Readme file for the code of the 2D Truss Analysis for the static Case

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I am thankful to Dr. Vaibhav Singhal, Associate Professor in the Structural Engineering Department of the Indian Institute of Technology, Patna, who motivated me eminently to write the fully automated generalized code for the analysis of the 2D truss analysis.

Verification of the Code:

The code is validated using the question written in the book Fundamentals of the Finite Elements. Written by David Hutton. Example No. 3.2 of this book is used.

Question Details:

The two-element truss shown in the figure is subjected to external loading, as shown. Using the same node and element numbering as in Figure, determine the displacement components of node 3, the reaction force components at nodes 1 and 2, and the element displacements, stresses, and forces. The elements have a modulus of elasticity of $E1 = E2 = 10 * 10^6 lb/in^2$and cross-sectional areas of $A1 = A2 = 1.5in^2$.

- **For running this code Just Run the main File named as"Static Analysis of 2d Truss run this file"**.
- **Put all function file in the current Directory of the MATLAB**
- **You need to answer some questions that are :**
  1. **Enter the type of the element which you want to analyse:-(enter in lower case letter)**

     linear

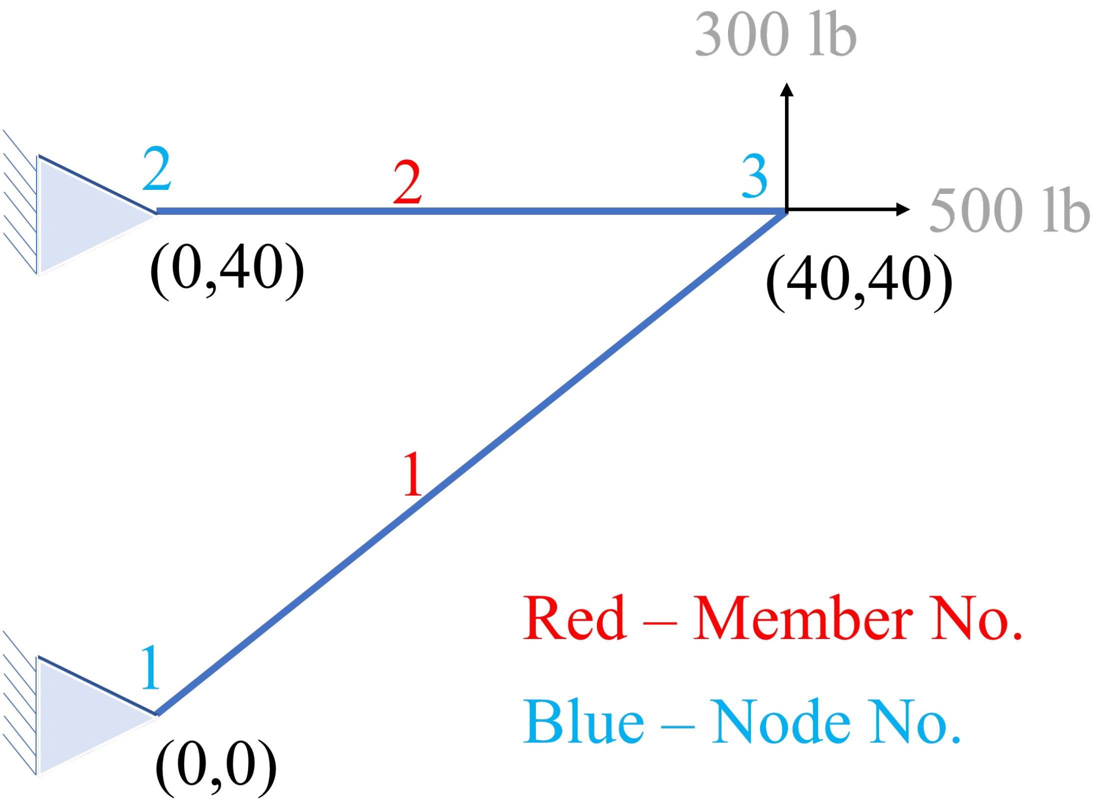

Fig. 1. Figure. 2D Truss

2. **Enter or Choose an option (Homework Question** 1 **and** 2 **for standard example solved,Example** 3.2 **of the book David Hutton (Fundamental of finite element analysis) for custom data press any numeric value other than the** $(1, 2, 3))$:

   Answer-

   3, solving the standard example: 3.000000

Steps for using this code of the any generalized Truss problem are: You need to answer these Questions.

- **Q1. Enter the type of the analysis which you want to analysis:-(enter in lower case letter)**

  Answer - linear

  Enter or Choose an option (Homework Question 1 **and** 2 **for standard example solved,Example** 3.2 **of the book David Hutton (Fundamental of finite element analysis) for custom data press any numeric value other than the** $(1, 2, 3))$:

Answer- 4

solving the standard example: 4.000000

Format of the node data is like Node Number Dof X X Coor Dof Y Y Coor

Q3. Enter the value of the node data with all assigned degree of freedom:

Answer-

$$\begin{matrix} 1 & 1 & 0 & 2 & 0 \\ 2 & 3 & 0 & 4 & 40 \\ 3 & 5 & 40 & 6 & 40 \end{matrix} \quad \text{node} = \begin{matrix} 1 & 1 & 0 & 2 & 0 \\ 2 & 3 & 0 & 4 & 40 \\ 3 & 5 & 40 & 6 & 40 \end{matrix}$$

Format of the connectivity matrix for the element data is like [Element Number, beginning node(i,:), end node(j,:)]

Q4. First Enter the name of the member then the enter the beginning node and the end node of the member :

$$\begin{matrix} 1 & node(1,:) & node(3,:); \\ 2 & node(2,:) & node(3,:) \end{matrix}$$

$$\begin{matrix} ElemntNo. & Nodei & Dof_X & X_Coor & Dof_Y & Y_Coor & Nodej & Dof_X & X_Coor & Dof_Y & Y_Coor \end{matrix}$$

$$\text{elem} = \begin{matrix} 1 & 1 & 1 & 0 & 2 & 0 & 3 & 5 & 40 & 6 & 40 \\ 2 & 2 & 3 & 0 & 4 & 40 & 3 & 5 & 40 & 6 & 40 \end{matrix}$$

Q5. Enter the Young's Modulus of Elasticity of each member in the form of the column vector:

Answer: 10*10^6 10*10^6

Q6. Enter the Cross-sectional Area of each member in the form of the column

vector:

Answer: 1.5 1.5

Q7. Enter the applied Force at the each node in the form of the column vector:

Answer: 0 0 0 0 500 300

Q8. Enter support conditions: 1. **Pinned**

2. **Roller**

3. **Free**

Enter support type for Node 1 (1**-Pinned,** 2**-Roller,** 3**-None):** 1

Enter support type for Node 2 (1**-Pinned,** 2**-Roller,** 3**-None):** 1

Enter support type for Node 3 (1**-Pinned,** 2**-Roller,** 3**-None):** 3

Answer -

Support Conditions:

Node 1 - Pinned

Node 2 - Pinned

Node 3 - None

Performing truss analysis...

Numerical Solutions. . .

- **Member No:** 1

  Member Length: 56.57

  cos(θ): 0.7071

  Sin(θ): 0.7071

  Stress: 282.8427

  Strain: $0.282842712474619 * 10^{-4}$

  Member Force: 424.2641

  ....

- **Member No:** 2

  Member Length: 40.00

  Cos(θ): 1.0000

  Sin(θ): 0.0000

  Stress: 133.3333

  Strain: $0.133333333333333 * 10^{-4}$

  Member Force: 200.0000

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References

Hutton, D. (2004). *Fundamentals of finite element analysis*. McGraw-Hill. Retrieved from https://books.google.co.in/books?id=CV2HLsuNMtsC

Inc., T. M. (2023). *Matlab version: 9.14.0 (r2023a).* Natick, Massachusetts, United States: Author Retrieved from https://www.mathworks.com

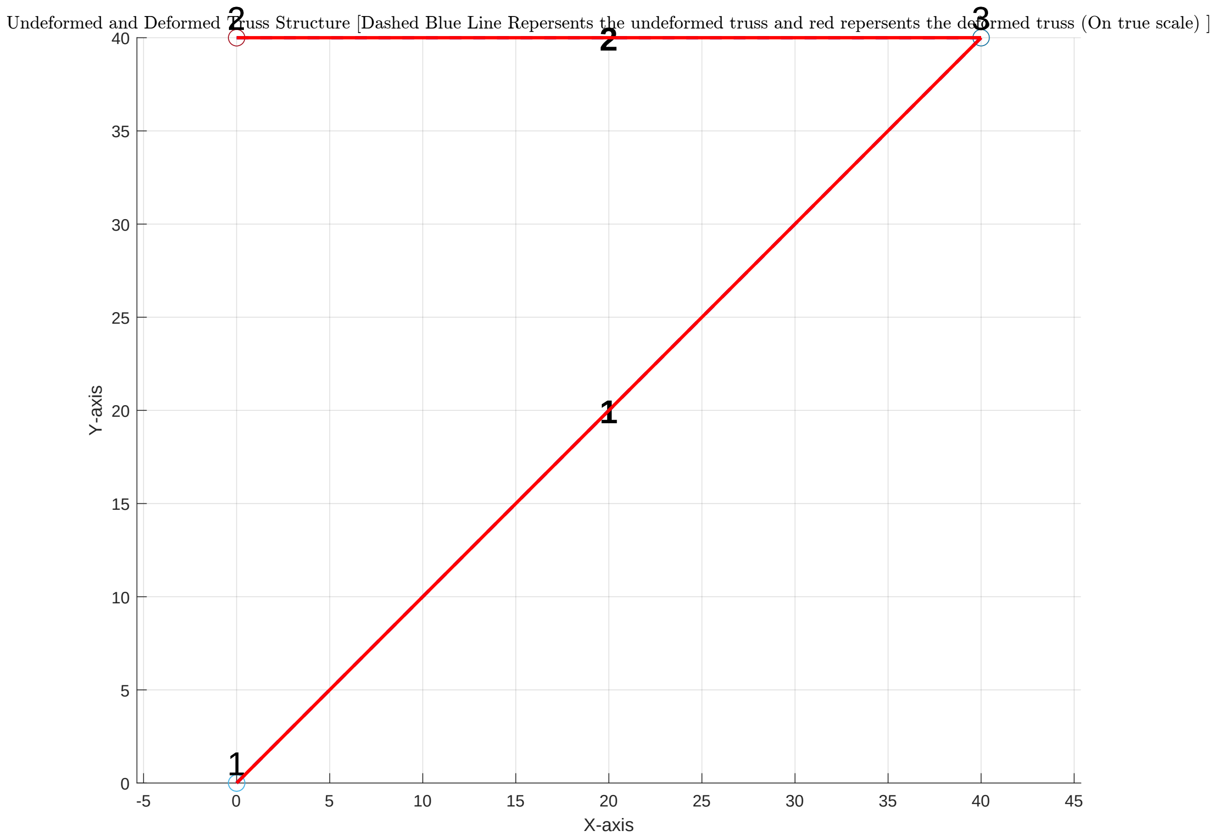

Fig. 2. Figure. 2D Truss

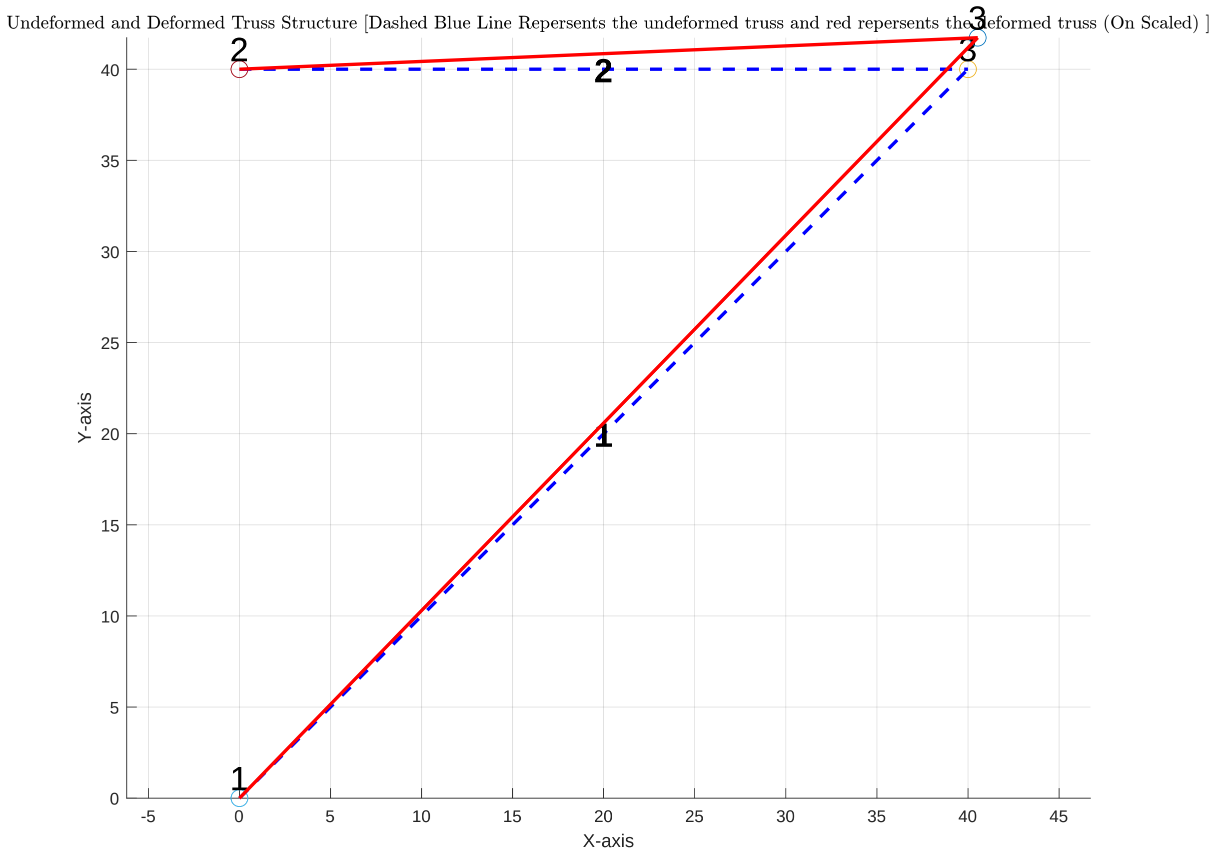

Fig. 3. Figure. 2D Truss

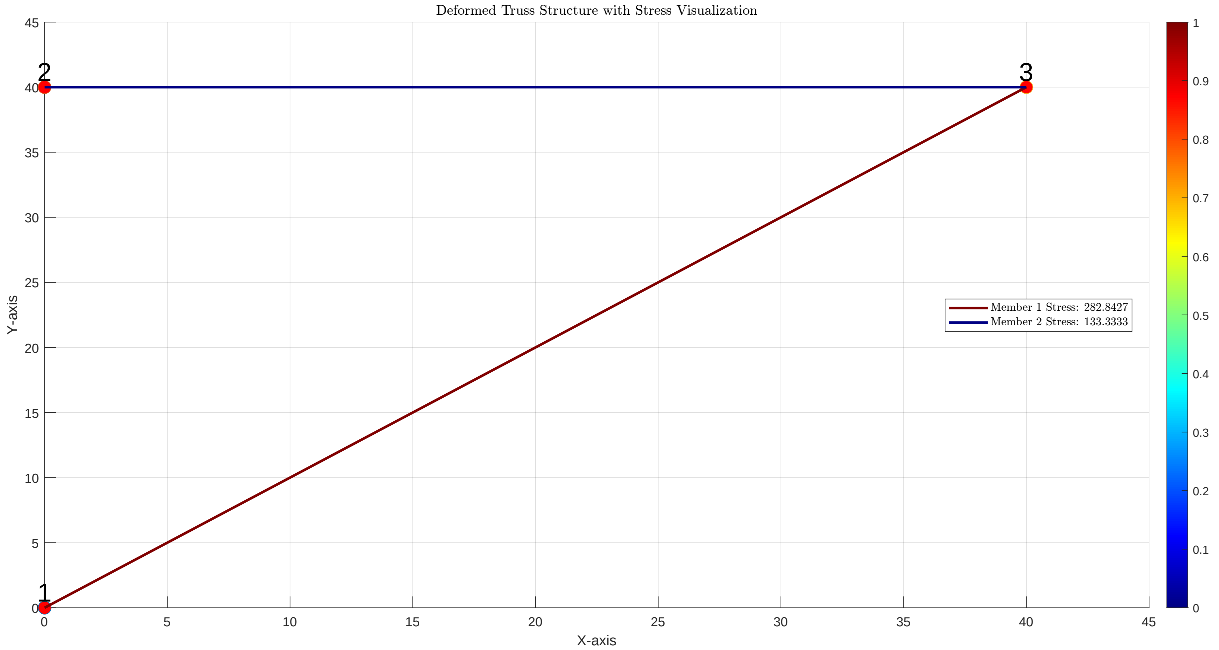

Fig. 4. Figure. 2D Truss

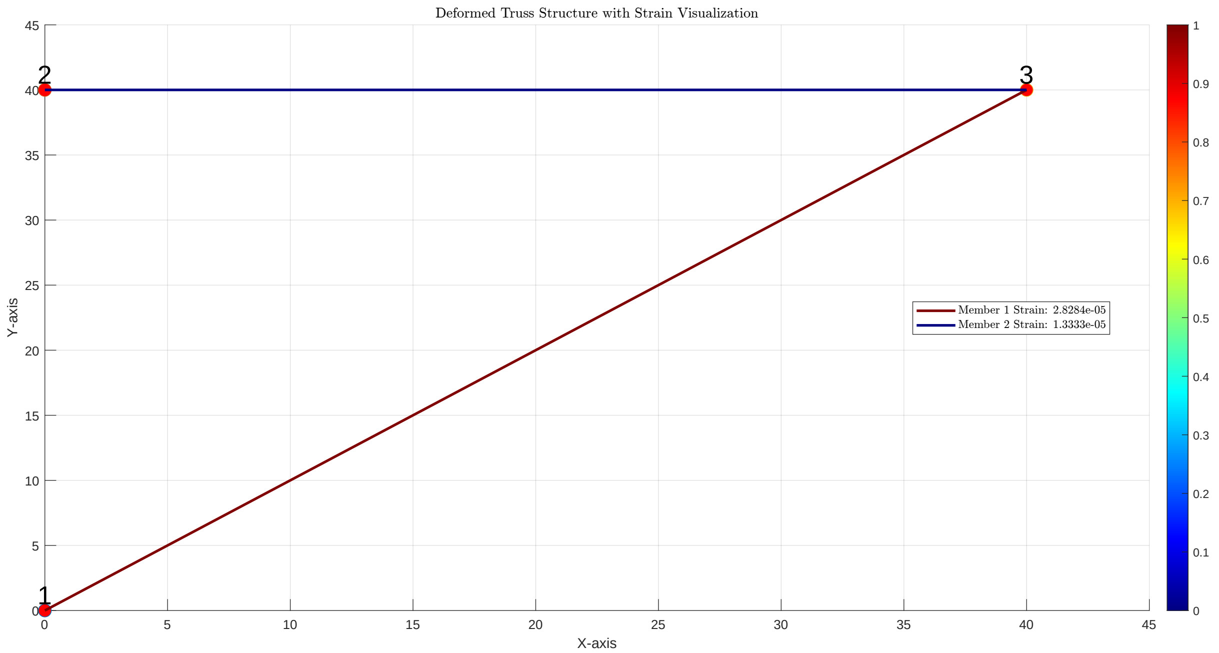

Fig. 5. Figure. 2D Truss

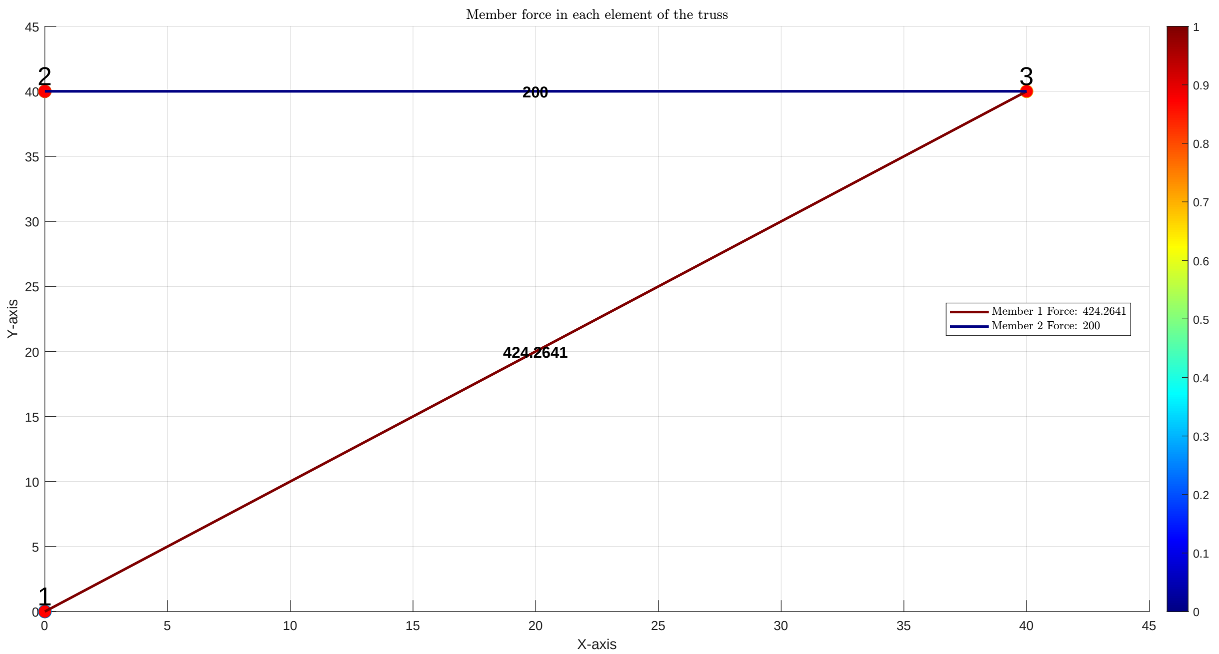

Fig. 6. Figure. 2D Truss