SOLUTIONS
PUMP STATION DESIGN COURSE
DAY 1

CONTINUING PROFESSIONAL DEVELOPMENT RESULTS SHEET

PUMP STATION DESIGN
HAND CALCULATION 1

D_1 = 0,125 m
Q_1 = 0,025 m³/sH_1 = 21 m
N_1 = 2900 rpm

The geometrically similar pump must now deliver
Q_2 = 0,055 m³/s
At a head of
H_2 = 21 * 1,2 = 25,2 m

With

$$\frac{Q_1}{D_1^2\sqrt{H_1}} = \frac{Q_2}{D_2^2\sqrt{H_2}}$$

$$\frac{0{,}025}{0{,}125^2\sqrt{21{,}0}} = \frac{0{,}055}{D_2^2\sqrt{25{,}2}}$$ thus D_2 = 0,1771 m

And

$$\frac{Q_1}{N_1 D_1^3} = \frac{Q_2}{N_2 D_2^3}$$

$$\frac{0{,}025}{(2900)(0{,}125)^3} = \frac{0{,}055}{N_2(0{,}1771)^3}$$ thus N_2 = 2241,7 rpm

Check with third equation

PUMP STATION DESIGN
HAND CALCULATION 2

Figure (a)

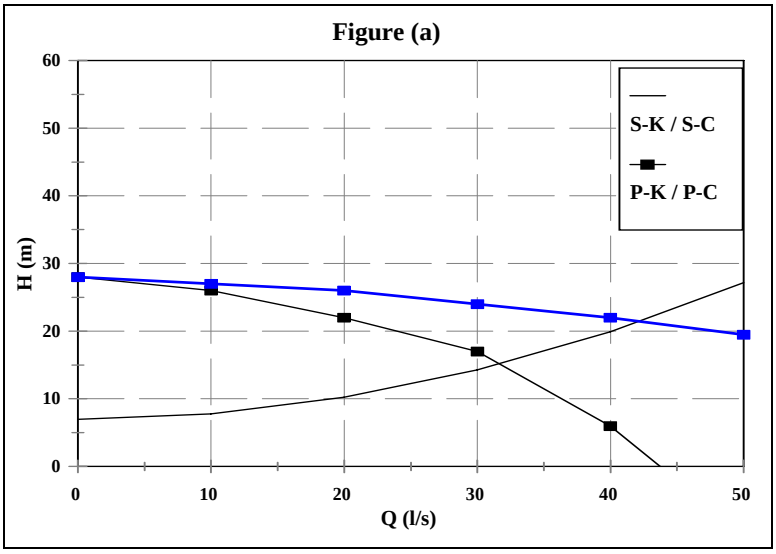


Figure (b)

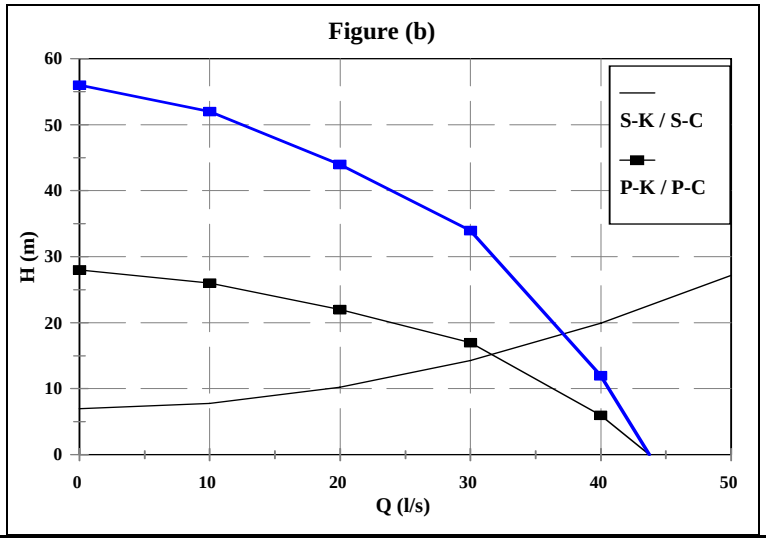
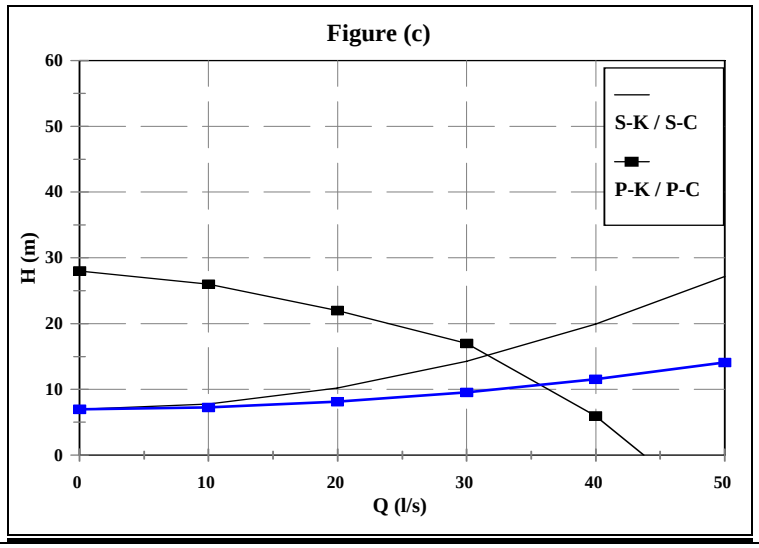


Figure (c)



PUMP STATION DESIGN
HAND CALCULATION 3

Approximate duty point:
Q = 57 m^3/h with a 250 mm impeller will deliver a 72,1 m head if it operates there.

$H = H_s + h_f + h_l$

Static height difference
H_s = 40 m
Secondary losses
h_l = 0 m

Calculate friction loss

$h_f = \frac{\lambda L V^2}{2gD}$ but D is unknown

$$72{,}1 = 40 + \frac{(0{,}018)(6620)\left(\frac{0{,}015833}{\frac{\pi D^2}{4}}\right)^2}{2(9{,}81)D}$$ thus D = 150 mm

PUMP STATION DESIGN Select the correct answer by marking with an "X"	
Question D1Q4	**B**
Question D1Q5	**B**
Question D1Q6	**C**
Question D1Q7	**A, B and C**
Question D1Q8	**A - True**
Question D1Q9	**B - False**
Question D1Q10	**A - True**
Question D1Q11	**A - True**
Question D1Q12	**B - False**
Question D1Q13	**B - False**
Question D1Q14	**Solution**

$H_{duty\ point}$ = **108,7 m (Alternative 1)**
Or = 112 m (Alternative 2)

$Q_{duty\ point}$ = **54 l/s (Alternative 1)**
Or = 58 l/s (Alternative 2)

P = **89,97 kW (Alternative 1)**
Or = 99,57 kW (Alternative 2) (pump only)

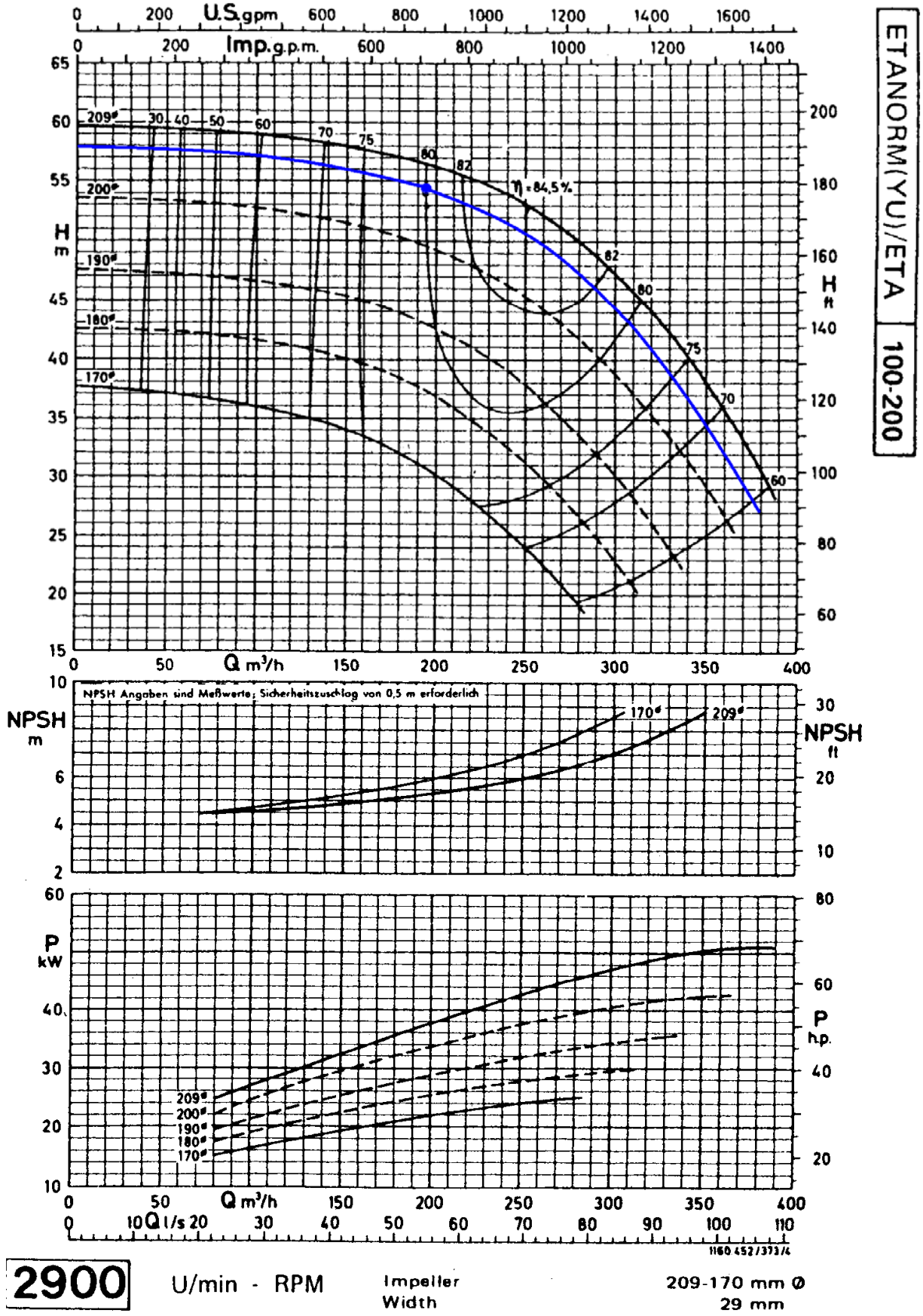
$NPSH_{available}$ = **5,745 m (required = 5,70 m ???)**

Estimated cost =
R12000 x (99,57*1,15) = R1,55 million ???

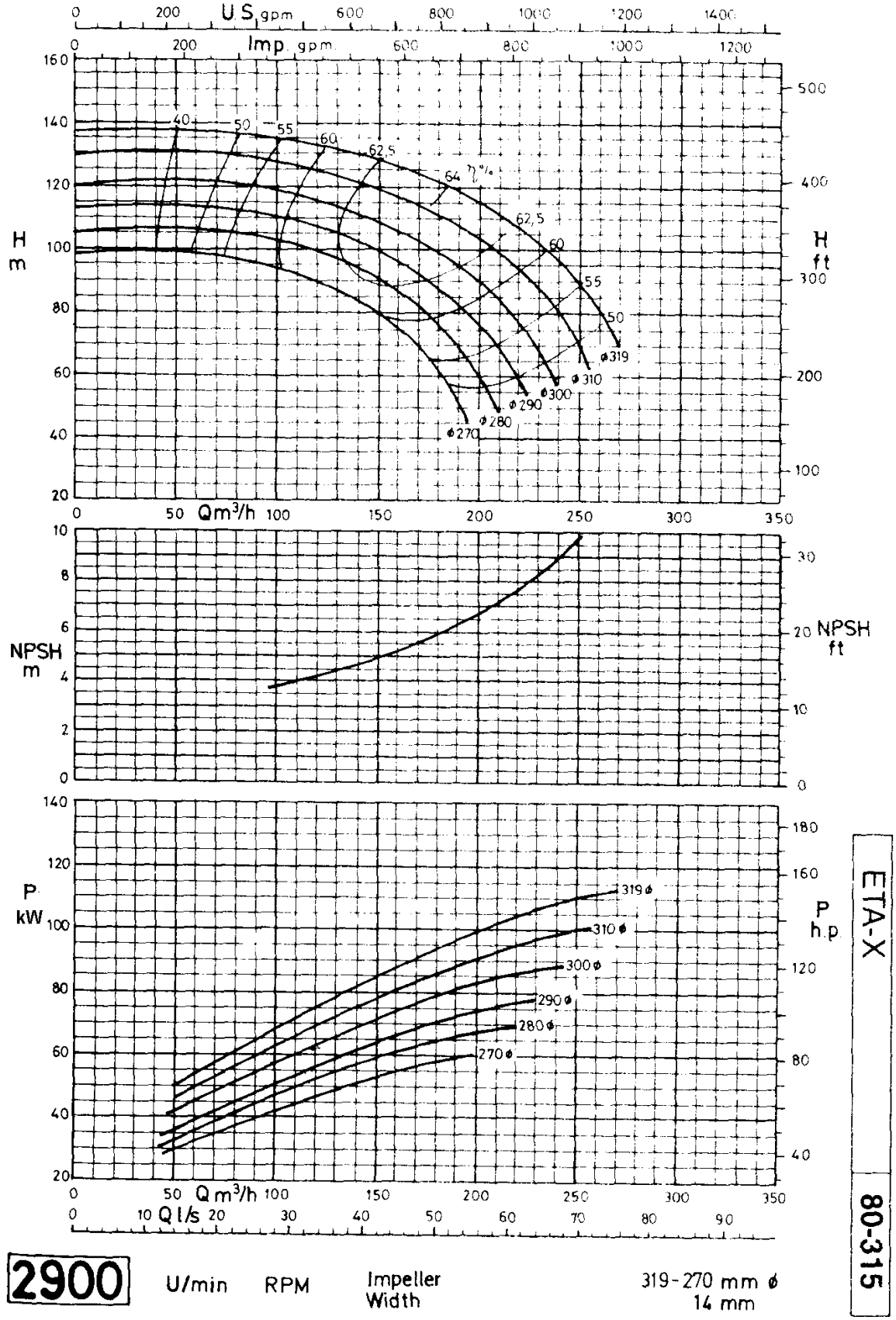
Based on Alternative 2 solution
$H_{duty\ point}$ (increased roughness) = **114,35 m**
$Q_{duty\ point}$ (increased roughness) = **56 l/s**

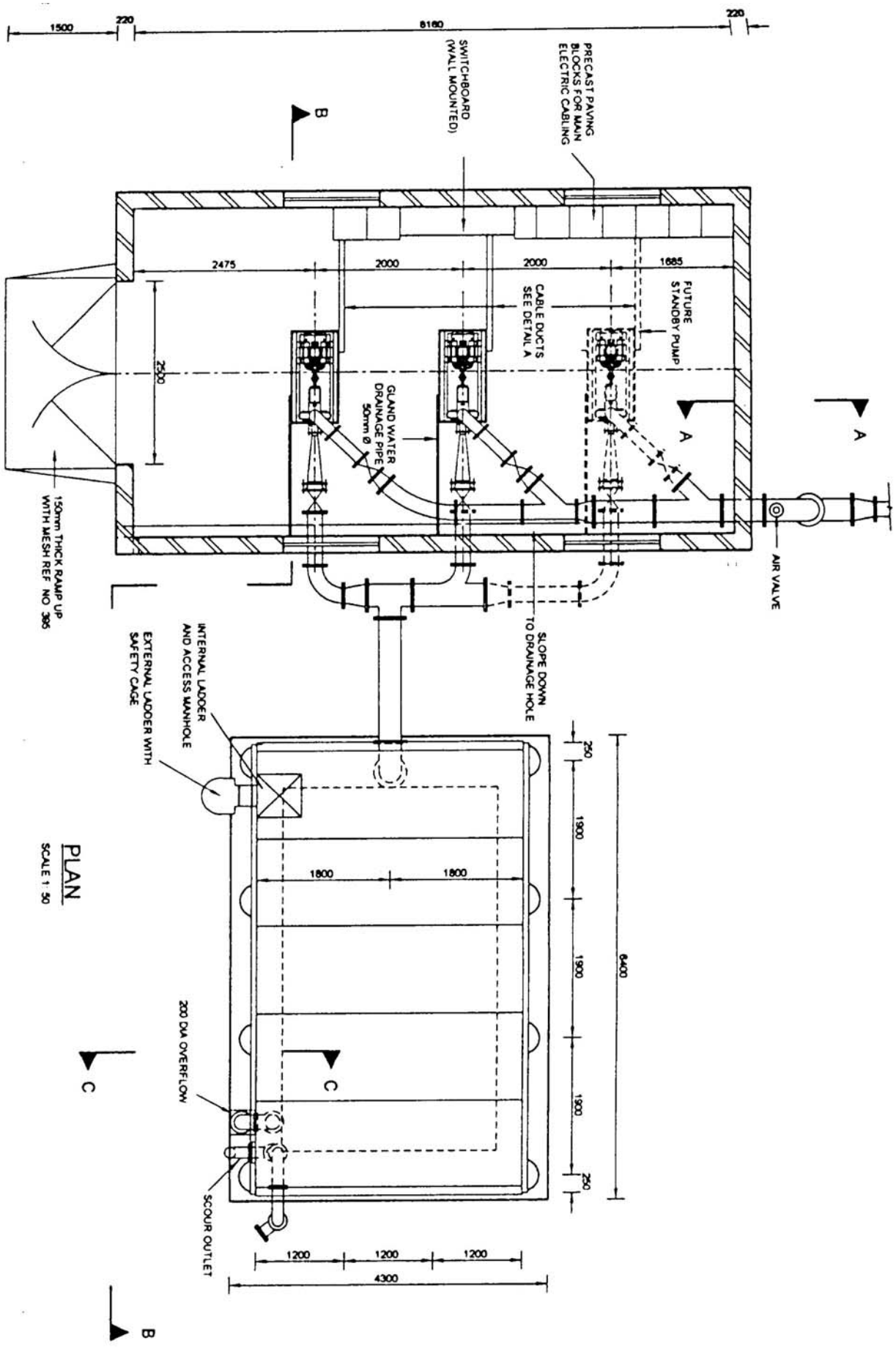
See attached calculations and pump curves

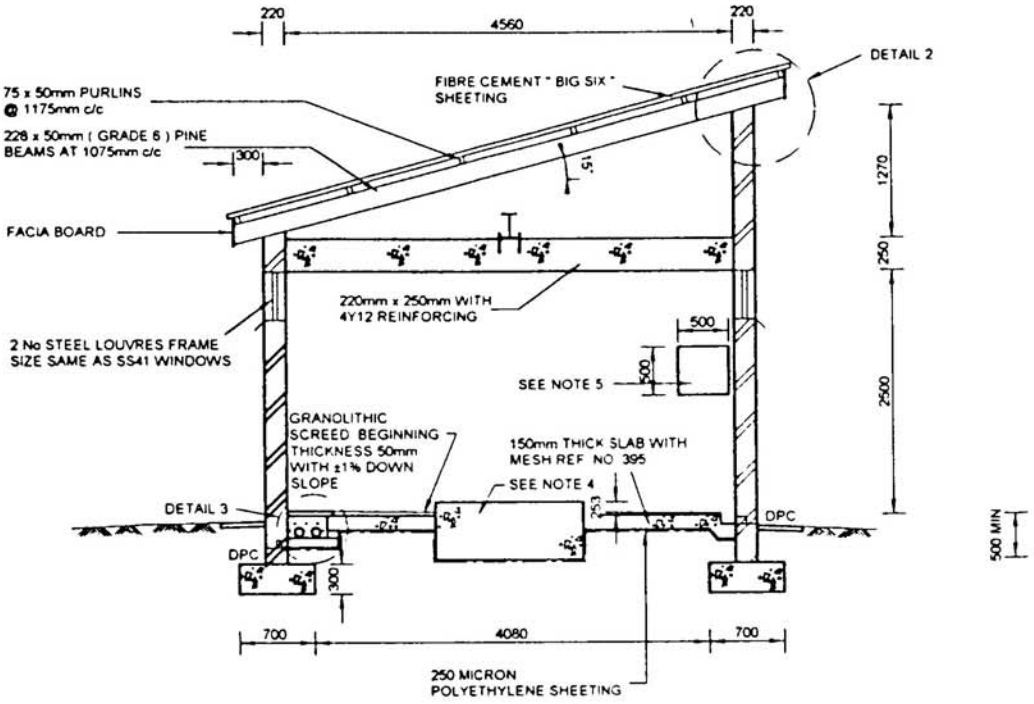
Alternative 1



Alternative 2

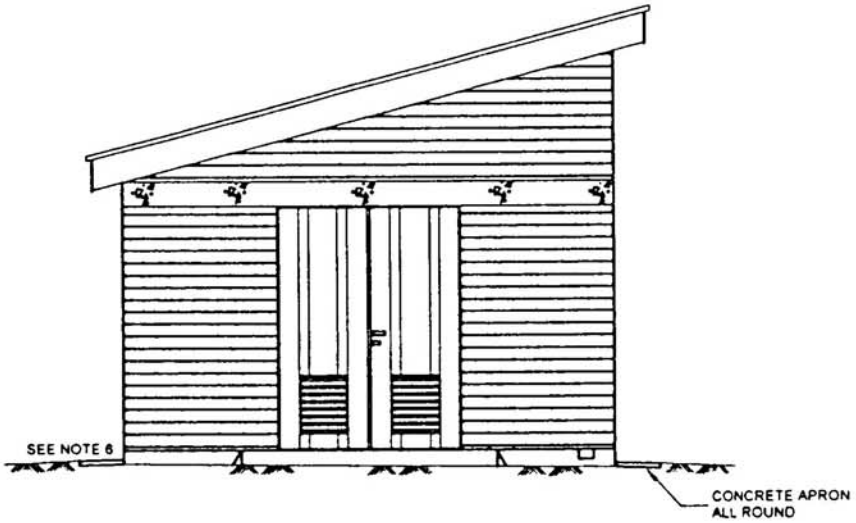



1500
220
8180
220
SWITCHBOARD (WALL MOUNTED)
PRECAST PAVING BLOCKS FOR MAIN ELECTRIC CABLING
B
2475
2000
2000
1685
2500
CABLE DUCTS SEE DETAIL A
FUTURE STANDBY PUMP
GLAND WATER DRAINAGE PIPE 50mm Ø
A
A
150mm THICK RAMP UP WITH MESH REF NO 386
AIR VALVE
SLOPE DOWN TO DRAINAGE HOLE
INTERNAL LADDER AND ACCESS MANHOLE
EXTERNAL LADDER WITH SAFETY CAGE
250
1900
1900
1900
1900
250
6400
1800
1800
PLAN
SCALE 1:50
C
C
200 DIA OVERFLOW
SCOUR OUTLET
1200
1200
1200
4300
B



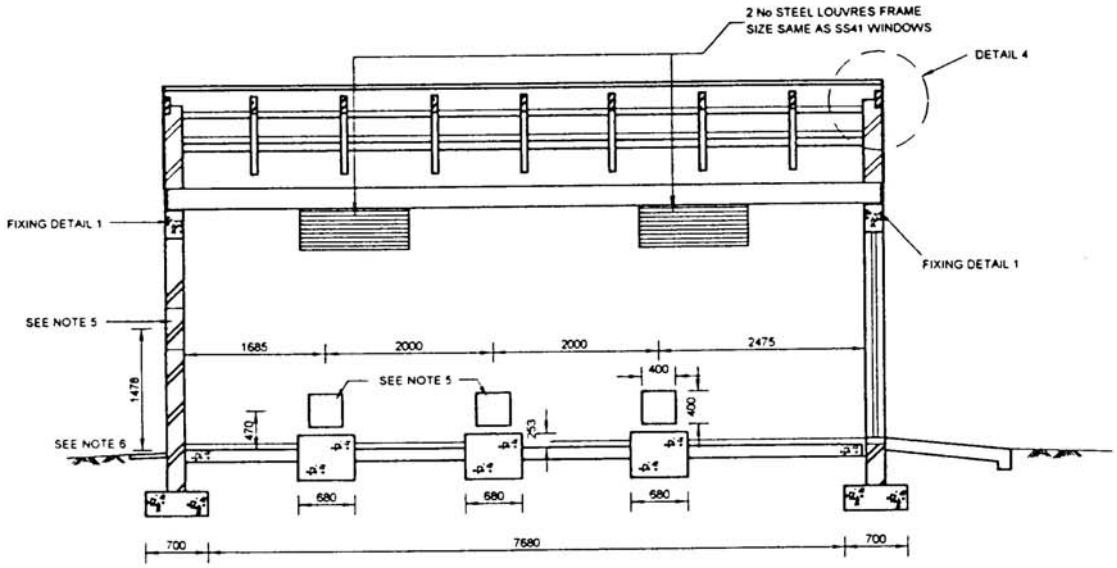
SECTION B - B

SCALE 1 50



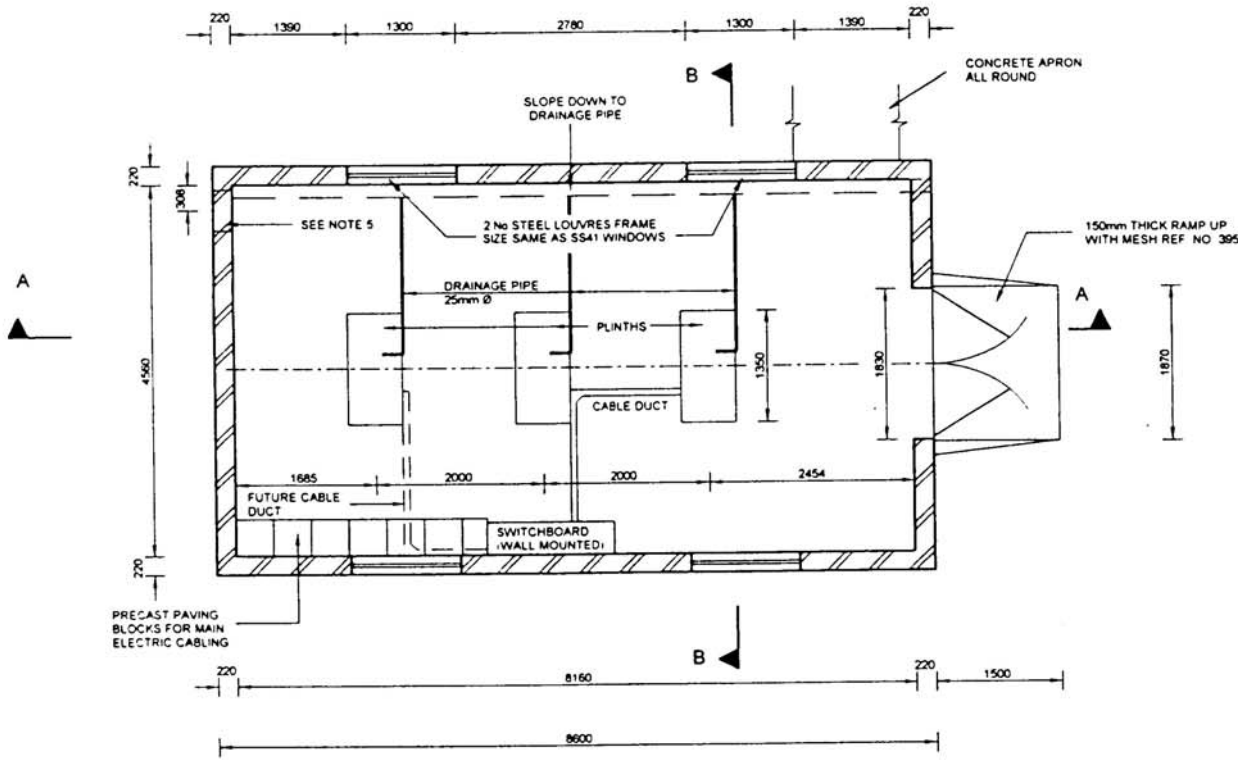
SIDE ELEVATION

SCALE 1 50



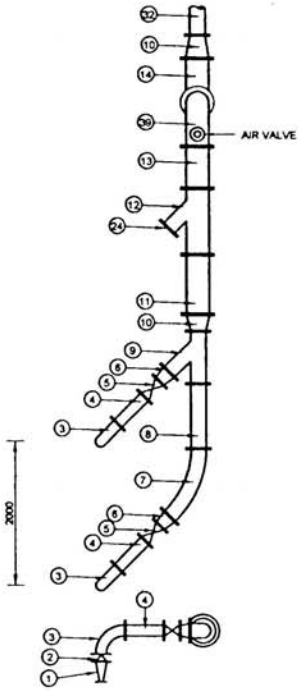
SECTION A - A

SCALE 1 50



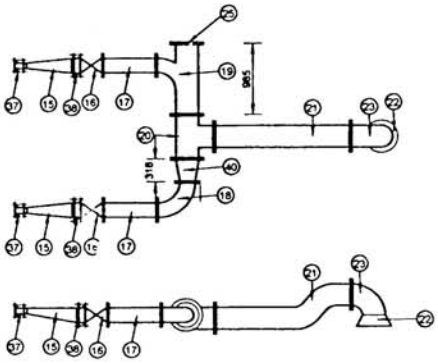
PLAN

SCALE 1 50



DETAIL OF DELIVERY PIPEWORK

SCALE 1: 50

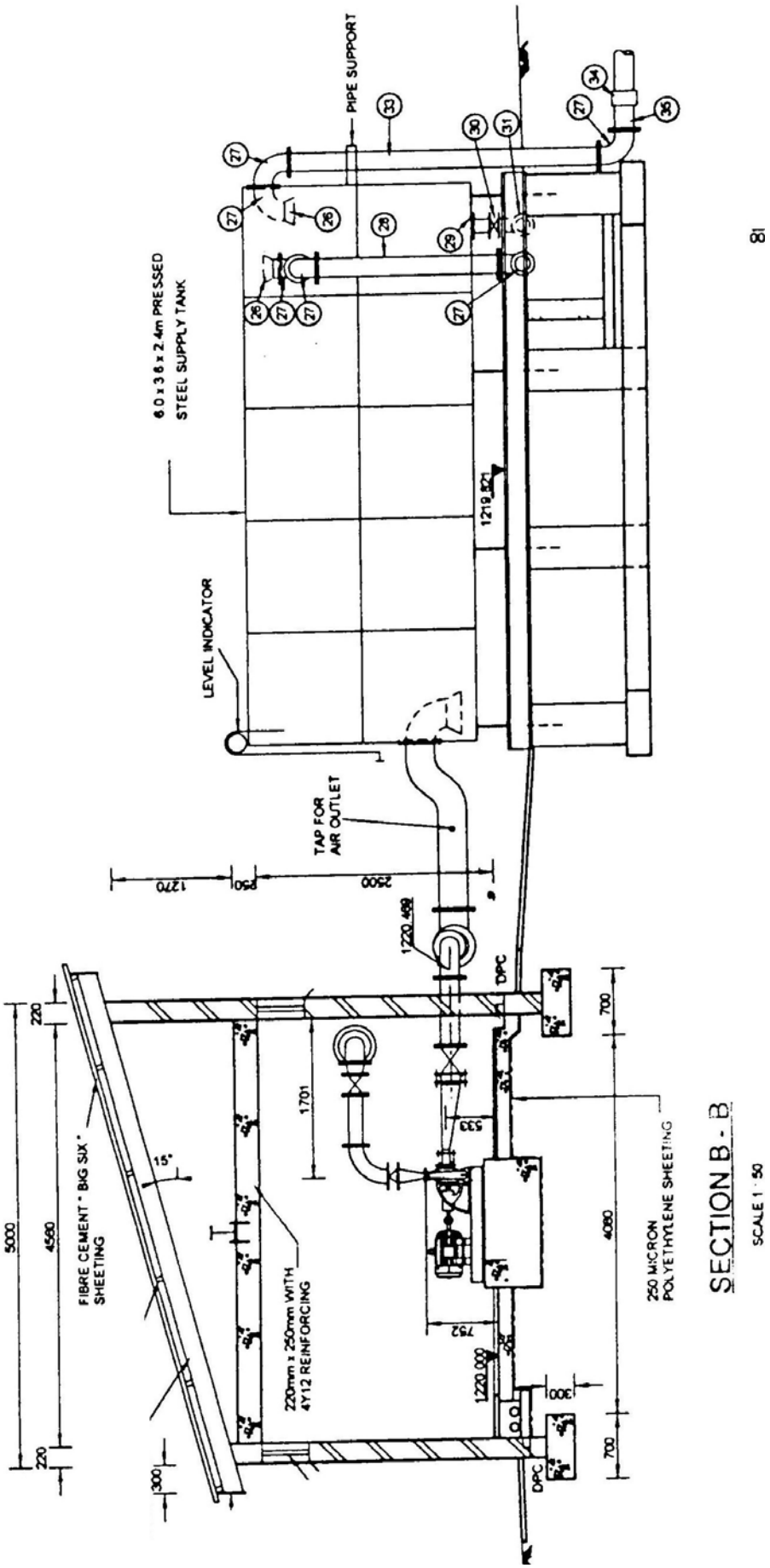


DETAIL OF SUCTION PIPEWORK

SCALE 1: 50

PIPEWORK AND VALVE SCHEDULE

1. 50mm x 150mm ND DOUBLE FLANGED CONCENTRIC REDUCER
2. 150mm ND WAFER TYPE CHECK VALVE
3. 150mm ND x 90° DOUBLE FLANGED MEDIUM RADIUS BEND
4. 150mm ND x 526mm LONG DOUBLE FLANGED DISTANCE PIECE
5. 150mm ND DOUBLE FLANGED RSV GATE VALVE
6. 150mm x 200mm ND DOUBLE FLANGED CONCENTRIC REDUCER
7. 200mm ND x 45° DOUBLE FLANGED LONG RADIUS BEND
8. 200mm ND x 895mm LONG DOUBLE FLANGED DISTANCE PIECE
9. 200mm ND ALL ROUND FLANGED LATERAL TEE
10. 200mm x 300mm ND DOUBLE FLANGED CONCENTRIC REDUCER
11. 300mm ND x 822mm LONG DOUBLE FLANGED DISTANCE PIECE
12. 300mm x 200mm ND ALL ROUND FLANGED LATERAL TEE
13. 300mm ND x 562mm LONG DOUBLE FLANGED DISTANCE PIECE
14. 300mm ND x 90° DOUBLE FLANGED MEDIUM RADIUS BEND
15. 200mm ND x 65mm ND x 800mm LONG ECCENTRIC REDUCER COMPLETE WITH RESTRAINING FLANGES
16. 200mm ND DOUBLE FLANGED RSV GATE VALVE
17. 200mm ND x 718mm LONG DOUBLE FLANGED DISTANCE PIECE
18. 200mm ND x 90° DOUBLE FLANGED MEDIUM RADIUS BEND
19. 300mm ND ALL ROUND FLANGED MEDIUM RADIUS SWEEP TEE
20. 300mm x 300mm ND ALL ROUND FLANGED TEE
21. 300mm ND DOUBLE FLANGED S-BEND DISTANCE PIECE (CUT TO SUIT ON SITE - APPROX. 1693mm LONG)
22. 300mm ND x 460mm ND STEEL BELLMOUTH
23. 300mm ND x 90° ONE END FLANGED SHORT RADIUS BEND
24. 150mm ND BLANK FLANGE
25. 300mm ND BLANK FLANGE
26. 200mm ND x 305mm ND ONE END FLANGED STEEL BELLMOUTH
27. 200mm ND x 90° DOUBLE FLANGED SHORT RADIUS BEND
28. 200mm ND x 1915mm LONG DOUBLE FLANGED DISTANCE PIECE
29. 150mm ND x 74mm LONG DOUBLE FLANGED DISTANCE PIECE
30. 150mm ND WAFER TYPE BUTTERFLY VALVE, WITH GEARBOX AND HANDWHEEL
31. 150mm ND x 90° DOUBLE FLANGED SHORT RADIUS BEND
32. 200mm ND F C DISTANCE PIECE (CUT TO SUIT ON SITE APPROX. 6000mm LONG)
33. 200mm ND x 2558mm LONG DOUBLE FLANGED DISTANCE PIECE
34. 200mm ND TRIPLEX ADAPTOR COUPLING
35. 200mm ND FLANGE ADAPTOR
36. 200mm ND DOUBLE FLANGED DISTANCE PIECE, CUT TO SUIT ON SITE APPROX. 2200mm LONG
37. 65mm ND VJ FLANGE ADAPTOR
38. 200mm ND VJ FLANGE ADAPTOR
39. 300mm ND x 90° DOUBLE FLANGED MEDIUM RADIUS BEND WITH 50mm ND FLANGED BRANCH WELDED ON FOR AIR VALVE
40. 200mm x 300mm ND DOUBLE FLANGED ECCENTRIC REDUCER


PIPE SUPPORT
6.0 x 3.6 x 2.4m PRESSED STEEL SUPPLY TANK
LEVEL INDICATOR
TAP FOR AIR OUTLET
DPC
FIBRE CEMENT "BIG SIX" SHEETING
220mm x 250mm WITH 4Y12 REINFORCING
250 MICRON POLYETHYLENE SHEETING
SECTION B - B
SCALE 1 : 50