MECHANICAL POWER AND DRIVE EFFICIENCY

$$P = T \times \omega = \frac{2\pi N T}{60}$$

P = POWER (WATT)

T = TORQUE (N-m)

ω = RADIAN VELOCITY = $\frac{2\pi N}{60}$ (rad/s)

N = SPEED (RPM)

MECHANICAL EFFICIENCY OF MACHINE $= \eta = \frac{P_{OUT}}{P_{IN}} \times 100$

ph THE INPUT SHAFT OF A GEAR BOX ROTATES AT 1450 RPM AND TRANSMITS A TORQUE OF 65.9 N-m. THE OUTPUT SHAFT ROTATES AT 500 RPM AND TRANSMITS A TORQUE 143.3 N-m DETERMINE THE INPUT AND OUTPUT POWER AND EFFICIENCY OF THE DRIVE.

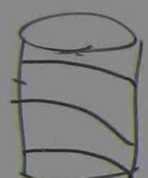
$$P_{IN} = \frac{2\pi N T}{60} = \frac{2 \times 3.1416 \times 1450 \times 65.9}{60} = 10{,}000 \text{ WATT}$$

$$P_{OUT} = \frac{2\pi N T}{60} = \frac{2 \times 3.1416 \times 500 \times 143.3}{60} = 7500 \text{ WATT}$$

$$\text{EFFICIENCY} = \frac{P_{OUT}}{P_{IN}} \times 100 = \frac{7500}{10{,}000} \times 100 = 75\%$$

GEAR DRIVES

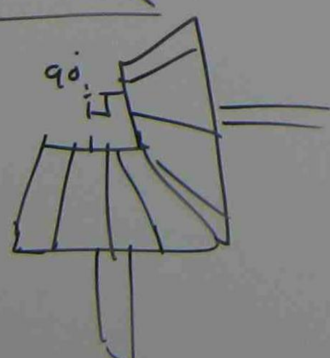
STRAIGHT TEETH → SPUR GEAR



HELICAL GEAR

BEVEL GEAR

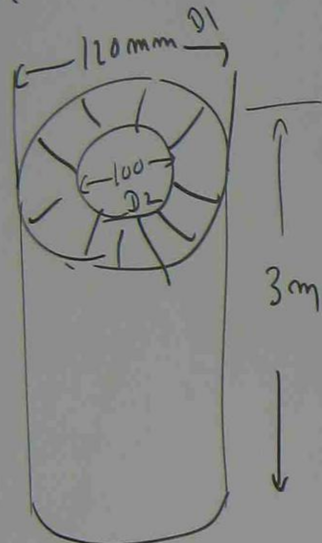
WORM GEAR



DENSITIES OF VARIOUS SOLIDS

MATERIAL	DENSITY (Kg/m^3)
ALUMINIUM	2780
ASBESTOS	3070
BALSA WOOD	160
BRASS	8250
BRICK	2080
BRONZE	8670
CAST IRON	7200
CONCRETE	2240
COPPER	8870
ICE	920
OREGON PINE TIMBER	530
RUBBER	920
SAND	1470
STEEL	7800
ZINC	7020

7) DETERMINE THE WEIGHT OF A TUBULAR STEEL COLUMN 120 mm OUTSIDE DIAMETER 100 mm INSIDE DIAMETER AND 3 m HIGH.



$$\text{STEEL COLUMN C.S.A} = \frac{\pi}{4} D_1^2 - \frac{\pi}{4} D^2$$

$$= 0.7854\left(D_1^2 - D_2^2\right)$$

$$= 0.7854\left(0.12^2 - 0.1^2\right)$$

$$\text{C.S.A} = 3.456 \times 10^{-3}\ m^3$$

$$\text{VOLUME} = \text{C.S.A} \times L$$

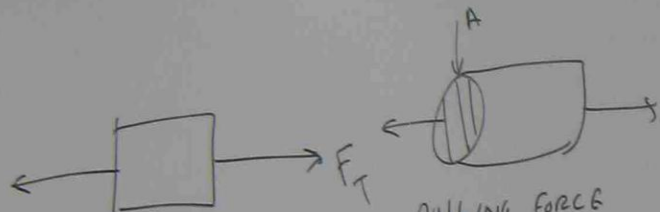
$$= 3.456 \times 10^{-3} \times 3 = 0.0104\ m^3$$

$$\text{MASS} = \text{VOLUME} \times \text{DENSITY} = 0.0104 \times 7800\ kg/m^3 = 80.86\ kg$$

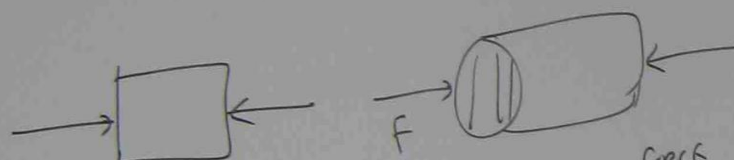
$$\text{WEIGHT} = \text{MASS} \times \text{GRAVITY} = 80.86 \times 9.81 = 793.3\ N$$

STRENGTH

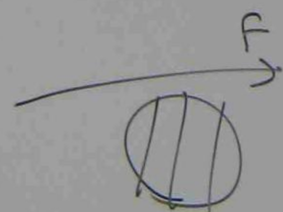
STRENGTH IS THE ABILITY OF THE MATERIAL TO WITHSTAND APPLIED FORCE WITHOUT FAILURE.



$$\text{TENSILE STRENGTH} = \frac{\text{PULLING FORCE}}{\text{C.SA}}$$



$$\text{COMPRESSIVE STRENGTH} = \frac{\text{COMPRESSIVE FORCE}}{\text{C.SA}}$$



$$\text{SHEAR STRENGTH} = \frac{\text{SHEAR FORCE}}{\text{C.S.A}}$$

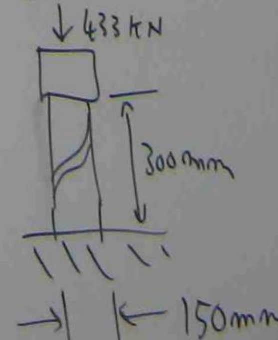
$$\text{ULTIMATE STRENGTH} = \frac{\text{MAXIMUM FORCE}}{\text{C.S.A}}$$

pb — A STEEL TEST SPECIMEN 10mm DIAMETER RUPTURED UNDER A TENSILE LOAD OF 37 KN. WHAT WAS THE ULTIMATE STRENGTH OF THE STEEL?

$$UTS = \frac{\text{MAXIMUM FORCE}}{\text{C.SA}}$$

$$= \frac{37 \times 10^3}{\frac{\pi}{4} \times (10)^2} = 471 \, N/mm^2$$

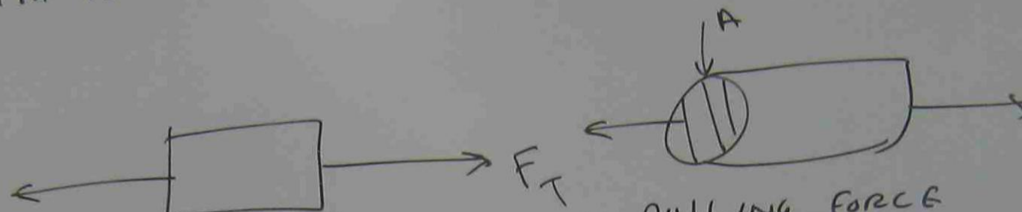
pb — A PORTABLE TESTING MACHINE FOR CARRYING OUT CRUSHING TESTS ON CONCRETE APPLIES A AXIAL FORCE OF 433 KN WHICH CAUSES COMPRESSION FAILURE IN A CONCRETE SPECIMEN, 150mm DIAMETER AND 300 mm HIGH. WHAT IS THE ULTIMATE COMPRESSIVE STRENGTH OF CONCRETE?



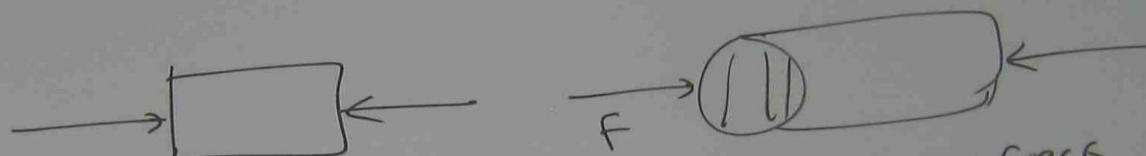
$$UTS = \frac{433 \, kN}{\frac{\pi}{4}(150)^2} = 24.5 \, N/mm^2$$

STRENGTH

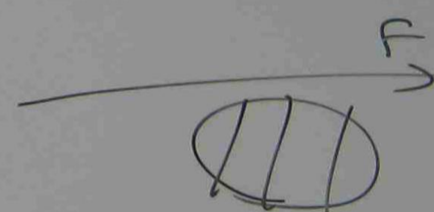
STRENGTH IS THE ABILITY OF THE MATERIAL TO WITHSTAND APPLIED FORCE WITHOUT



$$\text{TENSILE STRENGTH} = \frac{\text{PULLING FORCE}}{\text{C.SA}}$$



$$\text{COMPRESSIVE STRENGTH} = \frac{\text{COMPRESSIVE FORCE}}{\text{C.SA}}$$



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$$\text{ULTIMATE STRENGTH} = \frac{\text{MAXIMUM FORCE}}{\text{C.S.A}}$$

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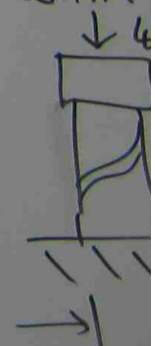

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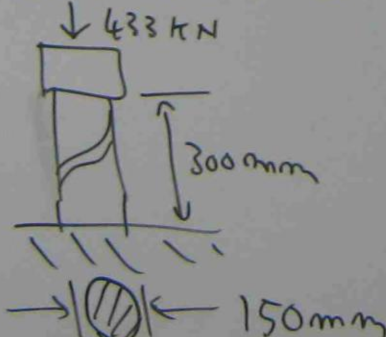

$$UTS = \frac{433\ kN}{\frac{\pi}{4}(150)^2} = 24.5\ N/mm^2$$