Department of Motor Transport
Chief Engineer's Branch

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A REVIEW OF DIMENSION LIMITS

APPLYING TO TRAILERS & SEMI-TRAILERS

COMPILED:

NOT FOR PUBLICATION

A REVIEW OF DIMENSION LIMITS APPLYING TO TRAILERS AND SEMI-TRAILERS

1 INTRODUCTION

Recently the New South Wales dimension limits for trailers and semi-trailers were reviewed as a result of the recommendations made by the NAASRA Study Team (Reference 1).

During this review existing N.S.W. Motor Traffic Regulations were compared with National Draft Regulations (Reference 2) as endorsed by the Australian Transport Advisory Council. Some items of the National Draft Regulations were found to be unsuitable for New South Wales. The main problem was that some limits contained in the Draft Regulations were more restrictive than corresponding limits already in the Motor Traffic Regulations. Adoption of the Draft Regulations would have required special arrangements in respect of existing vehicles and this was not acceptable because it is difficult to enforce a dual scale of dimension limits which depend on a vehicle's age. Therefore the New South Wales Government decided to retain the former dimension limits, where they exceeded the limits recommended by the NAASRA Study. There remain some aspects of the New South Wales Motor Traffic Regulations and National Draft Regulations which require review and these notes deal with these items.

2 TRAILER DRAWBAR LENGTH

2.1 Motor Traffic Regulations

The New South Wales Motor Traffic Regulations provide that, where the length of a trailer drawbar exceeds

5m, the overall length of a vehicle/trailer combination must not exceed 15.3 m. Otherwise the combination length may be 16.8 m. This is a long-standing requirement and is identical to Draft Regulation 1101 (which is superseded by DR1101A). It appears that the requirement was originally introduced to allow an increased length for combinations which include a dog-trailer (a trailer with a steerable front axle group which usually has a drawbar less than 5 m in length). The short drawbar provides improved swept path characteristics thereby justifying some increase in combination length. The Department is now being asked to allow a combined length of 16.8 m for all trailers irrespective of drawbar length.

2.2 Draft Regulations

The National Draft Regulations (DR1101A) provide that the length of a vehicle/trailer combination must not exceed 16.8 m and there is no restriction for trailers with drawbars exceeding 5 m in length because DR1101A limits the length of any trailer drawbar to 5 m. (This unconditional 5 m limit was not applied in N.S.W. because it would have limited the overall length of single-axle-group trailers to 8.2 m; Rear overhang of 3.2 m plus drawbar length of 5 m. These trailers would otherwise be permitted an overall length of 11 m.) It could be argued, from the definition of drawbar length, that this restriction is intended to apply only to trailers with two groups of axles (dog-trailers). However, a strict legal interpretation of the definition would not support this. If trailers with only one axle group are exempt from the restrictions on drawbar length then this should have been clearly stated in the Draft Regulations.

2.3 Operational Factors

There are two factors which should be considered in any review of restrictions on trailer drawbar length:

a) the effect of drawbar length on vehicle swept path characteristics. If trailers with only one group of axles are exempted from the limit on drawbar length will this result in an unacceptable deterioration in the turning ability of combinations with these trailers?

b) the effect of drawbar length on towing stability. Will longer trailer drawbars result in combinations which weave all over the road or suffer from other instabilities?

A detailed examination of these two factors follows.

2.4 Swept Paths

2.4.1 The simulation, by computer, of turning vehicles is now established as an accurate and acceptable technique. (reference 6). A computer routine has been developed for use in evaluating the effects of various dimension limits and also as an aid in the design of Motor Registries (to ensure that turning vehicles have adequate space etc).

2.4.2 Computer simulations of turning vehicle combinations were conducted to determine the effect of drawbar length on vehicle swept path characteristics. As expected, an increase in drawbar length produced an increased in the maximum width of the swept path. Figure 1 illustrates the effect of increasing the drawbar length from 5 m to 8.3m, all other factors being equal. (Trailer length was 11 m, the maximum allowable, and the hauling vehicle was 5.8 m long resulting in a combined length of 16.8 m. In the absence of the 5 m limit, drawbar length is effectively limited to 8.3 m due to the limit on the distance from the foremost extremity of rear overhang to the foremost point on the trailer).

2.4.3 The "worst case" trailer (with an 8.3 m drawbar) was compared, by computer, with an articulated vehicle of maximum dimensions to detemine if the trailer combination had an unreasonable swept path. Figure 2 illustrates that the swept path of the articulated vehicle is much worse than that of the trailer combination and therefore restrictions on trailer drawbar length should not be based on swept path considerations alone.

2.5 Combination Stability

Information on stability is scarce but that available (references 3, 4 and 5) suggests that a long trailer drawbar contributes to combination stability. Indeed, the current NAASRA study of road trains (reference 5) recommends a minimum drawbar length of 3 m for dolly trailers (which convert a semi-trailer into a free-standing trailer with two groups of axles) to aid towing stability. The study also points out that there is no necessity for trailers with two groups of axles to have drawbar lengths in excess of 5 m.

2.6 Conclusions

It is concluded that there is no reason to restrict the length of the drawbar on trailers with only one axle group, other than the universal restriction of 8.3 m on the distance from the front of the trailer to the foremost extremity of rear overhang.

2.7 Recommended amendment to the Draft Regulations

It would appear that some rationalisation of dimension limits is warranted. It is recommended that DR1101A (3) (b) be amended to read:

"(b) The maximum length of the drawbar of any trailer with more than one group of axles shall be 5 m."

(Note: It might be noted that, even with a drawbar in excess of 5 m, a dog-trailer would still have a better swept path than a similar sized single axle-group trailer combination. Since operational considerations discourage the use of long drawbars on dog-trailers consideration could be given to deleting the 5 m limit altogether).

3 TRAILER REAR OVERHANG

3.1 Under both the New South Wales Motor Traffic Regulations and the National Draft Regulations, the rear overhang of any trailer is limited to 3.2 m (or 3.7 m if the length of the trailer exceeds 9.5 m). This is a long-standing requirement and the recent regulation amendments, based on NAASRA recommendations, have not altered it. However the publicity over these amendments has brought the limit on rear overhang to the attention of caravan manufacturers. Some

of the larger caravans exceed the limit on rear overhang, however it appears that the limit was not enforced in some jurisdictions. The manufacturers are concerned that the limit will now be enforced.

3.2 Swept Paths

Figure 3 shows the effect of rear overhang on the swing out of the rear of the trailer at the start of a turn. The swing-out of the rear of the trailer with excessive rear overhang is noticeably greater than that of the legal trailer. There is no other vehicle combination with a swing out that is worse than the combination with the illegal trailer and it is considered that there are no grounds for relaxing the current limit on trailer rear overhang. This is reinforced by the observation that the driver of the combination would not be aware of the extent of the swing out of the tail of the trailer at the start of a turn, because the tail of the trailer would not be visible in the rear view mirrors. For a sharp left hand turn it is quite possible for the tail of the trailer to swing across to the wrong side of the road, thereby presenting a hazard to oncoming or overtaking vehicles.

3.3 Recommendation

It is strongly recommended that there be no relaxation of current limits on the rear overhang of trailers. An interim arrangement might be appropriate to permit trailers currently being manufactured to be accepted for registration even if they have excessive rear overhang. However this provision should apply only to those trailer models which were in production prior to introduction of the new dimension limits.

4 SEMI - TRAILER LENGTH

4.1 The NAASRA study recommended a limit of 12.5 m on the overall length of the semi-trailer portion of an articulated vehicle and further recommended that, if the semi-trailer had a round front, then this should not be included in the dimension limit. The National Draft Regulations and New South Wales Motor Traffic Regulations were amended in accordance with these recommendations.

4.2 Swept Paths

Enforcement problems have arisen over the measure-

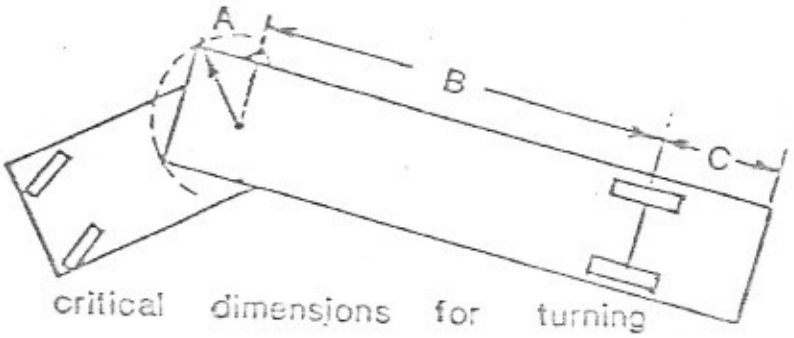
ment of this dimension limit and therefore an investigation was carried out on the rationale behind the limit. It was found that the limit is, in fact, redundant and can be deleted with little or no effect on the operation of large articulated vehicles. This is because the turning space requirements of an articulated vehicle are affected by three semi-trailer dimensions, namely:-

a) the radial distance from the kingpin to the trayfront - dimension A (limited by DR1101A (2)(d)).

b) the distance from the kingpin to the centre of the rear axle group - dimension B (limited by DR1101 (2)(c)).

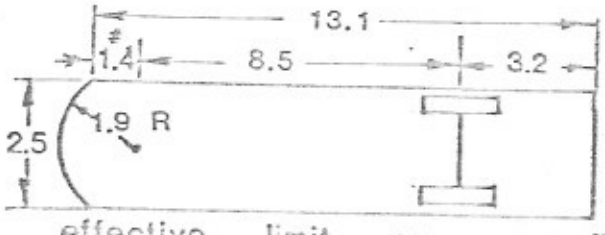
c) the rear overhang - dimension C (limited by DR1102 (1)).

Figure 4 illustrates the affects of these limits on swept paths. New South Wales Regulations contain these limits.



critical dimensions for turning

The 12.5 m limit on semi-trailer length does not have a direct effect on the turning space requirements of articulated vehicles. Its effect is that all three critical dimensions cannot be maximised on the one vehicle (if all three were maximised the length of the semi-trailer would be 13.1 m as illustrated).



effective limit on overall length

$\sqrt{(1.9)^2-(2.5/2)^2} = 1.4$

The usual dimension that the manufacturer would elect to reduce is the rear overhang because this would improve load distribution. Assuming this is the case then

it can be shown (Figure 5) that a 600 mm reduction in rear overhang (13.1 m - 12.5 m) has no appreciable effect on the turning space requirements of the vehicle (other than a slight decrease in rear swing-out) and therefore there are grounds for deleting the 12.5 m limit on semi-trailer length. This approach would solve the current problems with enforcing this limit. Note that no change is proposed to the 16 m limit on combination length for these vehicles.

4.3 Recommendation

It is recommended that sub-paragraph (b) of DR1101A (2) be deleted.

5 CONCLUSIONS

5.1 The limit on drawbar length should not apply to any trailer with one group of axles. Consideration should be given to the necessity for such a limit on any other trailer.

5.2 The limit on rear overhang of trailers should be retained.

5.3 The limit on the length of the semi-trailer portion of articulated vehicles is redundant and should be deleted.

REFERENCES

1. "New South Wales Motor Traffic Act and Regulations", New South Wales Government.
2. "Draft Regulations defining vehicle construction." Commonwealth Department of Transport.
3. "The Mathematical Theory of the Snaking of Two-Wheeled Trailers, with Practical Rules and Devices of Preventing Snaking." D. Williams, Proceedings of Inst. Mechanical Engineers; Automobile Division 1952 - 52.
4. "Tractor and Trailer Handling." F. Jindra. Automobile Engineer, February 1965.
5. "A Study of the Operation of Large Combination Vehicles (Road Trains)." NAASRA Working Party report 1.
6. "Determination of Swept Paths of Vehicles". R.G. Vaughan and A.G. Sims. Report 3/70, Traffic Accident Research Unit. New South Wales Department of Motor Transport.

EFFECT OF DRAWBAR LENGTH ON SWEPT PATH

12,5 m RADIUS (DRAFT REG. 114)

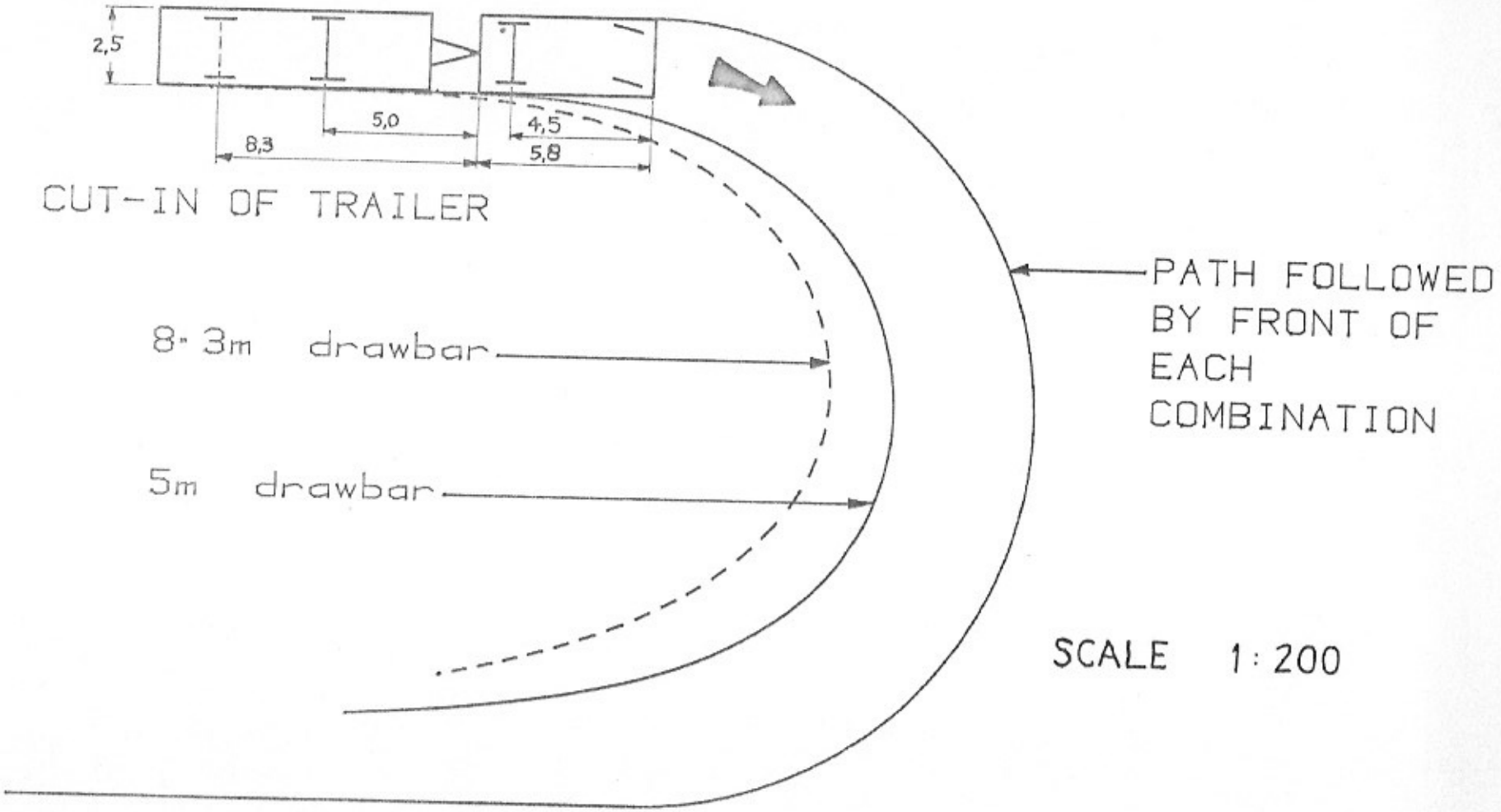


FIGURE 1

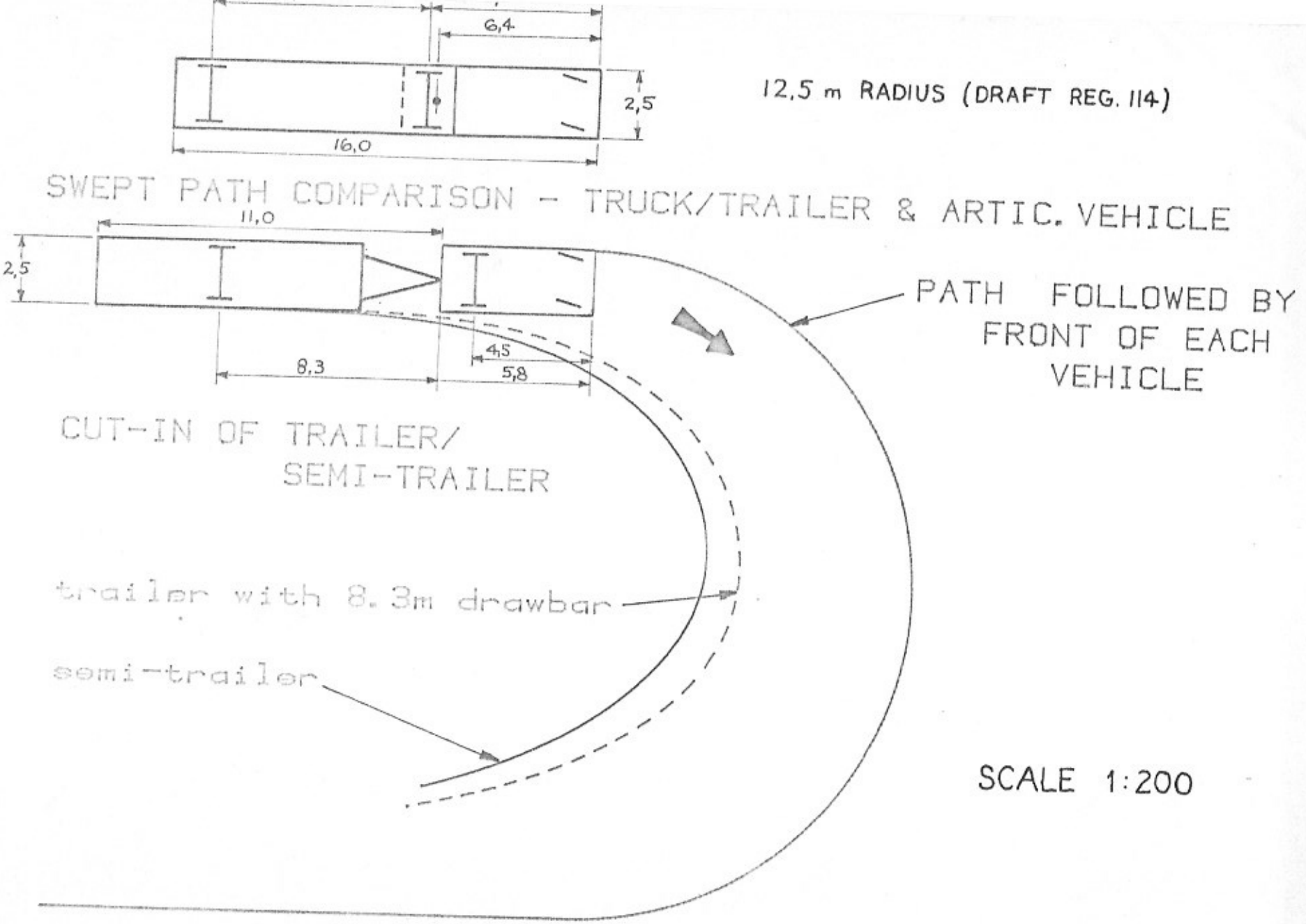
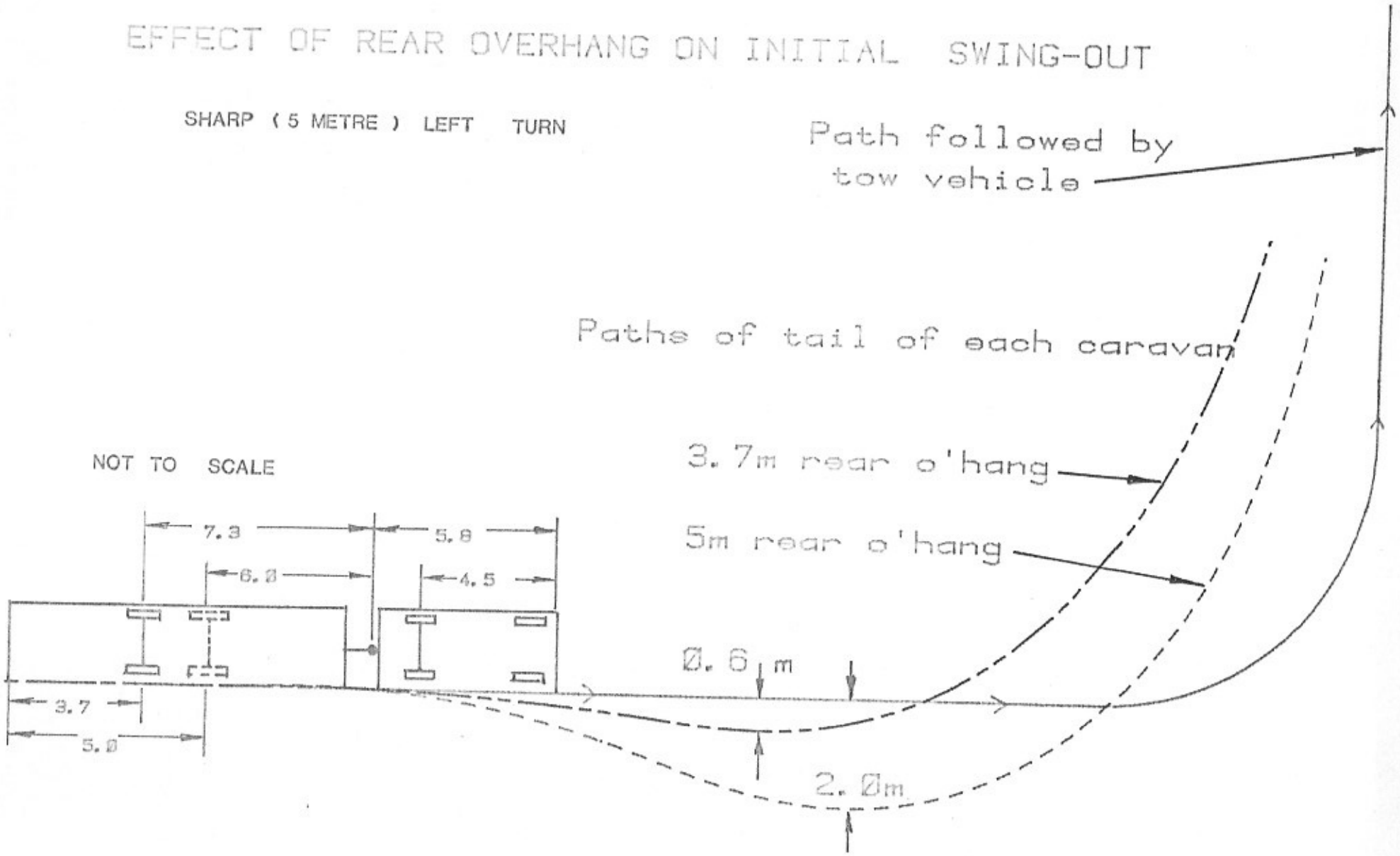

6,4
2,5
16,0
12,5 m RADIUS (DRAFT REG. 114)
SWEPT PATH COMPARISON - TRUCK/TRAILER & ARTIC. VEHICLE
11,0
2,5
8,3
4,5
5,8
CUT-IN OF TRAILER/
SEMI-TRAILER
PATH FOLLOWED BY
FRONT OF EACH
VEHICLE
trailer with 8.3m drawbar
semi-trailer
SCALE 1:200

FIGURE 2

FIGURE 3

EFFECT OF REAR OVERHANG ON INITIAL SWING-OUT

SHARP (5 METRE) LEFT TURN



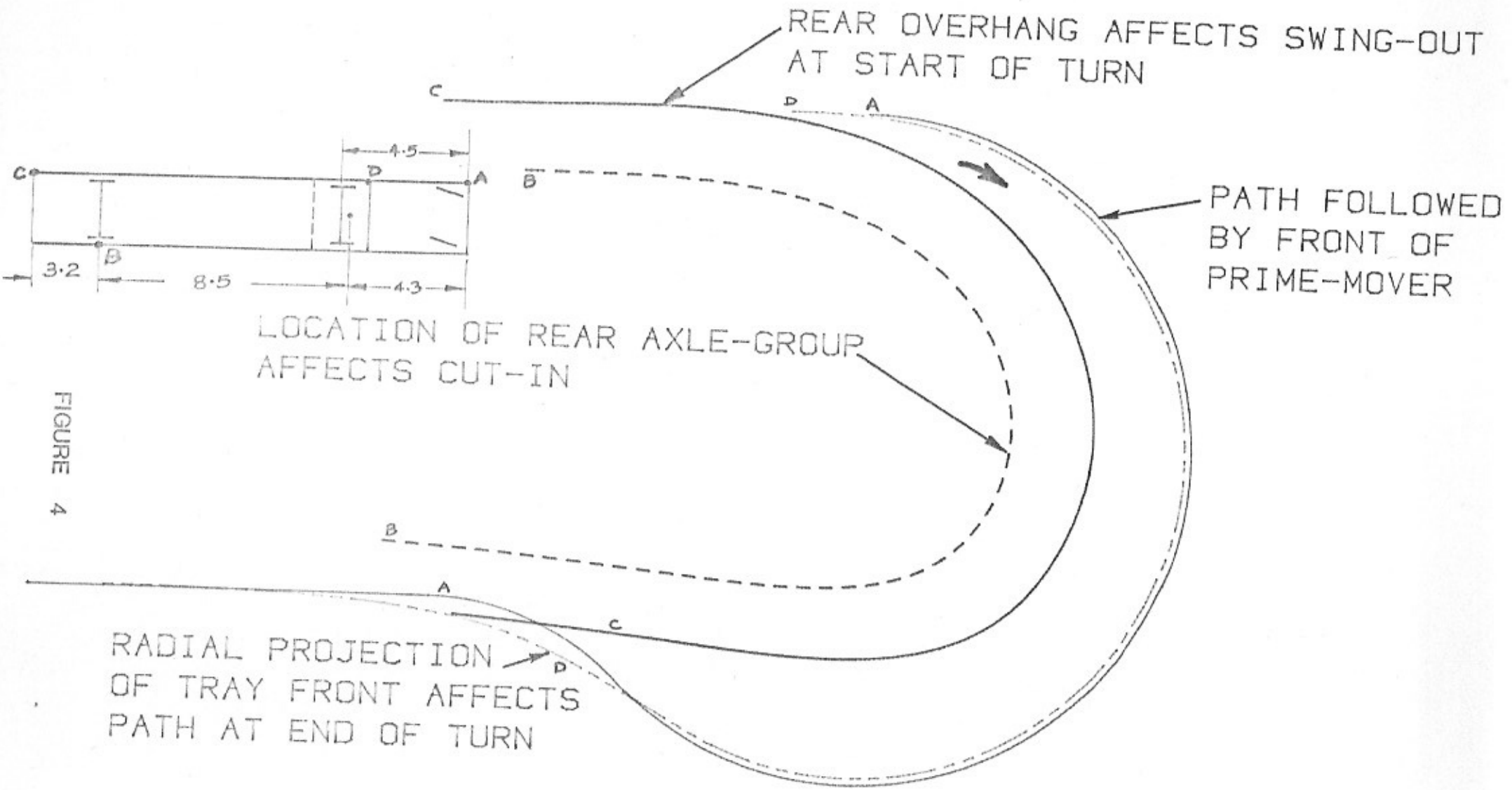

REAR OVERHANG AFFECTS SWING-OUT
AT START OF TURN
PATH FOLLOWED
BY FRONT OF
PRIME-MOVER
LOCATION OF REAR AXLE-GROUP
AFFECTS CUT-IN
RADIAL PROJECTION
OF TRAY FRONT AFFECTS
PATH AT END OF TURN
C
D
A
B
1·5
3·2
8·5
4·3

FIGURE 4

EFFECT OF REDUCING THE REAR OVERHANG BY 600mm
TO OBTAIN A SEMI-TRAILER LENGTH OF 12.5m.

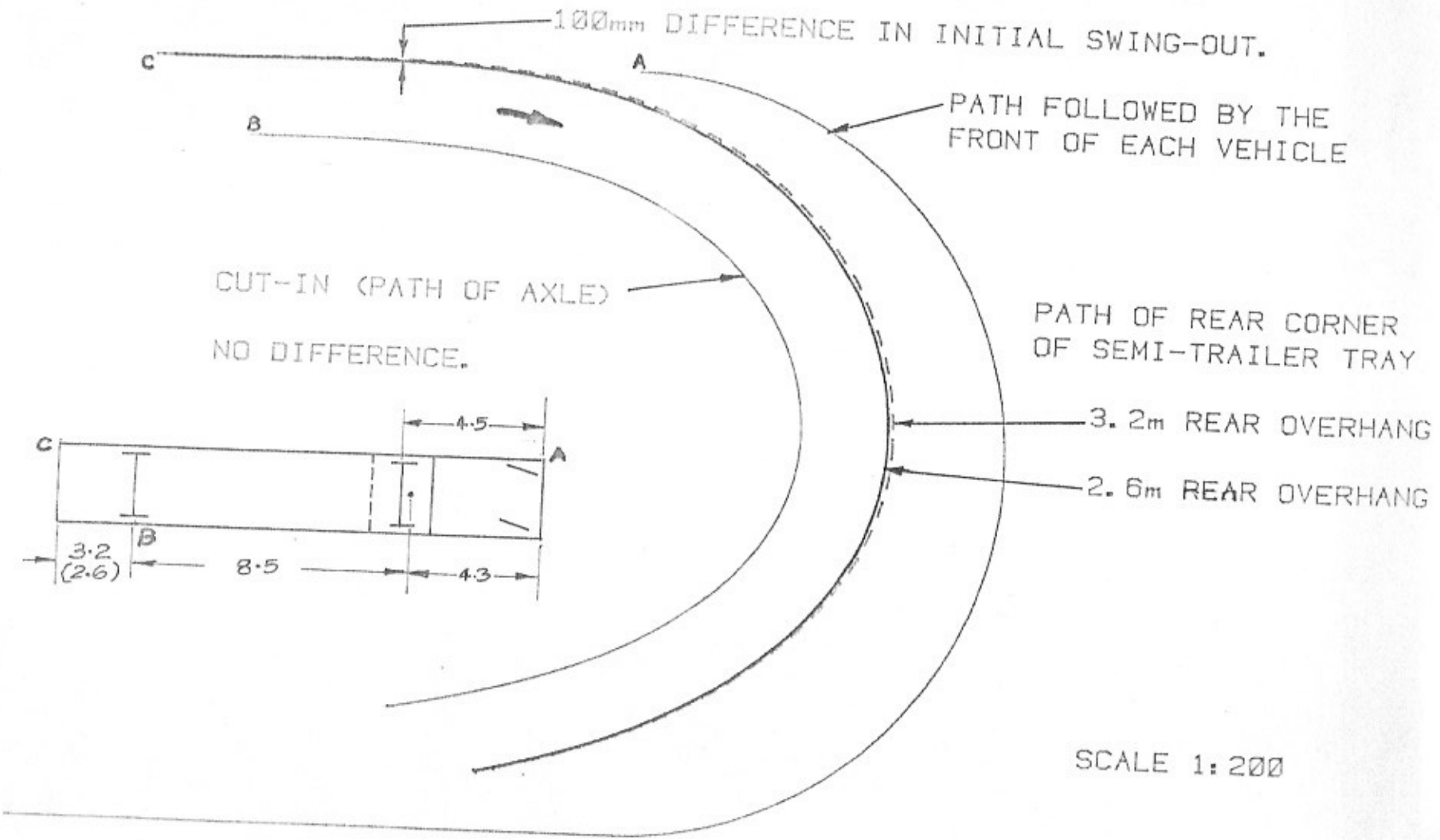


FIGURE 5