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# South Korea 2014 DTU Field trip

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**DTU Mekanik**  
Institut for Mekanisk Teknologi





# Preface

**Ingrid Marie Vincent Andersen,  
Head of Centre, Maritime DTU**

The Blue Denmark is one of the most important industries in Denmark. The Blue Denmark employs around 100,000 people and represents about 10% of Denmark's total production, while Danish shipowners account for the transport of approximately 10% of all world trade. Although Denmark is no longer – in a traditional sense – a shipbuilding nation growth is predicted for the sector. This is true both for traditional shipping as well as in the offshore sector. With the growth comes the need for qualified engineering candidates and it is becoming increasingly difficult for the Danish maritime industry to recruit maritime engineers. With the closure of the large Danish shipyards the choice of a maritime engineering career is not obvious to most students, and generally the maritime industry is not very visible in the public. At DTU much has been done the last three years to attract more engineering students to the field of naval architecture and maritime engineering. By establishing more clearly defined study tracks on bachelor's and master's level the opportunities in the education at DTU have become more visible to the students and the uptake on the maritime engineering course has almost tripled over the past years, but the recruitment of engineering students is a continuous task for DTU to be carried out in close collaboration with the industry.

Studying at a university is good but seeing things in real life is even better, and by visiting shipyards, ships and offshore structures the students obtain a much deeper understanding of maritime engineering and the applications of their education. By visiting the largest shipyards in Korea the students obtained an insight into state-of-the art ship design and shipbuilding and the complexity of the process of constructing a ship or a large offshore structure. 26 engineering students participated in the trip, together with associate professor Ulrik Dam Nielsen and the undersigned. The trip was generously sponsored by the following funds and institutions:

Skibssingeniør Aage Petersen og Hustrus Fond  
The Danish Society for Naval Architecture and Marine Engineering's Fund  
The Danish Maritime Fund  
Ib Moyells Fond  
DTU Mechanical Engineering

We wish to sincerely thank the funds for making this trip possible and would like to express the same sincere gratitude to the following companies for their openness, hospitality and assistance during the trip:

Hyundai Heavy Industries  
Hyundai Motor Company  
Samsung Heavy Industries  
Daewoo Shipbuilding and Marine Engineering  
STX Offshore and Shipbuilding, Jinhae  
Mærsk Line Korea

Mærsk Drilling  
Mærsk Maritime Technology  
DS Norden  
Ultraship  
National Oilwell Varco

It should be apparent from the present report that the trip was a great experience for the students and they have returned home more motivated than ever to become engineers with a bright future in the Blue Denmark.

## **Christian Simon Nielsen, President, The student union Nul-Kryds**

One of our most important tasks in Nul-Kryds is to create a social gathering point for students at DTU with interest in the maritime field. We are therefore very grateful for the opportunity to influence the planning of this year's study trip to South Korea.

It is, naturally, a spectacular experience to visit a selection of the largest shipyards in the world, even more so when it happens within so few days. At the same time it is very educational for us students to get away from the computer screen and out into the 'real' world. We have gained valuable knowledge in the field of ship-building, by seeing the process with our own eyes and meeting the people of the maritime industry close up, in a new context, far away from Denmark and DTU. Thereby we have gained insight into the challenges our choice of education may bring us in the future, and we have been reminded why our field of studies is the most interesting and exciting.

Aside from the academical value we have gained during the trip it has also united us students. To travel together, live and eat together, sharing the experience of visiting a new country, the excitement of seeing what the maritime business, our common field of interest, produces, and coming up with new ideas together; all of this ensures the creation of a strong network amongst the next generation of maritime engineers.

In summary, a study trip like this is the foundation of highly motivated and skilled engineers, which spreads the message of this field of studies and ensures the future of the Danish maritime industry.

I would therefore like to express my deepest gratitude towards all of those who have contributed to this year's study trip.

## Day 1: Monday in Busan

According to the official programme, we were supposed to visit Busan Port Authority, with accompanying port tour, to get an introduction to the port's activities. Unfortunately we arrived in the middle of the typhoon Vongfong; this typhoon was the most intense cyclone worldwide in 2014 so far and even though it travelled over Japan, Korea was also affected. Luckily we arrived in Korea safely, as we had our transit in Japan the day before it struck, but the official programme was cancelled for the day. Because of the weather conditions being rainy and windy, we choose to go for a visit to the Busan Aquarium.



Figure 1: The group readies for the stormy rain from Vongfong

After a morning of looking at the diversity of the aquarium, it was about time for a nice lunch, which was consumed in a traditional Korean restaurant. In the restaurant we were all gathered around a long table, where numerous traditional dishes composed of everything from squid to mushrooms was cooked at the table. After lunch we split up into smaller groups and went to different parts of the city to get the most out of the day. Some went to Shinsegae, which is the world's largest department store, other to the Sooyoung-man Marina, which is the largest marina in Korea with a lot of big and



expensive private boats and yachts. It was strange to see that prices for some brands was more expensive than expected and actually higher than back home in Denmark.



Figure 2: As seen in the above pictures; everything from small clown fishes to threatening jaws was to be admired.

When the weather got better in the afternoon, a group went to enjoy the large waves hitting the shores at Dongbaekseom Island. There are nice trails build close to the rocks, which gives some impressive views over the Haeundae Park Marina, the Haeundae Beach and of the sea. We had to jump away from the fences several times, as the waves would hit the rocks and easily climb the 10-20m distances to the trails.

In the evening we gathered for a dinner at Little Thai Kitchen; to conclude a day marked by an Asian storm, but none the less offered many new cultural experiences and insights.

## Day 2: Tuesday at Huyundai

On Tuesday, we went on a two and a half hour bus drive from Busan to Ulsan, to visit Hyundai Heavy Industries, the world's largest shipbuilder. The tour at the shipyard started with a presentation at their museum portraying the founding of Hyundai and the shipyard, starting as a small repair shop and evolving into a multi billion dollar company. Hyundai Heavy Industries is a subsidiary to the very big Hyundai Heavy Industries Group, covering almost anything from the automotive business to the space industry, in which Hyundai Heavy Industries covers seven business divisions: Shipbuilding, Offshore & Engineering, Industrial Plant & Engineering, Engine & Machinery, Electro & Electric Systems, Construction Equipment, and Green Energy.



Figure 3: HHI seen from Daewangam Seaside Park

Our visit to the shipyard was obviously focused on the shipbuilding part of the company. After the initial presentation we were taken on a bus drive through the huge shipyard grounds to the research and development department. After a presentation of the department we were taken on a tour through the building. Firstly we saw the deep water towing tank, used for hydrodynamic model tests with the associated workshop. All models were covered up, and they were quite mysterious about their tests, so it was difficult to gain detailed knowledge about the procedures they used. Afterwards we saw the streamline tunnel tank used for testing the direction of the flows along the hull when the ship is in motion, which was done with very small models compared to other tanks, and with the model being stationary and the water running past it. Lastly, we saw the cavitation test tank used for testing the cavitation on ship propellers in model scale, before going to lunch in the canteen.



Figure 4: Yesterday's storm was still influencing the waves at Daewangam Seaside Park

After a delicious lunch, we had the opportunity to spend some time at Daewangam Seaside Park. The park offered impressive views of the Huyundai Shipyard, and had beautiful trails with view points where we could read about the fables connected to each point.

The afternoon was spend on the only visit on the trip not only related to the maritime industry: Hyundai Motor Company. Hyundai Motor Company operates the largest automobile assembly plant in the world and the plant is located in the same industrial district as HHI. The visit started in their showroom, were we got the chance to test the interior of some of their newer car models. Hereafter the tour continued with a presentation on the company. Hyundai is the fourth largest vehicle manufacturer in the world. The plant in Ulsan has an annual production capacity of 1.6 million units. Furthermore Hyundai has production plants in U.S., China, India, Czech Republic, Turkey, Russia and Brazil, which makes a total annual production of 4.4 million vehicles worldwide.



(a) The showroom



(b) The RoRo vessel at the terminal

Figure 5: Views from our visit at Huyundai Motor Company



Next, we got a tour in the production facilities. Here we saw the Koreans working hard at the assembly line to be able to complete an new automobile every 10 seconds. The tour continued with a bus trip across the factory to the associated RoRo-terminal. Here, around 4-5000 vehicles are loaded on to a a RoRo-ferry every day and transported to different areas of the world. At the end of the worthwhile day in Ulsan, we were all gifted with a small Hyundai automobile model. The chatter about the experiences and impressions of the day continued on the bus ride home.



## Day 3: Daewoo Shipbuilding and Marine Engineering

We arrived at Daewoo Shipbuilding and Marine Engineering (DSME) at 9:00 am and were welcomed by the staff at DSME with a guided tour in their showroom which included presentation of their business areas (commercial, offshore etc.), facilities (docks, cranes), cooperate movie and the variety of ship models of which they had build in past years. After the presentation it was time for the sightseeing tour around the DSME shipyard. The tour started with an introduction to the steel workshop. The steel plates are cut by plasma cutting machines, which are working non-stop 24/7. After cutting, the steel pieces are welded into large assembly blocks. The up to 1,500 tons assembly blocks were transported on special purpose vehicles from the workshops to the dry-dock area, where vessels were assembled. Some blocks were even transported to the dry-dock by floating heavy lifting cranes with lifting capacity up to 3,600 tons.



Figure 6: Lift of a parallel midship mega block of a Triple-E container ship.

After the tour around the shipyard we drove to the site office of Maersk Maritime Technology (MMT) where Thomas Terkelsen (site office manager) had prepared a presentation. During the presentation he explained the process of the construction and showed the overall schedule for all the Triple-E ships, which are being built at DSME. The schedule for each ship was divided into three phases: construction and assembly of the sections, outfitting, and testing. At the shipyard of DSME they had enough capacity to construct up to three Triple-E ships at a time. It was clear that the shipyard and the site office were under a tight schedule, especially in the last two month during which, they will deliver three ships.



Figure 7: Triple-E ship ready for sea trial.

Thomas Terkelsen explained that the relatively simple middle sections of the ship were delivered by a DSME's shipyards in China to increase the rate of the construction and lower the expenses, the more complex section were built at the DSME shipyard in Korea. Apart from the construction process, he also showed the general arrangement of the ship, where we would later have a tour. He explained some details about the design, and mentioned that they had decided to remove one of the auxiliary engines, due to a surplus in auxiliary power. Some questions were asked about the workload and general conditions of the workers, and he explained that the shipyard cared a lot about safety of their employees and that the workers generally get a good pay. He also explained that it was expected of the workers, that they would be ready to work overtime whenever needed, which it often were.

After lunch in Okpo we went back by bus to the office building. Here we where all handed out safety helmets and received safety guidelines from Thomas Terkelsen. It was now time to drive back to the shipyard where Maersk had arranged a guided tour on Munkebo Maersk, one of the Triple-E container ships, which was only a month away from delivery.

When we arrived at the shipyard mechanical engineer Peter Bertelsen from Maersk welcomed us. The whole group was divided into two groups, one guided by Thomas and the other guided by Peter.

The tour began in the accommodation, where we saw the galley, the captain's chamber and the bridge. All the computer systems were still wrapped in plastic and a handful of workers were working on the bridge. Afterwards we went to the monkey island, just above the bridge. Here it was possible to get an amazing view and overview of the ship and really get a feeling of the size of it. At the same time a view of the whole DSME shipyard was possible.



Figure 8: Technical discussion on the deck.

Afterwards we went down on the deck and walked to the bow of the ship. Here we saw the mooring systems. The tour continued in the engine room, where it was possible to see the propulsion machinery. The two main engines consisted of 7 cylinders. Each main engine could provide a power of approximately 30 MW. The first Triple-E ships in the series were installed with two main engines each consisted of 8 cylinders. 3 auxiliary engines (3-4 MW) were installed in engine room and a 3 MW generator on each shaft. We also had a look at the pumps, the ballast water treatment system, steering gears and separators. At last we were shown the engineers' passageway.

After the tour inside the ship we went down on the ground again where it was possible to take a better look at the propellers. The two propellers were made by MMG in Germany, each with four blades and with a diameter of almost 10 meters.

The day on DSME was now finished, and it was time to head home.



## Day 4: Samsung Heavy Industries

The group departed the hotel at 6 o'clock in the morning to visit the Samsung Heavy Industries (SHI) yard near Geoje-do. The beautiful scenery of Korea with the vast amount of mountains and trees and incredible views from the many bridges once again amazed everyone. The program of the day began at 9 AM with a trip around the yard, which specializes in the offshore industry but simultaneously builds large passenger ferries as well as large container vessels. First, we visited their museum, where we learned about the history of SHI, tried a ship simulator and saw their vision for a floating city of the future. Next up was a guided tour by bus around the yard, which with its 34,000 employees constitutes the second largest shipyard in Korea next to Hyundai Heavy Industries.



Figure 9: View of Samsung Heavy Industries

We were lucky to see the largest ship in the world which was under construction at the yard. Its name is 'The Prelude' and it is a Floating Production Storage and Offloading (FPSO) vessel that processes crude oil. After the sight of this 488 meter long vessel the tour of the yard was completed by meeting Keld K. Nielsen from Maersk FPSO. The group received a lecture from Lars Møller from Maersk Drilling and Keld K. Nielsen about the supervision of the series of four drilling ships owned by Maersk, the two last ones currently under construction at the yard. The lecture took place in the site office of Maersk FPSO and Maersk Drilling. In the lobby we were lucky to see the technicalities of the insulation in an LNG tank. A short video and a mock-up section were shown to describe the layers, which were very educational. A large model of an oil platform was also on display.





Figure 10: Close-up of insulation in LNG tank

Maersk kindly supplied lunch in the 'Foreigners Cantina' on the yard, which is a special service for foreigners so they can avoid the rush of the five other cantinas on the yard where more than 5,000 people dine in each. A very thorough tour of the drilling ship 'Voyager' was given after lunch. It was due for delivery within two months and was almost completed. The group was able to see and get an explanation of all the main parts of the ship – from outfitting to drilling equipment and the engine room.



(a) Drill bit



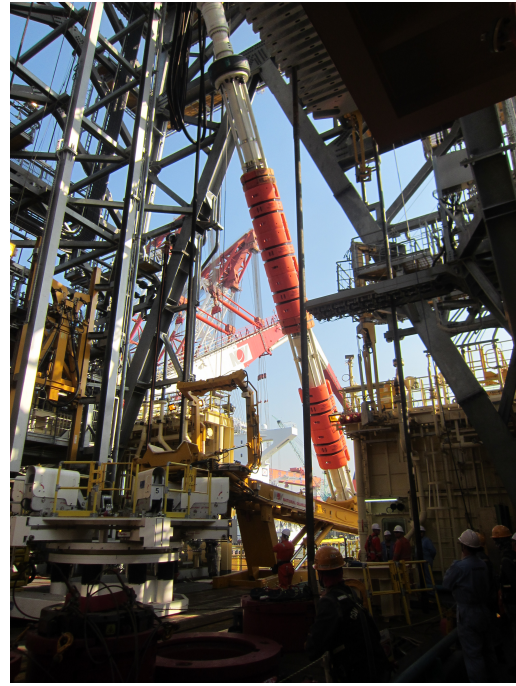
(b) Mud shakers

Figure 11: Details of equipment on 'Voyager'

A test of the riser transfer system and a test of the auxiliary engines were carried out while we were on-board which made the visit even more interesting. The visit gave the group a great practical understanding since Keld K. Nielsen and a representative from NOV Flexibles were happy to answer all technical questions.



(a) Moon Pool



(b) Test of riser handling



(c) Engine room

Figure 12: Areas on-board 'Voyager'

Keld K. Nielsen gave a presentation of the transport and installation of the Blow Out Preventer (BOP) after the tour. A BOP weighs 460 tons, costs around 40 mill.\$, and requires both precision and planning before handling. The presentation was followed by questions from the group, which were answered. The visit was completed with a visit to a local restaurant that served Korean Barbeque to have an amazing dinner and drinks



founded by Maersk Drilling. Lars, Keld and their coworkers, who had helped to plan our tour, joined the dinner. After a great and fun evening the group had to return to the hotel by bus.



Figure 13: The dinner provided a possibility to talk to the coworkers at Maersk Drilling in a more relaxed environment

## Day 5: DS Nordan and STX Offshore

This day started out with a nice traditional Korean lunch with representatives from DS Norden's site office and STX. While we enjoyed the Korean barbecue we had the opportunity to ask about shipbuilding, economical and technical challenges at the shipyard, Korean culture and the everyday life at the site office. We highly appreciated the time with the representatives and it was very learning to converse under informal circumstances.



Figure 14: Work at a dry dock at STX

After lunch with Norden we went to see STX Offshore where Norden gets their ships built. STX is a relatively small shipyard compared to other Korean shipyards like Samsung Heavy Industries, DSME and Hyundai Heavy Industries. They built mostly mid-sized product tankers and bulk carriers and large LNG carriers. Some of their more specialized constructions involves LEG carriers and small navy vessels. Of the 4 shipyards we saw in Korea, STX is the only one who are building specialized LEG carriers (Liquefied Ethylene Carrier) which are some of the more sophisticated types of gas carriers. Due to their involvement in the mid-sized ships segment, they are experiencing tough competition from the Chinese ship builders, which is one of the reasons for their financial troubles. Though our very good tour guide assured us that the problems were only temporary and that they were back on the right track now.





Figure 15: Welding workshop at STX

Before our arrival at the STX shipyard we were told that they would only have time for giving us a short bus ride around the shipyard. Luckily the bus ride ended up including some interesting inspection of their production facilities on foot. We saw how the metal plates were welded together mostly by use of automated welding machines, though some of the inside parts still have to be welded manually.



Figure 16: Side-view of ship under construction

The shipyard is a bit different than the other we have visited. Because they built smaller ships they are able to build the ships on-shore and then roll them into the sea. Some of

the smallest ships are built on a slope so they can be rolled into the sea via a ramp. The larger ships are transported into a floating dock and then made sea-borne by sinking the dock. The transport of the ship is very slow. They are only able to move the ship at 2 meters per hour. Even so, it is a smart way to build the ships because they save cost on dry dock and floating dock rents. We got to see all of the shipyard, the only place we were not allowed access to was the section where they built naval ships. We would like to thank Norden and STX Shipyard for a lovely day.