

Node 1: (Revised)

$$h_{air} \frac{\Delta x}{2} (T_{\infty} - T_1^i) + h_{wat} \frac{\Delta y}{2} (T_{\infty} - T_1^i) + k \frac{\Delta x}{2} \left(\frac{T_4^i - T_1^i}{\Delta y} \right) + k \frac{\Delta y}{2} \left(\frac{T_2^i - T_1^i}{\Delta x} \right) + \rho \frac{\Delta x}{2} \frac{\Delta y}{2} C_p (T_1^{i+1} - T_1^i) = 0$$

$$(10 \times \frac{0.1}{2}) (15 - T_1^i) + (100) (\frac{0.1}{2}) (15 - T_1^i) + (120) (\frac{0.1}{2}) \left(\frac{T_4^i - T_1^i}{0.1} \right) + (120) (\frac{0.1}{2}) \left(\frac{T_2^i - T_1^i}{0.1} \right) + \rho C_p \left(\frac{0.1}{2} \right) \left(\frac{0.1}{2} \right) (T_1^{i+1} - T_1^i) = 0$$

$$7.5 - 0.5 T_1^i + 75 - 5 T_1^i + 60 T_4^i - 60 T_1^i + 60 T_2^i - 60 T_1^i + 30690537.08 \left(\frac{0.1^2}{4} \right) (T_1^{i+1} - T_1^i) = 0$$

$$\rho C_p = \frac{k}{\alpha} \quad \text{since} \quad \alpha = \frac{k}{\rho C_p}$$

$$\therefore = \frac{120}{3.91 \times 10^{-8}}$$

$$= 30690537.08$$

$$7.5 - 0.5 T_1^i$$

$$7.5 - 0.5 + 75 - 5 T_1^i + 60 T_4^i - 60 T_1^i + 60 T_2^i - 60 T_1^i + 7672.63 T_1^{i+1} - 7672.63 T_1^i = 0$$

$$7672.63 T_1^{i+1} = 7798.13 T_1^i - 60 T_2^i - 60 T_4^i - 82.5$$

$$T_1^{i+1} = \frac{7798.13 T_1^i - 60 T_2^i - 60 T_4^i - 82.5}{7672.63}$$

$$T_1^{i+1} = 1.0164 T_1^i - 0.0078 T_2^i - 0.0078 T_4^i - 0.0108$$

Node 2 (Revised).

$$(10)(0.1)\left(\frac{15}{0.1} - T_1^i\right) + (120)\left(\frac{0.1}{2}\right)\left(\frac{T_3^i - T_2^i}{0.1}\right) + (120)\left(\frac{0.1}{2}\right)\left(\frac{T_1^i - T_2^i}{0.1}\right) \\ + (120)(0.1)\left(\frac{T_5^i - T_2^i}{0.1}\right) + \cancel{p(0.1)} \cancel{p} \Delta x \frac{\Delta y}{2} C_p \left(\frac{T_2^{i+1} - T_2^i}{\Delta t}\right) = 0$$

$$15 - T_1^i + 60 T_3^i - 60 T_2^i + 60 T_1^i - 80 T_2^i \\ + 120 T_5^i - 120 T_2^i + 30690537.08 (0.1)\left(\frac{0.1}{2}\right)\left(\frac{1}{10}\right)(T_2^{i+1} - T_2^i) = 0$$

$$15 - T_1^i + 60 T_3^i - 60 T_2^i + 60 T_1^i - 60 T_2^i + 120 T_5^i - 120 T_2^i \\ + 15345.27 T_2^{i+1} - 15345.27 T_2^i = 0$$

$$\Rightarrow 15345.27 T_2^{i+1} = -59 T_1^i + 15585.27 T_2^i - 60 T_3^i \\ - 120 T_5^i - 15$$

$$T_2^{i+1} = -0.0038 T_1^i + 1.0156 T_2^i - 0.0039 T_3^i \\ - 0.0078 T_5^i - 0.000977$$

Node 3 (Revised)

$$h_a \frac{\Delta x}{2} (T_{\infty} - T_3^i) + k \frac{\Delta x}{2} \left(\frac{T_2^i - T_3^i}{\Delta x} \right) + k \frac{\Delta x}{2} \left(\frac{T_6^i - T_3^i}{\Delta x} \right) + \rho \frac{\Delta x}{2} \frac{\Delta x}{2} c_p \left(\frac{T_3^{i+1} - T_3^i}{\Delta t} \right) = 0$$

$$(10) \left(\frac{0.1}{2} \right) (15 - T_3^i) + (120) \left(\frac{0.1}{2} \right) \left(\frac{T_2^i - T_3^i}{0.1} \right) + (120) \left(\frac{0.1}{2} \right) \left(\frac{T_6^i - T_3^i}{0.1} \right) + \rho c_p \left(\frac{0.1}{2} \right) \left(\frac{0.1}{2} \right) \left(\frac{T_3^{i+1} - T_3^i}{10} \right) = 0$$

$$7.5 - 0.5 T_3^i + 60 T_2^i - T_3^i + 60 T_6^i - 60 T_3^i + 30690537.08 \left(\frac{1}{4000} \right) (T_3^{i+1} - T_3^i) = 0$$

$$7.5 - 0.5 T_3^i + 60 T_2^i - T_3^i + 60 T_6^i - 60 T_3^i + 7672.63 T_3^{i+1} - 7672.63 T_3^i = 0$$

$$\begin{aligned} \Rightarrow 7672.63 T_3^{i+1} &= 7734.13 T_3^i - 60 T_2^i - 60 T_6^i - 7.5 \\ T_3^{i+1} &= -0.0078 T_2^i + 1.008 T_3^i - 0.0078 T_6^i - 0.00098 \end{aligned}$$

Node 4 (revised).

$$(100 \times 0.1)(15 - T_4^i) + (120 \times \frac{0.1}{2}) \left(\frac{T_7^i - T_4^i}{0.1} \right) + (120 \times \frac{0.1}{2}) \left(\frac{T_1^i - T_4^i}{0.1} \right) + (120 \times 0.1) \left(\frac{T_5^i - T_4^i}{0.1} \right) + \left(\rho \Delta y \frac{\Delta x}{2} C_p \right) \frac{T_4^{i+1} - T_4^i}{10} = 0$$

$$\rho C_p = 30690537.08$$

$$15 - 10T_4^i + 60T_7^i - 60T_4^i + 60T_1^i - 60T_4^i + 120T_5^i - 120T_4^i + 15345.27T_4^{i+1} - 15345.27T_4^i = 0$$

$$60T_1^i - 15595.27T_4^i + 120T_5^i + 60T_7^i + 15 + 15345.27T_4^{i+1} = 0$$

~~$\rightarrow 15345.27T_4^i$~~

$$15345.27T_4^{i+1} = -60T_1^i + 15595.27T_4^i - 120T_5^i - 60T_7^i - 15$$

$$T_4^{i+1} = -0.0039T_1^i + 1.0163T_4^i - 0.0078T_5^i - 0.0039T_7^i - 0.00098$$

Node 5 (revised)

$$(120)(0.1)(T_2^i - T_5^i) + (120)(0.1)(T_6^i - T_5^i) + (120)(0.1)(T_8^i - T_5^i) \\ + (120)(0.1)(T_4^i - T_5^i) + \rho \Delta x \Delta y C_p \left(\frac{T_5^{i+1} - T_5^i}{\Delta t} \right)$$

$$12T_2^i - 12T_5^i + 12T_6^i - 12T_5^i + 12T_8^i - 12T_5^i \\ + 12T_4^i - 12T_5^i + 30690.54 T_5^{i+1} - 30690.54 T_5^i = 0$$

$$30690.54 T_5^{i+1} = -12T_2^i - 12T_4^i + 30738.54 T_5^i - 12T_6^i - 12T_8^i \\ T_5^{i+1} = -0.00039T_2^i - 0.00039T_4^i + 1.0016T_5^i \\ - 0.00039T_6^i - 0.00039T_8^i$$

Node 6 (revised)

$$\left(120 \times \frac{0.1}{2}\right) \left(\frac{T_9^i - T_8^i}{0.1}\right) + \left(120 \times \frac{0.1}{2}\right) \left(\frac{T_3^i - T_6^i}{0.1}\right) + (120 \times 0.1)(T_5^i - T_6^i) \\ + j C_p \Delta x \frac{\Delta x}{2} \left(\frac{T_6^{i+1} - T_6^i}{10}\right) = 0$$

$$60 T_9^i - 60 T_8^i + 60 T_3^i - 60 T_6^i + 12 T_5^i - 12 T_6^i \\ + 15345.27 T_6^{i+1} - 15345.27 T_6^i = 0$$

$$15345.27 T_6^{i+1} = -60 T_3^i - 12 T_5^i + 15417.27 T_6^i \\ + 60 T_8^i - 60 T_9^i$$

$$T_6^{i+1} = -0.0039 T_3^i - 0.00078 T_5^i + T_6^i + 0.6039 T_8^i \\ - 0.0039 T_9^i$$

Node 7 (Revised)

$$(100)\left(\frac{0.1}{2}\right)(15 - T_7^i) + (100)\left(\frac{0.1}{2}\right)(15 - T_7^i) + (120)\left(\frac{0.1}{2}\right)\left(\frac{T_4^i - T_7^i}{0.1}\right) \\ + (120)\left(\frac{0.1}{2}\right)\left(\frac{T_8^i - T_7^i}{0.1}\right) + \rho C_p \frac{\Delta x}{2} \frac{\Delta x}{2} \left(\frac{T_7^{i+1} - T_7^i}{10}\right)$$

$$75 - 5T_7^i + 75 - 5T_7^i + 60T_4^i - 60T_7^i + 60T_8^i - 60T_7^i \\ + 7672.63 T_7^{i+1} - 7672.63 T_7^i = 0$$

$$7672.63 T_7^{i+1} = -60T_4^i + 7802.63 T_7^i - 60T_8^i - 150$$

$$T_7^{i+1} = -0.0078 T_4^i + 1.017 T_7^i - 0.0078 T_8^i - 0.0196$$

Node 8 (revised)

$$(100)(0.1)(15 - T_8^i) + (120)\left(\frac{0.1}{2}\right)\left(\frac{T_7^i - T_8^i}{0.1}\right) + (120)(0.1)\left(\frac{T_5^i - T_8^i}{0.1}\right) \\ + (120)\left(\frac{0.1}{2}\right)\left(\frac{T_9^i - T_8^i}{0.1}\right) + \rho C_p \frac{\Delta y}{2} \frac{\Delta x}{2} (T_8^{i+1} - T_8^i) = 0$$

$$150 - 10T_8^i + 60T_7^i - 60T_8^i + 120T_5^i - 120T_8^i \\ + 60T_9^i - 60T_8^i + 15345.27T_8^{i+1} - 15345.27T_8^i = 0$$

$$15345.27T_8^{i+1} = -120T_5^i - 60T_7^i + 15595.27T_8^i - 60T_9^i - 150 \\ T_8^{i+1} = -0.00782T_5^i - 0.0039T_7^i + 1.016T_8^i \\ - 0.00391T_9^i - 0.00977$$

Node 9 (revised)

$$(100)\left(\frac{0.1}{2}\right)(15 - T_9^i) + (120)\left(\frac{0.1}{2}\right)\left(\frac{T_8^i - T_9^i}{0.1}\right) + (120)\left(\frac{0.1}{2}\right)\left(\frac{T_6^i - T_9^i}{0.1}\right) + \rho C_p \frac{\Delta y}{2} \frac{\Delta x}{2} \left(\frac{T_9^{i+1} - T_9^i}{10}\right) = 0$$

$$75 - 5T_9^i + 60T_8^i - 60T_9^i + 60T_6^i - 60T_9^i + 7672.63T_9^{i+1} - 7672.63T_9^i = 0$$

$$7672.63T_9^{i+1} = -60T_6^i - 60T_8^i - 7797.63T_9^i - 75$$

$$T_9^{i+1} = -0.0078T_6^i - 0.0078T_8^i - 1.0163T_9^i - 0.00978$$