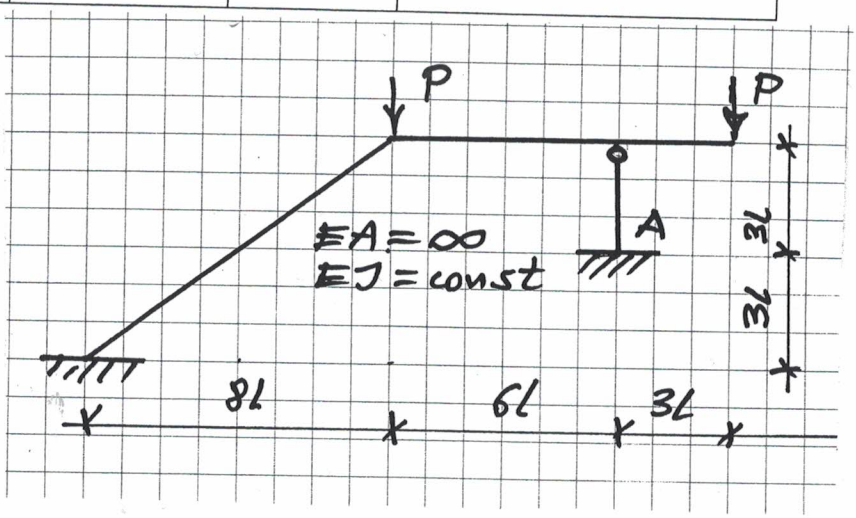
Egzamin pisemny z Mechaniki Konstrukcji I, 17 VI 2019 r.

Imię i NAZWISKO				
Prowadzący ćwiczenia, nr grupy				Nr albumu
ocena zadania 1	ocena zadania 2	ocena zadania 3	Ocena: wykład	Ocena łączna
				Data, podpis

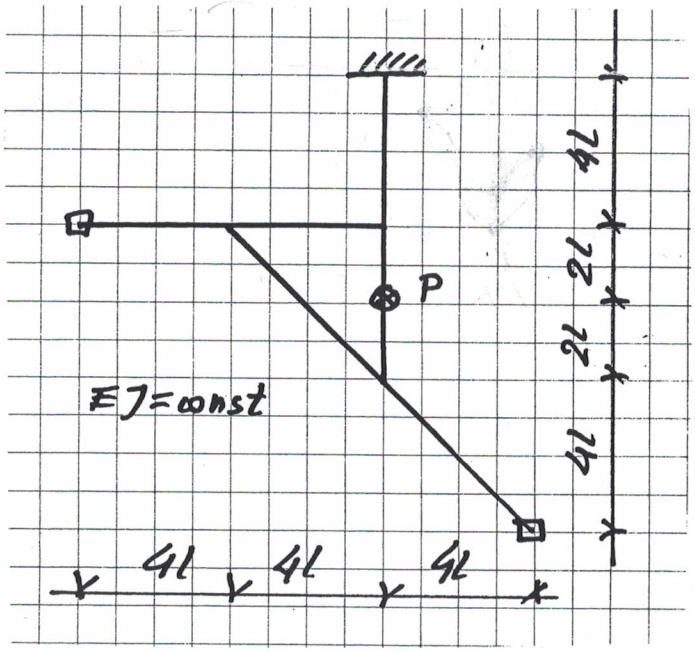
Zadanie 1
Dana jest rama
[EJ=const, $EA=\infty$]
obciążona siłami P.
Znaleźć moment
w utwierdzeniu A
metodą przemieszczeń.

(For the given frame
loaded by the forces P
find the bending moment
at the clamped edge A
using the
displacement method)



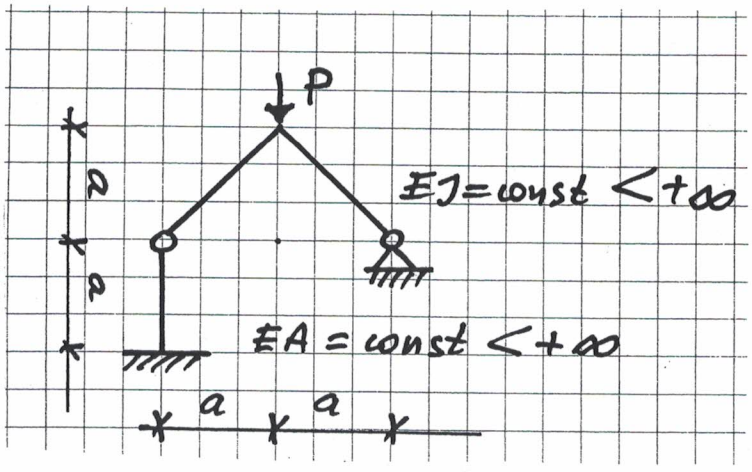
Zadanie 2
Dany jest ruszt przegubowy
obciążony jak na rys.
Znaleźć wykres
momentów zginających.

(For the given
system of beams
loaded as shown
in the figure
find the diagram
of the bending moments)



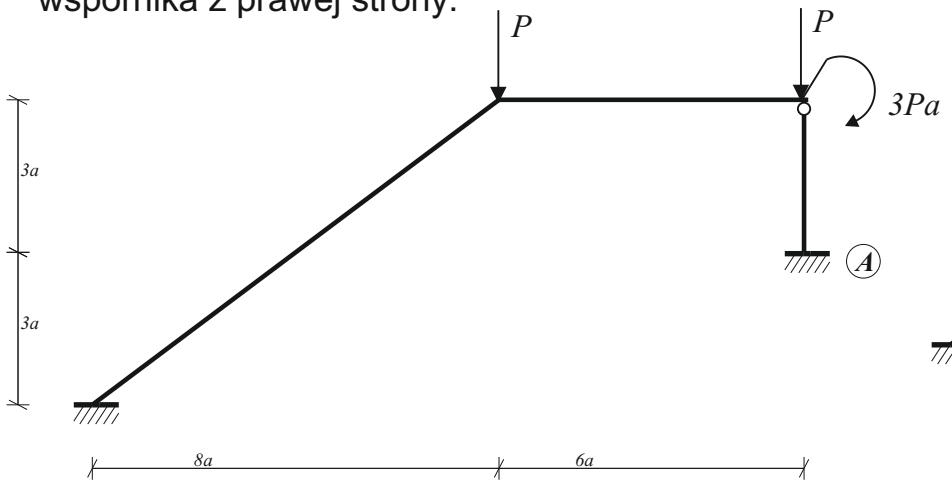
Zadanie 3
Dana jest rama
jak na rysunku.
Zapisać równania macierzowe
metody przemieszczeń

(For the given frame
write down the matrix equations
of the displacement method.)

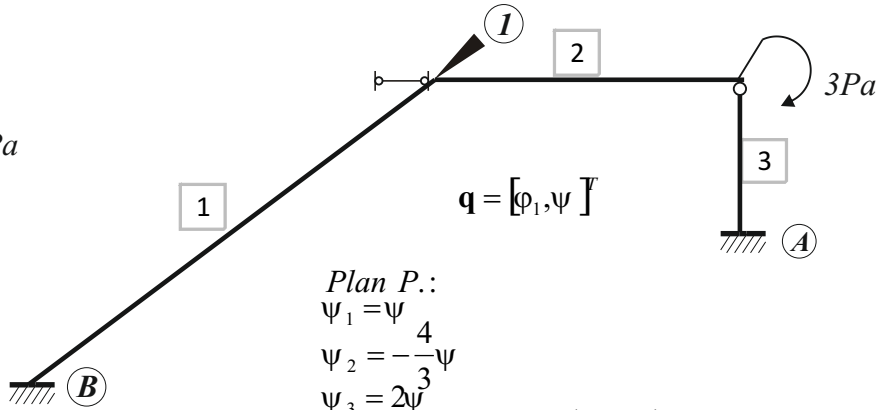


zad. 1/egz.MK1/17.06.2019

Zadanie po redukcji
statycznie wyznaczalnego
wspornika z prawej strony:



UGW:



Plan P.:

$\psi_1 = \psi$

$\psi_2 = -\frac{4}{3}\psi$

$\psi_3 = 2\psi$

$\bar{L}_z = P8a \cdot \bar{\psi} + 3Pa\left(-\frac{4}{3}\bar{\psi}\right) = 4Pa\bar{\psi}$

Równania równowagi:

1. $\Phi_1^1 + \Phi_1^2 = 0$
2. $\big|_{\bar{\psi}=-1}\ \left(\Phi_B^1 + \Phi_1^1\right)(-1) + \Phi_1^2 \frac{4}{3} + \Phi_A^3(-2) - 4Pa = 0$

Wzory transformacyjne:

	a/EJϕ_1	a/EJψ	+	Q0/**Pa**
Φ_B^1	0.2	-0.6		
Φ_1^1	0.4	-0.6		
Φ_1^2	0.5	2/3		1.5
Φ_A^3		-2		

Układ równań
i rozwiązanie:

0.9000	1/15	ϕ_1 =	-1 1/2	$\frac{Pa^2}{EJ}$
1/15	**6 4/45**	ψ =	2	

$\mathbf{q} =$ | -1.692E+00 | $\frac{Pa^2}{EJ}$ |
|---|---|
| 3.470E-01 | |

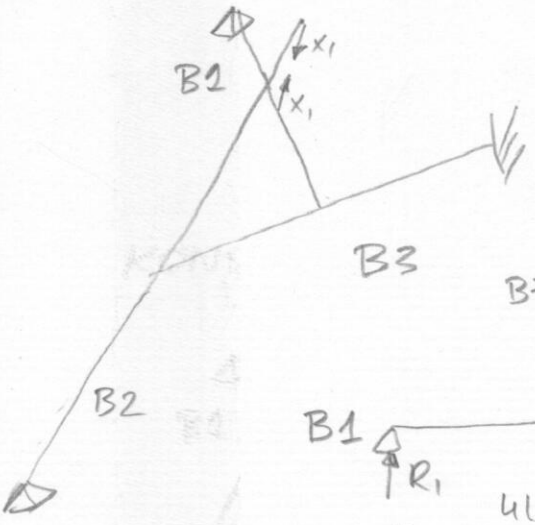
Odp: Φ_A^3 = **-0.6940** Pa

oprac. K. Hetmański

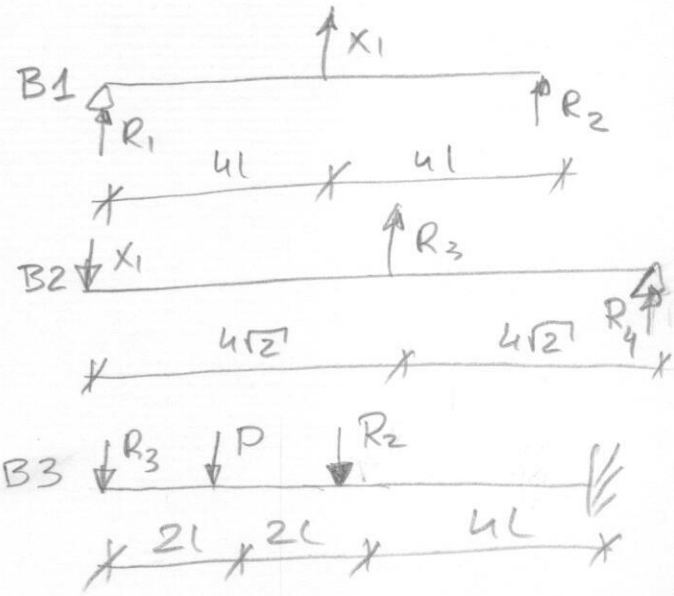
MECHANIKA KONSTRUKCJI 1. 17.06.2019

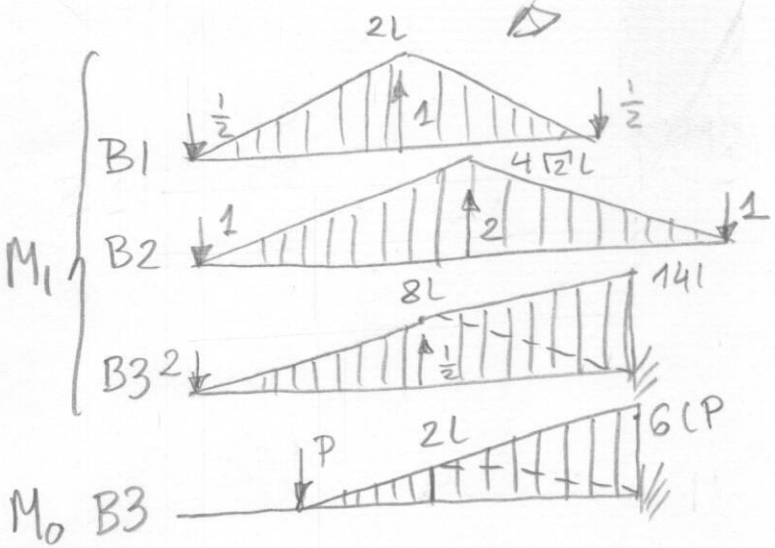
ZADANIE 2

→ SCHEMAT 1



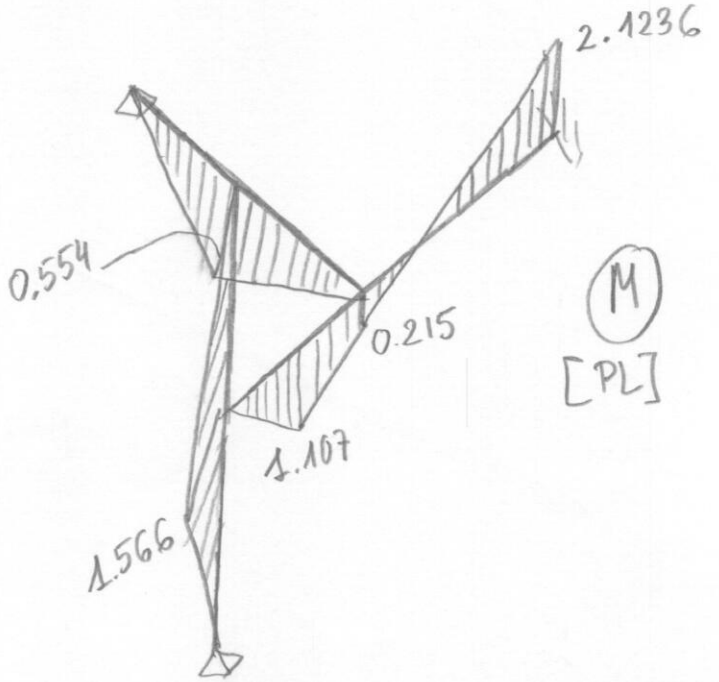
BELKA 1 (B1)





B1, B2 ≡ 0

$$d_{11} \approx 712.68 \frac{l^3}{EJ} \qquad d_{10} \approx 197.33 \frac{l^3 P}{EJ} \Rightarrow X_1 = -\frac{d_{10}}{d_{11}} = -0{,}277P$$



Opracował: R. Czubacki

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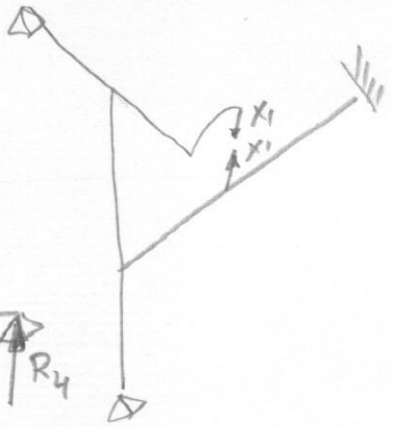
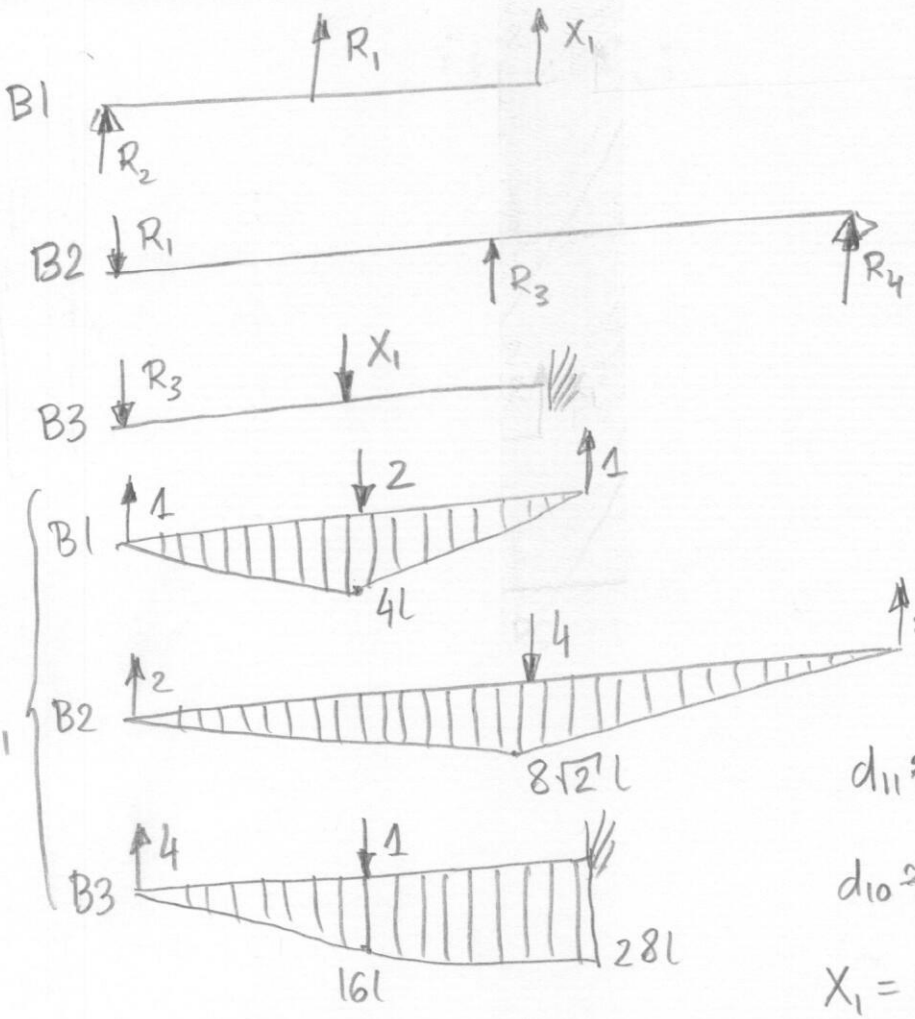
→ SCHEMAT 2





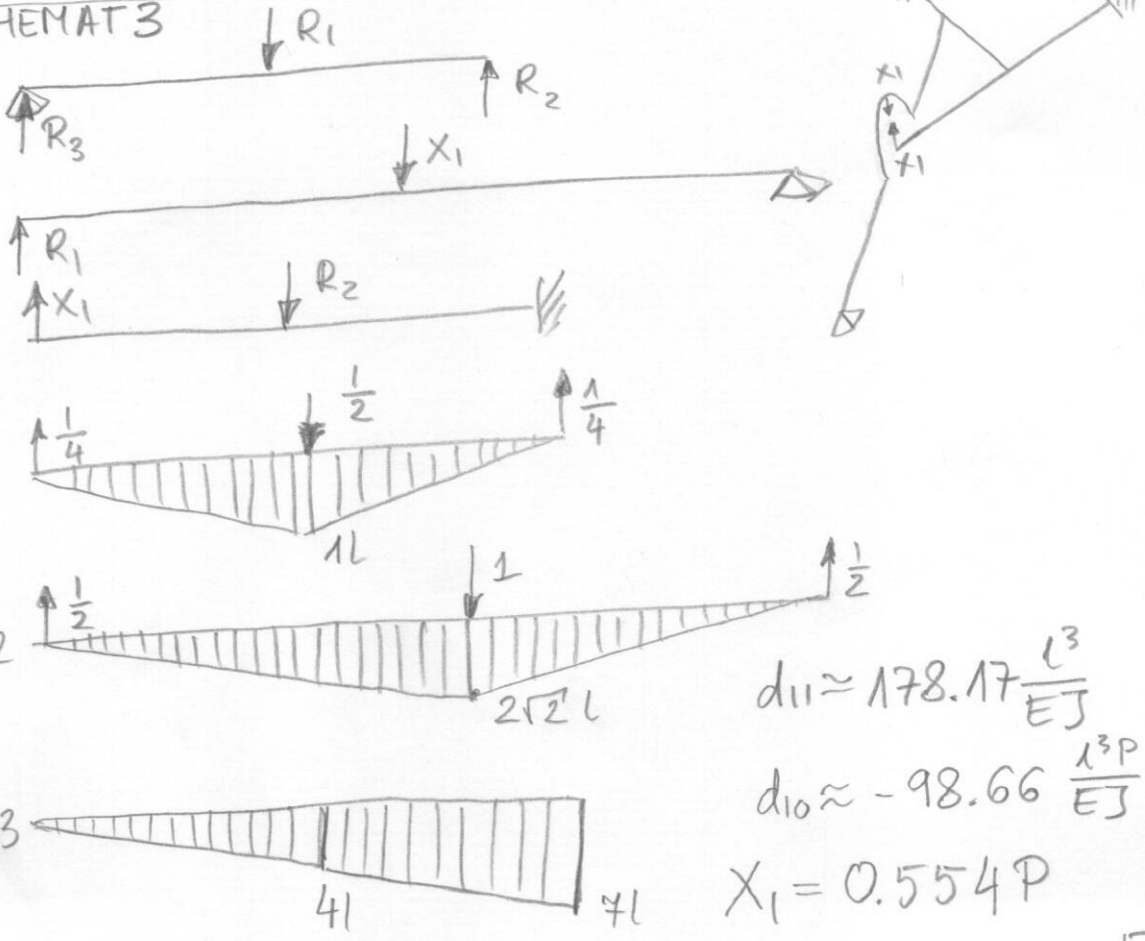
$d_{11} \approx 2850.72 \frac{l^3}{EJ}$

$d_{10} \approx -394.667 \frac{l^3 P}{EJ}$

$X_1 = 0.138P$

Mo jak dla schematu 1.

→SCHEMAT 3



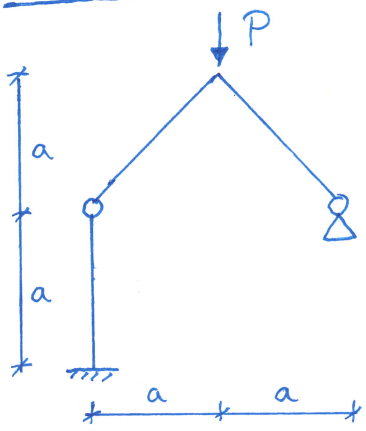
$d_{11} \approx 178.17 \frac{l^3}{EJ}$

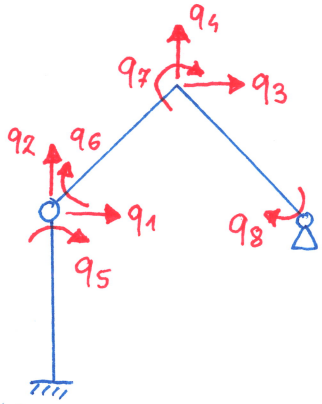
$d_{10} \approx -98.66 \frac{l^3 P}{EJ}$

$X_1 = 0.554P$

Mo jak dla schematu 1.

ZADANIE 3





$$q = \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \\ q_5 \\ q_6 \\ q_7 \\ q_8 \end{bmatrix} \qquad Q = \begin{bmatrix} 0 \\ 0 \\ 0 \\ -P \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\Delta = \mathbb{B} q$$

$$^{*}x = {}^{*}\mathbb{B} q$$

$$x^{*} = \mathbb{B}^{*} q$$

$$\mathbb{E} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \frac{1}{\sqrt{2}} & 0 \\ 0 & 0 & \frac{1}{\sqrt{2}} \end{bmatrix} \frac{EA}{a} \qquad \mathbb{D} = \begin{bmatrix} 2 & 0 & 0 \\ 0 & \sqrt{2} & 0 \\ 0 & 0 & \sqrt{2} \end{bmatrix} \frac{EJ}{a}$$

$$\mathbb{B} = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -\frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 0 & 0 & 0 & 0 \\ 0 & 0 & -\frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 0 & 0 & 0 & 0 \end{bmatrix}$$

$${}^{*}\mathbb{B} = \begin{bmatrix} -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \frac{1}{2} & -\frac{1}{2} & -\frac{1}{2} & \frac{1}{2} & 0 & 1 & 0 & 0 \\ 0 & 0 & -\frac{1}{2} & -\frac{1}{2} & 0 & 0 & 1 & 0 \end{bmatrix}$$

$$\mathbb{B}^{*} = \begin{bmatrix} -1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ \frac{1}{2} & -\frac{1}{2} & -\frac{1}{2} & \frac{1}{2} & 0 & 0 & 1 & 0 \\ 0 & 0 & -\frac{1}{2} & -\frac{1}{2} & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\mathbb{K} = \mathbb{B}^{T}\mathbb{E}\mathbb{B} + 2({}^{*}\mathbb{B})^{T}\mathbb{D}\,{}^{*}\mathbb{B} + ({}^{*}\mathbb{B})^{T}\mathbb{D}\mathbb{B}^{*} + (\mathbb{B}^{*})^{T}\mathbb{D}\,{}^{*}\mathbb{B} + 2(\mathbb{B}^{*})^{T}\mathbb{D}\mathbb{B}^{*}$$

$$\mathbb{K} q = \mathbb{Q} \Rightarrow q$$

$$N = \mathbb{E}\Delta$$

$${}^{*}\Phi = \mathbb{D}(2\,{}^{*}x + x^{*})$$

$$\Phi^{*} = \mathbb{D}({}^{*}x + 2x^{*})$$