Intermodal transport unit,
container, swap body,
semi-trailer

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UNCONVENTIONAL INTERMODAL TRANSPORT UNITS

Nowadays new unconventional intermodal transport units, which are characterized by dimensions larger than standardized ones, are being developed. This should brink higher utility value of such units. On the other hand this leads to many problems which should be solved. The paper also includes some brief information related to the new project TelliBox. Some unconventional methods of manipulation with transport units are mentioned in the paper as well.

NIEKONWENCJONALNE INTERMODALNE JEDNOSTKI TRANSPORTOWE

Współcześnie rozwijane są konstrukcje nowych niekonwencjonalnych intermodalnych jednostek ładunkowych, które charakteryzują się wymiarami mniejszymi niż standardowe. Powinno to podnieść wartość użytkową tych jednostek. Z drugiej strony prowadzi to do wielu problemów, które należy rozwiązać, Artykuł zawiera także informacje na temat nowego projektu o nazwie Tellibox. W pracy scharakteryzowano także pewne niekonwencjonalne metody prac przeładunkowych związanych z jednostkami ładunkowymi.

1. INTRODUCTION

Intermodal transport is the transport-handling system ensuring transport of goods in one and the same loading unit from sender to recipient as an uninterrupted chain. Components of this chain are: intermodal loading units (ILU), means of transport (wagons, road vehicles and vessels) and handling equipment for transhipment of ILUs. In some cases, mainly in some bimodal transport systems, handling equipment, one of components of before mentioned chain is partially or fully missing.

European Union strives for sustainable and efficient transport systems [1]. That means improving and promotion intermodal transport and thus shifting a greater share of transport from roads to railways, inland and off shore waterways.

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In European transport market, there exist various intermodal loading units. The main types are

containers,
swap bodies,
semi-trailers.

Their use depends on different factors, e.g. the specific relation served and the transport mode used for this relation. These ILUs exist in different variations of features like the construction type (tank, open/closed top, flat, etc.), dimensions (length, width, height), strength, ways of loading and unloading ILUs themselves, handling with ILUs during change of transport means, stackability etc.

There are two main ways for improvement of ILUs. One way is to ease charging and discharging ILUs and the second way is to enlarge its dimensions. Besides it, new systems of handling with ILUs are developed. Its aim is to push greater deal of transport to railways.

2. CONVENTIONAL AND UNCONVENTIONAL INTERMODAL LOADING UNITS

2.1 Containers

Large containers ISO 1 are the most used type of ILU, but they have some disadvantages, while the most serious one is the internal dimension of the container. When loaded by europallets the loading area of the container is not sufficiently used because the internal width of the container does not allow loading two europallets side by side. Comparison of standard ISO 1 container and swap body of approximately equivalent length from point of view utilisation of floor area is shown on Fig. 1. From this reason in the last years there is a trend to utilise so called High Cube containers that means containers with extended internal dimensions.

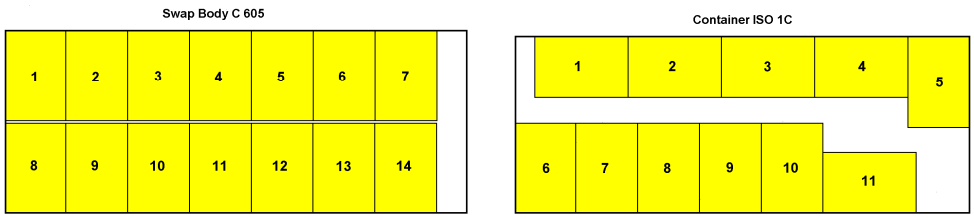

Fig.1. Distribution of europallets into swap body C 605 and container ISO 1C

Certain enlargement of container capacity was achieved by including 45 ft long containers into system ISO 1 containers. This reduced some competitive advantages of swapbodies and semi-trailers.

By adopting regulations on surface transport in the USA in 1982, new Series 2 of containers having width of 8 ft 6 5/32 in, height of 9 ft 6 in and length of 49 ft were introduced. These containers have gradually expanded on the base of bilateral agreements in international transport into Asia and Western Europe. The Series 2 is stated only as a technical report and not as a standard ISO.

In 2003, the EU proposed a Directive on intermodal loading units COM (2003)155 focusing on essential requirements in terms of security, safety, interoperability, handling, strength, coding and identification of UTIs. The intention was to increase the competitiveness of intermodal freight transport by providing a framework for a better use of intermodal loading units throughout all transportation modes. The second part of the Directive provided for standardising a „eurocontainer“ (EILU – European Intermodal Loading Unit), in practice a container with the dimensions of the commonly used swap bodies.

However, this EU initiative is still in a progress and there are many contradictious requirements from different parties involved. Discussions are on dimensions, stackability, but the basic philosophy is that as far as possible everything that can be transported by road should also be transportable by intermodal transport.

An example of unconventional container is shown at Fig. 2. This container has fully side opening besides end door opening, what makes loading and unloading operations easier. The fact that one side solid wall is replaced by doors leads to decreasing of stiffness and strength of the container structure which have to be compensate by enlargement of height of container base structure. This container has unusual width (2.55 m) as well.

Fig.2. Container equipped with fully opened side wall

2.2 Swap bodies

A swap body is unified and from transport means separable box (container). It has unified basic dimensions, gross weight and fixation elements. It is specially designed as an intermodal loading unit for carriage of goods mainly by road or railway. Special box designs of swap bodies can be used also by inland waterway, short sea and ferry traffic. For handling they are equipped with grooves at the bottom suitable for handling by grab-lifting appliances. Swap bodies are equipped with bottom fittings for fixation on railway wagons.

Swap bodies eliminate some disadvantages of ISO containers: dimensions of loading area are educed from dimensions of europallet (external width of swap bodies is usually from 2.5 to 2.55 m), by which more effective use of loading area was achieved (see Fig. 1). In terminal points of transportation the swap body can be taken off and on a road vehicle without use of handling facility (but category C only).

There are number of designs of swap bodies with different lengths (6 m and more) and various design solutions such as solid walls, openable sides, folding curtains, tank and specialised equipment for transportation of various types of goods.

Swap bodies are typically designed to less strength requirements than ISO containers. In general they are not stackable because of light structure and its design arrangement. There are also few swap bodies with stronger structure and the corner fittings enabling stackability [2, 3].

Megaboxes (Fig. 3) are basically specially developed and modified swap bodies, which were developed from the need for alternative offer for transportation of in particular car components and spare parts by another than direct road freight transport. Megaboxes were developed in cooperation of DB CARGO, DB Technik Zentrum Minden and new customer of German railways DB - Continental AG corp. In megaboxes the company carries transportation of automobile tyres from the individual production plants (e.g. Continental Púchov in Slovakia) into central distribution store in Hannover in Germany [4].

Fig. 3. Swap body "Megabox"

The Megabox has side doors along all length, external width 2.6 m and external height 3.29 m what causes problems during public road transport (see Council directive 96/53/EC

from July, 25 1996). Megaboxes are certain combination of ISO containers and swap bodies. They are whole metal boxes supported on four legs. Within the plant they are transported on special road vehicles equipped with hydraulic hoisting platform, these vehicles are not suitable for public transport. On railway they are transported on special low platform freight wagons (Sgkkms 698).

Another example of unconventional swap body is a special high volume loading unit A100 shown on Fig. 4 (Ewals Cargo Care). This special swap body is usable both on roads and railways and it is characterized by its external length of 13.62 m, internal height is 3 m and loading capacity is 100 m^3.

Fig. 4. Swap body A 100

The A100 swap body has openable left side using curtains and panels; right side is made of fixed metal (steel) wall. It allows rear & side (left) loading and offloading for better entering of fork-lift trucks it has one-side lifting roof (30 cm). The swap body is not stackable. Basis structure is made in a form of "fishbelly" with integrated kingpin and fittings for railway wagons at 30 ft. On railways it is transported on wagons Megafret and on road it is transported on special chassis.

2.3 Semi-trailers

Semi-trailers are primarily used in road transport. Only few of them can be used in intermodal transport. Compared to containers and swap bodies they prove to be more flexible especially in using of their cargo area. In road haulage semi-trailers are preferred because of their flexibility not only in terms of manoeuvrability but also concerning the

coupling and uncoupling process. When a semi-trailer is transported on railway its main disadvantage is high dead-weight.

The dimensions and mass of semi-trailers mainly depend on legal standards. There is a European consensus about which maximum semi-trailer dimensions have to be accepted throughout Europe. Besides, there are national legislations. The maximum dimensions are external width of 2 550 mm (2 600 mm for thermal boxes), maximum overall external height of 4 000 mm, and external length of 12 000 mm from the kingpin to the end plus 2 040 mm radial overhang at the front end (this goes in line with 96/53 EC rule on maximum dimensions). The inside dimensions naturally depend on the construction type (box type, soft superstructure with tarpaulins on a skeletal frame).

When semi-trailer is transported by railway then it becomes an ILU and part of intermodal transport. Road semi-trailers can be loaded on railway wagons by two methods – horizontal and vertical. In case of vertical handling it is necessary to use handling equipment, similar as in case of swap bodies and require stronger superstructure of semi-trailer equipped with grab handling grooves. In general, only less than 3 % of semi-trailers are permitted for vertical handling.

This fact leads to development of new methods how to get semi-trailers on railway wagons and part of road transport shift to railways by such way.

One way is utilization of basket wagons or very simple system ISU (Innovativer Sattelhänger Umschlag) in case of vertical handling.

As to horizontal handling of semi-trailers or road vehicles generally well known system is using of RoLa wagons. Another systems using horizontal handling are bimodal systems e.g. Kombitrailer, RoadRailer, RailTrailer, PROTEO etc. The direct embedding of semi-trailers on special bogies equipped with adapters however requires semi-trailers with special design.

The main problem is how to get conventional semi-trailers on wagons and with minimum of special handling machines if possible and as quickly as possible. If manufacturers of semi-trailers intentionally produce semi-trailers that are not possible to load on standard recess wagons by standard cranes, solving this problem is in using the special railway wagons and the special handling equipment. There were several systems worked up which make possible simultaneous loading of semi-trailers on specially designed railway wagons. Some examples of such systems are Cargo Speed [6], Modalohr [4, 7], CargoBeamer [8] etc.

Systems CargoSpeed and Modalohr exploit wagons equipped with swing-tray sections of main frame without any powered actuators on wagons. The swing-tray sections of wagons are moved by the special equipment placed beneath level of rails and between rails.

System CargoBeamer is based on wagon equipped with the special loading platform „JetModule“ in which semi-trailer is placed. Terminal is equipped with horizontal replacement units and rolling ground.

All mentioned systems enable parallel loading and unloading semi-trailers on/from wagons. Simultaneous loading/unloading of the intermodal train lasts from 10 to 30 minutes depending on system used. This is very short time in comparison with classic technologies (vertical handling, RoLa etc.).

The most widespread system is probably system Modalohr, where several lines are in use. One of them is „Lorry-rail“ from Luxembourg to Perpignan [9] which length is about 1 050 km. One of terminals on this line is shown at the Fig. 5.

Fig. 5. The terminal of Lorry-Rail

3. TELLIBOX

Our Department of Transport and Handling Machines is involved in the project Intelligent MegaSwapBoxes for Advanced Intermodal Freight Transport "TelliBox" funded by the European Commission as part of the Seventh Framework Programme for research and technological development for the period 2007 to 2013. The project is going on from April 2008. TelliBox consortium consists of 10 participants under leading of RWTH Aachen University, Germany [10]. MegaSwapBox will be unconventional ILU that combines some characteristics of container and mainly swap body.

The aim is to develop an ILU that can be used for transport by road, rail, inland and short sea shipping. Synergies from both containers and swap bodies will be combined to create a single MegaSwapBox. The challenges to be addressed are that the box has to:

- be trimodal,
- be stackable,
- be suitable for top handling,
- use existing low floor wagons for rail transport,
- provide an adaptable chassis for road transport,
- have an optimised cargo volume of 100 m^3 with an internal height of 3 m,
- have external length of 45 ft,
- be accessible on three sides for loading purposes,
- have liftable top for loading purposes,
- offer improved safety features against pilfering,

while respecting EU legislative vehicle and dimension limits.

ILU with such characteristics calls for a new unconventional design. External height of MegaSwapBox can be maximum 3,2 m as to fulfil requirements for road transport. If internal height should be 3 m only 200 mm remains for bottom and upper frame of the box. This is too little for securing sufficient stiffness of the box without stable side walls. Solving of this problem was found by design special side doors and its securing and locking mechanism. Preliminary design of MegaSwapBox is shown at the Fig. 6.

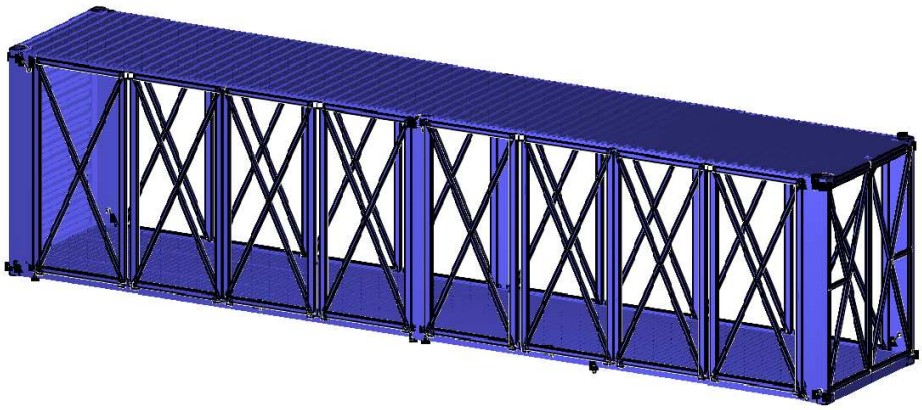

Fig. 6. The study of MegaSwapBox

4. CONCLUSIONS

In the paper some of new solutions in the field of intermodal transport were shown. Attention was focused mainly on intermodal loading units and their unconventional solutions. One of the new unconventional ILUs is MegaSwapBox designed in the frame of the project "TelliBox".

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