Condition Limite en haut de Neumann discrétisée par un schéma centré

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> restart : with(LinearAlgebra) :
> L := 20; H := 20; ndx := 3; ndy := 3;
```

$$L := 20$$
$$H := 20$$
$$ndx := 3$$
$$ndy := 3 \qquad (1.1)$$

```
> Td := 30; Tb := 10; Tg := 10; α := 0
```

$$Td := 30$$
$$Tb := 10$$
$$Tg := 10$$
$$\alpha := 0 \qquad (1.2)$$

> $\Delta x := \frac{L}{ndx}$; $\Delta y := \frac{H}{ndy}$; $\beta := \frac{\Delta x}{\Delta y}$

$$\Delta x := \frac{20}{3}$$
$$\Delta y := \frac{20}{3}$$
$$\beta := 1 \qquad (1.3)$$

> $i_{max} := ndx + 1$; $j_{max} := ndy + 1$;

$$i_{max} := 4$$
$$j_{max} := 4 \qquad (1.4)$$

> $N := (i_{max} - 2) \cdot (j_{max} - 2) + i_{max} - 2$;

$$N := 6 \qquad (1.5)$$

(1.6)

> **for** j **from** 2 **to** j_{max} **do** T[1, j] := Tg **end do**;

$$T_{1,2} := 10$$
$$T_{1,3} := 10$$
$$T_{1,4} := 10 \qquad (1.7)$$

> **for** j **from** 2 **to** j_{max} **do** $T[i_{max}, j]$:= Td **end do**;

$$T_{4,2} := 30$$
$$T_{4,3} := 30$$
$$T_{4,4} := 30 \qquad (1.8)$$

> **for** i **from** 2 **to** $i_{max} - 1$ **do** T[i, 1] := Tb **end do**;

$$T_{2,1} := 10$$
$$T_{3,1} := 10 \qquad (1.9)$$

(1.10)

(1.11)

```
k := 1 :
 for j from 2 to j_max − 1 do
     for i from 2 to i_max -1 do
            Eq[k] := − 2·(1 + β^2)·T[i, j] + T[i + 1, j] + T[i − 1, j] + β^2
   ·(T[i, j + 1] + T[i, j-1]) = 0 :
            Temps[k] := T[i, j] :
            k := k + 1 :
     end do
end do:
for i from 2 to i_max -1 do
     T[i, j_max + 1] := T[i, j_max − 1] + 2·α·Δy :
     Eq[k] := − 2·(1 + β^2)·T[i, j_max] + T[i + 1, j_max] + T[i − 1, j_max] + β^2·(T[i,
   j_max + 1] + T[i, j_max-1]) = 0 :
     Temps[k] := T[i, j_max] :
     k := k + 1 :
 end do:
```

```
> for k from 1 to N do Eq[k] end do;
```

$$-4\,T_{2,2}+T_{3,2}+20+T_{2,3}=0$$

$$-4\,T_{3,2}+40+T_{2,2}+T_{3,3}=0$$

$$-4\,T_{2,3}+T_{3,3}+10+T_{2,4}+T_{2,2}=0$$

$$-4\,T_{3,3}+30+T_{2,3}+T_{3,4}+T_{3,2}=0$$

$$-4\,T_{2,4}+T_{3,4}+10+2\,T_{2,3}=0$$

$$-4\,T_{3,4}+30+T_{2,4}+2\,T_{3,3}=0 \qquad \textbf{(1.12)}$$

(1.13)

```
> N := k − 1;
```

$$N := 6 \qquad \textbf{(1.14)}$$

```
> Eqs := {seq(Eq[k], k = 1 ..N)};
```

$$Eqs := \{-4\,T_{2,2}+T_{3,2}+20+T_{2,3}=0,\ -4\,T_{2,4}+T_{3,4}+10+2\,T_{2,3}=0,\ -4\,T_{3,2}+40+T_{2,2}+T_{3,3}=0,\ -4\,T_{3,4}+30+T_{2,4}+2\,T_{3,3}=0,\ -4\,T_{2,3}+T_{3,3}+10+T_{2,4}+T_{2,2}=0,\ -4\,T_{3,3}+30+T_{2,3}+T_{3,4}+T_{3,2}=0\} \qquad \textbf{(1.15)}$$

```
> Tmps := [seq(Temps[k], k = 1 ..N)];
```

$$Tmps := [T_{2,2}, T_{3,2}, T_{2,3}, T_{3,3}, T_{2,4}, T_{3,4}] \qquad \textbf{(1.16)}$$

```
> SolT := solve(Eqs, Tmps);
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$$SolT := \left[\left[T_{2,2}=\frac{1334}{99}, T_{3,2}=\frac{1856}{99}, T_{2,3}=\frac{500}{33}, T_{3,3}=\frac{710}{33}, T_{2,4}=\frac{1546}{99}, T_{3,4}=\frac{2194}{99}\right]\right] \qquad \textbf{(1.17)}$$

```
> Eqs := [seq(Eq[k], k = 1 ..N)];
```

$$Eqs := [-4\,T_{2,2}+T_{3,2}+20+T_{2,3}=0,\ -4\,T_{3,2}+40+T_{2,2}+T_{3,3}=0,\ -4\,T_{2,3}+T_{3,3} \qquad \textbf{(1.18)}$$

$+10+T_{2,4}+T_{2,2}=0,\ -4\,T_{3,3}+30+T_{2,3}+T_{3,4}+T_{3,2}=0,\ -4\,T_{2,4}+T_{3,4}+10$
$+2\,T_{2,3}=0,\ -4\,T_{3,4}+30+T_{2,4}+2\,T_{3,3}=0]$

```
> M, R := GenerateMatrix(Eqs, Tmps)
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$$M, R := \begin{bmatrix} -4 & 1 & 1 & 0 & 0 & 0 \\ 1 & -4 & 0 & 1 & 0 & 0 \\ 1 & 0 & -4 & 1 & 1 & 0 \\ 0 & 1 & 1 & -4 & 0 & 1 \\ 0 & 0 & 2 & 0 & -4 & 1 \\ 0 & 0 & 0 & 2 & 1 & -4 \end{bmatrix}, \begin{bmatrix} -20 \\ -40 \\ -10 \\ -30 \\ -10 \\ -30 \end{bmatrix} \quad \mathbf{(1.19)}$$