E = 200e9;

m = 0.3;

h = 0.08;

r1 = 0.3;

r2 = 1.4;

sigma = 240e6;

D = E \* h^3 / (12 \* (1 - m^2));

C = [1, r2^2, log(r2), log(r2) \* r2^2;

0, 2\*r2, 1/r2, 2\*r2\*log(r2)+r2;

0, 2\*r1, 1/r1, 2\*r1\*log(r1)+r1;

0, 0, 0, 4/r1];

b = [r2^4/(64\*D); r2^3/(16\*D); r1^3/(D\*16); 1/(2\*D)\*r1];

consts = linsolve(C, b);

C1 = consts(1);

C2 = consts(2);

C3 = consts(3);

C4 = consts(4);

W = @(C1, C2, C3, C4, D, r, p) ((C1 + C2\*r.^2 + C3\*log(r) + C4\*log(r).\*r.^2).\*p - r.^4.\*p./(64\*D));

W1 = @(C2, C3, C4, D, r) (2\*r\*C2 + C3./r + C4.\*(2\*r.\*log(r) + r) - r.^3./(16\*D));

W2 = @(C2, C3, C4, D, r) (2\*C2 - 1./r.^2.\*C3 + C4.\*(3 + 2\*log(r)) - r.^2\*3./(16\*D));

M\_r = @(W2, W1, r, D, m) (D\*(W2(C2, C3, C4, D, r) + m./r.\*W1(C2, C3, C4, D, r)));

M\_theta = @(W2, W1, r, D, m) (D\*(m\*W2(C2, C3, C4, D, r) + 1./r.\*W1(C2, C3, C4, D, r)));

sigma\_r = @(M\_r, h, r, D, m) (6\*M\_r(W2, W1, r, D, m)./h^2);

sigma\_theta = @(M\_theta, h, r, D, m) (6\*M\_theta(W2, W1, r, D, m)./h^2);

sigma\_eqv = @(sigma\_r, sigma\_theta) (sqrt(sigma\_r.^2 + sigma\_theta.^2 - sigma\_r .\* sigma\_theta));

sigma\_eqv\_max = sigma\_eqv(sigma\_r(M\_r, h, r2, D, m), sigma\_theta(M\_theta, h, r2, D, m));

p = sigma / (sigma\_eqv\_max \* 10^6);

tiledlayout(2,2)

r\_vals = linspace(r1, r2, 50);

titles = {'Distribution of $M\_r$', 'Distribution of $M\_{\theta}$', 'Equivalent Stress Distribution', 'Deflection at Maximum Allowable Load'};

ylabels = {'$M\_r$', '$M\_{\theta}$', '$\sigma\_{\text{eqv}}$', 'Deflection $W$'};

functions = {@(r) M\_r(W2, W1, r, D, m), @(r) M\_theta(W2, W1, r, D, m), @(r) sigma\_eqv(sigma\_r(M\_r, h, r, D, m), sigma\_theta(M\_theta, h, r, D, m)), @(r) W(C1, C2, C3, C4, D, r, p)};

for i = 1:4

nexttile

plot(r\_vals, functions{i}(r\_vals))

title(titles{i}, 'Interpreter', 'latex')

xlabel('Radius $r$ (m)', 'Interpreter', 'latex')

ylabel(ylabels{i}, 'Interpreter', 'latex')

grid on

grid minor

set(0,'DefaultLineLineWidth',1)

ax=gca;

ax.GridColor='k';

ax.GridAlpha = 0.8;

ax.GridLineStyle = '-';

end