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R. Exalto *Redesign of the container terminal Hanno*
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ECT (Europe Container Terminal B.V.) bought the Hanno terminal in 2004 from his competitor. This container terminal is located nearby one of their own terminals (the Home terminal), close to the city of Rotterdam. The Home terminal has reached maximum capacity and the container handling is still growing. The purpose of Hanno for ECT is to catch up the ongoing growth. The first phase was the integration of Hanno into the ECT concept. The personnel are now members of the ECT Company and the computer systems are almost adapted. The next phase will be a review of the layout of the terminal, specially focused on the internal container transport and stacking. In this report the possibilities for the handling of containers at the Hanno terminal are investigated.

The contribution of Hanno for ECT is estimated at 100.000 - 400.000 moves per year with a positive exploitation and the investments must be earned back in 5 years. Due to the uncertainties in the future and expected fluctuations is a flexible system important. At this moment the operation is mainly done by reach stackers, this working method has a relatively inefficient use of space. The reach stacker needs wide driving lanes and due to reshuffles has a low handling capacity. A solution needs to be sought to improve the stacking and handling capacity.

The Hanno terminal is shown in figure 1, the primary investments are made in the berth apron (blue zone) and the stacking area (yellow zone).

Figure 1: The berth and stacking area of the Hanno terminal

Hanno has two berthing zones (blue). At the left of the terminal is Jetty 5 (600 meter long). Here the barge and feeder ships are handled with a mobile crane. The other berthing zone is jetty six (800 meter long) here are standing five quay cranes, which mainly handle deep-sea vessels.

The stacking area (yellow zone of figure 1) is divided in different sections (see figure 2, the arrows in the figure indicate the driving route of the road trucks).

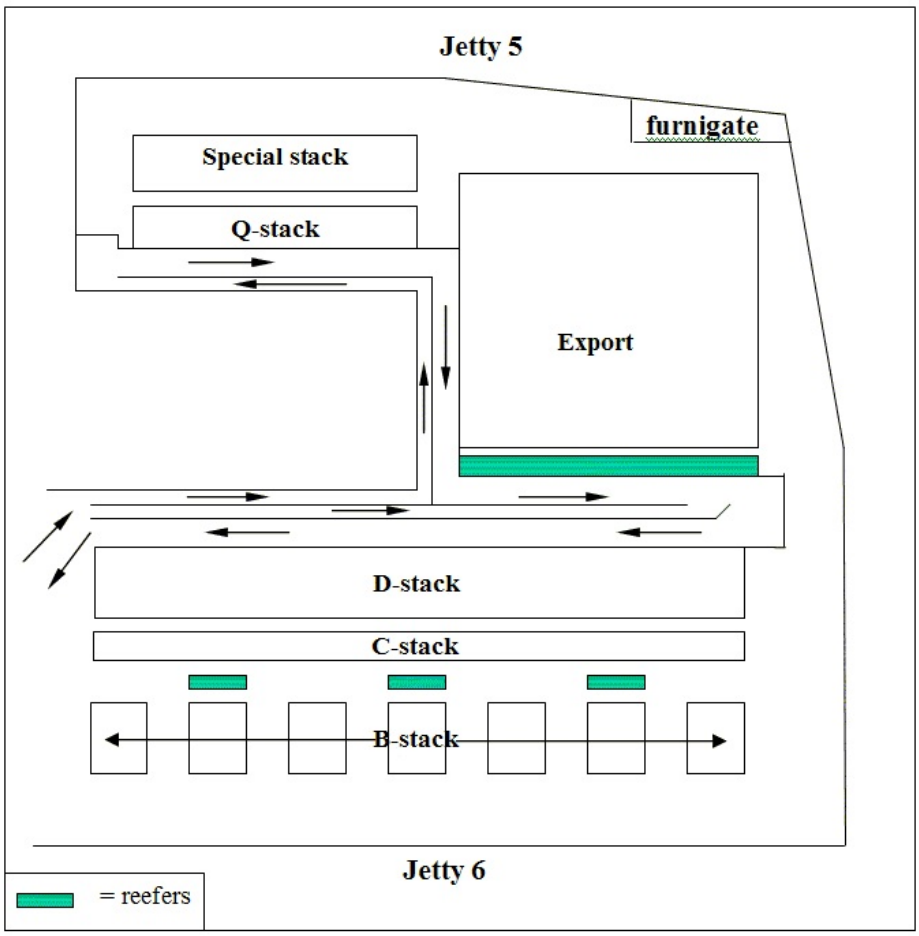

Figure 2: The stacking area

The stacking area is divided in:

- B-stack or the blocks: The transshipment containers are stacked here, this are mainly containers that are made ready to be loaded into a feeder or barge vessel that arrives soon at Jetty 6. This happens frequently with containers from deep-sea ships, which have to be loaded in a feeder or barge vessel. The stacking is done with reach stackers.
- C-stack: This is the import buffer. Containers are stacked here two wide against a concrete edge. This is the exchange place for containers between the gantry stacking crane (import stack) and the reach stacker.
- D-stack is the import stack: This is the place where the import containers are stacked with 3 stacking cranes. These cranes also load the road trucks.
- Export: This is the place for export containers; the empty containers are stacked here too. The containers are stacked with reach stackers.
- Q-stack: This place is mainly used for empty containers or large amounts of reefers. Here is standing one stacking crane, named the Q-crane.
- Special stack: This stack is used when there is to little place on the rest of the terminal. The stacking is also done with reach stackers.

The design assumptions for the new concepts are made for a call frequency of two per week, which is good for a throughput of 260.000 containers a year (or 293.280 water side moves per year). The design assumptions are based on data from the home terminal and the assumption is that in the ongoing five years the dwell time and TEU factor will rise. The overall estimated container flow is shown in figure 3. The deep-sea ships are loaded and unloaded with a rate of 120 containers per hour.

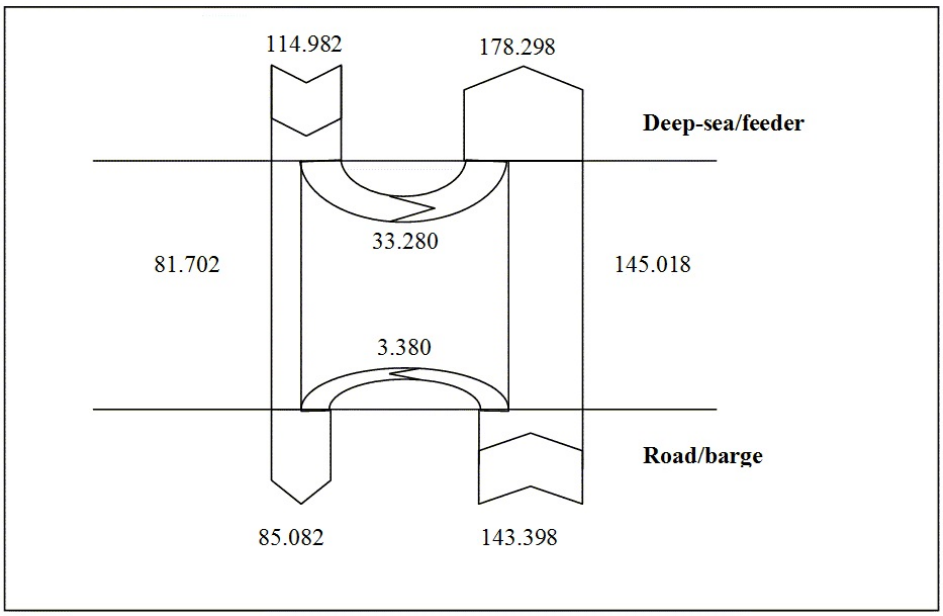

Figure 2: Overall picture container flow

With the current situation this is not realizable. Therefore, alternative terminal concepts have been developed. The three new concepts are:

- Concept zero plus, which is an improvement of the current reach stacker based situation.
- Concept 1, a straddle carrier based concept.
- Concept 2, a RTG based concept.

These concepts have been worked out and evaluated using different criteria. Although the criteria are self-explanatory, the following remarks are made:

- The costs are divided in:
- The operational costs for personnel and equipment.
- The annuity (sum that consists of redemption and interest).
- Investments for the new equipment and to adapt the terminal.
- The handling capacity is used to assess how close each concept can reach the 120 containers an hour for loading and unloading of the deep-sea vessels.
- The stacking capacity is used to assess the available stacking places.
- The flexibility or volume change is used to assess the possibilities of changes in the container flow (with taken costs in account).

To make a concept choice a multi criteria analysis has been used. The important of a criterion is defined by the weight factor. Each concept gets points between the 1 and 5 for each criterion. A one means bad while five means good. The points given are multiplied by the weight factor and totaled for each concept. The concept with the highest score fits best to the demands (Table 1).

Table 1: Multi criteria analysis

		Concepts	0+		1		2		Maximum
Criteria		Weight factor	Appreciation	Score	Appreciation	Score	Appreciation	Score	
Costs	Investments	3	4	12	2	6	1	3	15
	Operational	3	4	12	3	9	3	9	15
	Annuity	3	4	12	3	9	2	6	15
Handling capacity		3	2	6	3	9	4	12	20
Stacking capacity		3	4	12	2	6	5	15	20
Introduction aspects		1	4	4	2	2	5	2	10
Volume change (*)	Lower	4	5	20	2	8	1	4	15
	Higher	3	1	3	1	3	5	15	20
Total score				**81**		**52**		**66**	**130**

(*) With taken costs in account

In conference with ECT there has been chosen for concept 0+, because:

- The concept has the highest score with the multi criteria analysis.
- Low costs are important for ECT.
- The chance that the amount of moves decrease is more realistic than an increase.

The working methods that need to be made to the current situation are as follows:

- The current working method is to lift the container from the chassis, bringing it to the men who put on the twist locks and then the container goes in the ship (when unloading it is in reverse order). To make the cycle time of the quay crane shorter the twistlocks must be already on the container before the cranes pick it up from the chassis. With the chassis in use this is not possible, new chassis are needed.
- Terminal tractors must not be part of a crane team. Instead they should be more flexible as part of a ship team. One team working together with each other can absorb peaks of a crane very easily and gives no unnecessary waiting time of terminal tractors if one crane has a low productivity.
- With the unloading of the ship the containers for barge and road are separated. This means that besides an import road buffer (C-stack) also an import barge buffer is needed.

The facility improvements that need to be made to the current situation are as follows:

- In the special stack is made place for an empty stack (the red stacking area in figure 4).

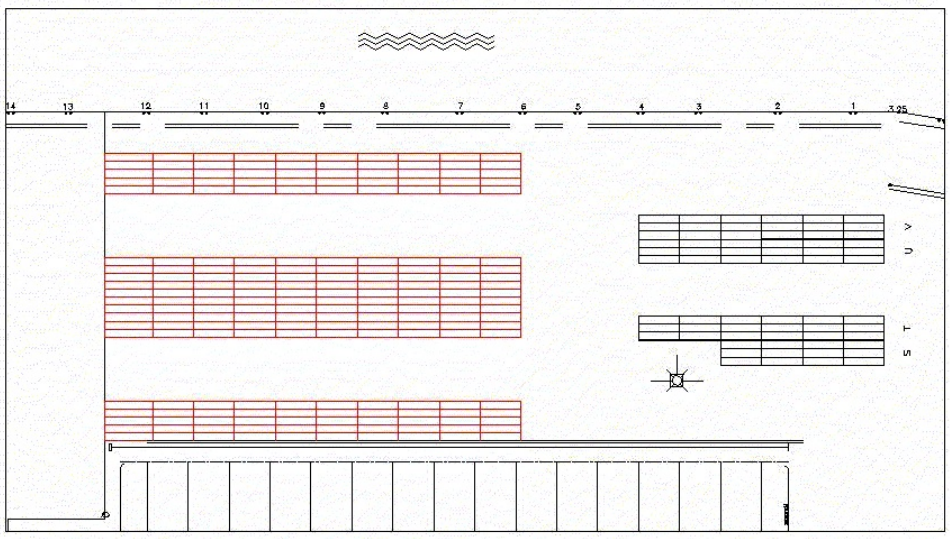

Figure 4: Empty stack

- The B-stack (transshipment stack) is reduced, to increase the driving possibilities for the terminal tractors. (figure 5)

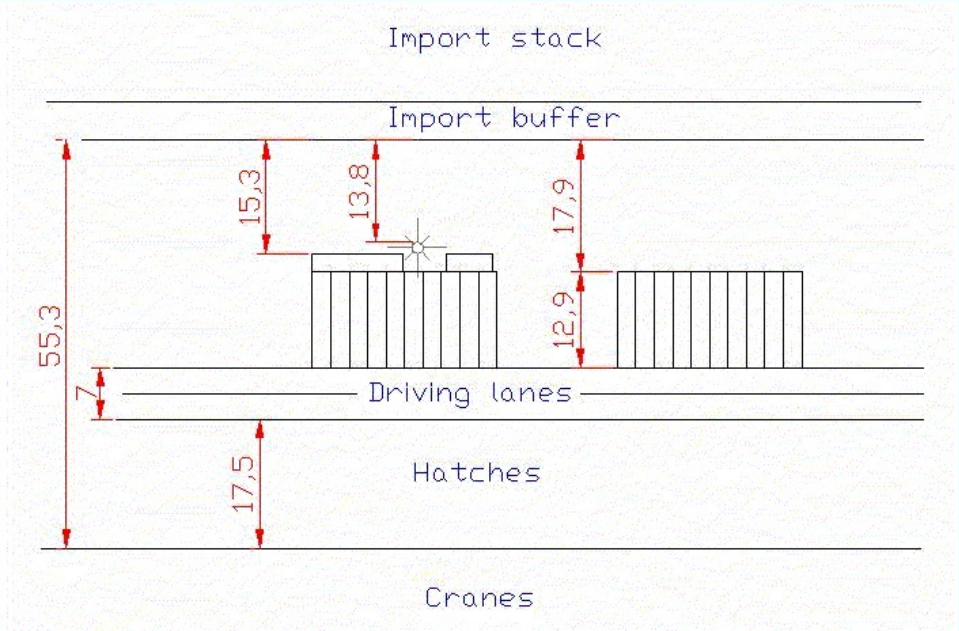

Figure 5: Improved situation transshipment stack

- The import stack has a lot of overcapacity that is why a part of the import stack could be used as transshipment stack (marked purple in figure S.6). Reach stackers do the stacking. This also made it possible to introduce a lane over the crane track for a fast connection from the quay to the export stack (marked blue in figure 6). The new barge buffer is made nearby the quay (marked red in figure 6).

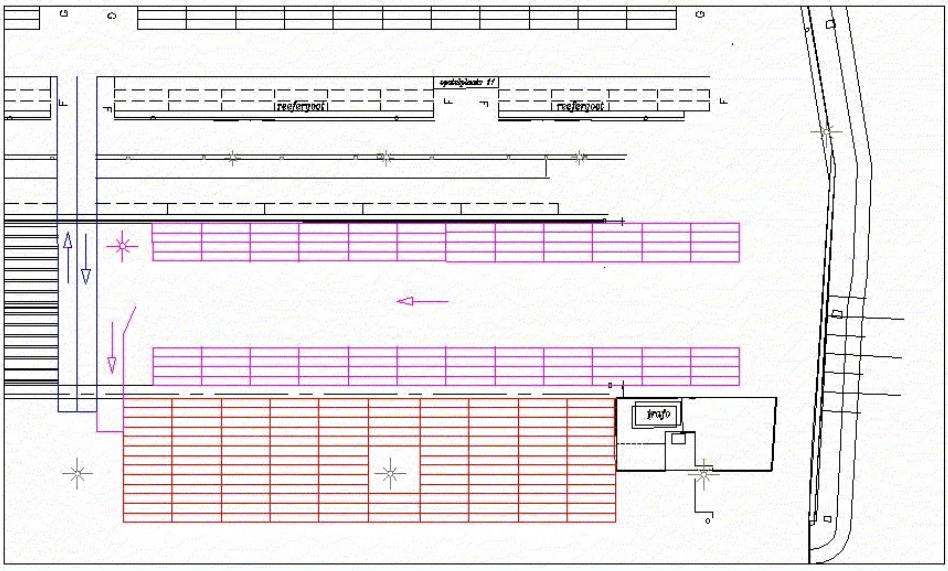

Figure 6: Improvement in import stack

- In the export stack, the driving lane to and from the empty stack is increased. In order to increase the transport capacity (for transporting the empty containers). The changes are marked red in figure 7.

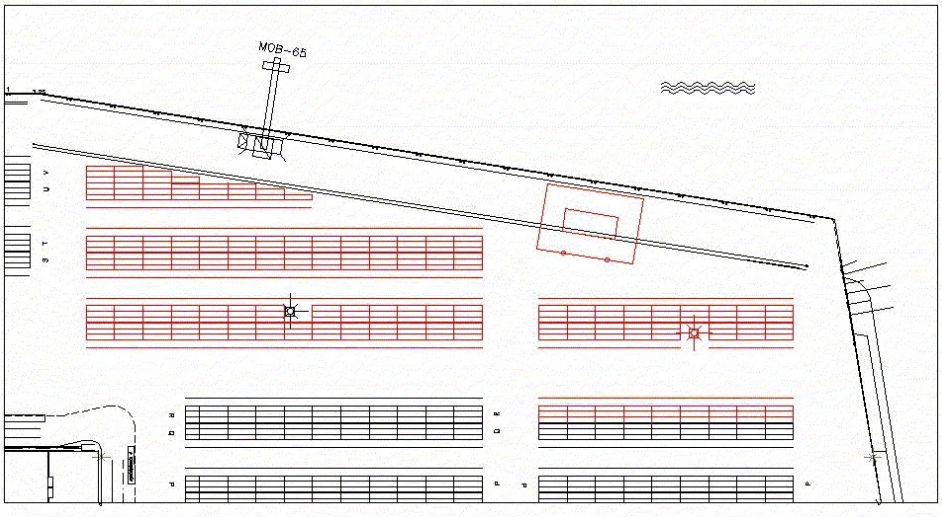

Figure 7: Changes in export stack

The conclusion is that Concept zero plus best fits to the demands of ECT for the Hanno terminal in the nearby future. The investigation leads to a terminal concept for Hanno with two calls per week of deep-sea ships, which results for 293.280 moves a year. The positive exploitation and the earn back time of five years for the investments are succeeded. The handling capacity with unloading is sufficient (120 containers per hour). With loading only 100 containers per hour is possible, due to high stack filling and reshuffles in the export stack. The stack capacity is sufficient, because the containers can be stacked. The introduction aspects are small, only a few adjustments need to be done to the layout with few costs. In addition, the Personnel and TOD needs no adjustment. The container flows in the stack cannot change much, but changes in the purpose of stacks are possible and make the concept to some extent flexible.

The concept zero plus has been further analyzed with a case study, which showed that the new client of ECT could be served at the Hanno terminal. With the designed concept the handling and stacking of the containers will not give any problem and the two calls per week can be handled. It can be concluded that with the new terminal concept Hanno is ready for the future.

The following recommendations are suggested:

- Prefer simulation studies so the influences like ships delays and breakdowns of equipment can be taken in account.
- Investigate the influence of 45 foot containers in the stacking area, cause these containers are not taken in account in the designing of the concepts.
- Aim to keep short dwell times because this has positive influences for the stack capacity.
- Focus on customers with smaller call sizes, because the equipment and layout of the terminal fits not sufficient to handle big ships.
- Consider the use of 1 over 1 straddle carriers for transport; this will improve the handling time.
- Consider the use of empty stackers in the empty stack, this equipment can stack empty containers more efficient then reach stackers.
- For good stack planning it is recommended to equip the reach stackers with weight measuring devices, so the weight of each container can be determined.
- Isolate the motor of the quay cranes, which produce too much noise so they can work at full power again. The crane cycle time becomes lower and the handling time will improve.

Reports on Transport Engineering and Logistics (in Dutch)

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