

THE PERILS OF MOVING CARGO BY RAIL AND MINIMIZING LOSSES



Capt. Philip Vardon

OUTLINES

- GENERAL INTRODUCTION TO MULTIMODAL OR INTERMODAL TRANSPORT
- PROS AND CONS OF TRANSPORTING CARGO BY RAIL
- PROS AND CONS OF TRANSPORTING CARGO BY SEA
- STRESSES ENCOUNTERED IN THE VARIOUS MODES OF TRANSPORTATION
- PERILS OF RAIL TRANSPORTATION
- PERILS OF THE SEA
- PACKAGING AND STOWING YOUR CARGO TO WITHSTAND THE RIGORS OF TRANSPORTATION BY RAIL AND SEA

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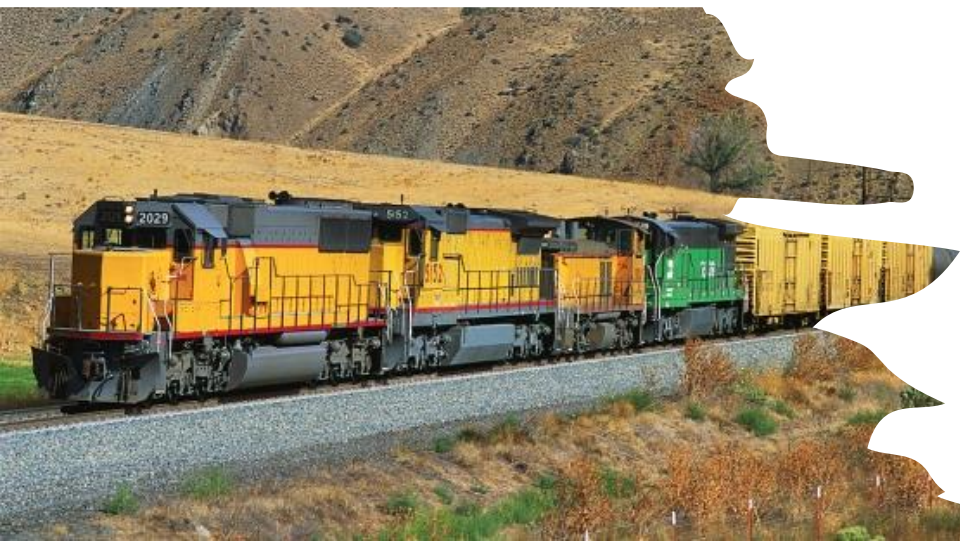
MULTIMODAL AND INTERMODAL TRANSPORT

In general, Multimodal and Intermodal Transport are very similar - transportation of goods by 2 or more modes of transport with some differences.

Multimodal Transport is defined as transportation of goods by 2 or more modes of transport but is governed by a single contract of carriage.

Intermodal Transport is defined as transportation of goods by 2 or more modes of transport but the shipper or the consignee may contract the carriage to multiple companies so there may be bills of lading issued by multiple parties.

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Besides Air, the three major modes of transport used for intermodal transportation are Road, Rail and Sea.

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PROS OF RAIL TRANSPORT

High Carrying Capacity (Freight Trains in Canada typically haul up to 130 railcars depending on the route. A freight train with 100 railcars is approximately 6,000 feet long.

Affordability – Rail Transportation is an economical option for transporting large volumes of cargo.

Low carbon footprint – trains consume less fuel and emit less gases that are harmful to the environment.

Designated Corridors (risk of changes or disruptions are minimized).

Updated infrastructure with investment in the latest technology to track and monitor railcar movements.

Large network - track sharing agreement with other rail companies.

Cargo security is comparatively high while cargo is in transit on rail.

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CONS OF RAIL TRANSPORT

- High operating costs – initial rail track installation, complex maintenance protocols.
- Strict governmental oversight.
- Limited Flexibility of delivery locations. Fixed routes restrict direct delivery of cargo and most often than not involves additional modes of transportation.
- Complex intermodal connections.
- Labor action by unionized employees causing disruptions in service are not uncommon although not frequent.
- Longer delivery times when compared with other modes of transport.

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THE RIGORS OF TRANSPORTATION

Shippers of cargo are required to package and secure their cargo in a manner that is adequate to withstand the rigors of transport.

There is a reasonable expectation from carriers and cargo underwriters that the shipper is aware of the rigors of transportation and will package and secure their cargo adequately.

Major Carriers (Ocean and Rail) post Guidance publications on their websites with recommendations for stowing and securing cargo.

P&I Clubs also issue Guidance publications which are accessible by their members.

The AAR (Association of American Railroads) – an Industry Trade Group representing primarily the major freight railroads of North America, establishes safety and operating standards that provide seamless and safe operations across America’s 140,000-mile freight rail network. This is a private industry association.

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THE RIGORS OF TRANSPORTATION

RAIL SHUNTING OR HUMPING

Marshalling yards including **hump yards** are railroad yards found at some freight train stations, used to separate railroad cars on to one of several tracks. First the cars are taken to a track, sometimes called a **lead** or a **drill**. From there the cars are sent through a series of switches called a **ladder** onto the classification tracks. Larger yards tend to put the lead on an artificially built hill called a **hump** to use the force of gravity to propel the cars through the ladder.

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ACCELERATION FORCES

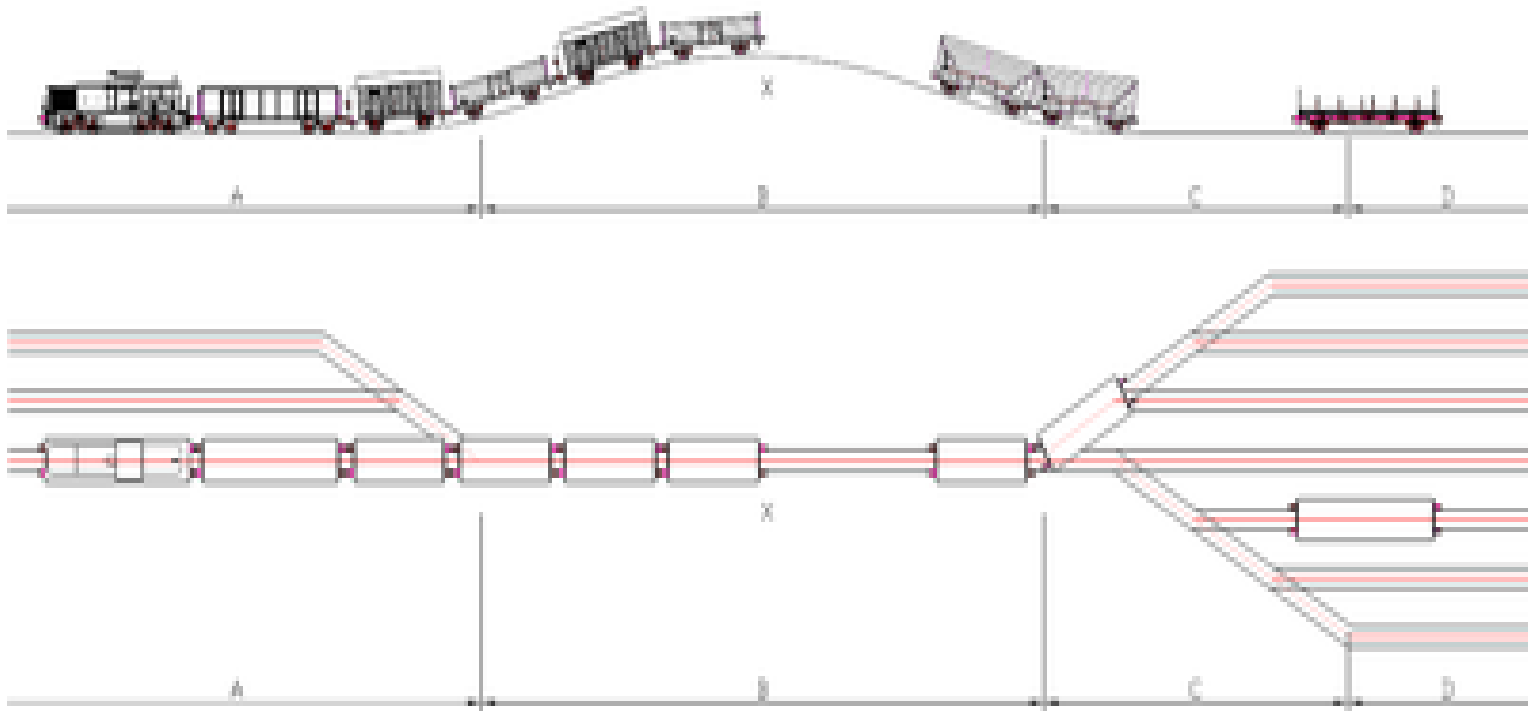
$$1 g = 9.81 \text{ m/s}^2$$

Mode of Transport	Forwards	Backwards	Sideways
ROAD	1.0 g	0.5 g	0.5 g
RAIL			
Shunting	4.0 g	4.0 g	0.5 g
Normal	1.0 g	1.0 g	0.5 g
SEA			
Open Sea	0.4 g	0.4 g	0.8 g

THE RIGORS OF RAIL TRANSPORTATION

- As can be seen from the table, Acceleration forces are highest during rail shunting or humping.
- The likelihood of cargo shifting during transit is thereby increased during rail transportation. The cargo shifting more often than not results in cargo damage and in some cases the outcome is catastrophic.

Rail shunting or humping



Source: Wikipedia

RAIL TRANSPORT GENERAL FACTS

Freight Trains are hauled by Diesel Locomotives

The average weight of a 4000 HP Diesel Locomotive used to haul freight cars in Canada is 245,000 lbs. (111,130 kgs.).

Multiple Diesel Locomotives are used to haul freight trains that are over 100 cars in length.

It is not uncommon to see freight trains stretch to 12,000 feet in length and sometimes up to 14,000 feet. Most freight trains are limited to 3.7 Km length (about 150 railcars).

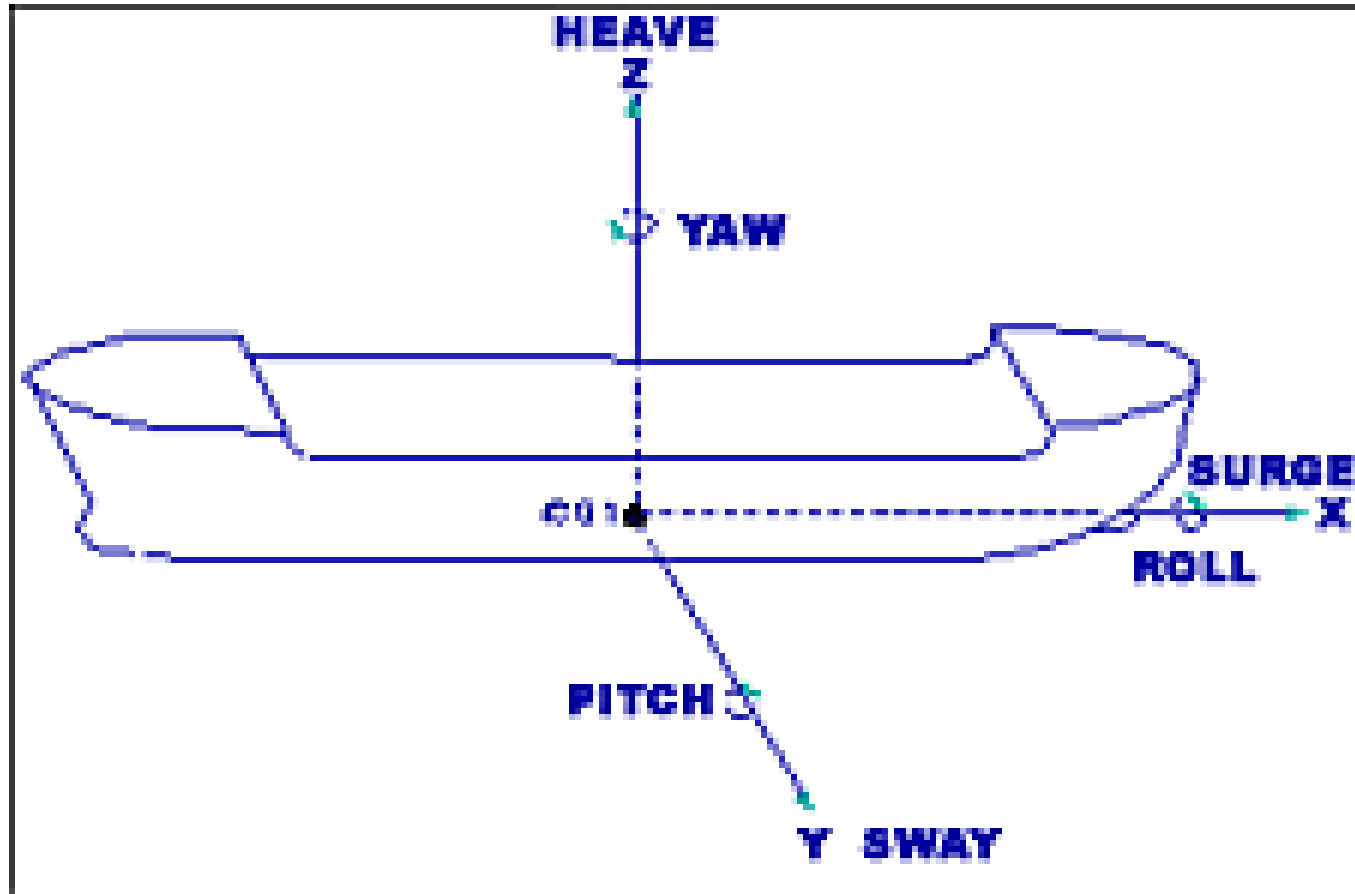
The average weight of a railcar is 30 tons and can carry about 100 tons cargo weight.)

The speed limit for freight trains in Canada is 80 miles per hour (128 kmph) on the mainlines but in practice they travel at an average of 55 mph. Speeds are much less when passing through urban areas and depends on the grade and other restrictions.

THE RIGORS OF SEA TRANSPORTATION

- Ocean/Sea-going cargo ships are floating vessels directly affected by the state of the waters they float on and traverse across.
- Heavy Weather events cause the ship to move about in different directions and velocity.
- The effect of the movement of the ship is to stress the cargo lashings/securings, and if they are inadequate the lashings/securings break or come loose causing cargo damage.
- The stability of the vessel is critical in these situations. The Metacentric Height (GM) of the vessel determines how hard it is to heel the vessel and how fast it can return to its upright position. A too high GM is as undesirable as a too low GM.

Six degrees of motion on a ship in a seaway



CARGO SECURING

Six degrees of motion on a ship in a seaway

LINEAR MOTION	ROTATIONAL MOTION
Surging is motion along the longitudinal axis.	Rolling is motion around the longitudinal axis.
Swaying is motion along the transverse axis.	Pitching is motion around the transverse axis.
Heaving is motion along the vertical axis.	Yawing is motion around the vertical axis.

THE CONSEQUENCES OF POOR OR INADEQUATE PACKAGING/SECURING

- Damage to the cargo.
- Damage to the container or package it is contained in.
- Damage to adjacent cargo/containers.
- Damage to the vessel or railcar.
- Risk of injury to the crew and other personnel involved in handling the cargo.
- Cargo claims



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Points to note when loading and securing cargo in containers:

- The size and weight of the load.
- The load limitations of the container.
- The load distribution within the container.
- The presence of voids in the stow.
- The structural integrity of the container and securing points.
- The centre of gravity of the load.

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- The size and weight of the load will determine the strength and number of lashings required.
- If point loading exceeds the floor rating then dunnage must be used to spread the weight.
- The securing arrangement is only as good as the weakest link.

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Strength of lashing materials:

- Wire rope is commonly used to secure cargo on ships and in containers. 16 mm diameter of 6 x 12 with fibre core construction is the most commonly used. It has a breaking strength of approx 7.7 t.
- Wire does stretch when in use. When a new wire rope is used to lash a cargo the lashing might stretch as much as 2% of the original length.

CARGO SECURING

- Chains, nylon webbing straps and for smaller items, nylon or fibre rope are other materials that can be used.
- Turnbuckles or tensioners are used to tighten lashings.
- When forming eyes in the lashings wire grips are used. These are also known as bulldog grips or Crosby clips.

CARGO SECURING

- Maximum Securing Load (MSL) is the load capacity for a device used to secure cargo.
- The MSL of a securing device is a proportion of its breaking strength.
- The MSL varies for different devices.
- e.g. Mild steel Shackles 50% of Breaking strength, Wire rope (single use) 80% of breaking strength.

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- Whenever two surfaces are in contact and are either static or sliding over each other, there will be a friction force acting against any force which is causing or likely to cause movement.
- The force required to overcome that friction force can be calculated by multiplying the weight of the item by the coefficient of friction for the two surfaces.
- $F = \mu \times m \times g$

Where F = Friction Force

μ = Coefficient of Friction

m= mass

g= acceleration due to gravity

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Materials in contact	Coeff .of Friction
Timber to Timber (wet or dry)	0.4
Steel to timber or steel to rubber	0.3
Steel to steel (dry)	0.1
Steel to Steel (wet)	0.0

The larger the coefficient of friction of the contact surfaces, the larger will be the force required to slide the item of cargo.

The friction coefficient is independent of the weight of the object pressing down on it.

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- The CSS (Code of Safe Practice for Cargo Stowage and Securing) gives 2 methods of assessing the efficiency of securing arrangements of non-standardized cargo: the rule of thumb method or the advanced calculation method.
- Rule of thumb method: The total of the MSL values of the securing devices on each side of the unit of cargo (port as well as starboard) should be equal to the weight of the unit.
- Whenever using this method, there should be sufficient fore-and-aft lashings as well as the required number leading athwartships.
- A tried and tested formula is to have 40% of the lashings' strength to port, 40% to starboard, with 10% leading forward and 10% leading aft.

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- With a uniformly applied load, the front end walls of standard swap-bodies and containers must be able to withstand forces of 0.4 times the payload.
- With a uniformly applied load, the side walls of standard swap-bodies must be able to withstand forces of 0.3 times the payload.
- With a uniformly applied load, the side walls of standard containers or of swap-bodies with a CSC plate which are used in maritime transport must be able to withstand forces of 0.6 times the payload.
- Recommendations for loading, blocking and bracing of freight in closed trailers and containers are contained in **Circular 43-D** published by the **Association of American Railroads (AAR)** Damage prevention and Freight Claim Committee.
- For ocean carriage, recommendations are contained in the **IMO CSS Code**.

CARGO SECURING

EXCERPT FROM AAR CIRCULAR 43-D

- *Trailer/container doors may not be used to secure loads containing hazardous materials.*
- The doors of the vehicle, meeting AAR Trailer Specification M-931 and AAR Container Specification M-930, can be relied on to secure *non-hazardous materials lading under the following conditions:*
 1. The load consists of multi-unit lading such as boxes of food-stuff, tissue or soft paper products, furniture, appliances, etc., not exceeding 40,000 lbs., covering a minimum of 60% of the door area and evenly distributed throughout the vehicle.
 2. Lading must be loaded tightly lengthwise and crosswise and flush to the rear doors of the vehicle allowing no room for movement. If any void exists, fill void space with recommended dunnage.
 3. The doors must fit squarely, the hinges must be tight, and locking bars must be in good condition and function properly.

HOW TO MINIMIZE THE RISK OF CARGO DAMAGE WHILE IN TRANSIT

- The cargo must be properly stowed, secured and protected from the elements where required.
- Use an experienced 3rd party contractor to secure the cargo (it is better to have a written agreement or contract drawn up) especially when it is a high-value cargo, special cargo, over-dimensional cargo or heavy lift.
- Provide the contractor with all the relevant information about the cargo (Weight, Centre of gravity, lifting and lashing points, special handling requirements etc.)
- Use only reputable freight forwarders and carriers and ensure that any special agreements do not waive or limit any rights to claim for damages.
- Use tracking devices, impact recorders, tilt recorders, temperature recorders etc. to establish where an incident occurred that could have caused damage to the cargo.

IN THE EVENT OF CARGO DAMAGE WHAT ACTIONS TO TAKE

- Inform your insurer of any changes in the Risk.
- Monitor the progress of the transit, obtain interchange receipts and endorse the POD with exceptions when damages are noted on delivery.
- Report the damage to your broker or insurer.
- Place all carriers and bailees on notice if any cargo damage is noted.
- Take reasonable measures to minimize the loss.

QUESTIONS ???

