Front Outswing of Heavy Vehicles

Prepared for

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Task Force on Vehicle Weights and Dimensions Policy

by

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1. INTRODUCTION

Vehicle weight and dimension regulations specify a maximum overall length for vehicles and combinations of vehicles. These are clear and absolute dimensional limits, and some classes of vehicle are designed and developed to use the limit to the full. Then, as innovation evolves, equipment is found desirable that would not fit within the allowable length on some vehicles of customary configuration. In some instances, such innovative devices arise are considered to have significant safety or other benefits, so are granted an exemption from the absolute length limit. Examples from the Ontario Highway Traffic Act are [1]:

- A liquid-filled or energy absorbing bumper on a bus is excluded from measurement of the length of the bus; and
- That part of a mirror extending beyond the front of a vehicle is excluded from measurement of the length of the vehicle.

The issue of moose bumpers has now arisen. A moose bumper is a substantial structure fitted to the front of a truck or tractor and designed to protect the front of the vehicle, especially the radiator, in the event the vehicle collides with a large and heavy animal, like a moose. A similar device intended to deflect kangaroos in Australia is known as a roo bar, and is shown in Figure 1.

Figure 1: Roo Bar

It is a principle of configuration of legal vehicles that they should be able to operate entirely within their own space, though typically an exemption may be made for a large

vehicle that must make a turn that requires it to use the space of other traffic, provided the turn is made in a prudent and safe manner and respecting other traffic. The national Memorandum of Understanding on Vehicle Weights and Dimensions ("the national M.o.U.") therefore has internal dimensional limits to control the space taken by a turning vehicle [2]:

- The swing radius of a semitrailer is limited to control front outswing of the semitrailer in a turn at an intersection; and
- The effective rear overhang of trucks, tractors, semitrailers and pony trailers is limited to control rear outswing.

The front overhang of trucks and tractors has not been restricted, yet the front overhang does extend outside the path of a vehicle in a turn, making front outswing. The addition of a moose bumper will increase the front overhang of a vehicle, so will also increase front outswing.

This paper discusses the extent of front overhang, the front outswing it causes, and the impact a moose bumper will have on front overhang and front outswing.

2. ANALYSIS

2.1 Dimensions of Vehicles

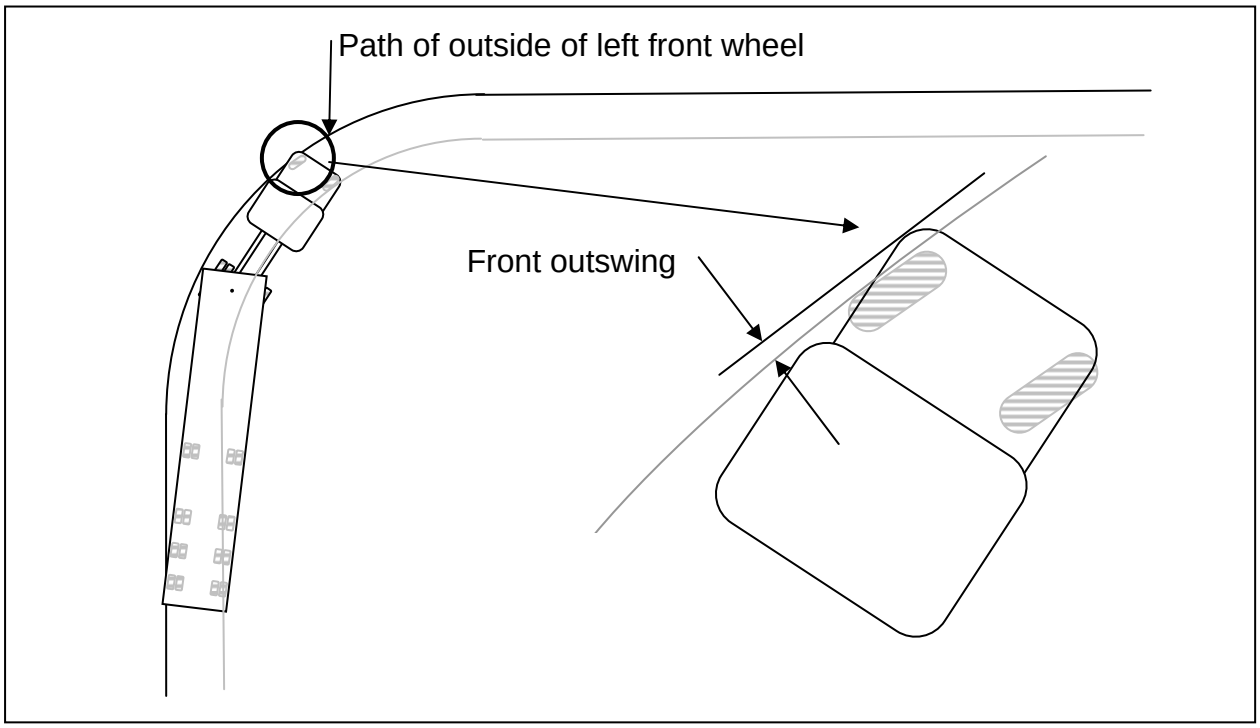
Tandem drive tractors typically have a wheelbase from about 4.06 to 6.20 m (160 to 244 in), with the upper limit derived from the national M.o.U. [2]. There is no restriction on the wheelbase of straight trucks, which may have a wheelbase up to about 7.62 m (300 in).

The front overhang of trucks and tractors, or front axle setback, as the vehicle emerges from the factory ranges from about 0.71 to 1.68 m (28 to 66 in), depending on the make and model and application [3]. Some vehicles may have equipment such as a winch or other device mounted on the front, which can increase the front overhang. However, such extensions are generally added by the final stage vehicle manufacturer, and are not a part of the chassis as originally manufactured.

2.2 Front Outswing in a Low-speed Right-hand Turn

Front outswing occurs in a low-speed right-hand turn made at an intersection as illustrated in Figure 2. Such turns are typically analysed by considering that the vehicle makes a turn with a specified radius at the outer face of the left front wheel. A radius of

Figure 2: Front Outswing in a Low-speed Right-hand Turn



14.00 m (46 ft) is normally used for assessment of the turning capability of vehicles, though many vehicles with a short or moderate wheelbase can make a turn with a radius in the range 11 to 12 m (36 ft to 39 ft 4 in).

Maximum front outswing occurs at the point where the front wheel has completed the turn, and the driver is straightening out.

Table 1 shows the maximum front outswing of a vehicle with specified wheelbase and front overhang in a turn with a specified radius. Front outswing increases as front overhang increase, increases as vehicle wheelbase increases, and increases as turn radius decreases. The results in Table 1 assume that full offtracking has developed in the turn, and that the front corner of the vehicle has square corners. The vehicles are close to full offtracking for the range of turn radius and vehicle wheelbase considered here. Values of front outswing in Table 1 will be reduced by approximately 0.4 times the corner radius when the vehicle has a distinct radius on the front corner, and by the amount off narrowing, to the extent that the measurement across the front of the vehicle, excluding any corner radius, may be narrower than the front axle track width.

Table 1: Front Outswing

Turn Radius (m)	Wheelbase (m)	Front Overhang (m)		
		0.76	1.22	1.68
14.0	4.0	0.22	0.35	0.48
13.0	4.0	0.23	0.38	0.52
12.0	4.0	0.25	0.41	0.56
11.0	4.0	0.28	0.44	0.61
14.0	5.1	0.28	0.44	0.61
13.0	5.1	0.30	0.48	0.66
12.0	5.1	0.32	0.52	0.71
11.0	5.1	0.35	0.57	0.78
14.0	6.2	0.34	0.54	0.74
13.0	6.2	0.36	0.58	0.80
12.0	6.2	0.39	0.63	0.87
11.0	6.2	0.43	0.69	0.95

2.3 Discussion

Typical heavy duty trucks and tractors generally have a front overhang up to about 1.37 m (52 in). Vehicles with a wheelbase towards the upper end of the range considered here may not be able to make the tighter turns. From Table 1, the maximum

front outswing likely for this class of vehicle would be in the range 0.50 to 0.61 m (20 to 24 in).

Most trucks with a front overhang beyond 1.37 m (52 in) would appear to be straight trucks that would mostly be used for local pickup and delivery, so would primarily be used in urban areas, where tight turns would often be required, and front outswing might be up to 0.91 m (36 in). However, such vehicles would be unlikely to require a moose bumper.

If a moose bumper would be similar to the roo bar shown in Figure 1, it would add about 0.25 m (10 in) or so to the front overhang of the vehicle. Thus, in most cases, a moose bumper fitted to a typical truck or tractor with a front overhang up to 1.32 m (52 in) would have no greater front overhang than a truck manufactured with the largest front overhang, and would add about 0.25 m (10 in) to the front outswing.

Rear outswing is a clear hazard, as the rear of a semitrailer may swing into an adjacent lane as a vehicle makes a turn without apparent warning to a vehicle travelling in that lane. The potential collision may have serious consequences if the vehicle in the adjacent lane is travelling at the prevailing speed, such as when it is crossing directly across the road into which the truck is turning. Rear outswing is a clear safety hazard for the driver of a tractor-semitrailer, because the driver cannot see the rear corner of a semitrailer with many types of body style.

The issue of front outswing is less clear. The front left corner of the turning vehicle may intrude into the space of other vehicles in the road into which the truck is turning if it is a two-lane two-way road, or the truck is turning into the left-most lane of that road. A vehicle stopped in the lane to the left of that into which the vehicle is turning may restrict the ability of the truck to make the turn, and the truck driver may have to wait for the other vehicle to move before it can complete the turn. This will result in a delay to other traffic. However, in all instances, the truck driver can see the front left corner of the truck, and drivers of other vehicles travelling in the opposite direction to that of the truck can also see that corner. The truck driver, and the driver of any vehicle that will potentially be in conflict with the truck due to front outswing, will be able to see each other's vehicle. In most cases, common sense will prevail, and one driver or other will give way momentarily, and conflict will be avoided.

3. CONCLUSIONS

Typical heavy duty trucks and tractors generally have a front overhang up to about 1.37 m (52 in), and would have front outswing in the range 0.50 to 0.61 m (20 to 24 in). A moose bumper would add about 0.25 m (10 in) or so to the front overhang of the vehicle, and would add about 0.25 m (10 in) to the front outswing.

Most trucks with a front overhang beyond 1.37 m (52 in) would appear to be straight trucks that would mostly be used for local pickup and delivery, so would primarily be used in urban areas, where tight turns would often be required. These vehicles would have front outswing up to about 0.91 m (36 in). However, such vehicles would be unlikely to require a moose bumper.

Thus, in most cases, a moose bumper fitted to a typical truck or tractor with a front overhang up to 1.32 m (52 in) would have no greater front overhang than a truck manufactured with the largest front overhang.

Front outswing and rear outswing may cause a vehicle to intrude into the space of other traffic. The rear corner of a semitrailer is often invisible to a truck driver, who may have little idea how it may be affecting other traffic. However, the truck driver and the drivers of other vehicles can see the front corner of the truck, and can track any front outswing. The safety concerns that apply to rear outswing may not be the same for front outswing.

A limit on front overhang, or front outswing, may restrict the options of final stage manufacturers who add equipment to the front bumper when they complete a vehicle.

REFERENCES

[1] Highway Traffic Act, Government of Ontario, http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90h08_e.htm.

[2] "Memorandum of Understanding Respecting a Federal-Provincial-Territorial Agreement on Vehicle Weights and Dimensions", Council of Ministers Responsible for Transportation and Highway Safety, June 1997, http://www.comt.ca/english/programs/trucking/MOU99.PDF.

[3] "Diesel Truck Index", Truck Index Inc, Santa Ana, California, 2007.