

Cavitating Foils

On a lifting foil (a hydrofoil), attached cavitation can take a number of forms, as discussed in the review by Acosta (1973). When, as sketched in Figure 1, the attached cavity closes on the suction surface of the foil, the condition is referred to as “partial cavitation.” This is the form of attached cavitation most

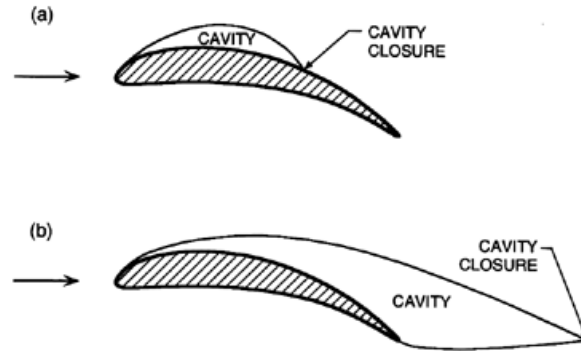


Figure 1: Sketch of the types of attached cavitation on a lifting foil: (a) partial cavitation (b) supercavitation.

commonly observed on propellers and in pumps. At lower cavitation numbers, the cavity may close well downstream of the trailing edge of the foil, as shown in the lower sketch in Figure 1. Such a configuration is termed “super-cavitation” and propellers for high-speed boats are often designed to be operated under these conditions. In between these regimes, experiments have shown (Wade and Acosta 1966) that, when the length of the cavity is close to the length of the foil (between about $3/4$ and $4/3$ times the chord), the flow becomes unstable and the size of the cavity fluctuates quite violently between these limits. During this fluctuation cycle, the cavity lengthens fairly smoothly. On the other hand, it shortens by a process of “pinching-off” of a large cloud of bubbles from the rear of the cavity, and this cloud can collapse quite violently as described previously. However, there is also shed vorticity bound up in the cloud, and this is concentrated by the collapse of the cloud. One result is the formation of the vortex ring seen in the last figure of section (Ntf). In pumps and other devices, this condition between partial and supercavitation clearly needs to be avoided because of the potential damage that can result. Further discussion of this oscillating cavity phenomenon is included in section (Nuh). It should also be noted that cavities may fluctuate for other reasons, as discussed in the next section.

Methods for the analysis of both partially and supercavitating flows are discussed in the next chapter.