INDIVIDUAL PROJECT 2

Assignment Date : 31 October, 2012 *Due Date : 09 November, 2012*

ASSIGNMENT ON USING FINITE ELEMENT SOFTWARE (TO BE DONE INDIVIDUALLY)

This project is concerned with design of a bicycle frame using aluminum tubes. The schematic dimensions of the bicycle are shown below. The following two load cases should be considered.

(a) ***Vertical loads***: When an adult rides the bike, the nominal load is estimated as a downward load of 900N at the seat position and a load of 300N at the pedal crank location. When a dynamic environment is simulated using the static analysis, the static loads are often multiplied by a dynamic load factor *G*. In this design project, use *G* = 2. Use ball-joint boundary conditions for the front dropout (location 1) and sliding boundary conditions for the rear dropouts (location 5 and 6).

(b) ***Horizontal impact***: The frame should be able to withstand a horizontal load of 1000N applied to the front dropout with rear dropouts constrained from any translational motion. For this load case, assume the front dropout can only move in the horizontal direction. Use *G* = 2.

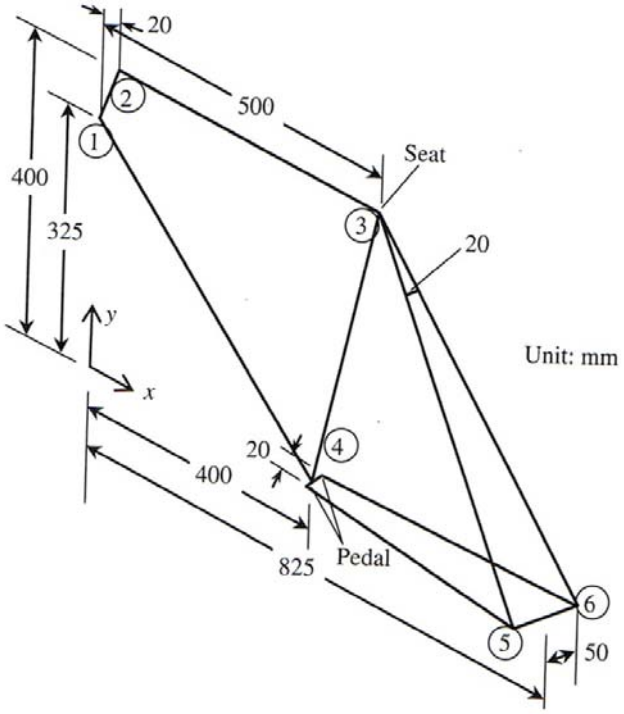
Choose aluminum tubes of various diameters for the various members of the frame shown in the figure such that the bicycle is as light as possible. The minimum outside diameter is 12mm and the wall thickness is 2mm. In addition to the dynamic load factor, use a safety factor of 1.5. Use von Mises failure stress criterion for yielding.

In your report, you must include the following for each load case:

1. For each member of the frame the maximum combined stress and the safety factor.
2. Nodal deflections at each joint should be given.
3. The weight of your frame.

Properties of Aluminum

Material property	Value
Young's Modulus (E)	70 GPa
Poisson's Ratio (ν)	0.33
Density (ρ)	2580 kg/m^3
Yield Strength (σ_Y)	210 MPa



Metric Aluminum Round Tubing

ALUMINUM
6060 T-6 (Extruded) EN 573-3, EN755-2, EN755-1, EN 755-9, DIN 1725, DIN 1746, DIN 1748

**** All Round Tubing is Quoted OD x Wall.***

SIZE mm	WEIGHT kg/m	EST. LBS. PER FT.
8 x 1	0.060	0.040
8 x 2.5	0.119	0.080
10 x 1	0.078	0.052
10 x 2	0.138	0.093
12 x 1	0.095	0.064
12 x 1.5	0.136	0.915
12 x 2	0.173	0.116
14 x 2	0.207	0.139
15 x 1	0.121	0.081
15 x 1.5	0.175	0.118
15 x 2	0.225	0.151
16 x 1	0.130	0.087
16 x 1.5	0.188	0.127
16 x 2	0.242	0.163
16 x 3	0.337	0.227
18 x 1	0.147	0.099
18 x 1.5	0.214	0.144
18 x 2	0.276	0.186
20 x 1	0.164	0.110
20 x 1.5	0.240	0.162
20 x 2	0.311	0.209

SIZE mm	WEIGHT kg/m	EST. LBS. PER FT.
48 x 3	1.166	0.785
48 x 4	1.520	1.023
50 x 1.5	0.628	0.423
50 x 2	0.829	0.558
50 x 2.5	1.025	0.690
50 x 3	1.218	0.820
50 x 4	1.589	1.069
50 x 5	1.943	1.308
50 x 10	3.454	2.325
54 x 2	0.898	0.604
55 x 2.5	1.133	0.763
55 x 5	2.159	1.453
60 x 1.5	0.758	0.510
60 x 2	1.002	0.674
60 x 2.5	1.241	0.835
60 x 3	1.477	0.994
60 x 4	1.934	1.302
60 x 5	2.375	1.598
60 x 6	2.798	1.883
60 x 10	4.318	2.906
65 x 2	1.088	0.732

20 x 2.5	0.378	0.254
20 x 3	0.440	0.296
20 x 5	0.648	0.436
22 x 1.5	0.266	0.179
22 x 2	0.345	0.232
25 x 1.5	0.304	0.205
25 x 2	0.397	0.267
25 x 2.5	0.486	0.327
25 x 3	0.570	0.384
25 x 5	0.864	0.581
28 x 1.5	0.343	0.231
28 x 2	0.449	0.302
28 x 2.5	0.550	0.370
28 x 4	0.829	0.558
30 x 1.5	0.369	0.248
30 x 2	0.484	0.326
30 x 2.5	0.594	0.400
30 x 3	0.699	0.470
30 x 4	0.898	0.604
30 x 5	1.079	0.726
32 x 1.5	0.395	0.266
32 x 2	0.518	0.349
32 x 3	0.751	0.505
35 x 1.5	0.434	0.292
35 x 2	0.570	0.384
35 x 2.5	0.702	0.472
35 x 3	0.829	0.558
35 x 4	1.071	0.721
35 x 5	1.295	0.872
38 x 1.5	0.473	0.318
38 x 2	0.622	0.419
38 x 3	0.907	0.610
38 x 4	1.174	0.790
40 x 1.5	0.499	0.336
40 x 2	0.656	0.441
40 x 2.5	0.810	0.545
40 x 3	0.958	0.645
40 x 4	1.243	0.837

65 x 2.5	1.349	0.908
65 x 5	2.591	1.744
70 x 2	1.174	0.790
70 x 3	1.736	1.168
70 x 4	2.280	1.534
70 x 5	2.806	1.888
70 x 10	5.181	3.487
75 x 2.5	1.565	1.053
75 x 5	3.022	2.034
76 x 2.5	1.587	1.068
76 x 3	1.891	1.273
80 x 2	1.347	0.907
80 x 2.5	1.673	1.126
80 x 3	1.995	1.343
80 x 4	2.625	1.767
80 x 5	3.238	2.179
80 x 10	6.045	4.068
84 x 2	1.416	0.953
86 x 3	2.150	1.447
90 x 2	1.520	1.023
90 x 3	2.254	1.517
90 x 5	3.670	2.470
100 x 2	1.692	1.139
100 x 2.5	2.105	1.417
100 x 3	2.513	1.691
100 x 4	3.316	2.232
100 x 5	4.102	2.761
100 x 10	7.772	5.231
106 x 3	2.668	1.796
108 x 3	2.720	1.831
108 x 4	3.592	2.417
110 x 3	2.772	1.866
110 x 5	4.533	3.051
115 x 5	4.749	3.196
120 x 3	3.031	2.040
120 x 5	4.965	3.341
120 x 10	9.499	6.393
125 x 5	5.181	3.487

40 x 5	1.511	1.017
40 x 8	2.211	1.488
40 x 10	2.591	1.744
42 x 2	0.691	0.465
42 x 3	1.010	0.680
45 x 1.5	0.563	0.379
45 x 2	0.743	0.500
45 x 2.5	0.917	0.617
45 x 3	1.088	0.732
45 x 4	1.416	0.953
45 x 5	1.727	1.162
48 x 2	0.794	0.534
48 x 2.5	0.982	0.661

130 x 3	3.290	2.214
130 x 5	5.397	3.632
140 x 5	5.829	3.923
150 x 3	3.808	2.563
150 x 5	6.260	4.213
150 x 10	12.089	8.136
156 x 3	3.963	2.667
160 x 3	4.067	2.737
160 x 5	6.692	4.504
180 x 5	7.556	5.085
200 x 5	8.419	5.665
200 x 10	16.407	11.042
250 x 5	10.578	7.119

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