Suspension considerations

Concessional mass limits apply for axle groups that have Road Friendly Suspensions (RFS), but what makes a suspension "road friendly"?

The definition of road friendliness was first made in the European Union Directive 96/53/EC in 1996, as a performance standard that does not mandate any particular suspension type. Based on it, the suspension is tested when installed on a vehicle with the axle group loaded to its rating. The axle is lifted at least 80cm off the ground and then dropped, or driven off an 80cm step, and the resulting vehicle oscillations are measured (*see drawing on this page*).

A Road Friendly Suspension will meet four distinct performance aspects when tested.

The first is static load sharing to ensure there is no greater than five per cent weight difference between any two axles in a group.

Load sharing avoids one axle having a relatively high weight – the lower the weight on the road, the less the road damage.

Another performance indicator is laden natural frequency, whereby the loaded suspension oscillation can be no more than 2 Hz.

The lower the frequency, the further apart the load peaks on the road arising from a road bump that stimulates oscillations. Load peaks should be far apart to avoid road stress due to multiple oscillation peaks.

Thirdly, the damping rate must be no less than 20 per cent (D=0.2) of the 'critical damping' level, for which no overshoot occurs.

The higher the damping level, the lower the second peak force is when compared to the first peak. However, the higher the damping, the more sluggish the suspension response. If the damping rate is above D=0.5 then the response will feel 'floaty'.

Finally, the damping due to friction (in the springs, airbags and tyres) must be no more than half of the total damping, meaning that shock absorbers are needed to do at least half the damping work.

Most air bag suspensions will qualify as road friendly and most mechanical (spring) suspensions do not. Invariably, RFS will have shock absorbers, the condition of which will determine whether the suspension will remain effective.

The tyres are also part of the suspension and changes to their size will affect the certification status of an RFS. To maintain load sharing between axles, the tyre pressures should be regularly checked and about equal.

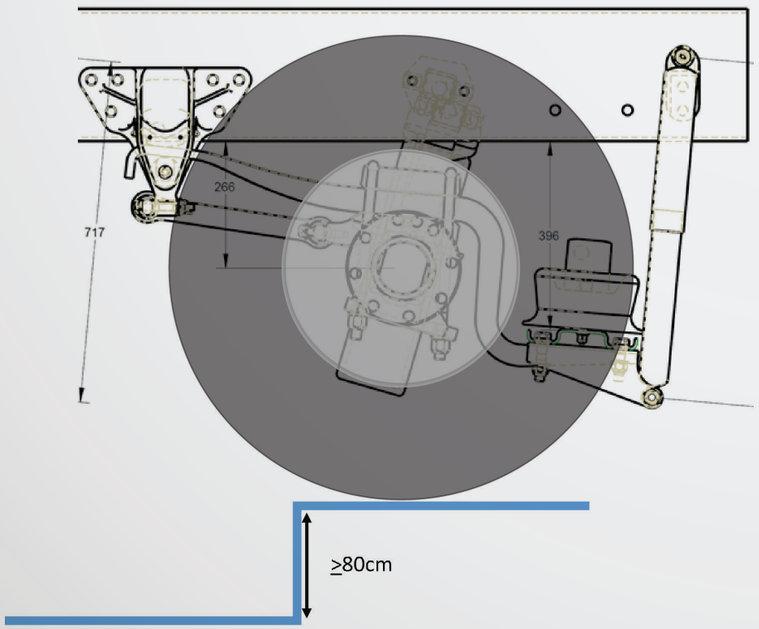
Is there a benefit for the truck dynamics in having RFS? Probably, because it will have a relatively soft ride when compared to very stiff and therefore road unfriendly suspensions. Suspensions at the rear of a motor vehicle will be installed on a strong section of the chassis rail ladder and there will usually be a rail insert.

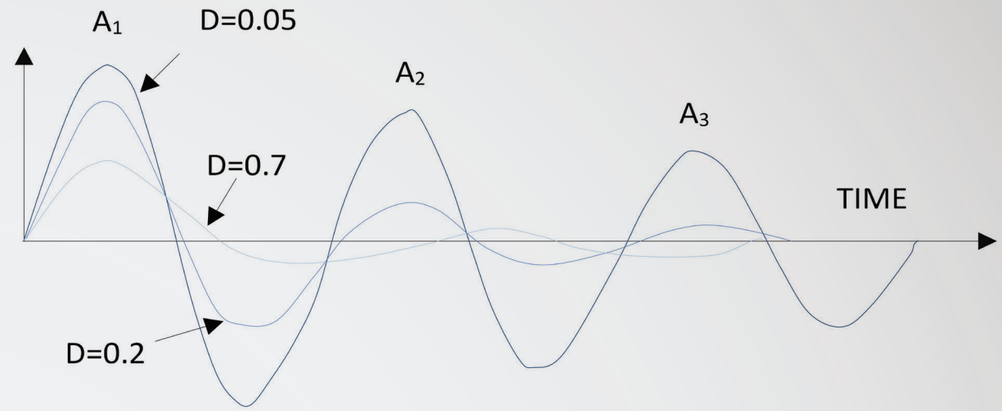
Consequently, the forces that the suspension exerts onto the chassis rails can be easily absorbed. A stiff chassis rail ladder, such as achieved with a full chassis rail insert, will provide a stiff platform for the suspension to work against and will assist the vehicle to follow the road.

Road friendliness is unrelated to roll-stiffness. High roll stiffness will improve the dynamic performance of the vehicle by reducing the twisting oscillations.

For air suspensions, roll stiffness is predominately provided by anti-roll bars, axle beam strength and trailing arm strength. Roll stiffness is not relevant to the road friendly test performance.

In summary, RFS are likely to provide a relatively soft cabin ride but chassis ladder stiffness and roll-stiffness are important factors that are independent of road friendliness.





Damped variation of chassis height above ground around its normal position: The form of the chassis rail position above the ground as the result of running over the step, as shown in Vehicle Standards Bulletin No. 11. D is the damping co-efficient. If D=1, then the suspension has no overshoot and is sluggish.

	General Access Limits	Concessional Mass Limits	Higher Mass Limits
Conditions:	The load on a single axles can be 6.5t with FUPs and Cabin strength certification	1 Mass management in NHVAS	1 RFS. 2 Mass management in NHVAS
Axle Group:			
Single steer axle with 2 tyres	6.5 t	6.5 t[1]	6.5 t[1]
Twin steer axle group with single tyres	10.0 t	10.5 t[5]	10.0 t[2]
Single axle with 4 tyres	9.0 t	9.45 t[5]	10.0 t
Tandem group with four tyres	11.0 t	11.5[4]	-
Tandem group with 6 tyres	13.0 t[3]	13.5 t	14 t
Tandem group with 8 tyres	16.5 t[3]	17.0 t	17 t
Tri-axle group with 6 tyres	15.0 t[3]	15.5 t[4]	-
Tri-axle group with 12 tyres	20.0 t	21.0 t	22.5 t
Quad-axle groups with 8 tyres	15.0 t[4]	15.75 t	-
Quad-axle groups with 16 tyres	20.0 t	21.0 t[5]	-

There is controversy about the speed of response of air bag suspensions to changed road conditions. Typically, levelling valves will have a five second response time. That is, the air bags will take more than five seconds to pump up or deflate when there is a change of road profile. Manufacturers deliberately avoid allowing having the air bags change height fast because the vehicle attitude might be wrong for the second bend in an S-bend. Some operators argue that fast air bag inflation can improve roll stability during turns. For example, some concrete agitator operators install an air bag control system that has fast acting levelling valves and large diameter air pipes. Such systems may have merit in specialist applications but they may increase roll over risk in general applications.

For reference, the mass limits that are applied by the National Heavy Vehicle Regulator are shown in the table on the left. Higher mass limits are available if the rear has RFS.

Peter Hart
Chairman, ARTSA

[1] With FUPS and meeting ECE Regulation 29 Cabin Strength. Without this requirement the axle mass limit reduces to 6.0 t.
[2] Based on non-load sharing suspension system. Load sharing suspension systems have greater load limits (11.0 t). Refer to NHVR GML Fact Sheet for more information.
[3] Based on most standard vehicles. Different vehicle types may have other mass limits. Refer to NHVR GML Fact Sheet for more information.
[4] Based on tyre section width of less than 375mm. Larger section width tyres have greater mass limits. Refer to NHVR GML Fact Sheet for more information.
[5] Subject to vehicle Gross Combination Mass and operating state. Refer to NHVR CML Fact Sheet for more information.