

HISTORY OF AVIATION IN MINAS GERAIS

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Abstract

The history of aviation in the Brazilian state of Minas Gerais is considered. Some pioneering work, going back to Alberto Santos Dumont and the Lagoa Santa Airplane factory is briefly described. The History of CEA-UFMG and its founder, Professor C. P. Barros is described in detail as the key which enabled the establishment of a most important centre for aeronautical activities in Belo Horizonte, the capital of Minas Gerais. The text describes how in a gradual process the whole supporting structure was shaped in a way which could not only supply well-qualified engineers, but also how it was the essential driving power behind the establishment of a complete chain, ranging from basic education to industry, flight operations and advanced research.

1 Introduction

It may be argued that the History of Aviation in Minas Gerais could not start without a mention to one of its famous son: the aviation pioneer Alberto Santos Dumont. He was born in 1873 at the Farm of Cabangu, now part of Santos Dumont, a Brazilian town in the state of Minas Gerais[1]. His father's French ancestry and engineering background probably influenced his decision to move to France and get involved with technology and engineering. It was in France that he carried out all his work related to aeronautical engineering. His ideas and what he achieved in this field influenced many followers around the world, and including, but not specifically, aviation activities in the state of Minas Gerais.

The first flight over Belo Horizonte took place in 1912, when Ernesto Dariolli demonstrated the capabilities of a Bleriot monoplane over the capital of the state. The extremely short 200 metres runway located at Prado quarter and used at this time had a very short life. In 1933, shortly after A. S. Dumont's death, what was to become Pampulha Airport was inaugurated. It was intended as a support for Correio Aéreo Nacional (National Air Mail) operations and three years would pass before regular commercial flights started to land at Pampulha runway. It was around that time that the Brazilian government decided to establish an aviation manufacturing facility at nearby Lagoa Santa. The Lagoa (lagoon) provided ideal conditions for the operation of hydroplanes, and the topography of the region also offered ideal conditions for flight operations. This same topography was also one of the main reasons for the choice of the present location of Belo Horizonte's international airport, located close to Lagoa Santa.

It may again be argued that the first planned and more complete aeronautical initiative was the construction of the military aircraft factory at Lagoa Santa. But at that time the difficulties were tremendous. The area lacked basic structure such as water and electricity supply, and trained engineering man labour did not exist. With the Second World War and associated conditions starting to appear on the horizon the planning had to be rescheduled and interrupted and the factory installations were only completed in 1944. The facility produced under licence the North America T6 advanced trainer until 1951. In 1945 the factory was transferred to the Pignatari group, and later to the administration of the Ministry of

Aeronautics. It was only in 1954, that finally Parque de Material Aeronáutico de Lagoa Santa (Lagoa Santa's Aeronautics Facility) PAMA-LS was officially established. PAMA-LS was to have a marked influence in other developments.



Fig.1. Lagoa Santa Military Airplane factory[2]

A stable and sound technological initiative can only exist if the adequate labour force is available. The lack of this condition was the main reason for the closing of the Lagoa Santa Factory. Many years would pass before this mandatory condition would appear. In Brazil, at the time when Lagoa Santa was being closed, Air Marshall Casimiro Montenegro with ITA and CTA laid the basis of what would become a powerful aeronautical research, training and manufacturing centre at São José dos Campos.

In Minas Gerais Centro de Estudos Aeronáuticos da UFMG, in short: CEA, the Aeronautical Studies Centre of the Federal University of Minas Gerais was created in 1963 enabling this basic deficiency to be gradually corrected.

2 CEA: An Aviation Cradle

CEA was founded by Professor Claudio Pinto de Barros in 1963. The founder, rightly believed it would be a sound strategy to lay the basis of Aeronautical Engineering in the state of Minas Gerais. Who was Claudio? What was his background, and above all what were his objectives? In fact CEA's History cannot be dissociated from Claudio's History. The next section tries somehow to answer these questions.

2.1 The Pioneer Claudio Pinto de Barros

Claudio Pinto de Barros, the founder of CEA-UFMG was above all a superb engineer, and a man with a privileged vision. A gifted and enthusiastic speaker who was able to contaminate anyone with what he himself described as "aerococcus". Indeed, he could contaminate nearly any person with his love for anything flyable. He claimed his contamination derived from the observation of flying "urubus" (birds similar to vultures) during his childhood



Fig.2. Professor Claudio at the cockpit of his Curumin.

in his native Curvelo, a town located in the centre of the Brazilian state of Minas Gerais, where he was born in 1937. A charming and captivating person he was a popular figure with both colleagues and students.

After taking the entrance examination to the Mechanical Engineering Course at the Federal University of Minas Gerais (UFMG) he moved to Belo Horizonte obtaining his Mechanical Engineering degree in 1962. A self-taught aeronautical engineer he started his aero training still as a student. His first book was a classical: Stelio Frati's *l'Aliante*, which he recommended as an inspiring text to all beginners, even at a later stage when carbon-fibre and advanced computational techniques had become common place. He believed in teaching things from basic scratch, so that advanced modern techniques could be later fully mastered. At that time the Engineering Faculty did not have any courses on Aeronautical Engineering and it took some hard convincing to persuade the head of department that CEA-UFMG was a sensible initiative. When he graduated in 1962, his first project, "Gaivota"

(gull) was already being constructed. In Fig 3 Student Claudio is the first from left.



Fig.3. The construction of Gaivota [1]

Gaivota made its maiden flight in 1964, when Claudio had already become a Machine Design lecturer at the Faculty of Engineering. It was the first aircraft completely designed and constructed in the state of Minas Gerais.



Fig.4. Gaivota coming in for a landing [1]

The Gliding Club at Osorio, learning about Claudio's successful enterprise offered him a free glider pilot course, an offer which he gladly accepted, and completed his pilots training at that time. Gaivota remained airworthy well into the 21st century, having undergone a major retrofit in 2002.

Claudio continued to design and build, always using the labour of his students, other aircraft, each one more advanced in conception and construction technique than its predecessor. In the early 1970s, having already proved that he was a good designer, he decided that the time was ripe to create an Aeronautical Engineering Course, and the first class entered the course in 1975.

In the late 1970s, because of economic difficulties he went to CETEC, the Technology

Centre of Minas Gerais, to develop and certificate a new technology: engines which were to run on sugar cane ethanol instead of petrol. But he did not abandon his dreams. It was during his years at CETEC that he designed and built the motor glider Vesper, fully constructed using composite construction, again a pioneering work in Brazil.

In the late 1980s he became again a full time professor of Aircraft Design at UFMG. At that time he started to consider the establishment of Post-Graduate studies in Aeronautical Engineering at UFMG. But before he could take the necessary steps he himself had to take formal post-graduate studies, something which many of his former students had already done.



Fig.5. Curumin, a typical professor Claudio's aircraft.

While this work was under way he received an invitation from a Portuguese university: Universidade da Beira Interior, to work as a visiting professor. He stayed in Portugal for a year, teaching Aircraft Design and returned to his post in Belo Horizonte in 1997, and started to working on his PhD thesis. His formal supervisor, was Professor Ricardo L. Utsch de Freitas Pinto, one of his former BSc engineering students. He successfully completed his thesis, "A methodology for the development of light subsonic aircraft", and was granted his PhD in 2001. Again it is interesting that some of his former students, the author included, formed part of the Board of Examination.

A short while after that, he retired but continued to work as a volunteer. He was always a constant figure at CEA and the faculty of Engineering.

He continued to be a leader and an inspiring influence to UFMG's Aerospace Engineering team until his abrupt, unexpected and sad passing in 2011. His inspiring influence and personal qualities continue to influence not only the course but the whole of the aero segment in Minas Gerais. Even now, seven years after his passing, his heritage and ideas remain present as ever.

2.2 CEA and its Aircraft

CEA was conceived in a way similar to the German Akaflieg structure, in the sense that design, construction and flying should be integrated. It became and has remained the mainstay of the Aeronautical Engineering course of UFMG for the last fifty five years.

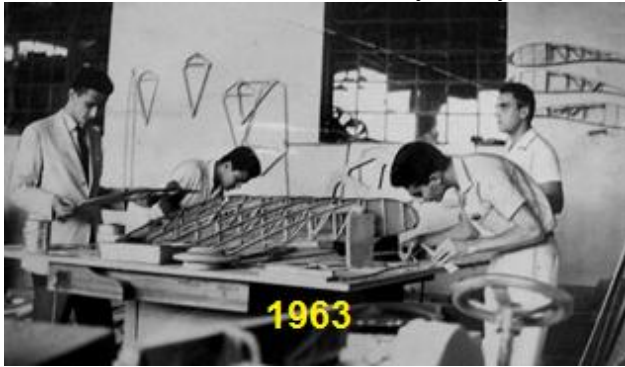


Fig.6. CEA's first prototype workshop

The facilities have also evolved from a small shared workshop into a well-equipped prototype manufacturing facility with a CAD/CAM structure, composite structure manufacturing, and a variety of supporting laboratories.



Fig.7. CEA world's beating record airplane: Anequim

During the whole of its existence a variety of prototypes were designed and built, ranging from the basic acrobatic wooden glider Gaivotas

to the advanced world record beater Anequim, an advanced high speed aircraft. Designed at CEA by professor Paulo Iscold it still keeps five speed world records in its class.

CEA has also been active in autonomous flight, having designed, built and flown a variety of UAVs.



Fig.8. A CEA's research UAVs being readied for flight

CEA has also employed its expertise on a variety of other special projects, such as the complete repair and structure re-design of a variety of older and vintage aircraft such as an old Wolf glider, a 1940 "Paulistinha" basic trainer, and many others.



Fig.9. CEA Prototype Facility

CEA continues to fulfill its original mission to provide support for training of engineers and developing aeronautical technology know how.

2.3 The Aeronautical Engineering Course

The Federal University of Minas Gerais, UFMG, with its Engineering Faculty, "Escola de Engenharia" has its main campus in Belo Horizonte. Nearly fifty thousand undergraduate and postgraduate students are presently enrolled at UFMG.



Fig.10. UFMG main Pampulha campus

The Aeronautical Engineering course was initially conceived as a version of UFMG's Mechanical Engineering course. Basic subjects such as Calculus and general engineering subjects such as Mechanics of Materials were taken together with Mechanical Engineering course. Specific subjects such as Aerodynamics and Aircraft Structures were taken separately by prospective aeronautical engineers.

The essential course guideline, which has remained throughout present days was that aircraft design was the final converging subject, where all the disciplines would be united as a strong unifying objective. At the same time there was also a perception that a strong demand existed both in Minas Gerais and Brazil for Aircraft Maintenance Engineers, and therefore Aircraft Maintenance was and remained an important part of the syllabus. It has proved to be a wise decision, not only because of the outside market demand but also because the concept of designing for maintenance is one the requisites of a sound vehicle design.

The first years were hard due to the lack of qualified permanent lecturers. In fact at that time qualified staff was scarce even in other parts of Brazil. Therefore Professor Claudio had to find an alternative solution, which was an agreement between UFMG and a Brazilian airline, in which qualified personnel could travel from CTA and Embraer to Belo Horizonte. In exchange for this courtesy UFMG would provide the necessary engineers for the airline, upon the conclusion of the course. The Brazilian Air Force also contributed allowing for one of his officers, now Major Brigadier (Ret.) Aluizio Weber, at that time still a Major at nearby

PAMA-LS took charge and organized the Aircraft Maintenance course. PAMA-LS at the time also provided a much valuable support for flight testing operations.



Fig.11. Minuano high performance glider over L.Santa

The whole arrangement did work well and the first class graduated in 1977, with just three engineers. A second class graduated in 1978 this time with seven engineers. The number of graduates went on increasing, some of the recent graduates going abroad and to ITA and INPE to take their Masters and PhDs and returning to UFMG to become aeronautical engineering professors. The agreements came to an end providing a most successful outcome.

Other graduates took a job at aircraft manufacturers such as EMBRAER or EADS, or at commercial airlines, such as TAM, a few are working in education in other parts of Brazil or abroad or at research centres such as CTA. Presently there are a few hundred of these graduates working around the world, in all continents in a variety of functions.

In the first days there were only three aeronautical engineering courses in Brazil, namely: ITA, UFMG and USP-SC. Going into the 21st century EMBRAER became a most important manufacturer, and in a country with continental proportions air travel continue to grow.

Other related business also grew in size. At the same time Brazil started to be involved with the space business. Clearly, the time was ripe for the furthering of other activities. UFMG together with the professors of the Aeronautical Engineering course decided to create a separate course: the Aerospace Engineering course,

3 The Aerospace Engineering Course

After a couple of years of planning and discussions the final proposal for the creation of the Aerospace Engineering Course was approved in 2008. The first entrees of the newly founded course were accepted after the standard UFMG competitive examination in 2009, the first class graduating in 2014. The additional year is accounted for the fact that most of the students joined the Federal Government Science without Borders Programme, and spent a year abroad at research and education institutions.

The structure of the course still keeps the original guidelines [5], where design is the culmination of the engineering education, but changes had to be made to take into account not only the introduction of space vehicles but also because disciplines such as automatic control and guidance have gained in importance.

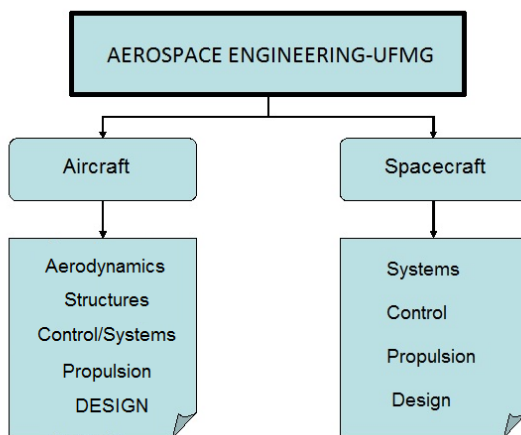


Fig.12. UFMG Aerospace engineering course structure.

As a part of their training students are encouraged to participate in a variety of projects, such as SAE Aerodesign. UFMG has participated with great success in these activities achieving several times the first place in the international competition, a fact which speaks highly of their training.

Another interesting fact is that with the creation of new course in Brazil some of the graduates have become lecturers at these education institutions.

New laboratories have also been created in order to enhance the abilities of the prospective engineers. Present students have at their disposal a variety of facilities such as flight simulator, and an aerodynamics laboratory.



Fig.13. CEA flight simulator

Most of the laboratories and educational facilities are located at the main UFMG Pampulha campus.



Fig.14. UFMG Aerodynamics Laboratory.

The most important outside facility, the hangar, is situated at the town of Conselheiro Lafaiete, roughly 90 km from UFMG main Pampulha campus. In addition to standard hangar facilities and runway it is also equipped with a complete classroom with a variety of educational resources. It became operational in 2008



Fig.15. Professor Claudio at the hangar main entrance.

As another result of both the new course structure and additional demands some of the graduates are now working or carrying research on Spacecraft, even though as a consequence of the market the majority of them are still working with aircraft.

4 Research and Post-graduate studies

Engineering education is not complete without associated research, post-graduate studies and a good interaction with industry. Post-graduate activities in aeronautical engineering take place at UFMG either at the Structural Engineering Post-graduate Programme or the Mechanical Engineering Postgraduate Programme. Several Masters Dissertations or PhD theses have been successfully completed in a variety of themes ranging from Aerodynamics to Composite Structures. Other related areas have also gained in importance, such as instrumentation for flight testing or wind turbine design.



Fig.16. Wind Turbine design an research at UFMG

These more recent research lines have had an increasing participation of undergraduate students, a fact which has provided additional encouragement for the professors involved in this research.

Cooperation with industry has been also a key issue for the School of Engineering and the engineering course. Successful cooperation has been carried out with Embraer in research areas such as structural health monitoring (SHM) or even in the event of participation in trainee programmes. In the space are the course has established a working relationship with the Brazilian Space Agency and the National

Institute for Space Research, with some research and Post-Graduate studies being carried out.

5 Conclusions

The History of Aviation in Minas Gerais could well be traced to the time when the aviation pioneer was born in 1873 in this Brazilian federal unit. However, a well laid foundation for an aeronautical centre is only feasible with adequate availability of labour force. CEA-UFMG founded in 1963 was the embryo which enabled all this and other essential conditions to exist. Professor Claudio Pinto de Barros was the architect and brain behind this creation. From his work an engineering and research centre were established, with a few hundred aeronautical engineers graduating and joining the aeronautical sector in Brazil and Minas Gerais. Further developments have occurred and making Belo Horizonte an important and complete aeronautical centre, with an engineering faculty, aeronautical companies, airline and support maintenance centres. It can be conclude that the initial work of professor Claudio was vital for the establishment of a solid aeronautical centre in the capital of Minas Gerais State.

Other related areas are also starting to make their debut such as wind turbine design, electric and hybrid propulsion design and next of kin engineering: Spacecraft engineering.

Acknowledgements

Even though Professor Claudio Pinto de Barros was and still remains an inspiring and pioneering figure most of what has been here described would not have been achieved without the dedicated work of his collaborators. And numerous have they been. Students, professors, and technicians, test pilots, companies and institutions, all who provided a much needed support and meritorious work throughout all these years. For avoiding the risk of omitting any important name, the author just wishes to say: - Thank you all for having been simply fantastic.

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