REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

PROJECT No.

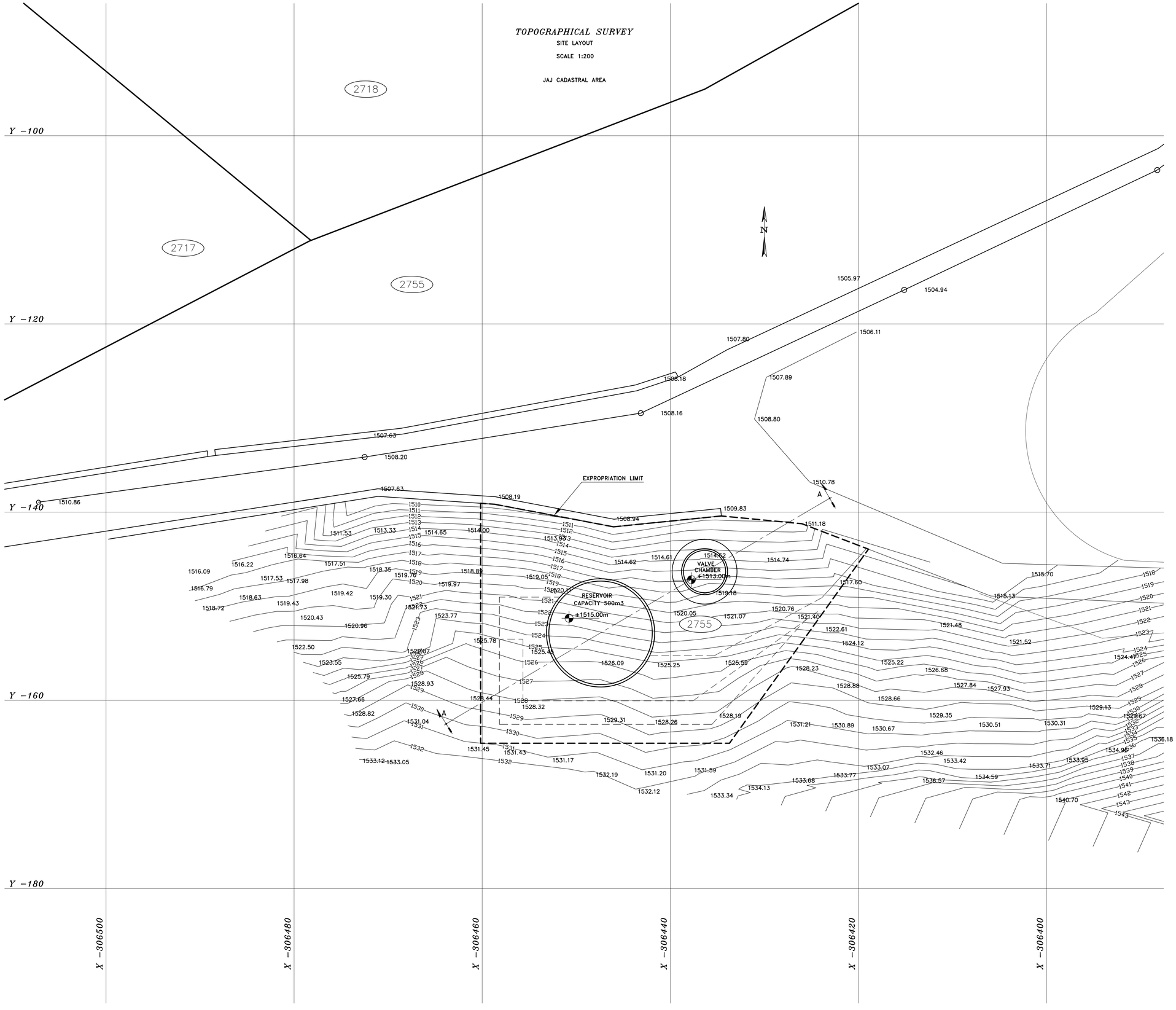
CONTRACT No.

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

VOLUME 5

DRAWINGS

FEBRUARY 2017



NOTES:

- GROUND LEVEL OF RESERVOIR = +1515.00m
- GROUND LEVEL OF VALVES CHAMBER = +1513.00m
- DO NOT SCALE FROM THIS DRAWING
- ALL LEVELS ARE IN M UNLESS OTHERWISE SPECIFIED

TOPOGRAPHICAL LEGEND

	CULVERT/BRIDGE		RETAINING WALL
Spr	SPRING		RAILWAY
	WELL	channel	CHANNEL
	DECIDUOUS/PINE TREE		TERRACE
			FENCE
	ROCKS		STREAM/RIVER
	BUSHES		
MH S	MANHOLE SEWER	PYL	PYLON
MH W	MANHOLE WATER	EL.S.S	ELECTRIC SUB STATION
MH T	MANHOLE TELEPHONE	EP/TP	ELECTRIC POLE/TELEGRAPH POLE
MH NI	MANHOLE NOT IDENTIFIED		OVERGROUND WATER PIPE
LP	LIGHTING POLE		UNDERGROUND WATER PIPE
	BUILDING	1160.12	SPOT HEIGHT
u/c	FOUNDATION/BUILDING UNDER CONSTRUCTION		TRAVERSING STATION
			TRIANGULATION POINT
	ROAD		BENCH MARK
	TRACK		ML
	REFERENCE LINE	384	LOT No
side walk	SIDE WALK		LOT LIMIT
			CIRCONSCRIPTION BOUNDARY
			EXPROPRIATION LIMIT

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

JAJ RESERVOIR CAPACITY 500 m³	TOPOGRAPHICAL SURVEY SITE LAYOUT

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05RS-01	W. SEIFEDDINE	W. SEIFEDDINE	W. SEIFEDDINE

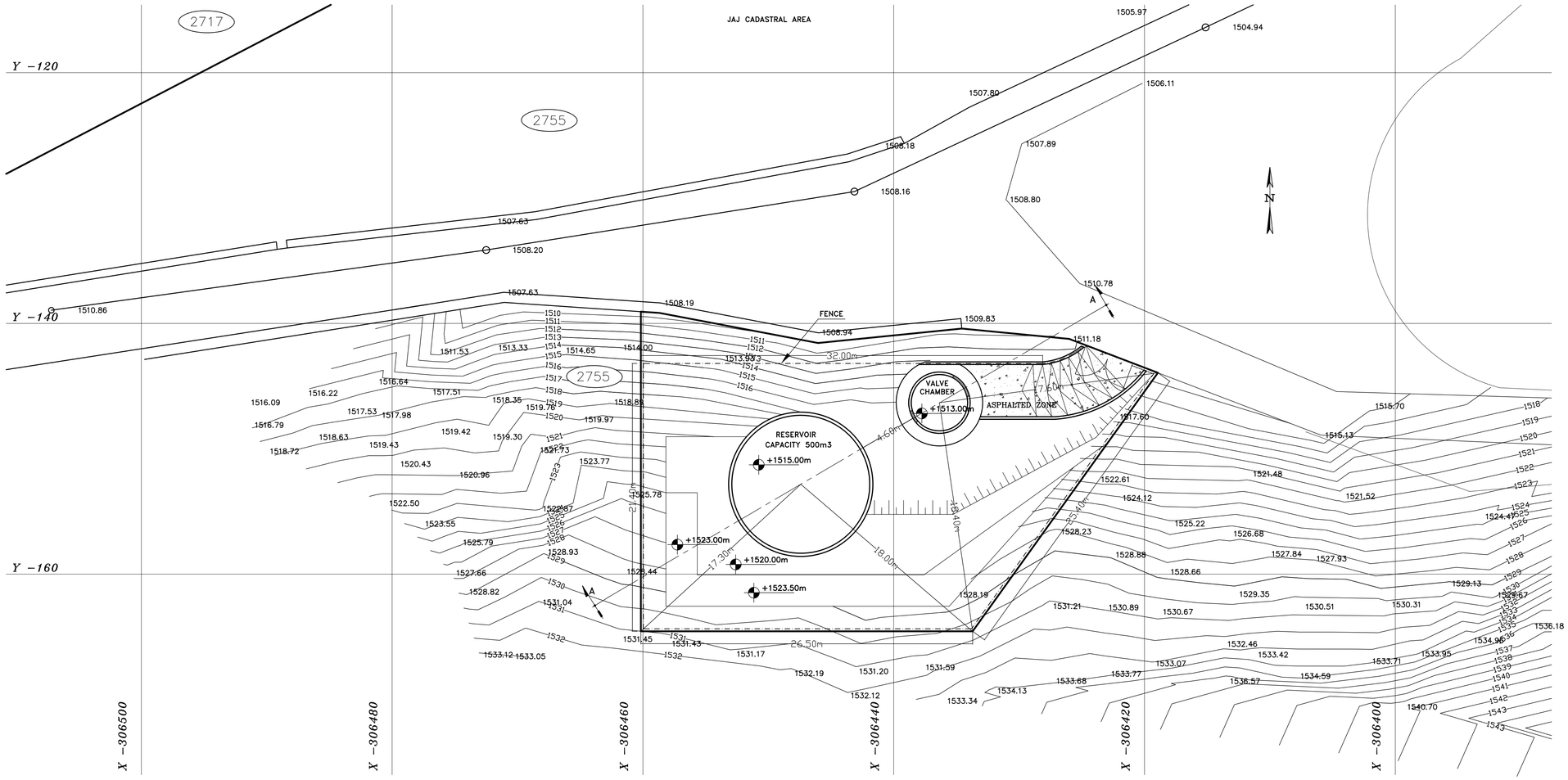
DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:200	1/2	462-05RS-01P01

ORIGINAL SIZE A1

SITE PLAN

SCALE 1:200

JAJ CADASTRAL AREA



NOTES:

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- GROUND LEVEL OF VALVES CHAMBER = +1513.00m
- DO NOT SCALE FROM THIS DRAWING
- ALL LEVELS ARE IN M UNLESS OTHERWISE SPECIFIED

TOPOGRAPHICAL LEGEND

	CULVERT/BRIDGE		RETAINING WALL
Spr	SPRING		RAILWAY
	WELL	channel	CHANNEL
	DECIDUOUS/PINE TREE		TERRACE
			FENCE
	ROCKS		STREAM/RIVER
	BUSHES	PYL	PYLON
MH S	MANHOLE SEWER	EL.S.S	ELECTRIC SUB STATION
MH W	MANHOLE WATER	EP/TP	ELECTRIC POLE/TELEGRAPH POLE
MH T	MANHOLE TELEPHONE		OVERGROUND WATER PIPE
MH NI	MANHOLE NOT IDENTIFIED		UNDERGROUND WATER PIPE
LP	LIGHTING POLE	1160.12	SPOT HEIGHT
	BUILDING		TRAVERSING STATION
u/c	FOUNDATION/BUILDING UNDER CONSTRUCTION		TRIANGULATION POINT
			BENCH MARK
	ROAD		ML
	TRACK	384	LOT No
	REFERENCE LINE		LOT LIMIT
side walk	SIDE WALK		CIRCONSCRIPTION BOUNDARY
			EXPROPRIATION LIMIT

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

EXPROPRIATION LIMIT

FENCE

NATURAL GROUND LEVEL

1523.50

1520.00

FINISHED GROUND LEVEL

1515.00

LEAN CONCRETE

COMPACTED GRAVEL

SECTION A−A

SCALE 1:100

FENCE

1513.00

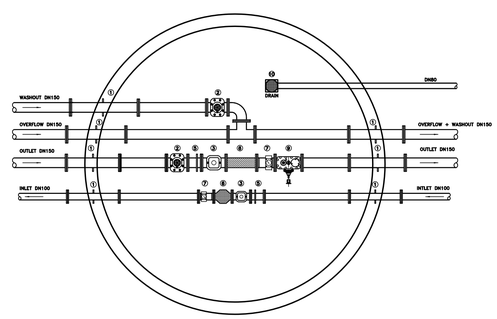
LEAN CONCRETE

COMPACTED GRAVEL

EXPROPRIATION LIMIT

VALVE CHAMBER

SCALE 1:50



LEGEND:

①: INSERT
②: GATE VALVE
③: FILTER
④: PRESSURE REDUCING AND SUSTAINING VALVE
⑤: DISMANTLING JOINT
⑥: FLOW STRAIGHTENER
⑦: WATER METER
⑧: BUTTERFLY VALVE
⑨: AIR RELEASE VALVE + GATE VALVE
⑩: FLOOR DRAIN

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ RESERVOIR CAPACITY 500 m³	SITE PLAN SECTION A - A VALVE CHAMBER DETAILS

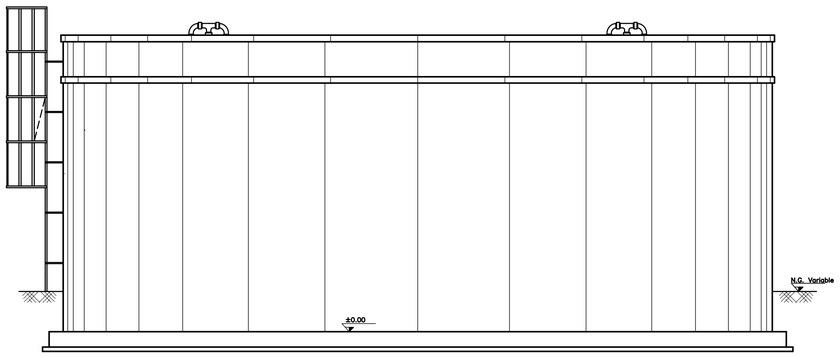
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05RS-01	W. SEIFEDDINE	W. SEIFEDDINE	W. SEIFEDDINE

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:200 - 1:100 - 1:50	2/2	462-05RS-01P02

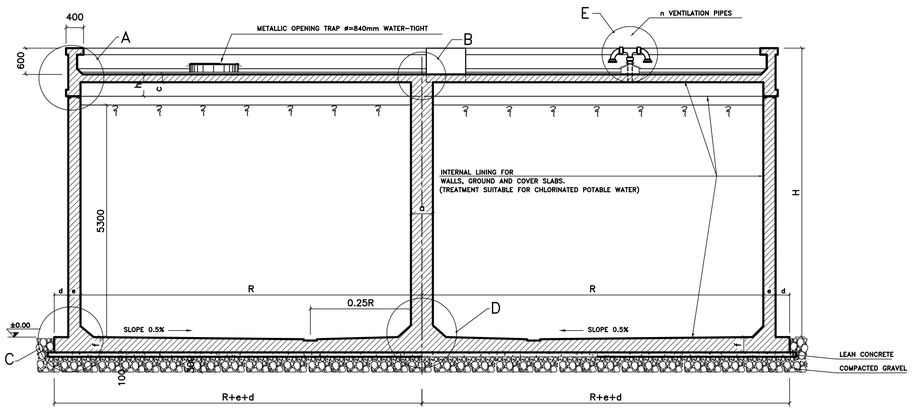
ORIGINAL SIZE A1

CAPACITY	500M3
R (mm)	5500
0.25R (mm)	1375
e (mm)	250
R+e (mm)	5750
c (mm)	200
f (mm)	350
d (mm)	200
R+e+d (mm)	5950
a (mm)	400
b (mm)	400
h (mm)	600
n (VENTILATION PIPE)	4
n' (RAIN WATER DRAINAGE)	4
H (mm)	6700
g (mm)	800
j (mm)	1200

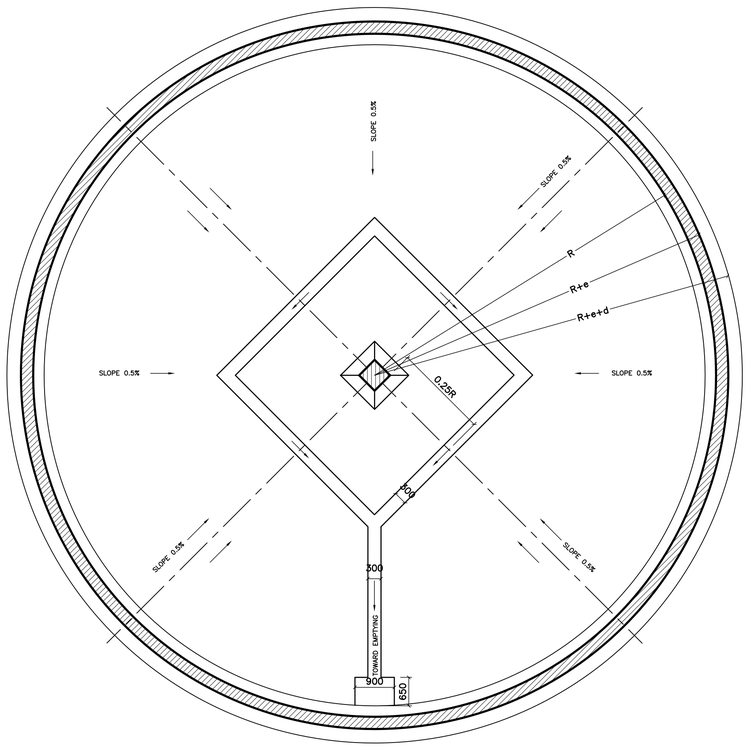
ELEVATION



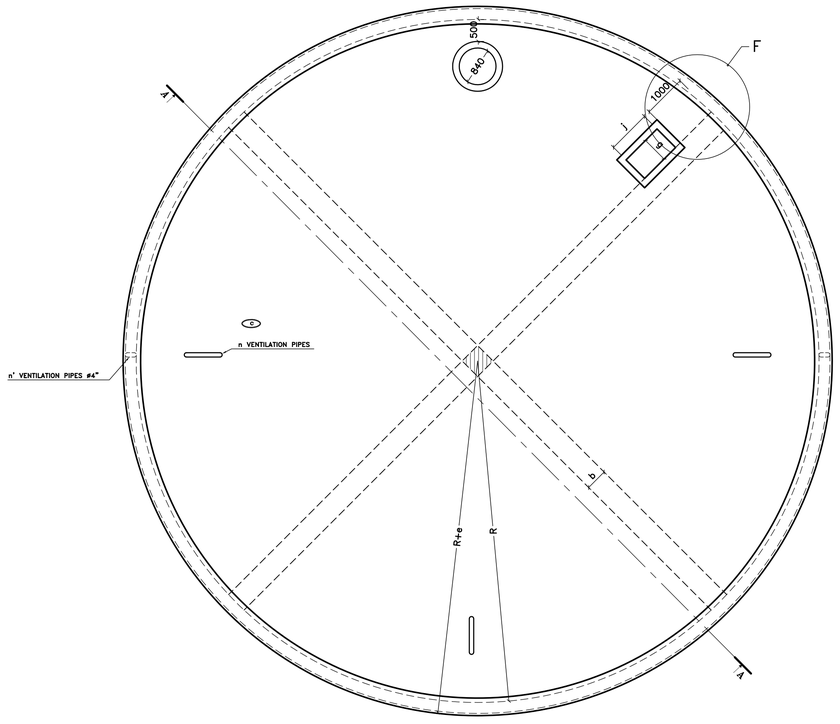
VERTICAL SECTION A-A



MAT FORMWORK



COVER SLAB FORMWORK



NOTES FOR RESERVOIRS:

REINFORCED CONCRETE:
CONCRETE GRADE C30 FOR ALL STRUCTURES.

MIX ELEMENTS:
ORDINARY PORTLAND CEMENT(400 Kg/m3 FOR LATERAL WALLS, FLOOR SLAB, AND THE COVER SLAB; 350 kg/m3 ELSEWHERE) SHOULD COMPLY WITH BS12.
AGGREGATES (SAND AND GRAVELS) FROM NATURAL QUARRIES, SHOULD COMPLY WITH BS882.
WATER SHOULD COMPLY WITH THE REQUIREMENTS OF BS5328.

LEAN CONCRETE / CYCLOPEAN CONCRETE:
MIX MADE WITH ORDINARY PORTLAND CEMENT, CONCRETE GRADE C20
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=420 MPa.
MILD STEEL BARS : SYMBOL ⌀ YIELD STRESS: Fy=250 MPa.

STRESSES:
SEVERE CONTROL
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS:
– ON A CUBE, a=150mm : 30 N/mm2
– ON A CYLINDER, ⌀=150mm, h=30mm : 25 N/mm2
CONCRETE TENSILE STRENGTH AT 28 DAYS : 2.1 N/mm2.

CONSTRUCTION JOINTS:
PROHIBITED IN RESERVOIR WALLS.
REDUCED TO THE STRICT MINIMUM ELSEWHERE PROVIDED THAT NECESSARY PRECAUTIONS ARE TAKEN, SUCH AS: SETTING RETARDERS, BONDING MATERIALS, WATER-STOP JOINTS.
MAXIMUM POURING HEIGHT: 1.50 m.

ADMIXTURES:
SETTING RETARDERS (CONSTRUCTION JOINTS).
WATERPROOFING ADMIXTURE (TO IMPROVE WATER PROOFNESS OF WALLS, FLOOR SLAB AND COVER SLAB)
THE USE OF CHLORINE BASED ADMIXTURES IS NOT ALLOWED.
EVERY ADMIXTURE SHALL BE APPROVED BY THE ADMINISTRATION.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 4 cm FOR THE RESERVOIR FLOOR SLAB AND WALLS, 3 cm ELSEWHERE.

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50⌀.
(⌀= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
STIRRUPS ⌀8 SHALL BE USED ON EACH LAP.

BENDING:
⌀ > 12mm MECHANICAL.
⌀ ≤ 12mm MANUEL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

DRAWINGS CONSIDERATION:
– – – – – – TOP BARS
——— BOTTOM BARS

FORMWORK:
ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE (METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
SURFACE WATERPROOFING TREATMENT OF RESERVOIR WALLS, COVER AND FLOOR SLAB.
COVER WATERPROOFING CONSISTING OF A VAPOUR BARRIER, A THERMAL INSULATION, A WATERPROOFING MEMBRANE AND ITS PROTECTION.

WATERPROOFING DETAILS:
(1) V.B. – SBS/OR/APP t>2.5mm
– ADHERENCE OR SEMI-ADHERENCE APPLICATION
(2) INSULATION – t=variable min. t=50mm
– EXPANSED POLYSTYRENE λ=0.037kcal/h.m2.°C
– WITH $\frac{t_1}{\lambda_1} = \frac{t_2}{\lambda_2}$
– SEMI-ADHERENCE OR TOTAL ADHERENCE APPLICATION ON VAPOUR BARRIER.
(3) WATERPROOFING – SBS/OR/APP t_{MIN} >4mm WITH MINERAL PROTECTION.
– SEMI-ADHERENCE OR TOTAL ADHERENCE APPLICATION.
(4) PROTECTION – IN FACTORY MINERAL AUTOPROTECTION.
(5) h'> 150mm (NILL SLOPE)

REMARKS:
* FLOOR SLAB INVERT LEVEL ±0.00: SEE LAYOUT DARWINGS.
* DOUBLE THREADED WATERPROOF CONNECTION SLEEVES SHALL BE USED FOR RESERVOIR FORMWORKS TIE-RODS.
* HOLES MADE BY THE TIE-RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* ALL THE DIMENSIONS ARE IN mm.
* SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
* PROVIDE PERFORATED DRAIN PIPES, ⌀4" IN THE GRAVEL PROTECTION LAYER.

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

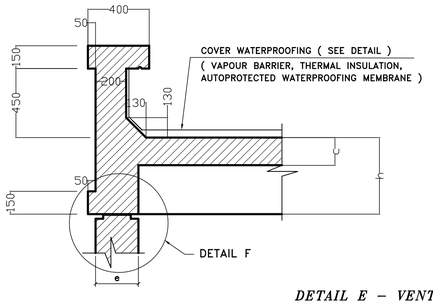
JAJ RESERVOIR (CAPACITY 500 m³)	ELEVATION AND SECTIONS FORMWORK

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SR-01	W. SEIFEDDINE	W. SEIFEDDINE	W. SEIFEDDINE

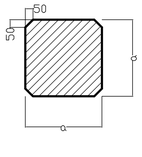
DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	N.T.S	1/5	462-05SR-01P01

ORIGINAL DRAWING SIZE A1

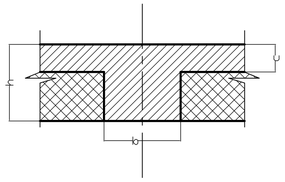
DETAIL A
PARAPET – SLAB SECTION



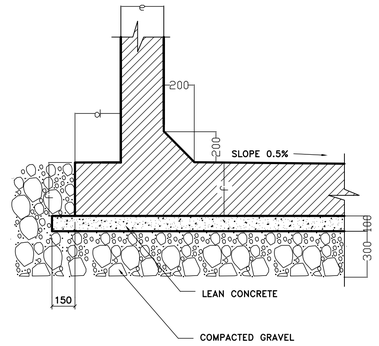
COLUMN DETAIL



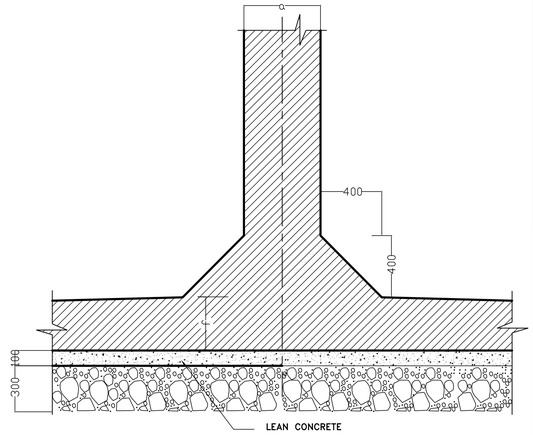
DETAIL B
BEAM–SLAB SECTION



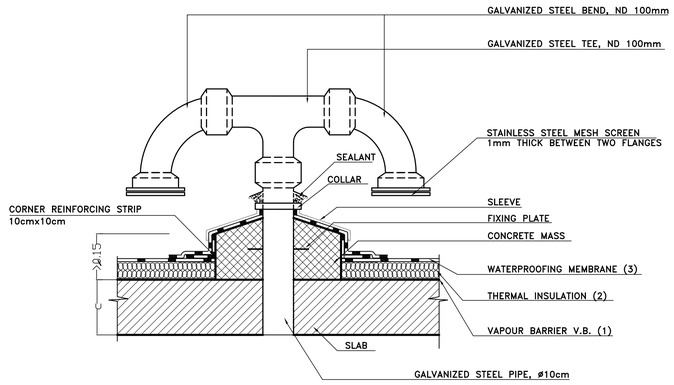
DETAIL C
MAT–WALL SECTION



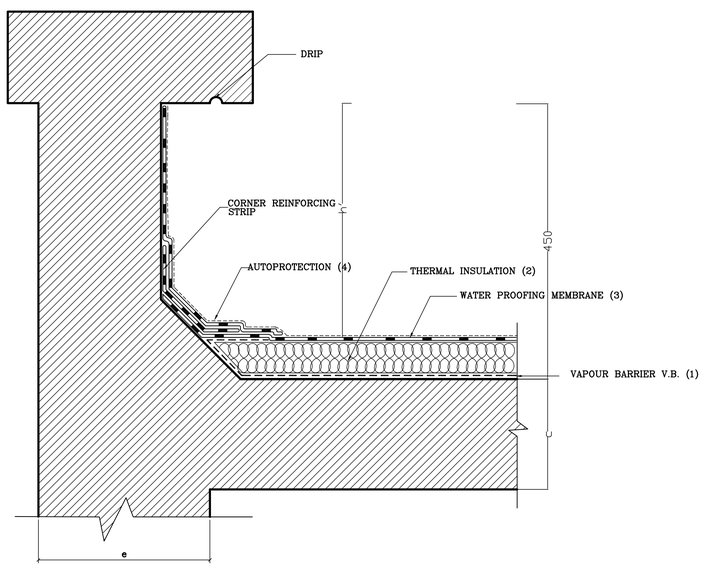
DETAIL D
COLUMN–MAT SECTION



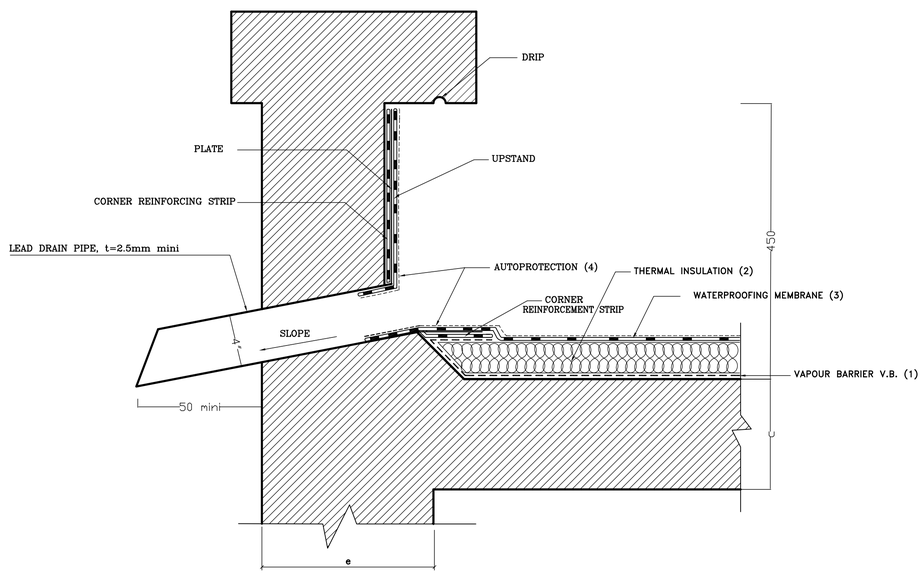
DETAIL E – VENTILATION PIPE
Scale 1:10



WATERPROOFING DETAIL



DETAIL RAIN WATER DRAINAGE



NOTES FOR RESERVOIRS:

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MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy=250 MPa.

STRESSES:
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CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS:
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BENDING:
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– WITH $\frac{t_1}{\lambda_1} = \frac{t_2}{\lambda_2}$
– SEMI–ADHERENCE OR TOTAL ADHERENCE APPLICATION ON VAPOUR BARRIER.
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Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ RESERVOIR (CAPACITY 500 m³)	DETAILS FORMWORK

DRAWING No.	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SR-01	W. SEIFEDDINE	W. SEIFEDDINE	W. SEIFEDDINE

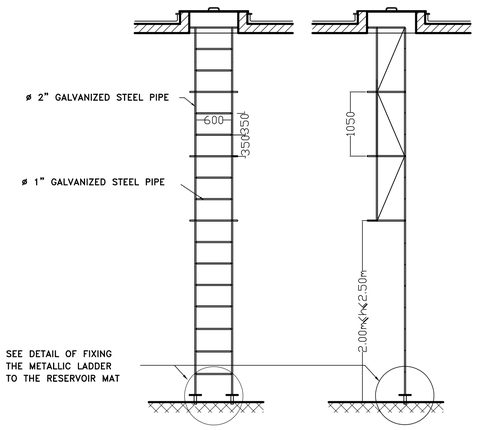
DATE	SCALE	SHEET No.	SEQ. No.
FEBRUARY 2017	1:50 - 1:20	2/5	462-05SR-01P02

ORIGINAL DRAWING SIZE A1

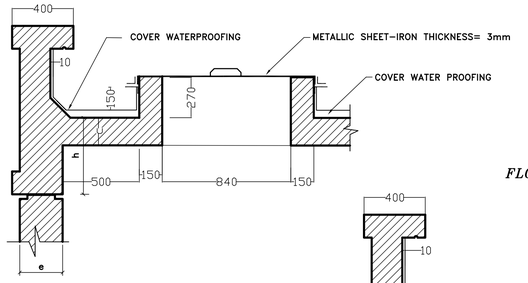
INTERNAL METALLIC LADDER DETAIL

FRONT VIEW
Scale 1:50

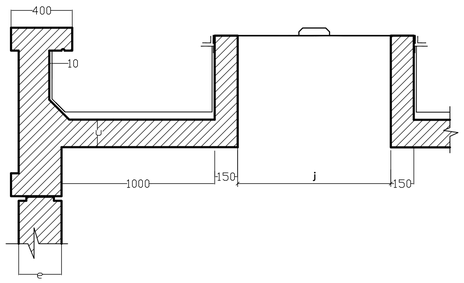
SIDE VIEW
Scale 1:50



PARAPET–SLAB–TRAP DOOR SECTION

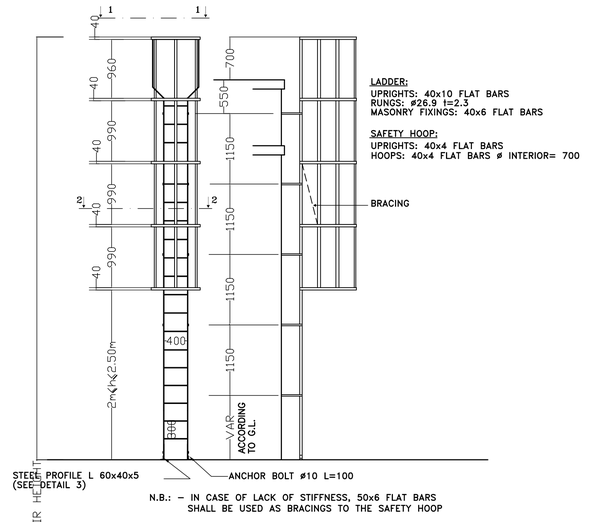


FLOAT TRAP–DOOR SECTION



EXTERNAL METALLIC LADDER DETAIL

Scale 1:50



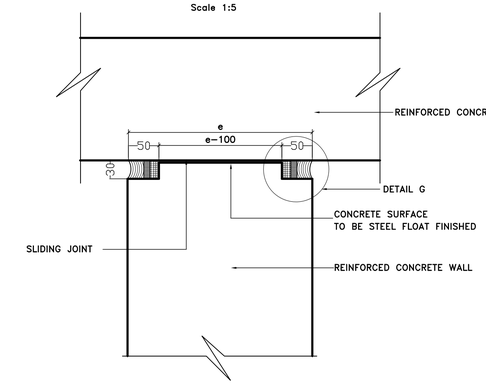
LADDER:
UPRIGHTS: 40x10 FLAT BARS
RUNGS: ø26.9 t=2.3
MASONRY FIXINGS: 40x6 FLAT BARS

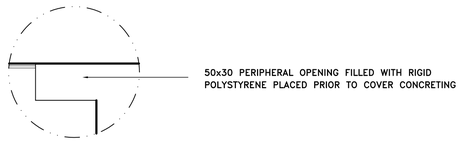
SAFETY HOOP:
UPRIGHTS: 40x4 FLAT BARS
HOOPS: 40x4 FLAT BARS ø INTERIOR= 700

N.B.: – IN CASE OF LACK OF STIFFNESS, 50x6 FLAT BARS SHALL BE USED AS BRACINGS TO THE SAFETY HOOP

DETAIL F DU JOINT GLISSANT

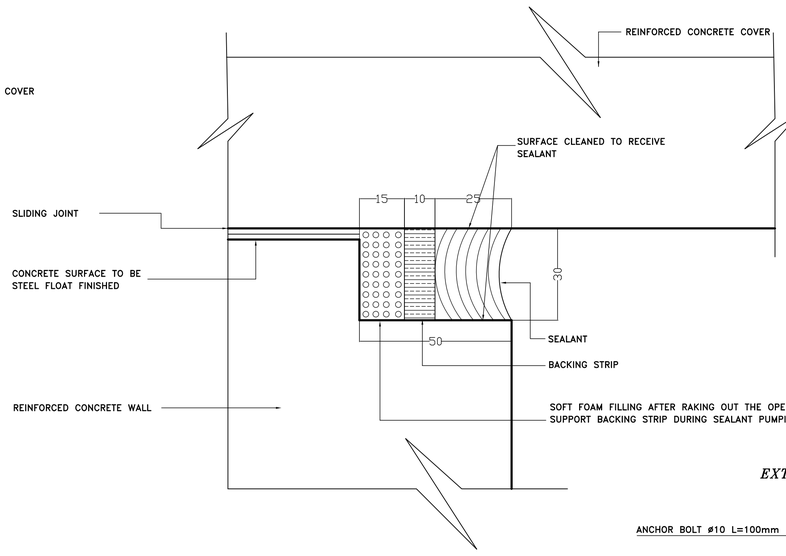
Scale 1:5



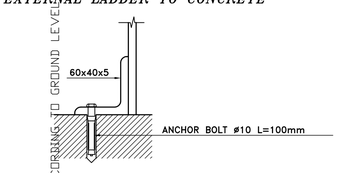


DETAIL C

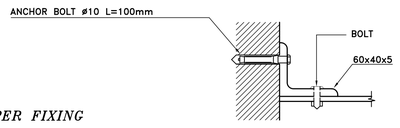
Scale 1:1



DETAIL 3: FIXING OF EXTERNAL LADDER TO CONCRETE



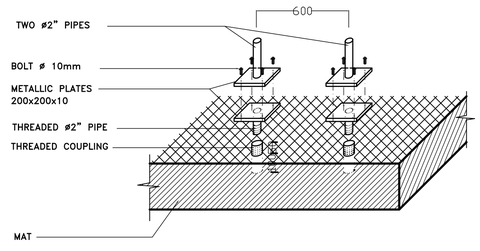
DETAIL 4: FIXING OF EXTERNAL LADDER TO RESERVOIR WALLS



CAPACITY	500M3
R (mm)	5500
0.25R (mm)	1375
e (mm)	250
R+e (mm)	5750
c (mm)	200
f (mm)	350
d (mm)	200
R+t+d (mm)	5950
a (mm)	400
b (mm)	400
h (mm)	600
n (VENTILATION PIPES)	4
n' (DRAIN WATER)	4
H (mm)	6700
g (mm)	800
j (mm)	1200

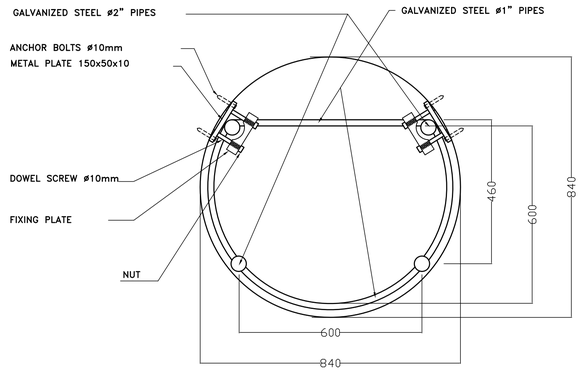
FIXING OF INTERNAL METALLIC LADDER DETAIL

Scale 1:20



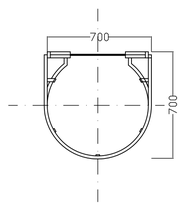
DETAIL OF INTERNAL LADDER AND UPPER FIXING PLAN VIEW

Scale 1:10



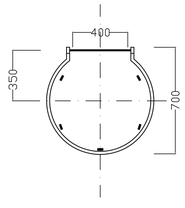
VIEW 1–1

Scale 1:10



VIEW 2–2

Scale 1:10



ORIGINAL DRAWING SIZE A1

NOTES FOR RESERVOIRS:

REINFORCED CONCRETE:
CONCRETE GRADE C30 FOR ALL STRUCTURES.

MIX ELEMENTS:
ORDINARY PORTLAND CEMENT(400 Kg/m3 FOR LATERAL WALLS, FLOOR SLAB, AND THE COVER SLAB; 350 kg/m3 ELSEWHERE) SHOULD COMPLY WITH BS12.
AGGREGATES (SAND AND GRAVELS) FROM NATURAL QUARRIES, SHOULD COMPLY WITH BS882.
WATER SHOULD COMPLY WITH THE REQUIREMENTS OF BS5328.

LEAN CONCRETE / CYCLOPEAN CONCRETE:
MIX MADE WITH ORDINARY PORTLAND CEMENT, CONCRETE GRADE C20
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=420 MPa.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy=250 MPa.

STRESSES:
SEVERE CONTROL
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS:
– ON A CUBE, a=150mm : 30 N/mm2
– ON A CYLINDER, ø=150mm, h=30mm : 25 N/mm2
CONCRETE TENSILE STRENGTH AT 28 DAYS : 2.1 N/mm2.

CONSTRUCTION JOINTS:
PROHIBITED IN RESERVOIR WALLS.
REDUCED TO THE STRICT MINIMUM ELSEWHERE PROVIDED THAT NECESSARY PRECAUTIONS ARE TAKEN, SUCH AS: SETTING RETARDERS, BONDING MATERIALS, WATER–STOP JOINTS.
MAXIMUM POURING HEIGHT: 1.50 m.

ADMIXTURES:
SETTING RETARDERS (CONSTRUCTION JOINTS).
WATERPROOFING ADMIXTURE (TO IMPROVE WATER PROOFNESS OF WALLS, FLOOR SLAB AND COVER SLAB)
THE USE OF CHLORINE BASED ADMIXTURES IS NOT ALLOWED.
EVERY ADMIXTURE SHALL BE APPROVED BY THE ADMINISTRATION.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 4 cm FOR THE RESERVOIR FLOOR SLAB AND WALLS, 3 cm ELSEWHERE.

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50ø.
(ø= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
STIRRUPS ø8 SHALL BE USED ON EACH LAP.

BENDING:
ø > 12mm MECHANICAL.
ø < 12mm MANUEL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

DRAWINGS CONSIDERATION:
– – – – – – TOP BARS
——— BOTTOM BARS

FORMWORK:
ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE (METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
SURFACE WATERPROOFING TREATMENT OF RESERVOIR WALLS, COVER AND FLOOR SLAB.
COVER WATERPROOFING CONSISTING OF A VAPOUR BARRIER, A THERMAL INSULATION, A WATERPROOFING MEMBRANE AND ITS PROTECTION.

WATERPROOFING DETAILS:
(1) V.B. – SBS/OR/APP t>2.5mm
– ADHERENCE OR SEMI–ADHERENCE APPLICATION
(2) INSULATION – t=variable min. t=50mm
– EXPANSED POLYSTYRENE λ=0.037kcal/h.m2.°C
– WITH $\frac{t_1}{\lambda_1} = \frac{t_2}{\lambda_2}$
– SEMI–ADHERENCE OR TOTAL ADHERENCE APPLICATION ON VAPOUR BARRIER.
(3) WATERPROOFING – SBS/OR/APP t_{MIN} >4mm WITH MINERAL PROTECTION.
– SEMI–ADHERENCE OR TOTAL ADHERENCE APPLICATION.
(4) PROTECTION – IN FACTORY MINERAL AUTOPROTECTION.
(5) h'> 150mm (NILL SLOPE)

REMARKS:
* FLOOR SLAB INVERT LEVEL ±0.00: SEE LAYOUT DARWINGS.
* DOUBLE THREADED WATERPROOF CONNECTION SLEEVES SHALL BE USED FOR RESERVOIR FORMWORKS TIE–RODS.
* HOLES MADE BY THE TIE–RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* ALL THE DIMENSIONS ARE IN mm.
* SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
* PROVIDE PERFORATED DRAIN PIPES, ø4" IN THE GRAVEL PROTECTION LAYER.

Rev.	Date	Dsgn.	Drwn.	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

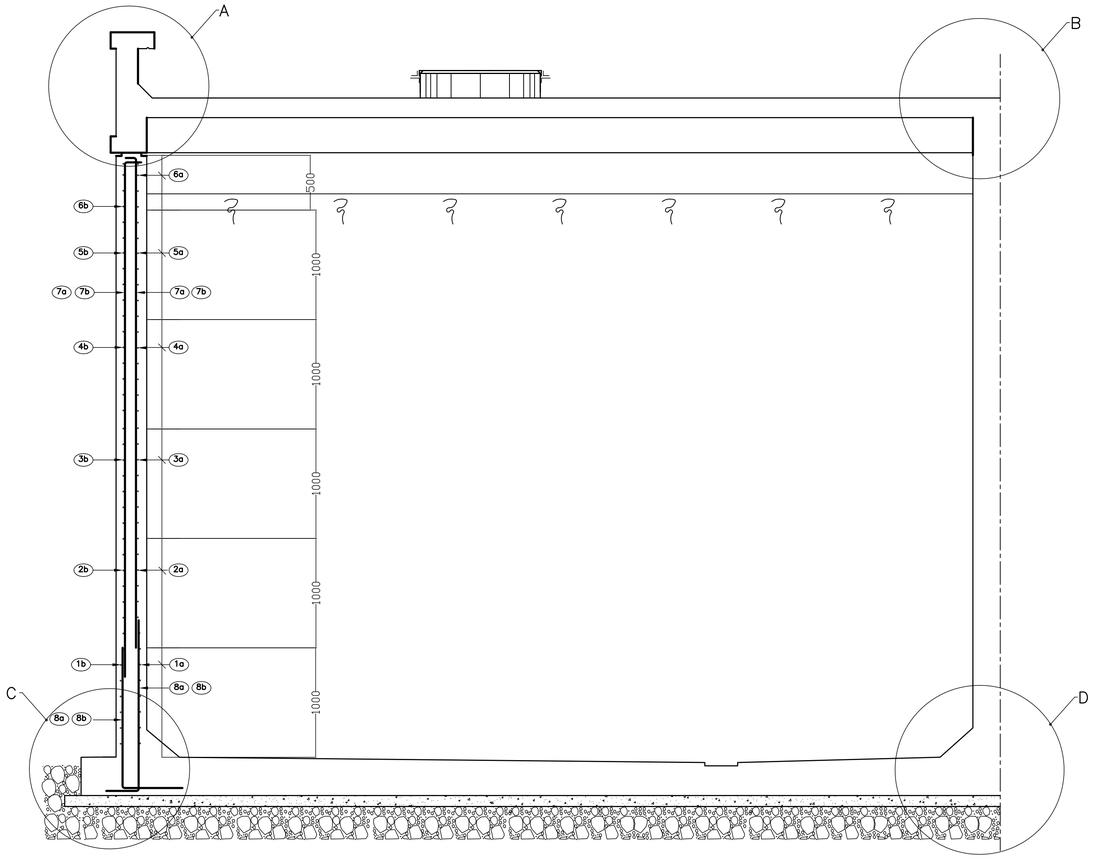
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ RESERVOIR (CAPACITY 500 m³)	DETAILS FORMWORK

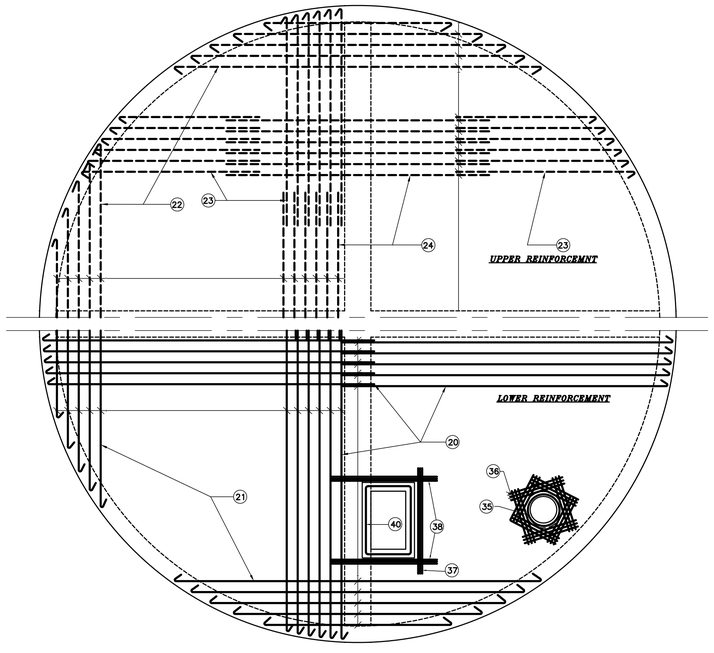
DRAWING No.	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SR-01	W. SEIFEDDINE	W. SEIFEDDINE	W. SEIFEDDINE

DATE	SCALE	SHEET No.	SEQ. No.
FEBRUARY 2017	1:50 - 1:20	3/5	462-05SR-01P03

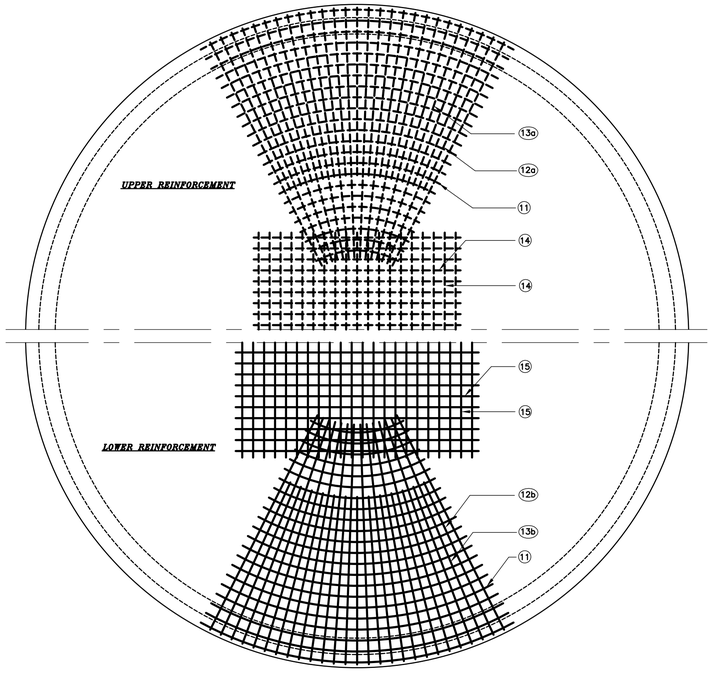
VERTICAL HALF-SECTION REINFORCEMENT



COVER SLAB REINFORCEMENT



MAT REINFORCEMENT



CAPACITY 500

Des.	Nber of layers per lm	Diameter T or ø	Length (m)	Nber of bars/layer	Type	Total Nber of bars
1a	6	T16	9.50	4	9.50 / 5.55	24
1b	6	T16	9.80	4	9.80 / 5.70	24
2a	5	T16	9.50	4	9.50 / 5.55	20
2b	5	T16	9.80	4	9.80 / 5.70	20
3a	5	T14	9.50	4	9.50 / 5.55	20
3b	5	T14	9.80	4	9.80 / 5.70	20
4a	6	T12	9.50	4	9.50 / 5.55	24
4b	6	T12	9.80	4	9.80 / 5.70	24
5a	6	T12	9.50	4	9.50 / 5.55	24
5b	6	T12	9.80	4	9.80 / 5.70	24
6a	6	T12	9.50	4	9.50 / 5.55	12
6b	6	T12	9.80	4	9.80 / 5.70	12
7a	3	T12	4.00		0.20 / 3.80	218
7b	3	T12	4.50		0.20 / 4.30	218
8a	3	T16	2.80		0.40 / 2.40	218
8b	3	T16	2.30		0.40 / 1.90	218
9a	6	T16	2.08		0.65 / 1.16 / 0.45	218
9b	2 (per section)	T14	9.15	4	9.15 / 5.20	8
10a	6	T12	0.50		0.50	218
10b	6	T14	1.13		0.27 / 0.18 / 0.58 / 0.30	218
11	7	T16	3.10 to 10.0	4	3.10 to 10.00 / 1.50 to 5.80	252
12a	3	T16	3.40		0.15 / 0.40 / 2.85	108
12b	3	T16	3.50		0.20 / 3.30	108
13a	3	T16	4.70		0.15 / 0.40 / 4.15	108
13b	3	T16	4.90		0.20 / 4.70	108
14	6	T16	4.65		4.65	56
15	7	T25	5.20		5.20	74
16	8 (per section)	T12	6.00		0.20 / 5.80	8
17a	6	ø8	1.50		0.32 / 0.32	36
17b	6	ø8	1.35		0.28 / 0.28	36
18a	8 (per section)	T12	2.50		0.65 / 1.80 / 0.45	8
18b	1 (per section)	T12	2.75		0.85 / 0.65	1
19	8 (per section)	T12	1.50		0.40 / 0.8 / 0.8 / 1.10	8
20	6	T12	4.25 to 6.15	2	0.8 / 0.8 / 4.05 to 6.05	208
21	6	T12	2.85 to 8.20	1	0.8 / 0.8 / 2.85 to 8.00	36
22	5	T12	2.85 to 8.20	1	0.8 / 0.8 / 2.85 to 8.00	36
23	5	T12	1.25 to 3.15	2	0.8 / 0.8 / 1.05 to 3.05	176
24	5	T12	6.50	1	6.50	88
25a	4 (per section)	T25	7.00	2	0.30 / 6.70	16
25b	4 (per section)	T16	4.50	2	4.50	16
26	4 (per section)	T16	3.75	2	0.30 / 3.45	16
27a	4 (per section)	T25	6.75	1	6.75	8
27b	4 (per section)	T25	4.00	1	4.00	8
28	–	–	–	–	–	–
29a		ø8	1.90	s1=10x0.13 s2=10x0.25	0.32 / 0.52	124
29b		ø8	1.70	s1=10x0.13 s2=10x0.25	0.23 / 0.52	124
29c	–	–	–	–	–	–
30	–	–	–	–	–	–
31a	15 (per section)	T12	9.10 or 9.55	4	9.10 or 9.55 / 5.45 to 5.70	60
31b	8 (per section)	T12	9.10 or 9.55	4	9.10 or 9.55 / 5.45 to 5.70	32
31c	5	ø8	0.80	–	0.09 / 0.24	170
32	5	ø8	1.00		0.09 / 0.34	170
33a	5	ø8	3.15		0.15 / 0.60 / 1.10 / 0.8	170
33b	5	ø8	0.90		0.8 / 0.50 / 0.20	170
34	4 (per section)	T10		1	3.25 or 4.00 / 0.45 or 0.56	4
35	5	ø8	1.10		0.09 / 0.41	15
36		T12	1.50		1.50	48
37		T16	3.20		3.20	3
38		T14	2.80		2.80	6
39		T10	2.60		2.60	3
40		T10	2.40		2.40	6
41	8 (per section)	T10	1.30 or 1.70		1.30 or 1.70	24
42	5	ø8	1.60		0.09 / 0.64	23

NOTES FOR RESERVOIRS:

REINFORCED CONCRETE:
CONCRETE GRADE C30 FOR ALL STRUCTURES.

MIX ELEMENTS:
ORDINARY PORTLAND CEMENT(400 Kg/m3 FOR LATERAL WALLS, FLOOR SLAB, AND THE COVER SLAB; 350 kg/m3 ELSEWHERE) SHOULD COMPLY WITH BS12.
AGGREGATES (SAND AND GRAVELS) FROM NATURAL QUARRIES, SHOULD COMPLY WITH BS882.
WATER SHOULD COMPLY WITH THE REQUIREMENTS OF BS5328.

LEAN CONCRETE / CYCLOPEAN CONCRETE:
MIX MADE WITH ORDINARY PORTLAND CEMENT, CONCRETE GRADE C20
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=420 MPa.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy=250 MPa.

STRESSES:
SEVERE CONTROL
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS:
– ON A CUBE, a=150mm : 30 N/mm2
– ON A CYLINDER, ø=150mm, h=30mm : 25 N/mm2
CONCRETE TENSILE STRENGTH AT 28 DAYS : 2.1 N/mm2.

CONSTRUCTION JOINTS:
PROHIBITED IN RESERVOIR WALLS.
REDUCED TO THE STRICT MINIMUM ELSEWHERE PROVIDED THAT NECESSARY PRECAUTIONS ARE TAKEN, SUCH AS: SETTING RETARDERS, BONDING MATERIALS, WATER-STOP JOINTS.
MAXIMUM POURING HEIGHT: 1.50 m.

ADMIXTURES:
SETTING RETARDERS (CONSTRUCTION JOINTS).
WATERPROOFING ADMIXTURE (TO IMPROVE WATER PROOFNESS OF WALLS, FLOOR SLAB AND COVER SLAB)
THE USE OF CHLORINE BASED ADMIXTURES IS NOT ALLOWED.
EVERY ADMIXTURE SHALL BE APPROVED BY THE ADMINISTRATION.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 4 cm FOR THE RESERVOIR FLOOR SLAB AND WALLS, 3 cm ELSEWHERE.

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50ø.
(ø= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
STIRRUPS ø8 SHALL BE USED ON EACH LAP.

BENDING:
ø > 12mm MECHANICAL.
ø < 12mm MANUEL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

DRAWINGS CONSIDERATION:
– – – – – – TOP BARS
——— BOTTOM BARS

FORMWORK:
ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE (METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
SURFACE WATERPROOFING TREATMENT OF RESERVOIR WALLS, COVER AND FLOOR SLAB.
COVER WATERPROOFING CONSISTING OF A VAPOUR BARRIER, A THERMAL INSULATION, A WATERPROOFING MEMBRANE AND ITS PROTECTION.

WATERPROOFING DETAILS:
(1) V.B. – SBS/OR/APP t≥2.5mm
– ADHERENCE OR SEMI-ADHERENCE APPLICATION
(2) INSULATION – t=variable min. t=50mm
– EXPANSED POLYSTYRENE λ=0.037kcal/h.m2.°C
– WITH $\frac{t_1}{\lambda_1} = \frac{t_2}{\lambda_2}$
– SEMI-ADHERENCE OR TOTAL ADHERENCE APPLICATION ON VAPOUR BARRIER.
(3) WATERPROOFING – SBS/OR/APP t_{MIN} ≥4mm WITH MINERAL PROTECTION.
– SEMI-ADHERENCE OR TOTAL ADHERENCE APPLICATION.
(4) PROTECTION – IN FACTORY MINERAL AUTOPROTECTION.
(5) h'> 150mm (NILL SLOPE)

REMARKS:
* FLOOR SLAB INVERT LEVEL ±0.00: SEE LAYOUT DARWINGS.
* DOUBLE THREADED WATERPROOF CONNECTION SLEEVES SHALL BE USED FOR RESERVOIR FORMWORKS TIE-RODS.
* HOLES MADE BY THE TIE-RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* ALL THE DIMENSIONS ARE IN mm.
* SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
* PROVIDE PERFORATED DRAIN PIPES, ø4" IN THE GRAVEL PROTECTION LAYER.

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

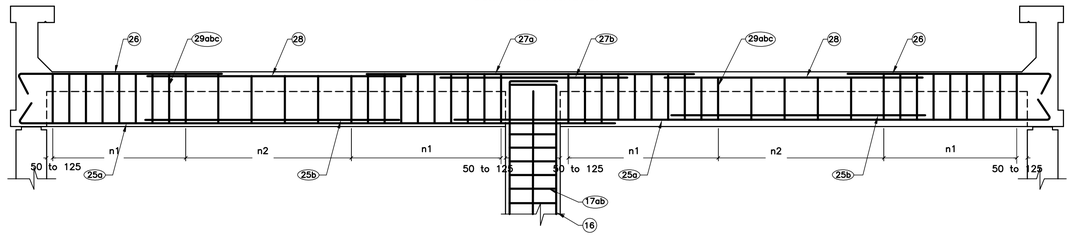
JAJ RESERVOIR (CAPACITY 500 m³)	VERTICAL HALF-SECTION PLANS REINFORCEMENT

DRAWING No.	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SR-01	W. SEIFEDDINE	W. SEIFEDDINE	W. SEIFEDDINE

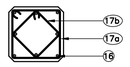
DATE	SCALE	SHEET No.	SEQ. No.
FEBRUARY 2017	N.T.S	4/5	462-05SR-01P04

ORIGINAL DRAWING SIZE A1

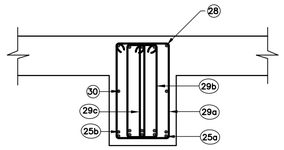
DETAIL B (COLUMN–BEAM–SLAB)
BEAMS REINFORCEMENT



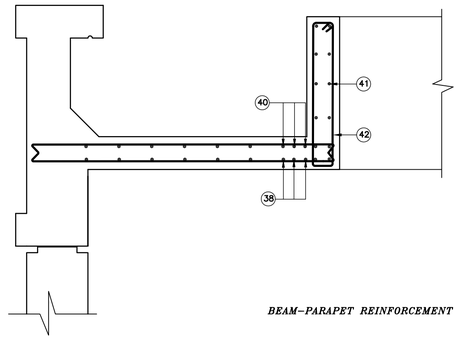
COLUMN REINFORCEMENT



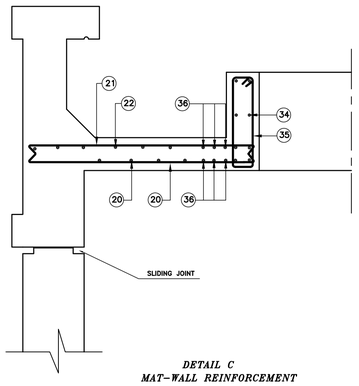
SECTION AT MID SPAN



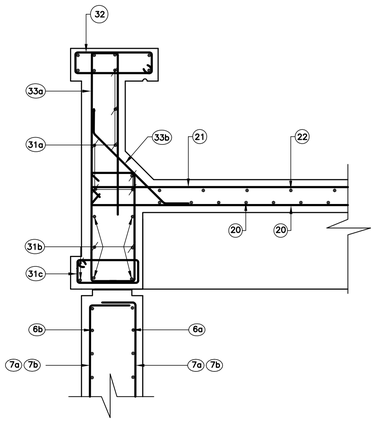
DETAIL F
FLOAT TRAP–DOOR SECTION



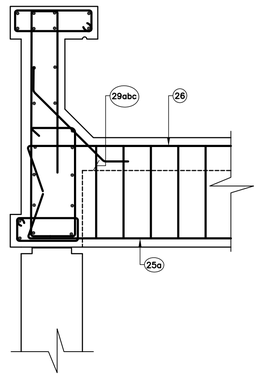
SLAB–TRAP DOOR REINFORCEMENT



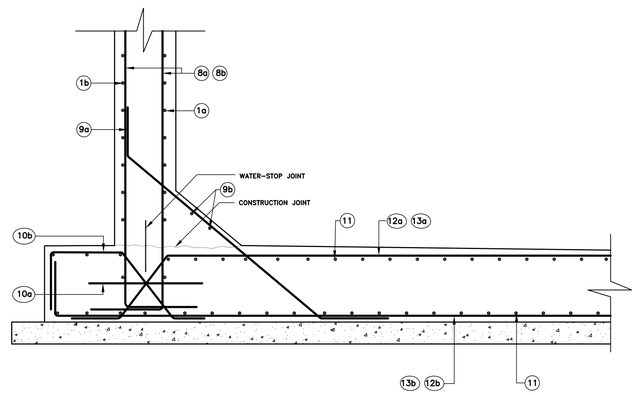
DETAIL A
SLAB–PARAPET REINFORCEMENT



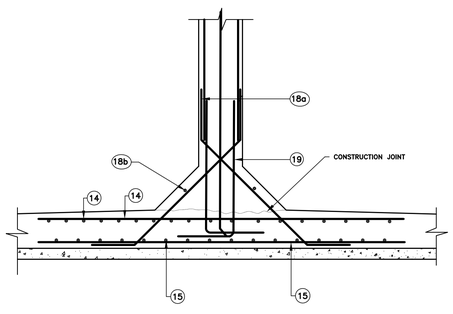
BEAM–PARAPET REINFORCEMENT



DETAIL C
MAT–WALL REINFORCEMENT



DETAIL D
COLUMN–MAT REINFORCEMENT



CAPACITY 500

Des.	Nber of layers per lm	Diameter T or ø	Length (m)	Nber of bars/layer	Type	Total Nber of bars
1a	6	T16	9.50	4	9.50 / 5.55	24
1b	6	T16	9.80	4	9.80 / 5.70	24
2a	5	T16	9.50	4	9.50 / 5.55	20
2b	5	T16	9.80	4	9.80 / 5.70	20
3a	5	T14	9.50	4	9.50 / 5.55	20
3b	5	T14	9.80	4	9.80 / 5.70	20
4a	6	T12	9.50	4	9.50 / 5.55	24
4b	6	T12	9.80	4	9.80 / 5.70	24
5a	6	T12	9.50	4	9.50 / 5.55	24
5b	6	T12	9.80	4	9.80 / 5.70	24
6a	6	T12	9.50	4	9.50 / 5.55	12
6b	6	T12	9.80	4	9.80 / 5.70	12
7a	3	T12	4.00		0.23 / 3.80	218
7b	3	T12	4.50		0.20 / 4.30	218
8a	3	T16	2.80		0.40 / 2.40	218
8b	3	T16	2.30		0.40 / 1.90	218
9a	6	T16	2.08		0.65 / 1.16 / 0.45	218
9b	2 (per section)	T14	9.15	4	9.15 / 5.20	8
10a	6	T12	0.50		0.50	218
10b	6	T14	1.13		0.27 / 0.18 / 0.95 / 0.30	218
11	7	T16	3.10 to 10.0	4	3.10 to 10.00 / 1.50 to 5.80	252
12a	3	T16	3.40		0.15 / 0.40 / 2.85	108
12b	3	T16	3.50		0.20 / 3.30	108
13a	3	T16	4.70		0.15 / 0.40 / 4.15	108
13b	3	T16	4.90		0.20 / 4.70	108
14	6	T16	4.65		4.65	56
15	7	T25	5.20		5.20	74
16	8 (per section)	T12	6.00		0.20 / 5.80	8
17a	6	ø8	1.50		0.32 / 0.32	36
17b	6	ø8	1.35		0.28 / 0.28	36
18a	8 (per section)	T12	2.50		0.45 / 1.60 / 0.45	8
18b	1 (per section)	T12	2.75		0.25 / 0.65	1
19	8 (per section)	T12	1.50		0.40 / 1.10	8
20	6	T12	4.25 to 6.15	2	0.8 / 0.8 / 4.15 to 6.05	208
21	6	T12	2.85 to 8.20	1	0.8 / 0.8 / 2.65 to 8.00	36
22	5	T12	2.85 to 8.20	1	0.8 / 0.8 / 2.65 to 8.00	36
23	5	T12	1.25 to 3.15	2	0.8 / 0.8 / 1.15 to 3.05	176
24	5	T12	6.50	1	6.50	88
25a	4 (per section)	T25	7.00	2	0.8 / 6.70	16
25b	4 (per section)	T16	4.50	2	4.50	16
26	4 (per section)	T16	3.75	2	0.8 / 3.45	16
27a	4 (per section)	T25	6.75	1	6.75	8
27b	4 (per section)	T25	4.00	1	4.00	8
28	–	–	–	–	–	–
29a		ø8	1.90	n1=10ø0.12 n2=10ø0.25	0.32 / 0.52	124
29b		ø8	1.70	n1=10ø0.13 n2=10ø0.25	0.23 / 0.52	124
29c	–	–	–	–	–	–
30	–	–	–	–	–	–
31a	15 (per section)	T12	9.10 to 9.55	4	9.10 to 9.55 / 5.45 to 5.70	60
31b	8 (per section)	T12	9.10 to 9.55	4	9.10 to 9.55 / 5.45 to 5.70	32
31c	5	ø8	0.80	–	0.09 / 0.84	170
32	5	ø8	1.00		0.09 / 0.34	170
33a	5	ø8	3.15		0.19 / 0.60 / 1.10 / 0.45	170
33b	5	ø8	0.90		0.20 / 0.50 / 0.20	170
34	4 (per section)	T10		1	3.25 to 4.00 / 0.45 to 0.56	4
35	5	ø8	1.10		0.09 / 0.41	15
36		T12	1.50		1.50	48
37		T16	3.20		3.20	3
38		T14	2.80		2.80	6
39		T10	2.60		2.60	3
40		T10	2.40		2.40	6
41	8 (per section)	T10	1.30 to 1.70		1.30 to 1.70	24
42	5	ø8	1.60		0.09 / 0.64	23

NOTES FOR RESERVOIRS:

REINFORCED CONCRETE:
CONCRETE GRADE C30 FOR ALL STRUCTURES.

MIX ELEMENTS:
ORDINARY PORTLAND CEMENT(400 Kg/m3 FOR LATERAL WALLS, FLOOR SLAB, AND THE COVER SLAB; 350 kg/m3 ELSEWHERE) SHOULD COMPLY WITH BS12.
AGGREGATES (SAND AND GRAVELS) FROM NATURAL QUARRIES, SHOULD COMPLY WITH BS882.
WATER SHOULD COMPLY WITH THE REQUIREMENTS OF BS5328.

LEAN CONCRETE / CYCLOPEAN CONCRETE:
MIX MADE WITH ORDINARY PORTLAND CEMENT, CONCRETE GRADE C20
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=420 MPa.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy=250 MPa.

STRESSES:
SEVERE CONTROL
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS:
– ON A CUBE, a=150mm : 30 N/mm2
– ON A CYLINDER, ø=150mm, h=30mm : 25 N/mm2
CONCRETE TENSILE STRENGTH AT 28 DAYS : 2.1 N/mm2.

CONSTRUCTION JOINTS:
PROHIBITED IN RESERVOIR WALLS.
REDUCED TO THE STRICT MINIMUM ELSEWHERE PROVIDED THAT NECESSARY PRECAUTIONS ARE TAKEN, SUCH AS: SETTING RETARDERS, BONDING MATERIALS, WATER–STOP JOINTS.
MAXIMUM POURING HEIGHT: 1.50 m.

ADMIXTURES:
SETTING RETARDERS (CONSTRUCTION JOINTS).
WATERPROOFING ADMIXTURE (TO IMPROVE WATER PROOFNESS OF WALLS, FLOOR SLAB AND COVER SLAB)
THE USE OF CHLORINE BASED ADMIXTURES IS NOT ALLOWED.
EVERY ADMIXTURE SHALL BE APPROVED BY THE ADMINISTRATION.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 4 cm FOR THE RESERVOIR FLOOR SLAB AND WALLS, 3 cm ELSEWHERE.

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50ø.
(ø= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
STIRRUPS #8 SHALL BE USED ON EACH LAP.

BENDING:
ø > 12mm MECHANICAL.
ø < 12mm MANUEL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

DRAWINGS CONSIDERATION:
– – – – – – TOP BARS
——— BOTTOM BARS

FORMWORK:
ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE (METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
SURFACE WATERPROOFING TREATMENT OF RESERVOIR WALLS, COVER AND FLOOR SLAB.
COVER WATERPROOFING CONSISTING OF A VAPOUR BARRIER, A THERMAL INSULATION, A WATERPROOFING MEMBRANE AND ITS PROTECTION.

WATERPROOFING DETAILS:
(1) V.B. – SBS/OR/APP t>2.5mm
– ADHERENCE OR SEMI–ADHERENCE APPLICATION
(2) INSULATION – t=variable min. t=50mm
– EXPANSED POLYSTYRENE λ=0.037kcal/h.m2.°C
– WITH $\frac{t_1}{\lambda_1} = \frac{t_2}{\lambda_2}$
– SEMI–ADHERENCE OR TOTAL ADHERENCE APPLICATION ON VAPOUR BARRIER.
(3) WATERPROOFING – SBS/OR/APP t_{MIN} >4mm WITH MINERAL PROTECTION.
– SEMI–ADHERENCE OR TOTAL ADHERENCE APPLICATION.
(4) PROTECTION – IN FACTORY MINERAL AUTOPROTECTION.
(5) h'> 150mm (NILL SLOPE)

REMARKS:
* FLOOR SLAB INVERT LEVEL ±0.00: SEE LAYOUT DARWINGS.
* DOUBLE THREADED WATERPROOF CONNECTION SLEEVES SHALL BE USED FOR RESERVOIR FORMWORKS TIE–RODS.
* HOLES MADE BY THE TIE–RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* ALL THE DIMENSIONS ARE IN mm.
* SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
* PROVIDE PERFORATED DRAIN PIPES, ø4" IN THE GRAVEL PROTECTION LAYER.

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

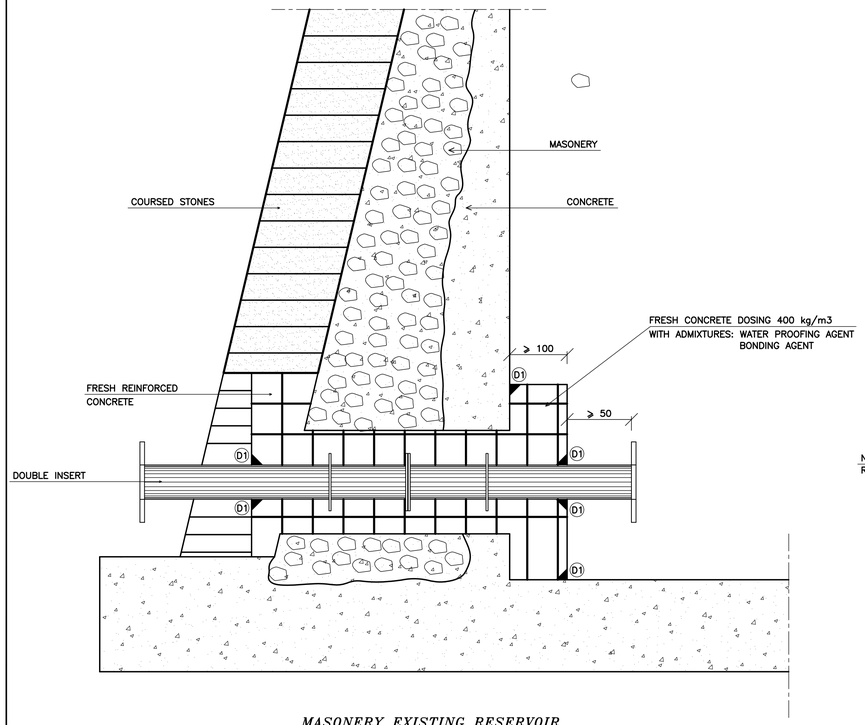
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ RESERVOIR (CAPACITY 500 m³)	SECTIONS AND DETAILS REINFORCEMENT

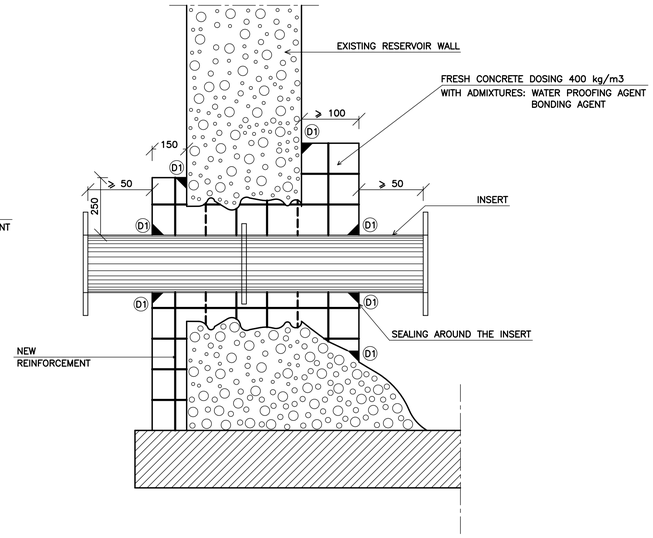
DRAWING No.	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SR-01	W. SEIFEDDINE	W. SEIFEDDINE	W. SEIFEDDINE

DATE	SCALE	SHEET No.	SEQ. No.
FEBRUARY 2017	N.T.S	5/5	462-05SR-01P05

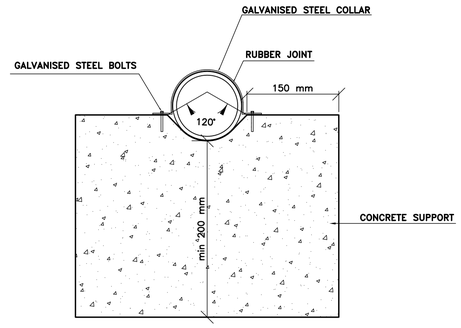
ORIGINAL DRAWING SIZE A1



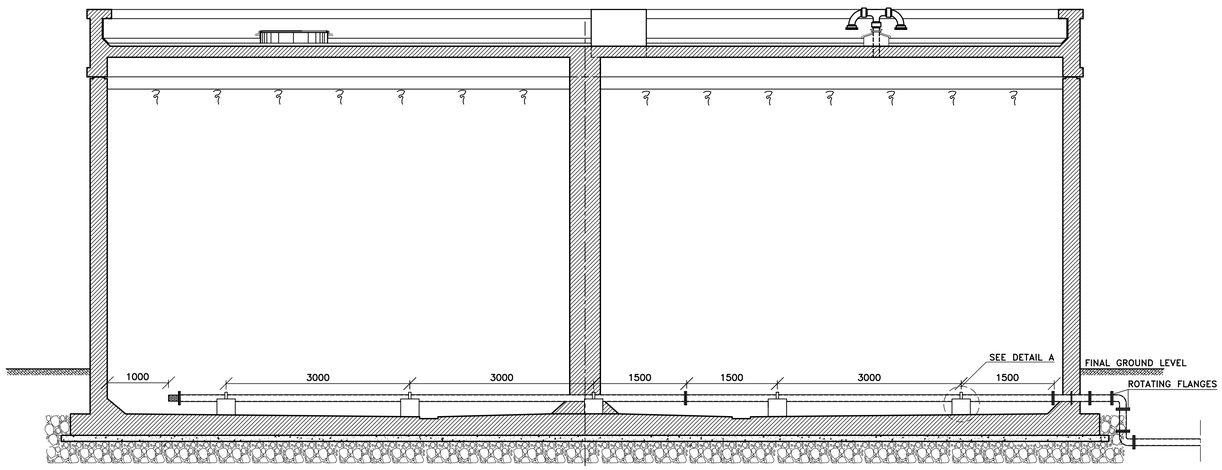
MASONERY EXISTING RESERVOIR
TYPICAL WATERTIGHT INSERT



REINFORCED CONCRETE EXISTING RESERVOIR
TYPICAL WATERTIGHT INSERT



TYPICAL SUPPORT DETAIL A



TYPICAL OUTLET DETAIL
FOR NEW RESERVOIRS

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

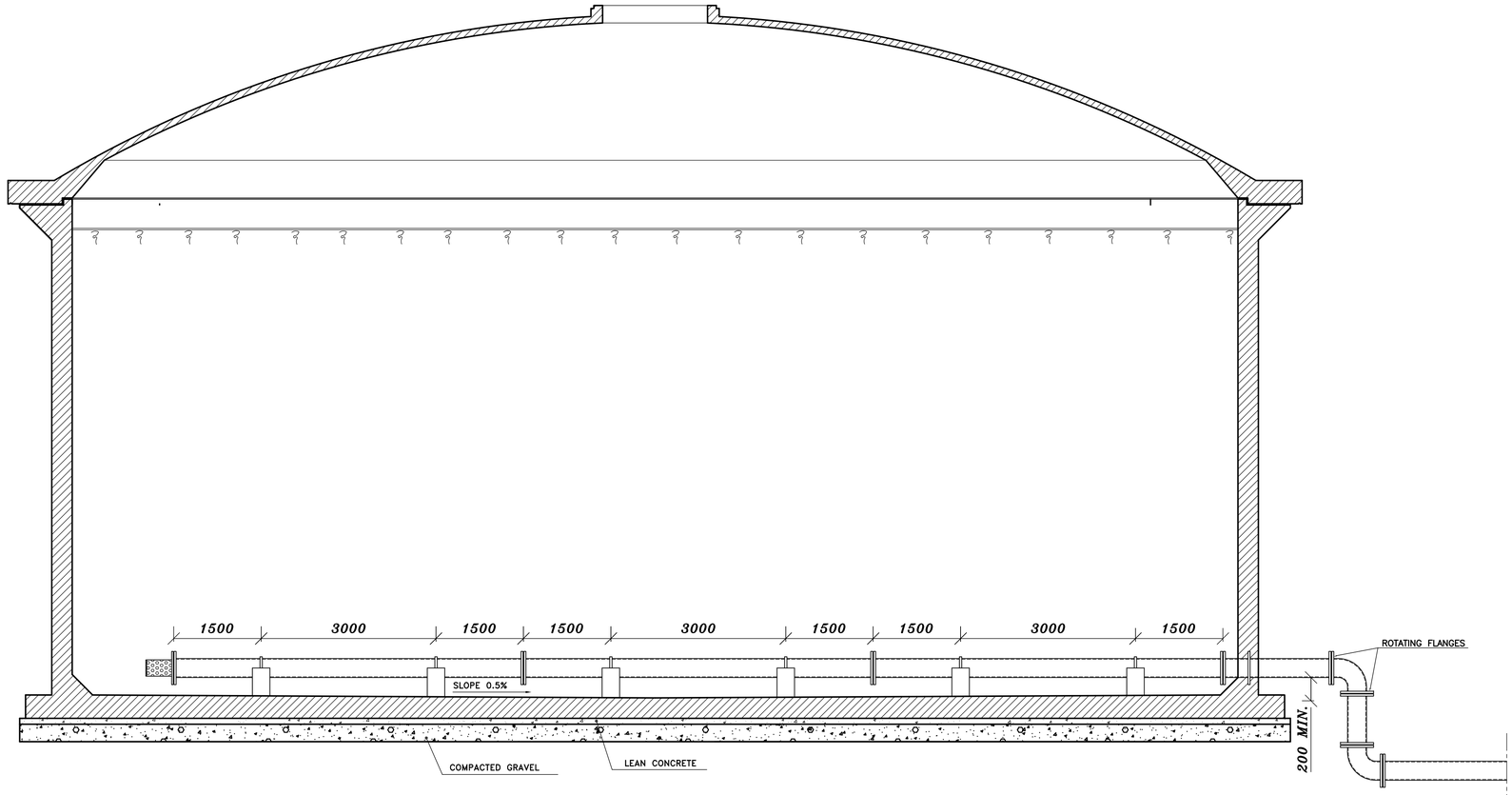
CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

HYDRAULIC ACCESSORIES	TYPICAL OUTLET FOR NEW RESERVOIRS AND WATERTIGHT INSERT FOR EXISTING RESERVOIRS

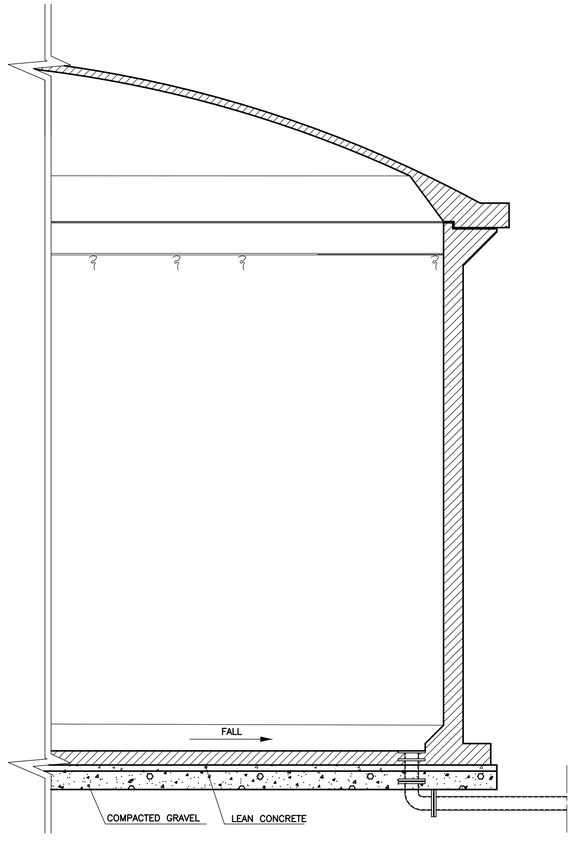
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SA-01P01	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	1/3	462-05SA-01P01

ORIGINAL DRAWING SIZE A1



TYPICAL OUTLET



TYPICAL WASHOUT

NOTES:

ALL DIMENSIONS ARE IN MILLIMETERS

CRS : CLEARANCE

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REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

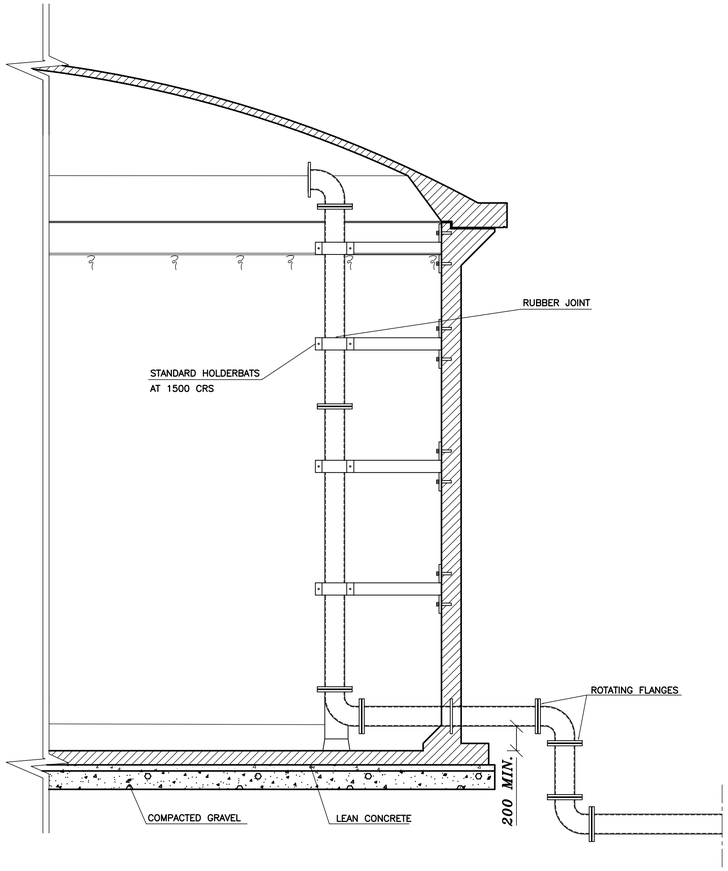
CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

HYDRAULIC ACCESSORIES	TYPICAL INLETS OVERFLOW AND WASHOUT

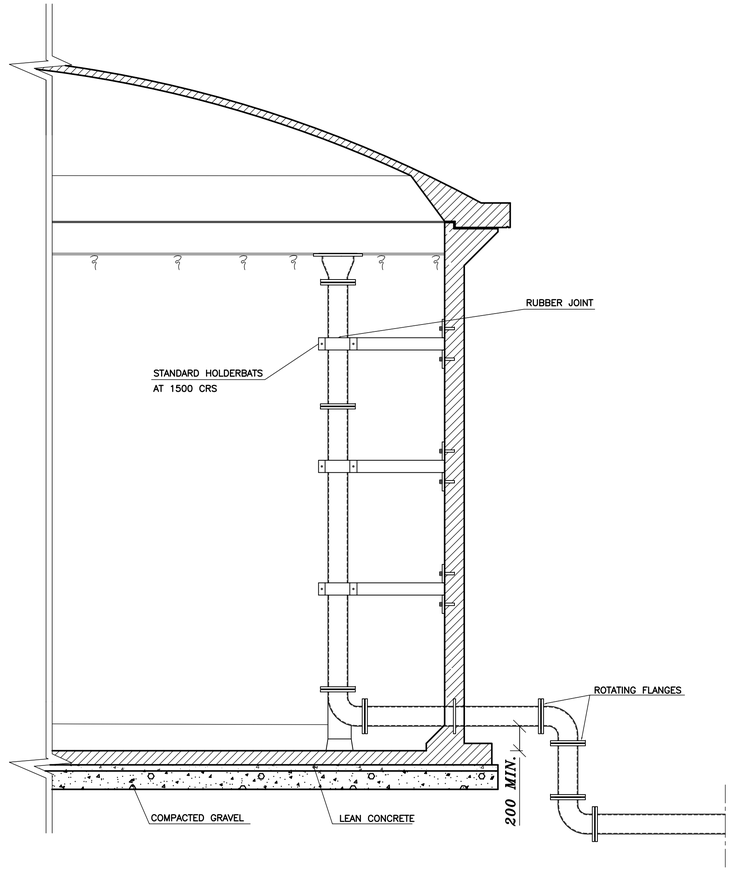
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SA-01P02	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:50	2/3	462-05SA-01P02

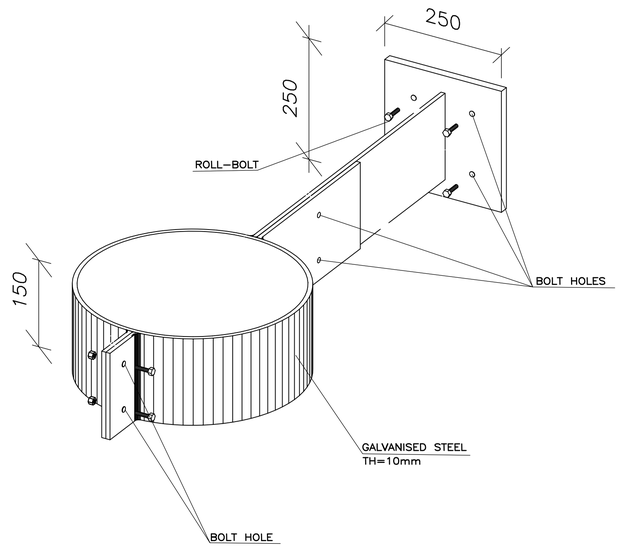
ORIGINAL DRAWING SIZE A1



TYPICAL INLET FOR DIAMETERS > 300 (WITH FLOAT CONTROLLED VALVE)



TYPICAL OVERFLOW



STANDARD HOLDERBATS

NOTES:

ALL DIMENSIONS ARE IN MILLIMETERS

CRS : CLEARANCE

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REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

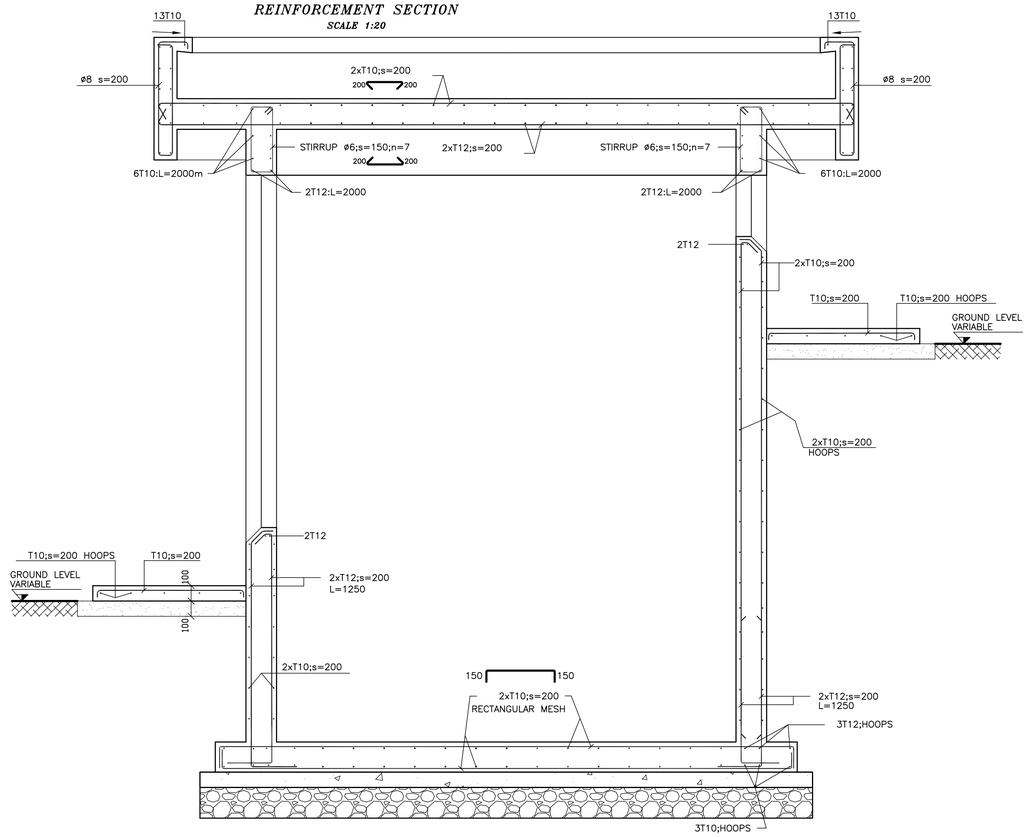
HYDRAULIC ACCESSORIES	TYPICAL INLETS OVERFLOW AND WASHOUT

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SA-01P03	Z. SABA	S. SAWAYA	T. ACHKAR

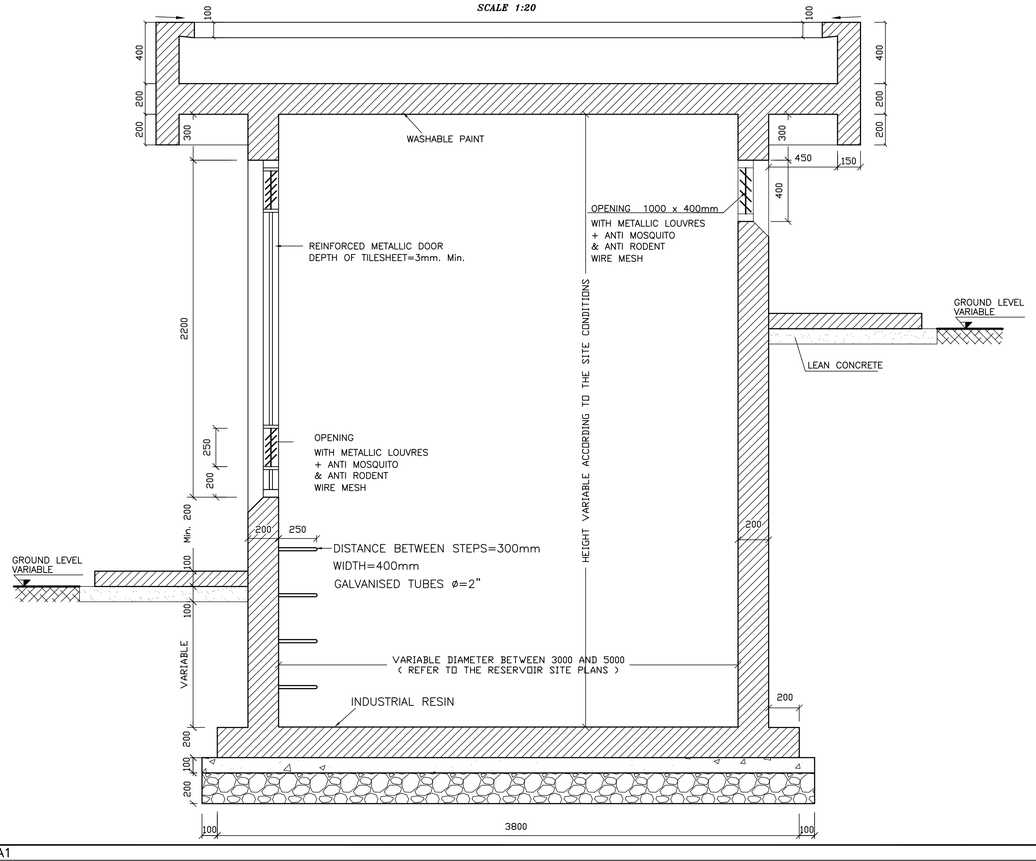
DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:50	3/3	462-05SA-01P03

ORIGINAL DRAWING SIZE A1

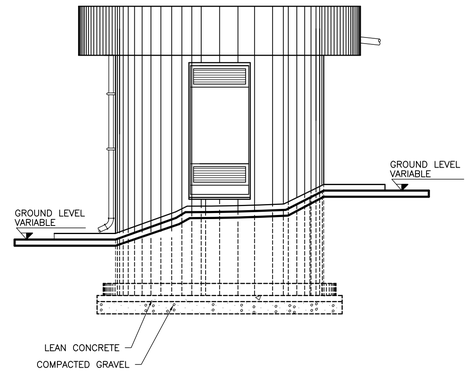
REINFORCEMENT SECTION
SCALE 1:20



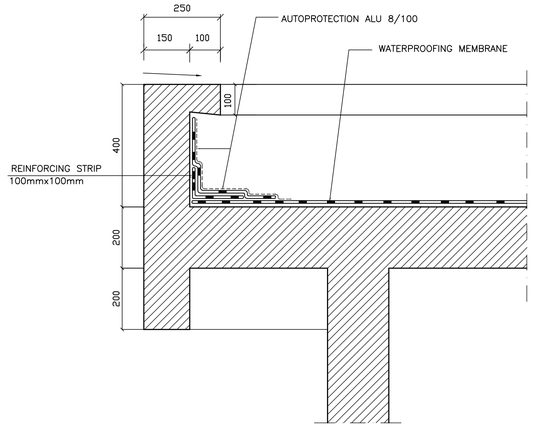
VERTICAL SECTION
SCALE 1:20



ELEVATION
SCALE 1:50



WATERPROOFING DETAIL
SCALE 1:10



NOTES:

REINFORCED CONCRETE:
REINFORCED CONCRETE SHALL BE MADE OF ORDINARY PORTLAND CEMENT AND SHALL BE OF GRADE C30.
THE MINIMUM CEMENT CONTENT IN CONCRETE FOR WALLS, FLOOR SLABS AND RESERVOIR DOME SHALL BE 350 KG PER 1 M3

LEAN CONCRETE/CYCLOPEAN CONCRETE:
LEAN AND CYCLOPEAN CONCRETES SHALL BE MADE OF ORDINARY PORTLAND CEMENT, AND SHALL BE OF GRADE C20.
THE MINIMUM CEMENT CONTENT SHALL BE 250 KG PER 1 M3

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy= 400 N/mm2.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy= 215 N/mm2.

CONCRETE STRENGTH:
SEVERE CONTROL.
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS:
– ON A CUBE SAMPLES (DIMENSIONS= 150 x 150 x 150 mm): 37.5 N/mm2
– ON A CYLINDER SAMPLES (DIAMETER= 160mm, HEIGHT= 320mm): 30 N/mm2
CONCRETE TENSILE STRENGTH AT 28 DAYS : 2.4 N/mm2
MAXIMUM FREE DROP HEIGHT: 1500 mm

CONSTRUCTION JOINTS:
CONSTRUCTION JOINTS SHALL BE FORMED ONLY IN THE POSITIONS SHOWN ON THE DRAWINGS OR AS INDICATED BY THE ENGINEER AND CONCRETING SHALL BE CARRIED OUT CONTINOUSLY BETWEEN AND UP TO JOINTS.
WATER–STOP JOINTS SHALL BE INCOPORATED IN CONSTRUCTION JOINTS FOR RETAINING AQUEOUS LIQUIDS IN PROPERLY CONSTRUCTED JOINTS.

ADMIXTURES:
SETTING RETARDERS (CONSTRUCTION JOINTS).
WATERPROOFING ADMIXTURE; TO ACHEIVE WATERTIGHT CONCRETE STRUCTURES.
THE USE OF CHLORINE BASED ADMIXTURES IS NOT ALLOWED.
ALL ADMIXTURES SHALL BE APPROVED BY THE ENGINEER.

CONCRETE COVER:
40 mm COVER OVER REINFORCEMENT, INCLUDING STIRRUPS AND DISTRIBUTION BARS FOR RESERVOIR FLOOR SLABS AND WALLS, AND 30 mm ELSEWHERE.

BARS OVERLAPPING:
MINIMUM LENGTH OF OVERLAP WILL BE 50 TIMES THE DIAMETER OF THE BARS.
LAPS OF ADJACENT PARALLEL REINFORCEMENT BARS SHALL BE STAGGERED.
FABRIC REIFORCEMENT SHALL BE LAPPED AT LEAST 40 DIAMETERS OR TWO SQUARES, WHICHEVER IS THE GREATER.
ALL LAPS OF BARS ARE TO BE TIED TIGHTLY WITH SIX LAPS OF 1.5 mm ANNEALED IRON WIRE AT INTERVALS OF TEN DIAMETERS OF THE BARS.

BENDING:
ø > 12mm MECHANICAL.
ø ≤ 12mm MANUAL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

FORMWORK:
FAIR FACE CONCRETE FORMWORK SHALL BE EMPLOYED FOR ALL EXPOSED CONCRETE FACES OR AS DIRECTED BY THE ENGINEER.
EMBEDDED WIRE TIES FOR HOLDING FORMS WILL NOT BE PERMITTED IN CONCRETE WALLS WHICH ARE TO COME INTO CONTACT WITH LIQUIDS.
WIRE TIES MAY BE USED FOR CONCRETE WALLS TO BE PLASTERED AND SHALL BE CUT BACK AT LEAST 15 mm FROM THE FACE OF THE CONCRETE.
HOLES LEFT IN THE CONCRETE SURFACES AFTER CUTTING BACK OF WIRE TIES AND REMOVAL OF FASTENERS OR HOLDING RODS OR SLEEVES, AND THE INSIDES OF SLEEVES WHERE SLEEVES ARE USED, SHALL BE COMPLETELY FILLED WITH AN APPROVED NON–SHRINKING MORTAR.

COVER WATERPROOFING CONSISTING OF A WATERPROOFING MEMBRANE AND ITS PROTECTION

WATERPROOFING	– SBS/OR/APP $t_{total} \geq$ 4mm WITH MINERAL PROTECTION. – SEMI–ADHERENCE OR TOTAL ADHERENCE APPLICATION.
PROTECTION	– IN FACTORY MINERAL AUTOPROTECTION.

REMARKS:
* ALL THE DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
* DO NOT SCALE FROM THE DRAWINGS; DIMENSIONS SHALL BE INDICATED OR COMPUTED FROM THE DRAWINGS.
* FLOOR SLAB INVERT LEVEL ±0.00: SEE LAYOUT DARWINGS.
* DOUBLE THREADED WATERPROOF CONNECTION SLEEVES SHALL BE USED FOR RESERVOIR FORMWORKS TIE–RODS.
* HOLES MADE BY THE TIE–RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* PROVIDE PERFORATED DRAIN PIPES, ø4" IN THE GRAVEL PROTECTION LAYER.

BOTTOM STEEL REINFORCEMENT
TOP STEEL REINFORCEMENT

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

CIRCULAR VALVE CHAMBER
INSIDE DIAMETER VARIABLE BETWEEN 300 AND 500 cm
INSIDE HEIGHT VARIABLE BETWEEN 300 AND 500 cm
DEPENDING ON GROUND LEVEL

STRUCTURAL DETAILS
FORMWORK
REINFORCEMENT

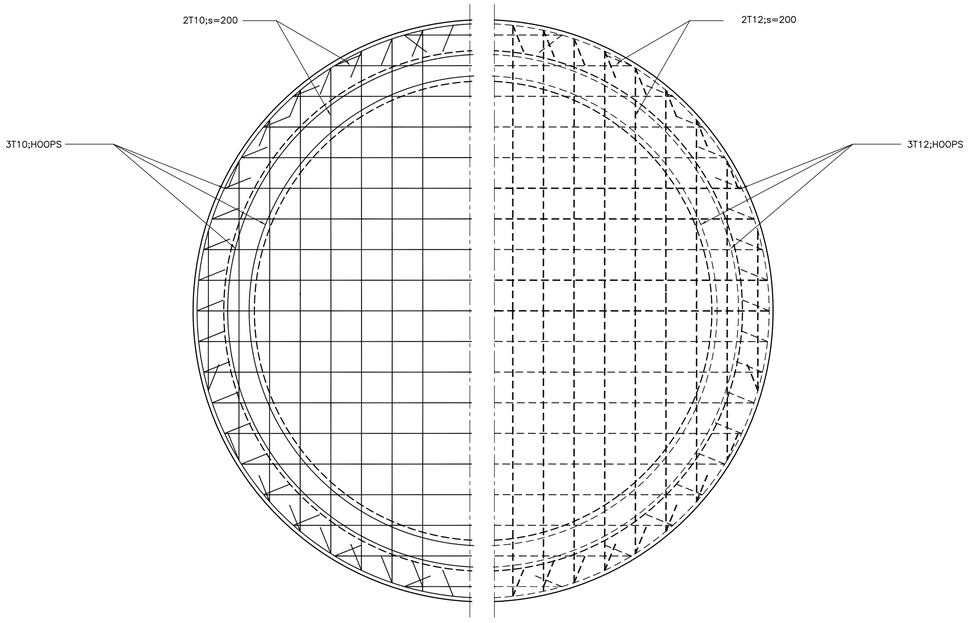
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SV-01	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:50 - 1:20 - 1:10	1/2	462-05SV-01P01

ORIGINAL DRAWING SIZE A1

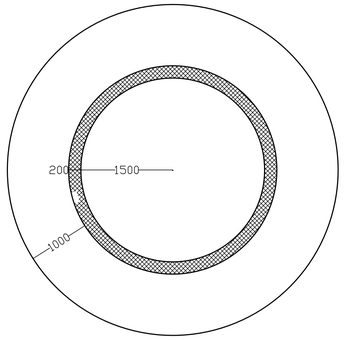
MAT REINFORCEMENT

SCALE 1:20



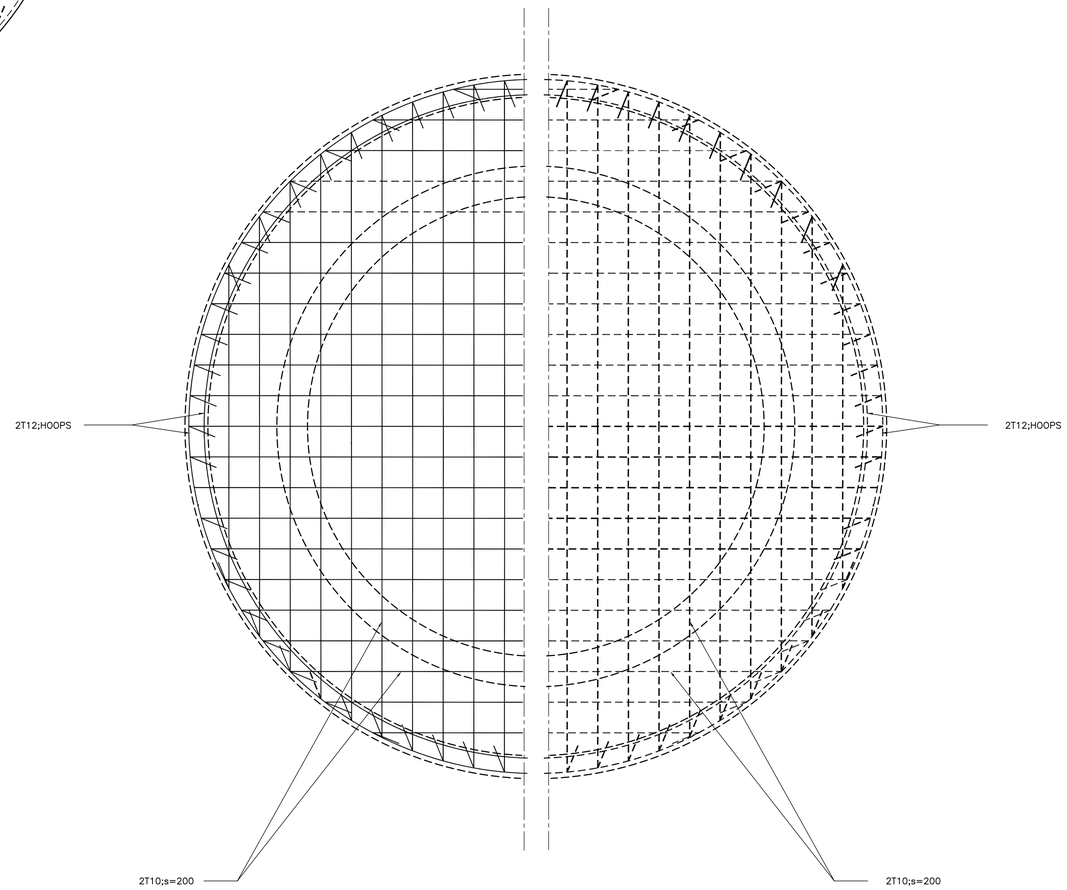
HORIZONTAL SECTION

SCALE 1:50



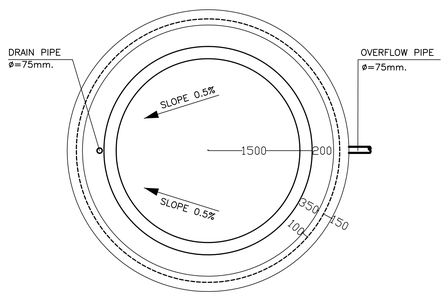
COVER SLAB REINFORCEMENT

SCALE 1:20



COVER SLAB FORMWORK

SCALE 1:50



NOTES:

REINFORCED CONCRETE:
REINFORCED CONCRETE SHALL BE MADE OF ORDINARY PORTLAND CEMENT AND SHALL BE OF GRADE C30.
THE MINIMUM CEMENT CONTENT IN CONCRETE FOR WALLS, FLOOR SLABS AND RESERVOIR DOME SHALL BE 350 KG PER 1 M3

LEAN CONCRETE/CYCLOPEAN CONCRETE:
LEAN AND CYCLOPEAN CONCRETES SHALL BE MADE OF ORDINARY PORTLAND CEMENT, AND SHALL BE OF GRADE C20.
THE MINIMUM CEMENT CONTENT SHALL BE 250 KG PER 1 M3

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy= 400 N/mm2.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy= 215 N/mm2.

CONCRETE STRENGTH:
SEVERE CONTROL.
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS:
– ON A CUBE SAMPLES (DIMENSIONS= 150 x 150 x 150 mm): 37.5 N/mm2
– ON A CYLINDER SAMPLES (DIAMETER= 160mm, HEIGHT= 320mm): 30 N/mm2
CONCRETE TENSILE STRENGTH AT 28 DAYS : 2.4 N/mm2
MAXIMUM FREE DROP HEIGHT: 1500 mm

CONSTRUCTION JOINTS:
CONSTRUCTION JOINTS SHALL BE FORMED ONLY IN THE POSITIONS SHOWN ON THE DRAWINGS OR AS INDICATED BY THE ENGINEER AND CONCRETING SHALL BE CARRIED OUT CONTINOUSLY BETWEEN AND UP TO JOINTS.
WATER–STOP JOINTS SHALL BE INCOPORATED IN CONSTRUCTION JOINTS FOR RETAINING AQUEOUS LIQUIDS IN PROPERLY CONSTRUCTED JOINTS.

ADMIXTURES:
SETTING RETARDERS (CONSTRUCTION JOINTS).
WATERPROOFING ADMIXTURE; TO ACHEIVE WATERTIGHT CONCRETE STRUCTURES.
THE USE OF CHLORINE BASED ADMIXTURES IS NOT ALLOWED.
ALL ADMIXTURES SHALL BE APPROVED BY THE ENGINEER.

CONCRETE COVER:
40 mm COVER OVER REINFORCEMENT, INCLUDING STIRRUPS AND DISTRIBUTION BARS FOR RESERVOIR FLOOR SLABS AND WALLS, AND 30 mm ELSEWHERE.

BARS OVERLAPPING:
MINIMUM LENGTH OF OVERLAP WILL BE 50 TIMES THE DIAMETER OF THE BARS.
LAPS OF ADJACENT PARALLEL REINFORCEMENT BARS SHALL BE STAGGERED.
FABRIC REIFORCEMENT SHALL BE LAPPED AT LEAST 40 DIAMETERS OR TWO SQUARES, WHICHEVER IS THE GREATER.
ALL LAPS OF BARS ARE TO BE TIED TIGHTLY WITH SIX LAPS OF 1.5 mm ANNEALED IRON WIRE AT INTERVALS OF TEN DIAMETERS OF THE BARS.

BENDING:
ø > 12mm MECHANICAL.
ø ≤ 12mm MANUAL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

FORMWORK:
FAIR FACE CONCRETE FORMWORK SHALL BE EMPLOYED FOR ALL EXPOSED CONCRETE FACES OR AS DIRECTED BY THE ENGINEER.
EMBEDDED WIRE TIES FOR HOLDING FORMS WILL NOT BE PERMITTED IN CONCRETE WALLS WHICH ARE TO COME INTO CONTACT WITH LIQUIDS.
WIRE TIES MAY BE USED FOR CONCRETE WALLS TO BE PLASTERED AND SHALL BE CUT BACK AT LEAST 15 mm FROM THE FACE OF THE CONCRETE.
HOLES LEFT IN THE CONCRETE SURFACES AFTER CUTTING BACK OF WIRE TIES AND REMOVAL OF FASTENERS OR HOLDING RODS OR SLEEVES, AND THE INSIDES OF SLEEVES WHERE SLEEVES ARE USED, SHALL BE COMPLETELY FILLED WITH AN APPROVED NON–SHRINKING MORTAR.

COVER WATERPROOFING CONSISTING OF A WATERPROOFING MEMBRANE AND ITS PROTECTION

WATERPROOFING	– SBS/OR/APP $t_{total} \geq$ 4mm WITH MINERAL PROTECTION. – SEMI–ADHERENCE OR TOTAL ADHERENCE APPLICATION.
PROTECTION	– IN FACTORY MINERAL AUTOPROTECTION.

REMARKS:
* ALL THE DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
* DO NOT SCALE FROM THE DRAWINGS; DIMENSIONS SHALL BE INDICATED OR COMPUTED FROM THE DRAWINGS.
* FLOOR SLAB INVERT LEVEL ±0.00: SEE LAYOUT DARWINGS.
* DOUBLE THREADED WATERPROOF CONNECTION SLEEVES SHALL BE USED FOR RESERVOIR FORMWORKS TIE–RODS.
* HOLES MADE BY THE TIE–RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* PROVIDE PERFORATED DRAIN PIPES, ø4" IN THE GRAVEL PROTECTION LAYER.

BOTTOM STEEL REINFORCEMENT
TOP STEEL REINFORCEMENT

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REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

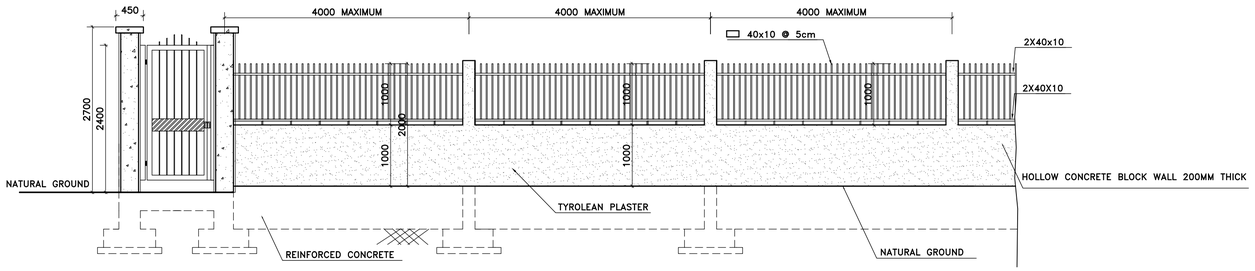
CIRCULAR VALVE CHAMBER
INSIDE DIAMETER VARIABLE BETWEEN 300 AND 500 cm
INSIDE HEIGHT VARIABLE BETWEEN 300 AND 500 cm
DEPENDING ON GROUND LEVEL

STRUCTURAL DETAILS
FORMWORK
REINFORCEMENT

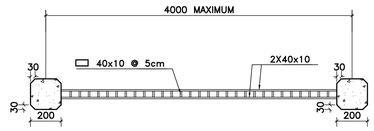
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SV-01	Z. SABA	S. SAWAYA	T. ACHKAR

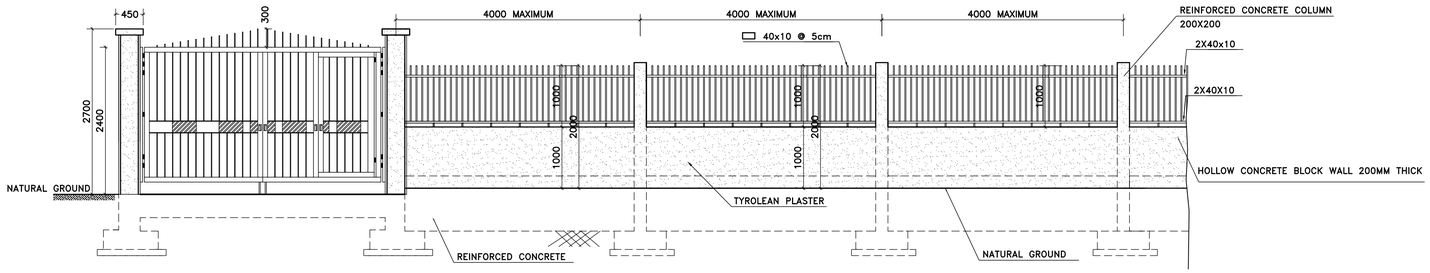
DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:50 - 1:20	2/2	462-05SV-01P02

ORIGINAL DRAWING SIZE A1

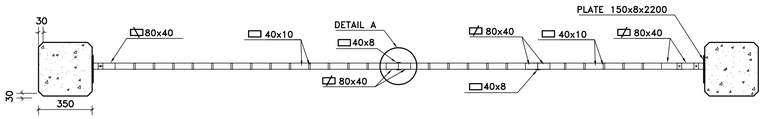


GATE 1.2 m (ELEVATION)
SCALE 1:50

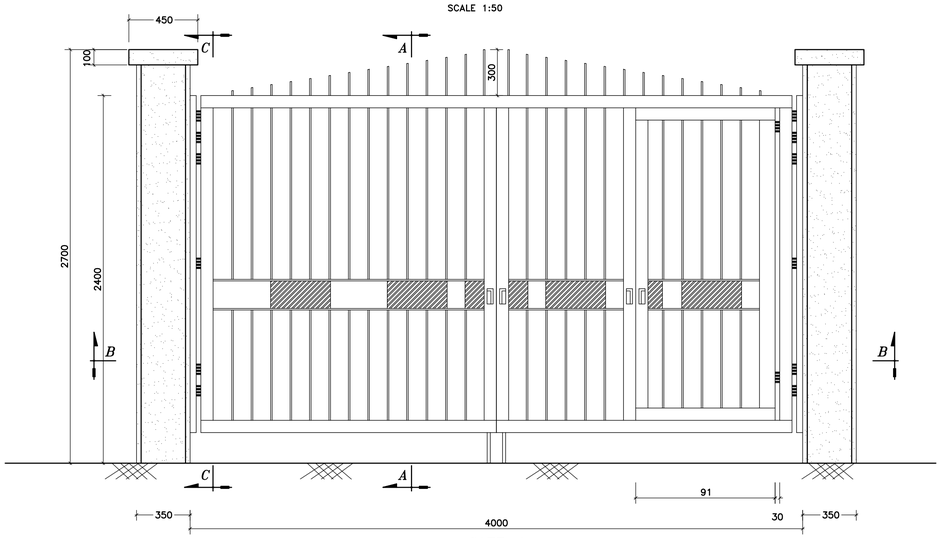




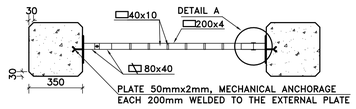
GATE 4 m (ELEVATION)
SCALE 1:50



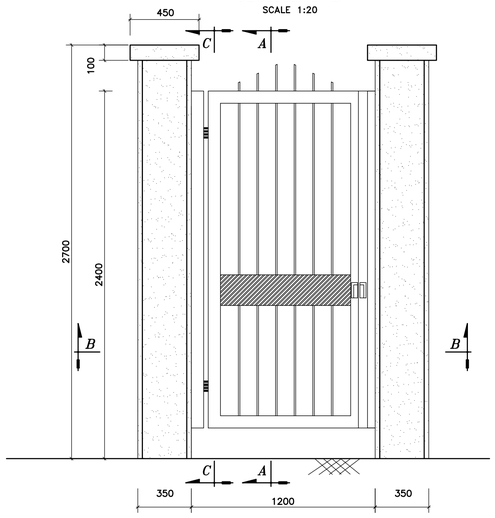
SECTION B–B
SCALE 1:50



GATE 4 m
ELEVATION
SCALE 1:20



SECTION B–B
SCALE 1:20



GATE 1.2 m
ELEVATION
SCALE 1:20

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

FENCE AND TYPICAL GATE 4m AND 1.2m	ELEVATIONS SECTIONS AND DETAILS

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SF-01	Z. SABA	S. SAWAYA	W. SEIFEDDINE

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:50 - 1:20	1/2	462-05SF-01P01

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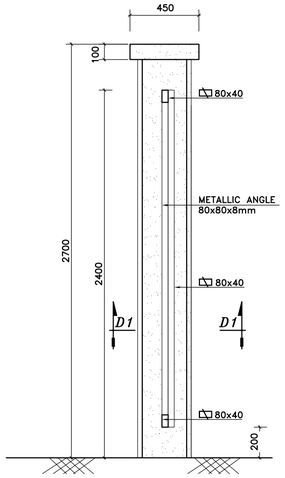
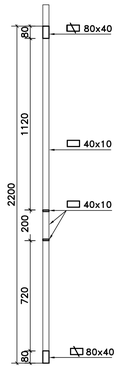
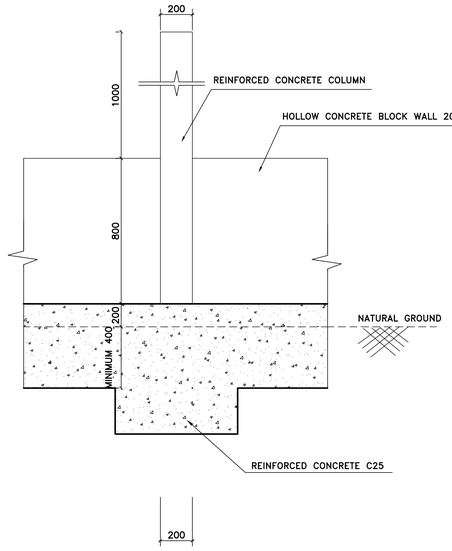


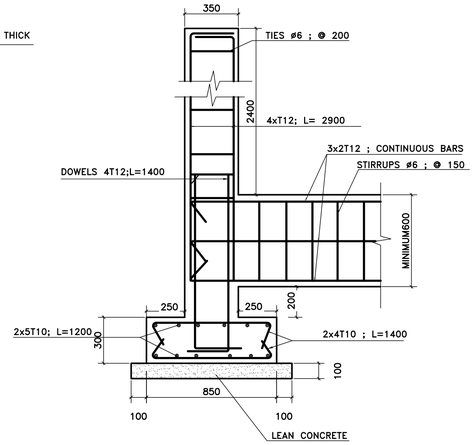
SECTION C–C
SCALE 1:20



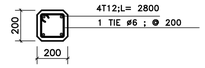
SECTION A–A
SCALE 1:20



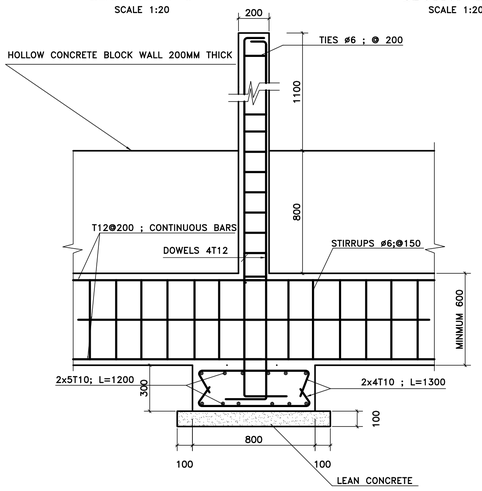
TYPICAL FENCE COLUMN
SCALE 1:20



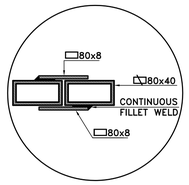
REINFORCEMENT OF TYPICAL ACCESS GATE COLUMN AND FOOTING
SCALE 1:20



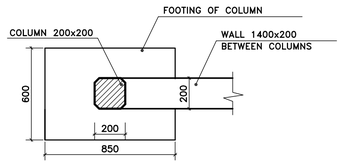
HORIZONTAL SECTION OF COLUMN
SCALE 1:20



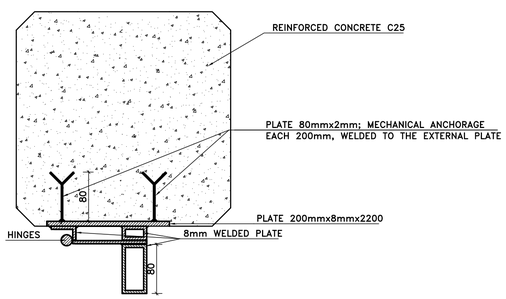
REINFORCEMENT OF TYPICAL COLUMN AND FOOTING
SCALE 1:20



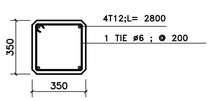
DETAIL A
SCALE 1:5



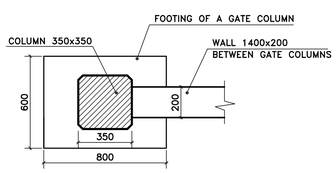
FOOTING
SCALE 1:20



SECTION D–D
SCALE 1:5



HORIZONTAL SECTION OF GATE COLUMN
SCALE 1:20



FOOTING
SCALE 1:20

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REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

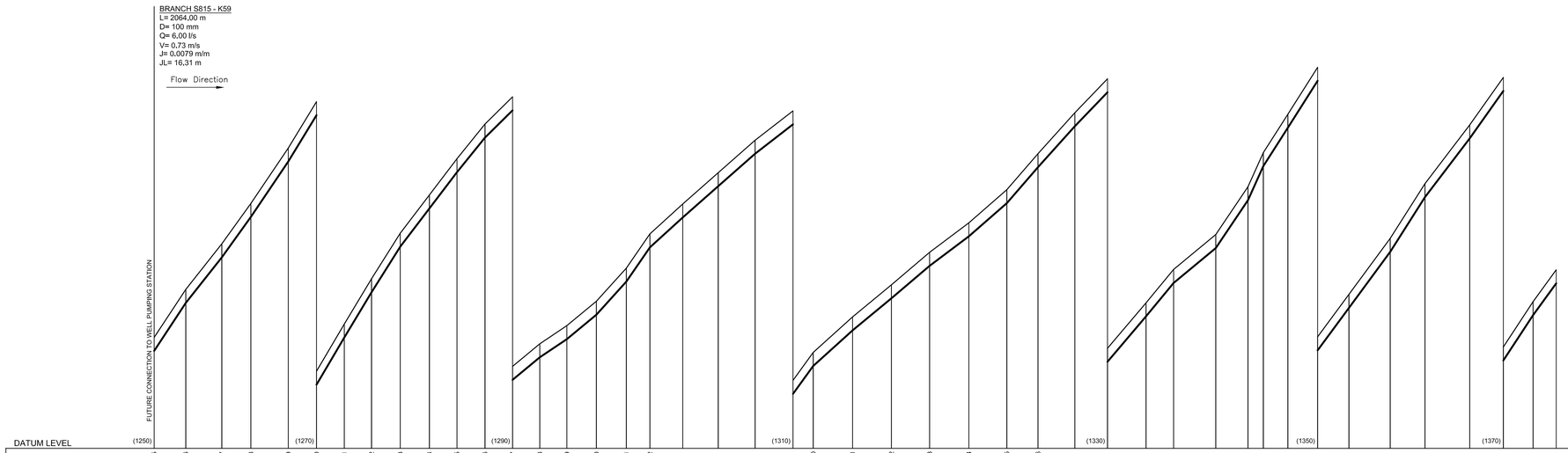
CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

FENCE AND TYPICAL GATE 4m AND 1.2m	ELEVATIONS SECTIONS AND DETAILS

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05SF-01	Z. SABA	S. SAWAYA	W. SEIFEDDINE

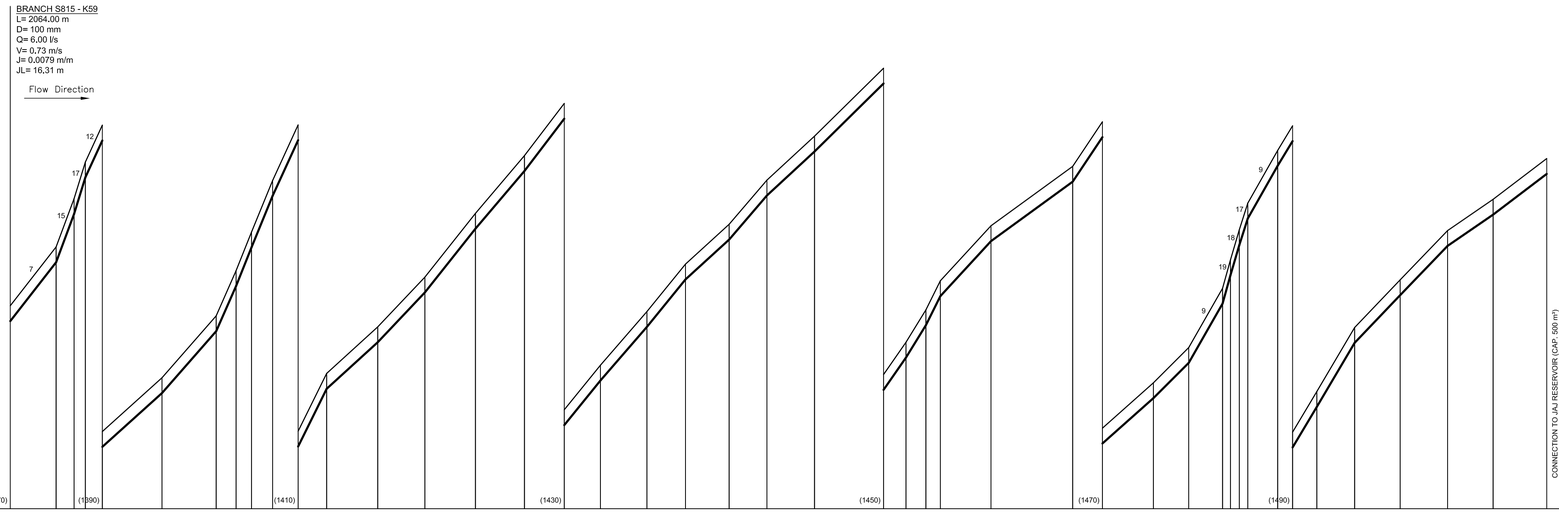
DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2 - 1:5 - 1:20	2/2	462-05SF-01P02

ORIGINAL DRAWING SIZE A1


BRANCH S815 - K59
L= 2064,00 m
D= 100 mm
Q= 6,00 l/s
V= 0,73 m/s
J= 0,0079 m/m
JL= 16,31 m
Flow Direction
FUTURE CONNECTION TO WELL PUMPING STATION
(1250)
(1270)
(1290)
(1310)
(1330)
(1350)
(1370)

| | | |

BRANCH S815 - K59
L= 2064,00 m
D= 100 mm
Q= 6,00 l/s
V= 0,73 m/s
J= 0,0079 m/m
JL= 16,31 m



| | | |



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MINISTRY OF ENERGY AND WATER

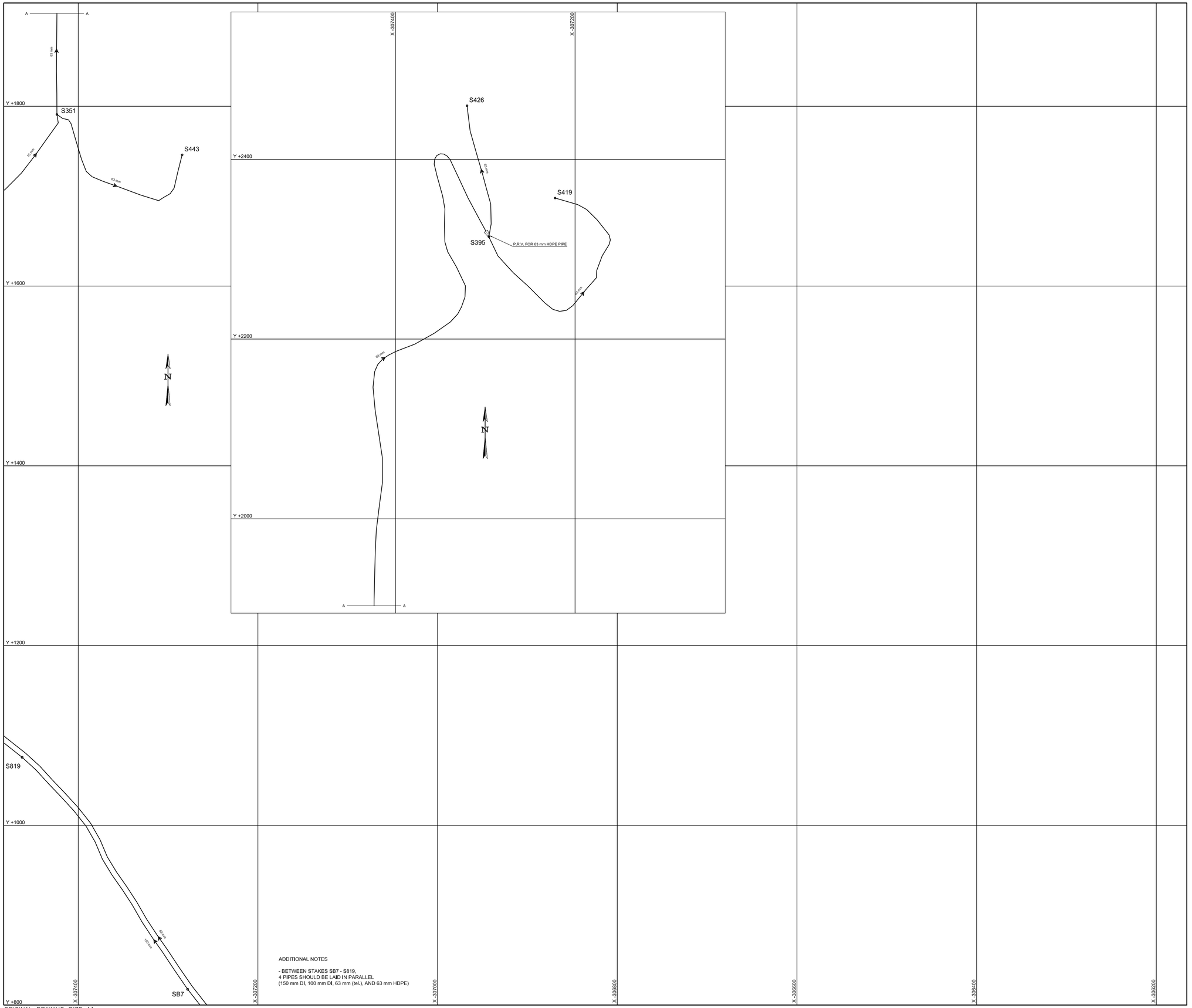
CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK	SCHEMATIC PLAN

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PA	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	1/4	462-05DS-01PA01

ORIGINAL DRAWING SIZE A1



ADDITIONAL NOTES

- BETWEEN STAKES SB7 - S819,
4 PIPES SHOULD BE LAID IN PARALLEL
(150 mm DI, 100 mm DI, 63 mm (tel.), AND 63 mm HDPE)

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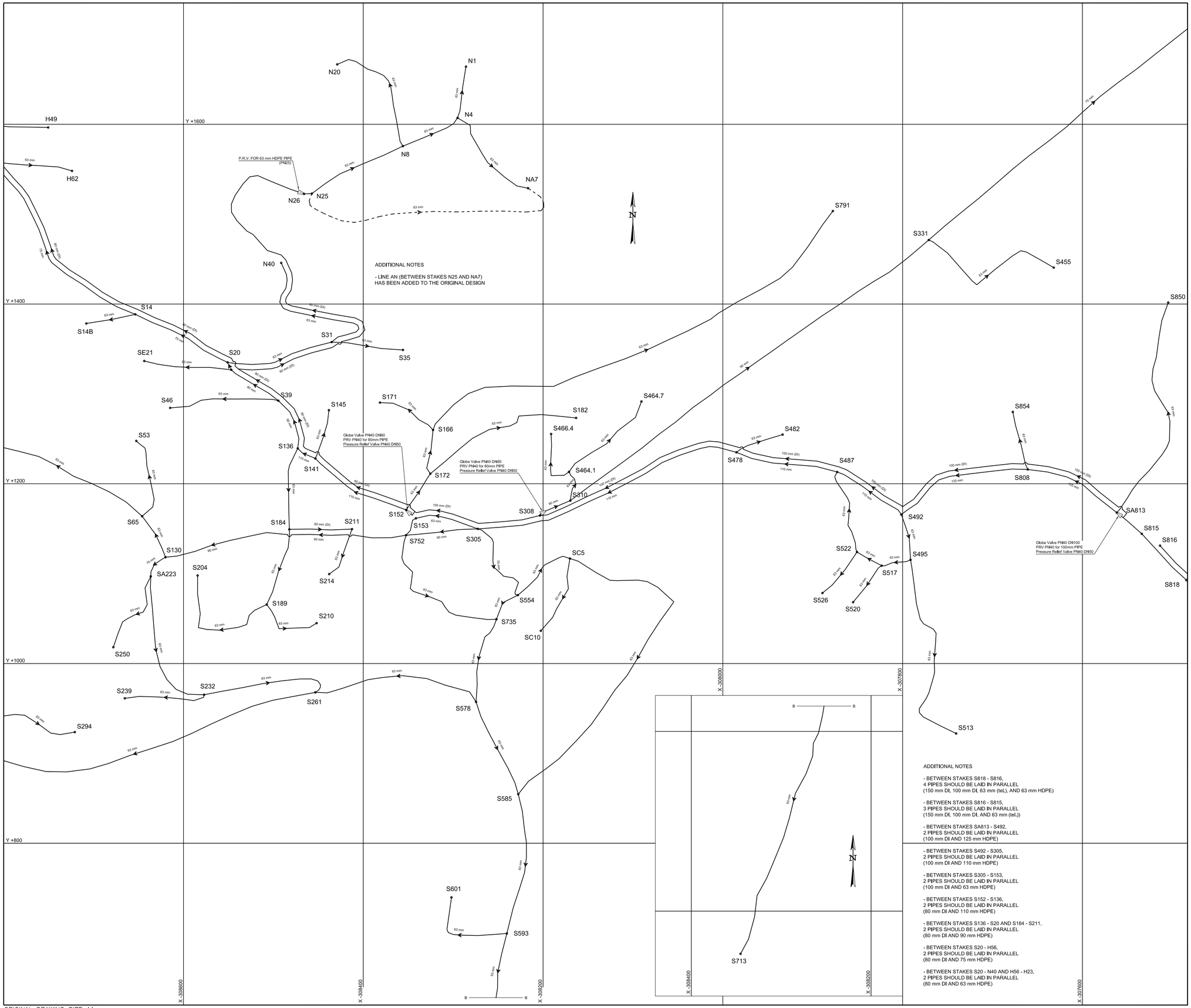
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK	SCHEMATIC PLAN

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PA	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	2/4	462-05DS-01PA02

ORIGINAL DRAWING SIZE A1



Rev.	Date	Dsgn.	Drwn.	Chk'd	Appr'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

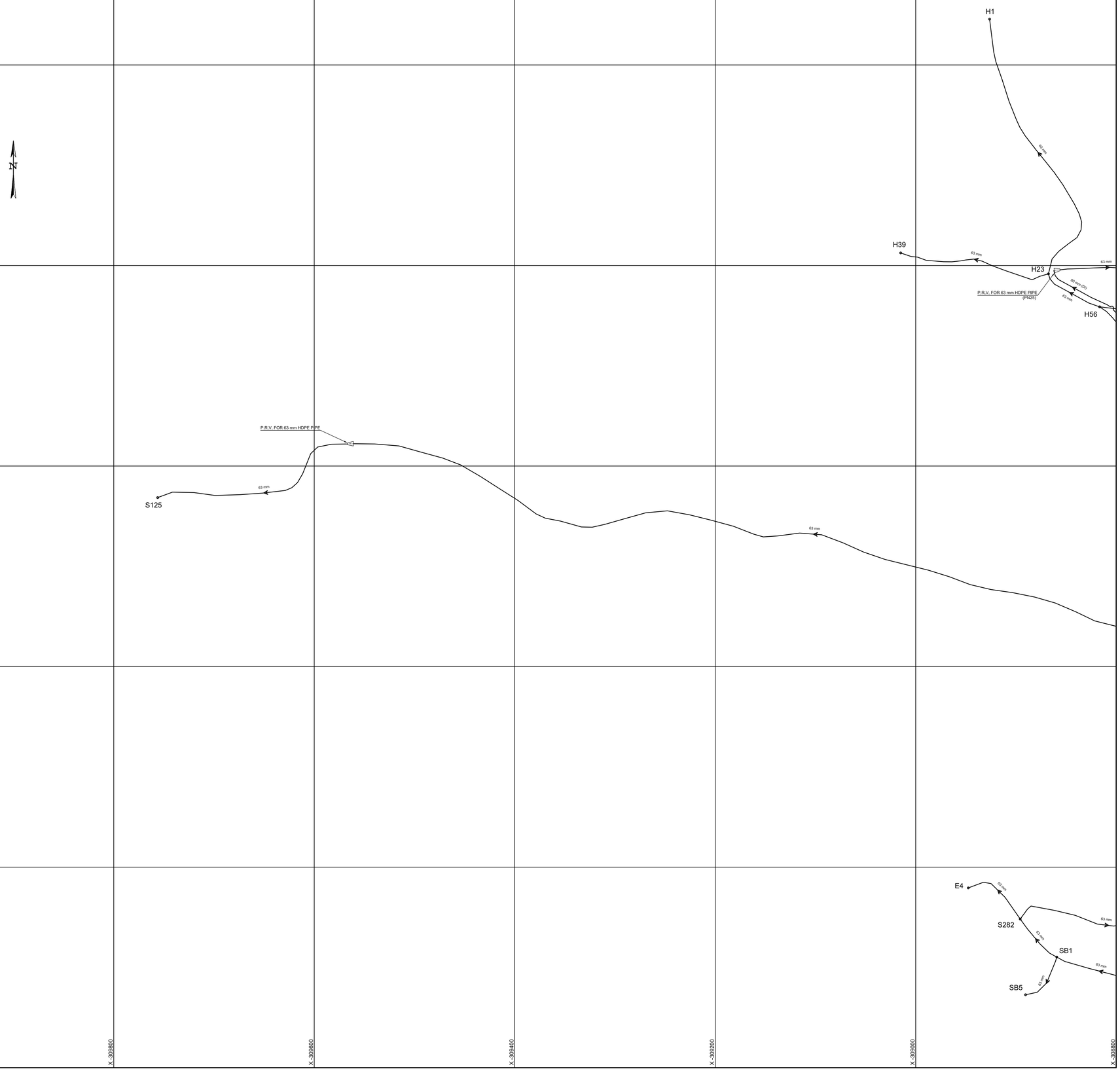
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK	SCHEMATIC PLAN

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PA	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	3/4	462-05DS-01PA03

ORIGINAL DRAWING SIZE A1



ORIGINAL DRAWING SIZE A1

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON

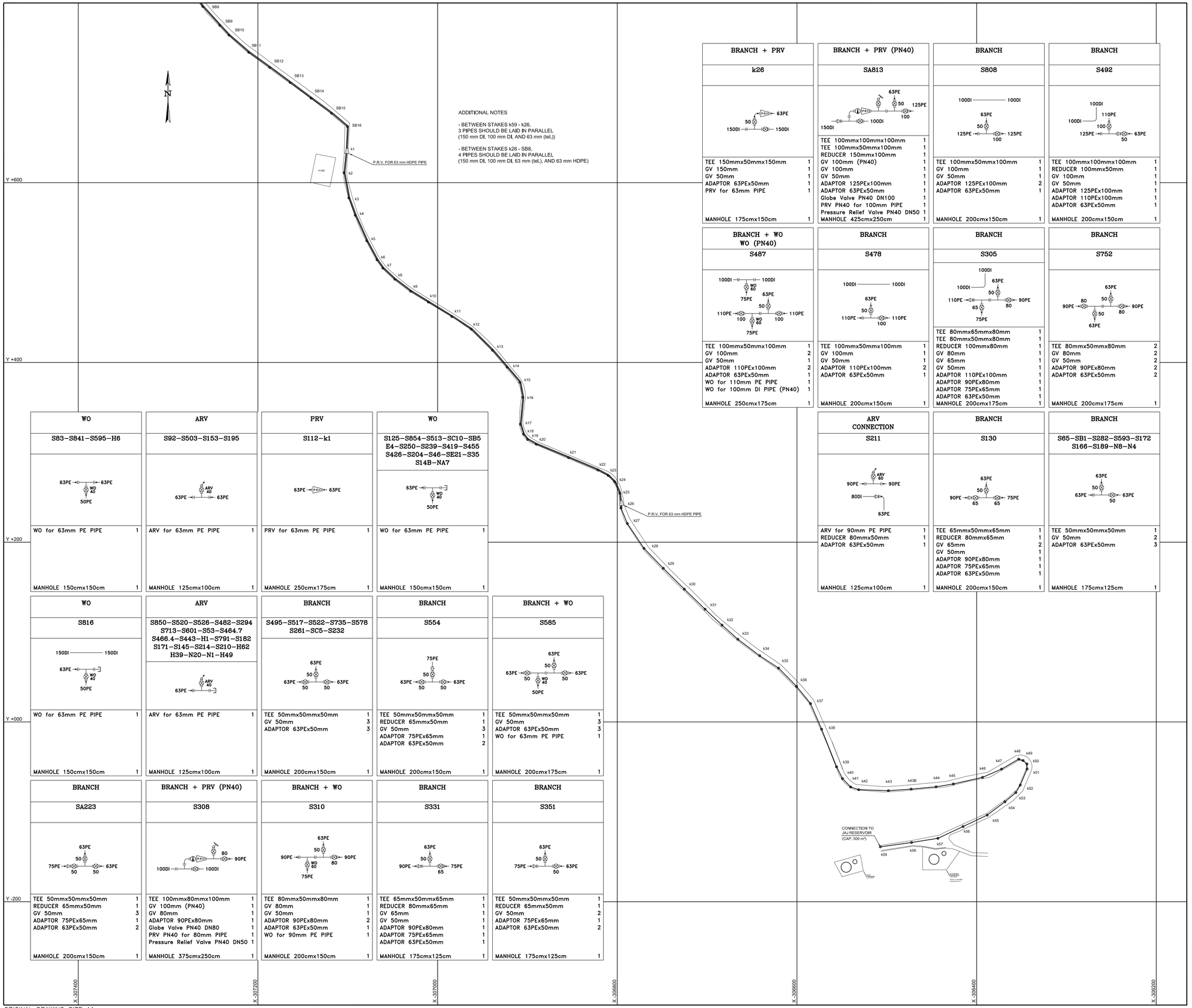
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK	SCHEMATIC PLAN

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PA	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	4/4	462-05DS-01PA04



ADDITIONAL NOTES

- BETWEEN STAKES k59 - k26,
3 PIPES SHOULD BE LAID IN PARALLEL
(150 mm DI, 100 mm DI, AND 63 mm (tel,))

- BETWEEN STAKES k26 - SB8,
4 PIPES SHOULD BE LAID IN PARALLEL
(150 mm DI, 100 mm DI, 63 mm (tel,), AND 63 mm HDPE)

BRANCH + PRV	
k26	
TEE 150mmx50mmx150mm	1
GV 150mm	1
GV 50mm	1
ADAPTOR 63PEx50mm	1
PRV for 63mm PIPE	1
MANHOLE 175cmx150cm	1

BRANCH + PRV (PN40)	
SA813	
TEE 100mmx100mmx100mm	1
TEE 100mmx50mmx100mm	1
REDUCER 150mmx100mm	1
GV 100mm (PN40)	1
GV 100mm	1
GV 50mm	1
ADAPTOR 125PEx100mm	1
ADAPTOR 63PEx50mm	1
Globe Valve PN40 DN100	1
PRV PN40 for 100mm PIPE	1
Pressure Relief Valve PN40 DN50	1
MANHOLE 425cmx250cm	1

BRANCH	
S808	
TEE 100mmx50mmx100mm	1
GV 100mm	1
GV 50mm	1
ADAPTOR 125PEx100mm	2
ADAPTOR 63PEx50mm	1
MANHOLE 200cmx150cm	1

BRANCH	
S492	
TEE 100mmx100mmx100mm	1
REDUCER 100mmx50mm	1
GV 100mm	1
GV 50mm	1
ADAPTOR 125PEx100mm	1
ADAPTOR 110PEx100mm	1
ADAPTOR 63PEx50mm	1
MANHOLE 200cmx150cm	1

BRANCH + WO WO (PN40)	
S487	
TEE 100mmx50mmx100mm	1
GV 100mm	2
GV 50mm	1
ADAPTOR 110PEx100mm	2
ADAPTOR 63PEx50mm	1
WO for 110mm PE PIPE	1
WO for 100mm DI PIPE (PN40)	1
MANHOLE 250cmx175cm	1

BRANCH	
S478	
TEE 100mmx50mmx100mm	1
GV 100mm	1
GV 50mm	1
ADAPTOR 110PEx100mm	2
ADAPTOR 63PEx50mm	1
MANHOLE 200cmx150cm	1

BRANCH	
S305	
TEE 80mmx65mmx80mm	1
TEE 80mmx50mmx80mm	1
REDUCER 100mmx80mm	1
GV 80mm	1
GV 65mm	1
GV 50mm	1
ADAPTOR 110PEx100mm	1
ADAPTOR 90PEx80mm	1
ADAPTOR 75PEx65mm	1
ADAPTOR 63PEx50mm	1
MANHOLE 200cmx175cm	1

BRANCH	
S752	
TEE 80mmx50mmx80mm	2
GV 80mm	2
GV 50mm	2
ADAPTOR 90PEx80mm	2
ADAPTOR 63PEx50mm	2
MANHOLE 200cmx175cm	1

WO	
S83–S841–S595–H6	
WO for 63mm PE PIPE	1
MANHOLE 150cmx150cm	1

ARV	
S92–S503–S153–S195	
ARV for 63mm PE PIPE	1
MANHOLE 125cmx100cm	1

PRV	
S112–k1	
PRV for 63mm PE PIPE	1
MANHOLE 250cmx175cm	1

WO	
S125–S854–S513–SC10–SB5 E4–S250–S239–S419–S455 S426–S204–S46–SE21–S35 S14B–NA7	
WO for 63mm PE PIPE	1
MANHOLE 150cmx150cm	1

ARV CONNECTION	
S211	
ARV for 90mm PE PIPE	1
REDUCER 80mmx50mm	1
ADAPTOR 63PEx50mm	1
MANHOLE 125cmx100cm	1

BRANCH	
S130	
TEE 65mmx50mmx65mm	1
REDUCER 80mmx65mm	1
GV 65mm	2
GV 50mm	1
ADAPTOR 90PEx80mm	1
ADAPTOR 75PEx65mm	1
ADAPTOR 63PEx50mm	1
MANHOLE 200cmx150cm	1

BRANCH	
S65–SB1–S282–S593–S172 S166–S189–N8–N4	
TEE 50mmx50mmx50mm	1
GV 50mm	2
ADAPTOR 63PEx50mm	3
MANHOLE 175cmx125cm	1

WO	
S816	
WO for 63mm PE PIPE	1
MANHOLE 150cmx150cm	1

ARV	
S850–S520–S526–S482–S294 S713–S601–S53–S464.7 S466.4–S443–H1–S791–S182 S171–S145–S214–S210–H62 H39–N20–N1–H49	
ARV for 63mm PE PIPE	1
MANHOLE 125cmx100cm	1

BRANCH	
S495–S517–S522–S735–S578 S261–SC5–S232	
TEE 50mmx50mmx50mm	1
GV 50mm	3
ADAPTOR 63PEx50mm	3
MANHOLE 200cmx150cm	1

BRANCH	
S554	
TEE 50mmx50mmx50mm	1
REDUCER 65mmx50mm	1
GV 50mm	3
ADAPTOR 75PEx65mm	1
ADAPTOR 63PEx50mm	2
MANHOLE 200cmx150cm	1

BRANCH + WO	
S585	
TEE 50mmx50mmx50mm	1
GV 50mm	3
ADAPTOR 63PEx50mm	3
WO for 63mm PE PIPE	1
MANHOLE 200cmx175cm	1

BRANCH	
SA223	
TEE 50mmx50mmx50mm	1
REDUCER 65mmx50mm	1
GV 50mm	3
ADAPTOR 75PEx65mm	1
ADAPTOR 63PEx50mm	2
MANHOLE 200cmx150cm	1

BRANCH + PRV (PN40)	
S308	
TEE 100mmx80mmx100mm	1
GV 100mm (PN40)	1
GV 80mm	1
ADAPTOR 90PEx80mm	1
Globe Valve PN40 DN80	1
PRV PN40 for 80mm PIPE	1
Pressure Relief Valve PN40 DN50	1
MANHOLE 375cmx250cm	1

BRANCH + WO	
S310	
TEE 80mmx50mmx80mm	1
GV 80mm	1
GV 50mm	1
ADAPTOR 90PEx80mm	2
ADAPTOR 63PEx50mm	1
WO for 90mm PE PIPE	1
MANHOLE 200cmx150cm	1

BRANCH	
S331	
TEE 65mmx50mmx65mm	1
REDUCER 80mmx65mm	1
GV 65mm	1
GV 50mm	1
ADAPTOR 90PEx80mm	1
ADAPTOR 75PEx65mm	1
ADAPTOR 63PEx50mm	1
MANHOLE 175cmx125cm	1

BRANCH	
S351	
TEE 50mmx50mmx50mm	1
REDUCER 65mmx50mm	1
GV 50mm	2
ADAPTOR 75PEx65mm	1
ADAPTOR 63PEx50mm	2
MANHOLE 175cmx125cm	1

HYDRAULIC LEGEND

PIPELINE		BEND 1/8	C1/8
FLOW DIRECTION		A.V (AIR VALVE)	
VALVE		W.O (WASHOUT)	
TEE		FLANGED ADAPTER	
REDUCER		END CAPS	
PRESSURE REGULATING VALVE	P.R.V		
D.J.	DISMANTLING JOINT		

TOPOGRAPHICAL LEGEND

A123	BUILDING / BUILDING CODE REFER TO BUILDING TABLE	MANHOLE SEWER	
	PAVED ROAD	MANHOLE WATER	
	CONCRETE ROAD	MANHOLE TELEPHONE	
	TRACK	MH	MANHOLE NOT IDENTIFIED
	REFERENCE LINE		LIGHTING POLE
channel	CHANNEL	TP	TELEPHONE POLE
	TERRACE		TRIANGULATION STATION
	FENCE	EL.S.S.	ELECTRIC SUB STATION
	STREAM/RIVER		ELECTRIC POLE/TELEGRAPH POLE
		Num	STAKE NUMBER STAKE POINT
	CULVERT/BRIDGE	1160.12	SPOT HEIGHT
Spr	SPRING	1262	PLOT No
	WELL		BOUNDARY
	DECIDUOUS/PINE TREE		CIRCONSCRIPTION BOUNDARY
	ROCKS		
	DownHill High-Hill		

NOTES

- ALL ALTITUDES ARE TIED TO THE NATIONAL ELEVATION OF LEBANON

- HEAD LOSSES HAVE BEEN CALCULATED TO THE COLEBROOK FORMULA WITH AN ABSOLUTE ROUGHNESS K=0,4 mm FOR DUCTILE IRON PIPES AND K=0,2 mm FOR HDPE PIPES

- FOR PIPELINE ANCHORS AND SUPPORT DETAILS REFER TO STANDARD DWG Nb 462-05ST14

- FOR PIPELINE TRENCH DETAILS REFER TO STANDARD DWG Nb 462-05ST05 AND DWG Nb 462-05ST06

- FOR HORIZONTAL BENDS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST11 AND DWG Nb 462-05ST12

- FOR VERTICAL BENDS AND TAPERS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST13

- FOR CONNECTION TO EXISTING PIPES REFER TO STANDARD DWG Nb 462-05ST09 AND DWG Nb 462-05ST10

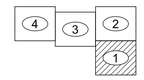
- PIPE MATERIAL: DUCTILE IRON CLASS K9
HDPE PE100 PN16

- ALL PIPE FITTINGS AND ACCESSORIES ARE PN16, UNLESS OTHERWISE SPECIFIED

- ALL PIPES SHOULD BE EXECUTED IN PUBLIC OR EXPROPRIATED ROADS

- BETWEEN STAKES k51 - k48 AND k19 - k17, ANCHOR BLOCKS SHOULD BE INSTALLED

KEY PLAN



Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

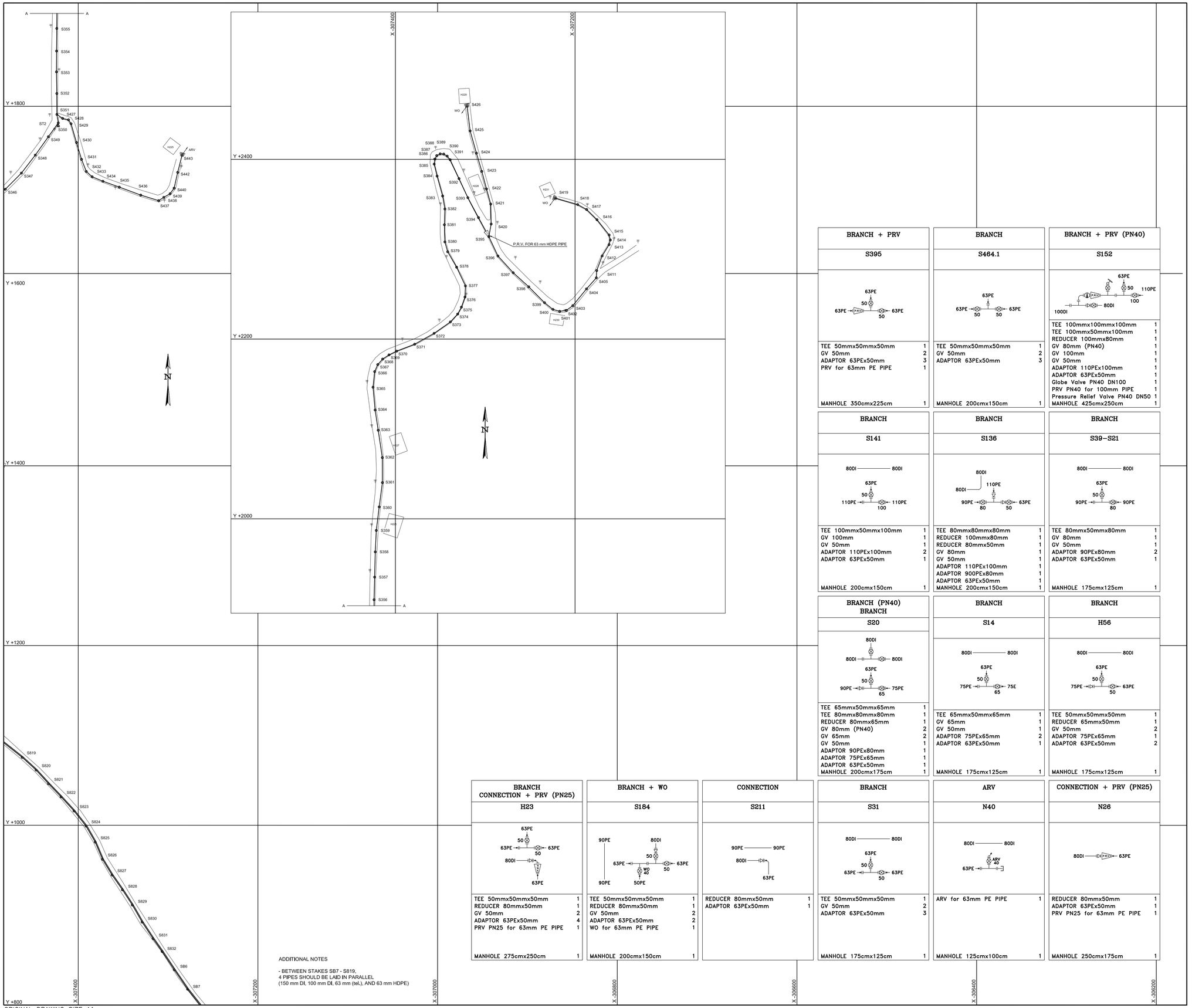
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK	PLAN HYDRAULIC ACCESSORIES

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PL	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	1/4	462-05DS-01PL01

ORIGINAL DRAWING SIZE A1



ADDITIONAL NOTES

- BETWEEN STAKES SB7 - S819,
4 PIPES SHOULD BE LAID IN PARALLEL
(150 mm DI, 100 mm DI, 63 mm (tel.), AND 63 mm HDPE)

BRANCH + PRV

S395

TEE 50mmx50mmx50mm	1
GV 50mm	2
ADAPTOR 63PEx50mm	3
PRV for 63mm PE PIPE	1
MANHOLE 350cmx225cm	1

BRANCH

S464.1

TEE 50mmx50mmx50mm	1
GV 50mm	2
ADAPTOR 63PEx50mm	3
MANHOLE 200cmx150cm	1

BRANCH + PRV (PN40)

S152

TEE 100mmx100mmx100mm	1
TEE 100mmx50mmx100mm	1
REDUCER 100mmx80mm	1
GV 80mm (PN40)	1
GV 100mm	1
GV 50mm	1
ADAPTOR 110PEx100mm	1
ADAPTOR 63PEx50mm	1
Globe Valve PN40 DN100	1
PRV PN40 for 100mm PIPE	1
Pressure Relief Valve PN40 DN50	1
MANHOLE 425cmx250cm	1

BRANCH

S141

TEE 100mmx50mmx100mm	1
GV 100mm	1
GV 50mm	1
ADAPTOR 110PEx100mm	2
ADAPTOR 63PEx50mm	1
MANHOLE 200cmx150cm	1

BRANCH

S136

TEE 80mmx80mmx80mm	1
REDUCER 100mmx80mm	1
REDUCER 80mmx50mm	1
GV 80mm	1
GV 50mm	1
ADAPTOR 110PEx100mm	1
ADAPTOR 90PEx80mm	1
ADAPTOR 63PEx50mm	1
MANHOLE 200cmx150cm	1

BRANCH

S39–S21

TEE 80mmx50mmx80mm	1
GV 80mm	1
GV 50mm	1
ADAPTOR 90PEx80mm	2
ADAPTOR 63PEx50mm	1
MANHOLE 175cmx125cm	1

BRANCH (PN40)
BRANCH

S20

TEE 65mmx50mmx65mm	1
TEE 80mmx80mmx80mm	1
REDUCER 80mmx65mm	1
GV 80mm (PN40)	2
GV 65mm	2
GV 50mm	1
ADAPTOR 90PEx80mm	1
ADAPTOR 75PEx65mm	1
ADAPTOR 63PEx50mm	1
MANHOLE 200cmx175cm	1

BRANCH

S14

TEE 65mmx50mmx65mm	1
GV 65mm	1
GV 50mm	1
ADAPTOR 75PEx65mm	2
ADAPTOR 63PEx50mm	1
MANHOLE 175cmx125cm	1

BRANCH

H56

TEE 50mmx50mmx50mm	1
REDUCER 65mmx50mm	1
GV 50mm	2
ADAPTOR 75PEx65mm	1
ADAPTOR 63PEx50mm	2
MANHOLE 175cmx125cm	1

BRANCH
CONNECTION + PRV (PN25)

H23

TEE 50mmx50mmx50mm	1
REDUCER 80mmx50mm	1
GV 50mm	2
ADAPTOR 63PEx50mm	4
PRV PN25 for 63mm PE PIPE	1
MANHOLE 275cmx250cm	1

BRANCH + WO

S184

TEE 50mmx50mmx50mm	1
REDUCER 80mmx50mm	1
GV 50mm	2
ADAPTOR 63PEx50mm	2
WO for 63mm PE PIPE	1
MANHOLE 200cmx150cm	1

CONNECTION

S211

REDUCER 80mmx50mm	1
ADAPTOR 63PEx50mm	1

BRANCH

S31

TEE 50mmx50mmx50mm	1
GV 50mm	2
ADAPTOR 63PEx50mm	3
MANHOLE 175cmx125cm	1

ARV

N40

ARV for 63mm PE PIPE	1
MANHOLE 125cmx100cm	1

CONNECTION + PRV (PN25)

N26

REDUCER 80mmx50mm	1
ADAPTOR 63PEx50mm	1
PRV PN25 for 63mm PE PIPE	1
MANHOLE 250cmx175cm	1

HYDRAULIC LEGEND

PIPELINE		BEND 1/8	C1/8
FLOW DIRECTION		A.V (AIR VALVE)	
VALVE		W.O (WASHOUT)	
TEE		FLANGED ADAPTER	
REDUCER		END CAPS	
PRESSURE REGULATING VALVE	P.R.V		
D.J.	DISMANTLING JOINT		

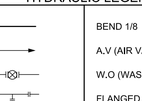
TOPOGRAPHICAL LEGEND

A123	BUILDING / BUILDING CODE REFER TO BUILDING TABLE		MANHOLE SEWER
	PAVED ROAD		MANHOLE WATER
	CONCRETE ROAD		MANHOLE TELEPHONE
	TRACK	MH	MANHOLE NOT IDENTIFIED
	REFERENCE LINE		LIGHTING POLE
channel	CHANNEL	TP	TELEPHONE POLE
	TERRACE		TRIANGULATION STATION
	FENCE	EL.S.S.	ELECTRIC SUB STATION
	STREAM/RIVER		ELECTRIC POLE/TELEGRAPH POLE
		Num	STAKE NUMBER STAKE POINT
	CULVERT/BRIDGE	1160.12	SPOT HEIGHT
Spr	SPRING	1262	PLOT No
	WELL		BOUNDARY
	DECIDUOUS/PINE TREE		CIRCONSCRIPTION BOUNDARY
	ROCKS		
	DownHill		
	High-Hill		

NOTES

- ALL ALTITUDES ARE TIED TO THE NATIONAL ELEVATION OF LEBANON
- HEAD LOSSES HAVE BEEN CALCULATED TO THE COLEBROOK FORMULA WITH AN ABSOLUTE ROUGHNESS K=0,4 mm FOR DUCTILE IRON PIPES AND K=0,2 mm FOR HDPE PIPES
- FOR PIPELINE ANCHORS AND SUPPORT DETAILS REFER TO STANDARD DWG Nb 462-05ST14
- FOR PIPELINE TRENCH DETAILS REFER TO STANDARD DWG Nb 462-05ST05 AND DWG Nb 462-05ST06
- FOR HORIZONTAL BENDS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST11 AND DWG Nb 462-05ST12
- FOR VERTICAL BENDS AND TAPERS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST13
- FOR CONNECTION TO EXISTING PIPES REFER TO STANDARD DWG Nb 462-05ST09 AND DWG Nb 462-05ST10
- PIPE MATERIAL: DUCTILE IRON CLASS K9
HDPE PE100 PN16
- ALL PIPE FITTINGS AND ACCESSORIES ARE PN16, UNLESS OTHERWISE SPECIFIED
- ALL PIPES SHOULD BE EXECUTED IN PUBLIC OR EXPROPRIATED ROADS

KEY PLAN



Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

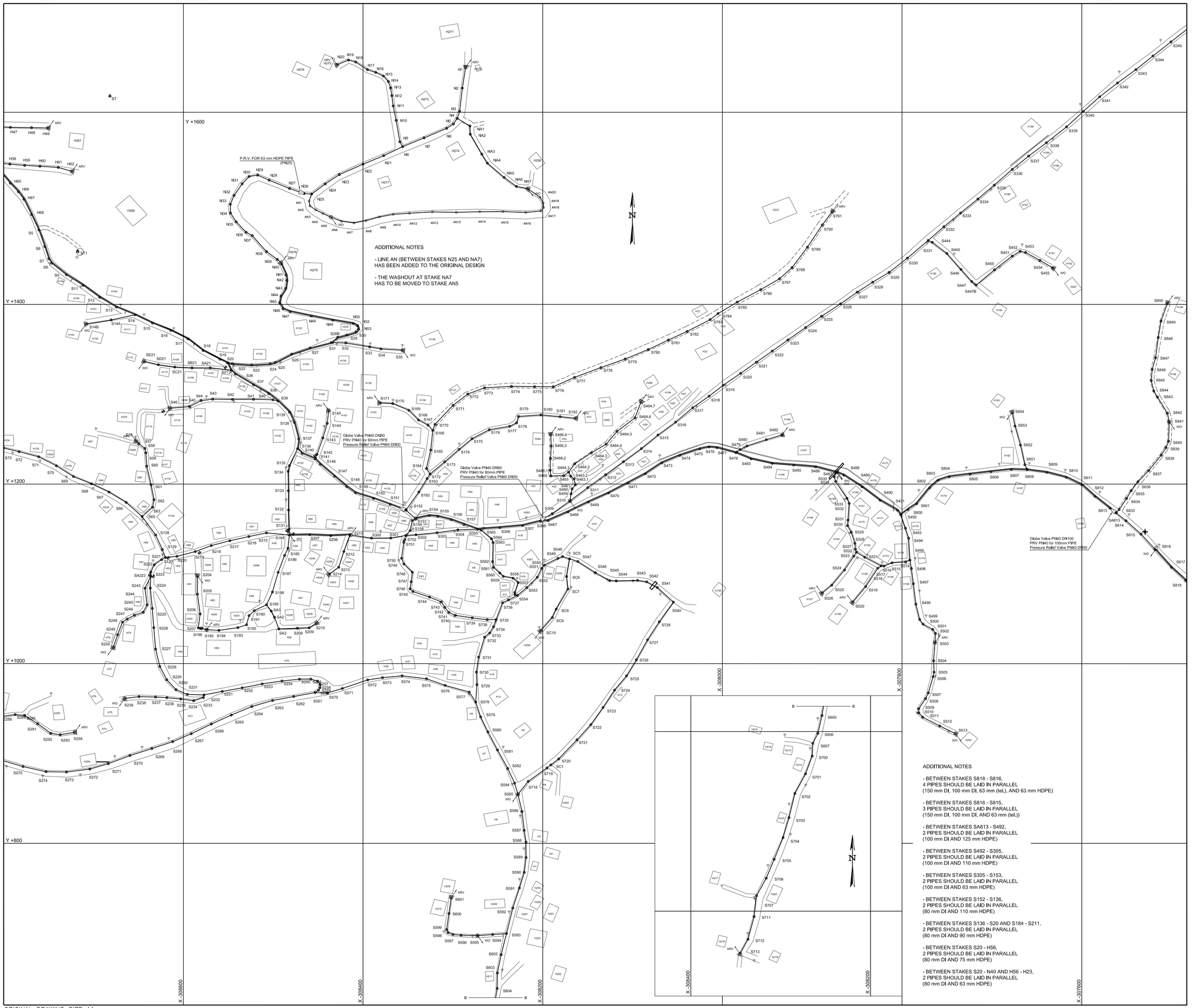
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK	PLAN HYDRAULIC ACCESSORIES

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PL	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	2/4	462-05DS-01PL02

ORIGINAL DRAWING SIZE A1



HYDRAULIC LEGEND

PIPELINE		BEND 1/8	C1/8
FLOW DIRECTION		A.V (AIR VALVE)	
VALVE		W.O (WASHOUT)	
TEE		FLANGED ADAPTER	
REDUCER		END CAPS	
PRESSURE REGULATING VALVE	P.R.V		
D.J.	DISMANTLING JOINT		

TOPOGRAPHICAL LEGEND

A123	BUILDING / BUILDING CODE REFER TO BUILDING TABLE		MANHOLE SEWER
	PAVED ROAD		MANHOLE WATER
	CONCRETE ROAD		MANHOLE TELEPHONE
	TRACK	MH	MANHOLE NOT IDENTIFIED
	REFERENCE LINE		LIGHTING POLE
channel	CHANNEL	TP	TELEPHONE POLE
	TERRACE		TRIANGULATION STATION
	FENCE	EL.S.S.	ELECTRIC SUB STATION
	STREAM/RIVER		ELECTRIC POLE/TELEGRAPH POLE
	CULVERT/BRIDGE	Num	STAKE NUMBER STAKE POINT
Spr	SPRING	1160.12	SPOT HEIGHT
	WELL	1262	PLOT No
	DECIDUOUS/PINE TREE		BOUNDARY
	ROCKS	+ — + — +	CIRCONSCRIPTION BOUNDARY
	DownHill High>Hill		

NOTES

- ALL ALTITUDES ARE TIED TO THE NATIONAL ELEVATION OF LEBANON
- HEAD LOSSES HAVE BEEN CALCULATED TO THE COLEBROOK FORMULA WITH AN ABSOLUTE ROUGHNESS K=0,4 mm FOR DUCTILE IRON PIPES AND K=0,2 mm FOR HDPE PIPES
- FOR PIPELINE ANCHORS AND SUPPORT DETAILS REFER TO STANDARD DWG Nb 462-05ST14
- FOR PIPELINE TRENCH DETAILS REFER TO STANDARD DWG Nb 462-05ST05 AND DWG Nb 462-05ST06
- FOR HORIZONTAL BENDS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST11 AND DWG Nb 462-05ST12
- FOR VERTICAL BENDS AND TAPERS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST13
- FOR CONNECTION TO EXISTING PIPES REFER TO STANDARD DWG Nb 462-05ST09 AND DWG Nb 462-05ST10
- PIPE MATERIAL: DUCTILE IRON CLASS K9
  HDPE PE100 PN16
- ALL PIPE FITTINGS AND ACCESSORIES ARE PN16, UNLESS OTHERWISE SPECIFIED
- ALL PIPES SHOULD BE EXECUTED IN PUBLIC OR EXPROPRIATED ROADS

KEY PLAN

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK	PLAN

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PL	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	3/4	462-05DS-01PL03

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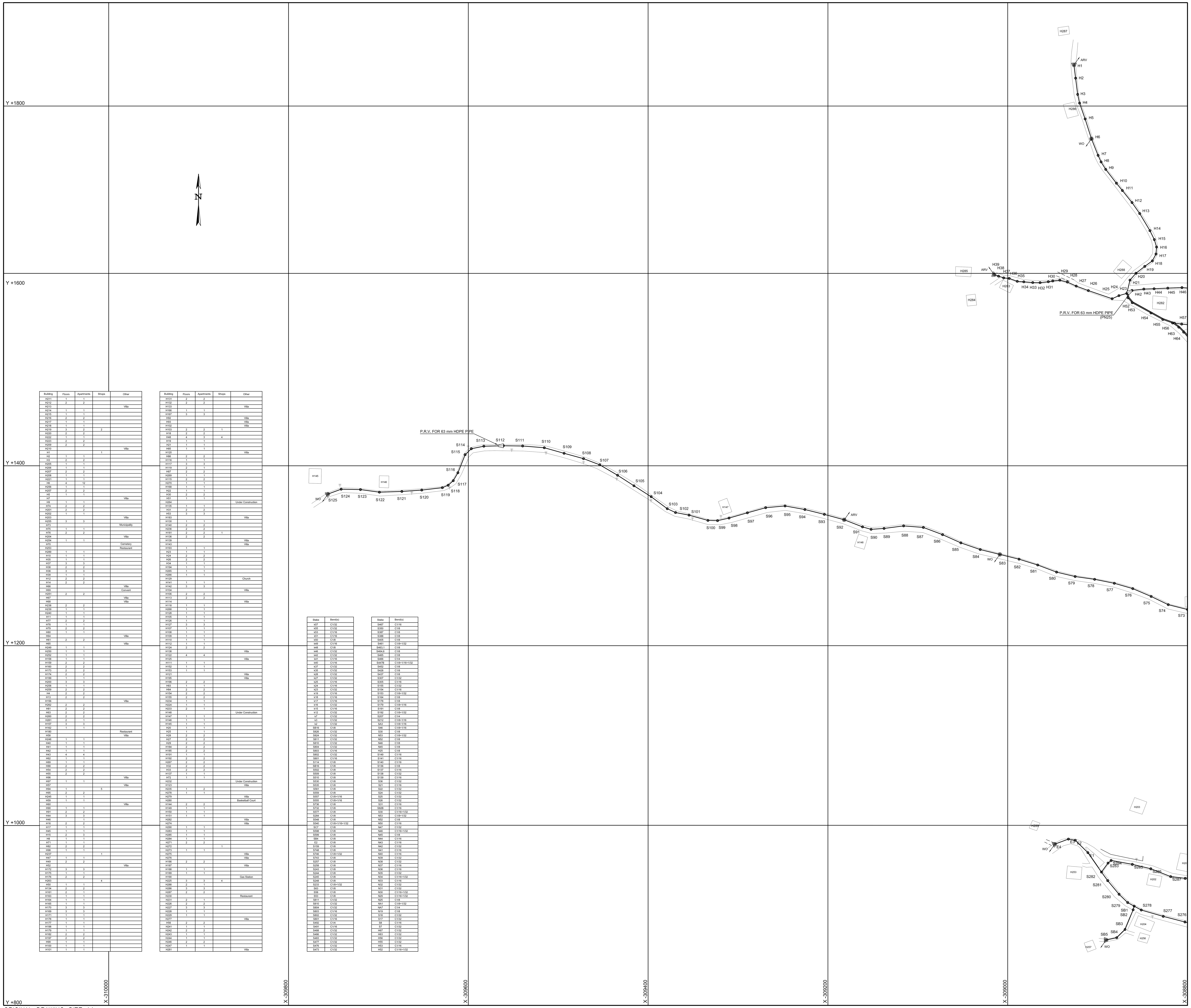

Building	Floors	Apartments	Shops	Other
H211	1	1		
H212	2	2		
H213				Villa
H214	1	1		
H215	1	1		
H216	2	2		
H217	1	1		
H218	1	1		
H219	3	2	2	
H220	2	2		
H222	1	1		
H223	2	2		
H209	2	2		
H210				Villa
H1			1	
H2	1	1		
H3	2	2		
H205	1	1		
H206	1	1		
H207	2	2		
H208	1	1		
H221	1	1		
H6	4	12		
H256	1	1		
H257	2	2		
H5	1	1		
H7				Villa
H9	1	1		
H74	2	2		
H201	2	2		
H202	1	1		
H203				Villa
H255	3	3		
H73				Municipality
H75	1	1		
H76	2	2		
H204				Villa
H254	1	1		
H70				Cemetery
H253				Restaurant
H289	1	1		
H10	1	1		
H35	1	1		
H37	3	3		
H38	2	2		
H36	3	3		
H39	1	1		
H12	2	2		
H14	2	2		
H66				Villa
H69				Convent
H251	2	2		
H67				Villa
H68				Villa
H238	2	2		
H239	1	1		
H240	1	1		
H11	1	1		
H77	2	2		
H78	1	1		
H79	2	2		
H80	1	1		
H64				Villa
H61	2	2		
H65				Villa
H249	1	1		
H250	1	1		
H252	1	1		
H158	1	1		
H159	2	2		
H160	2	2		
H173	2	2		
H174	2	2		
H199	1	1		
H200	3	3		
H258	1	1		
H259	2	2		
H4	2	2		
H13	2	2		
H156				Villa
H262	2	2		
H81	2	2		
H63	2	2		
H260	2	2		
H261	2	1		
H157	3	3		
H162	1	1		
H180				Restaurant
H58				Villa
H248	1	1		
H40	1	1		
H41	1	1		
H42	1	1		
H43	4	4		
H62	1	1		
H89	1	1		
H88	2	2		
H54	2	2		
H55	2	2		
H96				Villa
H97	1	1		
H57				Villa
H94	1		5	
H95	2	2		
H245	1	1		
H59	1	1		
H60				Villa
H90	1	1		
H91	2	2		
H44	3	3		
H46		1		
H16	2	2		
H17	1	1		
H45	1	1		
H15	2	3		
H8	1	1		
H71	1	1		
H82	2	2		
H98	1	1		
H237			1	
H47	1	1		
H49	2	2		
H52				Villa
H172	3	3		
H175	1	1		
H176	2	2		
H263			4	
H50	1	1		
H134	2	2		
H161	2	1		
H163	1	1		
H164	1	1		
H165	1	1		
H170	3	3		
H169	3	3		
H171	1	1		
H178	1	1		
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H198	1	1		
H179	1	1		
H182	2	2		
H197	2	2		
H99	1	1		
H100	1	1		
H101	1	1		

Building	Floors	Apartments	Shops	Other
H131	2	2		
H132	2	2		
H133				Villa
H166	1	1		
H167	3	3		
H92				Villa
H93				Villa
H102				Villa
H103	2	2	1	
H18	2	2		
H48	4	3	4	
H19	1	1		
H21	1	1		
H85	1	1		
H120				Villa
H86	2	2		
H116	1	1		
H117	3	3		
H119	2	1		
H87	2	2		
H269	1	1		
H115	2	2		
H270	1	1		
H168	1	1		
H22	1	1		
H30	2	2		
H51	1	1		
H264				Under Construction
H135	1	1		
H31	2	2		
H53	3	3		
H183				Villa
H130	1	1		
H140	2	2		
H236	2	2		
H181	2	2	1	
H136	2	2		
H139				Villa
H143				Villa
H193	1	1		
H23	1	1		
H24	2	2		
H26	2	2		
H34	1	1		
H194	1	1		
H265	1	1		
H266	1	1		
H129				Church
H141	1	1		
H142	3	3		
H104				Villa
H106	2	2		
H113	2	2		
H114				Villa
H118	1	1		
H268	1	1		
H128	1	1		
H105	1	1		
H126	1	1		
H127	3	3		
H107	1	1		
H108	1	1		
H109	1	1		
H110	1	1		
H112	1	1		
H124	2	2		
H138				Villa
H122	4	4		
H125				Villa
H111	1	1		
H152	1	1		
H153	1	1		
H121				Villa
H195				Villa
H196	2	2		
H83	1	1		
H84	2	2		
H154	2	2		
H155	2	2		
H234	1	1		
H224	1	1		
H233	2	1		
H148				Under Construction
H147	1	1		
H146	1	1		
H145	1	1		
H20	1	1		
H25	1	1		
H28	2	2		
H27	2	2		
H29	2	2		
H184	2	2		
H185	2	2		
H191	1	1		
H192	2	2		
H267	2	2		
H32	2	2		
H33	2	2		
H137	1	1		
H72	1	1		
H232				Under Construction
H123				Villa
H235	1	2		
H278	1	1		
H279				Villa
H280				Basketball Court
H144	2	2		
H149	1	1		
H150	1	1		
H151	1	1		
H282				Villa
H274				Villa
H290	1	1		
H283	1	1		
H285	1	1		
H284	1	1		
H271	2	2		
H272			1	
H273	1	1		
H275				Villa
H276				Villa
H186	2	2		
H187				Villa
H188	1	1		
H189	1	1		
H190				Gas Station
H225	3	3	4	
H288	2	1		
H286	3	3		
H287	2	2		
H230				Restaurant
H231	2	1		
H226	2	2		
H227	3	3		
H228	1	1		
H229	1	1		
H277				Villa
H56	2	2		
H241	1	1		
H242	2	2		
H243	1	1		
H244	1	1		
H246	2	2		
H247	1	1		
H281				Villa

Stake	Bend(s)
k57	C1/32
k55	C1/32
k53	C1/16
k51	C1/16
k50	C1/8
k49	C1/16
k48	C1/8
k46	C1/32
k42	C1/32
k41	C1/16
k40	C1/16
k37	C1/32
k35	C1/32
k28	C1/32
k27	C1/32
k25	C1/16
k24	C1/32
k23	C1/32
k19	C1/16
k18	C1/16
k17	C1/16
k16	C1/32
k15	C1/16
k12	C1/32
k7	C1/32
k3	C1/32
k2	C1/32
SB16	C1/8
S826	C1/32
S824	C1/32
S811	C1/32
S810	C1/32
S804	C1/32
S803	C1/16
S802	C1/32
S801	C1/16
S114	C1/8
SB16	C1/8
S502	C1/8
S509	C1/8
S510	C1/8
S530	C1/8
S535	C1/8
S561	C1/8
S559	C1/8
S557	C1/8+1/16
S555	C1/8+1/16
S736	C1/8
S732	C1/8
S577	C1/8
S284	C1/8
S548	C1/8
S540	C1/8+1/16+1/32
SC7	C1/8
S598	C1/8
S599	C1/8
SB4	C1/8
E2	C1/8
S159	C1/8
S748	C1/8
S746	C1/8+1/32
S743	C1/8
S257	C1/8
S258	C1/8
S243	C1/8
S244	C1/8
S245	C1/8
S248	C1/8
S233	C1/8+1/32
S63	C1/8
S58	C1/8
S53	C1/8
S811	C1/32
S810	C1/32
S804	C1/32
S803	C1/16
S802	C1/32
S801	C1/16
S492	C1/4
S491	C1/16
S488	C1/32
S486	C1/32
S483	C1/32
S477	C1/32
S476	C1/32
S473	C1/32

Stake	Bend(s)
S467	C1/16
S350	C1/8
S387	C1/8
S388	C1/8
S405	C1/8
S461	C1/8+1/32
S463,1	C1/8
S464,6	C1/8
S465	C1/8
S466	C1/4
S447B	C1/8+1/16+1/32
S452	C1/8
S428	C1/8
S437	C1/8
S307	C1/32
S305	C1/16
S155	C1/32
S154	C1/16
S153	C1/8+1/32
S164	C1/8
S178	C1/8
S179	C1/8+1/16
S191	C1/8
S192	C1/8+1/32
S207	C1/4
S212	C1/8+1/16
SA3	C1/8+1/16
S46	C1/8+1/16
S30	C1/8
N53	C1/8+1/32
N52	C1/8
N46	C1/8
N45	C1/8
H25	C1/8
S149	C1/16
S141	C1/16
S140	C1/16
S136	C1/8
S137	C1/16
S138	C1/32
S139	C1/16
S36	C1/32
S21	C1/16
S22	C1/32
S24	C1/32
S25	C1/32
S26	C1/32
S31	C1/16
S82B	C1/16
S30	C1/16+1/32
N53	C1/8+1/32
N52	C1/8
N50	C1/16
N47	C1/32
N46	C1/16+1/32
N45	C1/8
N44	C1/16
N43	C1/16
N42	C1/32
N41	C1/16
N40	C1/16
N39	C1/32
N38	C1/32
N37	C1/16
N36	C1/16
N35	C1/32
N34	C1/16+1/32
N33	C1/16
N32	C1/32
N31	C1/32
N30	C1/16+1/32
N29	C1/16+1/32
N25	C1/8
NA1	C1/8+1/32
NA7	C1/4
N19	C1/8
S18	C1/32
S17	C1/32
S8	C1/16
S7	C1/32
H67	C1/32
H63	C1/32
H56	C1/32
H55	C1/32
H53	C1/16
H52	C1/16+1/32

ORIGINAL DRAWING SIZE A1

HYDRAULIC LEGEND

PIPELINE
FLOW DIRECTION
VALVE
TEE
REDUCER
PRESSURE REGULATING VALVE (P.R.V)
D.J. — DISMANTLING JOINT
BEND 1/8 (C1/8)
A.V (AIR VALVE)
W.O (WASHOUT)
FLANGED ADAPTER
END CAPS

TOPOGRAPHICAL LEGEND

A123 — BUILDING / BUILDING CODE REFER TO BUILDING TABLE
PAVED ROAD
CONCRETE ROAD
TRACK
REFERENCE LINE
channel — CHANNEL
TERRACE
FENCE
STREAM/RIVER
CULVERT/BRIDGE
Spr — SPRING
WELL
DECIDUOUS/PINE TREE
ROCKS
DownHill
High-Hill
MANHOLE SEWER
MANHOLE WATER
MANHOLE TELEPHONE
MH — MANHOLE NOT IDENTIFIED
LIGHTING POLE
TP — TELEPHONE POLE
TRIANGULATION STATION
EL.S.S. — ELECTRIC SUB STATION
ELECTRIC POLE/TELEGRAPH POLE
Num — STAKE NUMBER STAKE POINT
1160.12 — SPOT HEIGHT
1262 — PLOT No
BOUNDARY
CIRCONSCRIPTION BOUNDARY

NOTES

- ALL ALTITUDES ARE TIED TO THE NATIONAL ELEVATION OF LEBANON
- HEAD LOSSES HAVE BEEN CALCULATED TO THE COLEBROOK FORMULA WITH AN ABSOLUTE ROUGHNESS K=0.4 mm FOR DUCTILE IRON PIPES AND K=0.2 mm FOR HDPE PIPES
- FOR PIPELINE ANCHORS AND SUPPORT DETAILS REFER TO STANDARD DWG Nb 462-05ST14
- FOR PIPELINE TRENCH DETAILS REFER TO STANDARD DWG Nb 462-05ST05 AND DWG Nb 462-05ST06
- FOR HORIZONTAL BENDS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST11 AND DWG Nb 462-05ST12
- FOR VERTICAL BENDS AND TAPERS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST13
- FOR CONNECTION TO EXISTING PIPES REFER TO STANDARD DWG Nb 462-05ST09 AND DWG Nb 462-05ST10
- PIPE MATERIAL: DUCTILE IRON CLASS K9
  HDPE PE100 PN16
- ALL PIPE FITTINGS AND ACCESSORIES ARE PN16, UNLESS OTHERWISE SPECIFIED
- ALL PIPES SHOULD BE EXECUTED IN PUBLIC OR EXPROPRIATED ROADS

KEY PLAN

4 3 2 1

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

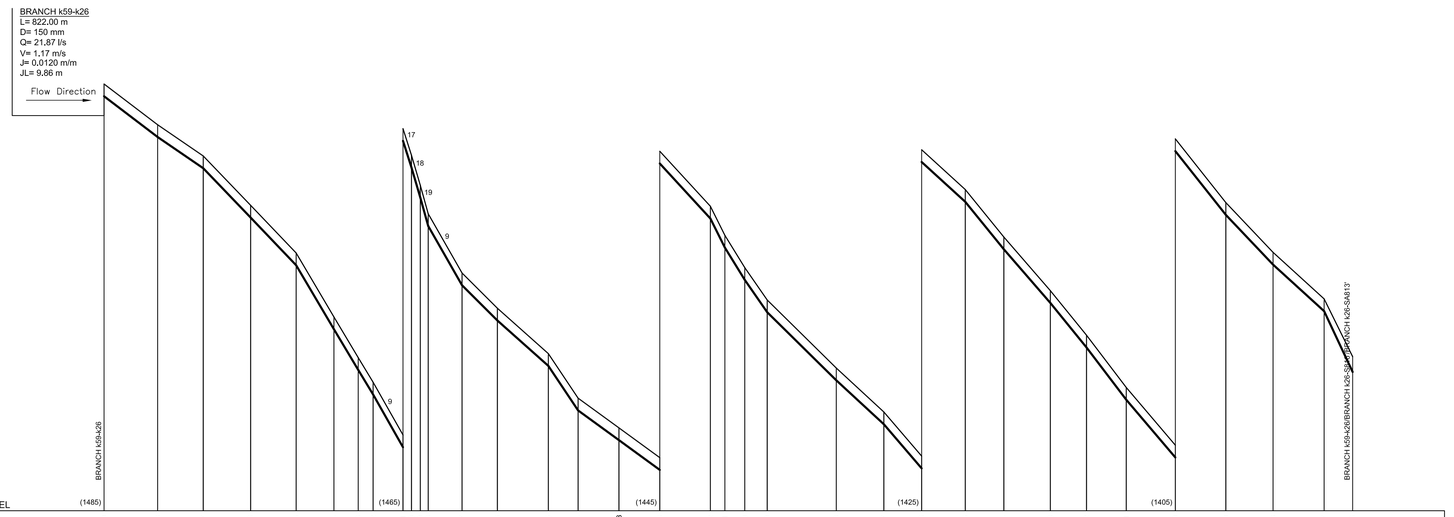
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK

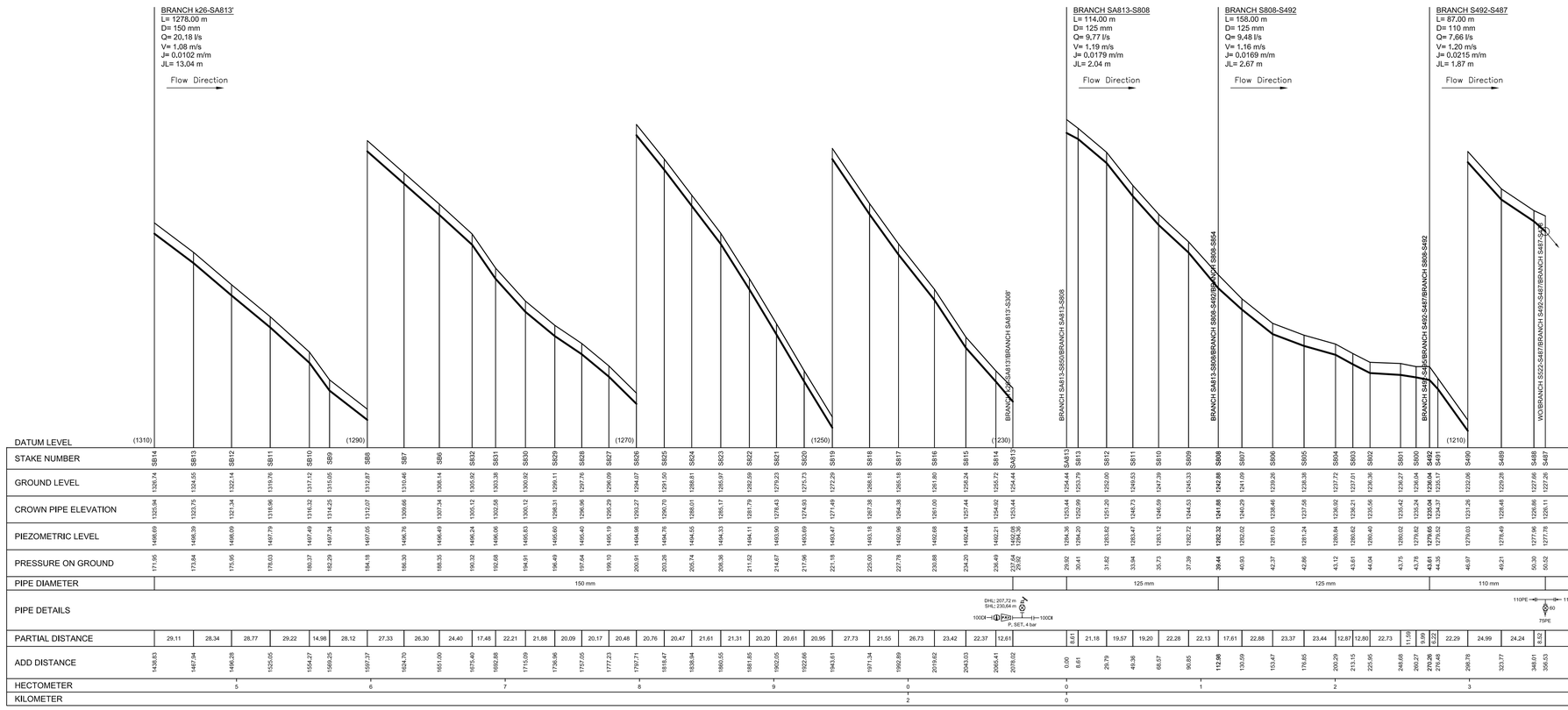
PLAN
TABLE OF BUILDINGS
TABLE OF BENDS

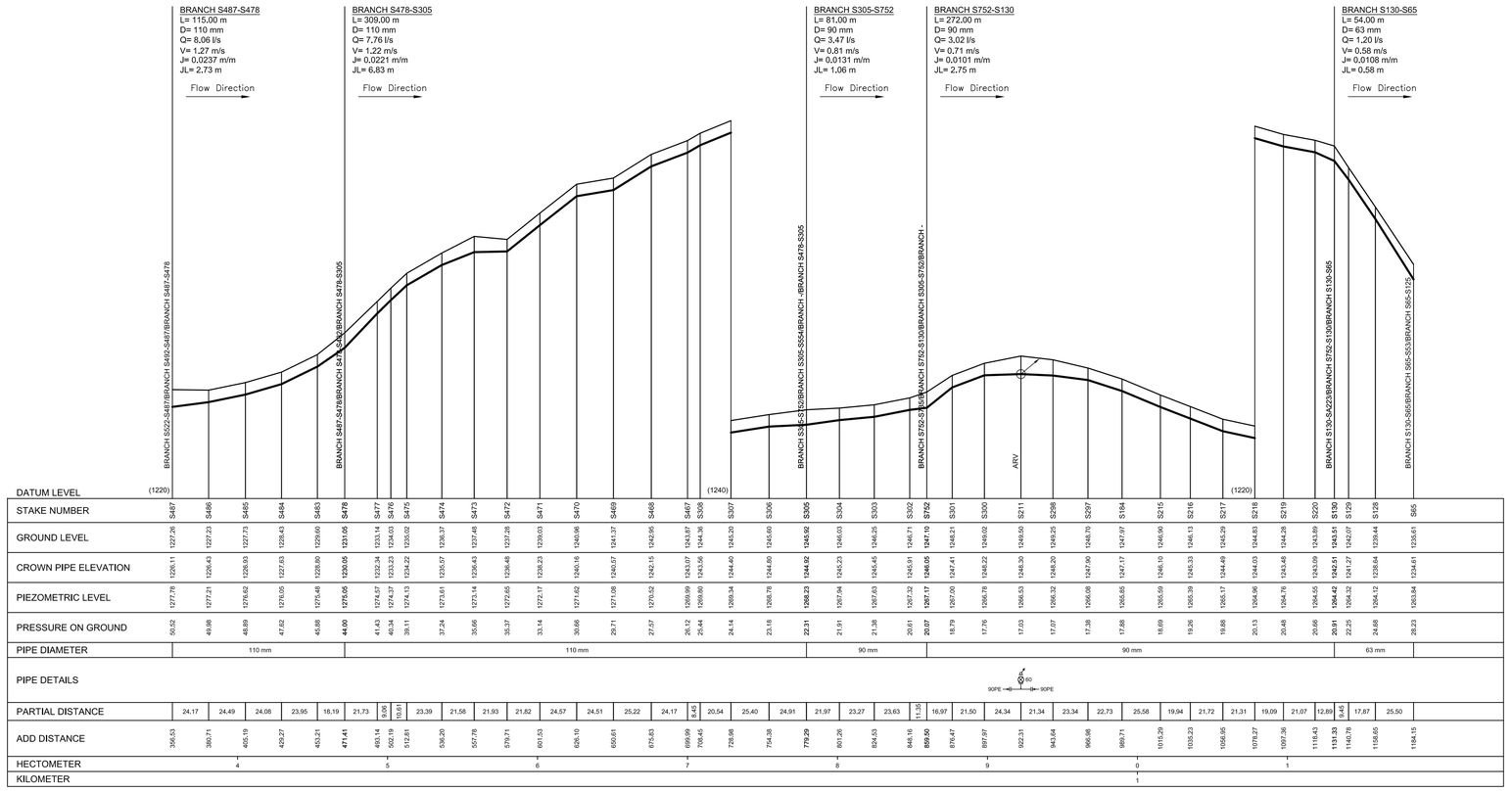
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PL	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	4/4	462-05DS-01PL04


BRANCH k59-k26
L= 822,00 m
D= 150 mm
Q= 21,87 l/s
V= 1,17 m/s
J= 0,0120 m/m
JL= 9,86 m
Flow Direction
BRANCH k59-k26
BRANCH k26-SA813'
17
18
19
9
9

| | | |





HYDRAULIC LEGEND

PIPELINE		BEND 1/8	C1/8
FLOW DIRECTION		A.V (AIR VALVE)	
VALVE		W.O (WASHOUT)	
TEE		FLANGED ADAPTER	
REDUCER		END CAP	
PRESSURE REGULATING VALVE	P.R.V	GLOBE VALVE	
D.J.	DISMANTLING JOINT	PRESSURE RELIEF VALVE	P.R.V

NOTES

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- FOR HORIZONTAL BENDS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST11 AND DWG Nb 462-05ST12
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- FOR CONNECTION TO EXISTING PIPES REFER TO STANDARD DWG Nb 462-05ST09 AND DWG Nb 462-05ST10
- PIPE MATERIAL: DUCTILE IRON CLASS K9
  HDPE PE100 PN16
- ALL PIPE FITTINGS AND ACCESSORIES ARE PN16, UNLESS OTHERWISE SPECIFIED
- ALL PIPES SHOULD BE EXECUTED IN PUBLIC OR EXPROPRIATED ROADS
- FOR MANHOLE DETAILS, REFER TO HYDRAULIC ACCESSORIES ON NETWORK PLAN

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

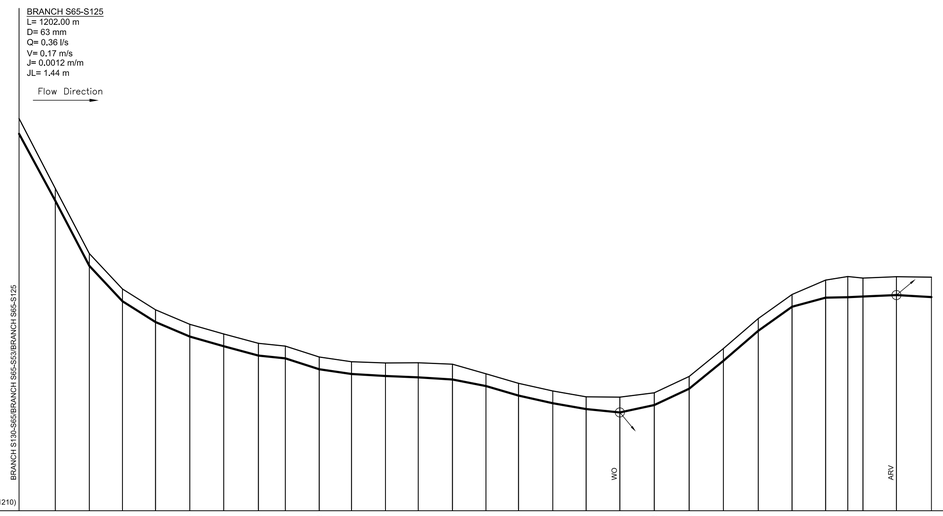
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK	PROFILES

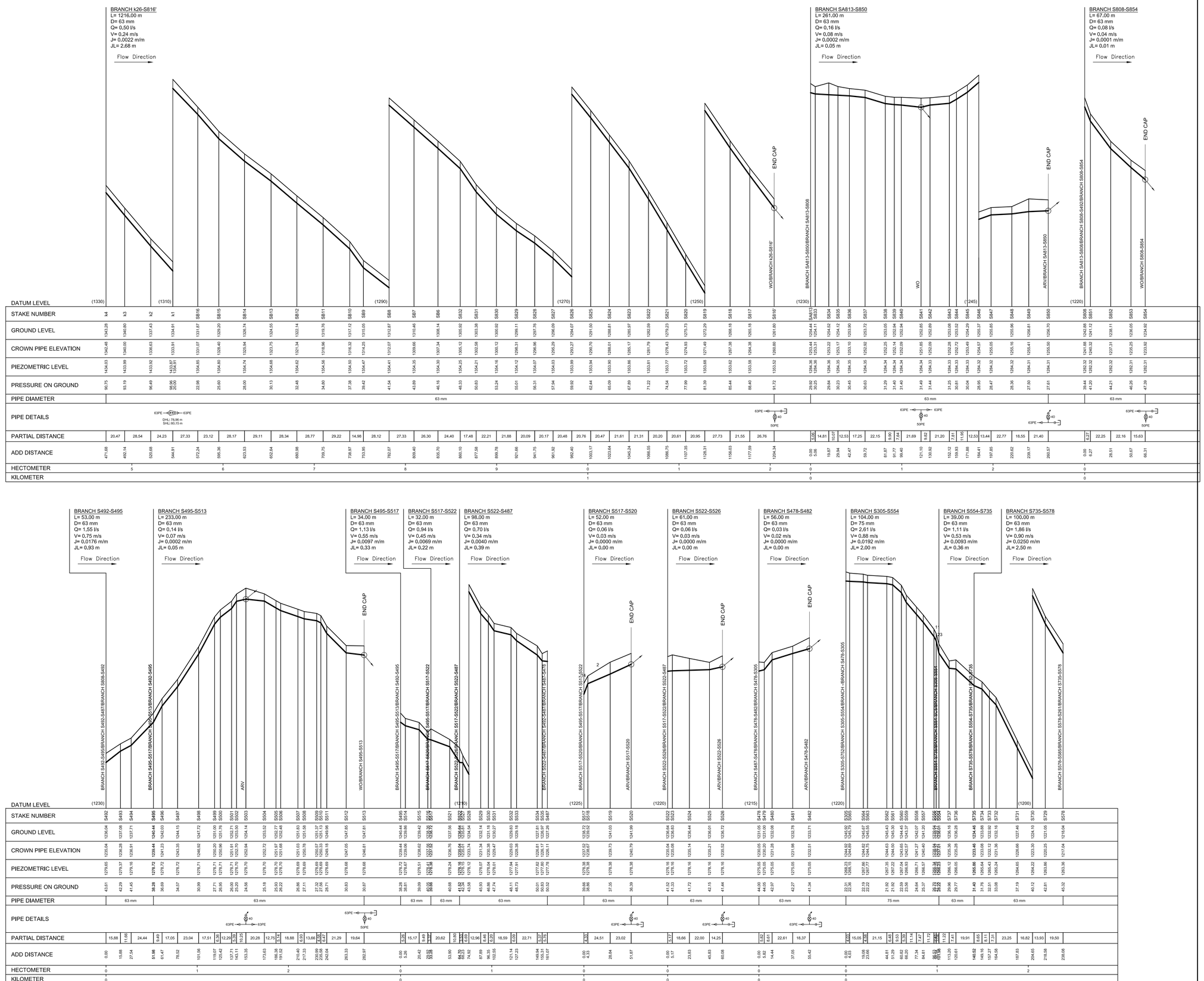
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PR	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	2/11	462-05DS-01PR02

ORIGINAL DRAWING SIZE A1


BRANCH S65-S125
L= 1202,00 m
D= 63 mm
Q= 0,36 l/s
V= 0,17 m/s
J= 0,0012 m/m
JL= 1,44 m
Flow Direction
BRANCH S130-S65/BRANCH S65-S53/BRANCH S65-S125
WO
ARV

| | | |



HYDRAULIC LEGEND

PIPELINE		BEND 1/8	C1/8
FLOW DIRECTION		A.V (AIR VALVE)	
VALVE		W.O (WASHOUT)	
TEE		FLANGED ADAPTER	
REDUCER		END CAP	
PRESSURE REGULATING VALVE	P.R.V	GLOBE VALVE	
D.J.	DISMANTLING JOINT	PRESSURE RELIEF VALVE	P.R.V

NOTES

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- FOR PIPELINE TRENCH DETAILS REFER TO STANDARD DWG Nb 462-05ST05 AND DWG Nb 462-05ST06
- FOR HORIZONTAL BENDS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST11 AND DWG Nb 462-05ST12
- FOR VERTICAL BENDS AND TAPERS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST13
- FOR CONNECTION TO EXISTING PIPES REFER TO STANDARD DWG Nb 462-05ST09 AND DWG Nb 462-05ST10
- PIPE MATERIAL: DUCTILE IRON CLASS K9
  HDPE PE100 PN16
- ALL PIPE FITTINGS AND ACCESSORIES ARE PN16, UNLESS OTHERWISE SPECIFIED
- ALL PIPES SHOULD BE EXECUTED IN PUBLIC OR EXPROPRIATED ROADS
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Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

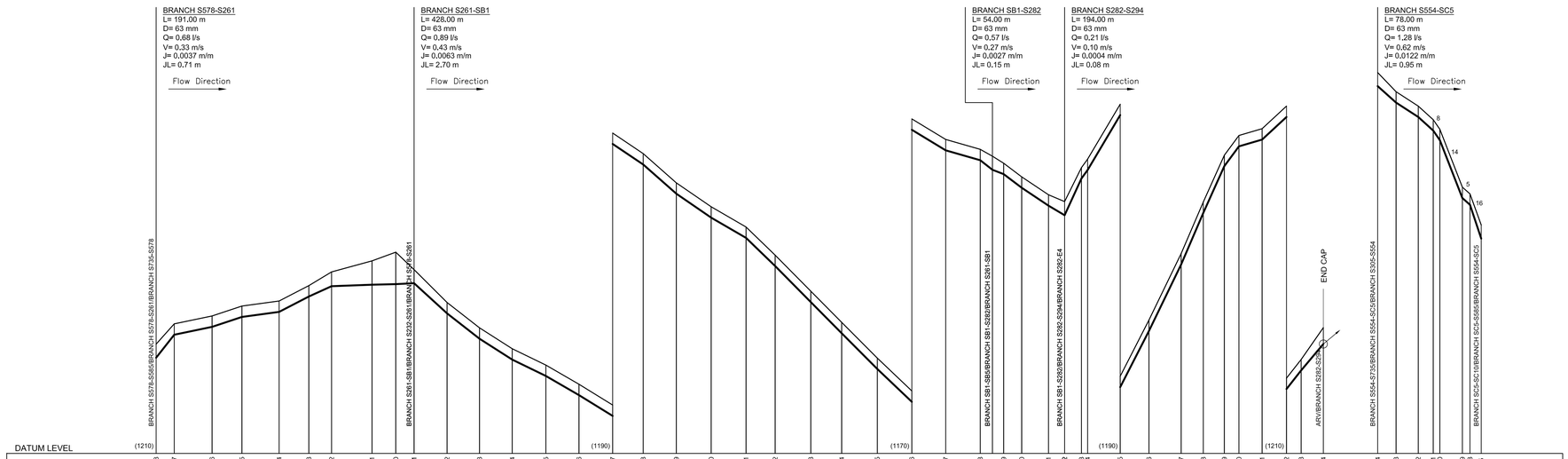
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK	PROFILES

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PR	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	4/11	462-05DS-01PR04

ORIGINAL DRAWING SIZE A1


BRANCH S578-S261
L= 191,00 m
D= 63 mm
Q= 0,68 l/s
V= 0,33 m/s
J= 0,0037 m/m
JL= 0.71 m
Flow Direction
BRANCH S261-SB1
L= 428,00 m
D= 63 mm
Q= 0,89 l/s
V= 0,43 m/s
J= 0,0063 m/m
JL= 2.70 m
Flow Direction
BRANCH SB1-S282
L= 54,00 m
D= 63 mm
Q= 0,57 l/s
V= 0,27 m/s
J= 0,0027 m/m
JL= 0,15 m
Flow Direction
BRANCH S282-S294
L= 194,00 m
D= 63 mm
Q= 0,21 l/s
V= 0,10 m/s
J= 0,0004 m/m
JL= 0,08 m
Flow Direction
BRANCH S554-SC5
L= 78,00 m
D= 63 mm
Q= 1,28 l/s
V= 0,62 m/s
J= 0,0122 m/m
JL= 0,95 m
Flow Direction
8
14
5
16
BRANCH S578-S585/BRANCH S578-S261/BRANCH S578-S578
BRANCH S261-SB1/BRANCH S232-S261/BRANCH S205-S261
BRANCH SB1-SB5/BRANCH SB1-S282/BRANCH S261-SB1
BRANCH SB1-S282/BRANCH S282-S294/BRANCH S282-E4
END CAP
ARV/BRANCH S282-S294
BRANCH S554-S735/BRANCH S554-SC5/BRANCH S305-S554
BRANCH SC5-SC10/BRANCH SC5-S585/BRANCH S554-SC5

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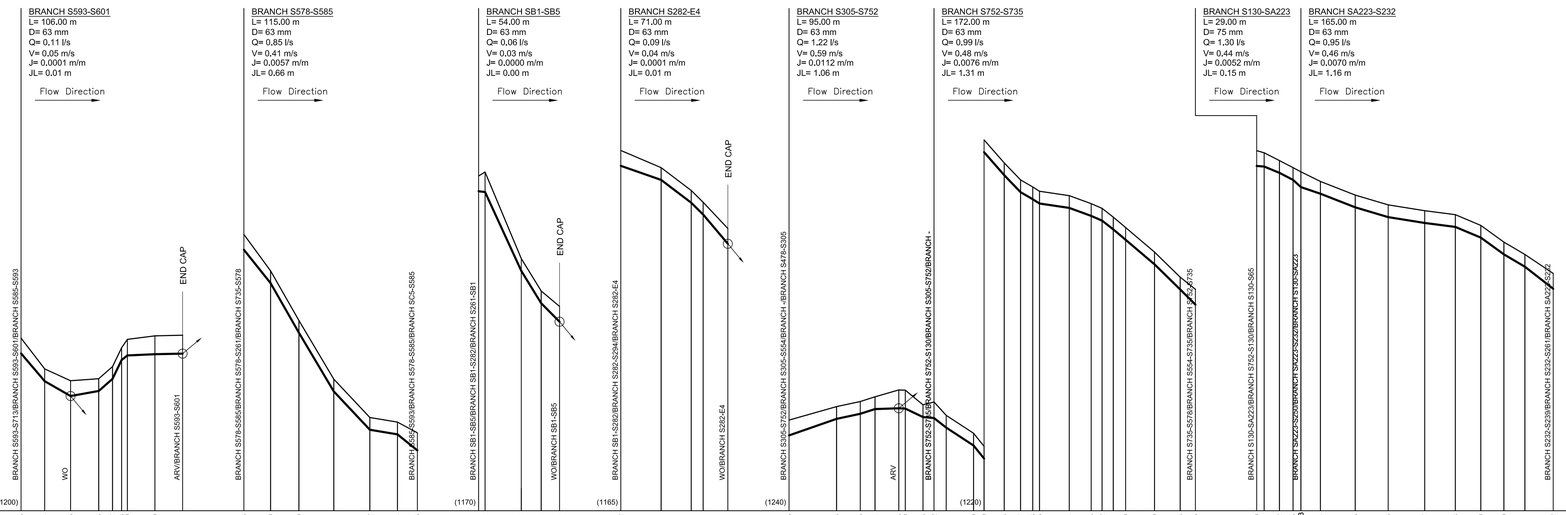
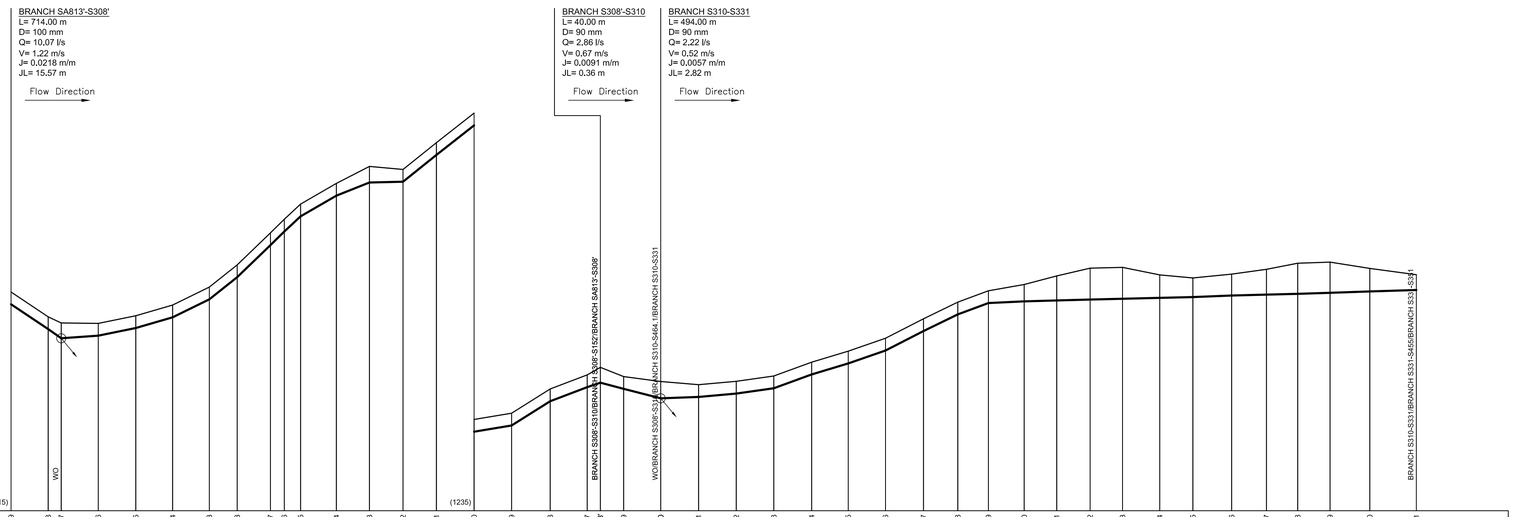
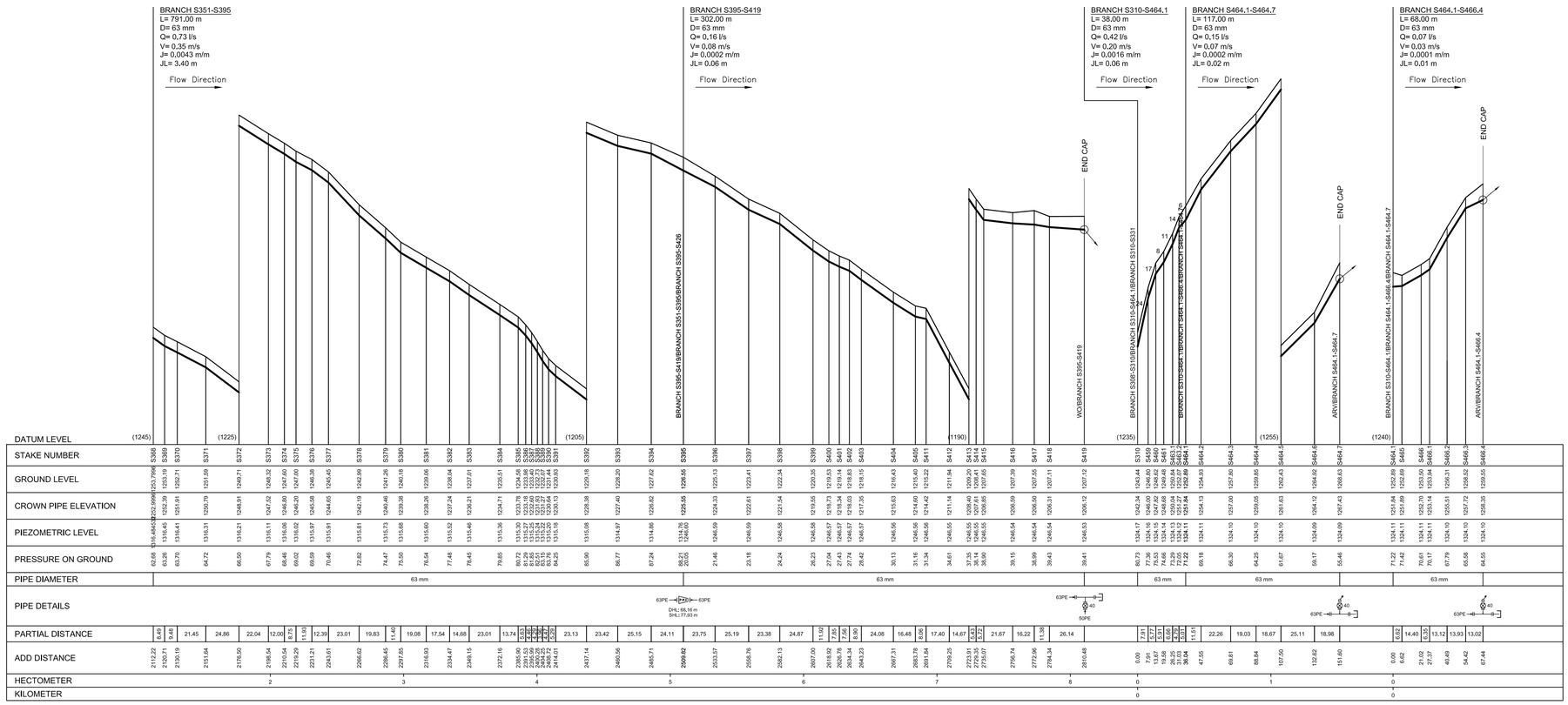
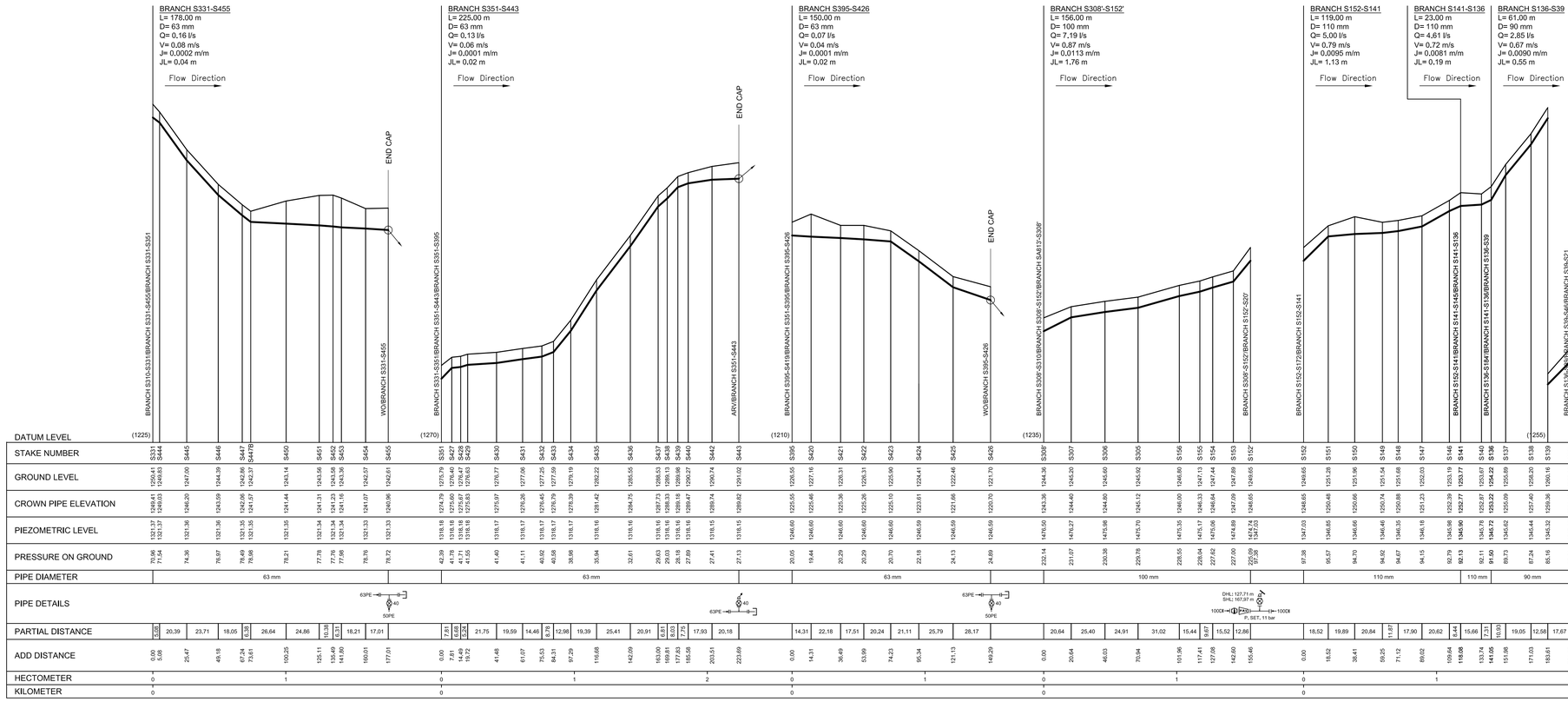

BRANCH S593-S601
L= 106.00 m
D= 63 mm
Q= 0.11 l/s
V= 0,05 m/s
J= 0,0001 m/m
JL= 0.01 m
BRANCH S578-S585
L= 115.00 m
D= 63 mm
Q= 0,85 l/s
V= 0,41 m/s
J= 0,0057 m/m
JL= 0.66 m
BRANCH SB1-SB5
L= 54.00 m
D= 63 mm
Q= 0,06 l/s
V= 0,03 m/s
J= 0,0000 m/m
JL= 0.00 m
BRANCH S282-E4
L= 71.00 m
D= 63 mm
Q= 0,09 l/s
V= 0,04 m/s
J= 0,0001 m/m
JL= 0.01 m
BRANCH S305-S752
L= 95.00 m
D= 63 mm
Q= 1,22 l/s
V= 0,59 m/s
J= 0,0112 m/m
JL= 1.06 m
BRANCH S752-S735
L= 172.00 m
D= 63 mm
Q= 0,99 l/s
V= 0,48 m/s
J= 0,0076 m/m
JL= 1,31 m
BRANCH S130-SA223
L= 29.00 m
D= 75 mm
Q= 1,30 l/s
V= 0,44 m/s
J= 0,0052 m/m
JL= 0,15 m
BRANCH SA223-S232
L= 165.00 m
D= 63 mm
Q= 0,95 l/s
V= 0,46 m/s
J= 0,0070 m/m
JL= 1.16 m
Flow Direction
END CAP
WO
ARV/BRANCH S593-S601
WO/BRANCH S593
WO/BRANCH SB1-SB5
WO/BRANCH S282-E4
ARV
WO/BRANCH S752-S735
BRANCH S593-S711/BRANCH S593-S601/BRANCH S585-S593
BRANCH S578-S585/BRANCH S578-S601/BRANCH S725-S578
BRANCH S578-S585/BRANCH S578-S585/BRANCH SC5-S585
BRANCH SB1-SB5/BRANCH SB1-S282/BRANCH S281-SB1
BRANCH SB1-S282/BRANCH S282-S294/BRANCH S282-E4
BRANCH S305-S752/BRANCH S305-S554/BRANCH -BRANCH S478-S305
BRANCH S752-S735/BRANCH S752-S130/BRANCH S305-S752/BRANCH -
BRANCH S735-S578/BRANCH S554-S735/BRANCH S735-S725
BRANCH S130-SA223/BRANCH S752-S130/BRANCH S130-S585
BRANCH SA223-S232/BRANCH SA223-S232/BRANCH S130-SA223
BRANCH S232-S232/BRANCH S232-S261/BRANCH SA223-S232

| | | |


BRANCH SA813'-S308'
L= 714,00 m
D= 100 mm
Q= 10,07 l/s
V= 1,22 m/s
J= 0,0218 m/m
JL= 15,57 m
Flow Direction
BRANCH S308'-S310
L= 40,00 m
D= 90 mm
Q= 2,86 l/s
V= 0,67 m/s
J= 0,0091 m/m
JL= 0,36 m
Flow Direction
BRANCH S310-S331
L= 494,00 m
D= 90 mm
Q= 2,22 l/s
V= 0,52 m/s
J= 0,0057 m/m
JL= 2,82 m
Flow Direction
WO
BRANCH S308'-S310/BRANCH SA813'-S192'/BRANCH SA813'-S308'
WO/BRANCH S308'-S310/BRANCH S310-S494 /BRANCH S310-S331
BRANCH S310-S331/BRANCH S331-S455/BRANCH S331-S351

| | | |





HYDRAULIC LEGEND

PIPELINE		BEND 1/8	C1/8
FLOW DIRECTION		A.V (AIR VALVE)	
VALVE		W.O (WASHOUT)	
TEE		FLANGED ADAPTER	
REDUCER		END CAP	
PRESSURE REGULATING VALVE	P.R.V	GLOBE VALVE	
D.J.	DISMANTLING JOINT	PRESSURE RELIEF VALVE	Qty

NOTES

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- FOR PIPELINE TRENCH DETAILS REFER TO STANDARD DWG Nb 462-05ST05 AND DWG Nb 462-05ST06
- FOR HORIZONTAL BENDS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST11 AND DWG Nb 462-05ST12
- FOR VERTICAL BENDS AND TAPERS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST13
- FOR CONNECTION TO EXISTING PIPES REFER TO STANDARD DWG Nb 462-05ST09 AND DWG Nb 462-05ST10
- PIPE MATERIAL: DUCTILE IRON CLASS K9
  HDPE PE100 PN16
- ALL PIPE FITTINGS AND ACCESSORIES ARE PN16, UNLESS OTHERWISE SPECIFIED
- ALL PIPES SHOULD BE EXECUTED IN PUBLIC OR EXPROPRIATED ROADS
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Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

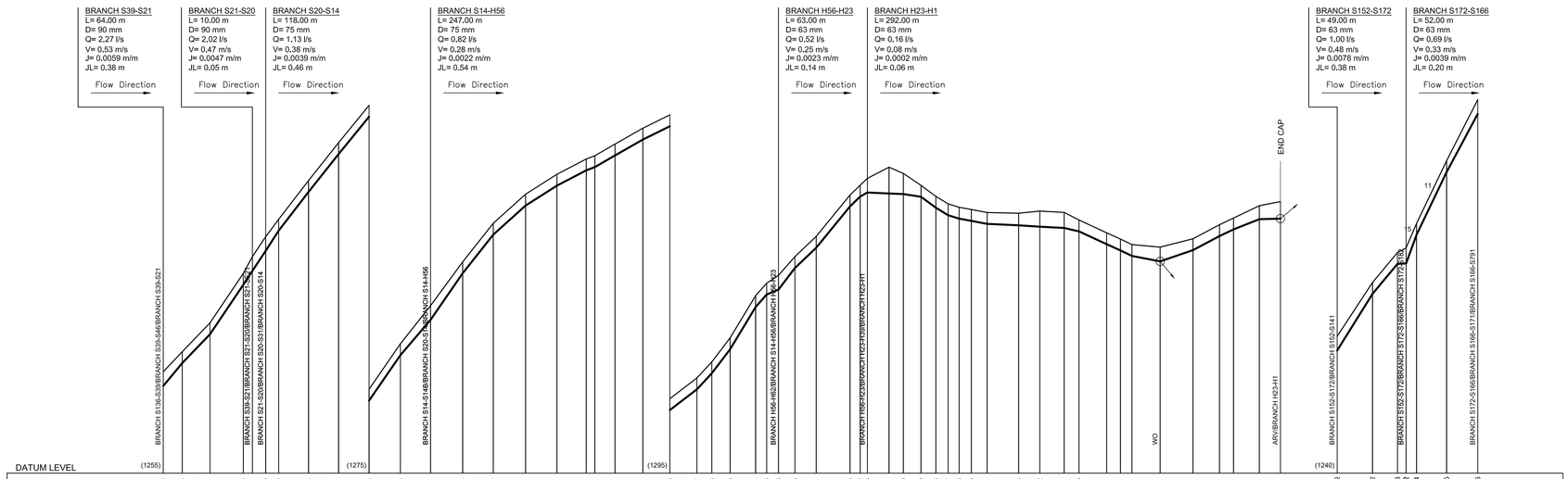
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

JAJ DISTRIBUTION NETWORK	PROFILES

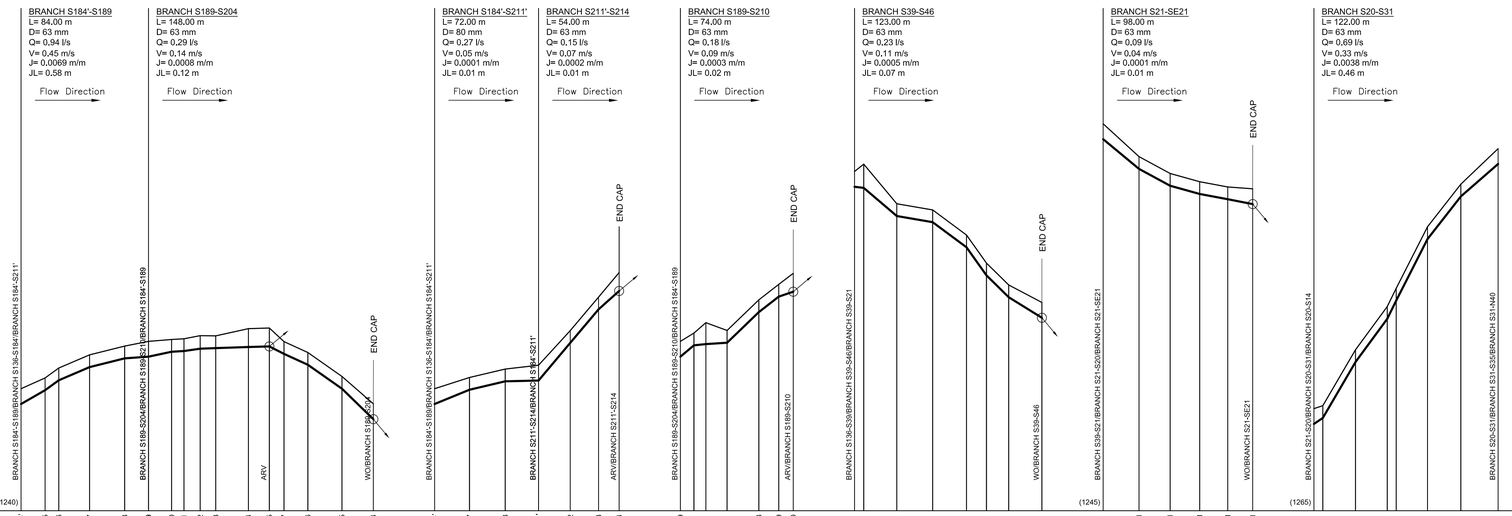
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PR	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	8/11	462-05DS-01PR08

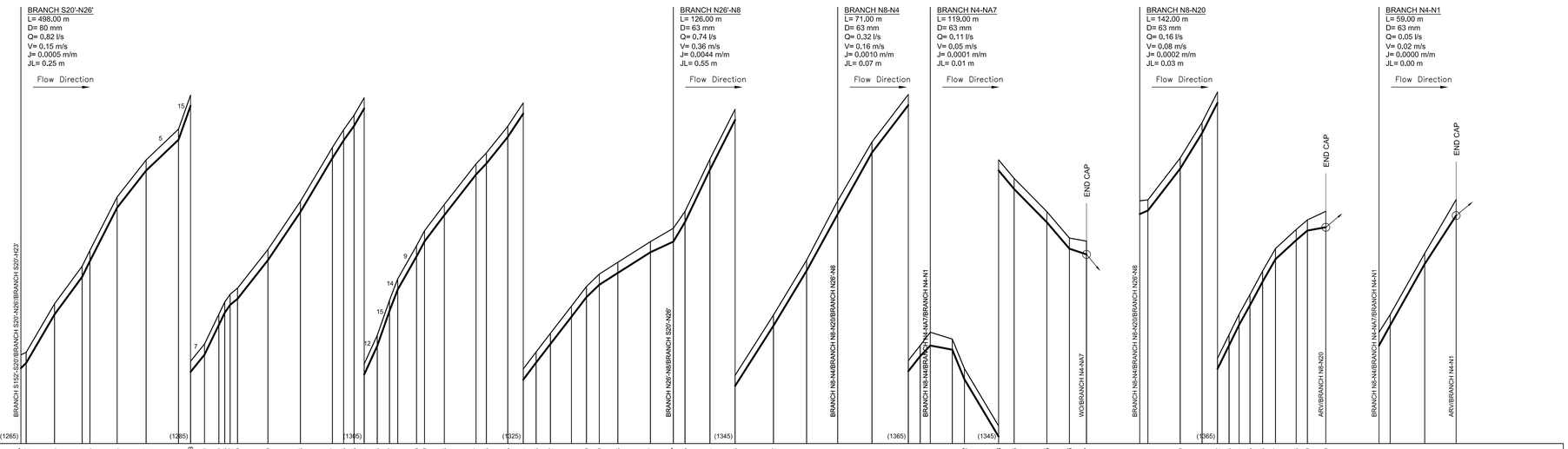
ORIGINAL DRAWING SIZE A1

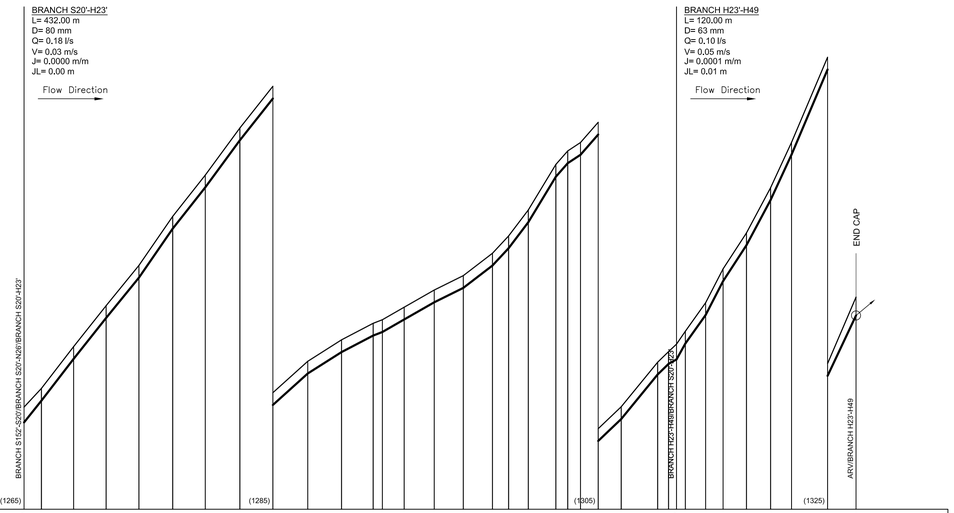

BRANCH S39-S21
L= 64,00 m
D= 90 mm
Q= 2,27 l/s
V= 0,53 m/s
J= 0,0059 m/m
JL= 0.38 m
BRANCH S21-S20
L= 10,00 m
D= 90 mm
Q= 2,02 l/s
V= 0,47 m/s
J= 0,0047 m/m
JL= 0.05 m
BRANCH S20-S14
L= 118,00 m
D= 75 mm
Q= 1,13 l/s
V= 0,38 m/s
J= 0,0039 m/m
JL= 0.46 m
BRANCH S14-H56
L= 247,00 m
D= 75 mm
Q= 0,82 l/s
V= 0,28 m/s
J= 0,0022 m/m
JL= 0.54 m
BRANCH H56-H23
L= 63,00 m
D= 63 mm
Q= 0,52 l/s
V= 0,25 m/s
J= 0,0023 m/m
JL= 0.14 m
BRANCH H23-H1
L= 292,00 m
D= 63 mm
Q= 0,16 l/s
V= 0,08 m/s
J= 0,0002 m/m
JL= 0.06 m
BRANCH S152-S172
L= 49,00 m
D= 63 mm
Q= 1,00 l/s
V= 0,48 m/s
J= 0,0078 m/m
JL= 0.38 m
BRANCH S172-S166
L= 52,00 m
D= 63 mm
Q= 0,69 l/s
V= 0,33 m/s
J= 0,0039 m/m
JL= 0.20 m
Flow Direction
BRANCH S139-S39/BRANCH S39-S46/BRANCH S39-S21
BRANCH S39-S21/BRANCH S21-S20/BRANCH S21-S20
BRANCH S21-S20/BRANCH S20-S31/BRANCH S20-S14
BRANCH S14-S148/BRANCH S20-S14/BRANCH S14-H56
BRANCH H56-H62/BRANCH S14-H56/BRANCH H56-H23
BRANCH H56-H23/BRANCH H62-H63/BRANCH H63-H1
WO
ARV/BRANCH H23-H1
END CAP
BRANCH S152-S172/BRANCH S152-S141
BRANCH S152-S172/BRANCH S172-S166/BRANCH S172-S183
BRANCH S172-S166/BRANCH S166-S171/BRANCH S166-S791
11
15

| | | |


BRANCH S184'-S189
L= 84,00 m
D= 63 mm
Q= 0,94 l/s
V= 0,45 m/s
J= 0,0069 m/m
JL= 0,58 m
BRANCH S189-S204
L= 148,00 m
D= 63 mm
Q= 0,29 l/s
V= 0,14 m/s
J= 0,0008 m/m
JL= 0,12 m
BRANCH S184'-S211'
L= 72,00 m
D= 80 mm
Q= 0,27 l/s
V= 0,05 m/s
J= 0,0001 m/m
JL= 0,01 m
BRANCH S211'-S214
L= 54,00 m
D= 63 mm
Q= 0,15 l/s
V= 0,07 m/s
J= 0,0002 m/m
JL= 0,01 m
BRANCH S189-S210
L= 74,00 m
D= 63 mm
Q= 0,18 l/s
V= 0,09 m/s
J= 0,0003 m/m
JL= 0,02 m
BRANCH S39-S46
L= 123,00 m
D= 63 mm
Q= 0,23 l/s
V= 0,11 m/s
J= 0,0005 m/m
JL= 0,07 m
BRANCH S21-SE21
L= 98,00 m
D= 63 mm
Q= 0,09 l/s
V= 0,04 m/s
J= 0,0001 m/m
JL= 0,01 m
BRANCH S20-S31
L= 122,00 m
D= 63 mm
Q= 0,69 l/s
V= 0,33 m/s
J= 0,0038 m/m
JL= 0,46 m
Flow Direction
END CAP
ARV
WO
(1240)
(1245)
(1265)

| | | |





HYDRAULIC LEGEND

PIPELINE		BEND 1/8	C1/8
FLOW DIRECTION		A.V (AIR VALVE)	
VALVE		W.O (WASHOUT)	
TEE		FLANGED ADAPTER	
REDUCER		END CAP	
PRESSURE REGULATING VALVE	A.V	GLOBE VALVE	
D.J.	DISMANTLING JOINT	PRESSURE RELIEF VALVE	

NOTES

- ALL ALTITUDES ARE TIED TO THE NATIONAL ELEVATION OF LEBANON
- HEAD LOSSES HAVE BEEN CALCULATED TO THE COLEBROOK FORMULA WITH AN ABSOLUTE ROUGHNESS K=0,4 mm FOR DUCTILE IRON PIPES AND K=0,2 mm FOR HDPE PIPES
- FOR PIPELINE ANCHORS AND SUPPORT DETAILS REFER TO STANDARD DWG Nb 462-05ST14
- FOR PIPELINE TRENCH DETAILS REFER TO STANDARD DWG Nb 462-05ST05 AND DWG Nb 462-05ST06
- FOR HORIZONTAL BENDS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST11 AND DWG Nb 462-05ST12
- FOR VERTICAL BENDS AND TAPERS THRUST BLOCKS DETAILS REFER TO STANDARD DWG Nb 462-05ST13
- FOR CONNECTION TO EXISTING PIPES REFER TO STANDARD DWG Nb 462-05ST09 AND DWG Nb 462-05ST10
- PIPE MATERIAL: DUCTILE IRON CLASS K9
  HDPE PE100 PN16
- ALL PIPE FITTINGS AND ACCESSORIES ARE PN16, UNLESS OTHERWISE SPECIFIED
- ALL PIPES SHOULD BE EXECUTED IN PUBLIC OR EXPROPRIATED ROADS
- FOR MANHOLE DETAILS, REFER TO HYDRAULIC ACCESSORIES ON NETWORK PLAN

Rev.	Date	Dsgn.	Drwn.	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

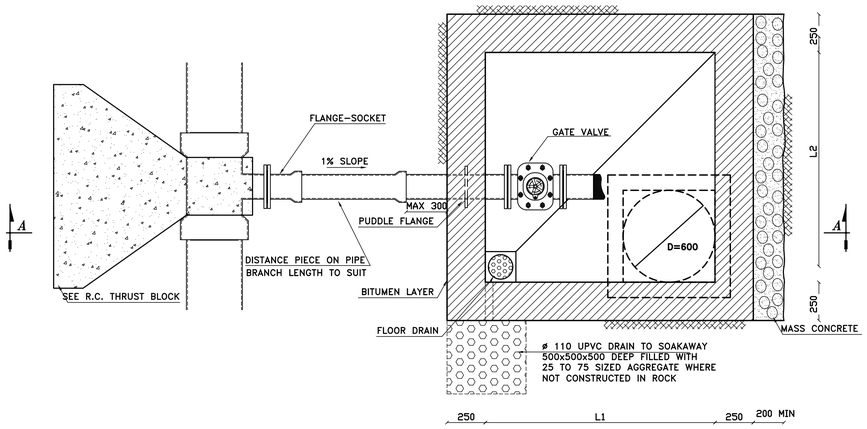
JAJ DISTRIBUTION NETWORK	PROFILES

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05DS-01PR	R. YAACOUB	R. YAACOUB	R. YAACOUB

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:2000	11/11	462-05DS-01PR11

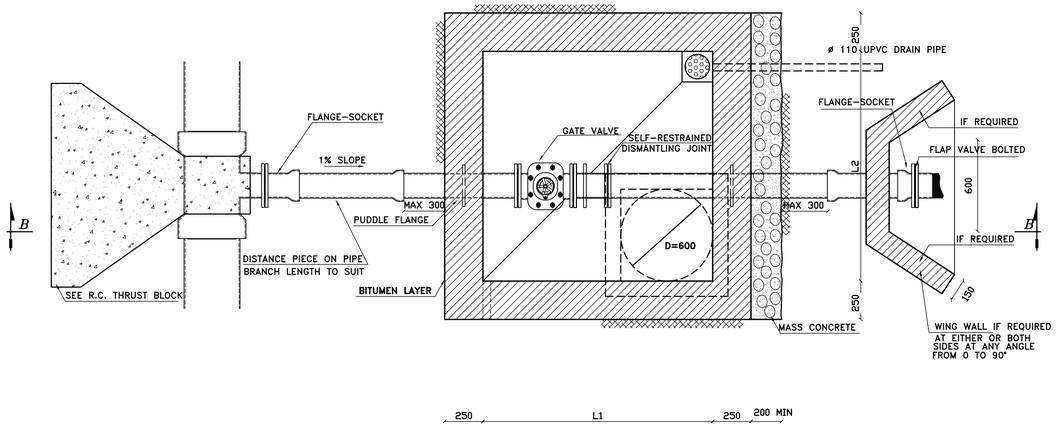
ORIGINAL DRAWING SIZE A1

TYPICAL WASHOUT CHAMBER DETAIL
TYPE I

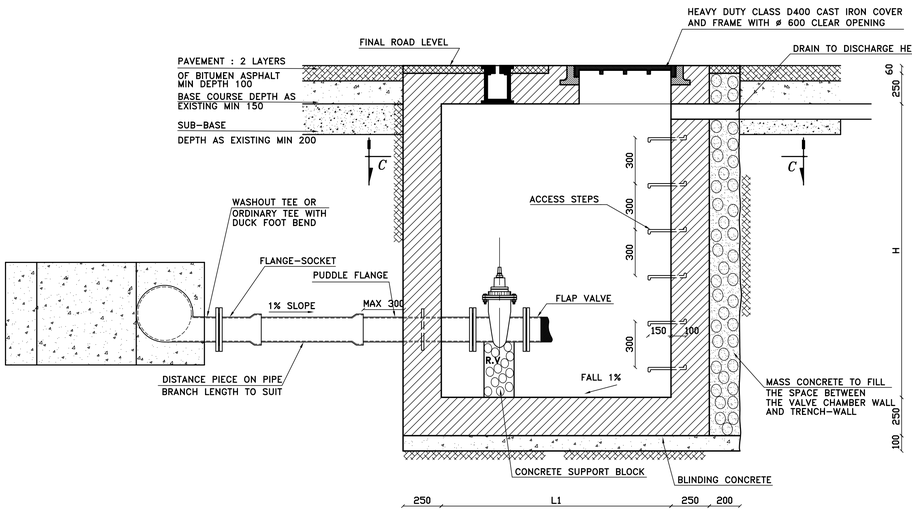


SECTION C–C

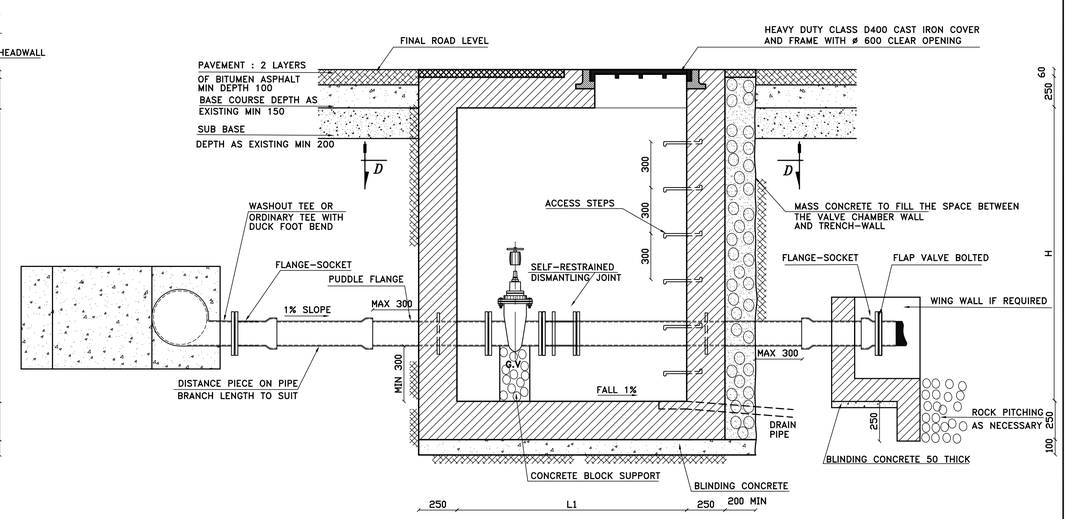
TYPICAL WASHOUT CHAMBER DETAIL
TYPE II



SECTION D–D

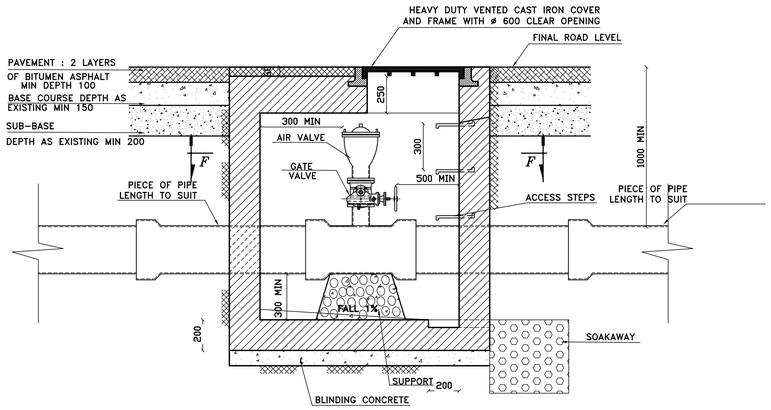


SECTION A–A

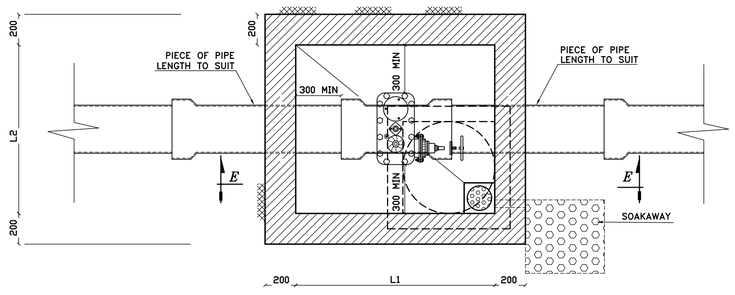


SECTION B–B

TYPICAL AIR VALVE CHAMBER DETAIL
NOT TO SCALE



SECTION E–E



SECTION F–F

NOTES:

REINFORCED CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 350 Kg/m3

BLINDING AND MASS CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=400 MPa.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy=215 MPa.

STRESSES:
SEVERE CONTROL.
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS: f'c =25 MPa.
CONCRETE TENSILE STRENGTH AT 28 DAYS: ft =2.1 MPa.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 30 mm

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50ø.
(ø= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
STIRRUPS ø8 SHALL BE USED ON EACH LAP.

BENDING:
ø > 12mm MECHANICAL.
ø ≤ 12mm MANUAL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

FORMWORK:
ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE
(METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
BITUMEN LAYER ON EXTERNAL SURFACES OF VALVE CHAMBER WALLS EXCEPT WHERE THERE IS MASS CONCRETE

REMARKS:
* HOLES MADE BY THE TIE–RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* ALL DIMENSIONS ARE IN MILLIMETERS.
* SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
* SOIL FRICTION ANGLE SHALL BE 25°
* GROUND/ MANHOLE FRICTION COEFFICIENT SHALL BE 2/3 tg ø
* THE PASSIVE EARTH PRESSURE SHALL BE TAKEN INTO ACCOUNT FOR MANHOLE STABILITY BY FILLING THE VOID BETWEEN THE MANHOLE AND THE TRENCH WALL WITH MASS CONCRETE OF A MINIMUM THICKNESS "200".

SOAKAWAY
TO BE USED ONLY IF THE INSTALLATION OF AN ADEQUATE GRAVITY DRAIN PIPE TO A FREE OUTLET IS DETERMINED BY THE ENGINEER NOT TO BE POSSIBLE.

WASHOUT CHAMBER DIMENSIONS :
IN THE CASES WHERE THE WASHOUT CHAMBER IS TO HOUSE, AT THE SAME TIME, THE WASHOUT GATE VALVE AND THE MAIN PIPE,THE CHAMBER DIMENSIONS MAY VARY FROM THOSE INDICATED ON THIS DRAWING. CONSEQUENTLY, THE EXACT DIMENSIONS ARE TO BE TAKEN FROM THE RELEVANT SPECIFICATIONS AND/OR DRAWINGS IN THE TENDER DOCUMENTS OR AS DIRECTED BY THE ENGINEER.

* T.P. =TEST PRESSURE
* WASHOUT CHAMBER TYPE II SHALL BE USED NORMALLY.IF DETERMINED BY THE ENGINEER NOT TO BE APPLICABLE , TYPE I WILL BE USED.

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

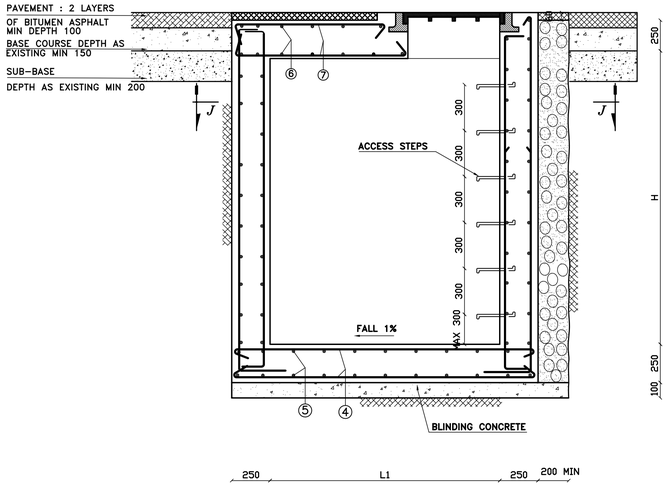
TRANSMISSION AND DISTRIBUTION SYSTEMS	WASHOUT AND AIR VALVE CHAMBER DETAILS

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

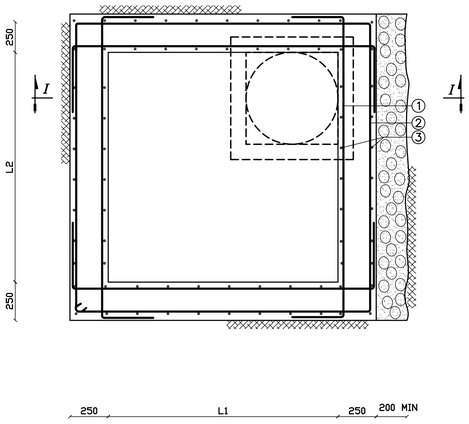
DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	1/21	462-05ST01

ORIGINAL DRAWING SIZE A1

TYPICAL REINFORCEMENT DETAIL FOR WASHOUT CHAMBER
NOT TO SCALE

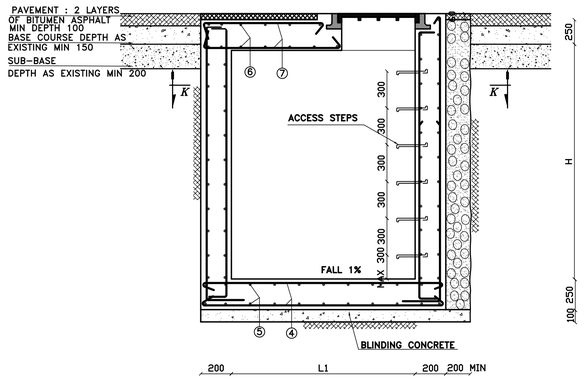


SECTION I–I

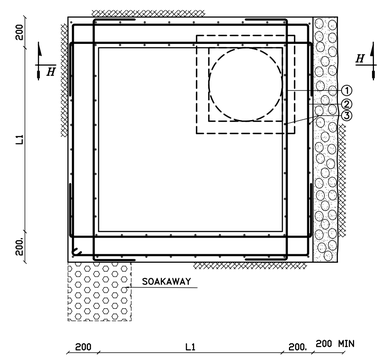


SECTION J–J

TYPICAL REINFORCEMENT DETAIL FOR AIR VALVE CHAMBER
NOT TO SCALE



SECTION H–H



SECTION K–K

TYPICAL SINGLE OR DOUBLE AIR VALVE CHAMBER
REINFORCEMENT STEEL TABLE

PIPE DIAMETER	REINFORCEMENT						
D mm	1 mm	2 mm	3 mm	4 mm	5 mm	6 mm	7 mm
80–150	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200
200–250	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200
300–400	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200
450–600	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200
700–800	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200
900–1000	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200

TYPICAL DOUBLE AIR VALVE CHAMBER
DIMENSIONS TABLE

MAIN LINE DIAMETER	AIR VALVE DIAMETER	L2	L1	H
ø mm	ø mm	mm	mm	mm
80–150	60	1000	1250	1200
200–250	60	1250	1500	1300
300–400	100	1250	1500	1500
450–600	100	1500	1500	2000
700–800	150	1500	1500	2100
900–1000	200	1750	2000	2300

TYPICAL SINGLE AIR VALVE CHAMBER
DIMENSIONS TABLE

MAIN LINE DIAMETER	AIR VALVE DIAMETER	L2	L1	H
ø mm	ø mm	mm	mm	mm
80–200	60	1000	1250	1200
250	60	1000	1500	1300
300–400	100	1000	1500	1500
450–600	100	1250	1750	2000

TYPICAL WASHOUT CHAMBER FOR TRANSMISSION PIPELINES–DIMENSIONS

TABLE 1 OF 2

MAIN PIPE DIAMETER	WASHOUT DIAMETER	DIMENSIONS		
mm	mm	L1 mm	L2 mm	H mm
80–150	80	1500	1500	1500
200	100	1500	1500	1500
250	150	1500	1500	1500
300–350	150	1500	1500	1500

TABLE 2 OF 2

MAIN PIPE DIAMETER	WASHOUT DIAMETER	T.P ⩽ 15 BARS		T.P > 15 BARS		
mm	mm	L1 mm	L2 mm	L1 mm	L2 mm	H mm
400–450	200	1500	1500	1500	1500	1600
500	250	1500	1500	2000	2000	2000
600⩽D⩽900	300	1500	1500			2150
600⩽D⩽900	250			2000	2000	2250

TYPICAL WASHOUT CHAMBER FOR TRANSMISSION PIPELINES–REINFORCEMENT

TABLE 1 OF 2

PIPE DIAMETER	REINFORCEMENT						
D mm	1 mm	2 mm	3 mm	4 mm	5 mm	6 mm	7 mm
80–150	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200
200	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200
250	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200
300–350	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200

TABLE 2 OF 2

PIPE DIAMETER	REINFORCEMENT						
D mm	1 mm	2 mm	3 mm	4 mm	5 mm	6 mm	7 mm
400–450	T12 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200
500	T14 @200	T12 @200	T12 @200	T12 @200	T12 @200	T14 @200	T14 @200
600⩽D⩽900	T14 @200	T14 @200	T14 @200	T14 @200	T14 @200	T14 @200	T14 @200

TYPICAL WASHOUT CHAMBER DETAIL FOR DISTRIBUTION PIPELINES
DIMENSIONS TABLE

MAIN PIPE DIAMETER	WASHOUT DIAMETER	DIMENSIONS		
mm	mm	L1 mm	L2 mm	H mm
80–125	60	1500	1500	1500
150	80	1500	1500	1500
200	100	1500	1500	1500
250	150	1500	1500	1500
300 ⩽ ø ⩽ 600	150	1500	1500	1650

REINFORCEMENT STEEL TABLE

PIPE DIAMETER	REINFORCEMENT						
D mm	1 mm	2 mm	3 mm	4 mm	5 mm	6 mm	7 mm
80–125	T12 @200	T12 @200	T10 @200	T12 @200	T12 @200	T14 @200	T14 @200
150	T12 @200	T12 @200	T10 @200	T12 @200	T12 @200	T14 @200	T14 @200
200	T12 @200	T12 @200	T10 @200	T12 @200	T12 @200	T14 @200	T14 @200
250	T12 @200	T12 @200	T10 @200	T12 @200	T12 @200	T14 @200	T14 @200
300 ⩽ ø ⩽ 600	T12 @200	T12 @200	T10 @200	T12 @200	T12 @200	T14 @200	T14 @200

NOTES:

REINFORCED CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 350 Kg/m3

BLINDING AND MASS CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=400 MPa.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy=215 MPa.

STRESSES:
SEVERE CONTROL.
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS: f'c =25 MPa.
CONCRETE TENSILE STRENGTH AT 28 DAYS: ft =2.1 MPa.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 30 mm

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50ø.
(ø= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
STIRRUPS ø8 SHALL BE USED ON EACH LAP.

BENDING:
ø > 12mm MECHANICAL.
ø ⩽ 12mm MANUAL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

FORMWORK:
ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE
(METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
BITUMEN LAYER ON EXTERNAL SURFACES OF VALVE CHAMBER WALLS EXCEPT WHERE THERE IS MASS CONCRETE

REMARKS:
* HOLES MADE BY THE TIE–RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* ALL DIMENSIONS ARE IN MILLIMETERS.
* SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
* SOIL FRICTION ANGLE SHALL BE 25°
* GROUND/ MANHOLE FRICTION COEFFICIENT SHALL BE 2/3 tg ø
* THE PASSIVE EARTH PRESSURE SHALL BE TAKEN INTO ACCOUNT FOR MANHOLE STABILITY BY FILLING THE VOID BETWEEN THE MANHOLE AND THE TRENCH WALL WITH MASS CONCRETE OF A MINIMUM THICKNESS "200".

SOAKAWAY
TO BE USED ONLY IF THE INSTALLATION OF AN ADEQUATE GRAVITY DRAIN PIPE TO A FREE OUTLET IS DETERMINED BY THE ENGINEER NOT TO BE POSSIBLE.

WASHOUT CHAMBER DIMENSIONS :
IN THE CASES WHERE THE WASHOUT CHAMBER IS TO HOUSE, AT THE SAME TIME, THE WASHOUT GATE VALVE AND THE MAIN PIPE,THE CHAMBER DIMENSIONS MAY VARY FROM THOSE INDICATED ON THIS DRAWING. CONSEQUENTLY, THE EXACT DIMENSIONS ARE TO BE TAKEN FROM THE RELEVANT SPECIFICATIONS AND/OR DRAWINGS IN THE TENDER DOCUMENTS OR AS DIRECTED BY THE ENGINEER.

* T.P. =TEST PRESSURE

* WASHOUT CHAMBER TYPE II SHALL BE USED NORMALLY.IF DETERMINED BY THE ENGINEER NOT TO BE APPLICABLE , TYPE I WILL BE USED.

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

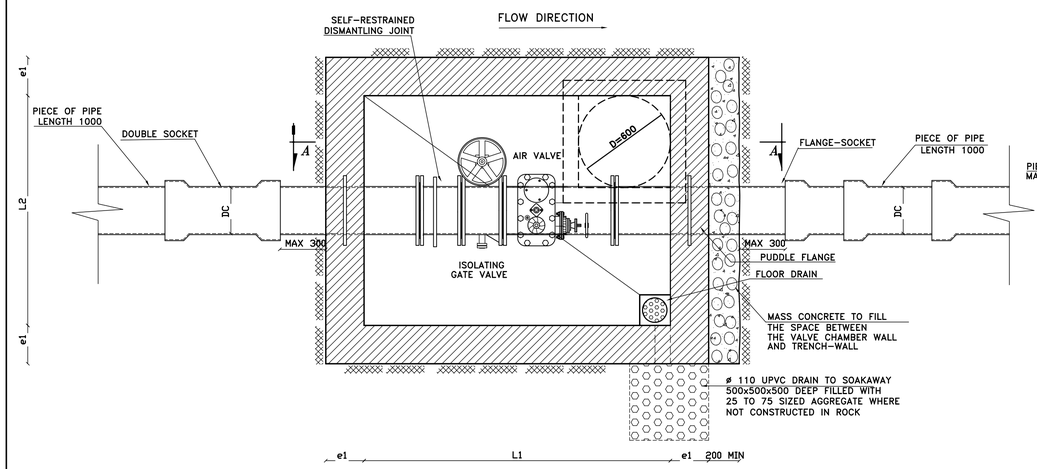
CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	WASHOUT AND AIR VALVE CHAMBER DETAILS

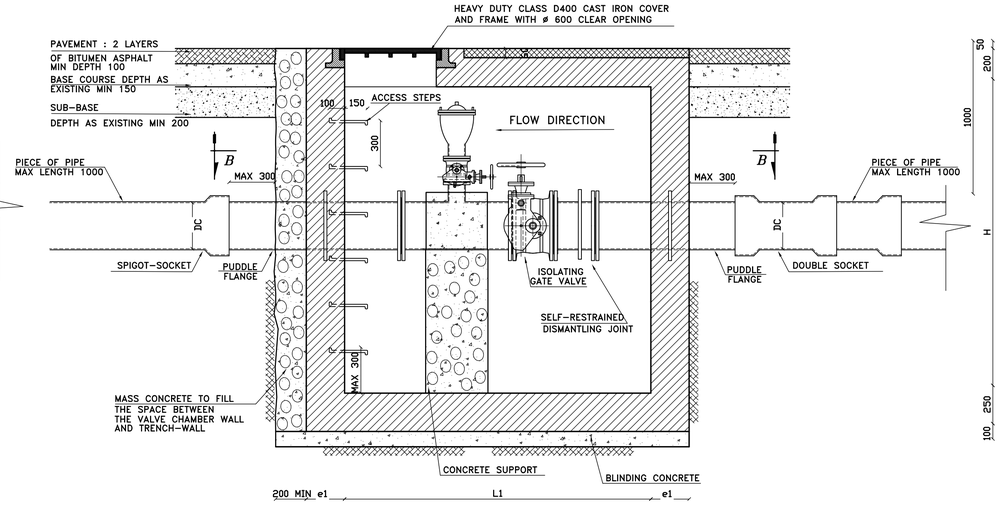
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:50 - 1:20	2/21	462-05ST02

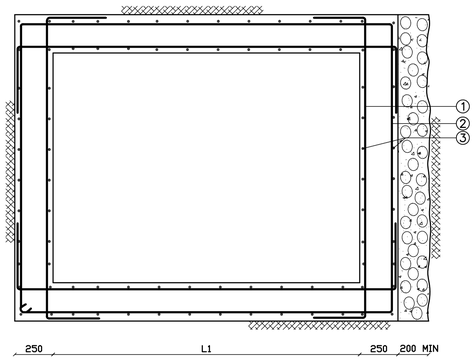
ORIGINAL DRAWING SIZE A1



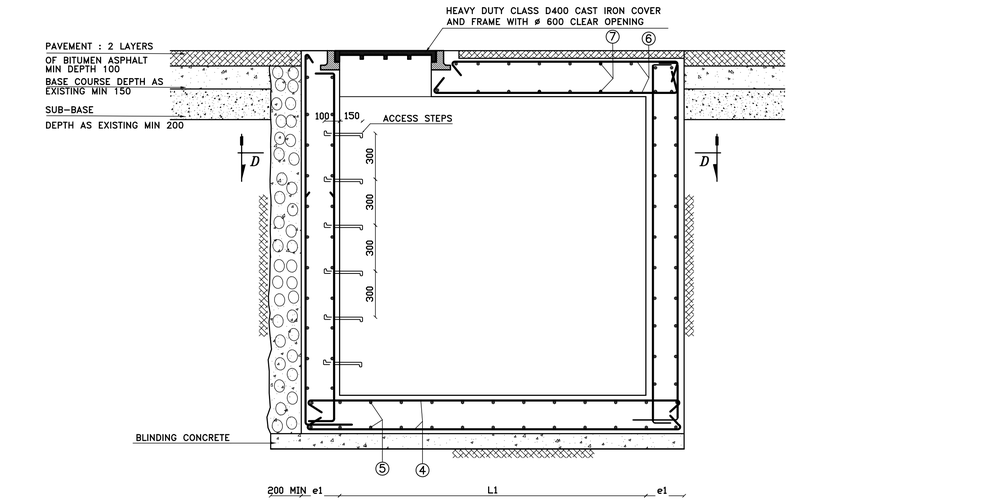
SECTION B–B
TYPICAL STOP VALVE CHAMBER DETAIL



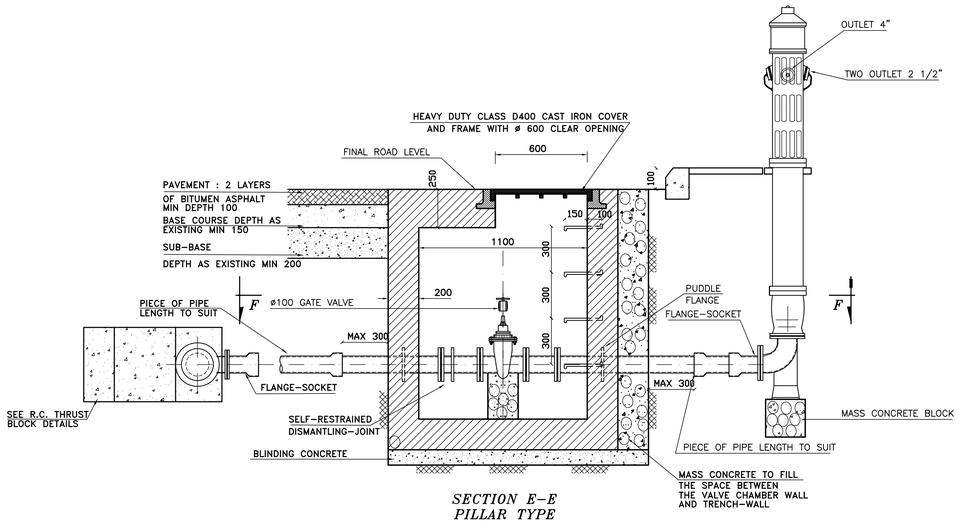
SECTION A–A
TYPICAL STOP VALVE CHAMBER DETAIL



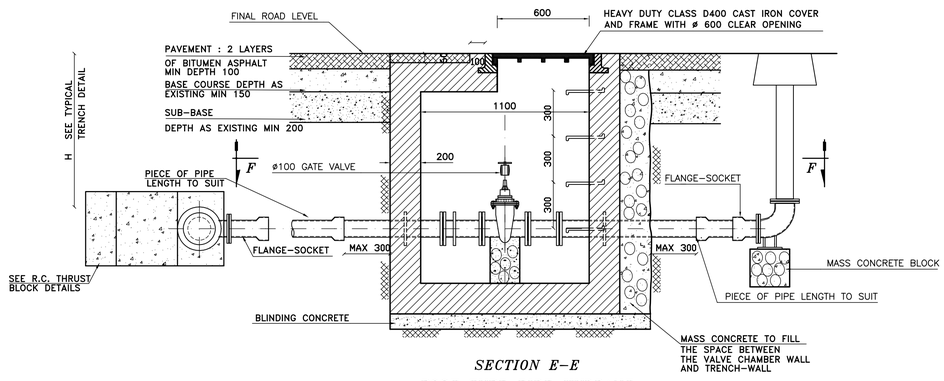
SECTION D–D
TYPICAL VALVE CHAMBER REINFORCEMENT DETAILS



SECTION A–A
TYPICAL VALVE CHAMBER REINFORCEMENT DETAILS



SECTION E–E
PILLAR TYPE



SECTION E–E
POST TYPE FIRE HYDRANT

NOTES:

REINFORCED CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 350 Kg/m3

BLINDING AND MASS CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=400 MPa.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy=215 MPa.

STRESSES:
SEVERE CONTROL.
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS: fć =25 MPa.
CONCRETE TENSILE STRENGTH AT 28 DAYS: fť =2.1 MPa.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 30 mm

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50ø.
(ø= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
STIRRUPS ø8 SHALL BE USED ON EACH LAP.

BENDING:
ø > 12mm MECHANICAL.
ø ≤ 12mm MANUAL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

FORMWORK:
ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE
(METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
BITUMEN LAYER ON EXTERNAL SURFACES OF VALVE CHAMBER WALLS EXCEPT WHERE THERE IS MASS CONCRETE

REMARKS:
* HOLES MADE BY THE TIE–RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* ALL DIMENSIONS ARE IN MILLIMETERS.
* SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
* SOIL FRICTION ANGLE SHALL BE 25°
* GROUND/ MANHOLE FRICTION COEFFICIENT SHALL BE 2/3 tg ø
* THE PASSIVE EARTH PRESSURE SHALL BE TAKEN INTO ACCOUNT FOR MANHOLE STABILITY BY FILLING THE VOID BETWEEN THE MANHOLE AND THE TRENCH WALL WITH MASS CONCRETE OF A MINIMUM THICKNESS "200".

SOAKAWAY
TO BE USED ONLY IF THE INSTALLATION OF AN ADEQUATE GRAVITY DRAIN PIPE TO A FREE OUTLET IS DETERMINED BY THE ENGINEER NOT TO BE POSSIBLE.

WASHOUT CHAMBER DIMENSIONS :
IN THE CASES WHERE THE WASHOUT CHAMBER IS TO HOUSE, AT THE SAME TIME, THE WASHOUT GATE VALVE AND THE MAIN PIPE,THE CHAMBER DIMENSIONS MAY VARY FROM THOSE INDICATED ON THIS DRAWING. CONSEQUENTLY, THE EXACT DIMENSIONS ARE TO BE TAKEN FROM THE RELEVANT SPECIFICATIONS AND/OR DRAWINGS IN THE TENDER DOCUMENTS OR AS DIRECTED BY THE ENGINEER.

* T.P. =TEST PRESSURE
* WASHOUT CHAMBER TYPE II SHALL BE USED NORMALLY.IF DETERMINED BY THE ENGINEER NOT TO BE APPLICABLE , TYPE I WILL BE USED.

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	STOP VALVE AND FIRE HYDRANT TYPICAL VALVE CHAMBER DETAILS

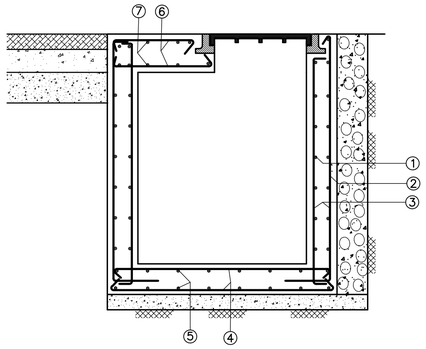
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	3/21	462-05ST03

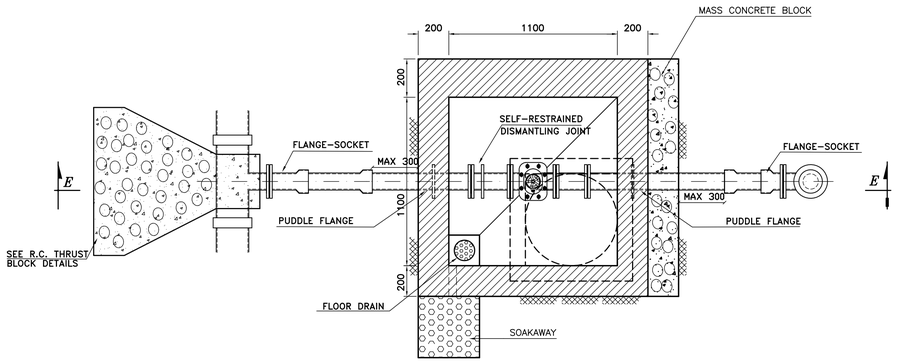
ORIGINAL DRAWING SIZE A1

TYPICAL STOP VALVE CHAMBER DIMENSIONS

MAIN PIPE DIAMETER	DIMENSIONS				
	WALL & LOWER SLAB THICKNESS	COVER SLAB THICKNESS	LENGTH	WIDTH	HEIGHT
DC mm	e1 mm	e2 mm	L1 mm	L2 mm	H mm
80–150	200	250	1500	1250	1450
200–250	250	250	1750	1500	1550
300–350	250	250	2000	2000	2100
400–450	300	300	2500	2250	2500
500–600	350	300	3000	3000	3000
700–800	400	300	3500	3000	3300
900–1000	500	400	3500	3000	4300



SECTION E–E
TYPICAL FIRE HYDRANT VALVE CHAMBER



SECTION F–F
POST TYPE & PILLAR TYPE FIRE HYDRANT

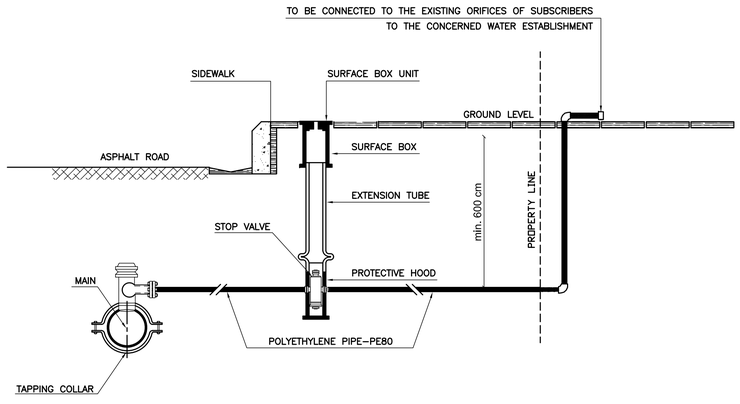
TYPICAL STOP VALVE CHAMBER REINFORCEMENT

PIPE DIAMETER	REINFORCEMENT						
D mm	1 mm	2 mm	3 mm	4 mm	5 mm	6 mm	7 mm
80–150	T12 ❁200	T12 ❁200	T12 ❁200	T12 ❁200	T12 ❁200	T14 ❁200	T14 ❁200
200–250	T12 ❁200	T12 ❁200	T12 ❁200	T12 ❁200	T12 ❁200	T14 ❁200	T14 ❁200
300–350	T14 ❁200	T14 ❁200	T14 ❁200	T14 ❁200	T14 ❁200	T14 ❁200	T14 ❁200
400–450	T14 ❁200	T14 ❁200	T14 ❁200	T14 ❁200	T14 ❁200	T14 ❁200	T14 ❁200
500–600	T16 ❁200	T16 ❁200	T16 ❁200	T16 ❁200	T16 ❁200	T14 ❁200	T14 ❁200
700–800	T16 ❁200	T16 ❁200	T16 ❁165	T16 ❁200	T16 ❁200	T14 ❁165	T14 ❁165
900–1000	T16 ❁200	T16 ❁200	T20 ❁200	T16 ❁200	T16 ❁200	T16 ❁200	T16 ❁200

TYPICAL FIRE HYDRANT VALVE CHAMBER

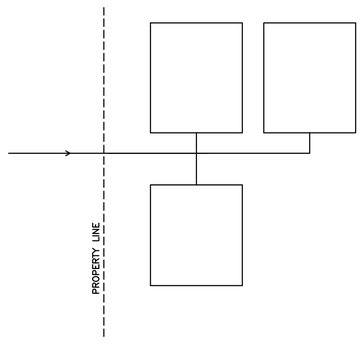
REINFORCEMENT STEEL TABLE

PIPE DIAMETER	REINFORCEMENT						
D mm	1 mm	2 mm	3 mm	4 mm	5 mm	6 mm	7 mm
80–1000	T12 ❁200	T12 ❁200	T12 ❁200	T12 ❁200	T12 ❁200	T14 ❁200	T14 ❁200

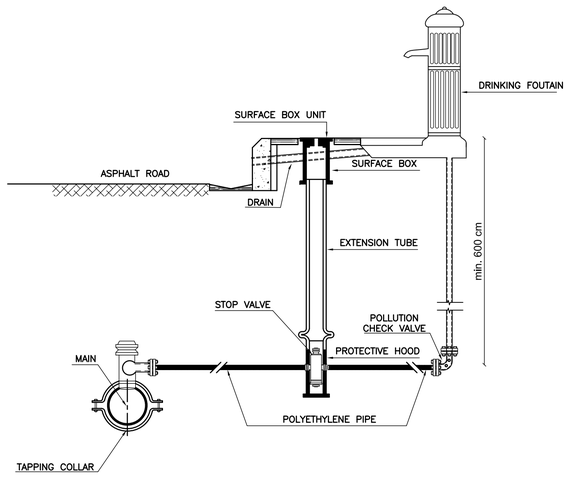


SERVICE CONNECTION

NUMBER OF CONSUMERS	SERVICE PIPE OUTER DIAMETER
1–2	20 mm
3–6	25 mm
7–16	32 mm
17–26	40 mm
>27 OR BIG CONSUMERS	50 mm



MULTIPLE SERVICE CONNECTION DETAIL



TYPICAL DRINKING FOUNTAIN INSTALLATION

NOTES:

REINFORCED CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 350 Kg/m3

BLINDING AND MASS CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=400 MPa.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy=215 MPa.

STRESSES:
SEVERE CONTROL.
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS: f'c =25 MPa.
CONCRETE TENSILE STRENGTH AT 28 DAYS: ft =2.1 MPa.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 30 mm

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50ø.
(ø= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
STIRRUPS ø8 SHALL BE USED ON EACH LAP.

BENDING:
ø > 12mm MECHANICAL.
ø ≤ 12mm MANUAL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

FORMWORK:
ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE (METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
BITUMEN LAYER ON EXTERNAL SURFACES OF VALVE CHAMBER WALLS EXCEPT WHERE THERE IS MASS CONCRETE

REMARKS:
* HOLES MADE BY THE TIE–RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* ALL DIMENSIONS ARE IN MILLIMETERS.
* SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
* SOIL FRICTION ANGLE SHALL BE 25°
* GROUND/ MANHOLE FRICTION COEFFICIENT SHALL BE 2/3 tg ø
* THE PASSIVE EARTH PRESSURE SHALL BE TAKEN INTO ACCOUNT FOR MANHOLE STABILITY BY FILLING THE VOID BETWEEN THE MANHOLE AND THE TRENCH WALL WITH MASS CONCRETE OF A MINIMUM THICKNESS "200".

SOAKAWAY
TO BE USED ONLY IF THE INSTALLATION OF AN ADEQUATE GRAVITY DRAIN PIPE TO A FREE OUTLET IS DETERMINED BY THE ENGINEER NOT TO BE POSSIBLE.

WASHOUT CHAMBER DIMENSIONS :
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* T.P. =TEST PRESSURE

* WASHOUT CHAMBER TYPE II SHALL BE USED NORMALLY.IF DETERMINED BY THE ENGINEER NOT TO BE APPLICABLE , TYPE I WILL BE USED.

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

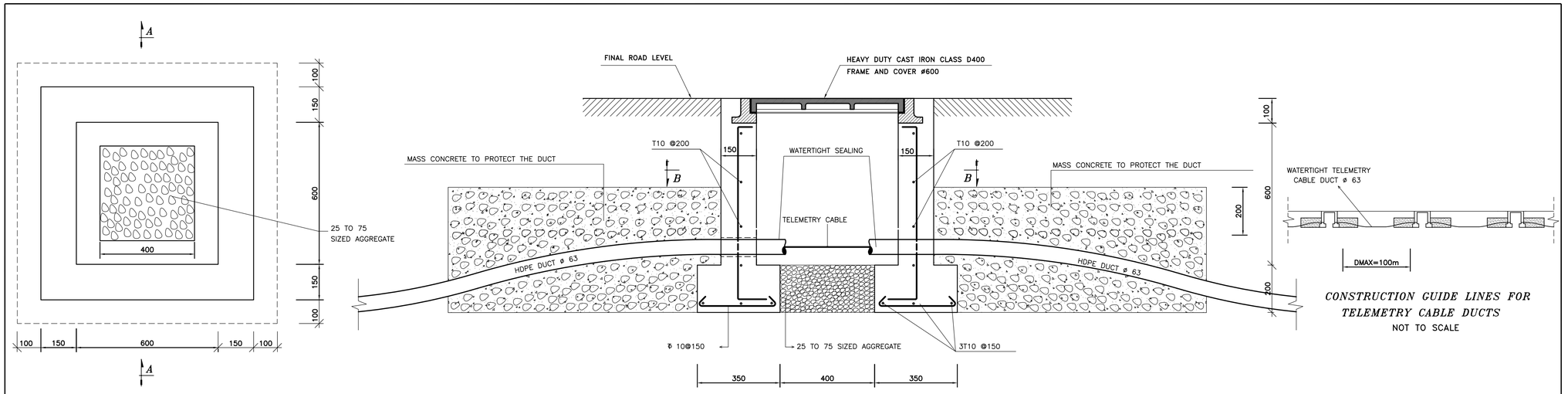
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	STOP VALVE AND FIRE HYDRANT TYPICAL VALVE CHAMBER DETAILS TYPICAL SERVICE CONNECTION AND DRINKING FOUNTAIN

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	4/21	462-05ST04

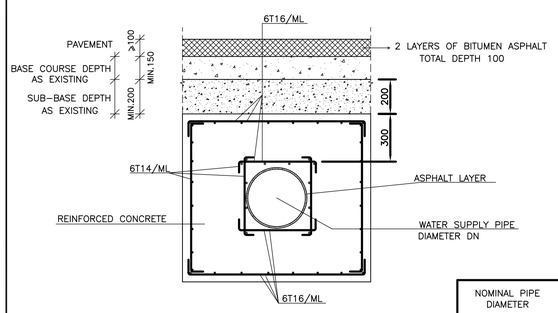
ORIGINAL DRAWING SIZE A1



SECTION B–B
TYPICAL TELEMETRY CABLE DRAW PIT
SCALE 1:10

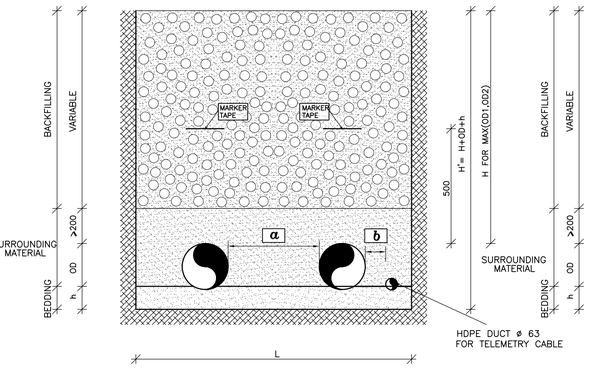
SECTION A–A
TYPICAL TELEMETRY CABLE DRAW PIT
SCALE 1:10

CONSTRUCTION GUIDE LINES FOR TELEMETRY CABLE DUCTS
NOT TO SCALE



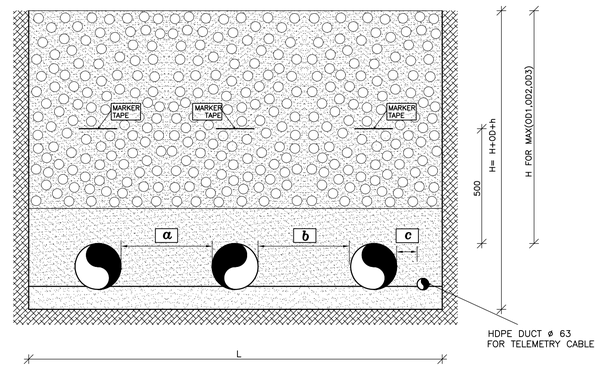
IN ROAD TRENCH SHALLOW DEPTH
NOT TO SCALE

NOMINAL PIPE DIAMETER DN mm	PIPELINE COVER H mm	
	DISTRIBUTION	TRANSMISSION
80–150	800	1000
200–350	1000	1000
400–450	1100	1200
>500	1200	1300



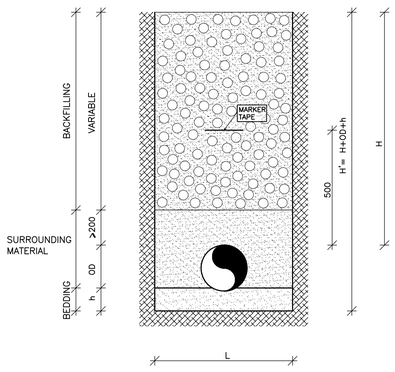
L: TRENCH WIDTH L= 5/4 (OD1+OD2)+1000
h: BEDDING DEPTH
h= 100+MAX(DN1,DN2)/10
a= MAX(DN1/2,DN2/2,300)
b≥200

TRENCH OFF ROAD WITH HDPE DUCT ⌀ 63 FOR TELEMETRY CABLE
NOT TO SCALE



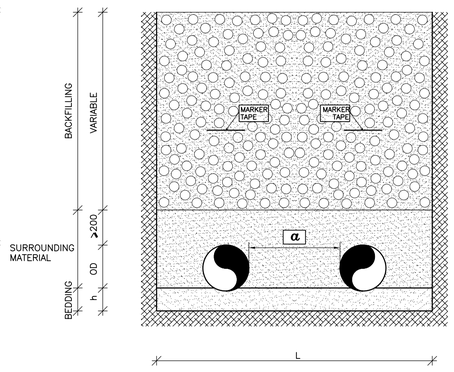
L: TRENCH WIDTH L= 6/5 (OD1+OD2+OD3)+1300
h: BEDDING DEPTH
h= 100+MAX(DN1,DN2,DN3)/10
a= MAX(DN1/2,DN2/2,300)
b= MAX(DN2/2,DN3/2,300)
c≥200

TRENCH OFF ROAD WITH HDPE DUCT ⌀ 63 FOR TELEMETRY CABLE
NOT TO SCALE



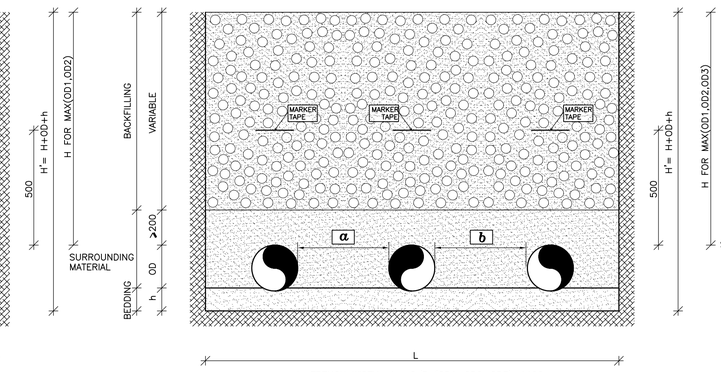
L: TRENCH WIDTH L= 4/3 OD+450(L≥600)
h: BEDDING DEPTH
h:=100+DN/10

TRENCH OFF ROAD FOR ONE PIPE
NOT TO SCALE



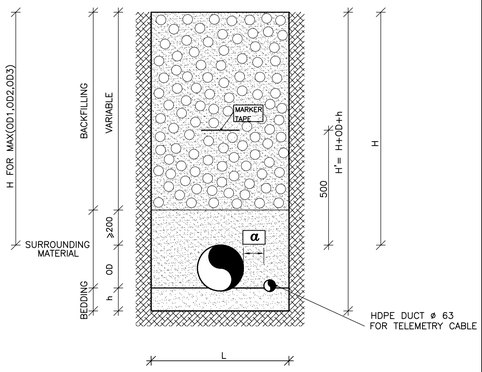
L: TRENCH WIDTH L= 5/4 (OD1+OD2)+800
h: BEDDING DEPTH
h= 100+MAX(DN1,DN2)/10
a= MAX(DN1/2,DN2/2,300)

TRENCH OFF ROAD FOR TWO PIPES
NOT TO SCALE



L: TRENCH WIDTH L= 6/5 (OD1+OD2+OD3)+1100
h: BEDDING DEPTH
h= 100+MAX(DN1,DN2,DN3)/10
a= MAX(DN1/2,DN2/2,300)
b= MAX(DN2/2,DN3/2,300)

TRENCH OFF ROAD FOR THREE PIPES
NOT TO SCALE



L: TRENCH WIDTH L=4/3 OD+600
h: BEDDING DEPTH h= 100+DN/10
a≥200

TRENCH OFF ROAD WITH HDPE DUCT ⌀ 63 FOR TELEMETRY CABLE
NOT TO SCALE

NOTES:

–ALL DIMENSIONS ARE IN MILLIMETERS.

–OD : OUTER PIPE DIAMETER

–DN : NOMINAL PIPE DIAMETER

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON

MINISTRY OF ENERGY AND WATER

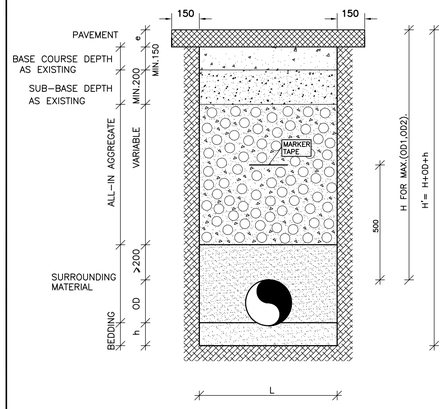
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	TYPICAL TRENCH DETAILS AND TELEMETRY CABLE DRAW PIT

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

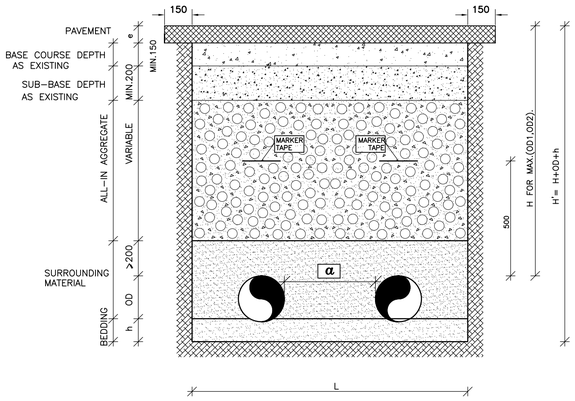
DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	1:50 - 1:20	5/21	462-05ST05

ORIGINAL DRAWING SIZE A1



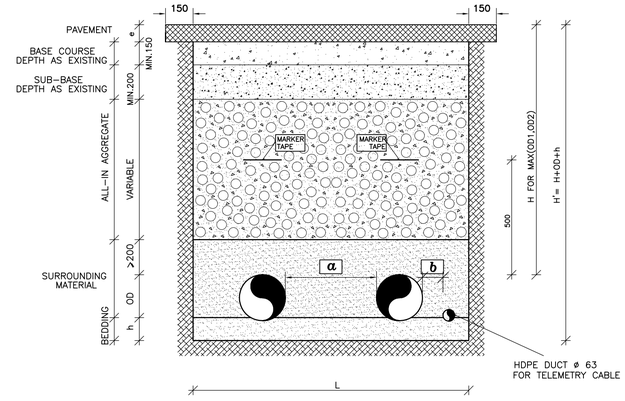
L: TRENCH WIDTH L= 4/3 OD+450(L>600)
h: BEDDING DEPTH h= 100+$\frac{DN}{10}$ mm

TRENCH IN ROAD FOR ONE PIPE
NOT TO SCALE



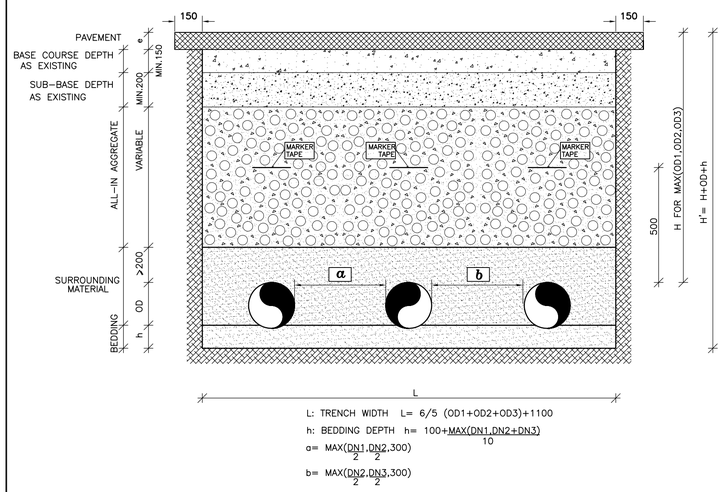
L: TRENCH WIDTH L= 5/4 (OD1+OD2)+800
h: BEDDING DEPTH h= 100+$\frac{MAX(DN1,DN2)}{10}$
a= MAX($\frac{DN1}{2}$,$\frac{DN2}{2}$,300)

TRENCH IN ROAD FOR TWO PIPES
NOT TO SCALE



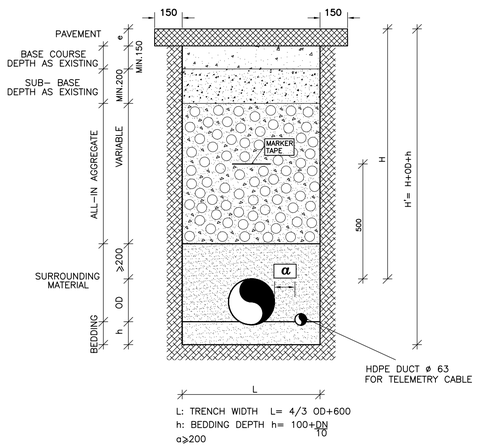
L: TRENCH WIDTH L= 5/4 (OD1+OD2)+1000
h: BEDDING DEPTH
h= 100+$\frac{DN}{10}$ mm
a= MAX($\frac{DN1}{2}$,$\frac{DN2}{2}$,300)
b≥200

TRENCH IN ROAD WITH HDPE DUCT ø 63 FOR TELEMETRY CABLE
NOT TO SCALE



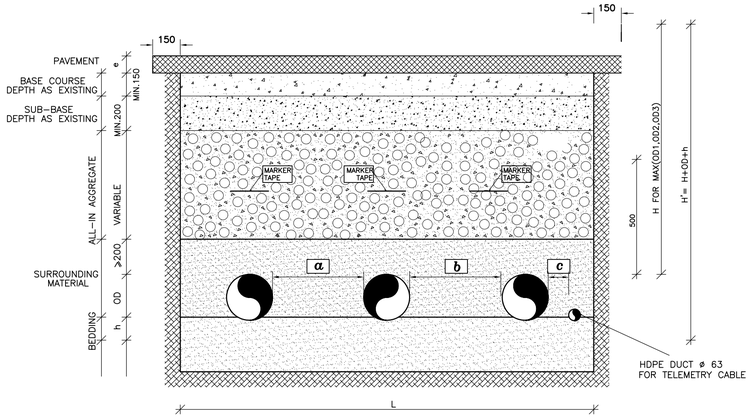
L: TRENCH WIDTH L= 6/5 (OD1+OD2+OD3)+1100
h: BEDDING DEPTH h= 100+$\frac{MAX(DN1,DN2+DN3)}{10}$
a= MAX($\frac{DN1}{2}$,$\frac{DN2}{2}$,300)
b= MAX($\frac{DN2}{2}$,$\frac{DN3}{2}$,300)

TRENCH IN ROAD FOR THREE PIPES
NOT TO SCALE



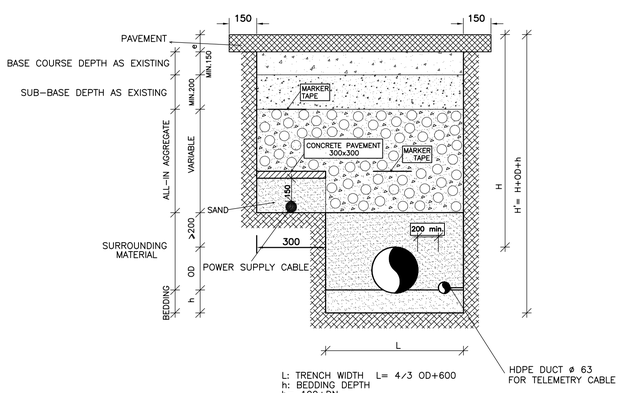
L: TRENCH WIDTH L= 4/3 OD+600
h: BEDDING DEPTH h= 100+$\frac{DN}{10}$
a≥200

TRENCH IN ROAD WITH HDPE DUCT ø 63 FOR TELEMETRY CABLE
NOT TO SCALE



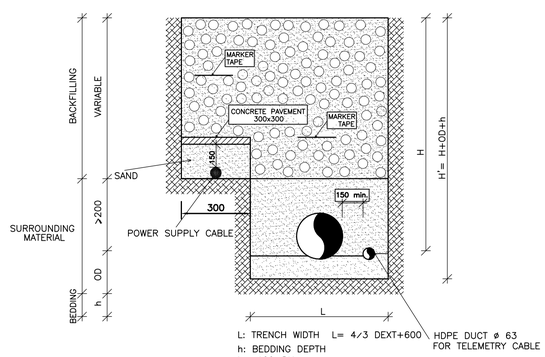
L: TRENCH WIDTH L= 6/5 (OD1+OD2+OD3)+1300
h: BEDDING DEPTH h= 100+$\frac{MAX(DN1,DN2+DN3)}{10}$
a= MAX($\frac{DN1}{2}$,$\frac{DN2}{2}$,300)
b= MAX($\frac{DN2}{2}$,$\frac{DN3}{2}$,300)
c≥200

TRENCH IN ROAD WITH HDPE DUCT ø 63 FOR TELEMETRY CABLE
NOT TO SCALE



L: TRENCH WIDTH L= 4/3 OD+600
h: BEDDING DEPTH
h= 100+$\frac{DN}{10}$

TRENCH IN ROAD WITH HDPE DUCT ø 63 FOR TELEMETRY CABLE AND POWER SUPPLY CABLE
NOT TO SCALE



L: TRENCH WIDTH L= 4/3 DEXT+600
h: BEDDING DEPTH
h= 100+$\frac{DN}{10}$
b ≥ 200

TRENCH OFF ROAD WITH HDPE DUCT ø 63 FOR TELEMETRY CABLE AND POWER SUPPLY CABLE
NOT TO SCALE

NOTES:

- ALL DIMENSIONS ARE IN MILLIMETERS.
- OD : OUTER PIPE DIAMETER
- DN : NOMINAL PIPE DIAMETER
- e : ASPHALT LAYER THICKNESS:
  FOR MAIN ROADS: 2 LAYERS TOTAL e ≥ 9cm
  FOR OTHER ROADS: 1 LAYER total e ≥ 5cm

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

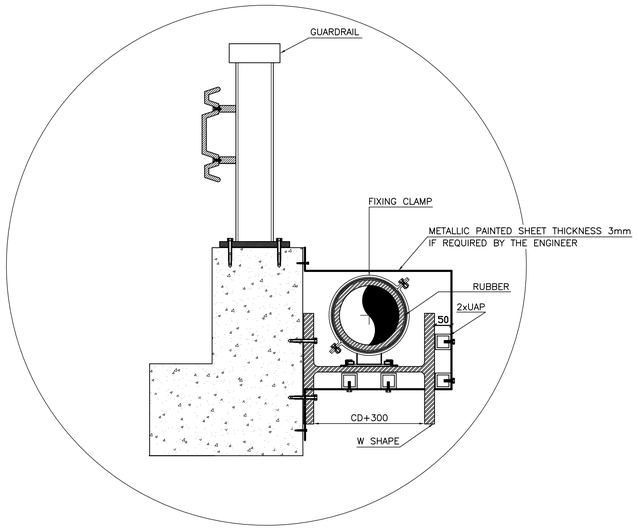
CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	TYPICAL TRENCH DETAILS AND TELEMETRY CABLE DRAW PIT

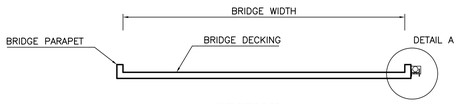
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	6/21	462-05ST06

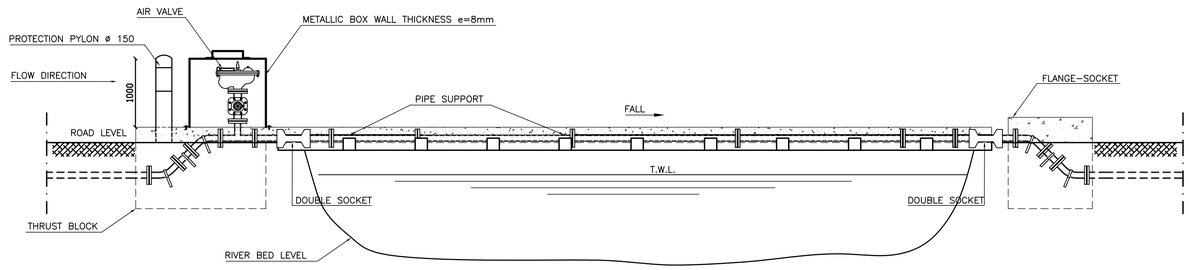
ORIGINAL DRAWING SIZE A1



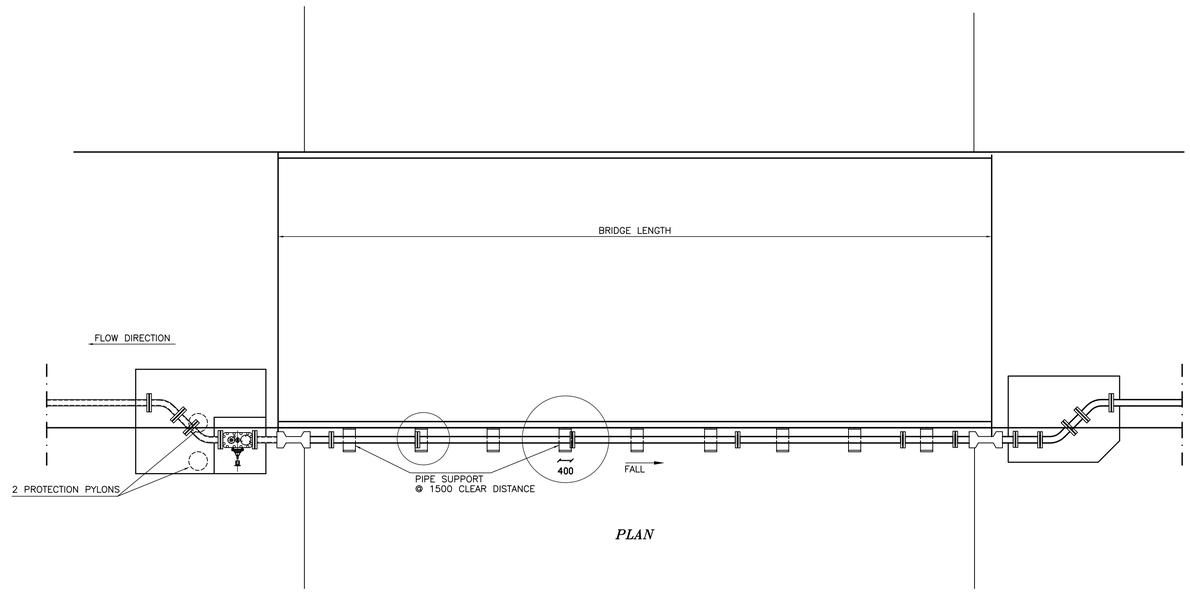
DETAIL A
TYPICAL PIPE SUPPORT ON
ROAD BRIDGE HIGHWAY CROSSING



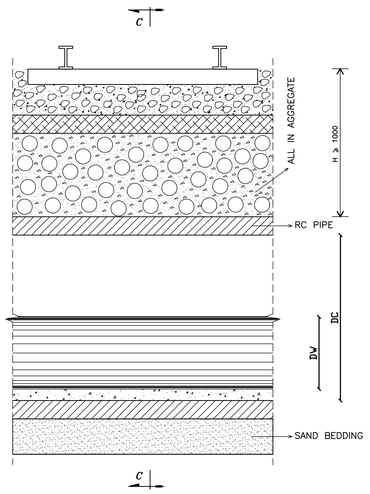
SECTION A–A



ELEVATION

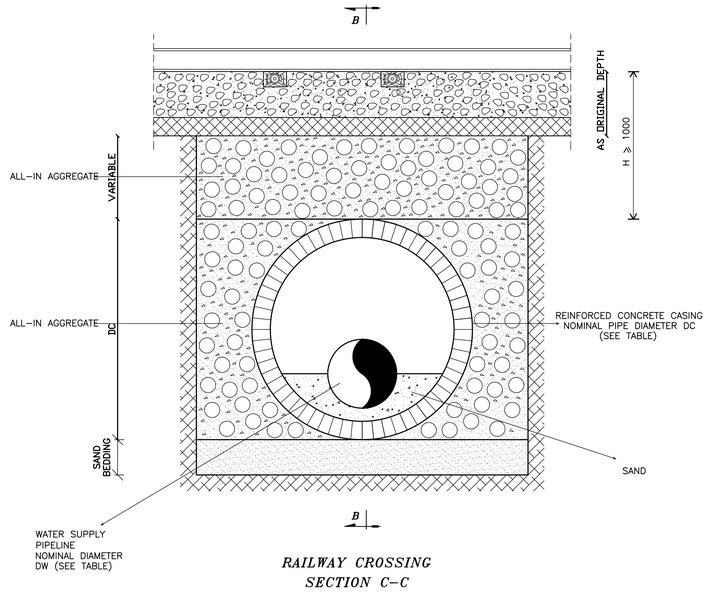


PLAN



RAILWAY CROSSING
SECTION B–B

WATER SUPPLY PIPE	CONCRETE CASING PIPE
DW MM	DC MM
80–100	400
150	600
200–300	800
350–400	1000
450–600	1200



RAILWAY CROSSING
SECTION C–C

NOTES:

–ALL DIMENSIONS ARE IN MILLIMETERS.

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MINISTRY OF ENERGY AND WATER

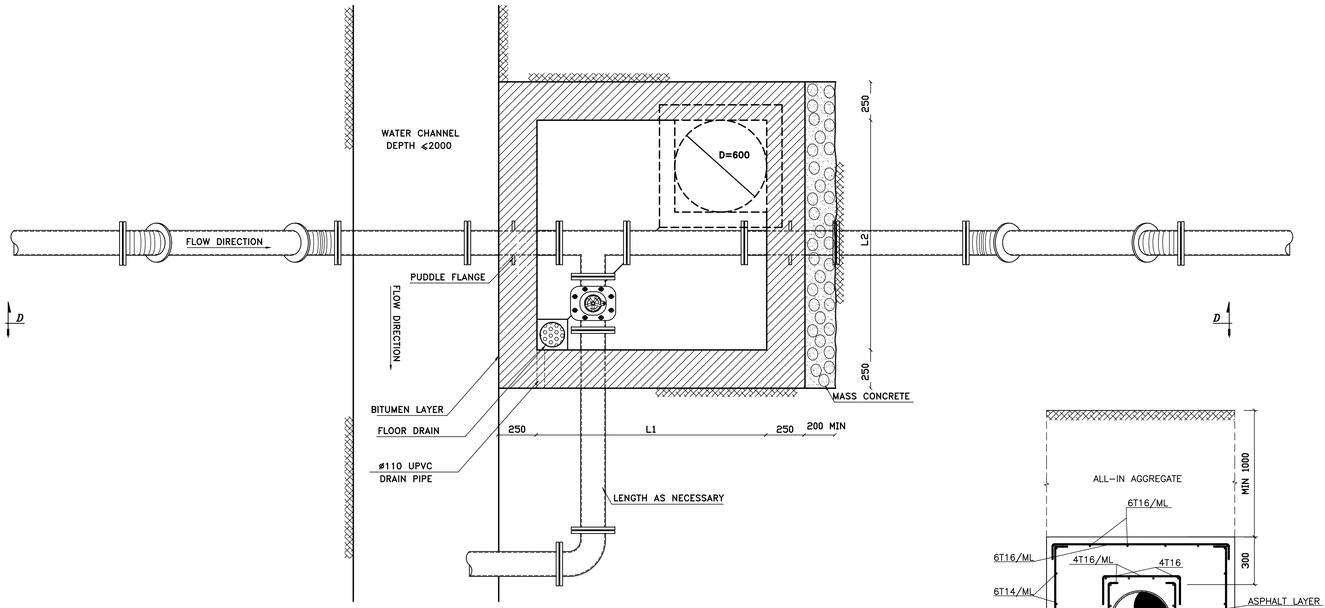
CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	PIPING UNDER SPECIAL CONDITIONS

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

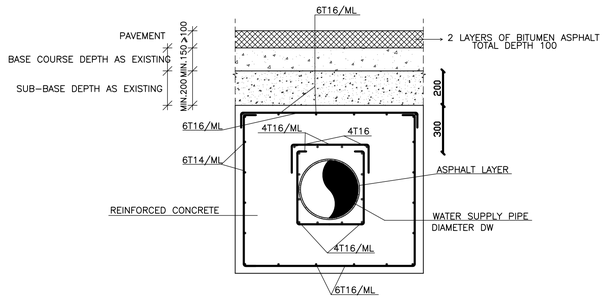
DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	7/21	462-05ST07

ORIGINAL DRAWING SIZE A1

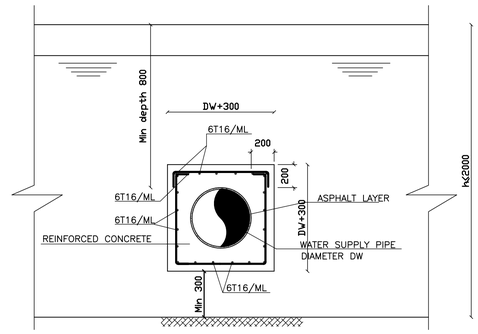


WATER CHANNEL CROSSING (TYPE I)
PLAN

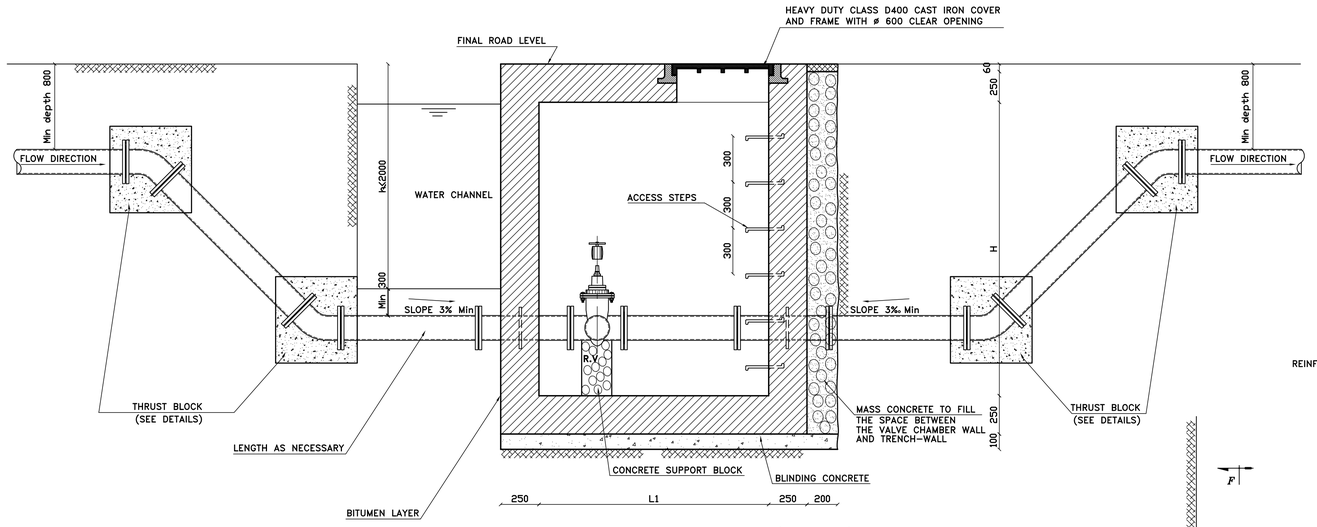
ALONG WATER COURSES
NOT TO SCALE



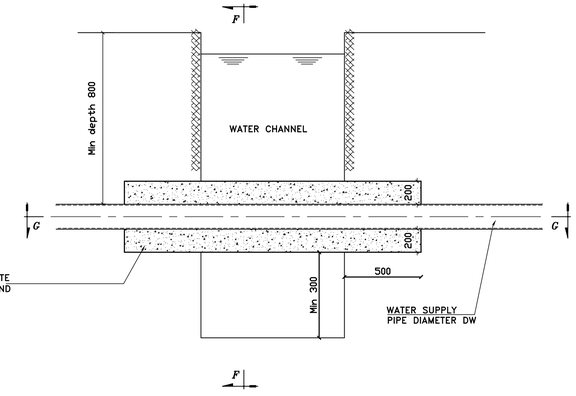
IN ROAD TRENCH SHALLOW DEPTH



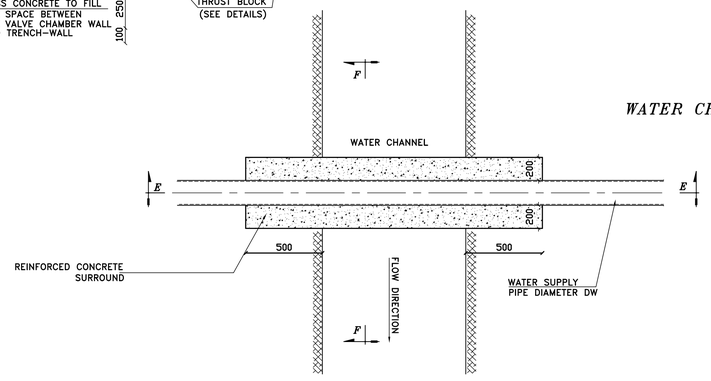
WATER CHANNEL CROSSING (TYPE II)
SECTION F-F



WATER CHANNEL CROSSING (TYPE I)
SECTION D-D



WATER CHANNEL CROSSING (TYPE II)
SECTION E-E



WATER CHANNEL CROSSING (TYPE II)
SECTION G-G

NOTES:

-ALL DIMENSIONS ARE IN MILLIMETERS.

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MINISTRY OF ENERGY AND WATER

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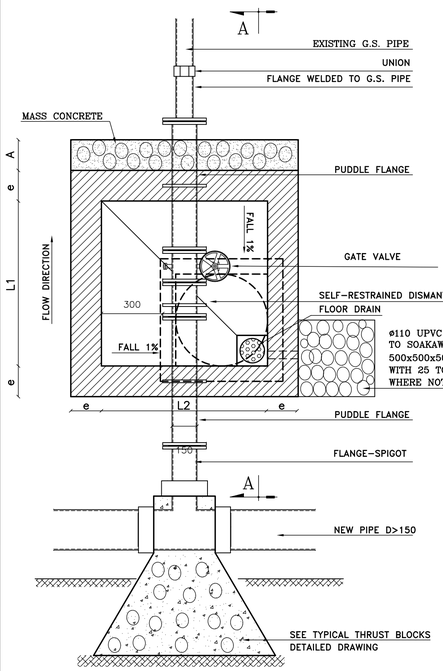
FEBRUARY 2017	NOT TO SCALE	8/21	462-05ST08

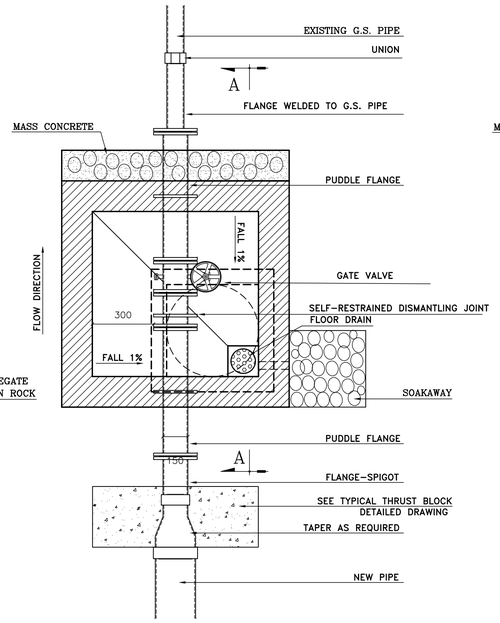
ORIGINAL DRAWING SIZE A1

TYPE 1
SECTION C–C



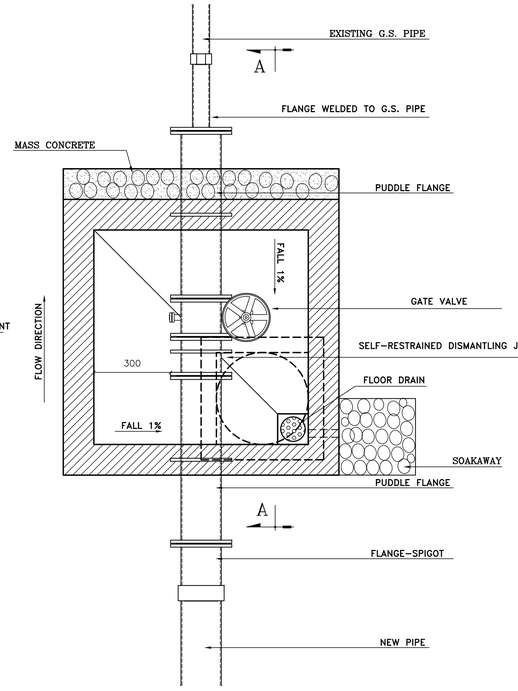
TYPE 1–A

TYPE 2
SECTION C–C



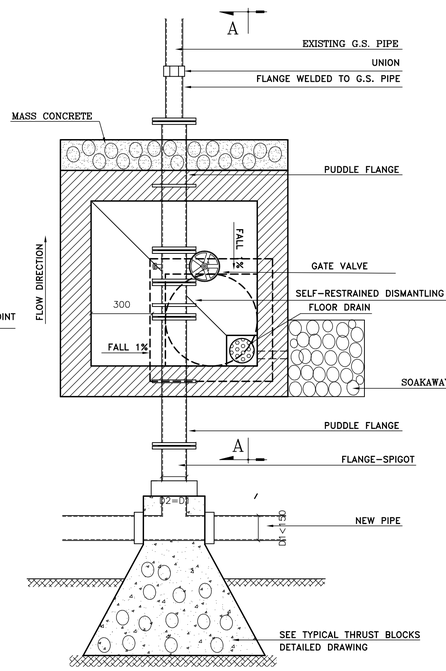
TYPE 2–A

TYPE 3
SECTION C–C



TYPE 3–A

TYPE 4
SECTION C–C



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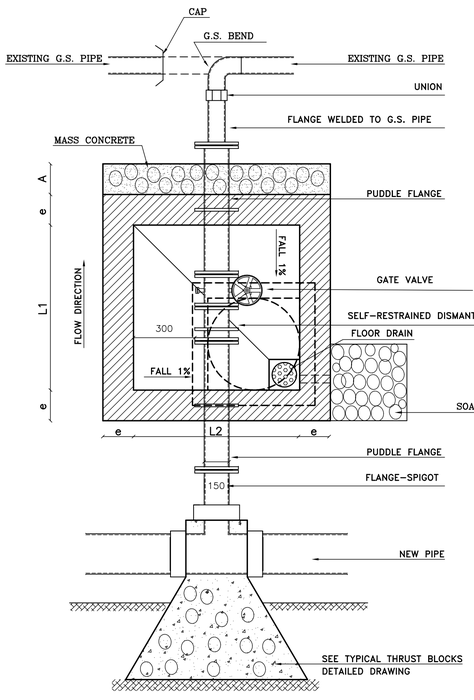

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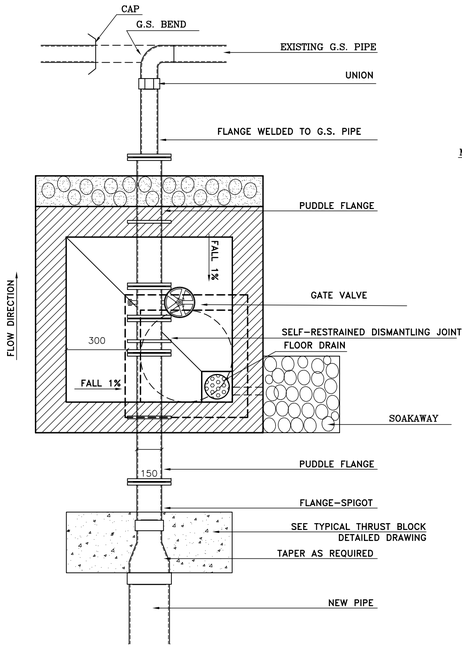

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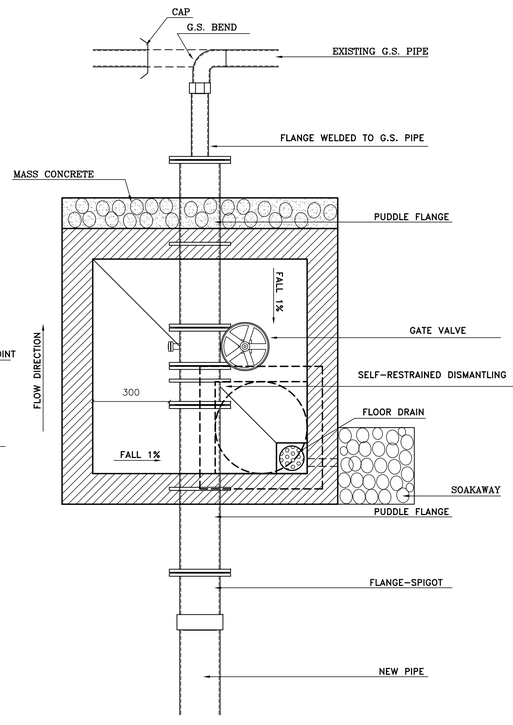

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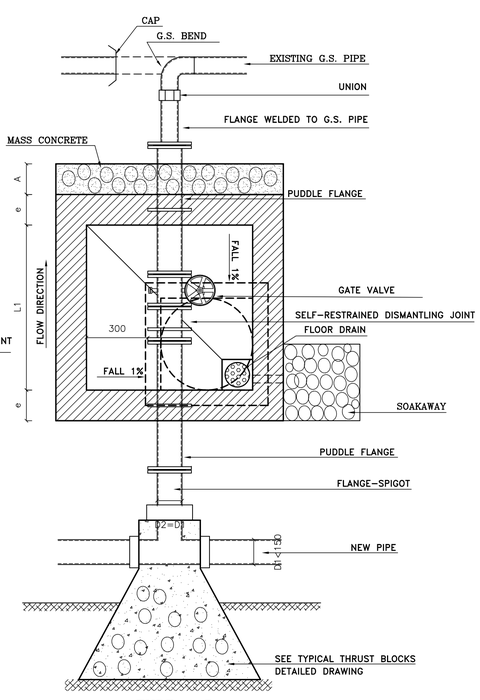


TYPE 4–B

NOTES:

REINFORCED CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 350 Kg/m3

BLINDING AND MASS CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=400 MPa.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy=215 MPa.

STRESSES:
SEVERE CONTROL.
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS: f'c =25 MPa.
CONCRETE TENSILE STRENGTH AT 28 DAYS: ft =2.1 MPa.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 30 mm

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50ø.
(ø= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
STIRRUPS ø8 SHALL BE USED ON EACH LAP.

BENDING:
ø > 12mm MECHANICAL.
ø ≤ 12mm MANUAL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

FORMWORK:
ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE
(METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
BITUMEN LAYER ON EXTERNAL SURFACES OF VALVE CHAMBER WALLS EXCEPT WHERE THERE IS MASS CONCRETE

REMARKS:
* HOLES MADE BY THE TIE–RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* ALL DIMENSIONS ARE IN MILLIMETERS.
* SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
* SOIL FRICTION ANGLE SHALL BE 25°
* GROUND/ MANHOLE FRICTION COEFFICIENT SHALL BE 2/3 tg ø
* THE PASSIVE EARTH PRESSURE SHALL BE TAKEN INTO ACCOUNT FOR MANHOLE STABILITY BY FILLING THE VOID BETWEEN THE MANHOLE AND THE TRENCH WALL WITH MASS CONCRETE OF A MINIMUM THICKNESS "200".

SOAKAWAY
TO BE USED ONLY IF THE INSTALLATION OF AN ADEQUATE GRAVITY DRAIN PIPE TO A FREE OUTLET IS DETERMINED BY THE ENGINEER NOT TO BE POSSIBLE.

WASHOUT CHAMBER DIMENSIONS :
IN THE CASES WHERE THE WASHOUT CHAMBER IS TO HOUSE, AT THE SAME TIME, THE WASHOUT GATE VALVE AND THE MAIN PIPE,THE CHAMBER DIMENSIONS MAY VARY FROM THOSE INDICATED ON THIS DRAWING. CONSEQUETLY, THE EXACT DIMENSIONS ARE TO BE TAKEN FROM THE RELEVANT SPECIFICATIONS AND/OR DRAWINGS IN THE TENDER DOCUMENTS OR AS DIRECTED BY THE ENGINEER.

* T.P. =TEST PRESSURE

* WASHOUT CHAMBER TYPE II SHALL BE USED NORMALLY.IF DETERMINED BY THE ENGINEER NOT TO BE APPLICABLE , TYPE I WILL BE USED.

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

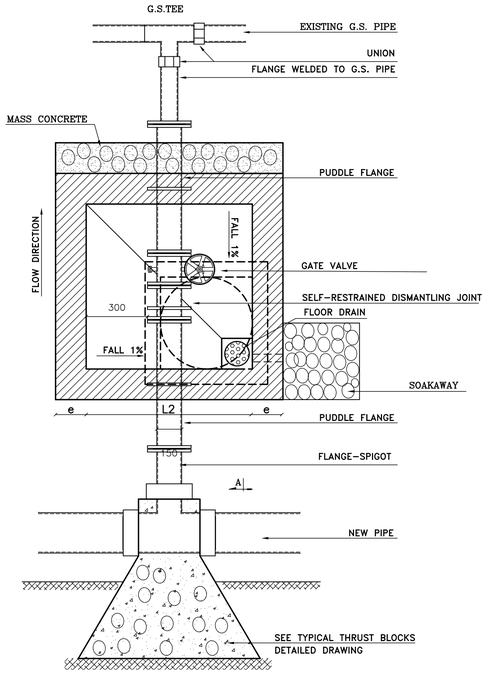
CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	TYPICAL CONNECTIONS OF NEW PIPES TO EXISTING GALVANIZED STEEL PIPES

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	9/21	462-05ST09

ORIGINAL DRAWING SIZE A1



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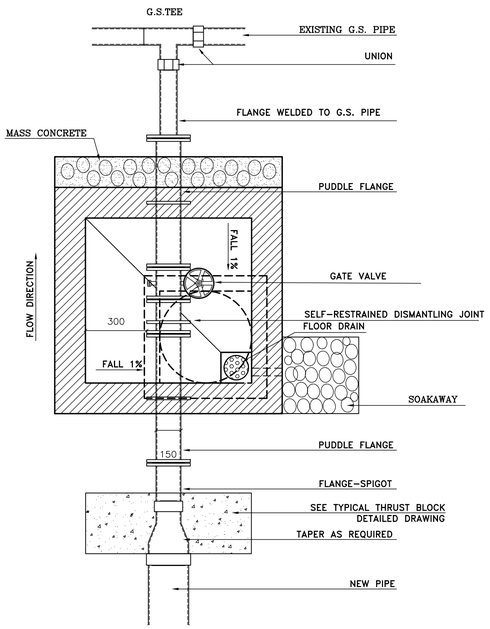

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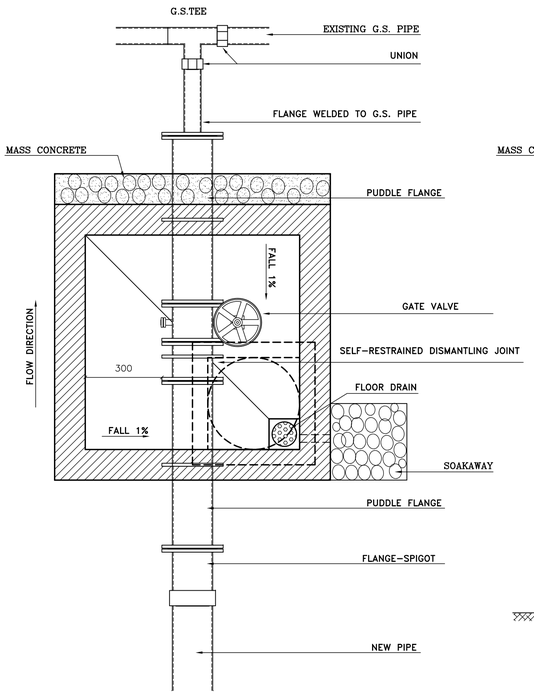

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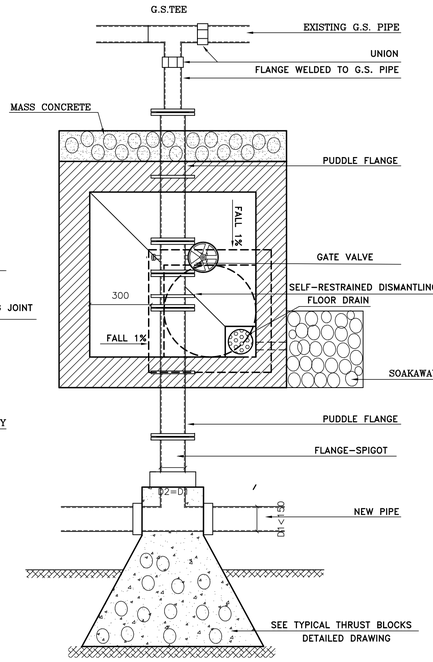

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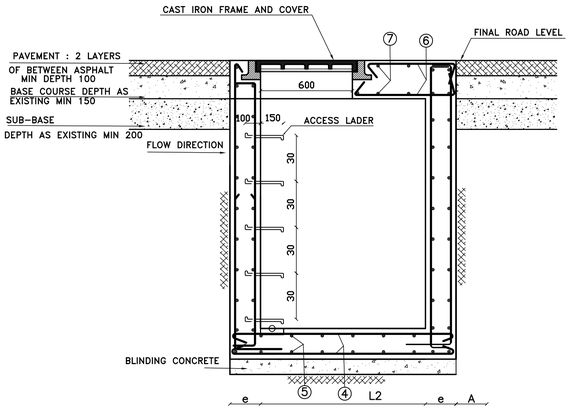
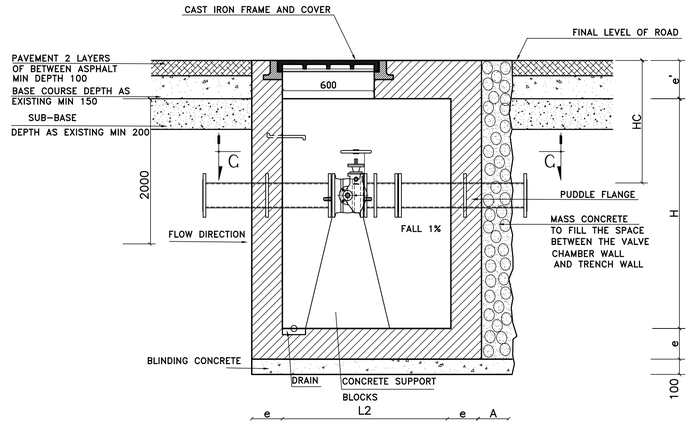
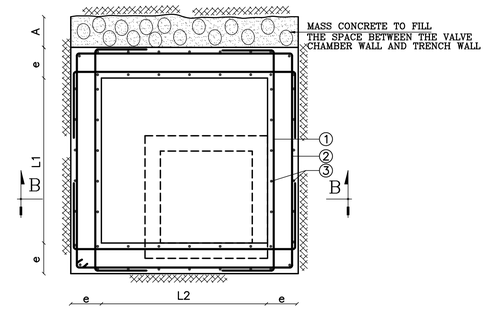


TYPICAL SECTION B–B



TYPICAL SECTION A–A



TYPICAL REINFORCEMENT OF VALVE CHAMBER

PIPE DIAMETER	LENGTH	WIDTH	HEIGHT	WALL & SLAB THICKNESS	UPPER SLAB THICKNESS	MASS CONCRETE THICKNESS	PIPE COVER
D mm	L1 mm	L2 mm	H mm	e mm	e' mm	A mm	HC mm
80–150	1100	1100	1500	200	250	200	800
200	1200	1200	1500	200	250	200	1000
250	1400	1400	1500	200	250	200	1000
300	1500	1500	2000	250	250	200	1000
350	1500	1500	2000	250	250	200	1000
400	1700	1700	2400	250	300	200	1100
450	1700	1700	2400	250	300	200	1100
500	2000	2000	2400	300	300	200	1200
600	2100	2100	2500	300	300	200	1200

PIPE DIAMETER	REINFORCEMENT						
D mm	1 mm	2 mm	3 mm	4 mm	5 mm	6 mm	7 mm
80–150	T12 ⌀200	T12 ⌀200	T10 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200
200	T12 ⌀200	T12 ⌀200	T10 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200
250	T12 ⌀200	T12 ⌀200	T10 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200
300	T12 ⌀200	T12 ⌀200	T10 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200
350	T12 ⌀200	T12 ⌀200	T10 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200
400	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200
450	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200	T12 ⌀200
500	T14 ⌀200	T14 ⌀200	T12 ⌀200	T14 ⌀200	T14 ⌀200	T12 ⌀200	T12 ⌀200
600	T14 ⌀200	T14 ⌀200	T14 ⌀200	T14 ⌀200	T14 ⌀200	T12 ⌀200	T12 ⌀200

NOTES:

REINFORCED CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 350 Kg/m3

BLINDING AND MASS CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=400 MPa.
MILD STEEL BARS : SYMBOL ⌀ YIELD STRESS: Fy=215 MPa.

STRESSES:
SEVERE CONTROL.
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS: f'c =25 MPa.
CONCRETE TENSILE STRENGTH AT 28 DAYS: ft =2.1 MPa.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 30 mm

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LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
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STIRRUPS ⌀8 SHALL BE USED ON EACH LAP.

BENDING:
⌀ > 12mm MECHANICAL.
⌀ ≤ 12mm MANUAL (POSSIBLY).
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MINISTRY OF ENERGY AND WATER

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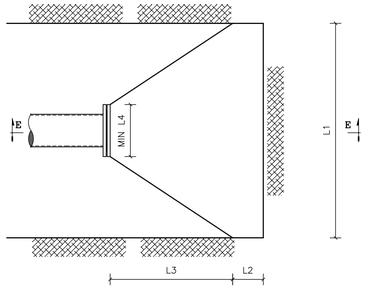
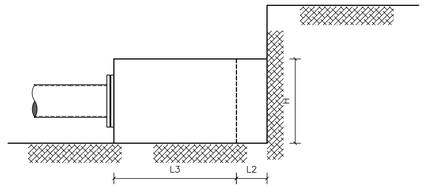
DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	10/21	462-05ST10

ORIGINAL DRAWING SIZE A1

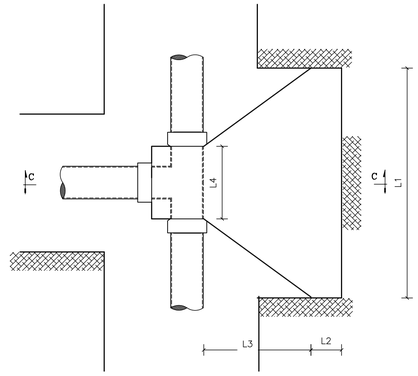
TYPICAL THRUST BLOCKS FOR TEES – HORIZONTAL BENDS – END CAPS



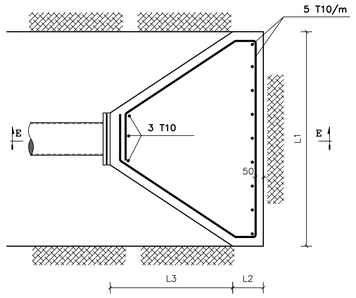
PLAN
END–CAP THRUST BLOCK



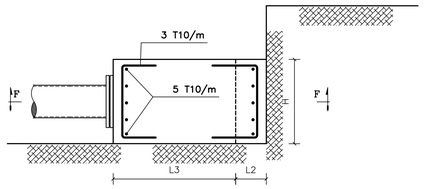
SECTION E–E
END–CAP THRUST BLOCK



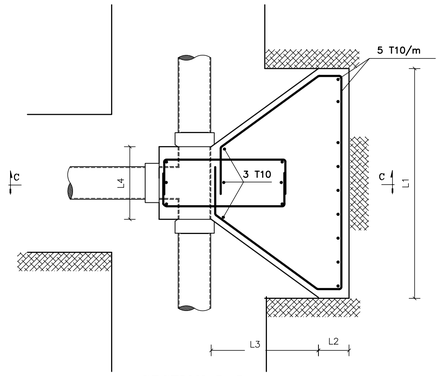
PLAN
TEE THRUST BLOCK



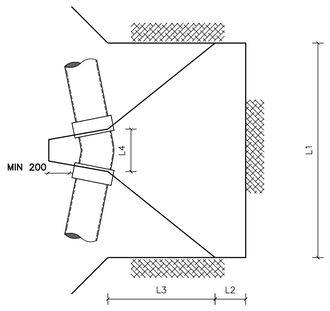
SECTION F–F
END–CAP THRUST BLOCK
TYPICAL REINFORCEMENT



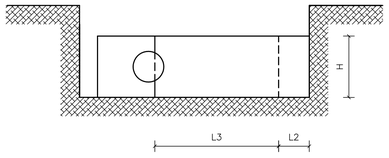
SECTION E–E
END–CAP THRUST BLOCK
TYPICAL REINFORCEMENT



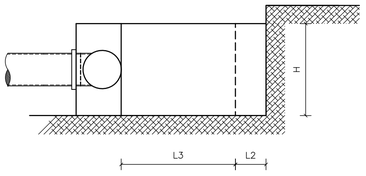
SECTION D–D
TEE THRUST BLOCK
TYPICAL REINFORCEMENT



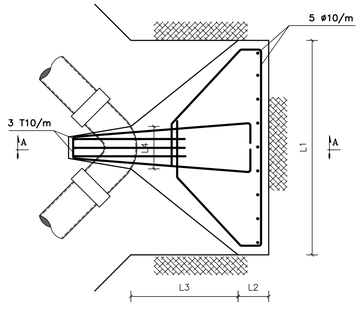
PLAN
TYPICAL HORIZONTAL BEND
THRUST BLOCK



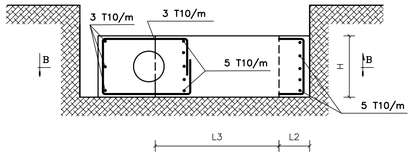
SECTION A–A
TYPICAL HORIZONTAL BEND
THRUST BLOCK



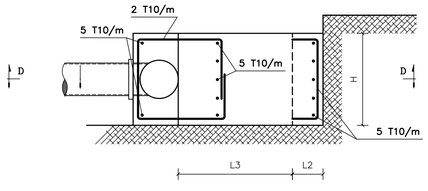
SECTION C–C
TEE THRUST BLOCK



SECTION B–B
HORIZONTAL BEND
THRUST BLOCK
TYPICAL REINFORCEMENT



SECTION A–A
HORIZONTAL BEND
THRUST BLOCK
TYPICAL REINFORCEMENT



SECTION C–C
TEE THRUST BLOCK
TYPICAL REINFORCEMENT

NOTES:

BASIC DATA :

SOIL DENSITY	1800	kg/m3
PIPE MATERIAL DENSITY (DUCTILE IRON)	7050	kg/m3
WATER SPECIFIC WEIGHT	1000	kg/m3
CONCRETE SPECIFIC WEIGHT	2300	kg/m3
SOIL INTERNAL FRICTION ANGLE	ø °	
SECURITY FACTOR	1.2	
SOIL BEARING CAPACITY	3	kg/cm2
SOIL–CONCRETE FRICTION ANGLE	2/3 * ø °	

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	PIPELINE THRUST BLOCKS

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	11/21	462-05ST11

ORIGINAL DRAWING SIZE A1

TYPICAL THRUST BLOCKS FOR TEES – HORIZONTAL BENDS – END CAPS

TABLE NO. 1 : THRUST BLOCKS TYPES

Diam.	Theta BEND ANGLE	Soil Cover	Pressure (bars)																																										
			1				5				10				15				20				25				30				35				40				45				50				55				60			
			Soil Internal Friction Angle (ø)																																															
(mm)	(°)	(m)	20	25	30	35	20	25	30	35	20	25	30	35	20	25	30	35	20	25	30	35	20	25	30	35	20	25	30	35	20	25	30	35	20	25	30	35	20	25	30	35	20	25	30	35	20	25	30	35
1000	T or E–C	1.2	15	15	15	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1000	90	1.2	15	15	15	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1000	45	1.2	15	15	15	15	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1000	22.5	1.2	15	15	15	15	15	15	15	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1000	11.25	1.2	15	15	15	15	15	15	15	15	15	15	15	15	–	–	15	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
900	T or E–C	1.2	14	14	14	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
900	90	1.2	14	14	14	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
900	45	1.2	14	14	14	14	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
900	22.5	1.2	14	14	14	14	14	14	14	14	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
900	11.25	1.2	14	14	14	14	14	14	14	14	14	14	14	14	16	15	14	14	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
800	T or E–C	1.2	13	13	13	13	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
800	90	1.2	13	13	13	13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
800	45	1.2	13	13	13	13	–	15	14	13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
800	22.5	1.2	13	13	13	13	13	13	13	13	–	16	14	13	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
800	11.25	1.2	13	13	13	13	13	13	13	13	13	13	13	13	15	14	13	13	–	16	14	14	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
700	T or E–C	1.2	10	10	10	10	–	16	14	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
700	90	1.2	10	10	10	10	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
700	45	1.2	10	10	10	10	15	14	13	12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
700	22.5	1.2	10	10	10	10	10	10	10	10	15	14	13	12	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
700	11.25	1.2	10	10	10	10	10	10	10	10	10	10	10	10	13	12	11	10	15	14	13	12	–	15	14	13	–	–	16	15	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
600	T or E–C	1.2	9	9	9	9	15	14	13	12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
600	90	1.2	9	9	9	9	–	16	15	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
600	45	1.2	9	9	9	9	13	12	11	10	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
600	22.5	1.2	9	9	9	9	9	9	9	9	13	12	11	10	16	15	14	13	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
600	11.25	1.2	9	9	9	9	9	9	9	9	12	10	9	9	13	12	11	10	15	14	13	12	16	15	14	13	–	16	15	14	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
500	T or E–C	1.2	7	7	7	7	13	12	10	10	–	16	15	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
500	90	1.2	7	7	7	7	15	14	13	12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
500	45	1.2	7	7	7	7	11	10	9	8	15	14	13	12	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
500	22.5	1.2	7	7	7	7	7	7	7	7	11	10	9	8	14	13	12	10	16	14	13	13	–	16	15	14	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
500	11.25	1.2	7	7	7	7	7	7	7	7	9	9	8	7	11	10	9	9	13	12	10	10	15	14	13	12	16	14	13	13	–	15	14	13	–	16	15	14	–	–	16	15	–	–	–	15	–	–	–	–
450	T or E–C	1.1	6	6	6	6	12	10	10	9	–	15	14	13	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
450	90	1.1	6	6	6	6	14	13	12	11	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
450	45	1.1	6	6	6	6	10	9	8	8	15	13	12	12	–	16	15	14	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
450	22.5	1.1	6	6	6	6	7	6	6	6	10	9	9	8	13	12	10	10	15	14	13	12	–	15	14	13	–	–	15	14	–	–	–	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
450	11.25	1.1	6	6	6	6	6	6	6	6	7	6	6	6	9	8	7	7	10	9	9	8	12	10	10	9	13	12	11	10	14	13	12	11	15	14	13	12	16	14	13	12	–	15	14	13	–	16	15	14
400	T or E–C	1.1	5	5	5	5	10	9	9	8	15	14	13	12	–	–	15	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
400	90	1.1	5	5	5	5	13	12	10	10	–	16	15	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
400	45	1.1	5	5	5	5	9	8	7	7	13	12	11	10	16	15	14	13	–	–	16	15	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
400	22.5	1.1	5	5	5	5	6	5	5	5	9	8	7	7	12	10	9	9	13	12	11	10	15	14	13	12	16	15	14	13	–	16	15	14	–	–	16	15	–	–	–	16	–	–	–	–	–	–
400	11.25	1.1	5	5	5	5	5	5	5	5	8	7	6	6	9	8	7	7	10	9	9	8	12	10	9	9	13	12	11	10	14	13	12	11	15	14	13	12	15	14	13	12	16	15	14	13	–	–	–	–
350	T or E–C	1.0	4	4	4	4	9	9	8	7	14	13	12	10	–	–	14	13	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
350	90	1.0	4	4	4	4	12	10	9	9	16	15	14	13	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
350	45	1.0	4	4	4	4	8	7	7	6	12	11	10	9	15	13	13	12	–	15	14	13	–	–	16	15	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
350	22.5	1.0	4	4	4	4	5	5	4	4	8	7	7	6	10	9	9	8	12	11	10	9	13	12	12	10	15	14	13	12	16	15	14	13	–	16	14	13	–	–	15	14	–	–	–	–	–	–
350	11.25	1.0	4	4	4	4	4	4	4	4	5	5	4	4	8	7	7	6	9	8	8	7	10	9	9	8	11	10	9	9	13	12	11	10	14	13	12	10	17	13	12	11	15	14	13	12	–	–	–	–
300	T or E–C	1.0	4	4	4	4	8	7	7	6	12	10	10	9	14	13	12	12	–	15	14	13	–	–	16	15	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
300	90	1.0	4	4	4	4	10	9	8	7	14	13	12	11	–	16	15	14	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
300	45	1.0	4	4	4	4	7	6	5	5	10	9	9	8	13	12	10	10	15	13	13	12	16	15	14	13	–	16	15	14	–	–	16	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–
300	22.5	1.0	4	4	4	4	4	4	4	4	7	6	6	5	9	8	8	7	11	10	10	9	13	12	12	10	16	15	14	13	–	15	14	13	–	–	16	15	–	–	–	–	–	–	–	–	–	–
300	11.25	1.0	4	4	4	4	4	4	4	4	6	5	5	4	7	6	6	5	8	7	7	6	9	8	8	7	11	10	9	9	12	10	10	9	12	11	10	9	13	12	11	10	–	–	–	–	–	–	–	–
250	T or E–C	1.0	2	2	2	2	6	6	5	5	10	9	8	7	12	11	10	9	14	13	12	11	16	14	13	12	–	16	15	14	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–
250	90	1.0	3	2	2	2	8	7	7	6	12	11	10	9	14	13	12	12	–	15	14	13	–	–	16	15	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
250	45	1.0	2	2	2	2	5	5	4	4	8	7	7	6	10	9	9	8	12	11	10	9	14	13	12	11	15	14	13	12	16	15	14	13	–	16	14	–	–	–	15	–	–	–	16	–	–	–	–	–
250	22.5	1.0	2	2	2	2	4	3	3	2	5	5	5	4	7	6	6	5	8	8	7	6	9	9	8	7	10	10	9	8	12	10	10	9	13	12	11	10	14	13	12	11	14	13	12	12	15	14	13	12
250	11.25	1.0	2	2	2	2	2	2	2	2	4	3	3	2	5	4	4	3	5	5	5	4	6	6	5	5	7	7	6	5	8	7	7	6	9	8	7	6	9	8	7	7	10	9	8	7	10	9	9	8
200	T or E–C	1.0	2	2	2	2	5	4	4	4	7	7	6	6	9	9	8	7	11	10	9	9	13	12	10	10	14	13	12	11	15	14	13	12	16	15	14	13	–	15	14	13	–	–	15	14	–	–	–	–
200	90	1.0	2	2	2	2	6	5	5	5	9	8	8	7	12	10	10	9	13	12	12	10	15	14	13	12	–	16	15	14	–	–	–	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–
200	45	1.0	2	2	2	2	4	4	3	3	6	6	5	5	8	7	7	6	10	9	8	7	11	11	10	9	13	12	11	10	14	13	12	12	16	14	13	12	16	15	14	13	–	16	15	14	–	–	–	–
200	22.5	1.0	2	2	2	2	2	2	2	2	4	4	3	3	5	5	4	4	7	6	5	5	7	7	6	6	8	8	7	7	10	9	8	7	11	10	9	9	12	10	10	9	12	11	10	9	–	–	–	–
200	11.25	1.0	2	2	2	2	2	2	2	2	2	2	2	2	4	3	3	2	4	4	4	3	5	5	4	4	6	5	5	5	7	6	5	5	7	6	6	5	8	7	7	6	8	7	7	6	8	8	7	6
150	T or E–C	1.0	2	2	2	2	4	4	3	3	5	5	4	4	7	6	6	5	8	7	7	6	9	9	8	7	10	9	9	8	12	10	9	9	12	11	10	9	13	12	11	10	14	13	12	10	14	13	12	11
150	90	1.0	2	2	2	2	4	4	4	3	7	6	6	5	9	8	8	7	10	9	8	8	12	10	9	9	14	13	12	10	14	13	12	12	15	14	13	12	16	15	14	13	–	15	14	13	–	16	15	14
150	45	1.0	2	2	2	2	3	2	2	2	5	4	4	3	6	5	5	4	7	6	6	5	8	7	7	6	9	8	7	7	10	9	8	7	11	10	9	9	12	11	10	9	13	12	10	10	13	12	11	10
150	22.5	1.0	2	2	2	2	2	2	2	2	4	4	3	3	5	4	4	3	6	5	5	4	7	6	6	5	8	7	7	6	9	8	7	7	9	8	8	7	10	9	9	8	11	10	9	9	12	11	10	9
150	11.25	1.0	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	3	3	3	2	4	4	3	3	4	4	4	3	5	5	4	4	6	5	5	4	6	6	5	5	7	6	6	5	8	7	7	6
125	T or E–C	1.0	1	1	1	1	3	2	2	2	4	4	4	3	5	5	4	4	6	5	5	4	7	6	6	5	8	7	7	6	9	8	8	7	10	9	9	8	11	10	10	9	12	11	10	10	13	12	11	10
125	90	1.0	1	1	1	1	3	3	3	2	5	5	4	4	7	6	6	5	8	7	7	6	9	9	8	7	10	9	9	8	11	10	10	9	12	11	10	9	12	11	11	10	13	12	11	10	14	13	12	11
125	45	1.0	1	1	1	1	2	2	2	2	4	3	3	2	5	4	4	4	6	5	5	4	7	7	6	5	8	7	7	6	9	8	8	7	10	9	9	8	11	10	10	9	12	11	10	10	13	12	11	10
125	22.5	1.0	1	1	1	1	2	2	1	1	3	3	2	2	4	4	3	3	5	4	4	4	6	5	5	4	6	6	5	5	7	6	6	5	7	7	6	5	8	7	7	6	8	8	7	6	9	8	8	7
125	11.25	1.0	1	1	1	1	1	1	1	1	2	2	1	1	3	3	2	2	4	4	3	3	5	4	4	3	5	5	4	4	6	5	5	4	6	6	5	5	7	7	6	5	8	7	7	6	9	8	8	7
100	T or E–C	1.0	1	1	1	1	2	2	2	2	4	4	4	3	5	5	4	4	6	5	5	4	7	6	5	5	7	7	6	5	8	7	6	6	8	7	7	6	9	8	8	7	9	9	8	7	10	9	8	7
100	90	1.0	1	1	1	1	2	2	2	2	4	4	3	3	5	5	4	4	6	6	5	5	8	7	7	6	9	8	7	7	9	9	8	7	10	9	9	8	11	10	9	8	12	10	9	9	12	11	10	9
100	45	1.0	1	1	1	1	2	2	2	1	3	2	2	2	4	3	3	2	4	4	4	3	5	5	4	4	6	5	5	5	7	6	5	5	7	6	6	5	8	7	7	6	9	8	8	7	10	9	9	8
100	22.5	1.0	1	1	1	1	1	1	1	1	2	2	2	1	3	3	2	2	4	3	3	3	5	4	4	3	5	5	4	4	6	5	5	4	6	6	5	5	7	6	6	5	8	7	7	6	9	8	8	7
100	11.25	1.0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	3	2	2	2	4	3	3	3	4	4	3	3	5	4	4	3	5	5	4	4	6	5	5	4	6	6	5	5	7	6	6	5
80	T or E–C	1.0	1	1	1	1	2	2	1	1	2	2	2	2	3	3	2	2	4	4	3	3	4	4	4	3	5	4	4	4	6	5	5	4	6	6	5	5	7	6	6	5	8	7	6	6	8	7	7	6
80	90	1.0	1	1	1	1	2	2	2	2	3	3	2	2	4	4	3	3	5	4	4	4	5	5	5	4	6	5	5	5	7	6	5	5	8	7	7	6	8	8	7	6	9	8	8	7	9	9	8	7
80	45	1.0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	2	2	4	3	3	3	4	4	3	3	5	5	4	4	6	5	5	4	6	6	5	5	8	7	7	6	9	8	8	7
80	22.5	1.0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	2	2	2	2	4	2	2	2	2	2	2	2	5	3	3	2	5	4	4	3	5	5	4	4	6	5	5	4	6	6	5	4
80	11.25	1.0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	2	1	1	1	3	2	2	2	3	3	2	2	4	3	3	2	4	4	3	3	5	4	4	3	5	5	4	4	6	5	5	4

TE : TEE
E–C : END CUP

*N.B.: * WHERE " – " EXIST REFER TO THE TABLE No. 2 (SELF ANCHORED PIPES)*
** FOR TEES " DIAM" IN THE FIRST COLUMN OF TABLE No. 1 REPRESENT THE BRANCH DIAM OF THE TEE*

LENGTH (IN METER) OF PIPE TO BE SELF ANCHORED AT EACH SIDE OF BENDS
WHERE THRUST BLOCKS ARE NOT USED (TEST PRESSURE=10 BARS) *TABLE No. 2*

DIAM (mm)	Bend 90°			Bend 45°			Bend 22.5°			Bend 11.25°			Blank flange		
Soil cover(m)	1	1.5	2	1	1.5	2	1	1.5	2	1	1.5	2	1	1.5	2
1000	36.9	27.2	21.6	22.9	16.9	13.4	12.8	9.5	7.5	6.8	5.0	4.0	46.9	34.7	27.5
900	34.1	25.0	19.8	21.2	15.6	12.3	11.9	8.7	6.9	6.3	4.6	3.7	43.4	31.9	25.2
800	31.2	22.8	17.9	19.4	14.4	11.1	10.9	7.9	6.2	5.8	4.2	3.3	39.8	29.0	22.8
700	28.2	20.4	16.0	17.5	12.7	9.9	9.8	7.1	5.6	5.2	3.8	2.9	25.8	25.9	20.3
600	25.0	17.9	14.0	15.5	11.1	8.7	8.7	6.2	4.9	4.6	3.3	2.6	31.8	22.8	17.8
500	21.5	15.3	11.9	13.4	9.5	7.4	7.5	5.3	4.1	4.0	2.8	2.2	27.4	19.5	15.1
450	19.7	14.0	10.8	12.3	8.7	6.7	6.9	4.9	3.8	3.6	2.6	2.0	25.1	17.8	13.8
400	17.9	12.6	9.7	11.1	7.8	6.0	6.2	4.4	3.4	3.3	2.3	1.8	22.8	16.0	12.4
350	16.0	11.2	8.6	9.9	7.0	5.4	5.6	3.9	3.0	2.9	2.1	1.6	20.3	14.3	11.0
300	14.1	9.8	7.5	8.7	6.1	4.7	4.9	3.4	2.6	2.6	1.8	1.4	17.9	12.5	9.6
250	12.0	8.3	6.4	7.5	5.2	4.0	4.2	2.9	2.2	2.2	1.5	1.2	15.3	10.6	8.1
200	9.9	6.8	5.2	6.1	4.2	3.2	3.4	2.4	1.8	1.8	1.3	1.0	12.6	8.7	6.6
150	7.7	5.3	4.0	4.8	3.3	2.5	2.7	1.8	1.4	1.4	1.0	0.7	9.8	6.7	5.1
125	6.6	4.5	3.4	4.1	2.8	2.1	2.3	1.6	1.2	1.2	0.8	0.6	8.4	5.7	4.4
100	5.4	3.7	2.8	3.4	2.3	1.8	1.9	1.3	1.0	1.0	0.7	0.5	6.9	4.7	3.6
80	4.5	3.1	2.3	2.8	1.9	1.5	1.6	1.1	0.8	0.8	0.6	0.5	5.7	3.9	3.0

WHERE TEST PRESSURE P ≠ 10 BARS, ANCHORING LENGTHS SHALL BE MULTIPLIED BY P/10
WHERE P.E SLEEVING IS USED, MULTIPLY BY 2.

TABLE No. 3 : THRUST BLOCKS DIMENSIONS

| Type | L1 (m) | L2 (m) | L3 (m) | L4 (

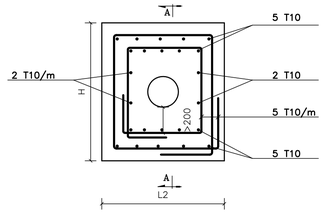
TYPICAL THRUST BLOCKS FOR VERTICAL BENDS

DOWNWARD DIRECTION TYPES

Diam (mm)	Theta Bend angle(°)	cover depth (m)	Test pressure 1	5	10	15	20	25	30	35	40	45	50	55	60
1000	90	1.20	12	–	–	–	–	–	–	–	–	–	–	–	–
1000	45	1.20	12	12	12	12	–	–	–	–	–	–	–	–	–
1000	22.5	1.20	12	12	12	12	12	12	12	–	–	–	–	–	–
1000	11.25	1.20	12	12	12	12	12	12	12	12	12	12	12	12	12
900	90	1.20	11	–	–	–	–	–	–	–	–	–	–	–	–
900	45	1.20	11	11	11	11	12	–	–	–	–	–	–	–	–
900	22.5	1.20	11	11	11	11	11	11	12	–	–	–	–	–	–
900	11.25	1.20	11	11	11	11	11	11	11	11	11	11	11	11	12
800	90	1.20	11	–	–	–	–	–	–	–	–	–	–	–	–
800	45	1.20	11	11	11	11	11	12	–	–	–	–	–	–	–
800	22.5	1.20	11	11	11	11	11	11	11	11	12	12	–	–	–
800	11.25	1.20	11	11	11	11	11	11	11	11	11	11	11	11	11
700	90	1.20	10	12	–	–	–	–	–	–	–	–	–	–	–
700	45	1.20	10	10	10	10	11	11	12	–	–	–	–	–	–
700	22.5	1.20	10	10	10	10	10	10	10	11	11	11	11	12	12
700	11.25	1.20	10	10	10	10	10	10	10	10	10	10	10	10	10
600	90	1.20	10	11	–	–	–	–	–	–	–	–	–	–	–
600	45	1.20	10	10	10	10	10	11	11	12	12	12	–	–	–
600	22.5	1.20	10	10	10	10	10	10	10	10	10	10	10	11	11
600	11.25	1.20	10	10	10	10	10	10	10	10	10	10	10	10	10
500	90	1.20	9	10	12	–	–	–	–	–	–	–	–	–	–
500	45	1.20	9	9	9	9	9	10	10	10	11	11	12	12	12
500	22.5	1.20	9	9	9	9	9	9	9	9	9	9	9	10	10
500	11.25	1.20	9	9	9	9	9	9	9	9	9	9	9	9	9
450	90	1.10	8	10	12	–	–	–	–	–	–	–	–	–	–
450	45	1.10	8	8	8	8	8	9	10	10	10	11	11	11	12
450	22.5	1.10	8	8	8	8	8	8	8	8	8	8	8	9	9
450	11.25	1.10	8	8	8	8	8	8	8	8	8	8	8	8	8
400	90	1.10	8	9	11	–	–	–	–	–	–	–	–	–	–
400	45	1.10	8	8	8	8	8	8	9	10	10	10	10	11	11
400	22.5	1.10	8	8	8	8	8	8	8	8	8	8	8	8	8
400	11.25	1.10	8	8	8	8	8	8	8	8	8	8	8	8	8
350	90	1.00	7	8	11	12	–	–	–	–	–	–	–	–	–
350	45	1.00	7	7	7	7	7	7	8	9	9	10	10	10	10
350	22.5	1.00	7	7	7	7	7	7	7	7	7	7	7	7	7
350	11.25	1.00	7	7	7	7	7	7	7	7	7	7	7	7	7
300	90	1.00	7	7	10	11	12	–	–	–	–	–	–	–	–
300	45	1.00	7	7	7	7	7	7	7	8	8	9	9	10	10
300	22.5	1.00	7	7	7	7	7	7	7	7	7	7	7	7	7
300	11.25	1.00	7	7	7	7	7	7	7	7	7	7	7	7	7
250	90	1.00	6	6	9	10	11	12	12	–	–	–	–	–	–
250	45	1.00	6	6	6	6	6	6	6	6	7	7	8	8	8
250	22.5	1.00	6	6	6	6	6	6	6	6	6	6	6	6	6
250	11.25	1.00	6	6	6	6	6	6	6	6	6	6	6	6	6
200	90	1.00	6	6	7	9	10	10	11	11	12	12	12	–	–
200	45	1.00	6	6	6	6	6	6	6	6	6	6	6	6	7
200	22.5	1.00	6	6	6	6	6	6	6	6	6	6	6	6	6
200	11.25	1.00	6	6	6	6	6	6	6	6	6	6	6	6	6
150	90	0.80	5	5	6	7	8	9	10	10	10	11	11	11	12
150	45	0.80	5	5	5	5	5	5	5	5	5	5	5	5	6
150	22.5	0.80	5	5	5	5	5	5	5	5	5	5	5	5	5
150	11.25	0.80	5	5	5	5	5	5	5	5	5	5	5	5	5
125	90	0.80	5	5	5	6	7	8	8	9	10	10	10	10	11
125	45	0.80	5	5	5	5	5	5	5	5	5	5	5	5	5
125	22.5	0.80	5	5	5	5	5	5	5	5	5	5	5	5	5
125	11.25	0.80	5	5	5	5	5	5	5	5	5	5	5	5	5
100	90	0.80	5	5	5	5	6	6	7	7	8	8	9	9	10
100	45	0.80	5	5	5	5	5	5	5	5	5	5	5	5	5
100	22.5	0.80	5	5	5	5	5	5	5	5	5	5	5	5	5
100	11.25	0.80	5	5	5	5	5	5	5	5	5	5	5	5	5
80	90	0.80	4	4	4	4	4	5	5	6	6	7	7	7	8
80	45	0.80	4	4	4	4	4	4	4	4	4	4	4	4	4
80	22.5	0.80	4	4	4	4	4	4	4	4	4	4	4	4	4
80	11.25	0.80	4	4	4	4	4	4	4	4	4	4	4	4	4

DIMENSIONS OF THRUST BLOCKS FOR VERTICAL BENDS

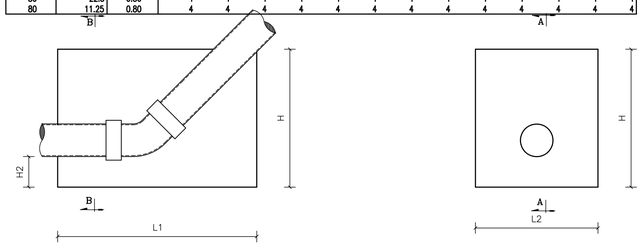
Type	L2(m)	L1(m)	H(m)	Volume (m3)
1	0.20	0.30	0.24	0.01
2	0.30	0.45	0.36	0.05
3	0.40	0.60	0.48	0.12
4	0.50	0.75	0.60	0.23
5	0.60	0.90	0.72	0.39
6	0.70	1.05	0.84	0.62
7	0.80	1.20	0.96	0.92
8	0.90	1.35	1.08	1.31
9	1.00	1.50	1.20	1.80
10	1.20	1.80	1.44	3.11
11	1.40	2.10	1.68	4.94
12	1.60	2.40	1.92	7.37



SECTION B–B
VERTICAL BEND ANCHOR BLOCK
TYPICAL REINFORCEMENT DETAIL

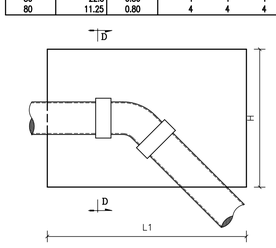
UPWARD DIRECTION TYPES

Diam (mm)	Theta Bend angle(°)	cover depth (m)	Test pressure 1	5	10	15	20	25	30	35	40	45	50	55	60
1000	90	1.20	–	–	–	–	–	–	–	–	–	–	–	–	–
1000	45	1.20	12	–	–	–	–	–	–	–	–	–	–	–	–
1000	22.5	1.20	12	–	–	–	–	–	–	–	–	–	–	–	–
1000	11.25	1.20	12	12	–	–	–	–	–	–	–	–	–	–	–
900	90	1.20	–	–	–	–	–	–	–	–	–	–	–	–	–
900	45	1.20	11	–	–	–	–	–	–	–	–	–	–	–	–
900	22.5	1.20	11	–	–	–	–	–	–	–	–	–	–	–	–
900	11.25	1.20	11	11	12	–	–	–	–	–	–	–	–	–	–
800	90	1.20	–	–	–	–	–	–	–	–	–	–	–	–	–
800	45	1.20	11	–	–	–	–	–	–	–	–	–	–	–	–
800	22.5	1.20	11	12	–	–	–	–	–	–	–	–	–	–	–
800	11.25	1.20	11	11	11	–	–	–	–	–	–	–	–	–	–
700	90	1.20	12	–	–	–	–	–	–	–	–	–	–	–	–
700	45	1.20	10	–	–	–	–	–	–	–	–	–	–	–	–
700	22.5	1.20	10	11	–	–	–	–	–	–	–	–	–	–	–
700	11.25	1.20	10	10	11	12	–	–	–	–	–	–	–	–	–
600	90	1.20	11	–	–	–	–	–	–	–	–	–	–	–	–
600	45	1.20	10	–	–	–	–	–	–	–	–	–	–	–	–
600	22.5	1.20	10	11	12	–	–	–	–	–	–	–	–	–	–
600	11.25	1.20	10	10	10	11	12	12	–	–	–	–	–	–	–
500	90	1.20	11	–	–	–	–	–	–	–	–	–	–	–	–
500	45	1.20	9	12	–	–	–	–	–	–	–	–	–	–	–
500	22.5	1.20	9	10	11	–	–	–	–	–	–	–	–	–	–
500	11.25	1.20	9	9	9	10	11	11	12	12	–	–	–	–	–
450	90	1.10	10	–	–	–	–	–	–	–	–	–	–	–	–
450	45	1.10	8	12	–	–	–	–	–	–	–	–	–	–	–
450	22.5	1.10	8	9	11	12	–	–	–	–	–	–	–	–	–
450	11.25	1.10	8	8	8	10	10	11	11	12	12	–	–	–	–
400	90	1.10	10	–	–	–	–	–	–	–	–	–	–	–	–
400	45	1.10	8	11	–	–	–	–	–	–	–	–	–	–	–
400	22.5	1.10	8	8	10	11	12	–	–	–	–	–	–	–	–
400	11.25	1.10	8	8	8	9	10	10	11	11	12	12	12	12	–
350	90	1.00	9	–	–	–	–	–	–	–	–	–	–	–	–
350	45	1.00	7	11	12	–	–	–	–	–	–	–	–	–	–
350	22.5	1.00	7	8	10	11	12	12	–	–	–	–	–	–	–
350	11.25	1.00	7	7	7	8	9	10	10	11	11	11	12	12	12
300	90	1.00	8	12	–	–	–	–	–	–	–	–	–	–	–
300	45	1.00	7	10	12	–	–	–	–	–	–	–	–	–	–
300	22.5	1.00	7	7	9	10	11	11	12	12	–	–	–	–	–
300	11.25	1.00	7	7	7	7	8	9	10	10	10	10	11	11	11
250	90	1.00	7	11	–	–	–	–	–	–	–	–	–	–	–
250	45	1.00	6	9	11	12	–	–	–	–	–	–	–	–	–
250	22.5	1.00	6	6	8	9	10	10	11	11	12	12	12	–	–
250	11.25	1.00	6	6	6	6	7	8	8	9	9	10	10	10	10
200	90	1.00	6	10	12	–	–	–	–	–	–	–	–	–	–
200	45	1.00	6	7	10	11	11	12	12	–	–	–	–	–	–
200	22.5	1.00	6	6	6	8	9	9	10	10	11	11	11	11	12
200	11.25	1.00	6	6	6	6	6	7	7	8	8	8	9	9	9
150	90	0.80	5	9	11	12	–	–	–	–	–	–	–	–	–
150	45	0.80	5	6	8	10	10	11	11	12	12	12	12	–	–
150	22.5	0.80	5	5	5	6	7	8	8	9	9	10	10	10	10
150	11.25	0.80	5	5	5	5	5	6	6	6	7	7	7	7	8
125	90	0.80	5	8	10	11	12	12	–	–	–	–	–	–	–
125	45	0.80	5	5	7	8	9	10	10	11	11	11	12	12	12
125	22.5	0.80	5	5	5	5	6	7	7	8	8	9	9	9	10
125	11.25	0.80	5	5	5	5	5	5	5	5	5	6	6	6	6
100	90	0.80	5	6	9	10	11	11	12	12	12	–	–	–	–
100	45	0.80	5	5	6	7	8	8	9	10	10	10	10	11	11
100	22.5	0.80	5	5	5	5	5	5	6	6	7	7	7	8	8
100	11.25	0.80	5	5	5	5	5	5	5	5	5	5	5	5	5
80	90	0.80	4	5	7	9	10	10	10	11	11	11	12	12	12
80	45	0.80	4	4	5	6	6	7	8	8	9	9	9	10	10
80	22.5	0.80	4	4	4	4	4	4	5	5	6	6	6	6	7
80	11.25	0.80	4	4	4	4	4	4	4	4	4	4	4	4	4



SECTION A–A
UPWARD FLOW DIRECTION

SECTION B–B
VERTICAL BEND ANCHOR BLOCK
UPWARD FLOW DIRECTION



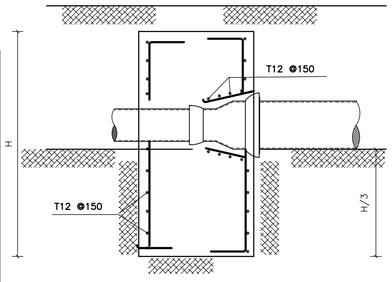
SECTION C–C
DOWNWARD FLOW DIRECTION

SECTION D–D
VERTICAL BEND ANCHOR BLOCK
DOWNWARD FLOW DIRECTION

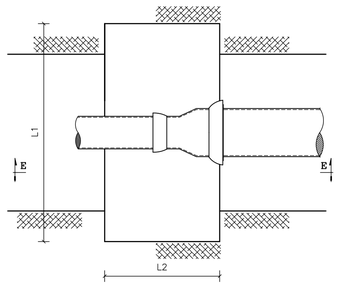
TYPICAL THRUST BLOCKS FOR TAPERS

THRUST BLOCK DIMENSIONS

Type	L1 (m)	L2 (m)	H (m)	Volume (m3)
1	0.50	0.40	0.50	0.10
2	0.60	0.48	0.60	0.17
3	0.70	0.56	0.70	0.27
4	0.80	0.64	0.80	0.41
5	0.90	0.72	0.90	0.58
6	1.00	0.80	1.00	0.80
7	1.20	0.96	1.20	1.38
8	1.40	1.12	1.40	2.20
9	1.60	1.28	1.60	3.28
10	1.80	1.44	1.80	4.67
11	2.00	1.60	2.00	6.40



SECTION I–I
TYPICAL REINFORCEMENT DETAILS



PLAN

THRUST BLOCKS TYPE

Large Diam (mm)	Small Diam (mm)	PRESSURE (BARS) 1	5	10	15	20	25	30	35	40	45	50	55	60
1000	900	9	–	–	–	–	–	–	–	–	–	–	–	–
1000	800	10	–	–	–	–	–	–	–	–	–	–	–	–
900	800	8	–	–	–	–	–	–	–	–	–	–	–	–
900	700	10	–	–	–	–	–	–	–	–	–	–	–	–
800	700	8	–	–	–	–	–	–	–	–	–	–	–	–
800	600	9	–	–	–	–	–	–	–	–	–	–	–	–
800	500	10	–	–	–	–	–	–	–	–	–	–	–	–
700	600	7	–	–	–	–	–	–	–	–	–	–	–	–
700	500	9	–	–	–	–	–	–	–	–	–	–	–	–
600	500	7	11	–	–	–	–	–	–	–	–	–	–	–
600	450	8	–	–	–	–	–	–	–	–	–	–	–	–
600	400	8	–	–	–	–	–	–	–	–	–	–	–	–
500	450	6	9	11	–	–	–	–	–	–	–	–	–	–
500	400	6	11	–	–	–	–	–	–	–	–	–	–	–
500	350	7	–	–	–	–	–	–	–	–	–	–	–	–
450	400	5	8	10	–	–	–	–	–	–	–	–	–	–
450	350	6	10	–	–	–	–	–	–	–	–	–	–	–
450	300	7	–	–	–	–	–	–	–	–	–	–	–	–
400	350	5	8	10	–	–	–	–	–	–	–	–	–	–
400	300	5	10	–	–	–	–	–	–	–	–	–	–	–
400	250	6	11	–	–	–	–	–	–	–	–	–	–	–
350	300	4	8	10	11	–	–	–	–	–	–	–	–	–
300	250	4	7	9	10	11	–	–	–	–	–	–	–	–
300	200	4	9	11	–	–	–	–	–	–	–	–	–	–
300	150	5	10	–	–	–	–	–	–	–	–	–	–	–
250	200	3	7	9	10	11	–	–	–	–	–	–	–	–
250	150	3	8	10	–	–	–	–	–	–	–	–	–	–
250	125	4	9	11	–	–	–	–	–	–	–	–	–	–
200	150	3	6	8	9	10	11	11	–	–	–	–	–	–
200	125	3	7	9	10	11	–	–	–	–	–	–	–	–
200	100	3	7	9	11	–	–	–	–	–	–	–	–	–
150	125	2	3	5	7	7	8	8	9	9	9	10	10	10
150	100	2	5	7	8	9	9	10	11	11	–	–	–	–
150	80	2	6	8	9	10	10	11	–	–	–	–	–	–
125	100	2	2	4	6	7	7	8	8	9	9	9	9	10
125	80	2	4	6	7	8	9	9	10	10	10	11	11	11
100	80	2	2	3	4	5	6	7	7	7	8	8	8	8

NOTES:

BASIC DATA :

SOIL DENSITY	1800	kg/m3
PIPE MATERIAL DENSITY (DUCTILE IRON)	7050	kg/m3
WATER SPECIFIC WEIGHT	1000	kg/m3
CONCRETE SPECIFIC WEIGHT	2300	kg/m3
SOIL INTERNAL FRICTION ANGLE	25°	
SECURITY FACTOR	1.2	
SOIL BEARING CAPACITY	3	kg/cm2
SOIL–CONCRETE FRICTION ANGLE	2/3 * 25°	

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

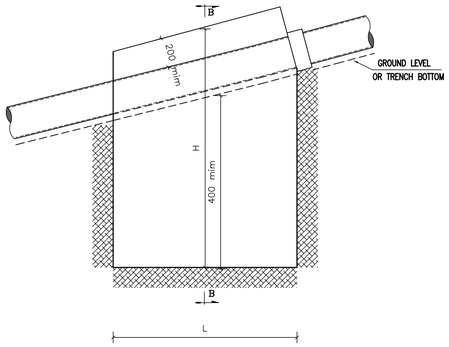
CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	PIPELINE THRUST BLOCKS

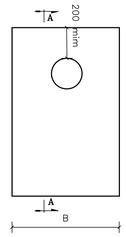
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	13/21	462-05ST13

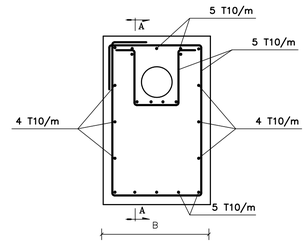
ORIGINAL DRAWING SIZE A1



SECTION A–A
ANCHOR BLOCK FOR BURIED
OR UNCOVERED PIPES (ONE BLOCK PER PIPE)
SLOPE ⩽ 50%



SECTION B–B
ANCHOR BLOCK FOR BURIED
OR UNCOVERED PIPES
SLOPE ⩽ 50%

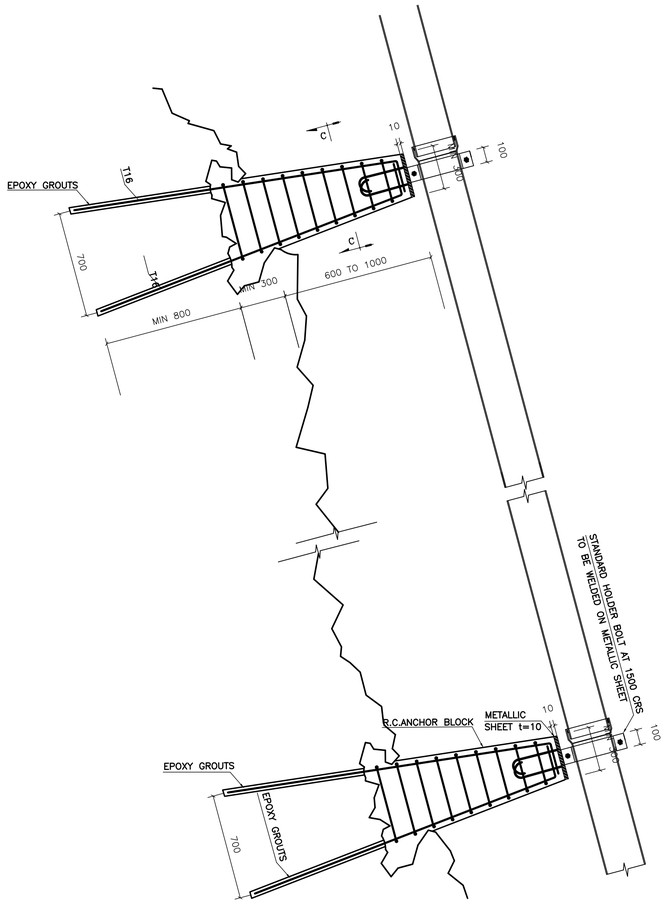


SECTION B–B
ANCHOR BLOCK FOR BURIED OR UNCOVERED PIPES
TYPICAL REINFORCEMENT DETAIL
SLOPE ⩽ 50%

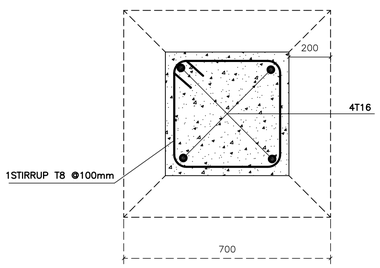
ANCHOR BLOCKS FOR BURIED SLOPED PIPES

Diam (mm)	SLOPE																		
	25%			30%			35%			40%			45%			50% *		
	L (m)	H (m)	B (m)	L (m)	H (m)	B (m)	L (m)	H (m)	B (m)	L (m)	H (m)	B (m)	L (m)	H (m)	B (m)	L (m)	H (m)	B (m)
1000	0.300	1.650	1.850	0.300	1.700	1.850	0.300	1.750	1.850	0.500	1.800	1.850	0.650	1.900	1.850	0.800	1.950	1.850
900	0.300	1.550	1.750	0.300	1.600	1.750	0.300	1.650	1.750	0.450	1.700	1.750	0.600	1.750	1.750	0.700	1.850	1.750
800	0.300	1.450	1.600	0.300	1.500	1.600	0.300	1.550	1.600	0.450	1.600	1.600	0.550	1.650	1.600	0.650	1.700	1.600
700	0.300	1.350	1.450	0.300	1.400	1.450	0.300	1.450	1.450	0.400	1.450	1.450	0.500	1.500	1.450	0.600	1.600	1.450
600	0.300	1.250	1.350	0.300	1.300	1.350	0.300	1.350	1.350	0.350	1.350	1.350	0.450	1.400	1.350	0.550	1.450	1.350
500	0.300	1.150	1.200	0.300	1.200	1.200	0.300	1.200	1.200	0.300	1.250	1.200	0.350	1.250	1.200	0.450	1.300	1.200
450	0.300	1.100	1.150	0.300	1.150	1.150	0.300	1.150	1.150	0.300	1.200	1.150	0.350	1.200	1.150	0.400	1.250	1.150
400	0.300	1.050	1.050	0.300	1.100	1.050	0.300	1.100	1.050	0.300	1.150	1.050	0.300	1.150	1.050	0.400	1.200	1.050
350	0.300	1.000	1.000	0.300	1.050	1.000	0.300	1.050	1.000	0.300	1.100	1.000	0.300	1.100	1.000	0.350	1.150	1.000
300	0.300	0.950	0.950	0.300	1.000	0.950	0.300	1.000	0.950	0.300	1.000	0.950	0.300	1.050	0.950	0.300	1.050	0.950
250	0.300	0.900	0.850	0.300	0.950	0.850	0.300	0.950	0.850	0.300	0.950	0.850	0.300	1.000	0.850	0.300	1.000	0.850
200	0.300	0.850	0.800	0.300	0.900	0.800	0.300	0.900	0.800	0.300	0.900	0.800	0.300	0.950	0.800	0.300	0.950	0.800
150	0.300	0.800	0.750	0.300	0.850	0.750	0.300	0.850	0.750	0.300	0.850	0.750	0.300	0.900	0.750	0.300	0.900	0.750
125	0.300	0.800	0.700	0.300	0.800	0.700	0.300	0.800	0.700	0.300	0.850	0.700	0.300	0.850	0.700	0.300	0.850	0.700
100	0.300	0.750	0.650	0.300	0.800	0.650	0.300	0.800	0.650	0.300	0.800	0.650	0.300	0.800	0.650	0.300	0.850	0.650
80	0.300	0.700	0.650	0.300	0.750	0.650	0.300	0.750	0.650	0.300	0.800	0.650	0.300	0.800	0.650	0.300	0.800	0.650

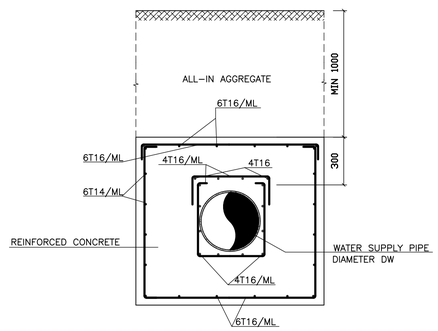
* FOR SLOPE > 50% SEE NOTE



ANCHORS ON ROCK
FOR SLOPE > 50 % AND FOR UNCOVERED PIPES



SECTION C–C
NOT TO SCALE



REINFORCED CONCRETE SURROUND
NOT TO SCALE

ANCHOR BLOCKS FOR UNCOVERED SLOPED PIPES.

Diam (mm)	Slope																	
	25%			30%			35%			40%			45%			50%		
	L (m)	H (m)	B (m)	L (m)	H (m)	B (m)	L (m)	H (m)	B (m)	L (m)	H (m)	B (m)	L (m)	H (m)	B (m)	L (m)	H (m)	B (m)
1000	1.200	1.800	1.600	1.350	1.900	1.850	1.450	1.950	1.850	1.550	2.050	1.850	1.600	2.100	1.850	1.650	2.200	1.850
900	1.100	1.700	1.500	1.250	1.750	1.750	1.350	1.850	1.750	1.400	1.900	1.750	1.450	1.950	1.750	1.500	2.050	1.750
800	1.050	1.600	1.400	1.150	1.650	1.600	1.250	1.700	1.600	1.300	1.750	1.600	1.350	1.850	1.600	1.400	1.900	1.600
700	0.950	1.450	1.300	1.050	1.500	1.450	1.150	1.600	1.450	1.200	1.650	1.450	1.250	1.700	1.450	1.300	1.750	1.450
600	0.800	1.350	1.200	0.900	1.400	1.350	0.950	1.450	1.350	1.050	1.500	1.350	1.100	1.550	1.350	1.100	1.600	1.350
500	0.650	1.250	1.100	0.750	1.250	1.200	0.800	1.300	1.200	0.850	1.350	1.200	0.900	1.400	1.200	0.950	1.450	1.200
450	0.600	1.150	1.050	0.700	1.200	1.150	0.750	1.250	1.150	0.800	1.300	1.150	0.850	1.350	1.150	0.850	1.350	1.150
400	0.550	1.100	1.000	0.650	1.150	1.050	0.700	1.200	1.050	0.750	1.200	1.050	0.750	1.250	1.050	0.800	1.300	1.050
350	0.500	1.050	0.750	0.550	1.100	1.000	0.600	1.100	1.000	0.650	1.150	1.000	0.700	1.200	1.000	0.700	1.200	1.000
300	0.450	1.000	0.700	0.500	1.000	0.950	0.550	1.050	0.950	0.550	1.050	0.950	0.600	1.100	0.950	0.600	1.150	0.950
250	0.350	0.950	0.650	0.400	0.950	0.850	0.450	1.000	0.850	0.500	1.000	0.850	0.500	1.050	0.850	0.500	1.050	0.850
200	0.300	0.850	0.600	0.300	0.900	0.800	0.350	0.900	0.800	0.400	0.950	0.800	0.400	0.950	0.800	0.400	0.950	0.800
150	0.300	0.800	0.550	0.300	0.850	0.750	0.300	0.850	0.750	0.300	0.850	0.750	0.350	0.900	0.750	0.350	0.900	0.750
125	0.300	0.800	0.525	0.300	0.800	0.700	0.300	0.800	0.700	0.300	0.850	0.700	0.300	0.850	0.700	0.300	0.850	0.700
100	0.300	0.750	0.500	0.300	0.800	0.650	0.300	0.800	0.650	0.300	0.800	0.650	0.300	0.800	0.650	0.300	0.850	0.650
80	0.300	0.750	0.480	0.300	0.750	0.650	0.300	0.750	0.650	0.300	0.800	0.650	0.300	0.800	0.650	0.300	0.800	0.650

NOTES:

WHEN THE SLOPE IS GREATER THAN 50 % ALL THE PIPELINE TRENCH SHALL BE FILLED BY MASS CONCRETE

BASIC DATA :

SOIL DENSITY	1800	kg/m3
PIPE MATERIAL DENSITY (DUCTILE IRON)	7050	kg/m3
WATER SPECIFIC WEIGHT	1000	kg/m3
CONCRETE SPECIFIC WEIGHT	2300	kg/m3
SOIL INTERNAL FRICTION ANGLE	25°	
SECURITY FACTOR	1.2	
SOIL BEARING CAPACITY	3	kg/cm2
SOIL–CONCRETE FRICTION ANGLE	2/3 * 25°	

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

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MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE,
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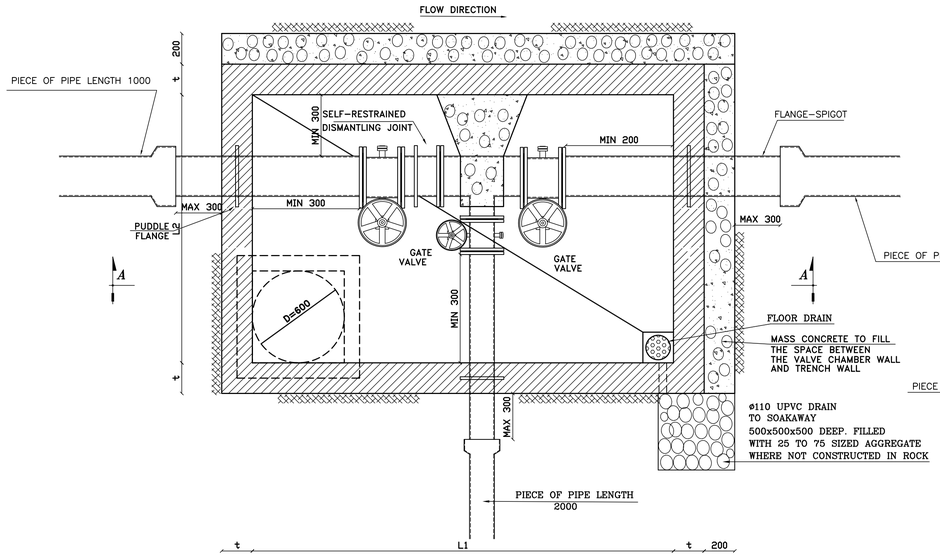
IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	PIPELINE ANCHOR BLOCKS

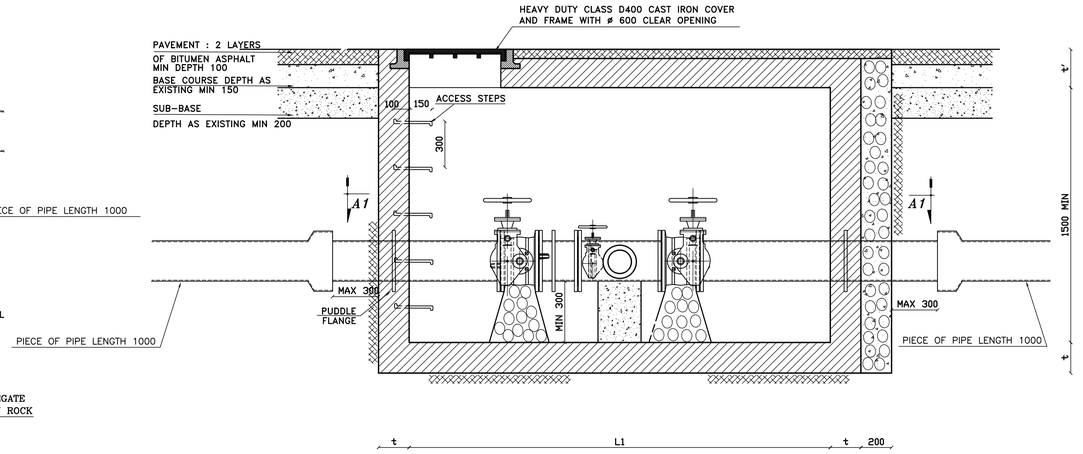
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	14/21	462-05ST14

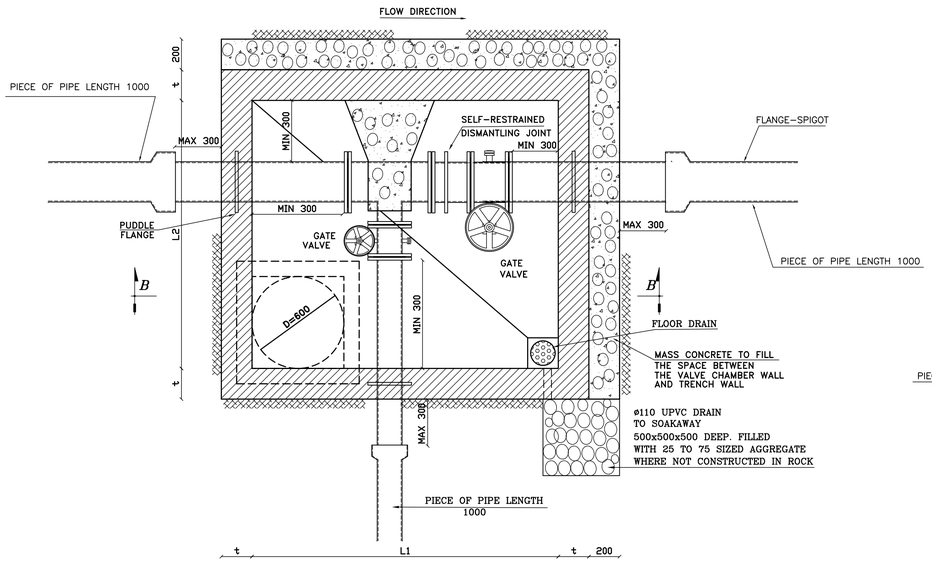
ORIGINAL DRAWING SIZE A1



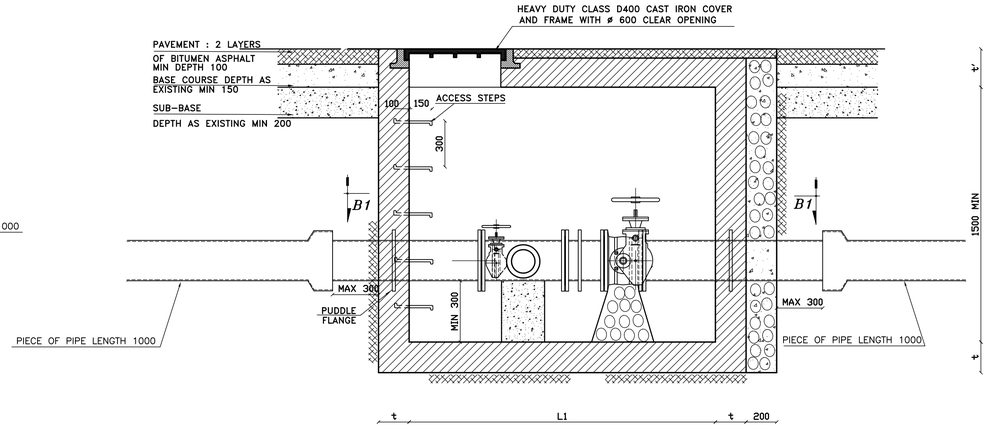
SECTION A1–A1



SECTION A–A



SECTION B1–B1



SECTION B–B

NOTES:

REINFORCED CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 350 Kg/m3

BLINDING AND MASS CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=400 MPa.
MILD STEEL BARS : SYMBOL ø YIELD STRESS: Fy=215 MPa.

STRESSES:
SEVERE CONTROL.
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS: f'c =25 MPa.
CONCRETE TENSILE STRENGTH AT 28 DAYS: ft =2.1 MPa.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 30 mm

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50ø.
(ø= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
STIRRUPS ø8 SHALL BE USED ON EACH LAP.

BENDING:
ø > 12mm MECHANICAL.
ø ≤ 12mm MANUAL (POSSIBLY).
STRAIGHTENING OF BENDED BARS IS NOT ALLOWED.

FORMWORK:
ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE
(METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
BITUMEN LAYER ON EXTERNAL SURFACES OF VALVE CHAMBER WALLS EXCEPT WHERE THERE IS MASS CONCRETE

REMARKS:
- HOLES MADE BY THE TIE-RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
- ALL DIMENSIONS ARE IN MILLIMETERS.
- SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
- SOIL FRICTION ANGLE SHALL BE 25°
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SOAKAWAY
TO BE USED ONLY IF THE INSTALLATION OF AN ADEQUATE GRAVITY DRAIN PIPE TO A FREE OUTLET IS DETERMINED BY THE ENGINEER NOT TO BE POSSIBLE.

* T.P. =TEST PRESSURE

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

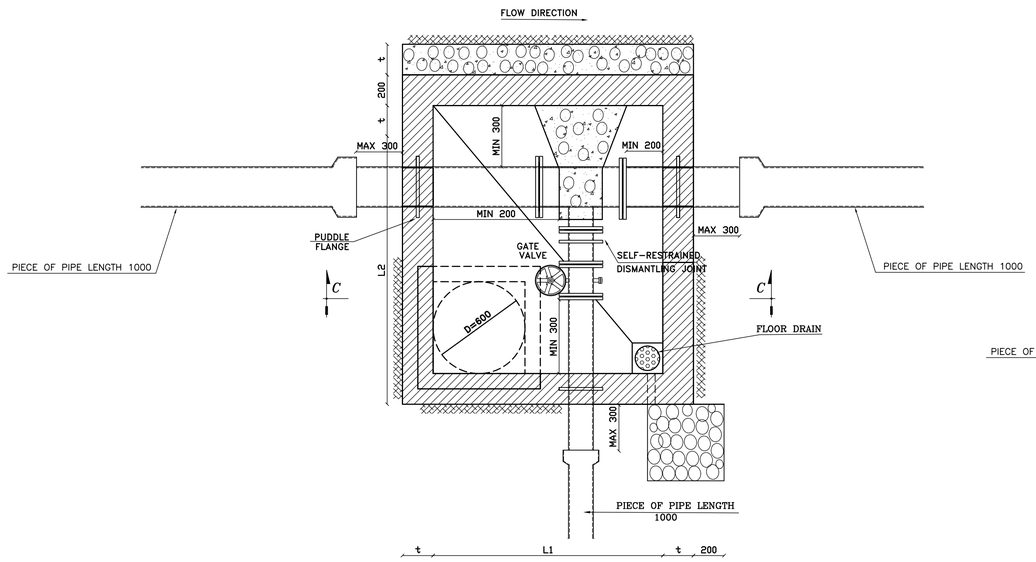
CONSTRUCTION OF RESERVOIR, LIFT LINE,
AND WATER DISTRIBUTION NETWORK
IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	TYPICAL VALVE CHAMBER DETAILS

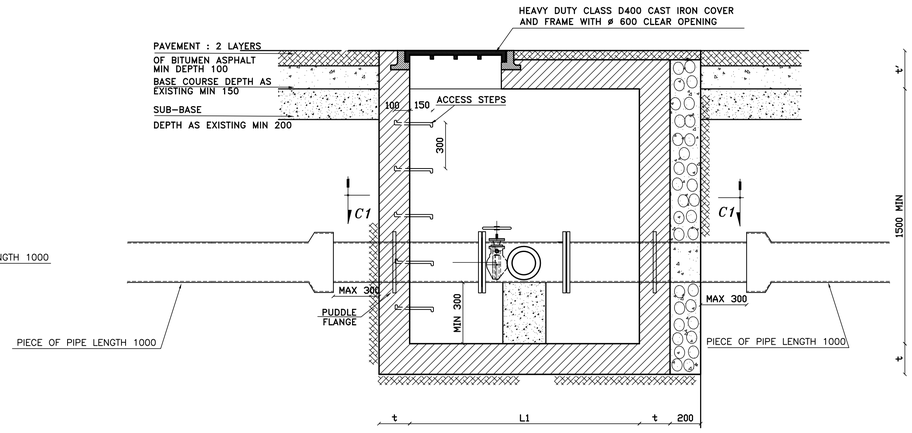
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	15/21	462-05ST15

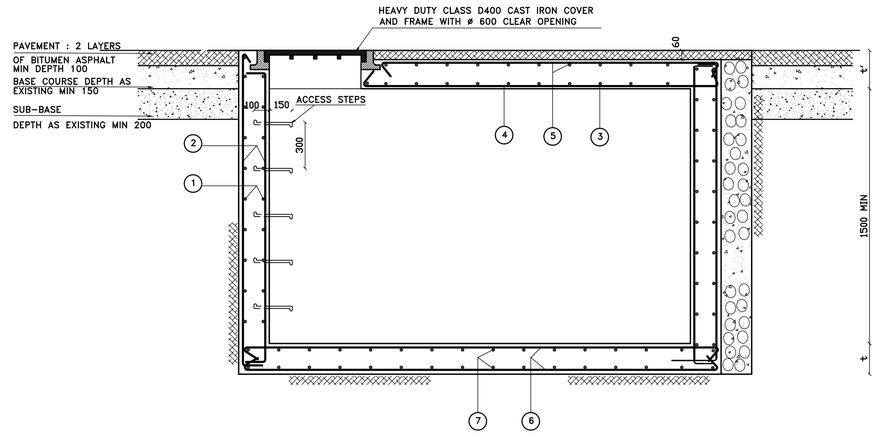
ORIGINAL DRAWING SIZE A1

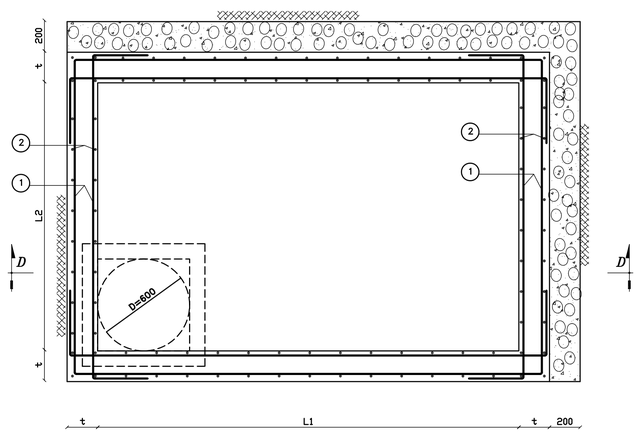


SECTION C1-C1



SECTION C-C





VALVE CHAMBER DIMENSIONS	
TYPE	LlxL2
R1	1000x1250
R2	1250x1000
R3	1250x1500
R4	1250x1750
R5	1500x1000
R6	1500x1500
R7	1500x1750
R8	1750x1250
R9	1750x1500
R10	1750x2000
R11	1750x2250
R12	2000x1500
R13	2000x1750
R14	2250x1500
R15	2250x1750
R16	2250x2000
R17	2500x1500
R18	2500x1750
R19	2500x2000
R20	2500x2250
R21	2750x1500

VALVE CHAMBER DIMENSIONS	
TYPE	LlxL2
R22	2750x1750
R23	2750x2000
R24	2750x2250
R25	2750x2500
R26	3000x1750
R27	3000x2000
R28	3000x2250
R29	3000x2500
R30	3000x2750
R31	3250x1750
R32	3500x1750
R33	3500x2000
R34	3500x2250
R35	3750x1750
R36	3750x2000
R37	3750x2250
R38	3750x2500
R39	4250x2000
R40	4250x2250
R41	4250x2500
R42	4250x2750

VALVE CHAMBER TYPE

BRANCH DIAM / NBR OF VALVES / MAIN PIPE	60			80			100			125			150			200			250			300			350			400			450			500			600		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
80	R1	–	–	–	R6	R12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
100	R1	–	–	R3	R6	R12	–	R6	R12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
125	R1	–	–	R3	R9	R14	R3	R9	R14	–	R9	R14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
150	–	–	–	R3	R9	R17	R3	R9	R17	R3	R9	R17	–	R9	R17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
200	–	–	–	R3	R12	R21	R4	R12	R21	R4	R12	R21	–	R13	R22	–	R13	R22	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
250	–	–	–	–	R12	R21	–	R12	R21	R4	R12	R21	R7	R13	R22	–	R13	R22	–	R13	R22	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
300	–	–	–	–	R14	R26	–	R15	R26	–	R15	R26	R7	R15	R26	R7	R15	R26	–	R15	R26	–	R16	R27	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
350	–	–	–	–	R15	R31	–	R18	R32	–	R20	R34	R7	R18	R32	R7	R18	R32	R10	R19	R33	–	R19	R33	–	R19	R33	–	–	–	–	–	–	–	–	–	–	–	–
400	–	–	–	–	R18	R32	–	R18	R32	–	R20	R34	–	R18	R32	R10	R19	R33	R10	R19	R33	–	R19	R33	–	R20	R34	–	R20	R34	–	–	–	–	–	–	–	–	–
450	–	–	–	–	R19	R33	–	R18	R32	–	R20	R34	–	R19	R33	R10	R19	R33	R10	R19	R33	R11	R20	R34	–	R20	R34	–	R20	R34	–	R20	R34	–	–	–	–	–	–
500	–	–	–	–	R23	R36	–	R22	R35	–	R24	R37	–	R23	R36	R10	R23	R36	R11	R24	R37	R11	R24	R37	–	R24	R37	–	R25	R38	–	R25	R38	–	–	–	–	–	–
600	–	–	–	–	R28	R40	–	R27	R39	–	R29	R41	–	R27	R39	–	R27	R39	R11	R28	R40	R11	R28	R40	R11	R28	R40	R11	R29	R41	–	R29	R41	–	R29	R41	–	R30	R42

REINFORCEMENT STEEL TABLE

VALVE CHAMBER TYPE	THICKNESS		REINFORCEMENT						
	t mm	t' mm	1	2	3	4	5	6	7
R1-R5	200	250	T14 ⌀200	T14 ⌀200	T16 ⌀200	T14 ⌀200	2xT12 ⌀200	T14 ⌀200	T14 ⌀200
R6-R11	200	250	T14 ⌀165	T14 ⌀165	T16 ⌀165	T14 ⌀165	2xT12 ⌀165	T14 ⌀165	T14 ⌀165
R11-R23	200	250	T14 ⌀150	T14 ⌀150	T14 ⌀150	T14 ⌀150	2xT12 ⌀150	T14 ⌀150	T14 ⌀150
R23-R38	250	300	T16 ⌀200	T16 ⌀200	T20 ⌀200	T14 ⌀200	2xT12 ⌀200	T16 ⌀200	T16 ⌀200
R39-R42	300	300	T16 ⌀165	T16 ⌀165	T20 ⌀165	T14 ⌀165	2xT12 ⌀165	T16 ⌀165	T16 ⌀165

NOTES:

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DOSING 350 Kg/m3

BLINDING AND MASS CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
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SOAKAWAY
TO BE USED ONLY IF THE INSTALLATION OF AN ADEQUATE GRAVITY DRAIN PIPE TO A FREE OUTLET IS DETERMINED BY THE ENGINEER NOT TO BE POSSIBLE.

* T.P. =TEST PRESSURE

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

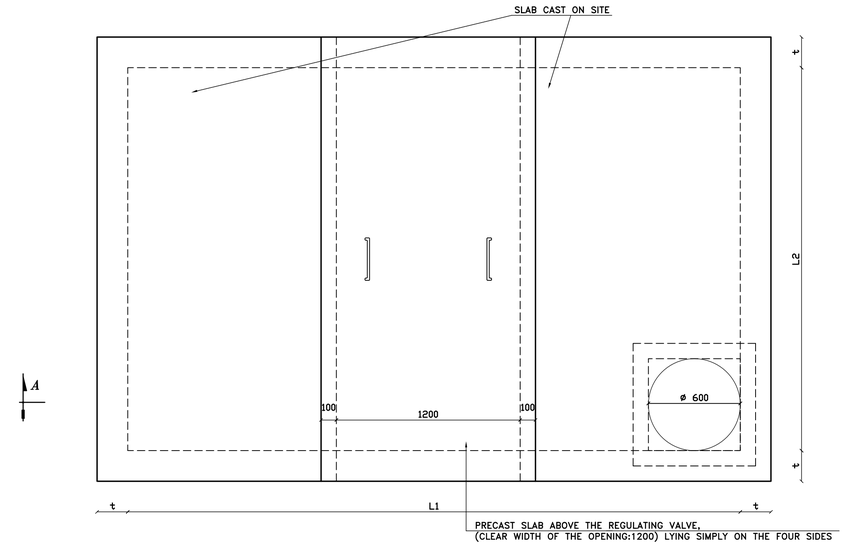
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	TYPICAL VALVE CHAMBER DETAILS

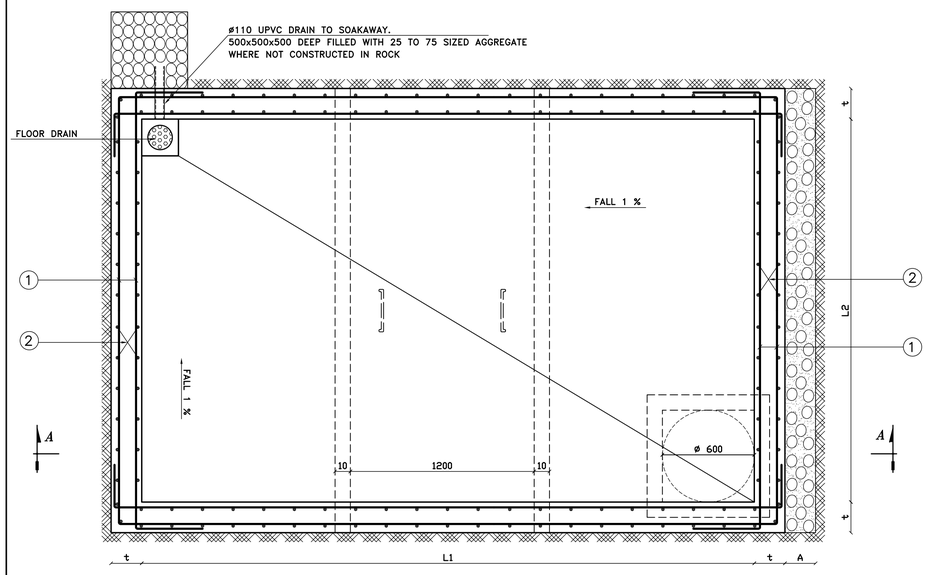
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	16/21	462-05ST16

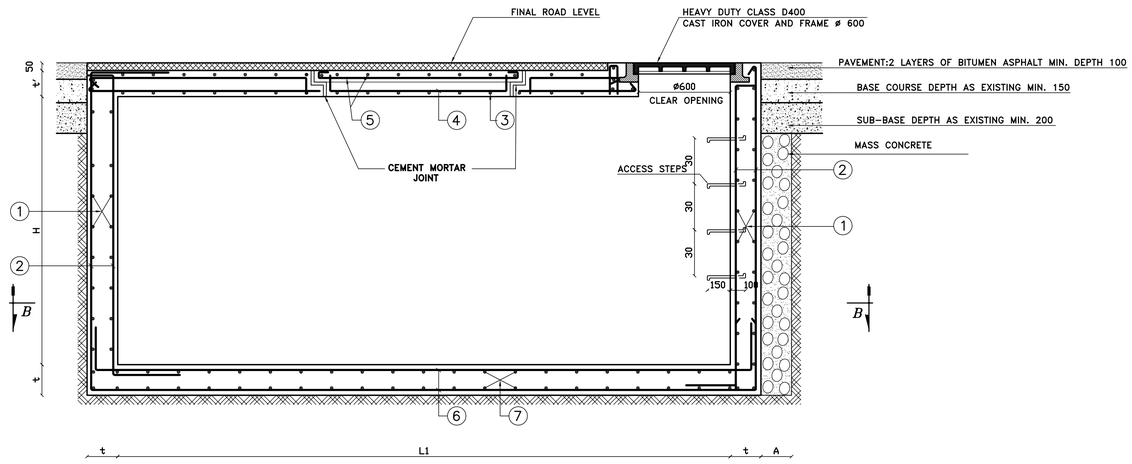
ORIGINAL DRAWING SIZE A1



PLAN VIEW



SECTION B–B



SECTION A–A

MAIN PIPE DIAMETER	REGULATING /SUSTAINING PIPE DIAMETER	BY PASS DIAMETER	UPSTREAM PRESSURE–DOWNSTREAM PRESSURE ≤25 BARS				
			AIR RELIEF VALVE DIAMETER	LENGTH	WIDTH	HEIGHT	BLOCK THICKNESS
D mm	dr mm	db mm	dv mm	L1 mm	L2 mm	H mm	A mm
80	80	80	60	2500	1750	2000	200
100	80	80	60	2500	1750	2000	200
150	100	80	60	2500	1750	2000	200
200	150	100	60	3600	2000	2000	200
250	200	150	60	3600	2000	2000	200
300	250	200	80	3600	2000	2000	200
350	300	250	80	4000	2500	2000	200
400	300	250	80	4000	2500	2000	200
450	350	250	100	4000	2500	2000	200
500	400	300	100	4200	2750	2000	200
600	500	400	100	5000	3100	2000	200
700	500	400	150	5000	3100	2000	200
800	600	400	150	5500	3100	2100	200

* UPSTREAM PRESSURE – DOWNSTREAM PRESSURE ≤ 16 BARS.

MAIN PIPE DIAMETER	REGULATING /SUSTAINING PIPE DIAMETER	BYPASS DIAMETER	UP STREAM PRESSURE–DOWN STREAM PRESSURE ≤ 20 BARS									20 BARS ≤ UPSTREAM PRESSURE– DOWNSTREAM PRESSURE <25 BARS								
			REINFORCEMENT							THICKNESS		REINFORCEMENT							THICKNESS	
D mm	dr mm	db mm	1	2	3	4	5	6	7	t mm	t' mm	1	2	3	4	5	6	7	t mm	t' mm
80	80	80	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250
100	80	80	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250
150	100	80	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250
200	150	100	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250
250	200	150	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250
300	250	200	T14●165	T14●165	T16●165	T12●165	2xT12●165	T14●165	T14●165	200	250	T16●200	T16●200	T16●165	T12●165	2xT12●165	T16●200	T16●200	250	250
350	300	250	T16●200	T16●200	T20●200	T12●200	2xT12●200	T16●200	T16●200	250	300	T16●165	T16●165	T20●165	T12●165	2xT12●165	T16●165	T16●165	300	300
400	300	250	T16●200	T16●200	T20●200	T12●200	2xT12●200	T16●200	T16●200	250	300	T16●165	T16●165	T20●165	T12●165	2xT12●165	T16●165	T16●165	300	300
450	350	250	T16●200	T16●200	T20●200	T12●200	2xT12●200	T16●200	T16●200	250	300	T16●165	T16●165	T20●165	T12●165	2xT12●165	T16●165	T16●165	300	300
500	400	300	T16●165	T16●165	T20●165	T12●165	2xT12●165	T16●165	T16●165	300	300	T16●165	T16●165	T20●165	T12●165	2xT12●165	T16●165	T16●165	350	300
600	500	400	T14●200	T14●200	T20●165	T12●165	2xT12●165	T14●200	T14●200	350	300									
700	500	400	T14●200	T14●200	T20●165	T12●165	2xT12●165	T14●200	T14●200	400	300									
800*	600	400	T16●200	T16●200	T20●165	T12●165	2xT12●165	T16●200	T16●200	400	300									

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* T.P. =TEST PRESSURE

LEGEND:

(a) PIECE OF PIPE MAX. LENGTH 1000
(b) FLANGED REDUCER
(c) INTAKE COLLAR
(d) PRESSURE GAUGE
(e) BUTTERFLY VALVE
(f) FILTER WITH WASHOUT VALVE
(g) PRESSURE REGULATING OR PRESSURE SUSTAINING VALVE
(h) SELF-RESTRAINED DISMANTLING JOINT
(i) AIR RELIEF VALVE+ISOLATING BUTTERFLY VALVE
(j) PUDDLE FLANGE
(k) FLANGE-SPIGOT
(l) FLANGE-SOCKET
(m) PRESSURE REDUCING DIAPHRAGM

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

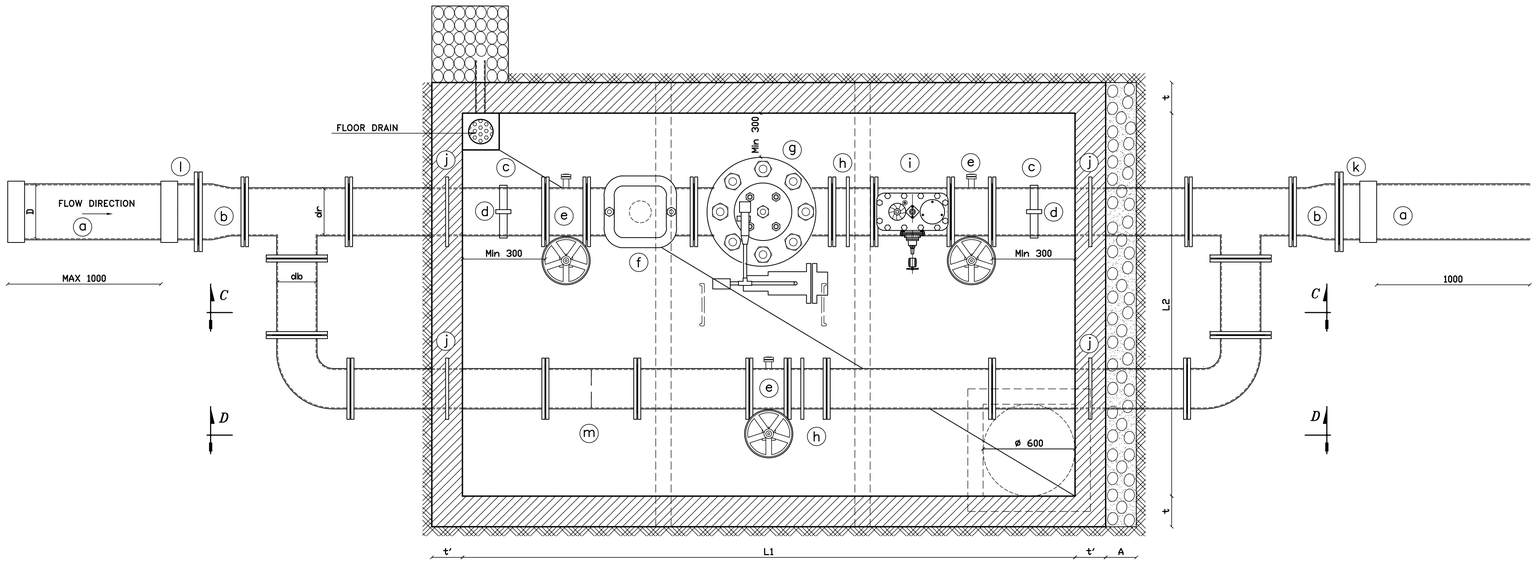
CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	PRESSURE REGULATING OR PRESSURE SUSTAINING VALVE DETAILS OF INSTALLATION AND PROTECTION CHAMBER

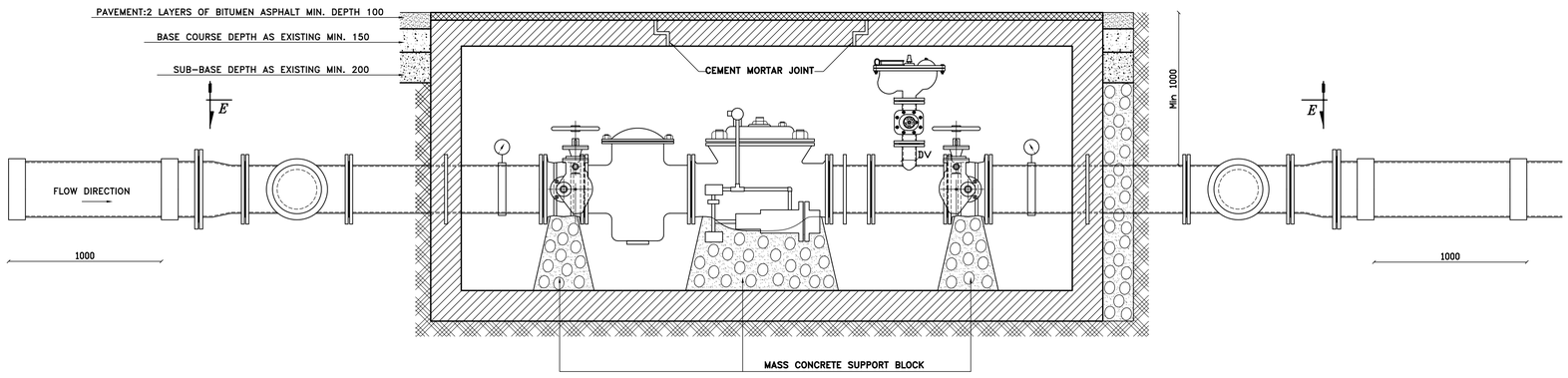
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST01-18	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	17/21	462-05ST17

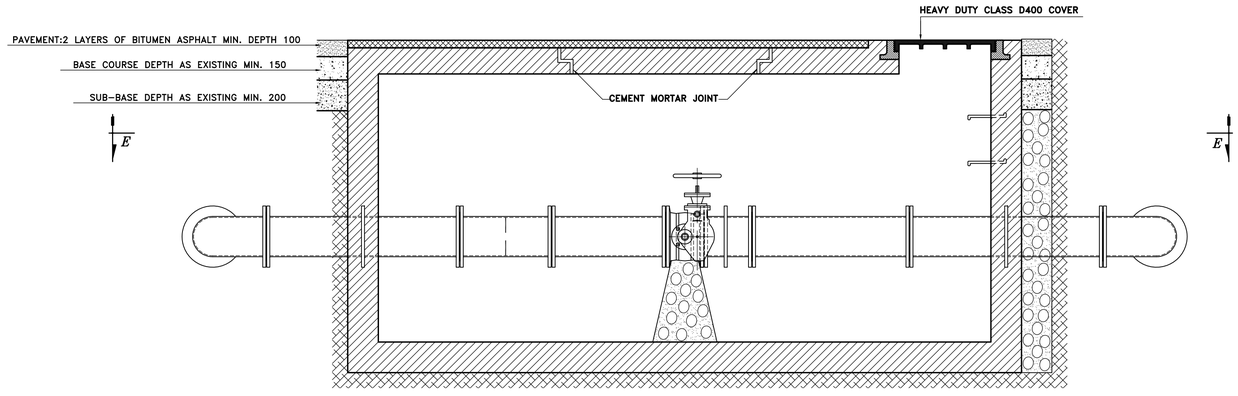
ORIGINAL DRAWING SIZE A1



SECTION E–E



SECTION C–C



SECTION D–D

NOTES:

REINFORCED CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 350 Kg/m3

BLINDING AND MASS CONCRETE:
NORMAL PORTLAND CEMENT, GRADE C45.
DOSING 250 kg/m3.

REINFORCEMENT:
DEFORMED HIGH STRENGTH STEEL BARS: SYMBOL T YIELD STRESS: Fy=400 MPa.
MILD STEEL BARS : SYMBOL # YIELD STRESS: Fy=215 MPa.

STRESSES:
SEVERE CONTROL.
CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS: f'c =25 MPa.
CONCRETE TENSILE STRENGTH AT 28 DAYS: f't =2.1 MPa.

CONCRETE COVER:
CLEARANCE BETWEEN THE EXTERNAL GENERATRIX OF BARS AND THE FACINGS SHALL BE 30 mm

OVERLAPPING:
LAPS SHALL NOT BE LESS THAN FIFTY TIMES THE BAR DIAMETER.
WHERE SPLICE BARS ARE USED, THEIR LENGTH SHALL NOT BE LESS THAN 2x50ø.
(ø= NOMINAL DIAMETER OF BAR).
LAPS SHALL BE STAGGERED FROM ONE HOOP TO THE OTHER AND/OR ONE BAR TO THE OTHER IN ORDER TO REDUCE THE NUMBER OF LAPS IN THE SAME SECTION.
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BENDING:
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FORMWORK:
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WATERPROOFING:
BITUMEN LAYER ON EXTERNAL SURFACES OF VALVE CHAMBER WALLS EXCEPT WHERE THERE IS MASS CONCRETE

REMARKS:
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SOAKAWAY
TO BE USED ONLY IF THE INSTALLATION OF AN ADEQUATE GRAVITY DRAIN PIPE TO A FREE OUTLET IS DETERMINED BY THE ENGINEER NOT TO BE POSSIBLE.

* T.P. =TEST PRESSURE

LEGEND:

(a) PIECE OF PIPE MAX. LENGTH 1000
(b) FLANGED REDUCER
(c) INTAKE COLLAR
(d) PRESSURE GAUGE
(e) BUTTERFLY VALVE
(f) FILTER WITH WASHOUT VALVE
(g) PRESSURE REGULATING OR PRESSURE SUSTAINING VALVE
(h) SELF-RESTRAINED DISMANTLING JOINT
(i) AIR RELIEF VALVE+ISOLATING BUTTERFLY VALVE
(j) PUDDLE FLANGE
(k) FLANGE-SPIGOT
(l) FLANGE-SOCKET
(m) PRESSURE REDUCING DIAPHRAGM

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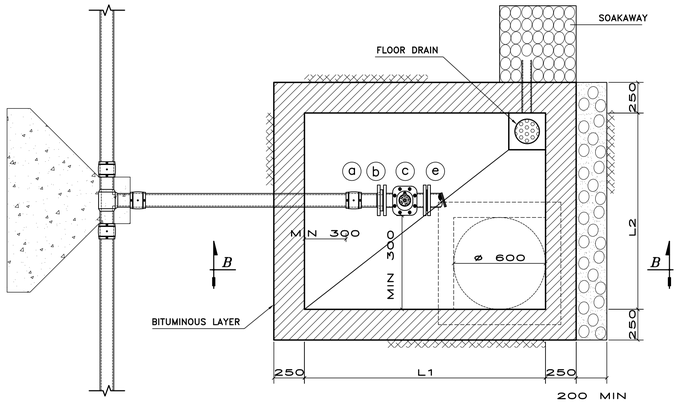
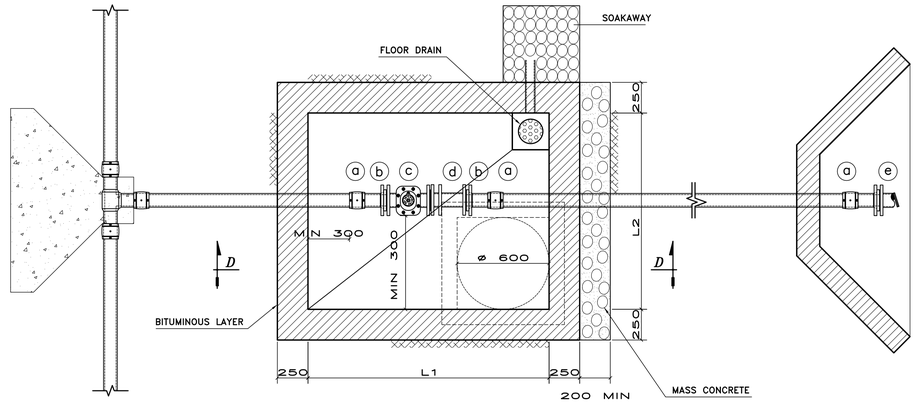
ORIGINAL DRAWING SIZE A1

TYPICAL WASHOUT CHAMBER DETAIL
TYPE I



SECTION A–A

TYPICAL WASHOUT CHAMBER DETAIL
TYPE II



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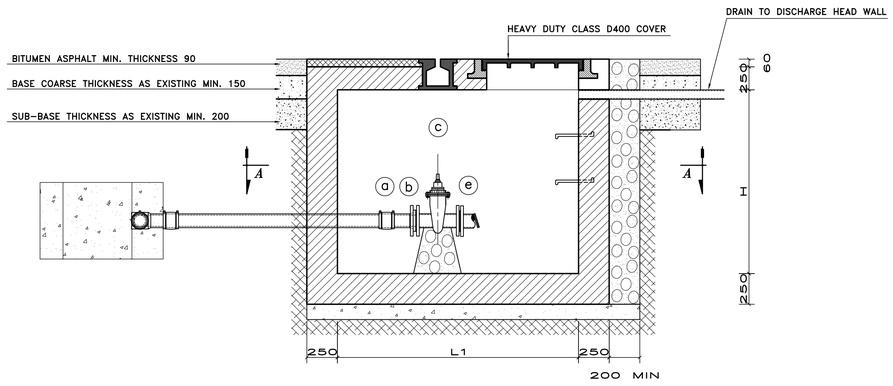

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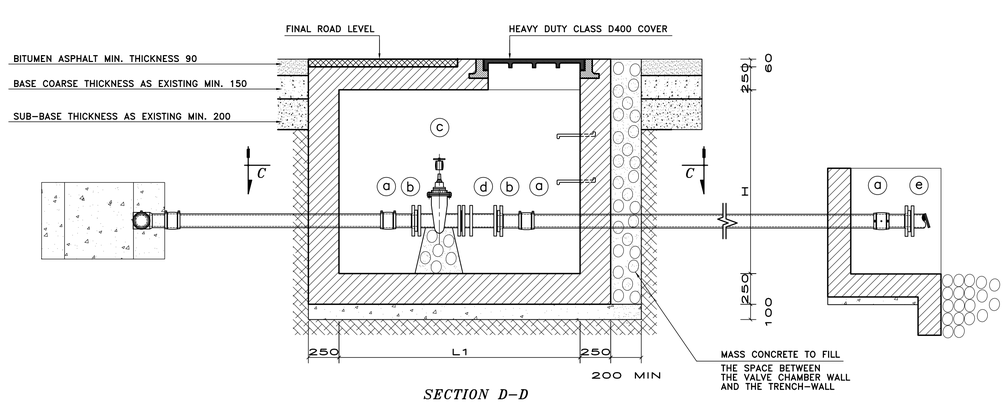
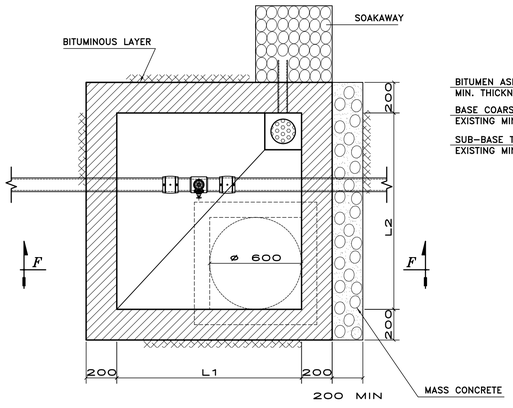
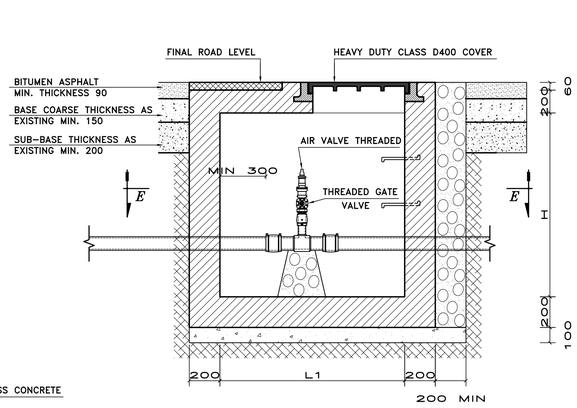


SECTION D–D

TYPICAL AIR VALVE CHAMBER DETAIL
TYPE I

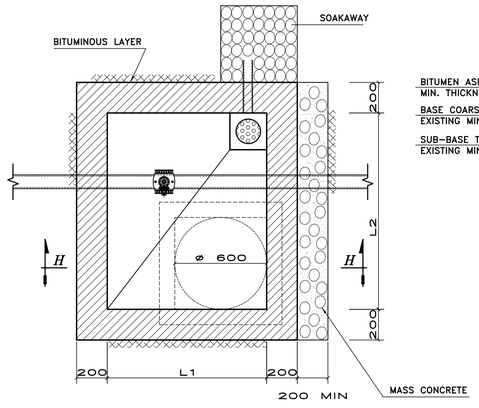


SECTION E–E

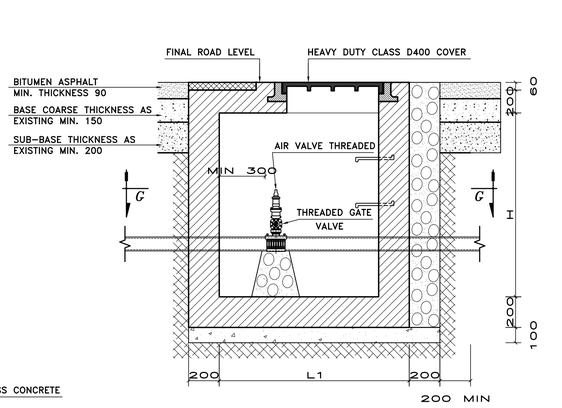


SECTION F–F

TYPICAL AIR VALVE CHAMBER DETAIL
TYPE II



SECTION G–G



SECTION H–H

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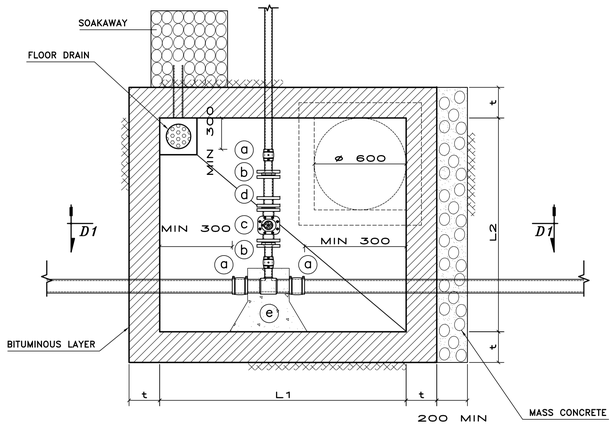
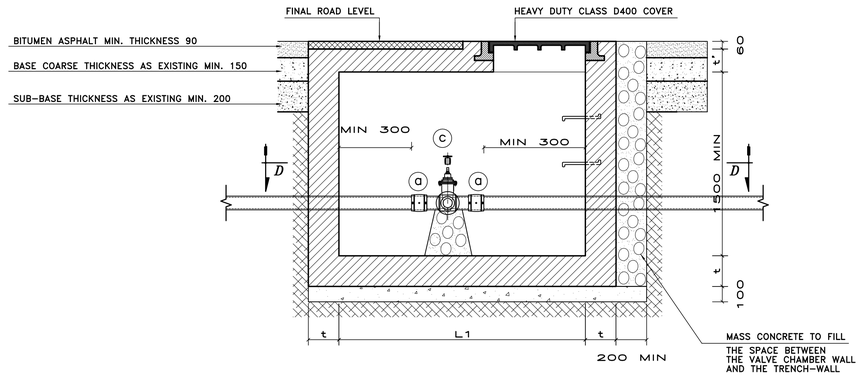
FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST19-21	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	19/21	462-05ST19

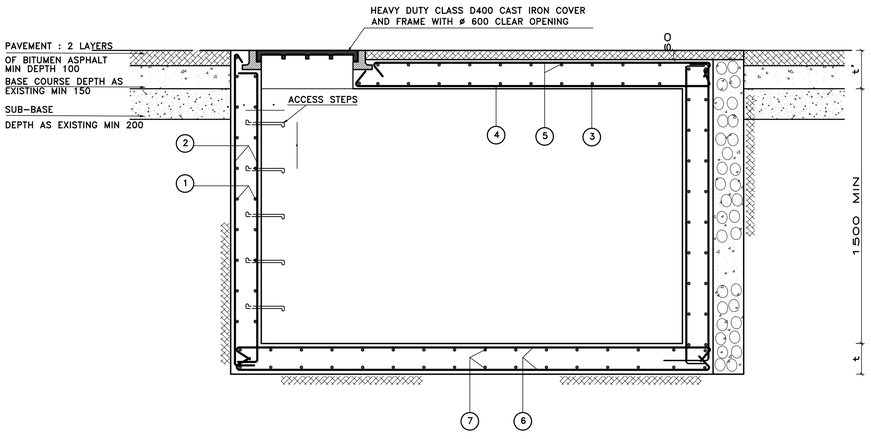
ORIGINAL DRAWING SIZE A1

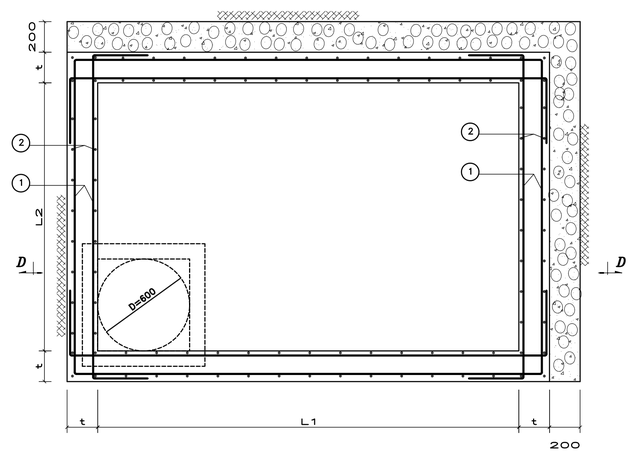


SECTION D–D



SECTION D1–D1





VALVE CHAMBER DIMENSIONS	
TYPE	LlxL2
R1	1000x1250
R2	1250x1000
R3	1250x1500
R4	1250x1750
R5	1500x1000
R6	1500x1500
R7	1500x1750
R8	1750x1250
R9	1750x1500
R10	1750x2000
R11	1750x2250
R12	2000x1500
R13	2000x1750
R14	2250x1500
R15	2250x1750
R16	2250x2000
R17	2500x1500
R18	2500x1750
R19	2500x2000
R20	2500x2250
R21	2750x1500

VALVE CHAMBER DIMENSIONS	
TYPE	LlxL2
R22	2750x1750
R23	2750x2000
R24	2750x2250
R25	2750x2500
R26	3000x1750
R27	3000x2000
R28	3000x2250
R29	3000x2500
R30	3000x2750
R31	3250x1750
R32	3500x1750
R33	3500x2000
R34	3500x2250
R35	3750x1750
R36	3750x2000
R37	3750x2250
R38	3750x2500
R39	4250x2000
R40	4250x2250
R41	4250x2500
R42	4250x2750

VALVE CHAMBER TYPE

BRANCH DIAM / NBR OF VALVES / MAIN PIPE	63			75			90			110			125			140		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
63	–	R8	R12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
75	R4	R8	R12	–	R8	R12	–	–	–	–	–	–	–	–	–	–	–	–
90	R4	R8	R12	R4	R8	R12	–	R8	R12	–	–	–	–	–	–	–	–	–
110	R4	R12	R14	R4	R12	R14	R4	R12	R14	–	R12	R14	–	–	–	–	–	–
125	R4	R12	R14	R4	R12	R14	R4	R12	R14	R4	R12	R14	–	R12	R14	–	–	–
140	R4	R12	R14	R4	R12	R14	R4	R12	R14	R4	R12	R14	R4	R12	R14	–	R12	R14

REINFORCEMENT STEEL TABLE

VALVE CHAMBER	THICKNESS		REINFORCEMENT						
TYPE	t mm	t' mm	1	2	3	4	5	6	7
R1–R5	200	250	T14 ❁200	T14 ❁200	T16 ❁200	T14 ❁200	2xT12 ❁200	T14 ❁200	T14 ❁200
R6–R11	200	250	T14 ❁165	T14 ❁165	T16 ❁165	T14 ❁165	2xT12 ❁165	T14 ❁165	T14 ❁165
R11–R23	200	250	T14 ❁150	T14 ❁150	T14 ❁150	T14 ❁150	2xT12 ❁150	T14 ❁150	T14 ❁150
R23–R38	250	300	T16 ❁200	T16 ❁200	T20 ❁200	T14 ❁200	2xT12 ❁200	T16 ❁200	T16 ❁200
R39–R42	300	300	T16 ❁165	T16 ❁165	T20 ❁165	T14 ❁165	2xT12 ❁165	T16 ❁165	T16 ❁165

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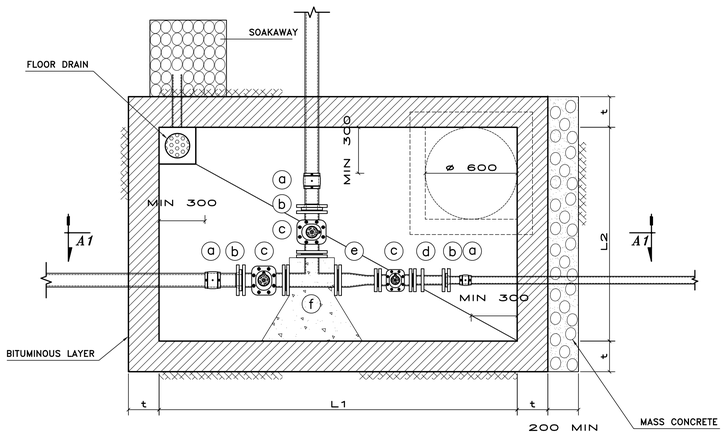
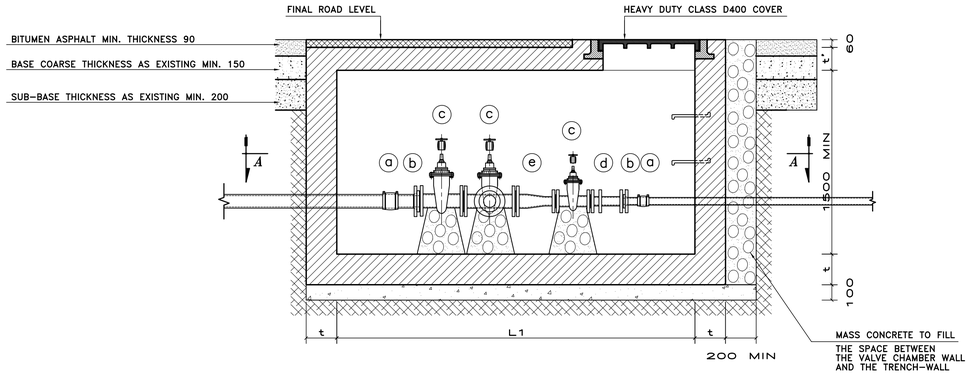
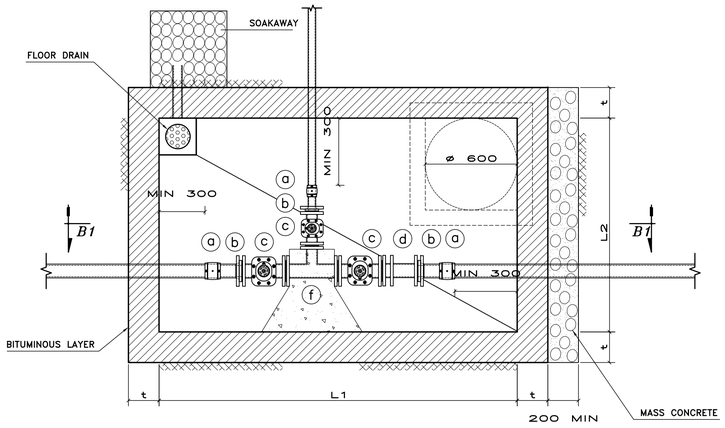


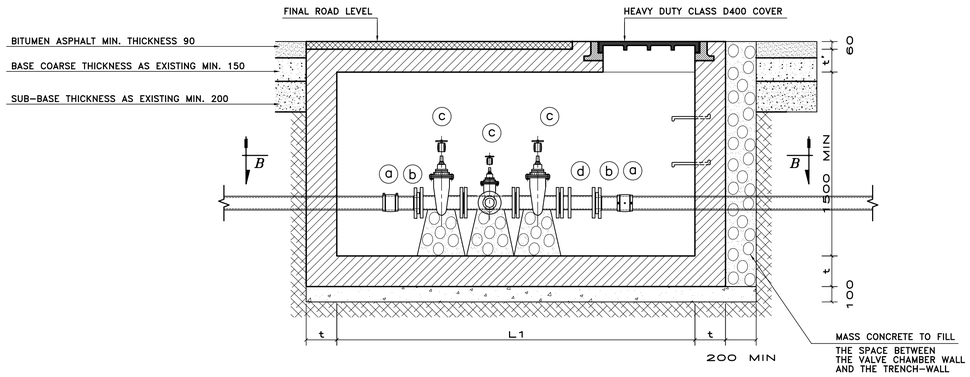
SECTION A–A



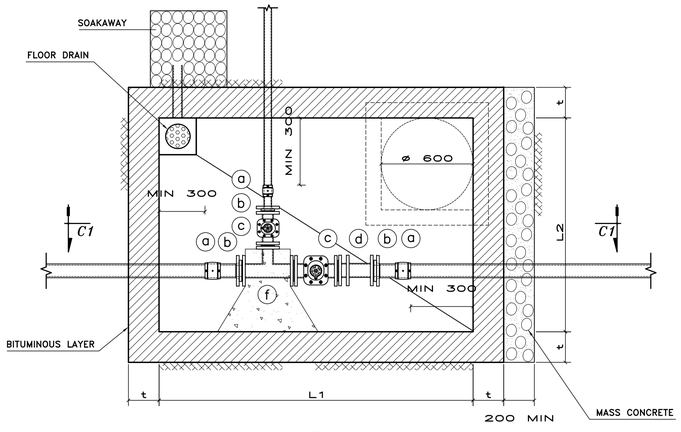
SECTION A1–A1



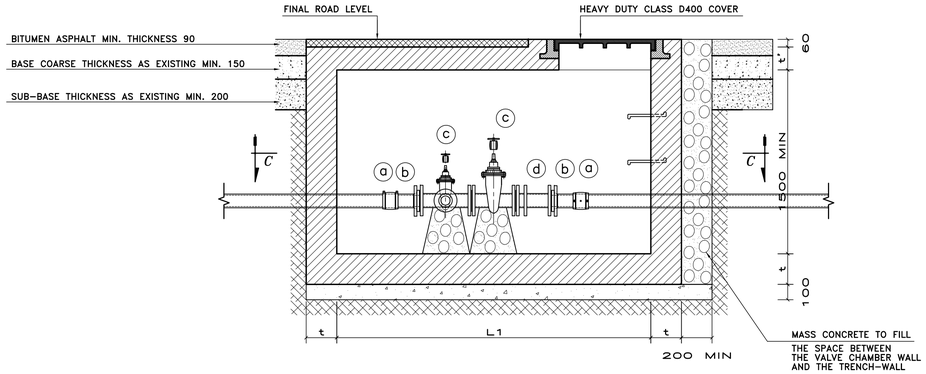
SECTION B–B



SECTION B1–B1



SECTION C–C



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ALL EXECUTED CONCRETE SHALL BE FAIR FACE CONCRETE
(METALLIC OR PLYWOOD FORMWORK).

WATERPROOFING:
BITUMEN LAYER ON EXTERNAL SURFACES OF VALVE CHAMBER WALLS EXCEPT WHERE THERE IS MASS CONCRETE

REMARKS:
* HOLES MADE BY THE TIE–RODS SHALL BE FILLED WITH A NON SHRINK GROUT BY MEANS OF SPECIAL INJECTION METHODS.
* ALL DIMENSIONS ARE IN MILLIMETERS.
* SCALING FROM THESE DRAWINGS IS NOT ALLOWED.
* SOIL FRICTION ANGLE SHALL BE 25°
* GROUND/ MANHOLE FRICTION COEFFICIENT SHALL BE 2/3 tg ø
* THE PASSIVE EARTH PRESSURE SHALL BE TAKEN INTO ACCOUNT FOR MANHOLE STABILITY BY FILLING THE VOID BETWEEN THE MANHOLE AND THE TRENCH WALL WITH MASS CONCRETE OF A MINIMUM THICKNESS "200".

SOAKAWAY
TO BE USED ONLY IF THE INSTALLATION OF AN ADEQUATE GRAVITY DRAIN PIPE TO A FREE OUTLET IS DETERMINED BY THE ENGINEER NOT TO BE POSSIBLE.

* T.P. =TEST PRESSURE

LEGEND:
(a) ELECTROFUSION COUPLING
(b) PE–FLANGE ADAPTOR WITH BACKING FLANGE
(c) GATE VALVE
(d) SELF–RESTRAINED DISMANTLING JOINT
(e) REDUCER
(f) ALL FLANGED TEE

Rev.	Date	Dsgn	Drwn	Chk'd	Appr'd

REPUBLIC OF LEBANON
MINISTRY OF ENERGY AND WATER

CONSTRUCTION OF RESERVOIR, LIFT LINE, AND WATER DISTRIBUTION NETWORK IN JAJ - JBAIL CAZA

TRANSMISSION AND DISTRIBUTION SYSTEMS	TYPICAL VALVE CHAMBER DETAILS FOR HDPE PIPES

FILE	DESIGNED BY	DRAWN BY	CHECKED BY
462-05ST19-21	Z. SABA	S. SAWAYA	T. ACHKAR

DATE	SCALE	SHEET No.	DRAWING No.
FEBRUARY 2017	NOT TO SCALE	21/21	462-05ST21

ORIGINAL DRAWING SIZE A1