

Project Title: Designing and Modeling a Tower Crane by
Using the Principle of Physics

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CONTEXT

Section 1 – Criterion A – Investigating..... Page 3-4

Section 2 – Criterion B – Planning..... Page 4-5

Section 3 – Criterion C- Taking action..... Page 5-6

Section 4 – Criterion D –Reflecting..... Page 7

Section 5 –Bibliography..... Page 8

**Section 6 – Appendices..... Page 9-10-
11-12**

MYP Personal Project Report

Section 1 – Criterion A – Investigating

When I start working on my personal project, the first idea that came into my mind was to design and model something unique. After a time of some thinking, I decided to design and model a building, but after more research and some discussion with my Engineer relatives, I understood that designing and modeling a building was really hard for me because I didn't have the any Engineering background to start off. So after that, I decided to design and model a tower crane, because the project was not as intense as designing a building project.

The main and only reason why I chose this project is, my interest in physics. As it is known, physics is a difficult lesson for most of the students. But for me, physics has always been interesting, and I've always enjoyed learning and understanding physics. Later, when my Engineer relatives told me that Engineering has a lot of physics in it, I inclined towards something Engineering related. Science and technical innovations develop every passing day and these innovations help humans in many ways. For this reason, I chose "scientific and technical innovation". The importance of science in the world we live in is enormous and our need for science is indisputable. The machines, which we humans use, i.e. such as a tower cranes, has a lot of physics and dynamics behind it and has a positive impact in our lives. For this reason I started researching the physics behind a tower crane. My main research tools were the internet, movies and books. But those were not enough, so I had to find new ways. One of my research technique ws consulting with people that were in the tower crane and construction industry. My goal was to better understand the principle of physics behind a tower crane and convey it to people by modeling and designing it.

One of the skills that help me throughout my project process was, my interest in physics and my knowledge about physics. I was always interested in physics since small age. Because of my interest I would always research or read books about science. Therefore I had knowledge about it, that helped me research easier. Throughout my project process what I hoped to learn and the product that I sought to achieve was a really well designed model and the importance of physics in engineering. But after researching for some time, I realized that building a model was not so easy. The model that I hoped to build was only achievable one way and that was having the model made by a company due to limited availability of material in the market to build a solid tower crane model.

The research in a project is the most important part. However the research throughout my process changed my perspective and my decisions majorly which lead to a better planning and a better achievable goal. When I first started my project I thought

that I could find a lot of information. When I could not find much information I knew that I had to change my decisions and plans; so I asked some Engineer acquaintances and a physics teacher for some help and they helped me with the information that I couldn't find. With their assistance I achieved a more successful goal.

Throughout my research I found out that resources such as websites were not very useful. The information on the web were limited to real tower crane construction and Engineering design. However, sources such as videos were more reliable and really helpful. On one of the movie, the Physics Professor had made videos about tower cranes and it helped me to understand the principles of tower crane operation and accomplished a better goal for me.

Section 2 – Criterion B – Planning

I believe that for a project product to be successful, it must be creative and unique. If a product is ordinary, it is ignored by people and naturally gets forgotten. But if that thing is unique, whatever is different and special, it leaves a mark and gives new information to people.

After making detailed research, I developed several criteria for my product. My product had to be strong, wind resistant and a flat top for the tower crane to carry higher amounts of weight. I believed that these criteria would make the product better. When I was working on my project, the source I mostly used was the internet because the availability of information on the web. Also I had people that had knowledge about physics and Engineering, which I consulted with them.

The timeline of my planning and work can be summarized as follows:

Dates	Progress and Process
12/09/2019	<p>Choosing the topic and the best suitable global context.</p> <p>Topic: Designing and Modeling a Tower Crane by Using the Principle of Physics Factor that made me choose this topic was because it was proposed to me by an acquaintance.</p> <p>Global Context: Scientific and technical innovation.</p> <p>While selecting this context, I looked at whether it would be suitable for my project or not.</p>
21/09/2019	<p>I found out that the following factors and principle of physics are the main design criteria of a tower crane design;</p> <ol style="list-style-type: none"> 1) Wind Resistance 2) Weight balancing 3) Counterbalancing

22/11/2019	I researched counterbalancing , one of the physics factor, that affect a tower crane design and researched a formula to find out the most balancing weight a tower crane can carry to its collapsing point (Kelechava, counterweight) and found the principle of crane construction (The principle of crane construction, 0:00-0:20).
03/01/2020	I found the best suitable ATL skills while doing the project and started putting entries to my journal and found a video that would help me with the design of the tower crane (Statics Example, 00:00-02:51)
17/01/2020	I visited a company that designs metal material and agreed with them to design and model a tower crane for this project and provided them some important principles behind a tower crane design. Later that day I researched about wind resistance in a tower crane design.
03/02/2020	I submitted the first draft report to my supervisor and listened to the feedback. Also on the same day I've received an e-mail from a physics teacher, which I had e-mailed earlier that day. about some basic formulas for pulley . After that, I adjusted the formulas for my tower crane model to calculate the maximum weight, which the model was able to carry. Also the same day I visited the company to see how much progress they had made and told them to make the crossovers.
19/02/2020	Attaching the pulley to the tower crane model and sending the final version of the report to the supervisor.

In this project the global context guided the direction of my research. This global context made me understand how much physics is involved in our lives. So I felt that I had a better understanding of the purpose of doing this project. Physics appears in every aspect of life and I understood how much physics is included in a human's life.

Section 3 – Criterion C- Taking action

I went through a tough process to achieve my final goal. The research was the part that I did first. After finding little information on the web, I consulted to Engineer relatives and a physics teacher. At one point I had to decide whether I would design and model the tower crane by myself or would agree to be made by a company. When I decided to have the tower crane made by the company, I met with them and discussed with them how the tower crane model was going to look like.

On my first visit, I told them to provide a counterweight/ weight balancing (Kelechava counterweight) behind the crane arm and to make my tower crane model flat top, (Flat top tower crane) which is going to help to carry the weight at low altitude. On my second visit, I told them that they needed to make crossovers which

would help make the tower crane not sway from winds. After that they told me that they couldn't add a pulley. When the tower crane was ready I couldn't decide which pulley was the most suitable for my tower crane, so I sought help to a physics teacher. After some research and the help of a physics teacher I decided that the most suitable pulley for my tower crane was a single movable pulley. A single movable pulley used less energy compared to the other ones because of the conservation of energy law (Dohrmann Law of Conservation of Energy) also it could carry high amounts of weight easily due to the Newton's 2nd law (Dohrman Newton's Second Law).

I applied different methods while working on this project. I was not used to the methods I applied, but after a while I got used to it and it helped me a lot. The method that was helpful the most was doing this project step by step, on a regular basis. Another method was to grasp the subject. Since I understood the subject well, there were good results after my studies. Working really consciously at every step of the project and creating something from scratch really helped me a lot. Things that I changed the most were the information that I researched. I could not find

While preparing the project I added a lot of things and changed a lot of things. The information on the internet so I decided to talk with my engineer relatives and found out my information was wrong so I changed it a lot.

From this project I gained a lot of really important skills. These skills were researching, self-organizing, thinking, communication and socializing. Throughout my process I had to face with different scenarios, while facing these scenarios I had to use some of these ATL skills. These skills helped me accomplish a better product and will help throughout my life.

I received a lot of assistance throughout my process. My project wouldn't be like this if I hadn't had any assistance. The company assisted me to make a really well designed and stable tower crane model and I also had assistance from Engineer relatives that helped me with the physics behind a tower crane.

Section 4 – Criterion D –Reflecting

While doing the project I had to deal with some challenges. The biggest challenge was how to model the tower crane. I visited stores that were selling some model parts. But all of the model parts were made of plastic, which were not suitable for my project and very expensive. I could not find any good solid materials for the model of my tower crane, therefore I agreed with a small steel company to model my the tower crane. This company modelled the tower crane out of metal, which was very stable and turned out to be a better option than using plastic model parts. The other challenge was not finding a lot of information about the principle of physics behind a tower crane. For the information to be viable, I consulted with Engineer relatives and people familiar of physics.

From this project, I learned that people produced the tools using physics would facilitate their own work, and I learned that working in a planned and programmed manner provided me convenience while working on the project. I also learned that in-depth research and not giving up right away will carry people to their goals more easily. As an IB student, I saw that I developed research and communication profiles. The more we do research and the use of different sources, the easier it is to reach to the right information.

The global context had a big role in my project and I learned a lot of things about it. I learned that science has a big role in our lives and that humans have learned to use it to help them make technological innovations.

Communicating, learning other people's ideas and thoughts have also improved my skills and added some qualities. First of all, I understood how important communication is and that it is the essential part of work and life. I think we always need each other because we live in the community. The way to learn to communicate correctly is by communicating with people more frequently. Since I could not find enough information on the Internet, my contact with people who had knowledge on this matter improved me in this regard.

I have also observed that conducting programmatic, planned and organized research is an important step in successfully completing the project.

This project was the best in some ways and not in other ways. It is the best through modelling the crane, because the model is a really well designed, impressive and viable. As stated above impressive and unordinary things affect humans and that is why I think the model is impressive and the best way I could do it. But in other ways such as research

it wasn't thoroughly achieved. I didn't use different types of material for research as stated above.

This project allowed me to use my ATL skills and I developed them since I used them. The ATL skills I think I have developed are also:

Self-management; When I was doing the project, I reminded myself that I had to write often to achieve my goals. In short, I took every step consciously. I saw that I was able to prepare a project confidently, without worrying, thanks to the time given for the project and the frequent meetings with my consultant teacher. Thanks to this project, I realized how important it was for me to realize my own capacity and develop my self-management direction. I believe that self-management skill also increases my sense of responsibility.

Research; This project is dedicated on researching because it is started from scratch. I made a preliminary research first. As a result, I saw that I did not have enough data. So I had to continue the project by communicating with engineer relatives and a physics teacher.

Communication; As stated previously the research was not enough so I had to communicate with members that knew the subject. Communication skills played a big role while doing my project because this project is dedicated on communication. Without communication skills I wouldn't have made a successful project like this.

Thinking; Throughout my process I faced against big challenges. I found solutions by thinking. These are the reasons why thinking skills were used.

Section 5 –Bibliography

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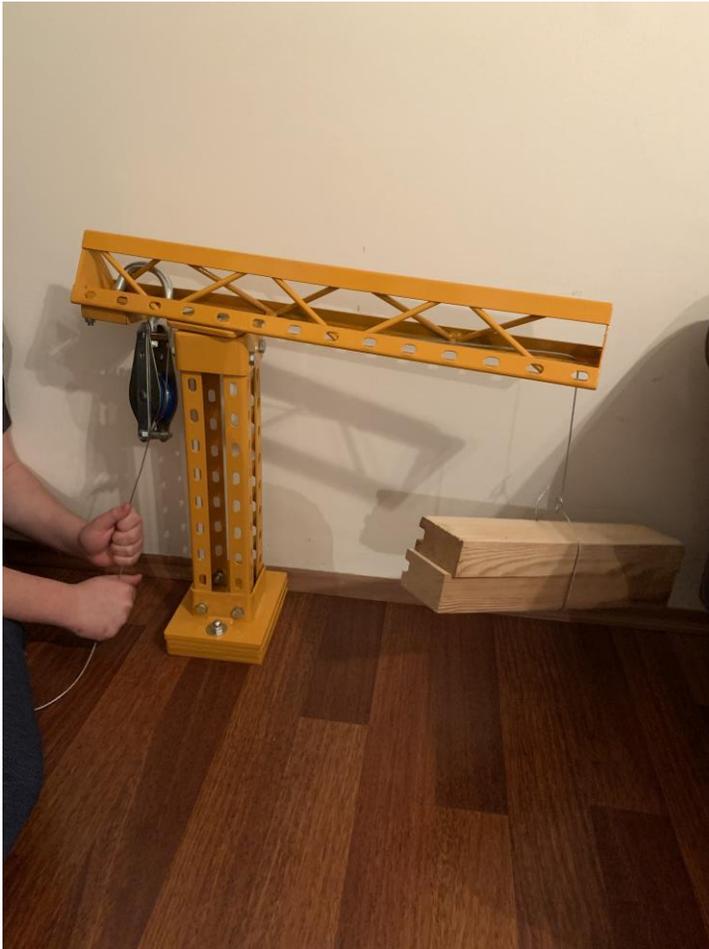
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4) "Statics Example 3 (Static Crane Design)" *Youtube*, uploaded by Acadiana Learning Center, 30 November 2011, <https://youtu.be/-Nx6jBIrUik>

5) Dohrman, Paul. "Formula for a Pulley." *Sciencing*, 2 Mar. 2019, sciencing.com/formula-pulley-5385313.html.

Section 6 - Appendices

My final model:



My correspondence with the the physics teacher at vocational college (in original language – Turkish):

Sevgili Arda,

Öncelikle projen de başarılar dilerim basit bir makara tasarlamam gerekiyor.

ama kullanacağın mazemelerde unutmaman gereken kaldırmak istediğin yük miktarına dayanacak halat(ip,tel vs.) seçimini yapmak makara olarak kullanacağın malzeme de kaldırmak istediğin ağırlığa uygun bir tasarım olmamalı.

Bu sebeple öncelikle basit makinalardan makaralar konusunu bir gözden geçirmelisin şayet makara sisteminde hareketli makara mı yoksa sabit makara mı kullanacak sını şayet hareketli makara kullanırsan kuvvetten kazanç yoldan kayıp yaşarsın ama daha az bir kuvvetle daha fazla yükü istediğin konuma çıkara bilirsin

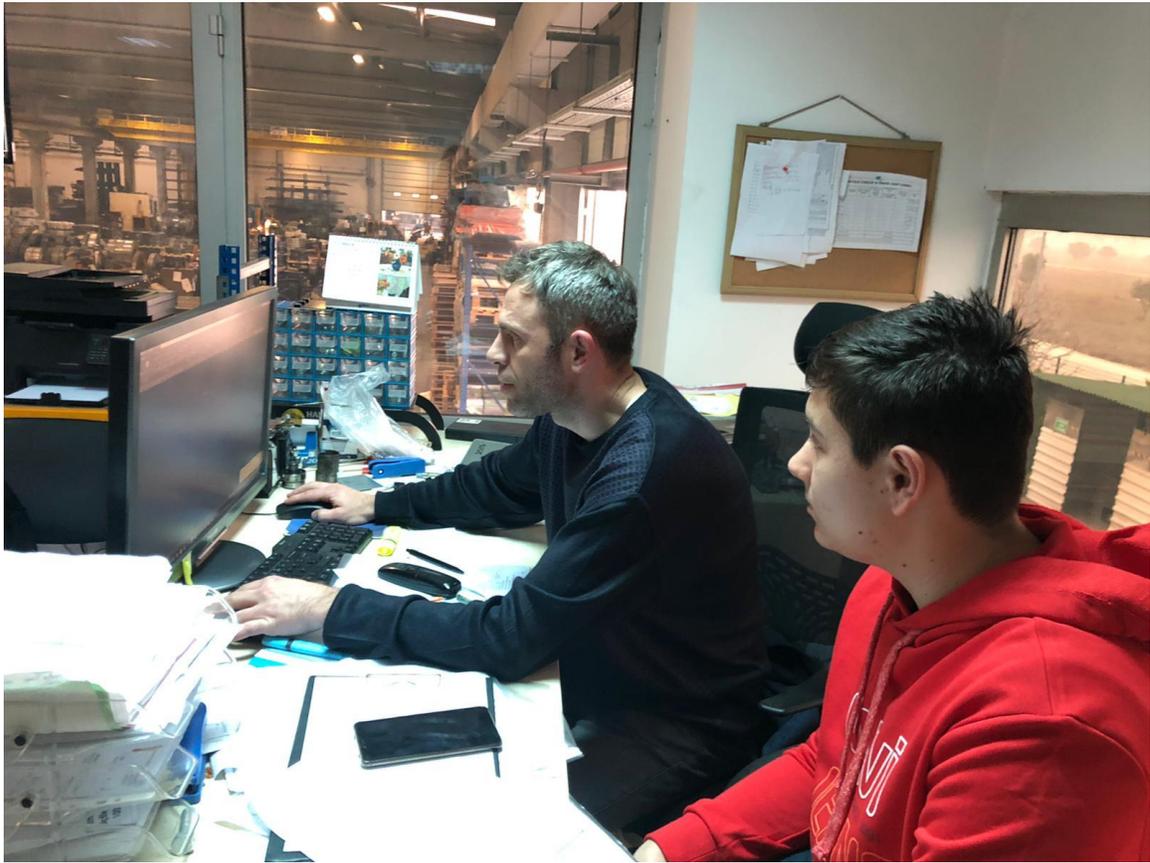
sana ek de bazı görseller gönderiyorum sana fikir verecektir.

şimdiden başarılar dilerim.

iyi çalışmalar.

Fikret YANDIM
Mazhar Zorlu MTAL

On my first visit to the workshop, I told the company how to make the counterweight for my crane and a flat top:



On my second visit I the company to make crossover and to see how much progress they had made:

