Attachment 2

Footbridge Design Checking Report

Section 16 Planning Application for Proposed Minor Relaxation of Plot Ratio Restriction for Permitted Residential Development at Lot 94 in D.D. 388 and Adjoining Government Land in Castle Peak Road, Tsing Lung Tau

Residential Development at Lot 94 in D.D. 388 and Adjoining Government Land in Castle Peak Road, Tsing Lung Tau

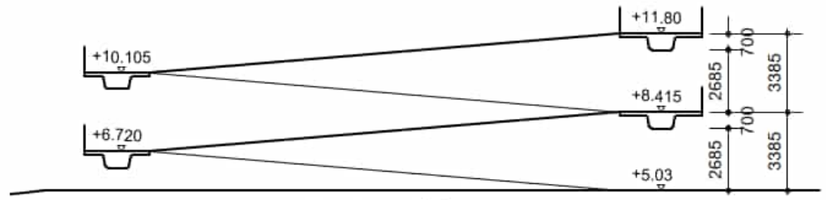
Footbridge Design Checking Report

AECOM

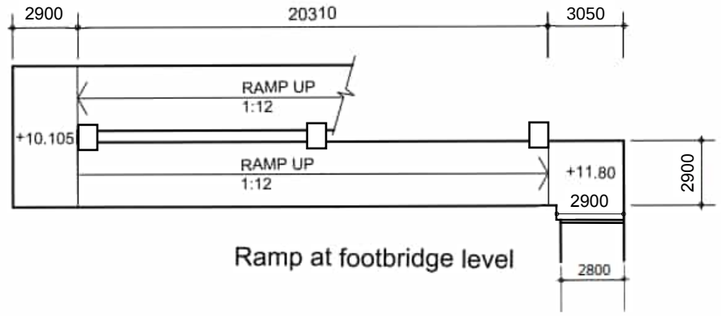
Aug 2022

Part A - Technical Drawings of Footbridge Modification

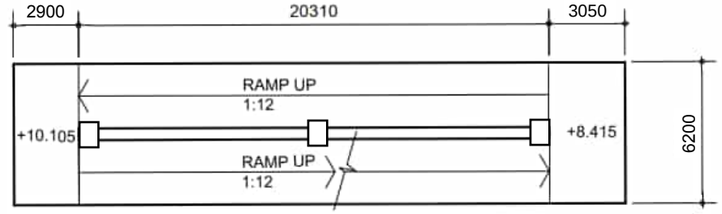
NOTES:
1. THE RAMP STRUCTURAL ARRANGEMENT REFERS TO DRAWING SK 02
2. THE RAMP SECTIONS REFER TO DRAWING SK03



Section of Ramp



Ramp at footbridge level

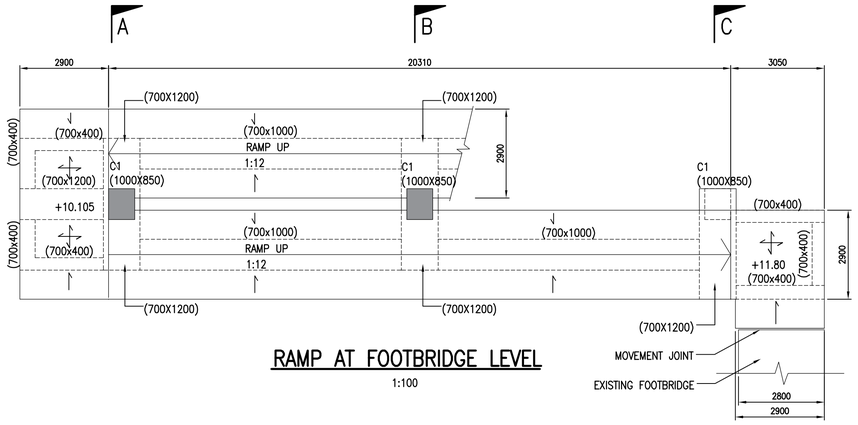


Ramp at mid level

LOCATION PLAN OF THE PROPOSED FOOTBRIDGE RAMP

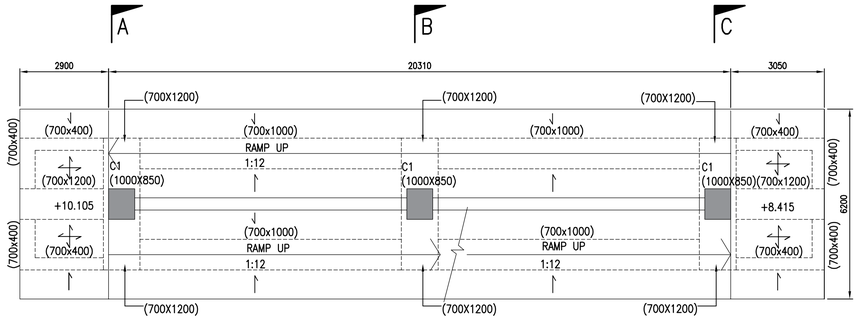
1:300 IN A3
9 JUNE 2022

SK 01A



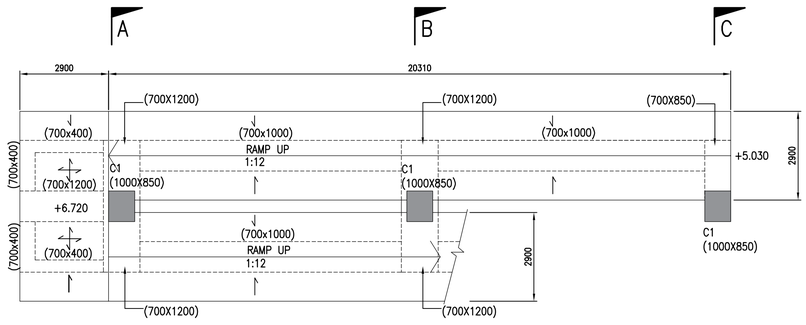
RAMP AT FOOTBRIDGE LEVEL

1:100



RAMP AT MID LEVEL

1:100



RAMP AT LOW LEVEL

1:100

PATH C:\Users\WongWS\OneDrive - AECOM\Desktop\Castle Peak Road\Study To Castle Peak Road\Bridge Prelim Sketch\From Drafts\v1\Footbridge Framing Plan And Details V1.dwg

Project Management Initials: Designer: IW Checked: CY Approved: SN ISO A1 594mm x 841mm

AECOM

PROJECT 項目

DD388 LOT 94, CASTLE PEAK ROAD - TSING LUNG TAU

CLIENT 業主

CONSULTANT 工程顧問公司

AECOM Asia Company Ltd.
www.aecom.com

SUB-CONSULTANTS 分判工程顧問公司

ISSUE/REVISION 修訂

I/R 修訂	DATE 日期	DESCRIPTION 內容摘要	CHK. 核核

STATUS 階段

SCALE 比例 — A1 AS SHOWN

DIMENSION UNIT 尺寸單位 — MILLIMETER

KEY PLAN 索引圖

PROJECT NO. 項目編號

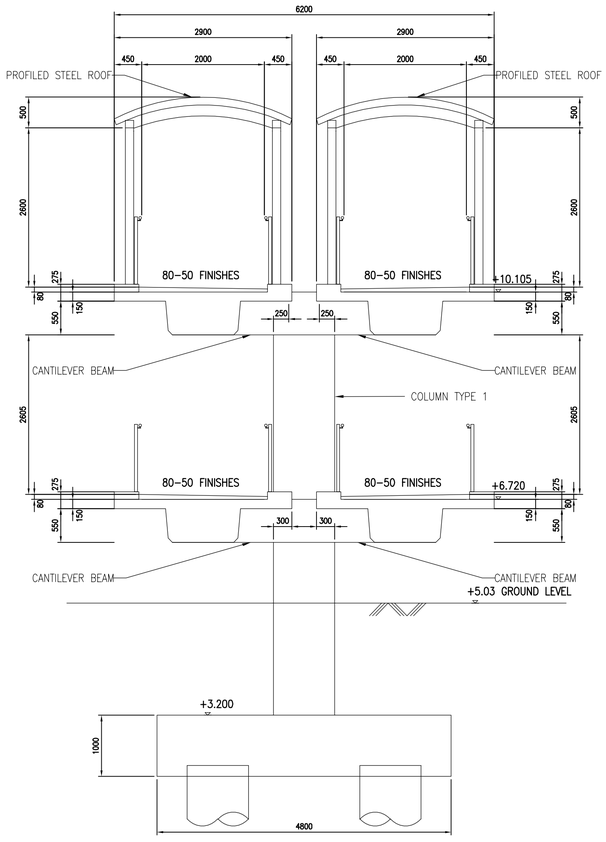
CONTRACT NO. 合約編號

SHEET TITLE 圖紙名稱

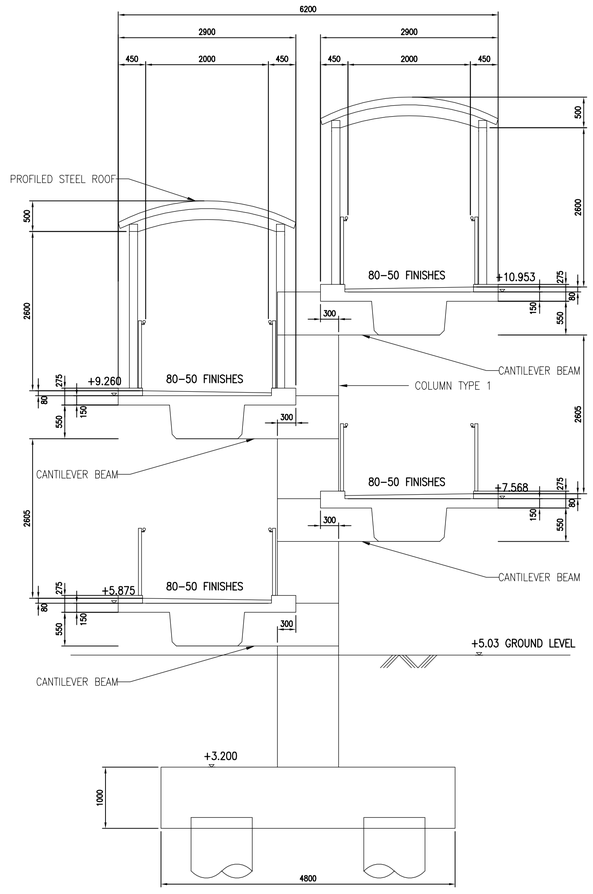
FOOTBRIDGE RAMP STRUCTURAL ARRANGEMENT

SHEET NUMBER 圖紙編號

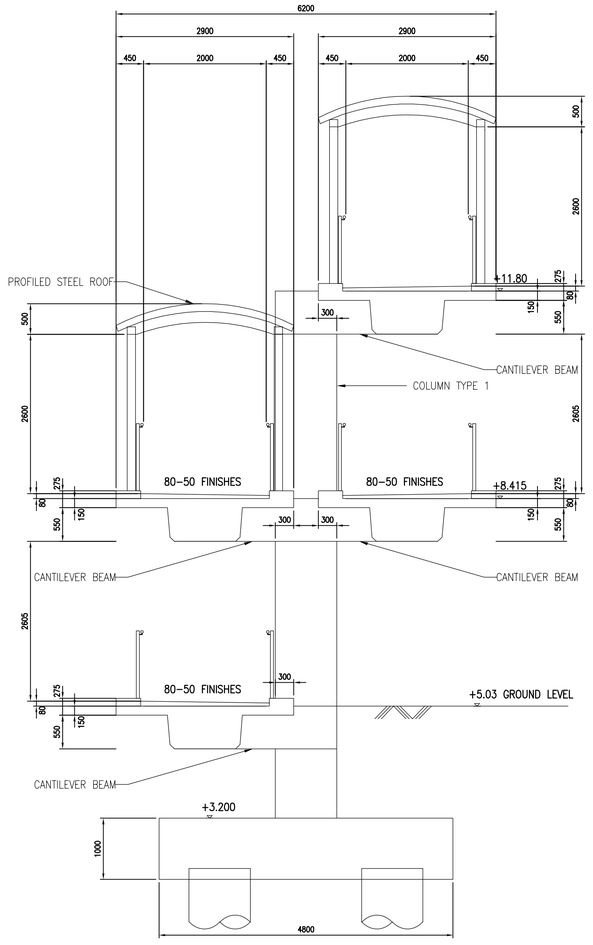
SK 02A



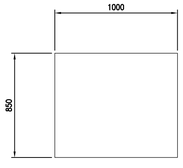
SECTION A
1:50



SECTION B
1:50



SECTION C
1:50



COLUMN PROFILE TYPE 1 (C1)
1:25

AECOM

PROJECT
項目
DD388 LOT 94, CASTLE PEAK ROAD - TSING LUNG TAU

CLIENT
業主

CONSULTANT
工程顧問公司
AECOM Asia Company Ltd.
www.aecom.com

SUB-CONSULTANTS
分判工程顧問公司

ISSUE/REVISION
修訂

I/R 修訂	DATE 日期	DESCRIPTION 內容摘要	CHK. 核准

STATUS
階段

SCALE 比例
A1 AS SHOWN

DIMENSION UNIT 尺寸單位
MILLIMETER

KEY PLAN
索引圖

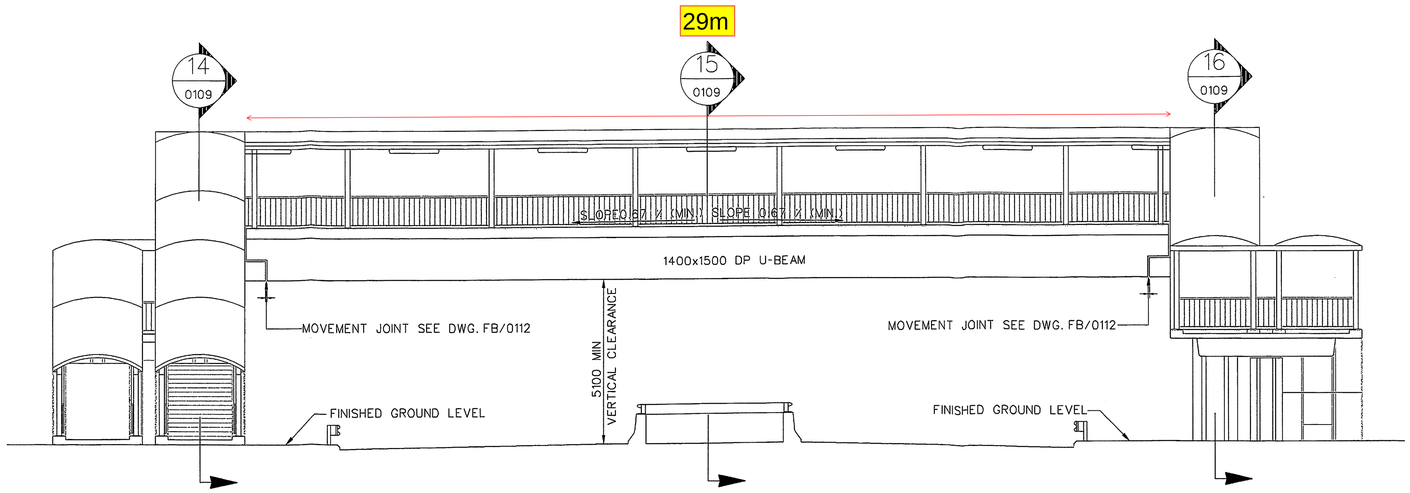
PROJECT NO. 項目編號

CONTRACT NO. 合約編號

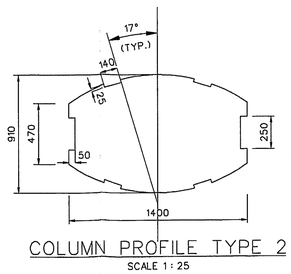
SHEET TITLE
圖紙名稱
FOOTBRIDGE RAMP SECTION

SHEET NUMBER
圖紙編號
SK 03A

Part B - As-built Footbridge Drawings



ELEVATION 13 / 0111
SCALE 1 : 50



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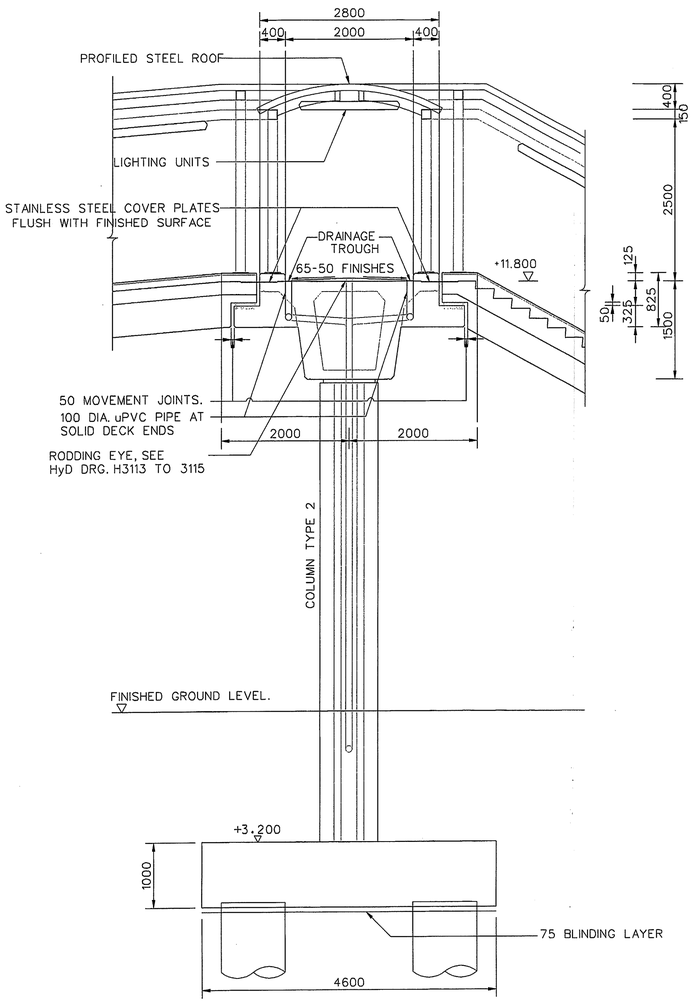
SCALE 1 : 25



SECTION 14 / 0111
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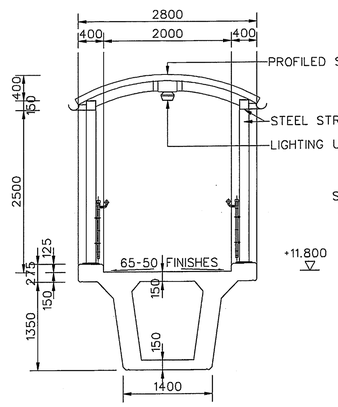
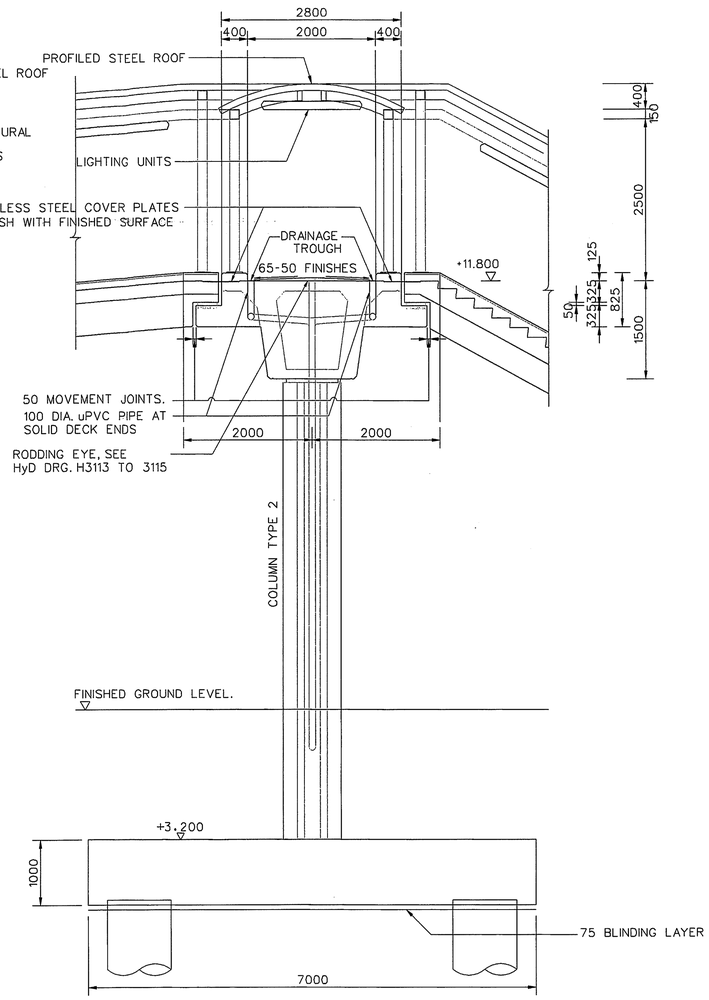


SECTION 15 / 0111
SCALE 1 : 50



SECTION 16 / 0111
SCALE 1 : 50

Note

1. For General Notes see drg. 90612/T/FB/5100.

AS-CONSTRUCTED DRAWING

Major Works Project Management Office,
Highways Department,
Hong Kong

Project No.	Contract No.
6553TH	HY/99/18

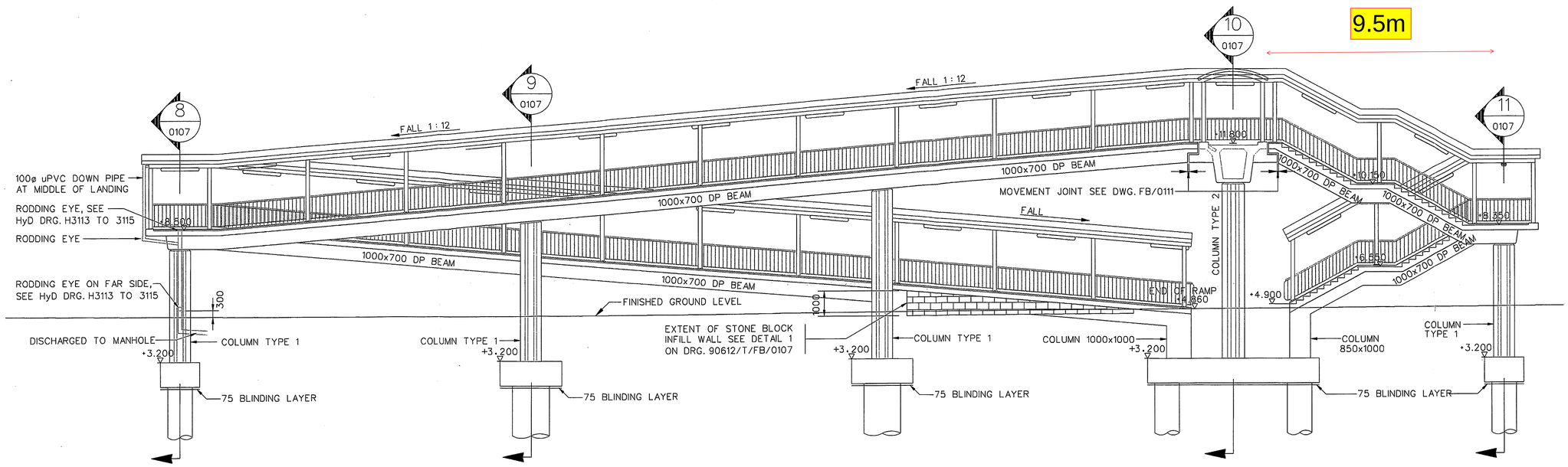
Meinhardt Halcrow JV
Sub-Consultants
ACL Asia, MVA Asia Ltd.,
Townland Consultants Ltd., Chesterton Petty Ltd.

Contract Title
Castle Peak Road Improvement Between Sham Tseng and Ka Loon Tsuen, Tsuen Wan

Drawing Title
FOOTBRIDGE No. 01
MAIN SPAN
ELEVATION AND SECTIONS

Drawn	Checked	Approved
CPS	LC	HL
Scale 1:50 AT A1	CAD File No. TFB0109	Date NOV 2007

Drawing No. 90612/T/FB/0109
Rev. Z



ELEVATION 12
SCALE 1 : 100 0101

Note

1. For General Notes see drg. 90612/T/FB/5100.

AS-CONSTRUCTED DRAWING

Major Works Project Management Office,
Highways Department,
Hong Kong

Project No.	Contract No.
6553TH	HY /99 /18

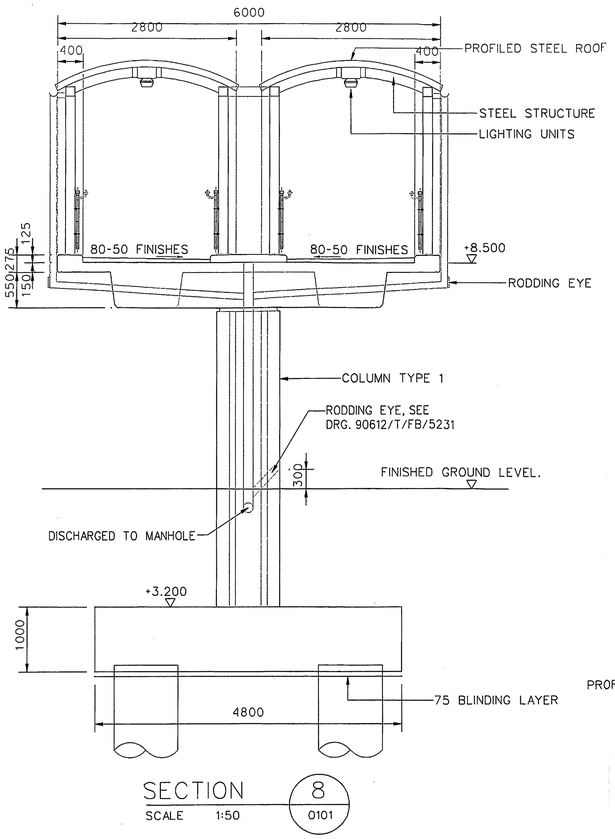
Meinhardt Halcrow JV
Sub-Consultants
ACL Asia, MVA Asia Ltd.,
Townland Consultants Ltd., Chesterton Petty Ltd.

Contract Title
Castle Peak Road Improvement Between Sham Tseng and Ka Loon Tsuen, Tsuen Wan

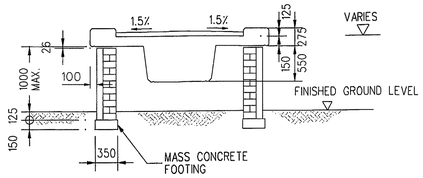
Drawing Title
FOOTBRIDGE No. 01
NORTH RAMP AND STAIRCASE
ELEVATION

Drawn	Checked	Approved
CPS	LC	HL
Scale 1:100 AT A1	CAD File No. TFB0108	Date NOV 2007

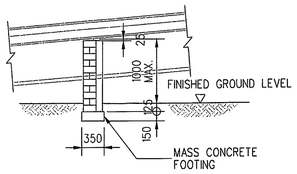
Drawing No. 90612/T/FB/0108 Rev. Z



SECTION 8
SCALE 1:50 — 0101



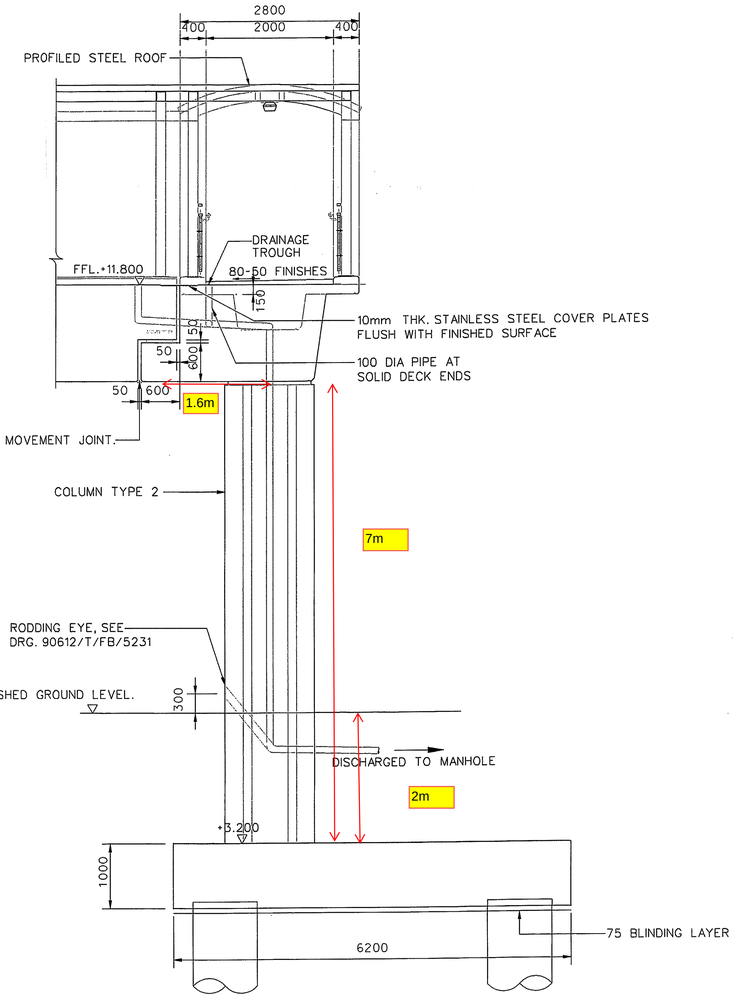
TYPICAL SIDE WALL DETAILS



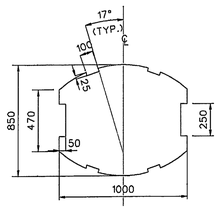
TYPICAL END WALL DETAILS

TYPICAL DETAIL FOR STONE BLOCK INFILL WALL

DETAIL 1
SCALE 1:50 — 0105/0108

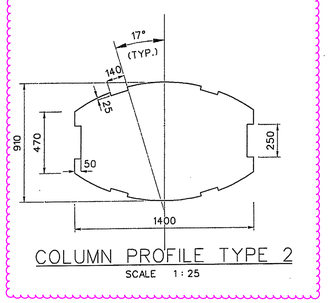


SECTION 10
SCALE 1:50 — 0101

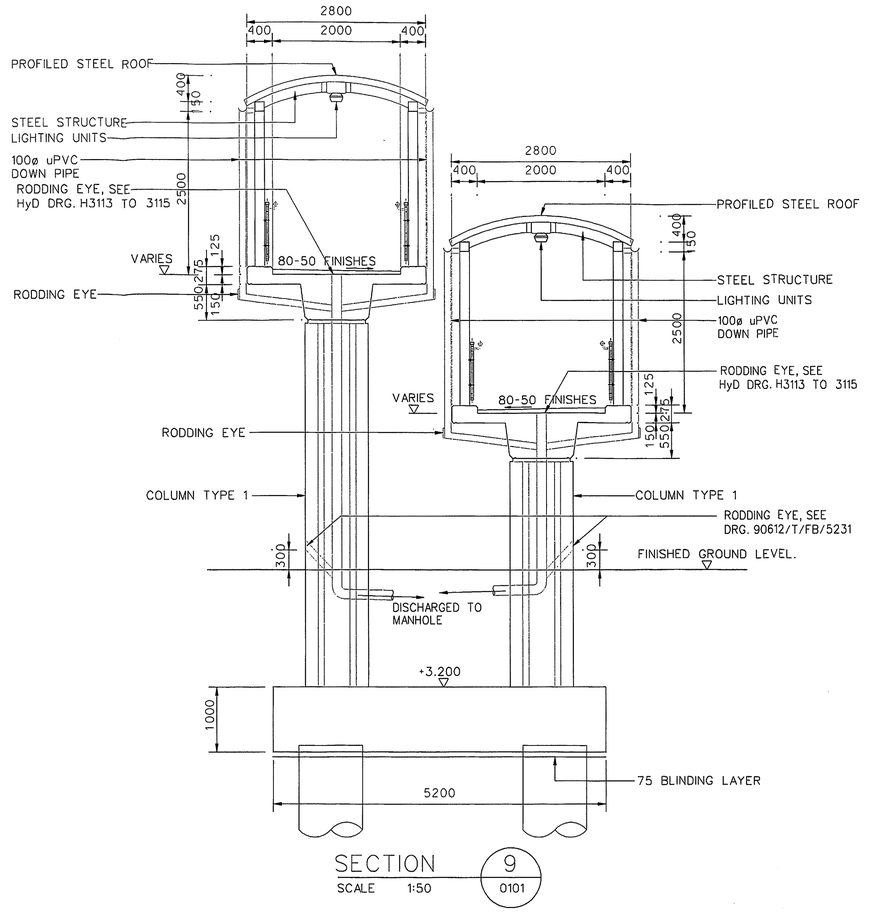


COLUMN PROFILE TYPE 1
SCALE 1:25

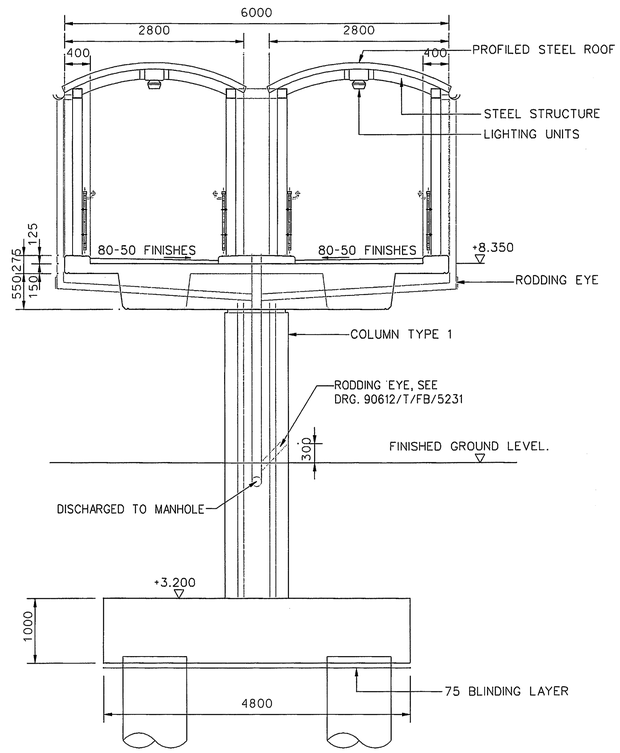
Checking of this Column



COLUMN PROFILE TYPE 2
SCALE 1:25



SECTION 9
SCALE 1:50 — 0101



SECTION 11
SCALE 1:50 — 0101

Note

1. For General Notes see drg. 90612/T/FB/5100.

AS-CONSTRUCTED DRAWING

Major Works Project Management Office,
Highways Department,
Hong Kong

Project No.	Contract No.
6553TH	HY /99 /18

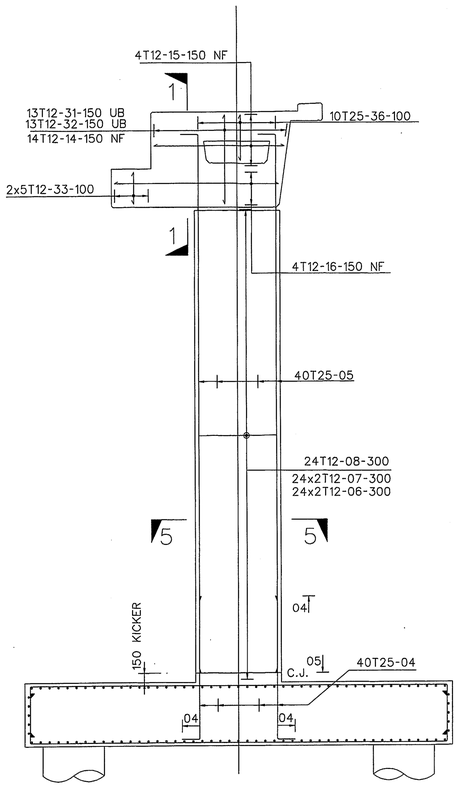
Meinhardt Halcrow JV
Sub-Consultants
ACL Asia, MVA Asia Ltd.,
Townland Consultants Ltd., Chesterton Petty Ltd.

Contract Title
Castle Peak Road Improvement Between Sham Tseng and Ka Loon Tsuen, Tsuen Wan

Drawing Title
FOOTBRIDGE No. 01
NORTH RAMP AND STAIRCASE
SECTIONS

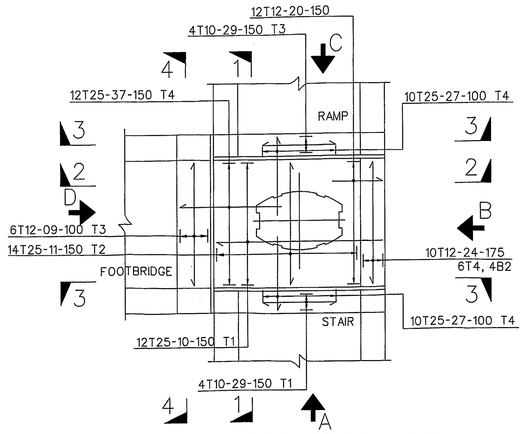
Drawn	Checked	Approved
CPS	LC	HL
Scale 1:50 AT A1	CAD File No. TFB0107	Date NOV 2007

Drawing No. 90612/T/FB/0107 — Rev. Z

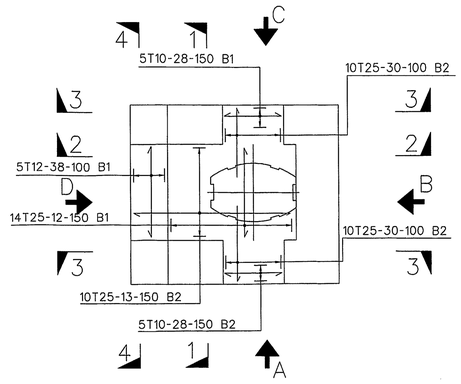


ELEVATION A
SCALE 1 : 50

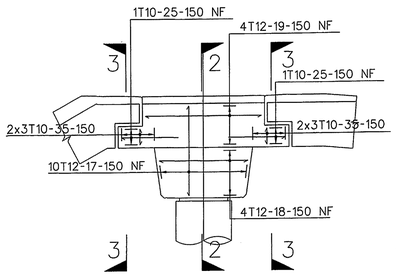
FOR PILE CAP DETAILS,
SEE DRG. 90612/T/FB/0165 & 0166



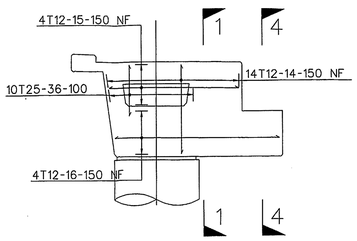
PLAN ON CROSS HEAD (TOP)
SCALE 1 : 50



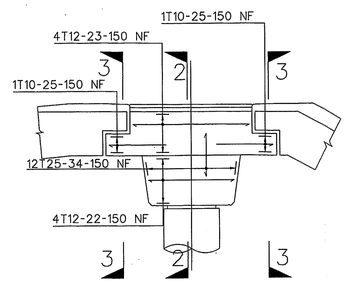
PLAN ON CROSS HEAD (BOTTOM)
SCALE 1 : 50



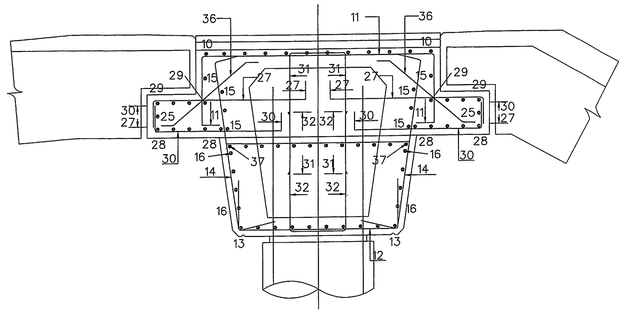
ELEVATION B
SCALE 1 : 50



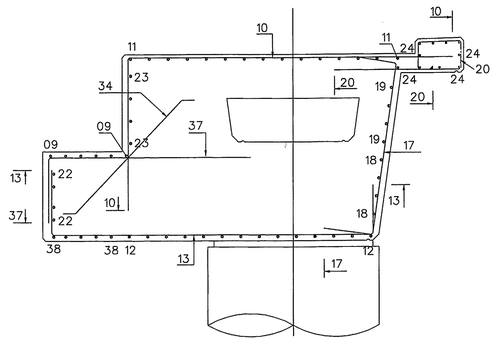
ELEVATION C
SCALE 1 : 50



ELEVATION D
SCALE 1 : 50



SECTION 1 - 1
SCALE 1 : 25



SECTION 2 - 2
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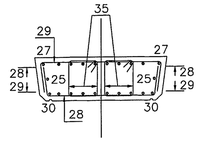

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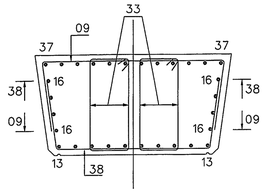

SECTION 4 - 4
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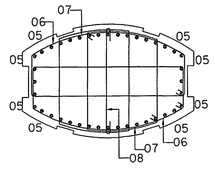


SECTION 5 - 5
SCALE 1 : 25

Note

1. For General Notes see drg. no. 90612/T/FB/5100.

AS-CONSTRUCTED DRAWING

Major Works Project Management Office,
Highways Department,
Hong Kong

Project No.	Contract No.
6553TH	HY /99 /18

Meinhardt Halcrow JV
Sub-Consultants
ACL Asia, MVA Asia Ltd.,
Townland Consultants Ltd., Chesterton Petty Ltd.

Contract Title
Castle Peak Road Improvement Between Sham Tseng and Ka Loon Tsuen, Tsuen Wan

Drawing Title
FOOTBRIDGE No. 01
NORTH PIER
REINFORCEMENT DETAILS

Drawn	Checked	Approved
CPS	LC	HL
Scale 1:25,1:50 AT A1	CAD File No. TFB0161	Date NOV 2007

Drawing No. 90612/T/FB/0161 Rev. Z

$DATE$
$FILE$

Part C - Checking of Existing Column

Existing Footbridge Loading
Span: 29m/2

DL of Beam and Deck:
Mass of concrete x sectional area x length
25 x 1.48 x 29/2 = 537 kN

Factored Load
1.35 x 537 = 724 kN

DL of Steel Roof:
Steel (kPa) x width x length
1.5 x 2.8 x 29/2 = 61 kN

Factored Load
1.2 x 61 = 74 kN

SDL on Beam and Deck:
Mass of finishes x thickness x width x length
23.6 x 0.065 x 2 x 29/2 = 44.5kN

Factored Load
1.5 x 44.5 = 67 kN

LL on Beam and Deck:
LL (kPa) x width x length
5 x 2 x 29/2 = 145kN

Factored Load
1.35 x 145 = 196 kN

Existing Staircase Loading
Span: 9.5m/2

DL of Beam and Staircase:
Mass of concrete x Beam sectional area x length
+ Mass of concrete x stair thickness x Area
25 x 0.7 x 9.5/2 + 25 x 0.3 x 2.8 x 9.5/2 = 182 kN

Factored Load
1.35 x 182 = 246 kN

DL of Steel Roof:
Steel (kPa) x width x length
1.5 x 2.8 x 9.5/2 = 20 kN

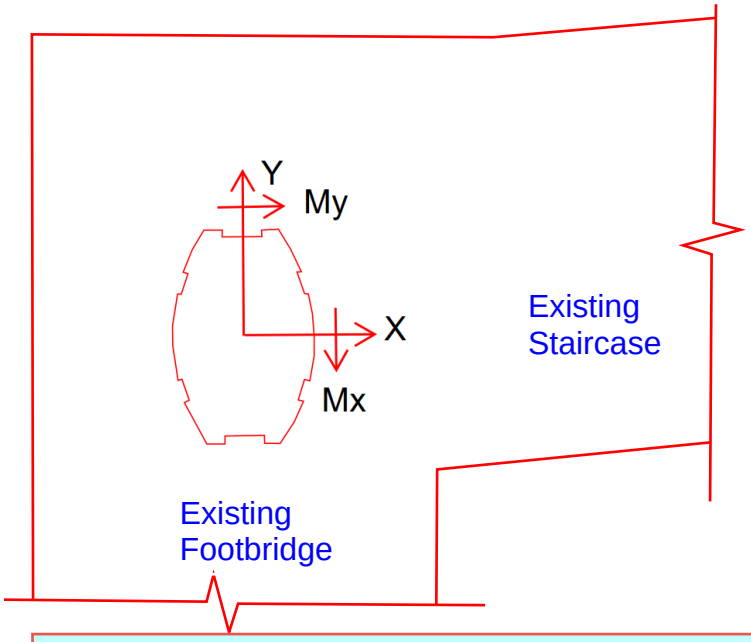
Factored Load
1.2 x 20 = 24 kN

SDL on Beam and Staircase:
Mass of finishes x thickness x width x length
23.6 x 0.05 x 2 x 9.5/2 = 12kN

Factored Load
1.5 x 12 = 18 kN

LL on Beam and Staircase:
LL (kPa) x width x length
5 x 2 x 9.5/2 = 48kN

Factored Load
1.35 x 48 = 65 kN



Earthquake Loading Estimation

Refer to Clause 4.2 of SDMHR 2013, the reference return period, TNCR, shall be taken as 475 years, Class I with importance factor 1.0. Based on the past bridge design experience, a conservative 15% of Total load (DL+SDL+LL) will be adopted for seismic horizontal force at column top

Existing Footbridge Earthquake Lateral Load:
0.15 x (537+61+45.5+145) = 119kN

Existing Staircase Earthquake Lateral Load:
0.15 x (182+20+12+48) = 40kN

Loading Summary for Column
Gravity Load = (Factored DL + SDL + LL) = (724+74+67+196+246+24+18+65)
= 1061+353 = 1414kN
Consider wind = 1414 x 1.2 = 1697 kN

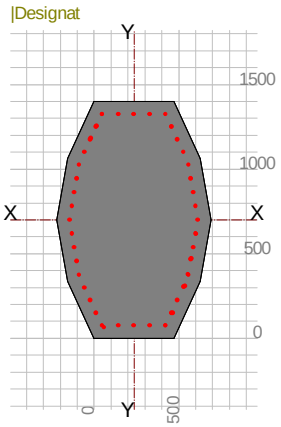
Moment x (Mx):
Gravity Load of bridge with wind x level arm of corbel = 1061 x 1.2 x 1.6 = 2038kNm
Earthquake moment = 119 x 7(Column Length) = 833 kNm
Accidental Load = 205 x (2+3) = 1025kNm
Total Mx = 3896 kNm

Moment y (My):
Gravity Load of bridge with wind x level arm of corbel = 353 x 1.2 x 1.6 = 678kNm
Earthquake moment = 40 x 7(Column Length) = 280 kNm
Accidental Load = 85 x (2+3) = 425kNm
Total Mx = 1383 kNm

Column

General column design by *PROKON*. (GenCol Ver W2.4.01 - 01 Apr 2008)

Design code : HK Concrete 2013



General design parameters:

Given:
Lo = 7.000 m
fcu = 45 MPa
fy = 460 MPa
Ac = 1014955 mm²

Assumptions:
(1) The general conditions of clause are applicable.
(2) The specified design axial loads include the self-weight of the column.
(3) The design axial loads are taken constant over the height of the column.
(5) Concrete simplified stress block depth set at 0.9x ; x = N.A. depth ; fcu in MPa *6.1*

Design approach:

The column is designed using an iterative procedure:
(1) An area of reinforcement is chosen.
(2) The column design charts are constructed.
(3) The corresponding slenderness moments are calculated.
(4) The design axis and design ultimate moment are determined .
(5) The design axial force and moment capacity is checked on the relevant design chart.
(6) The safety factor is calculated for this load case.

Check column slenderness:

End fixity and bracing for bending about the Design axis:
At the top end: Condition 4 (free).
At the bottom end: Condition 1 (fully fixed).
The column is unbraced.
ß = 2.20 *Table 6.11*

Effective column height:
le = ß· Lo = 15.400 m

Check if the column is slender: *6.2.1.1(b)*
le/h = 20.0 > 10
∴ The column is slender.

Initial moments:

The initial end moments about the X-X axis:
M1 = Smaller initial end moment = -0.0 kNm
M2 = Larger initial end moment = 3896.0 kNm

The initial moment near mid-height of the column : *6.2.1.3(b)*
∴ Mi = 0.4M1 + 0.6M2 ≥ 0.4M2 = -2337.6 kNm

The initial end moments about the Y-Y axis:
M1 = Smaller initial end moment = -0.0 kNm
M2 = Larger initial end moment = 1383.0 kNm

The initial moment near mid-height of the column : *6.2.1.3(b)*
∴ Mi = 0.4M1 + 0.6M2 ≥ 0.4M2 = -829.8 kNm

Deflection induced moments: *6.2.1.3(a)*

Design ultimate capacity of section under axial load only:
Nuz = 0.45· fcu· Ac + 0.87· fy· Asc = 30370.3 kN

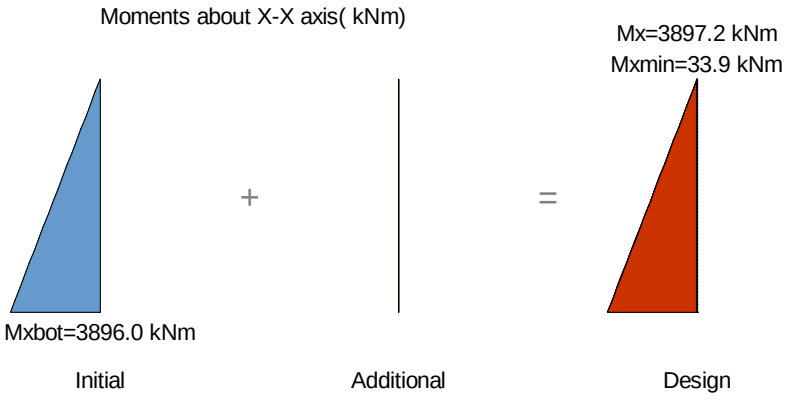
Maximum allowable stress and strain:
Allowable compression stress in steel, fsc = 0.87· fy = 400.0 MPa
Allowable tensile stress in steel, fst = 0.87· fy = 400.0 MPa
Allowable tensile strain in steel, ey = fst/Es = 0.0020 m/m
Allowable compressive strain in concrete, ec = 0.0035 m/m

For bending about the weakest axis:
Weakest axis lies at an angle of -89.78° to the X-X axis
Overall dimension perpendicular to weakest axis h-dc = 834mm
Balanced neutral axis depth, xb = ec/(ec+es)· (h-dc) =530.7 mm
Nbal = 0.44· b· fcu· xbal + ∑(Ast· fs + Asc· fsd) = 12018.1 kN
K = (Nuz - N) / (Nuz - Nbal) = 1.000≤ 1.0
ßa = (1/2000)· (le/h)² = 0.200
∴ Madd = N· ßa· K· h = 309.6 kNm
∴ Maddx = Madd*cos(-89.78°) = 1.2 kNm
∴ Maddy = Madd*sin(-89.78°) = 309.6 kNm

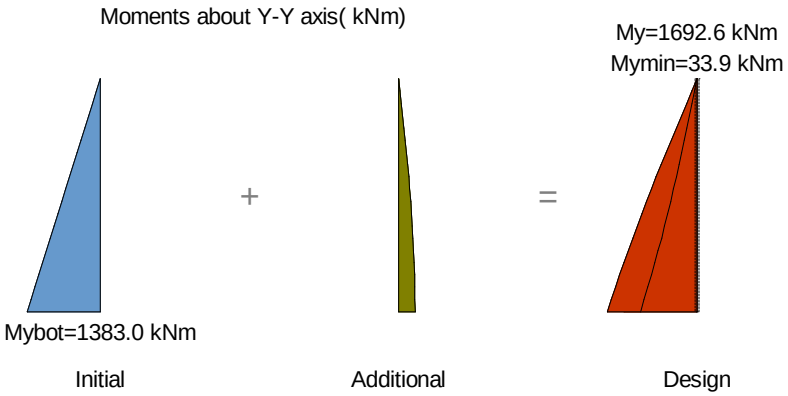
Design ultimate load and moment:

Design axial load:
P_u = 1697.0 kN

For bending about the X-X axis, the maximum design moment is the greatest of: *6.2.1.3(g)*
(a) M2 + Maddx = -3896.0 kNm
(b) emin· N = 33.9 kNm
∴ Mx = 3897.2 kNm



For bending about the Y-Y axis, the maximum design moment is the greatest of: *6.2.1.3(g)*
(a) M2 + Maddy = -1383.0 kNm
(b) emin· N = 33.9 kNm
∴ My = 1692.6 kNm



Check for miminum eccentricity: *6.2.1.2(d)*

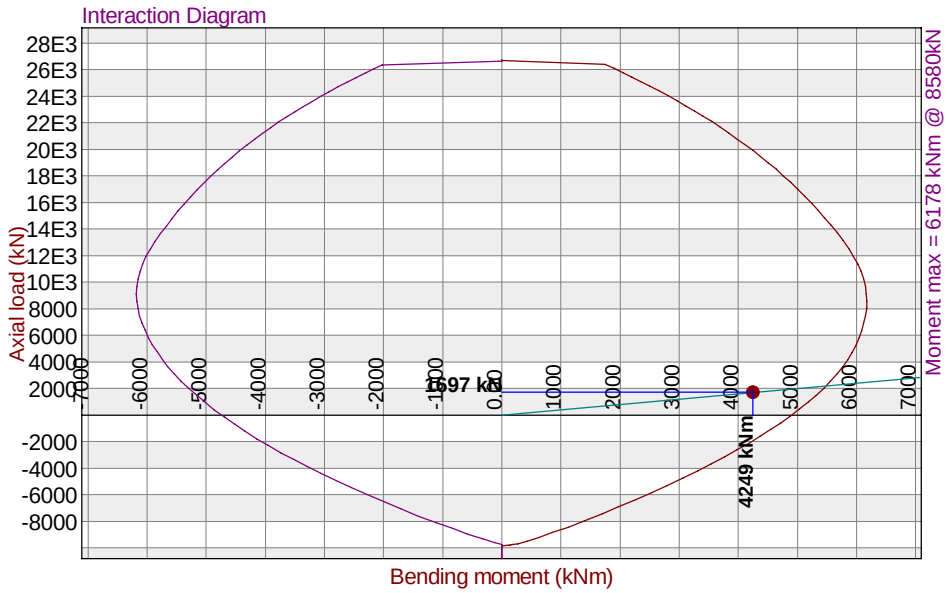
Check that the eccentricity exceeds the minimum in the plane of bending:
Use emin = 20mm
∴ Mmin = 33.9 kNm about the X-X axis.

Design of column section for ULS:

The column is checked for applied moment about the design axis.
Through inspection: the critical section lies at the bottom end of the column.
The design axis for the critical load case 1 lies at an angle of 336.52° to the X-axis
The safety factor for the critical load case 1 is 1.28

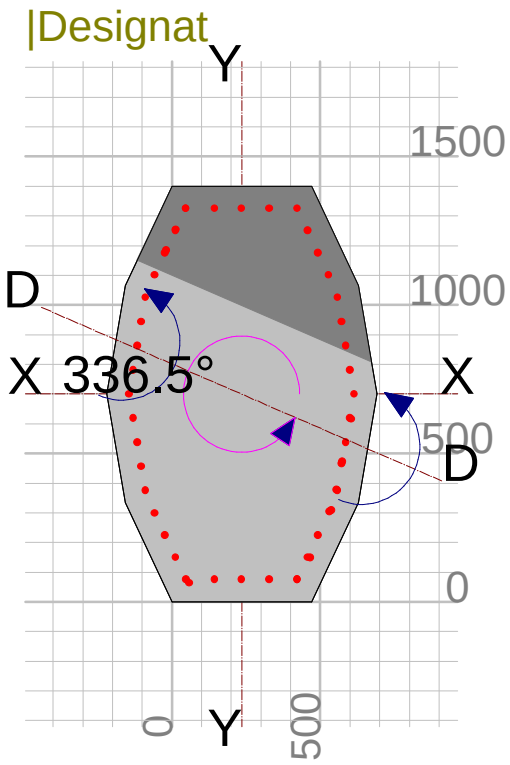
FOS = 1.28 >1 OK!

For bending about the design axis:



Moment distribution along the height of the column for bending about the design axis:
At the top, Mx = 33.9 kNm
Near mid-height, Mx = 2411.9 kNm
At the bottom, Mx = 4248.9 kNm

Stresses at the bottom end of the column for the critical load case 1



Summary of design calculations:

Design table for critical load case:

Moments and Reinforcement for LC 1:1			
	Top	Middle	Bottom
Madd-x (kNm)	0.0	0.9	1.2
Madd-y (kNm)	0.0	232.2	309.6
Mx (kNm)	0.0	-2336.7	3897.2
My (kNm)	0.0	-597.6	1692.6
M' (kNm)	33.9	2411.9	4248.9
Design axis (°)	0.00	345.65	336.52
Safety factor	15.76	2.56	1.28
Asc (mm²)	24544	24544	24544
Percentage	2.36 %	2.36 %	2.36 %
AsNom (mm²)	8120	8120	8120
Critical load case: LC 1			

Design results for all load cases:

Load case	Axis	N (kN)	M1 (kNm)	M2 (kNm)	Mi (kNm)	Madd (kNm)	Design	M (kNm)	M' (kNm)	Safety factor
Load case 1 1	X-X Y-Y	1697.0	0.0 0.0	-3896.0 -1383.0	-2337.6 -829.8	1.2 309.6	Bottom	3897.2 1692.6	4248.9	1.276

Conclusion

The checking of existing column Type 2 is found satisfactory with FOS = 1.29 > 1. Therefore, the removal of the existing ramp will not affect the structural adequacy and will not cause stability problem of the column Type 2.