

# DOS 2021 : Equivalent SDOF system

Number of participants: 18

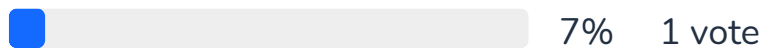
1

In order to compute an equivalent stiffness, one needs to

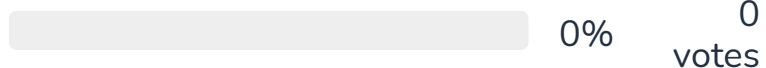
✓ Apply a static force at the location where the mass is attached and in the direction of the motion of the mass



Apply an harmonic force at the location where the mass is attached and in the direction of the motion of the mass



Compute the first 5 modes shapes of the flexible element



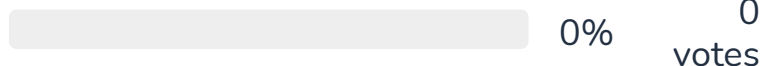
2

The equivalent stiffness is then given by

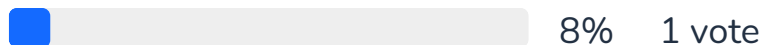
✓  $k=F/x$  where  $x$  is the displacement in the direction of motion at the location of the applied force



$k=F/x$  where  $x$  is the average displacement computed on the flexible element



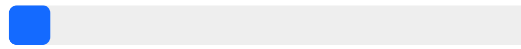
$k= F*x$  where  $x$  is the displacement in the direction of motion at the location of the applied force



3

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

$$k = E A L$$



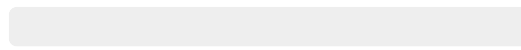
8% 1 vote

$$\checkmark k = EA/L$$



92% 11 votes

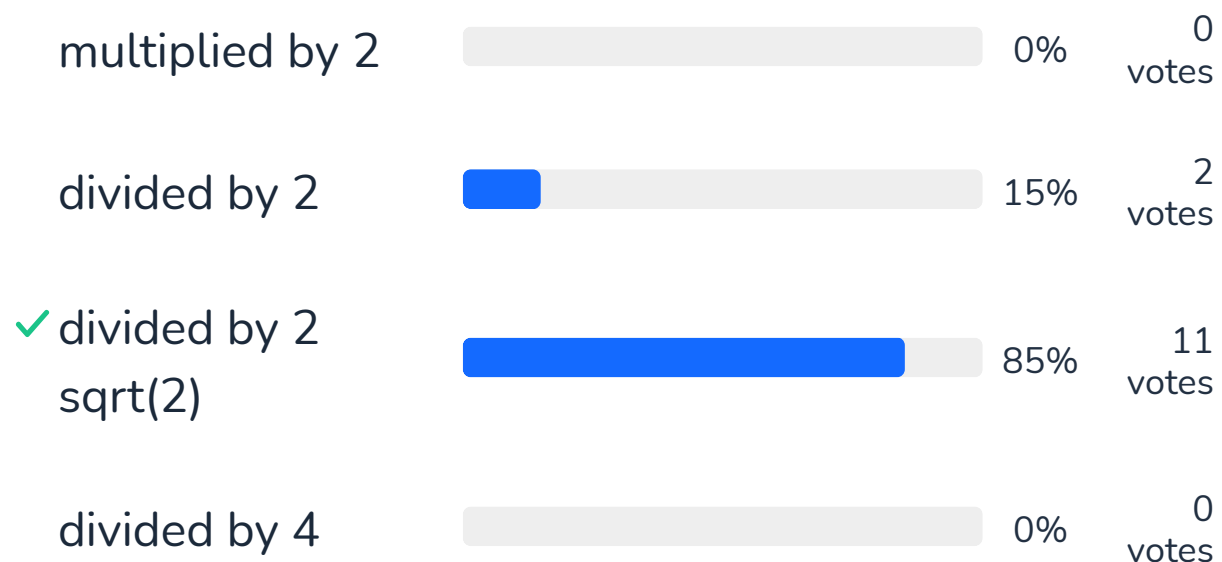
$$k = E/(A * L)$$



0% 0 votes

4

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



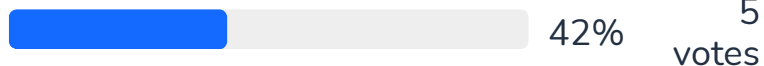
5

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

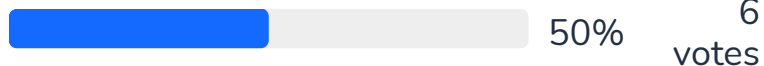
use the principle of d'Alembert



compute the total mass of the flexible element and divided it by 3



✓ equate the kinetic energy of the flexible element with the one of the additional mass located at the tip of the spring



6

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

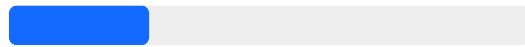
always valid



0%

0  
votes

valid only above  
the first natural  
frequency of the  
flexible element



27%

3  
votes

✓ valid in a limited  
frequency band  
where the  
element's  
natural  
frequencies are  
not excited



73%

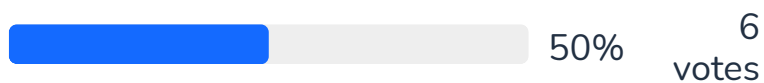
8  
votes



7

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

✓ the principles of equivalent mass and spring if the structure is made of a large mass attached to a flexible element



✓ a single mode approximation if the eigenfrequencies are well separated



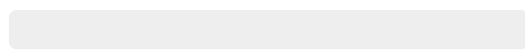
A division of the structure using single finite elements



8

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

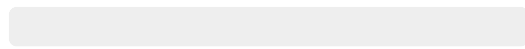
✓ The value of the eigen frequency of the mode



0%

0  
votes

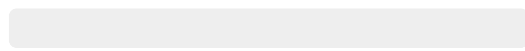
The average value of the modeshape considered



0%

0  
votes

✓ The value of the modeshape considered at the position and in the direction of the applied force



0%

0  
votes

