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CIVIL ENGINEERING

$$U_t - C U_x = 0$$

$$\frac{du}{dt} - C \frac{d^2 u}{dx^2} = 0$$

$$\frac{du}{dt} = C \frac{d^2 u}{dx^2}$$

$$\frac{U_{i,j+1} - U_{i,j}}{\Delta t} = \frac{C \cdot U_{i+1,j} - 2U_{i,j} + U_{i-1,j}}{\Delta x^2}$$

$$\frac{U_{i,j+1} - U_{i,j}}{\Delta t} = \frac{C \cdot U_{i+1,j} - 2U_{i,j} + U_{i-1,j}}{\Delta x^2}$$

$$U_{i,j+1} - U_{i,j} = \frac{C \Delta t}{\Delta x^2} [U_{i+1,j} - 2U_{i,j} + U_{i-1,j}] \quad \text{Let } \frac{\Delta t}{\Delta x^2} = C = 1$$

$$u(x=0) = x^4 k$$

$$\Delta x = 0.2 \text{ m}, \Delta t = 0.02 \text{ day}$$

For Initial conditions

$$\text{At } x=0 \rightarrow x^4 = 0$$

$$\text{At } x=0.2 \rightarrow 0.2^4 = 1.6 \times 10^{-3}$$

$$\text{At } x=0.4 \rightarrow 0.4^4 = 0.0256$$

$$\text{At } x=0.6 \rightarrow 0.6^4 = 0.1296$$

$$\text{At } x=0.8 \rightarrow 0.8^4 = 0.4096$$

$$\text{At } x=1 \rightarrow 1^4 = 1$$

$$\therefore U_{i,j+1} = U_{i,j} + r (U_{i+1,j} - 2U_{i,j} + U_{i-1,j})$$

$$U_{i,j+1} = \sigma U_{i-1,j} + (1-2\sigma)U_{i,j} + \sigma U_{i+1,j} \quad *$$

when $i=1, j=0$

$$U_{1,1} = 0.5 U_{0,0} + 0.5 U_{2,0}$$

$$= 0.5(0) + 0.5(0.0256)$$

$$U_{1,1} = 0.0128$$

When $i=2, j=0$

$$U_{2,1} = 0.5(U_{1,0}) + 0.5(U_{3,0})$$

$$= 0.5(1.6 \times 10^{-3}) + 0.5(0.1296)$$

$$U_{2,1} = 0.0656$$

when $i=3, j=0 = U_{3,1} = 0.5(U_{2,0}) + 0.5(U_{4,0})$

$$= 0.5(0.0256) + 0.5(0.4096)$$

$$U_{3,1} = 0.2176$$

when $i=4, j=0 = U_{4,1} = 0.5(U_{3,0}) + 0.5(U_{5,0})$

$$= 0.5(0.0256) + 0.5(0.4096)$$

$$U_{4,1} = 0.5648$$

For $j=1$,

when $i=1$, $U_{1,2} = 0.5(U_{0,1}) + 0.5(U_{2,1})$

$$= 0.5 U_{0,1} + 0.5 U_{2,1} = 0 + 0.5 (0.0656)$$

$$U_{1,2} = 0.0328$$

$$\text{When } i=2 \quad \therefore U_{2,2} = 0.5 (U_{1,1}) + 0.5 (U_{3,1})$$

$$= 0.5 (0.0128) + 0.5 (0.2176)$$

$$U_{2,2} = 0.1152$$

$$\text{When } i=3 \quad U_{3,2} = 0.5 (U_{0,1}) + 0.5 (U_{4,1})$$

$$= 0.5 (0.0656) + 0.5 (0.5648)$$

$$U_{3,2} = 0.3152$$

$$\text{When } i=4 \quad U_{4,2} = 0.5 (U_{2,1}) + 0.5 (U_{5,1})$$

$$= 0.5 (0.2176) + 0.5 (0)$$

$$U_{4,2} = 0.1088$$

For J=2

$$\text{When } i=1 \quad \therefore U_{1,3} = 0.5 (U_{0,2}) + 0.5 (U_{2,2})$$

$$= 0 + 0.5 (0.1152) = 0.0576$$

$$\text{When } i=2 \quad U_{2,3} = 0.5 (U_{1,2}) + 0.5 (U_{3,2})$$

$$= 0.5 (0.0328) + 0.5 (0.3152) = 0.174$$

$$\begin{aligned} \text{When } i=3 \quad U_{3,3} &= 0.5(U_{2,2}) + 0.5(U_{4,2}) \\ &= 0.5(0.1152) + 0.5(0.6055) = 0.362 \end{aligned}$$

$$\begin{aligned} \text{When } i=4 \quad U_{4,3} &= 0.5(U_{3,2}) + 0.5(U_{5,2}) \\ &= 0.5(0.3152) + 0.5(1) \\ U_{4,3} &= 0.6576 \end{aligned}$$

For j=3

$$\begin{aligned} \text{When } i=1 \quad U_{1,4} &= 0.5(U_{0,3}) + 0.5(U_{2,3}) \\ &= 0.5(0) + 0.5(0.174) = 0.084 \end{aligned}$$

$$\begin{aligned} \text{When } i=2 \quad U_{2,4} &= 0.5(U_{1,3}) + 0.5(U_{3,3}) \\ &= 0.5(0.0576) + 0.5(0.362) \\ &= 0.2098 \end{aligned}$$

$$\begin{aligned} \text{When } i=3 \quad U_{3,4} &= 0.5(U_{2,3}) + 0.5(U_{4,3}) \\ &= 0.5(0.174) + 0.5(0.6576) = 0.4158 \end{aligned}$$

$$\begin{aligned} \text{When } i=4 \quad U_{4,4} &= 0.5(U_{3,3}) + 0.5(U_{5,3}) \\ &= 0.5(0.362) + \\ &= 0.681 \end{aligned}$$

For $J=4$

$$\begin{aligned}\text{When } i=1 \quad U_{1,5} &= 0.5(U_{0,4}) + 0.5(U_{2,4}) \\ &= 0.5(0.2098) = 0.1049\end{aligned}$$

$$\begin{aligned}\text{When } i=2 \quad U_{2,5} &= 0.5(U_{1,4}) + 0.5(U_{3,4}) \\ &= 0.5(0.087) + 0.5(0.4158) = 0.2514\end{aligned}$$

$$\begin{aligned}\text{When } i=3 \quad U_{3,5} &= 0.5(U_{2,4}) + 0.5(U_{4,4}) \\ &= 0.5(0.2098) + 0.5(0.681) \\ &= 0.4454\end{aligned}$$

$$\begin{aligned}\text{When } i=4 \quad U_{4,5} &= 0.5(U_{3,4}) + 0.5(U_{5,4}) \\ &= 0.5(0.4158) + 0.5(0) \\ &= 0.2079\end{aligned}$$

Microsoft Excel ribbon: Home, Insert, Page Layout, Formulas, Data, Review, View

Home tab: Paste, Cut, Copy, Format Painter, Clipboard, Font (Calibri, 11, Bold, Italic, Underline, Paragraph), Alignment (Wrap Text, Merge & Center), Styles (Conditional Formatting, Format as Table, Cell Styles), Cells (Insert, Delete, Format), Editing (AutoSum, Fill, Clear)

