Edinburgh, Scotland
EURONOISE 2009
October 26-28

Noise emission RoRo terminals

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ABSTRACT

The RoRo (Roll On Roll Of) terminals are a booming business, certainly on short voyages around Europe and the Mediterranean. The terminal is characterized by activity peaks around loading and unloading times. The main equivalent noise sources are traffic with specialized terminal tractors and the RoRo-ships itself. Peak levels may arise by driving on to the ramp. This paper gives an overview of the general operations, current sound power levels and possible mitigating measures, based on our experiences in the market and future developments.

1. INTRODUCTION

Some products need fast and reliable connections over water, like flowers, greenery products, etc. Roll on Roll off terminals provide this services, mainly for trailers. The main RoRo lines in Europe can be found in the Mediterranean, between England and the continent/Ireland and the Baltic seas. Worldwide the amount of trailers that were moved by RoRo ships in 2004 is about 28 million. In 2008 over 31 million trailers were transported.

The terminal operation is described as follows:

2. Trailers arrive at terminal just before the ships departure
3. Ship is loaded with specialized trucks
4. Ship sails with about 100 till 400 trailers (capacity in lane meters)
5. Unloading at other port in short time
6. Trailers are picked op by trucks and driven off

The activities on the RoRo terminal are very much dependant on the arrival and departure of the ships, which may be any time during day, evening or nighttime.

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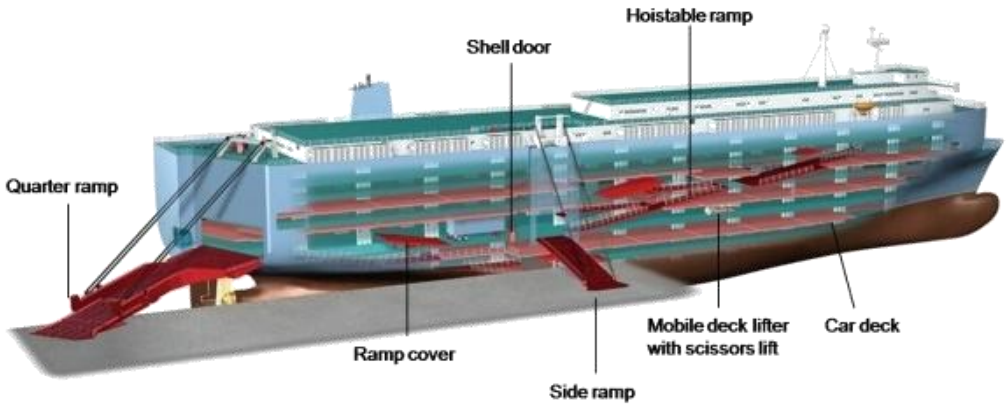
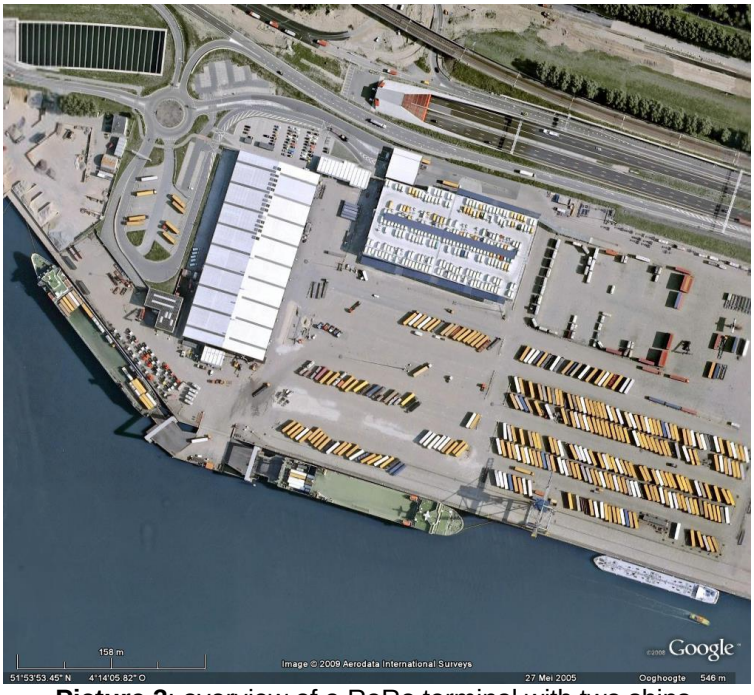


Picture 1: The inside of a RoRo ship

Picture 2: Terminal tractor unloading a trailer



Picture 3: overview of a RoRo terminal with two ships,
with a berth a two ramps and many trailers, situated near a motorway

2. MAIN NOISE SOURCES AND MITIGATING MEASURES

The three main sources of noise are as follows:

1. Ship(s)
2. Terminal Tractor
3. Traffic

A. Ships

The noise sources of the ships can be found at the exhaust pipes (main engine and aux engine), ventilation of the machine room, the forced ventilation of the cargo decks and the loading noise. The sound power for the ship as a whole varies a great deal from 106 until 125 dB(A). No connection between the sound power of the ship and its loading capacity can be found, like DGMR has found for other type of ships[1].

The deck ventilation goes up to 35 times the volume of the deck per hour. Therefore it can be assessed as open space and no air quality measures have to be taken. This ventilation units differ greatly from ship to ship. This is in most case the dominant source of this type of ship, but can also be the other way see table 1.

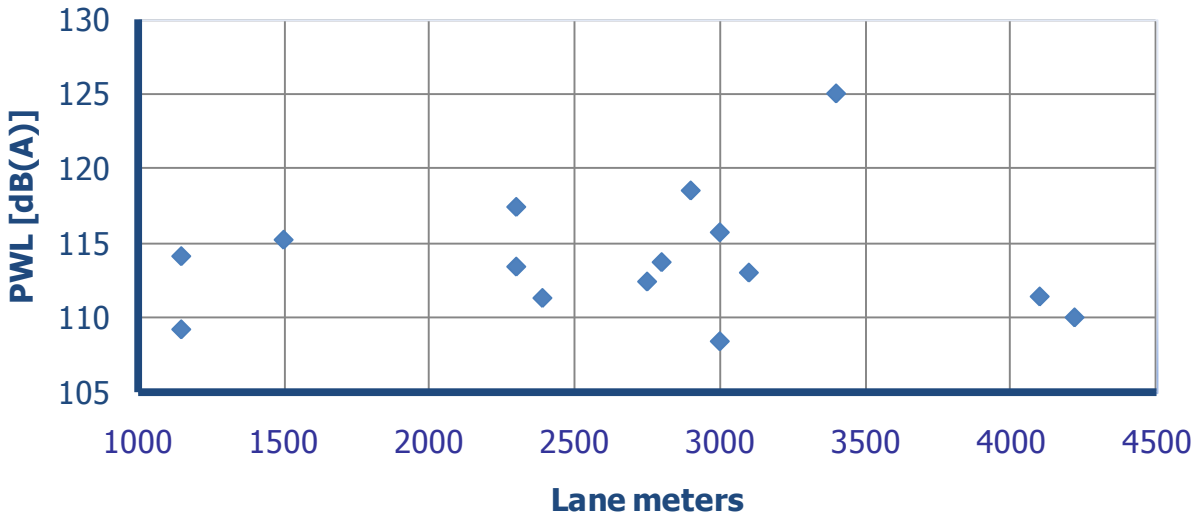


Figure 4: Sound power levels of RoRo ships based on lane meters (= load capacity for trailers).

Table 1: Examples of sound power levels for RoRo Ships

Ship	Auxiliary engines	Ventilation decks
A	104	120
B	114	84

Mitigating measures on ships can best be thought off during the design phase. Our idea is that Best Practical Means is not yet in the minds of ship yards.

The ventilation system of the decks can be applied with low noise vents instead of ordinary noisy types. Applying normal acoustic treatment of the ducts will lower the noise to desired

levels. Ship A in table 1 was treated with mufflers and the ventilation sound power was reduced by 15 dB[2].
The same treatment can be applied to the ventilation of the engine room.
The exhaust pipe of the auxiliary engine(s) can also be treated by applying a suitable exhaust silencer. Overall reductions of more than 20 dB can be obtained, like we have proven in a set of RoRo vessels[3].
If AMP (alternative marine power = electricity from the quay side) is used, there is no need for the auxiliary engines to run. Even the ventilation of the engine room can possibly be shut down and of course the exhaust. The deck ventilation still has to be operational. If active monitoring on the decks of the air quality is used, the need for ventilation may drop significantly.

A well low-noise designed RoRo ship can have a SPW of about 103 dB(A).

Figure 5 : Typical ventilator used in RoRo ships

B. Terminal Trucks

The terminal tractors sound power level is about 107 till 109 dB(A) for driving the diesel engine trailers. Most Ro-Ro-terminal tractors have four wheel drive because of the steep ramps they have to climb. The main sources are the gear box, engine noise and the outlet/inlet. Because of the large quantity, usually about 20 per ship, the contribution to the overall noise levels is significant. Also the peak levels arising from hitting the ramps or just crossing a smaller unevenness causes SPW of up till 125 dB(A).
Mitigating measures are not that easy to find that reduce the noise levels by a relevant amount. Of course the driving speed can be reduced, but that's against the whole idea of a RoRo terminal. Porous asphalt does not work due to the heavy loads and maneuvering on the premises and the relatively low speeds (30 km/hour). But the engines and gear boxes can be improved. For instance switching from diesel to LNG (Liquid Natural Gas) will reduce the SPL with about 3 dB. Making hybrid terminal tractors can reduce the SPL to about 100 dB(A). Of course the all electric terminal tractor will be the best solution. In Los Angeles the first 2-wheel driven terminal tractors are operational:

- Maximum Range (fully loaded): 45 km/full charge
- Charging Time (100% charge): 3-4 hours
- Price per truck: about double the price of a standard terminal tractor

If these terminal tractors can operate inside the RoRo ships has to be investigated.

Figure 6: Electric terminal tractor made by Balqon

C. Traffic

The trucks for the transport of the trailers driving over the premises of the terminal are of less influence. Only through their relative short distance to the street and may be housing areas, it might give a significant contribution. Normal sound power levels are about 104 dB(A). Mitigating measures can not be taken, since most of the time the trucks are not owned by the terminal operators. Of course with the use of a terminal management system, the amount of moves should be kept as low as possible for efficiency and safety.

3. MITIGATING PROPAGATION MEASURES

As already mentioned reduction by applying porous asphalt cannot be taken, due to the heavy loads and the maneuvering on the terminal. But screening can be applied for the trucks. But due to the larger operation space compared to for instance 4 traffic lanes, the screens have to be of a higher altitude. Next to the traffic sources, the noise from the exhaust pipes arise at a height of about 20 meters (and more). This is even harder to screen. So overall this screening measures are often costly and not very effective[4].

Figure 7: Screening on a RoRO terminal as seen from the RoRo ship.

4. CONCLUSIONS

The conclusions that can be drawn are as follows:

- RoRo ships are often not designed to the Best Practical Means
- Averaged sound power levels of RoRo ships are about 113 dB(A) and for 4 wheel driven trucks 107-109 dB(A)
- Low noise RoRO ships can be designed with SPL of about 103 dB(A). In the (near) future, electric propulsion will reduce the SPL of the trucks with 10 dB or more.

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