Returnable packaging for non-specific building materials

F. J.M. van Gassel
Eindhoven University of Technology, Faculty of Building and Architecture,
Department of Construction Engineering and Management,
Eindhoven, The Netherlands

Abstract
A certain amount of construction waste comes from disposable packaging and this waste is ecologically damaging, one solution would be to reduce the disposable by using returnable packaging for non-specific construction products. To find out if this solution is feasible a study has been carried out on the economical and ecological consequences.
A housing construction project was chosen to get insight into the sizes of the construction products and in the amount of packaging used in the construction products. Based on these results a transportation system has been developed. First an inventory was made of all the functions needed in the transportation system. For every function a solution is developed, and for the functions together, a principle design was chosen.
This study led us to design a synthetic crate with the floor dimensions of 400 by 600 and 400 mm height, and a lid which can be used as a small pallet. The crates are transported to the building site on EURO-pallets and are manually handled into the building by a specially designed handcart. The handcart has the functions of a pallet-cart, wheel barrow and sack car.
To manage these crates, lids and pallets a pool system was also designed. The principle of this system is that the pool organisation buys the crates and lends them to the packers with a deposit. The packer pay a fee to the pool organisation to can fill a crate. The transportation firm gets paid from the pool organisation for bringing back the empty crates to the packers. Based on this system, calculations are made on what the fee should be.
The use of the crate is economically and ecologically more interesting for construction products which use a high proportion of disposable packaging.
What important is in introducing a returnable crate is an efficient pool organisation. The packers must be the owners of the pool organisation.
The returnable crate is not only interesting for the environment, but it also has advantages for the working circumstances and the logistics between the producers and users of building materials.
Key words: Environment technology, packaging, return systems, transport equipment, waste prevention.

1 Introduction

The building of residential houses and non-resident buildings in 1993 in the Netherlands resulted in between 7,4 - 9,6 million ton waste [1]. Seven percent of this waste consists of disposable packaging materials [2]. The waste is transported from the building site to the recycling industry, dumping-ground or waste burning installations. The last two ways of getting rid off the waste are damaging to the environment.
The government says that there is a priority on what to do with the waste: first prevention, then re-use, burning and dumping. The government stated also that in the future packaging material has to be re-used for 66% [3].
A returnable packaging for building materials could be a solution that is in line with the government policy: it avoids the use of disposable packaging and encourages re-cycling because returnable packages can be re-used.
The idea using a returnable packaging is not new, other industries and shops are already using it.
Is the returnable packaging for non-specific construction products economical and ecological feasible? To find out this question a study on the order of the Ministry of Housing and Environment had been carried out.
This article will show the method and the results of this study [4].

2 Housing project

To develop a returnable packaging for non-specific building materials, insight into the number and sizes of these materials is necessary. To get these sizes and the number of the building materials, a housing construction project was chosen to measure these data.
The housing project consisted of 27 houses which will be sold to the residents.
Some materials were not measured. These are materials which are liquid or delivered in bulk, which have extreme weight and dimensions, and which are already mounted in prefab products. This leaves 288 materials with a volume of 1026 m^3.
All the data is put into a spreadsheet, so that selections and calculations can be made.

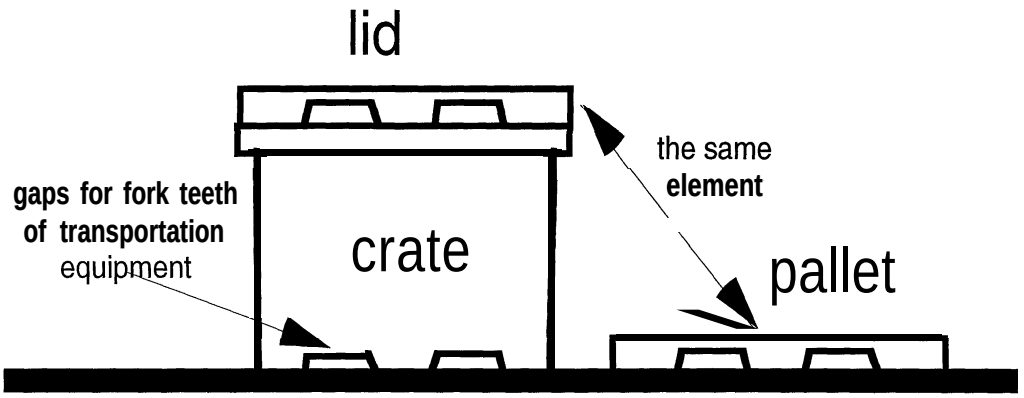

Figure 1 *Crate with lid.*

3 Transportation system

Based on these results a transportation system has been developed. First an inventory was made of all the functions needed in the transportation system. For every function a solution is developed, and for the functions together, a principle design was chosen.

This principle design is engineered to 'function models' of:

- A crate of re-cycled Poly Ethylene 400 by 600 mm ground floor and 450 mm inner height. The lid of the crate can be used as a small pallet. See Figure 1 for a sketch of the crate and lid. Eight crates can be transported to the building site on one EURO-pallet. The crates and lids can be stapled two layers height on the pallet in different ways. See Figure 2 for some possibilities. The empty crates can be nested to transport them with a minimum on volume.
- A handcart which can handle the crates from the EURO-pallet to the processing place in the building. The handcart has the functions of a pallet-cart, wheel barrow' and sack car. Figure 3 shows a 'function model' of this handcart.

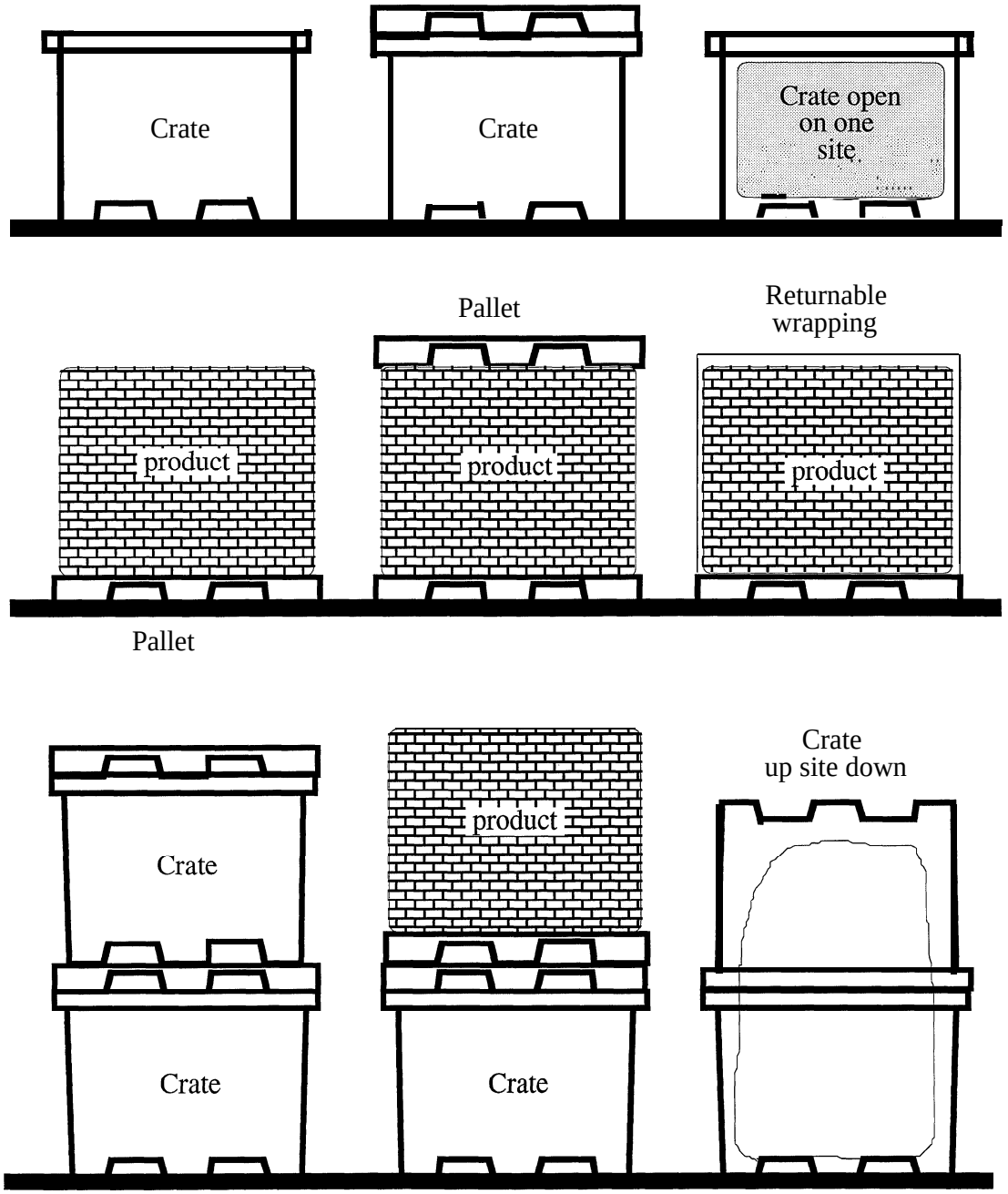

Figure 2 *Staple possibilities of the crate.*

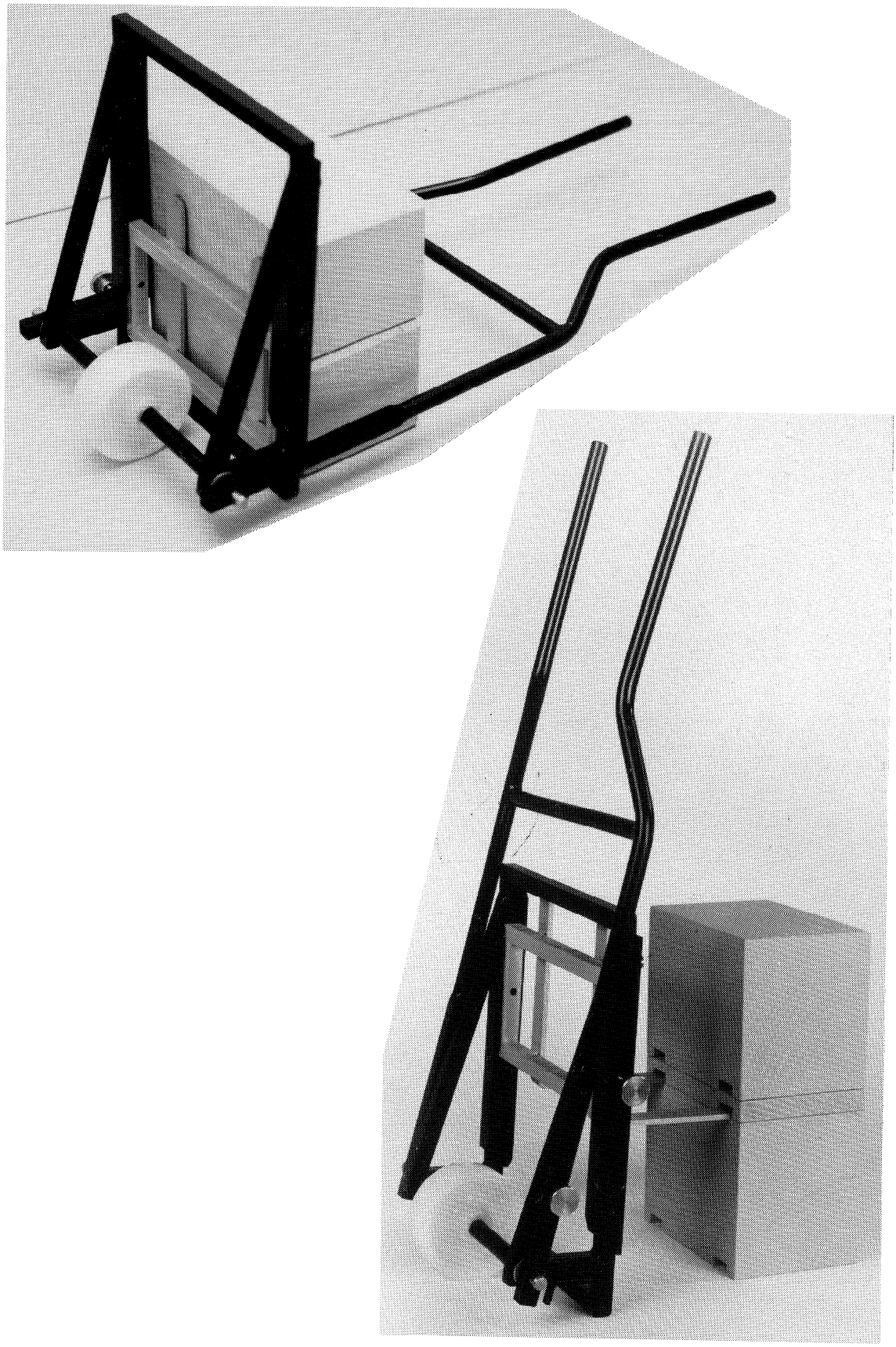

Figure 3 *Handcart as pallet-cart, wheel barrow and sack car.*

4 Pool system

To manage and to handle the return of the crates, a pool system is necessary. This system has the following partners:
- the producers of the crates, pallets and transportation equipment
- the producers of the building materials (packers)
- the transportation firms
- the trading firms of building materials (unpackers and packers)
- the contractors (unpackers)
- the pool organisation.

Every partner has a specific task and interest in the pool system. The packers are the owners of the pool system.
Two flows in the pool system are important: the money flow and the crate flow.
Figure 4 shows these flows.

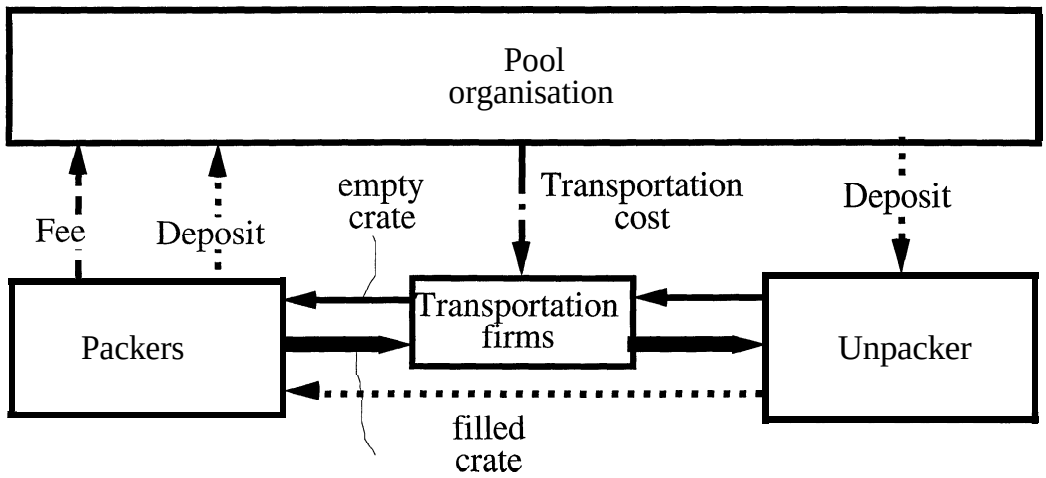

Figure 4 *The money flow and the crate flow.*

The principle of the system is that the pool organisation buys the crates and lends them to the packers with a deposit. The packer pay a fee to the pool organisation to can fill a crate. The transportation firm gets paid from the pool organisation for bringing back the empty crates to the packers. Based on this system, calculations are made on what the fee should be.
The calculation model has the following inputs:
- buying price of EURO-pallet
- buying price of crate with lid
- life of the pallet and crate with lid
- demolition cost
- maintenance cost
- interest
- deposit amount
- the number of filled crates on the pallet
- lost and damaged
- average transportation distance
- the number of empty crates on the pallet
- the number of pallets on the truck
- cost loading and unloading of pallets
- cost of administration and organisation pool
- the number of crates on stock by the packer
- stacking cost
- cleaning

5 Results

To find out if the developed transportation and pool system is economical and ecological feasible a study had carried out with the next results.
Some calculations have been made to study the economical feasible. The result is that the packer of the construction products pays a fee of HFL 1,22 per crate with lid to the pool organisation and has self about HFL 0,43 cost for storage and cleaning the crates.
Looking at the housing project we calculated that from the 175 products which can be packed in the crates 142 (8 1%) products give economical advantage to use the crate. In volume this is 33 m^3 on 672 m^3 (4,9%). The economical advantage for the contractor of the housing project is HFL 428 and for the packer HFL 1175. The advantage for the constructor increases as the cost to get rid off of the waste increases. The calculations stated that the use of the crate is no economically interesting by construction products which are delivered in great amounts and with limited disposable packaging. Such construction products are bricks and tiles.
The ecological feasibility is calculated with the Eco-indicator[5]. The result is that the value of the Eco-indicator for disposable packaging is 1,67 mPt and from the crate is 0,56 mPt. The lower this value, the better it is for the environment.

6 Discussion

In the building industry returnable packaging is already used; dry mortar in silos and window glasses in steel frames. EURO-pallets are also used on the construction sites but have problems with the paying of the deposit and the return transportation costs. The use of a returnable crate on the construction site is new. What important is in introducing a returnable crate is an efficient pool organisation. The packers must be the owners of the pool organisation. Also important is to normalise the transportation system for a broad acceptance.
The returnable crate is not only interesting for the environment, but it also has advantages for the working circumstances and the logistics between the producers and users of building materials.
To make the returnable crate successful in the short term it already can be used between the dealers of construction products and the contractors.

7 References

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