Turbomachinery CAD CWM PART 3A

RADIAL FLOW WATER TURBINE

Exercise 2 - Design, Manufacture and Testing of a Runner for Given Operating Point Conditions

Runner Performance

This part of the exercise is concerned with the testing of the runner over a range of flow rates through the turbine. Here, a series of measurements will be taken for varied settings of applied load at a target head and guide vane opening. The performance will be assessed in terms of power efficiency η versus flow rate Q. If a successful design has been achieved, the resulting curve should peak at the design operating point condition Q. Note that 1 bar = 10kPa.

MEASURED QUANTITIES

H ..... FLUID ENERGY HEAD	(bar)
Q ..... FLUID FLOW RATE	(litres/sec)
N ..... RUNNER SPEED	(revs/min)
T ..... ALTERNATOR TORQUE	(Nm)

Power Out

$$P_o = T \times \omega = T \times N/60 \times 2\pi = 0.10472 \times T \times N \ (W)$$

Power In

$$P_i = \rho g Q H = 1000 \times 9.81 \times Q \times 10^{-3} \times H \times 10.19$$

$$= 100 \times Q \times H \ (W)$$

Efficiency $\eta = P_o/P_i$

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DESIGN ANGLES:	β_1 = 107.616	β_2 = 26.53

OPERATING POINT:			
H = 0.7 bar	**Q = 2.0 l/s**	**N = 1300 rpm**	**α_o = 9.8°**

Θ^o = Guide Vane Indicator Angle ≈ 63%

Use Matlab to Plot efficiency η against volumetric flow Q for the points recorded, along with a best fit curve. Note the value of Q for maximum η. Include a title, a grid, and axes labels and units.
Include the graph and suitable comments in your report.

$(Q)_{\eta\ max}$ = 2 l/s _____ $(\eta)_{max}$ = 23% _____