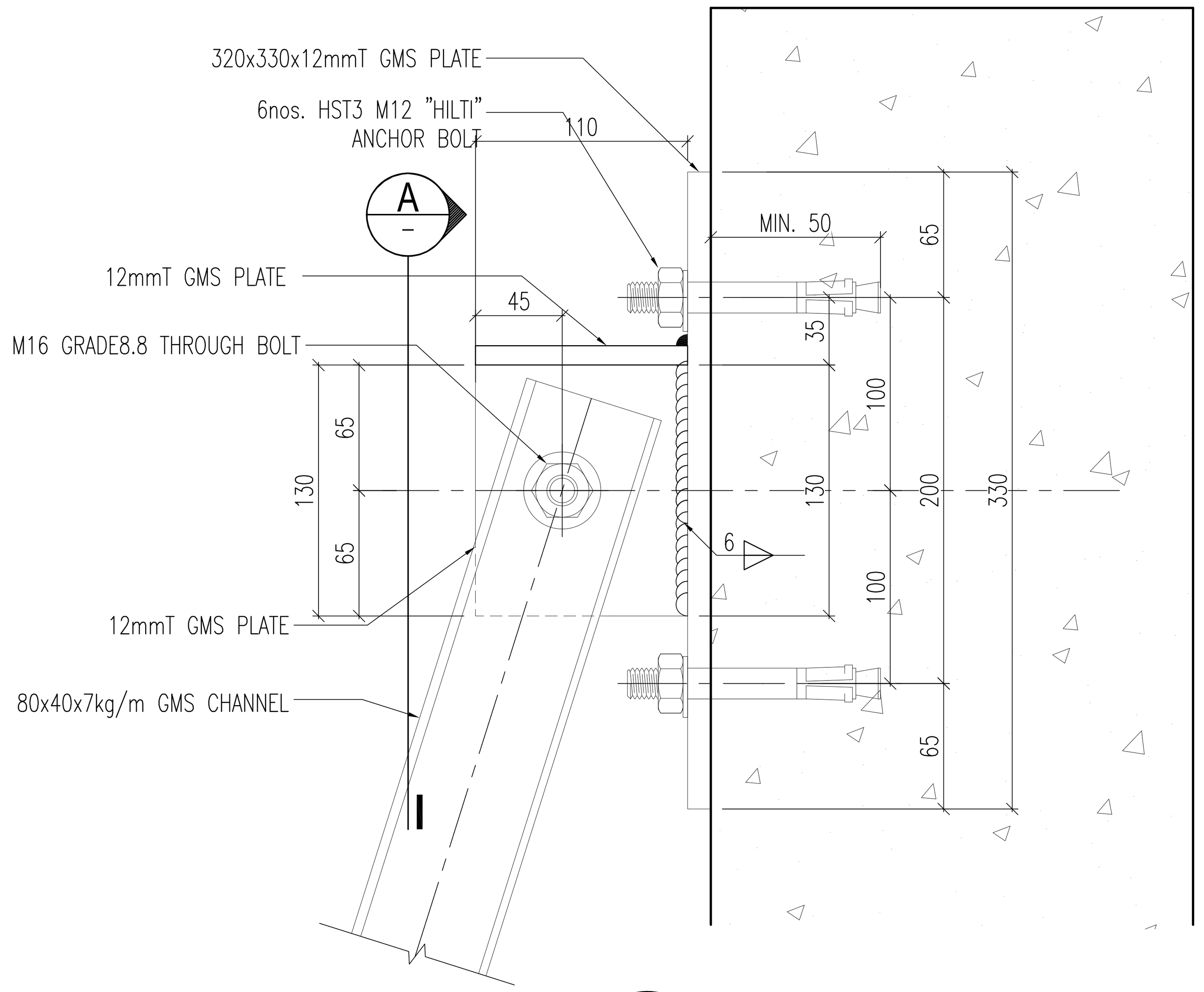
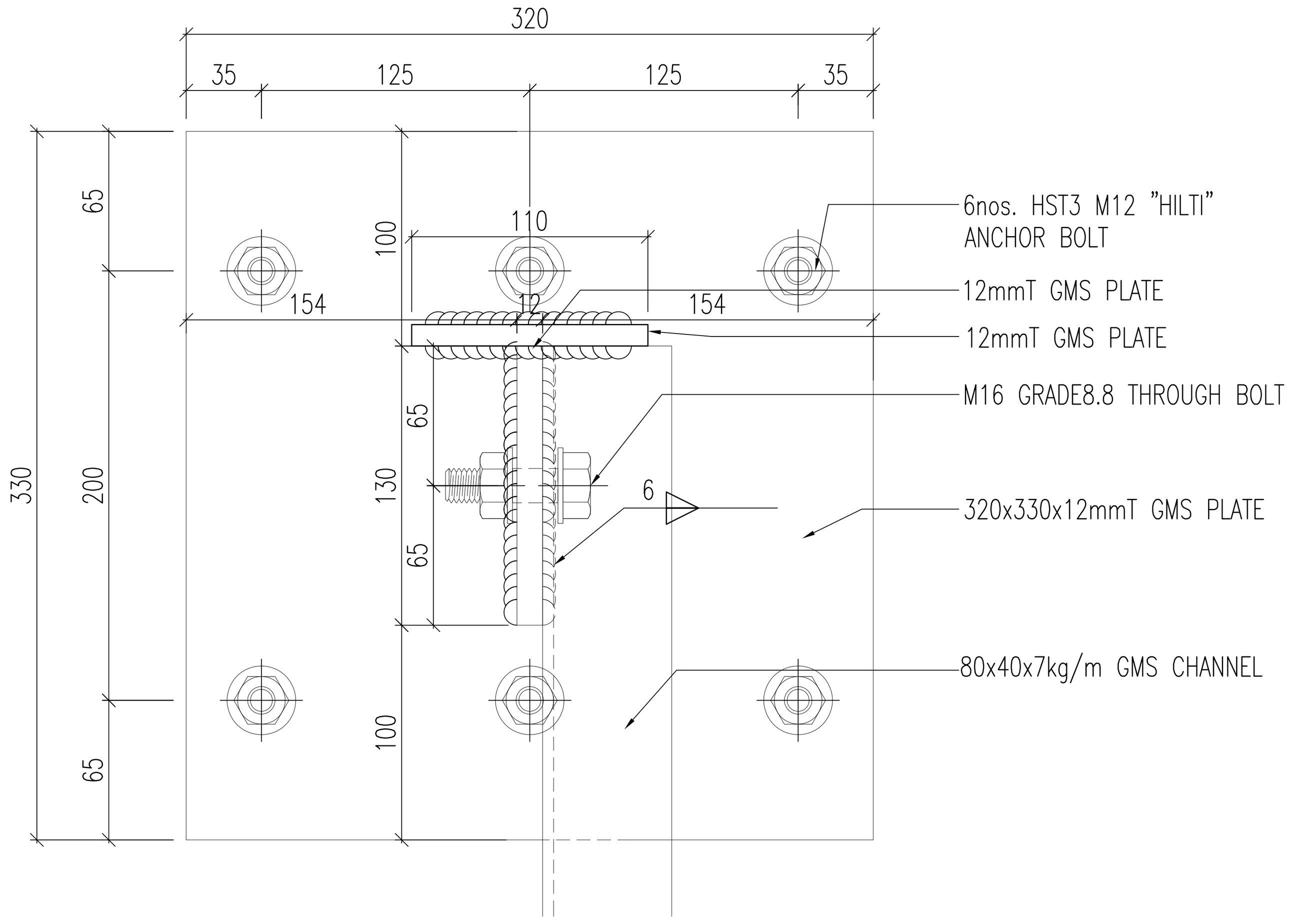


1 SECTION DETAIL
SCALE 1 : 6



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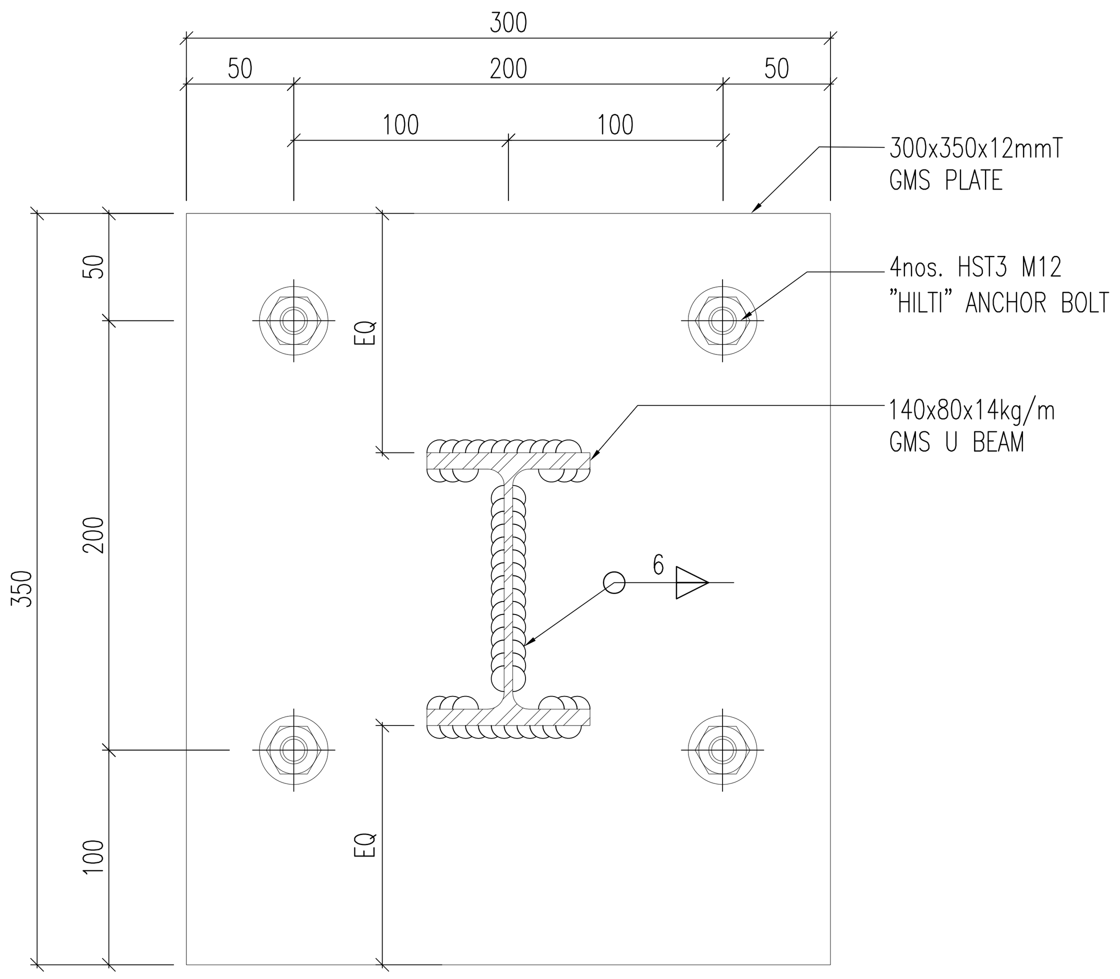
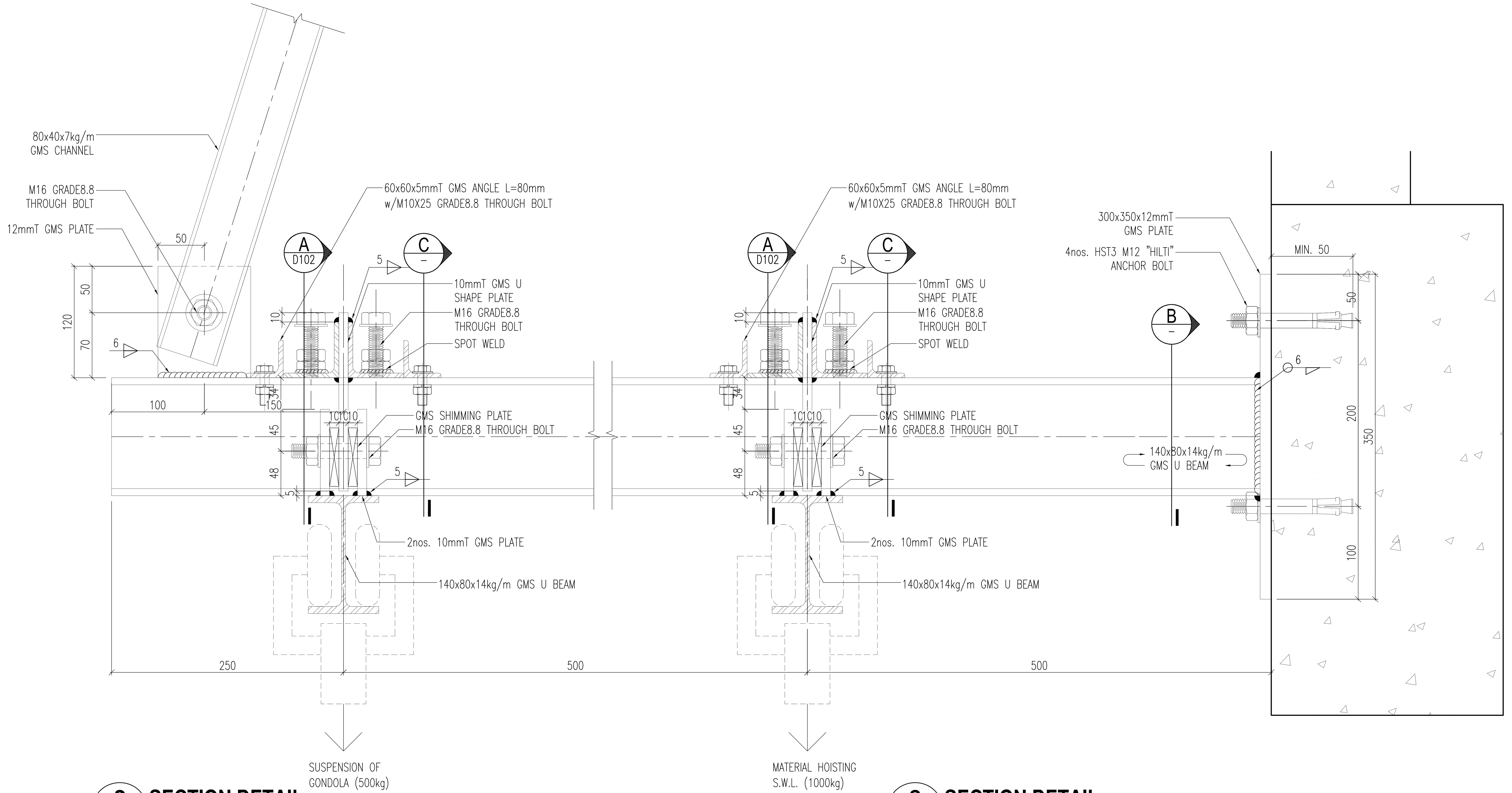
SCALE 1 : 6

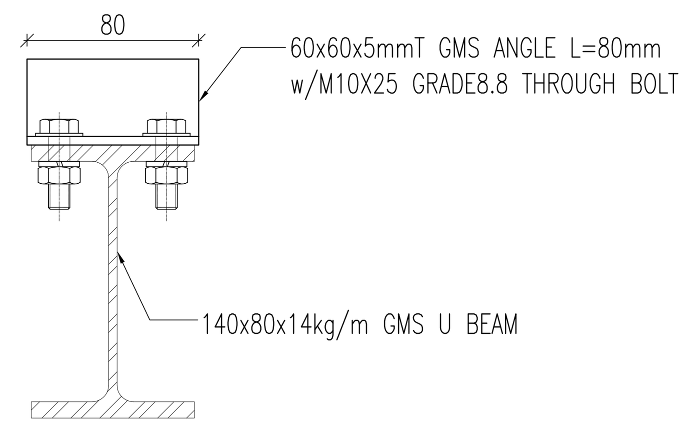


B FIXING DETAIL
SCALE 1 : 6



2 SECTION DETAIL
SCALE 1 : 6

3 SECTION DETAIL
SCALE 1 : 6



C FIXING DETAIL
SCALE 1 : 6

ALL DIMENSION ARE IN MILLIMETERS

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–	1ST SUBMISSION	AMEN	18/02/2022

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DRAWING TITLE : DETAIL FOR MONORAIL

DRAWN : BIN	DATE : 18/02/2022
DESIGNED : AMEN	SCALE : 1:6
CHECKED : DY	PROJECT NO.: –
DRAWING NO.: MR/D101	REV : A

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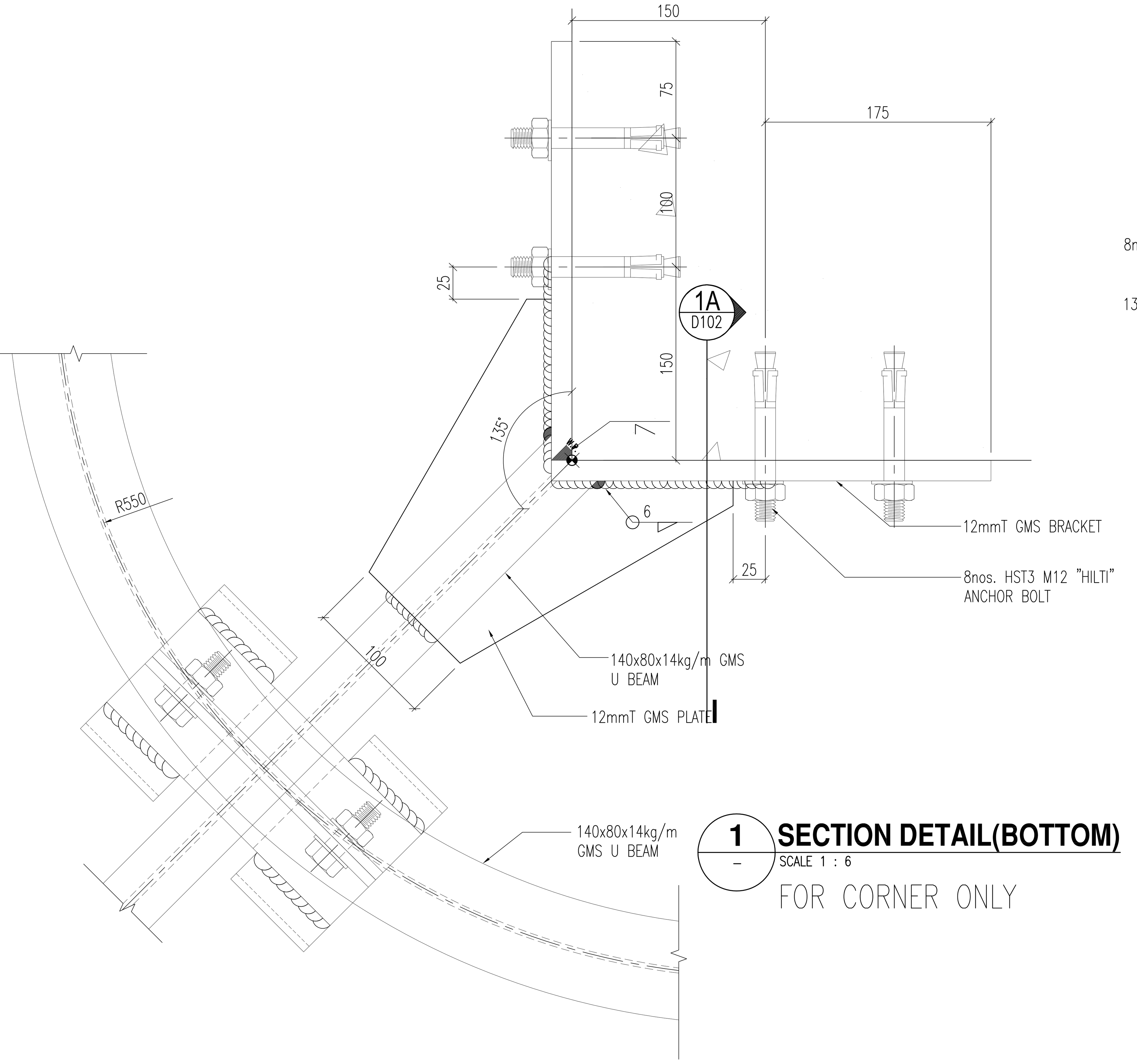
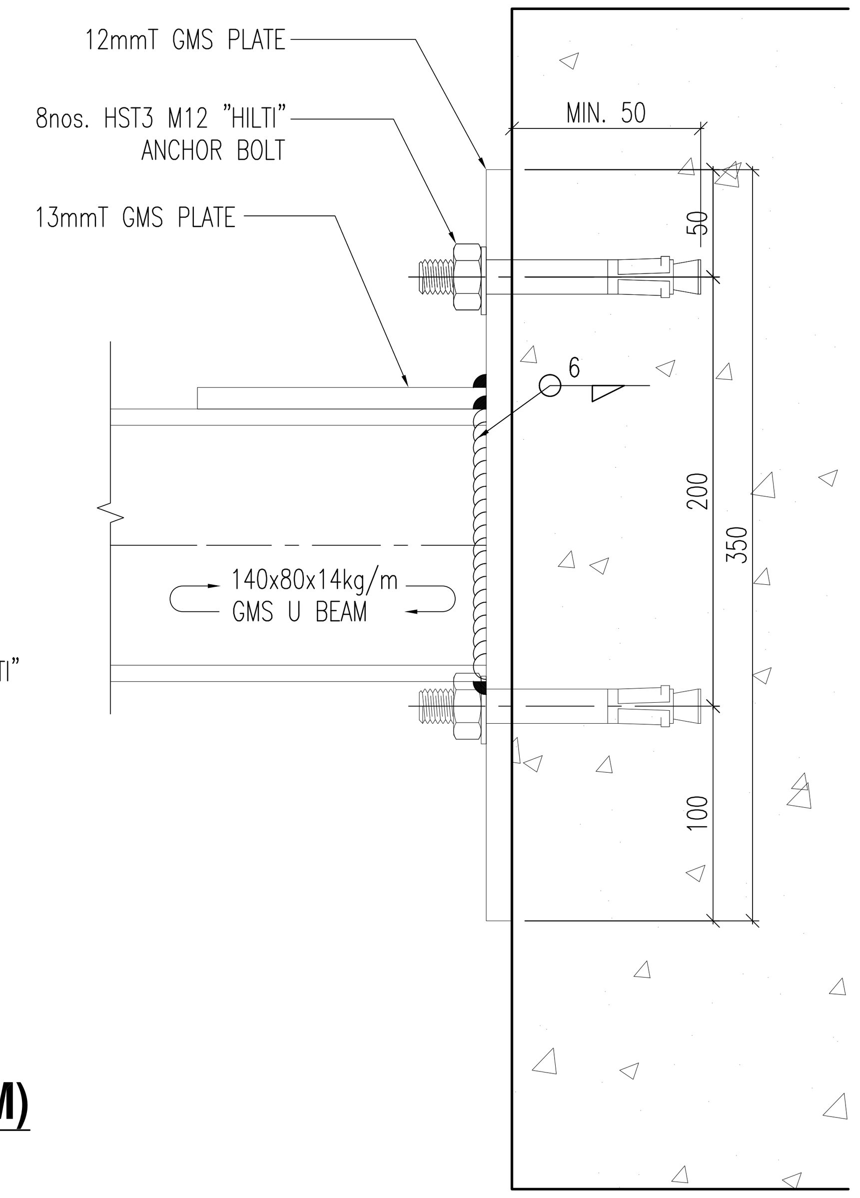
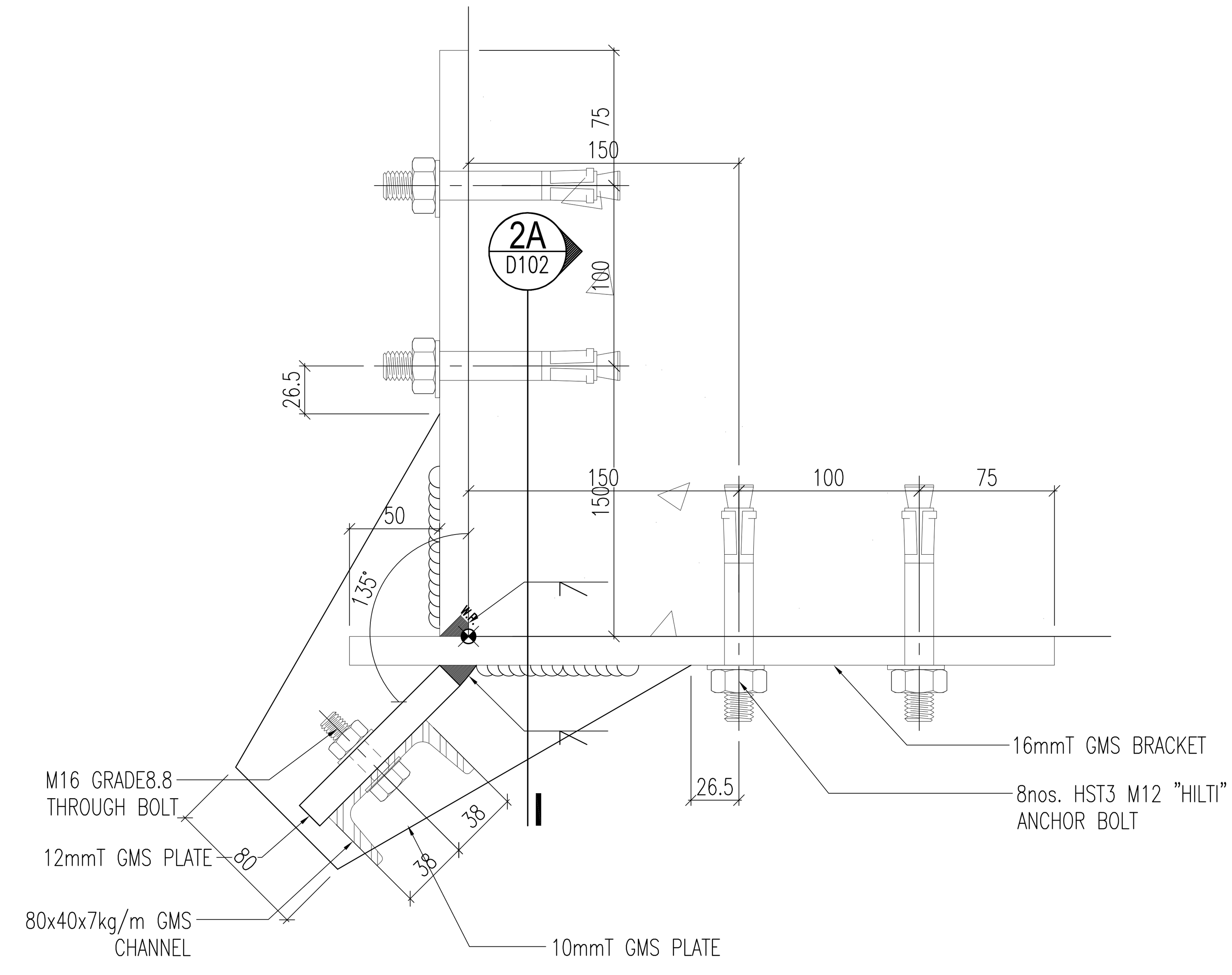


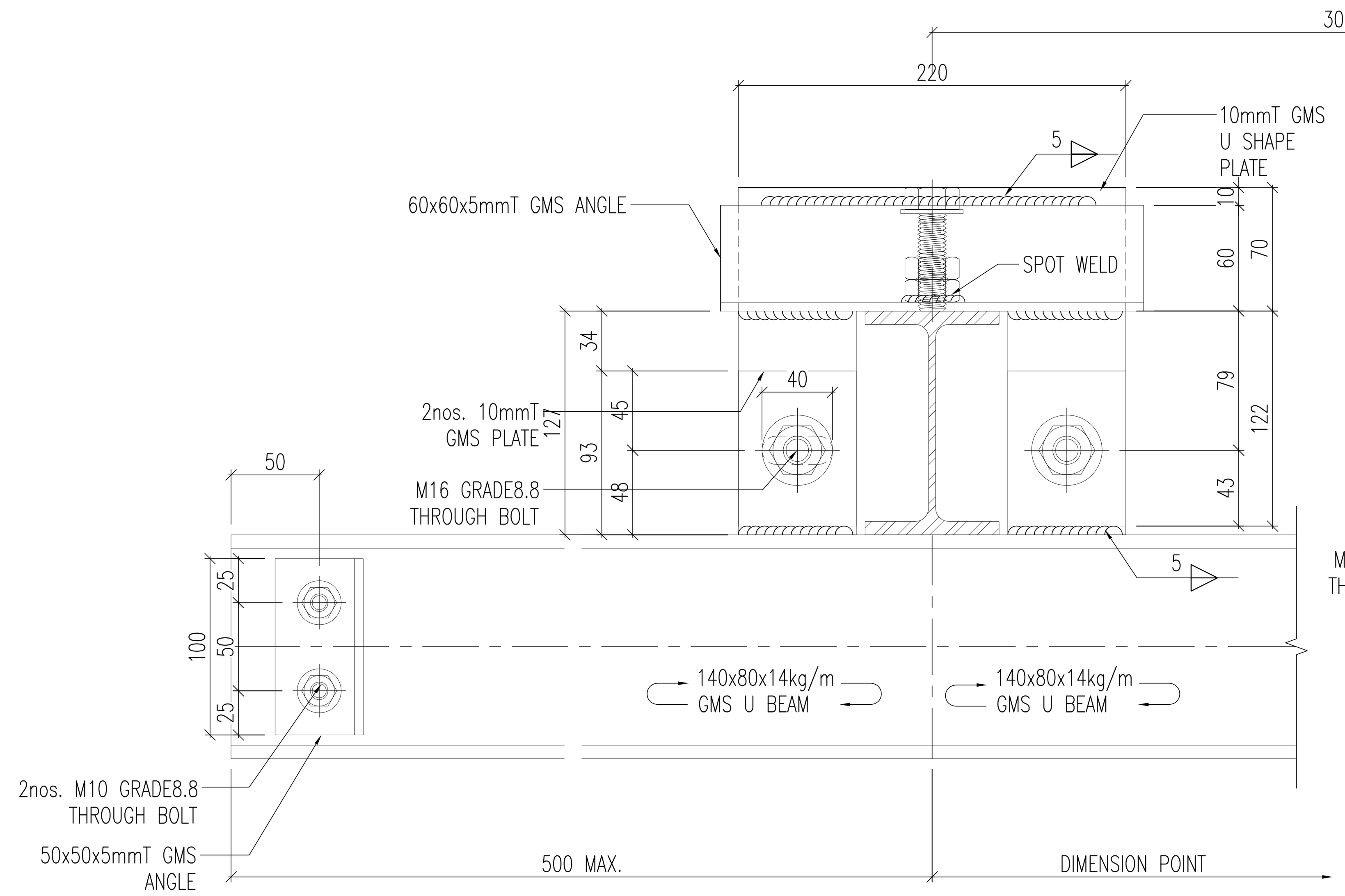
1 SECTION DETAIL(BOTTOM)
SCALE 1 : 6
FOR CORNER ONLY



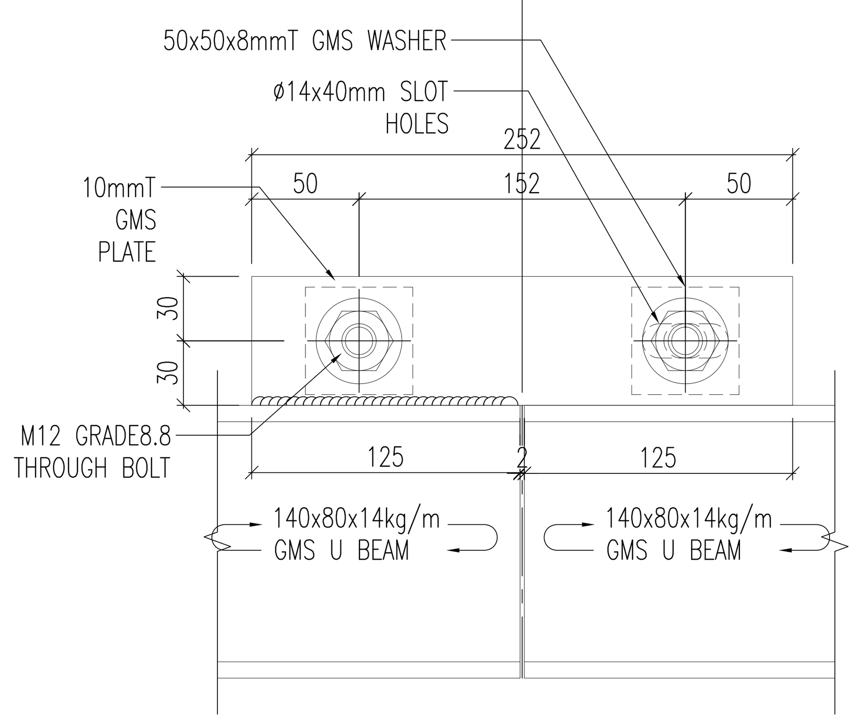
1A SECTION DETAIL
SCALE 1 : 6



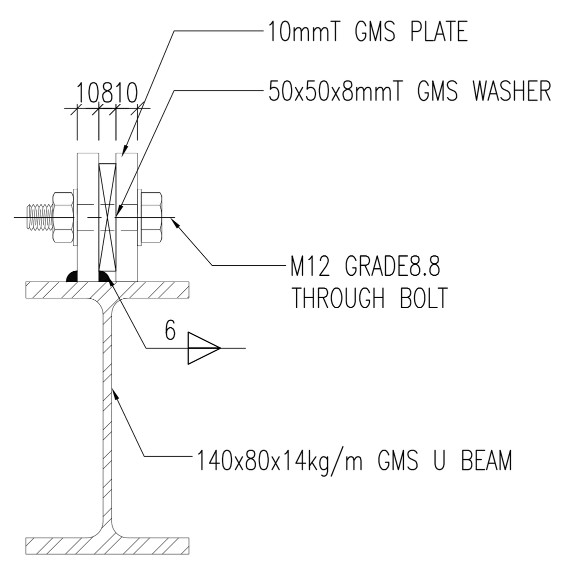
2 SECTION DETAIL (TOP)
SCALE 1 : 6
FOR CORNER ONLY



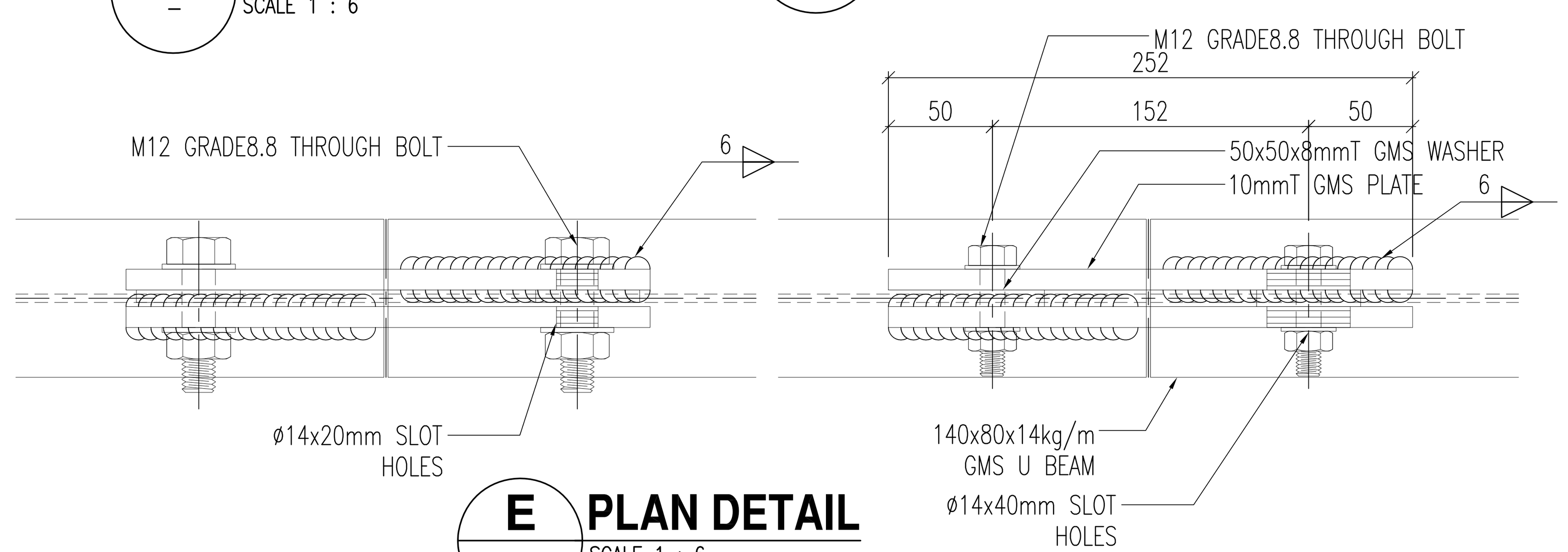
A FIXING DETAIL
SCALE 1 : 6



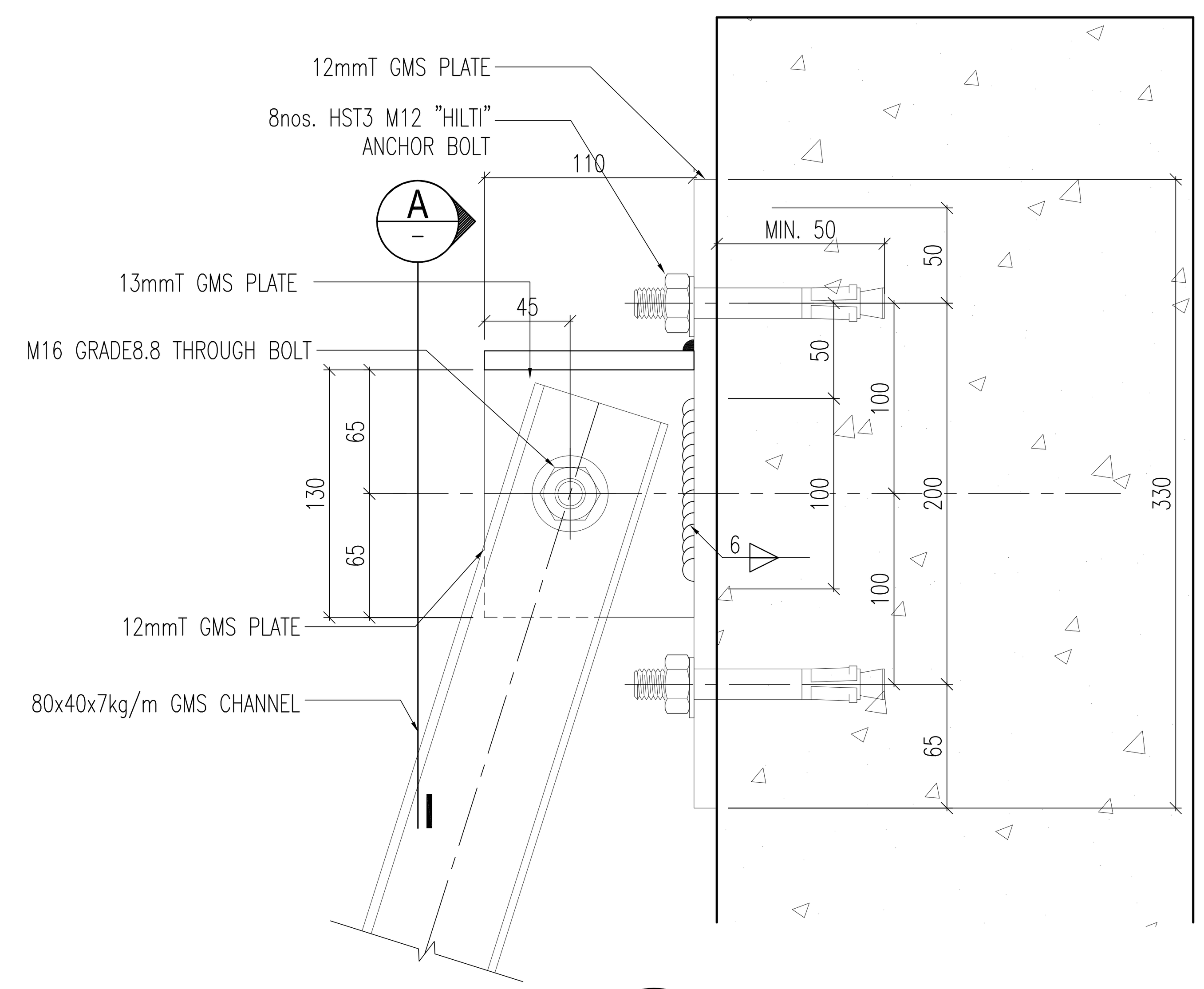
C FIXING DETAIL
SCALE 1 : 6



D FIXING DETAIL
SCALE 1 : 6



E PLAN DETAIL
SCALE 1 : 6



2A SECTION DETAIL
SCALE 1 : 6

ALL DIMENSION ARE IN MILLIMETERS

REV	AMENDMENTS	BY	DATE
–	1ST SUBMISSION	AMEN	18/02/2022

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DRAWING TITLE :
DETAIL FOR MONORAIL

DRAWN : BIN	DATE : 18/02/2022
DESIGNED : AMEN	SCALE : 1:6
CHECKED : DY	PROJECT NO. : –
DRAWING NO. : MR/D102	REV : A

A1

STRUCTURAL ANALYSIS

OF

MONORAIL SYSTEM

FOR

PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

Version _ (20220325)

TABLE OF CONTENT

APPENDIX

(1.0) INTRODUCTION

LOCATION OF PROJECT

PROPOSED RESIDENTIAL DEVELOPMENT AT NEW KOWLOON INLAND LOT. NO.6552

DESIGN CONTENT

The objective of this structural design calculation is to proved the structural adequacy of the proposed **Steel frame** under the dead load.
For this calculation,we will design the Steel Rail, & its fixing.

SYNOPSIS

The dead >>> Steel rail and fixing >>> steel truss >> R.C. structure.

(2.0) LIST OF REFERENCES

- Code of Practice on Wind Effects Hong Kong - 2013.
- Code of Practice for the Structural Use of Steel - 2011.
- Code of Practice for the Structural Use of Concrete - 2004.
- Hong Kong Building (Construction) Regulations .
- BS EN ISO 3506 : 1998 : Mechanical Properties of Corrosion-Resistant Stainess Steel Fasteners.
- Design Drawing

(3.0) MATERIAL PROPERTIES

(3.1) **Galvanized Mild Steel Grade S275 JR**
(Code of Practice for the Structural Use of Steel - 2011)

Ultimate Tensile Strength , $Uf := 430MPa$

Design Strength , $p_y := 275MPa$

Modulus of Elasticity , $E_s := 2.05\times10^5 MPa$

Design Strength of Fillet weld , $p_w := 220MPa$

Mild Steel Bolts Grade 4.6 *(BS 4190 &BS 3692)*

Ultimate Tensile Strength , $Uf := 400MPa$

Yield stress , $Ys := 240MPa$

Tensile Strength , $p_{t\_46} := 240MPa$

Shear Strength , $p_{s\_46} := 160MPa$

Bearing Strength , $p_{bb\_46} := 460MPa$

Stainless Steel Bolts Grade A2/A4-50 *(BS EN ISO 3506)*

Ultimate Tensile Strength , $Uf := 500MPa$

0.2% Proof stress , $Ys := 210MPa$

Tensile Strength , $p_{ts\_50} := 0.83\times Ys$

$p_{ts\_50} = 174.3\times MPa$

Shear Strength , $p_{ss\_50} := 0.69\times Ys$

$p_{ss\_50} = 144.9\times MPa$

Bearing Strength , $p_{bs\_50} := 0.72\times(Ys + Uf)$

$p_{bs\_50} = 511.2\times MPa$

(3.2) **RC Structural**

Characteristic Strength , $f_{cu} := 35MPa$

Compressive Strength ($f_c := 0.4 f_{cu}$), $f_c = 14 \times MPa$

Untimate Bond Strength ($f_b := 0.28 \sqrt{f_{cu} \times MPa}$), $f_b = 1.66 \times MPa$

(3.3) **Anchor Bolt**

All anchor bolts design are complied to " Hilti Fastening Technology Manual".

(4.0) DESIGN CRITERIA

(4.1) Design dead Load for truss

Design dead Load ,

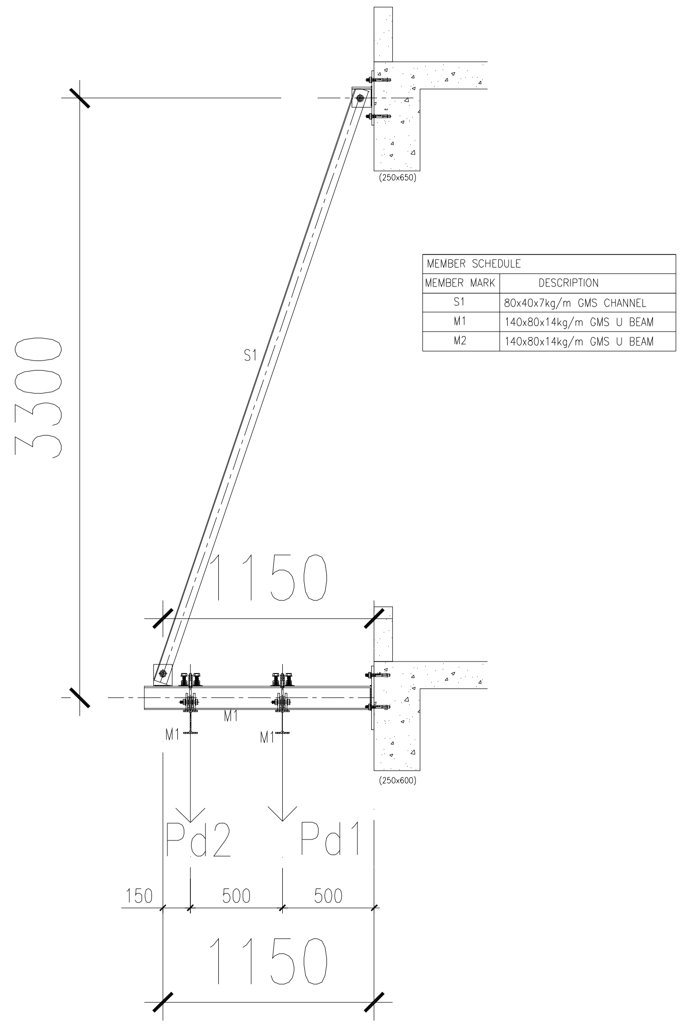
Dead load on point 1,	$P_{d0} := 1000kg \cdot g$	$P_{d0} = 9.81 \cdot kN$
Consider Dynamic Load,	$P_{d1} := P_{d0} \cdot 125\%$	$P_{d1} = 12.26 \cdot kN$
Dead load on point 2,	$P_{d0} := 500kg \cdot g$	$P_{d0} = 4.9 \cdot kN$
Consider Dynamic Load,	$P_{d2} := P_{d0} \cdot 125\%$	$P_{d2} = 6.13 \cdot kN$
Factored load,	load factored for dead,	$\gamma_d := 1.4$
	$P_{d1f} := \gamma_d \cdot P_{d1}$	$P_{d1f} = 17.16 \cdot kN$
	$P_{d2f} := \gamma_d \cdot P_{d2}$	$P_{d2f} = 8.58 \cdot kN$

(4.3) Allowable Deflection

For Steel member

Allowable deflection of simply support members to be Span/180 .

5.0) Check for the steel rail and it's fixing

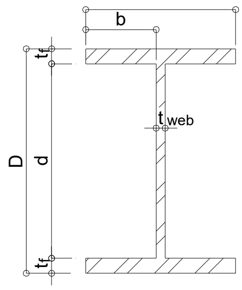


5.1) Check for the steel rail 140x80x17kg/m UB and it's fixing

	design load,	$P_d := \max(P_{d1f}, P_{d2f})$	$P_d = 17.16 \cdot kN$
simply support	Span,	$L_m := 1650mm$	(critical span)
	Moment ,	$M_x := \frac{1}{4} \cdot P_d \cdot L_m$	$M_x = 7.08 \cdot kN \cdot m$
	Shear ,	$V_x := \frac{1}{2} \cdot P_d$	$V_x = 8.58 \cdot kN$
cantilever,	span ,	$L_1 := 450mm$	
	Moment ,	$M_{x1} := P_d \cdot L_1$	$M_{x1} = 7.72 \cdot kN \cdot m$
	Shear ,	$V_{x1} := P_d$	$V_{x1} = 17.16 \cdot kN$

Dimension & section properties

(Obtain from AutoCAD,Refer current page)



Depth of the section,	$D_s := 140mm$	
Width of the section,	$B_s := 80mm$	
Web thickness,	$t_w := 5.5mm$	
Flange thickness,	$t_f := 9.1mm$	
so ,	$b_s := \frac{1}{2} \cdot B_s$	$b_s = 40 \cdot mm$
	$d_s := D_s - 2t_f$	$d_s = 121.8 \cdot mm$
Section area,	$A_s := 21cm^2$	
Moments of inertia-X,	$I_x := 475.9cm^4$	
Elastic modulus-X,	$Z_x := 74.9cm^3$	
Radii of gyration-X,	$r_x := 5.29cm$	
Radii of gyration-Y,	$r_y := 1.72cm$	
plastic modulus,	$S_x := 85.2cm^3$	

Check Lateral Torsional Buckling Resistance Moment

Member length,	$L_m = 1.65\,m$	
Effective length,	$L_e := L_m$	$L_e = 1.65\,m$
Radius of gyration minor axis,	$r_y = 17.2 \cdot mm$	
Slender ratio,	$\lambda := \frac{L_e}{r_y}$	$\lambda = 95.93$
Buckling parameter,	$u := 0.9$	(hot rolled section)
Slenderness factor,	$v := \left[1 + 0.05\left(\frac{\lambda \cdot t_f}{D_s}\right)^2\right]^{-0.25}$	$v = 0.76$
Ratio ,	$\beta_w := 1.0$	
Equivalent slenderness ,	$\lambda_{LT} := u \cdot v \cdot \lambda \cdot \sqrt{\beta_w}$	
	$\lambda_{LT} = 65.91$	

Bending Strength (Table 8.3), $p_b := 188MPa$

(for $p_y = 275 \cdot MPa$)

Section Capacity

Shear Capacity

$V_c := \left(\frac{1}{\sqrt{3}} \cdot p_y\right) \cdot (D_s \cdot t_w)$

$0.6 \cdot V_c = 73.35 \cdot kN$ > $V_x = 8.58 \cdot kN$ **O.K. (low shear)**

Moment Capacity

$M_{cx} := p_y \cdot Z_x$

$M_{cx} = 20.6 \cdot kN \cdot m$ > $M_x = 7.08 \cdot kN \cdot m$ **O.K.**

$M_{x1} = 7.72 \cdot kN \cdot m$ **O.K.**

buckling checking,

$M_{cx} := p_b \cdot S_x$

$M_{cx} = 16.02 \cdot kN \cdot m$ > $M_x = 7.08 \cdot kN \cdot m$ **O.K.**

$M_{x1} = 7.72 \cdot kN \cdot m$ **O.K.**

Check Deflection

Span of the member, $L_m = 1.65 \cdot m$

Modulus of elasticity, $E_{st} := 2.05 \cdot 10^5 MPa$

Max. deflection, $\delta_w := \frac{P_d \cdot L_m^{\ 3}}{48 \cdot E_{st} \cdot I_x \cdot \gamma_d}$ (simply support)

$\delta_w = 1.18 \cdot mm$ < $\frac{L_m}{200} = 8.25 \cdot mm$ **O.K**

$L_1 = 0.45\,m$ (cantilever)

$\delta_w := \frac{P_d \cdot L_1^{\ 3}}{3 \cdot E_{st} \cdot I_x \cdot \gamma_d}$

$\delta_w = 0.38 \cdot mm$ < $\frac{L_1}{200} = 2.25 \cdot mm$ **O.K**

5.1a) Check for the steel rail 140x80x17kg/m UB for special case

(Check the strength of rail for assume one bay of frame fault,)

design load, $P_d := \max(P_{d1f}, P_{d2f})$ $\quad P_d = 17.16 \cdot kN$

Span, $L_m := 1650mm \cdot 2$ (critical span)

Moment , $M_x := \frac{1}{4} \cdot P_d \cdot L_m$

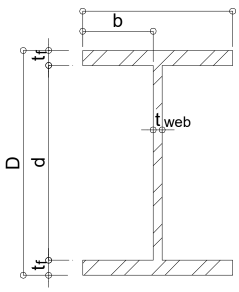
$M_x = 14.16 \cdot kN \cdot m$

Shear , $V_x := \frac{1}{2} \cdot P_d$

$V_x = 8.58 \cdot kN$

Dimension & section properties

(Obtain from AutoCAD,Refer current page)



Depth of the section, $D_s := 140mm$

Width of the section, $B_s := 80mm$

Web thickness, $t_w := 5.5mm$

Flange thickness, $t_f := 9.1mm$

so , $b_s := \frac{1}{2} \cdot B_s$ $\quad b_s = 40 \cdot mm$

$d_s := D_s - 2t_f$ $\quad d_s = 121.8 \cdot mm$

Section area, $A_s := 21cm^2$

Moments of inertia-X, $I_x := 475.9cm^4$

Elastic modulus-X, $Z_x := 74.9cm^3$

Radii of gyration-X, $r_x := 5.29cm$

Radii of gyration-Y, $r_y := 1.72cm$

plastic modulus, $S_x := 85.2cm^3$

Section Capacity

Shear Capacity

$$V_c := \left(\frac{1}{\sqrt{3}} \cdot p_y\right) \cdot (D_s \cdot t_w)$$

$0.6 \cdot V_c = 73.35 \cdot kN$ $\quad > \quad$ $V_x = 8.58 \cdot kN$ **O.K. (low shear)**

Moment Capacity

$M_{cx} := p_y \cdot Z_x$

$M_{cx} = 20.6 \cdot kN \cdot m$ > $M_x = 14.16 \cdot kN \cdot m$ **O.K.**

Check Deflection

Span of the member, $L_m = 3.3 \cdot m$

Modulus of elasticity, $E_{st} := 2.05 \cdot 10^5 MPa$

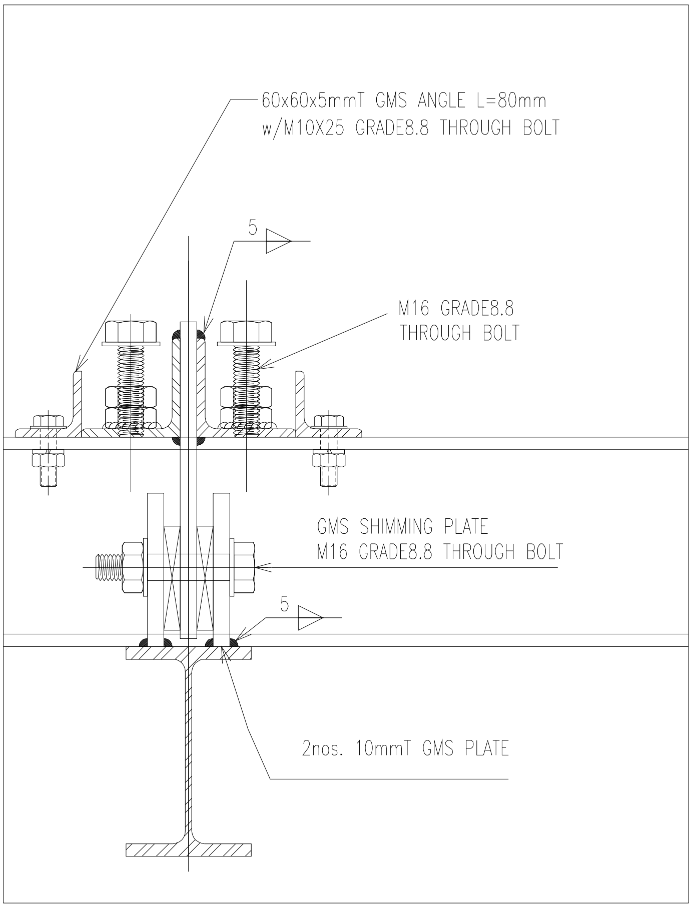
Max. deflection, $\delta_w := \dfrac{P_d \cdot L_m^{\,3}}{\gamma_d \cdot 48 \cdot E_{st} \cdot I_x}$

$\delta_w = 9.41 \cdot mm$ < $\dfrac{L_m}{200} = 16.5 \cdot mm$ **O.K**

5.1.1) Check for the steel rail's fixing

A) Check the 5mm thk. fillet weld all round and 2nos. 10mm thk. connection plate

- Check 5mm thk. connected weld



leg length, $s := 5mm$

effective length, $L_w := 8 \times 67mm$

factored weld stress, $\sigma_w := \dfrac{P_d}{(0.7 \times s) \times L_w \times 1.53}$ (k use 1.53)

$\sigma_w = 5.98 \times MPa$ < $p_w = 220 \times MPa$ **O.K.**

- Check 2 nos. 10mm thk. connected plate

Tensile area, $A_s := 67mm \cdot 10mm \cdot 2$ $A_s = 1.34 \times 10^{-3} m^2$

Tensile capacity, $P_{ct} := p_y \cdot A_s$

$P_{ct} = 368.5 \cdot kN$ > $P_d = 17.16 \cdot kN$ **O.K.**

B) Check for M16 GMS Bolt and nut

Nominal diameter of the bolts, $\phi := 16mm$

Effective area of the bolts, $A_o := A_{16} = 157 \cdot mm^2$ *(Table A.1 of BS EN ISO 3506-1)*

Tensile strength of the bolt, $p_t := p_{t\_46} = 240 \cdot MPa$

Shear strength of the bolt, $p_s := p_{s\_46} = 160 \cdot MPa$

Shear Capacity

$P_s := 2 \cdot 2 \cdot p_s \cdot A_o = 100.48 \cdot kN$ > $P_d = 17.16 \cdot kN$ **O.K.** (2 nos, double shear)

Bearing Capacity

Thickness of the bearing plate, $t_{br} := 10mm$

Diameter of bolt, $\phi := 16mm$

Bearing strength of plate, $p_{bs} := 460MPa$

End distance, $e_{br} := 51mm$

Hole coefficient, $k_{bs} := 1.0$ (for standard hold)

Bearing capacity,

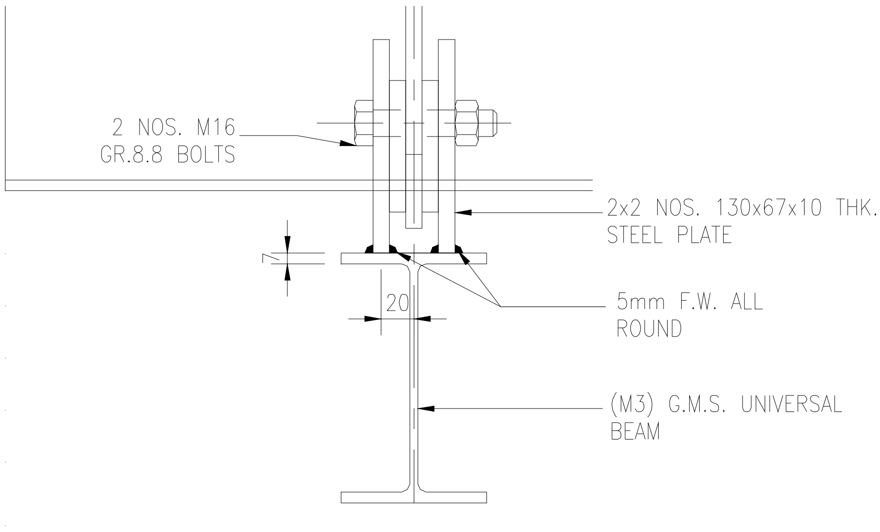
$P_{bs\_1} := k_{bs} \cdot \phi \cdot t_{br} \cdot p_{bs}$ $P_{bs\_1} = 73.6 \cdot kN$

$P_{bs\_2} := 0.5 \cdot k_{bs} \cdot e_{br} \cdot t_{br} \cdot p_{bs}$ $P_{bs\_2} = 117.3 \cdot kN$

$P_{bs} := \min(P_{bs\_1}, P_{bs\_2})$

$P_{bs} = 73.6 \cdot kN$ > $P_d = 17.16 \cdot kN$ **O.K**

C) Check for the local bending of the flange



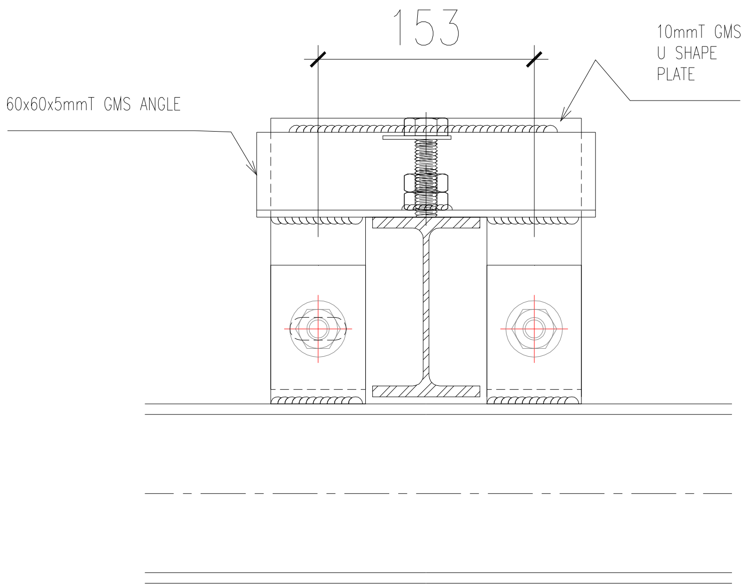
$M_p := \frac{P_d}{2} \cdot 20mm \qquad M_p = 171.62 \cdot kN \cdot mm$

moment capacity,

$M_{pc} := 1.2 \cdot p_y \cdot \left[\frac{1}{6} \cdot 120mm \cdot (7mm)^2\right]$

$M_{pc} = 323.4 \cdot kN \cdot mm \quad > \quad M_p = 171.62 \cdot kN \cdot mm$ O.K.

D) Check for the bending of the 60x60x5mm angle



$$L_m := 153mm$$

Max. moment, $M_x := \frac{1}{4} \cdot P_d \cdot L_m$

$M_x = 0.66 \cdot kN \cdot m$

Max. Shear force, $V_x := \frac{1}{2} \cdot P_d$

$V_x = 8.58 \cdot kN$

Dimension & section properties

Depth of the section, $D_s := 60mm$

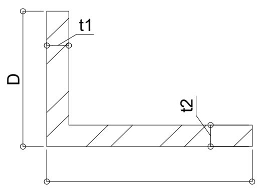
Width of the section, $B_s := 60mm$

Thickness, $t_1 := 5mm$

$t_2 := 5mm$

so , $b_s := B_s - t_1$ $\quad b_s = 55 \cdot mm$

$d_s := D_s - t_2$ $\quad d_s = 55 \cdot mm$



Section area,	$A_s = 575 \cdot mm^2$
Moments of inertia-X,	$I_x = 1.99 \times 10^5 \cdot mm^4$
Moments of inertia-Y,	$I_y = 1.99 \times 10^5 \cdot mm^4$
Elastic modulus-X,	$Z_x = 4.61 \times 10^3 \cdot mm^3$
Elastic modulus-Y,	$Z_y = 4.61 \times 10^3 \cdot mm^3$
Radii of gyration-X,	$r_x = 18.61 \cdot mm$
Radii of gyration-Y,	$r_y = 18.61 \cdot mm$
Radii of gyration-V,	$r_v = 11.85 \cdot mm$

Check lateral torsional buckling resistance moment

Shear Capacity

$V_c := (0.6 \cdot p_y) \cdot (0.9 A_s)$

$0.6 \cdot V_c = 51.23 \cdot kN$ > $V_x = 8.58 \cdot kN$ **O.K. (low shear)**

Check lateral torsional buckling resistance moment

For x-x direction,

For $\frac{b_s}{t_v} = 11$ < 15ε (Refer clause 8.5)

$M_b := 2 \cdot 0.8 \cdot p_y \cdot Z_x$

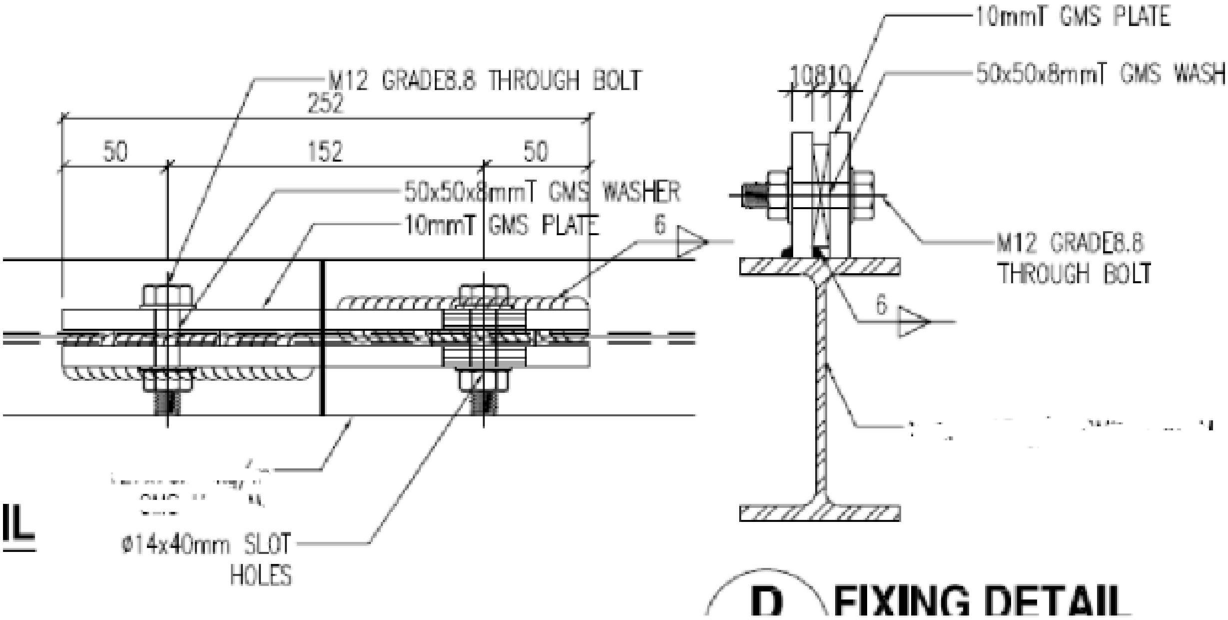
$M_b = 2.03 \cdot kN \cdot m$ > $M_x = 0.66 \cdot kN \cdot m$ **O.K.**

Check for the weld

leg length,	$s := 5mm$
effective length,	$L_w := 67mm \cdot 4$
factored weld stress,	$\sigma_w := \frac{P_d}{(0.7 \cdot s) \cdot L_w \cdot 1.53}$

$\sigma_w = 11.96 \cdot MPa$ < $p_w = 220 \cdot MPa$ **O.K.**

5.1.2) Check for the steel rail's connection for break joint



A) Check for M12 GMS Bolt and nut

Nominal diameter of the bolts, $\phi := 12mm$

Effective area of the bolts, $A_o := A_{12} = 84.3 \times mm^2$ *(Table A.1 of BS EN ISO 3506-1)*

Tensile strength of the bolt, $p_t := p_{t\_88} = 560 \times MPa$

Shear strength of the bolt, $p_s := p_{s\_88} = 375 \times MPa$

Shear Capacity

$P_s := p_s \times A_o = 31.61 \times kN$ > $P_d = 17.16 \times kN$ **O.K.**

Bearing Capacity

Thickness of the bearing plate, $t_{br} := 10mm$

Diameter of bolt, $\phi := 12mm$

Bearing strength of plate, $p_{bs} := 460MPa$

End distance, $e_{br} := 51mm$

Hole coefficient, $k_{bs} := 1.0$ (for standard hold)

Bearing capacity,

$P_{bs\_1} := k_{bs} \times \phi \times t_{br} \times p_{bs}$ $P_{bs\_1} = 55.2 \times kN$

$P_{bs\_2} := 0.5 \times k_{bs} \times e_{br} \times t_{br} \times p_{bs}$ $P_{bs\_2} = 117.3 \times kN$

$P_{bs} := \min(P_{bs\_1}, P_{bs\_2})$

$P_{bs} = 55.2 \times kN$ > $P_d = 17.16 \times kN$ **O.K**

B) Check for the 60x10mm thk. connection plate (2 nos.)

$M_p := P_d \cdot 152mm$ $\qquad M_p = 2.61 \times 10^3 \cdot kN \cdot mm$

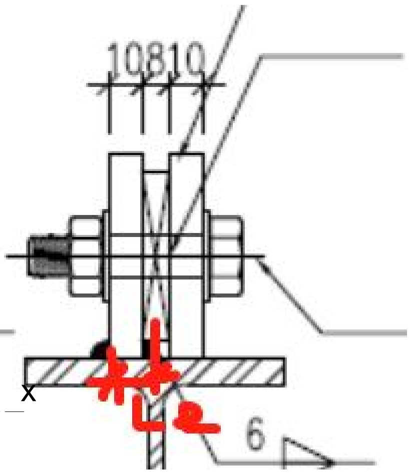
section properties, $\quad Z_x := \frac{1}{6} \cdot 10mm \cdot (60mm)^2 \qquad Z_x = 6 \times 10^3 \cdot mm^3$

moment capacity,

$M_{pc} := 2 \cdot (1.2 \cdot p_y \cdot Z_x)$

$M_{pc} = 3.96 \cdot kN \cdot m \quad > \quad M_p = 2.61 \cdot kN \cdot m$ O.K.

C) Check the 6mm thk. fillet weld (both side)



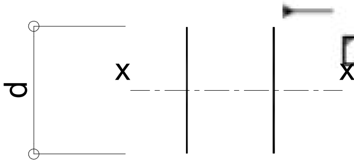
Loading on the weld, $\quad M_p = 2.61 \cdot kN \cdot m \qquad P_d = 17.16 \cdot kN$

$M_{py} := P_d \cdot 14mm \qquad M_{py} = 0.24 \cdot kN \cdot m$

weld size, $\quad s := 6mm$

properties of weld treated as line,

$d_w := 125mm - 2s \qquad b_w := 10mm$



$S_w := 2 \cdot \frac{d_w^2}{3} \qquad S_w = 8.51 \times 10^3 \cdot mm^3 \cdot mm^{-1}$

$S_{wy} := 2 \cdot b_w \cdot d_w \qquad S_{wy} = 2.26 \times 10^3 \cdot mm^3 \cdot mm^{-1}$

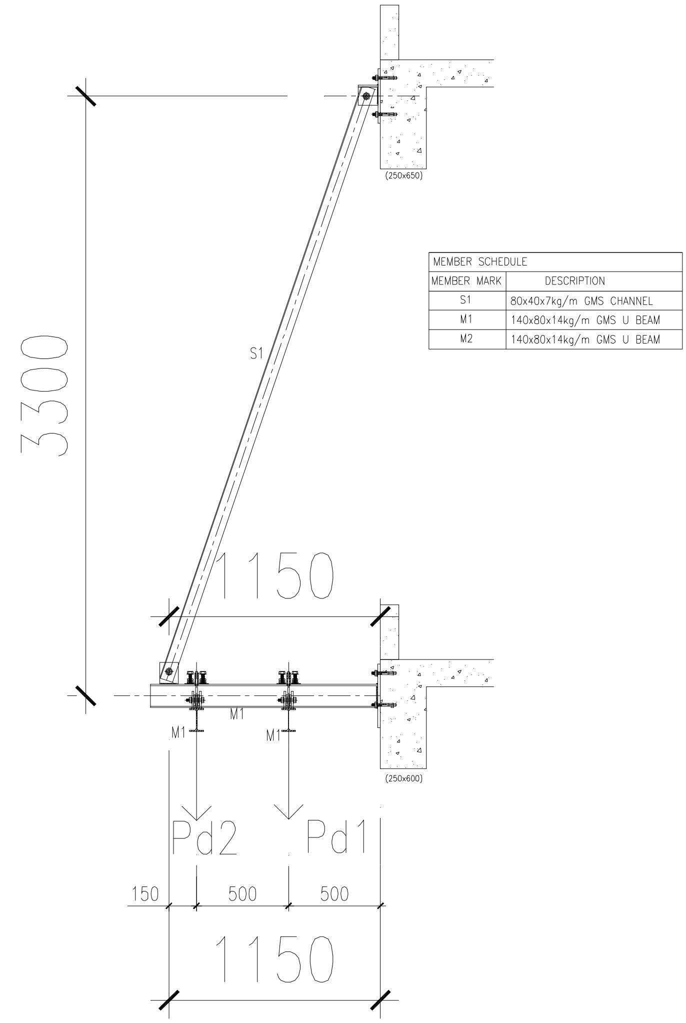
effective length, $\quad L_w := 200mm$

factored weld stress,

$$\sigma_w := \left[\frac{P_d}{(0.7 \cdot s) \cdot L_w} + \frac{M_p}{S_w \cdot (0.7 \cdot s)} + \frac{M_{py}}{S_{wy} \cdot (0.7 \cdot s)} \right]$$

$\sigma_w = 118.7 \cdot MPa \quad < \quad p_w = 220 \cdot MPa$ **O.K.**

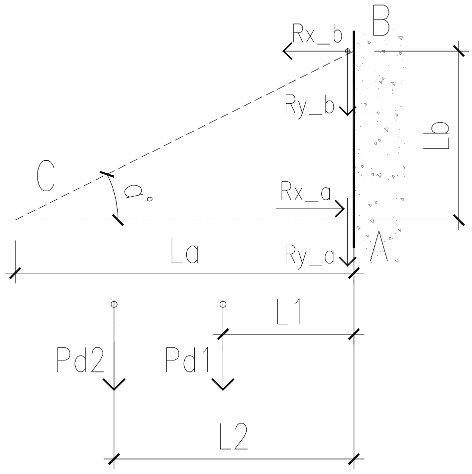
5.2) Check for the steel truss on top of the frame



Design load on the truss,

$P_{d1} = 12.26\,kN$ $\qquad$ $P_{d2} = 6.13\,kN$

Frame dimesion , $\qquad$ (refer sketchright hand)



$L_a := 1150mm$ $\qquad$ $L_b := 3300mm$

$\alpha_1 := \text{atan}\left(\frac{L_b}{L_a}\right)$ $\qquad$ $\alpha_1 = 70.79 \cdot deg$

$L_1 := 500mm$ $\qquad$ $L_2 := 1000mm$

Reaction and loading,

$$R_{x\_b} := \frac{P_{d1} \cdot L_1 + P_{d2} \cdot L_2}{L_b} \qquad R_{x\_b} = 3.71\,kN$$

$$R_{x\_a} := R_{x\_b} \qquad R_{x\_a} = 3.71\,kN$$

$$R_{y\_b} := \frac{P_{d1} \cdot L_1 + P_{d2} \cdot L_2}{L_a} \qquad R_{y\_b} = 10.66 \cdot kN$$

$$R_{y\_a} := P_{d1} + P_{d2} - R_{y\_b} \qquad R_{y\_a} = 7.73 \cdot kN$$

Brace force,

$$N_{BC} := \sqrt{R_{x\_b}^{2} + R_{y\_b}^{2}} \qquad N_{BC} = 1.13 \times 10^{4}\,N$$

$$N_{AC} := R_{x\_a} \qquad N_{AC} = 3.71 \cdot kN$$

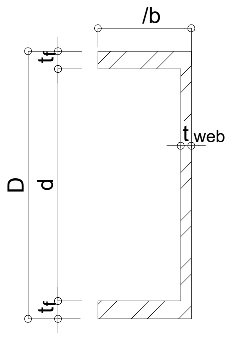
A) Check the 80x40x7.0kg/m thk. GMS channel brace

a) Design load on the member

$P_a := \max(N_{BC}, N_{AC})$ $\qquad$ $P_a = 11.29 \cdot kN$

Member Length, $\qquad L_m := \sqrt{L_b^2 + L_a^2}$ $\qquad L_m = 3.49\, m$

Dimension & section properties



Depth of the section, $\qquad D_s := 80mm$

Width of the section, $\qquad B_s := 43mm$

Web thickness, $\qquad t_w := 5mm$

Flange thickness, $\qquad t_f := 8mm$

so , $\qquad b_s := B_s \qquad b_s = 43 \cdot mm$

$d_s := D_s - 2t_f \qquad d_s = 64 \cdot mm$

Section area, $\qquad A_s = 1.01 \times 10^3 \cdot mm^2$

Moments of inertia-X, $\qquad I_x = 1 \times 10^6 \cdot mm^4$

Moments of inertia-Y, $\qquad I_y = 1.86 \times 10^5 \cdot mm^4$

Elastic modulus-X, $\qquad Z_x = 2.51 \times 10^4 \cdot mm^3$

Elastic modulus-Y, $\qquad Z_y = 6.74 \times 10^3 \cdot mm^3$

Radii of gyration-X, $\qquad r_x = 31.57 \cdot mm$

Radii of gyration-Y, $\qquad r_y = 13.57 \cdot mm$

Check local buckling $\qquad$ *(Grade S275)*

Design strength $\qquad p_y := 275MPa \qquad \varepsilon := \sqrt{\frac{275MPa}{p_y}} \qquad \varepsilon = 1$

Limits ratio $\qquad$ For flange (unweld), $\qquad \beta_{f3} := 15\varepsilon \qquad \beta_{f3} = 15$

For web (unweld), $\qquad \beta_{w3} := 15\varepsilon \qquad \beta_{w3} = 15$

Ratio $\qquad$ For flange , $\qquad \frac{b_s}{t_v} = 8.6 \quad < \quad \beta_{f3} = 15$

For web, $\qquad \frac{d_s}{t_v} = 12.8 \quad < \quad \beta_{w3} = 15$

Therefore ,cross-section is considered as ***semi-compact.***

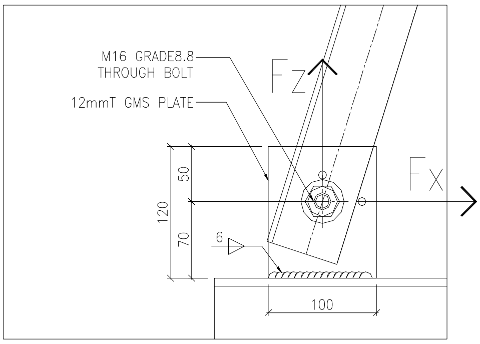
Compressive strength for member — Load factor, $\gamma_w := 1.4$

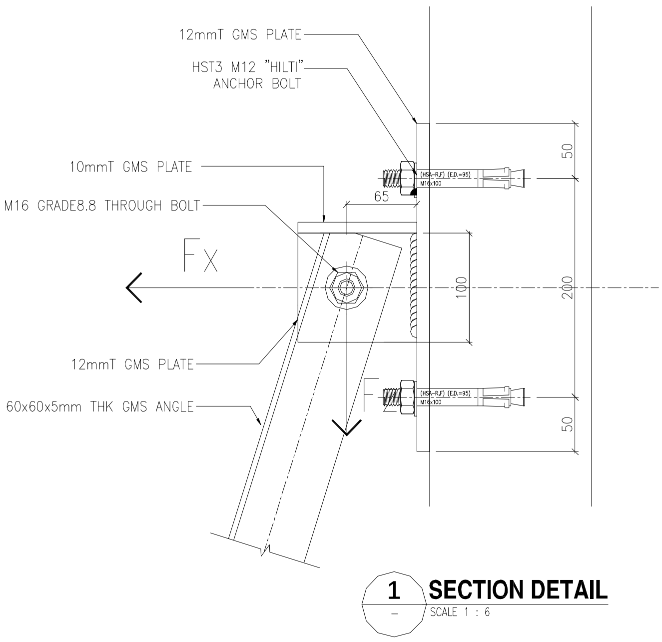
Member length,	$L_m = 3.49\,m$	
Effective length,	$L_{ex} := L_m$	$L_{ex} = 3.49\,m$
	$L_{ey} := L_m$	$L_{ey} = 3.49\,m$
Radius of gyration,	$r_x = 31.57 \cdot mm$	$r_y = 13.57 \cdot mm$
Slender radio,	$\lambda := \max\left(\frac{L_{ex}}{r_v}, \frac{L_{ex}}{r_v}\right)$	$\lambda = 294.97$
Design strength,	$p_c := 21MPa$	*(for py = 275 MPa and section type b)*

Axial Capacity

$P_{ca} := p_c \cdot A_s$ $\quad P_{ca} = 21.17 \cdot kN \quad > \quad P_a = 11.29 \cdot kN$ **O.K.**

B) Check the supporting at bottom





factored load for checking the support

$F_x := R_{x\_b}$ $\quad F_x = 3.71 \cdot kN$

$F_z := R_{y\_b}$ $\quad F_z = 10.66 \cdot kN$

A) <u>Check the M16 GMS bolt</u> $\gamma_w := 1.4$

loading on the bolt, $S_b := P_a$ $S_b = 11.29 \cdot kN$

$T_b := 0$ $T_b = 0 \cdot kN$

Nominal diameter of the bolts, $\phi := 16mm$

Effective area of the bolts, $A_o := A_{16}$ $A_o = 157 \cdot mm^2$ *(Table A.1 of BS EN ISO 3506-1)*

Tensile strength of the bolt, $p_t := p_{t\_88}$ $p_t = 560 \cdot MPa$

Shear strength of the bolt, $p_s := p_{s\_88}$ $p_s = 375 \cdot MPa$

Tensile capacity, $P_t := p_t \cdot A_o$

$P_t = 87.92 \cdot kN$ > $T_b = \blacksquare \cdot kN$ **<u>O.K.</u>**

Shear strength, $p_s := p_{s\_88}$ $p_s = 375 \cdot MPa$

Shear capacity, $P_s := p_s \cdot A_o$

$P_s = 58.88 \cdot kN$ > $S_b = 11.29 \cdot kN$ **<u>O.K.</u>**

Combine case,

$$\left(\frac{T_b}{P_t} + \frac{S_b}{P_s}\right) = 0.19 \quad < \quad 1.4$$ **<u>O.K.</u>**

B) <u>Check the gms plate</u> (L=100mm)

For $F_x = 3.71 \cdot kN$ (factored)

Load on the plate,

for $e_w := 70mm$

$M_w := F_x \cdot e_w$ $M_w = 0.26 \cdot kN \cdot m$

Section properties,

for $B_a := 100mm$ (width) $t_a := 5mm$ (thickness)

$Z_x := \frac{1}{6} \cdot B_a^2 \cdot t_a$ $Z_x = 8.33 \times 10^3 \cdot mm^3$

Moment Capacity,

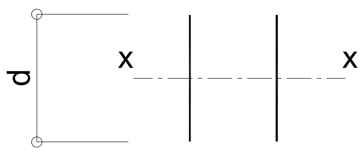
$M_{ax} := 1.2 \cdot p_y \cdot Z_x$

$M_{ax} = 2.75 \cdot kN \cdot m$ > $M_w = 0.26 \cdot kN \cdot m$ **<u>O.K.</u>**

C) Check the 6mm thk. fillet weld (both side)

properties of weld treated as line,

$d_w := 100mm$



$S_w := \frac{d_w^2}{3}$ $\quad S_w = 3.33 \times 10^3 \cdot mm^3 \cdot mm^{-1}$

weld size, $s := 6mm$

effective length, $L_w := 100mm$

factored weld stress,

$$\sigma_w := \left[\frac{V_x}{(0.7 \cdot s) \cdot L_w} + \frac{M_w}{S_w \cdot (0.7 \cdot s)} \right]$$

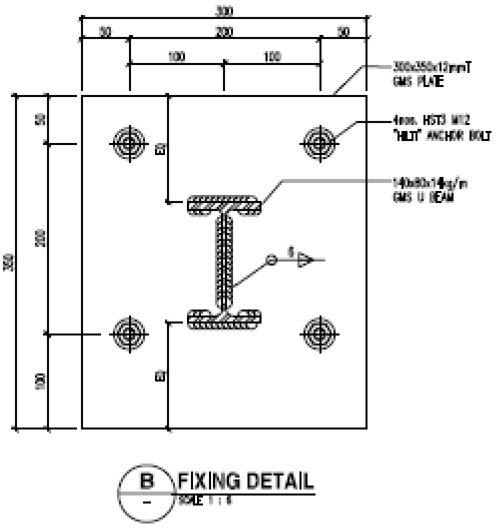
$\sigma_w = 39 \cdot MPa$ $<$ $p_w = 220 \cdot MPa$ **O.K.**

b) Check the Anchor Bolt For Support A (Use 4nos. Hilti HST3 M12 Anchor)

Reaction on the support, (factored)

$R_{x\_a} = 3.71 \cdot kN$

$R_{y\_a} = 7.73 \cdot kN$



check by hilti profisanchor, refer to appendix ' support A'

- Check the 6mm thk. fillet weld (all round)

throat size, $s := 6mm$

effective length, $L_w := 100mm$

factored weld stress, $\sigma_w := \frac{R_{x\_a} + R_{y\_a}}{(0.7 \cdot s) \cdot L_w}$

$\sigma_w = 27.24 \cdot MPa$ $<$ $p_w = 220 \cdot MPa$ **O.K.**

c) Check the plate thickness

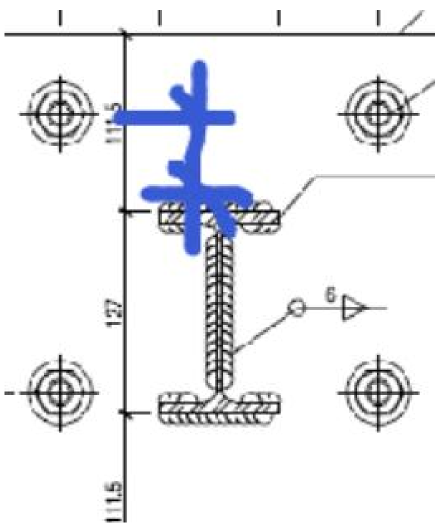
Factored load on the anchor bolt,

Anchor reactions [kN]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2.000	4.000	4.000	0.000
2	2.000	4.000	4.000	0.000
3	2.000	4.000	4.000	0.000
4	2.000	4.000	4.000	0.000

max. concrete compressive strain: - [‰]

Factored reaction on the anchor, $T_o := \frac{2kN}{2}$



factored Load on the plate, $e_p := 80mm$

$M_{px} := (2 \cdot T_o) \cdot e_p$ $\quad M_{px} = 0.16 \cdot kN \cdot m$

Section Properties,

$B := 300mm$ $\quad t_p := 12mm$

$Z_p := \frac{B \cdot t_p^{\,2}}{6}$ $\quad Z_p = 7.2 \cdot cm^3$

Moment capacity,

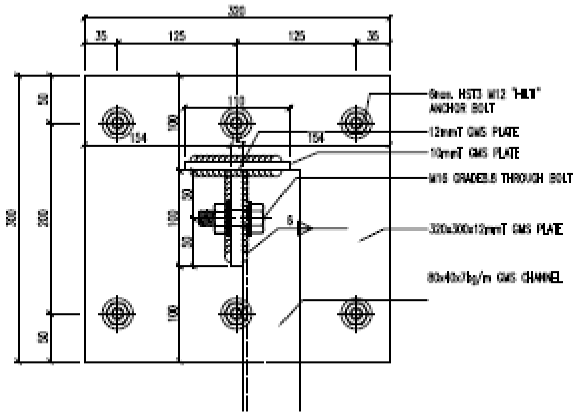
$M_c := 1.2 p_y \cdot Z_p$

$M_c = 2.38 \cdot kN \cdot m$ $\quad > \quad$ $\gamma_w \cdot M_{px} = 0.22 \cdot kN \cdot m$ **O.K.**

c) <u>Check the Anchor Bolt For Support B</u> (Use 6nos. Hilti HST3 M12 Anchor)

(checking by programme refer to appendix 'support B')

$R_{x\_b} = 3.71 \cdot kN$ $R_{y\_b} = 10.66 \cdot kN$ $M_1 := R_{y\_b} \cdot 65mm$ $M_1 = 0.69\ kN \cdot m$



A FIXING DETAIL
SCALE 1 : 6

c) <u>Check the plate thickness</u>

Anchor reactions [kN]

Tension force: (+Tension, -Compression)

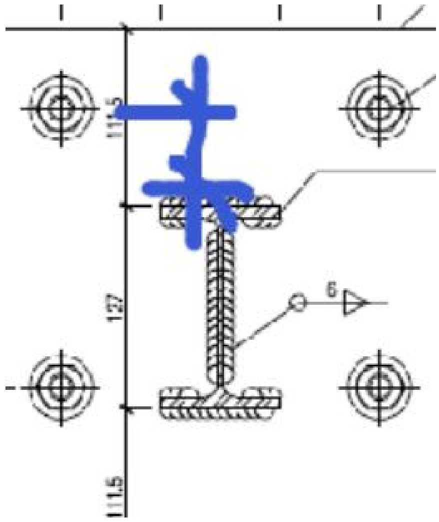
Anchor	Tension force	Shear force	Shear force x	Shear force
1	4.252	4.000	4.000	0.000
2	0.437	4.000	4.000	0.000
3	4.252	4.000	4.000	0.000
4	0.437	4.000	4.000	0.000
5	4.252	4.000	4.000	0.000
6	0.437	4.000	4.000	0.000

max. concrete compressive strain: 0.05 [‰]

Factored reaction on the anchor, $T := \frac{4.3kN}{2}$

factored Load on the plate, $e_p := 80mm$

$M_{px} := (3 \cdot T) \cdot e_p$ $M_{px} = 0.52 \cdot kN \cdot m$



Section Properties,

$B := 300mm$ $t_p := 12mm$

$Z_p := \frac{B \cdot t_p^2}{6}$ $Z_p = 7.2 \cdot cm^3$

Moment capacity,

$M_c := 1.2 p_y \cdot Z_p$

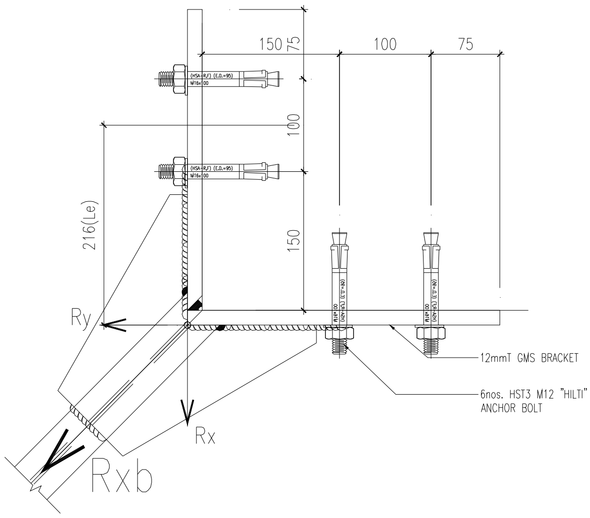
$M_c = 2.38 \cdot kN \cdot m$ > $\gamma_w \cdot M_{px} = 0.72 \cdot kN \cdot m$ **O.K.**

5.3) Check for the corner support case

5.3.1) Check for the corner support case on top

factored reaction on top,

introduce : as the reaction is same as typical case, and the weld length is large than it, so the welding coneecion checking can be covered by previous cases.



Loading on the support, $R_{x\_b} = 3.71 \times 10^{3}\,N$

$R_{y\_b} = 1.07 \times 10^{4}\,N$

so , $R_x := R_{x\_b} \cdot \cos(45deg)$ $\quad R_x = 2.63 \cdot kN$

$R_y := R_{x\_b} \cdot \sin(45deg)$ $\quad R_y = 2.63 \cdot kN$

Loading on per side of anchor,

$R_{x1} := R_x \qquad R_{x1} = 2.63 \times 10^3\,N$

$R_{y1} := \dfrac{R_{y\_b}}{2} \qquad R_{y1} = 5.33 \cdot kN$

torsion due to dead, $\qquad L_e := 216mm$

$M_t := R_{y1} \cdot L_e \qquad M_t = 1.15 \cdot kN \cdot m$

(checking by programme refer to appendix SB(C))

c) <u>Check the plate thickness</u>

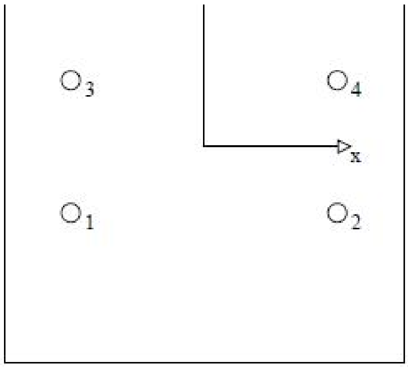
The plate is take shear force only, factored due to anchor ,

Load case 2 (1.0·permanent load + 1.43·variable load)
Load case 3 (1.43·permanent load)

Anchor reactions [kN]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.000	5.933	3.861	-4.505
2	0.000	4.525	3.861	2.360
3	0.000	4.525	0.429	-4.505
4	0.000	2.398	0.429	2.360

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [N/mm^2]
resulting tension force in (x/y)=(0/0): 0.000 [kN]
resulting compression force in (x/y)=(0/0): 0.000 [kN]



Factored reaction on the anchor, $\qquad S_o := 6kN$

<u>Check for the 10mm thk. steel plate</u>

Design load, $\qquad F_{br} := S_o \qquad F_{br} = 6 \cdot kN$

Bearing area, $\qquad A_{br} := 12mm \cdot 12mm \qquad$ (bolt size x plate thickness)

Bearing atrength for steel, $\qquad p_{br} := 460MPa$

Bearing capacity, $\qquad P_{cb} := p_{br} \cdot A_{br}$

$P_{cb} = 66.24 \cdot kN \qquad > \qquad F_{br} = 6 \cdot kN$ $\qquad$ **<u>O.K.</u>**

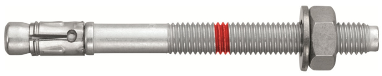
The bottom support checking can be covered by top support, as the same anchor bolt but less reaction.

APPENDIX

Company:		Page:	1
Specifier:		Project:	Support B(C)
Address:		Fastening Point:	
Phone I Fax:	|	Date:	2022/3/24
E-Mail:			

Specifier's comments:

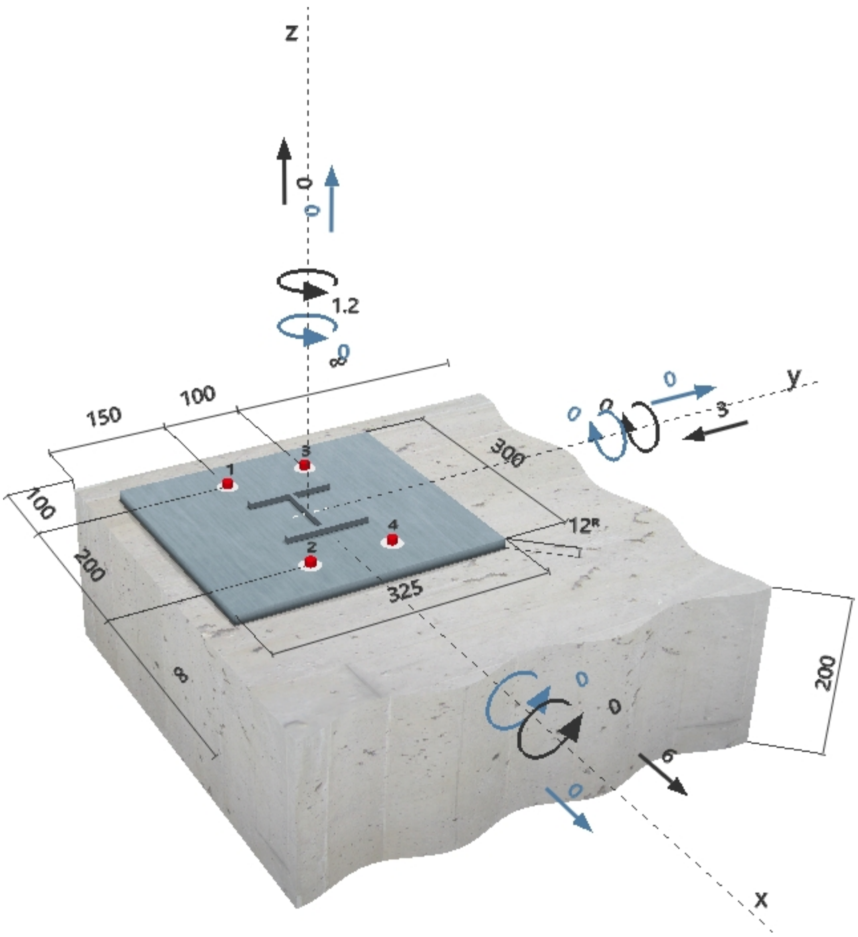
1 Input data



Anchor type and size:	**HST3 M12 hef1**
Return period (service life in years):	50
Seismic/Filling set or any suitable annular gap filling solution	
Effective embedment depth:	h_{ef} = 50 mm, h_{nom} = 60 mm
Material:	
Approval No.:	ETA-98/0001
Issued I Valid:	13/07/2020 | -
Proof:	Design method ETAG (No. 001 Annex C/2010)
Stand-off installation:	e_b = 0 mm (no stand-off); t = 12 mm
Baseplate:	l_x x l_y x t = 300 mm x 325 mm x 12 mm; (Recommended plate thickness: not calculated
Profile:	IPBi/HEA, IPBI 100 / HE 100 A; (L x W x T x FT) = 96 mm x 100 mm x 5 mm x 8 mm
Base material:	cracked concrete, C25/30, $f_{c,cube}$ = 30.00 N/mm^2; h = 200 mm
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	No reinforcement or Reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm)
	no longitudinal edge reinforcement

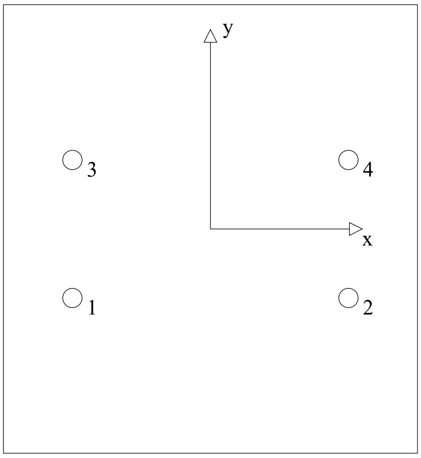
[R] - The anchor calculation is based on a rigid baseplate assumption.

Geometry [mm] & Loading [kN, kNm]



2 Load case/Resulting anchor forces

Load case 1 (1.43·permanent load + 1.43·variable load)
Load case 2 (1.0·permanent load + 1.43·variable load)
Load case 3 (1.43·permanent load)



Anchor reactions [kN]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.000	5.933	3.861	-4.505
2	0.000	4.525	3.861	2.360
3	0.000	4.525	0.429	-4.505
4	0.000	2.398	0.429	2.360

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [N/mm^2]
resulting tension force in (x/y)=(0/0): 0.000 [kN]
resulting compression force in (x/y)=(0/0): 0.000 [kN]

Anchor forces are calculated based on the assumption of a rigid baseplate.

3 Tension load (ETAG, Annex C, Section 5.2.2)

	Load [kN]	Capacity [kN]	Utilisation β_N [%]	Status
Steel failure*	N/A	N/A	N/A	N/A
Pull-out failure*	N/A	N/A	N/A	N/A
Concrete cone failure**	N/A	N/A	N/A	N/A
Splitting failure**	N/A	N/A	N/A	N/A

* most unfavourable anchor **anchor group (anchors in tension)

4 Shear load (ETAG, Annex C, Section 5.2.3)

	Load [kN]	Capacity [kN]	Utilisation β_V [%]	Status
Steel failure (without lever arm)*	5.933	27.200	22	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure*	5.933	21.534	28	OK
Concrete edge failure in direction y-**	11.866	14.232	84	OK

* most unfavourable anchor **anchor group (relevant anchors)

4.1 Steel failure (without lever arm)

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
34.000	1.250	27.200	5.933

4.2 Pryout failure

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k-factor
18,750	22,500	75	150	2.780

$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0	1.000	0	1.000	1.000	1.000

$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]
13.943	1.500	21.534	5.933

Group anchor ID
1, 3

4.3 Concrete edge failure in direction y-

l_f [mm]	d_{nom} [mm]	k_1	α	β
50	12.0	1.700	0.058	0.060

c_1 [mm]	$A_{c,V}$ [mm^2]	$A^0_{c,V}$ [mm^2]
150	105,000	101,250

$\psi_{s,V}$	$\psi_{h,V}$	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
0.833	1.061	1.246	76	0.748	1.000

$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
25.002	1.500	14.232	11.866

5 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 0.000 [kN] δ_N = 0.000 [mm]

V_{Sk} = 4.149 [kN] δ_V = 0.663 [mm]

δ_{NV} = 0.663 [mm]

Long term loading:

N_{Sk} = 0.000 [kN] δ_N = 0.000 [mm]

V_{Sk} = 4.149 [kN] δ_V = 1.005 [mm]

δ_{NV} = 1.005 [mm]

Comments: Tension displacements are valid with half of the required installation torque moment for uncracked concrete! Shear displacements are valid without friction between the concrete and the baseplate! The gap due to the drilled hole and clearance hole tolerances are not included in this calculation!

The acceptable anchor displacements depend on the fastened construction and must be defined by the designer!

Company:		Page:	4
Specifier:		Project:	Support B(C)
Address:		Fastening Point:	
Phone I Fax:	|	Date:	2022/3/24
E-Mail:			

6 Warnings

- The anchor design methods in PROFIS Anchor require rigid baseplates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the baseplate are not considered - the baseplate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required baseplate thickness with FEM to limit the stress of the baseplate based on the assumptions explained above. The proof if the rigid baseplate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Checking the transfer of loads into the base material is required in accordance with ETAG 001, Annex C(2010)Section 7! The software considers that the grout is installed under the baseplate without creating air voids and before application of the loads.
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 4.1 of ETAG 001, Annex C! For larger diameters of the clearance hole see Chapter 1.1. of ETAG 001, Annex C!
- The design method ETAG (filled holes) assumes that no hole clearance between the anchors and the fixture is present. This canbe achieved by filling the gap with mortar of sufficient compressive strength (e.g. by using the HILTI Seismic/Filling set) or by other suitable means
- The accessory list in this report is for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

Company:		Page:	5
Specifier:		Project:	Support B(C)
Address:		Fastening Point:	
Phone I Fax:	|	Date:	2022/3/24
E-Mail:			

7 Installation data

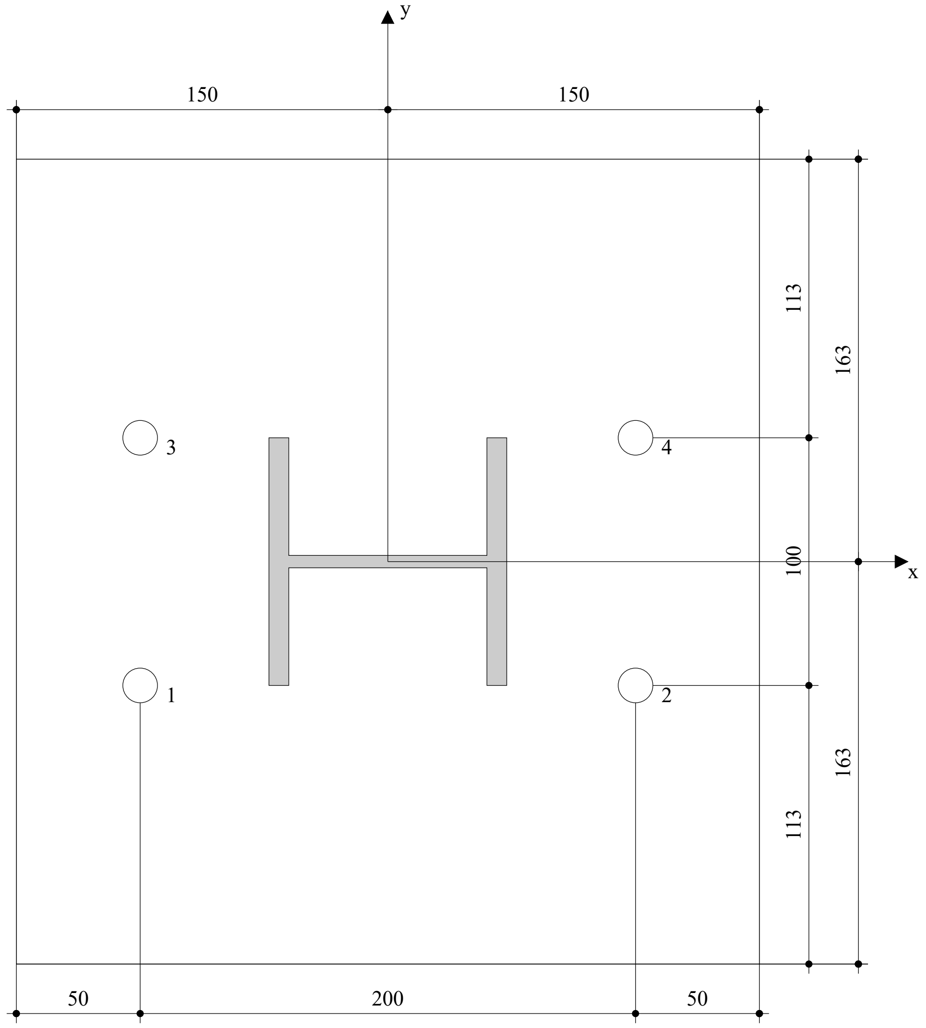
Baseplate, steel: -
Profile: IPBi/HEA, IPBI 100 / HE 100 A; (L x W x T x FT) = 96 mm x 100 mm x 5 mm x 8 mm
Hole diameter in the fixture: d_f = 14 mm
Plate thickness (input): 12 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and size: HST3 M12 hef1
Maximum installation torque: 0.060 kNm

Hole diameter in the base material: 12 mm
Hole depth in the base material: 70 mm
Minimum thickness of the base material: 100 mm

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Hilti SIW 6AT-A22 + SI AT-A22 • Seismic/Filling set • Torque wrench • Hammer



Coordinates Anchor [mm]

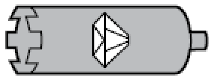
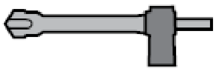
Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-100	-50	100	-	150	-
2	100	-50	300	-	150	-
3	-100	50	100	-	250	-
4	100	50	300	-	250	-

Company:		Page:	6
Specifier:		Project:	Support B(C)
Address:		Fastening Point:	
Phone I Fax:	|	Date:	2022/3/24
E-Mail:			

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

HST3 (-R) subject to:

Anchor size	M8	M10	M12	M16	M20	M24
Hammer drilling* 	TE2(-A) – TE30(-A)				TE40 – TE70	
Diamond core drilling* 	DD-30W, DD-EC1					
Setting tool* 	Setting tool HS-SC				-	
Hollow drill bit drilling* 	-		TE-CD, TE-YD			
Seismic Set/ Filling Set** 	Seismic/Filling Set M8-M20 (Carbon and Stainless Steel A4)					-

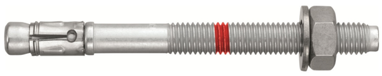
***Installation methods provided in ETA-98/0001**

**Seismic set needed to fill the annular gap between anchor and fixture:
No annular gap, double design resistance (αgap=1)

Company:		Page:	1
Specifier:		Project:	Support A
Address:		Fastening Point:	
Phone I Fax:	|	Date:	2022/3/24
E-Mail:			

Specifier's comments:

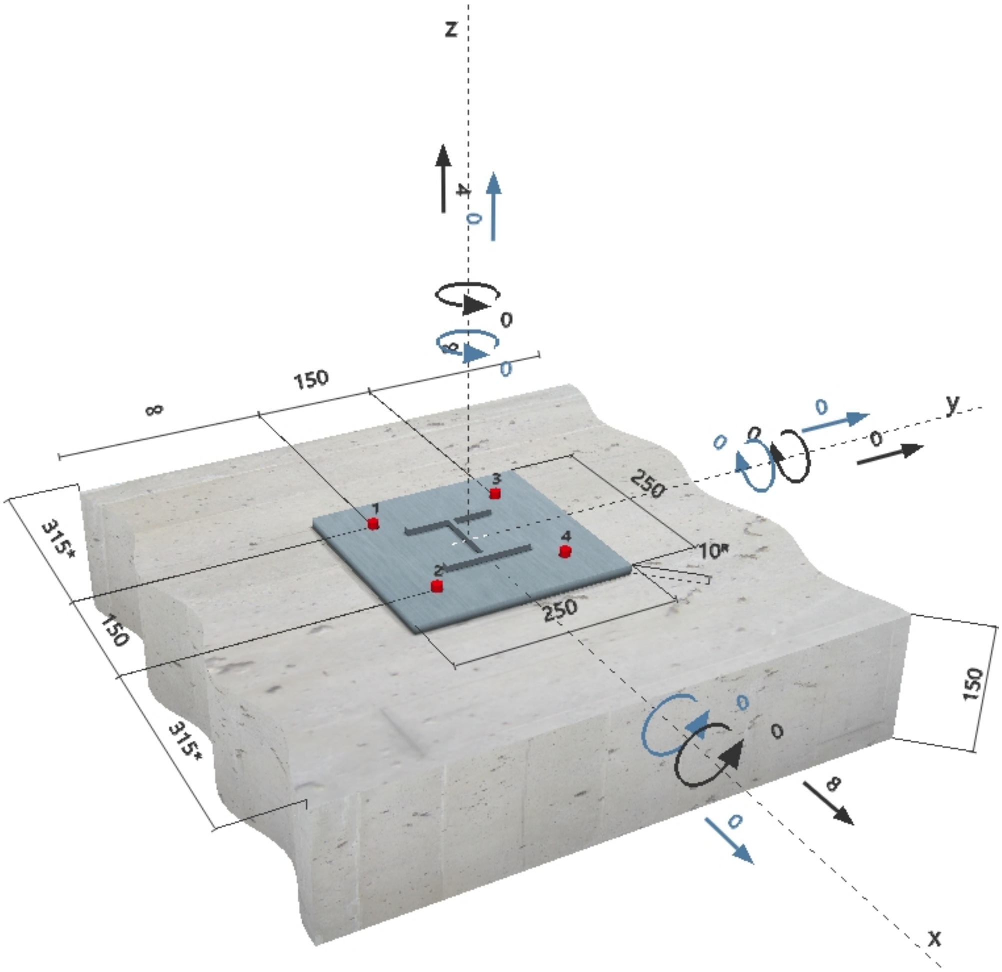
1 Input data



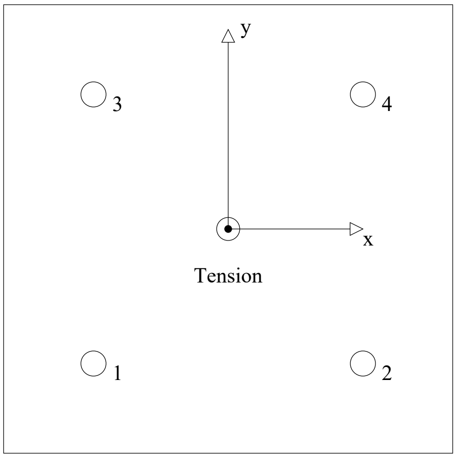
Anchor type and size:	**HST3 M12 hef1**
Return period (service life in years):	50
Effective embedment depth:	h_{ef} = 50 mm, h_{nom} = 60 mm
Material:	
Approval No.:	ETA-98/0001
Issued I Valid:	13/07/2020 | -
Proof:	Design method ETAG (No. 001 Annex C/2010)
Stand-off installation:	e_b = 0 mm (no stand-off); t = 10 mm
Baseplate:	l_x x l_y x t = 250 mm x 250 mm x 10 mm; (Recommended plate thickness: not calculated
Profile:	IPBi/HEA, IPBI 100 / HE 100 A; (L x W x T x FT) = 96 mm x 100 mm x 5 mm x 8 mm
Base material:	cracked concrete, C25/30, $f_{c,cube}$ = 30.00 N/mm^2; h = 150 mm
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	No reinforcement or Reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm) no longitudinal edge reinforcement

R - The anchor calculation is based on a rigid baseplate assumption.

Geometry [mm] & Loading [kN, kNm]



2 Load case/Resulting anchor forces



Load case 1 (2.00·permanent load + 2.00·variable load)
Load case 2 (1.0·permanent load + 2.00·variable load)
Load case 3 (2.00·permanent load)

Anchor reactions [kN]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2.000	4.000	4.000	0.000
2	2.000	4.000	4.000	0.000
3	2.000	4.000	4.000	0.000
4	2.000	4.000	4.000	0.000

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [N/mm^2]
resulting tension force in (x/y)=(0/0): 8.000 [kN]
resulting compression force in (x/y)=(0/0): 0.000 [kN]

Anchor forces are calculated based on the assumption of a rigid baseplate.

3 Tension load (ETAG, Annex C, Section 5.2.2)

	Load [kN]	**Capacity [kN]**	**Utilisation β_N [%]**	**Status**
Steel failure*	2.000	32.214	7	OK
Pull-out failure*	2.000	8.910	23	OK
Concrete cone failure**	8.000	37.181	22	OK
Splitting failure**	N/A	N/A	N/A	N/A

* most unfavourable anchor **anchor group (anchors in tension)

3.1 Steel failure

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
45.100	1.400	32.214	2.000

3.2 Pull-out failure

$N_{Rk,p}$ [kN]	ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
12.200	1.095	1.500	8.910	2.000

3.3 Concrete cone failure

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]
90,000	22,500	75	150

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0	1.000	0	1.000	1.000	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Sd} [kN]
7.200	13.943	1.500	37.181	8.000

Group anchor ID
1-4

Company:		Page:	3
Specifier:		Project:	Support A
Address:		Fastening Point:	
Phone I Fax:	|	Date:	2022/3/24
E-Mail:			

4 Shear load (ETAG, Annex C, Section 5.2.3)

	Load [kN]	Capacity [kN]	Utilisation β_V [%]	Status
Steel failure (without lever arm)*	4.000	27.200	15	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure**	16.000	103.362	16	OK
Concrete edge failure in direction x+**	16.000	30.661	53	OK

* most unfavourable anchor **anchor group (relevant anchors)

4.1 Steel failure (without lever arm)

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
34.000	1.250	27.200	4.000

4.2 Pryout failure

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k-factor
90,000	22,500	75	150	2.780

$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0	1.000	0	1.000	1.000	1.000

$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]
13.943	1.500	103.362	16.000

Group anchor ID
1-4

4.3 Concrete edge failure in direction x+

l_f [mm]	d_{nom} [mm]	k_1	α	β
50	12.0	1.700	0.040	0.052

c_1 [mm]	$A_{c,V}$ [mm^2]	$A^0_{c,V}$ [mm^2]
315	164,250	446,513

$\psi_{s,V}$	$\psi_{h,V}$	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
1.000	1.775	1.000	0	1.000	1.000

$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
70.445	1.500	30.661	16.000

5 Combined tension and shear loads (ETAG, Annex C, Section 5.2.4)

Steel failure

β_N	β_V	α	Utilisation $\beta_{N,V}$ [%]	Status
0.224	0.522	1.500	49	OK

$\beta_N^\alpha + \beta_V^\alpha \leq 1.0$

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk}	=	1.000 [kN]	δ_N	=	0.066 [mm]
V_{Sk}	=	4.000 [kN]	δ_V	=	0.639 [mm]
			δ_{NV}	=	0.643 [mm]

Long term loading:

N_{Sk}	=	1.000 [kN]	δ_N	=	0.262 [mm]
V_{Sk}	=	4.000 [kN]	δ_V	=	0.969 [mm]
			δ_{NV}	=	1.004 [mm]

Comments: Tension displacements are valid with half of the required installation torque moment for uncracked concrete! Shear displacements are valid without friction between the concrete and the baseplate! The gap due to the drilled hole and clearance hole tolerances are not included in this calculation!

The acceptable anchor displacements depend on the fastened construction and must be defined by the designer!

7 Warnings

- The anchor design methods in PROFIS Anchor require rigid baseplates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the baseplate are not considered - the baseplate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required baseplate thickness with FEM to limit the stress of the baseplate based on the assumptions explained above. The proof if the rigid baseplate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Checking the transfer of loads into the base material is required in accordance with ETAG 001, Annex C(2010)Section 7! The software considers that the grout is installed under the baseplate without creating air voids and before application of the loads.
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 4.1 of ETAG 001, Annex C! For larger diameters of the clearance hole see Chapter 1.1. of ETAG 001, Annex C!
- The accessory list in this report is for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

Company:
Specifier:
Address:
Phone I Fax: |
E-Mail:

8 Installation data

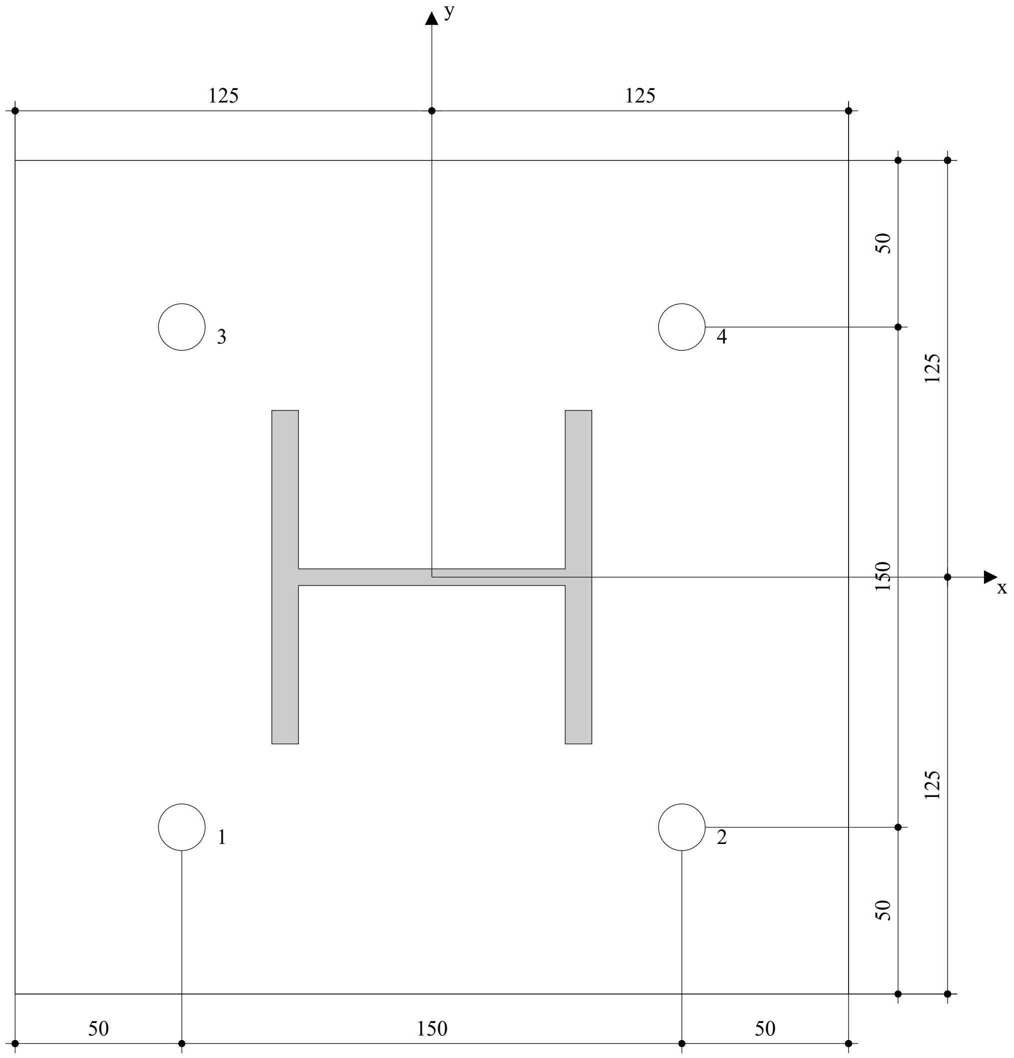
Baseplate, steel: -
Profile: IPBi/HEA, IPBI 100 / HE 100 A; (L x W x T x FT) = 96 mm x 100 mm x 5 mm x 8 mm
Hole diameter in the fixture: d_f = 14 mm
Plate thickness (input): 10 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and size: HST3 M12 hef1
Maximum installation torque: 0.060 kNm

Hole diameter in the base material: 12 mm
Hole depth in the base material: 70 mm
Minimum thickness of the base material: 100 mm

8.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer	• Manual blow-out pump	• Hilti SIW 6AT-A22 + SI AT-A22
• Properly sized drill bit		• Torque wrench
		• Hammer



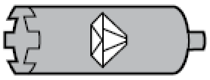
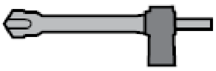
Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-75	-75	315	465	-	-
2	75	-75	465	315	-	-
3	-75	75	315	465	-	-
4	75	75	465	315	-	-

9 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

HST3 (-R) subject to:

Anchor size	M8	M10	M12	M16	M20	M24
Hammer drilling* 	TE2(-A) – TE30(-A)				TE40 – TE70	
Diamond core drilling* 	DD-30W, DD-EC1					
Setting tool* 	Setting tool HS-SC				-	
Hollow drill bit drilling* 	-		TE-CD, TE-YD			
Seismic Set/ Filling Set** 	Seismic/Filling Set M8-M20 (Carbon and Stainless Steel A4)					-

***Installation methods provided in ETA-98/0001**

**Seismic set needed to fill the annular gap between anchor and fixture:
No annular gap, double design resistance ($\alpha gap=1$)

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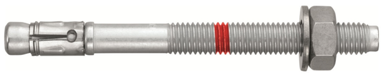
Specifier's comments:

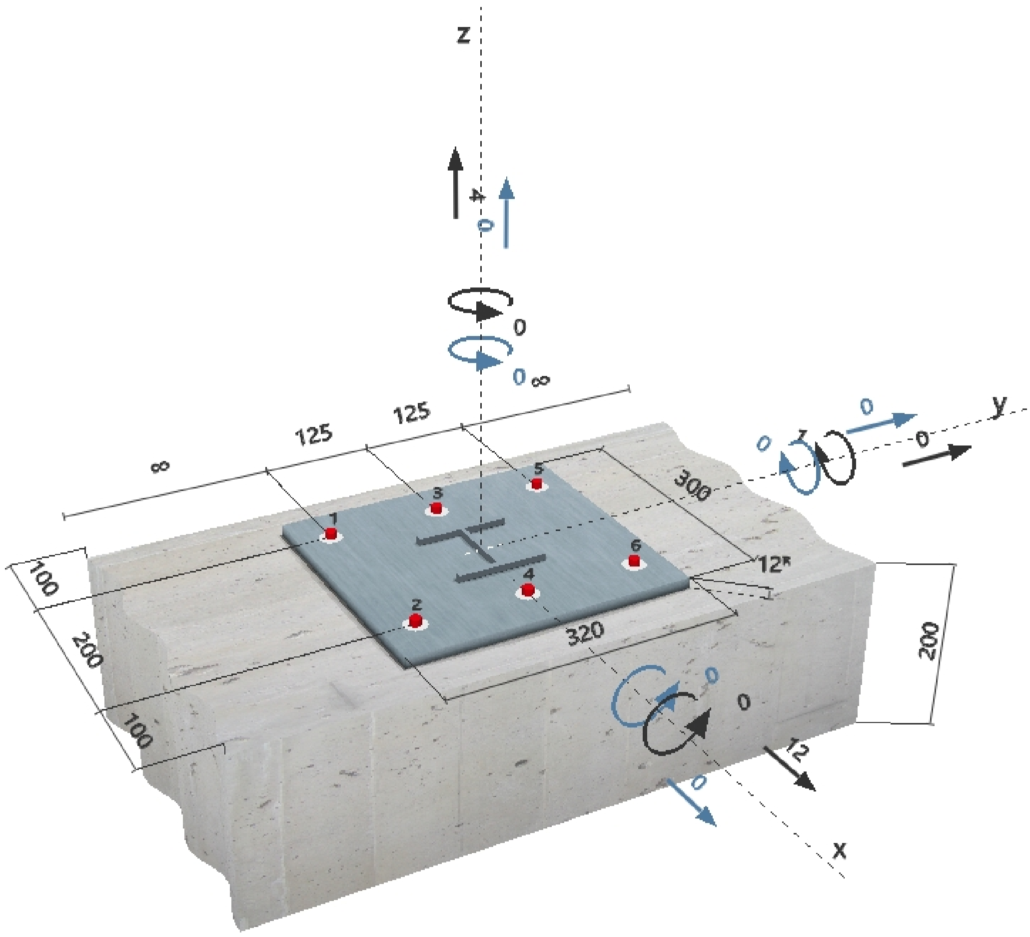
1 Input data



Anchor type and size:	**HST3 M12 hef2**
Return period (service life in years):	50
Seismic/Filling set or any suitable annular gap filling solution	
Effective embedment depth:	h_{ef} = 70 mm, h_{nom} = 80 mm
Material:	
Approval No.:	ETA-98/0001
Issued I Valid:	13/07/2020 | -
Proof:	SOFA design method + fib (07/2011) - after ETAG testing
Stand-off installation:	e_b = 0 mm (no stand-off); t = 12 mm
Baseplate:	l_x x l_y x t = 300 mm x 320 mm x 12 mm; (Recommended plate thickness: not calculated
Profile:	IPBi/HEA, IPBI 100 / HE 100 A; (L x W x T x FT) = 96 mm x 100 mm x 5 mm x 8 mm
Base material:	cracked concrete, C25/30, $f_{c,cyl}$ = 25.00 N/mm^2; h = 200 mm
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	No reinforcement or Reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm)
	no longitudinal edge reinforcement

R - The anchor calculation is based on a rigid baseplate assumption.

Geometry [mm] & Loading [kN, kNm]



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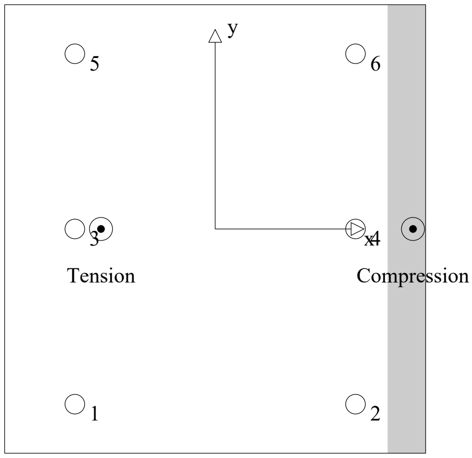
2 Load case/Resulting anchor forces



Load case 1 (2.00·permanent load + 2.00·variable load)
Load case 2 (1.0·permanent load + 2.00·variable load)
Load case 3 (2.00·permanent load)

Anchor reactions [kN]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	4.252	4.000	4.000	0.000
2	0.437	4.000	4.000	0.000
3	4.252	4.000	4.000	0.000
4	0.437	4.000	4.000	0.000
5	4.252	4.000	4.000	0.000
6	0.437	4.000	4.000	0.000

max. concrete compressive strain: 0.05 [‰]
max. concrete compressive stress: 1.40 [N/mm^2]
resulting tension force in (x/y)=(-81/0): 14.068 [kN]
resulting compression force in (x/y)=(141/0): 6.068 [kN]

Anchor forces are calculated based on the assumption of a rigid baseplate.

3 Tension load SOFA (fib (07/2011), section 10.1)

	Load [kN]	Capacity [kN]	Utilisation β_N [%]	Status
Steel failure*	4.252	32.214	14	OK
Pull-out failure*	4.252	14.606	30	OK
Concrete cone failure**	14.068	34.832	41	OK
Splitting failure**	14.068	44.182	32	OK

* most unfavourable anchor **anchor group (anchors in tension)

3.1 Steel failure

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
45.100	1.400	32.214	4.252

3.2 Pull-out failure

$N_{Rk,p}$ [kN]	ψ_c	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
20.000	1.095	1.500	14.606	4.252

3.3 Concrete cone failure

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$\psi_{A,N}$	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]
184,000	44,100	4.172	105	210

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
81	0.563	0	1.000	0.986	1.000

k_1	$N^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Sd} [kN]
7.700	22.548	1.500	34.832	14.068

Group anchor ID
1-6

3.4 Splitting failure

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$\psi_{A,N}$	$c_{cr,sp}$ [mm]	$s_{cr,sp}$ [mm]	$\psi_{h,sp}$
184,000	44,100	4.172	105	210	1.268

$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	k_1
81	0.563	0	1.000	0.986	1.000	7.700

$N^0_{Rk,c}$ [kN]	$\gamma_{M,sp}$	$N_{Rd,sp}$ [kN]	N_{Sd} [kN]
22.548	1.500	44.182	14.068

Group anchor ID
1-6

4 Shear load SOFA (fib (07/2011), section 10.2)

	Load [kN]	Capacity [kN]	Utilisation β_V [%]	Status
Steel failure (without lever arm)*	4.000	28.320	15	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure**	24.000	171.867	14	OK
Concrete edge failure in direction x+**	12.000	16.889	72	OK

* most unfavourable anchor   **anchor group (relevant anchors)

4.1 Steel failure (without lever arm)

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
35.400	1.250	28.320	4.000

4.2 Pryout failure

$A_{c,N}$ [mm^2]	$A^0_{c,N}$ [mm^2]	$\psi_{A,N}$	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k_4
184,000	44,100	4.172	105	210	2.780

$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0	1.000	0	1.000	0.986	1.000

$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]
22.548	1.500	171.867	24.000

Group anchor ID
1-6

4.3 Concrete edge failure in direction x+

l_f [mm]	d_{nom} [mm]	k_V	α	β
70	12.0	1.700	0.084	0.065

c_1 [mm]	$A_{c,V}$ [mm^2]	$A^0_{c,V}$ [mm^2]	$\psi_{A,V}$
100	82,500	45,000	1.833

$\psi_{s,V}$	$\psi_{h,V}$	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$	$\psi_{90°,V}$
1.000	1.000	1.000	0	1.000	1.000	2.500

$V^0_{Rk,c}$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
13.818	1.500	16.889	12.000

5 Combined tension and shear loads SOFA (fib (07/2011), section 10.3)

	β_N	β_V	α	Utilisation $\beta_{N,V}$ [%]	Status
steel	0.132	0.141	2.000	4	OK
concrete	0.404	0.711	1.500	86	OK

$\beta_N^\alpha + \beta_V^\alpha <= 1$

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6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk}	=	2.126 [kN]	δ_N	=	0.179 [mm]
V_{Sk}	=	2.000 [kN]	δ_V	=	0.376 [mm]
			δ_{NV}	=	0.417 [mm]

Long term loading:

N_{Sk}	=	2.126 [kN]	δ_N	=	0.358 [mm]
V_{Sk}	=	2.000 [kN]	δ_V	=	0.554 [mm]
			δ_{NV}	=	0.660 [mm]

Comments: Tension displacements are valid with half of the required installation torque moment for uncracked concrete! Shear displacements are valid without friction between the concrete and the baseplate! The gap due to the drilled hole and clearance hole tolerances are not included in this calculation!

The acceptable anchor displacements depend on the fastened construction and must be defined by the designer!

7 Warnings

- The anchor design methods in PROFIS Anchor require rigid baseplates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the baseplate are not considered - the baseplate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required baseplate thickness with FEM to limit the stress of the baseplate based on the assumptions explained above. The proof if the rigid baseplate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- The accessory list in this report is for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- The design method fib (07/2011) assumes that no hole clearance between the anchors and the fixture is present. This can be achieved by filling the gap with mortar of sufficient compressive strength (e.g. by using the HILTI Seismic/Filling set) or by other suitable means
- The compliance with current standards (e.g. EC3) is the responsibility of the user
- Checking the transfer of loads into the base material is required in accordance with fib (07/2011)!
- The characteristic bond resistances depend on the return period (service life in years): 50

Fastening meets the design criteria!

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8 Installation data

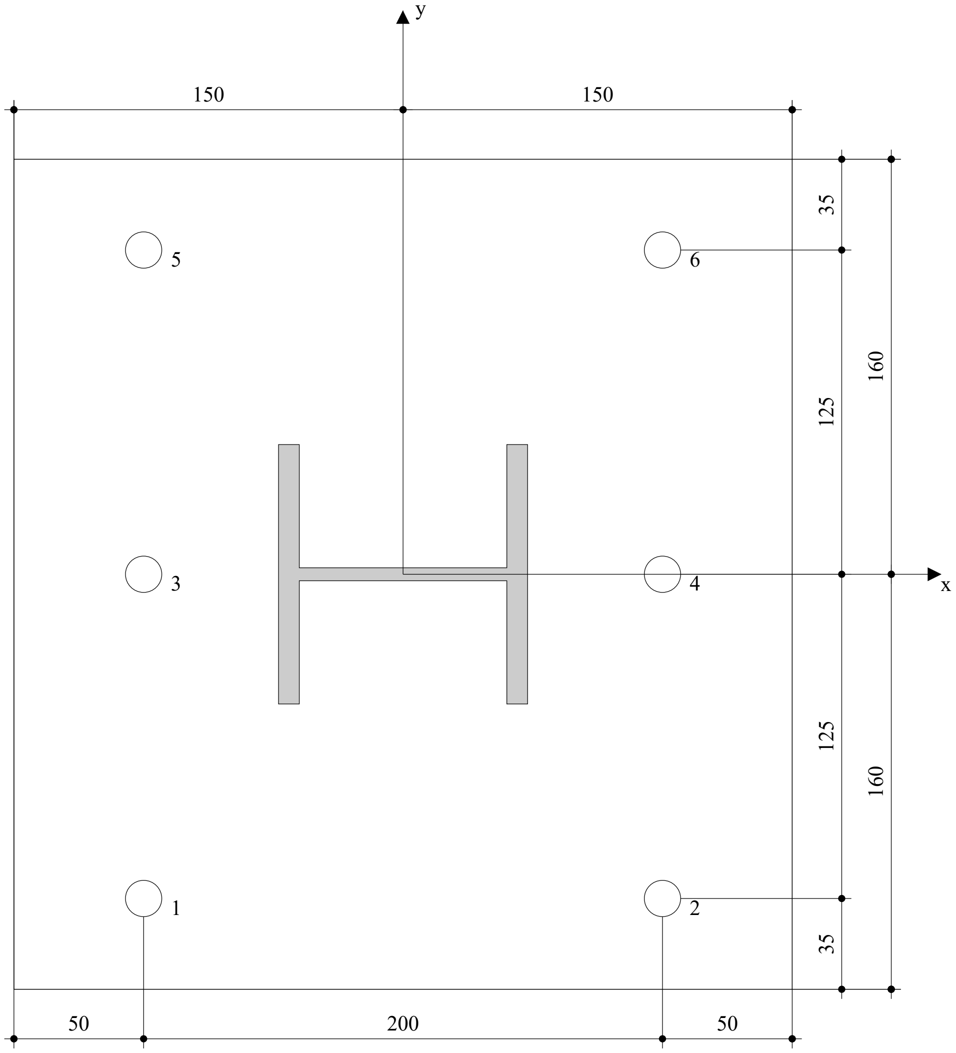
Baseplate, steel: -
Profile: IPBi/HEA, IPBI 100 / HE 100 A; (L x W x T x FT) = 96 mm x 100 mm x 5 mm x 8 mm
Hole diameter in the fixture: d_f = 14 mm
Plate thickness (input): 12 mm
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and size: HST3 M12 hef2
Maximum installation torque: 0.060 kNm

Hole diameter in the base material: 12 mm
Hole depth in the base material: 90 mm
Minimum thickness of the base material: 140 mm

8.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Hilti SIW 6AT-A22 + SI AT-A22 • Seismic/Filling set • Torque wrench • Hammer



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-100	-125	100	300	-	-
2	100	-125	300	100	-	-
3	-100	0	100	300	-	-
4	100	0	300	100	-	-
5	-100	125	100	300	-	-
6	100	125	300	100	-	-

9 Remarks; Your Cooperation Duties

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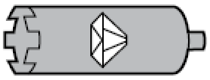
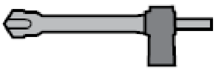
HST3 (-R) subject to:

Anchor size	M8	M10	M12	M16	M20	M24
Hammer drilling* 	TE2(-A) – TE30(-A)				TE40 – TE70	
Diamond core drilling* 	DD-30W, DD-EC1					
Setting tool* 	Setting tool HS-SC				-	
Hollow drill bit drilling* 	-		TE-CD, TE-YD			
Seismic Set/ Filling Set** 	Seismic/Filling Set M8-M20 (Carbon and Stainless Steel A4)					-

***Installation methods provided in ETA-98/0001**

**Seismic set needed to fill the annular gap between anchor and fixture:
No annular gap, double design resistance (αgap=1)