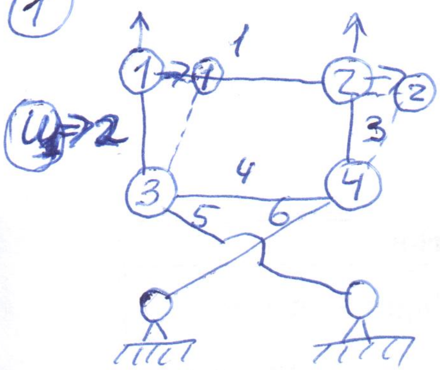
(1)



nodes $= 4 = N$

(edges / bars) $= 6 = m$

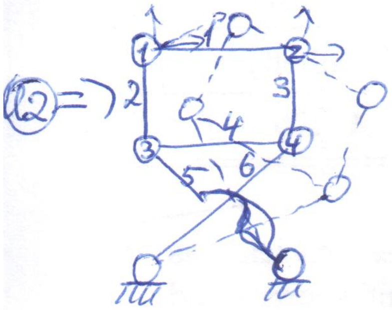
$4 \cdot 2 = 8$ displacements (rows), $Au = 0 \to 8 - 6 = 2$ indep. solutions

2 mechanism (truss deformations)

0 rigid motion (fixed truss)

$u_1 = (u_1^H, u_1^V, u_2^H, u_2^V, \dots, u_4^H, u_4^V)$

$u_1 = (1, 0, 1, 0, 0, 0, 0, 0)$



$u_2 = (1, 1, 1, -1, 1, 1, 1, -1)$

$A_{(6\times8)}, \; A^T_{(8\times6)}, \; A^T_{(8\times6)} A_{(6\times8)} = 8\times8$

First row $A = [-1\ 0\ 1\ 0\ 0\ 0\ 0\ 0]$

First row $A^T = [1\ 0\ -1\ 0\ 0\ 0\ 0\ 0]$

(2) 7 bars, $N = 5$, $n = 10 - 2 = 8$ unknown displacements

(1) $Au = 0$, $8 - 7 = 1$ independent solution

0 mechanism, 1 rigid motion

(2) No, rigid motion can't be stoped by 1 bar

(3) $45^\circ = \frac{\pi}{4}$,
$$\begin{array}{cccccccc} [\,0, & 0, & -\cos(\frac{\pi}{4}) & -\sin(\frac{\pi}{4}) & \cos(\frac{\pi}{4}) & \sin(\frac{\pi}{4}) & 0 & 0\,] \\ u_1^H & u_1^V & u_2^H & u_2^V & u_3^V & u_3^H & u_4^V & u_4^H \end{array}$$

(4) $A^T w = f$ with right side f_2^H

$\cos\theta = \frac{\sqrt{2}}{2}$, $\theta = \frac{\pi}{4}$

$f_2^H = -w_1 + w_2\cos(\frac{\pi}{4}) + 0 \cdot w_3 - w_4\cos(\frac{\pi}{4})$ — row of $A^T w$

3 nodes $= 4 = N$, $N \cdot 2 = 8$ displacements

$Au = 0 \rightarrow 8 - 4 = 4$ solutions, $u_n = (u_1^H, u_1^V, \dots u_8^H, u_8^V)$

horizontal movement $\rightarrow u_1 = (1,0,1,0,1,0,1,0)$

vertical movement $\rightarrow u_2 = (0,1,0,1,0,1,0,1)$

rotation (node 4) $\rightarrow u_3 = (1,1,1,0,0,1,0,0)$

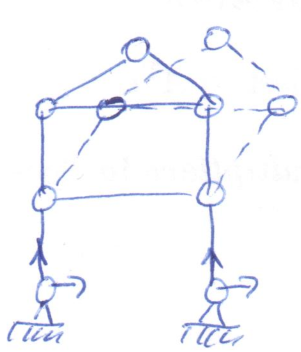
mechanism $\rightarrow u_4 = (1,0,1,0,0,0,0,0)$

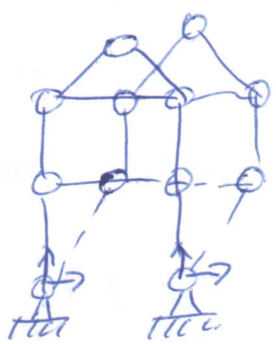
$A^T w = f$ has a solution, $u^T f = 0$ (prevent movements)

$f_1 = (1,0,-1,0,0,0,0,0)$; $f_2 = (0,1,0,0,0,-1,0,0)$

$f_3 = (0,0,0,1,0,-1,0,0)$; $f_4 = (-1,0,+1,0,0,0,0,0)$

5





nodes $= 7 = N$

$2 \cdot N = 14$ displacements

2 fixed nodes $= 4$ fixed displacements

$14 - 4 = 10$

$10 - 8 = 2$ independent solutions

$A^T A \rightarrow$ pos. semidefinite

A has indep. cols.