Exercise – static blade deflections

This problem deals with the static structural response of the DTU 10MW wind turbine blade.

The blade has the following structural properties as stated in the report "Description of the DTU 10MW Reference Wind Turbine"

r [m]	Structural pitch [deg]	Distributed mass [kg/m]	EI$_1$ [Nm2]	EI$_2$ [Nm^2]	Twist [deg]
2.80	0.00	1189.5	6.18725·10^{10}	6.10115·10^{10}	14.5
11.00	0.00	1113.6	5.45560·10^{10}	5.30459·10^{10}	14.43
16.87	18.93	868.87	2.26907·10^{10}	3.37672·10^{10}	12.55
22.96	8.87	735.79	1.26547·10^{10}	2.53839·10^{10}	8.89
32.31	4.25	566.23	5.39730·10^9	1.65096·10^{10}	6.38
41.57	3.09	477.51	2.95524·10^9	1.04400·10^{10}	4.67
50.41	2.05	385.14	1.53489·10^9	5.97308·10^9	2.89
58.53	1.29	291.66	7.71509·10^8	3.04985·10^9	1.21
65.75	0.92	221.77	4.29167·10^8	1.66656·10^9	-0.13
71.97	0.67	153.75	2.08212·10^8	8.15025·10^8	-1.11
77.19	0.57	108.93	1.08707·10^8	4.60660·10^8	-1.86
78.71	0.54	95.18	8.39391·10^7	3.59048·10^8	-2.08
80.14	0.57	82.34	6.30619·10^7	2.96049·10^8	-2.28
82.71	0.55	68.28	4.42760·10^7	2.17147·10^8	-2.64
84.93	0.59	54.47	2.83398·10^7	1.55000·10^8	-2.95
86.83	0.69	40.65	1.44813·10^7	1.00370·10^8	-3.18
88.45	0.79	25.20	4.49695·10^7	4.17163·10^7	-3.36
89.17	0.96	15.42	1.02747·10^6	1.27145·10^7	-3.43

Q: Calculate and plot the static deflections tangential and normal to the rotor plane with the loads computed from your BEM code from Assignment#1 for wind speeds 6, 11 and 20 m/s. The blade is rigidly clamped at r=2.8 m.

Compare your results with the ASHES software.

In case you have problems with your BEM code you may use the uploaded load distributions.