ASHGHAL

Interim Advice Note No. 002

Safety Barrier Performance Levels and Selection Criteria

Revision No. A1

DXW-P000-0000-PM-KBR-IAN-00002

Summary
This Interim Advice Note (IAN) provides information and guidance on:

- Minimum Safety Barrier Performance Criteria to be adopted for use on the Qatar Road Network, with an update to remove reference to containment level N2.
- Types of rigid concrete barrier systems accepted for use on the Qatar Road Network.
- The use and application of crashworthy barrier end terminals that have met appropriate test criteria.
- Restrictions on the use and application of ramped end terminals on high speed roads.
- Requirement for barrier systems used on the Qatar Road Network to be type approved / accepted by the Public Works Authority (Ashghal).

This document supersedes IAN 002 Rev 0 dated February 2012. Third parties not working on Ashghal projects make use of this document at their own risk. Paper copies of this document are uncontrolled. Refer to Ashghal's website for the most recent version.

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A1	Sept 2013	Issued for All Relevant Infrastructure Projects	DL	AM	AA
0	Feb. 2012	Issued for Expressway Projects	NH	FM	MG
Rev	**Date**	**Reason For Issue**	**Auth**	**Chk**	**App**

Contents

1. Foreword

1.1 Interim Advice Notes (IAN) may be issued by Ashghal from time to time. They define specific requirements for works on Ashghal projects only, subject to any specific implementation instructions contained within each IAN.

1.2 Whilst IANs shall be read in conjunction with the Qatar Highway Design Manual (QHDM), the Qatar Traffic Manual (QTM) and the Qatar Construction Specifications (QCS), and may incorporate amendments or additions to these documents, they are not official updates to the QHDM, QTM, QCS or any other standards.

1.3 Ashghal directs which IANs shall be applied to its projects on a case by case basis. Where it is agreed that the guidance contained within a particular IAN is not to be incorporated on a particular project (e.g. physical constraints make implementation prohibitive in terms of land use, cost impact or time delay), a departure from standard shall be applied for by the relevant Consultant / Contractor.

1.4 IANs are generally based on international standards and industry best practice and may include modifications to such standards in order to suit Qatar conditions. Their purpose is to fill gaps in existing Qatar standards where relevant guidance is missing and/or provide higher standards in line with current, international best practice.

1.5 The IANs specify Ashghal's requirements in the interim until such time as the current Qatar standards (such as QHDM, QTM, etc.) are updated. These requirements may be incorporated into future updates of the QHDM, QTM or QCS, however this cannot be guaranteed. Therefore, third parties who are not engaged on Ashghal projects make use of Ashghal IANs at their own risk.

1.6 All IANs are owned, controlled and updated as necessary by Ashghal. All technical queries relating to IANs should be directed to Ashghal's Manager of the Design Department, Infrastructure Affairs.

Signed on behalf of Design Department:

Abdulla Ahin A A Mohd
Acting Manager of Roads & Drainage Networks Design
Design Management (Roads Section)
Public Works Authority
Tel: 44950653
Fax: 44950666
P.O.Box 22188 Doha - Qatar
Email:aahin@ashghal.gov.qa
http://www.ashghal.gov.qa
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2. Ashghal Interim Advice Note (IAN) – Feedback Form

Ashghal IANs represent the product of consideration of international standards and best practice against what would work most appropriately for Qatar. However, it is possible that not all issues have been considered, or that there are errors or inconsistencies in an IAN.

If you identify any such issues, it would be appreciated if you could let us know so that amendments can be incorporated into the next revision. Similarly, we would be pleased to receive any general comments you may wish to make. Please use the form below for noting any items that you wish to raise.

Please complete all fields necessary to identify the relevant item			
IAN title:			
IAN number:		Appendix letter:	
Page number:		Table number:	
Paragraph number:		Figure number:	
Description comment: Please continue on a separate sheet if required:			
Your name and contact details (optional):			
Name:		Telephone:	
Organisation:		Email:	
Position:		Address:	

Please email the completed form to:

Abdulla Ahin AA Mohd

Acting Manager of Roads and Drainage Networks Design
Design Management
(Roads Section)
Public Works Authority

aahin@ashghal.gov.qa

We cannot acknowledge every response, but we thank you for contributions. Those contributions which bring new issues to our attention will ensure that the IANs will continue to assist in improving quality on Ashghal's infrastructure projects.

3. Introduction

3.1 This Interim Advice Note (IAN), which takes immediate effect, provides guidance on the minimum Safety Barrier Test Level Performance Levels to be implemented on the road network. This IAN provides interim guidance in lieu of the forthcoming update to the Qatar Highway Design Manual (QHDM) and further Barrier Specifications and Guidance.

3.2 This IAN removes reference to containment level N2. The use of safety barrier with containment level less that TL-3 / H1 will require approval by Ashghal Asset Affairs.

3.3 New Jersey Concrete Barriers referenced in the current QHDM (1997 edition) have been removed and replaced with the F-Shape Profile and the Single Slope Profile, due to the higher propensity for vehicles impacting the New Jersey profile to rollover. The Single Slope Profile shall be in accordance with the 9.1 degree Single Slope Barrier developed in California.

3.4 Further guidance on the use of appropriate crashworthy end terminals has been added to update the current guidance in line with international best practice by adopting crash tested products and restricting use of non-crash tested products (Ramped End Terminals).

4. Withdrawn / Amended Standard

4.1 Section 5.15 – P 5/24 of Qatar Highway Design Manual to be amended as attached.

4.2 Section 3.1.3.4 and Table 3.1 of Qatar Traffic Manual – Volume 2 to be amended to replace reference to “New Jersey Profile Concrete Barrier” with “F-Shape Profile Concrete Barrier”.

5. Implementation

5.1 The IAN is to be used with immediate effect on projects as follows:

- All Ashghal projects in Design Stage
- All Ashghal projects in Tender Stage

5.2 Ashghal projects in Construction Stage shall be reviewed by the Project Consultant / Contractor and the implications of adoption of this Interim Advice Note discussed with the respective Ashghal Project Manager.

5.3 The only exceptions are:

- Projects already in Construction, where a significant proportion of Safety Barriers have already been installed, where this would result in significant additional cost or delay.

5.4 If in doubt, Consultants / Contractors should seek guidance from the respective Ashghal Project Manager or designated Programme Management Consultant (PMC) on a scheme specific basis.

Appendix A-1: New Section 5.15 – P 5/24 QHDM (Full)

impacts, the roll angle toward the barrier imparted to high centre of gravity vehicles may be enough to permit contact of the top portion of the vehicle with objects on top of or immediately behind the barrier, such as bridge piers. Rigid (concrete) barrier systems accepted for use in Qatar are the public domain F-Shape Barrier or the California 9.1° Single Slope Barrier. Any alternative or proprietary systems must be accepted by the Public Works Authority.

Typically the system is relatively low cost, has generally effective performance for passenger-sized vehicles and has maintenance-free characteristics.

End Treatments

The untreated end of a safety barrier is extremely hazardous if hit, as the beam element can penetrate the passenger compartment and will generally stop the vehicle. A crashworthy end treatment is therefore considered essential if the safety fence is in an area where it is likely to be hit head-on by an errant vehicle. The termination of the safety barrier should not spear, vault or roll a vehicle for head-on or angled impacts. For impacts within the length of need, the end treatment should have the same redirectional characteristics as the standard safety fence, which means that the end must be also properly anchored.

There are a number of different types of end treatments which work on a range of principles, some of which are listed below:

- Breakaway Terminals
- Energy Absorption Systems
- Special Anchorage for Cable Fence
- Anchorage into Embankment

Further reference is essential to select the most appropriate system for each particular situation.

Only crashworthy end terminals that have met appropriate testing criteria such as NCHRP 350, MASH 08 or EN 1317 and have been approved by the Public Works Authority may be used.

Ramped end terminals should only be used in low speed environments (60km/h or below) or where the terminal cannot be hit head-on by vehicles. i.e. on one-way roads or on divided roads with a protective median barrier.

Transitions

Transition sections of safety barrier are necessary to provide continuity of protection when two different barriers join, when a barrier joins another barrier system (such as a bridge rail) or when a roadside barrier is attached to a rigid object (such as a bridge pier).

The transition section should be the same strength or stronger than the two systems.

The transition should be long enough so that significant changes in deflection do not occur within a short distance. Generally the transition length should be 10 to 12 times the difference in the lateral deflection of the two systems in question ego for a beam deflection of 1.5m the transition should be around 15m.

Drainage features such as ditches should be avoided at transition positions as they may initiate vehicle instability.

The stiffness of the transition should increase smoothly and continuously from the less rigid to the more rigid system. This can be achieved by decreasing the post spacing, increasing post size or strengthening the rail element.

Only transition systems accepted by the Public Works Authority may be used.

Selection of Performance Criteria

The selection of Safety Barrier performance shall be in accordance with US NCHRP 350, MASH 08 and/or EN 1317 requirements. Table 5.5a identifies the minimum equivalent test level performance for all Expressway Projects. Increased containment levels should be considered adjacent to bridge piers, overhead gantries, railways, and where the carriageway contains a high proportion (i.e. >10%) of HGVs.

Barrier Type	Minimum Equivalent Test Level Performance
Rigid Systems	
Rigid Median Barrier	TL4 / H2
Rigid Edge Barrier	TL4 / H2
Semi Rigid Systems	
Semi Rigid Median Barrier	TL4 / H2
Semi Rigid Edge Barrier	TL3 / H1
Flexible Systems	
Flexible Median Barrier	TL4 / H2
Flexible Edge Barrier	TL3 / H1

Table 5.5a Minimum Equivalent Safety Barrier Test Level Performance Levels

The performance for bridge parapets shall meet the guidance criteria as set by the Bridge Design Criteria and utilise only transition systems accepted by the Public Works Authority.

Selection of Safety Barrier

The selection process is not easily defined but the most desirable system is one that offers the required degree of protection at the lowest total cost. Table 5.6 summarises the factors to be considered.

Where high risk containment areas are expected, the engineer should refer to the "Design Manual for Roads and Bridges, Volume 2, Section 2, Part 8 TD19/06 or the AASHTO Roadside Design Guide 2002 for further guidance.

Only safety barrier systems, including crash cushions, end terminals and transitions. that have been accepted by the Public Works Authority may be used.

Appendix A-2: New Section 5.15 – P 5/24 QHDM (Track Changes)

impacts, the roll angle toward the barrier imparted to high centre of gravity vehicles may be enough to permit contact of the top portion of the vehicle with objects on top of or immediately behind the ~~fence~~barrier, ~~ego~~ such as bridge piers. ~~Commonly used~~ Rigid (concrete) barrier systems accepted for use in Qatar are the public domain ~~New Jersey Barrier~~ F-Shape Barrier or the California 9.1° Single Slope Barrier. Any alternative or proprietary systems must be accepted by the Public Works Authority. ~~in the USA, and the British Concrete Barrier in the UK.~~

Typically the system is relatively low cost, has generally effective performance for passenger-sized vehicles and has maintenance-free characteristics.

End Treatments

The untreated end of a safety ~~fence~~ barrier is extremely hazardous if hit, as the beam element can penetrate the passenger compartment and will generally stop the vehicle. A crashworthy end treatment is therefore considered essential if the safety fence ~~terminates within 10m of the travelled way and/or~~ is in an area where it is likely to be hit head-on by an errant vehicle. The termination of the safety ~~fence~~ barrier should not spear, vault or roll a vehicle for head-on or angled impacts. For impacts within the length of need, the end treatment should have the same redirectional characteristics as the standard safety fence, which means that the end must be also properly anchored.

There are a number of different types of end treatments which work on a range of principles, some of which are listed below:

- Breakaway Terminals
- ~~Turned Down Terminals~~
- Energy Absorption Systems
- Special Anchorage for Cable Fence
- Anchorage into Embankment

Further reference is essential to select the most appropriate system for each particular situation.

Only crashworthy end terminals that have met appropriate testing criteria such as NCHRP 350, MASH 08 or EN 1317 and have been approved by the Public Works Authority may be used.

Ramped end terminals should only be used in low speed environments (60km/h or below) or where the terminal cannot be hit head-on by vehicles. i.e. on one-way roads or on divided roads with a protective median barrier.

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Transition sections of safety ~~fence~~ barrier are necessary to provide continuity of protection when two different barriers join, when a barrier joins another barrier system (such as a bridge rail) or when a roadside barrier is attached to a rigid object (such as a bridge pier).

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Barrier Type	Minimum Equivalent Test Level Performance
Rigid Systems	
Rigid Median Barrier	TL4 / H2
Rigid Edge Barrier	TL4 / H2
Semi Rigid Systems	
Semi Rigid Median Barrier	TL4 / H2
Semi Rigid Edge Barrier	**TL3 / H1**
Flexible Systems	
Flexible Median Barrier	TL4 / H2
Flexible Edge Barrier	**TL3 / H1**

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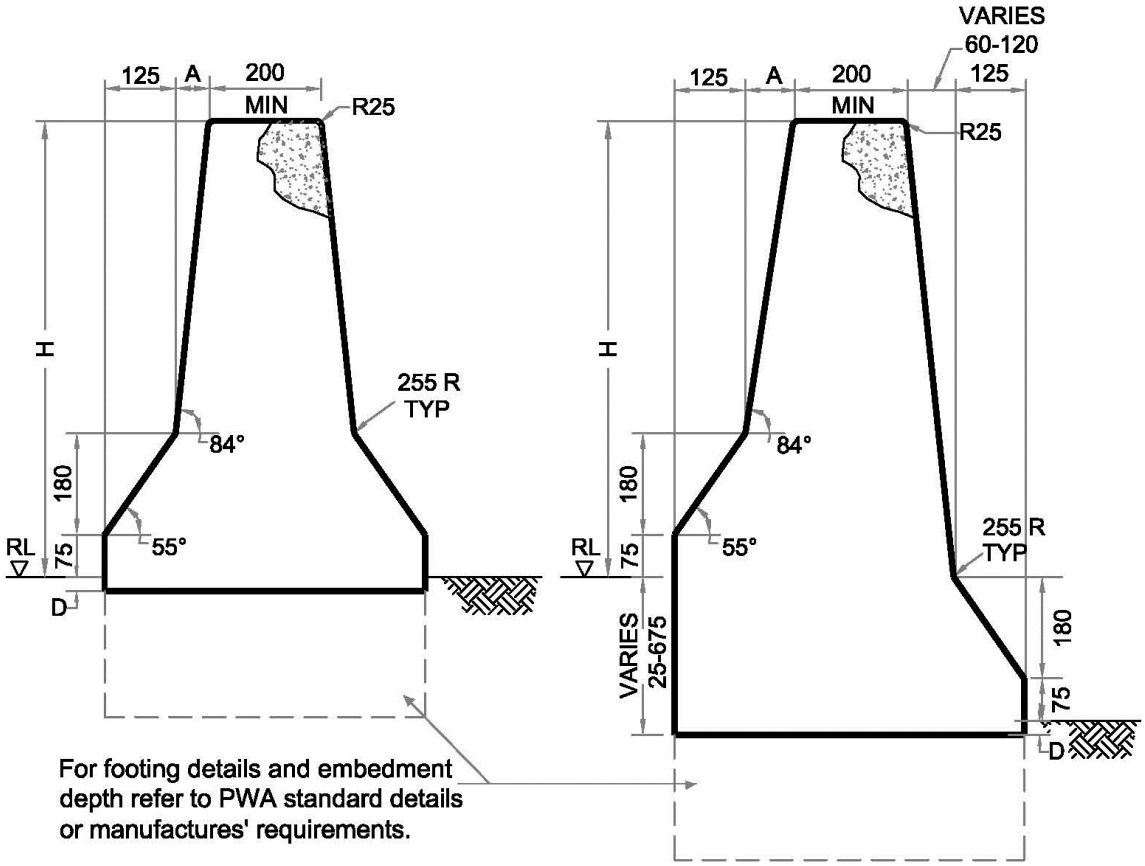
Only safety barrier systems, including crash cushions, end terminals and transitions, that have been accepted by the Public Works Authority may be used.

Appendix B-1: F-Shape Rigid Concrete Barrier Profile (TL-4 to TL-5)



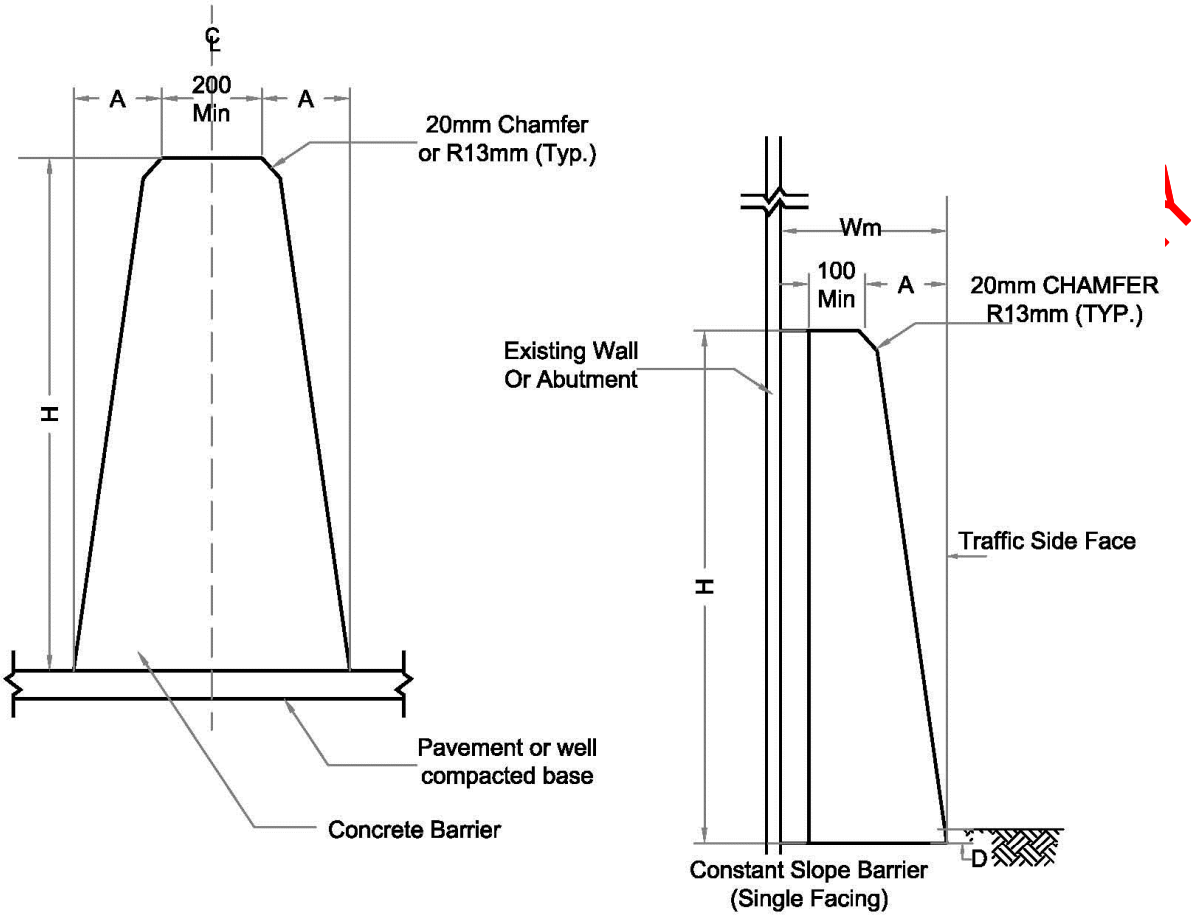
SYSTEM	A	H	
SGM10a	60	810	TL - 4
SGM10b	85	1070	TL - 5

* All dimensions are shown in millimeters

Note – All edges to be rounded to R25 except as shown. When used as a roadside barrier overall mass and dimensions must not be reduced.

The F-Shape concrete barrier system as shown above is described in the US Department of Transport - Federal Highways Administration. (Source AASHTO-AGC-ARTBA Joint Committee, Subcommittee on New Highway Materials, Task Force 13 Report: *A Guide to Standardized Highway Barrier Hardware – May 1995: System Drawing SGM 10a-b*) – FHWA Acceptance Letter B-64:2002.

Appendix B-2: California Single Slope Concrete Barrier Profile (TL-4 to TL-5)



SYSTEM	A	H	
TYPE 60	130	810	TL - 4
TYPE 60 E	170	1070	TL - 5

* All dimensions are shown in millimeters

The 9.1 degree face Single / Constant Slope Barrier system as shown above is described in State of California Department of Transport (CALTRANS), under the reference as Concrete Barrier Type 60. – FHWA Acceptance Letter B-45:1998.

For footing details and embedment depth refer to PWA standard details or manufactures' requirements.