

*

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*

-2

:

-3

[1,2]

5cm 0,02mm

[3]

(1-2)cm

(1-2)

.mm

()

[1,2]

(0,05 ÷ 0,02) mm

:

:

-1

[3]

:

-

-

()

-

:

-1

-2

-3

:

-4

-1

-2

-3

.()

-4

-5

-6

:

()

[4]

$$(D_1 = D_2)_i \neq (D_1 = D_2)_{i+1} \dots \dots \dots (2)$$

$$h_{i+1}, h_i$$

$$\Delta_i \neq \Delta_{i+1} \dots \dots \dots (3)$$

$$D_e$$

$$(2 \div 40)m \quad D_i$$

$$.D_e=20m$$

$$.D_e=20m$$

$$(4) \quad (1KM)$$

$$n_i = \frac{1000}{2D_e} \dots \dots \dots (4)$$

$$(5)$$

$$m_{1KM} = m_{h\ominus} \sqrt{\frac{1000}{2D_e}} \dots \dots \dots (5)$$

$$(6)$$

$$h_e = \frac{1}{2}(h_B + h_R)_{D_e} \dots \dots \dots (6)$$

$$(i)$$

$$(i+1)$$

$$f_\theta$$

$$P_{f\theta}$$

$$f_\theta$$

$$(\dots$$

$$P_{f\theta}$$

$$m_{f\theta}$$

$$P_{f\theta} = \frac{\mu_f^2}{m_{f\theta}^2}$$

$$(1)$$

$$[4]$$

$$- \mu_f$$

$$- \theta$$

$$.m_{f\theta}$$

$$\mu_f$$

$$\mu_f = m_{f\theta} :$$

$$P_{f\theta}$$

IV, III, II, I :

$$\mu_f$$

$$\mu_f = \mu_{\{h\}_{km}} : (1k.m)$$

$$[4]$$

$$(5KM)$$

$$(L_{KM})$$

$$\mu_f$$

$$(n)$$

$$m_{D_i} = (0.014 + 0.0014 D_i)mm \dots \dots \dots (10) \quad -h_R$$

$$) \quad -D_i : \quad \dots \quad (1) \quad D_e = 20m$$

$$T \quad -t \quad h_{D_i} \quad P_{h_{D_i}} \quad D_i \neq D_e \quad (7)$$

$$P_{h_{D_i}} = \frac{\Delta^2 D_e}{\Delta^2 D_i} \dots \dots \dots (7)$$

$$(7) \quad (\quad) \quad : \quad (8)$$

$$T_i = \frac{1}{P_i} \Rightarrow T_{h_{D_i}} = \frac{1}{P_{h_{D_i}}} = \frac{D_{D_i}^2}{D_{D_e}^2} \dots \dots \dots (8)$$

$$T_{h_{D_i}} \quad P_{h_{D_i}} \quad \Delta_{D_i} \quad : \quad (9)$$

$$\Delta_{D_i} = t \cdot m_{D_i} \dots \dots \dots (9)$$

$$(\quad) \quad -m_{D_i} \quad D_i \quad (10) \quad [3]$$

D_i : (1)

N°	(m)			m _{D_i} (mm)	m ² _{D_i}	T	
			D _i			T _A	T _B
1		7.5	5	0.021	0.000441	0.500	0.250
2	7.6	12.5	10	0.028	0.000784	0.889	0.444
3	12.6	17.5	15	0.035	0.001225	1.39	0.695
4	17.6	22.5	20	0.042	0.001764	2.00	1.00
5	22.6	27.5	25	0.049	0.002401	2.72	1.36
6	27.6	32.5	30	0.056	0.003136	3.56	1.78
7	32.6	37.5	35	0.036	0.003969	4.5	2.25
8	37.6	42.5	40	0.070	0.004090	5.56	2.78
9	47.6	52.5	50	0.084	0.007056	8.00	4.00
10	52.6	57.5	55	0.091	0.008281	9.36	4.68



()

F

.E

E

D_e

E

E

T

E

(1)

C.U

u_{i,j}

C

U

u

(1)

$\overline{\Delta_{\Delta S}}$

$\overline{\Delta S}$

$$\frac{1}{2}[T] = \frac{1}{2}(T_{u,i} + T_{u,j} + T_{i,j})$$

(11)

.i, j

:

- T_{i,j}

$(\frac{1}{500} - \frac{1}{2000})$

- T_{u,j}

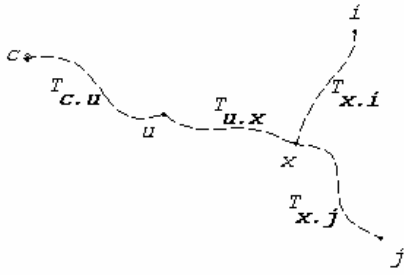
.i u

- T_{u,j}

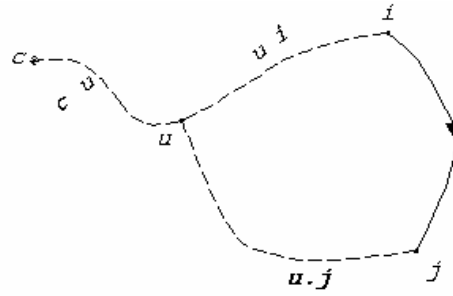
.j u

1m

.0.1m



الشكل (3)



الشكل (1)

$$T_{c,x} + T_{x,i} = T_{c,i} = Q_{ii} \quad (14)$$

$$T_{c,x} + T_{x,i} = T_{c,j} = Q_{jj} \quad (15)$$

$$: \quad (15) \quad (14)$$

$$2T_{c,x} + T_{x,i} + T_{x,j} = Q_{ii} + Q_{jj} \quad (16)$$

$$\Rightarrow T_{i,j} = T_{x,i} + T_{x,j} = Q_{ii} + Q_{jj} - 2T_{c,x} \quad (17)$$

$$(16) \quad T_{c,x} = Q_{ij}$$

:

$$T_{i,j} = Q_{ii} + Q_{jj} - 2Q_{ij} \quad (18)$$

Q

$$Q_{ii} = T_{c,i}, Q_{jj} = T_{c,j}, Q_{ij} = T_{c,x}$$

$$(17) \quad (16)$$

:

$$T_{x,i} = T_{c,i} - T_{c,x} \quad (19)$$

$$T_{x,j} = T_{c,j} - T_{c,x} \quad (20)$$

x.j x.i

$$: \quad (3)$$

$$T_{i,j} = \frac{1}{T_{u,x}} (T_{u,x}T_{x,i} + T_{x,i}T_{x,j} + T_{x,j}T_{u,x}) \quad (21)$$

$$(21)$$

$$: \quad T_{u,x}$$

$$T_{u,x} = \frac{T_{x,i} + T_{x,j}}{T_{i,j} - (T_{x,i} + T_{x,j})} \quad (22)$$

$$(22) \quad (20) \quad (19)$$

[3]

$$(11)$$

$$: \quad (12)$$

$$T_{u,i} < \frac{1}{2}[T] > T_{j,u} \quad (12)$$

(E)

$$\frac{1}{2}[T] - T_{u,i} \quad i, j$$

.i

$$: \quad (13)$$

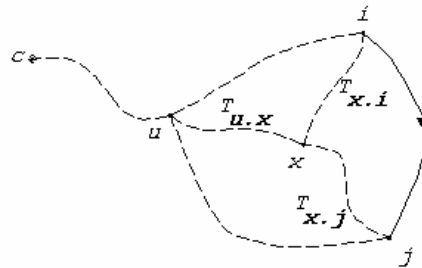
TR_{C,E}

$$TR_{C,E} = T_{c,u} + \frac{1}{4}[T] \quad (13)$$

(1)

u_{ij}

u I j



الشكل (2)

$$(2)$$

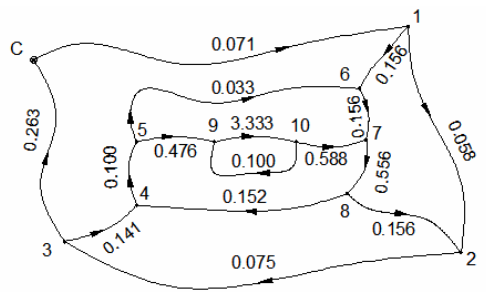
x

$$:(3)$$

C (10) (2) (3)

) $T_{u,i} = \frac{1}{T_{x,j}} (T_{u,x} T_{x,i} + T_{x,i} T_{x,j} + T_{x,j} T_{u,x})$ (23)

: $T_{u,j} = \frac{1}{T_{x,i}} (T_{u,x} T_{x,i} + T_{x,i} T_{x,j} + T_{x,j} T_{u,x})$ (24)



(4)

$N = P$

Popov, V.V. [5]

(2)

$T_{u,j}, T_{u,i}$ [T] $T_{i,j}$ (24)

(12)

$\frac{1}{2}[T] - T_{u,j}$ i, j

$T_{u,x}, T_{c,x}$

$T_{c,u} = T_{c,x} - T_{u,x}$ (25)

(13) $T_{h_{c,E}}$

(4)

$N = P$ (2)

	1	2	3	4	5	6	7	8	9	10
1	0.285	-0.058	-	-	-	-0.156	-	-	-	-
2	-0.058	0.282	-0.075	-	-	-	-	-0.149	-	-
3	-	-0.075	0.479	-0.141	-	-	-	-	-	-
4	-	-	-0.141	1.292	-1.00	-	-	-0.52	-	-
5	-	-	-	-1.00	1.509	-0.033	-	-	-0.476	-
6	-0.156	-	-	-	-0.033	0.574	-0.385	-	-	-
7	-	-	-	-	-	-0.385	1.582	-0.556	-	-0.588
8	-	-0.149	-	-0.152	-	-	-0.556	0.857	-	-
9	-	-	-	-	-0.476	-	-	-	4.810	-4.333
10	-	-	-	-	-	-	-0.588	-	-4.333	4.922

(3) $Q = N^{-1}$ $Q = N^{-1}$ (3)

$Q_{55} = T_{c,5} = 7.362$

$Q_{66} = T_{c,6} = 8.000$

$Q_{36} = T_{c,x} = 5.702$

(20) (19)

E T
5 6

(4) 1 2

$T_{x,5} = 1.66, T_{x,6} = 2,3$

.5 6

$$Q = N^{-1} \quad (3)$$

	1	2	3	4	5	6	7	8	9	10
1	-7.355	4.388	1.836	3.899	4.092	5.395	4.712	4.517	4.407	4.442
2		8.139	2.645	4.644	4.767	4.991	5.254	5.654	5.011	5.039
3			3.319	2.776	2.721	2.370	2.556	2.613	2.630	2.621
4				6.959	6.707	5.396	5.890	5.869	0.270	6.223
5					7.362	5.702	6.213	6.056	6.750	6.685
6						2.000	6.655	6.150	6.187	6.242
7							7.481	6.819	6.861	6.933
8								7.624	6.442	6.486
9									7.799	7.685
10										7.797

$$Q_{ii} = T_{C.i}$$

$$T_{c.x}, T_{x.6}, T_{x.5}$$

$$Q_{jj} = T_{c.j}$$

$$Q_{ij} = T_{c.x}$$

$$T_{5,6} = 30.6, T_{x.6} = 2.3, T_{x.5} = 1.66$$

: (22)

$$T_{u.x} = \frac{1.66 \cdot 2.3}{30.6 - (1.66 + 2.3)} = 0.14$$

(5) (24) (23)

(6) (6)

: (12)

$$\frac{1}{2}[T] = 17.56$$

E

5 6

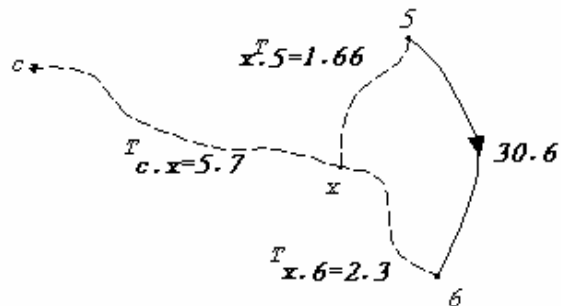
(3) $Q = N^{-1}$

: " " 5

$$T_{5,E} = 17.56 - 1.9 = 15.66$$

(25) $T_{c.u}$

: (13) $T_{c.u} = 5.56$



(5) الشكل

$$\bar{\Delta}_{\Delta S} \leq \mp 0.5mm$$

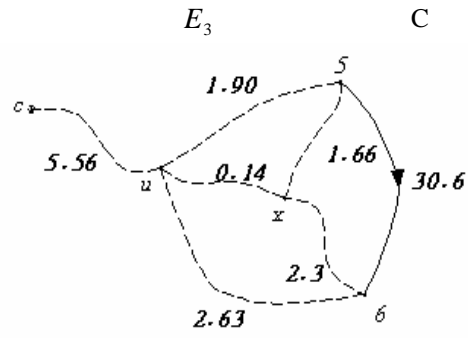
$$T_{C.E3} = T_{C,u} + \frac{1}{4}[T] = 5,56 + 8,78 = 14,34$$

(6)

(7)

$$\bar{T} \leq \frac{\bar{\Delta}_{\Delta S}}{2\Delta_e} = \frac{0.5^2}{2 \times 0.27^2} = 1,64$$

$$\bar{T} \leq \frac{\bar{\Delta}_{\Delta S}}{2\Delta_e^2} = \frac{2 \times 0.5^2}{0.27^2} = 6,6$$



الشكل (6)

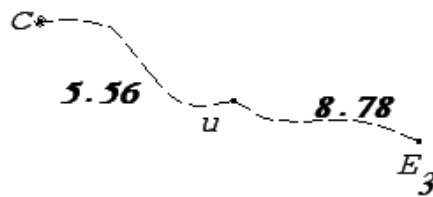
$$\bar{\Delta S} \leq +1,5mm [4]$$

-1

$$\bar{D}_e \leq \frac{1,5}{\sqrt{2 \times 14,4}} = \pm 0.27mm$$

-2

-3



الشكل (7)

-4

(1km)

Q

[4]

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