Program for design of shaft, Problem Number 3.

Problem Statement:A line shaft is transmitting 650 kW of power at 500 rpm and is made of C35 material. The shaft carries a central load of 1,000 N and is simply supported between the bearings 3 m apart. Determine the diameter of the shaft, considering ASME code and steady load for rotating shaft.

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```
clc;
clear all;
```

Given data :

= 650

n = 500

= 1,000

= 3m = 3 × 10^3m

```
P = 650
```

```
P = 650
```

```
n = 500
```

```
n = 500
```

```
F = 1000
```

```
F = 1000
```

```
L = 10^3
```

```
L = 1000
```

Initalizing the Ulimate and endurance stress. Also finding the max stress respectively using ASME standards.

```
S_u = 510;
S_e = 304;
S_max1 = 0.6*S_e;
S_max2 = 0.36*S_u;
```

Finding the lower values and setting it as the max shear stress.

```
if S_max1 < S_max2
    S_max = S_max1
else
    S_max = S_max2
```

```
end
```

```
S_max = 182.4000
```

Finding the maximum tau value, and setting the lower tau values.

```
Tu_max1 = 0.3*S_e;
Tu_max2 = 0.18*S_u;
if Tu_max1 < Tu_max2
    Tu_max = Tu_max1
else
    Tu_max = Tu_max2
end
```

```
Tu_max = 91.2000
```

Finding the torque value.

Using Eqn. 3.3(a),

$$T = \frac{9.55 \times 10^6 (P)}{n} = \frac{9.55 \times 10^6 (650)}{500}$$

$$T = 12.42 \times 10^6 N - mm$$

From Table, 1.4,

$$M_{max} = \frac{FL}{4} = \frac{1000 \times 3 \times 10^3}{4}$$

$$M_{max} = 750 \times 10^3 N - mm$$

For steady load for rotating shaft,

$$C_m = 1.5 \; and \; C_t = 1$$

```
T = Eqn_3_3_a(P,n)
```

```
T = 12415000
```

```
M_max = (F*L)/4
```

```
M_max = 250000
```

For steady load for rotating shaft,

```
Cm = 1.5;
Ct = 1;
```

According to Maximum Normal Stress Theory:

Using Eqn. 3.6(a),

$$d = \left[\frac{16}{\pi \sigma_{max}}\left(C_m M + \sqrt{(C_m M)^2 + (C_t T)^2}\right)\right]^{1/3}$$

$$d = 72.41\ mm$$

According to Maximum Shear Stress Theory:

Using Eqn. 3.6(b),

$$d = \left[\frac{16}{\pi \tau_{max}}\left(\sqrt{(C_m M)^2 + (C_t T)^2}\right)\right]^{1/3}$$

$$d = 88.64\ mm$$

```
[d_n, d_s] = Eqn_3_6(S_max,Tu_max,M_max,T,Cm,Ct)
```

```
d_n = 70.9582
d_s = 88.5197
```

Finding the larger value of diameter from the 2 stress theories.

```
if d_n > d_s
    d = d_n
else
    d = d_s
end
```

```
d = 88.5197
```

Finding the standard diameter from table 3.5a

```
d = Table_3_5_a(d)
```

```
Standard size of the shaft (mm) using table 3.5(a) is :
d = 90
d = 90
```

```
disp('Shear Stress (N/mm^2) induced on the shaft is : ')
```

```
Shear Stress (N/mm^2) induced on the shaft is :
```

```
Tu = Eqn_3_1(T,d);
```