Katedra za proizvodno mašinstvo
PROJEKTOVANJE OBRADNIH SISTEMA

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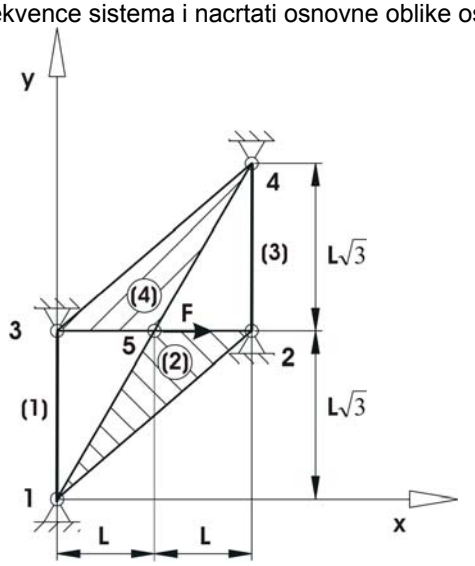
Zadatak 1

Za model planarne mehaničke strukture prikazane na slici potrebno je primenom metoda konačnih elemenata:

1. Sastaviti ukupnu matricu masa.
2. Odrediti sopstvene frekvence sistema i nacrtati osnovne oblike oscilovanja.



Matrica krutosti sistema je data sa:

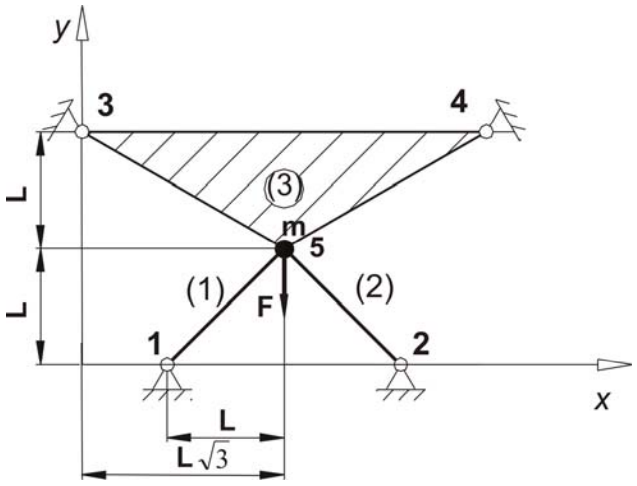
$$K = \frac{EA}{L}\begin{bmatrix}
\frac{\sqrt{3}}{16} & 0 & \frac{\sqrt{3}}{16} & \frac{-3}{16} & 0 & 0 & 0 & 0 & \frac{-\sqrt{3}}{8} & \frac{3}{16} \\
0 & \frac{25\sqrt{3}}{48} & \frac{-3}{16} & \frac{3\sqrt{3}}{16} & 0 & \frac{-\sqrt{3}}{3} & 0 & 0 & \frac{3}{16} & \frac{-3\sqrt{3}}{8} \\
\frac{\sqrt{3}}{16} & \frac{-3}{16} & \frac{5\sqrt{3}}{8} & \frac{-3}{8} & 0 & 0 & 0 & 0 & \frac{-11\sqrt{3}}{16} & \frac{9}{16} \\
\frac{-3}{16} & \frac{3\sqrt{3}}{16} & \frac{-3}{8} & \frac{17\sqrt{3}}{24} & 0 & 0 & 0 & \frac{-\sqrt{3}}{3} & \frac{9}{16} & \frac{-9\sqrt{3}}{16} \\
0 & 0 & 0 & 0 & \frac{5\sqrt{3}}{8} & \frac{-3}{8} & \frac{\sqrt{3}}{16} & \frac{-3}{16} & \frac{-11\sqrt{3}}{16} & \frac{9}{16} \\
0 & \frac{-\sqrt{3}}{3} & 0 & 0 & \frac{-3}{8} & \frac{17\sqrt{3}}{24} & \frac{-3}{16} & \frac{3\sqrt{3}}{16} & \frac{9}{16} & \frac{-9\sqrt{3}}{16} \\
0 & 0 & 0 & 0 & \frac{\sqrt{3}}{16} & \frac{-3}{16} & \frac{\sqrt{3}}{16} & 0 & \frac{-\sqrt{3}}{8} & \frac{3}{16} \\
0 & 0 & 0 & \frac{-\sqrt{3}}{3} & \frac{-3}{16} & \frac{\sqrt{3}}{16} & 0 & \frac{25\sqrt{3}}{48} & \frac{3}{16} & \frac{-3\sqrt{3}}{8} \\
\frac{-\sqrt{3}}{8} & \frac{3}{16} & \frac{-11\sqrt{3}}{16} & \frac{9}{16} & \frac{-11\sqrt{3}}{16} & \frac{9}{16} & \frac{-\sqrt{3}}{8} & \frac{3}{16} & \frac{13\sqrt{3}}{8} & \frac{-3}{2} \\
\frac{3}{16} & \frac{-3\sqrt{3}}{8} & \frac{9}{16} & \frac{-9\sqrt{3}}{16} & \frac{9}{16} & \frac{-9\sqrt{3}}{16} & \frac{3}{16} & \frac{-\sqrt{3}}{8} & \frac{-3}{2} & \frac{15\sqrt{3}}{8}
\end{bmatrix}$$

Napomena: konačni elementi u obliku štapa imaju površinu poprečnog preseka A; debljina trougaonih konačnih elemenata je t=A/L; svi elementi su od materijala čiji je modul elastičnosti E, gustina ρ, a Puasonov koeficijent ν=1/3.

Zadatak 2

Za model planarne mehaničke strukture prikazane na slici, potrebno je primenom metode konačnih elemenata:

1. Sastaviti ukupnu matricu masa.
2. Odrediti sopstvene frekvence sistema



Matrica krutosti sistema je data sa:

$$K = \frac{EA}{L}\begin{bmatrix}
\frac{\sqrt{2}}{4} & \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 & 0 & \frac{-\sqrt{2}}{4} & \frac{-\sqrt{2}}{4} \\
\frac{\sqrt{2}}{4} & \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & 0 & 0 & \frac{-\sqrt{2}}{4} & \frac{-\sqrt{2}}{4} \\
0 & 0 & \frac{\sqrt{2}}{4} & \frac{-\sqrt{2}}{4} & 0 & 0 & 0 & 0 & \frac{-\sqrt{2}}{4} & \frac{\sqrt{2}}{4} \\
0 & 0 & \frac{-\sqrt{2}}{4} & \frac{\sqrt{2}}{4} & 0 & 0 & 0 & 0 & \frac{\sqrt{2}}{4} & \frac{-\sqrt{2}}{4} \\
0 & 0 & 0 & 0 & \frac{3\sqrt{3}}{16} & \frac{-3}{16} & \frac{3\sqrt{3}}{16} & 0 & \frac{-3\sqrt{3}}{16} & \frac{3}{16} \\
0 & 0 & 0 & 0 & \frac{-3}{16} & \frac{5\sqrt{3}}{16} & 0 & \frac{\sqrt{3}}{4} & \frac{3}{16} & \frac{-9\sqrt{3}}{16} \\
0 & 0 & 0 & 0 & \frac{3\sqrt{3}}{16} & 0 & \frac{3\sqrt{3}}{16} & \frac{3}{16} & \frac{-3\sqrt{3}}{16} & \frac{-3}{16} \\
0 & 0 & 0 & 0 & 0 & \frac{\sqrt{3}}{4} & \frac{3}{16} & \frac{5\sqrt{3}}{16} & \frac{-3}{16} & \frac{-9\sqrt{3}}{16} \\
\frac{-\sqrt{2}}{4} & \frac{-\sqrt{2}}{4} & \frac{-\sqrt{2}}{4} & \frac{\sqrt{2}}{4} & \frac{-3\sqrt{3}}{16} & \frac{3}{16} & \frac{-3\sqrt{3}}{16} & \frac{-3}{16} & \frac{\sqrt{2}}{2}+\frac{3\sqrt{3}}{8} & 0 \\
\frac{-\sqrt{2}}{4} & \frac{-\sqrt{2}}{4} & \frac{\sqrt{2}}{4} & \frac{-\sqrt{2}}{4} & \frac{3}{16} & \frac{-9\sqrt{3}}{16} & \frac{-3}{16} & \frac{-9\sqrt{3}}{16} & 0 & \frac{\sqrt{2}}{2}+\frac{9\sqrt{3}}{8}
\end{bmatrix}$$

Napomena: konačni elementi u obliku štapa imaju površinu poprečnog preseka A; debljina trougaonih konačnih elemenata je t=A/L; svi elementi su od materijala čiji je modul elastičnosti E, gustina ρ, a Puasonov koeficijent ν=1/3.