Methodology & Specifications for Thrie Type Metal Beam Crash Barrier (MBCB) for Installation on Median Side of Yamuna Expressway Project

A. METHODOLOGY FOR INSTALLATION OF POSTS
(Refer Fig.-1 & 2)

1. The posts shall be installed with required lateral offset in such a way that the face of the crash barrier is flushed with the face of the raised median (Refer Figures-1 & 2).

2. After marking the position of the post on the ground, bore a hole of diameter which is about 20mm less than the width of the post. The hole shall be bored through the 150mm thick DLC layer, up to the bottom of the 150mm thick GSB layer using appropriate boring machine. The total depth of the bore-hole shall be 820mm (see **Figure-1**). Subsequently, re-fill the bore-hole completely up to top, using the excavated soil, with adequate tamping and ramming in layers not exceeding 150 mm. This completes first step of the process.

3. In the second step, the vertical post, shall be driven through the back-filled bore-hole, up to preferred depth, i.e., 1350mm below the top of the kerb, using a suitable driving/ ramming machine (refer **Figure-2**). The posts shall be driven ensuring the verticality in both horizontal directions, within acceptable tolerance limits, i.e., 6 mm in 3.0 m.

4. After installation of post, any visible damage to the galvanizing layer on top of the post, in terms of dents/ scratches, etc., shall be repaired adequately through anti-corrosive zinc sprays.

B. SPECIFICATIONS

1. The Thrie type Metal Beam Crash Barrier (MBCB) shall meet the specifications and performance criteria as mentioned in Section-B of the MORTH Circular dated 1st January, 2020, titled as follows:
   (A) Guidelines for providing type of Median on National Highways Network; and
   (B) Guidelines for Metal crash barrier (Semi Rigid) to be installed on National Highways

   Specifications of the Thrie type metal beam crash barrier other than specified in the above MORTH Circular, shall be in conformity with the following codes and standards:

   - MORTH Specifications for Road & Bridge Works (2013), 5th Revision
   - IRC: SP-99 (2013) Manual of Specifications & Standards for Expressways
   - IRC: 119-2015 Guidelines for Traffic Safety Barriers

2. The salient specifications out of the above referred MORTH Circular along with IRC:119-2015 that need to be followed for Yamuna Expressway Project are detailed below:

   a) The Thrie type metal beam crash barrier, hereinafter referred to as “crash barrier”, shall be crash tested 'Road restraint system' and shall meet the requirements of EN 1317 Part-2: Performance classes, impact test acceptance criteria and test methods for safety barriers and

vehicle parapets and/or to the requirement of the American Manual for Assessing Safety Hardware (MASH). The manufacturer shall demonstrate the compliance of these requirements by submission of videos of actual crash testing along with authenticated crash test reports. The crash tests must have been conducted in crash test laboratories/ institutions which are accredited for metal beam crash barrier testing.

b) The crash barrier system should be complete along with all required accessories and components such as transitions, end terminals etc. for required safety and performance standards in accordance with EN 1317 part-2 and/ or MASH. Recommended end terminals are either "Turned-down –guardrail" or "Anchored in back slope" type.

c) The crash barrier shall be performance tested for the Containment Level & Working Width as specified below:

Terrain	**Working Width**	**Containment Level**	**Remarks**
Plain/ Rolling	W4 (W_N <= 1.3m Or W5 (W_N <= 1.7m)	H2 as per EN 1317, Part 2 Or TL4 as per MASH	<u>Containment Level H2</u>: - Car of 900 kg, Speed 100 Kmph, Impact angle 20 degrees and, - Bus of 1,3000 kg, Speed 70 Kmph, Impact angle 20 degrees. <u>Containment Level TL4</u>: - Car of 1100 kg, Speed 100 Kmph, Impact angle 25 degrees and, - Pick up of 2270 kg, Speed 100 Kmph, Impact angle 25 degrees and, - Single unit truck 10,000 kg, Speed 90 Kmph, Impact angle 15 degrees.

It is important to note that the working width (W_N) mentioned above is the maximum lateral distance between the face of the barrier system before impact and the maximum dynamic lateral position of the barrier system or extreme point of the vehicle during impact unlike the dynamic deflection (Dm) which is the maximum lateral distance between the face of the barrier system before impact and the maximum dynamic lateral position of the face of the barrier system after impact.

d) All other requirement as per the EN 1317 and/or MASH should also be met by the crash barrier including following severity performances:

- **<u>Impact Severity level as per EN 1317</u>:**

  ASI (Acceleration Severity Index) and THIV (Theoretical Head Impact Velocity) should be of Level A, i.e. ASI <= 1.0 and THIV <= 33 Kmph

- **<u>Occupant Risk as per MASH</u>:**

  Occupant Impact Velocity (OIV) and Occupant Ride Down Acceleration (ORDA) should be as follows:

Occupant Impact Velocity Limits (m/s)		
Component	**Preferred**	**Maximum**
Longitudinal and lateral	9.1 m/s	12.2 m/s
Occupant Ride down Acceleration Limits (G)		
Component	**Preferred**	**Maximum**
Longitudinal and lateral	15.0 G	20.49 G

e) The posts, spacers, beam and fasteners of crash barriers shall be galvanized by hot dip galvanization process. The galvanizing on all other steel parts shall conform to the relevant IS specifications. All fittings (bolts, nuts and washers) shall conformed to the IS 1364 and IS 1367. All galvanizing shall be done after fabrication of individual structural components. Holes/ slots as required in various components shall be pre-punched before hot-dipped galvanizing.

f) Posts shall be installed as per methodology outlined in Section-A above.

g) Thrie beam to concrete crash barrier transition (at structures location) shall be carried out by decreasing the post spacing, nestling one rail behind another, and using steel section behind Thrie beam (refer Fig. 10.16 of IRC:SP:99-2013 for reduced post spacing and other details at transitions). If a different design for transition is proposed to be followed, the same shall be crash tested meeting the performance requirements as per EN 1317/ MASH standards.

The number of structures requiring transitions for each Phase of the project is listed below. At each structures location, a total of four (4) nos. of transitions are required, two (2) at both ends of the structure.

S. No.	Phase	Total no. of Structures	Total No. of Transitions	Remarks
1	PHASE-1	36	144	
2	PHASE-2	65	260	
3	PHASE-3	69	276	
	TOTAL	**170**	**680**	

h) Section 800 of MORTH Specifications shall be followed for installation of crash barrier. Any missing details for any structural element can be adopted from EN 1317 Part-2 and/ or MASH.

i) Test certificates for materials of all structural components shall be provided.

j) Following specific parameters for Thrie beam, post and hardware, wherever specified, shall be followed. Some of the parameters have been specified as “Preferred”, however, parameters

based on crash tested designs may be used. The vendor shall submit a general arrangement drawing clearly providing dimensional and material details of each of the components of the crash barrier system.

THRIE BEAM

1.	Thickness of steel sheet	=	3 mm profiled section (“Preferred”); however, should be at least >= 2.5mm
2.	Material Grade/Yield & Tensile strength	=	As per vendor’s crash tested design, however, min. E 250 Grade Steel with Yield Strength of 250 MPa & Min. Tensile Strength of 410 MPa
3.	Width	=	502 mm (“Preferred”)
4.	Depth of corrugation	=	81 mm (“Preferred”)
5.	Length	=	As per vendor’s crash tested design
6.	Hot-dipped galvanization	=	550 GSM (min. single spot)
7.	Splices	=	Complying to Fig. 10.15 of IRC:SP:99-2013 (“Preferred”), however, could be as per vendor’s crash tested design
8.	Holes & Slots in Beam	=	Pre-punched holes/ slots ready to erect
9.	Manufacturing process	=	Cold Roll Formed
10.	Tolerance in steel sheet thickness	=	+/- 0.20 mm

POST/ SPACER BLOCK

1.	c/c distance of posts	=	2.0 m (“Preferred”) (except at transition with concrete crash barrier at structures location), however, c/c post spacing could be as per vendor’s crash tested design
2.	Cross section of post	=	As per vendor’s crash tested design
3.	Cross section dimension of post	=	As per vendor’s crash tested design
4.	Cross section of spacer block	=	As per vendor’s crash tested design
5.	Cross section dimension of spacer block	=	As per vendor’s crash tested design
6.	Length of spacer block	=	As per vendor’s crash tested design
7.	Post Height	=	2000 mm (“Preferred”), however, could be as per vendor’s crash tested design
8.	Post height protruding above PQC top	=	850 mm (“Preferred”), however, could be as per vendor’s crash tested design
9.	Post embedment into soil	=	1350 mm (“Preferred”), however, could be as per vendor’s crash tested design
11.	Material Grade/Yield & Tensile strength	=	As per vendor’s crash tested design, however, min. E 250 Grade Steel with Yield Strength of 250 MPa & Min. Tensile Strength of 410 MPa
10.	Hot-dipped galvanization	=	550 GSM (min. single spot)
11.	Verticality tolerance	=	6 mm in 3.0 m
12.	Holes & Slots in Post/ Spacer block	=	Pre-punched holes/ slots ready to erect
13.	Manufacturing process	=	Cold Roll Formed

14.	Tolerance in steel sheet thickness	=	+/- 0.25 mm

HARDWARE

1.	Conforming to Indian Standard	=	IS:1367 & IS:1364
2.	Grade of bolts	=	Grade 8.8 with matching nuts ("Preferred"), however, could be as per vendor's crash tested design
3.	Dia. of Bolts	=	As per vendor's crash tested design
4.	Hot-dipped galvanization	=	550 GSM (min. single spot)

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