Chassis rail strength

All trucks and trailers carry loads, which stress chassis rails. If the stress is high (> 50 per cent of yield strength) the chassis rails will eventually crack. Chassis rails and the sub-frames that sit on top of them need to have a decent Factor of Safety (FoS) so stresses that occur in service when the truck is bumping along do not reach the Yield level and fatigue cracking does not occur. Experience shows that chassis rails, cross members and sub-frames should have a design FoS of 3 or more for hard working trucks and trailers.

First some basics. Metals deform when the stress levels reach tensile Yield Strength, and will break when stresses reach the Ultimate Tensile Strength. Chassis rails on heavy-duty trucks are usually made from mid-strength alloy steel, typically with Yield Strength of 500 - 750 MPa. Sub-frames and attachment brackets are more likely to be made from mild steel (yield = 250 MPa) or a low-strength alloy (yield = 350 MPa) so the material strength is probably about half that of the chassis rails.

All rigid trucks have a body attached to the chassis rails. The body, such as a tray, concrete pump or tank is attached to a sub-frame that in turn is attached to the chassis rails. The body will rarely fit neatly directly onto the chassis rails and so the sub-frame is needed to make a durable connection that is 'tailored' to the shapes involved. The sub-frame should also have adequate strength to spread the load so that the chassis rails do not experience point loads. Prime movers also experience point loads where the fifth wheel sits onto the chassis-rail angles.

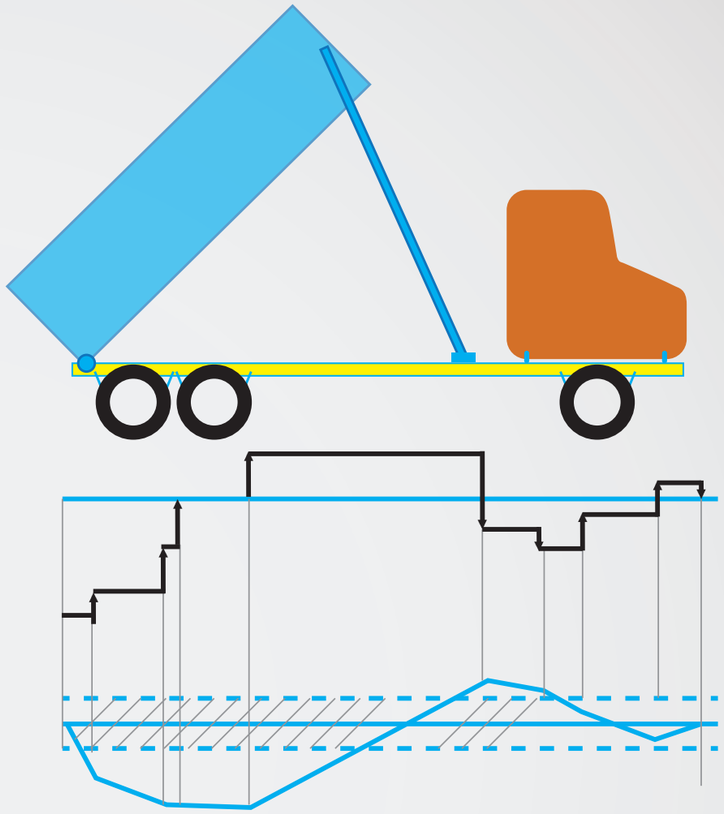
Image 1 shows a location that experienced significant point loads during tipping. Chassis rail strengthening was needed for about one metre on either side of the lifting bracket. The change of strength at the end of the cylinder attachment bracket was too great.

The strength of the chassis rail and sub-frame can be approximately calculated using the approach shown in Diagram 1. The load and support forces are estimated and drawn on the load diagram. Then the Bending Moment diagram is calculated. Finally the rail stress at any location is calculated by dividing the Bending Moment by the chassis rail Section Modulus. The rail Section Modulus is an engineering factor that depends upon the geometry of the chassis rails including any insert (see VSB 6 Section H). Locations with high Bending Moment (where high stresses occur) will probably needs rail inserts (cross hatching).

The Bending Moment diagram is generated by calculating the net area (allowing for positive and negative areas) under the load diagram from the left side to the point of interest.

Peter Hart
Chairman, ARTSA

Image 1: Chassis rail cracking near to a lifting cylinder attachment mid-chassis on a tilting compactor



Bending Moment diagram

GOOD PRACTICE GUIDELINES

- Gradual changes of strength along the vehicle are better than abrupt changes. For example, chassis rail inserts should have tapered ends.
- Chassis rail inserts or strengthening plates should not end at, or close to, a cross-member.
- Point loads kill chassis rails. Rail strengthening is required, for example, at the lifting cross-member of tip-trucks and at the rear pivot mounts.
- Flimsy sub-frames underneath heavy bodies may be inadequate because the load cannot be adequately spread.
- Tip-trucks should have a full rail insert from front to back. If not, a strong sub-frame and local inserts will be needed.
- Welding of high-tensile steel chassis rails, such as when a chassis extension is done, will weaken them.
- A chassis rail insert must be installed when a chassis rail extension has occurred. The insert should extend at least 500 mm beyond the join line.
- A chassis rail insert is needed through an entire axle group. If an axle is added, a new longer insert should be installed.
- Holes in rails should be well away from the flanges. As a guide holes should be located more than 20 per cent of the rail height away from the flanges.
- No more than two holes through the chassis rails should be on a vertical line.
- Holes produce stress risers. The fewer holes in the highly stressed locations the better.
- Cross members add ladder stiffness to the chassis rails. Cross members made from folded up 3mm mild steel will not be strong enough.
- Flexible mounts should be used on the front of a strong sub-frame. Otherwise excessive twisting of the chassis rails between the sub-frame and the cabin mounts can occur.
- Bolts used to attach a structural member to a chassis rail should be at least SAE grade 5 or metric grade 8.8.
- Section H in Vehicle Standards Bulletin 6, HV Modification Code of Practice, provides good information.
- Body builders should calculate rail stress as an essential part of the design.

MICHAEL KILGARIFF

Strengthening our supply chains must be new government's priority

As you read this, the election result will likely already be known: either three more years of Coalition rule, a surprise win by Labor or a hung parliament.

It is pleasing that infrastructure was a centrepiece of the election campaign. Both the Government and Opposition reaffirmed funding for a range of projects to improve the movement of freight, such as the Port Botany rail link, inland rail and a number of important road projects in our major cities to address rising congestion.

The next three years will be critical to deliver on these election commitments and to progress a number of key reforms to improve the efficiency of our national supply chains.

In light of this, during the election campaign ALC released our six point plan to improve Australia's supply chains, 'Getting the Supply Chain Right'. ALC is encouraging the incoming government to make supply chain efficiency and safety a priority by acting on six key areas of reform.

These are:

- Getting the Structure Right
- Getting Planning Right
- Getting Rail Right
- Getting Road Pricing Right
- Getting Road Safety Right
- Getting Technology Right

Chief among these is ensuring Infrastructure Australia has the resources necessary to develop a comprehensive National Freight and Supply Chain Strategy to underpin future actions and reforms across the logistics industry.

Without a Strategy that accurately identifies our major freight generating points, their key freight routes, and their efficient connections to markets or places of export, we are effectively flying blind.

Infrastructure Australia needs to guide the development of a long-term plan that incorporates the various, interlinked components of our national and international supply chains.

This Strategy should also assess the institutional framework supporting these freight networks, and recommend reforms and investments that will move the efficient movement of freight.

As a first step, ALC wants the incoming government to appropriately fund Infrastructure Australia to review the National Land Freight Strategy so it may 'audit' how well jurisdictions have implemented the existing agreement.

Another area where federal leadership is required is the establishment of effective corridor protection mechanisms to ensure the timely preservation of freight corridors and strategic sites for future infrastructure. This may, for example, involve the provision of incentive payments to encourage the states and territories to ensure they have appropriate planning regimes in place to protect key freight corridors for the long term.

Road safety is another area of concern. Despite some encouraging trends, official government figures show that there needs to be a greater effort to improve heavy vehicle safety and compliance.

The latest heavy vehicle fatality report from the Bureau of Infrastructure, Transport and Regional Economics shows fatal crashes involving articulated trucks decreased by an average of 4.4 per cent per year over the three years to March 2016.

'Getting the Supply Chain Right' proposes a number of measures to continue this downward trend.

The first of these is mandating the uptake of heavy vehicle technology that can capture data (such as speeding and fatigue) for compliance purposes to make our roads safer.

The second is making road operators meet a national operating standard that requires a heavy vehicle operator to have in place both the financial capacity to operate a business and a uniform safety management system to ensure that Australia's roads remain safe.

The third is ensuring funds allocated to the National Heavy Vehicle Regulator from the decommissioned Road Safety Remuneration Tribunal remain with the NHVR.

Industry simply cannot afford the re-establishment of the Road Safety Remuneration Tribunal, or a body similar to it, which research has shown delivers no safety benefits.

ALC will continue to advocate that improving safety in the heavy vehicle industry must be based on achieving greater compliance and enforcement of Chain of Responsibility provisions within the Heavy Vehicle National Law.

ALC looks forward to working with the new government on these six areas, which are critical to ensuring Australia has appropriate national regulation and infrastructure in place to meet Australia's future freight challenges.

Michael Kilgariff
Managing Director
Australian Logistics Council (ALC)