Silt Screen Deployment Plan

Rev.	Date	Status	Prepared By	Reviewed and Approved By Construction Manager
C	02/05/12	Full Set of Submission	Jeff Chu	Garry Law
B	07/01/12	Submission for Approval	Cecil Cheng	Garry Law
A	12/04/10	Submission for Approval	Cecil Cheng	P C Chan
0	11/03/10	Submission for Approval	Cecil Cheng	P C Chan

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1.0 Introduction

The purpose of this deployment plan is to illustrate the general layout, the construction programme, details on the design, operation and maintenance of the silt screens to be installed for the dredging and filling works of "Wan Chai Reclamation" as recommended in the approved EIA report (Registration No.:AEIAR-125/2008). Chun Wo - CRGL Joint Venture is responsible for the installation, operation, maintenance and removal of the silt screen.

2.0 List of documentation to be referenced

2.1 Particular Specification, the relevant clauses and our remarks for the works are listed as follows for ease of references.

PS Clause No.	Relevant Remarks
PS Appendix 25.4, EP No. EP-356/2009 Clause 2.9 refers.	The permit holder shall liaise with the owners and the operators of the seawater intakes on details of silt screen installation, maintenance and removal at the seawater intakes.
PS Appendix 25.4, EP No. EP-356/2009 Clause 2.9 refers.	At least two weeks prior to the commencement of the marine works, the permit holder shall deposit with the Director four hard copies and one electronic copy of a silt screen deployment plan to provide details of the design, operation and maintenance requirement of the silt screen systems.
PS Appendix 25.4, EP No. EP-356/2009 Clause 2.9 refers.	The silt screen deployment plan shall be certified by the ET Leader and verified by the IEC as conforming to the relevant information and recommendation contained in the approved EIA report (Reg. No. AEIAR-125/2008) and liaison results with the owners and the operators of the seawater intakes.
PS Appendix 25.4, EP No. EP-356/2009 Clause 2.9 refers.	Silt screens shall be installed at seawater intakes prior to the commencement of the corresponding marine works.
PS Appendix 25.4, EP No. EP-356/2009 Clause 2.9 refers.	To avoid refuse entrapment and to ensure representative impact monitoring results, silt screens shall be maintained and refuse around them shall be collected at regular intervals on a daily basis so that water behind the silt screens be kept free from floating debris during the impact monitoring period.

3.0 General Layout of Location of Silt Screen

3.1 The deployment of Silt Screen would be divided into two phase as follow:

3.1.1 **Phase 1 Silt Screens** to be deployed prior to the reclamation works of WCR1. The silt screen to be installed at the existing **WSD salt water intakes** and existing **Sun Hung Kai Centre intakes**. It is anticipated to be installed by **mid of April 2010** and would be maintained for approximate **28 months** until the

commissioning of the new WSD salt water pumping station and new Sun Hung Kai Centre pumping station by end of August 2012.

3.1.2 **Phase 2 Silt Screens** to be deployed prior to the reclamation works of WCR2. The silt screen to be installed at the temporary diversion intakes of **WSD salt water pumping station**, **Sun Hung Kai pumping station**. It is anticipated to be installed by **beginning of March 2012** and would be maintained for approximately **6 months** until the commissioning of the new WSD salt water pumping station and new Sun Hung Kai Centre pumping station by end of August 2012.

3.1.3 **Phase 3 Silt Screens** to be deployed prior to the commissioning of the new WSD salt water pumping station and new Sun Hung Kai Centre pumping station. The silt screen to be installed at the intakes of proposed **WSD salt water pumping station**, proposed **Sun Hung Kai pumping station**, proposed **China Resource Building pumping station** and proposed **Great Eagle Centre/ harbour Centre**. It is anticipated to be installed by **end of August 2012** and would be maintained for approximately **37 months** until the anticipated completion of all marine works by mid August 2015.

3.2 The layout plans and schedule for deployment of silt screens at different phases mentioned should refer to Appendix A.

4.0 Deployment Schedule

4.1 The deployment schedule of the silt screens could refer to the table below. It is prepared based on the Initial Works Programme and may subject to changes to reflect the actual site progress:

Staging	Anticipated Installation Works		Silt Curtain to be Maintained until	Anticipated Removal by	Total Duration, days
	From (a)	To		(b)	= (b) – (a)
Phase 1	15 April, 2010	30 April, 2010	31 August, 2012	31 August, 2012	869
Phase 2	01 March, 2012	06 March, 2012	31 August, 2012	31 August, 2012	183
Phase 3	15 August 2012	31 August 2012	04 August 2015	04 August 2015	1084

4.2 Silt screens installations would be completed prior to the commencement of relevant phase of dredging works, the silt screens would only be removed upon completion of the relevant phases or as agreed with the Engineer.

5.0 Installation Method

5.1 Preparation

5.1.1 Prior to installation of the silt screen, the contractor would liaise with relevant operators for the operation. The pump stations each consist of 2 to 4 number of water intake pipes. Temporary suspension of pump of each intake pipe in turns is required prior to the installation of the respective silt screen system to each intake pipe. The silt screen to each water intake pipe would be installed one by one such that the overall operations of the pump house would not be adversely affected. The schedule of installation works should be agreed by the relevant stakeholders.

5.1.2 The silt screen system would consist of a frame mounted on the external wall of the intake, and a steel fence with geotextile to be inserted into the frame. The silt screen system would be pre-fabricated prior to the installations. Extra number of steel fences with geotextile would be fabricated as standby unit in case of any repairing works required in the future. The details of the pre-fabrication units should refer to Appendix B.

5.2 Installation of the wall mounted frame

5.2.1 The relevant pump of water intake pipe should be switched off. The pre-fabricated steel frame would be lifted to the required position by use of mobile crane.

5.2.2 A foreman would be sited at location near the shoreline to supervise the operation.

5.2.3 Divers would be located at sea near the shoreline to help placing the steel frame in position and for installation of the frame to the external wall of the water pump house by bolt and nuts anchorage.

5.2.4 Holes drilling to the external wall would be carried out by the divers using pneumatic air driller and Hilti bolt Type HSL-3 or equivalent would be adopted as the anchorage system.

5.2.5 Refer to Appendix C for the graphical illustration of the installation of the wall mounted steel frame.

5.3 Installation of the silt screen fencing into the wall mounted frame

5.3.1 The relevant silt screen fencing should be inserted into the wall mounted frame. A foreman would be sited at location near the shoreline to supervise the operation.

5.3.2 The pump of water intake pipe should be switched off. The pre-fabricated silt screen fencing would be lifted to the required position by use of mobile crane or crane barge.

5.3.3 Divers would be located at sea near the shoreline to help placing of the silt screen fencing to proper positions. A steel wire would be installed to the lifting eye of the silt screen fencing for ease of later maintenance. The steel wire would then be brought up to the ground level and fix to the chain block pulley would to be installed on land.

5.3.4 Refer to Appendix C for the graphic illustration of the installation of the silt screen fencing into the wall mounted frame.

5.4 Silt Screen has been designed to have sufficient clearance from the external wall of the pump houses to allow placing of relevant equipment by Environmental Team to carry out water measurement and sampling behind the screens. Either marine access or land access would be maintained at all time for the Environmental Team to perform their monitoring duties, layout plans illustrating the access routes are attached in Appendix G.

6.0 Maintenance and Removal

6.1 Site foreman and supervisors will be assigned to check the condition of the silt screens at regular intervals on a daily basis during the course of the marine works. An inspection checklist with format as attached in Appendix D would be used for recording the conditions of the silt screens.

6.2 Completed checklists will be kept on site for record.

6.3 If silt screens are found damaged and repairing works are identified as necessary, all marine works at our works area in relation to the location of silt screens would be suspended. The silt screens would be lifted up from the sea by using chain block pulley system, and the damaged parts (e.g. geotextile filter, steel mesh, steel frame…etc) of silt screens would be replaced.

6.4 The suspended marine works as mentioned could only be resumed after satisfactorily repairing of the damaged silt screens.

6.5 As regular maintenance, refuse collection around the silt screens would be carried out on daily basis to avoid blockage of sea water flow by floating debris.

6.6 Spare geotextile materials and pre-fabricated silt screen would be stored on site. It would be treated as standby materials to allow for prompt replacement in case of any damages the silt screens observed.

6.7 Prior to removal of the silt screen, the contractor would liaise with relevant operators for the shutting down of system or reduce of intake rate by turning off 1 or 2 pumps. The silt screen would then be lifted up by using chain block pulley system. Any screw nuts of anchor bolts find to be loosen under the water level would be tied up immediately by divers.

7.0 Technical Details and Materials for the Silt Screen

7.1 The Silt Screens would be pre-fabricated on site prior to installation to the relevant intakes. The typical details and calculation checking of the silt screen system should refer to Appendix B. ICE checking certificates would be separately submitted to the Engineer on site.

7.2 The permeable Silt Screens would consist of geotextile materials. The technical properties of the geotextile materials should refer to Appendix E.

7.3 The Silt Screen would also consist of steel mesh material as fencing. The technical properties of the steel mesh material should refer to Appendix F. Galvanized mild steel mesh will be used.

7.4 All other steel materials for the steel frame to be complied with Grade 43A or S275 standards. All steel materials to be galvanized mild steel.

8.0 Liaison Results with the Intake Owner and Operator

8.1 Silt Screens for Existing Sun Hung Kei Pump Station Intakes

8.1.1 Responsible person named Mr. Y. C. Lee, posted Senior Maintenance Engineer, tel: 3766 6164, mobile 9160 6832 and e-mail: yclee1@shkmgt.com.

8.1.2 It is agreed that the silt screens to be mounted on the external wall face of the pump house. The permeable silt screens should be removable type and the screens should be lifted up and removed upon requested from Sun Hung Kei Pump Station for ease of their regular maintenance.

8.1.3 It is principally agreed that the installations of silt screens to be carried out on Saturday. The exact schedule of installation work shall be further coordinated in order to minimize downtime of the sea water pumps.

8.1.4 Trial test shall be performed on site to check the functionality of the silt screens before it is put into full operations.

8.2 Silt Screens for Existing WSD Pump Station Intakes

8.2.1 Responsible person named Mr. K. Y. Hong, posted Inspector Mechanical, tel: 2880 2528 and e-mail: kam_yiu_hong@wsd.gov.hk.

8.2.2 It is agreed that the silt screens to be mounted on the external wall face of the pump house. The permeable silt screens should be removable type and the screens should be lifted up and removed upon requested from Water Supplies Department for ease of their regular maintenance.

8.2.3 It is agreed that the base and sides of the wall mounted frame to be sealed up by fixed steel plate instead of hanging curtain materials, to ensure protection to the intake systems.

8.2.4 The exact date for installation works should be further confirmed with WSD representative prior to operations.

8.3 Silt Screens for other Proposed Pump Station Intakes

8.3.1 Liaisons with relevant owners to be carried out at least one month prior to installations of relevant silt screens.

8.3.2 The design and installation details of the silt screens for the proposed pump houses to be discussed and agreed with relevant owners prior to functioning of relevant pump houses on 2012.

9.0 Appendices

9.1 Appendix A – Silt Screen Deployment Plan

9.2 Appendix B – Detailed Drawing and Calculation Checking of the Silt Screen System

9.3 Appendix C – Graphical Illustration for the Installations of the Silt Screen System

9.4 Appendix D – Daily Inspection Checklist

9.5 Appendix E – Technical Properties of the Geotextile Material – Tencate Mirafi FW300

9.6 Appendix F – Technical Properties of the Steel Mesh Material – Golik 228G

9.7 Appendix G - Access of Environmental Team to carry out water measurement and sampling

9.1 Appendix A – Silt Screen Deployment Plan

SILT SCREEN SCHEDULE			
ACTIVITY	DURATION	START	FINISH
PHASE 1 SILT SCREEN Installation of silt screen at existing intakes of WSD salt water pump house & SHK Centre pump station prior to WCR1 reclamation & to be maintained until comission of phase 2 silt screen	Approx. 24 months	30/04/10	31/08/12
PHASE 2 SILT SCREEN Installation of silt screen at temporary diversion intake of WSD salt water pump house & SHK Centre pump station prior to WCR2 dredging, rockfilling and reclamation, & to be maintained until comission of new WSD & SHK pumping station	Approx. 6 months	06/03/12	31/08/12
PHASE 3 SILT SCREEN Installation of silt screen at proposed intakes of pump stations of Great Eagle Centre/ Habour Centre, SHK Centre, China Resource Building, and WSD Salt Water Pump House prior to commissioning of the new pump stations & to be maintained until completion of marine works	Approx. 37 months	31/08/12	04/08/15

N

E 836040

E 836240

E 836440

N 816230

N 816030

N 815830

GOLDEN BAUHINIA SQUARE

VICTORIA HARBOUR

VIC

RECLAMATION WORKS BY OTHERS

TUNNEL WORKS BY OTHERS

35m CLEAR SPACE

PROPOSED PHASE 3 SILT SCREEN

P7

P8

P9

WCR1 RECLAMATION

TEMPORARY SEAWALL

EXISTING SUBMARINE OUTFALL (SEWAGE)

TUNNEL WORKS BY OTHERS

TEMPORARY SEAWALL

PROPOSED PHASE 1 SILT SCREEN

ADDITIONAL PIPELINES FOR INTAKE DIVERSION DURING PHASE 2 WORKS

PROPOSED PHASE 2 SILT SCREEN

TEMPORARY DIVERSION INTAKE OF EXISTING WSD AND SHK PUMPING STATION

INTAKE OF EXISTING WSD SALT WATER PUMP STATION

INTAKE OF EXISTING SHK CENTRE PUMP STATION

INTAKE OF PROPOSED CHINA RESOURCE BUILDING PUMP STATION

INTAKE OF PROPOSED WSD SALT WATER PUMP HOUSE

INTAKE OF PROPOSED SHK CENTRE PUMP STATION

INTAKE OF PROPOSED GREAT EAGLE CENTRE / HARBOUR CENTRE PUMP STATION

0 20 40 60m

1 : 2000 SCALE BAR

REV. 修訂	DESCRIPTION 內容摘要	CHK'D 核對	APP'D 批准	DATE 日期

CLIENT

CEDD 土木工程拓展署 Civil Engineering and Development Department

俊和－中國中鐵聯營 CHUN WO – CRGL JOINT VENTURE

WAN CHAI DEVELOPMENT PHASE II–
CENTRAL – WAN CHAI BYPASS AT WAN CHAI EAST

SILT SCREEN DEPLOYMENT PLAN

AECOM

DRG.NO. 圖紙編號 HK/2009/02/M/R/007C

DESIGNED BY 設計	CONTRACT NO. 合約編號	P. Dir. APPROVED 批准人
CC	HK/2009/02	
DRAWN BY 繪圖 AC	STATUS 階段	
SCALE 比例 1:2000 (A3)		
DIMENSIONS ARE IN 尺寸單位 MILLIMETRES	© COPYRIGHT RESERVED 版權所有	

9.2 Appendix B – Detailed Drawing and Calculation Checking of the Silt Screen System

Certificate No. : HK200902/0257

Check Certificate for Temporary Works

(SCC Clause 26 and PS Clause 1.93)

CONTRACT NO. HK/2009/02

Wan Chai Development Phase II – Central – Wan Chai Bypass at Wan Chai East

Description of Temporary Works (*full description including drawing references, if any*)		
Temporary Works Design For Additional Silt Screen for WSD and SHK Pumping Station's Water Pipes Diversion **Document No.: S209.RP119 dated November 2011 (Prepared by WT Chan & Associates Ltd.)**		
Drawing No.	*Rev*	*Description*
S209/WCR2/SS/01	**-**	**Location Plan for Proposed Additional Silt Screen**
S209/WCR2/SS/02	**-**	**Typical Details (Sheet 1 of 3)**
S209/WCR2/SS/03	**A**	**Typical Details (Sheet 2 of 3)**
S209/WCR2/SS/04	**A**	**Typical Details (Sheet 3 of 3)**

I/We* certify that the Temporary Works described above have been properly and safely designed and the design has been checked and found satisfactory by the checking engineer.

Date 13 December 2011 Signed _____ *

(WONG KWOK KEUNG) (name)

For and on behalf of **CW-CRGL JV**

(Contractor)

I certify that reasonable professional skill and care has been used in the checking of the Temporary Works described above have been properly and safely designed and that I have checked the design and found it satisfactory.

Date 13 December 2011 Signed _____

ATKINS CHINA LIMITED
This document/drawing is endorsed by Independent Checking Engineer / Independent Design Checker
CHAN CHI KONG
REGISTERED STRUCTURAL ENGINEER-RSE 88/99
MSc MBA CEng MICE MIStructE MHKIE
RGE RSE (PRC)
Checked by
Reviewed by

(name and qualification of checking engineer)

* Delete as appropriate.

* Person signing shall be duly authorized by the Contractor.

Temporary Works Design
For Additional Silt Screen for
WSD and SHK Pumping Station's
Water Pipes Diversion And
The Wan Chai Development Phase II –
Central – Wan Chai Bypass at Wan Chai East
Under the Contract No. HK/2009/02

ATKINS CHINA LIMITED

This document/drawing is endorsed by Independent Checking Engineer / Independent Design Checker

CHAN CHI KONG
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Ir Dr. W. T. Chan

S209.RP119A

November 2011

Content

Appendices

Report Summary

Report Revision	Drawing no.	Design Changes	Date
	S209/WCR2/SS/01 S209/WCR2/SS/02 S209/WCR2/SS/03 S209/WCR2/SS/04	-	November 2011
A	S209/WCR2/SS/01 S209/WCR2/SS/02 S209/WCR2/SS/03 S209/WCR2/SS/04A	Response to ICE's comment	November 2011

1. Introduction

Chun Wo–CRGL Joint Venture has been awarded the Contract of construction works for the Wan Chai Development Phase II – Central – Wan Chai Bypass at Wan Chai East under the Contract No. HK/2009/02. This project is mainly comprised of Central – Wan Chai Bypass tunnel (from the east of Fleming Road to the west edge of the former Wan Chai Public Cargo Working Area) with associated reclamation works and construction of permanent seawall and also the reprovision of Wan Chai Ferry Pier.

Before the commencement of dredging works in WCR2, temporary steel frames are proposed for water pipe diversion including the intakes and outfall pipes along the existing shoreline for WSD Wan Chai Water Pumping Station and SHK Cooling Water Pumping Station.

This report aims to present the design calculation for the additional silt screen for supporting the water pipe diversion including the intakes and outfall pipes along the existing shoreline. For the location of the additional silt screen, refer to the submission drawing.

2. Checking Summary

1.	DESIGN CODE
1.1	Code of Practice for the Structural Use of Structural Steel 2005
2.	CRTICAL SECTIONS
2.1	The design calculation will cover the additional silt screen for supporting the water pipe diversion including the intakes and outfall pipes along the existing shoreline. Working platform and hoisting beam is also proposed for the maintenance purpose of silt screen.
2.2	For the steel frame design, the steel frame system is mainly used for supporting the 1.2m/1.0m intake pipes and 1.2m outfall pipe as well as the working platform and hoisting beam on top of the steel frame.
3.	ENGINEERING DESIGN
3.1	The structural design for the structural member of temporary supporting steel frame system is in accordance with Code of Practice for the Structural Use of Structural Steel 2005.

3. Engineering Design

Temporary steel frame with silt screen is proposed to support the temporary extension of intakes and outfalls pipes from the WSD pumping station and SHK pumping station. Decking platform and hoisting beam is also proposed on top of the steel frame to facilitate the routine maintenance of silt screen. It is also used as working platform for cleaning and silt screen panel maintenance works as required. The structural steel design is in accordance with Code of Practice for the Structural Use of Structural Steel 2005.

The detailed design calculation is shown in Appendix A.

4. Conclusion

This report presents the design calculation for the temporary steel well with decking platform and hoisting beam for supporting the temporary extension of intakes and outfalls pipes from the WSD pumping station and SHK pumping station as well as maintenance works for the silt screen. The structural steel design is in accordance with Code of Practice for the Structural Use of Structural Steel 2005.

Based on our structural analyses of the proposed steel frame system, we consider the proposed design works are structurally feasible and safe.

Appendix A

Temporary Design for Additional Silt Screen

B0. Total Dead Load from the framework system for supporting the gridmesh

Use	**SHS**	**150**	x	**150**	x	**8**	**thk**	**(Grade**	**S275**	**)**	-M1
Use	**SHS**	**100**	x	**100**	x	**8**	**thk**	**(Grade**	**S275**	**)**	-M2
Use	**SHS**	**100**	x	**100**	x	**8**	**thk**	**(Grade**	**S275**	**)**	-M3
Use	**UC**	**203**	x	**203**	x	**71**	**kg/m**	**(Grade**	**S275**	**)**	-M4
Use	**Channel**	**102**	x	**51**	x	**10.42**	**kg/m**	**(Grade**	**S275**	**)**	-M5
Use	**Angle**	**50**	x	**50**	x	**6**	**thk**	**(Grade**	**S275**	**)**	-M6

Total Length of member M1	=	7.2	m
Total Length of member M2	=	10.8	m
Total Length of member M3	=	7.0	m
Total Length of member M4	=	15	m
Total Length of member M5	=	45	m
Total Length of member M6	=	60.96	m

Total Dead Load of member M1 to M	=	35.4	x	7.2		(M1)	
(DL)	+	22.9	x	10.8		(M2)	
	+	22.9	x	7		(M3)	
	+	71	x	15		(M4)	
	+	10.42	x	45		(M5)	
	+	4.47	x	60.96		(M6)	
	=		2469		kg		
	=		24		kN	say 30	kN

Loading on beam (Side) DL1 = 30 / 4 x 0.25 = 2 kN/m

Loading on beam (Centre) DL2 = 30 / 4 x 0.50 = 4 kN/m

LENGTH OF BEAM TO DETERMINE THE EQUIVALENT UDL

B1. Steel Beam Design (Side)

Use 1 UC 305 x 305 x 97 kg/m (Grade S275)

Length of Beam L_B = 4 m (Max.)
Length of Pipe L_P = 5 m (Max.)

HALF OF THE BEAM

Vertical Load on Beam
weight of 1.2m CHS on beam wt = 1200 x 3.14 x 8 x 7850 kg/m³ x 5 / 2.0
= 592 kg/m
weight of water on beam ww = 600 x 600 x 3.14 x 1000 kg/m³ x 5 / 2.0
= 2827 kg/m

UDL due to the framework for supporting the gridmesh DL1 = 2 kN/m

Bending Moment $Mx = \frac{(1.4\,wt. + 1.6\,ww + 1.6DL1) \times L_B^2 \times 1}{8}$
= 105 kNm

Shear Force $Vx = \frac{(1.4\,wt. + 1.6\,ww + 1.6DL1) \times L_B \times 1}{2}$
= 109 kN

STRUCTURAL DESIGN BASED ON CODE OF PRACTICE FOR THE STRUCTURAL USE OF STEEL 2005

Use 1 UC 305 x 305 x 97 kg/m (Grade S275)

E	=	205000 N/mm²	r_x	=	13.4 cm					
I_{xx}	=	22202 cm⁴	r_y	=	7.7 cm	t	=	9.9 mm		
Z_x	=	1442 cm³	B	=	304.8 mm	T	=	15.4 mm	<	16mm
S_x	=	1589 cm³	D	=	307.8 mm	∴ p_y	=	275 N/mm²		
A	=	123.3 cm²	L_{Ex}	=	4 m	L_{Ey}	=	4 m		

Maximum Compression	P	=	0	/ 1 =	0	kN	per strut
Maximum Bending Moment	Mx	=	105	/ 1 =	105	kNm	per strut
Maximum Bending Moment	My	=	0	/ 1 =	0	kNm	per strut
Maximum Shear Force	Vx	=	109	/ 1 =	109	kN	per strut
Maximum Shear Force	Vy	=	0	/ 1 =	0	kN	per strut

i. Check for shear

$P_v = 0.6\, p_y A_v$ $\quad A_v = tD = 3047\ mm^2$

$= 0.6 \times 275 \times 3047 / 1000$

$= 503\ kN > F_v = 109\ kN$ O.K.

$P_v = 0.6\, p_y A_v$ $\quad A_v = tD = 3047\ mm^2$

$= 0.6 \times 275 \times 3047 / 1000$

$= 503\ kN > F_v = 0\ kN$ O.K.

ii. Check for moment

$F_v = 109\ kN$ (Shear Force @ max. moment)

$< 0.6\, P_v = 302\ kN$

$M_{cx} = p_y S_x$

$= 275 \times 1589 / 1000$

$= 437\ kNm < 1.2\, p_y Z_x = 1.2 \times 275 \times 1442 / 1000$

$= 476\ kNm$

$\therefore M_{cx} = 437\ kNm > M_x = 105\ kNm$ O.K.

$F_v = 0\ kN$ (Shear Force @ max. moment)

$< 0.6\, P_v = 302\ kN$

$M_{cy} = p_y S_y$

$= 275 \times 724 / 1000$

$= 199\ kNm > 1.2\, p_y Z_y = 1.2 \times 275 \times 477 / 1000$

$= 157\ kNm$

$\therefore M_{cy} = 157\ kNm > M_y = 0\ kNm$ O.K.

iii. Check for lateral torsional buckling

$\lambda_{LT} = u\, v\, \lambda\, (\beta_w)^{1/2}$

$u = 0.900$

$\lambda = L_{Ey} / r_y$

$= 3.85 \times 10^3 / (7.68 \times 10)$

$= 50.13$

$x = D / T = 19.99$

$v = \dfrac{1}{(1 + 0.05 (\lambda / x)^2)^{0.25}}$

$= 0.934$

$\beta_w = 1.00$

$\lambda_{LT} = 0.90 \times 0.934 \times 50.13 \times 1.00^{0.5}$

$= 42.14$

$\therefore p_b = 273.0\ N/mm^2$ (from table 8.3a)

$\therefore M_b = p_b S_x$

$= 273 \times 1589.0 \times 1000$

$= 433.80\ KNm > M_x = 105.31\ KNm$ O.K.

A3

iv. Check for compression

$\lambda_x = L_{Ex} / r_x$
$= 3.85 \times 10^3 / (13.4 \times 10)$
$= 28.7 \rightarrow p_c = 267 \ N/mm^2$ (from table 8.8(b))

$\lambda_y = L_{Ey} / r_y$
$= 3.9 \times 10^3 / (7.68 \times 10)$
$= 50.1 \rightarrow p_c = 238 \ N/mm^2$ (from table 8.8(c))

$\therefore p_c = 238 \ N/mm^2$

$\therefore P_c = p_c A$
$= 238 \times 123 \times 100$
$= 2934.5 \ kN > F_c = 0.00 \ kN$ O.K.

v. Combined axial compression and moment

a. Local capacity check

$$\frac{F_c}{A p_y} + \frac{M_x}{M_{cx}} + \frac{M_y}{M_{cy}} = \frac{0.00 \times 1000}{123.3 \times 100 \times 275} + \frac{105.31}{437.0} + \frac{0.00}{157.4}$$
$= 0.00 + 0.241 + 0.000$
$= 0.24$
< 1 O.K.

b. Overall buckling check

$m = 1$

$$\frac{F_c}{A p_c} + \frac{mM_x}{M_b} + \frac{M_y}{M_{cy}} = \frac{0.00}{2934.54} + \frac{1 \times 105.31}{433.80} + \frac{0.00}{157.4}$$
$= 0.000 + 0.243 + 0.000$
$= 0.243$
< 1 O.K.

B2. Steel Beam Design (Centre)

Use 1 UC 305 x 305 x 97 kg/m (Grade S275)

Length of Beam L_B = 4 m (Max.)
Length of Pipe L_P = 2.5 m (Max.)

Width of 1.2m dia.

Vertical Load on Beam

weight of 1.2m CHS wt = 1200 x 3.14 x 8 x 7850 kg/m3 x 2.5 / 1.2
= 493 kg/m

weight of wate ww = 600 x 600 x 3.14 x 1000 kg/m^3 x 2.5 / 1.2
= 2356 kg/m

UDL due to the framework for supporting the gridmesh DL2 = 4 kN/m

Bending Moment $$Mx = \frac{(\ 1.4\ wt.\ +\ 1.6\ ww\ +\ 1.6\ DL2\ )\ x\ L_B^{\ 2}\ x\ 1}{8}$$
= 102 kNm

Shear Force $$Vx = \frac{(\ 1.4\ wt.\ +\ 1.6\ ww\ +\ 1.6\ DL2\ )\ x\ L_B\ x\ 1}{2}$$
= 102 kN

STRUCTURAL DESIGN BASED ON CODE OF PRACTICE FOR THE STRUCTURAL USE OF STEEL 2005

Use 1 UC 305 x 305 x 97 kg/m (Grade S275)

E	=	205000	N/mm^2	r_x	=	13.4	cm				
I_{xx}	=	22202	cm^4	r_y	=	7.7	cm	t	=	9.9	mm
Z_x	=	1442	cm^3	B	=	304.8	mm	T	=	15.4	mm < 16mm
S_x	=	1589	cm^3	D	=	307.8	mm	∴ p_y	=	275	N/mm^2
A	=	123.3	cm^2	L_{Ex}	=	4.00	m	L_{Ey}	=	4.00	m

Maximum Compression	P	=	0	/ 1 =	0	kN	per strut
Maximum Bending Moment	Mx	=	102	/ 1 =	102	kNm	per strut
Maximum Shear Force	Vx	=	102	/ 1 =	102	kN	per strut

i. Check for shear

$P_v = 0.6\, p_y A_v$ $\qquad A_v = tD = 3047\ mm^2$

$= 0.6 \times 275 \times 3047 / 1000$

$= 503\ kN > F_v = 102\ kN$ O.K.

ii. Check for moment

$F_v = 102\ kN$ (Shear Force @ max. moment)

$< 0.6\, P_v = 302\ kN$

$M_{cx} = p_y S_x$

$= 275 \times 1589 / 1000$

$= 437\ kNm < 1.2\, p_y Z_x = 1.2 \times 275 \times 1442 / 1000$

$= 476\ kNm$

$\therefore M_{cy} = 437\ kNm > M_y = 102\ kNm$ O.K.

iii. Check for lateral torsional buckling

$\lambda_{LT} = u\, v\, \lambda (\beta_w)^{1/2}$

$u = 0.900$

$\lambda = L_{Ey} / r_y$

$= 4.00 \times 10^3 / (7.68 \times 10)$

$= 52.08$

$x = D / T = 19.99$

$$v = \frac{1}{(1 + 0.05 (\lambda / x)^2)^{0.25}}$$

$= 0.930$

$\beta_w = 1.00$

$\lambda_{LT} = 0.90 \times 0.930 \times 52.08 \times 1.00^{0.5}$

$= 43.57$

$\therefore p_b = 273.0\ N/mm^2$ (from table 8.3a)

$\therefore M_b = p_b S_x$

$= 273 \times 1589.0 \times 1000$

$= 433.80\ KNm > M_x = 102.18\ KNm$ O.K.

iv. **Check for compression**

$\lambda_x = L_{Ex} / r_x$
$= 4.00 \times 10^3 / (13.4 \times 10)$
$= 29.9 \rightarrow p_c = 267 \ N/mm^2$ (from table 8.8(b))

$\lambda_y = L_{Ey} / r_y$
$= 4.0 \times 10^3 / (7.68 \times 10)$
$= 52.1 \rightarrow p_c = 238 \ N/mm^2$ (from table 8.8(c))

$\therefore p_c = 238 \ N/mm^2$

$\therefore P_c = p_c A$
$= 238 \times 123 \times 100$
$= 2934.5 \ kN > F_c = 0.00 \ kN$ O.K.

v. **Combined axial compression and moment**

a. **Local capacity check**

$$\frac{F_c}{A\,p_y} + \frac{M_x}{M_{cx}} = \frac{0.00 \times 1000}{123.3 \times 100 \times 275} + \frac{102.18}{437.0}$$
$= 0.00 + 0.234$
$= 0.23$
< 1 O.K.

b. **Overall buckling check**

$m = 1$

$$\frac{F_c}{A\,p_c} + \frac{mM_x}{M_b} = \frac{0.00}{2934.54} + \frac{1 \times 102.18}{433.80}$$
$= 0.000 + 0.236$
$= 0.236$
< 1 O.K.

B3. Design of Welding - 6 mm F.W.

Provide 6mm F.W. in between Post and Strut

Max. Shear Force = 67 kN (factored load From part B2)

Welding length = 305 x 4
= 1220 mm

Strength of fillet weld = 220 N/mm^2

Allowable shear force from welding $= \frac{0.7 \times 220 \times 1220.0 \times 6}{1000}$
= 1127 kN
> 67 kN OK

B4. Steel Post Design

Use 1 UC 305 x 305 x 97 kg/m (Grade S275)

Loading from Side Beam $P = 109 \times 3$
$= 328$ kN

Loading from land Side Beam $P = 3 \times 3$
$= 10$ kN

Length on Post $L = 9$ m (Max.)

Compression Force $P = \frac{1.4 \text{ wt.} \times L \times 1}{1}$
$+ P = 350$ kN

STRUCTURAL DESIGN BASED ON CODE OF PRACTICE FOR THE STRUCTURAL USE OF STEEL 2005

Use 1 UC 305 x 305 x 97 kg/m (Grade S275)

E	= 205000 N/mm^2	r_x	= 13.4	cm						
I_{xx}	= 22202 cm^4	r_y	= 7.7	cm	t	=	9.9	mm		
Z_x	= 1442 cm^3	B	= 304.8	mm	T	=	15.4	mm	<	16mm
S_x	= 1589 cm^3	D	= 307.8	mm	$\therefore p_y$	=	275	N/mm^2		
A	= 123.3 cm^2	L_{Ex}	= 9.00	m	L_{Ey}	=	9.00	m		

Maximum Compression $P = 350 / 1 = 350$ kN per post

i. Check for compression

$\lambda_x = L_{Ex} / r_x$
$= 9.00 \times 10^3 / (13.4 \times 10)$
$= 67.2 \rightarrow p_c = 206$ N/mm^2 (from table 8.8(b))

$\lambda_y = L_{Ey} / r_y$
$= 9.0 \times 10^3 / (7.68 \times 10)$
$= 117.2 \rightarrow p_c = 111$ N/mm^2 (from table 8.8(c))

$\therefore p_c = 111$ N/mm^2

$\therefore P_c = p_c A$
$= 111 \times 123 \times 100$
$= 1368.6$ kN > $F_c = 350.23$ kN O.K.

B5. Steel Post Design

Use 1 CHS 273 x 8 **thk** (Grade S275)

Loading from UC post P = 350 kN

unit weight of CHS wt. = 52 kg/m

Length on Post L = 9.7 m (Max.)

Compression Force $P = \dfrac{1.4\,\text{wt.} \times L \times 1}{1} + P$ = 357 kN

STRUCTURAL DESIGN BASED ON CODE OF PRACTICE FOR THE STRUCTURAL USE OF STEEL 2005

Use 1 CHS 273 x 8 **thk** (Grade S275)

E	=	205000 N/mm^2	r_x	=	9.4	cm				
I_{xx}	=	5852 cm^4	r_y	=	9.4	cm	t	=	8	mm
Z_x	=	429 cm^3	B	=	273	mm	T	=	8	mm < 16mm
S_x	=	562 cm^3	D	=	273	mm	$\therefore p_y$	=	275	N/mm^2
A	=	66.6 cm^2	L_{Ex}	=	9.70	m	L_{Ey}	=	9.70	m

Maximum Compression P = 357 / 1 = 357 kN per post

i. Check for compression

$\lambda_x = L_{Ex} / r_x$
= 9.70 x 10^3 / (9.4 x 10)
= 103.5 > p_c = 149 N/mm^2 (from table 8.8(a))

$\therefore P_c = p_c A$
= 149 x 67 x 100
= 992.3 kN > P_c = 357.20 kN O.K.

B6. Design of Welding - 6 mm F.W.

Provide 6mm F.W. in between UC post and CHS post

Max. Shear Force = 357 kN (factored load between UC post and CHS post)

Welding length = 700 x 1
= 700 mm

Strength of fillet weld = 220 N/mm^2

Allowable shear force from welding $= \frac{0.7 \times 220 \times 700.0 \times 6}{1000}$

= 647 kN

> 357 kN OK

B7. Design of Bolt Connection

Provide 4 nos. M20 Through Bolt between Post and Strut

Max. Shear Force = 67 kN (factored load From part B2)

Force per bolt = 67 / 4
= 17 kN

Shear Strength of Grade 8.8 Through Bolt = 375 N/mm^2

Shear Area of M20 Bolt = $\frac{\pi \ (\ 20 \ - \ 2 \ )^{2}}{4}$
= 254.47 mm^2

Allowable shear force for Grade 8.8 Through Bolt = $\frac{375 \ x \ 254.5}{1000}$
= 95 kN
> 17 kN OK

A12

B8. Design for Anchor Bolt fix on Seawall

From Part B1 and B2,

Design Force (factored), V = 109 kN

6 No.s M 20 HSA Anchor Bolt with min. 103 mm embedment depth

Grade of concrete, f_{cu} = 30 N/mm^2

Adopted Factor of safety = 1.5

∴ Partial safety factor for working load required = adopted FOS / Hilti factor

= 1.5 / 1.5 = 1.00

SHEAR DESIGN CHECKING

As the edge diatance, c, is very far in these case, the value of concrete cone resistance would be very larg
Only steel shear resistance shall be considered for the anchor.

Design Shear Resistance, $V_{Rd,s}$ = 41.70 kN (Hilti 07/08)

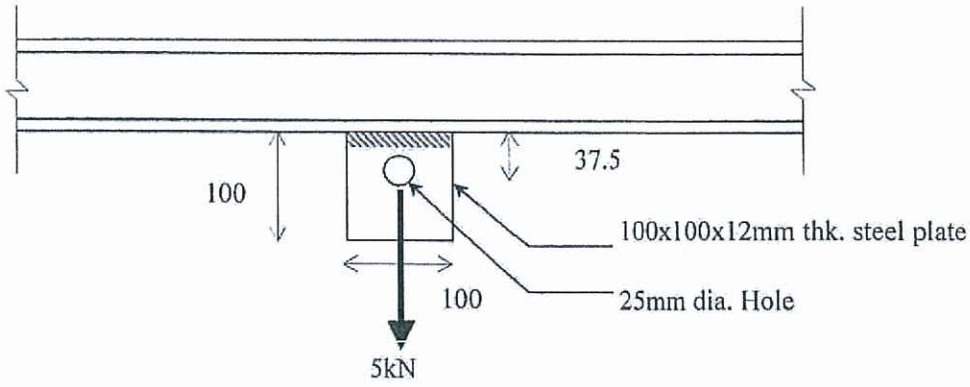
Factored Shear Force, P_s = T / 6 = 18.24 kN (per bolt)

∴ Factored Load acting on the anchor = P_s x α

= 18.24 kN

< 41.70 kN = $V_{Rd,s}$ O.K.

B9. Steel Plate Design Check for lifting system



Loading acting on steel plate $F_v = 5 \times 1.6$ (assumed maximum value)
$= 8$ kN

Yeild Strength $p_y = 275$ N/mm^2

Shear Area $Av = 50 \times 12 \times 0.9$
$= 540$ mm^2

i. Check for shear

$P_v = p_y A_v / (3)^{0.5}$
$= 0.58 \times 275.0 \times 540.0 / 1000$
$= 85.7$ kN $>$ $F_v = 8.0$ kN O.K.

i. Check for welding

Max. Tensile Forc = 8 kN (factored)

Welding length = 100 x 1
= 100 mm

Strength of fillet weld = 220 N/mm^2

Allowable shear force from welding $= \dfrac{0.7 \times 220 \times 100.0 \times 6}{1000}$
$= 92$ kN
$>$ 8 kN OK

Provide 6mm F.W. in between the steel plate and member M2.

AM

B10. Design Check for Member M2

Use 1 SHS 150 x 150 x 8 thk. (Grade S275)

Loading acting on steel plate $F_v = 5 \times 1.6$ (assumed maximum value)
$= 8$ kN

Self weight of M2 udl $= 35.4 \times 9.81 / 1000$
$= 0.35$ kN

Length of M2 $L = 2.3$ m

Bending Moment $Mx = \frac{(\text{1.4 wt.}) \times L^2 \times 1}{8} + \frac{Fv \times L}{4}$
$= 5$ kNm

Shear Force $Vx = \frac{(\text{1.4 wt.}) \times L \times 1}{2} + \frac{Fv}{2}$
$= 5$ kN

STRUCTURAL DESIGN BASED ON CODE OF PRACTICE FOR THE STRUCTURAL USE OF STEEL 2005

Use 1 SHS 150 x 150 x 8 thk. (Grade S275)

E	=	205000	N/mm^2	r_x	=	5.8	cm				
I_{xx}	=	1510	cm^4	r_y	=	5.8	cm	t	=	8	mm
Z_x	=	201	cm^3	B	=	150	mm	T	=	8	mm < 16mm
S_x	=	240	cm^3	D	=	150	mm	$\therefore$ p_y	=	275	N/mm^2
A	=	45.1	cm^2	L_{Ex}	=	2.30	m	L_{Ey}	=	2.30	m

Maximum Bending Moment Mx = 5 / 1 = 5 kNm
Maximum Shear Force Vx = 5 / 1 = 5 kN

A15

i. Check for shear

$P_v = 0.6\, p_y A_v$ $\qquad A_v = tD = 1200\ mm^2$

$= 0.6 \times 275 \times 1200 / 1000$

$= 198\ kN > F_v = 5\ kN$ O.K.

ii. Check for moment

$F_v = 5\ kN$ (Shear Force @ max. moment)

$< 0.6\, P_v = 119\ kN$

$M_{cx} = p_y S_x$

$= 275 \times 240 / 1000$

$= 66\ kNm < 1.2\, p_y Z_x = 1.2 \times 275 \times 201 / 1000$

$= 66\ kNm$

$\therefore M_{cy} = 66\ kNm > M_y = 5\ kNm$ O.K.

iii. Check for lateral torsional buckling

$\lambda_{LT} = u\, v\, \lambda (\beta_w)^{1/2}$

$u = 0.900$

$\lambda = L_{Ey} / r_y$

$= 2.30 \times 10^3 / (5.78 \times 10)$

$= 39.79$

$x = D / T = 18.75$

$$v = \frac{1}{(1 + 0.05 (\lambda / x)^2)^{0.25}}$$

$= 0.950$

$\beta_w = 1.00$

$\lambda_{LT} = 0.90 \times 0.950 \times 39.79 \times 1.00^{0.5}$

$= 34.04$

$\therefore p_b = 273.0\ N/mm^2$ (from table 8.3a)

$\therefore M_b = p_b S_x$

$= 273 \times 240.0 \times 1000$

$= 65.52\ KNm > M_x = 4.92\ KNm$ O.K.

iv. Check for welding

Max. Shear Force = 5 kN (factored)

Welding length = 600×1

$= 600$ mm

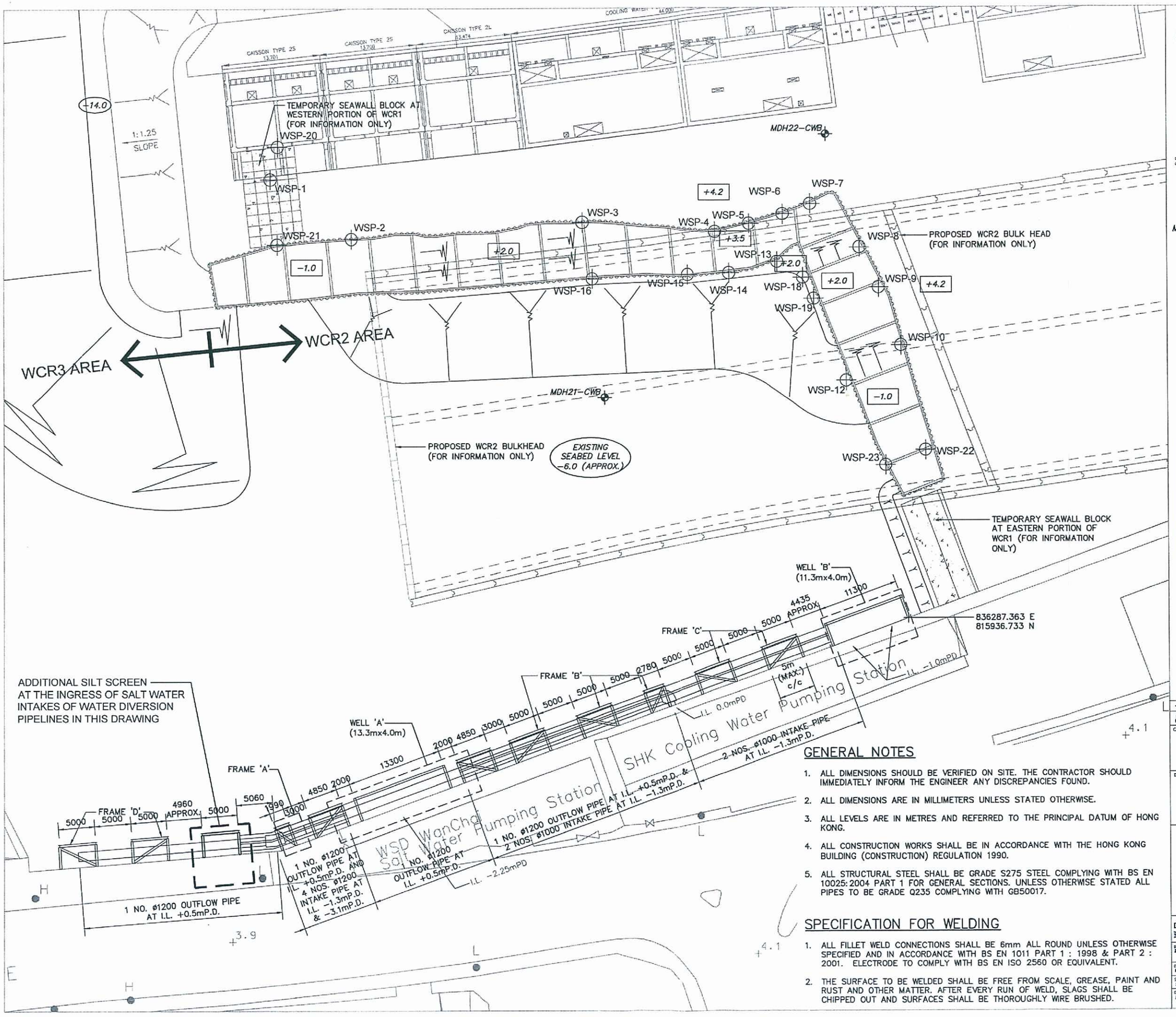
Strength of fillet weld = $220\ N/mm^2$

Allowable shear force from welding $= \dfrac{0.7 \times 220 \times 600.0 \times 6}{1000}$

$= 554\ kN$

$> 5\ kN$ OK

Provide 6mm F.W. in between member M2 and M1.



LEGEND

- -14.0 — PROPOSED EXCAVATION LEVEL
- +4.2 — PROPOSED RECLAMATION LEVEL
- PROPOSED 1:3 CUT SLOPE
- PROPOSED 1:1.5 ROCK FILL SLOPE
- ALIGNMENT OF PROPOSED DIAPHRAGM WALL (INDICATIVE ONLY)
- WSP-1 — SHEETPILE/SEAWALL MOVEMENT MONITORING POINT
- MDH22-CWB — EXISTING BOREHOLE
- EXISTING RUBBLE MOUND (1:1.5 SLOPE)

GENERAL NOTES

1. ALL DIMENSIONS SHOULD BE VERIFIED ON SITE. THE CONTRACTOR SHOULD IMMEDIATELY INFORM THE ENGINEER ANY DISCREPANCIES FOUND.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS STATED OTHERWISE.
3. ALL LEVELS ARE IN METRES AND REFERRED TO THE PRINCIPAL DATUM OF HONG KONG.
4. ALL CONSTRUCTION WORKS SHALL BE IN ACCORDANCE WITH THE HONG KONG BUILDING (CONSTRUCTION) REGULATION 1990.
5. ALL STRUCTURAL STEEL SHALL BE GRADE S275 STEEL COMPLYING WITH BS EN 10025:2004 PART 1 FOR GENERAL SECTIONS. UNLESS OTHERWISE STATED ALL PIPES TO BE GRADE Q235 COMPLYING WITH GB50017.

SPECIFICATION FOR WELDING

1. ALL FILLET WELD CONNECTIONS SHALL BE 6mm ALL ROUND UNLESS OTHERWISE SPECIFIED AND IN ACCORDANCE WITH BS EN 1011 PART 1 : 1998 & PART 2 : 2001. ELECTRODE TO COMPLY WITH BS EN ISO 2560 OR EQUIVALENT.
2. THE SURFACE TO BE WELDED SHALL BE FREE FROM SCALE, GREASE, PAINT AND RUST AND OTHER MATTER. AFTER EVERY RUN OF WELD, SLAGS SHALL BE CHIPPED OUT AND SURFACES SHALL BE THOROUGHLY WIRE BRUSHED.

ATKINS CHINA LIMITED

This document/drawing is endorsed by Independent Checking Engineer / Independent Design Checker

CHAN CHI KONG
REGISTERED STRUCTURAL ENGINEER-RSE 88/99
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Checked by

Reviewed by

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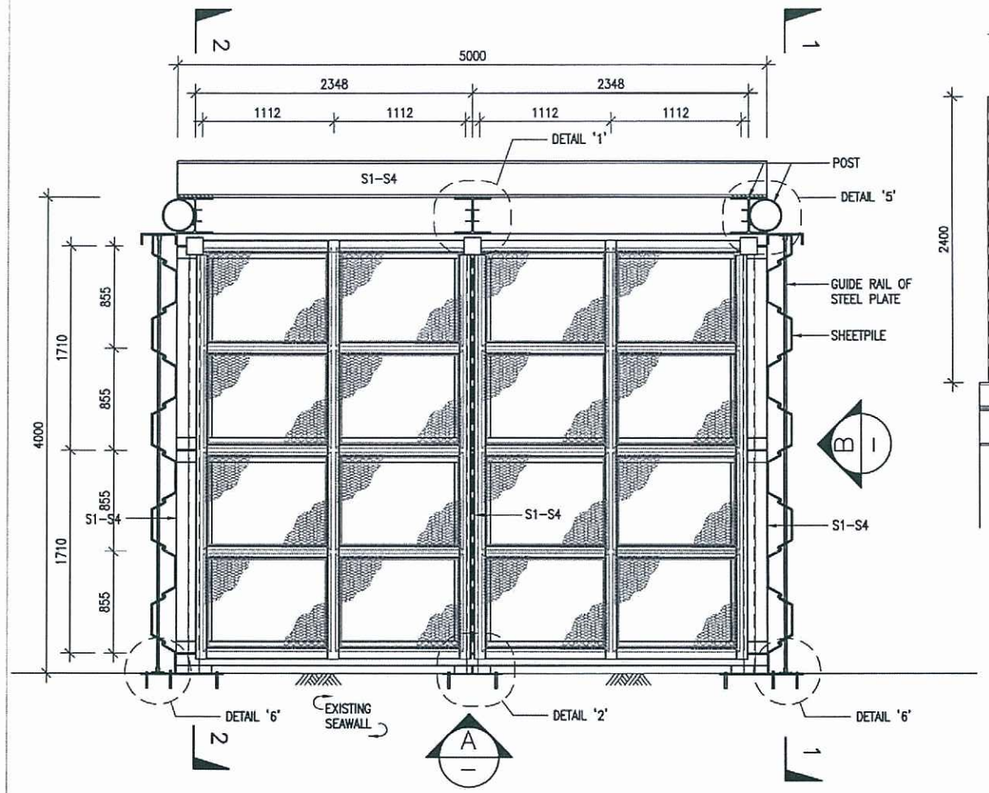
WAN CHAI DEVELOPMENT PHASE II - CENTRAL - WAN CHAI BYPASS AT WAN CHAI EAST

ADDITIONAL SILT SCREEN FOR COMBINED SEA WATER INLETS

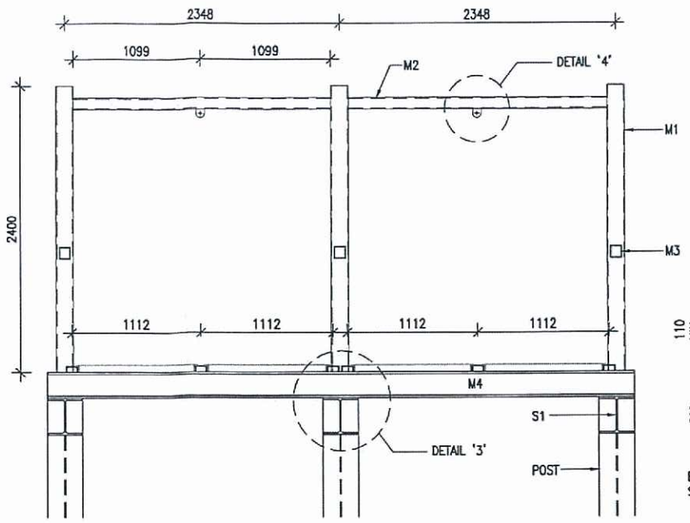
LOCATION PLAN FOR PROPOSED ADDITIONAL SILT SCREEN

DRG.NO. 圖紙編號	S209/WCR2/SS/01
DESIGNED BY 設計 KW	CONTRACT NO. 合約編號 HK/2009/02
DRAWN BY 繪圖 KY	P. DIR. APPROVED 批准人 WTC
SCALE 比例 1 : 500 (A3)	STATUS 狀態
DIMENSIONS ARE IN 尺寸單位 MILLIMETERS	



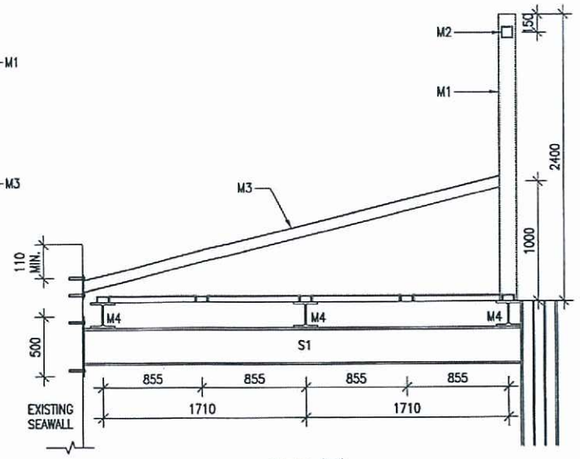
TYPICAL PLAN FOR PROPOSED ADDITIONAL SILT SCREEN

1 : 50



VIEW 'A'

1 : 50

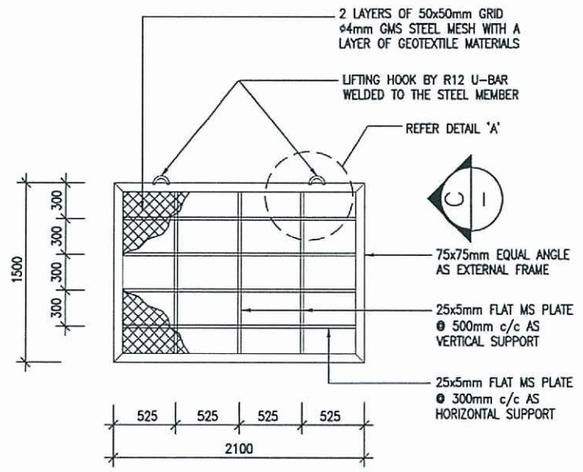


VIEW 'B'

1 : 50

MEMBER SCHEDULE

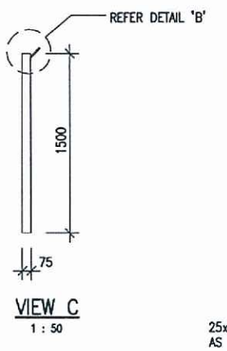
MEMBER	MEMBER SIZE
S1	305x305x97 kg/m UC (S275)
S2	305x305x97 kg/m UC (S275)
S3	305x305x97 kg/m UC (S275)
S4	305x305x97 kg/m UC (S275)
S5	305x305x97 kg/m UC (S275)
M1	150x150x8 THK. SHS (S275)
M2	100x100x8 THK. SHS (S275)
M3	100x100x8 THK. SHS (S275)
M4	203x203x71 kg/m UC (S275)
M5	102x51x10.42 kg/m CHANNEL (S275)
M6	50x50x6 THK. ANGLE (S275)
POST	305x305x97 kg/m UC (S275) & 273x8mm THK. CHS (S275)
TIE	203x203x71 kg/m UC (S275)



PRE–FABRICATED SILT SCREEN FENCING

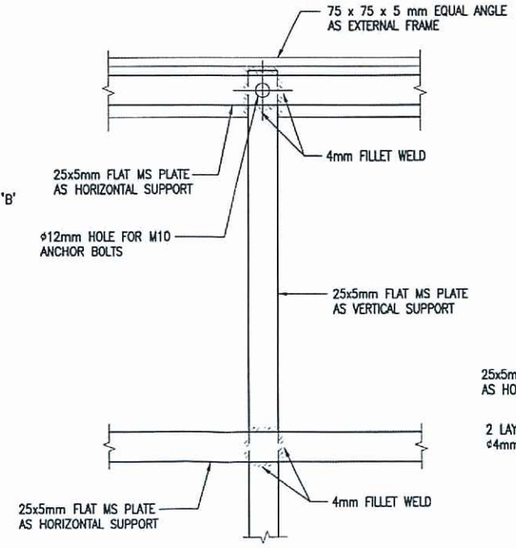
(2100mm WIDTH)

1 : 50



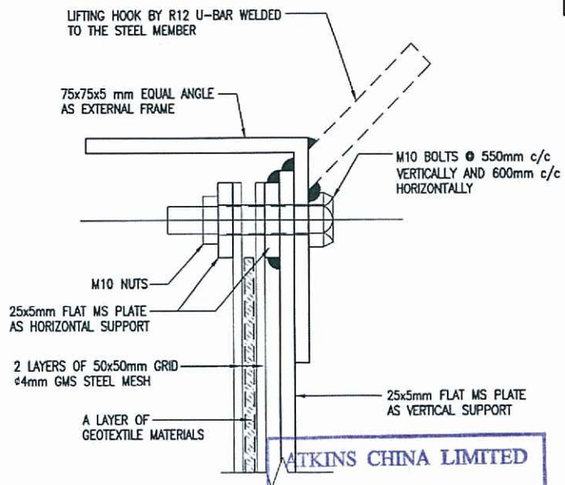
VIEW C

1 : 50



DETAIL 'A'

1 : 5



DETAIL 'B'

1 : 2

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CHAN CHI KONG

REGISTERED STRUCTURAL ENGINEER-RSE 88/99

MSc MBA CEng MICE MStructE MIStructE

RGE RSE (PRC)

Checked by

Reviewed by

REV. 修訂	DESCRIPTION 內容摘要	CHECKED 審核	DATE 日期
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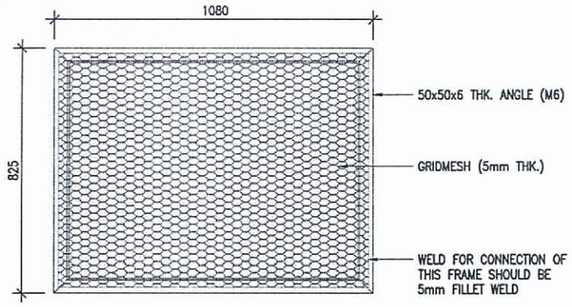
WAN CHAI DEVELOPMENT PHASE II– CENTRAL – WAN CHAI BYPASS AT WAN CHAI EAST

ADDITIONAL SILT SCREEN FOR COMBINED SEA WATER INLETS

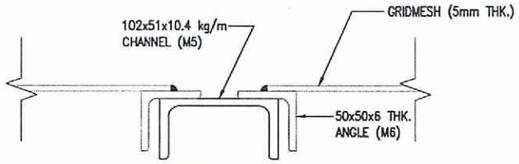
TYPICAL DETAILS (SHEET 1 OF 3)

DRG.NO. 圖紙編號 S209/WCR2/SS/02

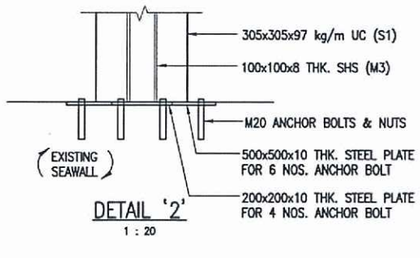
DESIGNED BY 設計 YC	CONTRACT NO. 合約編號 HK/2008/02	P. DIV. APPROVED 總工 WTC
DRAWN BY 繪圖 KY	STATUS 狀態	
SCALE 比例 AS SHOWN (A3)		
DIMENSIONS ARE IN 尺寸單位 MILLIMETERS	© COPYRIGHT RESERVED 版權所有	



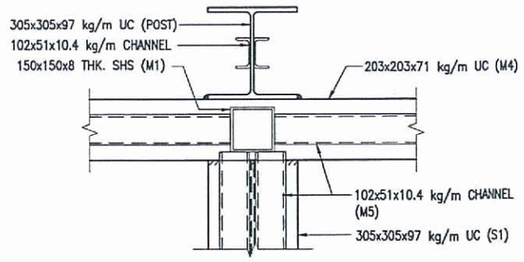
GRIDMESH DECKING
1 : 20



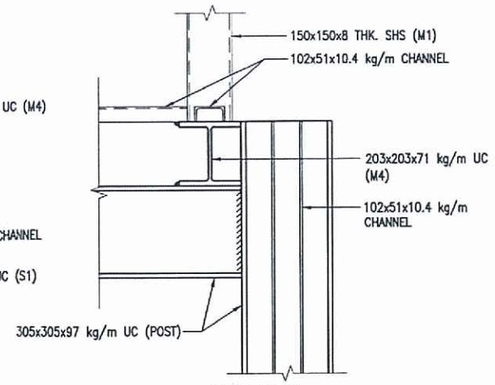
SIDE VIEW
1 : 5



DETAIL '2'
1 : 20



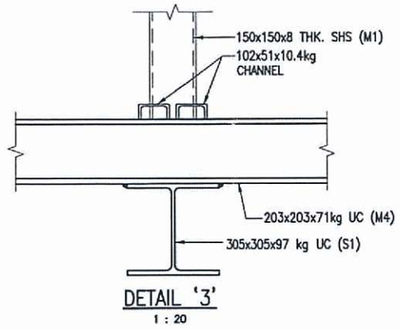
DETAIL '1'
1 : 20



SIDE VIEW
1 : 20

MEMBER SCHEDULE

MEMBER	MEMBER SIZE
S1	305x305x97 kg/m UC (S275)
S2	305x305x97 kg/m UC (S275)
S3	305x305x97 kg/m UC (S275)
S4	305x305x97 kg/m UC (S275)
S5	305x305x97 kg/m UC (S275)
M1	150x150x8 THK. SHS (S275)
M2	100x100x8 THK. SHS (S275)
M3	100x100x8 THK. SHS (S275)
M4	203x203x71 kg/m UC (S275)
M5	102x51x10.42 kg/m CHANNEL (S275)
M6	50x50x6 THK. ANGLE (S275)
POST	305x305x97 kg/m UC (S275) & 273x8mm THK. CHS (S275)
TIE	203x203x71 kg/m UC (S275)



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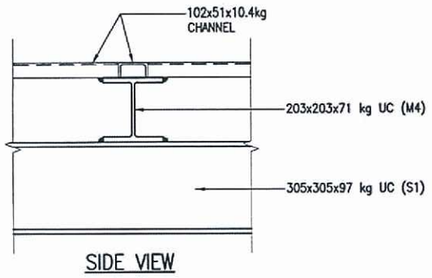

SIDE VIEW
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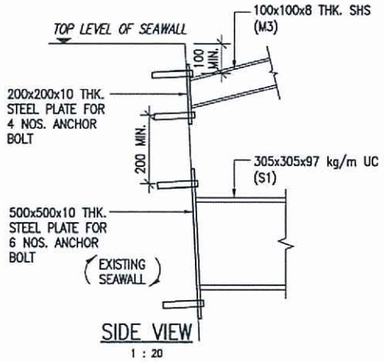
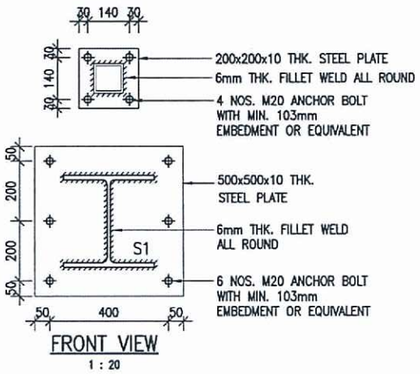
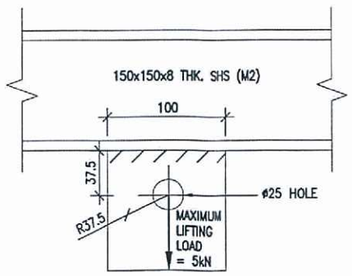


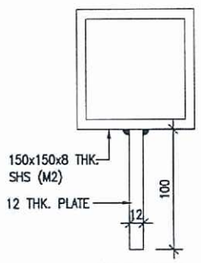
SIDE VIEW
1 : 20



FRONT VIEW
1 : 20



DETAIL '4'
1 : 5



SIDE VIEW
1 : 5

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REGISTERED STRUCTURAL ENGINEER-RSE 88/99
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Checked by

Reviewed by

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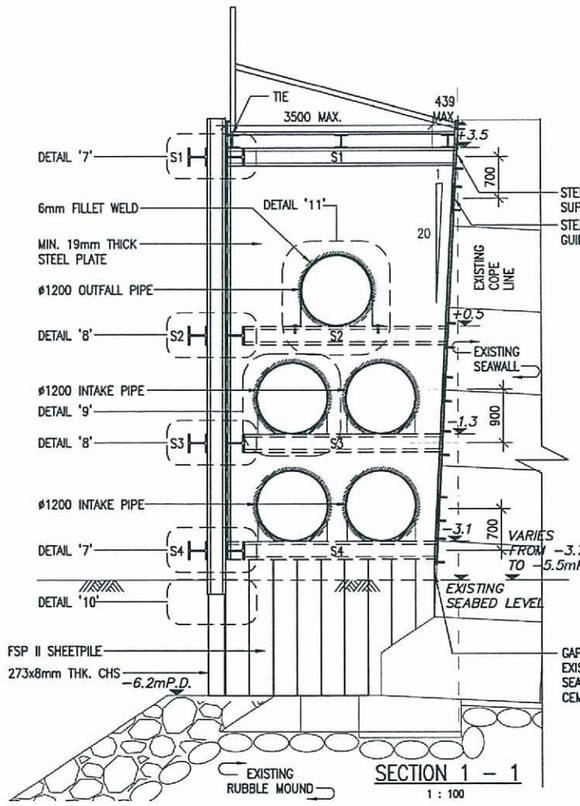
WAN CHAI DEVELOPMENT PHASE II – CENTRAL – WAN CHAI BYPASS AT WAN CHAI EAST

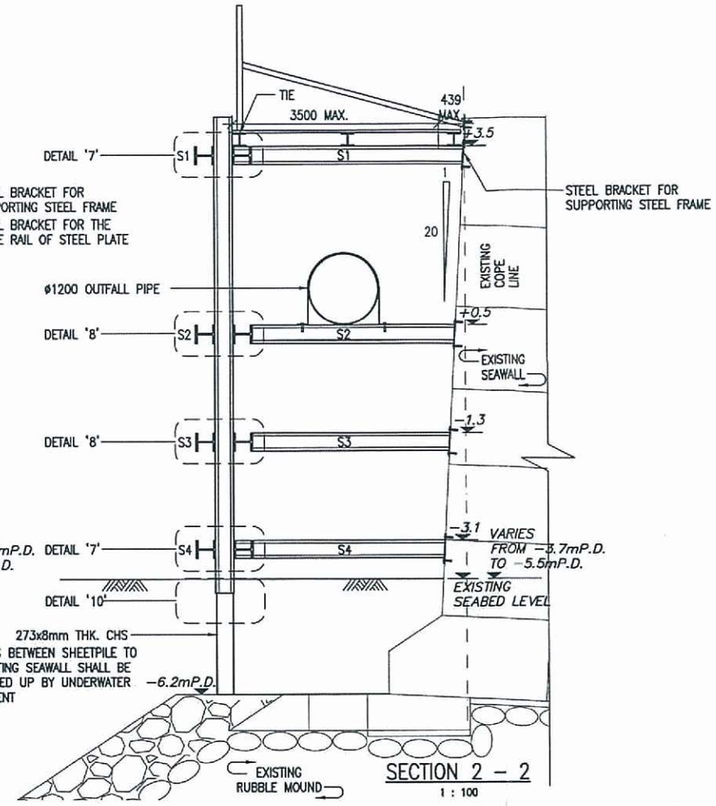
ADDITIONAL SILT SCREEN FOR COMBINED SEA WATER INLETS

TYPICAL DETAILS (SHEET 2 OF 3)

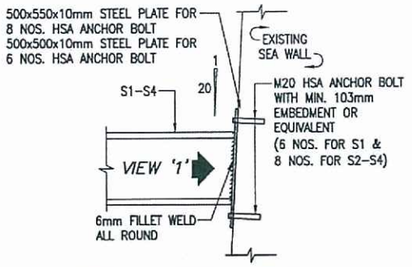
DRG.NO. 圖紙編號	S209/WCR2/SS/03A
DESIGNED BY 設計 YC	CONTRACT NO. 合約編號 HK/2009/02
P. Dir. APPROVED 批准人 WTC	
DRAWN BY 繪圖 KY	STATUS 狀態
SCALE 比例 AS SHOWN (A3)	
DIMENSIONS ARE IN 尺寸單位 MILLIMETERS	© COPYRIGHT RESERVED 版權所有



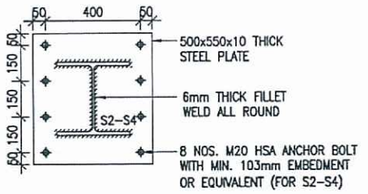
SECTION 1 – 1
1 : 100



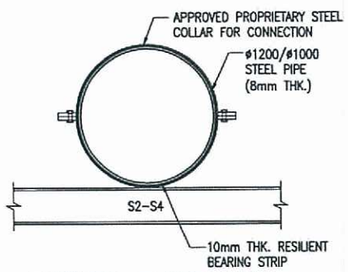
SECTION 2 – 2
1 : 100



TYPICAL CONNECTION DETAIL BETWEEN STRUT AND SEAWALL
1 : 25



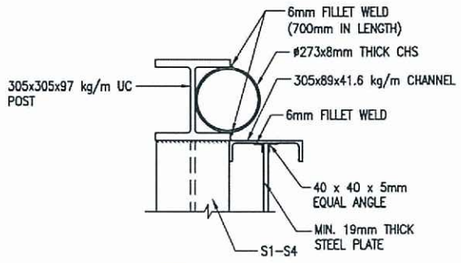
VIEW '1'
1 : 25



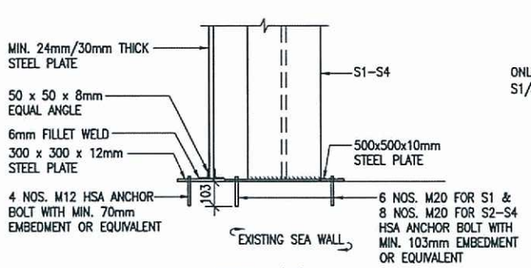
ELEVATION OF PIPE JOINT
(WEDGE NOT SHOWN FOR CLARITY)
1 : 50

MEMBER SCHEDULE

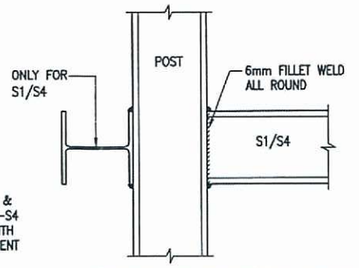
MEMBER	MEMBER SIZE
S1	305x305x97 kg/m UC (S275)
S2	305x305x97 kg/m UC (S275)
S3	305x305x97 kg/m UC (S275)
S4	305x305x97 kg/m UC (S275)
S5	305x305x97 kg/m UC (S275)
M1	150x150x8 THK. SHS (S275)
M2	100x100x8 THK. SHS (S275)
M3	100x100x8 THK. SHS (S275)
M4	203x203x71 kg/m UC (S275)
M5	102x51x10.42 kg/m CHANNEL (S275)
M6	50x50x6 THK. ANGLE (S275)
POST	305x305x97 kg/m UC (S275) & 273x8mm THK. CHS (S275)
TIE	203x203x71 kg/m UC (S275)



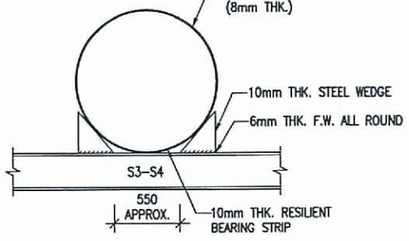
DETAIL '5'
1 : 25



DETAIL '6'
(SHEETPILE NOT SHOWN FOR CLARITY)
1 : 25



TYPICAL CONNECTION DETAIL BETWEEN POST AND STRUT
DETAIL '7'
1 : 25



DETAIL '9'
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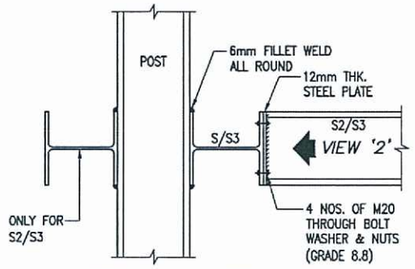
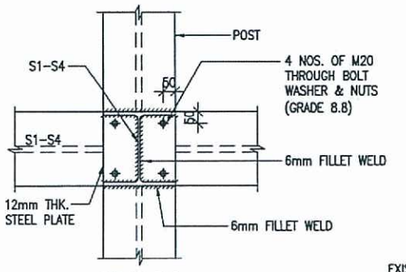


TYPICAL CONNECTION DETAIL BETWEEN POST AND STRUT
DETAIL '8'
1 : 25



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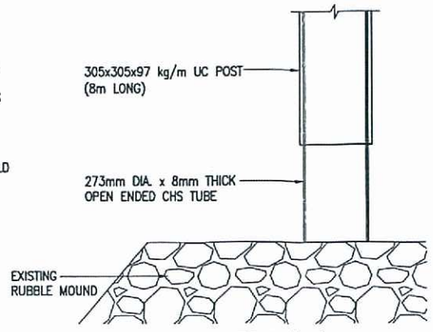

DETAIL '10'
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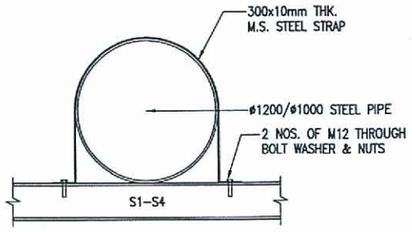

DETAIL '11'
1 : 50

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CHAN CHI KONG
REGISTERED STRUCTURAL ENGINEER-RSE 88/99
MSc MBA CEng MICE MIStructE MHKIE
RGE RSE (PRC)

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Reviewed by

NO. 編號	DESCRIPTION 內容摘要	C.C. 核查	P.C. CHECKED 審核	DATE 日期
A	RESPONSE TO ICE'S COMMENT			30.11.11
–	FIRST ISSUE			16.11.11

CONTRACTOR
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WAN CHAI DEVELOPMENT PHASE II-
CENTRAL - WAN CHAI BYPASS AT WAN CHAI EAST

ADDITIONAL SILT SCREEN FOR COMBINED SEA WATER INLETS

TYPICAL DETAILS
(SHEET 3 OF 3)

DRG.NO. 圖紙編號 S209/WCR2/SS/04A

DESIGNED BY 設計	CONTRACT NO. 合約編號	P. DIV. APPROVED 批准人
YC	HK/2009/02	WTC
DRAWN BY 繪圖 KY	STATUS 階段	
SCALE 比例 AS SHOWN (A3)		
DIMENSIONS ARE IN 尺寸單位 MILLIMETERS	© COPYRIGHT RESERVED 版權所有	

Design Calculation

Dimensions of steel fence:

Height of steel fence		=	**3.050**	m
width of steel fence		=	**2.250**	m
steel fence member	=	50 x 50 x 4mm Equal Angle		
no. of steel fence for each frame		=	2.000	nr
weight of steel angle member		=	3.060	kg/m
weight of steel mesh member		=	3.960	kg/m2
weight of geotextile		=	0.275	kg/m2

Loading of steel fences:

weight of steel member of each fence		=	32.436	kg
weight of 2 layer of steel mesh for each fence		=	54.351	kg
weight of 1 layer of geotextile for each fence		=	1.887	kg
Therefore, weight of each fence		=	88.674	kg
Factored DL = 1.2 x 10 x	88.674	=	1.064	kN
For 2.000 nr of fence, total factored DL		=	2.128	kN

Dimensions of wall-mounted steel frame:

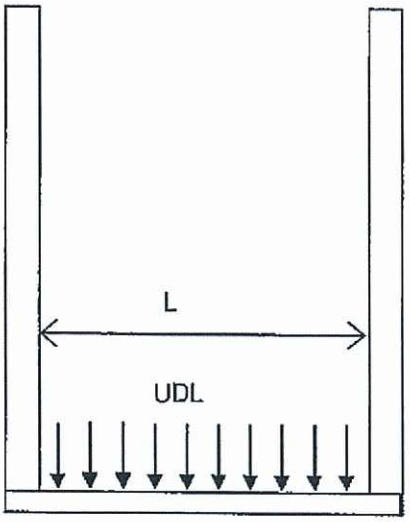
Height of steel frame		=	**6.000**	m
width of steel frame		=	**2.300**	m
steel frame member	=	102 x 51 x 10.6 kg/m		
no. of steel frame for each silt screen		=	1.000	nr
weight of steel angle member		=	10.600	kg/m

Loading of wall-mounted frame:

weight of major steel member of the frame		=	175.960	kg
weight of steel members for the MS plates		=	54.263	kg
Therefore, weight of each frame		=	230.223	kg
Factored DL = 1.2 x 10 x	230.223	=	2.763	kN

All steel material use to be Grade S275

Capacity Check for the Steel Frame:



Check Bending to the bottom member of frame

design UDL	=	2.128	kN
max. bending moment	=	0.125 x UDL x L^2	
	=	1.347	kNm

Use 102 x 51 x 10.6 kg/m

Z	=	8140.000	mm3
max. bending stress	=	165.447	N/mm2
	<	275.000	N/mm2 OK

Check Shear at Support of the bottom steel frame

max. shear force, V	=	2.394	kN
cross section area	=	1330.000	mm2
max. shear stress	=	1.800	N/mm2
	<	165.000	N/mm2 OK

Check Tension on the vertical members of the steel frame

max. shear force, V	=	2.394	kN
total DL of the steel frame	=	2.763	kN
DL at each vertical member	=	1.381	kN
cross section area	=	1330.000	mm2
max. tensile force	=	3.776	kN
max. tensile stress	=	2.839	N/mm2
	<	275.000	N/mm2 OK

Apply 4mm fillet welds to all connctions unless otherwise stated

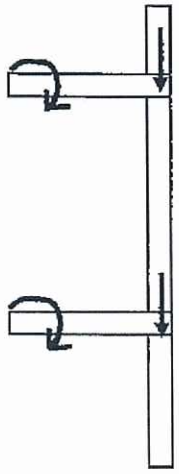
Welding Check:

max. shear force	=	2.394	kN	
welding length required	=	**2.394 x 1000** / **215.000 x 4 x 0.7**		
	=	**28.750**	**mm**	
Provide welding length	=	50.000	mm	OK

Capacity Check for the Cantilever Arm:

Check Bending to the cantilever arm

Cantilever arm	=	0.800	m
Number of support at each side	=	2.000	nr
max. bending moment	=	V x cantilever arm/ nr of support	
	=	0.958	kNm



Use 50 x 50 x 2.5mm x 3.68 kg/m

Z	=	6990.000	mm3
max. bending stress	=	137.007	N/mm2
	<	275.000	N/mm2

Check Shear at the cantilever arm

max. shear force, V	=	2.394	kN
Number of support at each side	=	2.000	nr
cross section area	=	468.000	mm2
max. shear stress	=	2.558	N/mm2
	<	165.000	N/mm2

Capacity Check for the Anchorage Bolts:

Total factored DL of the steel frame and steel fence, W:

W = 4.891 kN

Nos. of anchor bolts provided = 4.000 nr

max. shear force to each bolt = 1.223 kN

Use HSL-G-R M12 with 80mm anchorage length

max. allowable Shear Force at each bolt = 24.4 kN

> 1.223 kN OK

Allowable Flow Capacity of the Silt Screen

Flow capacity of the Geotextile FW300 = 90.000 L/m2/s

Total flow capacity allowable for each screen

= 2.25 x 3.05 x 2 x 90

= 1235.25 L/s > required flow rate = 375 L/s OK

Design resistance, R_d [kN]: f_{cc} = 30 N/mm²

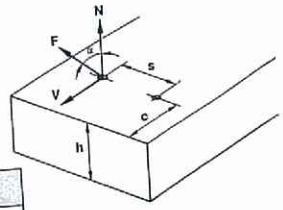
Anchor size		M8	M10	M12	M16	M20
Tensile, N_{Rd}	0°	10.4	15.1	19.1	30.9	47.3
Combined load	30°	11.9	17.9	24.1	41.8	64.6
	45°	12.6	19.3	26.6	47.3	73.3
	60°	13.4	20.7	29.1	52.7	82.0
Shear, V_{Rd}	90°	14.9	23.5	34.1	63.6	99.3

Recommended load, F_{30} in [kN], f_{cc} = 30 N/mm²

Anchor size		M8	M10	M12	M16	M20
Tensile, N_{Rec}	0°	7.5	10.9	13.8	22.2	34.1
Combined load	30°	8.5	12.8	17.3	30.0	46.3
	45°	9.1	13.8	19.1	33.8	52.5
	60°	9.6	14.8	20.8	37.7	58.6
Shear, V_{Rec}	90°	10.6	16.7	24.4	45.4	70.8

Recommended load for specific application

$$F_{rec} = F_{cc} \cdot f_T \cdot f_A \cdot f_R$$



f_{cc} (kN) : Load in different concrete strength

Anchor size	Concrete, f_{cc} [N/mm²]	M8	M10	M12	M16	M20
Tensile	20	7.1	9.8	11.4	17.5	27.0
	30	7.5	10.9	13.8	22.2	34.1
	40	7.9	11.9	16.1	26.9	41.2
	50	8.3	13.0	18.5	31.7	48.3
	55	8.5	13.5	19.7	34.0	51.9
Shear	≥ 20	10.6	16.7	24.4	45.4	70.8

f_T: Influence of anchorage depth

$$f_T = \frac{h_{act}}{h_{nom}} \qquad h_{nom} \geq h_{act} \geq 1.5 \cdot h_{nom}$$

h_{act} actual anchorage depth

Anchor size		M8	M10	M12	M16	M20
h_{nom}	[mm]	65	75	80	105	130

f_A: Influence of anchor spacing

Anchor spacing, s [mm]	Tensile / Shear HSL-G-R M8	M10	M12	M16	M20
65	0.70				
75	0.72	0.70			
80	0.73	0.71	0.70		
105	0.79	0.76	0.74	0.70	
130	0.85	0.81	0.79	0.73	0.70
155	0.90	0.86	0.84	0.77	0.72
175	0.95	0.90	0.87	0.80	0.75
195	1.0	0.94	0.91	0.82	0.77
225		1.0	0.97	0.87	0.80
240			1.0	0.89	0.82
275			1.0	0.94	0.86
315				1.0	0.91
350				1.0	0.95
395					1.0
430					1.0

$$f_A = 0.15 \frac{s}{h_{act.}} + 0.55$$

$s_{min} = h_{nom}$, $s_{cr} = 3 \cdot h_{act.}$

Separate multiple-anchor fastenings must be at least a ≥ 2 s_{cr} apart to ensure they do not influence each other.

f_R: Influence of edge distance

Edge distance, c [mm]	Tensile, f_{RN} Anchor size M8	M10	M12	M16	M20	Shear, f_{RV} Anchor size M8	M10	M12	M16	M20
65	0.70					0.30				
75	0.73	0.70				0.37	0.30			
80	0.75	0.71	0.70			0.40	0.44	0.30		
105	0.82	0.78	0.76	0.70		0.59	0.59	0.44	0.30	
130	0.90	0.85	0.83	0.74	0.70	0.77	0.74	0.59	0.41	0.30
155	0.97	0.91	0.88	0.79	0.73	0.95	0.78	0.74	0.52	0.39
162	1.0	0.93	0.90	0.80	0.75	1.0	0.85	0.78	0.55	0.41
187		1.0	0.96	0.85	0.78		1.0	0.92	0.66	0.50
200			1.0	0.88	0.80			1.0	0.72	0.55
225			1.0	0.92	0.84			1.0	0.83	0.64
265				1.0	0.91				1.0	0.79
275				1.0	0.92				1.0	0.82
300				1.0	0.96				1.0	0.91
325					1.0					1.0
350					1.0					1.0

$$f_{RN} = 0.2 \frac{c}{h_{act.}} + 0.5$$

$c_{min} = h_{nom}$, $c_{cr} = 2.5 \cdot h_{act.}$

$$f_{RV} = 0.47 \frac{c}{h_{nom}} - 0.17$$

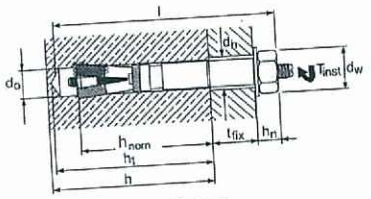
$c_{min} = h_{nom}$, $c_{cr} = 2.5 \cdot h_{nom}$

For combined loads with influence of edge distance: $f_{R\alpha} = f_{RN} - (f_{RN} - f_{RV}) \cdot \frac{\alpha}{90}$

There must be reinforcement in the edge of a concrete component which can take up 0.25 times the anchor load if the edge distance is equal to or less than c_{cr}.

HSL-G-R heavy-duty anchor

Setting details



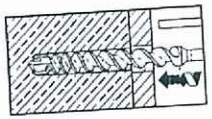
HSL-G-R

Setting Details			Anchor size HSLG-R	M 8/20	M 8/40	M 10/20	M 10/40	M 12/25	M 12/50	M 16/25	M 16/50	M 20/30	M 20/60
d_o	[mm]	Drill bit diameter		12		15		18		24		28	
h_1	[mm]	Hole depth		80		90		100		125		155	
h_{nom}	[mm]	Min. anchorage depth		65		75		80		105		130	
t_{fix}	[mm]	Max. fixture thickness		20	40	20	40	25	50	25	50	30	60
l	[mm]	Anchor length		102	122	115	135	125	150	157	182	190	220
h_n	[mm]	Head height + washer		9.5		12.0		15.0		18.0		22.0	
T_{inst}	[Nm]	Tightening torque		25		40		80		120		200	
Max. gap	[mm]			4		5		8		9		12	
S_w	[mm]	Width across flats		13		17		19		24		30	
d_h	[mm]	Clearance hole		14		17		20		26		31	
d_w	[mm]	Washer diameter		20		25		30		40		45	
h	[mm]	Min. base material thickness		120		140		160		180		220	
Drill bit			TE-CX-	12/22		15/27		-		-		-	
Drill bit			TE-T-	-		-		18/32		24/32		28/32	

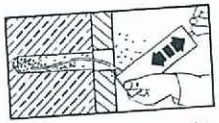
Installation equipment

Rotary hammer (TE1, TE2, TE5, TE6, TE6A, TE15, TE15-C, TE18-M, TE35, TE55, TE76), a hammer and a torque wrench.

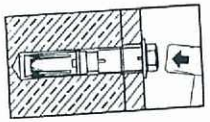
Setting operations



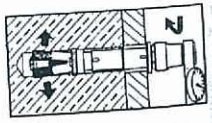
Drill hole with drill bit.



Blow out dust and fragments.



Install anchor.



Apply tightening torque

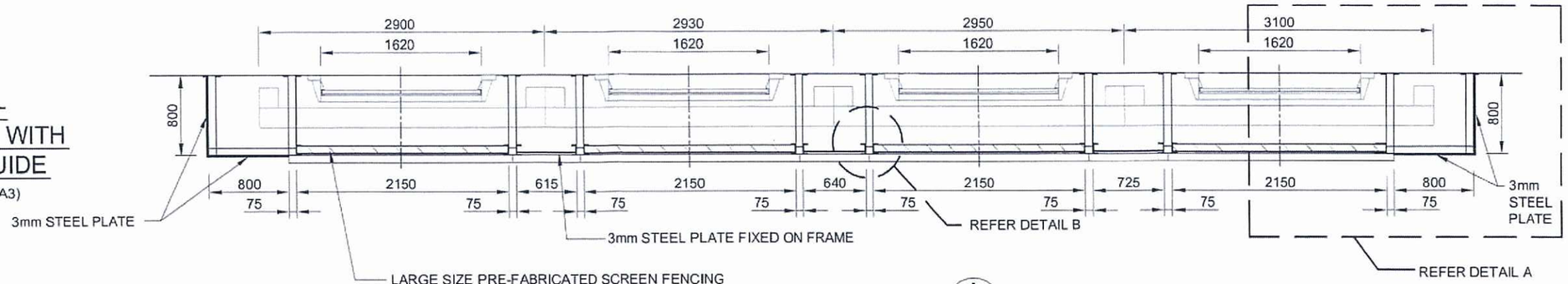
HSL-G-R heavy-duty anchor

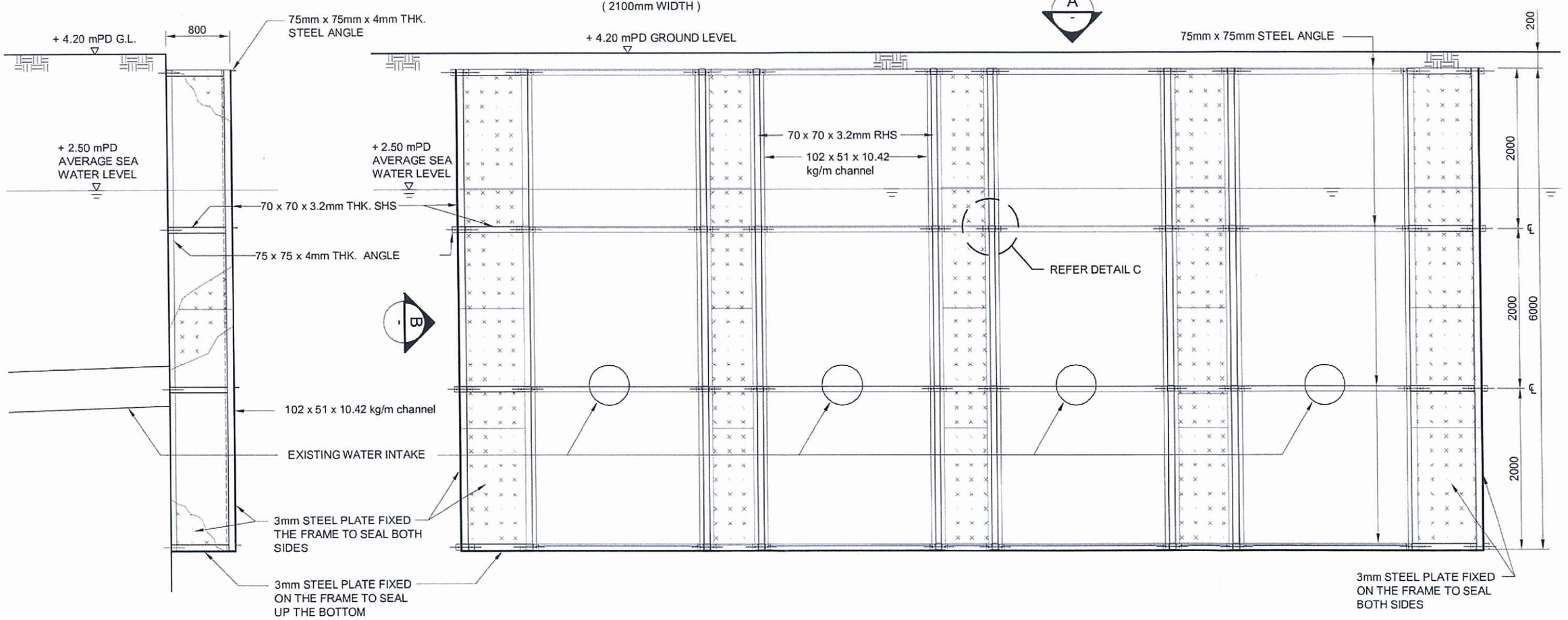
Anchor mechanical properties

Anchor size		HSL-G-R	M 8	M 10	M 12	M 16	M 20
f_{uk}	[N/mm²]	Nominal tensile strength	700	700	700	700	700
f_{yk}	[N/mm²]	Yield strength	450	450	450	450	450
A_s	[mm²]	Stressed cross-section	36.6	58.0	84.3	157	245
W	[mm³]	Effective moment of resistance	106	231	390	965	1421
M_d	[Nm]	Design bending moment	41	90	150	375	550

VIEW A - GMS FRAME WITH SCREEN GUIDE

SCALE 1 : 50 (A3)





VIEW B

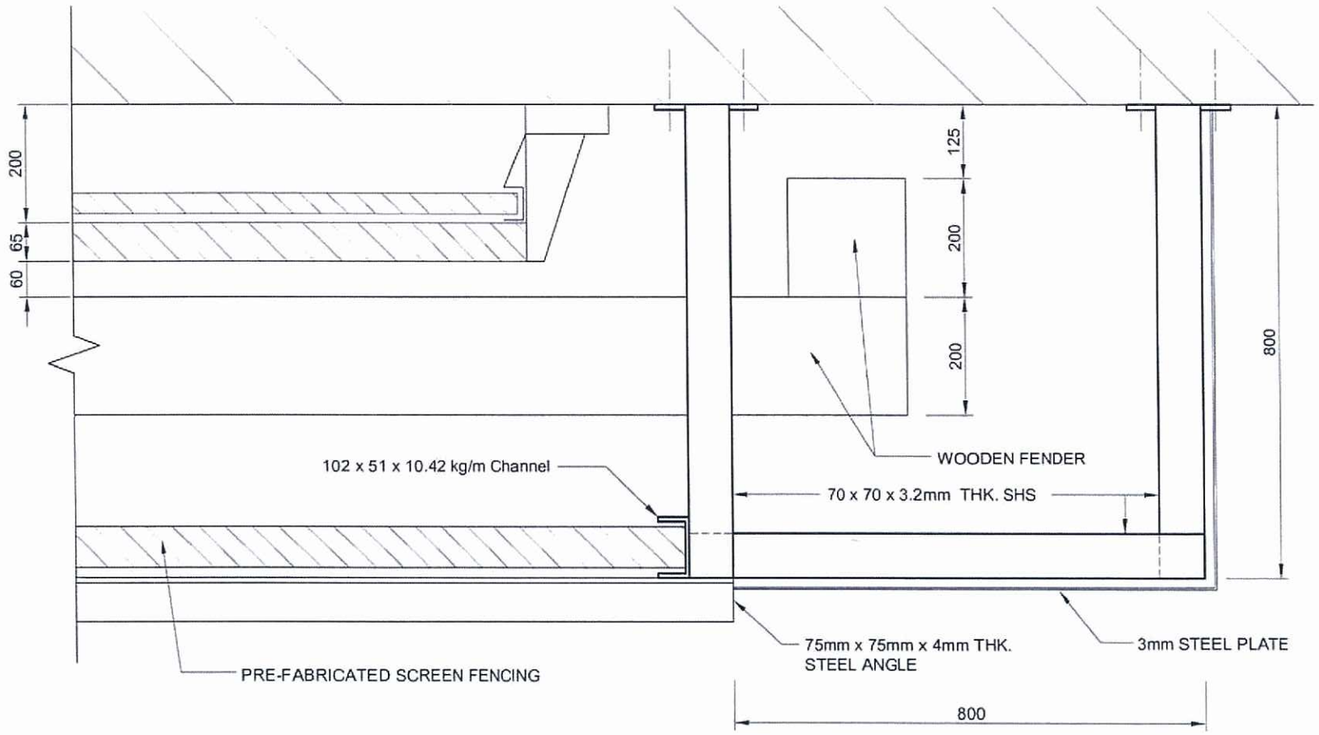
SCALE 1 : 50 (A3)

PRE-FABRICATED WALL MOUNTED FRAME FOR THE SILT SCREEN

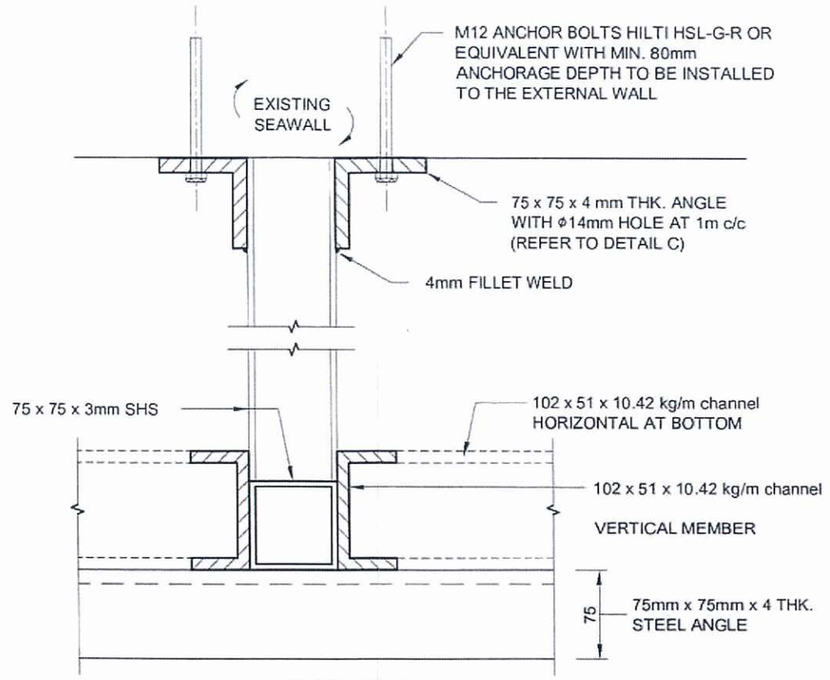
SCALE 1 : 50 (A3)

CLIENT: 土木工程拓展署 Civil Engineering and Development Department	CONTRACTOR: 俊和－中國中鐵聯營 CHUN WO - CRGL JOINT VENTURE	JOB TITLE: PROPOSED WSD INTAKE COVER	SCALE: AS SHOWN (A3)	REF. TO DWG NO.: CW-CR/ENG/ENG-0105-R013	
ENGINEER'S REPRESENTATIVE: AECOM	PROJECT: WAN CHAI DEVELOPMENT PHASE II – CENTRAL – WAN CHAI BYPASS AT WAN CHAI EAST (HK200902)		DATE: 30 MAR 2010		Sheet of
			DRAWN: M.S. SIN / DESIGNED		SKETCH NO: CWCRJV/HK200902/SK0022
			CHECKED: - / APPROVED		REV: B

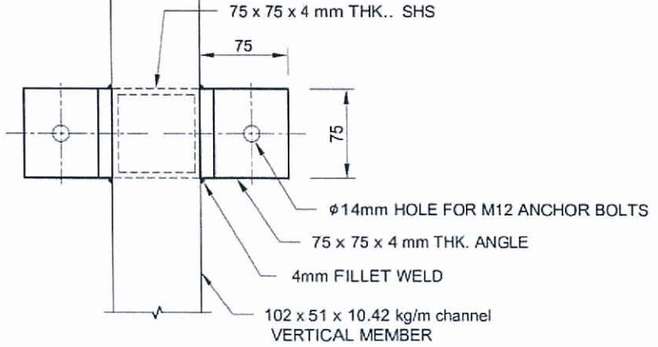
NOTE:
DIMENSION OF THE PRE-FABRICATED FRAME COULD BE ADJUSTED TO SUIT THE ACTUAL SIZE OF EACH WATER INTAKE.



DETAIL A
SCALE 1 : 10 (A3)



DETAIL B
SCALE 1 : 5 (A3)



DETAIL C
SCALE 1 : 5 (A3)

CLIENT: 土木工程拓展署 CEDD Civil Engineering and Development Department	CONTRACTOR: 俊和－中國中鐵聯營 CHUN WO - CRGL JOINT VENTURE	JOB TITLE: FIXING DETAILS OF THE WALL MOUNTED STEEL FRAME TO THE EXTERNAL WALL OF WSD PUMP STATION INTAKES	SCALE: AS SHOWN (A3)	REF. TO DWG NO.: CW-CR/ENG/ENG-0106-R014	
ENGINEER'S REPRESENTATIVE: AECOM	PROJECT: WAN CHAI DEVELOPMENT PHASE II – CENTRAL – WAN CHAI BYPASS AT WAN CHAI EAST (HK200902)		DATE: 30 MAR 2010		Sheet of
			DRAWN: M.S. SIN / DESIGNED:		SKETCH NO: CWCRJV/HK200902/SK0023 / REV: B
			CHECKED: - / APPROVED:		

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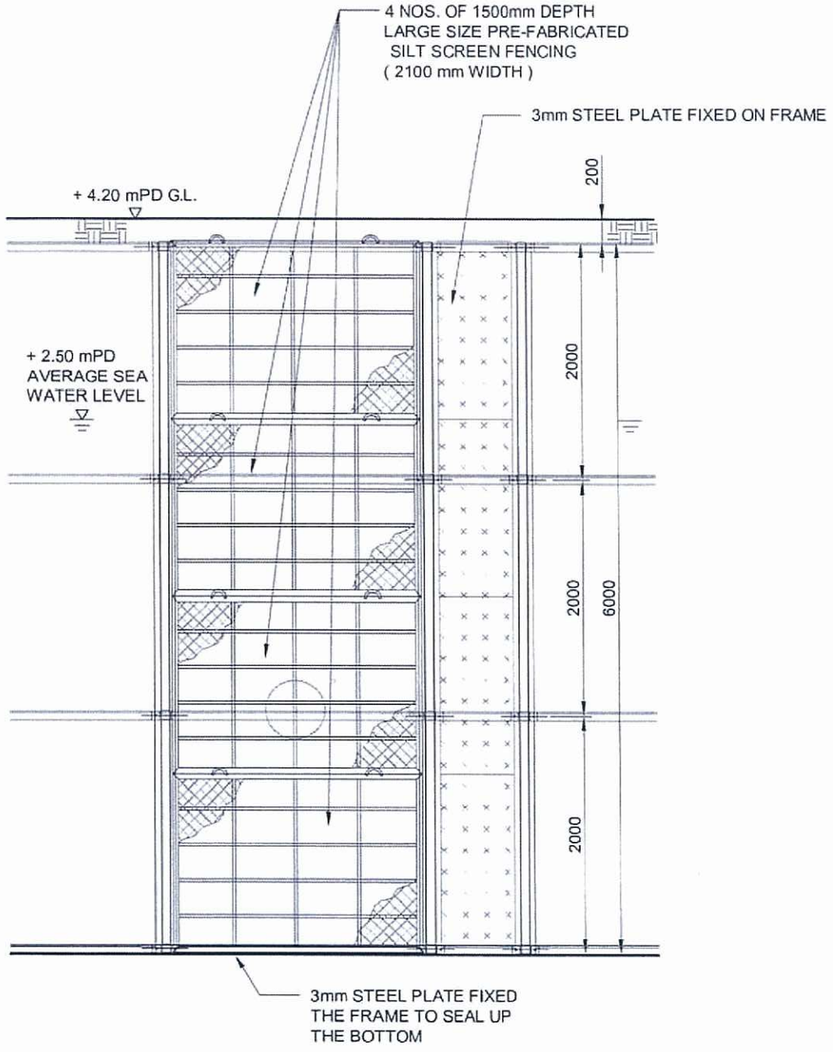
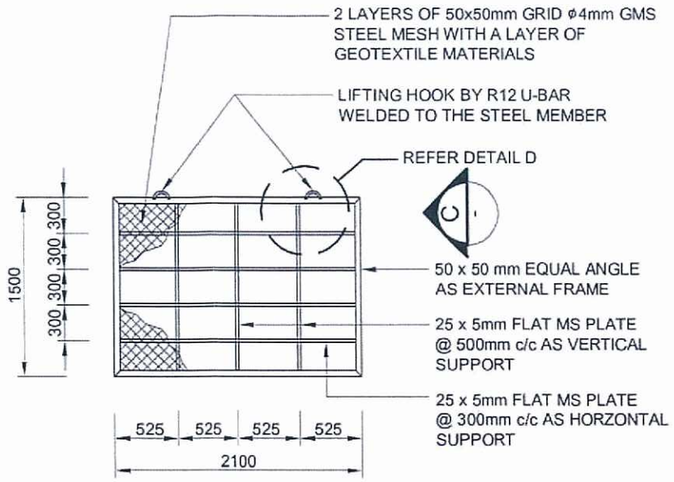


TYPICAL ARRANGEMENT OF SILT SCREEN FENCING INSTALLATION INTO THE WALL MOUNTED FRAME

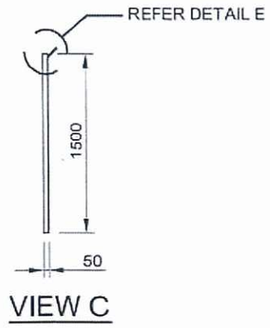
SCALE 1 : 50 (A3)



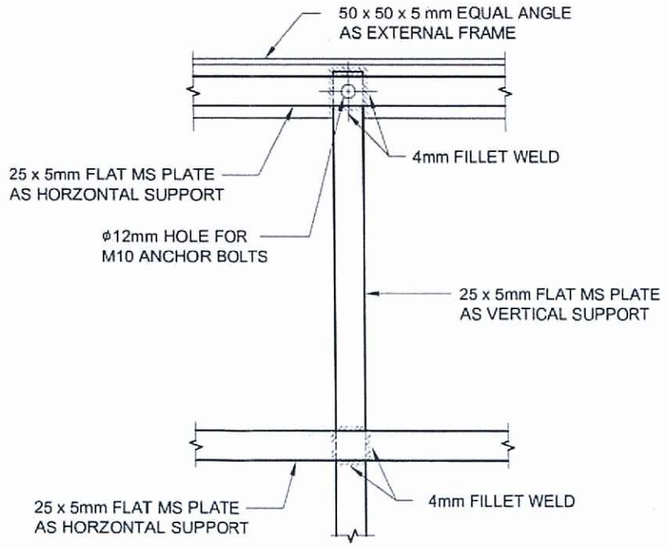
PRE-FABRICATED SILT SCREEN FENCING (2100mm WIDTH)

SCALE 1 : 50 (A3)

NOTE:
ALL CONNECTION OF STEEL MEMBER BY 4mm FILLET WELD UNLESS OTHERWISE STATED.

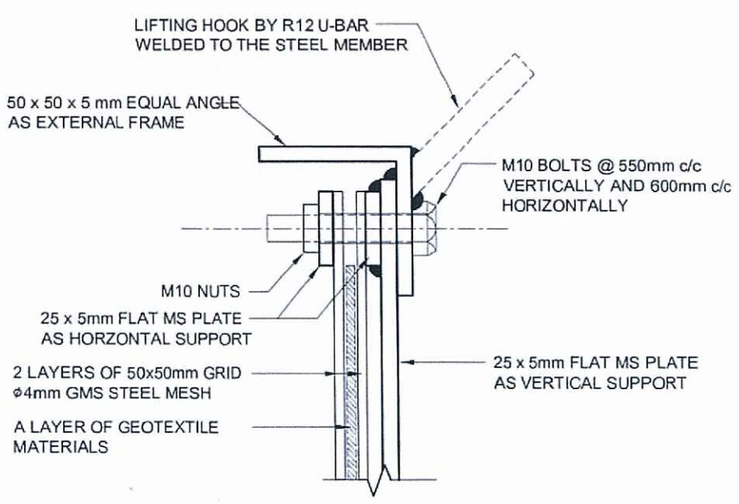


VIEW C



DETAIL D

SCALE 1 : 5 (A3)



DETAIL E

SCALE 1 : 2 (A3)

CLIENT: 土木工程拓展署 CEDD Civil Engineering and Development Department	CONTRACTOR: 俊和－中國中鐵聯營 CHUN WO - CRGL JOINT VENTURE	JOB TITLE: PROPOSED PRE-FABRICATED SILT SCREEN FENCING AND THE TYPICAL ARRANGEMENT FOR ITS INSTALLATION INTO THE WALL MOUNTED FRAME	SCALE: AS SHOWN (A3)	REF. TO DWG NO.: CW-CR/ENG/ENG-0107-R015	
ENGINEER'S REPRESENTATIVE: AECOM	PROJECT: WAN CHAI DEVELOPMENT PHASE II – CENTRAL – WAN CHAI BYPASS AT WAN CHAI EAST (HK200902)		DATE: 30 MAR 2010	Sheet of	
			DRAWN: M.S. SIN / DESIGNED:	SKETCH NO: CWCRJV/HK200902/SK0024	REV: B
			CHECKED: – / APPROVED:		

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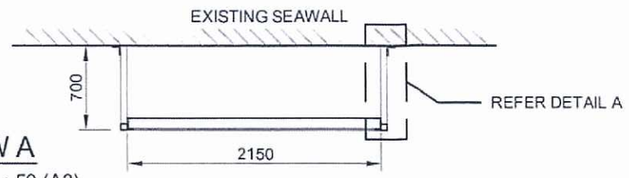
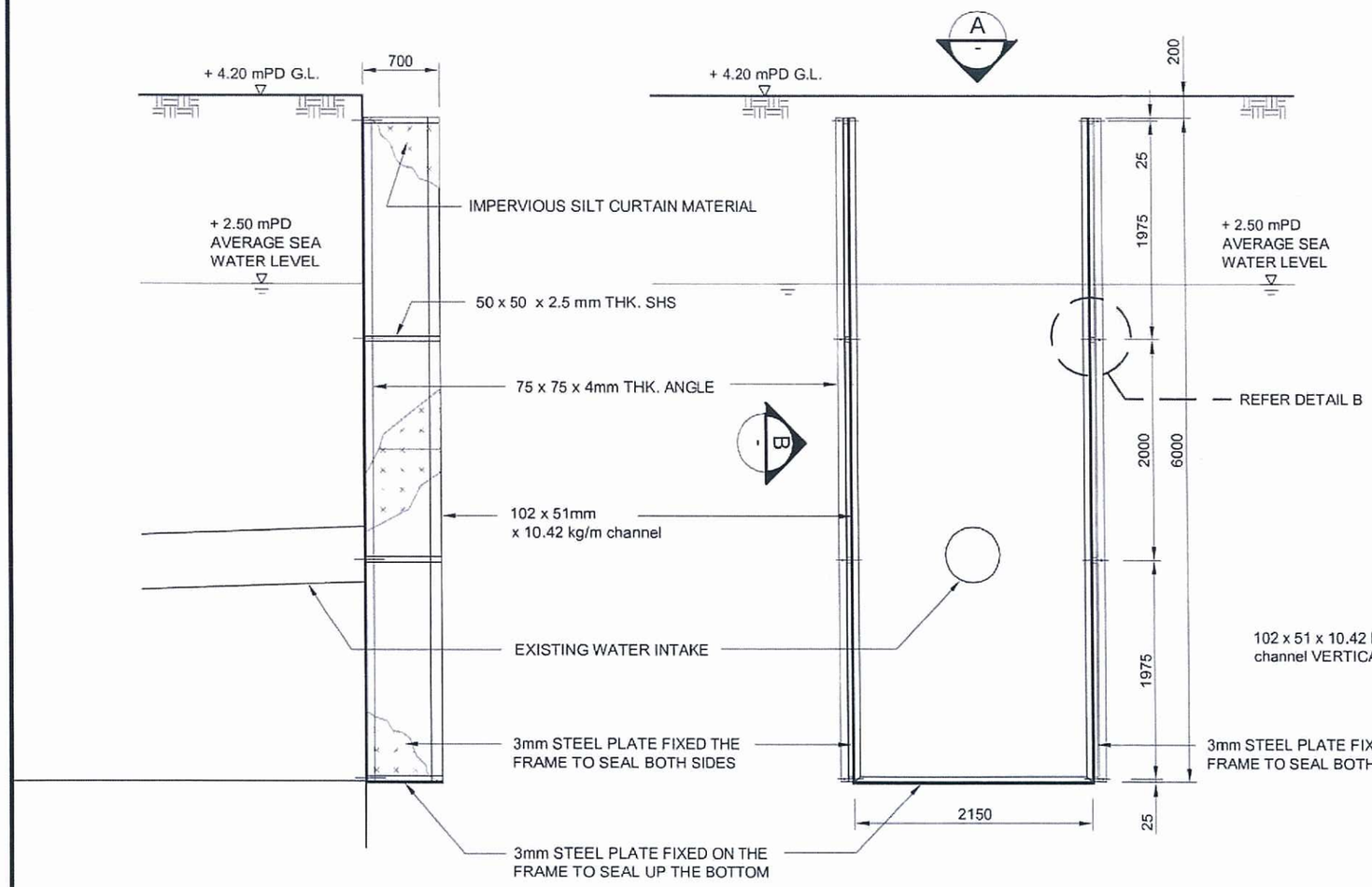
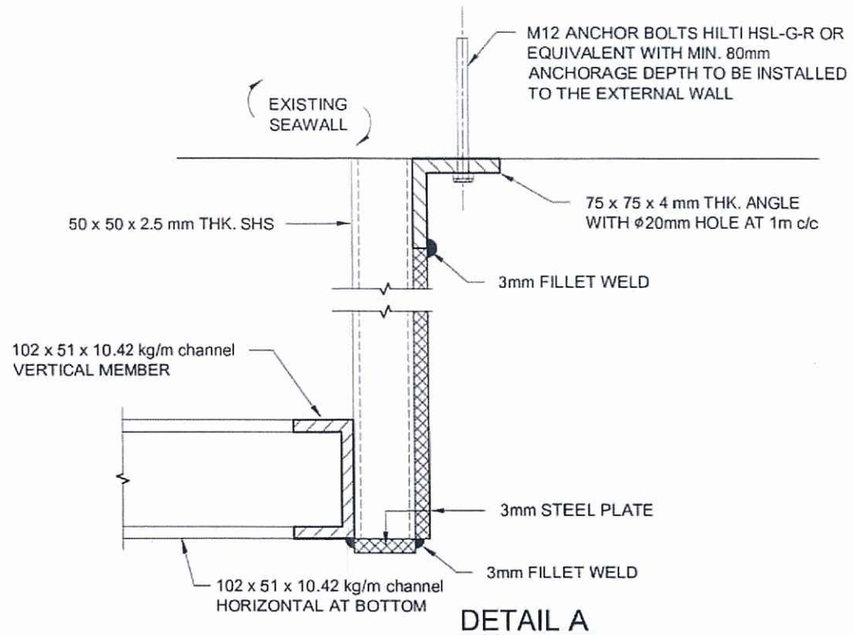


VIEW A
SCALE 1 : 50 (A3)

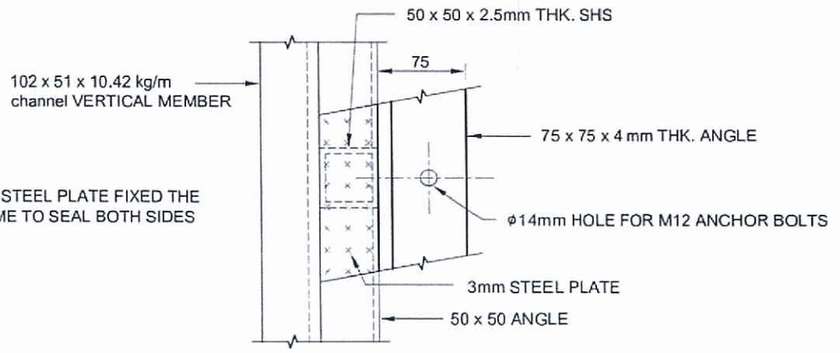


VIEW B
SCALE 1 : 50 (A3)

NOTE:
DIMENSION OF THE PRE-FABRICATED FRAME CLOULD BE ADJUSTED TO SUIT THE ACTUAL SIZE OF EACH WATER INTAKE.



DETAIL A
SCALE 1 : 5 (A3)



DETAIL B
SCALE 1 : 5 (A3)

PRE-FABRICATED WALL MOUNTED FRAME FOR THE SILT SCREEN

SCALE 1 : 50 (A3)

CLIENT: 土木工程拓展署 Civil Engineering and Development Department (CEDD)	CONTRACTOR: 俊和－中國中鐵聯營 CHUN WO - CRGL JOINT VENTURE	JOB TITLE: FIXING DETAILS OF THE WALL MOUNTED STEEL FRAME TO THE EXTERNAL WALL OF SUN HUNG KEI PUMP STATION INTAKES	SCALE: AS SHOWN (A3)	REF. TO DWG NO.: CW-CR/ENG/SK-SK0025	
ENGINEER'S REPRESENTATIVE: AECOM	PROJECT: CONTRACT NO. HK/2009/02 WAN CHAI DEVELOPMENT PHASE II - CENTRAL - WAN CHAI BYPASS AT WAN CHAI EAST		DATE: 11 MAR 2010		Sheet of
			DRAWN: MS SIN / DESIGNED:	SKETCH NO: CWCRJV/HK200902/SK0025	REV: B
			CHECKED: / APPROVED:		

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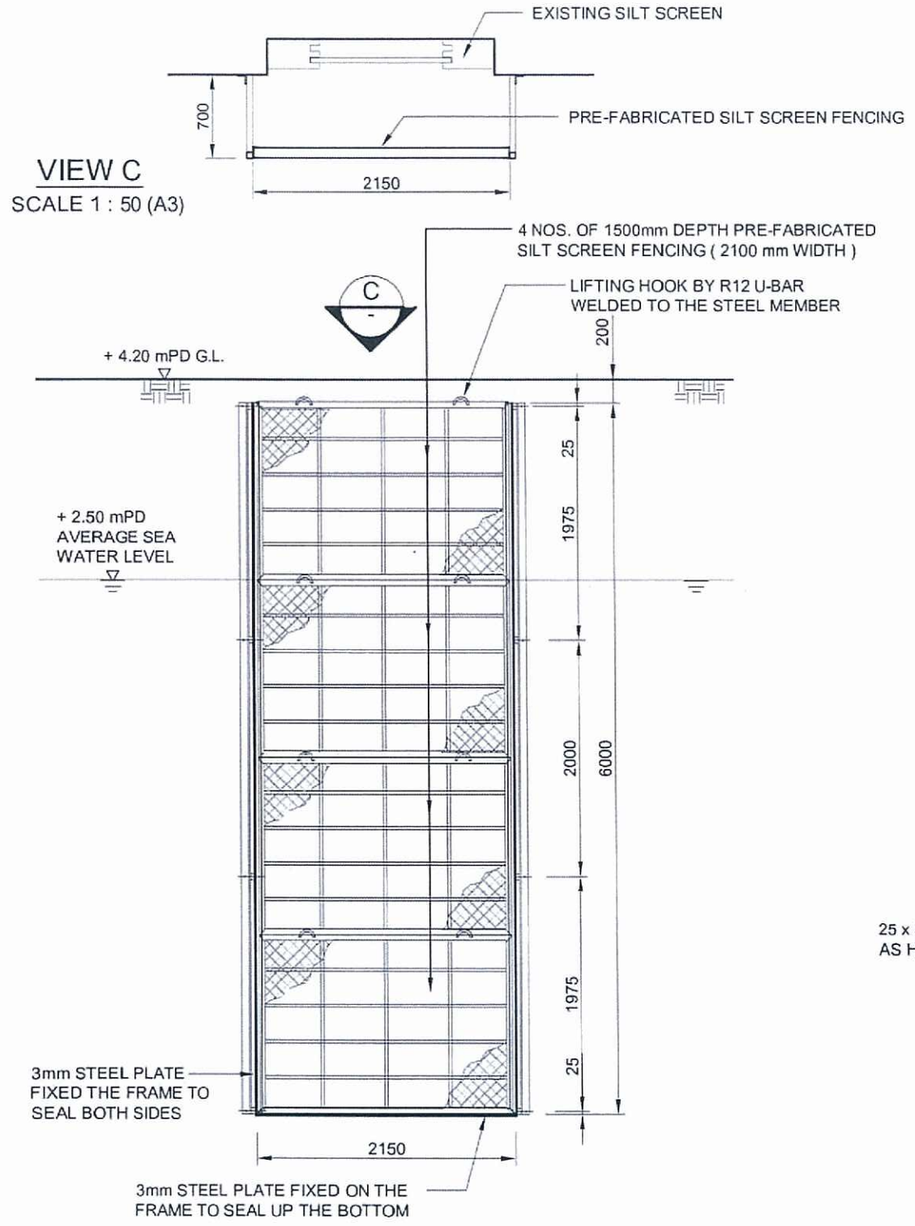
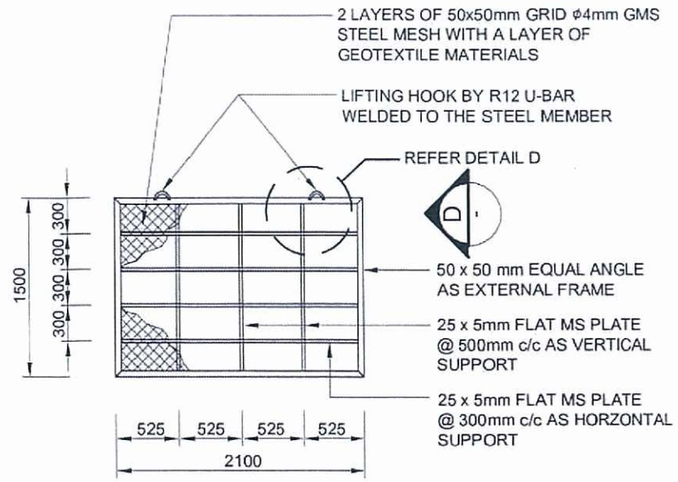
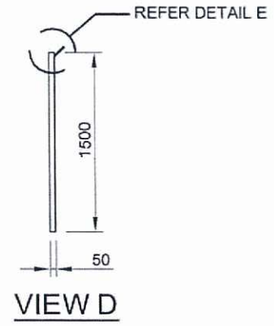
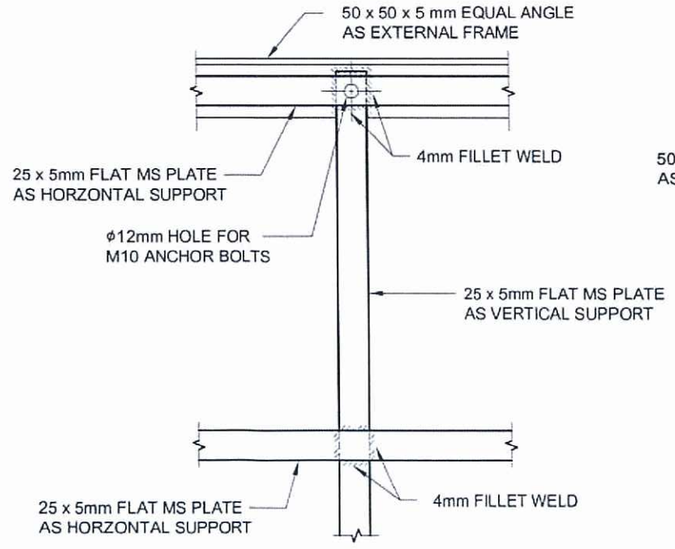
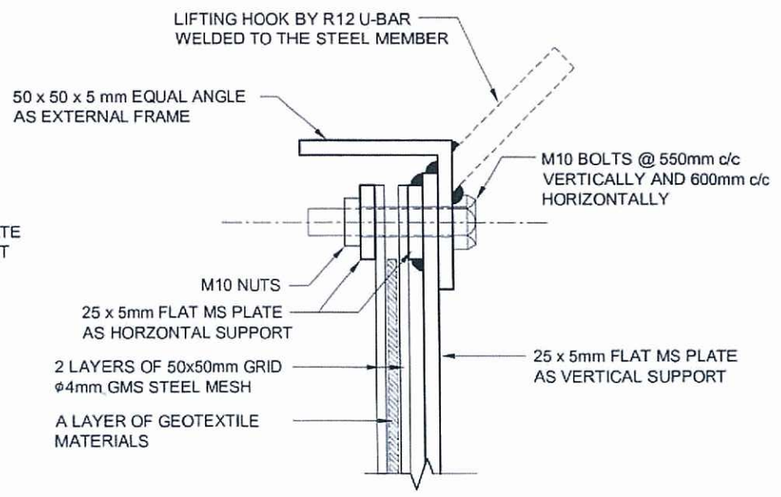




NOTE:
ALL CONNECTION OF STEEL MEMBER BY 4mm FILLET WELD UNLESS OTHERWISE STATED.





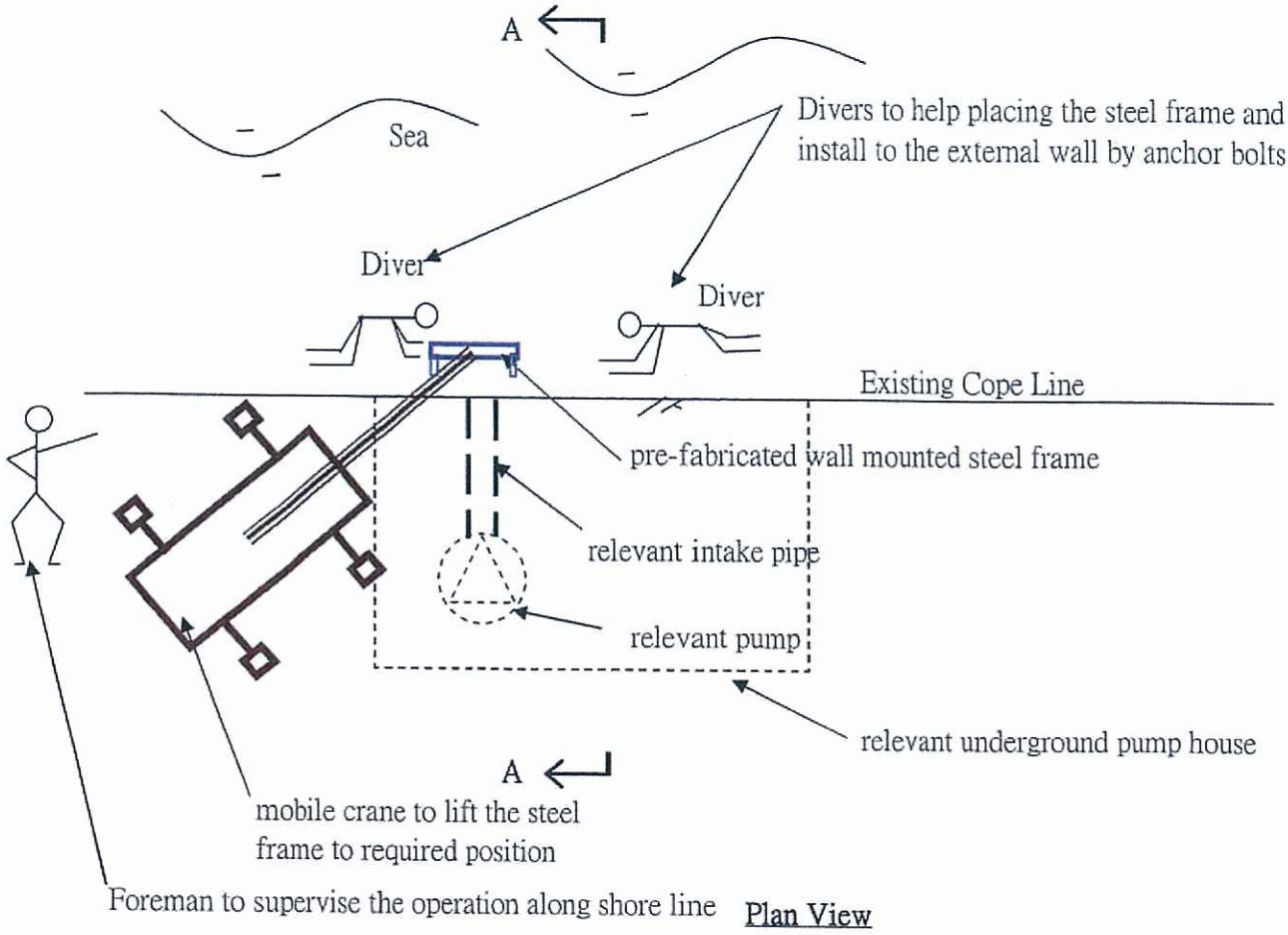


CLIENT: CEDD 土木工程拓展署 Civil Engineering and Development Department	CONTRACTOR: 俊和－中國中鐵聯營 CHUN WO - CRGL JOINT VENTURE	JOB TITLE: PROPOSED PRE-FABRICATED SILT SCREEN FENCING AND THE TYPICAL ARRANGEMENT FOR ITS INSTALLATION INTO THE WALL MOUNTED FRAME	SCALE: AS SHOWN (A3); REF. TO DWG NO.: CW-CR/ENG/SK-SK0026; DATE: 11 MAR 2010; Sheet of; DRAWN: MS SIN; DESIGNED; CHECKED: XXXX; APPROVED; SKETCH NO: CWCRJV/HK200902/SK0026; REV: B
ENGINEER'S REPRESENTATIVE: AECOM	PROJECT: CONTRACT NO. HK/2009/02 WAN CHAI DEVELOPMENT PHASE II - CENTRAL - WAN CHAI BYPASS AT WAN CHAI EAST		

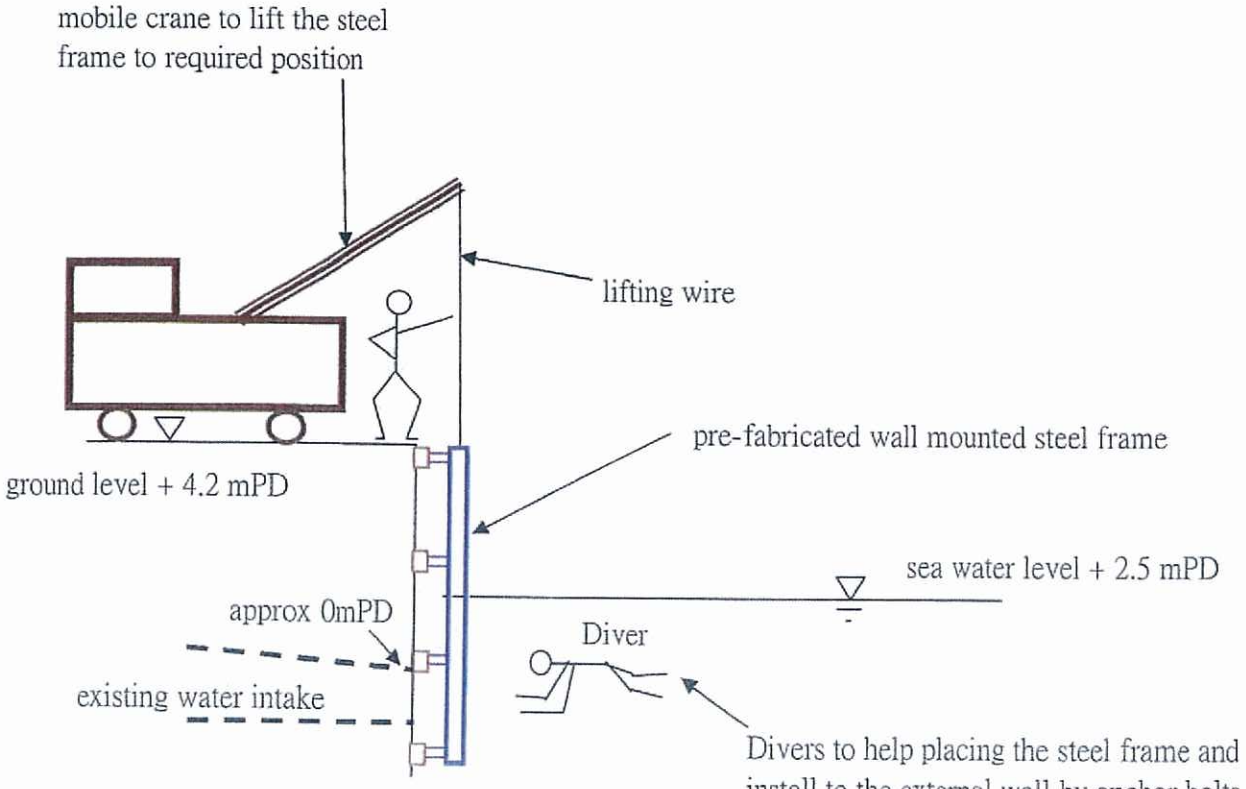
9.3 Appendix C – Graphical Illustration for the Installations of the Silt Screen System

Graphical Illustration for Installation of Wall Mounted Frame

1. Swith off the relevant intake pump
2. Lift the pre-fabricated steel frame to the required position



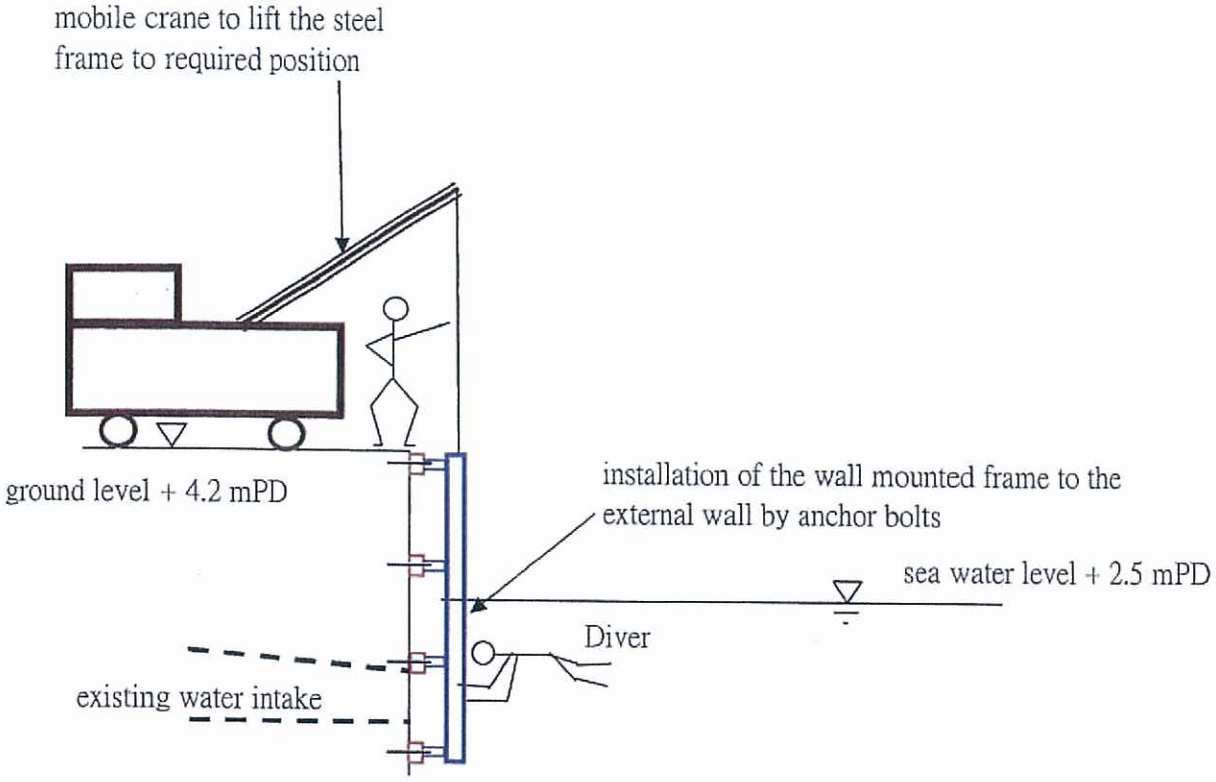
Plan View



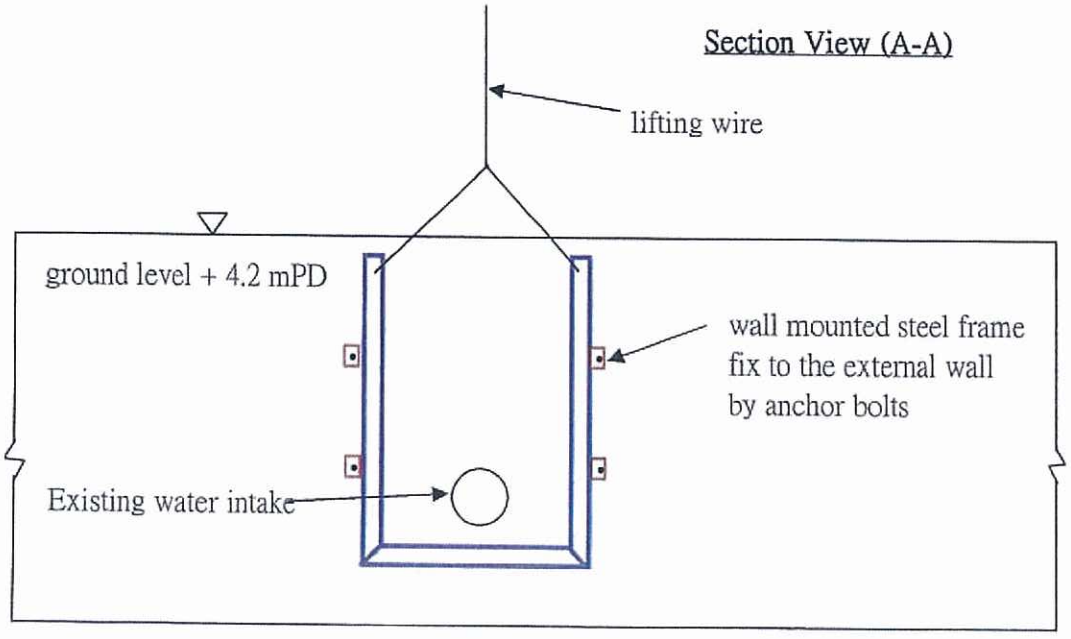
Section View (A-A)

Graphical Illustration for Installation of Wall Mounted Frame

3. Drill holes to the external wall by pneumatic air driller and install Hilti type HSL-3 bolts



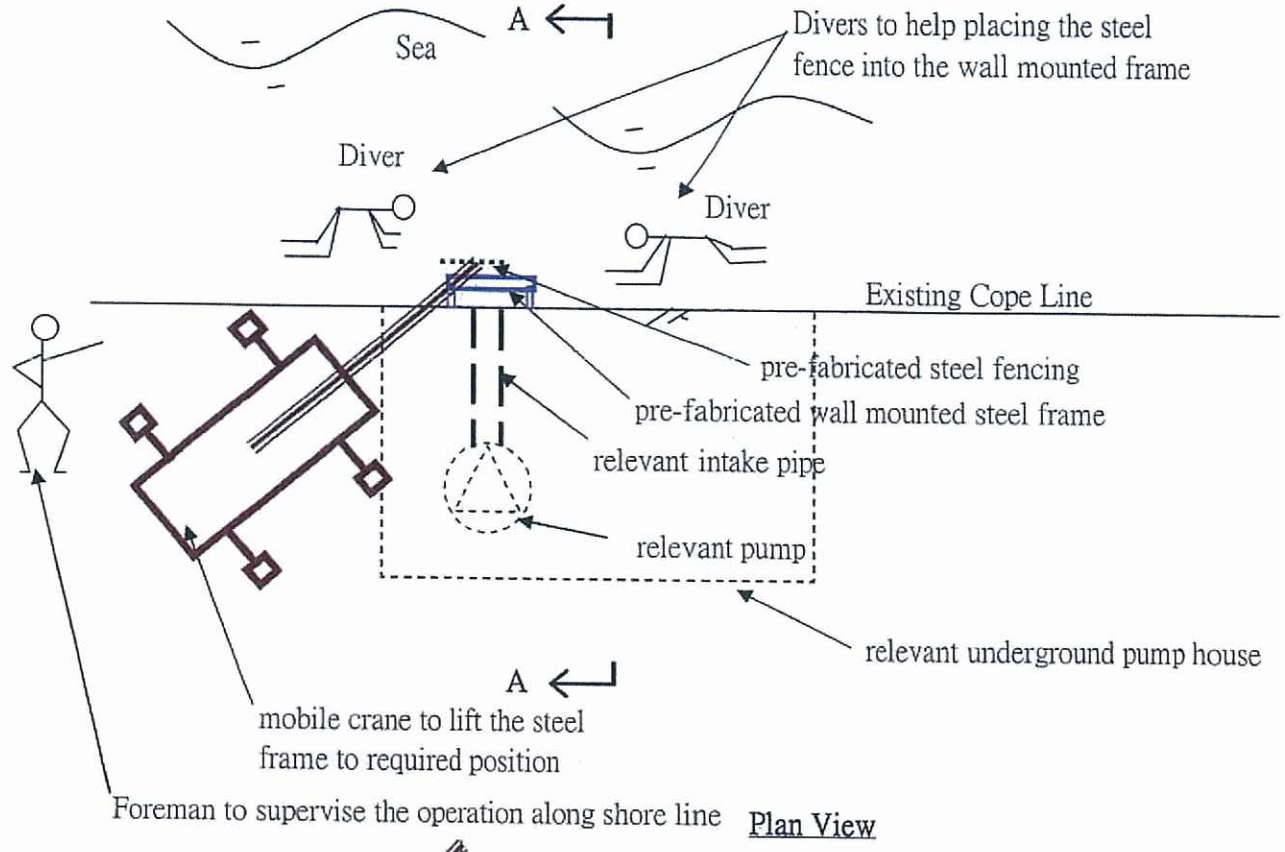
Section View (A-A)



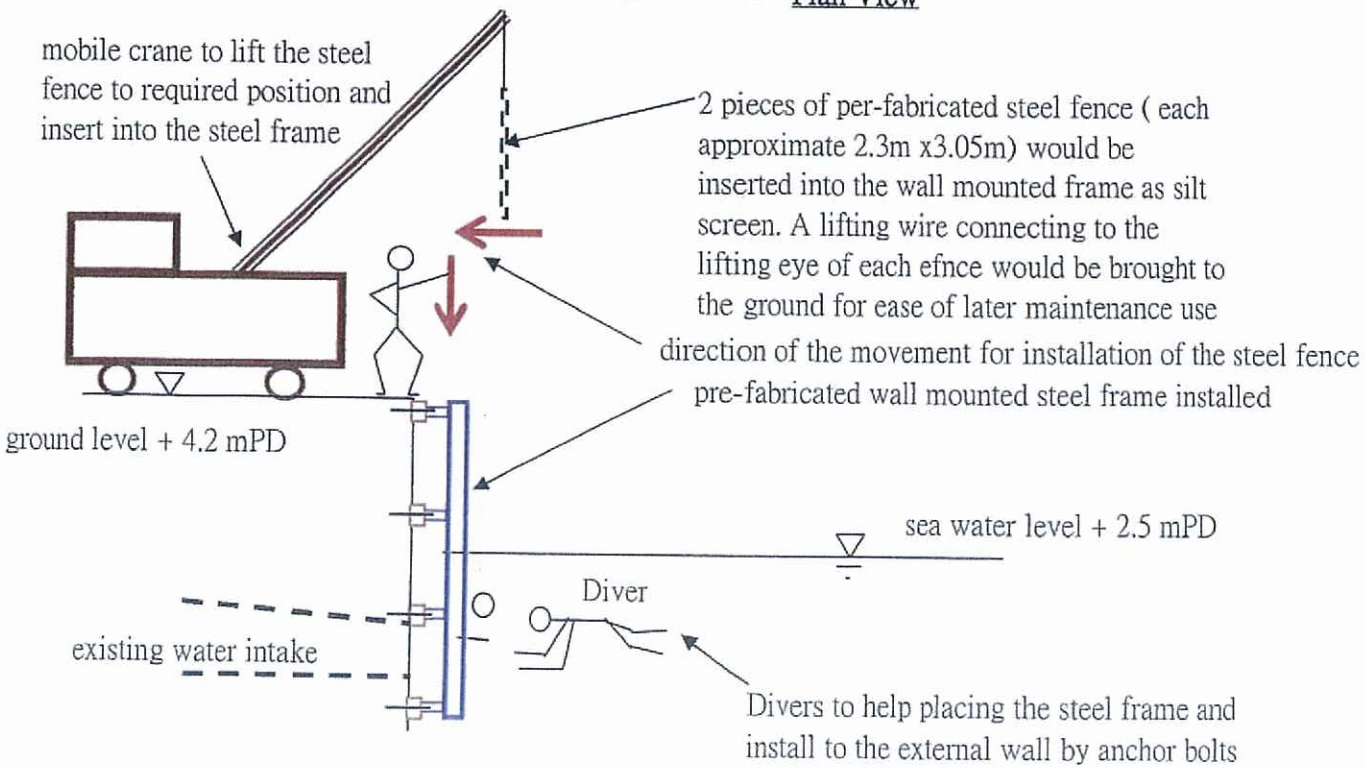
Elevation View

Graphical Illustration for Installation of the Silt Screen Fencing

1. Swith off the relevant intake pump
2. Lift the pre-fabricated silt screen fencing (bottom piece) to the required position and insert into the frame
3. Maintain a steel wire at the lifting eye of the steel fence and bring it to ground
4. Lift the other piece of pre-fabricated silt screen fencing (upper piece) and insert into the wall mounted frame
5. Maintain another piece of steel wire at the lifting eye of the steel fence and bring it to ground
6. Tie the two piece of steel wire properly at existing lifting arm of the pump house for ease of later maintenance use
7. Later maintenance would be carried out by lifting up the steel fencing by using typical chain block pulley system



Plan View



Section View (A-A)

9.4 Appendix D
– Daily Inspection Checklist

俊和－中國中鐵聯營
CHUN WO – CRGL JOINT VENTURE

Contract No. HK/2009/02

Contract Title Wan Chai Development Phase II – Central – Wan Chai By Pass at Wan Chai East

Silt Screen 每日檢查表

說明： ✔ = 滿意
✕ = 不滿意，須改善
\- = 不適用

位置：_____

日期：_____ 檢查員：_____

	星期一	星期二	星期三	星期四	星期五	星期六
整潔						
1. 沒有垃圾在架內						
2. 沒有泥水在架內						
3. 已清理架內垃圾						
其他問題(請註明)：						
鐵架狀況						
1. 鐵架沒有損壞						
2. 鐵網沒有損壞						
3. 繫緊螺絲沒有鬆脫						
其他問題(請註明)：						
隔泥布狀況						
1. 隔泥布沒有損壞						
2. 沒有隔泥布在業主的隔泥網上						
3. 隔泥布沒有鬆脫						
其他問題(請註明)：						
簽署：						

9.5 Appendix E – Technical Properties of the Geotextile Material – Tencate Mirafi FW300

TENCATE
Mirafi

Mirafi® FW Woven Filter Geotextiles

Properties of Mirafi® FW Woven Filter Geotextiles

Property		Unit	FW300	FW400	FW402	FW404	FW700
Mechanical properties							
Wide width tensile strength							
ISO 10319, ASTM D4595							
Mean tensile strength	MD	kN/m	45	35	45	45	45
Mean tensile strength	CD	kN/m	45	35	30	45	30
Grab tensile strength							
ASTM D4632							
Mean tensile strength	MD	kN	1.8	1.4	1.6	1.9	1.7
Mean tensile strength	CD	kN	1.5	1.2	0.9	1.5	1.1
Extension at peak strength	MD	%	20	20	25	20	25
Extension at peak strength	CD	%	20	20	20	20	20
CBR puncture strength							
ISO 12236, ASTM D6241							
Mean puncture strength		kN	5.5	4.5	3.0	5.5	4.5
UV resistance after 500 hrs							
ASTM D4355							
Strength retention		%	90	90	90	90	90
Hydraulic properties							
Characteristic opening size							
ISO 12956							
O_{90}		mm	0.35	0.30	0.25	0.20	0.20
Percent open area							
COE-22125*86							
POA		%	10	10	10	-	-
Water permeability							
ISO 11058							
Mean flow rate, Q_{50}		l/m²/s	90	50	100	45	20
Mean permittivity, ψ		s^{-1}	1.8	1.0	2.0	0.9	0.4
Mean permeability/velocity index, k_s		cm/s	0.15	0.04	0.15	0.08	0.02
Nominal roll width		m	4.0	4.0	4.0	4.5	3.8
Nominal roll length		m	100	100	100	100	100
Estimated roll weight		kg	110	75	85	130	80

200-605-da-12/08

* The mean flow rate is 90/m²/s which is capable to allow normal operations of the pump houses.

Ten Cate Industrial Zhuhai Co., Ltd.
South of Nangang West Road,
Gaolan Port Economic Zone, Zhuhai 519050, China
Tel: +86 756 086 1615, Fax: +86 756 086 1610
Email: info.zhuhai@tencate.com

TenCate Geosynthetics Asia Sdn. Bhd.
14, Jalan Somenta 27/91, Seksyen 27,
40400 Shah Alam, Selangor Darul Ehsan, Malaysia
Tel: +60 3 5192 8580, Fax: +60 3 5192 8575
Email: info.asia@tencate.com

TENCATE
materials that make a difference

TENCATE
Mirafi®

Mirafi® FW-Series Woven Geotextiles
for Engineered Filtration


Mirafi® FW Woven Geotextile

TenCate™ develops and produces materials that function to increase performance, reduce costs and deliver measurable results by working with our customers to provide advanced solutions.

The Difference Mirafi® FW-Series Engineered Filtration Geotextiles Make:

- Engineered Filtration. Resists clogging while maintaining flow rates in high gradient and dynamic flow conditions.
- Durability. High survivability rating in aggressive installation and loading conditions along with excellent resistance to chemicals in aggressive environments.
- Soil Interaction. Superior soil confinement resulting in greater load distribution.
- Unique Constructions. Manufactured with highly UV stabilized monofilament and multifilament fibers which provide highly uniform opening size (AOS) while maintaining high long-term flow rates. Mirafi® FW-Series geotextiles are manufactured with highly specialized processes to produce unique physical and hydraulic properties not possible with standard geotextiles, woven or nonwoven.
- Seams. Panels can be sewn together inthe factory or field, providing cross-roll direction strength to facilitate installation.

APPLICATIONS

Mirafi® FW-Series engineered filtration geotextiles are designed for long-term performance in problematic soil or site conditions to ensure clogging resistance, soil retention in erosion control, and subsurface drainage applications. Mirafi® FW-Series geotextiles are used underneath rip rap or concrete revetment systems along inland waterways and coastal shorelines to protect spillways and embankment dams from overtopping flow, encapsulating cut-off drains and collection systems surrounding landfills, filtration within dams. The geotextile is used adjacent to roadways and other critical structures, encapsulating leachate collection systems under landfills while maintaining long-term clogging resistance, and encapsulating edge drains for critical structures in problematic soils.

INSTALLATION GUIDELINES*

BANK STABILIZATION / ROCK (ARMOR) UNDERLAYMENT

Geotextile Placement

Place the geotextile in close contact with the soil, eliminating folds or excessive wrinkles both longitudinally and transversely. The geotextile need not be placed in tension before covering with riprap or other materials. Use care in placing the geotextile to avoid possible damage.

The geotextile can be joined by overlapping or sewing. Anchor the geotextile firmly at the top of the slope using an anchor trench. For maximum effectiveness, the trench should be at least 1m (3ft) from the crest of the slope and at least 0.6m (2ft) deep. Thoroughly compact soil in the trench to ensure good anchorage. When placing the geotextile along a stream or other places where water movements are expected, anchor the toe of the geotextile in a similar fashion as at the top to prevent scour beneath it.

* These guidelines serve as a general basis for installation. Detailed instructions are available from your TenCate™ representative.

Protective & Outdoor Fabrics
Aerospace Composites
Armour Composites
Geosynthetics
Industrial Fabrics
Synthetic Grass

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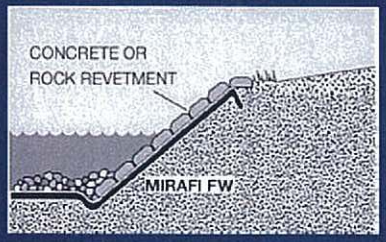
Mirafi® FW Woven Geotextiles

for Engineered Filtration

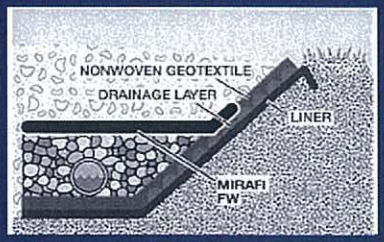
Property / Test Method	Units	FW300	FW402	FW403	FW404	FW500	FW700
MECHANICAL PROPERTIES							
Wide Width Tensile Strength ASTM D 4595							
MD @ Ultimate	kN/m (lbs/ft)	40.3 (2760)	35.0 (2400)	47.3 (3240)	43.8 (3000)	32.1 (2196)	39.4 (2700)
CD @ Ultimate	kN/m (lbs/ft)	39.4 (2700)	24.5 (1680)	39.4 (2700)	40.3 (2760)	43.8 (3000)	25.4 (1740)
Grab Tensile Strength ASTM D 4632							
MD @ Ultimate	N (lbs)	1780 (400)	1624 (365)	1891 (425)	1780 (400)	1446 (325)	1.6 (370)
CD @ Ultimate	N (lbs)	1491 (335)	890 (200)	1558 (350)	1402 (315)	1891 (425)	1.1 (250)
MD Elongation @ Ultimate	%	15	24	21	15	15	15
CD Elongation @ Ultimate	%		10	21	15	15	15
Trapezoidal Tear Strength ASTM D 4533							
MD	N (lbs)	645 (145)	512 (115)	645 (145)	666 (150)	601 (135)	0.4 (100)
CD	N (lbs)	556 (125)	334 (75)	556 (125)	734 (165)	668 (150)	0.3 (60)
Puncture Strength ASTM D 4833	N (lbs)	556 (125)	401 (90)	668 (150)	668 (150)	632 (140)	0.5 (120)
UV Resistance after 500 hrs. ASTM D 4355	% Strength	90	90	90	90	70	90
HYDRAULIC PROPERTIES							
Apparent Opening Size (AOS) ASTM D 4751	mm (US Sieve)	0.60 (30)	0.43 (40)	0.43 (40)	0.43 (40)	0.30 (50)	0.212 (70)
Permittivity ASTM D 4491	sec^{-1}	1.50	2.1	0.96	0.90	0.51	0.28
Percent Open Area COE-02215-86	%	8	10	6	1	4	4-6
Flow Rate ASTM D 4491	$l/min/m^2$ ($gal/min/ft^2$)	4685 (115)	5907 (145)	2852 (70)	2852 (70)	1426 (35)	733.3 (18)
Packaging							
Roll Width	m (ft)	3.8 (12.5)	3.8 (12.5)	3.8 (12.5)	4.5 (15)	3.7 (12)	3.7 (12)
Roll Length	m (ft)	91 (300)	91 (300)	91 (300)	91 (300)	91 (300)	91 (300)
Est. Gross Weight	kg (lbm)	100 (221)	76.6 (169)	110 (243)	132 (292)	96 (212)	74 (164)
Area	m^2 (yd^2)	348 (417)	348 (417)	348 (417)	418 (500)	334 (400)	334 (400)

*NOTE: Mechanical Properties and Hydraulic Properties shown are Minimum Average Roll Values (MARV). Apparent Opening Size (AOS) properties shown are Maximum Average Roll Values.
NP - Not Published

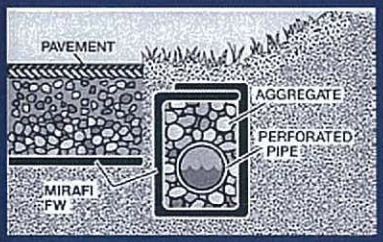
Mirafi® FW Woven Geotextiles



Shoreline Erosion Control



Leachate Colletion System



Cut-off/Interceptor Drain Along a Roadway

PDS.FW1009

365 South Holland Drive Tel 800 685 9990 Fax 706 693 4400
Pendergrass, GA 30567 Tel 706 693 2226 www.mirafi.com

ISO 9001
FM 61026

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Mirafi® FW300

Mirafi® FW300 geotextile is composed of high-tenacity monofilament polypropylene yarns, which are woven into a stable network such that the yarns retain their relative position. Mirafi® FW300 geotextile is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Wide Width Tensile Strength	ASTM D 4595	kN/m (lbs/in)	40.3 (230)	39.4 (225)
Grab Tensile Strength	ASTM D 4632	N (lbs)	1780 (400)	1491 (335)
Grab Tensile Elongation	ASTM D 4632	%	20	15
Trapezoid Tear Strength	ASTM D 4533	N (lbs)	645 (145)	556 (125)
CBR Puncture Strength	ASTM D 6241	N (lbs)	5563 (1250)	
Apparent Opening Size (AOS)[1]	ASTM D 4751	mm (U.S. Sieve)	0.60 (30)	
Percent Open Area	COE-02215	%	8	
Permittivity	ASTM D 4491	sec^{-1}	1.5	
Permeability	ASTM D 4491	cm/sec	0.13	
Flow Rate	ASTM D 4491	$l/min/m^2$ ($gal/min/ft^2$)	4685 (115)	
UV Resistance (at 500 hours)	ASTM D 4355	% strength retained	90	

[1] ASTM D 4751, AOS is a Maximum Opening Diameter Value

Physical Properties	Test Method	Unit	Typical Value
Mass/Unit Area	ASTM D 5261	g/m^2 (oz/yd^2)	271 (8.0)
Thickness	ASTM D 5199	mm (mils)	0.9 (35)
Roll Dimensions (width x length)	--	m (ft)	3.8 (12.5) x 91 (300)
Roll Area	--	m^2 (yd^2)	348 (417)
Estimated Roll Weight	---	kg (lbs)	100 (221)

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INSTALLATION GUIDELINES FOR GEOTEXTILES USED IN FILTRATION AND DRAINAGE APPLICATIONS

Prepared by

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INSTALLATION GUIDELINES FOR GEOTEXTILES USED IN FILTRATION AND DRAINAGE APPLICATIONS

GENERAL

This document is prepared to help ensure that a subsurface drainage geotextile, once installed, will perform its intended design function. To do so, the geotextile must be identified, handled, stored, and installed in such a way that its physical property values are not affected and that the design conditions are ultimately met as intended. This document contains information consistent with generally accepted methods of identifying, handling, storing and installing geotextile materials. Failure to follow these guidelines may result in the unnecessary failure of the geotextile in a properly designed application.

MATERIAL IDENTIFICATION, STORAGE AND HANDLING

The geotextile shall be rolled on cores having strength sufficient to avoid collapse or other damage from normal use. Each roll shall be wrapped with a plastic covering to protect the geotextile from damage during shipping and handling, and shall be identified with a durable gummed label or the equivalent, clearly readable on the outside of the wrapping for the roll. The label shall show the manufacturer's name, the style number, and the roll number. Roll identification corresponding to the proposed location of the roll as shown on the construction drawings and as approved by the Engineer, Owner and Contractor can be provided.

While unloading or transferring the geotextile from one location to another, prevent damage to the wrapping, core, label, or to the geotextile itself. If the geotextile is to be stored for an extended period of time, the geotextile shall be located and placed in a manner that ensures the integrity of the wrapping, core, and label as well as the physical properties of geotextile. This can be accomplished by elevating the geotextile off the ground on dunnage and ensuring that it is adequately covered and protected from ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, fire or flames including welding sparks, temperatures in excess of 60°C (140°F), and human or animal destruction.

Before unrolling the geotextile, verify the roll identification, length, and installation location with the contract drawings. While unrolling the geotextile, inspect it for damage or defects. Repair any damage that occurs during storage, handling or installation as directed by the Engineer. Normally light traffic will not damage the exposed geotextile. However, as a safety precaution, it is recommended that traffic not run on exposed geotextile.

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Mirafi® FW-Series Woven Geotextiles

High Performance Filtration Fabric

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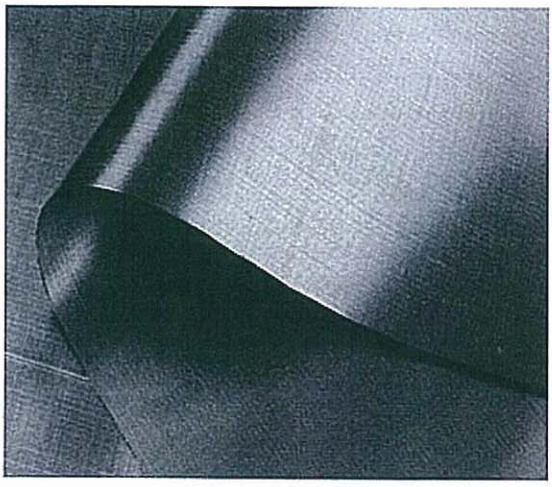
Mirafi® FW-Series Woven Geotextiles

High Performance Filtration Fabric

The Unique Product

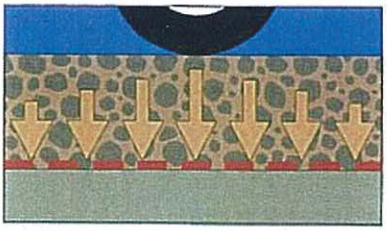


Mirafi® FW-Series geotextiles are manufactured using highly specialised fibre technology and processes to produce unique mechanical and hydraulic properties not possible with standard geotextiles, woven or nonwoven. The result is a series of geotextiles that combines the following benefits:

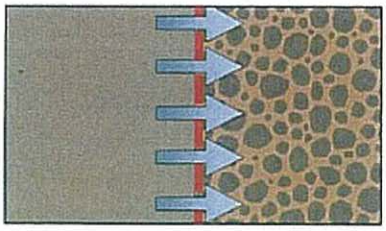
- High tensile strength
- High geotextile permeability
- High resistance to compression, thus permeability and pore size remain stable even when subject to high overburden loads
- Simple fabric structure that resists clogging while maintaining flow rates in high gradient and dynamic flow conditions
- Excellent durability and resistance to chemicals in aggressive environments
- Exceptionally high UV resistance
- Excellent survivability or damage resistance during installation

The Functions Performed

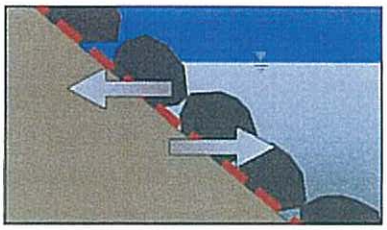
When Mirafi® FW-Series geotextiles are placed in soil, hydraulic and environmental structures they fulfill a range of functions that enhance the performance of these structures.



Separation: preventing the intermixing of soft foundation soils with granular materials thereby maintaining the structural integrity of the granular material.



Filtration: allowing fluids to pass while preventing the migration of soil particles.



Erosion control: preventing the erosion of soil particles due to water flow, surface run-off, or wave and tidal action.

Clogging Resistance

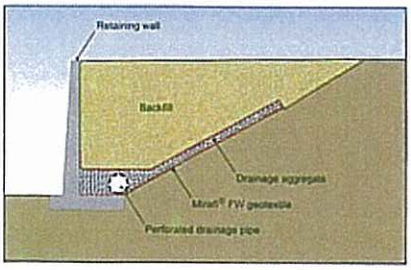
Experience have shown that geotextile clogging may be an important design consideration under the following filtration application operating environment:

- Poorly graded fine, cohesionless, soils such as loess, rock flour, and stone quarry fines
- Cohesionless soils consisting of gap-graded, particle-size distributions and functioning under high hydraulic gradients
- Dispersive clays that separate into individual fine particles over time
- High alkalinity groundwater where the slowing of the liquid when it flows through the filter geotextile can cause a calcium, sodium, or magnesium precipitate to be deposited
- High suspended solids in the permeating liquid, as found in turbid river water or dredged water that can build up on, or within, the filter geotextile
- High suspended solids coupled with high micro-organisms content, as in landfill leachates and agricultural wastes, can combine to build up on, or within, the filter geotextile

Mirafi® FW-Series geotextiles, with a simple and open structure, offers high permeability with no complex pore space to trap particles within. They have relatively much smaller specific surface area for chemical deposits and biofilm growth. Thus Mirafi® FW-Series geotextiles have superior resistance to clogging unmatched by any conventional geotextiles in the market.

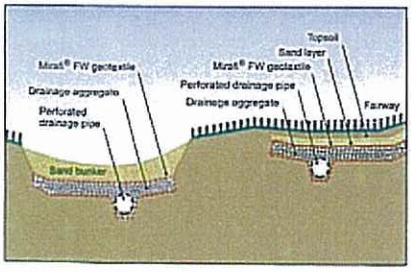
Subsurface Drainage Applications

Mirafi® FW-Series geotextiles are used as filter layer for a wide range of subsoil drainage structures; including trench drains, horizontal drainage blankets, vertical drainage behind retaining structures, chimney and toe drains to provide seepage control for earth dams and levees. Due to their high permeability even when under low hydraulic gradient conditions, they are ideally suited for sports ground drainage applications, where it is important to be able to resume play within the shortest possible time after heavy rain.



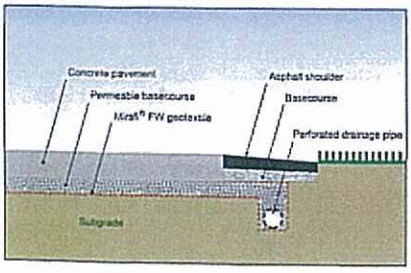
GROUND WATER SEEPAGE CONTROL

The uncontrolled movement of groundwater can be detrimental to geotechnical structures by reducing effective shear strengths in soils, lubricating failure planes, contributing to liquefaction during earthquakes and promoting soil piping. Mirafi® FW-Series geotextiles are used as filters in subsoil drainage systems for even the most problematic soils as well as groundwater seepage conditions.



RAINWATER INFILTRATION CONTROL

Sports grounds require drainage of surface ponding of water within the shortest possible lag time after rain for early resumption of use or play. Often, that requires a drainage blanket close to the ground surface, with a highly permeable and efficient filtration system as well as minimal clogging risk over time. Mirafi® FW-Series geotextiles are ideal candidates for such applications.

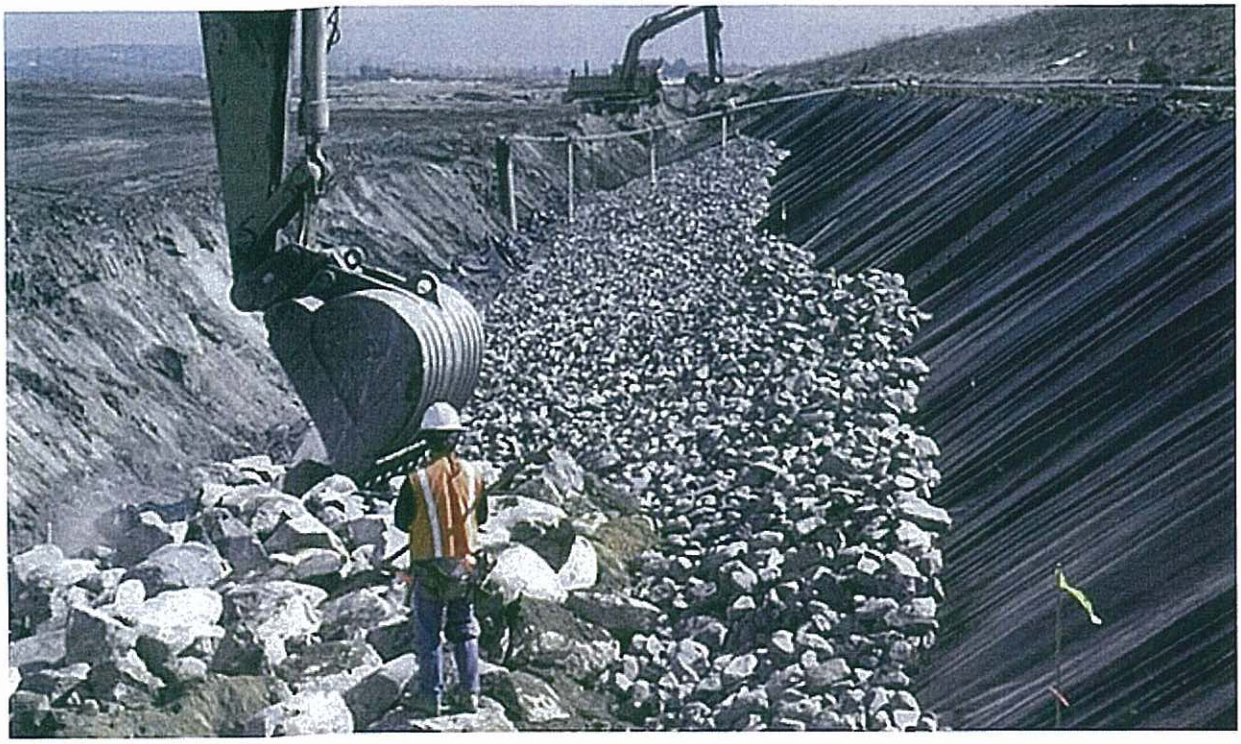


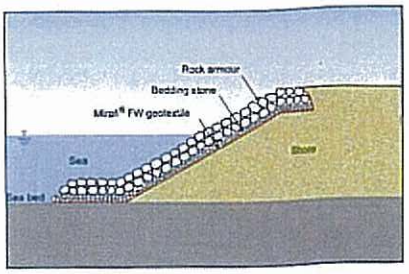
PERMEABLE PAVEMENT BASECOURSES

For pavements designed with permeable basecourses, these basecourses need to function structurally as well as hydraulically to drain away surface infiltration and groundwater seepages from the subgrade. The high strength Mirafi® FW-Series geotextiles will provide excellent ground stabilisation benefits in addition to performing the filtration function required over the lifespan of the pavement.

Marine Applications

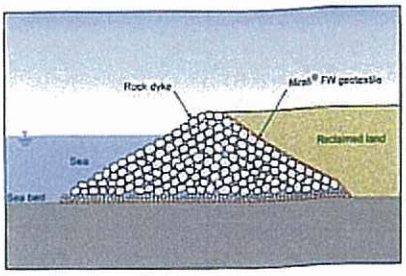
In high gradient shoreline applications, the quick release of hydrostatic pressure through the geotextile is critical to long-term performance. Due to their low clogging potential, Mirafi® FW-Series geotextiles are also ideally suited as filter layers between soil and rock dykes as well as under armour protection layers. Mirafi® FW-Series geotextiles are extremely robust and can withstand high installation stresses. They can be easily prefabricated into large panels for quick deployment. This is done by seaming adjacent rolls of geotextiles to ensure structural continuity and integrity.





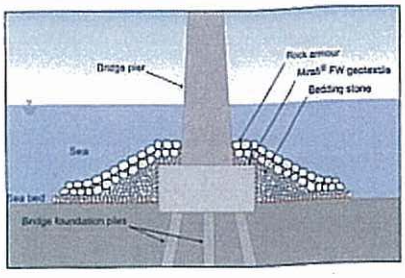
REVETMENTS

Mirafi® FW-Series geotextiles are uniquely engineered filter geotextiles that exhibit a consistent and simple pore structure along with high permeability. This makes them suitable as revetment filters for problematic soils and sands in difficult environments where quick and unimpeded release of pore water pressure is required. Mirafi® FW-Series geotextiles can be installed with ease. They have excellent resistance against ultraviolet radiation to ensure minimal loss of strength during installation exposure.



RECLAMATION DYKES

Dykes prevent soil washout by waves and currents during land reclamation works in marine environment. Mirafi® FW-Series geotextiles prevent the loss of reclamation fill through the permeable reclamation dykes, which can be an important issue especially in an environmentally sensitive area. Mirafi® FW-Series geotextiles with high permeability will ensure rapid dewatering of dredged reclamation fill.

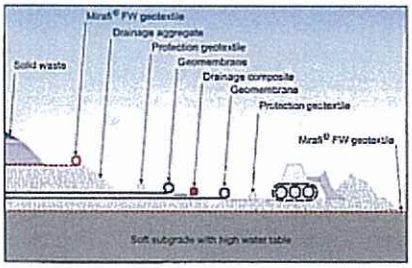


SCOUR PROTECTION LAYERS

Mirafi® FW-Series geotextiles act as filtration layer underneath scour protection armour layers. They can be prefabricated into large and unique paneling for easy underwater deployment. The high tensile strength and robust Mirafi® FW-Series geotextiles can resist high installation stresses that are normally associated with underwater installation of filtration geotextiles.

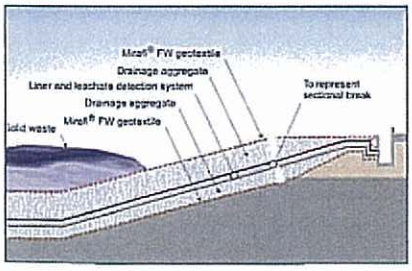
Landfill Applications

Mirafi® FW-Series geotextiles with high tensile strength are used as support layers over soft subgrades, where they act as separator and filter, before landfill liner systems are constructed. Due to their low clogging potential, they are also ideally suited as leachate filter layers prior to placement of solid wastes. Planar drainage geocomposites are often used for subsoil drainage, gas transmission and leachate detection in liner systems in landfills. Mirafi® FW geotextiles will resist caving into the drainage core space even under high compression load and are the ideal geotextiles for fabrication of the drainage composites.



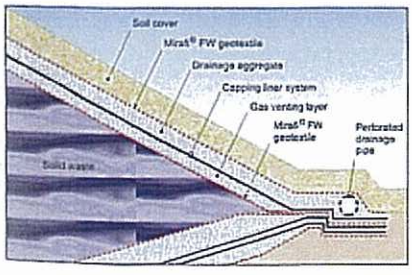
SUBGRADE STABILISATION AND DRAINAGE LAYER FILTRATION

For landfills constructed on soft ground, subgrades may need to be stabilised prior to installation of liner systems. Often, the subgrade stabilisation platform layer is required to perform a long term subsoil drainage function as well. Mirafi® FW-Series geotextiles with high tensile strength and good hydraulic properties are ideal for soft subgrade stabilisation cum drainage layer filtration in landfill engineering.



LEACHATE FILTRATION

Studies have shown that the magnitude of decrease in leachate filtration geotextile permeability in landfills depends on the openness of the geotextile, the flow rate and the concentration of the leachate. Mirafi® FW-Series geotextiles engineered with even pore sizes and a high degree of openness are the geotextiles of choice for leachate filtration in landfills.



LANDFILL COVER SYSTEMS

The primary purpose of a landfill cover is to isolate waste materials from the environment by minimising the infiltration of surface water, preventing human and animal contact with waste materials, and controlling landfill gases. Mirafi® FW-Series geotextiles are ideal as filters used within cover systems for rapid removal of infiltrating water as well as generated gases from the decomposing waste matters within the landfills.

Filtration Design [1]

Hydraulic design criteria

There are two fundamental geotextile properties that govern how it behaves hydraulically, namely opening size (relating to the soil retention criterion) and water permeability (relating to the permeability criterion). Table 1 may be used for the hydraulic design of Mirafi® FW-Series woven geotextiles as filters and are applicable for subsurface drainage and marine applications.

Table 1: Hydraulic Design Criteria for Mirafi® FW-Series Woven Geotextiles

	Drainage applications	Marine applications
1. Soil retention		
where the soil to be filtered is predominantly granular soil	$O_{90} \leq D_{85}$	$O_{90} \leq D_{50}$
where the soil to be filtered is predominantly silty soil	$O_{90} \leq 2D_{85}$	$O_{90} \leq D_{50}$
where the soil to be filtered is predominantly cohesive soil	$O_{90} \leq 0.22$mm	$O_{90} \leq 0.22$mm
2. Permeability	$k_g \geq A\, k_s$	$k_g \geq k_s$

Notes:
(a) k_g denotes the geotextile permeability or velocity index
(b) k_s denotes the permeability of the soil to be drained
(c) O_{90} denotes the geotextile characteristic opening size
(d) D_{50} denotes the soil particle size for which 50% are smaller
(e) D_{85} denotes the soil particle size for which 85% are smaller
(f) A denotes the safety factor applied for permeability (for normal applications, A = 1; for high clogging risk applications, A = 10)

Mechanical design criteria

In addition the filter geotextile must also survive the installation process (relating to the mechanical criteria). If the geotextile does not have adequate mechanical properties, it may become punctured or torn during installation resulting in adverse effects on its hydraulic performance. The mechanical property requirements of the geotextile filter are related to the types and magnitudes of the stresses imparted by the permeable drainage media in contact with the geotextile filter. Most applications involve the filter geotextile to be in contact with stones. The installation for subsurface drainage applications typically involves either stones dropped directly onto the geotextile (eg. trench drains) or stones tipped onto a stabilised aggregate platform that is extended further by dozing the stones over the edge of the platform (eg. subsurface blanket drains). The installation for erosion control systems typically involves either stones dropped directly onto the geotextile (eg. revetments and scour protection layers) or the geotextile is placed after the stones have been installed (eg. reclamation dykes). When stones are dropped directly onto the geotextile, the mechanical strength requirement would depend on the size of stone and the height that it is dropped from. When stones are dozed from the edge of an aggregate platform, the mechanical strength requirement would depend on the size of stone and the subgrade CBR strength beneath the aggregate platform.

Operating spectra of Mirafi® FW-Series geotextiles as filters for subsurface drainage applications

For a specific geotextile of known mechanical properties, it would be possible to develop an operating spectrum for subsurface drainage applications with a specific mode of installation of geotextile. Figure 1 shows the operating spectra of Mirafi® FW-Series geotextiles for use as filter layer at the underside of blanket drains. Figure 2 shows the operating spectra of Mirafi® FW-Series geotextiles for use as filter layer in trench drains.

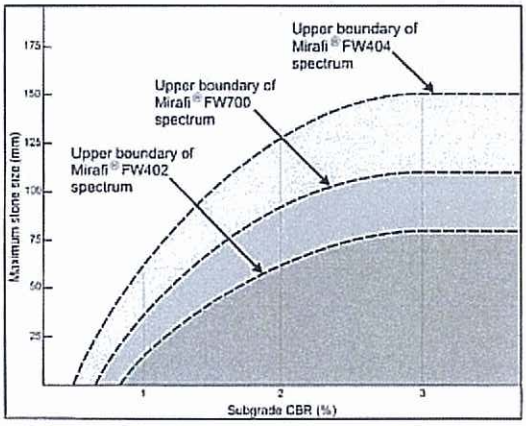


Figure 1: Operating spectra of Mirafi® FW-Series geotextiles for use at the underside of blanket drains

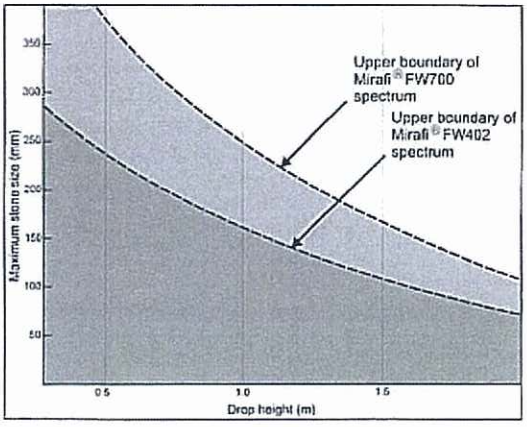


Figure 2: Operating spectra of Mirafi® FW-Series geotextiles for use in trench drains

Filtration Design [2]

Operating spectra of Mirafi® FW-Series geotextiles as filters for marine applications

For a specific geotextile of known mechanical properties, it would be possible to develop an operating spectrum for marine applications with a specific mode of installation of geotextile. Figure 3 shows the operating spectra of Mirafi® FW-Series geotextiles for use as filter layer in revetments and scour protection applications. Figure 4 shows the operating spectra of Mirafi® FW-Series geotextiles for use as filter layer between reclamation dykes and fill.

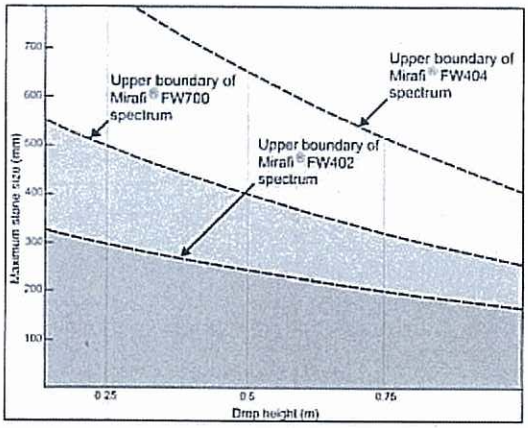


Figure 3: Operating spectra of Mirafi® FW-Series geotextiles for use in revetents and scour protection

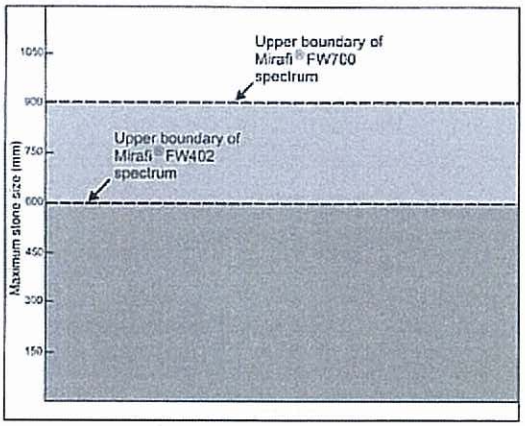


Figure 4: Operating spectra of Mirafi® FW-Series geotextiles for use between reclamation dykes and fill

Leachate filtration in landfills

The role of geotextile filter in leachate drainage and collection system is to allow adequate leachate flow from the solid waste through to the drainage blanket and at the same time prevent or reduce clogging in the drainage gravel and pipes. The use of geotextile as a filter above the drainage gravel has been reported to result in less clogging than that observed in areas with no geotextile filter (Rowe et al., 2004).

Chemical and microbiological clogging is a critical issue for leachate filter geotextiles in landfills. The rate of reduction of geotextile permeability due to chemical and microbiological clogging is dependent on the initial pore size and the solid surface area that the leachate will come into contact with while flowing through the geotexile. Woven monofilament geotextiles (eg. Mirafi® FW-Series geotextiles) are the preferred engineering choice for leachate filtration. Giroud (1996) has discussed the issue of clogging as part of a broad review of filter design. He tentatively recommends that sand and nonwoven filters should not be used even if the waste has been stabilised to produce low strength leachate by pretreatment. Rather, he recommends the use of monofilament woven geotextiles. Percent opening area (POA) should be an additional specification item for leachate filter geotextiles. Koerner and Koerner (1995) recommended that for mild leachate, monofilament woven geotextiles should have a minimum POA of 10%. For more severe leachate conditions, the minimum POA of 15% should be specified as per the recommendation of Giroud (1996).

Leachate filter geotextiles are sometimes left uncovered for significant periods to time. UV resistance of geotextile is an important considaration and should also be a specification item for leachate filter geotextiles. It is recommended that a strength retention of 90% according to the UV resistance test ASTM D4355 be specified.

Filtration is a critical element in design and geotextile filters must not be selected on cost alone. Often, the cost of geotextile filters is an insignificant contribution to the overall project cost but the consequence of problems associated with use of an inadequate geotextile filter can be very significant.

References

Giroud, J.P. (1996). *Granular Filters and Geotextile Filters*, Proceedings Geofilters '96, pp. 565-680.

Koerner, R.M. & Koerner, G.R. (1995). *Leachate clogging assessment of geotextile (and soil) landfill for filters*, US EPA Report, CR-819371, March.

Rowe, R.K., Quigley, R.M. & Booker, J.R. (2004). *Barrier Systems for Waste Disposal Facilities*, 2nd Edition, Spoon Press: London & New York, 978 pgs.

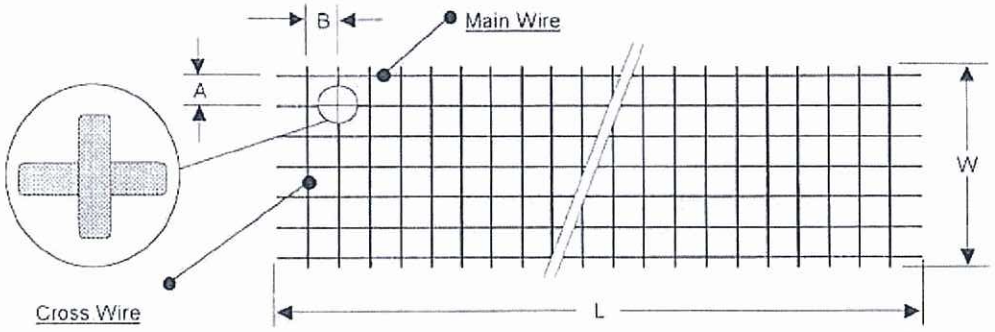
9.6 Appendix F - Technical Properties of the Steel Mesh Material – Golik 228G

GALVANIZED / STAINLESS STEEL MESH 鍍鋅 / 不銹鋼網

Golik Reference No. 高力編號		Diameter 鍍鋅線規格		Pitch 網眼規格		Sheet Size 網片規格			Weight 重量
		Main 直	Cross 橫	Main 直 (A)	Cross 橫 (B)	Width 闊 (W)	x	Length 長 (L)	
Galvanized Steel 鍍鋅	Stainless Steel 不銹鋼	(mm)	(mm)	(mm)	(mm)	(Metre)		(Metre)	(kg/m2)
21G	21S	4.00	3.00	50	25	2.1	x	3.6	4.18
210G	210S	3.00	3.00	50	50	2.1	x	3.6	2.20
228G	228S	4.00	4.00	50	50	2.1	x	3.6	3.96
31G	31S	4.00	3.00	75	25	2.1	x	3.6	3.52
310G	310S	3.00	3.00	75	75	2.1	x	3.6	1.46
3110G	3110S	3.00	3.00	75	25	2.1	x	3.6	2.93
310aG	-	3.20	3.20	75	75	2.1	x	3.6	1.68
410G	410S	3.00	3.00	100	100	2.1	x	3.6	1.11
48G	48S	4.00	4.00	100	100	2.1	x	3.6	1.98
1111G	1111S	3.00	3.00	25	25	2.1	x	3.6	4.40
1112G	1112S	2.70	2.70	25	25	1.2	x	2.1	3.64
3315 *	- *	1.50	1.50	75	75	1.8	x	30.0	0.36
D31 *	D31S *	2.00	2.00	100	100	1.8	x	60.0	0.50
E31 *	E31S *	2.00	2.00	50	50	1.8	x	30.0	0.99
D49 *	D49S *	2.50	2.50	100	100	1.8	x	50.0	0.77
E49 *	E49S *	2.50	2.50	50	50	1.8	x	20.0	1.54
E49a (2212) *	E49aS *	2.70	2.70	50	50	1.8	x	20.0	1.80
1520G *	1520S *	1.50	1.50	20	20	0.915	x	30.0	1.40
1117G *	1117S *	1.50	1.50	25	25	0.915	x	30.0	1.12
1118G *	1118S *	1.20	1.20	25	25	0.915	x	30.0	0.72
1119G *	1119S *	1.00	1.00	25	25	0.915	x	30.0	0.48

Remark : (1) "*" Types of mesh are supplied in form of rolls.

(2) Stainless Steel Mesh is supplied in grade of AISI 304 and AISI 316.



Galvanized Mesh used in Fencing
使用於圍網之鍍鋅網

Galvanized Mesh in rolls
卷裝鍍鋅網

Other usage of Galvanized Mesh
鍍鋅網之其它使用方法

INTRODUCTION 公司簡介

Golik Metal Manufacturing Co., Ltd. was established in 1977 and rapidly emerged as one of Hong Kong's leading manufacturers and suppliers of Welded Steel Wire Fabric and steel mesh related products used in the building and civil construction works.

Our experience has been acquired over 25 years of manufacturing Welded Steel Wire Fabric. During the Period, we have produced over 250,000 tons of Fabric and related products destined for most projects in Hong Kong, Macau and China.

Golik had successfully acquired the qualification of ISO 9002 Certification in 1995 and ISO 9001: 2000 in 2003. In addition, Golik had been approved as Quality Assured Stockist in 1998, for reinforcing steel bars.

This brochure is intended to provide product information, material specifications and some technical details of Welded Steel Wire Fabric for Architects, Designers, Engineers, and Contractors.

高力金屬製品廠有限公司創立於1977年。現已發展成為香港主要的熔接鋼筋網生產商及其它有關之鋼網產品供應商。

我們已有超過 25 年生產及供應熔接鋼筋網的經驗。其間已生產超過250,000噸各種熔接鋼筋網供應香港、澳門及中國地區的各項大小房屋及基建工程。

高力於一九九五年成功獲取 ISO 9002 之國際認証，並於二零零三年提升為 ISO 9001：2000 年版本之審核驗証；在一九九八年則通過 Quality Assured Stockist 認証，成為認可之熱軋鋼筋供應商。

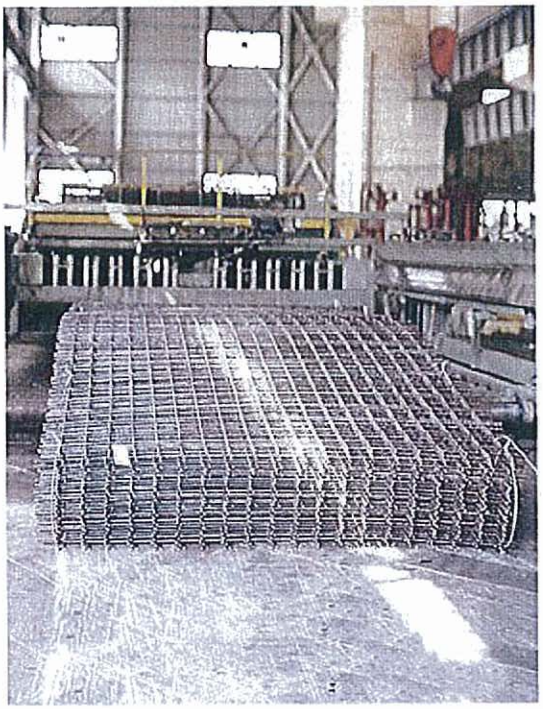
這產品目錄主要是提供所生產鋼筋網之標準及規格，以及一些使用的技術資料，以加深各有關之技術人員（則師、設計人員、工程師）及承建商對熔接鋼筋網之了解。

OUR PRODUCTS 產品介紹

BENEFITS OF USING GOLIK FABRIC
高力鋼筋網的優點

In an environment of increased site-labour cost, Golik Fabric provides Developers, Designers, Engineers and Contractors a convenient and economical steel reinforcement for concrete structures. Golik produces wide range of mesh products include Standard Fabric, Non-standard Fabric and tailor-made Engineered Fabric. Other products such as galvanized finemesh, galvanized wire mesh and hard-drawn wires etc.

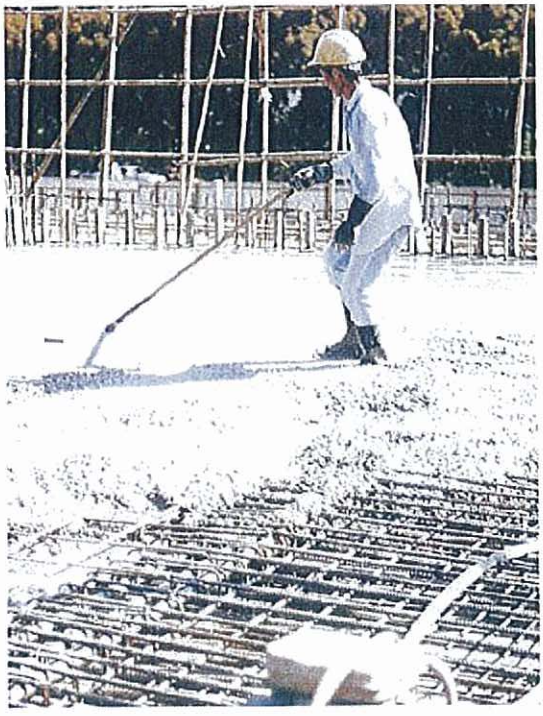
在目前建築業勞工成本上升情況下，高力鋼筋網給發展商、設計師、工程師及建築商提供了一種使用於混凝土結構上之經濟、方便及高效能的建築材料。我們的產品包括標準、非標準及特定規格鋼筋網，其他產品包括有鍍鋅電焊網及冷拉鋼筋等。



GOLIK FABRIC FOR CONCRETE REINFORCEMENT
高力鋼筋網用於混凝土結構

Golik Fabric is a prefabricated steel product which replaces traditional steel cutting and fixing. The higher strength of the Golik Fabric can considerably save the quantity of steel used on a project.

高力鋼筋網主要是用以代替傳統人手裁剪及固定鋼筋的建築方法。使用高強度性能的高力鋼筋網代替傳統方法可以節省鋼材。

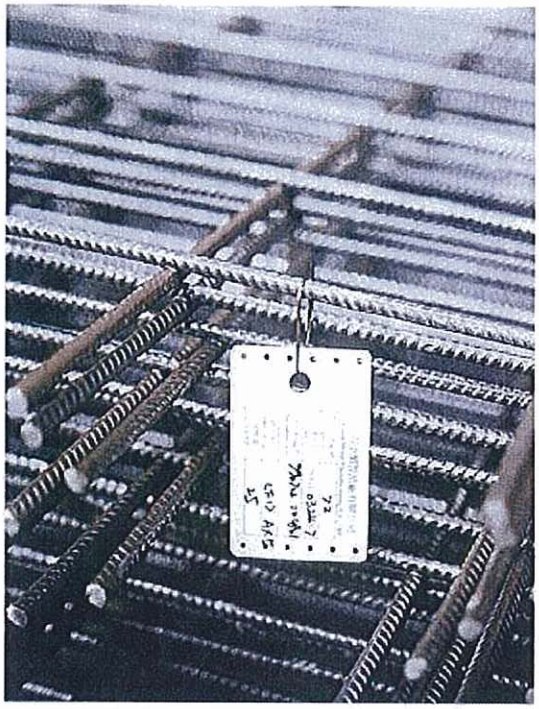


APPLICATIONS 用途

GOLIK FABRIC IS QUALITY STEEL FIXING
高力鋼筋網能保証工程質量

The spacing of the steel wires is uniformly controlled, as Golik Fabric is produced by fully computerized mesh making machines. Each wire intersection is welded with a controlled weld, not loosly fixed with tying wire. Golik Fabric eliminates human error in manual steel fixing. Golik Fabric is widely used for the following applications : **Paving, Buildings, Concrete Pipes, Shaped Fabric, Precast Components etc.**

高力鋼筋網的鋼筋排放是標準化及機械化。使用標準化的鋼筋網可以大大減少由人手綁扎而做成的錯漏。高力鋼筋網片已廣泛地被使用於：路面地台、高層建築物、水泥管、混凝土預製件等。



PAVING
路面及地台

Concrete pavements are exposed directly to atmospheric conditions, expanding and contracting with every change of temperature or moisture condition. Golik Fabric functions as shrinkage reinforcement, permitting the transfer of internal stresses and loads, maintaining an even surface, and safeguarding the strength and durability of the pavement.

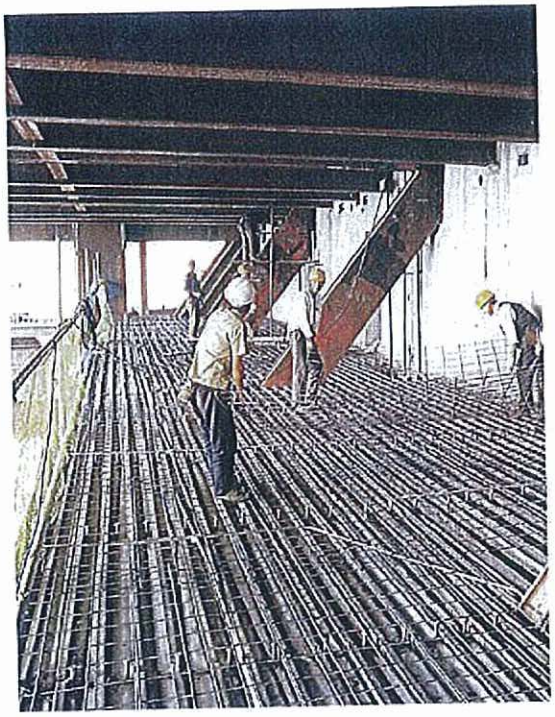
一般混凝土路面龜裂的主要原因是受到溫度及濕度變化而澎脹或收縮。高力鋼筋能有效地加強路面之強度及平均分散路面所承受之壓力，有效地減少混凝土路面出現龜裂之情況。

APPLICATIONS 用途

BUILDINGS
高層建築物

Golik Fabric is used successfully and economically in practically every form of concrete building such as footings, slabs, walls, staircases, refuse chutes. Golik Fabric is adaptable for use for all types of building designs, including public housing, office buildings, schools, hospitals, industrial and commercial buildings, airport hardstanding's, apartments and other residential buildings.

高力鋼筋網在高層建築工程中代替普通鋼筋都有非常成功及滿意的效果。工程包括有公共房屋、政府辦工大樓、學校、醫院、工業及商業大廈等。從數據顯示，使用高力鋼筋網能夠節省大量人手及施工時間。



CONCRETE PIPES
預製水泥管

Golik Fabric and Golik Hard Drawn Wire are standard reinforcing materials used in the manufacture of concrete pipes. Welded steel fabric is used because of its high strength and consequently, less material is required. If mild steel bars are used in the same application, about 40% more steel is required.

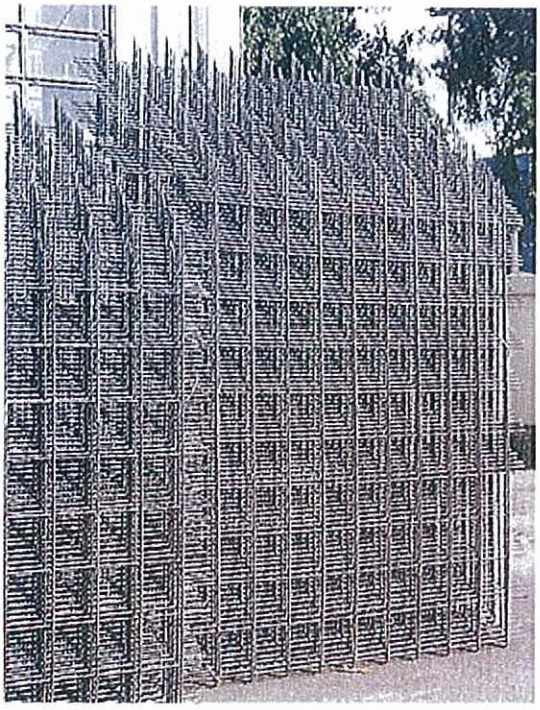
高力鋼筋網及冷拉鋼筋用於生產預製大型水泥管是一種堅固及標準化之材料。由於熔接鋼筋網的抗拉強度高，在製造同一產品時，比使用普通圓鋼節省高達 40% 之材料。

APPLICATIONS 用途

SHAPED FABRIC
成型鋼筋網

Golik Fabric can easily be bent to required shapes, U-shape or L-shape or trapezoidal to reinforce concrete walls, panels, floor slabs or drains. Use of shaped fabric ensures better quality workmanship, lower steel wastage and higher productivity.

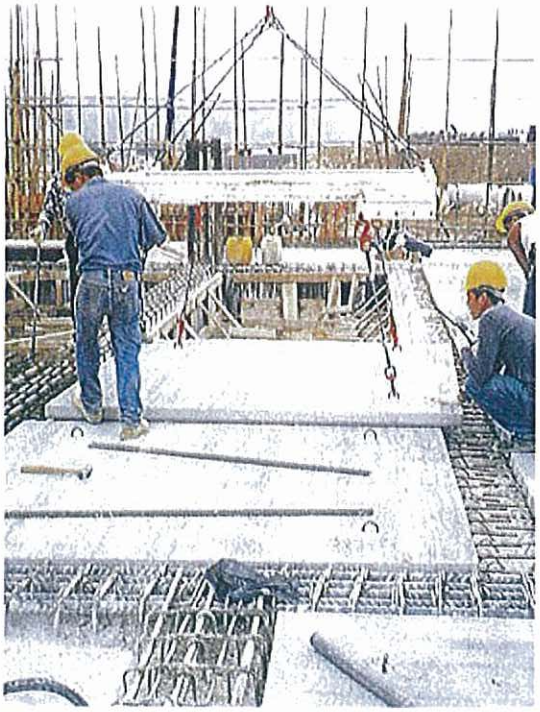
高力鋼筋網可以加工屈成各種形狀如 U 型、L 型或其他特別形狀；以配合設計不同之結構混凝土牆、預製牆、樓面及水渠等。使用已加工成形之鋼筋網可以保証工程質量，減低鋼材損耗及能提高效率。



PRECAST COMPONENTS
預製混凝土產品

The quality of construction work has improved significantly with the use of precast components. Golik Fabric is widely used in precast components ranging from architectural precast facades, parapet walls, lightweight partition panels, sun shades, staircases, refuse chutes, planks (slabs), water tanks, secondary roofing, U-drains and box culverts etc.

在建築工程中使用預製混凝土件可以把工程質量大大提高。高力熔接鋼筋網是預製混凝土產品最好的結構材料；已被廣泛地使用於大部份鋼筋混凝土件如樓宇外牆、間格牆、篷蓬、樓梯及樓面扳等。



SPECIFICATIONS 標準

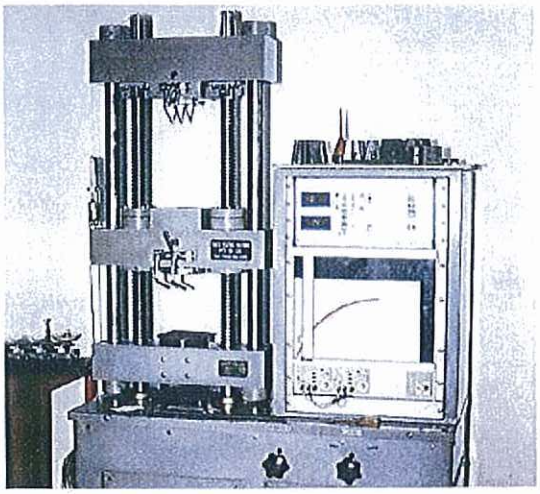
CONFORMITY TO INTERNATIONAL STANDARDS
符合國際標準

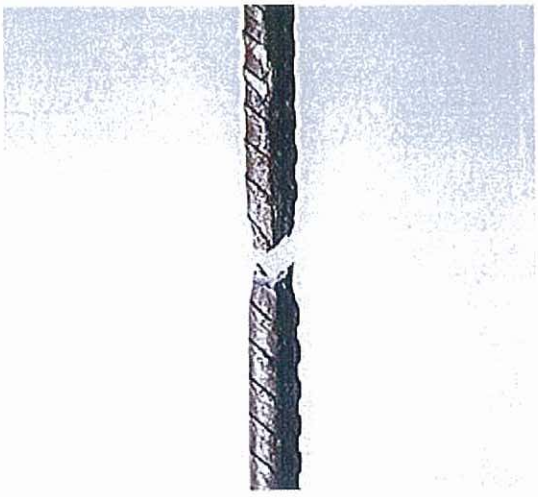
Golik Fabric is manufactured in accordance with the following standards :

- BS4482 "Cold Reduced Steel Wire for the Reinforcement of Concrete"
- BS4483 "Steel Fabric for the Reinforcement of Concrete"
- BS4466 "Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete"
- ASTM A82 "Steel Wire, Plain, for Concrete Reinforcement"
- ASTM A185 "Steel Welded Wire Fabric, Plain, for Concrete Reinforcement"

高力鋼筋網是按照以下標準生產 :

- 英國標準 BS4482:1985
- 英國標準 BS4483:1985
- 英國標準 BS4466:1989
- 美國標準 ASTM A82
- 美國標準 ASTM A185





TENSILE PROPERTIES
拉伸特性

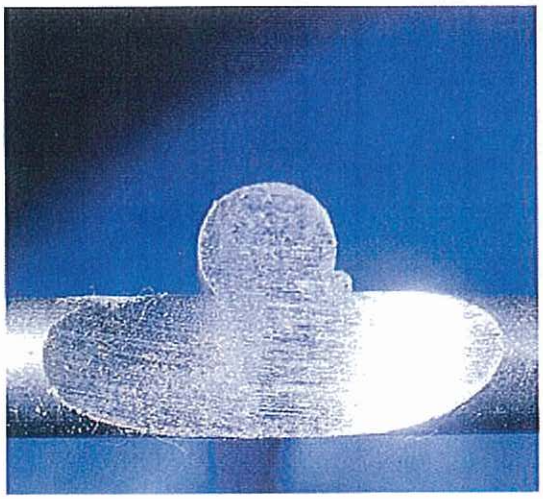
The British Standards BS4482:1985 & BS4483:1985, requires that the cold-drawn steel wire used in the Welded Steel Fabric must have a minimum proof stress of 460N/mm^2.

英國標準 BS4482:1985 及 BS4483:1985 要求用作生產熔焊鋼筋網的"冷拉鋼筋"之屈服強度不少於 460N/mm^2 。

WELD SHEAR
熔接點強度

Golik Fabric is welded into secure mats of reinforcement. The shearing load required to produce failure of a welded intersection is not less than 0.25 Afy where A is the nominal cross-sectional area of the smaller wire and fy = 460N/mm^2.

高力鋼筋網是利用電焊方法將縱橫鋼筋熔接。熔接點的剪斷強度要求不低於 0.25 Afy ， A 是較小的鋼筋之橫切面積， fy 是等於 460N/mm^2 。



SPECIFICATIONS 標準

GOLIK FABRIC
高力鋼筋網

Golik Fabric is prefabricated steel reinforcement consisting of a series of parallel, longitudinal, cold-drawn high-yield steel wires welded at regular intervals to transverse wires. Golik Fabric is manufactured on automatic welding machines, ensuring uniform spacing of wires providing consistent cross sectional areas of steel.

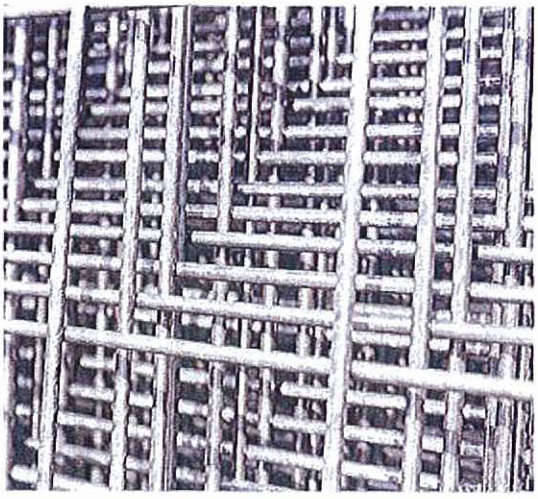
高力鋼筋網是使用經過冷拉處理而成之高抗拉力鋼筋，進行有規則之縱橫方向排列後焊接而製成的。

高力鋼筋網是使用大型自動焊接機，按照標準大批量焊製成鋼筋網片； 使用電腦控制之焊接機能保証生產出質量及規格統一之鋼筋網片。

PLAIN ROUND STEEL FABRIC
光面鋼筋網

Plain round Steel Fabric has been used as prefabricated reinforcement for reinforced concrete construction around the world for more than sixty years.

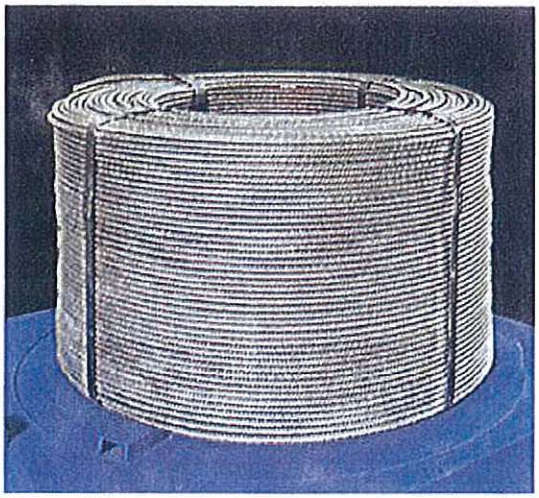
光面鋼筋網片使用於鋼筋混凝土在世界各地建築工程方面已有超過60年歷史。



DEFORMED STEEL WIRE
帶肋鋼筋

Deformed Steel Wire is used as reinforcement for various concrete elements and structures either as wire, cut into lengths, or bent into the required shape to fix into the concrete. Deformed Wire complies to all the requirements BS4482, BS4466 and BS4449 weldable quality steel reinforcement. The deformations improve the "local bond" of the steel bars in the concrete.

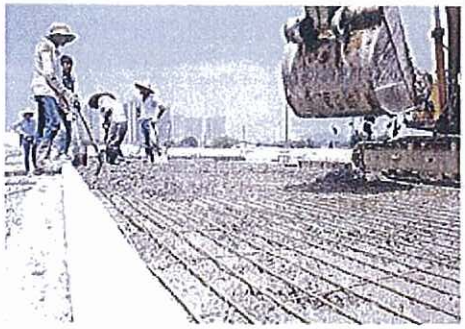
帶肋鋼筋已廣泛地用於鋼筋混凝土方面，可以剪切成長短及屈成不同形狀。帶肋鋼筋符合 BS4482, BS4466 及 BS4449 標準，帶肋鋼筋可以增強鋼筋在混凝土中的"附著力"。



APPLICATIONS OF FABRIC 鋼筋網應用

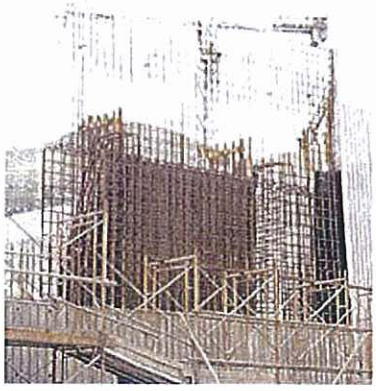
Floor Making of Buildings
多層大廈之樓面鋪設

Channel of Drainage
河道骨架



Paving of Motor way
鋪設行車公路

Concrete Pavement
混凝土地台



Protecting Wall Constructing
保護牆之建造

Wall and Slab intersection
牆身與樓面接合

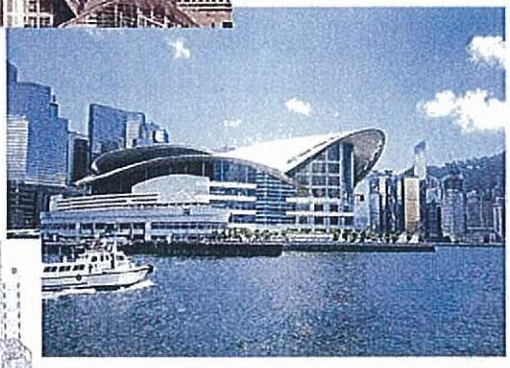
Semi-Precast Slabs
預製樓面板

PROJECT REFERENCES 參予工程

Hong Kong
International Airport
香港國際機場

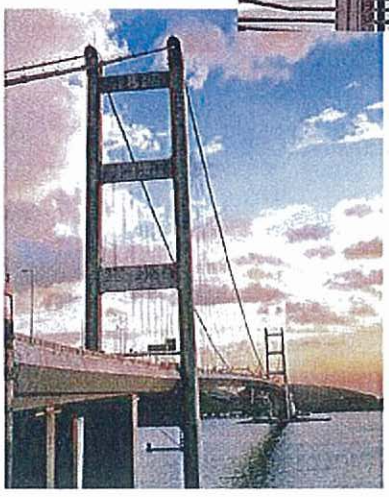
Central Plaza
中環廣場

Western Cross Harbour Tunnel
西隧



Hong Kong Convention &
Exhibition Centre
香港會議展覽中心

Times Square
時代廣場



Tsing Ma Bridge
青馬大橋

The Hong Kong and Shanghai Banking
Corporation Headquarter
香港滙豐銀行總行

PROJECT REFERENCES 參予工程

MTR Tseung Kwan O Station
地鐵將軍澳站

Tai Po Water Treatment and Pumping Work
大埔抽水站工程

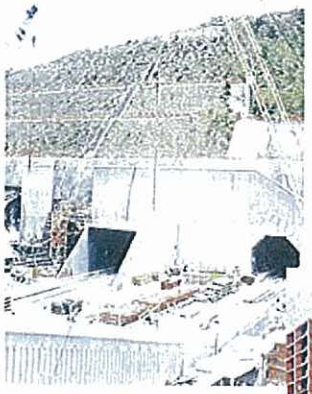
Yau Tong No.2 Reservoir
油塘二號水庫

Tseung Kwan O MTR Depot
將軍澳地鐵車廠

Tseung Kwan O Bauhinia Garden
將軍澳寶盈花園

Ocean Shore Phase I & II
維景灣畔第一及二期

North District Hospital
北區醫院



Tseung Kwan O Choi Ming Court
將軍澳彩明苑

Tseung Kwan O Pak Shing Kwok Tunnels
將軍澳白勝角隧道

Yau Tong Phase 5
油塘 5 期

Sheung Shui Slaughterhouse
上水屠房

QUALITY ASSURANCE 質量保證

SGS United Kingdom Ltd
Yarsley International Certification Services

ASSESSMENT SCHEDULE

Q5187

Assessment Standard: ISO 9001 : 2000

Company: Golik Metal Industrial Co., Ltd.
Golik Metal Manufacturing Co., Ltd.
Golik Steel Co., Ltd.

Location: Suite 5605, Central Plaza, 18 Harbour Road
Wanchai, Hong Kong

3 Dai Shing Street, Tai Po Industrial Estate
Tai Po, N. T., Hong Kong

DD132, Tong Hang Road, Lot 775-777
Tuen Mun, N. T., Hong Kong

Product Area Assessed: Supply, stockholding and manufacture of steel wire fabrics to BS4482, BS4483 and BS 4466
Supply and stockholding of reinforcing bars to BS 4449 and CS2 (Class 2)

Authorised by

Director

Issue No: 7

06 March 2003

Page 1 of 1

Further clarifications regarding the scope of this certificate and the applicability of ISO 9001:2000 requirements may be obtained by consulting the organisation.

SGS Yarsley International Certification Services is accredited by the following authorities:

UK - United Kingdom Accreditation Service (UKAS)

005

SGS United Kingdom Ltd
Yarsley International Certification Services

Certificate Number

Q5187

This is to certify that the
Quality Management systems of

Golik Metal Industrial Co., Ltd.
Golik Metal Manufacturing
Co., Ltd.
Golik Steel Co., Ltd.
Hong Kong

have been assessed and registered as meeting the requirements of ISO 9001

The scope of registration is detailed on the Assessment Schedule bearing this certificate number

SGS Yarsley International Certification Services
Signed by

09 June 1995 06 March 2003

This certificate remains valid subject to satisfactory maintenance of the system

SGS Yarsley International Certification Services
Registered Office:
SGS House, 217-221 London Road
Camberley, Surrey, GU15 3EY, United Kingdom

005

Member of the SGS Group (Société Générale de Surveillance)

SGS Hong Kong Limited
International Certification Services

Certificate Number

Q0040.HK.HK

This is to certify that the
Quality Management systems of

Golik Metal Industrial Co., Ltd.
Golik Metal Manufacturing
Co., Ltd.
Golik Steel Co., Ltd.
Hong Kong

have been assessed and registered as meeting the requirements of ISO 9001

The scope of registration is detailed on the Assessment Schedule bearing this certificate number

SGS Hong Kong Limited
International Certification Services
Signed by

16 January 2001 06 March 2003

This certificate remains valid subject to satisfactory maintenance of the system

Registered Office:
SGS Hong Kong Limited
International Certification Services
5/F, Metropole Square, 2 On Yiu Street
Fo Tan, New Territories, Hong Kong

005

Member of the SGS Group (Société Générale de Surveillance)

SGS Hong Kong Limited
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Product Area Assessed: Supply, stockholding and manufacture of steel wire fabrics to BS4482, BS4483 and BS 4466
Supply and stockholding of reinforcing bars to BS 4449 and CS2 (Class 2)

Authorised by

Issue No: 3

06 March 2003

Page 1 of 1

Further clarifications regarding the scope of this certificate and the applicability of ISO 9001:2000 requirements may be obtained by consulting the organisation.

SGS Hong Kong Limited International Certification Services is accredited by the Hong Kong Accreditation Service (HKAS)

005

9.7 Appendix G
- Access of Environmental Team to carry out water measurement and sampling

STAGE 1
SITE LAYOUT PLAN

E 836040 | E 836240 | E 836440 | E 836640

N

MAIN SITE OFFICE
DAY 0 - 260
(28JAN 2010 - 15OCT 2010)

Marine Access

LEGEND:
- HOARDING
- UTILITY METER
- TEMPORARY SITE OFFICE CONTAINER
- PORT : 3m x 10m
- HANDKEY SYSTEM : 7m X 2.5m
- GATE: ENTRANCE (10m) / EXIT (6m)
- 1.2m WIDE WALKWAY
- WHEEL WASHING PIT : 5m x 10m
- PIPE STOCK YARD : 16m x 9m

REMARKS:
CONCRETE BATCHNG PLANT TO BE DEMOLISHED ON DAY 900 - 949

STAGE 1 DAY 0 - 830

SEDIMANTATION TANK AND AQUSED
DAY 0 - 1000

BENTONITE SLURRY PLANT, DAY 562 - 1000

REBAR STORAGE & BENDING YARD
DAY 216 - 1000

EXISTING GULLY TRAP

WASHING FACILITY AND TOILET
DAY 0 - 1000

FIRST AID POINT
DAY 0 - 1000

2 NOS TEMPORARY SITE OFFICE CONTAINE
DAY 40 - 1000

2 NOS. 2" WATER METER & 400mAh MAIN ELECTRIC METER
DAY 0 - 1000

GUARD HOUSE

WHEEL WASHING PIT
DAY 0 - 900

DISCHARGE POINT

GUARD HOUSE & HANDKEY SYSTEM ENTRANCE
DAY 0 - 900

Land Access

6m WIDE ENTRANCE / EXIT
DAY 0 - 830

TEMPORARY SITE OFFICE
2x20' CONTAINER
DAY 0 - 40

STORAGE YARD
DAY 0 - 830

10m WIDE ENTRANCE 2

6m WIDE EXIT

DISCHARGE POINT

10m WIDE ENTRANCE 1

Existing Intakes and Pump Houses

WATER METER

WSD SALT WATER PUMPING STATION

MAIN GATE
DAY 0 - 830

GUARD HOUSE

ELECTRIC METER

CONVENTION AVENUE | HARBOUR ROAD | EXPO DRIVE EAST | EXPO DRIVE NORTH | EXPO DRIVE WEST | HUNG HOM | WAN CHAI ROAD | GLOUCESTER ROAD

0 20 40 80m
1 : 2000 SCALE BAR

CEDD 土木工程拓展署 Civil Engineering and Development Department

俊和－中國中鐵聯營 Chun Wo – CRGL Joint Venture

WAN CHAI DEVELOPMENT PHASE II-
CENTRAL – WAN CHAI BYPASS AT WAN CHAI EAST
SITE ACCOMMODATION LAYOUT PLAN (STAGE 1)

AECOM

DRG.NO. 圖紙編號 CWCRJV/HK200902/SK0001

DESIGNED BY MS SIN | SCALE 1:2000 (A3) | METRES

STAGE 2
SITE LAYOUT PLAN

E 836040 E 836240 E 836440 E 836640

N

MAIN SITE OFFICE
DAY 0 - 260
(28JAN 2010 - 15OCT 2010)

LEGEND:
- HOARDING
- UTILITY METER
- TEMPORARY SITE OFFICE CONTAINER
- PORT : 3m x 10m
- HANDKEY SYSTEM : 7m X 2.5m
- GATE: ENTRANCE (10m) / EXIT (6m)
- 1.2m WIDE WALKWAY
- WHEEL WASHING PIT : 5m x 10m
- PIPE STOCK YARD : 16m x9m

REMARKS:
CONCRETE BATCHNG PLANT, WHEEL WASHING PIT AND 6M GATE EXIT TO BE REMOVED ON DAY 900 - 949

STAGE 1 DAY	0 - 830
STAGE 2 DAY	741 - 1000
STAGE 3 DAY	950 - 1440
STAGE 4 DAY	1300 - 2190

Marine Access

SEDIMANTATION TANK AND AQUSED
DAY 850 - 1440

MAIN SITE OFFICE WITH FIRST AID POINT
DAY 0 - 1440

BENTONITE SLURRY PLANT, DAY 562 - 1440

REBAR STORAGE & BENDING YARD
DAY 562 - 1440

EXISTING GULLY TRAP

TOILET

WASHING FACILITY AND TOILET
DAY 0 - 1440

FIRST AID POINT
DAY 0 - 1440

PORT

2 NOS TEMPORARY SITE OFFICE CONTAINER
DAY 40 - 1440

2 NOS. 2" WATER METER & 400Amh MAIN ELECTRIC METER
DAY 0 - 1440

HANDKEY SYSTEM ENTRANCE #2
DAY 880 - 1440

HANDKEY SYSTEM ENTRANCE #1
DAY 0 - 900

WASHING FACILITY
DAY 0 - 900

WHEEL WASHING PIT
DAY 0 - 900

CONCRETE BATCHING PLANT
* SEE REMARKS

6m MAIN GATE EXIT

SEDIMANTATION TANK AND AQUSED
DAY 0 - 900

MOBILE TOILET

GUARD HOUSE

10m WIDE ENTRANCE & EXIT

TEMPORARY AT-GRADE ROAD
DAY 918 - 1387

1.2m WIDE WALKWAY
DAY 0 - 900

GUARD HOUSE

HANDKEY SYSTEM ENTRANCE #1
DAY 915 - 1300

GUARD HOUSE

10m WIDE ENTRANCE & EXIT

MOBILE TOILET

Land Access

10m WIDE ENTRANCE 2

6m MAIN GATE EXIT

DISCHARGE POINT

10m WIDE ENTRANCE 1

GUARD HOUSE

WATER METER

MAIN GATE
DAY 0 - 830

GUARD HOUSE

ELECTRIC METER

Proposed Intake and Pump Houses

0 20 40 60m
1:2000 SCALE BAR

CLIENT
CEDD 土木工程拓展署 Civil Engineering and Development Department

俊和－中國中鐵聯營 CHUN WO – CRGL JOINT VENTURE

WAN CHAI DEVELOPMENT PHASE II–
CENTRAL – WAN CHAI BYPASS AT WAN CHAI EAST
SITE LAYOUT PLAN
(STAGE 2)

AECOM

DRG.NO. SK002F