CIVIL ENGINEERING DEPARTMENT / MATERIALS SCIENCE AND ENGINEERING

Problem 2

Gold has a face-centered cubic (FCC) crystal structure with a lattice parameter (a) of 4.078 Å. The atomic weight of gold is 197 g/mol. Calculate the atomic radius (r) and theoretical density of gold.

Answers: $r = 1.4418 \times 10^{-8}$ cm ; $\rho = 19.3$ g/cm^3

Problem 5

A concrete pipe has internal diameter of 80 cm and wall thickness of 4 cm. Permeability coefficient (K_p) of the concrete is 2×10^{-8} cm/sec. Find the amount of water loss daily under 6 atm pressure for a length of 1 km? (1 atm ≈ 1000 cm-water column)

Answer: $Q \approx 65.1$ m^3

Problem 7

A tensile stress is to be applied along the long axis of a cylindrical brass rod that has a diameter of 10 mm. Determine the magnitude of the load required to produce a $2.5.10^{-3}$ mm change in diameter if the deformation is entirely elastic. (For brass, the modulus of elasticity is 97 GPa and the Poisson's ratio is 0.34).

Answer: $P \approx 5600$ N

Problem 8

What should be the maximum length of a 2 mm diameter copper wire to bear its own weight without yielding? The yield strength of the copper is 120 MPa and it has a density of 8.9 g/cm^3.

Answer: $l_{max} \approx 1374.4$ m

Problem 9

The yield strength and the tensile strength of the aluminum are 125 and 150 MPa, respectively; and it has a modulus of elasticity of 68.6 GPa.

a) Calculate the required stress to extend the 3 m-long aluminum wire by 1.5 mm.

b) What is the minimum diameter of the aluminum bar to bear 10 kN load without plastic deformation?

c) Considering the diameter calculated at (b), what is the maximum load that the bar can bear without fracture?

Answers: a) $\sigma = 34.3$ MPa **b)** $d_{min} = 10.1$ mm **c)** $P_{max} \approx 12$ kN