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# Design of tension member

# Input ultimate tensile strength and other properties
Tu = float(input("Enter the value of ultimate tensile strength: "))
fy = float(input("Enter the value of yield strength of steel: "))
fu = float(input("Enter the value of ultimate strength of steel: "))
fub = float(input("Enter the value of ultimate strength of bolt: "))
Gamma_mo = float(input("Enter the value of partial factor of safety Gamma_mo: "))
Gamma_m1 = float(input("Enter the value of partial factor of safety Gamma_m1: "))
Gamma_mb = float(input("Enter the value of partial factor of safety Gamma_mb: "))

# Calculate required gross area
Agreq = 1.1 * Tu * 1000 / fy
print("Gross Area Required")
print("The value of gross area required is:", 1.2 * Agreq)

# Selection of section
Ag = float(input("Enter the value of gross area of steel: "))
Lcl = float(input("Enter the length of connected leg: "))
Lol = float(input("Enter the length of outstand leg: "))
t = float(input("Enter the value of least thickness: "))

# Design of connections
d = float(input("Enter the value of diameter of bolt: "))
do = d + 2
print("The diameter of bolt hole is:", do)

# Minimum pitch distance
pmin = 2.5 * d
print("The minimum pitch is:", pmin)

# Edge distance as per IS 800
e = float(input("Enter the value of edge distance: "))

# Input for shear planes
nn = float(input("Number of shear planes with threads intercepting the shear plane:
ns = float(input("Number of shear planes without threads: "))

# Area calculations
Anb = 0.78 * 0.7854 * d * d
print("Threaded area of bolt is:", Anb)

Asb = 0.7854 * d * d
print("Plain shank area of bolt is:", Asb)

Vdsb = (fub / (1.732 * Gamma_mb)) * (nn * Anb + ns * Asb) * 10**-3
print("The value of Vdsb:", Vdsb)

kbl = e / (3 * do)
print("Kbl:", kbl)

kb2 = (pmin / (3 * do)) - 0.25
print("Kb2:", kb2)
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kb3 = fub / fu
print("Kb3:", kb3)

kb4 = 1
print("Kb4:", kb4)

kb = min(kbl, kb2, kb3, kb4)
print("Kb:", kb)

Vdpb = (2.5 * kb * d * t * fu * 10**-3) / Gamma_mb
print("Vdpb:", Vdpb)

Vd = min(Vdsb, Vdpb)
print("Vd:", Vd)

N = Tu / Vd
print("Number of bolts required:", N)

N = float(input("Enter the value of number of bolts: "))

# Check for strength
# Criteria 1: Yielding of Gross Section
Tdg = (Ag * fy) / Gamma_mo  # Corrected formula
Tdg=Tdg/10**2
print(f"The value of tensile strength due to yielding of gross section is: {Tdg}")

# Criteria 2: Rupture
Anc = (Lcl - (t / 2) - do) * t
print("Net Area of Connecting leg (Anc):", Anc)

Ago = (Lol - (t / 2)) * t
print("Gross Area of outstand leg (Ago):", Ago)

Lc = (N - 1) * pmin
print("Lc:", Lc)

bs = 0.6 * Lcl + Lol  # Updated formula for 'bs'
print("bs:", bs)

# Beta calculation
Beta = (fy / fu) * (bs / Lc) * (Lol / t)
print("Beta:", Beta)

# Check 1
print("Check 1")
if Beta > 1.4:
    print("Not Safe")
else:
    print("Safe")

# Check 2
print("Check 2")
if Beta < 0.7:
    print("Not Safe")
else:
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        print("Safe")

    # Tdn Calculation
    Tdn = ((0.9 * fu * Anc) / Gamma_m1) + (Beta * Ago * fy / Gamma_mo)
    print("Tdn:", Tdn)

    # Additional calculations for Avg and Atn
    Avg = (pmin * (N - 1) + e) * t
    print("Avg:", Avg)

    Avn = ((pmin * (N - 1) + e) - (N - 1) * do + (8.5 * do)) * t
    print("Avn:", Avn)

    Atg = 0.6 * Lcl * t
    print("Atg:", Atg)

    Atn = 0.5 * do * t  # Ensure this formula aligns with your needs
    print("Atn:", Atn)

    # Calculate Tb1 and Tb2
    Tb1 = (((Avg * fy) / (1.732 * Gamma_mo)) + (0.9 * fu * Atn) / Gamma_m1) * 10**-3
    print("Tb1:", Tb1)

    Tb2 = ((0.9 * Avn * fu) / (1.732 * Gamma_m1) + (Atg * fy) / Gamma_mo) * 10**-3
    print("Tb2:", Tb2)

    # Minimum Tb calculation
    Tb = min(Tb1, Tb2)
    print("Tb:", Tb)

    # Final Td calculation
    Td = min(Tdg, Tdn, Tb)
    print("Td:", Td)

    # Safety check
    if Td > Tu:
        print("Revise the Section")
    else:
        print("SAFE")
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Enter the value of ultimate tensile strength: 225
Enter the value of yield strength of steel: 250
Enter the value of ultimate strength of steel: 410
Enter the value of ultimate strength of bolt: 400
Enter the value of partial factor of safety Gamma_mo: 1.1
Enter the value of partial factor of safety Gamma_m1: 1.25
Enter the value of partial factor of safety Gamma_mb: 1.25
Gross Area Required
The value of gross area required is: 1188.0
Enter the value of gross area of steel: 1257
Enter the length of connected leg: 100
Enter the length of outstand leg: 65
Enter the value of least thickness: 8
Enter the value of diameter of bolt: 20
The diameter of bolt hole is: 22.0
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The minimum pitch is: 50.0
Enter the value of edge distance: 33.0
Number of shear planes with threads intercepting the shear plane: 1
Number of shear planes without threads: 0
Threaded area of bolt is: 245.0448
Plain shank area of bolt is: 314.16
The value of Vdsb: 45.273866050808316
Kbl: 0.5
Kb2: 0.5075757575757576
Kb3: 0.975609756097561
Kb4: 1
Kb: 0.5
Vdpb: 65.6
Vd: 45.273866050808316
Number of bolts required: 4.969754510195687
Enter the value of number of bolts: 5
The value of tensile strength due to yielding of gross section is: 2856.818181818182
Net Area of Connecting leg (Anc): 592.0
Gross Area of outstand leg (Ago): 488.0
Lc: 200.0
bs: 125.0
Beta: 3.0964176829268295
Check 1
Not Safe
Check 2
Safe
Tdn: 518179.2702882483
Avg: 1864.0
Avn: 2656.0
Atg: 480.0
Atn: 88.0
Tb1: 270.571343439009
Tb2: 561.7763594373295
Tb: 270.571343439009
Td: 270.571343439009
Revise the Section
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