# I. INTRODUCTION

In the development of new vehicles, resistance minimization is a primary design focus since the propelling force must match this drag. In general, less resistance permits higher speeds and decreases fuel consumption for the same propulsion plant. Surface ships are exposed to two mediums: air and water. This thesis focuses on the subsurface resistances of the SLICE ATD (Advanced Technology Demonstration), shown in Figure 1.1.

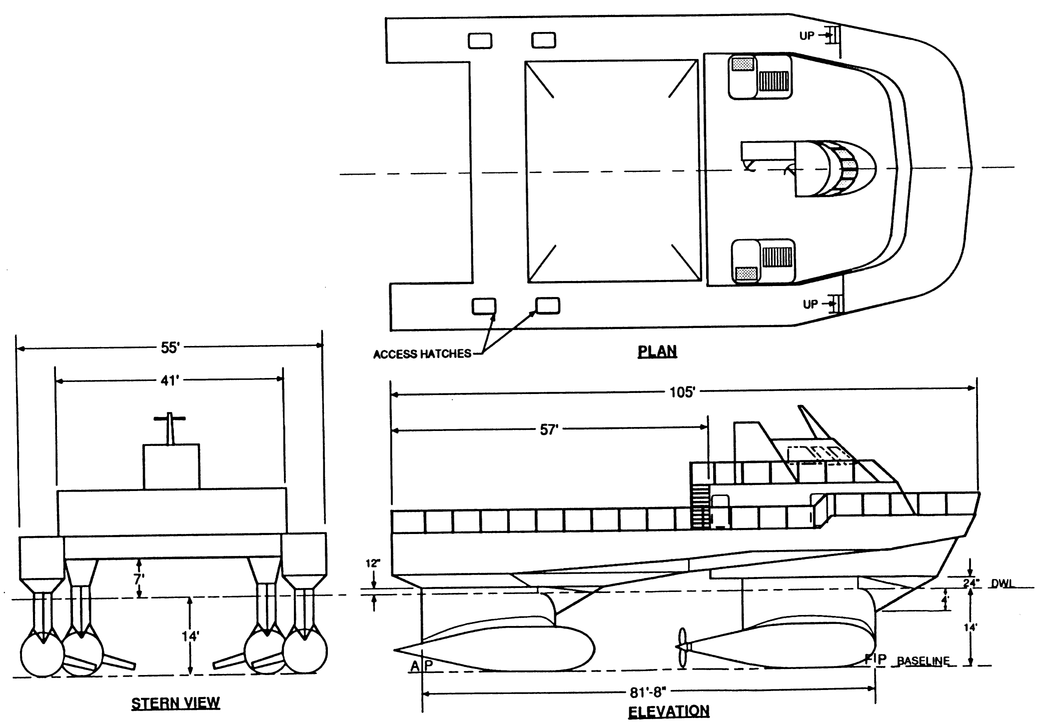


**Figure 1.1.** The SLICE configuration (Lockheed, 1994).

The SLICE concept was developed from the SWATH hull. A comparison of Figures 1.1 and 1.2 reveals the difference between the two hull forms. Essentially, the SLICE design cuts the middle section out of the SWATH's struts and pods.

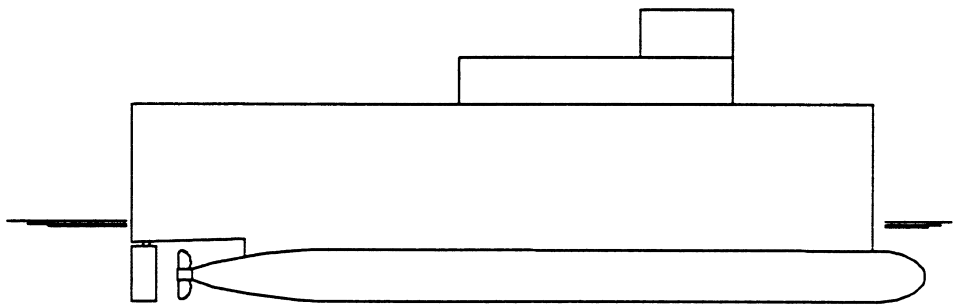

**Figure 1.2**. A typical SWATH vessel (Kennell, 1992).

Two accepted approaches used to extrapolate ship resistances from model data are the ITTC and Hughes methods (SNAME, 1988). These techniques break up a model resistance into subsidiary resistances and employ Reynolds and Froude scaling in different ways to predict ship resistance. Both procedures were performed on the SLICE model data.

A classical ITTC model to ship calculation was done using a single length approximation. This first guess was expected to overestimate the ship resistance since Kennell reported that the single length ITTC prediction overestimated SWATH resistances (Kennell, 1992). These results provided an upper limit by which other extrapolation techniques employed on the SLICE could be compared.

It was established that the resistance characteristics of a SWATH hull differ from those of a full displacement monohull (Kennell, 1992). The source of this difference was the relationship between the overall length and the wetted surface area. Figure 1.3 shows equal displacement ships and Kennell documents that SWATH ships have approximately sixty percent more wetted surface area than monohulls of the same displacement (Kennell, 1992). For the same reason, one would expect the resistance characteristics of a SLICE hull to differ from those of the monohull. The single length procedure uses equivalent flat plates of the prescribed length and area for resistance predictions. A monohull may be approximated in this manner but SWATH research indicates that separate evaluation of struts and pods yields predictions which more closely match actual ship data.

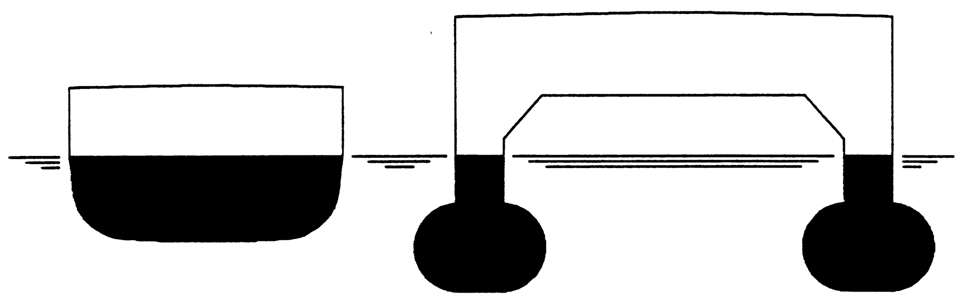

**Figure 1.3**. Comparison of an equal displacement monohull and SWATH (Kennell, 1992).

Using the ideas of Kennell, the SLICE wetted surface area was divided into strut and pod components (Kennell, 1992). The ITTC method was applied to extrapolate ship resistances and the Hughes method, which by definition, predicts smaller ship resistances was also applied to the sectioned hull.

Finally, a hybrid procedure analyzing the struts as wing shapes and the pods as full hull forms was developed. The hybrid examination results fell in between the ITTC and Hughes estimates.

The Lockheed Missile and Space Company, Inc. designed the SLICE and their analysis, also a variation of the Hughes method, predicted lower ship resistances than those presented here (Lockheed, 1994). Even though the drag is larger, this thesis, like Lockheed, anticipates that speeds of greater than thirty knots are achievable with the primary engine choice, depending on the overall propulsive efficiency.