Concrete Step Barrier Design Guidance
CSB: Conforming to BS EN 1317

DRAWINGS CSB/002 CSB/1000

Design Guidance Notes

The CSB products illustrated on the Britpave drawings and described in these data sheets conform to BS EN 1317. Design and construction outside the specification and design provided in the current Britpave drawings will result in a non-compliant system.

Safety standards and test requirements for road vehicle restraint systems are specified in BS EN 1317-2[1]. The requirements for the tests and the achieved values are summarised in Table 1 below. Britpave Surface-Mounted Concrete Step Barrier was tested at MIRA in the UK in April 2006. This product is discussed on Data Sheet DS/CSB/522.

Embedded CSB was tested in 1995 at L.I.E.R. in France and was subjected to both a car and bus collision.

Cat	Standards		L.I.E.R. test results	
Test No.	TB11	TB51	TB11	TB51
Vehicle Type	Car	Bus	Car	Bus
Vehicle Mass (kg)	900 ±400	13 000 ±400	870	12 650
Vehicle Speed (km / h)	100	70	101.4	72.1
Impact angle (°)	20	20	20	21

Table 1: Test parameters for embedded CSB

There are three main criteria within BS EN 1317:

- Containment level – maximum vehicle impact without failure of the barrier
- Impact severity level – the effect of impact on the occupants
- Deformation of restraint system – the dynamic envelope of the barrier or vehicle

[1] BS EN 1317-2: Road Restraint Systems Performance classes, impact test acceptance criteria and test methods for safety barriers
[2] TD 19 Requirement for Road Restraint Systems

Containment Level

CSB has containment class H2. Vehicle tests require the barrier to successfully contain vehicles up to 13 tonnes. The results from the test demonstrate that CSB can contain and redirect cars and buses. Although CSB can contain a 13 tonne bus, it can also minimize injuries to the occupants of small vehicles, thus ensuring safety for all kinds of vehicles.

Impact Severity Level

The effect of impact on occupants is more severe for a small vehicle than for larger vehicles. The impact severity level (Table 2) of the system has been assessed, in accordance with BS EN 1317, on three measures for the TB11 (car) test:

- ASI: Acceleration severity index
- THIV: Theoretical head impact velocity
- PHD: Post-impact head deceleration

Impact severity level class	ASI value	THIV & PHD values
A	≤1.0	THIV ≤ 33 km/h PHD ≤ 20 g
B	≤1.4	
C	≤1.9	

Table 2: Impact severity levels

Systems that provide lower Impact Severity Levels offer a greater level of safety for the occupants of an errant vehicle.

Additionally, TD 19[2] requires that the impact severity level for safety barriers should not exceed Class B.

Category		EN 1317 requirements	LIER test
Impact severity levels	ASI	A, B or C	1.4
	THIV	33 km/h	27.9 km/h
	PHD	20 g	12.55 g
Containment level		H2	H2

Table 3: Test requirements & results for CSB

Results for CSB are significantly better than those achieved for VCB. Britpave has conducted a study into ASI and impact with CSB. Further information is available on request.

THE KNOWLEDGE
Issue No **03**
Issue Date **July 09**

Deformation of Restraint System

The deformation of the restraint system during impact tests is characterised by dynamic deflection and the working width. CSB is a rigid safety barrier system; the test shows that dynamic deflection is zero in both the car and bus tests, while there is a working width of W1 and W2 respectively. Table 4 shows the relationship between levels and classes.

The centre of gravity of the test vehicle does not cross the centreline of the deformed system, eliminating the catastrophic crossover accident. The barrier contains and redirects the vehicle without structural damage to the principle longitudinal elements of the system.

Working width (m)	Classes of working width
W≤0.6	W1
W≤0.8	W2
W≤1.0	W3
W≤1.3	W4
W≤1.7	W5
W≤2.1	W6
W≤2.5	W7
W≤3.5	W8

Table 4: Levels of working width reproduced from BS EN 1317

When CSB is subjected to a TB51 test (Figure 1), CSB contains the vehicle and re-directs it along the face of barrier in the same direction as the traffic flow (Figure 2).

Minimal Damage

Under test conditions, CSB sustains minimal damage on impact (Figure 3); the barrier continues to be serviceable and provide containment, even after the TB51 test.

This contrasts with deformable steel safety barrier products, which are severely damaged during the TB51 test (Figure 4) and require replacement even after the TB11 car impact.

Deformable steel safety barriers are unusable following impact and require replacement, leading to high maintenance costs, with disruption to the road network.

CSB does not need repair, resulting in low maintenance costs, and lower risk to maintenance workers.

Figure 1

TB51 test showing 13t bus at 70kph approaching CSB at 20°

Figure 2

TB51 test showing 13t bus after impact with CSB

Figure 3

CSB following TB51 test

Figure 4

A deformable steel safety barrier following TB51 test

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