

# A study on an intermodal terminal at the Port of Esbjerg



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The Interreg IVB  
North Sea Region  
Programme



# Port of Esbjerg

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This study is conducted by:

Port of Esbjerg  
Hulvejen 1  
6700 Esbjerg  
Denmark  
T +45 7612 4000  
[www.portesbjerg.dk](http://www.portesbjerg.dk)

Incentive Partners  
Birkerød Kongevej 137E  
3460 Birkerød  
Denmark  
[www.incentivepartners.dk](http://www.incentivepartners.dk)

Grontmij A/S  
Granskoven 8  
2600 Glostrup  
Denmark  
T +45 4348 6060  
[www.grontmij.com](http://www.grontmij.com)

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## Introduction to the port of Esbjerg

Located on the west coast of Denmark facing the UK, Norway, the Faroe Islands, Iceland and Greenland as well as the Western part of continental Europe, the Port of Esbjerg is the international port of Western Denmark. Due to the port's efficient hinterland connections, Sweden and the Baltic countries are also within easy reach. Over the years, the Port of Esbjerg has demonstrated firm determination to further develop the port's infrastructure and its capability of attracting new liner services. All in all, this makes the Port of Esbjerg a dynamic hub for cargo flows between the Nordic countries, the Baltic area and Europe.

In addition, the Port of Esbjerg serves the oil and gas industry as well as the ever-growing offshore wind farm industry in the North Sea. Since the start of the Danish offshore activities in the North Sea, the Port of Esbjerg has established a unique position as one of the world's leading ports for the provision of offshore services and support. Currently, 80 per cent of the Danish offshore industry is based in Esbjerg.

The development into a multimodal transport centre makes the Port of Esbjerg an ideal shortsea shipping alternative to road transport on Europe's congested and expensive highways. On the whole, the Port of Esbjerg regards itself as being well prepared for the challenges of the future.

Port of Esbjerg expands with 1 million m<sup>2</sup> and has potential for further expansion with a large space for a dry port. Infrastructure is developed by Esbjerg Municipality and the Port of Esbjerg for over 65 million euro - there's highway and railway all the way to the port area.

## Introduktion to the LO-PINOD

LO-PINOD (Logistics Optimisation for Ports Intermodality: Network, Opportunities, Development) aims to enhance the multi-modal accessibility and interconnectivity of ports in the North Sea Region, enabling the movement of more freight by water. It seeks to make North Sea ports more accessible, sustainable and competitive, promote job retention and creation and encourage sustainable interaction with local economies and communities. The result will be a more balanced, polycentric European transport network through a transnational approach.

The project focuses on three areas:

**INLAND** - a transnational investment preparation approach for multi-modal inland connections will trigger significant investments and facilitate the testing, assessment and improvement of existing regional, national and EU policies.

**PORTS** - enhancing transnational co-operation of regional ports and building a joint knowledge platform, capacities and procedures, will enable ports to improve their management, efficiency and competitiveness.

**SEASIDE** - research into the market potential and setting up of new short sea shipping and coastal feeder connections will improve seaside accessibility.

To find out more about the LO-PINOD programme, please go to [www.lopinod.eu](http://www.lopinod.eu)

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 TVI\_1\_TR\_O\_005\_phase2\_Overview plan  
 TVI\_1\_TR\_O\_006\_phase2a\_Overview plan



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## Introduction

This report is a study on a trimodal, intermodal rail/road/sea terminal at the Port of Esbjerg. There either exists or is commissioned a number of studies on road and rail access to the Port of Esbjerg. In order to utilize this knowledge, there are however a need to address this in a more holistic way that links the intermodal possibilities at the Port of Esbjerg to the sea connections within the North Sea Region.

The work will focus on the potential for developing a rail-connected terminal in the port area close to the port's new facilities. Terminal design will take into account the opportunities which the electrification of the main railway to Esbjerg (planned for 2015) will entail as well as potential ways for shifting freight from road to rail, especially in regard to the transportation of goods between West and East Denmark. This work is done by the consulting firm Incentive.

It is an important part of this description that in addition to the transport/freight related studies of a trimodal, intermodal rail/road/sea terminal a conceptual design project relating to the terminal will be carried out. This work is performed by the consulting/engineering firm Grontmij and will describe how the first stage of the terminal must be established with rails connected to the existing rail systems in the western part of the port with crossing at Taurusvej. The first stage must also be designed so that, without major conversion, it is possible to construct a second phase of the terminal with train service from the east via a new and electrified freight track. The projects are carried out in close contact so that the overall result appears as an integrated project which constitutes an important input within the Lo-Pinod context and at the same time ensures the development of the project in the Port of Esbjerg.



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## Cargo prerequisites — Introduction

In the summer of 2012 Incentive conducted a number of interviews with rail customers/logistic businesses as well as providers of rails solutions as a part of the data collection for the freight part of the National Transportation Model.

The purpose of the interviews was:

- To collect data for modelling in the National Transportation Model
- To identify future developments
- To identify the customers' future expectations
- To ensure knowledge of how the Danish railways are used for freight transport — today and onwards.

This has influenced the assessment of the use of a new intermodal terminal in the Port of Esbjerg.

### *The interview tool*

The interview tool was a number of questions on PC with a consecutive Stated Preference game, developed by Significance for the National Transportation Model.

The interviews are rather comprehensive — as many as 90 questions.

We are happy about the initiative regarding the interview tool, but it is also characterised by the architects having a background in the modelling of passenger transportation. The logic behind the freight transport is in some areas different from the logic behind the transportation of passengers. In practice, transferring the experiences from the area of passenger transport to freight transport is very difficult.

### *Freight data*

The problems of achieving access to freight data have often been discussed. In this project too, it has been rather difficult to get access to data from freight transport companies, which has complicated the work with this part of the model significantly.

The general explanation is lack of time. We must also acknowledge the level of competition between the companies, hindering the exchange of information.

The interviews conducted are a way of supplementing the data gathered, specifically regarding freight transport on rail.

### *Freight solutions on rail*

The supply of and the demand for freight solutions on rail are significantly different from other transport solutions. In Denmark, freight on rail forms only a limited part of the total freight turnover.<sup>1</sup> The use of rail is dominated by a few customers. Therefore the traditional supply and demand mechanisms characterizing e.g. road transportation to some extent become invalid.

What determines the demand for rail solutions in practice is often the supply provided by the traction companies.

When looking at the transportation by road, the opposite is the case. A large supply and a large number of customers demanding the solution result in a more traditional market.

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<sup>1</sup> IN 2011 app. 10% of the freight on rails. (0.9 million ton). Road handled 169 million ton. DST Statistikbanken

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## Interviews

In the following, we sum up the interviews conducted.

## Businesses and traction companies

We have conducted interviews with the following businesses and traction companies:

- Blue Water Shipping (BWS). Logistics company that buys services on rails and transports to and from Italy.
- TX Logistik. Rail traction company/traction company carrying out rail transports from Southern Denmark to Northern Italy as well as from Sweden/Norway to Northern Italy. The company also carries out many transports in other parts of Europe.
- Lauritzens Eftf., Esbjerg. Logistics company with a tradition of using rail solutions to and from Esbjerg. The company also uses the intermodal terminal in Taulov.
- IAT/ Breinholt. Eftf., Esbjerg. The company works with sea and road transport solutions. Currently they do not use rail solutions, but they may do so in the future.
- CFL Cargo, Padborg. Traction company with Danish headquarters in Padborg. In Denmark the company is known for using older diesel-based traction, using the entire railway system. They carry out transport on stretches outside the main system on Zealand as well as in Western Jutland.
- Niels Winther Shipping. The company imports cars from Italy and tinned tomatoes, which are transported by rail from Taulov to Høje Taastrup. Today, the transport between Esbjerg and Taulov is by lorry.

## Assessments of potentials

Generally, all persons interviewed see fairly large potentials for rail solutions. They also mention the wellknown problems regarding flexibility, market access, size of shipments, price, and frequency still being challenges for rail transportation in comparison to road transportation.

This challenge has not decreased over the last years, although congestion and road tolls have slowed down the development of road transportation. On the other hand, the combination of larger vehicles and the financial crisis have reduced pressure on the roads.

## Access to equipment

Access to equipment, e.g. pocket wagons to semi-trailers, is an issue causing challenges for rail transportation. A further challenge is shortage of elevation trailers and to some extent the lack of electrification of the Danish railway system.<sup>2</sup> The latter will not change in the near future, but the other challenges can be solved in the — not too distant — future.

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<sup>2</sup> However to Esbjerg in 2015.



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The supply of elevation trailers is adjustable, and elevation trailers can be delivered within a few months. Pocket waggons can be delivered within approx. 1 year. Modern diesel traction is difficult to procure.<sup>3</sup>

It is obvious that the market situation for rail transport is very different from that of road transport. This is due partly to the limited number of providers/traction companies and partly to the access to the infrastructure. Moreover, the lack of flexibility in the rail system is of significant importance when customers decide on the mode of transportation.

### Costs in the terminals

The cost of handling freight in the dedicated intermodal terminals in connection with the change from one mode of transport to another is high (40 - 50 EUR). Moving these may entail larger volumes as well as reduce handling costs. We believe that the staff of the ports or the stevedoring companies will be able to handle the freight in a cheaper and better way. This is possible because they are able to fit these operations into the ongoing operations in the port, avoiding non-productive time as well as purchase of extra equipment. Thus, the intermodal terminals in ports have various operational and cost related advantages compared to the traditional intermodal terminals.

### The traffic-related development

With just a few exceptions, the development of the railway solutions in recent years shows the demand for transit and international rail traffic. Despite the financial crisis, transit traffic has experienced significant growth (approx. 110% from 2006 to 2011).

During same period, the other types of traffic have decreased. The decrease in the national and international traffic is ascribed to the recession and the competition between rail and road. The growth in the transit traffic is mainly due to the purchase of more traction and with it a significantly higher supply. The increasing congestion of the European roads has made other solutions than the road-based attractive. Due to the very low wages of international lorry drivers, the competition from lorries is still strong and will remain to be so for a numbers of years.

Strong potentials for the future development of international traffic exist, primarily between Central Europe and Denmark, especially for the traffic crossing the Alps. In the long term, this will probably include traffic to and from Southern Germany and the Benelux countries, and possibly also the important North Sea ports. The last may also come into play, if the ports demand a large part of the pre and post transports to be carried out via other transport modes than the road-based. The latest transports of wind turbine wings from Germany to the Port of Esbjerg show potentials for using a broader transport setup than hitherto assumed.

### The national traffic — to and from Esbjerg

The national traffic within Denmark is rather complex. In recent years, the traffic has decreased significantly, with a small increase in the first part of 2013. The decrease is caused by a significant limitation of the rail traffic supply. An end to the semi-trailer transport on a number of stretches in combination with the crisis has had a great influence on the development.

A few companies dominate the traffic. How they act is critical to the development of the traffic. Some of these companies are Carlsberg (Fredericia — Høje Taastrup), Maersk (Aarhus — Høje Taastrup) and Fragtmændene (Taulov — Høje Taastrup). A change in the traffic of one of these companies will cause significant changes in the total traffic.

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<sup>3</sup> To Esbjerg electrification will be the main solution, combined with diesel ranger engines.

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The companies are also struggling with the fact that the distances in Denmark are rather short. This, in combination with the high handling costs, makes it difficult to bring the total costs down to a level, where they are competitive with the road solutions. Thus, lower costs in the terminals will be of great importance.

New traffic is also a possibility, such as re-establishing the traffic to and from the Port of Esbjerg as well as other ports. For Esbjerg, it would also be obvious to reestablish the container and trailer traffic from England to HTTC (Høje Taastrup Transportcenter) and vice versa. By establishing solid solutions, new traffic may (e.g. containers from Cobelfret and other operators) would start using this new transport concept. The options are primarily East/West traffic, and Niels Winther's containers from Italy would be more relevant in Esbjerg rather than in Taulov.<sup>4</sup> In the long term, the transport of imported cars for sale and possible preparation on Zealand could form part of a rail solution.

### Other traffic

We also see opportunities in developing rails solutions for the international port of Hirtshals (traffic to and from Norway) and the port of Skagen (probably primarily fishmeal transports). In the long term, also Aalborg may be a part of this traffic with e.g. international transports of tiles and wind turbine wings and national transports of carrier goods to Høje Taastrup. Traffic to and from the Greenland terminal would be possible here.

A number of these transports would pass Taulov and might be included in transport by rails to and from Esbjerg. The advantage of this is using the tractions and reducing the costs of crossing the Great Belt. All things considered, the traffic to and from Esbjerg seems most relevant and the most promising for the rail.

We do not consider it realistic to establish other regular, national transports locally within Jutland or Zealand. Some new East/West transports might be possible going out of Aarhus, Aalborg and Taulov destined for Høje Taastrup on Zealand.

### Change of rail charges

A significant change is the increase of rail charges from 2013 and onwards. A change from kilometre charges to ton-kilometre charges as well as increases in ton-kilometres payment on rail from 0.0038 DKK/ton-kilometre today to up to 0.01 DKK/ton-kilometre in 2020. The latter will be launched from 2016. Naturally, these initiatives will reduce the competitiveness of the rail.

This will be the result even if the congestion fees for using the infrastructure will be removed. The total level of rail infrastructure fees per unit will still be significantly below the road toll level. The higher rail charges will entail an underlying pressure of increasing the capacity utilization of the current and coming trains. This may be in the form of longer and heavier trains. The rail infrastructure holds the opportunity of such a development.<sup>5</sup>

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<sup>4</sup> The potentials of international traffic to terminals in Southern Sweden will be mentioned later.

<sup>5</sup> Up to 750 meters and a total train weight (freight and wagons) of up to 2,000 tons.

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## The incorrect claims regarding rail transportation

To increase the scope of rail freight transport, it is important to clarify a number of incorrect claims regarding rail transportation. One of these is the claim of significant delays and freight damages. The interviews have proven this claim to be generally wrong. Delays as well as damages are on level with — or below — those of lorry transports.

The interviews also show the traditional damages being related to damages on supporting legs on trailers, tarpaulins etc. A more thorough control, including photo documentation from the traction company, has proven that in practice not all of these damages arise during the rail transport and the handling. The control has caused some handling processes to be more complicated but has at the same time removed a number of uncertainties.

Transportation of wind turbine wings on rail has been an eye-opener due to a much talked-about potential to being carried out. The port's position as the focal point of handling and shipping out the wind mills, this opportunity naturally of crucial importance from now on.<sup>6</sup>



Above photo shows the transportation of a 55 m wind turbine wing on the existing track in the Port of Esbjerg. The photo demonstrates the possibility of using the current track for the transportation of large objects. By erecting a terminal in the new port area, we expect the number of such transports to grow significantly.

## Co-operation between traction companies

The traction companies have demonstrated their will to co-operate using a practical approach. An example of this is the use of diesel freight trains when repairing the tracks in Southern Jutland; only a few of the traction companies currently have the necessary diesel traction. A number of capacity problems will occur. An electrified main track to Esbjerg would facilitate further traffic in a combination of sea and rail transport via Esbjerg. The destinations could be Central European ports handling intermodal traffic. Establishing traffic of this type would require close co-operation between these ports.

<sup>6</sup> Transportation of wind turbine elements have been sketched for several years, but only a few transports have been carried out. But restrictions and price of road transports will open up the market for rail whenever possible.

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By using this dual track development, Esbjerg as well as the Port of Esbjerg could call attention to themselves as an alternative to the direct, southern rail solution. However, we have to acknowledge the complicity of this solution due to the rail conditions. Such a solution would be interesting only if the Port of Esbjerg contributed to transferring some freight on rails to a sea-based solution. Whether freight for this kind of solution exists is not clarified yet, but due to the electrification of the train connection to Esbjerg, the new intermodal terminal and the track modernisation such a solution is more likely.

Generally, closer co-operation between the parties is needed, including solutions for attracting new customers. The total offer of solutions must ensure a continuous transport solution even though more traction companies handle it — and the customers must be aware of this. The transport solution will then be available in situations where a single traction company withdraws from the market. It is of the utmost importance that the transport buyers are aware of the rail solutions matching or almost matching of the level of service provided by a lorry.

The quality must include cost, frequency, flexibility and security of supply, the latter in the shape of a number of transport suppliers delivering homogeneous services.

The example of the wind turbine wing also demonstrates the rail's ability to take over transports — in close co-operation with sea transport. It may take over from road regarding consolidated goods, a very competitive area, but also regarding new segments of special and oversized freight such as wind turbine parts, etc. The rail service could also enter the market of "traditional" consolidated goods and new markets for heavy/oversized goods. The latter being a supplement to or a replacement for part of the heavy bulk goods, which historically have been a very large part of the goods on rail. A part of this is no longer being transported or has been transferred to other destinations (by ship).<sup>7</sup>

### The role of the freight forwarders

A number of studies (including the Cowi study that was performed under the East/West Corridor project) have indicated that the fact that the forwarding agents are rather reluctant to use rail-based solutions constitutes a significant challenge. This is indeed a problem, as the forwarding agents make the decisions regarding the transport solutions for a large part of the freight, including the freight to be consolidated and thus needing handling. Convincing the forwarding agents of the fact that transportation by rail is an actual alternative to transportation on road is an important task.

The experiences from the National Transportation Model have displayed the significant difficulties of communicating this to others than the transporters. In other words: It was very difficult to get to talk to the direct users as well as logistics companies about rail-based solutions. The reluctance is in most cases due to lack of knowledge of the possibilities of these solutions.

Moreover, there seems to be a lack of knowledge of the advantages of this solution — with respect to financial gains and regarding improved logistics and possible time savings. Furthermore, experiences from the German MAUT<sup>8</sup> show that the competition interface toward other transport modes is limited. Danish analysis have come to the same result — looking at the effects of road tolls, the competition interface with lorries and other transport modes. Even a fairly high road toll will not in itself move freight from road to rail. If this is to succeed, it will be necessary to take initiatives to make the quality of the rail solution match the quality of the road solution. In this connection, an efficient terminal in the port will be a step in the right direction.

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<sup>7</sup> An example to this is the transport of wood pellets from overseas destinations to Danish district heating plants.

<sup>8</sup> The German road toll for vehicles of a total weight more than 12 tonnes.

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## The important steps

Even after 10 years of massive support of rail projects with EU funding (such as TEN-T and Marco Polo) it is still very difficult to convince potential customers of the rail being a competitive alternative to the road. In Norway, Sweden and Finland rail transport has experienced a revival. This may be due to the electrification of the railway system many years ago. This has caused easier and cheaper access to equipment. In addition, the long distances and the large volumes have been important factors.

Particularly in Sweden, one has seen political will and support for the rail projects, including a will to apply for funds for this development in the form of EU funding for terminals, etc. The intermodal terminal in the Port of Karlshamn is a successful example of this approach. The potential goods turnover in this terminal has not been analysed yet due to the problems of receiving the necessary data.

A successful development of the traffic on rail must be linked to the logistics and forwarding agencies. With these, we find the important opportunities of consolidating goods; and exactly the consolidated goods are crucial, since large volumes are needed if rail solutions are to succeed. The same trend is seen when looking at the combination of rail and ship, as the ship is a transport form focusing on consolidated volumes.

The physical interface between ship and rail obviously is the port, and the erection of an intermodal terminal thus is evidently a good idea. By placing the terminal in the port, access to the trained workforce and the equipment (reach stackers, tractors and the like) necessary to handle the goods between the transport modes is much easier. Due to the very high costs in terminals, every initiative focusing on reducing costs is positive, as well as a precondition for strengthening the intermodal solutions competitiveness towards the lorry transports.

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## What to achieve with an intermodal terminal in the port?

### The new service

A new and improved intermodal terminal located in the new section of the port will open up possibilities of creating new and better transport solutions for the land-based part of the transports. It is a fact that quite a substantial part of the trailers are going to and from the UK on the DFDS routes to Immingham and Harwich. With more than 100,000 units per year, Port of Esbjerg is without question the largest handler of ro/ro units in Denmark, however, the port still does not have a suitable rail connection.

Most of these units are destined to locations outside the region of Esbjerg. A substantial part is going to Zealand, thereby travelling a long distance by road and crossing the Great Belt Bridge. Both the distance and the costs connected with this crossing make it reasonable to make a switch towards a rail-based solution.

In addition, as an obvious supplement to these ro/ro units' containers now shipped from Taulov could go into the system. In addition, a number of the Cobelfret units (containers) from Belgium via the Port of Esbjerg going to Zealand and further away.

It has been estimated that at least 15,000 units (trailers) could use such a connection, making up a daily connection to/from Esbjerg. In a longer perspective, even transports going further on to Sweden and the Baltic States could be part of this concept as described in the EACW studies. These studies indicate a potential volume of more than 2 million tons/year equal to 6 fully loaded return transports per day 5 days a week. Such a volume is not realistic, as it would completely drench the direct ferry connections to Sweden, but it does indicate a scope.<sup>9</sup>

### Learning from past experiences

An obvious question in relation to this is of course why the previous service connecting Port of Esbjerg with HTTC stopped in 2006. The most obvious explanation to this is that the service at that time was running at a very low price level creating a major deficit for the traction company (Railion). In addition, due to unsuccessful negotiations between the costumers and the traction company, the services closed rather hastily.

Finally, the infrastructure linking the port to the main line was (and unfortunately will continue to be) less than perfect imposing a change of traction from an electrical main line locomotive to a diesel shunting locomotive. Even though this imposes some restrictions on the flexibility of the service, a new setup in the intermodal terminal will surely help solve these problems. One possible traction company has indicated that they will stick to the use of diesel locomotives all along, thereby eliminating the necessity to change traction.<sup>10</sup>

Reopening a service will therefore be based on a price level for the transshipment of goods which is in line with the costs of operating the service. Assuming that the cost level and thus the price of such a new service will be below the price of a road based transport solution, the present users of the road-based concept therefore should be interested in switching modality whenever suitable.

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<sup>9</sup> EAWC 2 study task 4. E p 60. DK. 2012. Further on this issue have been discussed with the EWAC team at the Lo-Pinod meeting in Karlshamn in June 2013

<sup>10</sup> This is not a policy in line with EU policies, but it illustrates a hand-on solution to a real problem



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Based on recent experiences from the closing and reopening of the trailer ferry route linking Aarhus to Kalundborg, it was demonstrated, that prices on a service can go up, if it constitutes a reasonable alternative to what would else be considered being a monopoly<sup>11</sup>. However, only if the service meets the demands of the costumers with respect to transit time, frequency, etc.

This experience will be taken into account when describing a possible new rail-based transport concept to the costumers. However, at the same time it seems to be of paramount importance that the rail-based transport solution is able to present solutions which offers a better price/quality mix than the present road-based solution.

### The terminal

In order to achieve this, a new mix of traction companies and handlers including a better setup of the intermodal terminal in the port seems to be a necessity. One of the promising elements related to the establishment of the new terminal is the possibility to include a number of new, professional terminal traction companies<sup>12</sup> with a vast amount of knowledge on the port operation business.

Why is this important? Because it is often difficult to operate the intermodal rail-based terminals on a cost efficient basis, especially when they are small or medium sized. This is due to the fact that cost effective use of both equipment and labour is often limited due to a certain excessive handling capacity in the terminal.

This excessive capacity is a combination of necessary infrastructure and labour on the one hand and the fact that trains are calling/using the terminal during a limited span of time. Any measure taken which can reduce the fixed amount of labour and capital invested in the terminal therefore will help in bringing around a better economic output thereby improving the competitiveness of the terminal and the intermodal setup.

As mentioned earlier, locating the terminal in the port will open up the possibilities for sharing equipment and labour between the intermodal terminal and the other operations in the port. E.g., the same labour and equipment (reach takers) can be used when handling wind turbine equipment to and from the vessels in the port and later on handling trailers on/off the train. By doing so, the costs can be shared by many operations, thereby lowering the “per action” costs. In addition, it opens up the possibility of accessing more terminal equipment in the port and in the terminal, thereby reducing the time spent on a specific operation. This will definitely be one way of improving the competitiveness of the intermodal transport solution.

### Train systems

Even though it is expected that freight passing through the intermodal terminal will most likely be for destinations on Zealand<sup>13</sup>, also international or even transit freight might use the terminal. Such use could occur when forming large trains encompassing both national, international and transit volumes producing a cost effective solution.

When the Femern Belt connection opens in 2021, we expect a number of channels across Zealand and Funen will be given free due to traffic being diverted to the Copenhagen — Ringsted connection and further on to Germany via Femern. In conjunction with the electrification of the main line to Esbjerg this will open up for traffic going from Esbjerg (Taulov) both to other destinations in Jutland (Aarhus and Aalborg) and to destinations south of the Danish/German border. There will obviously be room for more rail-based transports on these sections. This will open further potentials with respect to rail/sea combinations using Port of Esbjerg as well as the intermodal terminal. Examples are stated below.

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<sup>11</sup> At presnt one could say, that road transports constitute a monopoly on the east transports investigated here

<sup>12</sup> Existing companies within the port with a vast experience in handling goods

<sup>13</sup> Mostly the metropolitan area

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## Wind turbines and rail

Using rail for the transport of wind turbines is a good opportunity to remove heavy and voluminous transports from the roads. It has now been fully demonstrated that it is possible to handle even large wind turbine wings on rail and the possibility to link the terminal to the production sites in Aalborg and Ringkøbing. In addition, sites in Germany and other places south of the border will open up a number of possibilities with respect to the use of rail as an alternative to road.

Moreover, even though the rail system is not capable of handling all issues relating to the transports of big/heavy items, it seems to be an obvious solution to engage the rail-based solutions whenever possible. The use of rail will undoubtedly help reducing costs as well as the stress on the road infrastructure, where the wind turbine elements from time to time cause major problems due to their size and low speed of transportation.

## Other rail related transport objects

Transport of new cars mostly from European manufacturers to importers in various countries is often handled by train and to some extent by ship. Port of Esbjerg handles around 20,000 new cars per year, which are transported to the port by ship. The subsequent post haulage of the cars to the dealers are carried out by truck, but for cars going to Zealand and even further on to Sweden the use of trains might prove to be a viable solution.

The intermodal terminal will therefore be designed in a way that allows for the handling of new cars in addition to the above-mentioned items.

## Lessons learned from the East West Corridor 2 study

The East West Corridor study focuses in various ways on the development of a transport corridor from the UK via Esbjerg and Malmö and further on to Karlshamn, Klaipėda and into Russia and China. Most sections of the corridors are intended for rail service. Transshipment from other modalities and routes therefore would be partly sea based (ro/ro connections mostly) and road based. As part of this, the corridor from Esbjerg to the Baltic States and eventually further on should be designed as a Green Transport Corridor.<sup>14</sup>

The main purpose of the study of the green transport corridor linking Esbjerg with Malmö has been to investigate the possibility of establishing a rail connection linking the two nodes via the Høje Transport intermodal terminal outside Copenhagen.

The study has identified the necessity to establish an intermodal terminal in the Port of Esbjerg. However, besides this, the focus has been on identifying the relevant players within the transport chain and the potential volumes of freight which could be shifted to a rail connection.

Very much in line with the outcome of other studies, the potential users have shown little or no interest in this. Therefore the possibility to come up with a viable result with respect to the use of such a corridor has not been within reach.

Finally, the study pointed towards the fact that organizing a new train service is rather difficult. Therefore, an alternative way of organizing this should be taken into consideration.<sup>15</sup>

In the EWTC study it was recognized that the supply of services linking the UK with Denmark, Sweden and the Baltic States in general are rather comprehensive. Based on a number of cost comparisons between a new rail solution and existing

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<sup>14</sup> See East West Corridor II Task 3b final report for more information upon this topic.

<sup>15</sup> At a recent meeting with traction companies in Port of Esbjerg, a somewhat more positive picture was seen. Several traction companies showed a positive approach towards such a solution.

## Port of Esbjerg

solutions, therefore mainly transports between Esbjerg and the Copenhagen, Malmoe and Southern Sweden area were within reach from such a perspective.<sup>16</sup>

As a supplement to these calculations an interview process was set up that focused on the possibility of getting more information and reflections from involved stakeholders. The interviews focused on assessing the potential of rail freight transport in the corridor Esbjerg- Malmoe. In addition, the study was to compile data about the transport market and the specific competitive aspects and to identify possible barriers towards the development of rail freight within the corridor.

Unfortunately, the study did not succeed with this as most of the stakeholders - and in particular the large stakeholders - refused to take part.<sup>17</sup> This was the same experience which the parties developing the new national transport model encountered. Therefore, there are major uncertainties with respect to the future volumes in a new system. Once again this stresses the fact that rail-based transports of this nature are mostly driven by supply of services less by demand. Moreover, traction companies would have to act and launch a service even though the costumers have not signed a contract, in order to demonstrate an alternative to the road based solutions

### Crucial element in the Danish Transport Authorities rail freight forecast

The supply side elements are strongly envisaged<sup>18</sup> in the forecast model redeveloped for the Danish Transport Authorities in 2012. Based on the experience with earlier forecasts and the development of the transit transports on rail during the financial crisis (a rise of more than 100 %), the supply side approach was kept in mind when putting up the new forecast. In the new forecast, the driving force for new rail transports was a combination of the development of new rail infrastructure and the overall development of the economy. In addition, the transfer of road transports to rail will have a certain impact on this development.

The upcoming electrification of the main train line to Esbjerg has not been taken into consideration in an isolated calculation. However, together with the new terminal it is a major prerequisite for the reopening of a rail freight connection to the port.

In the forecast, a very conservative approach was rolled out. Therefore only one return train per day was included in the total forecast. However, it is stated that the potential for more transport was within reach due to the large amount of combined units being handled in the port.

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<sup>16</sup> East West Transport Corridor Task 4 E

<sup>17</sup> East West Transport Corridor Task 4 E p 22.

<sup>18</sup> Earlier studies have demonstrated, that rail based transports of this nature seems to be driven from the supply of new services, which will eventually bring around new demands

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## Goods transport in the new terminal

### Traffic effects

It is very difficult to estimate the amount of goods likely to be transferred from lorry to train if a rail connection to the port of Esbjerg is established.

The interested parties estimate between 10,000 and 20,000 units (primarily semi-trailers) per year. The largest part (estimated 90-100%) is goods to the metropolitan area of Copenhagen via the terminal in Høje Taastrup.

The estimates of the terminal goods turnover result in different ways of designing the rail system: A low, a medium and a high estimate:

Low estimate: 10,000 units (1 freight train/day in both directions, 5 weekdays, 50 weeks, 20 wagon/train)

Medium estimate: 15,000 units (1 freight train/day in both directions, 5 weekdays, 50 weeks, 30 wagon/train)

High estimate: 20,000 units (2 freight trains/day in both directions, 5 weekdays, 50 weeks, 20 wagon/train)

All estimates have been constant since 2008. In the analyses made in 2012 the span was the same.

As a supplement to these, the Port of Esbjerg has contacted a number of key players to identify how many units are transported between Esbjerg and the metropolitan area. Probably for reasons of competition, it has not been possible to get access to data.<sup>19</sup>

### Further findings of the market analysis

Furthermore, the market analysis reveals the following.

The rail connection will not increase the total amount of goods handled in the Port of Esbjerg but the current amount of goods is transported by freight train and not by lorry. This is probably a rather conservative estimate. The setting up of the rail solution and the erection of a new intermodal terminal will give room for new transport opportunities thereby attracting new customers. The market for rail goods is a market that is primarily driven by tenders, as is shown in earlier analyses of the development of rail goods.<sup>20</sup> The goods transferred from road to rail come from abroad and are intended for the metropolitan area.

Transport by rail of wind turbine wing has started again. These have been transported to existing areas in the port, which are placed at some distance from the future terminal. Interviews carried out earlier indicate that traction companies are indifferent to the current solution (with a minimal upgrading of the rail at the Port of Esbjerg) and the solutions proposed for the rail in the port areas. However, we expect the establishing of the new terminal with improved facilities and a location closer to the new port areas will increase the interest for using a rail solution. And this interest will in the long run create a wish for an upgrade of the rail tracks in the port. Thus, the new terminal will be designed in a way, enabling a new and more direct rail at a later time.

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<sup>19</sup> Mail from Søren Clemmensen, Port of Esbjerg. June 27 2013.

<sup>20</sup> "Fremskrivning af gods på Bane" for Trafikstyrelsen, 2008 and 2012

# Port of Esbjerg

## *Time gains*

The market analyses and the experiences from the current rail solution show that the end users of the goods will not experience a delay on rail compared to road.

Furthermore, the market analyses show that the goods consignors do not focus on potential time gains/ losses for the goods. When looking at the increasing congestion problems on the E20 motorway across Funen<sup>21</sup>, it is more likely that this perception will change. And we expect a rail solution to deliver more precisely than the road solution.

Overall, we expect a new terminal and a rail solution to increase the attractiveness of the Port of Esbjerg and to improve the transport system in Denmark.

## **Customer related economics in a road and rail service; some final remarks**

The cost of using either a rail-based or a truck-based concept is essential with respect to the customer's preferences. Mainly due to the competitive situation on both the rail and the truck market, it is difficult to assess the correct price level. With respect to trucks the most important parameter is the cost level of the driver. In addition, this is fully dependent on whether the company uses a Danish or a foreign driver to carry out the transport. With respect to the train, a whole range of issues will determine the cost and thereby the price of the transport. Among the most prominent issues are the handling cost within the terminals and the cost of operating the train.

When operating the train in the port terminal, these costs are lower compared to a traditional intermodal rail/road terminal. Lower costs are mainly due to smarter and more efficient operation procedures within a port terminal. The port traction companies can provide services both to ships and to rail at the same time, using the same work force and equipment for both types of operations.

In a study of possible rail connections to ports reported in 2009<sup>22</sup>, a cost estimate for road and rail was carried out. This estimate concluded that a rail-based system carrying 30 units (trailers) per trip was approximately 25 % cheaper than a road-based concept. These figures are surely not the accurate ones but they indicate that a rail-based solution should be economically viable. Moreover, based on these figures, a rail solution should be a solid alternative to the road.

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<sup>21</sup> Including problems related to the upgrade of the road connection

<sup>22</sup> Trafikstyrelsen: Screening af havneforbindelser og restbaner. September 2009

# Port of Esbjerg

## Conclusion on rail transports in Port of Esbjerg from 2016 and onwards

The new intermodal terminal in the port will open up for more possibilities of handling the growing amounts of freight. The port will be able to offer its customers all major modalities and thereby be a real intermodal transport centre. Focus will still be on sea-based transports – now in combination with road and rail. However, the port area with its facilities and companies will also form a platform for other activities, most of them being in demand for transport.

A rail system handling 10 to 15,000 units (trailers and containers) serviced by one or more traction companies therefore should be an essential part of this transport system. As stated in the previous sections, it is not possible to provide more details and more exact figures for the moment. The search for an interested traction company and the setting up of a society and/or network of cargo handling companies therefore must be the next step.

## Existing conditions within the port

From our travels we have learned to appreciate quick, uncomplicated and efficient shifts from one means of transport to another – ship, car, train and plane.

Smooth shifts between different means of transport are exactly what characterises the infrastructure of the Port of Esbjerg. Direct railroad connections to Scandinavia and quick access to the European motorways are integrated parts of the port area as well as the adjacent areas with combi-terminals, warehouses, service companies, and industry. Combining different means of transport, all these elements ensure efficient logistics and flexible solutions.

Therefore, already today the Port of Esbjerg is a multimodal transport centre – an innovative and efficient hub for the shipment and transshipment of all types of goods to and from Scandinavia, Europe and the rest of the world.





## Port of Esbjerg

The entire port is connected to the rail network via Esbjerg Station. It is prospectively the Port of Esbjerg, Esbjerg Municipality and the parliament's position that it is important to ensure that freight trains has access to the port of Esbjerg.



The construction of the bridges across the Great Belt and the Sound meant a substantial extension of the hinterland of the Port of Esbjerg. Moreover, the direct railroad and motorway connections to Sweden, the Baltic States and Germany have reduced transit times considerably. In addition, the Port of Esbjerg plays an important role as developer, mediator and coordinator in the constantly increasing co-operation with other commercial ports.

In 2012 Banedanmark investigated various solutions for a new track for freight trains to the Port of Esbjerg. The investigation is described in "Programfaserapport – Nyt godsspor til Esbjerg Havn" prepared by Niras. On 21<sup>st</sup> March 2013 the Danish Parliament decided to renew the existing track from Esbjerg Station to the Port of Esbjerg and to establish a new intermodal terminal with two new tracks for freight trains with a length of 450 m. This project is shown on plans TLF\_1\_TR\_P\_301 and TLF\_1\_TR\_P\_311 and TXS\_1\_TR\_S\_304. Based on this decision, the Port of Esbjerg wants to a terminal.

# Port of Esbjerg

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## Design of the intermodal terminal

### 2 DIFFERENT PHASES FOR EXTENDING THE TERMINAL

On plan TVI\_1\_TR\_O\_004, Phase plan, the 3 phases are indicated in a schematic way.

Phase 1 is the phase which is decided by the Danish Parliament. The rail line will be electrified to Esbjerg Station and from there on it will be necessary to use a diesel shunting locomotive to and from the new intermodal terminal in the port between Esbjerg Station and Taurusvej.

Phase 2 is in principle the same solution as phase 1, so the capacity is only extended for the loading area with two new tracks east of Taurusvej. Plan TVI\_1\_TR\_O\_005, Overview plan phase 2, show the new loading area with a length of 750 m, but it is naturally not necessary to build the whole terminal on the first day. It can be extended according to the demands.

The rail line will still be electrified to Esbjerg Station and from there on it will be necessary to use a diesel shunting locomotive to and from the two intermodal terminals in the port.

The crossing of Taurusvej is in phase 2 a level crossing.

Phase 2a is an extension of phase 2 shown in plan TVI\_1\_TR\_O\_006, Overview plan phase 2a. This solution foresees the establishing of a new electrified rail line for freight trains from Tjæreborg to the eastern part of the port. Then the electrified locomotive can drive to the new receiving yard east of the terminal established in phase 2. It will then only be necessary to use a diesel shunting locomotive to and from the receiving yard to the loading zone.

The loading area in phase 2 and 2a is the same. It is only the train access which has been changed. The access by lorry to the loading area is both in phase 2 and 2a to take place from Taurusvej.

In phase 2a there will be no need for the rail connection from Esbjerg Port to Esbjerg Station, and the stretch can in principle be shut down or be maintained as an alternative route.

## **Port of Esbjerg**

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### **Pavement design for the intermodal terminal**

This is a preliminary evaluation of various technical solutions with regard to the selection of pavement design for the intermodal terminal in Esbjerg which is part of the construction of a new cargo rail track to the Port of Esbjerg.

Two different types of pavement are applicable. Options are using either concrete block paving with a concrete element (curb) or special types of asphalt/bitumen. The preferred pavement has to be selected in connection with the upcoming project design.

#### **ASSUMPTIONS**

It is anticipated to handle containers and other types of intermodal cargo as swap body etc. using reach stackers for the handling. An intermodal terminal situated alongside two cargo tracks is defined. It is expected to use reach stackers similar to the ones already being used in the Port of Esbjerg.

By using reach stackers for handling of cargo from the cargo rail track close to the terminal the axle load on the front wheels will reach 110 t.

It should be noticed that it is of importance to the design of the terminal life cycle, whether it should be based on the chosen 110 t axle load or e.g. 130 t axle load, that might be realistic by handling of cargo from another rail track than the one located immediately against the terminal site.

The estimated cargo volume amounts to max. 1 train per day on each of the two tracks. Based on a paving life cycle of 20 years, this will result in about 60,000 passages of an area, presuming that 20% of all handlings will pass the same part of the site.

The above assumptions are important and will require verification and decision prior to the project design.

The final pavement design will also depend on the bearing capacity of the subsoil. This must be examined and stipulated further during the projecting phase.

#### **RESULT**

##### **Pavement**

Below we have stated two optional pavement designs based on our experiences from similar terminals for handling of combined cargo using reach stackers and an axle load of ca. 110 t.

The strength parameters of the base course layers in the surface must be rather high, requiring stiffened demands to the compaction, resulting in the fact that the chosen elastic moduli for gravel etc. is higher than it is typical in normal road construction.

We expect to have surface constructions more or less as stipulated below, however, depending on the bearing capacity of the subsoil as to the thickness of particularly the sub base sand.

## Port of Esbjerg

Terminal		Asphalt/bitumen	Stone
	Unit	Thickness	Thickness
Semi-flexible wearing course	mm	70	0
Asphalt base (type HM)	mm	100	0
Paving stone	mm	0	90
Levelling sand bed	mm	0	25
Lean concrete	mm	300	350
Specific graded gravel	mm	500	500
Sub base course layer	mm	Min. 500	Min. 500

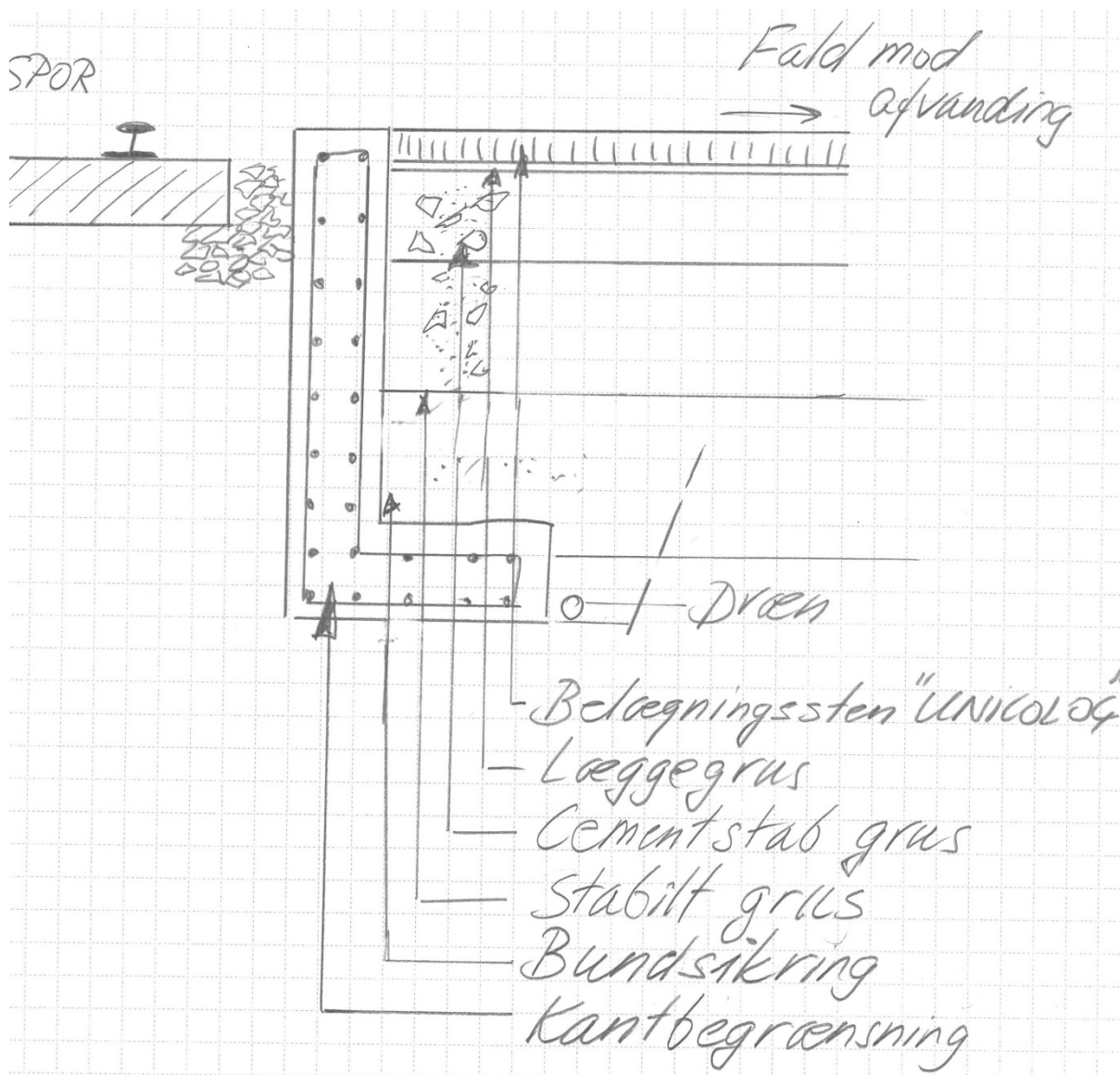
Having a reasonable bearing capacity of the subsoil, the thickness of the sub base course layer will amount to approx. 500 mm. As a result of an inferior bearing capacity the layer thickness could be considerably larger, so other possible reinforcements should be considered depending on the condition of the subsoil. A number of subsurface geotechnical investigations - partially in the project area - are available, indicating the presence of some silt deposits in the area. This will require additional evaluations as to the design.

To our knowledge the paving stone surface has a technical advantage compared to the asphalt surface because it appears a little rough at wintertime with slush at the site pavement. On the contrary, it might be a little easier to carry out a spot repair of the asphalt surface in case of damage to the surface from e.g. a dropped container. This will require lifting and replacement of typically 2-4 stones, and it is difficult to have a smooth surface afterwards. Certain types of asphalt surfaces have problems with impressions left on the surfaces in hot periods.

## Port of Esbjerg

### - Concrete element, curb

To avoid that the large horizontal braking forces from haulage with reach stacker "remove" the surface, it must be secured by a concrete element, (curb).



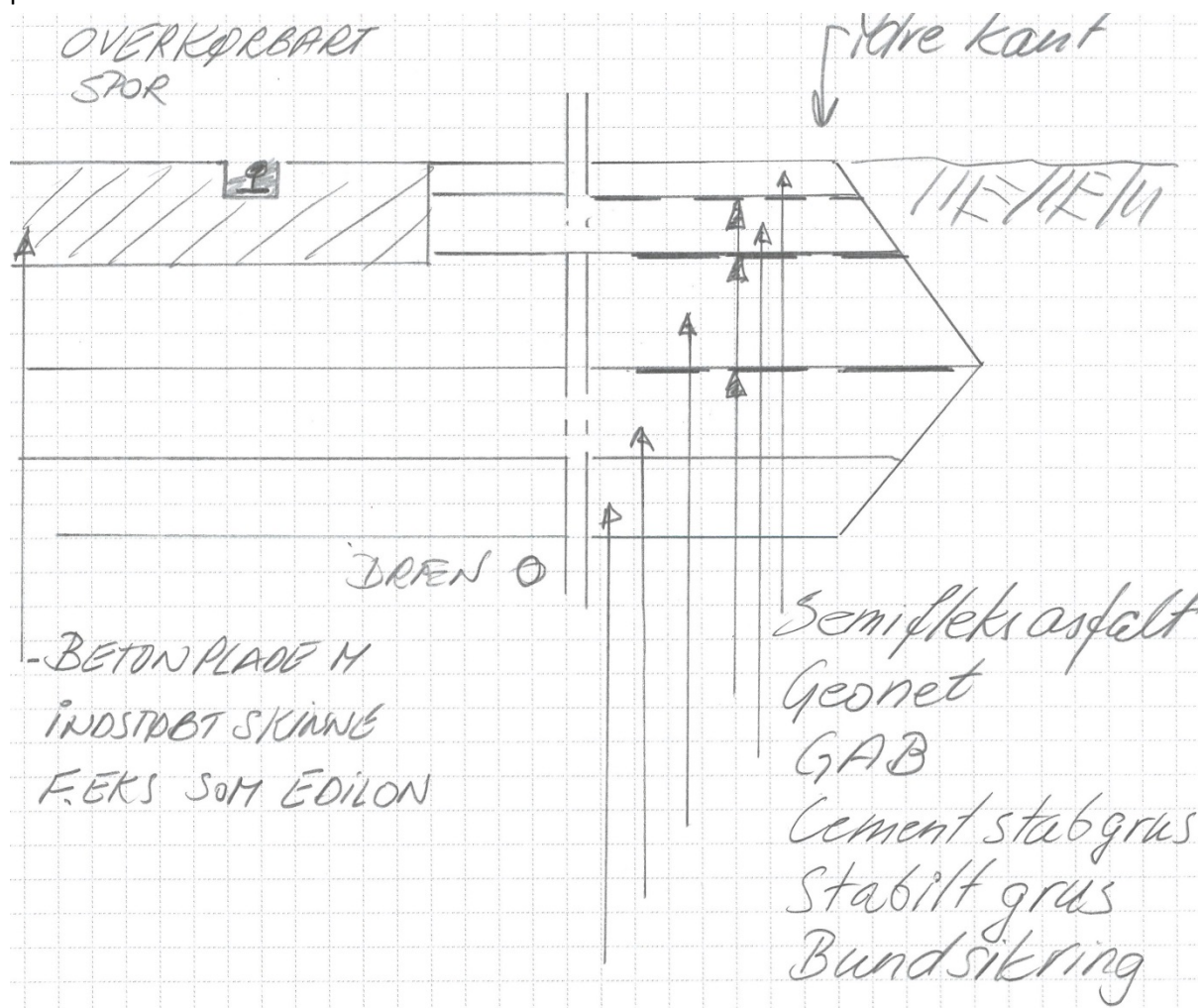
In the Port of Esbjerg there are two options.

One option looks like a traditional curb solution which, however, requires construction of an approx. 0.5 – 1.5 m high concrete element (curb) made of reinforced concrete including base forming the curb. This is typically precast elements that are transported to the site and placed. This option is well-known from other sites with paving stone as pavement. There are alternative ways of construction of curbs that might be useful also in the Port of Esbjerg. Based on several projects a.o. one carried out in Banedanmark's terminal in Høje Taastrup, where a reinforcement mesh acts as a "ground anchor" in the pavement as a substitute for the more traditional concrete solution. It has until now been evaluated that choosing this reinforcement mesh requires the semi-flexible asphalt solution to be used as pavement described above.

## Port of Esbjerg

### - Slab track with hard surfacing for heavy traffic

If appropriate, that the constructed track system should be a slab track with hard surfacing for heavy traffic, this could be solved by a concrete slab with embedded rails similar to "Edilon", that has been approved by Banedanmark, alternatively as grooved rails on a concrete slab with paving stone or asphalt up against the rails. In this way, it is possible to level slab track with hard surfacing and pavement.



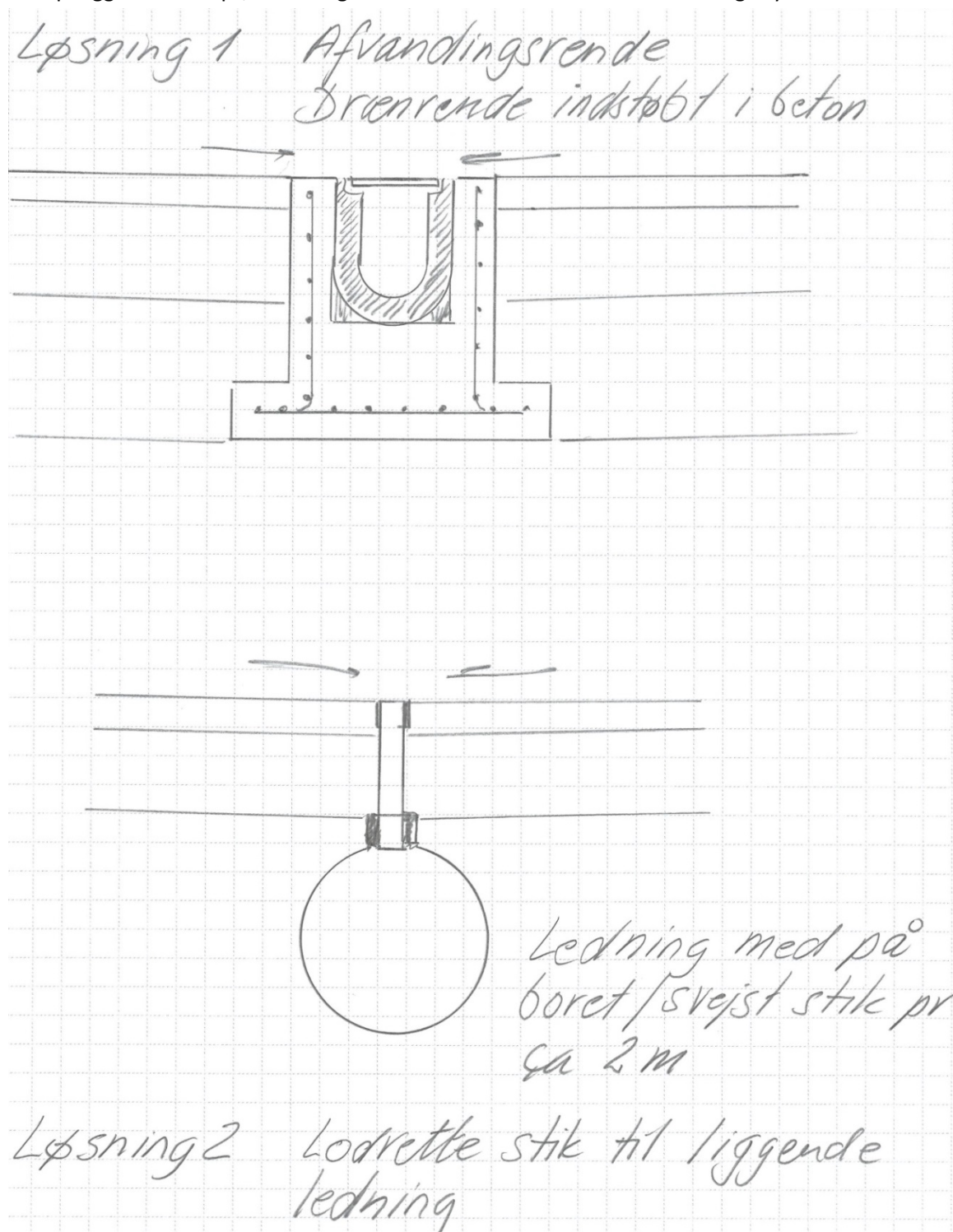
We find the asphalt solution most suitable taking the joining of the concrete slab and the pavement into consideration.



## Port of Esbjerg

### - Drainage

At a terminal, where reach stackers are used for handling of cargo, the drainage typically takes place either to a trench drain in the centre, or to a number of vertical small pipes leading to a bigger "horizontal" pipeline, similar to roof drainage from flat roofs. In both cases, the drainage trench or pipelines might be filled with sand from the ice control. Consequently, it is absolutely necessary to set up bigger sand traps, collecting the sand which runs off into the drainage system.



## **Port of Esbjerg**

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### **- Preliminary recommendation**

The specific project in the Port of Esbjerg has not been investigated in detail. However, we expect that a financial evaluation of the selection of pavement and the concrete element/curb might show that the asphalt solution will be the cheapest solution. It will, however, be appropriate to make a thorough evaluation with regard to the definition of a.o. braking forces from reach stackers against the track to be used for an optimization of the necessary concrete element (curb), especially in connection with the concrete option, which might make this design advantageous.

We recommend the option using vertical pipes for drainage.