

WIND TURBINE DESIGN IN BARCELONA

Sun, sea, MATLAB and load calculations; enjoying the good life.

After my Delft Aerospace bachelor curriculum which is as flexible as a solid rock I was determined to do an interesting internship abroad. The wind energy industry is a rapidly developing industry with a lot of future potential. Being able to work in the wind energy industry for a large international company in Barcelona made the perfect internship for me.

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I started my master as a DAR-student, but I have been following several wind turbine design courses as well. Therefore I have been looking for internships within the aeronautical as well as wind energy industry. I have one important advice for people that are looking for an internship abroad: do not bother to try any web application forms at large companies, unless you might have the perfect curriculum. This is a complete waste of time, generally you will not even get a response. What you should do is talking to your course teachers and ask them for contacts in the industry.

Wind energy is a growing industry that is very active within Europe and the industry is very interested in contacts with universities due to the fact that the industry is still developing rapidly. Through course

teachers in wind energy I finally achieved two interesting internship options at large international players: Vestas and Alstom. Finally I have chosen for Alstom, because the content of the internship, the pay and also the location were more appealing.

THE COMPANY

Alstom is a global leader in power generation and rail infrastructure and is developing innovative and environmentally friendly technologies. Alstom builds the fastest train and the highest capacity automated metro in the world, and provides turnkey integrated power plant solutions and associated services for a wide variety of energy sources, including hydro, nuclear, gas, coal and wind. The group employs 81,500 people in seventy countries, and had orders of 24.6 billion in 2008/2009. The company consists of Alstom Power

which has its headquarters in Swiss and Alstom Transport which has its headquarters situated in France. I have been doing my internship at Alstom Ecotecnia in Barcelona which is the Wind Energy sector of Alstom. Alstom Ecotecnia designs, assembles and installs a wide range of onshore wind turbines in the power range from 1.67 MW to 3 MW.

THE INTERNSHIP

During the internship at Alstom Ecotecnia I have been working in the innovation department of the Aerodynamic Design Area (ADA). The innovation consists of around a hundred people and this department is responsible for the development and certification of the Alstom wind turbines. The team of ADA consists of approximately ten employees.

Apart from the development and innovations of turbine rotors ADA is responsible for the calculations of all loads and performance of the turbines. As aerodynamics is the initial source of all loads occurring in the wind turbine the department is in charge of all calculations of static and dynamic loads according to wind turbine standards for certification. During the development of a machine or in case of adjustments to an existing model, loads are calculated using scale models of the wind turbines. At the moment, these load calculations are the most important work done within this department. Results of such calculations are communicated with other areas within the innovation department that are responsible for specific parts or systems of the wind turbine. The current economic climate drives the urge to sell existing machines by doing client specific calculations or innovate in the sense of cost reductions within the machine, there was less time to go into the real aerodynamic innovations.

My work consisted of several load calculations on new or changed machines to determine whether the machine could be certified or if the loads fitted within the already certified margin. After a while I got familiar with the way of working within the department and I have been developing several computation tools to execute these kind of calculations. The tools that I developed often combined MS Excel and Visual Basic with MATLAB and Bladed (wind turbine modeling software) in order to speed up computations which would manually take a lot of hours. The most extensive program I wrote could save two to four days of an engineer's work by pushing one button. Besides load calculations I have been doing several smaller projects such as yield calculations for wind parks to be sold. I have also been working on an interesting study into possible aerodynamic wind turbine innovations, to provide knowledge for better economic tides.

BARCELONA LIFE

Barcelona is a city that is made to enjoy life. Of course the climate is amazing and its location (with the the Mediterranean sea at your doorstep) makes you experience a feeling of freedom and spatiality uncommon for a large city. The ancient city center consists of many little streets in which tapas bars, restaurants and bars supply the perfect atmosphere to enjoy your free nights. The rest of the city, with its famous Cerda grid and spatial streets, make a very lively area but unlike the Netherlands these more residential areas are also full of bars restaurants and little shops. In this L'eixample area I rented a little penthouse with a Dutch friend of mine who had already been living in Bar-



Figure 1. Cutting the jamon



Figure 2. Mid Winter Sailing with colleagues and friends

celona for a while. Almost every night of the week we enjoyed our dinner on the private terrace next to our kitchen and in the weekends we used to have on average two barbecues there. In the Spanish indoor markets around you can buy very nice fresh products. We invited friends to have some freshly caught roasted 'Lubina' or 'Dorada' before going out to bars or clubs.

After a while you get to know the best bars in town to start your night with a nice bottle of quality Cava for only ten euros or a 'Mojilitro'. If you can avoid going the commercial nightclubs near the beach, Barcelona has a respectable nightlife scene. Every weekend there are plenty of good parties and international dj's playing in several venues.

Barcelona's location next to the sea determines its atmosphere with the nice beach-

es and harbors in town. However, this also provides the perfect opportunity for nice days out. Several times I have rented a large yacht to take friends and colleagues out on the sea for a perfect sunny day of sailing and Cava or even a VIP view on the Red Bull Air Race.

Barcelona public transport is quite good and not too expensive. Many bus lines as well as the metro and train system bring you to any place you want to be. These lines are perfect to use at night when you have been drinking, but at daytime these connections are very inferior to your own 'Moto'. I bought an old Vespa by which I could be in any position in or around the city within twenty minutes. In Spain you can drive up to 125cc with your car driver's license; and these 'motos' easily drive up to 90km/h. A moto also provides a perfect ride home. ✈