MODELIZACIÓN MECÁNICA DE ELEMENTOS ESTRUCTURALES

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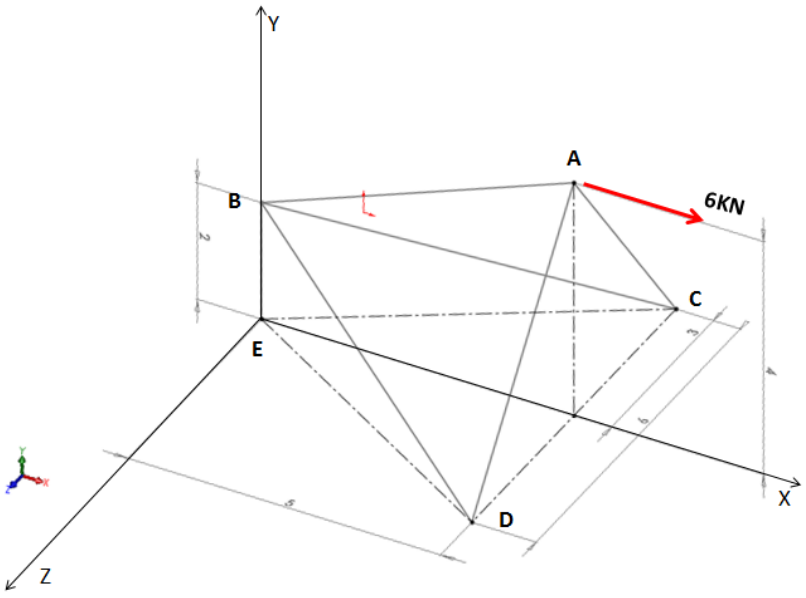
PRACTICA 2: ESTRUCTURAS 3D DE BARRAS

En el informe de prácticas debe incluirse:

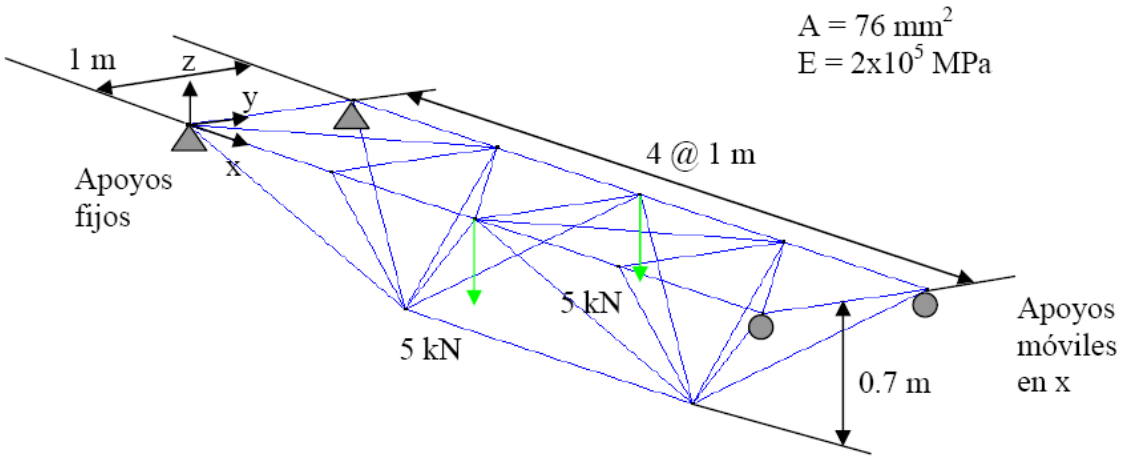
1) Croquis del problema: indicando las posiciones de las cargas y las restricciones consideradas.
2) Dimensiones, materiales de la estructura. Valor de la tensión máxima admisible del material que se vaya a utilizar
3) Se utilizará la librería de perfiles del Solidwork para dimensionar los perfiles.
4) Se incluirán el gráfico de las tensiones máximas
5) Se incluirá un breve comentario indicando los resultados obtenidos

1. Problema. Estructura de barras.

Datos:
Material: Acero
Sección transversal: 90 x 50 x 5.0 mm
Carga: 6KN Aplicada en el nodo A, positiva en el plano z-x
Coordenadas de los nodos en metros: A(5,4,3), B(0,2,3), C(5,0,0), D(5,0,6), E(0,0,3)
Restricciones: los apoyos E, D y C están completamente restringidos



2. Problema. Armadura. 3D



3. Problema. Truss 3D

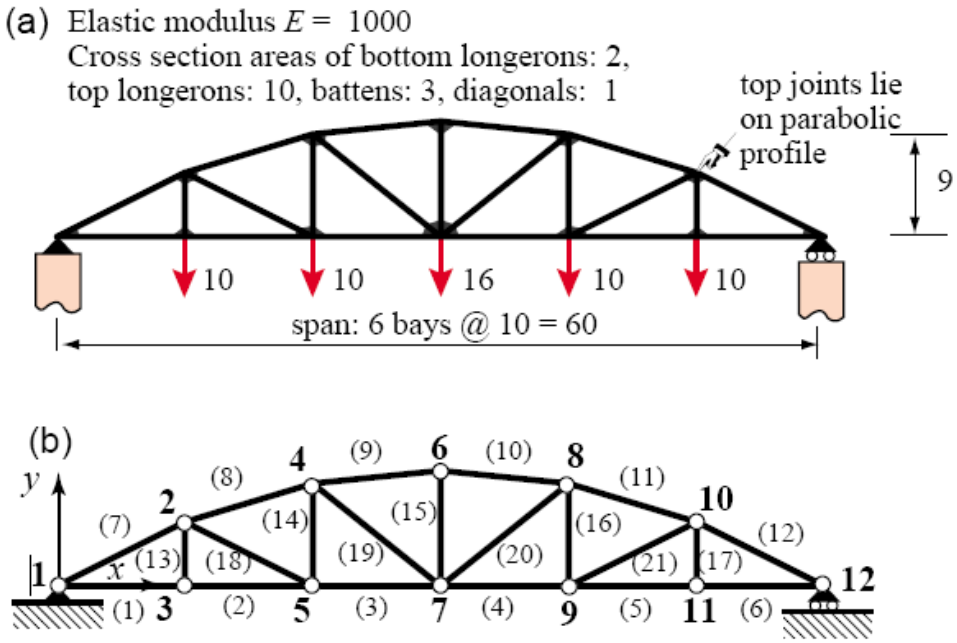


FIGURE 21.13. Six-bay bridge plane truss used as example problem: (a) truss structure showing supports and applied loads; (b) finite element idealization as pin-jointed truss.

4. Problema. Torre de transmisión 3D

EXERCISE 21.5 [C:25] Analyze the structure shown in Figure E21.1. This is a pin-jointed truss model of a 200-in-high (5m) transmission tower originally proposed by Fox and Schmit in 1964 [96] as a test for early automated-synthesis codes based on FEM. It became a standard benchmark for structural optimization.

The truss has 10 joints (nodes) and 25 members (elements). The truss geometry and node numbering are defined in Figure E21.1(a). Joints 1 and 2 at the top of the tower lie on the $\{x, z\}$ plane. The truss (but not the loads) is symmetric about the $\{y, z\}$ and $\{x, z\}$ planes. Figure E21.1(b) gives the element numbers.

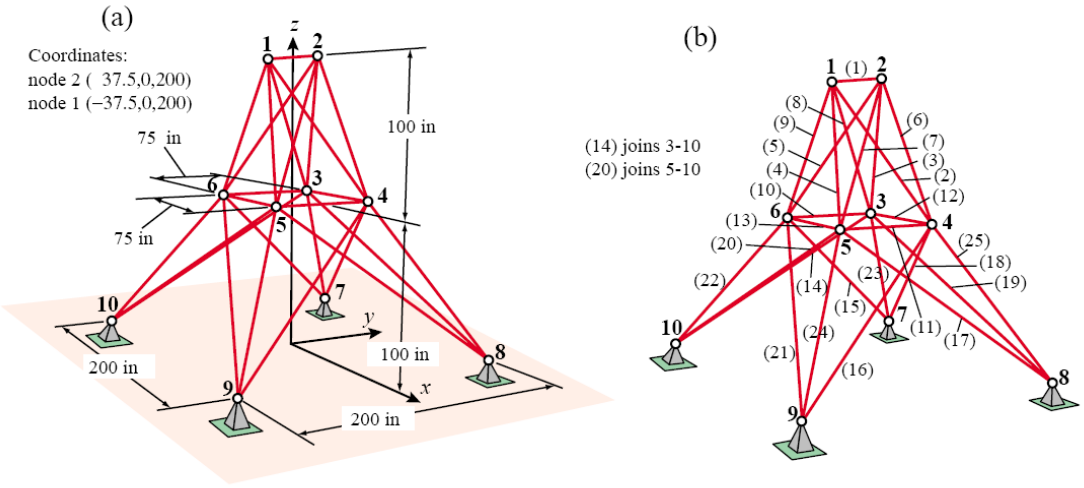


FIGURE E21.1. 25-member space truss model of a transmission tower. (a): Geometry definition and node numbers; (b) element numbers. For member properties and loads see Tables E21.1 and E21.2.

Table E21.1 Cross section areas of transmission tower members

Element	A (sq in)	Element	A (sq in)	Element	A (sq in)
1	0.033	10	0.010	19	1.760
2	2.015	11	0.010	20	1.760
3	2.015	12	0.014	21	1.760
4	2.015	13	0.014	22	2.440
5	2.015	14	0.980	23	2.440
6	2.823	15	0.980	24	2.440
7	2.823	16	0.980	25	2.440
8	2.823	17	0.980		
9	2.823	18	1.760		

Table E21.2 Applied load case for transmission tower

Node	x-load (lb)	y-load (lb)	z-load (lb)
1	1000	10000	−5000
2	0	10000	−5000
3	500	0	0
6	500	0	0

Applied forces at all other nodes are zero.
Own-weight loads not considered.

The members are aluminum tubes with the cross sections listed in Table E21.1.[4] The modulus of elasticity is $E = 10^7$ psi for all members. The specific weight is 0.1 lb/in^3. The applied load case to be studied is given in Table E21.2.

Analyze the transmission tower using the program provided in the `SpaceTruss.nb` Notebook (downloadable from Chapter 21 Index). Results to report: driver program cell, node displacements and element stresses. (More details on HW assignment sheet.) Note: as a quick check on model preparation, the total weight of the tower should be 555.18 lb.