

Combustible Facades & AS 5113 Amendment 1 (Draft)

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Fire spread on facade



What is acceptable?



Outline

- Overview of current situation
- Engineering perspective of NCC requirements
- Definition of combustibility
- AS5113 fire propagation testing and classification of external walls revisited
- AS5113 Amendment 1
- AS5113 debris criterion



Combustible Facades

- Energy efficiency requires:
 - insulation on outside and thermal mass inside
 - Insulation, waterproofing membranes and vapor barriers are often combustible
- Composite panels extensively used for cladding
 - Core material can be EPS, XPS, PE, PP, PU, PIR and Phenolic
 - Aluminium - PE composite panel most common (sometimes with flame retardants/fillers)
- NCC 2016 Amendment 1
 - Clarified combustible external wall provisions
 - Introduced Verification Method CV3
- AS 5113 Amendment 1 out for public comment



Fire Hazard

- Window plumes from fires
 - Radiative and convective heat flux - Severe exposure sufficient to melt aluminium
- Fire spread via façade and external wall
 - Internal via cavities (both vertical and lateral)
 - External via combustible cladding (façade)
- Radiant heat flux from surrounding building
 - Radiant flux typically well resisted by low absorptivity aluminium
- Increased heat flux to surrounding buildings
 - Radiant source needs to consider façade contribution
- Fires outside building (ground and balconies)
 - External fires more likely to break into building



NCC Performance Requirements

- Fire spread **between** buildings; and
- Fire spread **within** buildings
- Fire spread on/in external walls controlled only to degree necessary
- Provision for safe evacuation
- Provision for fire brigade intervention

CP2

(a) A building must have elements which will, to the degree necessary, avoid the spread of fire—

(i) to exits; and

(ii) to sole-occupancy units and public corridors; and

Application: CP2(a)(ii) only applies to a Class 2 or 3 building or Class 4 part.

(iii) between buildings; and

(iv) in a building.



Spandrels

- NCC spandrel provisions are marginal at best
 - Only just effective for traditional narrow windows
- Adding extra fuel (combustible façade) makes it worse
- Equivalence not possible, absolute assessment difficult
- Fire propagation via cavity between spandrel and cladding further reduces effectiveness
 - Flame length longer as there is very limited entrainment
 - Flames likely to impinge directly on window of storey above
 - Weakest point around window (opening trim)
- Cavity barriers are needed to limit fire spread
 - NCC is silent on cavity barriers except for protected timber



Fire Code Reform Centre

- FCRC investigated the issue of non-combustible construction requirements in the BCA (Project 3)
- Identified post-fire performance expectations
- FCRC looked at the appropriate test method for assessment of combustible facades (Project 2)
- The Vertical Channel Test was recommended
- Identified limitations of AS1530.3 test and cone calorimeter for assessing fire behaviour of composites

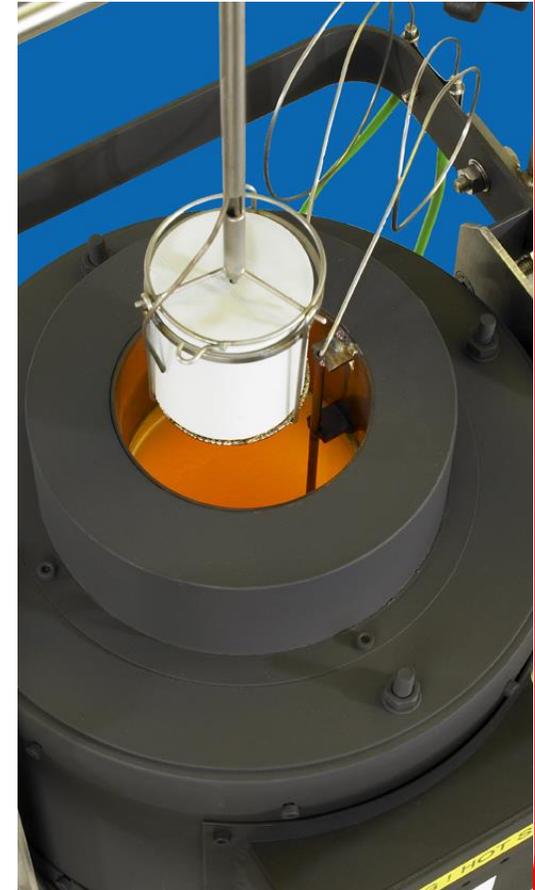


Vertical Channel Test at BRANZ



Combustibility Test – AS1530.1

- Called up by NCC to define “Non-combustible”
- Based on ISO 1182
 - Measures even small exothermic reaction without flaming
 - Specimen 50mm high (number of layers if less)
 - 45mm dia. cylindrical specimens inserted into furnace at 750°C
 - Must not flame for > 5s
 - Must not cause temperature rise > 50K
- Number of attempts internationally to adopt less strict definition
- FCRC Project 2 recommended basing it on Heat Release Rate



AS1530.1 Issues

- Inconsistency between NCC use and Clause 1.4 of standard
- NCC call-up overrides intended application in standard
- Suitable to determine combustibility of product if representative specimen can be made
- Emphasis on representing:
 - average properties (proportions)
 - surfaces at top and bottom

1.4 APPLICATION TO FIRE HAZARD

ASSESSMENT The test results relate only to the behaviour of the test specimens of the material under the particular conditions of the test, and are not intended to be the sole criteria for assessing the potential fire hazard of the material in use.

The test method is **not applicable to products which are coated, faced or laminated**. In such cases, tests may be carried out separately on the individual materials from which the product is formed.

2.1 SAMPLING The sample shall be selected to be representative of the **average properties** of the material.

2.2.3 Preparation If the thickness of the material is less than the required height, specimens of the height specified in Clause 2.2.2 shall be made by **using a sufficient number of layers** of the material and by adjustment of the material thickness if required.



AS 5113:2016

- Classification standard
- Provides guidance on testing and interpretation of test data
- Draws upon the ISO and British façade test standards for classification of External Wall Fire Performance
- Uses a 3 m x 3 m radiant heat source (vertical furnace) for classification for building-to-building fire spread
- Specifies criteria for classification
- Includes criteria for debris
- Temperature used to assess risk of fire spread
- Temperature criteria applied 2 storeys above fire



AS 5113:2016 – Classification External Wall

Provision	External Wall Performance (EW)
Applicable Test Methods	ISO13785-2 or BS8414
Classification	EW External wall system shall satisfy Classification Criteria in Clause 5.4.3 for ISO13785-2 or Clause 5.4.5 for BS8414
Modifications to Procedures	YES. Refer to Clauses 5.4.2 to 5.4.5



AS 5113:2016 –

Classification Building-to-Building

Provision	Building-to-Building Performance (BB)
Applicable Test Methods	Appendix C
Classification	BBnn External wall system shall satisfy Classification Criteria in Clause 5.4.6 when exposed to nn kW/m ² incident flux for 30 minutes.
Modifications to Procedures	No

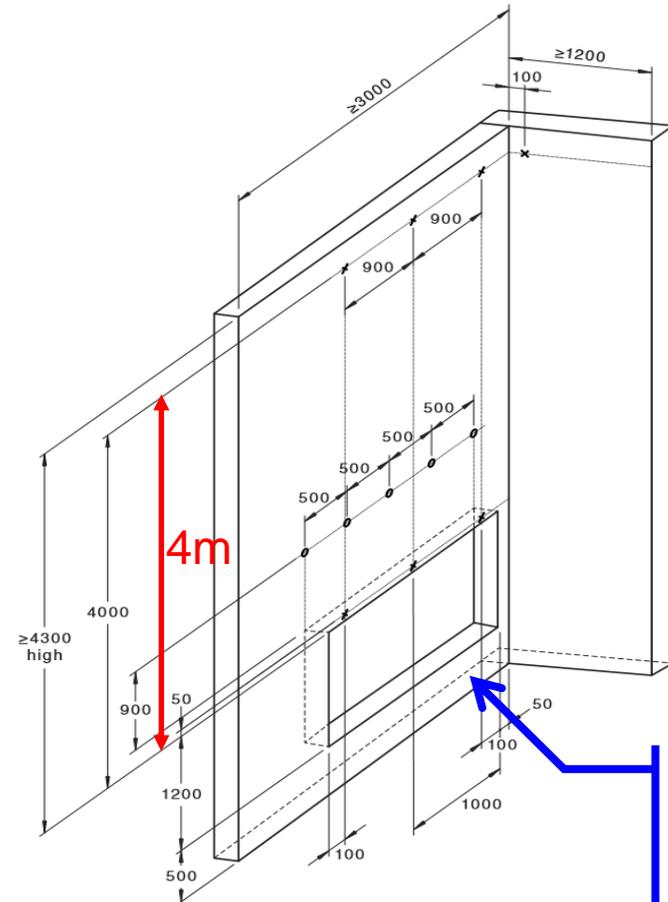


AS 5113:2016 – Test Requirements EW

- Test on external wall system (wall or “attachment”)
- Test specimen >4.3 m (ISO) or 5.0 m (BS) above opening
- Simulates two storeys at 0.3 m and 3.0 m above window
- Includes cavity barrier where part of system
- Classification based on temperatures 4 m (ISO) or 5.0 m (BS) above opening (2 storey above!)
- No flame spread beyond edge of specimen to occur
- No flaming on ground (debris or molten material) >20 s
- Not more than 2kg of fallen debris

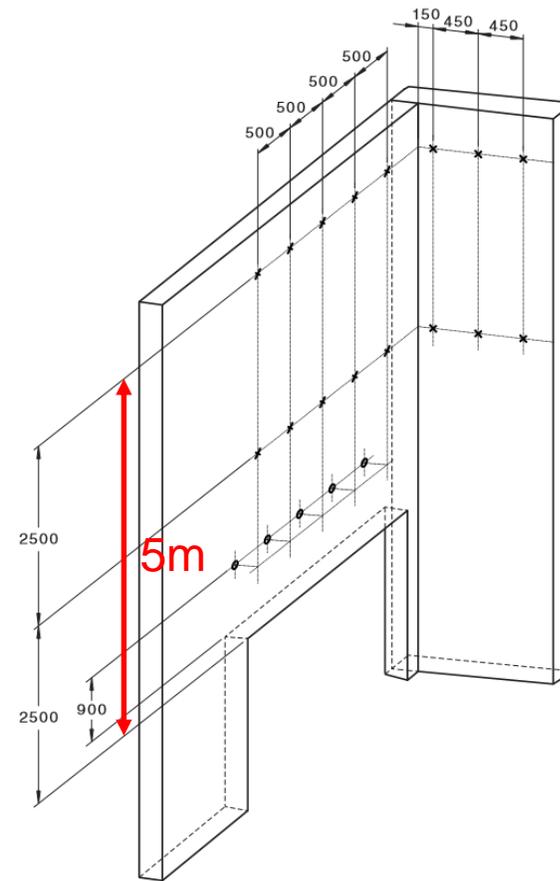


Comparison Test Configurations



ISO TEST

Note
Spandrel
Panel



BS TEST



AS 5113:2016 – Classification Criteria EW

Classification indices	Test method	Classification criteria	Related classification measure	Result in test	Pass/Fail
EW	ISO 13785-2	5.4.3(a) T_{w4m}	<600°C		
		5.4.3(b) $T_{cavity4m}$	<250°C		
		5.4.3(b) $T_{layer4m}$	<250°C		
		5.4.3(c) $T_{Unexposedside0.9m}$	<180°C		
		5.4.3(d) flaming	No flaming		
		5.4.3(d) openings	No openings		
		5.4.3(e) flame spread	No spread beyond specimen		
		5.4.3(f) debris flaming	<20 s		
		5.4.3(g) debris mass	<2 kg		



AS 5113:2016 – Classification Criteria EW

Classification indices	Test method	Classification criteria	Related classification measure	Result in test	Pass/Fail
EW	BS 8414-1 or BS 8414-2	5.4.5(a) T_{w5m}	<600°C		
		5.4.5(b) $T_{cavity5m}$	<250°C		
		5.4.5(b) $T_{layer5m}$	<250°C		
		5.4.5(c) $T_{Unexposedside0.9m}$	<180°C		
		5.4.5(d) flaming	No flaming		
		5.4.5(d) openings	No openings		
		5.4.5(e) spread	No spread beyond specimen		
		5.4.5(f) debris flaming	<20 s		
		5.4.5(g) debris mass	<2 kg		



AS 5113:2016 – Classification Criteria BB

Classification indices	Test method	Classification criteria	Related classification measure	Result in test	Pass/Fail
BB80 BB40 BB20 BB10	Appendix C	Prescribed level of exposure, in kW/m ²			
		5.4.6(a) T _{cavity}	<250°C		
		5.4.6(a) T _{layer}	<250°C		
		5.4.6(b) T _{unexposedside}	<180°C		



AS 5113:2016 – Possible Building Control

CLASSIFICATION OF EXTERNAL WALLS

Class	Application	Combustible option	
		External wall fire spread requirement	Additional building requirements
A100 plus	Type A construction, greater than 100 m effective height	No combustible option	None
A100	Type A construction, greater than 25 m but less than or equal to 100 m effective height	EW	Automatic sprinklers system with balcony protection
A25	Type A construction, less than or equal to effective height of 25 m	EW	Automatic sprinklers system with balcony protection
B	Type B construction	EW	Spandrels/horizontal projections



AS 5113:2016 – Possible Building Control

CLASSIFICATION OF EXTERNAL WALLS—BUILDING-TO-BUILDING SPREAD

Minimum distance from boundary or adjacent building	Combustible option	
	Façade fire requirement	Additional building requirements
On boundary or no distance between buildings	BB80	Nil
1 m from boundary or 2 m between buildings	BB40	Nil
3 m from boundary or 6 m between buildings	BB20	Nil
6 m from boundary or 12 m between buildings	BB10	Nil



AS 5113:2016 - Commentary

- Appendix B provides Informative Commentary
 - Selection of test protocol
 - Tests selected as they contains wing wall with re-entrant corner
 - Crib fire more meaningful and less costly than other fire sources
 - ISO preferred standard but BS commonly used and similar
 - Fire severity such as to challenge façade without dominating performance
 - Classification levels intended to be consistent with NCC
 - BB levels consistent with Verification Methods CV1 and CV2
 - BB assessment based on common AS 1530.4 test



AS 5113:2016 – Amendment 1 Draft

- Amendment 1 has just been released for public comment
- “Debris” now defined as having individual mass >100g
- Recommends debris weight distribution be reported
- Intended to be compatible with CV3 of NCC 2019
- Appendix A on possible regulatory framework replaced
- Appendix B now enhanced with further clarification as to performance assessment of facades based on test data
 - Clarifies that CV3 is not mandatory and normal performance assessment remains an option
- If debris criteria not satisfied: Recommends risk assessment
 - Risk assessment to consider height of building, proximity to egress routes, likely fire brigade intervention, sprinklers and nature of fallen debris

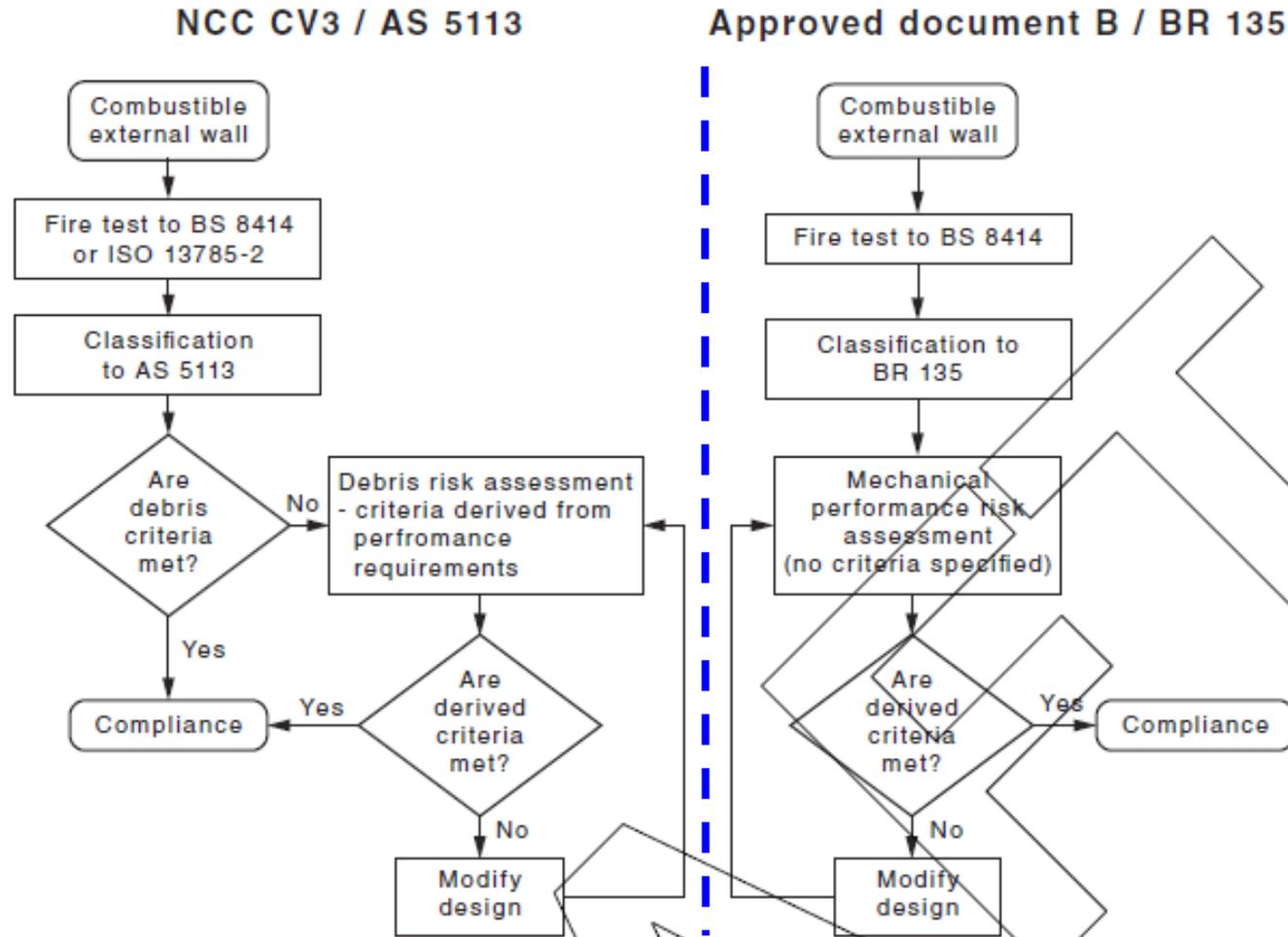


AS 5113:2016 – Classification Criteria Intent

Risk Mitigation	Measurement/Observation	Criteria
Prevention of fire spread to two floor levels above fire	Temperature 50 mm from façade, 5 m above opening	<= 600°C
Prevention of incipient fire spread to two floor levels above fire	Internal temperatures of materials and cavities 5 m above opening	<= 250°C
Prevent fire spread to two floor levels above fire and lateral spread	Flame spread beyond confines of specimen	Not permitted
Prevent fire spread to floors below	Continuous flaming on ground for more than 20 s from debris or molten material	Not permitted
Limit debris impact with fire fighters, occupants and passers-by	Total mass of debris	<= 2 kg
Prevent fire spread to floor above if wall not fire resistant	Non-fire side temperature 900 mm above opening	<= 180K rise
Prevent fire spread to floor above if wall not fire resistant	Flaming on non-fire side or the occurrence of openings in the unexposed face	Not permitted



AS 5113 Draft Debris Risk Assessment



AS 5113 Issues

- ISO 13785-2 and BS 8414 standards are not identical
 - Fire sizes are different
 - Specimen sizes are different
 - Temperature measurement locations are different
 - Opening dimensions are different (spandrel panel in ISO test)
- Tests have poor repeatability and reproducibility
- Specimens do not contain opening on next storey
 - Fire spread from opening to opening not assessed
- Heat flux from flames would cause fire spread with NCC spandrels
- Fire spread to next storey only assessed with fire-rated walls
- Fallen debris subject to high heat flux in BS8414 test



Debris Criteria

- Concern expressed about 2kg debris limit
 - Is total 2kg of charred flakes or dust really a hazard?
- Studies conducted on risk posed by drones
 - Objects falling from heights may reach terminal velocity
 - Terminal velocity for 4cm² 100g steel bolt is about 70m/s
 - Impact energy is 245J
 - 2kg limit based on survivability of blunt object impacts
 - 100g limit based on impact energy
 - 76J limit proposed for head
 - 200J limit proposed for body
- FB helmet impact energy criterion of 50J shock absorption

$$v_t = \sqrt{\frac{2mg}{C_d A}}$$

2013

Human injury model for small unmanned aircraft impacts

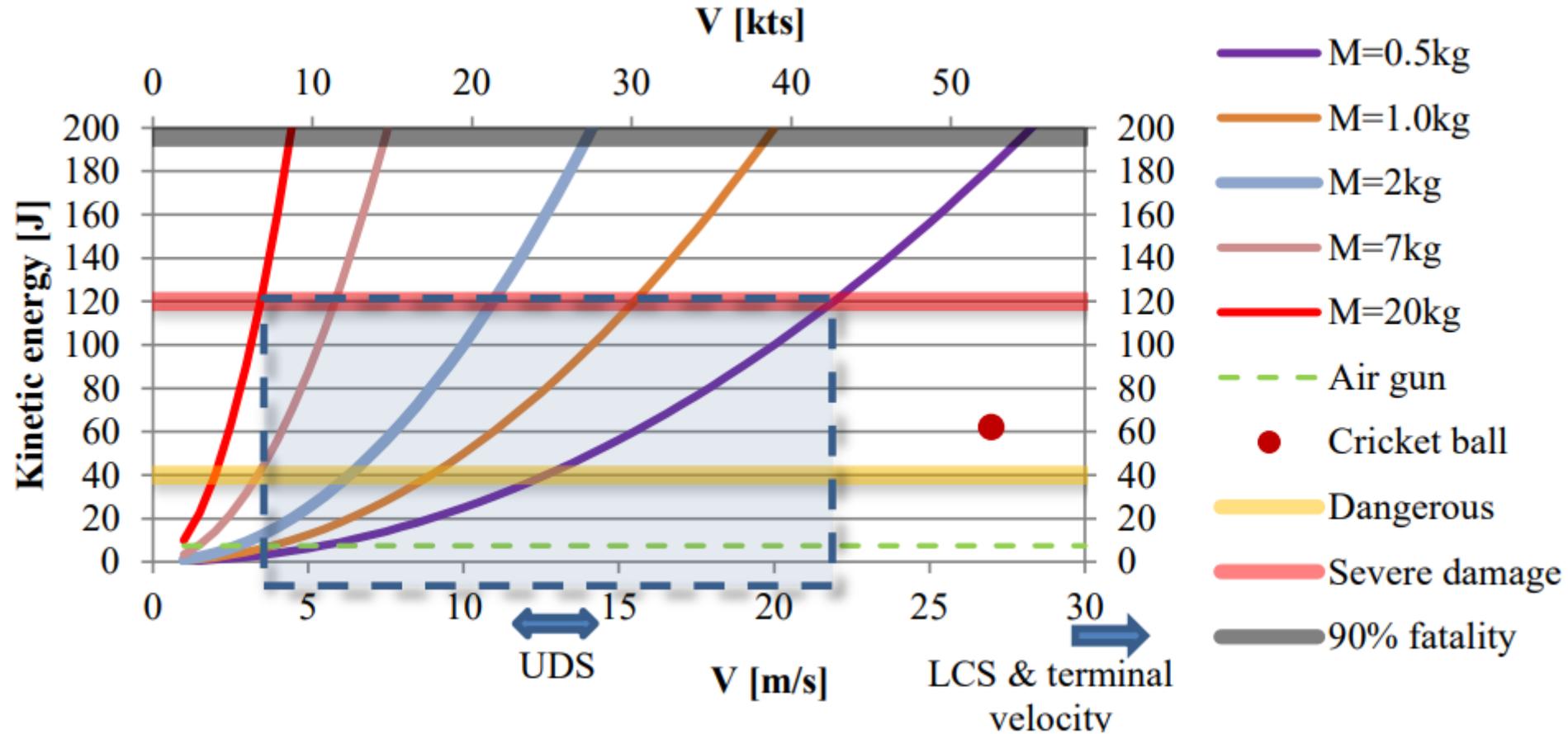


The impact into the thorax with a 2kg object at 10m/s (20kts) is survivable with serious injuries. The model predicts the absence of serious head injuries (skull fracture) for an RPA mass under 2kg and impact velocities below 7.5m/s (15kts).

Civil Aviation Safety Authority
Civil Aviation Safety Authority /
Monash University
12/23/2013



Impact Energy of Debris



Conclusions

- Combustible materials are often needed in external walls
- Combustible facades must meet community expectations for fire safety
- Require objective assessment of:
 - Fire performance – contribution to fire spread (compartment & building)
 - Impact on egress – risk of falling debris
 - Impact on fire brigade intervention – risk of falling and flaming debris
- NCC 2019 confirms:
 - Default non-combustible external walls
 - CV3 combustible external walls of proven performance with sprinklers
- AS 5113 provides:
 - classification and assists with interpretation of test data
 - guidance to fire engineers on test data

