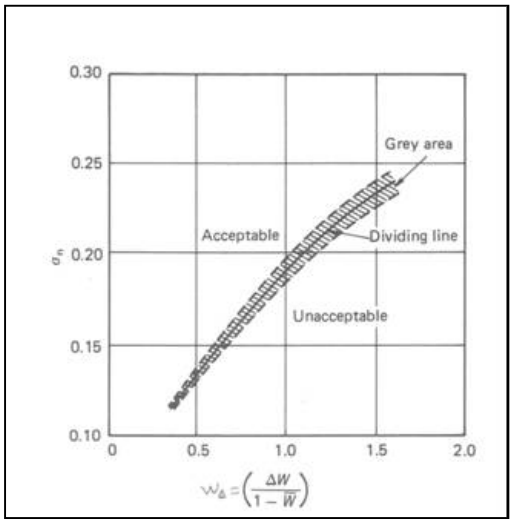
ADVANCED PROPULSION SYSTEM – MID-TERM EXAM
14/11/2003 - 14:00-15:00

1. Asses the quality of the wake given below according to the BMT's wake non-uniformity criteria (w_Δ, σ_{nI}) given in figure 1. (**20 Points**)

Given:

D =2.2 m (propeller diameter)
N =265 (number of propeller revolution per minute - RPM)
Z = 4 (number of blades)
Zp = 1.45 m. (shaft height from the base line)
Ta = 4.747 (Draft at aft perpendicular)
Vapour pressure ($P_a - P_v$) = 99 577 N/m^2
ρ = 1025 kg/m^2. (Density of sea water)
g = 9.80665 m/sn^2. (Acceleration of gravity)



$$\sigma_{nI} = \frac{P_a - P_v + P_H}{\frac{1}{2}\rho(\pi n D)^2}$$

P_H = *Hydrostatic pressure at the propeller tip*

$$w_\Delta = \left(\frac{\Delta w}{1 - \bar{w}}\right)_{1.0R}$$

The wake is given in terms of the velocity ratio's method.

theta	r/R=0.582	r/R=0.727	r/R=0.873	r/R=1.000	r/R=1.164
0	0.143	0.128	0.094	0.067	0.065
10	0.141	0.147	0.139	0.176	0.228
20	0.184	0.213	0.231	0.264	0.308
30	0.251	0.298	0.330	0.350	0.375
40	0.308	0.373	0.414	0.434	0.454
50	0.337	0.420	0.476	0.515	0.545
60	0.341	0.442	0.521	0.587	0.637
70	0.337	0.452	0.558	0.650	0.722
80	0.343	0.470	0.595	0.705	0.791
90	0.371	0.507	0.641	0.754	0.843
100	0.421	0.565	0.694	0.800	0.880
110	0.476	0.628	0.749	0.841	0.906
120	0.514	0.677	0.793	0.874	0.924
130	0.514	0.685	0.809	0.890	0.934
140	0.466	0.640	0.781	0.877	0.932
150	0.382	0.547	0.705	0.830	0.915
160	0.291	0.434	0.594	0.756	0.882
170	0.227	0.344	0.501	0.691	0.850
180	0.183	0.313	0.532	0.717	0.866

Here 0 – Top death center – 180 – bottom death center

Good Luck! . Ali Can Takinacı

SOLUTIONS

1. **a)** First calculate the parameter σ_{NI},

$$\sigma_{nI} = \frac{99577 + 9.80665 \times 1025 \times \left(4.747 - \frac{2.2}{2} - 1.45\right)}{\frac{1}{2} \times 1025 \times \left(\pi \times \frac{265}{60} \times 2.2\right)^2} = 0.256$$

Second calculate the wake parameter

$$w_{\Delta} = \left(\frac{\Delta w}{1 - \bar{w}}\right)_{1.0R} = \left(\frac{0.933 - 0.110}{1 - 0.367}\right)_{1.0R} = 1.300$$

0.933 (=1-0.067) is the max wake at the radius r/R = 1.
0.110 (=1-0.890)is the min wake at the radius r/R = 1.
0.367 is the average wake at the radius r/R = 1. (computed)