NUS National University of Singapore

Faculty of Engineering

EG3601/EG3611: Industrial Attachment

Mid -Term Internship Report

for reporting period 2 Jul 2018 to 21 Dec 2018

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Matriculation No.	A0155095B	Year	2018
Department	Mechanical Engineering		
Internship Period	2 July 2018	to	21 December 2018
Mentor	Fuad Zain		
Company	Schlumberger		

Introduction

Since the past 5 months I have been in this company, I have gained a lot, in terms of the skills, knowledge and habits that I will gladly bring with me in my career as an engineer. Skills such as the basic assembly skills, knowledge of correctly using process piping standards and flange standards and habits such as the constant thought of design for manufacturability are just a few of the countless lessons that I have managed to acquire from my supervisors, colleagues from the same department and even some from the other departments. In this report, I will be sharing major projects that I have underwent, which have helped me achieve some valuable experience as a mechanical engineer. By solving the problems I have faced during the course of the projects, I have picked up the mentioned skills and knowledge in which I will ponder upon in the later paragraphs.

Furthermore, through the past five months, I have discovered the part Schlumberger plays in the industry it is in, which is the oilfield, oil and gas industry. This is much relatable to one of the modules I am reading this semester, ME4105, which is a specialization module for the Oilfield, Oil and Gas Technology specialization. Therefore I will make connections to what I have learnt throughout the module.

Projects

The two projects that were given to me in the second part of the internship program is very much higher in difficulty as compared to the previous tasks that I have done in the first part. But I felt that the increase in intensity is healthy enough to make me learn new things at a higher rate and to test my understanding on the basics I have learnt in the first part of this internship. Also, adding on to this, my supervisor forced me to be more autonomous so that it will help me to look around in the web more or even refer to other colleagues while at the same time build my interpersonal skills. In this section, I will describe the two projects, the acrylic V-channel and fixture projects, and discuss their usefulness in terms of lessons learnt and its possible future applications.

Acrylic V-channel

In week 16 of my internship, my supervisor passed a task to me that he has been working on recently. It is an engineering modelling project that requires me to liaise with a stakeholder that is stationed in Cambridge. The acrylic V-channel will be manufactured by the people at Cambridge from the model that my supervisor and I have created. Basic dimensions are provided by them and we have to come up with the other dimensions in the model that is feasible enough for the purposes of the project. The reason for the choice of material is so that the flow in the channel can be recorded and analyzed, since acrylic is transparent.

Challenges

Many challenges were encountered during this project. As usual, there are technical factors that has to be tackled. Firstly, clarity of the acrylic at the frame that is being recorded has to be consistent, meaning that the thickness has to be maintained throughout specified areas of the channel. Secondly, since the acrylic is going to be casted, the surface of the inner portion of the channel are skewed by a few degrees. This means that datum referencing to these surface can be confusing and relaying the information regarding these features into drawings will take more effort than normal designs. Thirdly, design for assembly is thoroughly checked because of the use of unfamiliar parts, such as Dk-Lok compression fittings and Helicoils.

Furthermore, other than technical issues, there is a constant communication disadvantage that was experienced. This is due to the difference in time-zone that exist between the two of us, which makes relaying of information slow because the only mode of communication was email and the occasional skype calls.

Reflection

Eventually, I managed to complete the project albeit the technical and communication challenges. Through this project, I felt that it improved my CAD skills because I constantly need to handle with references that are different from the usual, Front, Right and Top, that I was used to. After a while, I got used to working with unconventional references and it definitely taught me to always be ready for tasks that are not always what I am used to.

This project also forced me to find answers when I am uncertain about my work. Having brief descriptions of the unfamiliar parts is not enough for me to dive into this project, because I need to know the features and use of the Helicoils and compression fittings. By knowing these information, I can know the exact dimensions to set for the acrylic v-channel. Helicoils for example, only come in specific lengths of 1D, 1.5D, 2D and so on. D refers to the diameters of the specified Helicoils. Also, installation of Helicoils are much more complicated than I have thought because it has specific instructions to obtain the fresh taps in the drilled hole so that it can be easily fitted with a specialized installation tool. Compression fittings are a common tool in assemblies that involves pipes. However, there is a wide array of compression fittings in the market. Therefore, careful study and of the part that I am using has to be done before I consider it for the assembly, to make sure that it is the right compression fitting for this particular use.

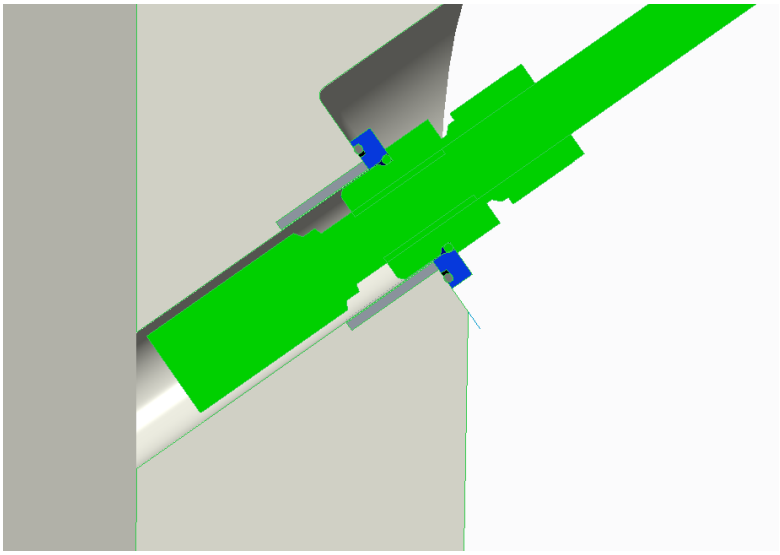


Fig.1 Assembly of transducer probe, Helicoil, washer and compression fitting

As for the communication issue, I learnt that it is part and parcel of a life of an engineer to be communicating with someone from another country or even region. To overcome the inevitable ineffective communication, sometimes there is a need to go out on one's way to ensure that things can be done effectively. For example, there are days where I would stay a bit longer in office just so that I can skype call my stakeholder and show him my work whilst adjusting and modifying my model with his guidance. This expedited the modelling process because he can immediately give his input and more is done within a short span of time. Be that as it may, I will need to prepare materials before every call to make sure that I have thought out all the ideas for the model, by considering the failure modes that can occur. This is to ensure that time will not be wasted if he manages to point out any plausible failure modes during the skype presentation.

To sum up this project, it made me go through some inconveniences that design engineers experience throughout their careers and it molded me into an engineer that is more predictive over failures by being more critical over my models.

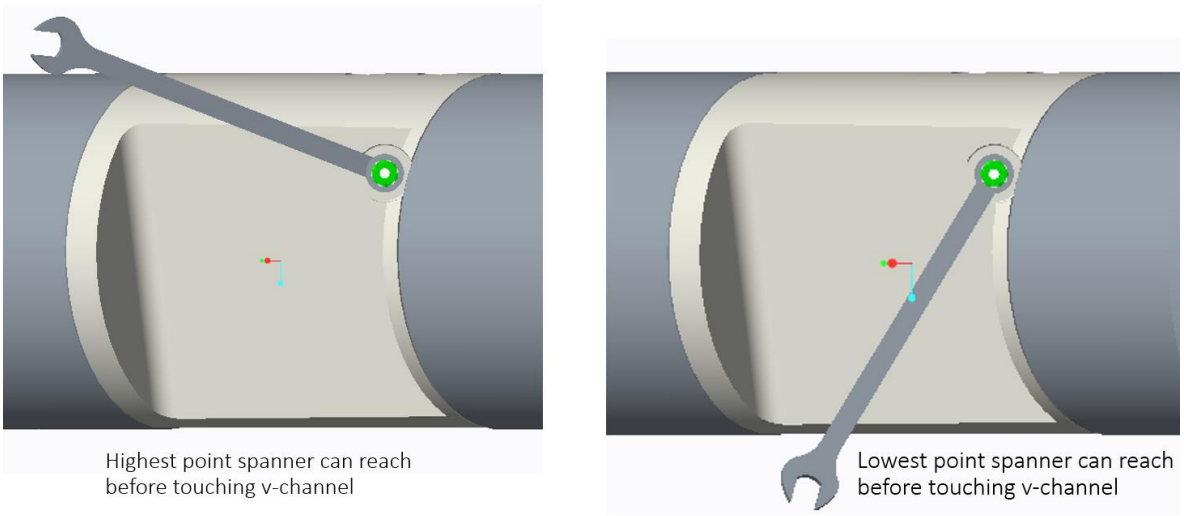


Fig.2 Acrylic V-Channel designed for assembly, with the consideration of torquing of wrench

Fixture

In the midst of the acrylic v-channel project, I was also assigned a task of creating a fixture for the engineering team. This fixture will be used to mount a PCB and used as a platform to precisely solder spring loaded connectors to it. The soldered PCB will then be mounted onto a 3-inch pipe.

Before that, I was also tasked to map out the locations of the spring loaded connectors, which was soldered onto a rigid PCB, on a circular tube. This was done by means of geometry which made me realize that even at this stage of engineering, basic mathematical concepts are still being used every now and then.

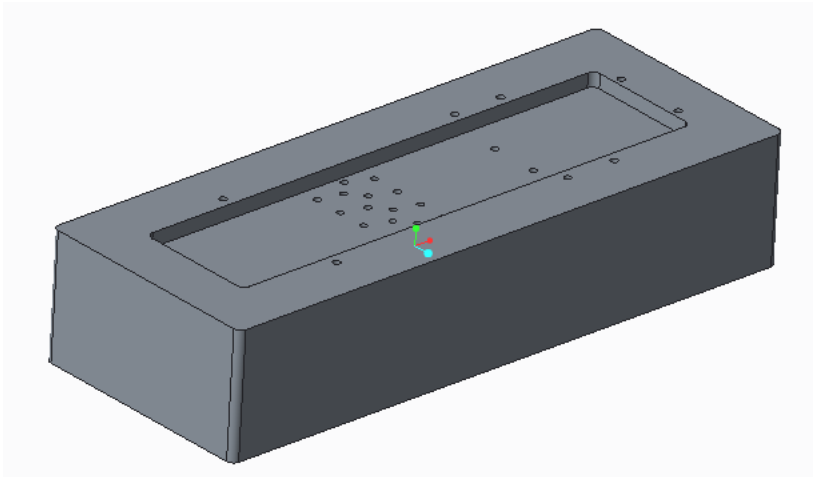


Fig.3 Model of a fixture

Challenges

To ensure that the spring loaded connectors are as vertical as possible tight tolerances have to be applied onto the dimensions and shown on the drawings. To obtain the magnitude for these tolerances, tolerance analysis has to be carried out. Tolerance analysis is the method in which to ensure that the accumulation of tolerances (or tolerance stack) will not lead to failure in assembly where there is an interference and the parts cannot fit. There are two methods to carry out tolerance analysis: worst-case analysis and statistical variation analysis. I implemented the worst-case analysis for this project since we would want a 100 percent chance of success for the machining and assembling of this model. Worst-case analysis method is one where the nominal values of dimensions in a certain axis are summed up in vectors along with the tolerances. The minimum and maximum values of the dimensions are obtained by adding or subtracting the sum of tolerances.

It took me quite some time to understand the concept of tolerance analysis. Even so, applying it on my model is not as easy as understanding the concept because a keen and meticulous eye is need to identify the many dimensions that can affect the eventual outcome of your tolerance stack. I spent an extensive period of time to get used to the whole idea and because a great deal of imagining is needed to visualize the different ways in which the dimensions can be skewed or affected by tolerances. Applications such as Creo (CAD program) and Microsoft PowerPoint are essential in helping me to visualize the assembly in ways that can help me with the whole process. In addition, I seek the help of my mentor and other experienced employees to guide me to the right path in this learning journey such as asking them to point out to the errors I have made in my analysis.

Reflection

Since this whole concept is new to me, I had to do quite a bit of research on it to understand how and why we apply tolerance analysis. With the research I managed to gain, not only the knowledge that was needed for this whole project, but additional information that I found very useful (such as the use of statistical model in tolerance analysis).

Following that, it led me to learn about geometric dimensioning and tolerancing (GD&T), a concept used in drawings, in forms of tables and symbols, to show the references to specific datums in the model. This means that references is not only made to the default datums, Front, Back and Top, but also to datums made anywhere in the model. Doing so will lead to stricter definitions for machinists to adhere to, resulting in more accurate features. This was specifically applied to the fixture, because the holes made to cater to the spring load connectors need to be accurate just among themselves (to ensure straightness of all the

connectors) and that was made a priority. Thus GD&T was used to refer the centers of each hole to a certain datum in the model.

In summary, this task exposed me to an aspect of mechanical and design engineering that is not covered in the school syllabus, but is still essential and should be considered when new parts and assemblies are being manufactured. GD&T is a powerful concept which is universally used, but as engineering undergraduates, we are still uncertain or do not even know its existence. There are so many tools, or symbols, found in GD&T that can be utilized to communicate the straightness, flatness, cylindricity, circularity, and other geometric characteristics. These symbols can highlight the important features of the model that needs to be retained by the end of the manufacturing process.

On a separate note, I realized that I had struggled for a bulk of the exercise, and required the help of my supervisors and colleagues. For that, I plan to pursue this issue and read up on more materials regarding this concept, and also practice more of this problems during my free time. Hopefully, I will be more ready in the future if it is needed during the course of my career.

Conclusion

About Schlumberger

Through the projects I have undertook, the meetings I have attended throughout the course of this internship and the conversations I have had with my full-time colleagues, I have learnt the position and the situation of Schlumberger as an oilfield services company. Currently, Schlumberger is the world's leading oilfield services company, ahead of competitors such as Halliburton, Baker Hughes GE and the rest. However, along with other oilfield companies, business has not been particularly good over the last few years, especially since the fall in oil prices in 2016. But from what I gathered, this is part and parcel of what the oilfield economy experiences and oil is a resource that is important in our daily lives, therefore there is a constant demand for it.

About Design Engineering (Mechanical Engineering)

Design engineering, a branch of mechanical engineering, is something I would like to pursue in the future, after my graduation. I felt that this internship has given me a short yet fulfilling experience of what to expect as a design engineer. Here is a list of design engineering work that I have managed to cover throughout the past 6 months:

- Created parts, assemblies and drawings using CAD software
- Utilize the concept of tolerance analysis
- Designing with assembly considerations

- Referring to standards to verify models
- Undergo the process of engineering change order
- Studied the various methods of design verification
- Studied the possibilities and use of Finite Element Analysis

Future Career Paths in the Oilfield Industry

Along with this internship, I was reading an Oilfield Oil and Gas Technology module, which informed us about the many equipment and systems that are found in the oilfield industry. From that, I have come to realize that oilfield companies is constantly looking to increase the efficiency of the operations in the field. The increase in efficiency means that new technologies have to be pursued from time to time. This is where design engineers, both mechanical and electrical, will come in to help integrate the new technologies into products that will be commercialized to the oilfield market. For my case, in my department, we are looking for ways to recreate our Multiphase Flowmeters in ways to increase its performance, decrease the cost, and improve the convenience when using the equipment.

Summary

Before the internship commenced, I set a couple of goals for myself to spur me to learn as much as possible throughout this 6 months. One of it was to practice as much concepts I have read so far in school. These concepts include, engineering modelling (ME2102), fluid mechanics (ME2134), strength of materials (ME2112) and manufacturing processes (ME3162). My second goal was to learn as many new things as possible, so as to get ready for my work life as an engineer in the future, or even to gear me up for my upcoming modules in year 3 and 4.

After the internship, I am glad to share that I have fulfilled all the objectives that I have set. I managed to constantly apply the mentioned concepts in my work, especially because I am working on a new concept of multiphase flowmeter. Additionally, I have learnt new things such as tolerance analysis, FEA, GD&T, and even do assemblies along the way.

However it is worthy to note that I faced many challenges along the way. Needless to say, at every stage of our career, there are always obstacles, because without it, there is no platform for us to improve ourselves and achieve better results.

Faculty of Engineering
Office of Undergraduate Programmes
EG3601/EG3611 Industrial Attachment

NUS National University of Singapore

IA REPORT CLEARANCE FORM

Please ensure that this form is attached at the back of your IA report before the submission to the faculty.

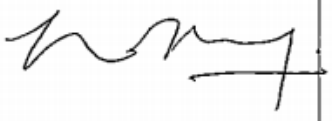
Student Information

Name of Student:	Muhammad Hazim Bin Sulaiman
Department:	Mechanical Engineering
Matriculation No:	A0155095B
IA Report:	Mid-Term / End-Term ✓

Company Information

Name of Company	Schlumberger
Name of Supervisor:	Fuad Zain
Designation:	Mechanical Engineer
Email / Telephone:	mzain5@slb.com

Report Clearance by Company

Signature	Company Stamp	Date
	SWTC Schlumberger Oilfield (S) Pte Ltd 1 Benoi Crescent Singapore 629986	19/11/2018

Note: If the company wishes to have a copy of the report, the arrangement is left between the company and the intern.

Faculty Internship Team
Email: enginternship@nus.edu.sg

WEEKLY JOURNAL

The weekly journal should serve as your work log diary. Highlight *one* key learning point you gain each week. The point should be kept succinct. Bullet points are accepted.

As a guide, you may think of how your activities performed in the week fit within the larger project/goals of your business unit. You may also think of how your perspectives about a particular matter (e.g. academic goals, life goals, motivations) have strengthened or changed following your work experiences including interactions with your managers/colleagues.

Attach this journal log to your internship report for submission to your internship mentor. While the internship report must be signed by your workplace supervisor, supervisor's endorsement of the journal is not required.

Note: If you are absent due to In-Camp Training or other approved reasons, please indicate so and the dates of your absence.

Period	Key learning point
Week 13	- **Understood the concept of tolerance analysis**
Week 14	- **Tolerance analysis is more skill than concept learning**
Week 15	- **Communication barrier should be overcome for more efficient work**
Week 16	- **Think of the problem thoroughly before arriving at the solution**
Week 17	- **Be predictive of failures**
Week 18	- **Be more critical over our own work**
Week 19	- **Reading is essential in learning**

Week 20	- **Every engineer works in their own ways even though we are bound by standards**
Week 21	- **Asking questions is not a sign of weakness**
Week 22	- **Sometimes hazard can only be minimized. There is always a chance of an accident happening**
Week 23	- **Rest is as important as working**
Week 24	- **Good work takes time to materialize**

Student's Signature / Date (of last journal log written):

19 December 2018