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PNEUMATIC CHANNEL WING POWERED-LIFT ADVANCED SUPER-STOL AIRCRAFT

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ABSTRACT

The powered-lift Channel Wing concept has been combined with pneumatic Circulation Control aerodynamic and propulsive technology to generate a Pneumatic Channel Wing configuration intended to have Super-STOL or VSTOL capability while eliminating many of the operational problem areas of the original Channel Wing vehicle. A preliminary design study of this pneumatic vehicle based on previous wind-tunnel and flight-test data for the two technologies integrated into a simple Pneumatic Channel Wing (PCW) configuration showed very strong Super-STOL potential. Wind-tunnel development and evaluations of a PCW powered model conducted at Georgia Tech Research Institute (GTRI) have shown substantial lift capabilities for the blown configuration (C_L values of 8.5 to 9.0). Variation in blowing of the channel was shown to be more efficient than variation in propeller thrust. Also revealed was the ability to operate unstalled at very high angles of attack of 40°-45°, or to achieve very high lift at much lower angle of attack to increase visibility and controllability. In order to provide greater flexibility in Super-STOL takeoffs and landings, the blown model also displayed the ability to interchange thrust and drag by varying blowing without any moving parts. This paper presents these experimental results, discusses variations in the configuration geometry under development, and extends this integrated technology to advanced design studies of PCW-type vehicles.

INTRODUCTION / BACKGROUND

The ability to achieve Super-STOL or V/STOL capability with fixed-wing aircraft has been an attractive goal in the aerospace community for over 50 years. The impetus toward its achievement has historically been the numerous benefits associated with very-short to zero-field-length operations of non-rotary-wing aircraft. While such capability has direct application for military missions such as those of a tilt-rotor or tilt-wing aircraft, there also exists an additional need for simple/reliable/effective personal and business-sized Super-STOL or VSTOL aircraft operating from remote or small sites as well as increasingly dense urban environments. The development of simple efficient aeropropulsive technology and corresponding low-speed control systems to make this possible is a goal which now seems practical due to technical breakthroughs in pneumatic and powered-lift aerodynamic technologies.

Two promising technologies to evolve from earlier STOL/VSTOL research are the Custer Channel Wing powered-lift configuration and the Circulation Control Wing (CCW) pneumatic high-lift concept. Through innovative use of the propeller slipstream, the Channel Wing airplane developed by Willard Custer (Refs. 1, 2, 3) was able to achieve significant lift coefficient and efficient downward thrust deflection without varying the high-lift configuration geometry. This powered-lift technology, tunnel-tested by NACA in 1953, (Ref. 1) and then flight-tested and further developed by Custer in the late 1950's (Ref. 2), employed the concept shown in the sketch of Figure 1 (from Ref. 3). In essence, the propeller located at the very trailing edge of the 180°-arc circular channel in the wing further increased the velocity over the channel's upper surface and augmented the circulation and lift there in much the same manner as a flap,

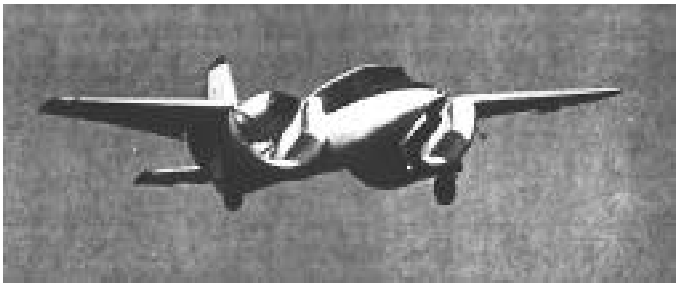

Figure 1– Basis of Channel Wing Propulsive Aerodynamics, and Current Pneumatic Developments at GTRI/NASA
a. 1950s Custer Channel Wing Aircraft (Refs. 2 and 3)

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