Please answer total 3 questions by selecting the optional items (a or b). Note: Only one item for each question must be answered.

**Question 1.** In this question, the beams are IPE400 and columns are IPB260.

IPE400: \( h=400 \ b=180 \ s=8.6 \ t=13.5 \ F=84.5 \ cm^2 \ h-2c=331 \\
IPB260: \ h=260 \ b=260 \ s=10 \ t=17.5 \ F=118 \ cm^2 \\

a) In the beam column connection given in the following figure, beam is connected to the plate with 15x220x620 dimensions. The flange of the beam is connected by using the groove weld and the web of the beam is connected by using the fillet weld. The plate is connected to the column by using 8 M24 bolts (\( d=25 \ d_1=25 \)). The internal forces at point “A” are \( M=-50 \ kNm \), \( Q=100 \ kN \) and \( N=20 \ kN \). Check the connection elements (bolts and welds) under these internal forces. Please consider the strength losses at the end of welding. (M24 tension area: 3.17 cm²)

b) In the beam column connection given in the following figure, the beam is connected to the plates with bolts. The plates are connected to the column with welding. The dimensions of flange plates are 15x180x340 and they are connected to the column with groove weld. Each flange plate is connected to the beam by using 8 M24 (\( d=25 \ d_1=25 \)) bolts. The dimension of web plate is 15x120x220 and it is connected to the column with fillet weld. It is also connected to the beam by using 3 M24 bolts. The internal forces at point “A” are \( M=-80 \ kNm \), \( Q=100 \ kN \) and \( N=19 \ kN \). Check the connection elements (bolts and welding) under these internal forces. Please consider the strength losses at the end of welding. (M24 tension area: 3.17 cm²)
**Question 2.**

a) A tube section beam with 30cmx35cm dimensions is connected to a tube section column with a filled weld applied throughout the section as shown in the figure. The thickness of the welding is 6 mm. Check the welding group under the given loading condition. Please assume that, the internal forces are transferred by all parts of the welding group. Note: The loads are applied at geometrical center of the section.

![Diagram of a tube section beam connected to a tube section column with applied loads and welding](image)

b) A new tube element part is added at the end of the beam given in the first item and the following load is applied at the end of the element. Check the welding group under the given loading condition. Please assume that, the internal forces are transferred by all parts of the welding group. Note: The load is applied at geometrical center of the section.

![Diagram of a tube section beam with additional load and welding](image)
Question 3.

In this question, splice details for tension elements are presented. Please calculate the maximum force which tension elements can bear. After that, check the connection elements (bolts and welds) under 300 kN tension force.

a) The beam sections are IPE400 and are connected to plates with groove welds on flanges and fillet welds on the webs. The plates are connected to each other by using M24 bolts (d=25 d1=25). Please consider the strength losses at the end of welding. (M24 tension area: 3.17 cm$^2$)

a) The beam sections are IPE400 and are connected to each other by using flange plates with 15x180x320 dimensions and web plates with 12x300x180 dimensions. The beams and plates are connected with M24 bolts (M24 tension area: 3.17 cm$^2$).
Question 4.

A tube section beam with 1m length is connected to a plate with 20x270x370 dimensions. The plate is connected to a reinforced concrete column by using M24 bolts (d=25 d1=25).

a) Check the bolts under the 5kNm torsional moment affected at the end of the beam as shown in the following figure.

![Figure showing torsional moment](image1.png)

a) Check the bolts under the 5kN vertical force affected at the end of the beam as shown in the following figure.

![Figure showing vertical force](image2.png)

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Allowable Stress for Steel
\[ \sigma_{em} = 14 \text{ kN/cm}^2 \]

Allowable stress for welding
\[ \tau_{k,em} = 11kN / cm^2 \]

Allowable stress values for bolt
\[ \sigma_{z,em} = 14 \text{ kN/cm}^2 \]
\[ \tau_{em} = 14 \text{ kN/cm}^2 \]
\[ \sigma_{em} = 11.2 \text{ kN/cm}^2 \]

Exam time is 120 min.
We wish you success.

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