Conditions Limites en bas et en haut de Neumann discrétisée par un schéma centré

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

$$L := 20$$
$$H := 20$$
$$ndx := 3$$
$$ndy := 3 \quad \textbf{(1.1)}$$

```
> Tg := 10; Td := 30; α[b] := 0; α[h] := 0
```

$$Tg := 10$$
$$Td := 30$$
$$\alpha_b := 0$$
$$\alpha_h := 0 \quad \textbf{(1.2)}$$

```
> Δx := L/ndx; Δy := H/ndy; β := Δx/Δy
```

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

```
> i_max := ndx + 1;  j_max := ndy + 1;
```

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

```
> N := (i_max - 2)·(j_max - 2) + 2·(i_max - 2);
```

$$N := 8 \quad \textbf{(1.5)}$$

(1.6)

```
> for j from 1 to j_max do T[1, j] := Tg end do;
```

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

```
> for j from 1 to  j_max do T[i_max, j] := Td end do;
```

$$T_{4,1} := 30$$
$$T_{4,2} := 30$$
$$T_{4,3} := 30$$
$$T_{4,4} := 30 \quad \textbf{(1.8)}$$

(1.9)

(1.10)

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

$$-4\,T_{2,1} + T_{3,1} + 10 + 2\,T_{2,2} = 0$$
$$-4\,T_{3,1} + 30 + T_{2,1} + 2\,T_{3,2} = 0$$
$$-4\,T_{2,2} + T_{3,2} + 10 + T_{2,3} + T_{2,1} = 0$$
$$-4\,T_{3,2} + 30 + T_{2,2} + T_{3,3} + T_{3,1} = 0$$
$$-4\,T_{2,3} + T_{3,3} + 10 + T_{2,4} + T_{2,2} = 0$$
$$-4\,T_{3,3} + 30 + T_{2,3} + T_{3,4} + T_{3,2} = 0$$
$$-4\,T_{2,4} + T_{3,4} + 10 + 2\,T_{2,3} = 0$$
$$-4\,T_{3,4} + 30 + T_{2,4} + 2\,T_{3,3} = 0 \qquad (1.11)$$

(1.12)

```
> N := k - 1;
```

$$N := 8 \qquad (1.13)$$

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

$$Eqs := \{-4\,T_{2,1} + T_{3,1} + 10 + 2\,T_{2,2} = 0,\ -4\,T_{2,4} + T_{3,4} + 10 + 2\,T_{2,3} = 0,\ -4\,T_{3,1} + 30 + T_{2,1} + 2\,T_{3,2} = 0,\ -4\,T_{3,4} + 30 + T_{2,4} + 2\,T_{3,3} = 0,\ -4\,T_{2,2} + T_{3,2} + 10 + T_{2,3} + T_{2,1} = 0,\ -4\,T_{2,3} + T_{3,3} + 10 + T_{2,4} + T_{2,2} = 0,\ -4\,T_{3,2} + 30 + T_{2,2} + T_{3,3} + T_{3,1} = 0,\ -4\,T_{3,3} + 30 + T_{2,3} + T_{3,4} + T_{3,2} = 0\} \qquad (1.14)$$

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

$$Tmps := [T_{2,1}, T_{3,1}, T_{2,2}, T_{3,2}, T_{2,3}, T_{3,3}, T_{2,4}, T_{3,4}] \qquad (1.15)$$

```
> SolT := solve(Eqs, Tmps);
```

$$SolT := \left[\left[T_{2,1} = \frac{50}{3}, T_{3,1} = \frac{70}{3}, T_{2,2} = \frac{50}{3}, T_{3,2} = \frac{70}{3}, T_{2,3} = \frac{50}{3}, T_{3,3} = \frac{70}{3}, T_{2,4} = \frac{50}{3}, T_{3,4} = \frac{70}{3}\right]\right] \quad (1.16)$$

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

$$Eqs := [-4\,T_{2,1} + T_{3,1} + 10 + 2\,T_{2,2} = 0,\ -4\,T_{3,1} + 30 + T_{2,1} + 2\,T_{3,2} = 0,\ -4\,T_{2,2} + T_{3,2} + 10 + T_{2,3} + T_{2,1} = 0,\ -4\,T_{3,2} + 30 + T_{2,2} + T_{3,3} + T_{3,1} = 0,\ -4\,T_{2,3} + T_{3,3} + 10 + T_{2,4} + T_{2,2} = 0,\ -4\,T_{3,3} + 30 + T_{2,3} + T_{3,4} + T_{3,2} = 0,\ -4\,T_{2,4} + T_{3,4} + 10 + 2\,T_{2,3} = 0,\ -4\,T_{3,4} + 30 + T_{2,4} + 2\,T_{3,3} = 0] \quad (1.17)$$

```
> M, R := GenerateMatrix(Eqs, Tmps)
```

$$M, R := \begin{bmatrix} -4 & 1 & 2 & 0 & 0 & 0 & 0 & 0 \\ 1 & -4 & 0 & 2 & 0 & 0 & 0 & 0 \\ 1 & 0 & -4 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & -4 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & -4 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & -4 & 0 & 1 \\ 0 & 0 & 0 & 0 & 2 & 0 & -4 & 1 \\ 0 & 0 & 0 & 0 & 0 & 2 & 1 & -4 \end{bmatrix}, \begin{bmatrix} -10 \\ -30 \\ -10 \\ -30 \\ -10 \\ -30 \\ -10 \\ -30 \end{bmatrix} \quad (1.18)$$