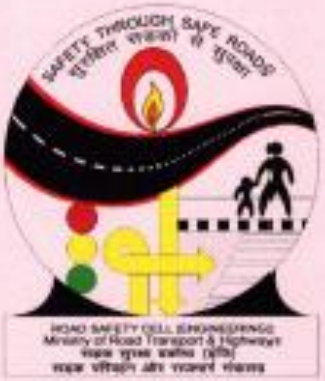
Report on

Installation of Crash Barriers at accident prone locations on National Highways in Hilly Terrain



Ministry of Road Transport & Highways

Government of India

June, 2016

1.Background:

A meeting was convened by Hon'ble Minister (RTH&S) on 08.06.2016 in respect of Crash Barriers on National Highways in hilly terrain in view of repeated accidents occurring at curves in Hilly terrain, wherein about 30 manufacturers of Crash Barriers have participated apart from the officers of Ministry/NHAI/NHIDCL. After detailed deliberations on relevant issues, Hon'ble Minister directed that a report on installation of crash barriers in hilly terrain at accident prone locations covering the technology to be used / methodology for implementing the installation of theses crash barriers etc., be prepared by a three Member Committee comprising Shri S.N. Das, DG(RD) &SS, Shri B.N. Singh, Coordinator-III and Shri Ravi Prasad, Chief Engineer (Road Safety). Accordingly, all these issues were studied and the following report is submitted.

2. Purpose and requirements for crash barriers

2.1 Crash barriers of appropriate type are installed at accident prone locations especially at locations like valley sides of hilly roads, high embankments, sharp/blind curves etc. These are very useful in absorbing impact energy of the hitting vehicles and reducing the severity of the accidents. Various important considerations that go into the safety barriers are, they should contain the impacting vehicles and redirect them without allowing the crash barriers penetrating in to the vehicles or allowing the vehicles to volt over the crash barriers. To reduce the severity of the accident, the vehicle should remain upright after the impact. When the vehicle hits the crash barrier, it should not deflect for a distance more than the space available for the deflection. The crash barriers should have height & length above the minimum required height & length so that the crash barrier is able to withstand the impact of the vehicle without the entire crash barrier getting thrown off.

3. Types of crash barriers considered

3.1. Different types of crash barriers have been considered and their advantages and disadvantages have been studied.

(a) Concrete barrier (Rigid): New jersey type concrete rigid barrier is commonly used on bridges and medians of the highways and other locations especially where the median width are low. This barrier is slopped on front face and has a height of about 80 cm. This barrier requires adequate footing design or earth support. The severity in case of accident, hitting this type of barriers is high especially when the speeds are high in non-urban locations. Besides this construction of these barriers and installing pre-cast concrete barriers of this type is cumbersome. Due to these reasons, these barriers are not considered suitable for hilly regions.

(b) W Beam type steel barrier (Semi-rigid) : W Beam type barrier shall be about 70 cm above ground level and the posts are placed at about 2m centre to centre. These barriers when impacted by vehicles absorb energy through deflections. These barriers are found to make the vehicles having high centre of gravity fall and turn up side down which leave substantial fatalities and may also lead to catching fire, which adds to the severity of accident.

(c)Thrie Beam type steel barriers (semi-rigid): These barriers have a thrie beam shaped rail fixed at the top of the posts and cause less severe damage when impacted by vehicles especially at shallow angles of impact. This type of crash barrier is about 85cm above ground level and thus suitable for vehicles having higher centre of gravity. All the steel components are galvanized by hot dip process. In this crash barrier also, it is observed that the vehicles do not remain upright after the impact there by causing substantial damage to the vehicle.

(d)Modified Thrie beam crash barriers (semi-rigid): In this crash barrier, a few modification cations have been made competed to normal thrie beam type barriers by increasing the spacer channel size compared to the post size leaving the lower the lower edge of the thire bream unconnected to the spacer channel and providing large notch cut to the web of the spacer channel at the lower end. These modification improved

the performance of the crash barrier by way of keeping the deflection lower and keeping the vehicle upright even after the Impact.

(e) Wire rope crash barriers (flexible): These crash barriers have large deflections and a such required substantial space allowing deflection which is normally not available in the hilly areas. These barriers are not considered suitable for radii of curves are much lesser than 450 m. therefore, these barriers are not considered suitable for hilly regions.

3.2 Due to improvements in Modified Thrie beam type crash barrier, it is considered most appropriate for the hilly areas where space is constrained and lesser space is available for deflection and is recommended for installation

4. Specifications and installation of the crash barriers:

4.1 IRC-119-2015 "Guidelines for traffic safety barriers" gives elaborate details on the design and installation of different types of crash barriers including thrie beam type steel crash barriers. IRC- SP-73 and IRC- SP-84 also cover the details on installation of crash barriers for two lane and four lane Highways. Suitable connections are to be provided on the approaching and trailing sides duly taking into account the availability of space and other site constraints in the light of the provisions of these IRC codes

4.2 As recommended above, modified thrie beam crash barrier is considered suitable and appropriate for installation at curves on National Highways in Hilly terrain. The details of modified thrie beam crash barriers which are slightly improvised version of the thrie beam type are elaborated in "Road Side Design Guide" of AASHTO. Testing of this crash barrier is as per European Standard for safety testing of crash barriers i.e, EN 1317 or NCHRP Report 350/ Manual for Assessing Safety Hardware (MASH). The crash barriers have to be installed with appropriate end connections like Modified Eccentric Loader Terminal and Trailing Terminal within the space & site constraints. The work of installing crash barriers should be for complete item of supply, transportation to site, inspection & testing at site etc. Sketches giving broad details of this type of modified thrie beam type crash barrier are at Annex-l.

4.2 The crash barriers should have desirably a horizontal clearance of 2.5m from the travelled path of the vehicles. However, due to site constraints, this space may not be available at many of the locations. Therefore, a minimum horizontal clearance of 0.6m should be maintained while making the crash barriers highly conspicuous by affixing retro reflective tapes of 100mm X 100mm (high intensity grade) at 2m centre to centre at top and bottom of the thrie beam rail in a staggered manner). In order to provide lateral support to the crash barrier posts, there should be a minimum edge distance of preferably one metre. However, in case of space constraints, a minimum distance of 0.6m should be maintained ensuring stability with adequate embedment. The post should be taken below ground level up to sufficient depth (not less than 1.15m) as per the instructions of manufacturers. Suitable Hazard markers should be fixed at the ends to warn the road users of the approaching hazard. Other installation details should be strictly as per the instructions of the manufacturers to ensure the intended performance of the crash barriers.

5. Costing and procurement:

5.1. The cost of the crash barrier shall be assessed on per metre basis which includes end terminals and installation but not transportation to the site which would be a separately payable item. The crash barriers should have a minimum length of 50m so as to function effectively in containing the impacted vehicle. The cost of the crash barriers including supply, installation, testing including transportation to the site can be obtained through bidding from the prospective crash barrier suppliers. A minimum supply quantity of 10000m can be specified in the conditions so that the benefit of cost reduction resulting from the scale of supply and installation can be taken. The manufacturers should furnish a warranty for the crash barrier for a period of three years during which the performance of the crash barriers in case of impacts in the accidents would be monitored by the executing agency and a report on the same shall be furnished to the Ministry by its agencies like NHAI/NHIDCL/State PWDs/BRO for future guidance. In case of failure of the crash barrier to contain the vehicle as intended, an appropriate penalty would be imposed on the crash barrier

provider and the crash barrier should be replaced by the provider. These provisions should be suitably incorporated in the tender documents.

5.2. Sanction can be issued to the respective states for installation of crash barriers in selected stretches. The details of proposed stretches for installation of crash barriers in hilly terrain on National Highways shall be obtained from the concerned Chief Engineers of NHs based on the following criteria:

(i) Locations of repeated fatal accidents as evidenced by accident records.
(ii) Locations at which the sight distance is less than 60m
(iii) | Locations where the radius of curve is less than 100 m.
(iv) Locations where cross roads are joining the NH at acute angles.

5.3 In due course, a panel of suppliers who are ready to supply the crash barriers of specified type at lowest cost assessed through competitive bidding can be put on empanelled list of crash barrier providers on the lines of cement & steel presently placed on the web portal. The list along with the lowest rate can be circulated to the concerned requesting them to take the supply from the nearest supplier subject to availability of capacity with them to supply the required quantity with in the stipulated time schedules. In case of repeated failures In intended performance of the crash barrier, the provider would be taken off from the empanelled list.

5.4 The committee recommends the installation of crash barriers on National Highways in Hilly terrain as per the above guidelines

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16-06-2016

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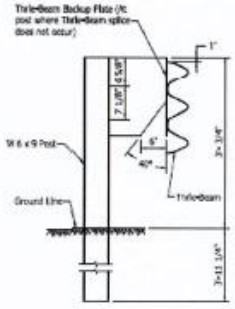
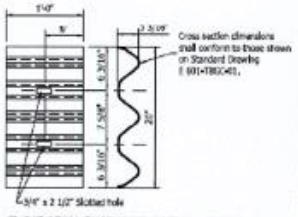
Broad details of modified thrie beam steel crash barriers

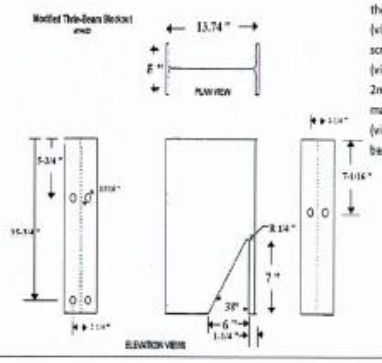
Annex-I



THRIE BEAM GUARDRAIL



THRIE BEAM GUARDRAIL BACK-UP PLATE AT LOCATIONS WITHOUT SPLICE



Notes:

(i) Posts of I-section of minimum 150mm x 100mm x 4.3mm and spacers of I-section of minimum 350mm x 127mm x 5.9mm shall be used.

(ii) Thrie beam steel section shall be of specified dimensions of minimum 3 mm thickness.

(iii) Steel to be used shall have minimum ultimate tensile strength of 490 Mpa.

(iv) All the bolts/ fasteners shall develop requisite strength in the intended working conditions and all the components of crash barrier shall be galvanized through hot dip process.

(v) All the details of installation, fixing to ground, end connections etc., meeting the requirements of modified thrie beam steel crash barrier keeping in view the above shall be furnished by the manufacturer of the crash barrier to ensure the intended performance of the crash barrier in the working conditions.

(vi) During execution the instructions of the manufacturers shall be scrupulously followed.

(vii) Red retro reflective tapes of 100mm x 100m (high intensity grade) at 2m centre to centre at top and bottom of thrie beam rail in staggered manner shall be provided.

(viii) Suitable hazard markers shall be provided at the ends of the crash barriers to make the end terminals conspicuous.