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Reply by Author to P. A. Sullivan

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I APPRECIATE very much the attention that Dr. Sullivan has given to my paper.[1] The purpose of my paper is to propose a method which can serve as a practical procedural tool to estimate the stability at the initial stage of ACV design. Even though it is incomplete in setting up assumptions as Dr. Sullivan has criticized, I believe that it would serve at least for this purpose.

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Dr. Sullivan has indicated three points which are not considered in my analysis; they are

1) Compressibility of air (air flowing through ducts and air in the cushion cavity).

2) Dynamic (unsteady) effects appearing in flow motions in fans, fan rotor-stator systems, ducts and the cushion.

3) Aero- and visco-elastic effects of skirts.

These would actually cover almost all the effects which are to be considered in ACV stability analysis, and I know, of course, about the basic studies which have dealt with some of these effects in the past 15 years. Substantially, I agree with Dr. Sullivan's opinion and his comment would be correct inasmuch as the works cited by him are correct.

As indicated by Dr. Sullivan, considerable progress has been made since 1965, but I consider, not all of the results are universally or directly applicable to the practical estimation and design of ACV stability, since, besides the complexities involved in analyses, there are various types of air cushion application, such as TLV (tracked levitated vehicles), marine ACV's and aircraft landing gears, and the types of the air feeding system, the magnitude of cushion pressure and the oscillation frequency differ among these applications. One example would be given here. Some of the analyses made since 1970 have aimed mainly at the application to TLV where the combination of a straight duct and a chamber would be a realistic model. In ACV's (particularly in marine ACV's), the air feeding system is composed of complex combinations of ducts and chambers. Even though I do appreciate, of course, that recent analyses have made some contributions in studying the effects 1-3 mentioned above and that they would give some estimations of these effects, I can not find a way actually to apply them to the construction of a practical procedural tool.

Under these situations, I have taken another way, where I have developed simple analyses[2,3] based on simple assumptions (quasistatical motion of incompressible fluids), compared the results with experiments or practice and empirically modify them if necessary. According to the results of my own studies[3,4] the consideration of quasistatic characteristics of all of the fan, ducting and powerplant has so much improved the results as to be applied to the practice.

I believe that, at least in the practice of marine ACV's, in the development work of which I was personally engaged for 8 years at Mitsubishi Heavy Industries Ltd., Japan, the method I proposed in Ref. 1 can serve as a procedural tool for the practical estimation and design of stability.

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