

假定 1-2/3-4 节点间管长为 8000m

1-3/2-4 节点间管长为 4000m

假定初始状态 $h_2 = 4m$ $h_{24} = 3m$

$h_{34} = 3m$ $h_{13} = 4m$

固定 $H_4 = 0m$

$h_{ij} = S_{ij} \cdot Q_{ij}^2$, 采用巴甫洛夫斯基公式计算. 取 $D = 0.2m$, $n = 0.014$

则 $a = 10.7$

则 $h_{ij} = a L_{ij} Q_{ij}^2 \Rightarrow Q_{ij} = \sqrt{\frac{h_{ij}}{a \cdot L_{ij}}}$, $\Delta H_i = \frac{-2\Delta Q_i}{\sum \frac{1}{S_{ij} h_{ij}}}$

初始状态

$Q_{1-2} = 9.7 \times 10^{-3} m^3/s$

$Q_{1-3} = 9.7 \times 10^{-3} m^3/s$

$Q_{2-4} = 8.4 \times 10^{-3} m^3/s$

$Q_{2-4} = 8.4 \times 10^{-3} m^3/s$

$\Rightarrow \Delta Q_1 = 3.3 \times 10^{-3} m^3/s$

$\Delta Q_2 = 5.7 \times 10^{-3} m^3/s$

$\Delta Q_3 = 3.7 \times 10^{-3} m^3/s$

$\Delta Q_4 = -12.7 m^3/s$

$\Rightarrow \Delta H_1 = -1.38m$

$\Delta H_2 = -2.19m$

$\Delta H_3 = -1.42m$

第一次迭代后

$H_1 = 5.62m$

$H_2 = 0.81m$

$H_3 = 1.58m$

$H_4 = 0m$

$Q_{1-2} = 10.6 \times 10^{-3} m^3/s$

$Q_{2-4} = 4.3 \times 10^{-3} m^3/s$

$Q_{3-4} = 6.1 \times 10^{-3} m^3/s$

$Q_{3-1} = 9.7 \times 10^{-3} m^3/s$

计算节点流量

$\Delta Q_1 = 4.3 L/s$

$\Delta Q_2 = 0.7 L/s$

$\Delta Q_3 = 1.4 L/s$

$\Delta Q_4 = 6.4 L/s$

$\Rightarrow \Delta H_1 = -1.88m$

$\Delta H_2 = -0.2m$

$\Delta H_3 = -0.43$

第二次迭代后

$$H_1 = 3.74 \text{ m} \quad H_2 = 0.61 \text{ m} \quad H_3 = 1.14 \text{ m} \quad H_4 = 0 \text{ m}$$

$$q_{1-2} = 8.6 \text{ L/s} \quad q_{2-4} = 3.8 \text{ L/s} \quad q_{3-4} = 5.2 \text{ L/s} \quad q_{3-1} = 7.8 \text{ L/s}$$

$$\Delta q_1 = 0.3 \text{ L/s} \quad \Delta q_2 = 2.2 \text{ L/s} \quad \Delta q_3 = 2.4 \text{ L/s} \quad \Delta q_4 = -5 \text{ L/s}$$

$$\Delta H_1 = -0.12 \text{ m} \quad \Delta H_2 = -0.5 \text{ m} \quad \Delta H_3 = -0.65 \text{ m}$$

第三次迭代后

$$H_1 = 3.62 \text{ m} \quad H_2 = 0.11 \text{ m} \quad H_3 = 0.51 \text{ m} \quad H_4 = 0 \text{ m}$$

$$q_{1-2} = 9.1 \text{ L/s} \quad q_{2-4} = 1.6 \text{ L/s} \quad q_{4-3} = 3.5 \text{ L/s} \quad q_{1-3} = 8.5 \text{ L/s}$$

$$\Delta q_1 = 1.6 \text{ L/s} \quad \Delta q_2 = -0.4 \text{ L/s} \quad \Delta q_3 = -0.1 \text{ L/s} \quad \Delta q_4 = -1.1 \text{ L/s}$$

$$\Rightarrow \Delta H_1 = -0.6 \text{ m} \quad \Delta H_2 = 0.05 \text{ m} \quad \Delta H_3 = 0.01 \text{ m}$$

第四次迭代后

$$H_1 = 3.03 \text{ m} \quad H_2 = 0.16 \text{ m} \quad H_3 = 0.53 \text{ m} \quad H_4 = 0 \text{ m}$$

$$\Rightarrow q_{1-2} = 8.2 \text{ L/s} \quad q_{2-4} = 2 \text{ L/s} \quad q_{4-3} = 3.5 \text{ L/s} \quad q_{3-1} = 7.6 \text{ L/s}$$

$$\Delta q_1 = 0.2 \text{ L/s} \quad \Delta q_2 = 0.8 \text{ L/s} \quad \Delta q_3 = 0.9 \text{ L/s} \quad \Delta q_4 = -1.5 \text{ L/s}$$

$$\Rightarrow \Delta H_1 = 0.06 \text{ m} \quad \Delta H_2 = -0.1 \text{ m} \quad \Delta H_3 = -0.18 \text{ m}$$

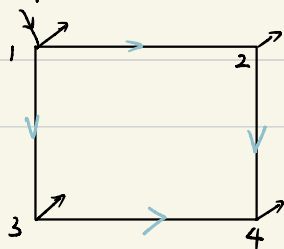
第五次迭代后

$$H_1 = 3.09 \text{ m} \quad H_2 = 0.06 \text{ m} \quad H_3 = 0.35 \text{ m} \quad H_4 = 0 \text{ m}$$

$$\Rightarrow q_{1-2} = 8.4 \text{ L/s} \quad q_{2-4} = 1.2 \text{ L/s} \quad q_{3-4} = 2.9 \text{ L/s} \quad q_{1-3} = 8 \text{ L/s}$$

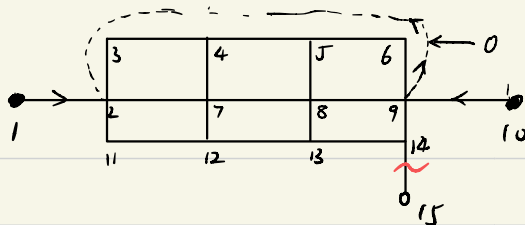
$$\Delta q_1 = 0.4 \text{ L/s} \quad \Delta q_2 = -0.2 \text{ L/s} \quad \Delta q_3 = -0.1 \text{ L/s} \quad |\Delta q_4| < 0.1 \text{ L/s}$$

对手工计算而言可以认为平差完成，下为求解结果：



| 管段 | 流量 (L/s) | 节点 | 水头 (m) |
|-----|----------|----|--------|
| 1-2 | 8.18 | 1 | 3.09 |
| 2-4 | 1.37 | 2 | 0.06 |
| 1-3 | 2.96 | 3 | 0.35 |
| 3-4 | 7.75 | 4 | 0 |

习题 14



对环状网 $P = JL - 1$

引入虚环 0-2-3-4-5-6-9-0, 切割 14-15

则环状部分 $J = 12 + 1 = 13$ $L = 6 + 1 = 7$ $P = 17 + 2 = 19$

随后连接 14-15. 此时为树状网. $L = 0$

$$\therefore P' = J' - 1 \quad P' = 1 \quad J' = 2$$

去掉虚环得到 $P_{\text{实际}} = J_{\text{实际}} + L_{\text{实际}} - 1$

$$20 \quad 15 \quad 6$$

习题 15

主要流向为 1-2-7-8

1-2-3-4-5

1-2-11-12-13

10-9-6

10-9-14-16

以 4-7 段为例 $h_{4-7} = S_{4-7} \cdot q_{4-7}^n = H_4 - H_7$

$$\Rightarrow q = \left(\frac{H_4 - H_7}{S_{4-7}} \right)^{\frac{1}{n}}$$

