How do you find an internship in Australia? It might sound like a difficult question, but it does not have to be. I made an appointment with professor Beukers and after chatting for fifteen minutes I walked out of his office with an amazing idea and, just as important, a contact. That same afternoon I wrote to Bas Veldman, who later became my supervisor, and one week later my internship in Brisbane was arranged.

CRC-ACS
I did my internship with the Cooperative Research Centre for Advanced Composite Structures (CRC-ACS). This is a research institute in the field of advanced composite structures that collaborates with Australian educational institutions and industry. The CRC-ACS currently has four offices in Melbourne, Sydney and Brisbane. With about thirty researchers in total it is an organisation of limited size. I had found my internship with Bas Veldman in Brisbane and lived there from mid-August to mid-February. The Brisbane office is dedicated to a helicopter program in collaboration with Australian Aerospace and the University of Queensland (UQ), both also located in Brisbane. This program consists of various sub-projects, one of which is the crashworthiness project that I worked on.

ASSIGNMENT
The topic of my internship was ‘thermo-plastic energy absorbers in helicopter sub-floor structures’. Because there appeared to be a delay in the manufacturing of the tooling when I arrived in Brisbane, I also worked on other projects. Since thermoplastics still formed the main part of my internship I will explain a bit more about that furtheron and leave the moisture removal from sandwich panels and the ply book for what they are.

High performance composites have taken flight in the aviation industry in the past years. The main reason is saving weight which is allowed by the higher specific strength and stiffness compared to traditional aluminium alloys. Moreover, composites are capable of absorbing crash energy more effectively than aluminium. In the NH-90, for example, a sine-wave beam made out of fibre reinforced thermo-set can be found in the helicopter floor. Research has shown that it is possible to achieve an even higher specific energy absorption with fibre reinforced thermoplastics and thus possibly an additional weight reduction. The fact that this can be shown in a laboratory with a closed tube and under controlled conditions, does not mean that it will also work straightaway in a real helicopter. Therefore research has to be carried out. Besides weight savings, thermoplastics also have a potential advantage for manufacturing, because a long curing cycle is not required and thermoplastics have the ability to melt similar to metals.

MATERIALS AND MANUFACTURING PROCESSES
Currently, high performance thermoplastics have little application in the aviation industry. An example of a current application is the J-nose of the A380 which is made by Stork Aerostructures. One of the reasons that thermoplastics are used for
this part is because of its good properties against impact. The semi-finished product that is used is Cetex semipreg from Ten-Cate and the production process is lay-up followed by autoclave consolidation (High-Performance Composites, March 2006). Based on this example, the intention was that I would manufacture crush elements of the same material with an autoclave process in the lab of UQ. These elements would then be crushed to determine the specific energy absorption.

The autoclave process of a thermoplastic is different from a thermoset. In the case of a thermoset, a chemical reaction takes place under elevated temperature and pressure, while a thermoplastic is only heated above the melting temperature for the layers of semipreg to melt together (consolidation). Beside the process being different, the conditions are different too. Thermosets cure typically around 200°C but our material (PPS) is processed at 320°C, and the required pressure is significantly higher for thermoplastics. The temperature requirement makes the tacky tape and bagging material used for thermosets not suitable for thermoplastics. Special material must be used that is not only more expensive, but also much harder to work with. The tacky tape barely sticks and bagging material is very stiff. For our specimens it even ment that we failed to create a leak-free vacuum bag over our laminate. As a consequence it was not possible to apply pressure in the autoclave and to consolidate the specimens.

Eventually, we decided to leave the autoclave process and use matched metal forming instead. The high temperature and pressure were still required but with the available equipment it was difficult to accurately monitor the process parameters. Another disadvantage of matched metal die forming was the uneven distribution of pressure, reducing the quality of consolidation. This would have been one of the elegant advantages of the autoclave. Still, we had more success with this process and I managed to make several specimens, (see figure 1 for an example).

WORKING EXPERIENCE
My personal experience of my six months internship in Brisbane consists of two parts. Part one is of course the internship itself and the second part is the experience of living abroad and the country of Australia. The internship has certainly taught me a lot about thermoplastics. The experience of working in an engineering office was also very valuable. Through the partnership with UQ, I even got to experience another university than the one in Delft. Yet I have to admit that my internship at the CRC-ACS was not perfect in every way. As I said, there was a delay in the manufacturing of tooling for the autoclave. Originally, I would spend the full six months on the crashworthiness project, but eventually it took until December before I could start working with the autoclave. Unfortunately, I therefore never arrived at the phase of doing crush tests to determine the specific energy absorption of my specimens. Meanwhile, I spent time on preparing the specimens and other projects, but at times it also meant I had little else to do than be patient. Something I really liked about the CRC-ACS was the wide variety of people in our office. We were with a total of thirteen from eight different countries. There was also attention for the social aspect of work. For example, I played trivia in the pub almost every Tuesday evening with a couple of colleagues. But the absolute highlight was a weekend of camping at Bribie island. With three 4x4’s, some eski’s (Aussie slang for cool box) full of beer and four tents we stayed on the beach for two nights, (see figure 3). The typical Australian way of having a chilled out weekend!

A CAMPUS THAT MAKES YOU JEALOUS
Though I have not spent most of my time at UQ, the university is definitely worth noting. TU Delft is of course a great university with high quality education and, particularly at the faculty of Aerospace
Engineering, world class facilities. But if you look at the campus, there is a world of difference in favour of UQ. The campus is accessible by bus, but much nicer, also by boat! Not over a small canal like the Schie, but over a decent river where you would have to swim for your life if you fall out of your rowing boat. And along the shores you find the most fantastic houses. Then there is the ferry. Not a silly water taxi that brings a few cyclists from one side to the other, but a high-speed catamaran that more or less teleports you from the city to the campus. After arrival you walk between the palm trees and other tropical plants along the ponds to the lab. Along the way you come across some ibises, lizards (average half a meter long) and turtles. Since the Brisbane sun shines 360 days a year and there is no air conditioning in the lab, you just wear a T-shirt and shorts. For lunch, you walk to the food court where you can choose from at least five different caterers including a Subway. In the same corner of the campus you will also find the dentist, the travel agency and many other convenient facilities. Finally, UQ’s sport facilities beat ours by miles. Endless pitches, a huge gym and a fifty meter outdoor swimming pool with palm trees. Maybe it would not be such a bad idea if the TU Delft would set-up an exchange programme with them one day...

**THE ADVANTAGE OF BEING ALONE**
When I left to Australia I was very excited about what my life besides work would look like. I expected to meet a lot of Australians, but it turned out to be much easier to get to know other foreigners. Before, I would have preferred to go together with other students from Delft so I would not be alone. But looking back it was a big advantage to be alone because it is much easier to make new contacts. I also believe that it makes the experience more full-on. Of course it is sometimes a bit boring in the beginning, but if you put some effort in it Brisbane is an easy place to meet new people. In addition, you get into situations you would never experience before. By the time you are a seventh year student in Delft, you have built up a comfortable life in which you do things in the same way all the time. You like that one pub next to the Old Church, so why would you go somewhere else? But if you are alone and meet someone new over a cup of coffee and you are invited to go camping on an island with some complete strangers, you just say yes.

**WHAT AUSTRALIA HAS TO OFFER**
I deliberately did not use this report to describe my weekend trips to Sydney, rainforests and so on. I did a lot of that kind of stuff next to work and it was great, but you can find all that in travel guides as well. But I do want to mention a few things about Australia that really impressed me. First of all the weather in Brisbane. It is just incredible. Every day, for six months, was warm enough to walk in shorts. Also the long periods of drought made a big impression. The first two months it rained maybe twice and then only a few drops. Then there is the amazingly beautiful nature. I don’t even know where to begin to describe it. And there is so much of it. And finally there is the “no worries” culture. The pace at which people live lays a few notches below ours and that is also a great experience.

I intended to go back to Delft after my internship in February and start my final thesis, but that is not how this story ends. Instead, I had a talk with my supervisor Bas about what to do after Australia and just like professor Beukers did, he gave me a great idea and a contact. Again I wrote an email and within a month I had found a final thesis position. Unfortunately a bit less exotic location this time, but certainly more exotic composites: Eurocopter Germany in Munich.

If you are interested in an internship at CRC-ACS you should send an email to Bas Veldman at sveldman@yahoo.com

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### References


University of Queensland: [http://www.uq.edu.au](http://www.uq.edu.au)