

Professor Ion Stroescu's role to the construction of aerodynamic wind tunnels

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Ion STROESCU, a high school teacher (of drawing and gymnastics), as well as Traian Vuia, the lawyer, belongs to the generation of Romanian that in the early 20th century have contributed to the progress of aviation.

Regardless of their professional background, these people were fascinated by the flight and the air flow around obstacles, phenomena that influenced their existence because of the accomplishments they have achieved in these areas. Through them, Romania became a European leading country of that time in the attractive and difficult field of aerodynamics, spurred by the theoretical formula of Kutta -Joukovski ($\bar{P} = \rho \bar{V} \Lambda \bar{\Gamma}$) of 1905 and by the aerodynamic profiles mapping using conformal transformations.

I met Mr. Ion STROESCU by the 1950's as a student at the Aviation Department of the *Politehnica* University of Bucharest and I wish to point out the further cooperation with him, along with his influence on my career in Experimental Aerodynamics. I felt a deep satisfaction comparing the experimental data of pressure distribution on aerodynamic profiles with theoretical calculation results obtained by Professor CARAFOLI's method. The experiences were made in the wind tunnel with $\Phi = 1,5$ m built in the University yard after the project of "Mr. Jean STROESCO"(1) and inaugurated in 1931, in the presence of the King Carol II . The quality of uniformity of rates (1%) in the experimental area, obtained by suction of the boundary layer (Ion STROESCU's priority) and the input nozzle contour contraction (Ion STROESCU's method) contributed to the recognition of that wind tunnel as the first in Southeastern Europe, being validated in comparison with the wind tunnels certified by testing of same aerodynamic profile (¹).

The great accuracy of measurement in high quality wind tunnels actually led to obtaining the aerodynamic profile series NACA-23, which cannot be obtained from the flow optimization by theoretical calculations.

I was also impressed by the attempts of visualization using smoke and tufting that for an expert eye "talk about the quality of flow". I once asked Mr. STROESCU to sketch some current lines around an aerodynamic profile that I'd drawn. Quietly smoking his pipe, he drew with a steady hand some lines on the upper side wing and underside wing surface. I calculated them theoretically and I found that they almost coincided. That "aerodynamic incident" remembered me that Michelangelo, in his time, drew arches that supported the dome of the church of San Pietro in Rome. After 500 years, modern engineering, which has methods for calculating the optimization of the loads distribution and resistance structures,

¹ Travaux du Laboratoire Aerodynamique, vol. 1, E. Carafoli, Imprim. National, Buc. 1938

found almost exactly the contour of MICHELANGELO's arches. "Toute proportion gardée" Mr. STROESCU also had an exceptional sense of subsonic flows around bodies.

After 1948, when The Polytechnic Institute has been gradually influenced by the Bolshevism, Professor Elie CARAFOLI managed to save the aviation department but at the cost of lowering the professional standards. Later work focused more on research in the new Institute of Mechanics and Metallurgy, which started its activity in the basement of the University where, after 1950 I was colleague with Mr. Ion STROESCU. For the future wind tunnel that he envisaged, with the experimental section of 2 x 2.5 m, Mr. Ion STROESCU designed the aerodynamic circuit while I drawn for my graduation thesis the project of a 150 hp fan with double rotor. The present subsonic wind tunnel from the Militari district was designed by Ion STROESCU and equipped with a propeller aircraft engine, as the industry at that time still could not achieve my project which was subsequently used in ventilation of the coal mines galleries. In almost half a century of operation, that wind tunnel, led with authority and responsibility by the late N. CAMARASESCU and his team. (Dinu CAPRITA, Marian CRANGASU, Petre UIU) worked in the service of research, education and industry.

By 1952, once admitted to doctoral studies with Mr. CARAFOLI I suggested a thesis named "Calculation and experiments on a finite span wing". But he firmly rebuffed my attempt: "Only fools still do such thesis today; for you I have something else in mind: we do not have specialists in the country on flow with friction, so you deal with boundary layers". Researching the relevant literature of specialty - especially the Anglo-German one - I noticed the compulsory dualism: theory and experience. Theoretically, I introduced a transformation, known as SAVULESCU - FERRARI, with which we obtained more directly the laminar boundary layer characteristics.

Prof. Elie CARAFOLI told me: "I am not a specialist in boundary layers, but I asked colleagues abroad and I was told that your transformation was valid". Thus, I obtained a strictly theoretical PhD degree. But I wanted terribly to be able to measure physically a Blasius speed profile. Then I asked Mr. STROESCU who advised me to work in the flat wind tunnel that he had built with educational purposes. Meanwhile, Professor CARAFOLI had got a Swiss hot wire anemometer Dätwiler - and gave it to me. Then I had to face the "turbulence" that, as the boundary layer, were the "most annoying provocations" of the fluid ideal flow. It had occurred to me to obtain a flow where I could control these "fundamental vices".

I consider myself a successor of Mr. STROESCU by introducing in Romania a new quality aspect of flows in the wind tunnels, namely the *degree of turbulence*. To lower an order of magnitude, i.e. to have a degree of turbulence of 0.1%, I had to increase greatly the stillness Chamber of Mr. STROESCU's flat wind tunnel and to equip it with nets. We were in a relatively clean area of Bucharest and yet, when we were cleaning the nets weekly, my collaborator FILIP Ovid was amazed at how much dust was deposited on them. So I got the notion of "*air pollution*" a topic further developed in Ecology.

The thickness of this layer were only a few millimeters and measurement equipment should have positioning accuracy of tens of microns The technician Vasile BUDURINCA performed the crossing device that provides that precision and that was appreciated by a researcher from Göttingen, came to visit our laboratories. We could thus determine the speed profiles in laminar, transitional and turbulent limit layers, assisted by my collaborator, the engineer Victor TOMA.

Therefore following Mr. Ion STROESCU, I created the IMFCA Laboratory of boundary layer and turbulence which I introduced into the international scientific circuit. I had distinguished guests as Henri COANDA or SCHLICHTING and I also offered internships for many foreign researchers including Prof. TRITTON of England. As a result, Professor CARAFOLI introduced the course of Experimental Aerodynamics within the Aviation Department of the Politehnica Institute, a subject of study that I taught some time together with late colleague Lucian DUMITRESCU.

In addition, I have achieved varying degrees of turbulence wind tunnels equipped with adequate measuring equipment. These wind tunnels were purchased by universities (at the initiative of the theorists Academicians Caius IACOB and Victor VALCOVICI) and by research institutes.

In the last years of his life, Ion STROESCU patented a system for evaluating the wind speed, using the calibration of a inclination angle of a rectangular plate that could rotate around a horizontal axis, a method used in the meteorology of the last century.

I recently remembered Ion STROESCU in July 2011 when I visited TUBerlin and the respective Professor (after discovered in the department documents that I had been a collaborator of Professor FIEDLER) showed me their latest achievement: a wind tunnel with a small *degree of turbulence* of 0.01%, located in a bunker to avoid the influence of mechanical disturbances, noise and pollution.

I could see a high ratio of contraction and sophisticated devices for the boundary layer control. He said that molecular physics, biology and pharmacy are interested in such flows.

The conclusion of Ion STROESCU's activity is the following: subsonic flows deep knowledge requires two components: *the theoretical modeling with mathematical formalisms and correct experiments* in the appropriate cases.