BRAND : “ LISENG ”

PRODUCT : INSPECTION CHAMBER

DESCRIPTION : SANITARY INSTALLATION

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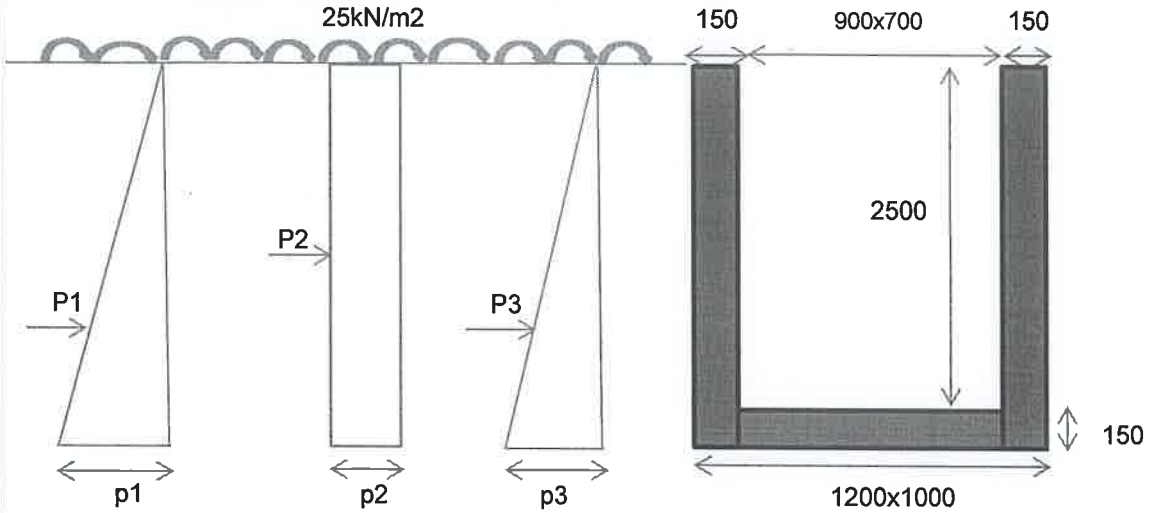
DESCRIPTION : SANITARY INSTALLATION

LISENG MATERIAL PTE LTD	Contract :		Job Ref.
Blk 549, Hougang Street 51 #02-198, Singapore 530549 HP:9850 1820	Part of Structure :	900x700x2500D 150TK 1H10-150	Calc. Sheet No. 1
	Drawing Ref.	Cal By: Alan Yap / Checked By:	Date: 26/8/2019

Member Ref.	Calculations

Material Design Details:

1. Density of Concrete = 25 kN/m3
2. Steel Reinforcements = 500 N/mm2
3. Load Combination (1.35 DL + 1.5 LL)
4. Concrete Cover = 40 mm



Weight of Precast Inspection Chamber & Weight of Water Within IC

Concrete Density =		25 kN/m3	Water Density =		10 kN/m3
Concrete Grade =		35 N/mm2			
Size :	Wi =	900 mm	We =	1200 mm	
	Bi =	700 mm	Be =	1000 mm	
	Hi =	2500 mm	He =	2650 mm	
	T =	150 mm	T =	150 mm	
Volume of Walls =		1.43 m3			
Vol of Base Slab =		0.18 m3			
Total Vol =		1.61 m3			
Total Weight of IC =		40.1 kN	Weight of Water within IC=		15.75 kN

Details of Steel Reinforcements

T bars	fy =	500 N/mm2	Soil density =		21 kN/m3
Dia of Com bars =		10 mm	Angle of int friction @ =		30 deg
Spacing =		150 mm	ka = (1-sin@)/(1+sin@)=		0.333
	Asc =	549.78 mm2	Depth of Soil Layer =		3.65 m
Dia of Ten bars =		10 mm			
Spacing =		150 mm			
	Asc =	549.78 mm2			

Soil Properties

Water Properties

Water Density = 10 kN/m3 Surcharge Loading = 25 kN/m2

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Bearing Pressure on Soil

Pressure of the soil = (Weight of Water + Total Weight of IC) / Area = 47 kN/m2

< 75 kN/m2 }OK

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Blk 549, Hougang Street 51 #02-198, Singapore 530549 HP:9850 1820	Part of Structure :	900x700x2500D 150TK 1H10-150	Calc. Sheet No. 2
	Drawing Ref.	Cal By: Alan Yap / Checked By:	Date: 26/8/2019

Member Ref.	Calculations

Lateral External Pressure

Water (p1) =	26.5	kN/m2	(triangle pressure)
Surcharge (p2) =	8.33	kN/m2	(rectangular pressure)
Soil pressure (p3) =	18.55	kN/m2	(triangle pressure)

Forces from the elements

Water (P1) =	35.11	kN
Surcharge (P2) =	22.08	kN
Soil pressure (P3) =	24.58	kN
Total	81.77	kN

Max Moments (Analysis as a slab)

ly/ly = 2.78 < 2 (1 way Slab)

For 1m width slab, Ultimate Limit State = 80.08 kN/m2 (Considered Max Pressure)

M = 8.10759 kNm

Bending Reinforcements

Mu = Klim x fck x bd2 = 0.168 x 35 x 1000 x 110^2 = 71.148 kNm } OK
M/bd2fck= 0.01914 So z/d = 0.98 But adopt z/d = 0.95
Therefore, la = 0.95
d = 110 mm
So z = 104.5 mm

As req = M/0.87fykZ
= 178.355 mm2

As prov = 549.78 mm2 } OK, As prov > As req
} H10-150
} > 0.13bh

Distribution Bars

b = 1000 mm
d = 150 mm

As min = 0.13xbd = 195 mm2

As prov = 549.78 mm2 } OK, As prov > As req
} H10-150

Shear Check

V = Force /2 = 36.80 kN
Shear Stress v = 0.33 N/mm2 < 0.8√fcu or 5N/mm2
100As/bd = 0.50
vc = 0.69 N/mm2
Since vc > v } No Shear Reinforcements Required

LISENG MATERIAL PTE LTD	Contract :		Job Ref.
Blk 549, Hougang Street 51 #02-198, Singapore 530549 HP:9850 1820	Part of Structure :	900x700x2500D 150TK 1H10-150	Calc. Sheet No. 3
	Drawing Ref.	Cal By: Alan Yap / Checked By:	Date: 26/8/2019

Member Ref.	Calculations

Deflection Check

Span = 900 mm
d = 104.5 mm
Span /d = 8.61 (< Basic span/d =20) } Deflection OK

Lifting Check

Dead Load IC = 40.13 kN
Factor of Safety = 2.00
Ultimate Loading = 80.25 kN

No of Lifting Hook = 4 pcs
Ult Load per Hook = 20.06 kN

Dia of Rebar hook = 13 mm
Tensile Strength per hook = 46.46 kN } Tension Capacity OK

Bond Length = 103.79 mm
Embedded Length = 550 mm } Anchorage OK

fcu = 35 N/mm2
beta = 0.4 deformed bars
fbu = 2.37 N/mm2
fy = 500 N/mm2
fs= 75.58 N/mm2

Provide 4 H 13 Lifting hook with embedded depth of 550mm

Design of Base Slab

Dead Load of IC = 40.1 kN
Live Load of IC = 25.0 kN
Water from Below = 26.5 kN/m2
ULS 1 (1.35DL+1.5LL) = 76.39 kN/m2
ULS 2 (1.5WL) = 39.75 kN/m2
Therefore, ULS = 76.39 kN/m2

ly = 1200 mm
lx = 1000 mm
ly/ly = 1.2 (Table 3.14)

Asx = 0.084
Asy = 0.061

Msx = Asxnlx2 = 6.42 kNm
Msy = Asynly2 = 6.71 kNm

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26/8/19

Design Bending in the shorter span

Msx/bd2fck = 0.015 So z/d = 0.985 But adopt z/d =0.95
Therefore, la = 0.95
z = 104.50 mm

As req = Msx/0.95fykz
= 129.27 mm2/m
As pro = 549.78 mm2/m } OK, As pro > As req
} H10-150
} > 0.13bh

LISENG MATERIAL PTE LTD	Contract :			Job Ref.
Blk 549, Hougang Street 51 #02-198, Singapore 530549 HP:9850 1820	Part of Structure :	900x700x2500D 150TK 1H10-150		Calc. Sheet No. 4
	Drawing Ref.	Cal By: Alan Yap	Checked By:	Date: 26/8/2019

Member Ref.	Calculations

Design Bending in the longer span

Msx/bd2fcu = 0.016 So z/d = 0.983 d = 94.50 mm
Therefore, z/d = 0.95
z = 89.78 mm

As req = Msy/0.95fykz
= 157.36 mm2/m
As pro = 549.78 mm2/m } OK, As pro > As req
} H10-150
} > 0.13bh

Shear Check

V = Force /2 = 45.83 kN
Shear Stress v = 0.42 N/mm2 < 0.8√fcu or 5N/mm2
100As/bd = 0.58
vc = 0.76 N/mm2
Since vc > v } No Shear Reinforcements Required

Deflection Check

Span = 900 mm
d = 94.50 mm
Span /d = 9.52 (< Basic span/d =20) } Deflection OK

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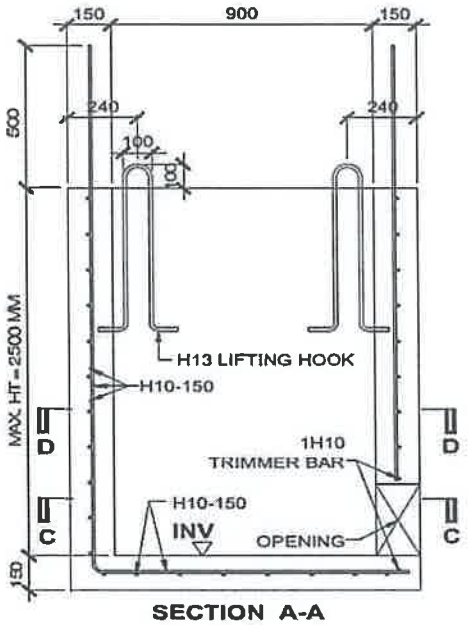
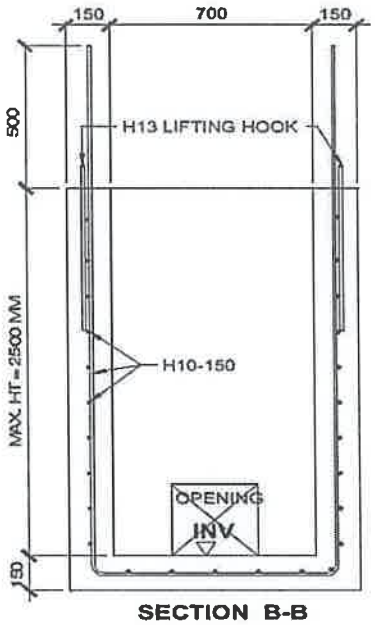
LISENG MATERIAL PTE LTD	Contract :			Job Ref.
Blk 549, Hougang Street 51 #02-198, Singapore 530549 HP: 9850 1820	Part of Structure :	900x700x2500D 150TK 1H10-150		Calc. Sheet No. 5
	Drawing Ref.	Cal By: Alan Yap	Check By:	Date: 26/8/19

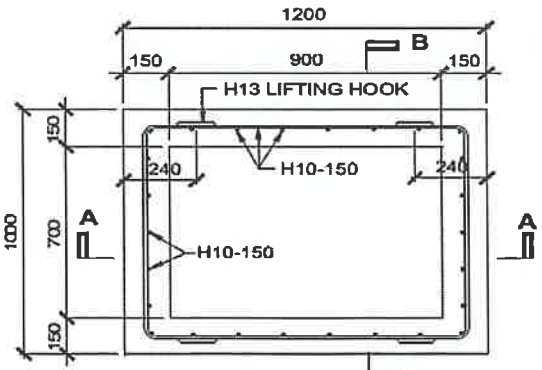
GENERAL NOTE
1. Grade of concrete = 35 N/mm²
2. Grade of steel
   Mild Steel = 300 N/mm²
   High Yield Steel = 500 N/mm²
   Mesh Steel = 500 N/mm²
3. Concrete cover = 40 mm



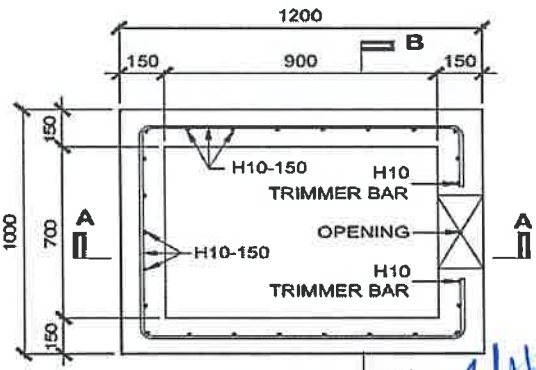
SECTION A-A



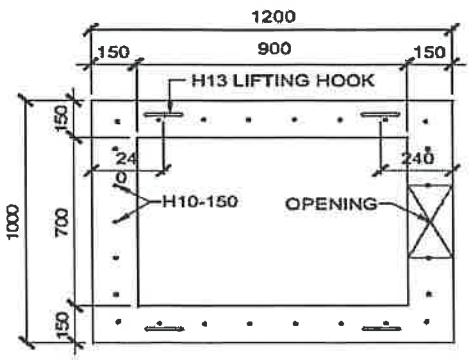
SECTION B-B



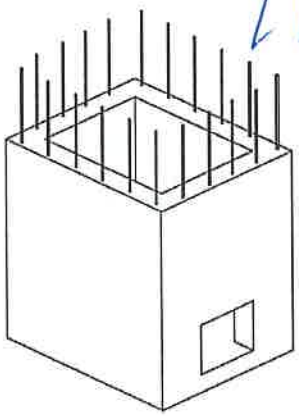
SECTION D-D



SECTION C-C



PLAN OF PRECAST IC
900x700x150T



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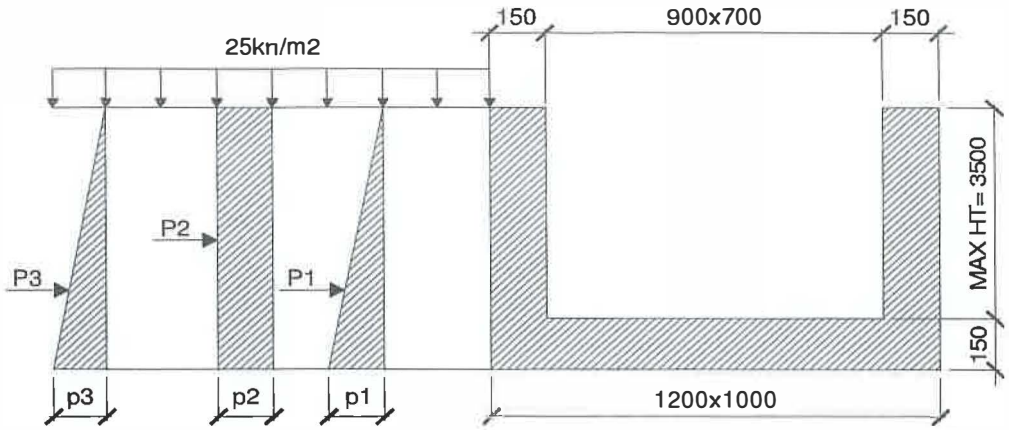
26/8/19

LS LISENG MATERIAL PTE LTD Blk 549 Hougang Street 51 #02-198, Singapore 530549 HP: 9850 1820

PROJECT	MEMBER	SHEET	1
PROPOSED PROJECT IN SINGAPORE	PRE-CAST INSPECTION CHAMBER 900 IW x 700 IB x 3500 IH x 150 T W/ 2H10-150	PREP	Achilles
		DATE	18/11/2020
		CHECK	

Eurocode Design Details

1. Density of Concrete: γ = 25 kN/m3
2. Steel Reinforcement: fy = 500 N/mm2
3. Load combination (1.35 DL + 1.5 LL)



Precast Inspection Chamber

Concrete density	γ	=	25 kN/m3					
Concrete grade	fcu	=	**35** N/mm2					
Size : Internal	WI	=	900 mm	External	W	=	1200 mm	
	BI	=	700 mm		B	=	1000 mm	
	HI	=	3500 mm		H	=	3650 mm	
	T	=	150 mm		T	=	150 mm	
Volume	Vol	=	2.18 m3					
Weight	Wt	=	54.4 kN					

STEEL REINFORCEMENT

H bar	fy	=	500 N/mm2
Compression steel :	Ø	=	10 mm
	Asc	=	78.54 mm2
Tension steel :	Ø	=	10 mm
	Ast	=	78.54 mm2

SOIL PROPERTIES

Soil density	γs	=	21 kN/m3
Angle of int friction	Ø	=	30 °
ka = (1-sinθ)/(1+sinθ)		=	0.333
Depth of soil layer		=	3.65 m

WATER PROPERTIES

Water density	γw	=	10 kN/m3
Water column		=	1 m

SURCHARGE

Live load	q	=	25 kN/m2

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28 NOV 2020

LS LISENG MATERIAL. PTE LTD Blk 549 Hougang Street 51 #02-198, Singapore 530549 HP: 9850 1820

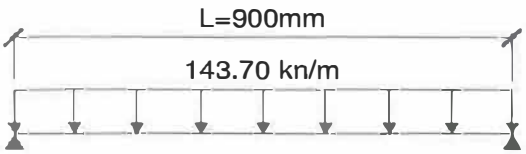
PROJECT	MEMBER	SHEET	2
PROPOSED PROJECT IN SINGAPORE	PRE-CAST INSPECTION CHAMBER 900 IW x 700 IB x 3500 IH x 150 T W/ 2H10-150	PREP	Achiles
		DATE	28/11/2020
		CHECK	

LATERAL PRESSURE (EXTERNAL)

H = 3650 mm

1	WATER	γ*H =	36.50 kN/m2	(p1)	(triangle pressure)
2	Surcharge	ka*q =	8.33 kN/m2	(p2)	(rectangle pressure)
3	Soil	ka*γ*H =	25.55 kN/m2	(p3)	(triangle pressure)

	Total Lateral press. (kN/m)
P1	66.61
P2	30.42
P3	46.63
Total	**143.7** kN/m



MOMENT CALCULATION

Method 1 :

h	=	1050	K1	=	2.235	K6	=	7.235
l	=	850	K2	=	3.235	K7	=	9.471
hs	=	150	K3	=	4.235	K8	=	11.71
hw	=	150	K4	=	13.94			
k	=	1.2	K5	=	5.471			

SPAN (mm)	q (kN/m2)	Moment	Ma (kN-m)	Mc (kN-m)
1050	143.7	Ma=Mc= $-qh^2k/12K1$	-7.29	-7.29
850	143.7	Ma=Mc= $-ql^2k/12K1$	-4.78	-4.78
Total moment			**-12.1**	**-12.1**

Method 2 :

Larger span	=	900 mm
Pressure	=	143.7 kN/m
Moment	=	14.5 kN-m
Factor of safety	=	1.50
Adopt moment	=	14.5 kN-m
Ultimate design moment	=	**21.8 kN-m**

DESIGN DATA

			Provide		
Thickness	=	150 mm		Bar Size =	10 mm
Concrete cover	=	40 mm		Spacing =	150 mm
Size of tensile bar	=	10 mm		Nos. of bar =	6.7 pcs
d	=	105 mm		use 2 layers =	13
b	=	1000 mm			
0.95d	=	99.8 mm			
k	=	0.057			
z	=	97.93 mm			
Adopt z	=	97.93 mm			
Required As	=	512.2 mm2/m			
Actual rebar As	=	1047 mm2/m	>	512.2 mm2/m	
Provide 2 layers	=	(H 10	@	150 c/c)	

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28 NOV 2020

LS **LISENG MATERIAL PTE LTD** Blk 549 Hougang Street 51 #02-198, Singapore 530549 HP: 9850 1820

PROJECT	MEMBER	SHEET	3
PROPOSED PROJECT IN SINGAPORE	PRE-CAST INSPECTION CHAMBER 900 IW x 700 IB x 3500 IH x 150 T W/ 2H10-150	PREP	Achiles
		DATE	28/11/2020
		CHECK	

SHEAR CHECK

F	=	143.7 kN/m2	
Size of wall : b	=	1000 mm	
L	=	900 mm	
Factor of safety	=	1.50	
Ult F	=	193.9 kN	
V	=	96.97 kN	
v	=	0.924 N/mm2	(not > 5N/mm2 or 0.8 ✓ fcu)
100As/bd	=	0.997	(not > 3)
400/d	=	3.81	(not < 1)
vc	=	0.882 N/mm2	

Hence, no shear reinforcement is required

DEFLECTION CHECK

Span	=	900 mm	
d	=	105 mm	
Span/d	=	8.571 mm	(< Basic span/d= 20)

Deflection check satisfactory

LIFTING CHECK

Dead load	=	54.4 kN	fcu	=	10	N/mm2
Factor of safety	=	2	β	=	0.4	deformed
Ultimate load	=	108.8 kN	fbu	=	1.265	N/mm2
			fy	=	500	N/mm2
Nos. of lifting hook	=	4 pcs				
Ultimate load per hook	=	27.19 kN				
Try Size of bar	=	13 mm				
Tensile strength of bar	=	57.74 kN				
Bond length	=	526.3 mm				
Embeded length	=	550 mm				

Provide 4 H13 lifting hook with min. embedded length of 550mm.

BASE SLAB

DL

IC	=	54.4 kN	b	=	1000 mm
WATER (Full)	=	22.05 kN	d	=	105 mm
			0.95d	=	99.75 mm
LL			k	=	0.086
Live load	=	30 kN	z	=	93.71 mm
			adopt z	=	93.71 mm
Gk	=	76.43 kN			
Qk	=	30 kN	required As	=	733.6 mm2/m
Ultimate load (1.35DL+1.5LL) F	=	148.2 kN			
For span L	=	900 mm			
Ultimate moment M= (FL / 4)	=	**33.34** kN-m			
Actual Rebar As	=	1047 mm2/m	>	733.6 mm2/m	
Provide 2 layers	=	(H 10	@	150 c/c bothways)	

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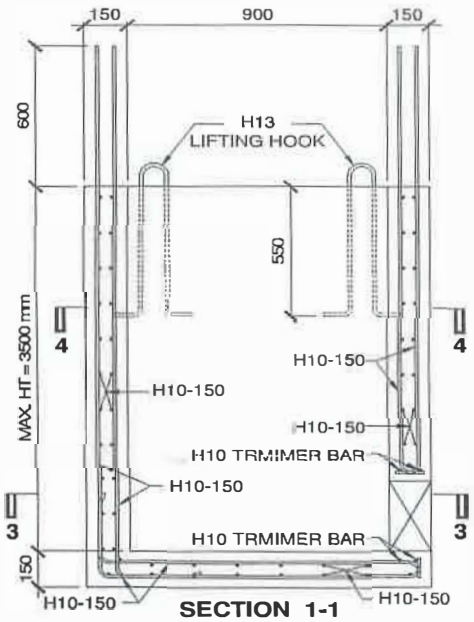
LS LISENG MATERIAL PTE LTD Blk 549 Hougang Street 51 #02-198, Singapore 530549 HP: 9850 1820

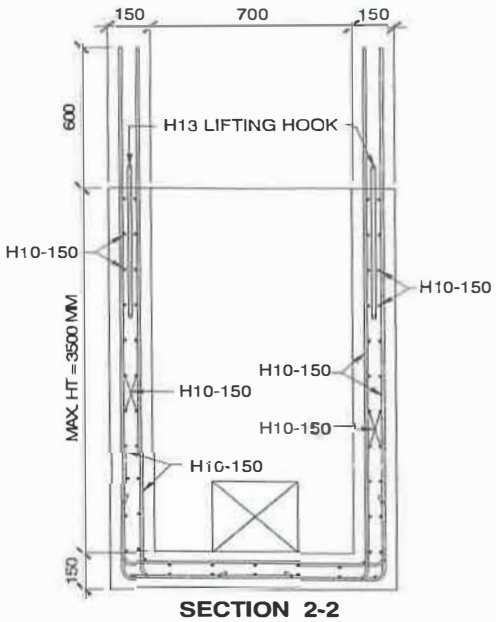
PROJECT	MEMBER	SHEET	4
PROPOSED PROJECT IN SINGAPORE	PRE-CAST INSPECTION CHAMBER 900 IW x 700 IB x 3500 IH x 150 T W/ 2H10-150	PREP	Achiles
		DATE	28/11/2020
		CHECK	

GENERAL NOTE

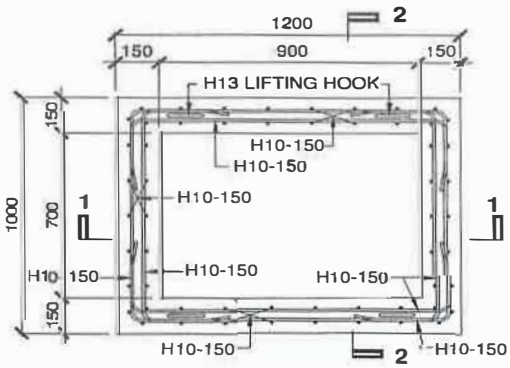
1. Grade of concrete = 35 N/mm²
2. Grade of steel High Yield Steel = 500 N/mm²
3. Concrete cover = 40 mm



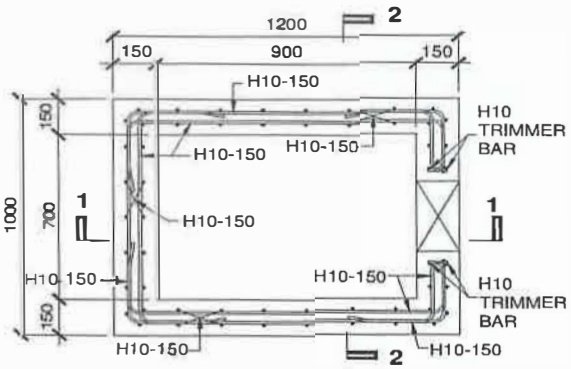
SECTION 1-1



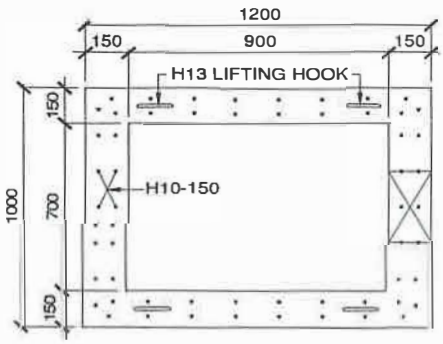
SECTION 2-2



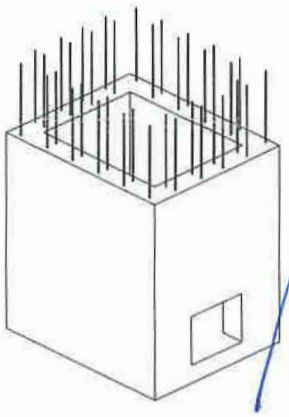
SECTION 4-4



SECTION 3-3



PLAN OF PRECAST IC
900x700x150T



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28 NOV 2020

LISENG MATERIAL PTE LTD

CO REG: 201632829M
Blk 549 Hougang ST 51 #02-198 Singapore 530549
Tel: 6362 1811 Fax: 6362 0895 H/P: 9850 1820 Email: sales@liseng.com.sg

PROJECT REFERENCE (HDB) DATE: 05-04-2017

PC INSPECTION CHAMBER

COMPANY NAME	PROJECT
Chang Hua Constn PL	Kallang Whampoa RC21
Chiu Teng Constn PL	Bidadari C4
Chuan Lim Constn PL	Tech Whye Lane
Eng Chin Hang P&S PL	Clementi N4C10@Commwealth DR
Hi-tek Constn P L	Bt Batok N4C5 & 7
LC & T Builder (1971) PL	Sengkang N3C28A
Nanjing Dadi Constn (Group) Co Ltd	Sembawang N1C12
Progressive Builders PL	Dawson C5
Qingjian International (SP) Group	Bt Batok N4C18-C21
Rich Construction PL	Tampines N4C8
Sunhuan Constn PL	Clementi N4C10
Straits Constn PL	Bt Merah C50
Straits Constn PL	16 Yio Chu Kang EC
Tiong Seng Contractor PL	Woodlands N7C29
Teambuild E&C PL	Yishun N4C22@Yishun Ave 1
Teambuild E&C PL	Bt Batok N4C16&17@Bt Batok West Ave 3