ABOUT THE USAGE OF LOADING UNITS IN INTERMODAL FREIGHT TRANSPORTATION

Vasile DRAGU, Ştefan BURCIU
Politehnica University of Bucharest, Transport Faculty

ABSTRACT: Society evolution led to road traffic growth, with major implications on environment and life quality. Given this human evolution aspect, intermodal freight transportation is the unanimous accepted solution of transport specialists for decreasing road traffic. The large scale development of intermodal transportation is subject of political, organizational, operational, infrastructure and technique constrains. This paper closely analyses the technical difficulties arising from the lack of loading unit standardization in intermodal freight transportation. Loading units for intermodal transportation (LUIT) and problems that appear in railway-road-water transfer due to different standardization in water and land transportation (mainly for containers) are being presented. The analyze of the present situation leads to solutions to unify loading units dimensions in order to reduce transfer time in intermodal terminals. Finally, solutions for increasing loading capacity of LUIT (palletwide) are identified, with the advantage of rational usage of the loading capacity, shorter manipulation time for the transfer from one mode to another, safer stowing of pallets inside and a decrease of the number of transportation means used.

1. LOADING UNITS USED IN INTERMODAL TRANSPORTATION

From the 1990's, the European Union started promoting the transfer of freight from road transportation to railway and water transportation. The existing standardization differences for loading units in intermodal transportation (LUIT) and mainly the different dimensions of loading units (LU) such as containers (water transport) and swap bodies (road and railway transportation) made the Minister Council, the leading board of the European Conference of Transport Ministers (ECTM), suggest a standard width of 2.5 m for containers and swap bodies in Europe (91/124 ECTM/MC Resolution).

LUIT are trailers and semitrailers and they ensure intermodal transportation like LU, containers and swap bodies.
Trailers and semitrailers are the most used loading units in road transportation, RO-RO ships and combined transportation trains. They have a fixed length of 13.6 m, 2.55 m width and 26.9 to 27.2 t sole weight. ISO maritime containers couldn't impose in European transportation except the short maritime distance and some river links.

Accepted in theory, for the transfer from one transportation mode to another, containers, even though obeying the ISO standards, don't offer enough space for an optimal loading of pallets. The 40 ft maritime container used in land transportation offers a loading capacity of 25 europallets instead of 33 europallets in a trailer, 25% less capacity for the 40 ft container than the trailer. Many types of swap bodies for land transportation appeared in order to ensure a lower cost of m^3 transported pallets than ISO containers transportation. Once the explosive growth of road freight transportation, *swap body* or *caisse mobile* became the most used loading unit. Conceived as a box similar to the container, but built from light materials or composed from a strong frame covered with a baffle cloth, standing on 4 retractable feets and having 4 corner pieces on the inferior side, without any possibility of stowing, the swap body became mostly used in road-railway combined transportation. Smaller weights and dimensions in comparison to ISO containers made most of the European railway companies (mainly from Germany, France and Scandinavia) sustain standardization. As a consequence, starting from 1991, the European Committee for Standardization (ECS) defined the standard for swap bodies.

In 1995, the International Union of Railways (UIC) adopted five of the seven lengths determined by ECS, but with the same width (table 1).

Tab. 1. Links between ECS and UIC standards for swap bodies

Type		Length [mm]
ECS	UIC	
C 625	1	6250
C 715		7150
C 745	2	7450
C 782		7820
A 1219	3	12192
A 1250	3a	12500
A 1360	4	13600

The main advantage of a swap body is its dimension, similar to the one of a semitrailer body and that it can benefit of road transport advantages. The maximum length is 13.6 m with a 2.55 m external width and 2.44 m internal width. A growth of 25 % in loaded europallets (33 loaded units) arises in comparison to the capacity of a 40 ft container (25 loaded units). The disadvantage is the similarity with the trailer and that it can't be stowed, making it unusable in inshore navigation and river transportation.

Conceiving diversity, from dimensions to technical details (table 2), makes difficult the usage of swap bodies in intermodal transportation and shortens the desired interoperability of UIC. Their handling is more difficult because every swap body needs to be identified independently in order to choose the appropriate handling technology. The cranes have to be adjusted often and even modified, leading to additional costs in the transport chain. This situation makes difficult adopting a decision for further investments in LUIT.

Tab. 2. LU standard dimensions in Europe

Year	LU type	External dimensions (m)			Internal dimensions (m)			Loaded pallets		Aproval documentation
		width	height	length	width	height	length	Euro	UK	
Nov-91	Container CEMT	2,500	2,590	7,450				18	24	91/124 ECTM/MC Resolution
Nov-91	Swap body CEMT	2,500	2,670	7,450				18	24	91/124 ECTM/MC Resolution
Feb-92	Swap body C715	2,500	2,670	7,150				17	12	Standard CEN EN 284:1992
Feb-92	Swap body C 745	2,500	2,670	7,450				18	14	Standard CEN EN 284:1992
Feb-92	Swap body C 782	2,500	2,670	12,500				18	14	Standard CEN EN 284:1992
Jul-95	Swap body A 1219	2,500	2,670	12,192				30	24	Standard NF EN 452
Jul-95	Swap body A 1250	2,500	2,670	12,500				30	24	Standard NF EN 452
Jul-95	Swap body A 1360	2,500	2,600	13,600				33	26	Standard NF EN 452
Dec-95	Container 1 AAA (40')	2,438	2,896	12,192	2,330	2,655	11,998	25	22	Standard ISO:1995
Dec-95	Container 1 AA (40')	2,438	2,591	12,192	2,330	2,350	11,998	25	22	Standard ISO 668:1995

Year	LU type	External dimensions (m)			Internal dimensions (m)			Loaded pallets		Aproval documentation
		width	height	length	width	height	length	Euro	UK	
Dec-95	Container 1 A (40')	2,438	2,438	12,192	2,330	2,197	12,027	25	22	Standard ISO 668:1995
Dec-95	Container 1 BBB (30')	2,438	2,896	9,125	2,330	2,655	8,931	19	15	Standard ISO 668:1995
Dec-95	Container 1BB (30')	2,438	2,591	9,125	2,330	2,350	8,931	19	15	Standard ISO 668:1995
Dec-95	Container 1 B (30')	2,438	2,438	9,125	2,330	2,197	8,931	19	15	Standard ISO 668:1995
Dec-95	Container 1 CC (20')	2,438	2,438	6,058	2,330	2,350	5,867	11	9	Standard ISO 668:1995
Dec-95	Container 1 C (20')	2,438	2,438	6,058	2,330	2,197	5,893	11	9	Standard ISO 668:1995
Dec-95	Container 1 D (10')	2,438	2,438	2,991	2,330	2,197	2,802	5	4	Standard ISO 668:1995
May-97	Swap body cit. A 1219	2,500	2,670	12,192				*	*	Standard CEN EN 1432:1997
May-97	Swap body cit. B 912	2,500	2,670	9,125				*	*	Standard CEN EN 1432:1997
May-97	Swap body cit. C715	2,500	2,670	7,150				*	*	Standard CEN EN 1432:1997
May-97	Swap body cit. C 605	2,500	2,670	6,058				*	*	Standard CEN EN 1432:1997
Dec-03	Combined transportation LU	2,550	<2,900	7,450				18	14	Technical specification CEN/TS 13853:2003

(*source: www.cnt.fr; Annexes au rapport du CNT sur le transport combine*)

As one can notice in table 2 the 2.5 m width adopted for swap bodies in May, 1997, was suddenly abandoned in December, 2003, when a 2.55 m width was adopted. This change has no positive effect in sustainable modal distribution, supposing transfer from road transportation to water transportation. No internal dimensions were fixed. This makes them lighter, especially the ones covered with baffle cloth, but less resistant and not storable.

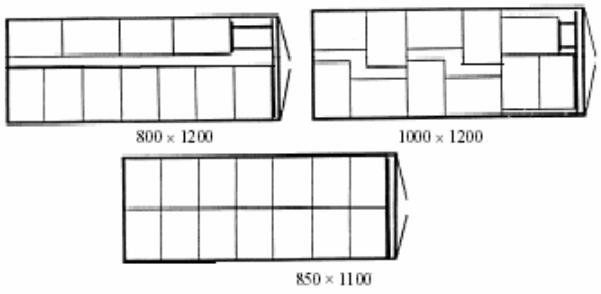
In the past years, swap bodies were imposed to have upper corner pieces, so they could be stowed and handled with the same equipments as the ISO containers, but researches to find loading units (pallet, swap body, container, semitrailer) characteristics appropriated to land and water transportation are far from being over. For the time being, a new loading unit for intermodal transportation (N-LUIT) seems to impose, having the

length of 13600 or 7450 mm and a section of 2250x2900 mm, with corner pieces on the upper side, allowing it to be stowed on 4 levels (A class) or on 6 levels (C class) – mostly desired in the cooperation between railway transportation and river transportation. Finally, because of the weight of the three-axel truck, we can't say whether swap bodies are better, considering the total weight, than containers.

2. USAGE OF LOADING UNITS CAPACITY

For the loading of freight in containers, grouping means are used, such as different dimensions pallets. Freight palletization is a growing phenomenon starting from the 80th. Europeans searched modularity and were based on a model unit with 600x400 mm dimensions, specified in ISO 33940 Standard. The europallet has the dimension of two model units, 1200x800 mm, except Great Britain where the UK pallet has 1200x1000 mm, and is widely used in all continental Europe.

The first constraint deriving from palletization is maritime containers dimensions. So, ISO maritime containers, with an internal width of 2.33 m, don't allow a rational loading of europallets (space is not efficiently used), a width of 2.4 m or more being necessary for LU. Figure 1 shows pallets loading modes in 20 ft maritime containers.



(source: Lumsden, 2006)

Fig. 1. Different pallets loading modes in 20 ft maritime containers

The present swap bodies with a 2.44 m internal width allow a rational usage of the loading space and the increase of the number of loaded pallets, being the specific mode of loading in europallets combined transportation.

Another constraint can be found in river transportation: European barges like Europe 2 have a width of 11.4 m, determined by the canal lock width of 12 m starting from the end of World War 2, which is very difficult to be modified. This external width determines an internal width of 10.2 m, which allows frontal loading of 4 ISO containers of 2.438 m width. River transportation needs LU standardization and the possibility of stowing swap bodies on 4 levels for an efficient transportation. Adopting a standard width of 2.5 m for the European LUIT a higher efficiency is obtained.

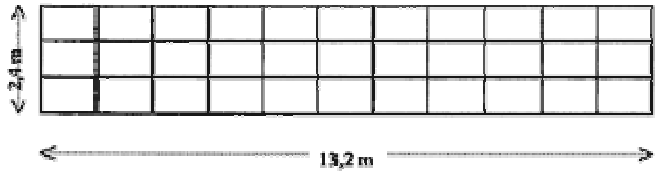
There is a certain interest in defining a European standard LU (ESLU) that would allow europallets transportation through any surface transport mode (road/ railway/ river/ sea) and would lead to technical and economical performances.

Main characteristics of such an ESLU:

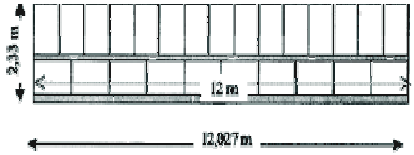
- maximum external width 2.5 m;
- internal width allowing three rows europallets loading (3x800=2400 mm);
- internal length allowing loading the europallets on 11 rows, meaning 33 europallets for the longer version and 18 for the shorter one (fig. 2);
- stowage pieces compatible with all the 4 transport modes;
- proof against falling or handling and storage on 4 levels shocks so they won't brake or open.

An ESLU has to be a multipurpose box for dry goods that can be frontally, side or roof loaded.

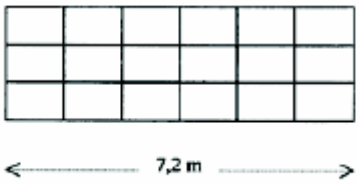
Long ESLU – 33 loaded europallets



ISO maritime container 40 ft – 25 loaded europallets



Short ESLU – 18 loaded europallets



ISO maritime container 20 ft – 18 loaded europallets

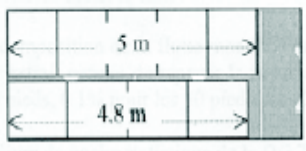


Fig. 2. European loading units (*source: www.cnt.fr; Annexes au rapport du CNT sur le transport combine*)

3. SOLUTIONS TO INCREASE LOADING UNITS CAPACITY

In order to obey palletization problems, certain container producers came up with ingenious solutions to increase the external width approved through ISO standardization. They were named *palletwide*. The ways they grew the dimensions are being presented in figure 3. It's a new market as in June 1999 there were no palletwides and in June 2002 their number was 96500. Nowadays, there are three producers of such containers: GESeaCO, Cronos şi Containerleasing UK. One of them, GESeaCO, built in 2004 more than 1000 palletwides a month. This type of container brought major savings, because of its road-river transportation advantages:

- better usage of 40 ft container loading capacity (30 europallets on a 40 ft container, stowed on one row);
- europallets faster loading/unloading (from 15 to 45 minutes);
- better fixing of europallets, not allowing them to move inside the container in case of shocks;
- safety increase due to a more stable stowage;
- conformation to four transport means;
- financial advantages as 10000 europallets can be loaded in 333 40ft palletwides, instead of 400 containers of 40 ft, so 67 trucks or freight cars less used.

There is also a 45 ft palletwide closed as functionality to the swap body, that could be also considered an ESLU.

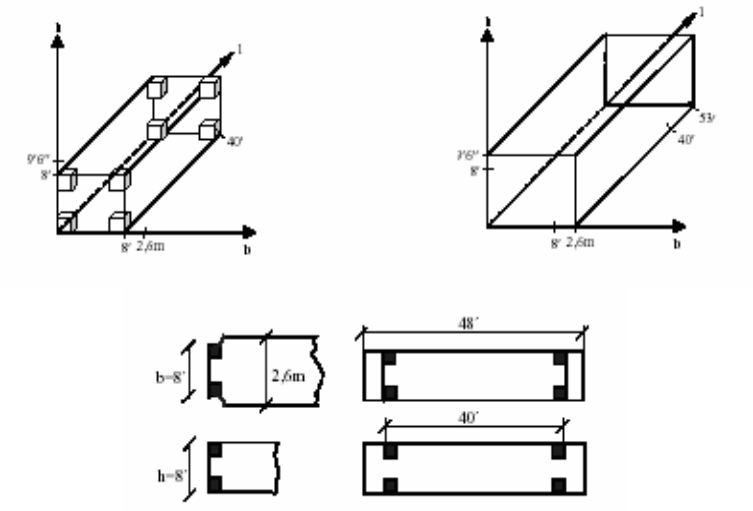


Fig. 3. Ways of increasing container dimensions
(source: Lumsden, 2006)

The main characteristics of palletwide containers are being presented in table 3.

Tab. 3. Main characteristics of palletwide containers

Container type / Characteristics	GESeaCO 40 ft	Cronos 45 ft High Cube	Continerleasing UK 45 ft
External length (m)	12,192	13,716	13,716
External width (m)	2,484/2,438	2,462/2,438	2,550
External height (m)	2,591	2,896	2,896
Internal length (m)	12,100	13,540	13,620
Internal width (m)	2,426	2,420	2,550/2,500/2,425
Internal height (m)	2,389	2.690	2,448
Back door width (m)	2,374	2,400	2,432
Back door height(m)	2,280	2,590	2,329
Side opening width (m)	No side opening	No side opening	12,610
Side opening height (m)	No side opening	No side opening	2,363
Own weight (t)	4,1	4,7	5,15
Loading capacity (t)	29,9	29,3	28,7
Maximum weight (t)	34	34	34
Efficient volume (m^3)	70,1	85,25	85
Levels of stowage	6	7	6
Usage	Intercontinental combined transportation	Road, sea intercontinental transportation intercontinental	Short cabotage, railway, road transportation

(*source: www.cnt.fr; Annexes au rapport du CNT sur le transport combine*)

The cost of a 20 ft palletwide container is approximately 2500 $ and 4100 $ for the 40 ft one. It's certain that by using these 2.5 m width loading units not all the intermodality problems are solved, but by achieving a loading

capacity usage coefficient close to 1 brings considerable advantages and makes intermodal transportation more attractive.

Loading units are economically efficient for all the actors in the intermodal chain and also for other economy sectors through:

- making door-to-door transportation possible;
- stimulation of intermodal transportation;
- increase of actual usage time of transport vehicles by decreasing loading/unloading/interchange operations time;
- building stocks and reducing actual state and buffer stocks of the producers;
- less freight damage, degradation and steal with effects in insurance costs as part of transport and transfer costs;
- better stock control, supply/distribution logistics (by using management information system for the identification of the LU);
- major environmental aggression reducing (shipping 100000 t of freight in containers and not in common packages we can save 2000 m^3 of wood and 2 million m^3 of paper, that is almost 200t of paper, 4000 trees or 40 ha of forest, knowing that to get 1 t of paper 20 trees are needed and that 100 trees are on 1 hectare).

REFERENCES:

1. Cataramă, I — Teoria generală a maşinilor de ridicat şi transportat, maşini cu acţiune continuă, litografiată UPB, Bucureşti 1993
2. Hagiac, C., ş.a. — Transportul paletizat şi containerizat al mărfurilor, Editura Tehnică, Bucureşti 1975
3. Ilieş, L., ş.a. — Sistemul de transport containerizat, Editura Dacia, Cluj-Napoca 1988
4. Popescu Violeta — Exploatarea navelor şi porturilor, Editura University Press, Constanţa 2002
5. Raicu, Ş. — Sisteme de transport, Editura AGIR, Bucureşti 2007
6. Raicu, Ş., Maşală, Gh. — Transport feroviar. Funcţionare-Dezvoltare-Eficienţă, Editura Ştiinţifică şi enciclopedică, Bucuresti 1981
7. Tabacu, S.C. — Transport intern. Manipulare depozitare, Editura Tehnică, 1991
8. *** — www.trb.org

9. *** www.cordis.europa.eu
10. *** www.isetar.ro
11. *** www.untrr.ro
12. *** www.cnt.fr
13. *** www.piarc.org