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To whom it may concern,

IWA 14-1 Impact-tested product design alterations
Protect Core Medium Duty 1.5T with Bollard

The following report documents the proposed adaptation of the original *Protect Core Medium Duty*, which was successfully tested in accordance with the impact test standard, IWA 14-1 [1] by MIRA Horiba Ltd. on 24th March 2021. The *Protect Core* was tested in conjunction with the *Inspira Protect Litter Bin*.

The *Protect Core* system is proposed to be marketed with a bollard sleeve.

Test Details

The tested *Protect Core* with *Inspira Protect Litter Bin* is described below:

MIRA test report reference	1223164-004-028-01, dated 26/04/2021
Test Standard	IWA 14-1:2013
Test date	24/03/2021
Test reference	Y0019
Rating awarded	V/1500[M1]/48/90:2.2

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Tested Design

The design of the original tested product is described as follows. The litter bin system incorporates a *Protect Core* impact structure with ground frame and foundation and an Inspira Protect litter bin.

The tested components are shown in the following manufacturing drawings and in Figure 1 and Figure 2 below:

- BSSMAN2737_A – PROTECT CORE [3] – *Impact structure*
- BSSMAN2764_0 – PROTECT LITTER [4]

Protect Core impact structure

The Protect Core impact structure consists of a ground frame assembly providing a socket for a post above ground. The ground frame comprises a 750x750mmx10mm thick steel base plate. 650x130x10mm half lap gussets are chamfered and welded around the post, to each other and to the base plate, to form the socket. Four lugs are welded to each of two sides of the baseplate, through which 12mm diameter reinforcing bars are threaded. A hoop of reinforcing bar is tied across the top of these lateral bars.

The impact post is formed from an 100x8 square hollow section (SHS) and 80x8 SHS inner section. The sections are 1010mm long and welded together on two sides at the top and bottom. A 16mm diameter pin is inserted through the base of the post to secure it into the socket. All steel is S355JR grade structural steel.

The height of the impact post above finished ground level (FGL) is 783mm.

The ground frame assembly is cast within a concrete foundation measuring 1300x1300x200mm deep atop a compacted MOT type 1 subbase. In the test installation, 80mm of compacted type 1 was used as a mock surface finish levelled with the ground. The total depth of the foundation below FGL is 280mm.

The concrete specification is C32/40 CEM 1. Toproc Rapid 1 additive was included in the concrete mix to ensure full strength within 8 days from the test installation. The final measured cube compressive strength of the concrete was 57.5N/mm².

Inspira Protect Litter Bin

The *Protect Litter Bin* is a bin assembly which has been modified to be installed on to the impact core. The outer shell is constructed from 5mm thick folded steel sheet with internal braces and a 2.5mm thick steel door and back panels. The shell is lightly secured to the post by 3no. 5.5x38 self-drilling screws though a folded fascia panel fixed to the back panel. A 0.8mm galvanised steel liner bin is rebated to fit around the post.

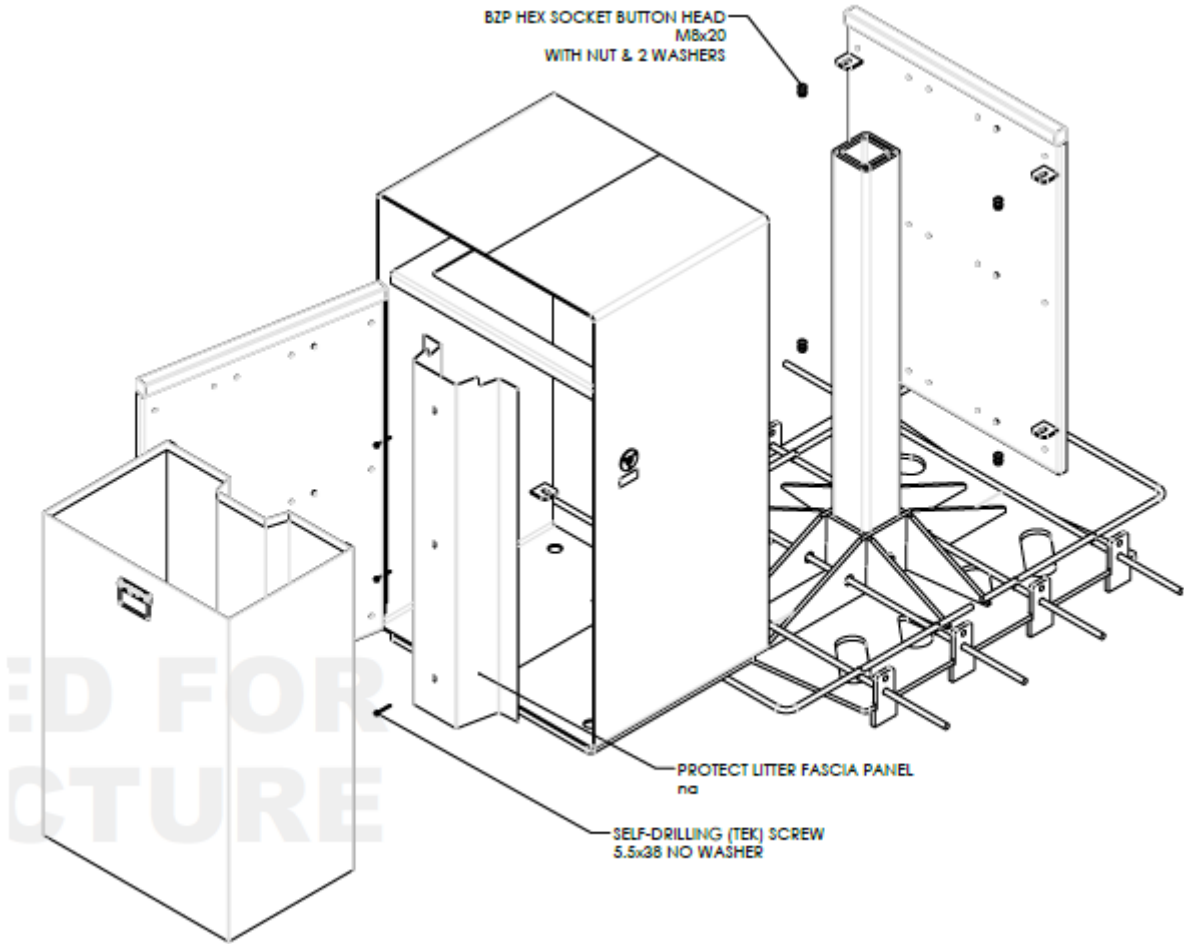


Figure 1: Isometric assembly view of Inspira Protect bin on Protect Core impact post and ground frame, taken from drawing BSSMAN2764_0

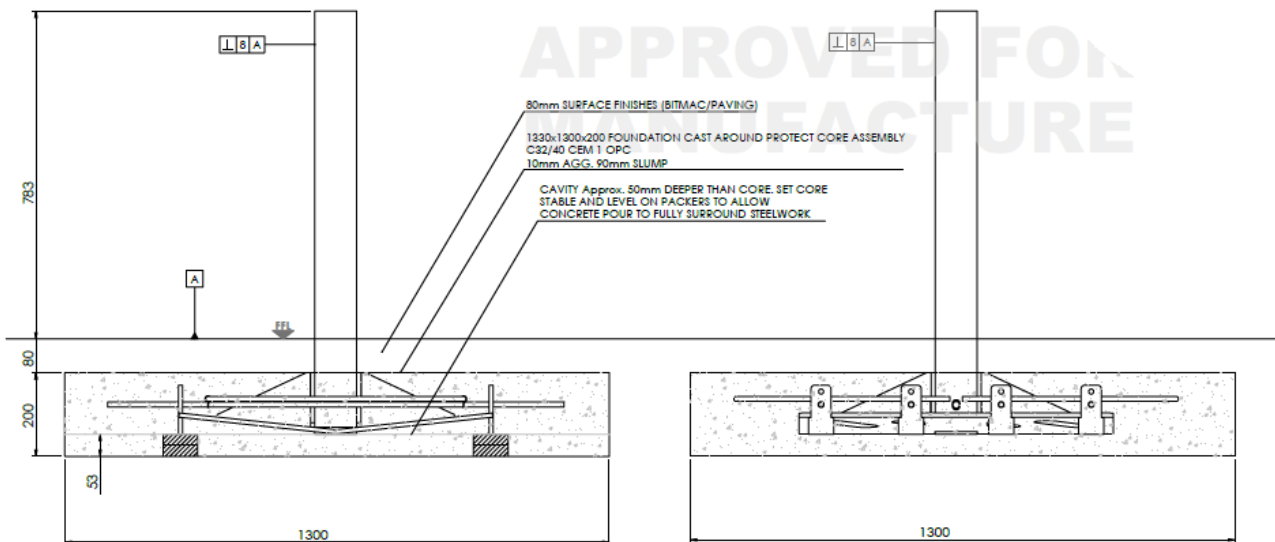


Figure 2: Front and side elevations of the Protect Core Medium Duty, taken from drawing BSSMAN2737_A

Impact Performance

Inspira Protect Litter Bin and Core test

The product was impacted with a 1,500kg M1 class vehicle aimed centrally at the bin/post. The bin assembly was immediately ejected from the back of the post and projected by 10.5m. The post bent backwards by 40° and the outer post tore on the front face, exposing the inner post. There was no visible damage observed to the concrete foundation below the surface finishes.

The vehicle was brought to a stop on top of the post midway along its wheelbase. The maximum recorded penetration of the vehicle beyond the barrier datum was 2.2m. The vehicle was disabled during the impact and was therefore awarded a pass rating in accordance with IWA 14-1 [1].

Proposed Design

Protect Bollard Single

The bollard consists of a thin-gauge sleeve over the *Protect Core Medium Duty* impact core. The impact core is coupled with the same ground frame as per the tested system.

The bollard sleeve will be offered in two designs shown in the following drawings and Figure 3 below:

- *Flat Top* – BSSGA2889_0 [5]
- *Semi-dome Top* – BSSGA2890_0 [6]

The bollard sleeves are shown as Ø139.7x2 stainless steel grade 304, but will also be offered in galvanised mild steel, Ø139.7x3.2.

The bollard sleeves will be lightly secured to the face of the impact post with self-drilling screws positioned within the impact zone (at least 250mm above FGL), covered with Sapele hardwood bumper strips. The bollard will sit 900mm above FGL and finish a few millimetres below the ground finishes. The sleeve is straight-ended; there is no flange or anchorage into the surface finishes or to the foundation.

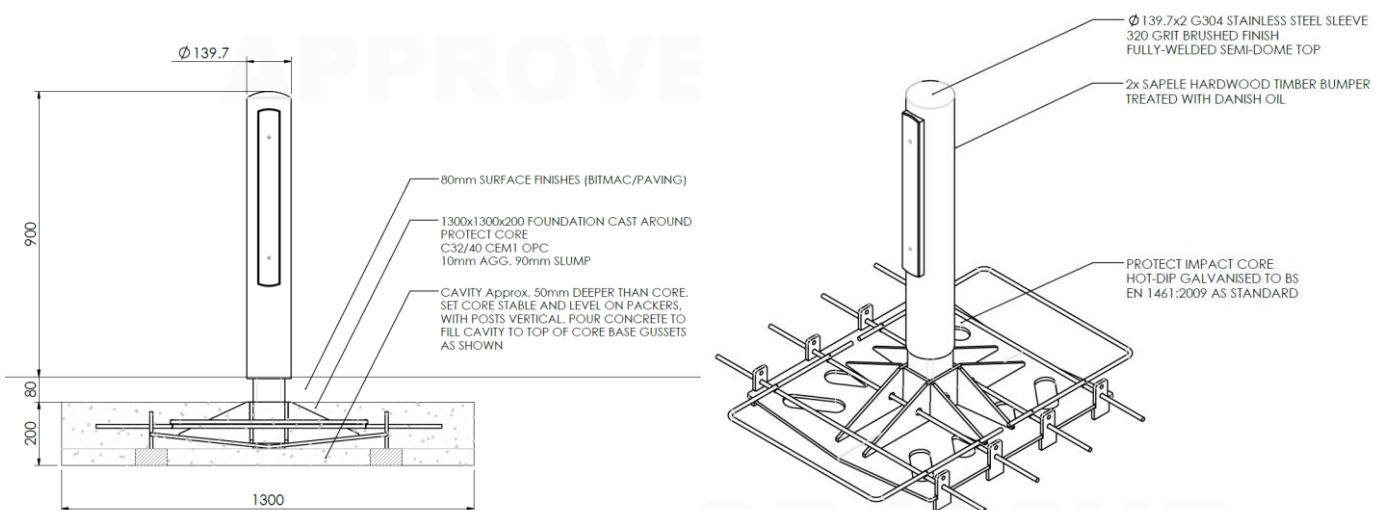


Figure 3: Front elevation and isometric of proposed Protect Bollard design, taken from drawing BSSGA2889_0

Concluding statement – RSES

The impact core, ground frame and foundation of the proposed *Protect Bollard Single (Flat Top and Semi-Dome Top)* design are identical to the *Protect Core Medium Duty* tested on 24/03/2021 in conjunction with the *Inspira Protect Litter Bin*. The proposed sleeve design will be offered in both 2mm thick stainless steel or 3.2mm thick mild steel. The sleeves will have no connection to the surface finishes or foundation and go down to approximately finished ground level.

It is considered that the sleeve will have no interaction with the ground or foundation. As it is lightly secured to the post within the vehicle impact zone at least 250mm above the bending location at or below FGL, it is considered that they will offer very little enhancement to the stiffness and resistance of the impact post. Therefore, there will be no significant increase to the force and moment transferred to the foundation during the impact. The foundation was observed to remain intact and uncompromised during the impact test.

It is noted that the foundation concrete must be specified as per the test condition, where the concrete achieves a minimum cube strength of 57.5N/mm². This may be achieved using the specified C32/40 grade concrete with Toproc Rapid 1 additive, or by increasing the concrete grade.

Based on the observations made during the impact test and an assessment of the drawing information provided we accept that the proposed *Protect Bollard Single*, in either stainless steel or mild steel, should not compromise the impact resistance of the underlying *Protect Core Medium Duty* impact core. It is noted that the aforementioned impact test was conducted with the vehicle aimed centrally to the product. On this basis, we believe the performance and penetration of the proposed product would be similar to that of the *Inspira Protect Litter Bin*, when impacted by a 1,500kg vehicle at 30mph.

The above statement is based upon a desktop study of the impact test results and comparison of the data made available to DGA. This study does not replicate a full, live impact test and the actual performance may differ to the expert opinion of the author.

RSES Member

Mark Coates IEng MICE RSES

(Principal HVM)

Signed



Document References

- [1] IWA 14-1:2013 – *Vehicle Security Barriers – Part 1: Performance Requirement, vehicle impact test method and performance rating*
- [2] HORIBA MIRA Ltd, test report reference 1223164-004-028-01, *Test Report – Y0019 Bailey Streetscene Ltd Inspira Protect Litterbin*, 07/12/2021
File name: [HORIBA MIRA Report 1223164 004 028 01 Y0019 Bailey Streetscene Ltd Inspira Protect Litterbin.pdf](#)
- [3] Bailey Streetscene Ltd drawing reference BSSMAN2737_A, *Protect Core Medium Duty 1.5t*, revision A, 01/09/2021
File name: [BSSMAN2737_A - PROTECT CORE.PDF](#)
- [4] Bailey Streetscene Ltd drawing reference BSSMAN2764_0, *Protect Litter*, 04/07/2021
File name: [BSSMAN2764_0 - PROTECT LITTER.PDF](#)
- [5] Bailey Streetscene Ltd drawing reference BSSGA2889_0, *Protect Bollard Flat Top*, 21/06/2022
File name: [BSSGA2889_0 - PROTECT BOLLARD_SINGLE_FLAT TOP.PDF](#)
- [6] Bailey Streetscene Ltd drawing reference : BSSGA2890_0, *Protect Bollard Semi-Dome*, 21/06/2022
File name: [BSSGA2890_0 - PROTECT BOLLARD_SINGLE_SEMI-DOME TOP.PDF](#)