Rail Accident Investigation Branch

RAIB Bulletin 03/2010

Passenger train collision with road vehicle at Broken Cross bridge between Salisbury and Grateley, 22 September 2009

Description of the accident

1. Before dawn on 22 September 2009, a passenger train collided with a car which had left the highway at Broken Cross bridge near Salisbury, and rolled onto the railway line a few seconds before. The car, which had been travelling south on the A338, landed on its passenger door side and facing towards an oncoming train.
2. The car driver, the only occupant of the vehicle, was able to see the lights of the approaching train and climbed out of the vehicle before the collision occurred. He attempted to make an emergency call using his mobile phone, but was unable to prevent the collision. The train driver applied the emergency brake, and the train came to a halt after propelling the car along the track for a distance of 460 metres (see figure 1).

Figure 1: Train and car following collision. The road bridge from which the car fell can been seen in the distance

3. The train, comprising a two car class 158 diesel multiple unit (leading) and a three car class 159 diesel multiple unit, was damaged by the collision and the effects of flying ballast which struck four of the five under-floor diesel engines. There were no injuries to the three crew and nine passengers on the train. Evidence from the train's data recorder showed that the train was travelling at 65 mph (105 km/h) at the time of the collision, on a section of track with a line speed of 80 mph (129 km/h). The train's forward facing CCTV indicates that the driver had approximately two seconds warning of the collision when the train's headlights reflected off the car's number plate.

Findings of the RAIB

4. The bridge is situated on a double bend, which requires drivers to slow down as they approach. The car involved in the accident was travelling south and did not negotiate the left-hand bend approaching the bridge. It crossed the carriageway before colliding with a substantial garden wall constructed of concrete blocks (figure 2) on the opposite side of the road. The force of this impact did not topple the wall, but instead caused the car to rebound diagonally back across the road. This trajectory projected the car to the left of the bridge parapet and onto the railway (figure 3). There were no other vehicles involved.

Figure 2: Concrete block wall showing impact damage

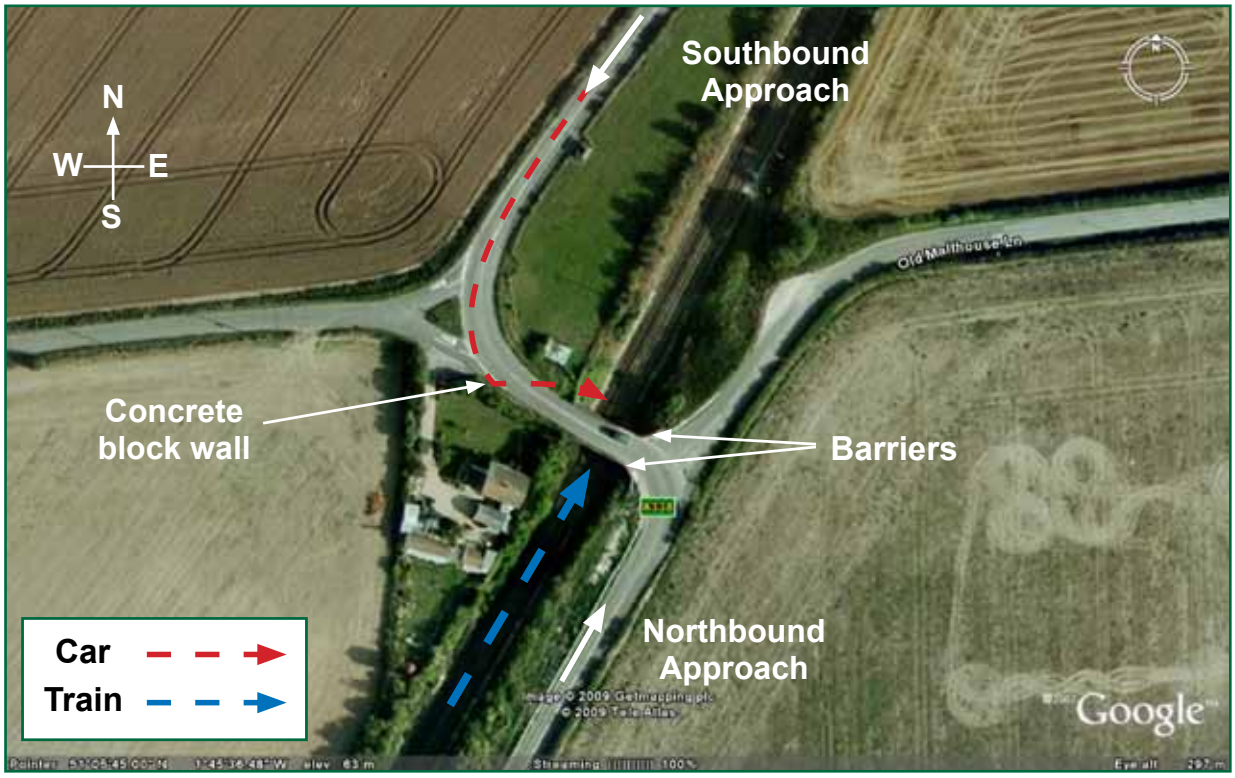

Figure 3: Path of car before the collision with train

5. The west approach to the bridge is not provided with highway crash barriers extending from the end of the bridge parapets (figure 4), and the adjacent railway boundary fence was incapable of preventing the car from passing through. The east approach is immediately adjacent to a bend, and is provided with crash barriers on both sides of the carriageway as a consequence (figures 3 and 5).

Figure 4: Gap at north-west corner of the bridge through which the car travelled

Figure 5: Steel crash barrier installed at the south-east corner of the bridge

6. Collision records for this site for the ten year period to September 2009 show that there have been 15 incidents involving northbound vehicles during this period that resulted in personal injury[1]. The most serious of these occurred in November 2003 when a car crashed through the north-east parapet and landed between the tracks (figure 6). On that occasion, trains were stopped before a collision occurred. During the same ten year period, only one accident is recorded involving a southbound vehicle, which collided with the garden wall in a similar manner to the most recent accident, but without rebounding onto the railway.

Figure 6: 2003 incursion involving a northbound vehicle

[1] Only accidents involving personal injury are recorded.

7. The relatively high frequency of accidents at this site indicates that other risk factors are present. The reverse curve and narrow carriageway combine to limit visibility for oncoming traffic, while requiring large vehicles to straddle the double white line in the centre of the road. This creates a collision risk with vehicles approaching in the opposite direction (figure 7), the risk to the railway being compounded by the substandard level of containment offered by the low brick parapets. Furthermore, there are road junctions on both approach bends (figure 3).

Figure 7: Southbound vehicle straddling centre white lines due to sharply curved road alignment

8. The Department for Transport (DfT) led the development of guidance for managing the risk of accidental obstruction of the railway by road vehicles in response to the 2001 accident at Great Heck in North Yorkshire, which led to the loss of 10 lives. This report[2] and an associated protocol, published in February 2003, provides railway infrastructure managers and highway authorities with a method of calculating a risk-based 'road vehicle incursion' (RVI) score. Collection of accident data to support this process commenced in April 2003. This protocol was necessary because the legal responsibility to assess the risk and provide any mitigation measures to prevent accidental incursions by road vehicles onto railway property could have fallen onto either a highway authority or a railway infrastructure manager (in this instance, Network Rail).
9. The protocol established that the highway authority leads in the risk assessment process if highway-related mitigation is required, such as traffic calming and barriers. The railway infrastructure manager leads if the measures required are associated with the railway. The protocol recommends a joint evaluation of the effectiveness of the mitigation measures after they have been in place for three years.
10. The method involves consideration of 14 key factors, including road alignment, volume of traffic, data on any previous accidents and the speeds and types of trains. The document states 'As a guide, scores of 100 or more are significant (in relative terms) and scores of 70 or more would suggest that highway authorities should at least consider the practicability of improvements.' The scoring system is used as a tool to identify high risk sites and apportion budgets.

[2] 'Managing the accidental obstruction of the railway by road vehicles' Department for Transport, February 2003. Product code 03 RRLG 01000

11. In 2004, a consultant on behalf of the local highway authority, Wiltshire County Council (now Wiltshire Council), assessed the bridge. The structure was given an initial road vehicle incursion (RVI) score of 109, but this was subsequently adjusted by agreement to 107 following a joint inspection between Wiltshire Council and Network Rail. This score still put the structure within the highest risk category (ie with a score of 105 or over), shared by an estimated 3% of sites nationally. The document gives an indicative amount to be spent to reduce the risk of road vehicle incursion, and for sites scoring 105 or above, the figure is £30K to £200K.

12. The second stage of this process was to assess the scope for treatment by investigating the site in more detail. A risk scoring exercise for all four corners of the bridge identified the highest risk to be from vehicles approaching from the south, failing to turn properly onto the bridge at its eastern end, and instead, going through the brick parapet of the bridge or the gap on the approach to the parapet. As a consequence, steel barriers were installed on both sides of the road at the east end of the bridge (figure 5) to mitigate the identified incursion risk. These barriers were installed in conjunction with improved static signing, additional vehicle-activated signs initiated by Wiltshire Council, a change of fence line and vegetation clearance to improve sightlines. This brought the overall RVI score for the bridge down to 95, but this was still above the threshold for considering further remedial action.

13. Barriers were not installed at the west end of the bridge as the risk of vehicle incursion from southbound vehicles was not considered significant, and historically, most accidents had occurred at the opposite end of the bridge (paragraph 6). However, guidance within the DfT report emphasises that 'curved approaches increase the chance of an accident due to reduced sighting distance and reaction time', and 'sites need to be protected at their most vulnerable points (eg at bends) and from all possible points of approach (nearside, offside, all directions and access points)'. This, and the fact that the RVI score remained above 90, suggests that further mitigation measures were required to address the known risk factors (paragraph 7). However, the RAIB do not consider that the particular risk of a vehicle rebounding off the garden wall on the opposite side of the road and onto the railway was of itself reasonably foreseeable.

14. Following these improvements, Network Rail continued to work with Wiltshire Council to find a long-term solution to the risk at this site. The solution was likely to be a substantial independent restraining structure outside the parapet, but this raised questions because head-on impact with such a structure could cause serious injury to the occupants of a vehicle or motor cyclist in a collision.

15. More recently, a proposal to reconstruct the bridge to increase the clearance for rail freight traffic has been developed. This is scheduled to occur within the period 2010 – 2012, and the design is being developed on the basis of a replacement superstructure supported by the existing foundations. Network Rail has approached Wiltshire Council with a proposal to share the cost of a replacement structure on a revised alignment to allow a substantial straightening of the carriageway, but Wiltshire Council has stated that it believes that it will be unable to secure funding for such a joint approach.

16. At the time of the accident, the structure was fitted with a 'bridge strike plate' at carriageway level. This gave information on the location of the structure and a contact telephone number to be used in case of emergency. Originally, anyone dialling this number would have been able to contact Network Rail's Route Control Office, who would have been able to make arrangements to stop trains in the area. However, the number quoted was prefixed with 0171 and was therefore obsolete as most central London numbers are now prefixed 0207. There was no automatic call-forwarding facility or recorded message available to anyone using this number. Although the location of the bridge strike plate is of limited use to somebody involved in an accident that results in their vehicle obstructing the railway, a witness to such an accident could use it.

17. Bridge strike plates are normally fitted only to under-bridges (i.e. road under rail) to mitigate the risk arising from over-height vehicles striking the bridge. It is probable that the plate was only fixed to this particular bridge because of the previous accident history, and that the need to inspect and renew it was consequently overlooked.

18. On 1 October 2009, the RAIB issued urgent safety advice to Network Rail regarding structures fitted with bridge strike plates displaying obsolete information. Network Rail has renewed the plate at the structure concerned, and commenced to update signage at other structures so that emergency telephone numbers are current.

19. As a result of this accident, Wiltshire Council has taken the decision to install safety barriers at the north-west corner of the bridge to prevent a recurrence. This work commenced at the end of 2009, and it is anticipated that this will cause the overall RVI score to drop below 90 when the structure is subsequently rescored.

Conclusion

20. Following the accident, the RAIB has conducted a preliminary examination of the circumstances and key evidence. On the basis of a review of this information the RAIB has concluded that, in this case, further investigation by the RAIB would be unlikely to result in formal recommendations for the improvement of safety[3]. Nevertheless, the preliminary examination has highlighted three safety lessons. These are described at paragraph 22.

21. The RAIB has involved Network Rail with the preliminary examination.

[3] It should be noted that this does not affect the railway industry's obligation to comply with health and safety legislation by conducting its own investigation into the accident and implementing appropriate measures to address the risk.

Learning points

22. The RAIB believes that there are learning points from the accident:

- The need for both the initial risk assessment, and the review of mitigation measures after three years (paragraph 9), to consider all reasonably foreseeable mechanisms by which road vehicles could reach the railway. This should make use of any new intelligence on near misses, road traffic accidents and damage to highway structures which might indicate an increased risk of vehicles leaving the road.
- The need for the proper identification of the changes necessary when critical information (such as emergency telephone numbers) is changed. This includes bridge strike plates, and other signs conveying safety critical information, such as at level crossings.
- The need for those undertaking infrastructure inspections to verify that safety critical information is correct, where this is displayed (paragraph 17).

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