MOS Project

Raj bansal 2019ume0191 group_4

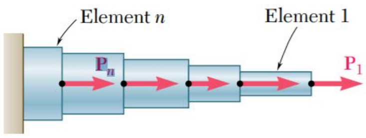

Fig. P2.C1

2.C1 A rod consisting of n elements, each of which is homogeneous and of uniform cross section, is subjected to the loading shown. The length of element i is denoted by L_i, its cross-sectional area by A_i, modulus of elasticity by E_i, and the load applied to its right end by $\mathbf{P}_i$, the magnitude P_i of this load being assumed to be positive if $\mathbf{P}_i$ is directed to the right and negative otherwise. (*a*) Write a computer program that can be used to determine the average normal stress in each element, the deformation of each element, and the total deformation of the rod. (*b*) Use this program to solve Probs. 2.20 and 2.126.

Here is the screenshot of my code.

MOS_C2_P1.cpp > main()

```cpp
#include <iostream>
#include <iomanip>
using namespace std;
int32_t main(){
    int n;
    cout<<"Enter the number of components ";
    cin>>n;
    cout<<"\n";
    double p[n],l[n],a[n],E[n];
    double P=0;
    cout<<"Enter the values in this format:load(kN),length(m),area of cross-section(mm^2)";
    cout<<"modulus of elasticity(GPa) respec. (with spacing)"<<"\n";
    for(int i=0;i<n;i++){
        cout<<"Enter values for "<<i+1<<" components: ";
        double x;
        cin>>x;
        P+=x;
        p[i]=P;
        cin>>l[i];
        cin>>a[i];
        cin>>E[i];
    }
    double d=0;
    cout<<"----------------------------------------------------------------------"<<"\n";
```

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MOS_C2_P1.cpp > main()

```cpp
        p[i]=P;
        cin>>l[i];
        cin>>a[i];
        cin>>E[i];
    }
    double d=0;
    cout<<"------------------------------------------------------------------"<<"\n";
    cout<<"Element       "<<"Stress(MPa)        "<<"Deformation(mm)"<<"\n";
    for(int i=0;i<n;i++){
        cout<<i+1<<"             ";
        cout<<setprecision(4)<<((p[i]*1000)/a[i]);
        d+=((p[i]*l[i])/(a[i]*E[i]*1000));
        cout<<"            ";
        cout<<setprecision(4)<<((p[i]*l[i])/(a[i]*E[i]*1000))*(1000000)<<"\n";
        cout<<"------------------------------------------------------------------"<<"\n";
    }
    cout<<"The net deformation is ";
    cout<<setprecision(4)<<d*1000000<<"\n";
}
```

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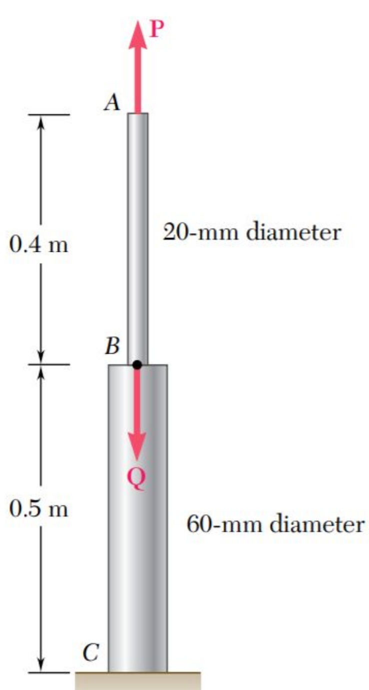
Example of this question:

2.20 The rod *ABC* is made of an aluminum for which $E = 70$ GPa. Knowing that $P = 6$ kN and $Q = 42$ kN, determine the deflection of (*a*) point *A*, (*b*) point *B*.



Solution of example(using code):

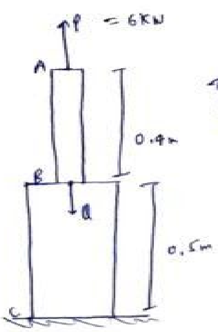
```
PS C:\Users\ss\Documents\C++> cd "c:\Users\ss\Documents\C++\" ; if ($?) { g++ MOS_C2_P1.cpp -o MOS_C2_P1 } ; if ($?) { .\MOS_C2_P1 }
Enter the number of components 2

Enter the values in this format:load(kN),length(m),area of cross-section(mm^2)modulus of elasticity(GPa) respec. (with spacing)
Enter values for 1 components: 6 0.4 314.16 70
Enter values for 2 components: -42 0.5 2827.4 70
------------------------------------------------------------------
Element        Stress(MPa)          Deformation(mm)
1              19.1                 0.1091
------------------------------------------------------------------
2              -12.73                 -0.09095
------------------------------------------------------------------
The net deformation is 0.01819
PS C:\Users\ss\Documents\C++>
```

Written solution:

Airtel 7:02 PM 52%

Adobe Scan 30 Nov 2020



↑ +ve ↓ -ve

$E_{AB} = E_{BC} = 70\,GPa$

$P = +6\,kN$, ($Q = 42\,kN$ ↓)

$Q = -42\,kN$

$A_{AB} = \frac{\pi}{4} d_{AB}^2 = \frac{\pi}{4} \times (0.020)^2 = 314.16\,mm^2$

$A_{BC} = \frac{\pi}{4} d_{BC}^2 = \frac{\pi}{4} \times (0.060)^2 = 2.8274 \times 10^{-3}\,m^2 = 2827.4\,mm^2$

stress in $AB = \frac{P}{A_{AB}} = \frac{(6 \times 10^3)\,N}{314.16 \times 10^{-6}\,(m^2)} = 19.09 \times 10^6\,Pa$

$= 19.09\,MPa$

Stress in $BC = \frac{(P+Q)}{A_{BC}} = \frac{(-36 \times 10^3)\,N}{(2827.4 \times 10^{-6})\,m^2} = -12.73\,MPa$

$= 12.73\,MPa$ (in downward direction)

δ_{AB} = deformation in $AB = \frac{P_{AB} \times 0.4}{A_{AB} \times E} = \frac{(6 \times 10^3 \times 0.4)}{(314.16 \times 10^{-6}) \times (70 \times 10^9)}\,m$

$\delta_{AB} = 0.1091\,mm$

δ_{BC} = deformation in $BC = \frac{(P+Q) \times 0.5}{A_{BC} \times E} = \frac{-36 \times 10^3 \times 0.5}{(2827.4 \times 10^{-6}) \times (70 \times 10^9)}$

$\delta_{BC} = -0.0909\,mm$

$\delta_{net} = \delta_{AB} + \delta_{BC} = 0.01819\,mm$

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