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Road restraint systems – what Auditors need to know

Outline

- what is a road restraint system?
- brief history of RRRAP
- **Road Restraint Risk Assessment Process**
- overview of RRRAP and application
- review questionnaire results
- recommendations for good practice
- references and websites for further research

What is a road restraint system?

- Safety Barriers
- Temporary Safety Barriers
- Parapets
- Terminals
- Vehicle Attenuators
- Transitions
- Crash Cushions



TD19/06

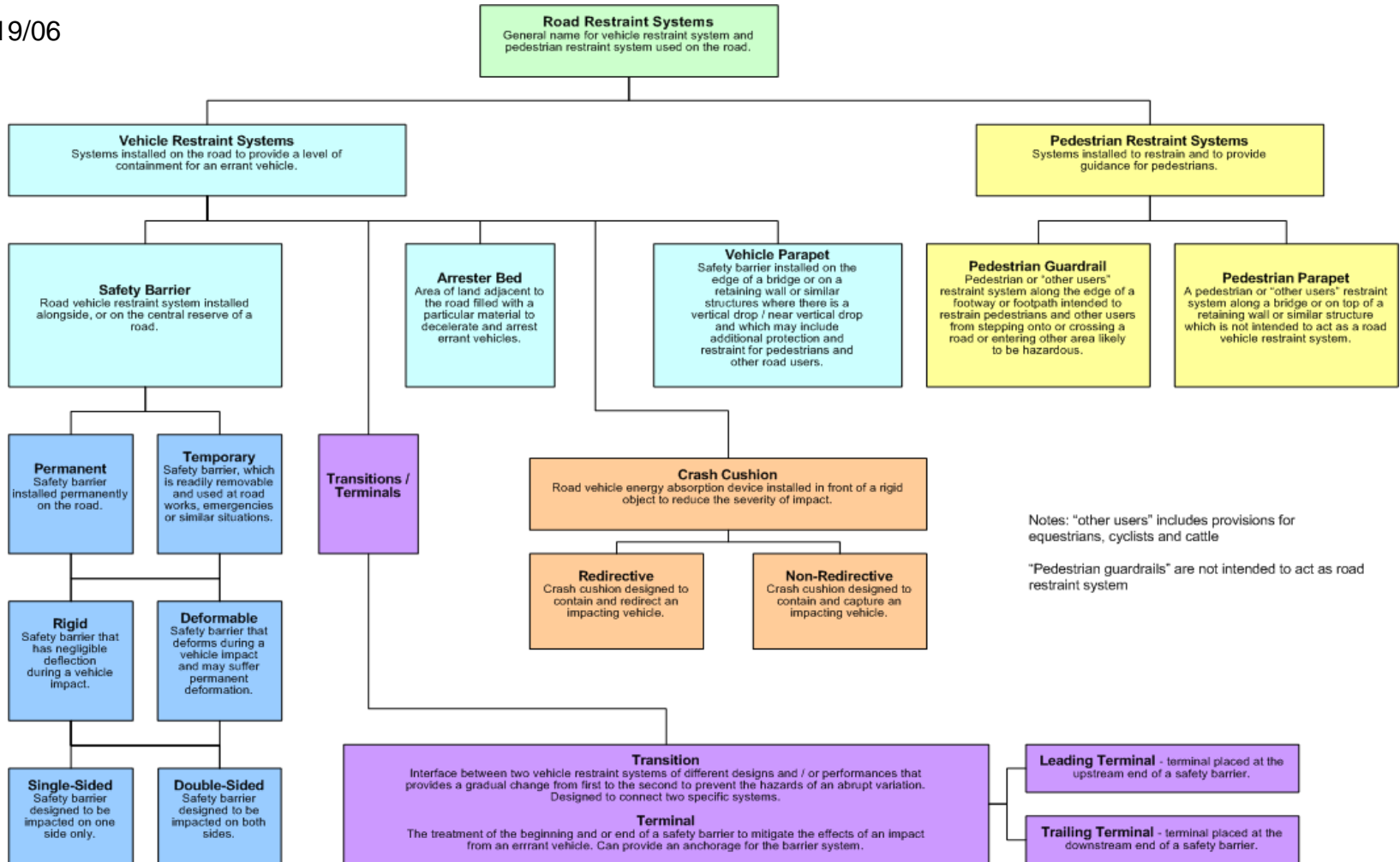


Figure 1-2 Road Restraint Systems Terminology and Definitions

Highways Agency Accepted EN 1317 Compliant Road Restraint Systems

- A definitive list of tested and accepted road restraint products
- The road restraint products in the list are divided into the following categories:
 - Safety Barriers (SB)
 - Temporary Safety Barriers (TSB)
 - Parapets (P)
 - Terminals (T)
 - Lorry Mounted Crash Cushions (LMCCs)
 - Transitions (TRANS)
 - Miscellaneous (M)
 - Crash Cushions (CC)
 - Safety Barrier Gates (SBG)

Highways Agency Accepted EN 1317 Compliant Road Restraint Systems

- Each category
 - States what standards the products have been tested against,
 - specifies what Containment Performance Class and Working Width Class applies to each product
- Copies of documents, drawings and more information about products are available from the individual product promoters specified in the PDF
- The list has been produced in PDF format and is available for download from DfT website.

http://www.dft.gov.uk/ha/standards/tech_info/files/HA_Accepted_Product_List_March_2011.pdf

Safe roads. Reliable journeys. Informed travellers.



HA ACCEPTED EN1317 COMPLIANT ROAD RESTRAINT SYSTEMS

March 2011

CONTENTS:

Sector Scheme Training Requirements

New Products & Amendments

Safety Barriers (SB)

Temporary Safety Barriers (TSB)

Parapets (P)

Terminals (T)

Lorry Mounted Crash Cushions (LMCCs)

Transitions (TRANS)

Miscellaneous (M)

Crash Cushions (CC)

Safety Barrier Gates (SBG)

The HA Accepted EN1317 Compliant Road Restraint Systems List is periodically updated.

To view or download the current version of this list contact:

<http://www.highways.gov.uk/business/8720.aspx>

New Products – March 2011

- **Safety Barriers (Permanent)**

- Highway Care; Quick-change Moveable Barrier (QMB) for permanent applications (inc. CE mark)
- Hill and Smith Ltd; Double sided FlexBeam at 4.0m post spacing
- SafeRoad BLG; Birsta W2 at 4.0m post spacing
- Tata Steel Construction Products; Vetex N2 W4 Single Sided Safety Barrier at 3.5m post spacing

- **Safety Barriers (Permanent and Temporary)**

- Delta Bloc; Delta Bloc 65S (K120)

- **Parapets**

- SafeRoad BLG; SafeRoad SN1 Parapet

- **Terminals**

- Marcegaglia P4 Terminal

- **Transition**

- Hill and Smith; TranzFlex 100 N2 FlexBeam to single sided H1/H2 FlexBeam Plus Transition

Note: For further details on these systems, please see relevant section within the HA Accepted EN1317 Compliant Road Restraint Systems List.

BACKGROUND TO RRRAP

Background to RRRAP

- road/rail accident at Great Heck, near Selby in March 2001
- both train drivers, two additional train crew on board the InterCity 225, and six passengers were killed,
- Deputy Prime Minister commissioned the HA to review standards for the provision of nearside safety barriers on major roads.



HA working group recommendations

- latest UK research and best practice from international experience is incorporated at the earliest opportunity into UK barrier standards
- risk assessments are further developed for the provision of safety barriers including additional and/or alternative protection/mitigation measures to take account of local circumstances
- safety barrier standards are reviewed to take account of the group's recommendations and the thinking behind the standards made clearer.

Road Restraints Risk Assessment Process (RRRAP)

- The Risk based Road Restraint Systems Standard does not follow the traditional standard format. The Standard has two parts that must be used together;
 - The written Standard TD19 'Requirement for Road Restraint Systems' - some mandatory requirements but mainly advice and guidance.
 - 'Road Restraint Risk Assessment Process (RRRAP)', in Excel - enables the Designer for each site/scheme to establish the need and performance requirements for a vehicle restraint.

Design Manual for Roads and Bridges

- Volume 2 Highway Structures: Design (Substructures And Special Structures) Materials
 - Section 2 Special Structures
 - Part 8
 - TD 19/06
 - Requirement For Road Restraint Systems
- Now on DfT website:
<http://www.dft.gov.uk/ha/standards/dmrb/vol2/section2/td1906.pdf>

TD 19/06 Contents

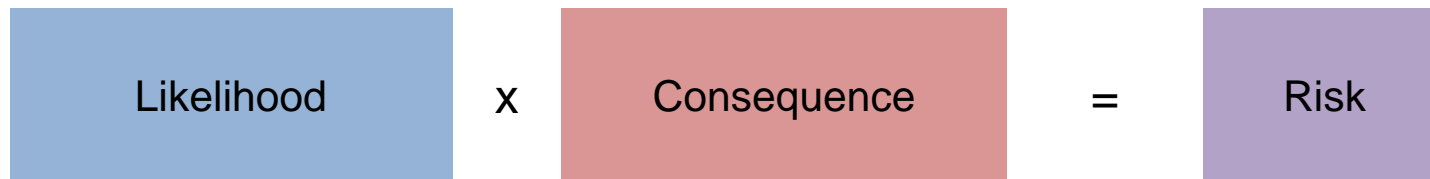
1. Introduction
 2. Overview of Risk and Mitigation and Considerations for Selection
 3. Criteria and Guidance for the Provision of Permanent Safety Barriers
 4. Criteria for the Provision of Vehicle Parapets
 5. Criteria and Guidance for the Provision of Terminals
 6. Criteria and Guidance for the Provision of Transitions
 7. Criteria and Guidance for the Provision of Crash Cushions
 8. Criteria and Guidance for the Provision of Temporary Safety Barriers at Road Works
 9. Pedestrian Restraint Systems
 10. Vehicle Arrester Beds
 11. Anti-glare Screens
 12. References
 13. Enquiries
- Appendix 1 Lists A and B
- Appendix 2 Guidance on the Specification of Vehicle Restraint Systems for Low Speed and/or Low Traffic Flow Roads

“A common mistake that people make when trying to design something completely foolproof is to underestimate the ingenuity of complete fools.”



Assessing the Risk

- The RRRAP uses fairly simple formulae. It assesses risk as:
 - Likelihood of an errant vehicle hitting a roadside hazard multiplied by the resulting Consequences.



- Likelihood of an errant vehicle hitting a hazard is based on the likelihood of it leaving the road, the distance of the hazard from the running lane, the nature of the ground the errant vehicle would have to cross, etc
- Consequences are based on the speed of the errant vehicle and the aggressiveness of the hazard (i.e. the ability to do harm).

Risk Assessment – 5 steps

1. Identify the hazards
2. Decide who might be harmed and how
3. Evaluate the risks and decide on precaution
4. Record your findings and implement them
5. Review your assessment and update if necessary

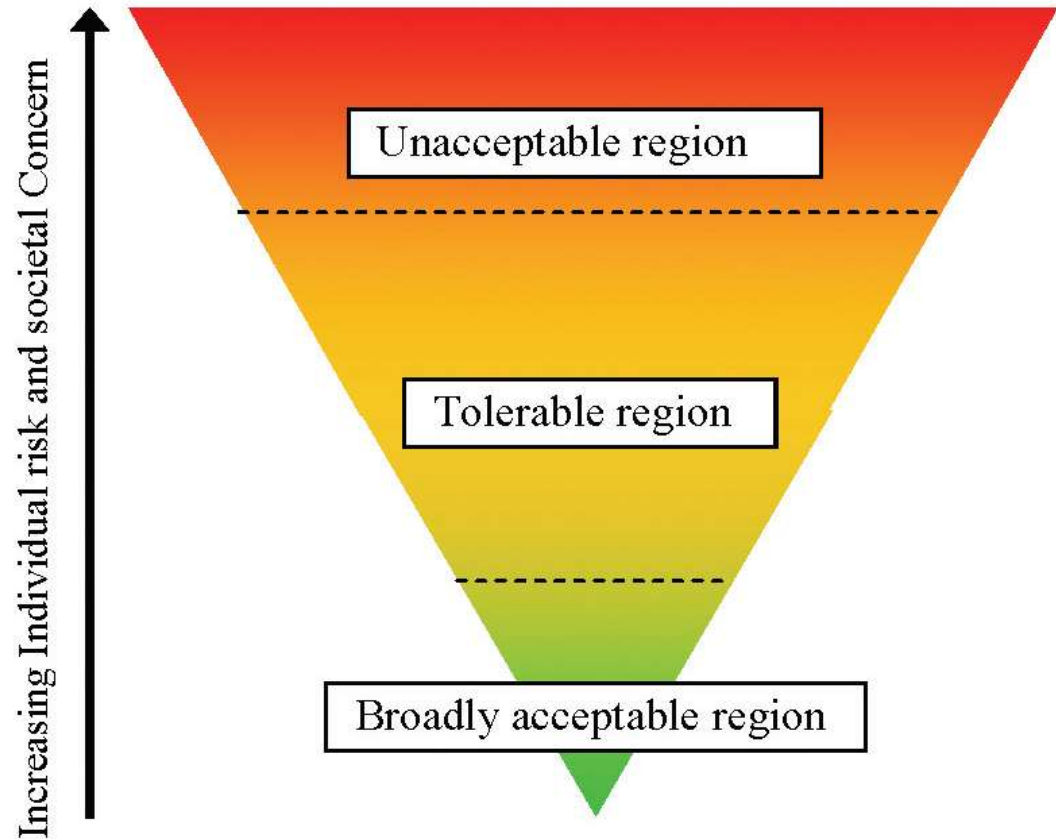
ALARP

As

Low

As

Reasonably
Practicable



Guidance on the use of the RRRAP associated with TD 19/06 - Issue 1 rev 2 30/3/11

[http://www.dft.gov.uk/ha/standards/tech_info/files/rrrap/Guide to the RRRAP Issue 1 rev 2.pdf](http://www.dft.gov.uk/ha/standards/tech_info/files/rrrap/Guide_to_the_RRRAP_Issue_1_rev_2.pdf)

- Précis of what the RRRAP covers and does not cover added
- Error messages – further information added
- Further information and guidance on the following
 - Comms cabinets and equipment to allow for maintenance workers;
 - Crib walls and smooth faced walls
 - how parapet risk calculated; 5.9.5 specifying parapet working width,
 - pedestrian restraints; 5.9.7 ref to IAN 91, Structural Collision Loading and Collapse
 - Utility poles with stays; 5.11.2 Pylons and need to consider implication of pylon or cables falling
 - If H1 or H4a required on embankment
 - Slip roads in the vicinity of nosings

What the RRRAP covers...

- The RRRAP covers and enables an assessment to be made, based on risk, whether a VRS is warranted to prevent the occupants of an errant vehicle from hitting near side or offside hazards in the following situations:
 - Motorways, All Purpose Roads and Other Classified Roads having a speed limit of 50 mph or greater and AADT of 5,000 or greater
 - Temporary VRS
 - Gantries and Railway parapets.

... and does not cover

- Central reserves
- Roundabouts and junction areas
- Lay-bys
- Pedestrian Restraint Systems
- Vehicle Arrester Beds
- Anti-Glare screens

Useful note for auditors...

- “Designers should use the ‘User Comments’ worksheet of the RRRRAP to describe the process they have gone through in determining the provision of VRS and their conclusions.”

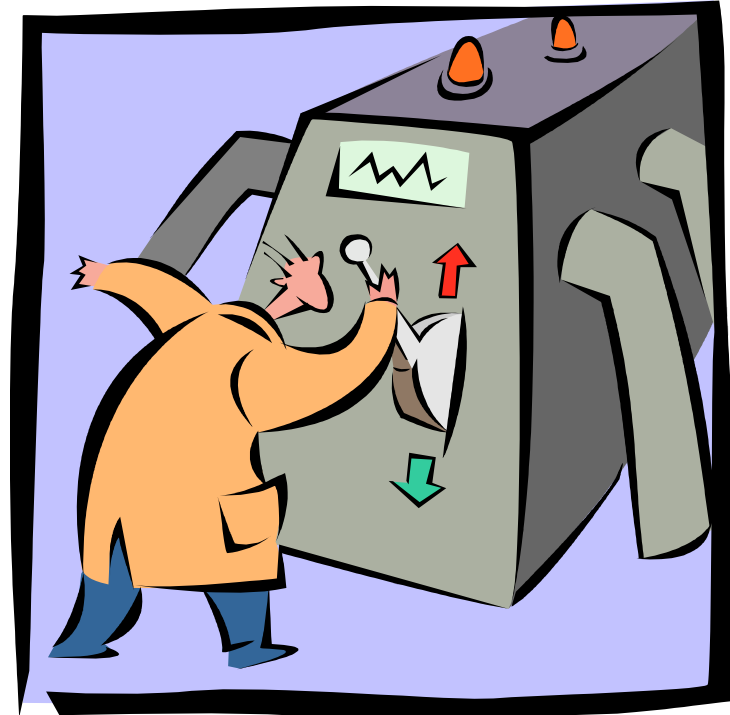
Feedback on RRRAP

“We would welcome feedback on the following items:

- content and usefulness of the Guidance and where it could be improved, e.g. where additional examples may be of benefit.
- Problems encountered in understanding the RRRAP and or the Guidance.
- Instances where the RRRAP has returned unexpected answers, e.g. unusually long length of provision, or no provision where some VRS would have been expected.
- Situations where the RRRAP has been unable to provide a solution
- Areas where you consider that training would be of benefit.

The feedback should be sent to HARRRAP@mouchelparkman.com.”

“The major difference between a thing that might go wrong and a thing that cannot possibly go wrong is that when a thing that cannot possibly go wrong goes wrong it usually turns out to be impossible to get at or repair.”



WHY DO AUDITORS NEED TO KNOW ABOUT IT?

“Anything that is in the world when you’re born is normal and ordinary and is just a natural part of the way the world works.

Anything that’s invented between when you’re fifteen and thirty- five is new and exciting and revolutionary and you can probably get a career in it.

Anything invented after you’re thirty-five is against the natural order of things.”



Why do Auditors need to know about RRRAP?

Road Safety Audits

1.36 Road Safety Audits must be undertaken on all highway schemes involving removal, provision or improvement of RRS in accordance with **HD 19 [DMRB 5.2.2]**.

Why do Auditors need to know about RRRAP?

- Key issue in highway design
- Vehicles leaving carriageway is a safety issue
- Links to passive safety
- TD19/06 is a good read
- Able to fight your corner, defend comments etc
- CPD

"To summarise: it is a well-known fact, that those people who most want to rule people are, ipso facto, those least suited to do it.

To summarise the summary: anyone who is capable of getting themselves made President should on no account be allowed to do the job.

To summarise the summary of the summary: people are a problem."



Unscientific questionnaire to establish differences of opinion between
auditors and designers

RESPONSES FROM PRACTITIONERS

1. Are you a highway designer or a road safety auditor?

Highway Designer	3
Safety Auditor	25
Both	18

2.a Do you use RRRAP?

Yes	14
No	16

2.b Does it cause you any difficulties in developing a sensible design?

Yes	6
No	5
sometimes	1

“yes – very inflexible.”

“yes – in creating practical, workable designs. Passive safety vs road restraint systems”

2.c What difficulties do you encounter?

“Doesn’t accept speed limits <50mph or 5000 AADT. Guidance leaves it to the designer to enter into RRRAP as a 50mph limit when it may be 20mph or 30mph and possibly overdesign the RSS, or leave it to a risk assessment which may be less likely to provide a consistent approach.”

“You have to fill out everything in order to get the assessment complete.”

“Difficulties with the program arise from existing street furniture lying within the working width of the supposed barrier that the program/macro applies and also street furniture located in front of the supposed VRS system. Difficulties resulting from the macro within the spreadsheet being buggy and causing system crashes.”

“For small schemes RRRAP is a sledgehammer – cut down version required?”

“If we have a risk which is more than 5m away from point of setback, the protection is not required (according to RRRAP). However, in reality the judgment needs to be made on existing road alignment.”

2.d Do you have any specific examples of these problems?

“I once encountered an error with a ditch on top of a cutting requiring barrier (13m away from the main carriageway) and yet when testing the program using the same dimensions but applying them to a embankment rather than cutting no VRS system was required. I actually contacted the creator of the program... and was told to ignore it.”

“Design of a footbridge replacement. VRS in place but not sure what criteria is met.”

3.a Have you identified any issues with safety barrier due to RRRAP

Yes	15
No	24
“Lack of info or designer understanding.”	
“As an auditor, you would not typically know whether any issues were due to RRRAP, as generally we only have the safety barrier drawings and not the corresponding RRRAP outputs.”	

3.b What are these issues?

“Occasionally, erroneous input has resulted in the acceptance of an absence of barrier where aggressive hazards exist – esp water.

“Barrier crops up in strange places for an unknown reason, as there are no ‘rules’ to give Auditors any guidance, such as at the top of slope over 3m, less than 4.5m from edge of carriageway...”

“Where 2 sets of barrier come together, e.g. at the top of an entry slip road of a grade separated interchange. The P4 end arrangement gives little protection to prevent a vehicle ... ending up on the carriageway below.”

“Lack of P2W knowledge – sometimes one PS post & no RR is better but designers don’t realise this!”

“Inadequate info input into RRRAP resulted in hazards being overlooked.”

“The conflict between protecting road users against trees.”

3.c How has the designer responded?

“along the lines that ‘RRRAP requires it’, but no further explanation.”

“Don’t know”

“‘will investigate a compliant design’ but nothing has been done so far.”

“Usually not able to as local TPOs are put in place.”

“Manufacturer has to supply information. Don’t worry!”

“< 50mph so not a problem”

“RRRAP redone with full site survey – all hazards treated appropriately.”

“Generally favourably but worried about moving away from standards.”

“Positively if caught early enough.”

"They wouldn't even lift a finger to save their own grandmothers from the Ravenous Bugblatter Beast of Traal without orders signed in triplicate, sent in, sent back, queried, lost, found, subjected to public inquiry, lost again, and finally buried in soft peat for three months and recycled as firelighters."



4.a Do you think RRRAP has improved road safety?

Yes	15
No	2
Not really / possibly / don't know / 'yes & no'	15

“The process still needs to be more integrated both into designers’ and auditors’ minds, and an update of HD19/03 would help!”

“Yes - it has put a structured approach to evaluating sites.”

“It has made people better identify the potential risks and hazards to provide better road restraint.”

“Yes - tool to assess something complex and raise profile of forgiving roadside.”

“Improved appreciation of hazards in some circumstances.”

Comments...

- “Difficult to say. On some schemes there didn’t seem to be a history of leaving the carriageway or colliding with street furniture before the works, so why was it installed?”
- “ Fewer incidents of hazards being not considered by the designer and being left to auditor.”
- “Yes, it provides an audit trail to show that the designers have considered RSS for hazards and thus are more likely to consider all hazards in their assessment.”
- “More outputs should be available to RSA teams.”
- “It must have because the amount of road furniture requiring safety fence has increased.”
- “The need to use the process for the smallest of jobs can deter designers from using it.”

4.b Any general comments? +ve

- “It is a great design tool – places the designer in a position of determining risk from a level playing field.”
- “RRRAP output is a useful reference material for Auditors to understand how combinations of roadside features affect safety risk analysis.”
- “additional information submitted for audits which has aided the understanding of the scheme proposals.”
- “RRRAP skills are useful for Auditors to have.”

4.b Any general comments? –ve ...

- “In some circumstances i.e. narrow rural roads, implementation can result in a more significant hazard than that which is being protected.”
- “RRRAP is theoretically a good concept. However the current system is not flexible enough and overly complex. It needs to be stripped back to a more basic and fundamental process that gives the designer control and more input into the specific requirements of safety barrier. “
- “Absence of knowledge guidance within RRRAP about alternative ways to achieve safety.”
- “It’s not always user friendly.”
- “struggles to cope with complex situations and existing street furniture.”

... 4.b Any general comments? -ve

- “over reliance upon results can still mean no barrier when needed or barrier when not required.”
- “time consuming and the fact that everything has to be filled out “
- “appears to be a good method, however from feedback of those using it is apparently quite complicated so could put people off using.”
- “additional information submitted for audits which has aided the understanding of the scheme proposals.”
- “many revisions etc has led to some confusion over the past few years as to which system is the latest version /standard.”
- “simplification of the assessment process as designers tend to go with the result as opposed to ‘commonsense’ approach.”
- “ too black and white – real world has shades of grey.”

4.b Any general comments? neutral

- “Auditor’s life would be easier if there were some general ‘rules’ where barrier should be installed.”
- “designers often forget the ‘Do nothing’ scenarios.”
- ”would be good to know calculations behind the risk assessments. “
- “Don’t forget hazards on lower-speed roads.”
- “Easy to use by the inexperienced who may not know what results to expect.”
- “Some local authorities are looking for simplified systems for small jobs on local roads.”

General Comments – worrying!

- “What is RRRAP?” – designer/auditor
- “Not come across RRRAP”. – designer/auditor
- “Others in team have more experience, so if RRRAP is required I delegate to them.” – designer/auditor
- “Do designers think in 3 dimensions?”

EXAMPLES



©Veljko Komad BBMM

A20 trunk road, protection of TSB. Tunnel support building is more than 5m away from the point of setback, engineering judgment was used to protect the building and equipment, new access road was built for TSB

A21 Bessels Green Noise Barrier (slip road from A25 to A21). The speed limit change from 30mph (protection not required) to National speed limit (protection is required) 30m from the start of the barrier. Safety barrier extended to protect the noise barrier.



“Ah, this is obviously some strange usage of the word 'safe' that I wasn't previously aware of. “





M20 motorway Noise Barrier Phase 4B. According to RRRAP, the protection was not required due to the sufficient setback. However, the barrier has been hit 3 times in 3 years

RECOMMENDATIONS

"If it looks like a duck and quacks like a duck, then we must at least accept the possibility that we have a small aquatic bird from the Anatidae family on our hands"



Recommendations

- Go with instincts – if something feels wrong don't be afraid to say so – use commonsense
- Find out about RRRAP (read TD19/06)
- Sit with designer when s/he is completing the spreadsheet
- Importance of site visit
- Work with designers to feedback to RRRAP developers and within SoRSA to build up best practice guidance

“Human beings, who are almost unique in having the ability to learn from the experience of others, are also remarkable for their apparent disinclination to do so.”



Conclusions

- RRRAP is a positive development
- Can be applied too rigorously – or wrongly!
- Needs commonsense approach.
- Some auditors and designers are not familiar with it and perhaps they should be...?
- Need to find out if it has improved safety...

“I may not have gone where I intended to go, but I think I have ended up where I needed to be.”



Further Information

- TD 19/06 DMRB
- Guidance on the use of the Road Restraint Risk Assessment Process (RRRAP) associated with TD 19/06 - 30 March 2011
- http://www.dft.gov.uk/ha/standards/tech_info/files/rrrap/Guide_to_the_RRRAP_Issue_1_rev_2.pdf
- http://www.dft.gov.uk/ha/standards/tech_info/rrrap.htm
- <http://www.hse.gov.uk/risk/assessment.htm>
- http://www.dft.gov.uk/ha/standards/tech_info/files/HA_Accepted_Product_List_March_2011.pdf
- Hitchhiker's Guide to the Galaxy – Douglas Adams
- <http://www.bbc.co.uk/h2g2/>



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