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JAN PERNER TRANSPORT FACULTY

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Analysis of technology transportation
wagon loads in road transport

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TITLE

Analysis of technology transportation wagon loads in road transport

ANNOTATION

First part of this thesis is focused on legislation form and description of road freight, transport transportation including their characteristic features such as technical parameters of vehicles etc. Further is mentioned conditions and analysis of technology transportation wagon loads. In second and third part is more focused in international road transportation and average loading, form of transportation including transporting heavy goods and safety requirements.

KEYWORDS

ADR; Haulage; road freight; SABS; transport technology

NÁZEV

Analýza technologie přepravy vozové zásilky v silniční dopravě

ANOTACE

První část této bakalářské práce je zaměřena na jednotlivé druhy dopravy a jejich charakteristické rysy včetně technických parametrů jednotlivých vozidel. Dále jsou uvedeny podmínky, za jakých je možné provést přepravu těžkých a nadrozměrných zásilek danou dopravou a analýza technologie jejího provedení. Ve druhé části je proveden výpočet teoretického kusu pro jednotlivé druhy dopravy pro posouzení a porovnání možností jednotlivých druhů doprav a vyzdvižení lodní dopravy jako jednoznačně nejvýhodnější technologie přepravy těžkých a nadrozměrných kusů.

KLÍČOVÁ SLOVA

ADR; dopravní technika; nákladní doprava; silniční nákladní doprava

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INTRODUCTION

The aim of this study is to analyse road freight transportation. Road freight is often the most effective mode of transport for many countries, particularly when exporting to the land-locked countries. And road transport or hauliers offer the door to door basis, where the road haulier collects a consignment of goods from an exporter's premises, and transports the goods to their final destination in a neighbouring country.

As it is commonly accepted that in surface transportation the rail freight mode is more appropriate for transporting heavy consignment over long distances whereas road freight mode is more appropriate for light consignments over short distances.

Road freight transport is an essential economic activity. Without it, or improve the infrastructure economic will not function. Czech republic and South Africa road freight transport are estimate growing as the rail freight leading.

The aim of this research is to analyse the way or technology used in road freight transport in Czech Republic and South Africa. And to analyse the infrastructure of the technology transportation of wagon loads or road consignment.

1 TECHNOLOGY TRANSPORTATION OF WAGON LOADS

Full load is usually handled in one place at one sender interpreted again in one place for one recipient. Sometimes it may be disposed of at multiple locations.

Technologically transport process has the following phases :

- launch vehicle - delivery of the vehicle when empty habitat in the shipment from the place of acceptance sender
- Loading on the vehicle and its acceptance by the carrier
- Relocation shipment driving the vehicle at the place of delivery recipients
- Delivery to the recipient and explaining its
- The vehicle is based on habitat or its delivery to the next sender
- Termination of operation of the vehicle.

Wagon load consignment by-one to the sender once driving a road vehicle, further shipments, which have a mass greater than 2500 kg, or shipments without regard to their weight, terms of shipment:

- which will be used payload or load area road vehicle
- the carriage held special driving a road vehicle under an agreement with the sender
- whose nature requires it, eventually. It requires the execution of transport within the required time
- when shipments loaded or unloaded at two or more locations.

1.1 Transport systems wagon of the road consignments

There are four basic transport systems for wagon or trailer consignment:

1.1.1 Shuttle

It consists of repeated runs of trucks between two permanent places of loading and unloading.

Distance from the loading point to the unloading point is then called a shuttle section transport. Depending on what part of the shuttle ride is implemented as bulk, we distinguish four types of shuttle transportation:

- unidirectionally busy - when driving in reverse the vehicle is empty
- mutually busy - when the ride there and back takes place vehicle with cargo
- Closed ride partially occupied - when it is, used to reverse part of the section
- with commuting - the vehicle retracts partly to the main direction for the return cargo.

1.1.2 Radial drive

They are, used in the collection and distribution of goods to and from railway stations or in the transport of special single-purpose vehicles (cement). During these sessions the goods are exported or bind by truck from one place or in one place. One ride is usually empty, and therefore is not suitable to use for transportation to larger transport distances.

1.1.3 Circular drive

Connect each drive to a closed circle in which are located the loading and unloading. Organizations operating in this way work places heavy demands on the work of staff drawing up operational plans; dispatchers. In the circuit is usually a large amount of traffic demands, which can combine the various cyclic runs in different variants. It is very difficult for them to choose the one which produces the maximum effect. There is the possibility of using mathematical methods and

computational techniques to facilitate the work of dispatchers. By reducing empty runs to the minimum is achieved by rationalization of transport work.

Often they are, used in the collection and distribution of general cargo, catering trade networks, etc. This system is also suitable for full loads.

When compiling these rides is to be divided shipment, as required for each type of vehicle and payload. Most are in the planning work vehicles used in mixed driving.

1.1.4 Mixed drive

It's a combination of all of the previously mentioned ways away, allowing the most economic (or rational) use of performance vehicles. To ensure transport is important that agreed with the carrier while loading and unloading the truck and trailer for those goods that require long periods of downtime during loading manipulations. Loading and unloading requires sufficient human resources and mechanisms.

1.2 Road freight transport

Road transport is a very popular mode of transport used by suppliers and businesses to deliver orders. Many transport companies provide scheduled delivery days and next day delivery services, depending upon your needs. Goods can be packed/grouped in containers which are also used for sea transportation and rail transportation.

1.2.1 Advantages of road freight transportation

Many advantages are available to manufacturers and exporters by moving their shipments via road transport. One advantage is the availability of a wide variety of trucking options, carriers and specialized equipment, capable of handling many different cargoes. Truck transport links with all other modes, so moving goods intermodally, from truck to ocean to truck (ro/ro, etc.), from air to truck or from truck to rail ("piggy backs") etc. creates a considerable variety of choices for door-to-

door shipping. In terms of meeting scheduling demands, trucks are generally available to move your goods with flexible scheduling and fast delivery timeframes. In addition, trucks are able to get your goods to your buyer's door, regardless of whether that destination is served by rail, air or water transport, along a free choice of routes.

1.2.2 Disadvantages of road freight transport

Truck transport has some disadvantages too. These include the fact that licensing and other regulations governing truck transport are imposed differently across countries: from province to province and from state to state. Additionally, goods moved by truck, are at higher risk of damage and delay resulting from the frequency of highway accidents. Weather is certainly a delay factor, too. Finally, trucks are limited in terms of the size of shipments they can carry and are not generally suited to carry oversized and bulk cargo.

1.2.3 Road freight capacity

Capacity in the freight transport is defined as the ability to carry a certain number of things. It is the usefulness of the vehicle weight or volume, or length of loading area of the vehicle for transportation. Capacity in road freight transport is evaluated by static instantaneous, time, or dynamic (by weight) for a period of time.

Static capacity is the maximum number of things that can be loaded on each vehicle, a group of vehicles. It is distinguished according to the physical unit capacity:

- mass, which is the given usefulness vehicle weight [kg], [t],
- volume, which is the given vehicle loading space, its units is [m³], [l],
- surface, which is the given vehicle loading area in square units [m²],
- length which is the given usable length of the vehicle to transport, the units of length is [m].

1.3 Divided by the road freight vehicles

In the Czech Republic, road vehicle categories are defined by the act No. 56/2001 Sb. and the ordinance No. 341/2002 Sb. The categories below are for road freight transport and are also defined according to the European union transport.

South Africa Department of Road and transport and SABS are the one who defined the categories road freight vehicles. South Africa land vehicle categories are the same as the Europe categories. Moreover there are defined categories:

Category N

used for the carriage of goods

- Category N1: having a maximum mass not exceeding 3.5 tonnes
- Category N2: having a maximum mass exceeding 3.5 tonnes but not exceeding 12 tonnes
- Category N3: having a maximum mass exceeding 12 tonnes

Category O

trailers (including semi-trailers)

- Category O1: maximum mass not exceeding 0.75 tonnes (1,700 lb)
- Category O2: exceeding 0.75 tonnes but not exceeding 3.5 tonnes (7,700 lb)
- Category O3: exceeding 3.5 tonnes but not exceeding 10 tonnes (22,000 lb)
- Category O4: exceeding 10 tonnes.

2 ANALYSIS OF ROAD FREIGHT SYSTEMY OF SOUTH AFRICA

South Africa has a modern and well-developed transport infrastructure and the roads in good condition. The transport sector has been highlighted by the government as a key contributor to South Africa's competitiveness in global markets.

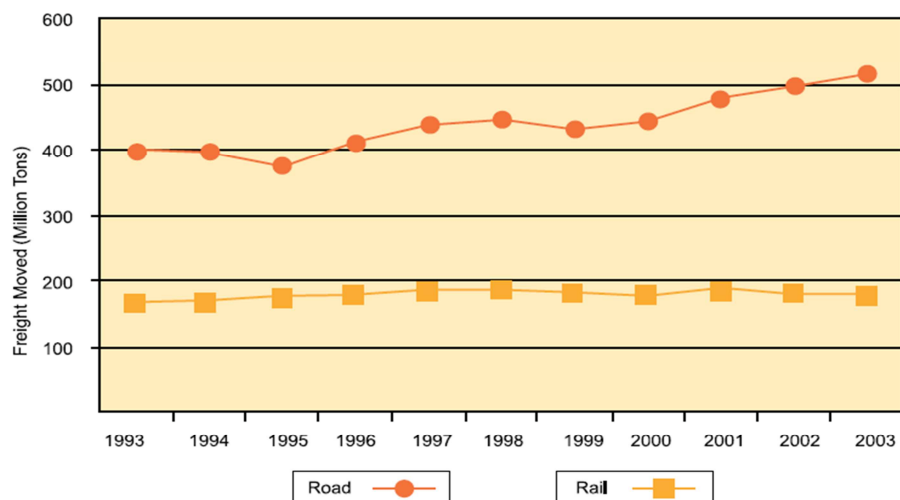
2.1 Road infrastructure

South Africa's total road network is about 747 000 km, the longest network of roads of any African country. The drive from Musina on South Africa's northern border to Cape Town in the south is a 2 000 km journey on well-maintained road.

Sanral is responsible for the country's network of national roads, which cover around 16 200 km. There are about 185 000 km of provincial roads, and the municipal network totals around 66 000 km, according to the SA Institute of Civil Engineering.

2.2 Model description

South Africa move 693 millions of ton of freight domestically in 2003, 73 % by road and 26 % by rail. The graph demonstrates the shift between road and rail over the last decade and indicates a 4 growth rate per annum for road freight since 2000 in comparison to rail.



Pic. 1: Model description

Source: (1)

2.3 Road haulier services

Road hauliers in South Africa offer the following services:

On a door-to-door basis, where the road haulier collects a consignment of goods from an exporter's premises, and transports the goods to their final destination in a neighbouring country.

On a depot-to-depot basis with support facilities for collection at the point of origin and delivery to the country of destination.

2.3.1 Road transport quality system

In terms of the Road Transport Quality System (RTQS), South African road hauliers is strictly monitored. This is achieved through the issuance of permits. Permits will not be issued or renewed if a haulier is found to be overloading and/or operating sub-standard vehicles. Irrespective the type of cargo road hauliers carry, they are required to obtain a local transport permit for the purpose of transporting goods within the country of destination as well as those countries through which the vehicle may travel.

2.4 Techniques and load process

2.4.1 Techniques process

The Consignor is responsible for ensuring that all goods have been properly, lawfully and sufficiently packed, loaded, secured and prepared to both withstand all modes of transport applicable to the journey contemplated and to avoid personal injury to any person or damage to road freight equipment. Inadequate packaging or

packing may result in any claim for damages being rejected by the insurers where that was the proximate cause of the loss or damage.

Guidelines for packaging, packing and loading methods are available from department of roads and transport or the freight company on request. If goods are likely to harbour or encourage vermin or other pests the consignor must ensure that those goods are free from such creatures upon loading and are packaged appropriately.

2.4.2 Restraint devices

A variety of materials may be used for restraining general freight loads. These include rope, steel chain, steel wire rope and specially designed webbing strapping made up into a harness or net. For the securing of loads inside van bodies and similar load containers, specially designed shoring poles used in conjunction with the appropriate securing fixtures on the vehicle deck and sides are suitable. Custom-built restraining devices should only be used as outlined by the manufacturer.

2.4.3 Lashing

A lashing is a restraint device such as webbing, chain or wire rope that either ties cargo together or keeps cargo in contact with the load platform or any blocking device. Lashings should be positioned so that they are in contact only with the cargo to be secured and/or the securing points. They should not be bent over flexible items, side gates etc. This are types of lashing:

2.4.4 Chain lashing

Two properties determine the strength of a chain: the thickness of the links and the quality of the metal used. Standard EN12195-3 - Load restraint assemblies on road vehicles - Safety; Part 3: Lashing chains - gives the requirements for lashing chains. The chain used should be compatible with the requirements of the load carried. Where necessary strong packing or bevelled sections should be used on

corners or sharp edges, which prevent damage to the chains and also increase the radius around which they bend thus increasing their effective strength.



Pic. 2: Container Lashing
Source: (2)

2.4.5 Wire rope lashing

Steel wire ropes are suitable for lashing load when used in a similar manner to chains. Single part wires should never be used for lashing as they cannot easily be assessed for serviceability and any failure will result in complete failure of the restraint.

If bent over edges, ropes strength decreases depending on the bending diameter. For a rope to retain its full mechanical resistance, the diameter of the bend needs to be at least 6 times the diameter of the rope. As a rule of thumb, for smaller bending diameter, the strength is reduced by 10% for each unit under 6 if the bending diameter equals 4 times the diameter of the rope, the rope strength is reduced by 20%; so the residual strength represents 80% of its nominal value).

2.4.6 Nets or covers with lashings

Nets used for securing or retaining certain types of cargo may be constructed from webbing straps or ropes of either natural or man-made fibres or steel wire. Webbing nets are generally used as barriers to divide the load space into compartments. Rope or cord nets may be used to secure loads either to pallets or directly to the vehicle as the primary restraint system.

Lighter nets can be used to cover open vehicles and skips when the type of load does not require a cover sheet. Care should be taken to ensure that the metal parts of nets are not corroded or damaged, that the webbing is not cut and that all stitching is sound. Rope and cord nets should be checked for cuts or other damages to the fibres. If necessary, repairs must be carried out by a competent person before the net is used. The mesh size of the net must be smaller than the smallest part of the cargo.



Pic. 3: Cargo securing net
Source: (3)

2.5 Stowing Loads In The Container

- Proper planning should be done before stowing. Stowing should be planned in a way that the cargo weight is distributed as evenly as possible, and total weight to be within the maximum payload limit.
- The center of gravity of the stowed cargo should be at or below the half-height point of the container. In other words, heavy cargo should be stowed at the bottom of the container for better stability. The center of gravity should be at or close to the half-length position of the container for safer container handling.
- When necessary, dunnage such as wood planks, plastic foam and paper boards should be used to protect against mechanical damage, such as the damage caused by the container corner post, or corrugation of the container wall or by the uneven surfaces of the load next to it.
- When stacking cargo on top of each other, interlayer dunnage can be used to create a level surface for proper stacking.

- When transporting moisture-sensitive cargo, desiccants can be used to protect the cargo from damp. Roof dunnage and floor dunnage should be used to dissipate moisture and to avoid accumulation of damp or sweat. In addition, wrapping moisture-sensitive cargo using plastic sheet, oiled paper and tarpaulins can effectively reduce the risk of the cargo being damaged by container sweat or cargo sweat.

2.5.1 Container load

Contained loads should be packed tightly together within the vehicle's body or sides to prevent any movement during transportation. Where loads cannot be packed tightly together, they must be restrained or block if their movement could cause the vehicle to become unstable or load to dislodge.

Load separators, such as empty pallets, tires, boxes, including dunnage bags, should be used where necessary to restrain individual items within the load and to protect fragile items from damage. Surrounding them with larger items may assist in containing smaller items.

Loading any general freight container with uneven weight distribution more than 60 % of the load in less than half its length should be clearly marked by the consignor with centre of mass cargo symbol, to enable any necessary special precaution be made for its transport

Loading container should be followed with the measurement of such as standardized load carriers, 20,40, or 45 ft in length and 8 ft in width.

2.5.2 Loading pallet

This is the guidelines of loading pallets and securing the load. And this section analysis the process of carrying goods using pallets:

When cargo boxes of a size equal to or smaller than the pallet are loaded on a pallet, the pallet constitutes a load carrier similar to a load platform without sideboards. Measures to prevent the cargo from sliding or tipping in relation to the pallet should be taken by lashing means similar to the methods described above. The friction between the surfaces of the cargo and pallet are therefore important for calculating the cargo securing. The ratio of the loaded pallet height/width and weight also has to be taken into account (here the loaded pallet's weight corresponds to the weight of a cargo section).



Pic. 4: Loading pallet

Source: (4)

Any means of securing the load to the pallet, for example lashing and shrink wrapping can be used as long as the load pallet is able to withstand a sideways tilt angle of at least 26° without any significant sign of distortion.

2.5.3 Loose bulk loads

Loose bulk loads can generally be described as having a nature which does not readily lend itself to any form of packaging or containerisation, eg sand, shingle,

rubble, rubbish, asphalt For ease of loading they are usually carried in open bodied vehicles. Removable open top containers (skips), normally used for transporting waste materials, also come into this load category. Shedding of loose bulk loads is more likely to take the form of small quantities of material falling through gaps in the bodywork or being lifted by air turbulences from the top of the load compartment.and other similar materials.

2.5.4 Timber loads

The sawn timber and logging sections of this code include the relevant parts of the Department of Labour codes, which have been based on a joint industry and government department group that has researched and proved the safety needs. The style of this section is slightly different from the rest of the code as it has been written by the Department of Labour. Some sections that are not relevant to road transport have been omitted.

2.5.5 Packeting timber

The major cause of timber spillage has been the collapse of the base of the packets, where extreme force has been imposed on the load restraint devices. As all types of packet binders are tensioned from the top and do not effectively consolidate the base, it is extremely important that when packets are being assembled and bound, the bottom layers are mauled up tightly.

The use and placement of binder fillets are important factors in creating a stable packet. Generally, they should never be more than 1 metre apart along the length of the packet. However, where an automated fillet system is, used a maximum spacing of 1.2 metres is allowable. Details of fillet position for various dimensions of timber are shown in figures in picture below.

As with filleting timber, packeting timber spaces should be long enough and should not protrude more than 50mm beyond the packet. The packets should be placed immediately above each other in relation to stack bearers.

All timber is to be packeted with its greater dimension on the flat. Packets of random-length timber should be formed so that the short lengths are securely housed within the body of the packet. All outside pieces must engage all of the fillets. Where short lengths are butted, extra care must be taken to ensure that they remain secure.



Pic. 5: Ngodwana Mill truck
Source: (5)

2.6 Packing of goods

If goods are stored in cartons, crates and boxes, they should be bundled into appropriate sizes by using receptacles. These sizes should enable easy loading and unloading. If possible, they should be packed in the palletized units that enable them to be handled by a forklift truck.

- When goods are palletized, any part of the goods should be within the bonds of the pallet, since parts exceeding the bonds of the pallet will easily incur damages during handling and transportation.
- The surface of the package should be leveled to allow stacking.
- If the sides are not perfectly flushed with the pallet base, gaps between pallets should be filled using additional measures.
- Cargoes other than cartons and boxes such as drums, barrels, etc, should be packed using similar principles. Surfaces should be leveled to allow stacking. Sides should be flushed to prevent damages to the goods placed next to them. Otherwise, additional dunnage - cushioning material like wood planks, plastic foam, or paper boards - should be used to ensure proper protection against damages. The sides of the load should provide enough friction to prevent it from sliding against other loads.

Factors influencing the choice of road haulage for export

The decision to use a road haulier for the whole or part of the transit, to a foreign destination is influenced by a number of factors:

2.6.1 Speed

The transit time for over-the-border consignments can be shorter by road than by rail (or sometimes even by air). This is because the road haulier controls the delivery of the goods right up to the final destination (which may be near the border and far from the main airport), whereas goods transported by rail can be delayed when railway trucks are handed over from one railway authority to another.

2.6.2 Convenience of distribution

When goods are being exported to a neighbouring country, a road haulage service may provide either direct delivery to the importer or to a convenient point nearby.

2.6.3 Freight rates

Freight rates in respect of road freight rates are generally lower than those rates offered for carriage by air. However consideration should be given to the higher risk which cargo is exposed to when freighting goods by road, and, as an example of this, it is worth noting that insurance cover for war and riots, is not available when goods are dispatched by road or rail freight. Road freight movements are prepaid, as road hauliers are reluctant to deliver cargo into an African country without having the freight prepaid in South Africa.

3 ANALYSIS OF ROAD FREIGHT SYSTEMY OF CZECH REPUBLIC

The Czech Republic possesses one of the most advanced transport networks in Central and Eastern Europe. Its geographical position at the very centre of Europe makes it a natural crossroads for major transit corridors. An extensive network of transport routes serves not only the Czech Republic but also links the country to neighbouring and other European states, and the density of the transport network ranks the Czech Republic among the world's most advanced countries.

3.1 Road infrastructure

Road infrastructure in Czech is divided in to domestic and international which is the road conect to the rest of Europe. And the road network and highways in Czech Republec length of about 55 000 km. The highways Incomplete are backbone network of motorways and expressways slows traffic and creates barriers to the availability of certain regions such as Karlovy Vary, Bohemia, Pardubice, Zlín and Moravian-Silesian Region and the connection of these regions respectively. Czech Republic to neighboring states .

3.2 Transport Documentation

When items are transported either domestically or internationally the delivery must be accompanied by the relevant documentation. The amount of documentation varies depending if the shipment is within the country one or to another country.

3.2.1 CMR

CMR - waybill is, used in the international exchange of goods and, accordingly, is an instrument for international transportation. The main difference is the presence of the customs authority of destination, where the customs transit procedure is completed and change the customs regime (eg to produce for domestic consumption, the customs warehouse, processing, etc.)

Waybill shall be completed not less than three copies, which should be signed by the sender and the carrier. The first copy of the invoice shall be made to the sender, the second shall accompany the goods, while the third remains in the carrier.

3.2.2 Bill of Lading

The bill of lading is the most important document that is, use in transporting goods. The legal definition of a bill of lading is a contract for the carriage of goods and a document of title to them. It provides any and all information that the carrier will need to transport the items. It contains the shipment origin and the contract terms for the transportation and is required by a carrier before the shipment is taken. The bill of lading should include the name and address of the consignor and consignee, and often it will have the routing instructions for the carrier.

3.2.3 The TIR Carnet

The TIR Carnet is a customs transit document used to prove the existence of the international guarantee for duties and taxes for the goods transported under the TIR system, within the limit of the amounts specified by the contracting parties and under conditions stipulated in the TIR Convention.

Each TIR Carnet has a unique reference number. A TIR Carnet may have 4, 6, 14, or 20 vouchers, as one pair of vouchers is, used per country; the number of vouchers indicates the number of countries that can be transited, including the countries of departure and destination, under cover of this type of Carnet.

3.3 Road freight transportation

Czech republic road freight operators move about million tons of freight per annum. Although it is relatively more efficient, there are still high-level strategic challenges facing this sector as shown in the diagram below.

Tab. 1: Load transport - road

Year's	Tons (in millions)	Tonne-kilometers* (v millions)
2008	432	51
2009	370	45
2010	356	52
2011	349	55
2012	339	51

*součin hmotnosti a absolvované vzdálenosti

Source: Ministry of transport of the Czech republic

3.4 Techniques and technology used to load

The first priority with any load is to keep within the maximum legal weight limits and vehicle dimensions. The load should be placed against the headboard if this can be done, provided the handling of the vehicle is not impaired. If the load cannot be placed against the headboard, baulking should be used or twice the strength of lashings are required.

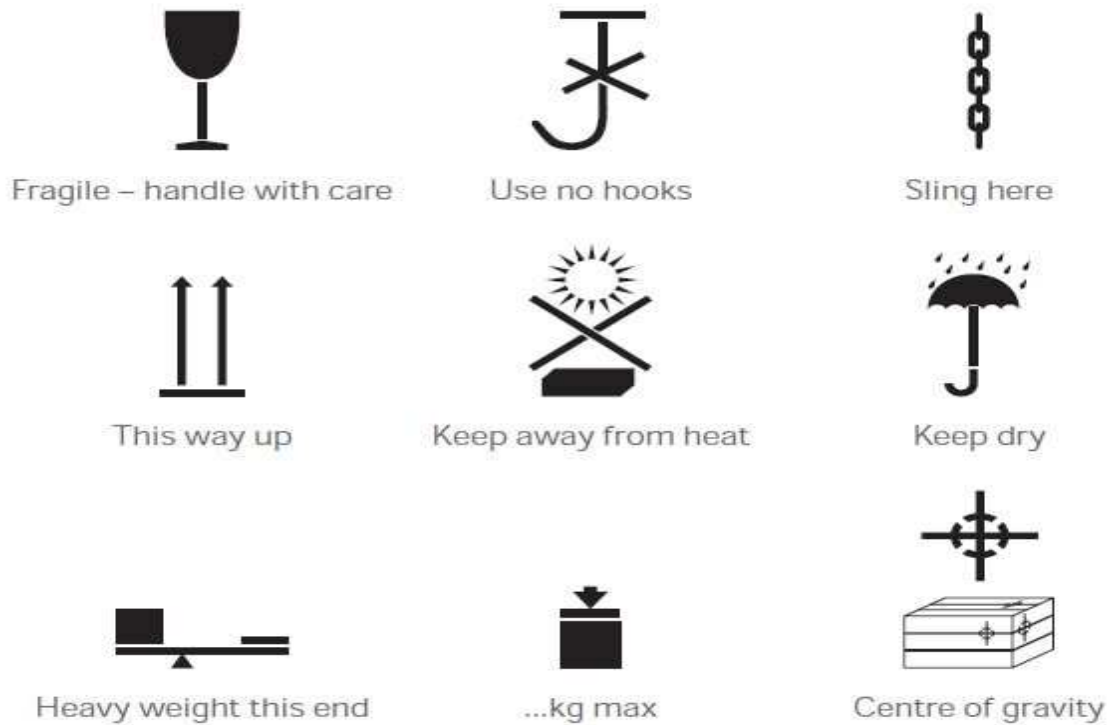
3.5 General freight

General freight company engaged in shipping packaged, boxed, and palletized goods that can be transported in standard, enclosed tractor-trailers, generally 40 to 48 feet in length.

3.5.1 Symbols on the load

Symbols are marked on cargo to be recognised with and some are for safety loading goods. And all indicate general handling instructions to handlers of cargo who may speak a different language.

The symbols should measure over 100mm in height and be painted in black on a light background or white on a dark background. They can be in the form of a label or stencilled directly on to the package. The common symbols are shown in picture and other are recognise universally.



Pic. 6: International cargo symbols
Source (6)

3.5.2 Load arrangement

Two essential requirements must be satisfied when loading vehicles, namely the load must be distributed so that:

- the maximum vehicle and axle weights are not exceeded
- maximum stability is ensured when the vehicle is braked, accelerated or changes direction.

For maximum stability, the items that comprise the total load need to be evenly spread to achieve minimum height and to form a unified whole so that no excessive stress is applied to whatever restraining devices are, used. Where a part of the load is to be picked up or removed in the course of a journey, the effect on gross vehicle

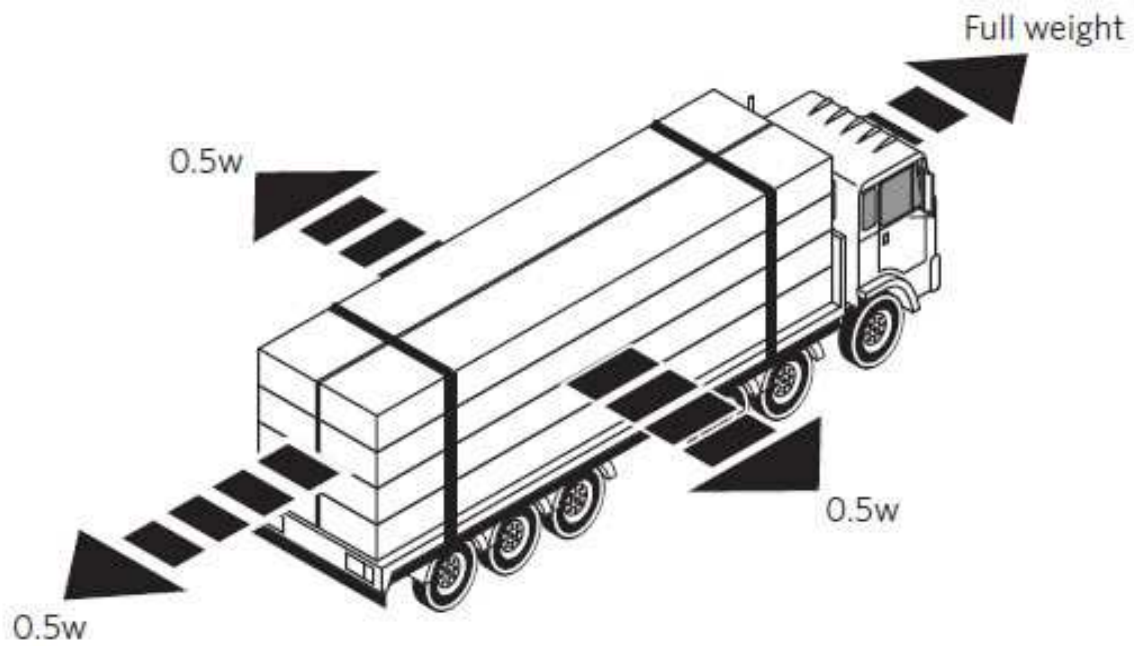
weight, individual axle loadings and the securing and stability of the load being carried must not be overlooked. Although the removal of part of the load will reduce the aggregate vehicle weight, it may change the mass distribution, and this possibility must be borne in mind during the initial loading operation.

In addition to the general principles outlined above, the following procedures should be followed whenever applicable:

Where mixed loads, such as heavy, solid articles and light crushable boxes, etc are involved, the former should provide the base and forward parts of the load. The light portions should be loaded on top and to the rear, provided the load arrangement does not overload the prime mover axles.

Throughout the journey, at every stop, the load should be checked for security and the lashings tested. Weather conditions can affect the tension of ropes and this may lead to damage of the load or loss of security.

- Where mixed goods in different sizes of container are involved, small items should be central with larger items forming the outer walls of the load. The smaller items should not be so low as to act as a pivot point for the larger items around the edge to tip either way, inwards or outwards.
- It is possible for gas cylinders to be placed vertically in the centre of a mixed load.
- Plastic containers may be contained within the load, as illustrated.
- Keep irregular-shaped items for the upper part of the load when it is not possible to place them centrally within the load.
- The load must be packed tightly before applying restraint.



Pic. 7: Payload forces
Source: (7)

3.5.3 Anchor points on the vehicle

The principles to follow when deciding on the strength, number and position of anchor points to be fitted to a vehicle are as described more fully in the Strength requirements of restraint systems section. The anchor points should be fixed securely to metal members of the chassis or cross members and should be capable of transmitting all the forces imposed on them to the main chassis frame of the vehicle.

Each anchor point should be capable of withstanding a force equal to the lashings being used, acting in any direction through which the lashing can be attached. In deciding the number of anchor points to be used when devising a restraint system, the following factors should be considered:

- The need to position the machine to achieve the correct load distribution to meet the axle load requirements and to ensure that the vehicle's handling is not impaired.
- The extent to which other load restraint features are incorporated in the design of the vehicle.
- Whether the machine has wheels, tracks or rolls.

- The mass of the machine to be carried.

Unless loaded on a special purpose vehicle, there should never be less than four anchor points used, ie two per side.

The lashings or securing devices should only be attached to those parts of the engineering plant that are compatible in strength with the vehicle's anchorage points. They should not be attached to any part of the machine being carried where there is a risk that damage can be caused when the vehicle is moving, eg a draw bar provides an ideal anchor point. When suitable anchor points are not readily available on a machine, it is recommended that special additional anchor points be provided . It is also recommended that, when purchasing new machines, suitable anchor points should be included before accepting delivery of the machine.

3.5.4 Restraint devices

A variety of materials may be used for restraining general freight loads. These include rope, steel chain, steel wire rope and specially designed webbing strapping made up into a harness or net. For the securing of loads inside van bodies and similar load containers, specially designed shoring poles used in conjunction with the appropriate securing fixtures on the vehicle deck and sides are suitable. Custom-built restraining devices should only be used as outlined by the manufacturer.

The restraining devices you use should be based on load securing principles. However, there are some special points that need to be considered when dealing with general freight and these are outlined below.

3.5.5 Restraining Methods

Restraining methods are principally the following:

- locking,
- blocking ,
- direct lashing,
- top-over lashing and

- combinations of these in conjunction with friction.

The restraining method (s) used should be able to withstand the varying climatic conditions (temperature, humidity...) likely to be encountered during the journey.

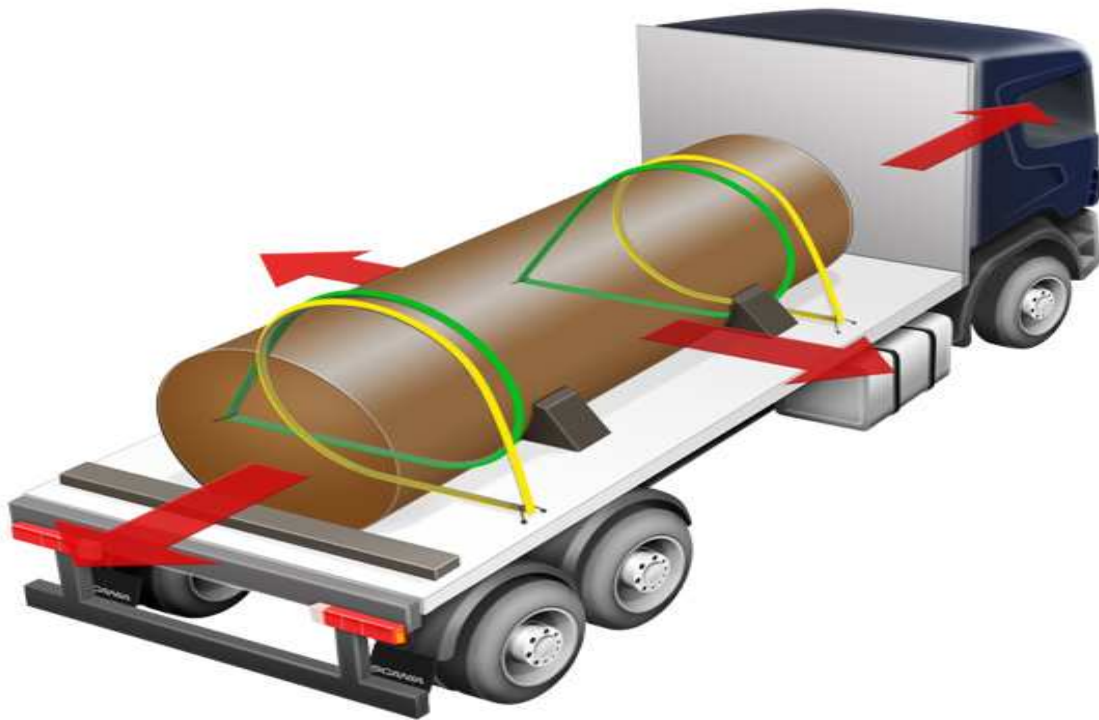
3.5.6 Blocking load

Blocking or bracing means that the cargo is stowed to lie flush against fixed structures and fixtures on the load carrier. These may be in the form of headboards, sideboards, sidewalls or stanchions. The cargo can be stowed directly or indirectly by means of filling against the fixed blocking devices built into the load carrier, and these prevent any horizontal movement of the cargo. In practice it is difficult to achieve a tight fit against the blocking devices and a small clearance usually remains. Gaps must be kept to a minimum, especially those to the headboard. The cargo should be blocked against the head board either directly or the use of filler material in between.

Be aware that the loaded packages also have to be secured to the vehicle. If the vehicle's superstructures comply with standard EN12642 and the load is uniformly distributed, total maximum sideways gaps must not exceed 80 mm for packages to be considered as properly blocked between sideboards. With heavy concentrated loads, any gaps should be avoided. Improperly blocked packages need supplementary securing measures to the vehicle.

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Pic. 8: Blocking load
Source: (8)

3.5.7 Blocking braces

When there are large gaps between the cargo and blocking fixtures, and high bracing forces, it is often appropriate to use blocking braces fitted with sufficiently strong wooden spacers. It is essential that blocking braces are fixed in such a way that the spacers are always at right angles to the cargo that is being braced. This will ensure that the blocking braces are more able to resist the forces exerted by the cargo.

3.5.8 Diagonal and cross battens

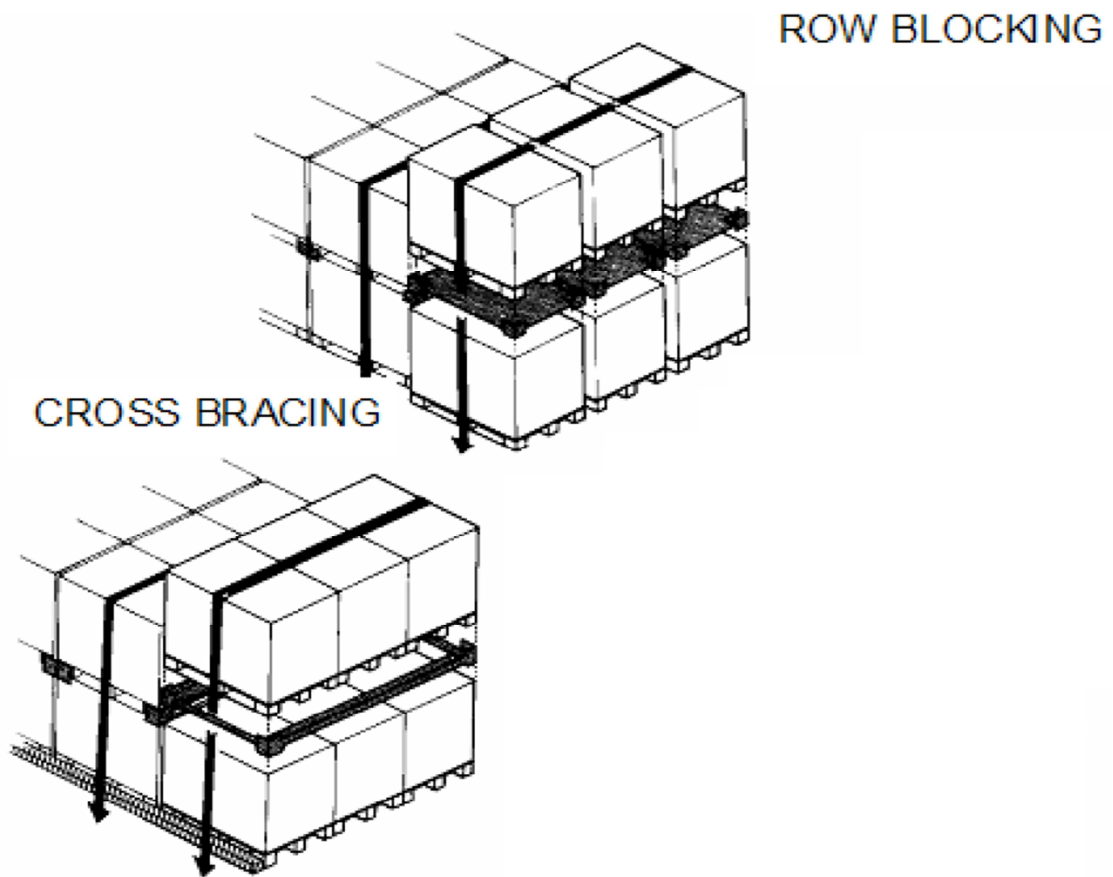
Blocking in longitudinal direction by means of diagonal and cross battens is a direct blocking method particularly suited to containers, where the container's robust and vertical corner beams are, used as counter holds for diagonal battens. Blocking braces are, used for longitudinal base blocking, but can also in certain cases be used as filler material.

3.5.9 Threshold blocking and panel blocking

When there is a height difference between various layers, threshold blocking or panel blocking can be used for base blocking of the upper layer against the lower layer. Using some form of base material, such as load pallets, the cargo section is raised so that a threshold is formed, and the upper cargo layer is base blocked longitudinally. When threshold or panel blocking is used at the rear, at least two sections of the bottom layer must be behind the blocking section.

3.5.10 Blocking with filler

Effective securing of cargo by blocking requires close stowage of the packages both against the load carrier's blocking fixtures and between the individual packages. When the cargo does not fill the space between the side and end boards, and is not otherwise secured the gaps must be filled with a filler material to create compressive forces that ensure a satisfactory blocking of the cargo. These compressive forces should be proportionate to the total cargo weight.



Pic. 9: Cross bracing and row blocking
Source: (9)

3.5.11 Types of blocking

- Wedges and wedge beds
- Wooden battens nailed to the load platform
- Threshold blocking and panel blocking
- Blocking with filler

Pointed wedges, normally with a 15° wedge angle, have no cargo securing capacity, and their chief function is to keep round shaped goods in position during loading and unloading. The small angle means that the wedge normally self locks to prevent sliding.

Block wedges (approximately 45°) are used as blocks to prevent rows of round shaped goods from shifting, and must therefore be blocked against suitable blocking

devices on the load carrier. The rolls must also be lashed against the platform bed, with an edge beam and top-over lashing being required over both the rear rolls.

3.6 Wedge bed

The two long wedges are kept in position by adjustable cross bracing such as bolts or chains. The cross bracing should be arranged so that a minimum clearance of 20 mm is achieved between the roll and the platform bed in order to ensure the wedge bed is prevented from moving sideways

The height of the wedges should be:

- minimum $R/3$ (third of the roll radius) if there is no top-over lashing or,
- maximum 200mm in combination with top-over lashing.

Some possible filler materials are shown hereafter.

3.6.1 Air cushions

Inflatable air cushions are available both as disposable items and as recyclable products. The cushions are easy to install and are inflated by compressed air, often by means of an outlet in the truck's compressed air system. Suppliers of air cushions are expected to provide instructions and recommendations concerning load capacity and appropriate air pressure. For air cushions it is important to avoid damage as a result of wear and tear. Air cushions should never be used as filler against doors or any non rigid surfaces or partitions.

3.7 Container services

There are two types of container service available:

- A full container load (FCL),
- Less than container load (LCL).

3.7.1 Full container load:

This is suitable for the exporter who has sufficient cargo to justify the use of a whole container. In this case, the container operator or the exporter will arrange for a container to be delivered to the exporters premises together with a seal and the exporter will load the cargo into the container himself and, thereafter seal the container. When the container arrives at its destination, the container operator or the consignee will normally arrange for the container to be delivered to the consignee's premises, and the consignee will unpack it himself. If the exporter or the importer arranges the delivery or collection of containers to or from a port, the transportation involved is termed merchant haulage. If, however, delivery or collection of containers to or from port is arranged by the container operator, the transportation is termed carrier haulage. An FCL consignment, loaded and secured by the exporter, will be handled and shipped by the shipping line as a single item of cargo. The shipping company accepts no responsibility for damage caused by some external force on the container. The exporter therefore is responsible for securing the cargo within the container in a manner sufficient to withstand all the normal hazards associated with each mode of transport to be used.



Pic. 10: Container truck
Source: (10)

3.7.2 Less than container load (LCL)

This is a service that is offered to exporters whose consignments are not sufficient to fill a container. To take advantage of containerisation, however, their consignments are consolidated with those of other exporters. Such services are offered by certain shipping lines, consolidators and many forwarders. When the service is offered by a shipping line, it is called a LCL service. When it is offered by a forwarder or a consolidator, it is called a groupage service in both cases; it involves cargo being transported by traditional means from the exporter's premises to a warehouse which has facilities for handling and loading containers, or to a container depot. At that warehouse/depot, it is responsibility of either the groupage operator or the shipping line to accumulate sufficient cargo to constitute a full container load for a location conveniently situated in relation to the ultimate destination of each consignment.

A further responsibility of the groupage operator/shipping line is to ensure that the cargoes which are loaded into such a container are compatible, that the stowage

and securing of the cargo is adequate for the transport involved, and that the container is in a suitable condition. The discharge of the goods from the container at the final destination will be the responsibility of the groupage operator/shipping line. This is normally performed at a licensed container depot where the goods will be held for customs clearance prior to their being collected by the importer.

3.8 Goods pallets

Goods pallets are often a suitable form of filler material. If this clearance towards the blocking is larger than the height of a EURO pallet (about 15 cm) then the gap could be filled with, for example, such pallets standing on end, for the cargo to be properly blocked. If the clearance towards the sideboards on any side of the cargo section is smaller than the height of a EURO pallet then the gap to the sideboard must be filled with suitable filling, for example planks of wood.

3.8.1 Palletized loads

Is the most common pallet used for goods transportation in road and rail transport. And the pallet constitutes to load carrier similar to a load platform without sideboard. Pallets - allow smaller packing units such as boxes and cartons to be grouped together. They allow easy mechanical transporting (eg forklift trucks), which eases the process of loading, unloading and warehouse.

The most common pallet used for goods transportation is the EURO pallet (ISO 445-1984). It is made primarily of wood, and the standard dimensions are 800x1200x150 mm.



Pic. 11: Euro-pallet
Source: (11)

The three points below are methods of loading goods on pallets to the trailer or container. This point also applies in transporting goods in short or long distance and in loading different freight transport:

Straight loading : involves using two-way pallets and loading them straight (in the direction of the pallet stringers) into the trailer or container.

Loading pallets turned (or sideways): requires the use of four-way pallets. In this method, the lift truck will pick up the pallet from the side (perpendicular to the pallet stringers) and place them in the trailer

Pinwheeling: refers to a method where you alter the direction of every other pallet. It's a combination of loading pallets straight and turned.

Common freight types:

Stacked load - restraint force distributed evenly over the height of each load item. A load with a number of loose single items or unitized packs of items stacked on top of each other, including pallets stacked two high, loose cartons and stretch-wrapped pallets.

- Point load- restraint force acts at the point of contact with the load.
- Impact load - restraint force could be very high.

Loose bulk load - restraint forces are evenly distributed over the height of the load. A loose load that cannot be stacked. Loose bulk loads should be covered with a tarpaulin, netted or sheeted as appropriate whenever there is a risk of load shedding due to wind action or movement. The figure below is the loose bulk load vehicle.



Pic. 12: Loose bulk loads
Source: (12)

3.9 Swap bodies

Swap bodies are another product of efforts to reduce the loading of manipulación, and the means of transport. This is the loading unit during road transport forms part of a temporary road vehicles, while other transport modes do not. Compared with swap body containers during loading and unloading of the carrier (or even transship) the advantage that the road is no need for mechanical handling equipment. Special road vehicle itself can swap-body load on himself or herself from the fold. In contrast, however, have the disadvantage against the containers during storage and handling. This drawback lies in the fact that their construction does not allow stacking up multiple layers of manipulation is necessary to use a forklift (vehicle) with the forks or the arm of the vehicle or crane with collets.



Pic. 13: Swap bodies truck
Source: (13)

3.10 Car carriers

Vehicles used regularly for the carriage of motor cars over long distances are generally well equipped with specially designed wheel wells/chocks, anchor points, winches and other restraining devices, but operators carrying motor cars intermittently for short distances are tempted to rely on the force of gravity or on inadequate cordage lashed to the suspension members of the motor cars being carried.

4 COMPARISON ROAD FREIGHT SYSTEM BETWEEN SOUTH AFRICA AND CZECH REPUBLIC

There is a number of system which are, used in cargo road transport comparison to rail transport. Czech republic have many difference system that are, used in transportation goods in road vehicle, such as swap body, containerzation , palletization ,intermodal and information technology.

4.1 Dangerous Goods

In contrast to the transport of other cargoes, there are European legal provisions for the transport of dangerous goods. The transport of dangerous goods by road is covered by the UNECE European Agreement Concerning the International Carriage of Dangerous Goods by Road ADR, as amended. The European Directive 94/55/EC4 (the so-called "ADR framework directive") makes the provisions of the ADR uniformly applicable to national and international road transport within the European Union. The ADR oversee specific provisions for securing of dangerous goods because there can be extra risks for safety and the environment during the transport of such goods.

Handling of dangerous goods in South Africa is under South Africa Bureau of Standards (SABS). The SABS are the one bureau that approved the carriage of dangerous good in road freight.

The provisions for the securing of dangerous goods can be found on the ADR - Handling and stowage. The relevant paragraphs read as follows:

The various components of a load comprising dangerous goods shall be properly stowed on the vehicle or in the container and secured by appropriate means to prevent them from being significantly displaced in relation to each other and to the walls of the vehicle or container. The load may be protected, for example, by, the use of side wall fastening straps, sliding slat boards and adjustable brackets, air bags and anti-slide locking devices. The load is also sufficiently protected within

the meaning of the first sentence if each layer of the whole loading space is completely filled with packages.

The process apply to the loading, stowage and unloading of containers on to and from vehicles.

4.2 Vehicle Equipment

It should be remembered that any accessories or equipment, either permanently or temporarily carried by the vehicle, are also considered to be load and as such their securing is the responsibility of the driver. The damage that an unsecured landing leg can do if it extends whilst the vehicle is in motion is enormous as some fatal experiences have shown.

WARNING: Any landing legs, loader cranes, tailgates etc. should be stowed and locked according to the manufacturer's instructions prior to moving the vehicle. Any vehicle on which such a piece of equipment cannot be locked should not be used until such time as repairs have been undertaken to rectify the fault. Loose chains on unladen skip vehicles should also be restrained so as not to present a hazard to other road users.

WARNING: Vehicles should never be driven, no matter how short a distance, with any equipment extended or in an unlocked position. Loose equipment, such as webbing, ropes, sheeting etc., should also be carried in a manner so as not to endanger other road users. Good practice is to have a separate locker in which to safely store these items when not being used. If, however they are kept in the driver's cab, they must be stowed in such a manner that they cannot interfere with any of the drivers controls.

4.3 Contain terminal

Czech republic is the landlocked country and its handling its goods in inland terminal. South Africa also developing inland teminal as result of high volume road

freight transportation in country. The picture below is image of inland terminal in Prague.



Fig. 14: Container terminal in Prague
Source: (14)

4.4 Load distribution

4.4.1 Objectives and conditions

A load distribution plan is the basis for placing load on the vehicle so that individual axles are neither under or over loaded. For a single vehicle, the load distribution plan will only need to be drawn once and will depend on its maximum total weight and the minimum/maximum axle loads. Recalculation of the load distribution plan will need to be carried out if any characteristics of the vehicle are changed, such as a body change for example. Any machinery mounted on the vehicle (vehicle mounted cranes, forklifts) and vertical loads from trailers also need to be considered in a load distribution plan.

Trucks that are equipped with a trailer coupling device must be treated according to their usual operating conditions. Vertical coupling loads may be considered as load (in cases where a trailer is not usually drawn) or as part of the vehicle weight (if the truck is usually used with a trailer).

Necessary data for calculating the load distribution plan:

- maximum total weight;
- maximum payload;
- unladen weight;
- front axle load of unladen vehicle;
- rear axle load of unladen vehicle;
- maximum permitted front axle load;
- maximum permitted rear axle load;
- minimum front axle load;
- minimum rear axle load (% of total weight);
- wheelbase;
- distance front axle to foremost point of the headboard;
- load platform length.

Most of this data may be taken from plates fitted to the vehicle, registration documents, type approval document or determined by measuring the vehicle. However, some of the information may only be available from the vehicle manufacturer (minimum front axle load for example).

4.4.2 The load distribution plan

Before the vehicle is loaded and a loading plan is developed, the weight/dimensions and the horizontal location of the centre of gravity for each piece of load carried must be determined.

A virtual loading plan may then be drawn. The horizontal location of the whole load has to be calculated, for example by calculating a torque balance around the foremost point of the load panel (or any other point of reference if more convenient).

As described hereafter, the load distribution plan will determine whether the vehicle has sufficient capacity to carry the total weight of the load at the calculated centre of gravity.

4.4.3 Developing a load distribution plan.

To determine the maximum of cargo mass which may be loaded onto the vehicle taking into account the position of the centre of gravity for the entire load.

4.4.4 Technical equipment of terminal

Freight handling requires specific loading and unloading equipment. In addition to the facilities required to accommodate truck loading, freight transport terminals have a set of characteristics linked with core and ancillary activities.

4.5 Modal Competition

Each transportation mode has key operational and commercial advantages and properties. However, contemporary demand is influenced by integrated transportation systems that require maximum flexibility in the respective use of each mode. As a result, modal competition exists at various degrees and takes several dimensions. Modes can compete or complement one another in terms of cost, speed, accessibility, frequency, safety, comfort and load. There are three main conditions that insure that some modes are complementing one another:

- Different geographical markets. It is clear that if different markets are involved, modes will permit a continuity within the transport system, particularly if different scales are concerned, such as between national and international transportation. This requires an interconnection, commonly known as a gateway, where it is possible to transfer from one mode to the other. Intermodal transportation has been particularly relevant to improve the complementarity of different geographical markets.
- Different transport markets. The nature of what is being transported, such as passengers or freight, often indicates a level of complementarity. Even if the same market area is serviced, it may not be equally accessible depending of

the mode used. Thus, in some markets rail and road transportation can be complementary as one may be focusing on passengers and the other on freight.

- Different levels of service. For a similar market and accessibility, two modes that offer a different level of service will tend to complement another. The most prevailing complementarity concerns costs versus time.

Challenges Facing Road Freight Transport

The major impacts from advances in science and technology is undoubtedly in the ability to transport cargo from one geographic location to another. This can be seen in the increasing distances covered in the same amount of time using different types of vehicles. In addition, large cargo volumes are being transported each day. Increasing capabilities of transport systems have coincidentally correlated with some important indicators of economic well being.

Advances in scientific research and technology provides improved possibilities for measuring the true effect of transport in areas such as accidents, environmental emissions, load restraint and energy consumption . Specific capabilities are built on the use of computer based information processing, data collection with the help of sensors, and mobile wireless communication. Therefore new tools using these capabilities are helping to improve ways of measuring the performance of transport systems, hence, their cost and benefits, on a society-wide scale

4.6 Accident

Safety of roads and trucks is a central concern of regulators, as well as truck drivers and owners, shippers, other motorists, roadside property owners and the general community. Factors contributing to truck accidents include the number of hours drivers spend at the wheel per week, driver fatigue and driver attitude toward regulations governing speed and overtaking. Vehicle defects also contribute to accidents. Studies have shown that a significant portion of heavy haulage vehicles are found to be defective during inspections. The most common defects are in vehicle lighting systems, and the most common major and extremely dangerous

defects are in braking systems, tires, and steering systems. Road conditions, overloading and poor loading also influence safety.



Pic. 15: Heavy commercial vehicles
Source: (15)

4.7 Overloading on roads (damage)

The practice of overloading damages roads and is often cited by reformers when arguing for regulations. Overloading among small operators will continue to be a problem for regulators attempting to minimize road damage. Overloading is rooted in operator behavior, usually owner-drivers. In South Africa, for example, overloading is a common practice; trucks are reinforced, well maintained, and carefully driven at slow speed. Imposing penalties and investing in expensive control systems is unlikely to deter overloading and is, more likely to create more opportunities for the unofficial payments so common in these countries.



Pic. 16: Overload truck
Source: (16)

4.8 Congestion

Reduction of road congestion because congestion cost transporting companies a lot of money. The time their vehicles spend stuck in traffic is the time they could be transporting other loads. To reduce congestion, road infrastructure must be improve and the existing ones can be improved and widened.

5 PROPOSALS FOR IMPROVING ROAD TRANSPORT/ FREIGHT TRANSPORT

The need to improve infrastructure in road consignment and goods loading in trailer or container and goods handling. The proposals of using technology in consignment like software that plan the structure of container loading or trailer for's example the Ty-Garder 2000 a pallet loading software.

5.1 Improving road safety

The department and ministry of transport improve road safety by, for example:

- introducing digital tachographs.
- introducing blind-spot mirrors.
- better loading of lorries and delivery vans.
- trials with accident-prevention systems.
- driving courses for delivery van drivers.

5.1.1 Safe freight traffic and environmental zones

In South Africa and Czech republic, stringent conditions apply to the transport of hazardous materials. To improve air quality and reduce noise nuisance, some cities have set additional requirements for lorries.

5.1.2 Poor public perception of the road freight industry

Challenges: Curfews, restricted access to roads, poor treatment at warehouses and docks. The government is reluctant to grant reforms because of public backlash.

Responses: Develop industry performance metrics. Publicise good practice and good achievements. Criticise bad practice. Industry associations should co-operate and promote the industry. Identify infrastructure bottlenecks to government. Promote accreditation-scheme participation.

Overall: Governments generally recognise the essential service nature of the road freight industry but are extremely sensitive to community criticism

5.1.3 Tight controls on dangerous goods

Moving dangerous goods like chemicals or flammable materials by road (and other means of transport) is governed by a series of EU/SABC directives. The rules also cover the movement of transportable pressure equipment. They prescribe requirements like technical type-approval for vehicles, special training for drivers and uniform control procedures for checking the transport of dangerous goods both at the roadside and at operators' premises. EU laws also provide for the appointment and training of safety advisers.

5.1.4 Driver Checklist for Cargo Securing

The ten most important tips for cargo securing according to the EU's Cargo Securing for Road Transport European Best Practice Guidelines:

- Check that load platform, bodywork, and load securing equipment are sound and serviceable.
- Secure cargo so that it cannot move, roll over, wander because of vibrations, fall off the vehicle or tip.
- Determine the securing method (s) best adapted to the cargo (locking, blocking, lashing, top-over lashing, or a combination of these).
- Check that the vehicle and blocking equipment manufacturer's recommendations are adhered to.
- The securing equipment must withstand the conditions of the journey like bad road and weather conditions.
- Ensure that the cargo is distributed in such a way that the center of gravity of the total cargo lies as close as possible to the longitudinal axis of the truck and is kept as low as possible.
- Check the cargo securing regularly, especially after heavy braking.
- Use friction mats, boards, straps and beams to support the cargo.
- Ensure that the securing equipment does not damage the cargo.

- Drive smoothly and avoid brisk change of direction and heavy braking.

5.1.5 Improved knowledge about trailer fleets

Challenges: The characteristics of the South Africa trailer fleet are not well known. The trailer manufacturing industry is large and has about many suppliers for each truck supplier. The activity level is not measured and government does recognise its importance.

Responses: An activity index for the trailer industry should be developed by industry associations. Co-operation between trailer manufacturers should be promoted so that a reliable index can be developed. A regular 'census' classification of trailer types and ages is needed for good planning purposes. And trailer that are well developed for the road.

Overall: Much better information about the activity level and characteristics of the trailer industry is needed for planning and industry support purposes.

5.2 Cargo transport planning

Planning is required to achieve good result when stowing and packing a cargo transport unit. Recurrent as well as occasional shipments should be planned with the aim to use the cargo transport unit best adapted to the mode of transport and the cargo.

It is also essential that all personnel involved in loading and securing have good education and training in cargo handling especially regarding the forces acting on the cargo and the cargo transport unit during the transport. A basic requirement is that adequate equipment and material for loading and securing of the cargo in question is provided prior to the transport.

5.2.1 Technology

Technology will help the sector meet the challenges both in terms of efficient use of infrastructures and transport management and loading goods.

For some load and product types it is vital to monitor the load weight to avoid overloading. Axle weighing technology creates an easy solution. There are several different methods of weighing your vehicle: axle weighbridges, on-board weighing systems and portable and semi-permanent equipment.

CONCLUSION

The aim of the thesis is to analyse general technical loading process in transport vehicles. And to determine major problem in load transport vehicle. The most aim of this work is to improve loading system in road transport and using the safety way to load. And the work also focus on other way of loading.

The thesis analyzes difference types of method of loading goods and securing method. And analyzes the transport infrastructure of South Africa and Czech Republic and comparison truck loading process.

Characterize and analysis the transport wagon loading and highlight some new concepts and proposals for the possible development of loading in road freight. And the use of information technology as suggestion to improve vehicle load.

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LIST OF ABBREVIATIONS

ADR - Road transport

CMR - International waybill

EU - European Union

ISO - International Standards Organisation

km - Kilometer

MDČR - Ministerstvo dopravy

SABS - South African Bureau of Standards