INDIAN INSTITUTE OF TECHNOLOGY KANPUR

DEPARTMENT OF AEROSPACE ENGINEERING

AE-675A INTRODUCTION TO FINITE ELEMENT METHOD

One Dimensional Code for Beam Bending Problem

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Beam Bending Plots

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# Sample inputs for boundary conditions

Enter number of elements: 1
Type of BC at ( x=0 ) (1 or 2): 1
Type of BC at ( x=1 ) (1 or 2): 2
Enter displacement: 0
Enter slope: 0
Enter force: 10
Enter moment: 10
Enter order of ( t ): 3
Enter coeff: 1
Enter coeff: 0
Enter coeff: 0
Enter coeff: 0
```

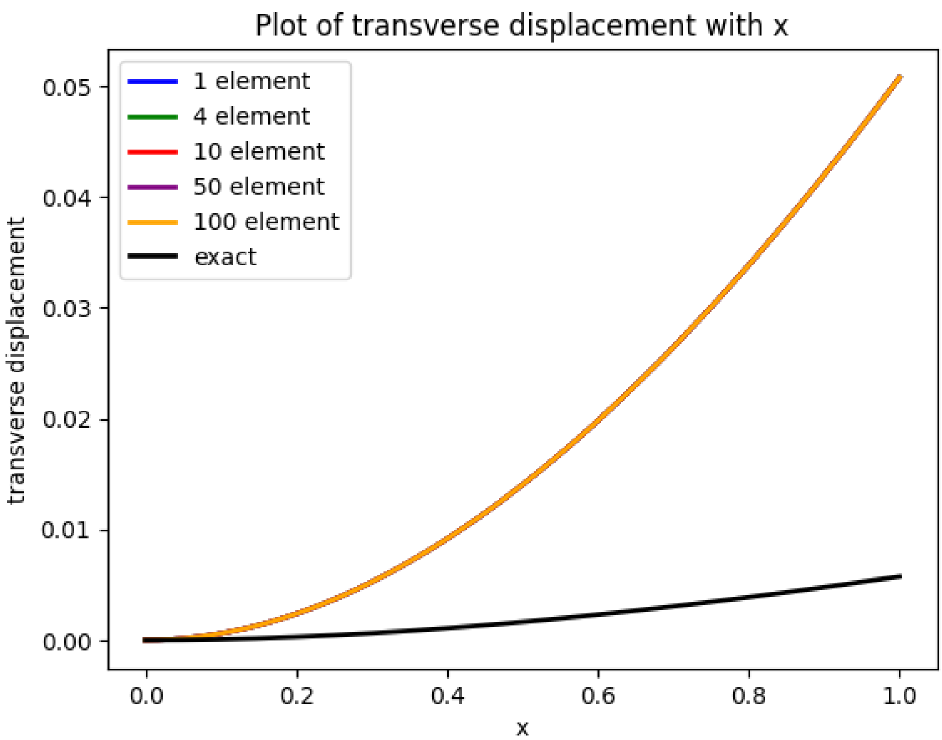

Figura 1: Variation of transverse displacement

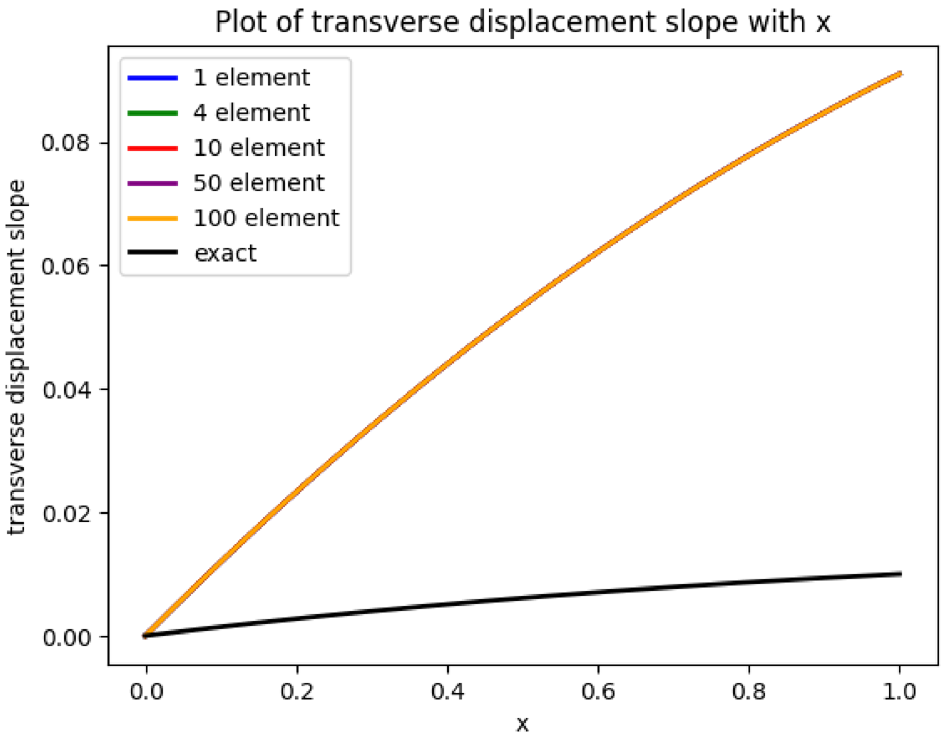

Figura 2: Variation of transverse displacement's slope

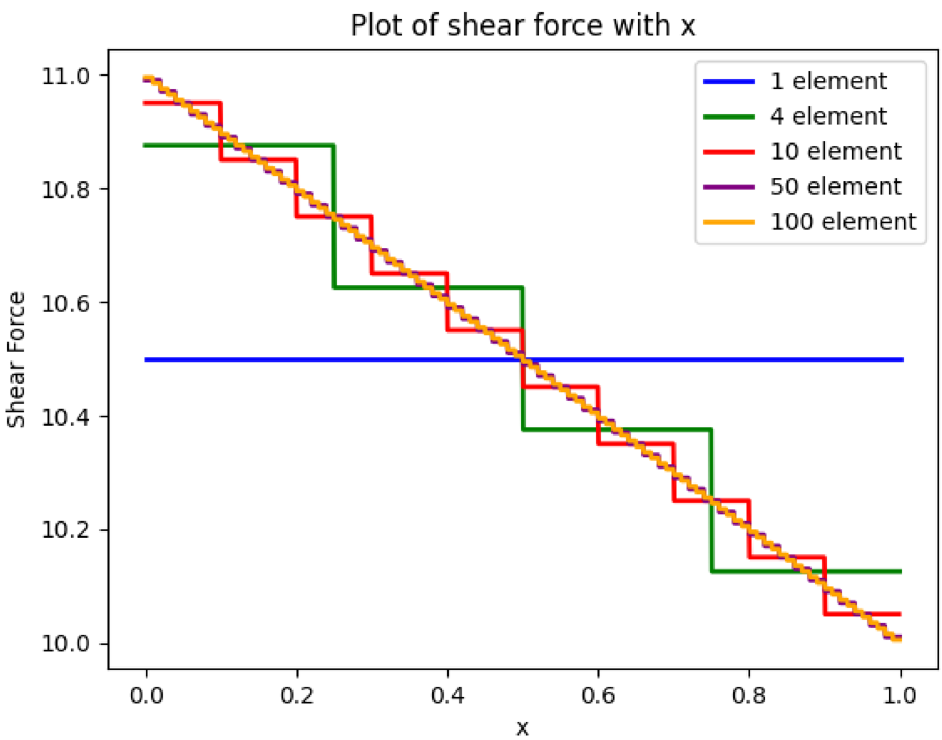

Figura 3: Variation of shear force

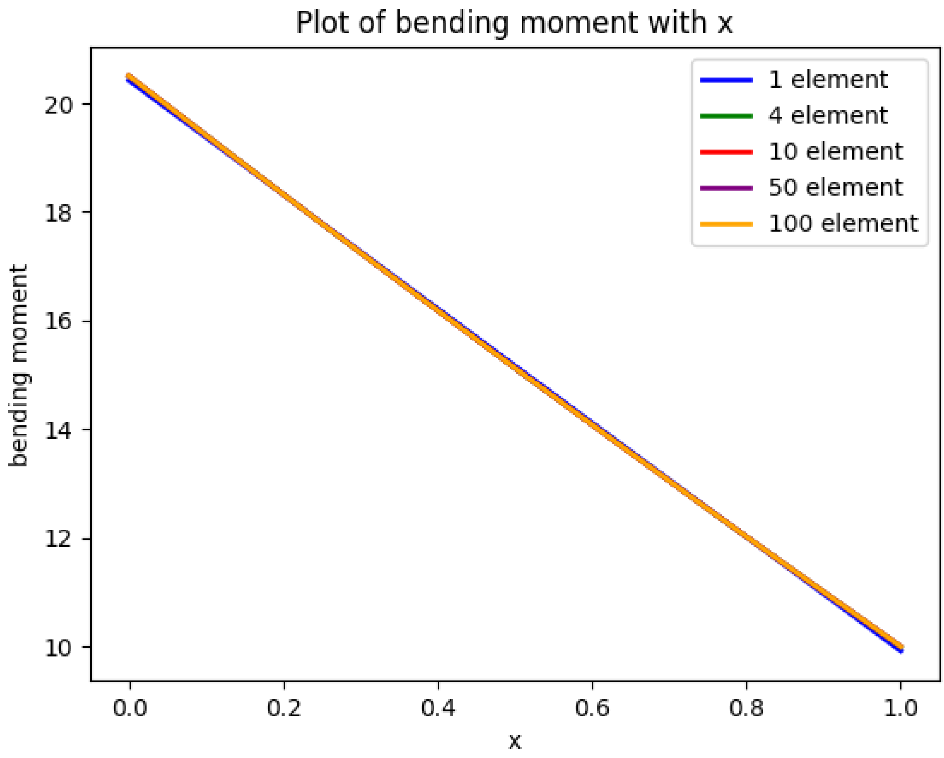

Figura 4: Variation of bending moment

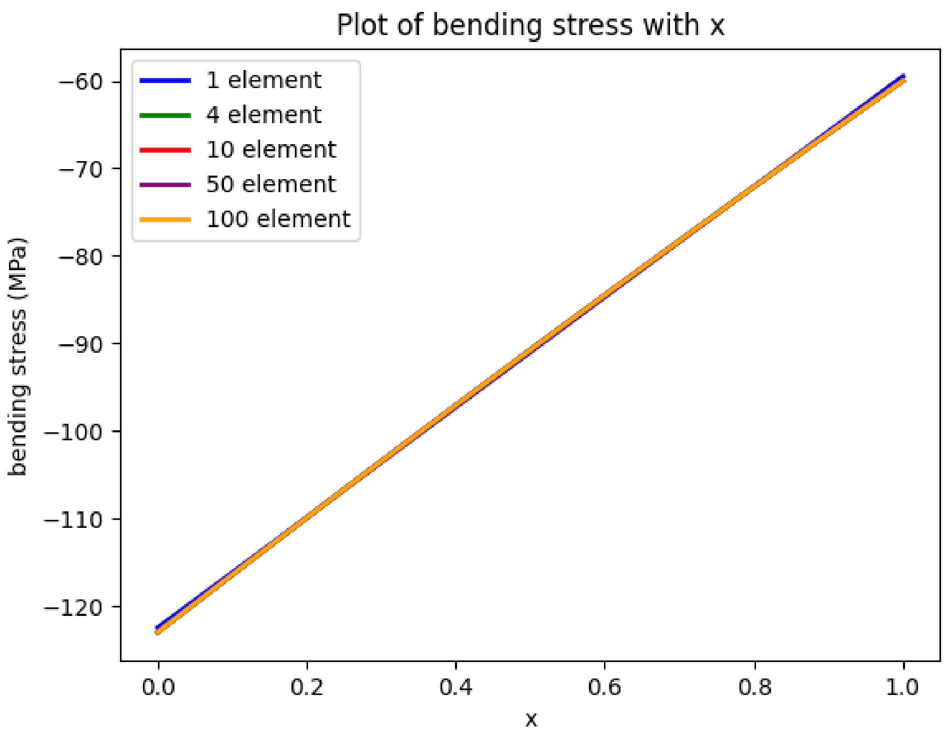

Figura 5: Bending stress on the top most line of beam along its entire length

Conclusion

When applying a constant force to the beam and plotting the exact solution, we observe a quartic function resulting from the Euler-Bernoulli beam bending theory. Using cubic Hermite polynomials to approximate this quartic function introduces some error, but as the number of elements increases, the approximation approaches the exact solution more closely.
Similarly, when considering the slope, the approximation moves from cubic polynomials to quadratic polynomials. This progression mirrors that of the deflection, with the approximation improving as the number of elements increases.
In contrast, when examining the moment curves, the quadratic curves are approximated by linear curves, resulting in minimal RMS error. However, beyond 10 elements, the difference in approximation becomes less noticeable.
For the shear force, which is linear, constant functions are used for approximation. As the number of elements increases, the approximation tends towards a sloped line, with the average value at the boundary of each element representing the value of the constant.