UDK: 533.6.071.3:808.62-316
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Gustave Eiffel and the Wind: A Pioneer in Experimental Aerodynamics

Dijana Damljanović[1)]

1912 - 2012 *Centenary of the Eiffel Wind Tunnel*

"Le vent, mon ennemi…" **Gustave Eiffel**

GUSTAVE Eiffel (1832-1923) is a prominent name in the history of engineering and technology. Educated as a civil engineer at the *École Centrale des Arts et Manufactures*, Eiffel had a career spanned over fifty years during which he designed dozens of legendary iron and steel structures, including the Porto Viaduct in Portugal, the supporting structure for the Statue of Liberty in New York Harbor, and the Eiffel Tower in Paris – the structure that cemented his name in history. This long and successful career brought him considerable wealth, and late in his life he decided to invest in the newly emerging field of aeronautics. At the age when many people retire, Eiffel built and operated some of the finest aeronautical research tools of his day using his own funds. In 1909, at the foot of his famous tower, Gustave Eiffel built one of the first wind tunnels dedicated to a new science: Aerodynamics. In 1912, the wind tunnel was moved to Auteuil, in Paris, where it is still in operation. He gathered data systematically setting new standards for measurement accuracy. His wind tunnels and methods served as models for subsequent laboratories around the world. This article traces the evolution of Alexandre Gustave Eiffel as an engineer and scientist, and gives a short overview of the celebration of the centenary of the Eiffel wind tunnel at Auteuil. The VTI has also taken part in this celebration.

Alexandre-Gustave Eiffel was born in Dijon, France in 1832. Interested in construction from an early age, he attended the *École Polytechnique* (Polytechnic School) and later the *École Centrale des Arts et Manufactures* (College of Art and Manufacturing) in Paris, graduating in 1855. After graduation, Eiffel specialized in metal constructions, most notably bridges. He worked on several ones over the next few decades, letting mathematics find ways to build lighter, stronger structures.

1) Military Technical Institute (VTI), Ratka Resanovića 1, 11132 Belgrade, SERBIA

Alexandre-Gustave Eiffel, [1]

Early Projects

One of Eiffel's first projects dates back to 1858, when he supervised the construction of an iron bridge in Bordeaux. By 1866, Eiffel set up his own company. By the time he designed the arched Gallery of Machines for the Paris Exhibition of 1867, his reputation had already been well established. Also in 1867, he designed the 160-meter steel arch bridge over the Douro River in Oporto, Portugal. Working from the same design nearly 20 years later, he built the renowned 165-meter long Garabit viaduct in Truyère, France (suspended 122 meters above the water surface, it was the highest bridge in the world for years after its construction).

As his career advanced, Eiffel moved away from bridgework. In 1879 he created the movable dome for the astronomical observatory in Nice, France. That same year, when the Statue of Liberty's first engineer Eugène Viollet-le-Duc unexpectedly died, Eiffel was hired to continue his work. Eiffel created a new support system for the statue that would rely on its skeletal structure to support the copper skin. Together with his team, he built the statue from the ground up and then dismantled it for its journey to New York Harbor.

Eiffel Tower

Eiffel is most famous for what would become known as the Eiffel Tower. The works started in 1887 for the 1889 Universal Exposition in Paris. The tower is composed of 12,000 different components and 2,500,000 rivets, all designed and assembled to handle wind pressure. The structure is a marvel in material economy, which Eiffel perfected in his years of building bridges – if it were melted down, the tower's metal would only fill up its base about two and a half inches deep. Onlookers were both awed by Eiffel building the world's tallest structure (at 300 meters) in just two years and torn by the Eiffel Tower's unique design, derided by most as hideously modern and useless. Although the tower became a tourist attraction immediately, only years later did critics and Parisians begin to view the structure as a work of art.

Eiffel Tower, an intricacy of the member connections – a view of the base arch; an upward view of the tower from the inside; and a view of the corner; Author's personal collection

The tower also directed Eiffel's interest to the field of aerodynamics, and he used the structure for several experiments and built the first aerodynamic laboratory at its base (which was later moved to the outskirts of Paris). The lab included the first wind tunnel ever built, and his work there influenced some of the first aviators, including the Wright brothers.

He went on to write several books on aerodynamics, most notably *Résistance de l'air et l'aviation* (Resistance of the Air and Aviation). Eiffel turned his interest to meteorology in the last years of his life, studying the subject at length before dying on December 27, 1923.

Eiffel is justifiably remembered for his famous bridges and other landmarks of civil engineering, but his mechanical engineering contributions to aerodynamics are seldom mentioned in today's aeronautical circles. This is a pity, not only because of his wind tunnel innovations, but also because of his significant contributions to aeronautical research techniques.

Eiffel and Aerodynamics

There was much interest in flight as the twentieth century dawned, particularly in Europe and America, but no one had yet flown in a powered aircraft when Gustave Eiffel began his own investigations into the effects of a solid body moving through the air. Several test methods had been used by various experimenters, including drop testing, whirling arms, and rudimentary wind tunnels (although the term "wind tunnel" would not appear until later), but most of these techniques were very primitive, and they yielded inconsistent results.

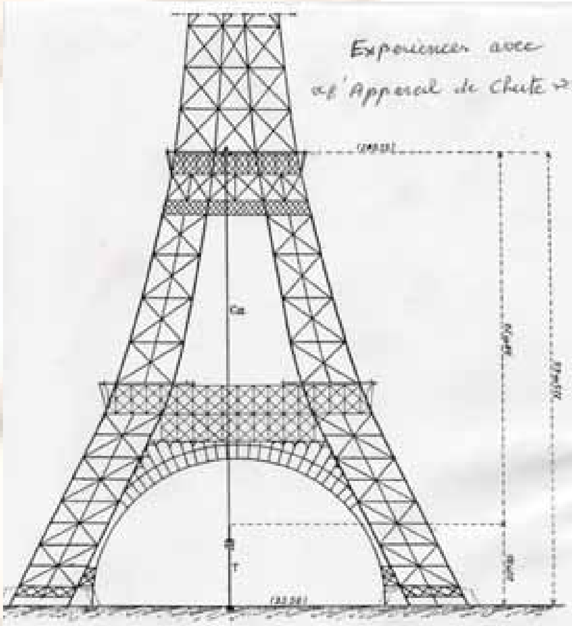
Eiffel applied his engineering knowledge and experience to two of these methods, and he produced what arguably are the most sophisticated drop-testing apparatuses ever constructed and some of the most capable and consistently performing early wind tunnels. Eiffel designed these devices with specific research programs in mind. Unlike many of his contemporaries who tried to build gliders and flying machines based on unproven notions, Eiffel realized that certain basic information about how solid bodies and air interact would be crucial to success.

The Drop Test Machine

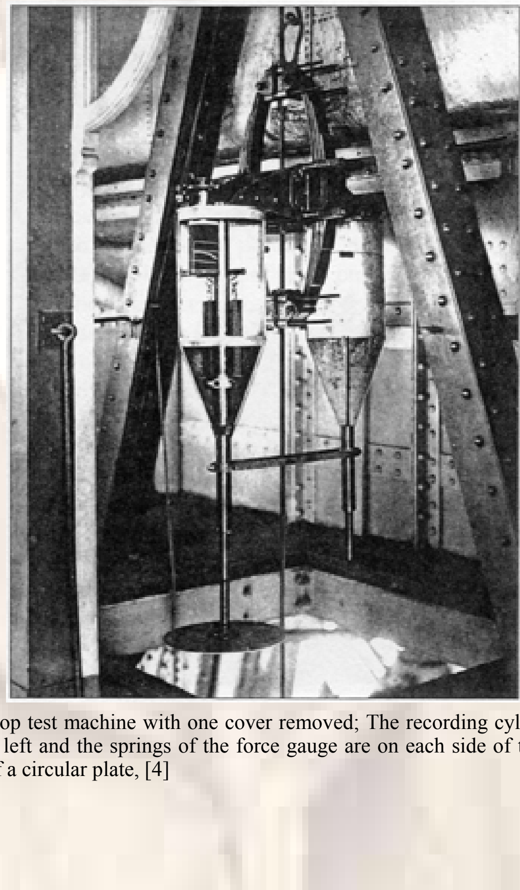
Eiffel began experimenting with drop tests in which a body was simply dropped from a height, with gravity doing the work. This method was simple and reliable, but it proved very difficult for an observer on the ground to measure and records the body's motion and the forces acting on it. When released, a body would accelerate until the air resistance force equaled the force of gravity, after which it would move at a constant speed until it struck the ground, or was otherwise stopped. To get useful data, it was necessary to know the portion of the fall where the body was moving at a constant speed and the air resistance force, called "drag", was constant.

Eiffel designed a machine that could record the drag on an internal paper graph during the test. Rather than trying to measure velocity during the test, he could examine the chart afterwards, when he could carefully measure points on the line drawn on the graph at his leisure. Eiffel's machine featured two identical parallel cylinders with conical noses. Inside each one was a recording mechanism and a measurement device attached to a rod that protruded out the bottom. Various shaped objects were fastened to it. When released, the amount of drag drawn on the graph would increase as the machine accelerated, but then level off at a constant value once the constant speed was reached. The device recorded the time and the distance traveled on the graph as well, so it was easy to compute the magnitude of the constant speed for each test. Eiffel calibrated the device by dropping it with no test specimen attached. This revealed the drag on the machine itself, which could later be deducted from the total drag to get the net result for each test body.

Not coincidentally, Eiffel had an excellent location for his drop testing, the Paris tower that bears his name. He installed a vertical guide wire from the tower's second floor to the ground, a distance of approximately 115 meters. Eiffel also included a brake that actuated about 21 meters above the ground. This preserved the machine and test body, and the sudden reduction in drag on the graph indicated the end of the steady-state test conditions.



Installation for the Eiffel drop testing, [6]



The drop test machine with one cover removed; The recording cylinder is on the left and the springs of the force gauge are on each side of the rod; Test of a circular plate, [4] Eiffel conducted his first drop test at the tower on July 30, 1903. Over the next three years, he tested some 40 different two-dimensional and three-dimensional shapes. All were tested facing directly into the air stream, and several were mounted so that they could be tested at various angles of attack. In 1907 Eiffel published *Recherches expérimentales sur la résistance de l'air exécutées à la Tour* (Experimental research on air resistance executed at the Tower), detailing his methods and results. His speed-versus-drag values were soon accepted as the most reliable data available.

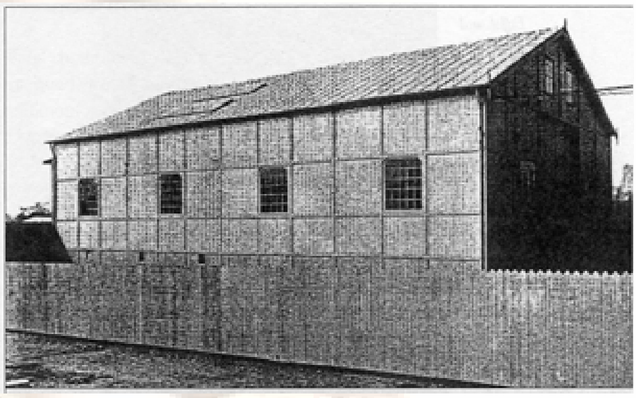
Eiffel generated important data with this apparatus, but he soon realized that it limited the scope of his investigations. If he wanted to study wing lift, propeller action, or just about anything else aeronautical, he needed something better, a device capable of longer duration tests under more carefully controlled conditions. In his characteristic fashion, Eiffel performed a thorough, systematic review of existing aeronautical research methods, publishing the results in *La Résistance de l'air: Examen des formules et des expériences* (Air Resistance: Review of formulas and experiments) in 1910. By then, Eiffel knew what his next device would be.

Eiffel's First Wind Tunnel

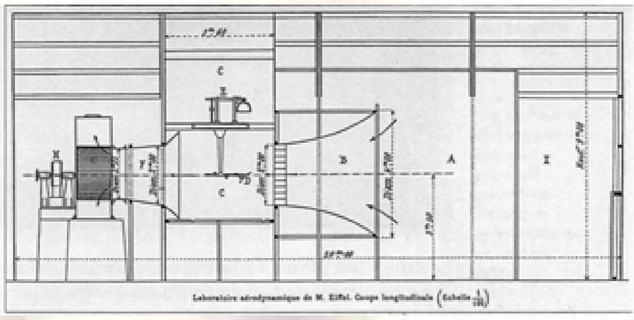
Eiffel decided that the device now known as a wind tunnel would best suit his needs, but this decision rested on an important assumption: that the forces on a stationary body from a fluid moving around it are the same as the forces on that body moving at the same speed through still air. This concept, called relative motion, had been postulated at least four centuries earlier by Leonardo da Vinci, and later recognized by notables such as Isaac Newton and Jean le Rond d'Alembert. But no one had ever run physical tests to confirm the theory, and some doubts remained. Having reviewed the state of the art, Eiffel felt confident in accepting the validity of relative motion, and he realized that such a tunnel could give him the repeatability and long test times he wanted.

Eiffel built his first tunnel at Champs-de-Mars near the foot of the Eiffel Tower. The tower had a generator to produce electricity that powered the tower's elevators and lights, so he could use power from it to drive the tunnel's blower. A Sirocco blower driven by a 50-kilowatt (68-horsepower) motor sucked air through the test section and then blew it through a hall and back into the building's main room. A flared inlet duct with a honeycomb-type flow straightener streamlined the air flow entering the test section.

The most unique feature of this wind tunnel, and the one most notably associated with Eiffel, was its test section. Like other experimenters of the time, Eiffel had concerns about how the walls near the test specimen would affect the air flow around it. Other tunnels had been built with open test sections that had no walls, but open test sections were affected by atmospheric changes, or even movements within the room. Eiffel devised a test section that addressed both issues. He built a room closed off from the rest of the building. The inlet duct fed air in through one wall of this "experimental chamber" and the blower's suction inlet penetrated the wall directly across the test room from it. This allowed a horizontal column of air 1.5 meters in diameter to move across the room, but not come in contact with its walls. The air speed was 20 meters per second. Since the experimental chamber was closed off from the larger space, the test room conditions remained much more constant than did those in a typical open-section tunnel. The force measuring apparatus, known as a balance, was mounted on a mezzanine in this chamber above the test area. Only the end of the bracket that held test specimens protruded into the air stream. Future tunnels with this type of test section came to be known as "Eiffel type" tunnels.

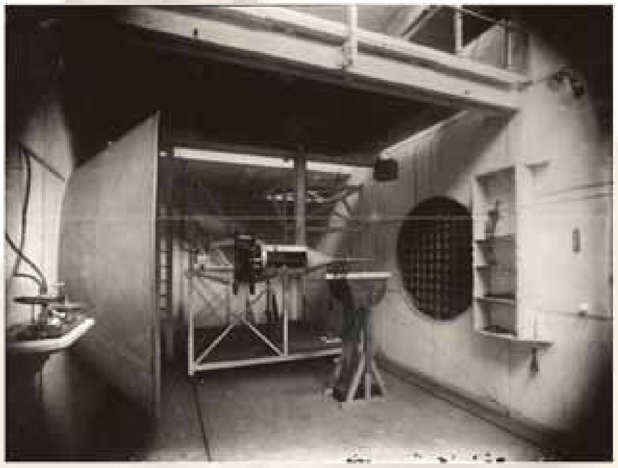


Building for the Eiffel wind tunnel at Champs-de-Mars, [4]



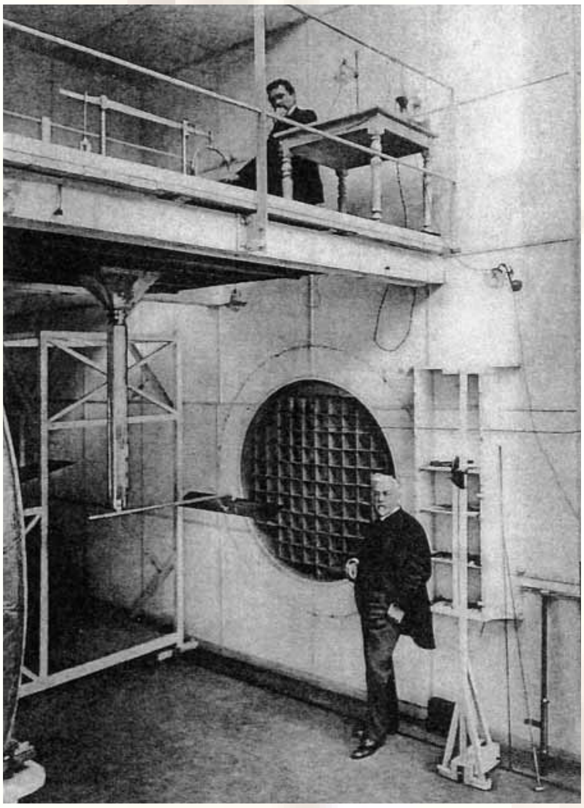
Section of the wind tunnel at Champs-de-Mars; Note the enclosed experimental chamber (C), [4]

Eiffel finished this wind tunnel and began his experiments in 1909. One of his test programs was to test systematically the bodies he had drop-tested in the wind tunnel to validate the performance of the tunnel. This was the first true test of the relative motion theory, and the data proved it valid. The forces measured in the wind tunnel matched those obtained during the drop tests.



Validation of the tests made in free fall at the Tower, [6]

The Wright brothers had successfully flown their *Flyer* six years earlier, and they had recently demonstrated their improved airplane in France to great acclaim. Aviation fever quickly gripped Europe, and many pioneers pursued a wide variety of concepts for what they hoped would be successful airplanes. Because of Eiffel's reputation, many of these pioneers sought him out to test their wing and propeller designs. Between 1909 and 1912, Eiffel ran over 4,000 tests in this tunnel, and his systematic experimentation set a new standard for aeronautical research. As with his drop tests, Eiffel published his methods and early findings in 1911 under the title *Résistance de l'air et l'aviation: Expériences effectuées au Laboratoire du Champs-de-Mars* (Resistance of the Air and Aviation: Experiments performed in the laboratory at Champs-de-Mars). So important was this work that American naval officer Jerome C. Hunsaker translated it into English two years later.



Eiffel and a coworker at the wind tunnel of Champs-de-Mars, [4]

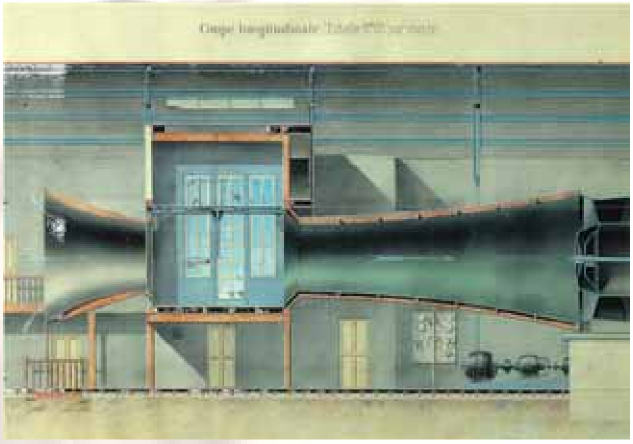
With this basic laboratory at Champs-de-Mars, Eiffel proved the validity and usefulness of wind tunnel testing beyond any doubt, but he realized that still more could be accomplished with more sophisticated facilities. While tests were still being conducted at the Champs-de-Mars laboratory, Eiffel began to design and build a much-improved, permanent laboratory.

The Auteuil Laboratory

Eiffel selected a location for his new laboratory at Auteuil, then a suburb southwest of Paris. There he erected a substantial building with offices and a large hangar. While the hangar included some shop space for model construction and test preparation, its dominant features were two wind tunnels, one with a 1-meter-diameter test section, and a larger one with a test section measuring 2-meters in diameter. These tunnels shared a common experimental chamber, similar to the one at Champs-de-Mars, so only one could be operated at a time.

While similar in design, the smaller tunnel had a Sirocco blower, but the larger tunnel featured a multi-blade propeller fan. This propeller proved to be very efficient and most subsequent wind tunnels would incorporate one. A 37.5-kilowatt (50-horsepower) electric motor and a flat belt drove each fan. A motor-generator set converted commercial alternating current into direct current that allowed operators to vary the fan speed easily.

Inauguration of the Eiffel Laboratory at Auteuil, March 19, 1912, [6]

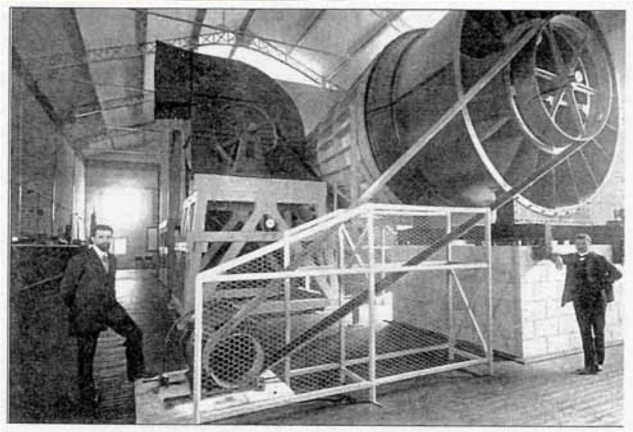


A cross-section drawing of the wind tunnel with the 2-meter test section in the Eiffel Laboratory at Auteuil, [6]

Eiffel improved the efficiency of these tunnels in another important way as well. He understood that air velocity and its static pressure could be traded off. As air velocity increased, its static pressure decreased. Since fast-moving air experienced turbulence and frictional energy losses, he limited high velocity to the test section. He added a long diffuser between the test chamber and the blower of each tunnel that roughly doubled the tunnel's diameter at the fan. This made the fan inlet velocity approximately one-quarter of that in the test section, and the static pressure of the air correspondingly higher, both of which enhanced fan performance. As with the propeller fan, a diffuser downstream of the test section became a standard part of future wind tunnels.

Each fan discharged into the hangar, where the air moved slowly through the room until it was recaptured by the inlet cone. Each inlet cone was flared so that the entering air would not have to make abrupt, energy-absorbing changes in direction. As the air moved through the converging cone, it accelerated smoothly to test speed. Honeycomb-type flow straighteners at the test chamber wall ensured the smoothest possible flow of air across the test specimen and, thus, the best possible measurements.

As expected, these two wind tunnels outperformed their Champs-de-Mars predecessor. The 1-meter tunnel could produce a maximum speed of 40 meters per second, twice that in the earlier tunnel. The performance of the 2-meter tunnel was even more impressive. Its top speed of 32 meters per second was slower than in the 1-meter tunnel, but still 60 percent faster than the Champs-de-Mars tunnel, and the large tunnel moved three times the volume of air that went through the smaller one. In both cases, these improvements were achieved using approximately 25 percent less power than at Champs-de-Mars, primarily owing to the diffusers. Eiffel patented his diffuser in 1912. He never asked for royalties but requested that a plaque of 1 by 0.5 meters indicating *Appareil Aérodynamique Système Eiffel, G. EIFFEL, PARIS* (Aerodynamic apparatus of Eiffel system, G. EIFFEL, PARIS) be posted at the entrance of the test chamber.

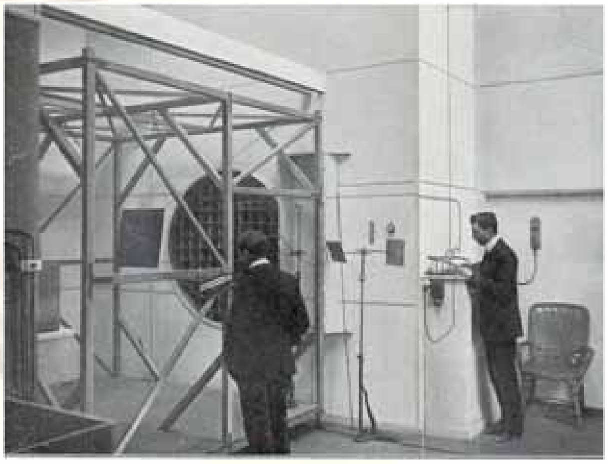


View inside the Auteuil laboratory showing the electric motors and blowers at the discharge ends of the tunnels, [4]

Eiffel and Lapresle in the control room, [4]

More than Wind Tunnels

In addition to lift and drag measurements taken with the balance, Eiffel performed the first comprehensive studies of the pressure distribution over bodies in an air stream. While primitive pressure-distribution measurements had been made by two Danes, Johan Irminger and H.C.Vogt, in 1894, Eiffel's were extensive and detailed, and unlike Irminger and Vogt's studies, these were specifically oriented towards airplanes and flight. Eiffel opened a valuable new window of aerodynamic understanding, and pressure-distribution studies remain one of the most common and important uses of wind tunnels. In performing pressure-distribution tests on various airfoils, Eiffel demonstrated that more of a wing's lift came from the pressure reduction on its top surface than from the pressure increase on its lower surface, a question hotly debated at the time. He plotted the pressure distributions as contour plots, graphical representations that were easily understood and compared.

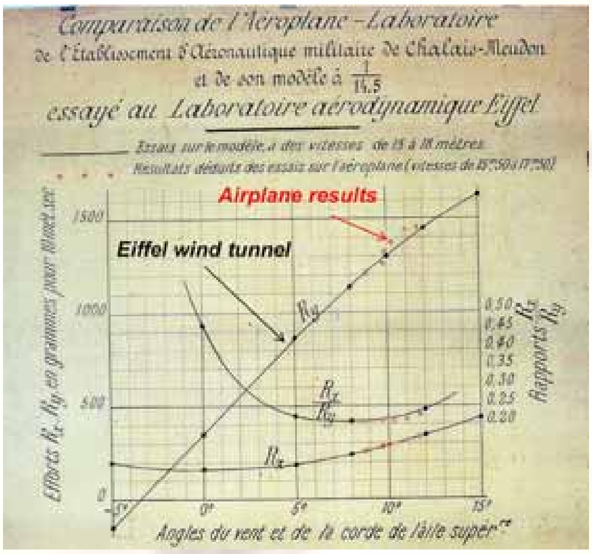


Pressure-distribution measurement on a flat plate, [6]

In addition, he showed a direct correlation between pressure distribution and lift and drag forces, noting, "The direct measurement of pressure has given us a result to which we attach great importance; viz., *the summation of the observed pressures was equal in every case to the reaction weighed on the balance*." [Eiffel's italics] This was no trivial statement, and it became an important foundation stone in the long saga that would ultimately link empirical and theoretical aerodynamics. Although Eiffel was primarily an empiricist who sought understanding through experimentation, the design of his experiments coupled with such insightful analysis of the resulting data also places him solidly among the ranks of the early aeronautical theorists.

Eiffel was the first to test models of complete airplanes in his wind tunnels and to show a correlation between test data and the actual performance of a full-size airplane. He understood something of a scale effect, where aerodynamic coefficients change with the size of similar shapes. Because air molecules do not "scale down" in size like a model airplane, the forces measured with a model do not precisely "scale up" to those on the full-sized airplane. Even though he did not fully grasp the modern concept of dynamical similarity to account for these scale effects, he did use "augments" as he called them, to adjust model data when predicting full-size performance. He developed these augments from his experiments and concluded that, "the calculations are in each case in complete accord with the actual conditions observed in flight."

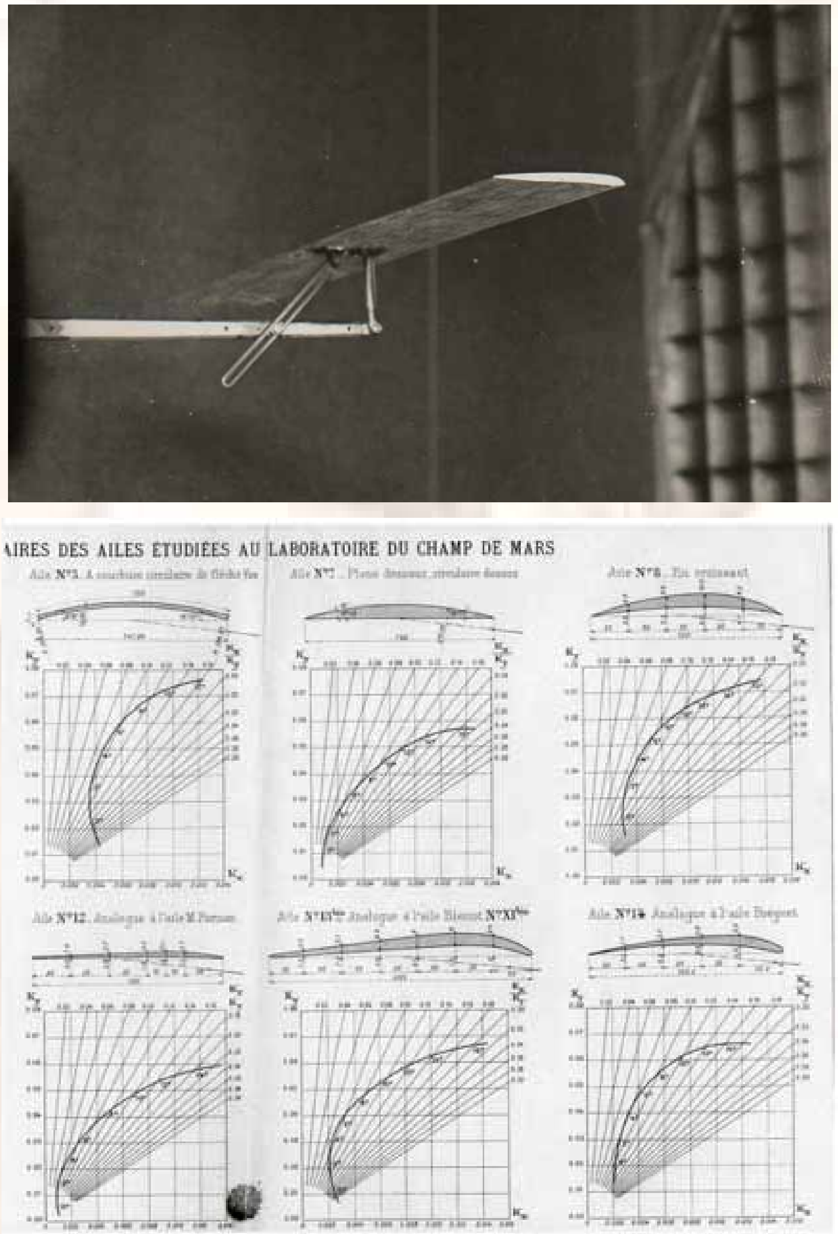
Commandant Dorand's airplane (scale 1/14.5), [6]



Comparison between model testing and results obtained at Meudon on Commandant Dorand's airplane, [6]

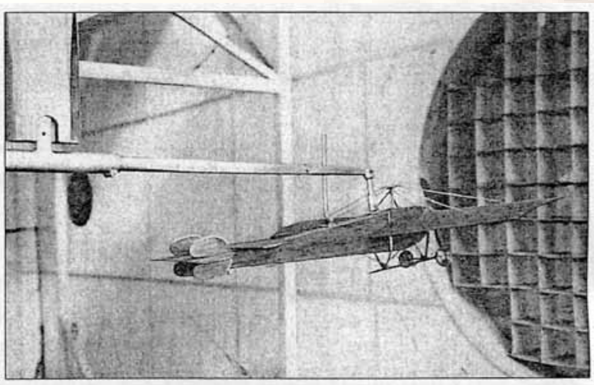
Although his understanding of dynamical similarity may have been weak and this was something of over-statement, Eiffel nevertheless pioneered the use of wind tunnels in designing complete airplanes.

Interested in all aspects of applied aerodynamics, Eiffel also did important work on propeller aerodynamics, and he is credited with developing the term "advance ratio" to describe a propeller's basic performance parameters. Realizing that knowledge was worthless unless it could be communicated to others and understood by them, he devised ways to make aeronautical data clear and understandable. The most significant of these was his *la polaire* (polar diagram), a graphical depiction that integrated all important aerodynamic characteristics into a single diagram. Finally, he must get the credit for the tests that proved the validity of relative motion.



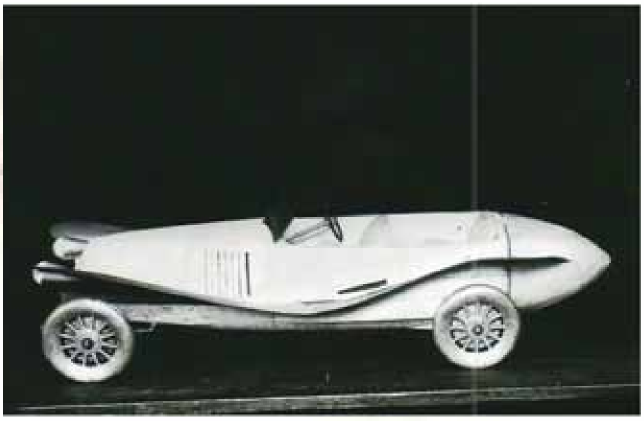
Wing testing and polar representation, [6] Although two prototypes of a monoplane designed by Gustave Eiffel were produced during World War I, he is not primarily known for building airplanes, but his work in applied aerodynamics formed the basis for all subsequent developments in the field. This drop test machine and wind tunnel laboratory form a fitting memorial to one of the world's true pioneers of aviation.

The Tatin airplane, [6]



1/10 scale model of a Nieuport monoplane being tested in the Champs-de-Mars wind tunnel, [4]

1/5 scale model of Nieuport monoplane on floats tested in the Auteuil wind tunnel on January 14, 1913, [4]



Renault car (1920), [6]

The Eiffel Laboratory at Auteuil – From 1912 to Nowadays

1912 – Inauguration of the Eiffel Laboratory

1921 – STAé takes the Laboratory in charge (STAé: *Service Technique de l'Aéronautique*)

1929 – Ministry of Air and GIFAS use simultaneously the wind tunnel (GIFAS: *Groupement des Industries de l'Aéronautique et de l'Espace*)

By 1933, ten years after Eiffel's death at the age of 91, the 2-meter tunnel was hosting almost all of the research at Auteuil, so the 1-meter tunnel was dismantled. This provided a bigger shop and set-up space for what had become a heavy research load.

Other wind tunnels were built in France and throughout the industrialized world during the years that followed, most of them with features introduced by Eiffel.

1983 – Martin Peter creates the firm *"Aérodynamique Eiffel"*

2001 – CSTB buys the wind tunnel (CSTB: Centre Scientifique et technique du Bâtiment)

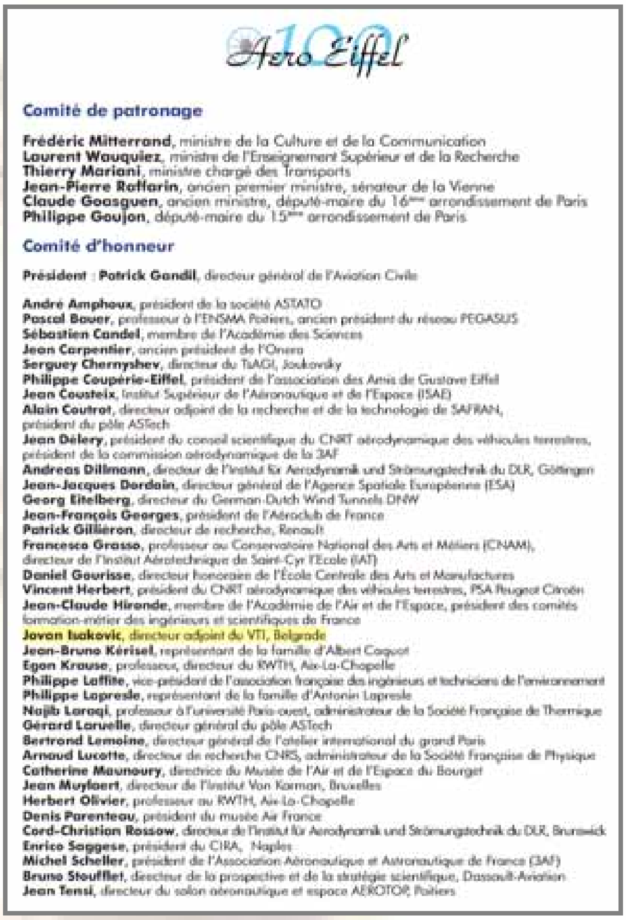
The Eiffel Laboratory in Paris; Author's personal collection

Even with the capabilities of these newer wind tunnels, the Auteuil tunnel remains in useful service, over 90 years after its debut, thanks in part to the installation of a new balance in 1960 and a drive upgrade in 2002. Test programs have included airplanes, buildings, and even Formula 1 racecars.

Now as a French National Monument, the Eiffel Laboratory's survival is assured.

Blower at the discharge end of the tunnel, The Eiffel Laboratory; Author's personal collection

Control room; Author's technical visit to the Eiffel Laboratory, March 2012; Author's personal collection



Aero Eiffel 100

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Honorable committee of the celebration

VTI representatives, The 47th International Symposium of Applied Aerodynamics, Arts et Métiers ParisTech; Author's personal collection

VTI Representatives at the Celebration of the Centenary of the Eiffel Wind Tunnel

In 2012, the French aerodynamics community celebrated the centenary of the Eiffel wind tunnel and its continued use for the study of a large number of aerodynamic problems concerning aircraft, automobiles, buildings, etc.

Jovan Isaković, Deputy of VTI General Manager, as a member of honorable committee, took part in the celebration of the centenary of the Eiffel wind tunnel (1912-2012) organized by the French Directorate of Civil Aviation (DGAC) and association Aero Eiffel 100 with the support of the National Office for Aerospace Research (ONERA) and French Aeronautical and Astronautical Association (3AF) in Paris, 26th–28th March 2012. The celebration was attended by about 200 representatives of aeronautical organizations worldwide.

The 47th International Symposium of Applied Aerodynamics, on the subject 'Wind tunnel and Computation – a Joint Strategy for Flow Prediction', was placed under the auspices of this celebration. It was focused on today's strategy used for performance predictions and detailed flow analysis. This included intensive use of CFD in connection with wind-tunnel experiments aiming at assessing the accuracy of computations, investigating the physics of complex flows and improving theoretical models. The symposium also considered the close connection between the wind-tunnel operation and CFD within the context of a computer-aided wind tunnel. The symposium was also attended by Đorđe Vuković, Marija Samardžić and Dijana Damljanović, engineers from the VTI, who presented three papers related to wind tunnel testing.

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Received: 15,06.2012.

Gustav Ajfel i vetar: Pionir eksperimentalne aerodinamike

1912-2012 *Stogodišnjica Ajfelovog aerotunela*

Gustav Ajfel (1832-1923) je istaknuto ime u istoriji inženjerstva i tehnologije. Pedeset godina duga karijera građevinskog inženjera francuske škole obeležena je desetinama legendarnih struktura od gvožđa i čelika, uključujući Porto vijadukt u Portugalu, unutrašnju strukturu Kipa Slobode u Njujorku i Toranj u Parizu, koji je i učvrstio njegovo ime u istoriji. Ovako duga i uspešna karijera donela mu je znatno bogatstvo, koje je kasnije investirao u novu oblast rada – vazduhoplovstvo. U godinama kada se većina ljudi penzioniše Ajfel je, uloživši sopstvena sredstva, izgradio neke od najboljih vazduhoplovnih istraživačkih alatki svog doba. Ajfel je 1909. godine u podnožju svog čuvenog tornja podigao jedan od prvih aerotunela, posvećen novoj nauci – aerodinamici. Aerotunel je 1912. godine premešten u predgrađe Pariza, gde je još uvek u upotrebi. Ajfel je koristio aerotunel u sistematičnom prikupljanju podataka i postavio nove standarde za tačnost merenja, a aerotunel i metode koje je primenio bili su polazna osnova eksperimentalnim aerodinamičkim laboratorijama koje su osnivane širom sveta. Ovaj rad prati razvoj Aleksandra Gustava Ajfela kao inženjera i naučnika, i daje kratak osvrt na proslavu stogodišnjice Ajfelog aerotunela u Parizu, kojoj su prisustvovali i predstavnici Vojnotehničkog instituta.

Густав Эйфель и ветер – Пионер экспериментальной аэродинамики

1912-2012 *Столетие аэродинамической трубе Eiffel*

Густав Эйфель (1832-1923) является именем с хорошей репутацией в истории техники и технологии. Пятьдесят-летняя карьера в качестве инженера-строителя французской школы была отмечена десятками знаменитых структур из железа и стали, в том числе виадука Порто в Португалии, внутренней структуры Статуи Свободы в Нью-Йорке и знаменитой Башни в Париже, которая и укрепила его имя в истории. Такая долгая и успешная карьера принесла ему и значительное состояние, которое он позже инвестировал в новую область своей деятельности – в авиацию. В годы, когда большинство людей уходит в отставку, Эйфель свои собственные средства вкладывает чтобы построить некоторые из лучших авиационных исследовательских строений своего времени. Эйфель в 1909 году в подножье своей знаменитой Башни построил одну из первых аэродинамических труб, посвящённую новой науке - аэродинамике. Аэродинамическая труба в 1912 году была перенесена в пригород Парижа, где и до сих пор работает. Эйфель использовал свою аэродинамическую трубу в систематическом сборе данных и установил новые стандарты для точности измерений, а аэродинамическая труба и методы которые были применены стали базовыми экспериментальными аэродинамическими лабораториями, которые потом были созданы по всему миру. Эта работа прослеживает развитие Александра Густава Эйфеля как инженера и учёного, и даёт краткий обзор празднования столетия аэродинамической трубы Эйфеля в Париже, в котором приняли участие и представители сербского Военно-техническиого института из Белграда.

Gustave Eiffel et le vent: Pionnier de l'aérodynamique expérimentale

1912– 2012 *cent ans de la soufflerie de Gustave Eiffel*

Gustave Eiffel (1832 – 1923) représente un nom célèbre dans l'histoire de l'ingénierie et de la technologie. Sa carrière d'ingénieur, longue de cinquante ans, est marquée par de dizaines de structures légendaires en fer et en acier, y compris le viaduc Porto au Portugal, la charpente intérieure de La statue de la Liberté à New York et la Tour à Paris qui a assuré son nom dans l'histoire. Une carrière si durable lui a apporté une richesse considérable qu'il a investie plus tard dans une activité toute nouvelle – l'aéronautique. A l'âge où la plupart des gens prend la retraite Effel a financé et fait construire certains de meilleurs objets pour les essais aérodynamiques de son époque. En 1909 il a fait bâtir au pied de sa célèbre Tour la première soufflerie consacrée à une nouvelle science – l'aérodynamique. En 1912 cette soufflerie a été transférée dans la banlieue parisienne où elle est encore en service. Eiffel a utilisé cette soufflerie pour ramasser systématiquement les données et il a établi les nouvelles normes de précision de mesurage . La soufflerie et les méthodes qu'il a appliquées ont servi de base pour les laboratoires aérodynamiques expérimentales qui ont été construits dans le monde entier. Ce travail présente le développement du savant et de l'ingénieur Alexandre Gustave Eiffel et donne une courte information sur la célébration du centenaire de cette soufflerie à Paris où étaient présents aussi les représentants de l'Institut militaire technique.