VIB : Equivalent SDOF system

Number of participants: 30

1. In order to compute an equivalent stiffness, one needs to

17 correct answers out of 20 respondents

✓ Apply a static force at the location where the mass is attached and in the direction of the motion of the mass	85%	17 votes
Apply an harmonic force at the location where the mass is attached and in the direction of the motion of the mass	15%	3 votes
Compute the first 5 modes shapes of the flexible element	0%	0 votes

2. The equivalent stiffness is then given by

22 correct answers out of 22 respondents

✓ k=F/x where x is the displacement in the direction of motion at the location of the applied force	100%	22 votes
k=F/x where x is the average displacement computed on the flexible element	0%	0 votes
k= F*x where x is the displacement in the direction of motion at the location of the applied force	0%	0 votes

3. For a bar in traction with section A, young's modulus E and length L, the equivalent stiffness is given by

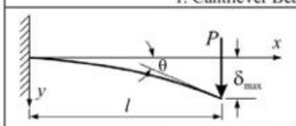
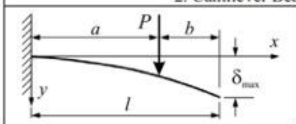
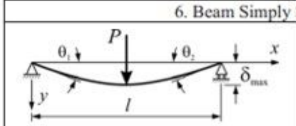
6 correct answers
out of 8 respondents

k = E A L	0%	0 votes
✓ k=EA/L	75%	6 votes
k=E/(A*L)	13%	1 vote
k=1/(EAL)	13%	1 vote

4. Consider a cantilever beam with a mass attached at the tip. If the length of the beam is doubled, the first natural frequency is

11 correct answers
out of 15 respondents

BEAM DEFLECTION FORMULAE

BEAM TYPE	SLOPE AT FREE END	DEFLECTION AT ANY SECTION IN TERMS OF x	MAXIMUM DEFLECTION
1. Cantilever Beam – Concentrated load P at the free end			
	$\theta = \frac{Pl^2}{2EI}$	$y = \frac{Px^2}{6EI}(3l - x)$	$\delta_{max} = \frac{Pl^3}{3EI}$
2. Cantilever Beam – Concentrated load P at any point			
	$\theta = \frac{Pa^2}{2EI}$	$y = \frac{Px^2}{6EI}(3a - x)$ for $0 < x < a$ $y = \frac{Pa^2}{6EI}(3x - a)$ for $a < x < l$	$\delta_{max} = \frac{Pa^2}{6EI}(3l - a)$
6. Beam Simply Supported at Ends – Concentrated load P at the center			
	$\theta_1 = \theta_2 = \frac{Pl^2}{16EI}$	$y = \frac{Px}{12EI}\left(\frac{3l^2}{4} - x^2\right)$ for $0 < x < \frac{l}{2}$	$\delta_{max} = \frac{Pl^3}{48EI}$

multiplied by 2	0%	0 votes
divided by 2	13%	2 votes
✓ divided by 2 sqrt(2)	73%	11 votes
divided by 4	13%	2 votes

5. To compute the equivalent mass of a flexible element simplified by a spring element, one needs to

11 correct answers
out of 12 respondents

Answer	%	Votes
use the principle of d'Alembert	0%	0 votes
compute the total mass of the flexible element and divided it by 3	8%	1 vote
✓ equate the kinetic energy of the flexible element with the one of the additional mass located at the tip of the spring	92%	11 votes

6. When replacing a flexible element by a spring, the approximation is

18 correct answers
out of 21 respondents

Answer	%	Votes
always valid	5%	1 vote
valid only above the first natural frequency of the flexible element	10%	2 votes
✓ valid in a limited frequency band where the element's natural frequencies are not excited	86%	18 votes

7. A complex structure can be represented by an equivalent mass-spring model using

1 correct answer
out of 17 respondents

✓	the principles of equivalent mass and spring if the structure is made of a large mass attached to a flexible element	41%	7 votes
✓	a single mode approximation if the eigenfrequencies are well separated	18%	3 votes
	A division of the structure using single finite elements	71%	12 votes

8. When using single mode approximation, the equivalent mass and stiffness of the SDOF system depend on

3 correct answers
out of 16 respondents

✓	The value of the eigenfrequency of the mode	44%	7 votes
	The average value of the modeshape considered	6%	1 vote
✓	The value of the modeshape considered at the position and in the direction of the applied force	81%	13 votes

9. Consider the wing of an aircraft, which method is most suited to reduce it to an equivalent SDOF system ?

1 correct answer
out of 20 respondents

The equivalent mass and stiffness approach using static computation and equivalence of kinetic energy	45%	9 votes
The single mode approximation	50%	10 votes
✓ It depends on the type of aircraft considered	5%	1 vote

10. What are the necessary assumptions to model a car as a SDOF mass-spring-damper system ?

13 respondents

- No slip
- Negligible Vertical Motion of the Wheels
- Negligible Vertical Motion of the Wheels
- Consider concentrated mass
- M = weight of the car
- Tiers damping, spring and mass with car mass, spring and damping
- Motion is in one direction only
- Suspension has constant stiffness
- No aerodynamic resistance
- The wheel does not have mass
- One direction of oscillation
- Depends on the car
- Mass uniform distributed

11. What type of model would you use to model the dynamic response of a wind turbine ?

0 respondent

No answers in this question