Chapter 11

DESIGN OF COLD WATER PIPING SYSTEM TO REFRIGERATE SYSTEMS

11.1 ABOUT PIPE MAKING MATERIALS:

11.1.1 Pipe Materials

A variety of materials are used to make the pipeline as follows:

<table>
<thead>
<tr>
<th>Function</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiller Cold water Hose</td>
<td>Steel to black or zinc-steel</td>
</tr>
<tr>
<td>Heat and water supply pipes</td>
<td>Galvanized Steel Pipe</td>
</tr>
<tr>
<td>Condenser or exhaust water hose</td>
<td>Galvanized Steel Pipe</td>
</tr>
<tr>
<td>Air-conditioning or water-stopping security</td>
<td>Black Steel Pipe</td>
</tr>
<tr>
<td>Hot water</td>
<td>Black Steel Pipe</td>
</tr>
</tbody>
</table>

11.1.2. Characteristics of steel tube

The black steel tubes are often used to lead water that has a wide variety of thin thickness. At a rate the thickness is divided into a number of varying degrees from Schedule to Schedule 160. In the table the ST tubes are tubing that has standard thickness and the XS tube is the type of pipe that has very large thickness.

Table of the calculation of steel tube

The simplicity of heat of pipe type

In the process of working the temperature of the water varies in a relatively rhe clause, it should be noted for the enthusiasm of heat of the pipeline for proper prevention measures. On the table is the hatch level of the steel pipe compared to the state 0°C. The hatch level is almost proportional to the temperature changes. To compensate in the harmonic technique people use U, Z, L.

The level of pipeline bloom.
### 11.2 CALCULATION OF PLUMBING DESIGN

<table>
<thead>
<tr>
<th>T1</th>
<th>T2</th>
<th>Cap</th>
<th>Pi</th>
<th>Chilled Water temperature Difference (outlet/inlet)</th>
<th>Cooling Water temperature Difference (outlet/inlet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>°C</td>
<td>°C</td>
<td>Kw</td>
<td>L/min</td>
<td>m³/h</td>
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<td>25</td>
<td>963</td>
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<td>2761</td>
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<td>2666</td>
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<td>T1</td>
<td>T2</td>
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<td>Chilled Water temperature Difference (outlet/inlet)</td>
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<td>5 °C</td>
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<td>45</td>
<td>956</td>
<td>230.2</td>
<td>2740</td>
<td>164.4</td>
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</table>

Ta designed the plumbing based on the basis of pressure loss response to 1m of pipe thickness in the experience of not leaving the 100 PA/m (δp1 ≤ 1000 pa/m) throughout the plumbing. In this design plumbing goes from pump through evaporation of air conditioner (WC) then enters the upper level tube Get down through the water level to the ground floor. The outgoing track of our state-level symbols A-B-C-D, then cross the tube back to the pump.

Traffic through pipe passages:

Total air conditioner with total cold capacity calculated Q₀ = 2400 KW and the decrease of water temperature in a evaporation tank (as well as in the FCU) δTn= 5°C so we have:

\[
G_0 = \frac{Q_0}{c_n \Delta T_n} = \frac{2400}{4.185} = 114.8 \text{ Kg/s} = 114.8 \text{ L/S}
\]

Floor 2 With total cold productivity is Q₁ = 280Kw
\[ G_1 = \frac{Q_1}{c_n \cdot \Delta t_n} = \frac{280}{4.18} = 13.4 \text{ Kg/s} = 13.4 \text{ L/S} \]

Water flow via CD segment:
\[ G_{CD} = G_0 - G_1 = 114.8 - 13.4 = 101.4 \text{ l/s} \]

Floor 4 With total cold productivity is \( Q_2 = 500 \text{ Kw} \)
\[ G_2 = \frac{Q_2}{c_n \cdot \Delta t_n} = \frac{145.9}{4.18} = 6.99 \text{ L/S} \]

The temperature number of water temperatures to the chiller and the water temperature out of the condenser has the water flow required for 1 chiller

Calculation of the check again:

Water flow through the pump:
\[ V = \frac{Q_0}{c_n \cdot \rho_n \cdot \Delta t_n} \]

In it:
\( Q_0 = 800 \text{ KW-Cold capacity} \)
\( C_n = 4.192 \text{ KJ/kg. K} \) – The country's own thermal tolerance
\( \Delta t_n = 5^\circ \text{C} \) – Temperature spreads
\( \rho_n = 999.714 \text{ kg/m}^3 \)
\[ V = \frac{800}{4.192 \times 999.714 \times 5} = 0.0381 \text{ m}^3/\text{s} \]

Water flow level for 1 instrument M Chiller is \( V = 0.0381 \text{ M}^3/\text{s} = 137.16 \text{ M}^3/\text{h} \)
So flow level to the entire 3 The Chiller cluster is: \( 412.8 \text{ M}^3/\text{h} = 0114 \text{ M}^3/\text{s} \)

**Pipeline contribution of evaporated equipment:**

Select \( \omega = 2 \text{ m/s} \)

The inner diameter of the pipeline is:
\[ d = \frac{4 \cdot V}{\pi \cdot \omega} \]

In it:
V: Water flow
\( \omega \): Water speed
\[ d = \sqrt{\frac{4V}{\pi \omega}} = \sqrt{\frac{4 \times 0.114}{\pi \times 2}} = 0.27m = 270mm \]

Select:
Diameter of 275 Mm
Outer diameter 305 Mm
Nominal diameter 280 Mm

Calculating the water velocity in the tube:

\[ \omega = \frac{4 \times 0.114}{\pi \times 0.275^2} = 1.9 \text{ m/s} \]

**Pipe out of the evaporated equipment:**

Select \( \omega = 2 \text{ m/s} \)

The water flow for a chiller cluster is \( V = 0.0381 \text{ M}^3/\text{s} \)

In a chiller cluster of three evaporated equipment, flow \( V = 0.0381/3 = 0.0127 \text{ M}^3/\text{s} \)

The inner diameter of the pipeline is: 

\[ d = \sqrt{\frac{4V}{\pi \omega}} \]

In it:

- \( V \): Water flow
- \( \omega \): Water speed

\[ d = \sqrt{\frac{4 \times 0.0127}{\pi \times 0.0972^2}} = 0.09m = 90mm \]

Select:
Diameter in 97.2 mm
Diameter Beyond 114.3 mm
Nominal diameter of 90 mm

Calculating the water velocity in the tube:

\[ \omega = \frac{4 \times 0.0127}{\pi \times 0.0972^2} = 1.7 \text{ m/s} \]

**Pipeline output of condenser device:**

Select \( \omega = 2 \text{ m/s} \)
The water flow for a chiller cluster is \( V = 0.0381 \text{ m}^3/\text{s} \)

In a chiller cluster, three condenser devices should flow \( V = 0.0381 / 3 = 0.0127 \text{ M}^3/\text{S} \)

The inner diameter of the pipeline is: \( d = \sqrt[4]{\frac{4V}{\pi \omega^2}} \)

In it:

- \( V \): Water flow
- \( \omega \): Water speed

\[
\omega = \frac{4.00127}{\pi \cdot 0.9^2} = 1.9 \text{ m/s}
\]

**11.3 DETERMINE THE DIAMETER AND SPEED OF WATER IN THE TUBE AND \( \Delta P_1 (\text{PA/M}) \)**

11.3.1 The pressure loss on the plumbing:

\[
\Delta_p = \Delta_{pm} + \Delta_{pcb} + \Delta_{FCU} + \Delta_{EVA}
\]

- \( \Delta_p \): Total pressure loss (Pa)
- \( \Delta_{pm} \): Friction losses on pipes (Pa)
- \( \Delta_{pcb} \): Local pressure loss (Pa)
- \( \Delta_{FCU} \): Pressure loss via FCU
- \( \Delta_{EVA} \): Pressure loss over evaporated tank

The pressure loss local cold water supply:

**Section H2** : \( v = 1.9; D_{DN} = 100 \text{ mm} \) Length \( L = 1 \text{ m} \)

1 Quail 90 standard type with \( L_{Td} = 1 \times 3.05 = 3.05 \text{ m} \)
So \( L_{A-B} = 1 + 3.05 = 4.05 \) m

**Section H2** : \( v = 1.86; D_{DN} = 300 \) mm Length \( L = 14 \) m

2 T have \( L_{Td} = 2 \times 18.29 = 36.58 \) m

1 Quail 90 standard type with \( L_{Td} = 1 \times 9.14 = 9.14 \) m

So \( L_{B-C} = 14 + 36.58 + 9.14 = 59.72 \) m

**H2 – T2** : \( v = 2.01; D_{DN} = 300 \) mm Length \( L = 21.5 \) m

5 T have \( L_{Td} = 5 \times 18.29 = 91.45 \) m

So \( L_{H2-T2} = 21.5 + 91.45 = 111.95 \) m

**T3 – T7** : \( v = 1.86; D_{DN} = 250 \) mm Length \( L = 20 \) m

5 T have \( L_{Td} = 5 \times 15.24 = 76.2 \) m

1 Thu 0, 25d Yes \( L_{Td} = 1 \times 7.96 = 7.96 \) m

So \( L_{T3-T7} = 20 + 76.2 + 7.96 = 104.16 \) m

**T8 – T10** : \( v = 1.81; D_{DN} = 200 \) mm Length \( L = 12 \) m

5 T have \( L_{Td} = 3 \times 12.19 = 36.57 \) m

1 Thu 0, 25d Yes \( L_{Td} = 1 \times 7.01 = 7.01 \) m

So \( L_{T8-T10} = 12 + 36.57 + 7.01 = 55.58 \) m

**T11 – T12** : \( v = 1.74; D_{DN} = 150 \) mm Length \( L = 12 \) m

2t Yes \( L_{Td} = 2 \times 6.4 = 12.8 \) m

1 Thu 0, 25d Yes \( L_{Td} = 1 \times 3.66 = 7.01 \) m

1 Quail 90 Yes \( L_{Td} = 1 \times 3.05 = 3.05 \) m

So \( L_{T11-T12} = 8 + 7.01 + 3.05 + 12.8 = 30.86 \) m

**Horizontal axis T12** : \( v = 1.32; D_{DN} = 50 \) mm Length \( L = 19 \) m

2t Yes \( L_{Td} = 2 \times 3.05 = 6.1 \) m

1 Port Valve with \( L_{Td} = 1 \times 0.457 = 0.457 \) m

3 Quail 90 Yes \( L_{Td} = 3 \times 1.52 = 4.56 \) m

So \( L_{St} = 19 + 6.1 + 0.457 + 4.56 = 30.117 \) m

**Transverse axis T12** : \( v = 1.32; D_{DN} = 50 \) mm Length \( L = 19 \) m

2t Yes \( L_{Td} = 2 \times 3.05 = 6.1 \) m
1 Port Valve with $L_{Td} = 1 \times 0.457 = 0.457$ m

3 Quail 90 Yes $L_{Td} = 3 \times 1.52 = 4.56$ m

So $L_{St} = 19 \times 6.1 + 0.457 + 4.56 = 30.117$ m

**Anise T11 – T12**: $v = 1.74$; $D_{DN} = 150$ mm Length $L = 12$ m

2t Yes $L_{Td} = 2 \times 6.4 = 12.8$ m

1 Thu 0, 25d Yes $L_{Td} = 1 \times 3.66 = 7.01$ m

1 Quail 90 Yes $L_{Td} = 1 \times 3.05 = 3.05$ m

So $L_{T11-T12} = 8 + 7.01 + 3.05 + 12.8 = 30.86$ m

**Anise T8 – T10**: $v = 1.81$; $D_{DN} = 200$ mm Length $L = 12$ m

5 T have $L_{Td} = 3 \times 12.19 = 36.57$ m

1 Thu 0, 25d Yes $L_{Td} = 1 \times 7.01 = 7.01$ m

So $L_{T8-T12} = 12 + 36.57 + 7.01 = 55.58$ m

**Anise T3 – T7**: $v = 1.86$; $D_{DN} = 250$ mm Length $L = 20$ m

5 T have $L_{Td} = 5 \times 15.24 = 76.2$ m

1 Thu 0, 25d Yes $L_{Td} = 1 \times 7.96 = 7.96$ m

So $L_{T3-T7} = 20 + 76.2 + 7.96 = 104.16$ m

**Anise H2 – T2**: $v = 2.01$; $D_{DN} = 300$ mm Length $L = 21.5$ m

5 T have $L_{Td} = 5 \times 18.29 = 91.45$ m

So $L_{H2-T2} = 21.5 + 91.45 = 111.95$ m

**Transverse axis of H2**

$v = 1.86$; $D_{DN} = 300$ mm Length $L = 14$ m

2 T have $L_{Td} = 2 \times 18.29 = 36.58$ m

1 Quail 90 standard type with $L_{Td} = 1 \times 9.14 = 9.14$ m

So $L_{B-C} = 14 + 36.58 + 9.14 = 59.72$ m

axis of pipe to FCU:

Of the carrier’s FCU losses:

$\Delta_{pm} = 26000$ Pa
The pipeline loss of losses on the supply pipeline (vertical axis and connector to FCU)
\[ \Delta_{p_{ms}} = 13979 \, Pa \]

The passage of the vertical axis is returned to a slightly more:

From Daikin's volatility loss:
\[ \Delta_{p_{ms}} = 46000 \, Pa \]

<table>
<thead>
<tr>
<th>Paragraph</th>
<th>Diameter mm</th>
<th>Velocity (m/s)</th>
<th>Ld M</th>
<th>Loss (Pa/m)</th>
<th>Loss Pa</th>
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</table>

The total pressure loss \[ \Delta_p = 20.0745 \times 1.2 = 24.0894 \, mH2O \]

11.3.2 Calculate selection of cold water supply pumps

Choose 2 running pumps and 1 backup pump:

Pump has \( V = 156 \, m3/h \)

Pump pressure column is 24 \( MH2O \)

We choose the pump of the Ebara: Model ERN 125-315

11.3.3 Calculation selection Choose the water supply pump for cooling

Calculate similar cold water supply pump to the FCU
\[ \Delta_p = \Delta_{p_{ms}} + \Delta_{pcb} + \Delta_{CD} + \Delta H_s \]

The total pressure loss \[ \Delta_p = 18821 + 24000 = 67821 \, Pa = 6.78 \, mH2O \]
The total pressure loss $\Delta_p = 6.78 \times 1.2 = 8.14 \text{ mH}_2\text{O}$

Choose 3 running Pumps and 1 backup pump

Pump has $V = 189.2 \text{ m3/h}$

Pressure mast is 8.14 MH$_2$O

We chose the pump of Ebara: ERN-125-200
## OUTLINE DIMENSION

<table>
<thead>
<tr>
<th>Pump size</th>
<th>Sup.</th>
<th>Pump dimensions</th>
<th>Foot dimensions</th>
<th>Shaft end</th>
<th>Weight kg</th>
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<tbody>
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<td>94</td>
<td>50 300</td>
<td>100 70</td>
<td>M12</td>
<td>190 400</td>
</tr>
<tr>
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<td>50 300</td>
<td>100 70</td>
<td>M12</td>
<td>190 400</td>
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</table>

1. Dimensions given are for reference only. Actual dimensions may vary.

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**THE GRADUATION THESIS**

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214
11.4 IMPEFORCE

Gross impedance hydraulic (pressure loss) water from the pump to the FCU then back to the Δp pump includes:

$$\Delta p = \Delta p_c + \Delta p_h + \Delta p_{FCU} + \Delta p_{BH}$$

Δpc – Force (friction and local) water level from pump to AHU finally;

Δph - The Anise state force from AHU to the end of the pump;

ΔpFCU – Return of the last FCU;

ΔpBH - Become a force when the water is evaporated by air conditioning;

Water level Force ($\Delta P_{ca}$)

We have the formula (with $\Delta p_m$ – Force friction, $\delta p_c$ – Local force return):

$$\Delta p_{ca} = \Delta p_m + \Delta p_c, Pa$$

$$\Delta p_m = l \times \Delta p_f, Pa$$

$$\Delta p_c = l_{sd} \times \Delta p_f, Pa$$

L – Total length of water level, m

$l_{td}$ – the equivalent thickness where the local pressure loss occurs, m;

$\Delta p_L$ – Pressure loss reacts with 1m length tube.

Onward friction $\Delta p_m$

I have a piece of ABC with the length $L = 25m$, pressure loss with 1m $\delta p_f = 350$ PA/m. So the pressure loss friction:

$$\Delta p_m = l \times \Delta p_f = 25 \times 170 = 4250Pa = 4.25kPa$$

Friction losses from A to S are: 36500 Pa = 36.5 KPa

Local impedance of $\Delta p_c$

AC: 3 ball valve (adjustable valve), 1 quail 90°C standard with nominal diameter $d_f = 152.4$ mm, $\delta p_L = 350$ PA/m

From the table of equivalent length (table 3-31 TL2) the valve with $D_f = 152.4$ mm, the equivalent length through the valve $l_{td} = 51.816$. From the equivalent length table (table 3-32 TL2) of the CUC and T, $D_f = 152.4$ mm, via Daisy 90°C, $L_{td} = 4,877$ m.

The local total effort of the AC segment:

$$\Delta p_{AC} = (3 \times 51.816 + 4.877) \times 170 = 27255Pa = 27.25kPa$$
The CD at C has the force of the line going straight through T with a constant diameter $d_Y = 101.6$ mm, $\delta p_l = 800$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 2.04$ m. The local force is:

$$\Delta p_{CD} = 2.042 \times 800 = 1633 \text{Pa} = 1.63 \text{kPa}$$

The DE paragraph in D has the force of the line going straight through T with constant diameter $D_Y = 101.6$ mm, $\delta p_l = 700$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 2.04$ m. The local force is:

$$\Delta p_{DE} = 2.04 \times 700 = 1428 \text{Pa} = 1.42 \text{kPa}$$

The EF in E has the force of the line going straight through T-quail with constant diameter $d_Y = 101.6$ mm of $\delta p$ pressure loss $l = 550$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 2.04$ m. The local force is:

$$\Delta p_{EF} = 2.04 \times 550 = 1122 \text{Pa} = 1.12 \text{kPa}$$

The FG segment at F has the force of the line going straight through T with constant diameter $d_Y = 101.6$ mm, $\delta p_l = 320$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 2.04$ m. The local force is:

$$\Delta p_{FG} = 2.04 \times 320 = 652 \text{Pa} = 0.65 \text{kPa}$$

The GH in G has the force of the line going straight through T with constant diameter $d_Y = 101.6$ mm, $\delta p_l = 280$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 2.04$ m. The local force is:

$$\Delta p_{FG} = 2.04 \times 280 = 571 \text{Pa} = 0.57 \text{kPa}$$

The HI paragraph in H has the force of the line going straight through T-quail with the diameter in D1 (from 102.3 mm to 77.93 mm, see 0.75. D1) Nominal diameter $d_Y = 77.93$ mm of $\delta p$ pressure loss $l = 800$ PA/m

$$\Delta p_{HI} = 2.13 \times 800 = 1704 \text{Pa} = 1.7 \text{kPa}$$

The IJ paragraph in I has the force of the line goes straight through T with a constant diameter $d_Y = 77.93$ mm, $\delta p_l = 390$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 1.5$ m. The local force is:

$$\Delta p_{IJ} = 1.5 \times 390 = 585 \text{Pa} = 0.58 \text{kPa}$$

The JK paragraph at J has the force of the line going straight through T-quail with the diameter in D1 (from 77.93 mm to 63.5 mm, see 0.75. D1) Nominal diameter $d_Y = 63.5$ mm of $\delta p$ pressure loss $l = 300$ PA/m
From the table of equivalent length (table 3-32 TL2), $l_{Td} = 1.7$ m. The local force is:

$$\Delta p_{jk} = 1.7 \times 300 = 510 Pa = 0.51 kPa$$

$$\Delta p_{kl} = 1.524 \times 500 = 762 Pa = 0.762 kPa$$

The LM at L has a clout with a T-go pass line, with a bridge valve, nominal diameter $d_y = 62.71$ mm of $\delta p$ pressure loss $l_i = 250$ PA/m

From the table of equivalent length (table 3-32 TL2) branching line, $L_{Td} = 3.65$ M.

From the table of equivalent length (table 3-32 TL2) of Van Bridge, $L_{Td} = 21.03$ m.

The local thrust:

$$\Delta p_{LM} = (3.65 + 21.03) \times 250 = 6170 Pa = 6.17 kPa$$

The MN paragraph at M has the force of the line goes straight through the T-quail with the diameter in D_1 (from 62.71 mm to 52.5 mm, see 0.75. D_1) Nominal diameter $d_y = 52.5$ mm of $\Delta p$ pressure loss $l_i = 500$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 1.43$ m. The local force is:

$$\Delta p_{MN} = 1.43 \times 500 = 715 Pa = 0.71 kPa$$

No paragraph at N to force the line to go straight through T-quail with nominal diameter $d_y = 52.5$ mm of $\delta p$ pressure loss $l_i = 420$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 1.006$ m. The local force is:

$$\Delta p_{MN} = 1.006 \times 420 = 422 Pa = 0.42 kPa$$

The OP at O's force goes straight through T-quail with nominal diameter $d_y = 52.5$ mm of $\Delta p$ pressure loss $l_i = 300$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 1.006$ m. The local force is:

$$\Delta p_{MN} = 1.006 \times 300 = 301 Pa = 0.3 kPa$$

The PQ in P has the force of the line going straight through T-quail with the diameter in D_1 (from 50.8 mm to 38.1 mm, see 0.75. D_1) Nominal diameter $d_y = 38.1$ mm of $\delta p$ pressure loss $l_i = 700$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 1.128$ m. The local force is:

$$\Delta p_{PQ} = 1.128 \times 700 = 789 Pa = 0.78 kPa$$

The QR paragraph at Q has the force of the line goes straight through T-quail with nominal diameter $d_y = 38.1$ mm of $\delta p$ pressure loss $l_i = 400$ PA/m

From the table of equivalent length (table 3-32 TL2), $l_{Td} = 0.79$ m. The local force is:
\[ \Delta p_{QR} = 0.79 \times 400 = 316 Pa = 0.31 kPa \]

The RS piece at R has the force of line going straight through T-quail with the diameter in \( D_1 \) (from 40.98 mm to 31.75 mm, see 0.75. \( D_1 \)) Nominal diameter \( d_y = 31.75 \text{ mm} \) of \( \delta p \) pressure loss \( l = 400 \text{ PA/m} \)

From the table of equivalent length (table 3-32 TL2), \( l_{Td} = 0.94 \text{ m} \). The local force is:

\[ \Delta p_{MN} = 0.94 \times 400 = 376 Pa = 0.37 kPa \]

The RS at R have a force that goes straight through the T-quail with a constant diameter, and has a bridge valve, with 1 quail \( 90^\circ D_Y = 19.05 \text{ mm} \), \( \delta p \) = 900 PA/m

From the table of equivalent length (table 3-32 TL2) of line go straight \( l_{Td} = 0701 \text{ m} \), of Quail \( 90^\circ L_{Td} = 0792 \text{ m} \).

From the table of equivalent length (table 3-31 TL2) of Van \( L_{Td} = 8,839 \text{ m} \).

Local impedance of the RS paragraph

\[ \Delta p_{RS} = (0.701 + 0.792 + 8.839) \times 400 = 4132 Pa = 4.13 kPa \]

** Gross local water supply force from A to S:

<table>
<thead>
<tr>
<th>Pipe section</th>
<th>Pressure on each of ( \delta p ) (KPa)</th>
<th>Total local Force ( \Delta p_C = \Delta p_{C(A-S)} ) KPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ac</td>
<td>27.25</td>
<td></td>
</tr>
<tr>
<td>Cd</td>
<td>1.63</td>
<td></td>
</tr>
<tr>
<td>De</td>
<td>1.43</td>
<td></td>
</tr>
<tr>
<td>Ef</td>
<td>1.12</td>
<td></td>
</tr>
<tr>
<td>Fg</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td>Gh</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Hi</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Ij</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>Jk</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>Lm</td>
<td>6.17</td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Op</td>
<td>0.3</td>
<td><strong>43.02</strong></td>
</tr>
</tbody>
</table>
Gross water supply of $\delta p_{ca}$

$$\Delta p_{ca} = \Delta p_c + \Delta p_m = 43 + 36.5 = 79.5 kPa$$

Retraction of $\delta p$ Water

With the tube size and equipment on the pipeline with addition of the Julu on the return line, the pipeline is not changed compared to the pipeline level so temporarily wet the total amount of the pipe in the total level of the pipeline.

$$\Delta p_h \approx \Delta p_{ca} = 79.5 kPa$$

Resistors through heat exchanger

The last FCU losses of the second floor have pressure loss of water: $\delta p_{FCU} = 38.4$ kpa

The loss of damage in tubes and evaporation of the WC machine is $\delta p_{BH} = 104$ kpa

Total force of $\Delta P$, the capacity of the pump $N$

We have a total force:

$$\Delta p = \Delta p_{ca} + \Delta p_h + \Delta p_{FCU} + \Delta p_{BH} = 79.5 + 79.5 + 38.4 + 104 = 301 Kpa$$

Select pump for System (TA select 4 pump):

We have: total volume of 4 pumps

$V = 32.3$ L/s

Traffic volume of 1 pump:

$$V_1 = \frac{32.3}{4} \approx 8.1 l / s = 29.16 m^3 / h = 0.486 m^3 / min$$

$\delta p = 301$ kpa $\approx 18.7$ HM

From the voltage and flow we select the pump of the Ebara
Technical Specifications:

Model: 65x50 2ha 34.5

Power: 7, 5kw

Impeller DIA: 207 mm

Coupling CLA: 160

Pump DP: 24 mm

Motor DM: 42 mm