Answer Sheet Introduction to FEM

Practical 1, Group: …

|  |  |
| --- | --- |
| **Student name** | **Student number** |
|  |  |

**Before you start, read the practical preparation manual carefully!**

**Only fill in the answers for nodes and elements that apply to your specific problem. This answer sheet may contain more elements/nodes than needed.**

**1.** Determine the displacements and reaction forces in the nodes.

|  |  |  |  |
| --- | --- | --- | --- |
| **node** | ***ux* [mm]** | | ***uy* [mm]** |
| 1 |  |  | |
| 2 |  |  | |
| 3 |  |  | |
| 4 |  |  | |
| 5 |  |  | |
| 6 |  |  | |
| 7 |  |  | |

|  |  |  |  |
| --- | --- | --- | --- |
| **node** | ***Fx* [kN]** | | ***Fy* [kN]** |
| 1 |  |  | |
| 2 |  |  | |
| 3 |  |  | |
| 4 |  |  | |
| 5 |  |  | |
| 6 |  |  | |
| 7 |  |  | |

**2a.** Check whether the sum of the forces equals zero (display the entire equation!).

|  |  |  |
| --- | --- | --- |
| **sum** | **equation** | **[kN]** |
|  |  |  |
|  |  |  |

**2b.** Check whether the sum of the moments equals zero (display the entire equation!).

|  |  |  |
| --- | --- | --- |
| **sum** | **equation** | **[kNm]** |
|  |  |  |

The truss forces can be calculated in two different ways to determine whether the results are correct.

**3a.** Determine the elongation of the truss elements. Use the rotation matrices to rotate the element deformations into the local coordinate system.

|  |  |
| --- | --- |
| **elem.** | **[mm]** |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |

|  |  |
| --- | --- |
| **elem.** | **[mm]** |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |

|  |  |
| --- | --- |
| **elem.** | **[mm]** |
| 10 |  |
| 11 |  |
| 12 |  |
| 13 |  |

**3b.** Redo the calculation of question 3a using the initial and final coordinates of the nodes and the Pythagoras rule.

|  |  |
| --- | --- |
| **elem.** | **[mm]** |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |

|  |  |
| --- | --- |
| **elem.** | **[mm]** |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |

|  |  |
| --- | --- |
| **elem.** | **[mm]** |
| 10 |  |
| 11 |  |
| 12 |  |
| 13 |  |

**3c.** The answers of questions 3a and 3b are different. Using rotation matrices, the elongations are slightly off. Explain why:

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**3d.** Calculate the strains using the elongations from question 3a.

|  |  |
| --- | --- |
| **elem.** | **[-]** |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |

|  |  |
| --- | --- |
| **elem.** | **[-]** |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |

|  |  |
| --- | --- |
| **elem.** | **[-]** |
| 10 |  |
| 11 |  |
| 12 |  |
| 13 |  |

**3e.** Determine the stresses using the strains from question 3d.

|  |  |
| --- | --- |
| **elem.** | **[MPa]** |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |

|  |  |
| --- | --- |
| **elem.** | **[MPa]** |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |

|  |  |
| --- | --- |
| **elem.** | **[MPa]** |
| 10 |  |
| 11 |  |
| 12 |  |
| 13 |  |

**3f.** Determine the truss forces using the stresses from question 3e.

|  |  |
| --- | --- |
| **elem.** | **[kN]** |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |

|  |  |
| --- | --- |
| **elem.** | **[kN]** |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |

|  |  |
| --- | --- |
| **elem.** | **[kN]** |
| 10 |  |
| 11 |  |
| 12 |  |
| 13 |  |

**4a.** Determine the truss forces using the local stiffness matrix and the local displacement vectors using MATLAB.

|  |  |
| --- | --- |
| **elem.** | **[kN]** |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |

|  |  |
| --- | --- |
| **elem.** | **[kN]** |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |

|  |  |
| --- | --- |
| **elem.** | **[kN]** |
| 10 |  |
| 11 |  |
| 12 |  |
| 13 |  |

**4b.** Do the answers of questions 3f and 4a agree? Why does that make sense?

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