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M = 600; % max torque (in-lbf)
L = 18; % length from drive to where load applied (inches)
h = 0.6; % width
b = 0.32; % thickness
c = 1.0; % distance from center of drive to center of strain gauge
E = 29.2*(10^6); % Young's modulus (psi)
nu = 0.285; % Poisson's ratio
su = 151*(10^3); % tensile strength use yield or ultimate depending on
material (psi)
KIC = 59.2*(10^3); % fracture toughness (psi sqrt(in))
sfatigue = 64.6*(10^3); % fatigue strength from Granta for 10^6 cycles
name = 'Low Alloy Steel, AISI 4150, Normalized'; % material name

a = 0.04; % assumed crack depth
GF = 2; % gauge factor
bridgeType = 0.5; % half bridge

F = M / L;
I = (b * h^3) / 12;
delta_max = (F * L^3) / (3 * E * I);
y = h / 2;
sigma_max = (M * y) / I;

sf_strength = su / sigma_max;
K = 1.12 * sigma_max * sqrt(pi * a);
sf_crack = KIC / K;
sf_fatigue = sfatigue / sigma_max;

M_gauge = F * (L - c);
sigma_gauge = (M_gauge * y) / I;
epsilon_gauge = sigma_gauge / E;
output = GF * epsilon_gauge * bridgeType * 1000;

fprintf('Stress and deflection analysis\n');
fprintf('load point deflection = %.3f in\n', delta_max);
fprintf('max normal stress = %.2f ksi\n', sigma_max / 1000);
fprintf('Safety factor results:\n');
fprintf('safety factor for strength = %.2f\n', sf_strength);
fprintf('safety factor for crack growth = %.2f\n', sf_crack);
fprintf('safety factor for fatigue = %.2f\n', sf_fatigue);
fprintf('Strain gauge results:\n');
fprintf('strain at gauge = %.1f microstrain\n', epsilon_gauge * 1e6);
fprintf('output = %.2f mV/V at 600 in-lbf using half bridge', output);

Stress and deflection analysis
load point deflection = 0.385 in
max normal stress = 31.25 ksi
Safety factor results:
safety factor for strength = 4.83
safety factor for crack growth = 4.77
safety factor for fatigue = 2.07
Strain gauge results:

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strain at gauge = 1010.7 microstrain
output = 1.01 mV/V at 600 in-lbf using half bridge
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