INCA Technical Guide 02

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Impact Resistance of EWI Systems

The fundamental requirement for a building façade to be able to resist impact loads is the same for external wall insulation (EWI) systems as other cladding types. Building façades have to cope with a variety of load conditions during their lifetime from self-weight and wind loads to everyday bumps and scrapes. These loadings must be accommodated by the EWI system without risk to the safety of the occupants or those around the building. At the same time, damage to the façade must be minimised, which would otherwise affect the serviceability of the structure. This guide considers the impact resistance of EWI systems depending on the type and location of building and the part of the building in question.

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Types of Impact

Soft Body impacts result primarily from people falling or thrown against the façade. They can be defined as bodies that can be deformed under impact and thus redistribute the load and an object such as a football would also be an example. *Soft Body* impacts tend to result in general bending of the façade.

Hard Body impacts result from the collision of rigid objects with the façade. As the bodies are unable to deform, they tend to cause localised punching through of the finish. Examples of *Hard Body* impacts include access equipment, bumps from vehicles and malicious damage from objects such as hammers etc.

There is a further impact type for *Perforation*, which refers to small-headed objects that can penetrate or perforate the surface.

Heavy and robust materials such as masonry or concrete are expected to withstand normal impacts; however, lighter forms of construction used in modern façades such as EWI require testing to determine their impact resistance, which must then be matched to the use category of the particular façade.

Test Standards

Guidance and test methods for impact resistance come from a variety of different sources; however, they are broadly similar using either steel balls for *Hard Body* impacts or canvas bags/balls filled with glass beads for *Soft Body* impacts. Perforation tests are conducted using special indentors.

The current standards, requirements and test methods are summarised and tabled overleaf.

Test Standard	Hard Body	Soft Body	Perforation	Pass Criteria	Use Categories	Comments
BS 8200:1985 British Standard	2 sizes of steel ball (6Nm or 10Nm) dropped on to horizontal test wall	Glass spheres in canvas bag (120Nm serviceability or 500 Nm safety) swung in a pendulum movement on to a vertical test panel	N/A	For minimum defined impact loads, walls are described as failure/ no damage/ damage to surface finish/ indentation	A – F depending on location and use Safe impacts for serviceability and security of persons Both relate to categories A – F	BS 8200:1985 has now been declared obsolescent [going out of use] although alternative guidance has not been produced.
ETAG 004 March 2000 Guideline for European Technical Approval Issued by European Organisation for Technical Approvals	Refer to ISO 7892	Non*	Perfotest using small hemispherical indentors (3 sizes)	No deterioration/ rendering not penetrated/ rendering not cracked Not perforated	Categories I, II and III define zones describing type of location and possible impact	Gives large and small Hard Body impacts as well as risk from perforation on systems < 6mm thick
ISO 7892:1988 International Organisation for Standardisation Vertical Building elements-impact bodies & general test procedures	2 sizes of steel ball (3J & 10J) swung in a pendulum motion against a vertical wall	Small soft body – 3kg ball Large soft body – 50kg spheroconical bag Both swung in a pendulum motion against a vertical wall	Non*	Non*	Non*	Test procedure only

Test Standard	Hard Body	Soft Body	Perforation	Pass Criteria	Use Categories	Comments
EN 13497:2002 European Standard specifying equipment and procedure for testing impact resistance of ETICS	2 sizes of steel ball (2J & 10J) falling through a pipe on to a horizontal test specimen or a rig in accordance with ISO 7892	Non*	Non*	No damage where damage is defined as visible reinforcement, delamination of coats, perforation of reinforcing coat	Non*	
MOAT 22:1988 UEAtc Directive for Assessment of EWI systems (EPS with thin rendering)	2 sizes of steel ball (3J & 10J) tested by pendulum or vertical drop	Non*	Perfotest using small hemispherical or cylindrical indentors	No deterioration, not perforated or not cracked Record indentor size against no perforation	Classes I, II & III ranging from severe exposure to stress to unexposed referenced to impact test results	
MOAT 43:1987 UEAtc Directive for impact testing on opaque vertical building components	2 sizes of steel ball (1kg & 0.5kg) but 3 energy levels (10Nm, 6Nm & 3Nm) tested by pendulum or vertical drop	Small soft body – 3kg ball Large soft body- 50kg spheroconical bag Tested by pendulum or vertical drop	Non*	Some damage can occur. Penetration not allowed for soft body. No falling debris or dislodging from fixings. Must not impair safety of structure.	5 use categories depending on location and risk of impact. Safe impacts for serviceability and security of persons.	Includes a bending test using a point load application & recording stress/ strain

Notes:

* Not tested under the standard
1Nm = 1 Joule

Key Design Considerations

Whilst there are several test methods, a common thread runs through them all. They all seek to demonstrate the resistance to impact through both *Hard Body* or *Soft Body* contact and some show additional resistance to perforation of small pointed objects.

The impact resistance needed for any particular building or part of building will depend on the type of building, its location and risk factors (such as vandalism or vehicular impact).

BS 8200, ETAG 004, MOAT 22 and MOAT 43 all provide guidance on categories of use depending on the impact test results.

Building designers should match the appropriate use category to EWI systems with adequate impact performance for the specified use. Due to the complexity of formulation and system design, it is not possible to define which EWI systems will perform best under given use categories. Advice and test data should be sought from system designers to establish the most suitable materials/systems.

The use categories and impact resistance levels are reproduced from the standards in Appendix A.

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Appendix A – Use Categories

BS 8200:1985

Table 2 – Categories Associated with Impacts on Surfaces of the Vertical Enclosure to Buildings (BS 8200:1985)

Category	Description	Examples	
A	Readily accessible to public and others with little incentive to exercise care. Prone to vandalism and abnormally rough use	External walls of housing and public buildings in vandal prone areas	Zone of wall up to 1.5m above pedestrian or floor level
B	Readily accessible to public and others with little incentive to exercise care. Chances of accident occurring and of misuse.	Walls adjacent to pedestrian thoroughfares or playing fields when not in category A	
C	Accessible primarily to those with some incentive to exercise care. Some chance of accident occurring and of misuse.	Walls adjacent to private open gardens. Back walls of balconies	
D	Only accessible, but not near a common route, to those with high incentive to exercise care. Small chance of accident occurring or of misuse	Walls adjacent to small fenced decorative garden with no through paths	
E	Above zone of normal impacts from people but liable to impacts from thrown or kicked objects	1.5m to 6m above pedestrian or floor level at location categories A and B	
F	Above zone of normal impacts from people and not liable to impacts from thrown or kicked objects	Wall surfaces at higher positions than those defined in E above	

Table 3 – Test Impacts for Retention of Performance of Exterior Wall Surfaces (BS 8200:1985)

Wall category (see Table 2)	Test impact energy for impactor shown		
	H1	H2	S1
	Nm	Nm	Nm
A	(see note 1)		
B		10	120
C	6		120
D	(see note 2)		
E	6		
F	3		

NOTE 1 No test impact values are given for category A walls. In each case the type and severity of vandalism needs to be carefully assessed and appropriate impact values determined.
NOTE 2 With category D walls the risk of impact is minimal and impact test values are therefore not appropriate.

The wall, when subjected to the impacts in Table 3, should not have a reduced performance.

The results of the test should be defined as follows:

Brittle materials: failure or no damage

Other materials: damage to surface finish, indentation or no damage

Where the damage is a dent, the depth of the dent should be quantified although the criterion for failure may be an aesthetic one only. The depth of indentation which is acceptable visually depends on the characteristics of the material, its finish and location.

Table 4 – Test Impacts to Ensure Safety to Persons (BS8200:1985)

Wall category (see Table 2)	Test impact energy for impactor shown	
	H2	S1
	Nm	Nm
A	(see note 1 to Table 3)	
B and C external and indoor surfaces	10	500
D	(see note 2 to Table 3)	
E external and indoor surface	10	
E and F external surface if access is required for regular cleaning and maintenance		350

ETAG 004 March 2000

The categories given in the following table have been adopted to correspond to the degrees of exposure in use. They do not include an allowance for acts of vandalism.

Table 8 – Definition of Use Categories (ETAG 004 March 2000)

Use Category	Description
I	A zone readily accessible at ground level to the public and vulnerable to hard body impacts but not subjected to abnormally rough use
II	A zone liable to impacts from thrown or kicked objects, but in public locations where the height of the system will limit the size of the impact; or at lower levels where access to the building is primarily to those with some incentive to exercise care
III	A zone not likely to be damaged by normal impacts caused by people or by thrown or kicked objects

The *Hard Body* impact with steel ball and the dynamic perforation with Perfotest represent the action from heavy, non-deformable or pointed objects which accidentally hit the system. Based upon the obtained results the system is assessed as being in category I, II or III as follows:

	Category III	Category II	Category I
Test 5.1.3.3.1 Impact 10 Joule		Rendering not penetrated[2]	No deterioration[1]
Test 5.1.3.3.1 Impact 3 Joule	Rendering not penetrated[2]	Rendering not cracked	No deterioration[1]
Test 5.1.3.3.2 Perfotest	Not perforated[3] by using an indentor of 20mm	Not perforated [3] by using an indentor of 12mm	Not perforated[3] by using an indentor of 6mm

[1] Superficial damage, provided there is no cracking, is considered as showing “no deterioration”.
[2] The test result is assessed as being “penetrated” if circular cracking penetrating as far as the insulation is observed.
[3] The test result is assessed as being “perforated” if a destruction of the rendering is shown up to a level beyond the reinforcement in at least 3 of the 5 impacts.

MOAT 43:1987

Five classes of vertical components, E_2, E'_2, E_3, E_4, E_5, have been adopted to correspond to various degrees of exposure to external impact which are defined in Table 3.1. Class E_1, which has not been included, would correspond to components subjected to particularly severe external impacts such as acts of vandalism.

Table 3.1 – Classification of Opaque Vertical Components according to Extent of Exposure to External Impacts (MOAT 43:1987)

Category	Description	Examples of components(*)
E_2	Readily accessible to public and others with little incentive to exercise care. Chance of accident occurring and of misuse.	Walls adjacent to pedestrian thoroughfares or playing fields, up to 1.5m above pedestrian level, but not in vandal prone locations.
E'_2	Above zone of normal impacts from people but liable to impacts from thrown or kicked objects	1.5m to 6m above pedestrian level at location category E_2
E_3	Accessible primarily to those with some incentive to exercise care. Small chance of accident occurring or of misuse.	Walls adjacent to private open gardens, back walls of access galleries or balconies, up to 1.5m above pedestrian level.
E_4	Only accessible, but near a common route, to those with high incentive to exercise care. Small chance of accident occurring or of misuse	Walls adjacent to small fenced decorative gardens with no through paths
E_5	Above zone of normal impacts from people and not exposed to impact from thrown or kicked objects.	Locations similar to E_2, but over 6m above pedestrian level. Locations similar to E_3 and E_4 but over 1.5m above pedestrian level.
*The height of 1.5m corresponds to the region where human impacts with the energies established in Table 2.1 are likely to occur in normal buildings. However, for some types of building, such as gymnasia and warehouses, greater heights may have to be considered.		