



UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
JULY 2025 SEMESTER SESSION

SUBJECT CODE	: LMB22902
SUBJECT TITLE	: MECHANICS OF MATERIALS
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	: BACHELOR OF MARINE ENGINEERING TECHNOLOGY WITH HONOURS
TIME / DURATION	: 09.00 AM – 11.30 AM (2.5 HOURS)
DATE	: 22 DECEMBER 2025

INSTRUCTIONS TO CANDIDATES

1. Please **CAREFULLY** read the instructions given in the question paper.
 2. This question paper has information printed on both sides of the paper.
 3. This question paper consists of **ONE (1)** section **ONLY**; Section A.
 4. Answer **FOUR (4)** questions **ONLY** in Section A.
 5. Please write your answers on the answer booklet provided.
 6. Answer should be written in blue or black ink except for sketching, graphics and illustration.
 7. Answer all questions in English language **ONLY**.
 8. Appendixes have been appended for your references.
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THERE ARE 5 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 100 marks)

INSTRUCTION: Answer FOUR (4) questions only.

Please use the answer booklet provided.

Question 1

With reference to the mechanical properties of materials;

- (a) Figure 1 shows part of a control linkage of an airplane having a rigid member CBD and a flexible cable AB. Originally the cable was unstretched. A force is applied to the end D of the member and causes a normal strain in the cable of 0.0035 mm/mm. Calculate the displacement of point D.

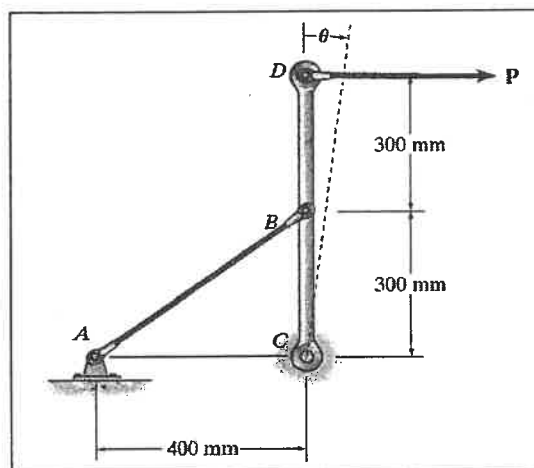


Figure 1

(10 marks)

- (a) The lap joint is connected using a 30 mm diameter bolt. The bolt is made from materials having a shear stress-strain diagram as shown in Figure 2. Determine the shear strain developed in the shear plane of the bolt when $P = 340 \text{ kN}$.

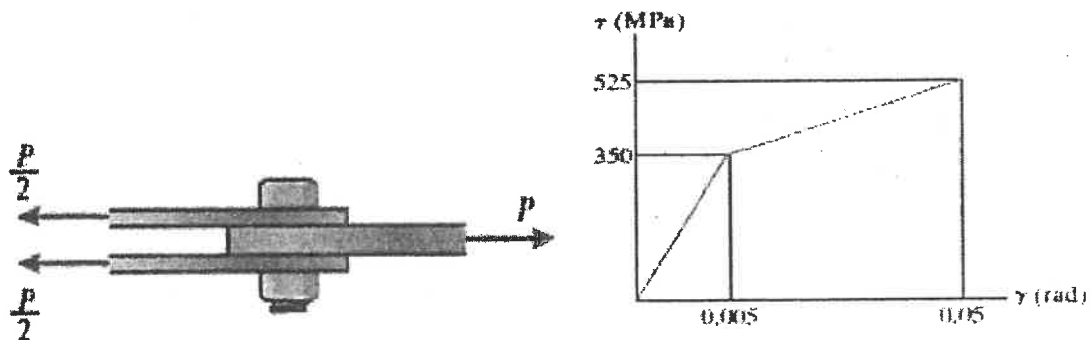


Figure 2

(15 marks)

Question 2

With reference to the mechanical properties of materials;

- (a) A specimen is originally 300 mm long, has a diameter of 12 mm and is subjected to a force of 2.5 kN. The force increased from 2.5 kN to 9 kN, resulting in the specimen elongating to 0.225 mm. Evaluate,
- the stress and strain of the specimen. (4 marks)
 - the modulus of elasticity for the material if it remains linear elastic. (6 marks)
- (b) A diagram of an elastic composite fiberglass boat that is made of polyester and fiberglass is shown in Figure 3.
- Define the modulus of elasticity, modulus of toughness and modulus of resilience. (6 marks)
 - Calculate the modulus of elasticity of the composite fibers. (3 marks)
 - Calculate the modulus of toughness of the composite fibers. (3 marks)
 - Calculate the modulus of resilience of the composite fibers. (3 marks)

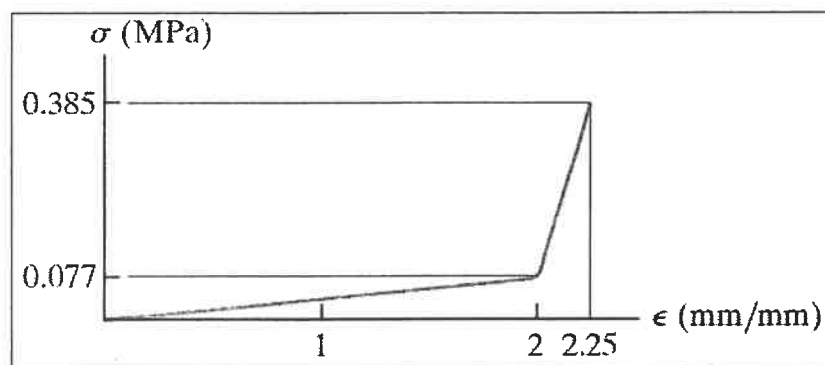


Figure 3

Question 3

With reference to the concept of axial load;

- (a) Figure 4 shows a bar with dimensions in mm subjected to a tension force of $P = 8 \text{ kN}$. Calculate the maximum normal stress developed in the bar. (Refer to *Appendix A*).

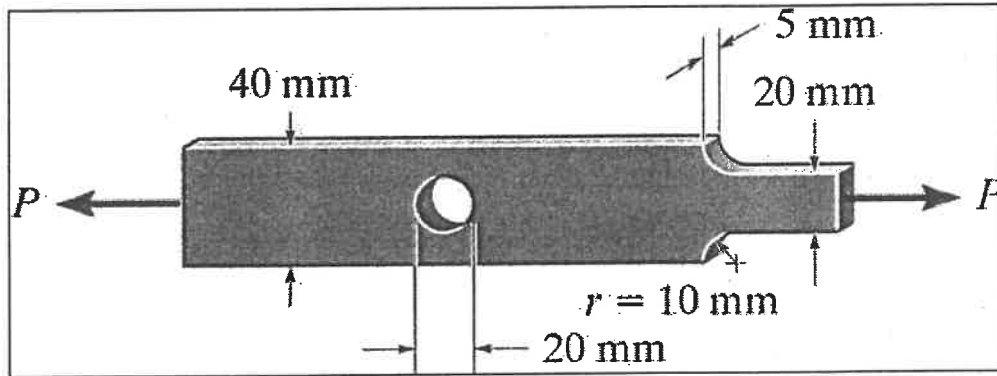


Figure 4

(10 marks)

- (b) The 12 m long A-36 steel rails on a train track are laid with a small gap between them to allow for thermal expansion as shown in Figure 5. The cross-sectional area of each rail is 3200 mm^2 . Temperature is increased from $T_1 = -30 \text{ }^\circ\text{C}$ to $T_2 = 30 \text{ }^\circ\text{C}$, calculate;
- the required gap, δ so that the rails just touch one another. (6 marks)
 - the axial force in the rails if the temperature were to rise to $T_3 = 40 \text{ }^\circ\text{C}$. (use gap in (a)). (9 marks)

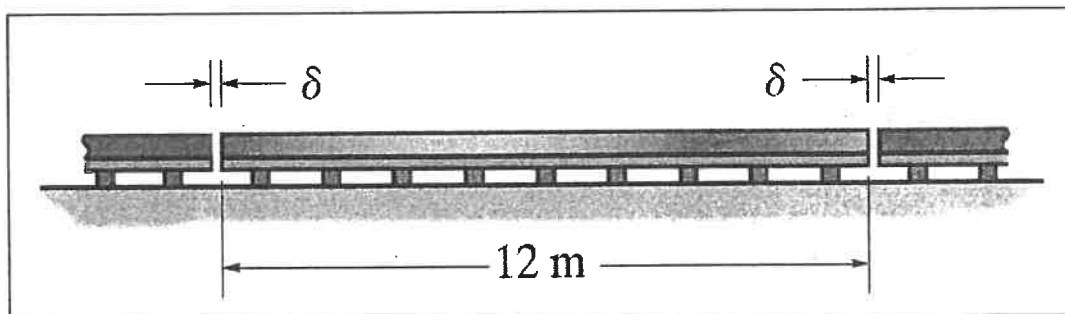


Figure 5

Question 4

With reference to the concept of stress, strain, axial load, bending and torsion;

- (a) The propeller of a ship is connected to an A-36 steel shaft that is 60 m long and has an outer diameter of 340 mm and an inner diameter of 260 mm. If the power output is 4.5 MW when the shaft rotates at 20 rad/s, determine
- the maximum torsional stress in the shaft (6 marks)
 - angle of twist. (4 marks)
- (b) Figure 6 shows the journal bearing at A and B only support vertical forces that are subjected to the concentrated forces with allowable bending stress is $\sigma_{\text{allow}} = 150\text{MPa}$.
- Calculate and sketch shear and moment diagrams. (10 marks)
 - Determine the smallest allowable diameter of the shaft. (5 marks)

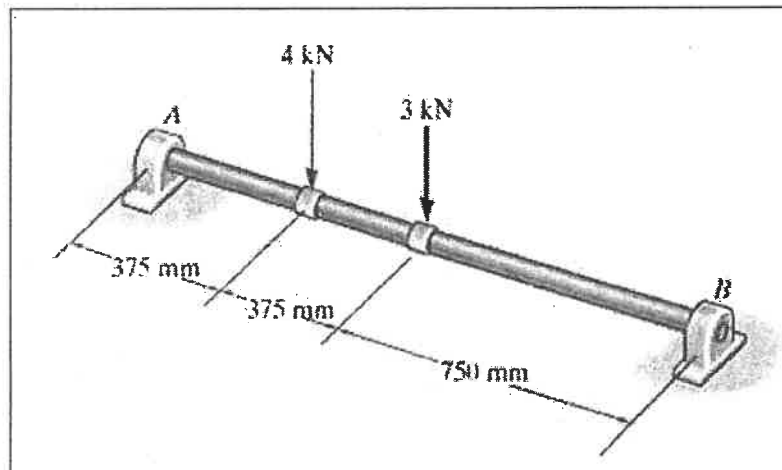


Figure 6

Question 5

With reference to the concept of stress, strain, axial load, bending and torsion.

- (a) Figure 7 shows the propeller of a ship connected to an A-36 steel shaft that is 60 m long and has an outer diameter of 340 mm and an inner diameter of 260 mm. If the power output is 4.5 MW when the shaft rotates at 20 rad/s, determine
- the maximum torsional stress in the shaft. (6 marks)
 - angle of twist. (4 marks)

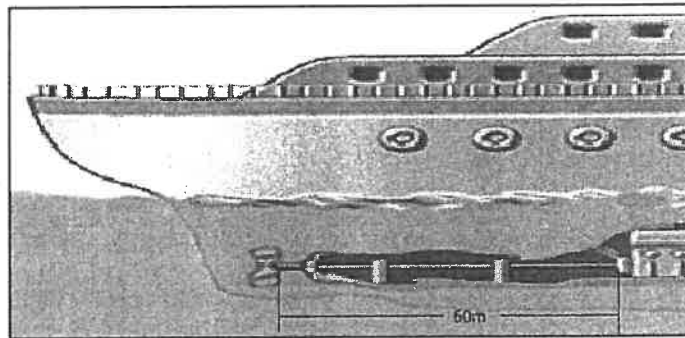


Figure 7

- (a) Figure 8 shows bearings at A and D exert only vertical reaction on the shaft. Loading is applied to the pulleys at B (360 N) and C (500 N) and E (160 N).
- determine the shear force and bending moment. (5 marks)
 - sketch the moment diagrams of the shaft. (10 marks)

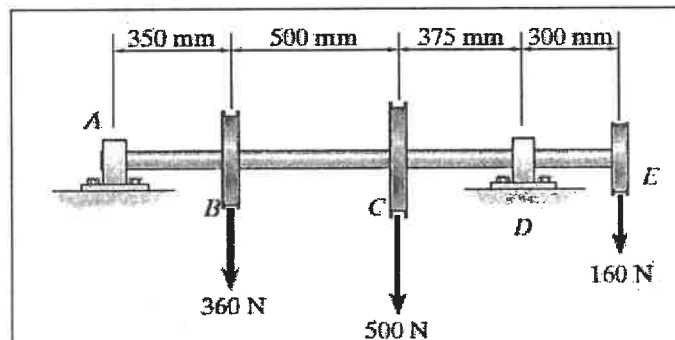
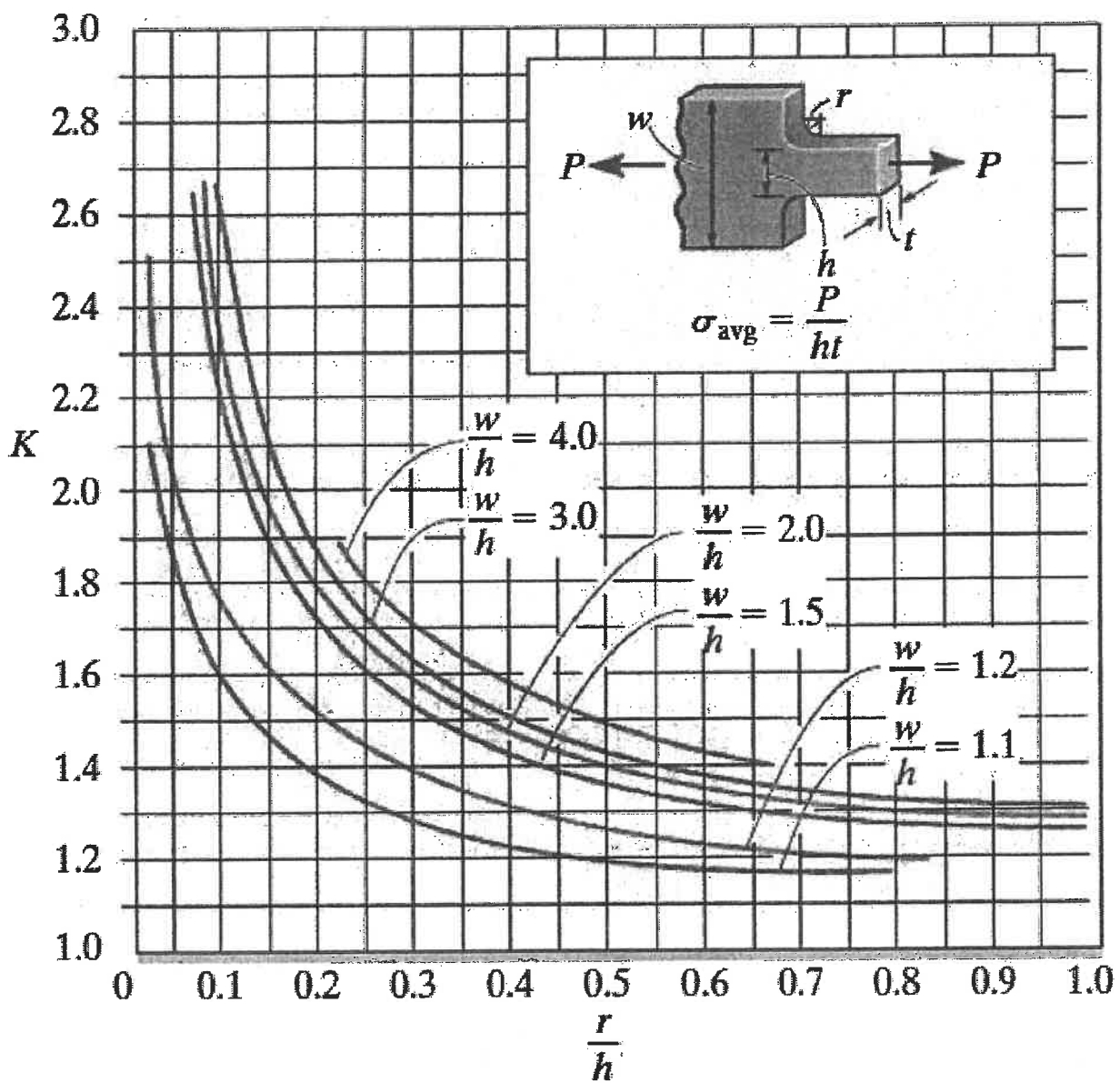
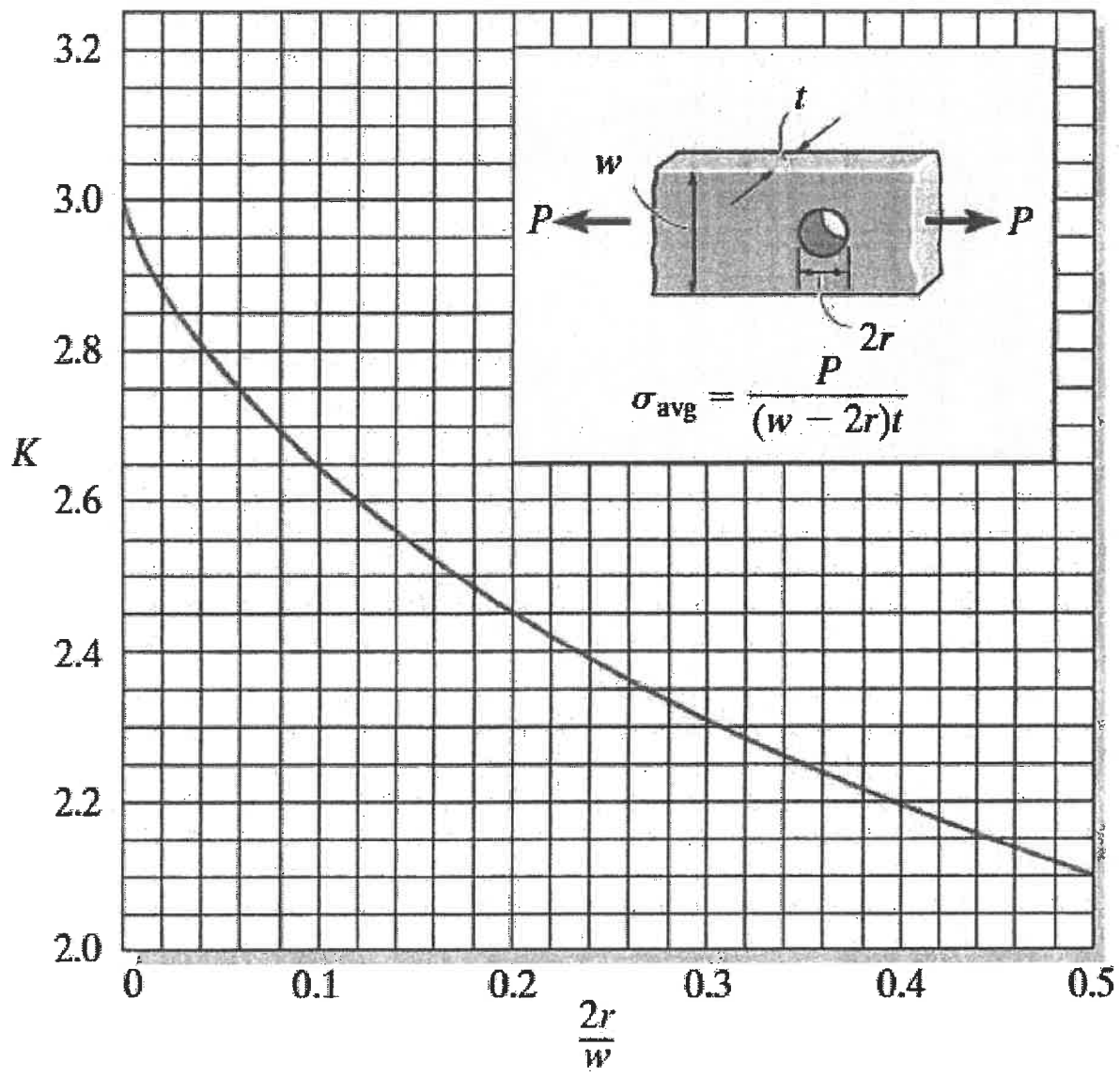


Figure 8

END OF EXAMINATION PAPER

Appendix A





Appendix B

Average Mechanical Properties of Typical Engineering Materials^a (SI Units)

Materials	Density ρ (Mg/m ³)	Modulus of Elasticity E (GPa)	Modulus of Rigidity G (GPa)	Yield Strength (MPa)		Ultimate Strength (MPa)		% Elongation in 50 mm specimen	Poisson's Ratio ν	Coef. of Therm. Expansion α (10 ⁻⁶ /°C)
				Tens.	Comp. ^b	Tens.	Comp. ^b			
Metallic										
Aluminum <input type="checkbox"/> 2014-T6	2.79	73.1	27	414	414	469	469	10	0.35	23
Wrought Alloys <input type="checkbox"/> 6061-T6	2.71	68.9	26	295	255	290	290	12	0.35	24
Cast Iron <input type="checkbox"/> Gray ASTM 20	7.19	67.0	27	-	-	179	669	0.6	0.28	12
Alloys <input type="checkbox"/> Malleable ASTM A-197	7.28	172	68	-	-	276	572	5	0.26	12
Copper <input type="checkbox"/> Red Brass C83400	8.74	101	37	70.0	70.0	241	241	35	0.35	18
Alloys <input type="checkbox"/> Bronze C86100	8.83	103	38	345	345	655	655	20	0.34	17
Magnesium Alloy <input type="checkbox"/> [Amp 1034-T61]	1.83	44.7	18	152	152	276	276	1	0.30	26
Steel <input type="checkbox"/> Structural A-36	7.85	200	75	250	250	400	400	30	0.32	12
Alloys <input type="checkbox"/> Structural A992	7.85	200	75	345	345	450	450	30	0.32	12
Alloys <input type="checkbox"/> Stainless 304	7.86	193	75	207	207	517	517	40	0.27	17
Alloys <input type="checkbox"/> Tool L2	8.16	200	75	703	703	800	800	22	0.32	12
Titanium Alloy <input type="checkbox"/> [Ti-6Al-4V]	4.43	120	44	924	924	1,000	1,000	16	0.36	9.4
Nonmetallic										
Concrete <input type="checkbox"/> Low Strength	2.38	22.1	-	-	-	-	-	-	0.15	11
Concrete <input type="checkbox"/> High Strength	2.37	29.0	-	-	-	-	-	-	0.15	11
Plastic <input type="checkbox"/> Kevlar 49	1.45	131	-	-	-	717	483	2.8	0.34	-
Reinforced <input type="checkbox"/> 30% Glass	1.45	72.4	-	-	-	90	131	-	0.34	-
Wood <input type="checkbox"/> Douglas Fir	0.47	13.1	-	-	-	2.1 ^c	26 ^d	-	0.29 ^e	-
Select Structural <input type="checkbox"/> White Spruce	3.60	9.65	-	-	-	2.5 ^c	36 ^d	-	0.31 ^e	-
Grade:										

^a Specific values may vary for a particular material due to alloy or mineral composition, mechanical working of the specimen, or heat treatment. For a more exact value reference books for the material should be consulted.

^b The yield and ultimate strengths for ductile materials can be assumed equal for both tension and compression.

^c Measured perpendicular to the grain.

^d Measured parallel to the grain.

^e Deformation measured perpendicular to the grain when the load is applied along the grain.

