THIRTEENTH EUROPEAN ROTORCRAFT FORUM

INTRODUCTORY LECTURE

René DORAND : The Life of a Pioneer

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by

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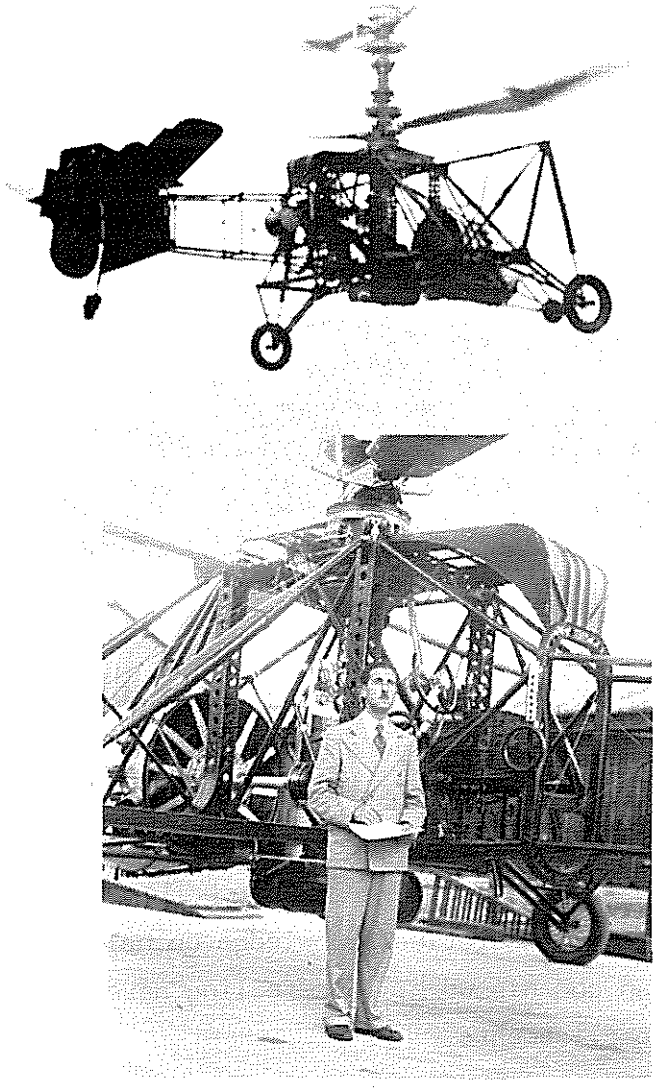
1949 : The NC 2001 helicopter in the hover

I am particularly honoured to be invited to recall the work of René DORAND. I met him 41 years ago and a 36 year period of close collaboration and friendly relationship have marked my personal life. At that time, when we met, René DORAND had already the figure of a pioneer and a number of achievements in the rotary wing domain were attributed to him. To the team that worked with him, he was a unique source of practical and theoretical knowledge on helicopters. So we were all much impressed by the man and his work. This feeling never left me, now that I understand better his accomplishments.

Born in 1898, he died six years ago, leaving behind him a rich amount of results contributing to the development of rotary wings.

Whatever the present difficulties, we must continue without respite, in the endless search for improved performance and better solutions. This was his principle, this was the rule of his life. Since we met I had the opportunity of sharing his work, his projects, his successes and his everyday effort for the advancement of rotary wings. Those who met him were extremely impressed with his warmth, charm , wit and intelligence. He was an original thinker who left his mark on the industry during the 60 years he spent meeting challenges and overcoming aeronautical problems. René DORAND was brought up in the environment of attempting to fly the first heavier-than-air machines. His father, Emile DORAND, was a fixed wing pioneer, a graduate of the Ecole Polytechnique, later Director of the Service Technique Aéronautique and one of the founders of the Ecole Supérieure de l'Aéronautique. He was responsible of the production of military planes during the World War 1. René DORAND was naturally attracted by an aeronautical career.



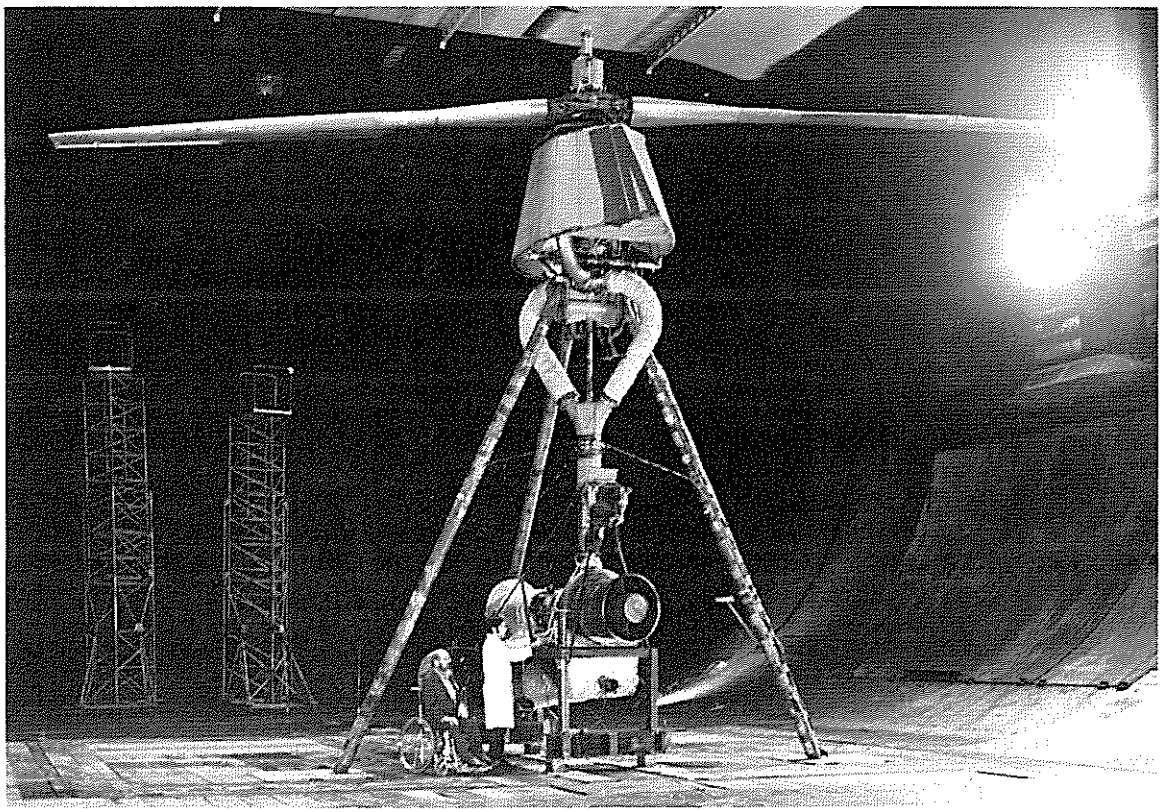
1935 : René DORAND in front of his world record helicopter, the "Gyroplane-Laboratoire"

1952 : Testing of the DH 011 gas-driven helicopter

His scientific and personal gifts for creativity encouraged to study engineering. Having graduated from the Ecole Supérieure d'Electricité and the Ecole Centrale, he entered in 1923 the Civil Service in the Service Technique Aéronautique. But not for long. His life was to be marked with sudden changes demanding all his energy to control the course of events. In 1925, he joined the Louis BREGUET Company, where his duties brought him into contact with leading figures of the aviation industry.

René DORAND's far-sighted, sometimes almost visionary, brilliance was always soundly based upon engineering feasibility. He prepared long-distance flights, met promenent pilots such as COSTES, CODOS, worked on the construction of the Bréguet 27. A new technology enthusiast, he left the fixed wings, in 1930, for the rotary wings and created with Louis Bréguet a Company devoted to helicopters. He studied the work of Lock, Glauert, La Cierva, designed and built the first practical helicopter : the "Gyroplane BREGUET-DORAND". The aircraft had two two-bladed coaxial rotors of 50 ft. diameter and was capable of lifting 2200 lbs. of payload.

1958 : DORAND at one of numerous technical meetings, seen in company of CLAISSE, CODOS, KRETZ, LEPERE (from left to right)



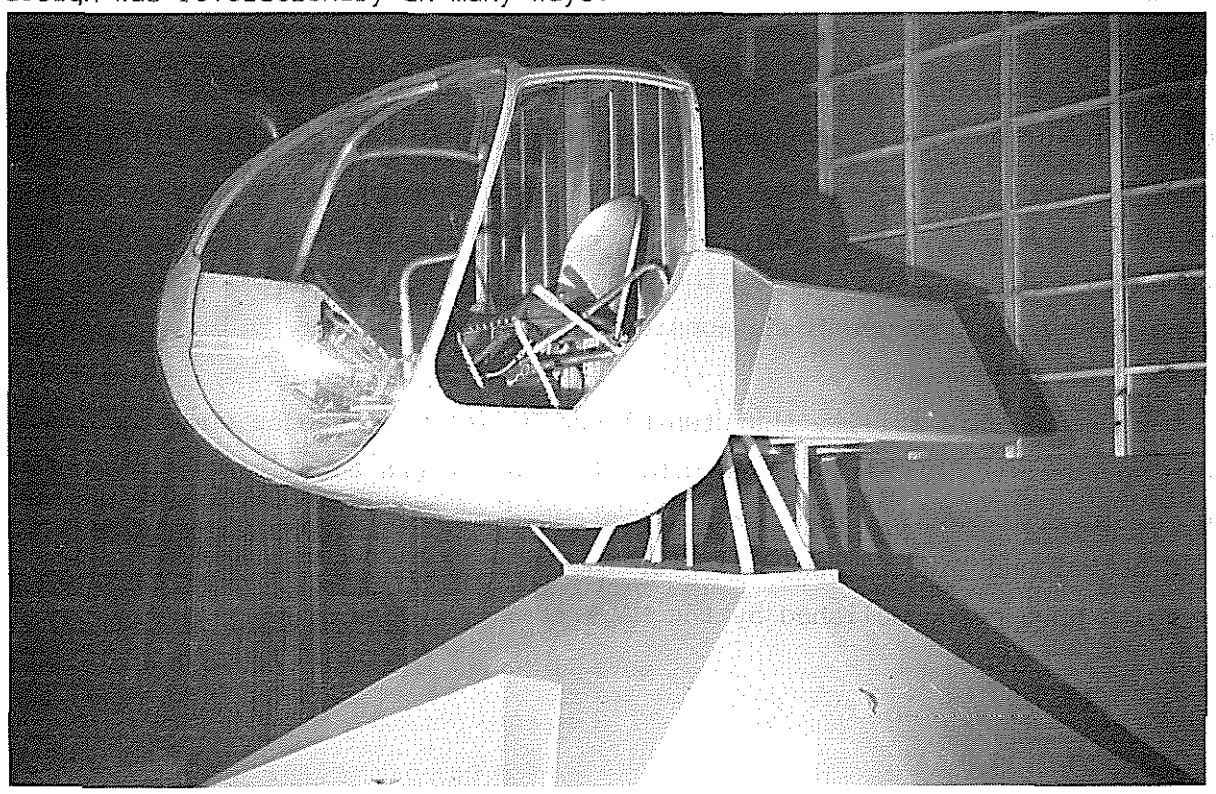
1965 : The DH 2011 jet-flap rotor during tests in the NASA 40 × 80 wind tunnel

It was equipped with an ingenious device of his invention, which all helicopters possess : the swashplate. In 1935, the Air Ministry issued Award Specifications for helicopter performance. Their level was extremely high for the technology standards at that time. Nevertheless, the BREGUET-DORAND gyroplane met all award specifications and, at the same time beat all then existing world records by flying at 65 kts and staying in the air for over an hour, making autorotative landings and thus opening the way to operational helicopters.

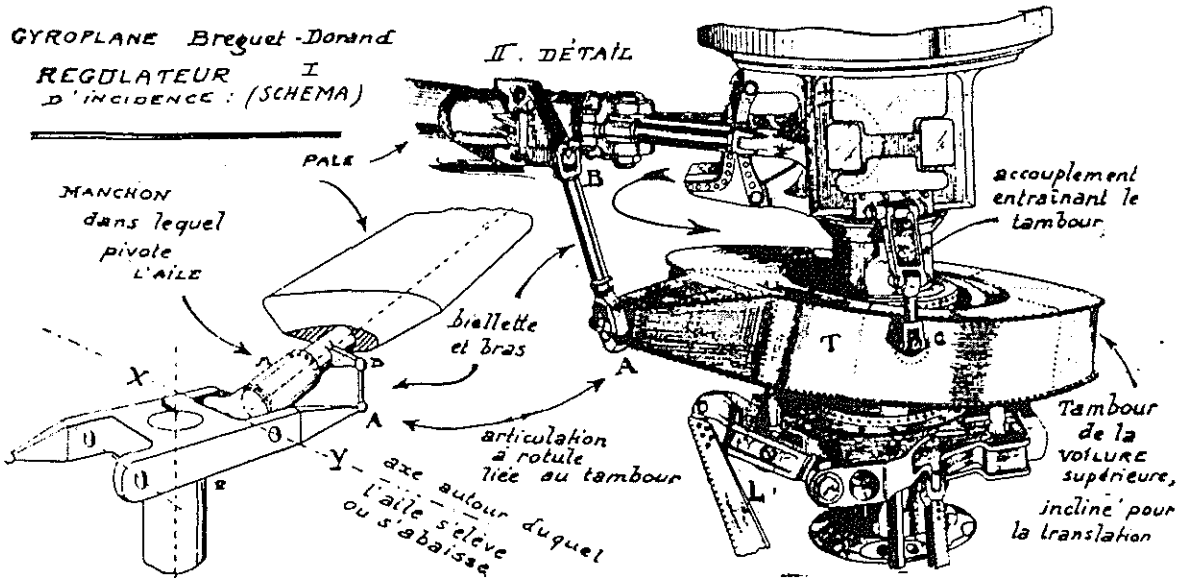
Performance achieved :		Award Specification :
Speed	: 108 km/h	100 km/h
Flight time	: 1h 2' 58''	1 hour
Altitude	: 158 m	100 m
Hover time	: 10 minutes	10 minutes
Autorotation	: Simulation of engine failure at different altitudes	Autorotative landings

To attain this exceptional level of development, an exceptional pilot was needed, Maurice CLAISSE, who participated during the years 1933-1936 in all tests of the gyroplane, thus opening the way to the modern helicopter. Shortly after the record flights, René DORAND was decorated Chevalier de la Légion d'Honneur and the Air Ministry ordered two different helicopter prototypes.

The war stopped construction of the G 10 and G20 prototypes. The original gyroplane was destroyed to avoid capture by invading enemy. For René DORAND started a painful period of five long years during which work on rotary-wing projects went underground. A new era begins in 1945. René DORAND created a helicopter division in one of the nationalized aviation companies and built a 4-ton helicopter with intermeshing rotors, the NC 2001. One of the two prototypes built was flown in 1949, but financial problems cumulated and the company was shut down. I remember his alerting all his friends and official agencies with the energy typical to his character. A small group of technicians, firmly believing in the future of rotary wings, assembled around him and created a private company, GIRAVIONS DORAND. The year 1949 ended in a rush of feverish activity. Numerous projects were being produced on the drawing board : heavy lift gas-driven helicopters, gyrogliders, wind-turbines. In 1951, gyrogliders and gas-driven helicopters were under construction. At that time René DORAND proposed the use of jet-flaps to drive and control the rotor. A new idea with new successes : two rotors were tested in the ONERA wind tunnel in the 50's. The results attracted the attention of the U.S. Army, who ordered a 40 ft. diameter rotor capable of lifting 4 tons. The design was revolutionary in many ways.



1952 : The moving cabine of the DX 50 flight simulator



1930 : Invention of the swashplate, French patent N° 711-456

Light weight, simplicity and low cost result in a large number of basic advantages characterising jet-flap craft. The jet-flap rotor is fixed pitch, which is a structural advantage dominating this type of rotor and is unique among rotary wings in general.

Together with the possibility, due to blowing, of using two-bladed rotors for obtaining high forward velocity, this rotor avoids the present complications of hub and blade-root. This difference may be compared with that between fixed and variable pitch propellers. From the aerodynamic point of view, the jet-flap possesses the property of being able to vary lift very rapidly up to high harmonic frequencies. In forward flight, the azimuthal variation in jet-flap deflection is obtained by a multicyclic control system. This ability to vary lift forces according to a desired law enables the level of vibration transmitted to the fuselage and blade stresses to be considerably reduced.

It is because of this ability that two-bladed helicopters can be envisaged for forward speeds of 250 knots. The possibilities of stress and vibration reduction using multicyclic control have been demonstrated experimentally in the NASA 40 × 80 tunnel and to our knowledge, for the first time, by the DH 2011 rotor. The results have been published by the NASA.

In addition to its structural simplicity, the fixed-pitch, jet-flap rotor has other advantages : it eliminates the danger of aeroelastic vibration and allows the use of low-solidity rotors. In most cases, the average lift coefficient is close to 1, thereby enabling blade surface to be decreased by at least half compared with unblown rotors. Furthermore, the fact that the jet exhausting from the trailing edge induces a region of very low pressure, similar to that at the leading edge, displaces the aerodynamic center from the quarter-chord point towards the middle of the chord enabling the blade to be balanced much nearer the trailing edge, whence considerable saving in blade weight. It should be noted that the DH 2011 rotor blade had its center of gravity at the 35% point of the mean chord and never showed any signs of aeroelastic instability.

Moreover, rapid lift variation may be usefully employed in the case of transient conditions such, for example, as during the stopping of a rotor, when the feedback channels enable forces operating on the blades to be measured precisely and continuously.

The rotor was tested by the NASA in the years 1965 to 1971. The outcome of these tests is now being vigorously pursued as research on active controls applied to rotary wings, work done under French DRET contracts.

The prime advantage of active controls is the higher-order optimization of helicopter working conditions. Such optimization is achieved essentially by sensing the helicopter work and load states, processing the resulting information in an appropriate manner and then feeding it back to a conventional or unconventional control system for improving the dynamic behavior of the craft. It should be mentioned here that optimal estimation theory is highly valuable in the quest for expansion of the helicopter flight envelope. This was made possible by the development of an extremely simple analytical model of the rotor : the rotor transfer matrix, discovered in 1971.

The scientific curiosity of René DORAND was very wide. In the early 50's, the problem of handling quality was critical one and we had many discussions on this subject : "Why not build a simulator ?". This apparently simple question had an important impact on the future. We built a full scale, moving cabine research simulator, the DX 50, that resolved the instability and handling quality problems of the helicopters to come and opened a new activity of training simulators. These early simulators were based on an ingenious electromechanical device invented by René DORAND : the double integrator. Later, the simulators, more particularly guided missile simulators, became the main activity of the GIRAVIONS DORAND Company, which today employs 400 people.

René DORAND was active in his company as its Technical Director until 1976 and then continued to work on urgent technical problems. Most of the challenging problems of energy became his prime concern.

These scientific activities were interrupted by his sudden and unexpected death. His many friends and colleagues on both sides of the Atlantic will always remember René DORAND as an exceptional pioneer and a man of great charm and unimpeachable integrity. We miss him very much.