

# **A RO-RO RAMP WITH SOME SPECIAL FEATURES**

**By Ir Ch.J.A. Hakkaart  
Principal engineer Delta Marine Consultants**

## **1 General**

Increasing commercial traffic between Ireland and England resulted in the decision to enlarge the Dublin Harbour with 60.000 m<sup>2</sup> new loading/unloading facilities and a new Ro-Ro ramp. Merchant Ferries is the operator of the terminal with Ove Arup as their Engineer. Ascon, the Irish main contractor, subcontracted the Ro-Ro ramp to HSM, which in its turn subcontracted the design to Delta Marine Consultants. In June 1994 the contract was awarded, under the condition that the ramp would be operational in December 1994. Only about seven months were available for the design, the construction of the 350 ton ramp with mechanical installation in The Netherlands, the transport [in winter season] to Ireland and the commissioning. Planning showed that construction had to start immediately, leaving no time to finish the detailed design before start of construction. So concurrent engineering had to take place with design and construction as two parallel activities.

## **2 Description of the Ro-Ro Ramp**

The Ro-Ro ramp is located at the far end of a new dock quay, allowing ships to berth along mooring dolphins. It consists of a bridge part, supported at the shore by a hinge and integrated at the sea side with a pontoon. The width of the bridge is 10 meters and the shipside of the pontoon is 20 meters, allowing a wide range of Ro-Ro vessels to berth.

The allowable length of the total structure was limited, due to the available length of the harbour and the dimensions of the vessels to be expected. This resulted in a bridgelength of 22.5 m and a pontoonlength of 12.5 m.

At the shore side, the hinge allows changes of inclination of the ramp and small rotational movements in the horizontal plane. At the sea side, the ramp is supported in horizontal direction by a fenderpile and floats up and down with the tide [Appendix A, figure 1].

The ramp is fitted out at the sea side with a large ballast tank with submersible pumps, located in the pontoon, to adjust the freeboard of the ramp in relation to the draft of the vessel and the changes in freeboard of the pontoon due to the tidal movement.

***We refer to Appendix A, Fig.1 Ro-Ro Ramp***

---

### 3 Performance Specifications

The Ro-Ro ramp has to cater for the following principle operational conditions:

#### 3.1 four different types of ferries, each characterized by:

- \* the beam of the ferry, which determines the difference between the centerline of the ship and the centerline of the Ro-Ro ramp, due to the fact that the ferries are always moored alongside the mooring dolphins. It results in asymmetrical traffic loading on the Ro-Ro ramp.
- \* the stern ramp length of the ferry, which influences the slope of her own ramp during operation. The dimensions vary between 8.50 m and 12.30 m.
- \* the stern ramp width of the ferry, which influences the a-symmetrical traffic loading on the Ro-Ro ramp. The dimensions vary between 7.60 m and 11.54 m [App. A, figure 2].

***We refer to Appendix A, Fig. 2 Ro-Ro Ramp with several ferry layouts***

- \* the structural dimensions of the ramp of the ferry, which requires careful attention to the nose design of the Ro-Ro ramp, to prevent [non acceptable] structural contact.
- \* the changes in freeboard of the ferry during loading and unloading. The lowest level is L.A.T. + 1.45 m and the highest level L.A.T. + 4.00 m, while for each individual ferry the freeboard varies during loading/unloading about 1 meter in respectively 1.5 or 2 hours [App. A, fig. 3].

***We refer to Appendix A, Fig. 3 Transitions and inclinations***

#### 3.2 Loading and unloading must be able to take place in between waterlevels L.A.T. + 0.00 m and L.A.T. + 4.50 m.

#### 3.3 Because this Ro-Ro ramp is intended to be used for heavy commercial [lorry] traffic transport only, special design load cases were defined:

- \* to allow quick loading and unloading, double lanes of HA traffic loading, according to the British Standard. The HA load represents a lane full with cars.
- \* a special transport defined as a 45 unit HB load. This represents a single 180 ton transport with wheel basis defined in the British Standard. This can be e.g. factory equipment.
- \* a single 100 tons MAFI trailer. This is a theoretical future trailer, based on the existing 45 tons MAFI trailers. Besides the high load and special wheel layout, it is characterized by a very small 'bottomclearance'.

#### 3.4 Besides these specific criteria, the Ro-Ro ramp has to cater for standards like:

- BS MA 97, which defines details of ramps and the allowable slopes and gradients.
- Numerous British Standard [steel] codes for the bridge section.
- Lloyd's Rules for the pontoon section.

To allow the Ro-Ro ramp to operate under all these criteria, an adjustable freeboard is required. For this purpose a waterballast tank is foreseen, which can adjust the freeboard, according to the requirements during [un]loading periods.

Besides the operational conditions, the Ro-Ro ramp has to be capable of surviving certain non operational local environmental conditions. This is a maximum waveheight of 1.2 meters and 3 second period.

---

## 4 From idea to final Design

The initial idea of the operator was, to make a structure with an internal freshwater ballasting system. For this purpose tanks were foreseen at the seaside of the pontoon and at the landside of the bridge. Pumping water from one into the other tank should adjust the freeboard of the ramp sufficiently. However, the very short allowable length, about 35 meters [comparable structures under these conditions are about 75 meters], made it impossible to get this idea realised. Finally, a seawater ballast system, which means a seawater ballast tank only in the pontoon, operated by a pumpsystem for ballasting and deballasting, was designed.

Up till now, often one of the compartments of the pontoon is outfitted as pumphroom and another as intake. However the allowable dimensions of this Ro-Ro ramp made it unattractive and difficult to design an independent pumphroom and intakeroom, because it would result in extra torsional forces in the structure.

It was decided, unconventionally, to locate the pumphroom in the ballasttank itself and to omit the intakeroom. This by itself very simple solution avoided the aforementioned difficulties [App. A, figure 4].

*We refer to Appendix A, Fig. 4 Location of ballast tank and pumps*

Another important interaction between Ro-Ro ramp and expected Ro-Ro ferries is the shape of the ferryramp. Several types of ferryramp structures with different dimensions exist and they differ significantly. Although it is the intention to standardize the ferryramp layout, this is not always the case with existing ships.

## 5 Operational Conditions

First a preliminary design was made to establish the expected selfweight and center of gravity. With these figures all loading combinations were calculated and checked. This resulted in the conclusion that a sea waterballast tank of 525 m<sup>3</sup> was required, which could be located inbetween the framework spacing of the pontoon.

One of the important items for the operational conditions - and especially for the very heavy trailers - is the waterplane area of the pontoon. At the moment the trailer passes the pontoon, its weight will increase the draft of the pontoon, resulting in a change of the gradient and the transition angle. A small waterplane area will have a larger impact on these values. It is not possible of course, to adjust the waterballast quickly during passage of the trailer, so the design has to take care, that the trailer cannot touch the Ro-Ro and ferry ramp.

To fulfil all criteria for this structure, such as ramp shapes, gradients, transition angles, combination of structure length and special trailer dimensions, was impossible. In cooperation with the owner, the best fit pontoon deck geometry to accommodate the foreseen ferries was designed [figure 5].



Fig. 5 Deck geometry

## 6 Design/Construct

The fact that the total design/construction time was minimal and critical, it was necessary to implement in the design production friendly aspects, allowing construction to start long before the total final design was ready.

To minimize interference between design and construction and to allow flexibility in time, both for the design and for the construction, the following actions were taken:

- The layout of the structure was set-up in a standard grid, avoiding adjustments in overall dimensions.
- The structure was divided in parts, to allow parallel design by several engineers, reducing the design period and allowing the construction to start with several items at the same time.
- The bridge part was designed as an independent bridge, with its own girders and supports.
- The pontoon was designed independently.
- The pumpsystem was designed independently.
- Especially for steel structures, complicated details or connections cause often delays. Therefore one of the first actions was to design, establish and agree a number of standard [weld]connections for the total structure. These were the preferable connections of the contractor and were checked by the designers [App. A, fig. 6]. So production could not be delayed by details.
- The amount of steelplate thicknesses and qualities was minimized.
- Directly after the preliminary design, the contractor investigated the availability of steelplates and profiles, because there was hardly time available for delivery of special materials. Construction had to take place with direct available materials.

To keep all activities under control, both in time as in money, coordination is of utmost importance. Communication lines were very short, mostly directly between the designer and the production staff.

