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DISCUSSION

O. M. Griffin[1]. Rooney and Peltzer have conducted extensive experiments and they have provided interesting and useful new data for the effects of shear (nonuniform) flow on vortex shedding from circular cylinders. They have clearly shown the re-emergence of the transcritical vortex shedding regime at high Reynolds number by examining the pressure distribution around and the wake flow downstream from a rough circular cylinder. It should be noted that here and in the paper by Rooney and Peltzer the same order of prefixes employed by Roshko [12] is used to characterize the different flow regimes for a circular cylinder, i.e. subcritical → critical → supercritical → transcritical or postcritical. Some authors, including Szechenyi [8], characterize the last two flow regimes in the order transcritical → supercritical.

As observed by the authors, the effects of the surface roughness are to hasten the onset of the critical Reynolds number well before the usual value of $Re = 2 \times 10^5$ for a smooth cylinder and to initiate the re-emergence of regular vortex shedding in the transcritical Reynolds number range at about 4×10^5. Similar findings have been reported recently by Alemdaroglu, Rebillat, and Goethals [14][2] who employed aeroacoustic coherence measurements in the wake of several roughened cylinders to study the transition from subcritical to critical and to transcritical Reynolds numbers. The results obtained by Rooney and Peltzer are in excellent agreement with those of Alemdaroglu, Rebillat and Goethals, as shown in a recently-published report [1].

When shear was added to the incident flow a typical cellular shedding pattern was obtained at transcritical Reynolds numbers, similar to previous findings at subcritical Reynolds numbers. Although the relatively short length-to-diameter ratios of their cylinders ($L/D = 9$) certainly influenced the cell structure in Rooney and Peltzer's experiments, their results clearly demonstrate for the first time the existence of the cellular vortex structure at very large Reynolds numbers. It would be interesting if the authors could comment upon the effects of larger length-to-diameter ratios (L/D) and different shear parameters (β) on the presence or absence of the cell structure.

The objective of the authors' experiments was to provide data to aid in the design of the cold water intake pipe for an ocean thermal energy conversion (OTEC) power plant. The cold water pipe is thought by many observers to be the critical problem in OTEC development, since the long, slender pipe is particularly vulnerable to problems caused by vortex shedding in steady currents [15] and to other hydrodynamic forces. The problem potentially is made more serious because experiments by Fischer, Jones, and King [16,17] have shown that marine structures undergo large amplitude cross flow vortex-excited oscillations (± 1.5 diameters) even when the incident flow is characterized by shear parameters in the range $\beta = 0.01$ to 0.02, so long as the structural damping of the cylindrical structure is sufficiently small. This range of shear parameters was characteristic of both the model test conditions and field site conditions discussed by Fischer, Jones and King. The experiments conducted by Rooney and Peltzer clearly demonstrate that regular vortex shedding takes place at the large Reynolds numbers, $Re = 10^6$ to 10^7, and shear parameters, $\beta = 0.01$ to 0.03, that characterize the OTEC cold water pipe.

[1]Marine Technology Division, Naval Research Laboratory, Washington, D.C. 20375.

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Authors' Closure

The above paper having documented the existence of a stable cellular shedding structure in transcritical flow, the effects of altering both the aspect ratio and the shear parameter will now be addressed briefly. Assuming that the transcritical cellular structure behaves similarly to that found in subcritical Reynolds number flows (which has just been demonstrated), newly obtained data on shear parameter and aspect ratio effects in subcritical-critical flows can be applied to the high Reynolds number cases.

The authors have, in a more recent investigation, observed that increasing the shear parameter β resulted in a decrease in the average cell length along a cylinder of aspect ratio L/D = 17.3 in a flow range $1.0 \times 10^5 \leq \mathrm{Re} \leq 3.0 \times 10^5$. A cellular structure existed at virtually all shear values between β = 0.007 and β = 0.041, values which represent typically predicted shear levels for the CWP.

Increasing the aspect ratio should generally result in the presence of more cells along the cylinder span. Increasing β should also result in a greater spanwise frequency spread, resulting in a very wide range to be encountered in the design of a large aspect ratio CWP subjected to sheared transcritical flow.