Technical Guidance Note

THE BUILDING REGULATIONS 2004 EDITION – ENGLAND AND WALES
REQUIREMENT A3 – DISPROPORTIONATE COLLAPSE

1. INTRODUCTION

(a) This technical guidance note outlines NHBC’s interpretation of the disproportionate collapse Requirement A3 of the Building (Amendment) Regulations 2004, as detailed in the 2004 edition of Approved Document A. The guidance in Section 5 of the Approved Document is supplemented by the additional guidance in Section 2 of this document. This has been produced by NHBC Standards & Technical after liaison with the CLG, whose help is gratefully acknowledged, to cater for specific new build and conversions situations that may typically be encountered by NHBC, but that are not explicitly dealt with in the Approved Document guidance.

(b) Requirement A3 is reproduced below:

**Disproportionate Collapse**

_A3. The building shall be constructed so that in the event of an accident the building will not suffer collapse to an extent disproportionate to the cause._

Requirement A3 is mandatory and all buildings have been brought under control. The Requirement is met by an appropriate choice of measures to reduce the sensitivity of a building to disproportionate collapse should an accident occur. The means of achieving this is open to limited interpretation based on risk management principles and each application should be considered on its merits.

(c) **Section 5 of Approved Document A** contains guidance on measures that will meet Requirement A3. This has been developed from commissioned research and consideration of the recommendations given in Eurocode EN1991-1-7 _Action on structures - Accidental actions_. The approach adopted is to apply a level of robustness measures appropriate to the Class of the building. Four Classes of building (1, 2A, 2B and 3) are listed using building type and occupancy as their defining criteria. The building size and number of storeys are also critical in determining which Class applies. The guidance states the measures to be provided to ensure sufficient robustness for each Class.

(d) Compliance with the Building Regulations is the responsibility of the builder. Each building should be considered according to its individual circumstances. **This technical guidance note outlines concepts which, if proposed by a builder or consultant, would be considered by NHBC in principle to meet Requirement A3.** There is no obligation to adopt any particular solution contained in the Approved Document or this technical guidance note if there is a preference to meet the requirement in some other way and compliance can be demonstrated.
(e) It is important that disproportionate collapse provisions are considered in conjunction with other aspects of the building’s required performance (for example the transmission of sound, thermal insulation and the structural design philosophy) to avoid conflict. 

**Note:** for all separating walls and separating floors a check is needed to ensure the performance with respect to the requirements of Building Regulations Part E (Resistance to the passage of sound) is achieved.

(f) In addition to the disproportionate collapse issues in Approved Document A and Section 2 of this technical guidance note, PD 6697 *Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2* draws attention to the need to consider the potential effect of vehicular impact with masonry structures. Whilst not directly a building control matter, where there is a possibility that this could damage or remove vital load-bearing members of the structure, protective measures (such as the provision of bollards or barriers) should be considered. This would apply regardless of the Building Class in the Approved Document.

2. GUIDANCE AND INTERPRETATION

2.1 Robustness measures

(a) **Class 1 building robustness measures**

Buildings designed in accordance with the guidance for meeting compliance with Requirements A1 and A2 contained in

- Sections 2 – 4 of Approved Document A (2004 Edition), or
- the documents referenced under Section 1 of Approved Document A (2004 Edition)

are deemed to have adequate robustness to meet Requirement A3 for Class 1 buildings.

Section 2 of Approved Document A gives sizes of structural elements for certain residential buildings and other small buildings of traditional construction. **Note:** the guidance relating to thickness of walls and other general stability considerations is contained in **Section 2C** and applies to residential buildings of not more than 3 storeys.

**Example 1:**

Up to and including 3-storey houses of masonry construction

**Apply:**

- **Class 1** robustness measures, provided by design and construction in accordance with Sections 2 – 4 of Approved Document A.

**Example 2:**

4-storey houses of masonry construction

**Apply:**

- **Class 1** robustness measures, provided by design and construction in accordance with Sections 2 – 4 (excluding **Section 2C**) of Approved Document A, PD 6697 *Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2*, and other references in Section 1 of Approved Document A.
Class 1 buildings include “Buildings into which people rarely go…”. This is intended to cater for buildings such as plant rooms, sub-stations and storage warehouses.

(b) **Class 2A building robustness measures**

The robustness measures required for Class 2A buildings consist of
- effective horizontal ties, or
- effective anchorage of suspended floors to walls

in accordance with the Codes and Standards referenced in Section 5 of Approved Document A, paragraph 5.2.

In the case of masonry wall construction, the connection details in Clause 6.1.2 of PD 6697 *Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2* may be assumed to provide effective anchorage of suspended floors to walls where:
- straps or restraint type joist hangers are provided at the spacing specified for the building type and occupancy under consideration (see (i) below); or
- a precast concrete plank floor, precast concrete beam and block floor or in-situ concrete floor spanning on to a wall has a bearing of 90 mm or one-half the thickness of the wall or inner leaf of a cavity wall, whichever greater; or
- a precast concrete plank floor or in-situ concrete floor spanning parallel to a wall is effectively built into the wall (see (v) below).

Attention is drawn to the following:

(i) Where provided, anchors (i.e. straps or restraint type hangers) should be at intervals of not more than 2 m in houses of not more than 3 storeys and not more than 1.25 m for all storeys in all other buildings. This means, for example, that 2-storey flats would require anchors at 1.25 m intervals.

(ii) Galvanised mild steel anchors having a cross section of 30 mm x 5 mm may be assumed to have adequate strength for Class 2A buildings.

(iii) Where timber joists run parallel to the wall straps should be carried over at least three joists.

(iv) Floors (timber and concrete) abutting internal walls should be anchored at intervals as noted in (i) above.

(v) For effective anchorage of a precast concrete plank floor or in-situ concrete floor spanning parallel to a wall, the “built-in width” should not be less than 90mm or one-half the thickness of the wall or inner leaf of a cavity wall, whichever greater. In addition, for a precast concrete plank floor, the built-in plank should
- be fully bedded on wet mortar extending to the full built-in width of the floor, taking account of any pre-camber, and
- extend a minimum distance of 800 mm from the inner face of the wall.

Where floors are built in but these conditions are not met or workmanship is unsatisfactory (e.g. due to the method of placement of the planks), effective anchorage should not be assumed and anchors are required at intervals as noted in (i) above. These should be located *either* on top of the floor in which case they should turn up the cavity, or on the underside of the floor in which case they should turn down the cavity.
Example 3:  
4-storey flats of masonry construction

Apply:

- **Class 2A** robustness measures, provided by design and construction in accordance with PD 6697 *Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2*, including anchorage of suspended floors to walls using the details in Clause 6.1.2 of PD 6697 (see also 2.1(b)(i) above) or other details providing equivalent or better anchorage.

(c) **Class 2B building robustness measures**
There is some ambiguity in the wording in Section 5 of Approved Document A, paragraph 5.1d. The intention is as follows: The robustness measures required for Class 2B buildings consist of
- effective horizontal ties and effective vertical ties in all supporting columns and walls (both in accordance with the Codes and Standards referenced in Section 5 of Approved Document A, paragraph 5.2), or alternatively
- checks can be made that upon the notional removal of supporting elements the building remains stable and that the risk of collapse does not exceed limits stated in Section 5 of Approved Document A, paragraph 5.1d. Where these limits are exceeded the relevant member should be designed as a "key element" as defined in Section 5 of Approved Document A, paragraph 5.3.

(d) **Class 3 building robustness measures**
The robustness measures required for Class 3 buildings should be determined after a systematic risk assessment has been undertaken in accordance with Section 5 of Approved Document A, paragraph 5.1e.

**Note:** The National Annex to BS EN 1991-1-7 *Action on structures - Accidental actions* (Clause NA.3.1 Design for consequences of localized failure in buildings from an unspecified cause) states that the nationally determined values for minimum horizontal tie forces in the case of lightweight building structures (e.g. those whose primary structure is timber or cold formed thin gauge steel) in expressions A.1 (internal ties) and A.2 (perimeter ties) should be taken as 15 kN and 7.5 kN respectively.

2.2 *Determining the number of storeys in a building*
In determining the number of storeys in a building

(i) some small areas may justifiably be excluded provided they do not significantly increase either the chance of an accident occurring or the extent of damage that would arise from an accident. Examples include the following provided the total area of each is not more than 20% of the plan area of the building or 20m², whichever is the smaller:
- light structures or service housings above the main roof level
- mezzanine and gallery floors and similar habitable accommodation.

**Note:** common areas should not be excluded under this category.
(ii) basement storeys may be excluded provided they fulfill the robustness requirements of Class 2B buildings. To qualify as a basement storey, the distance between external ground level and the top surface of the basement floor should be at least 1.2m for a minimum of 50% of the plan area of the building. See also 2.5, which includes examples.

(iii) ground floor storeys may be excluded provided they are designed as key elements in accordance with relevant guidance in Approved Document A, paragraph 5.3. Where used for parking, all of the following conditions shall apply:
- parking is exclusively for users of the building
- the ground floor storey must not be accessible to or contain a right of way for the general public
See also 2.6, which includes examples.

(iv) habitable areas of roof space should be included as a storey irrespective of the slope of the roof.

2.3 Buildings with varying numbers of storeys
For buildings with varying numbers of storeys that fall into more than one Class, the robustness measures for the more onerous Class may need to continue until a structural discontinuity (such as a movement or construction joint) is reached. However, each case should be considered on its merits. This is the case even where the only areas of more onerous Class are common parts such as stairwells.

Example 4:
Block of flats partly 4 storeys and partly 5 storeys.
Apply:
- Class 2B robustness measures to the 5-storey areas and extending to a suitable structural discontinuity in the 4-storey area and Class 2A robustness measures to the remaining 4-storey areas.
2.4 Buildings of mixed occupancy
For buildings intended for more than one type of use, the Class should be that pertaining to the most onerous type.

**Example 5:**
1 storey educational use (e.g. nursery) over 2 storeys of flats should be taken as an educational building of 3 storeys

**Apply:**
- Class 2B robustness measures to the whole of the building.

![Diagram of 1 storey educational use over 2 storey flats]

However, where the upper storeys are of less onerous Class, robustness measures to storeys may vary.

**Example 6:**
2 storeys of flats over 1 storey of retailing premises.

**Apply:**
- Class 2A robustness measures to the whole building if floor area of retail premises is less than 2000m², or
- Class 2B robustness measures to the lowest storey if floor area of retailing premises is 2000m² or more and Class 2A robustness measures to the remaining two residential storeys.

![Diagram of 2 storey flats over 1 storey retail]

Where different occupancies are in horizontally adjacent parts of the same building, the same approach to robustness measures may be adopted as described in 2.3 above for buildings with varying numbers of storeys. i.e. the robustness measures for the more onerous Class may need to continue horizontally until a structural discontinuity (such as a movement or construction joint) is reached. Each case should be considered on its merits.
**Example 7**
4 storeys of flats adjacent to (same building) 5 storeys of offices

*Apply:*
- **Class 2B** robustness measures to the 5-storey office area and extending to a suitable structural discontinuity in the 4-storey residential area and **Class 2A** robustness measures to the remaining 4-storey residential area.

2.5 **Buildings above basements**
Refer to 2.2 (ii) above. The minimum robustness measures required to the part of the building above the basement depend on the total number of storeys and the robustness measures applied to the basement storey. The basement can be for habitable accommodation or parking. The following examples illustrate the appropriate robustness measures to be applied.

**Examples 8 - 11:**
Single occupancy houses over basements

*Apply:*
- Classes of robustness measures shown in the sketches below
Examples 12 - 16:
Flats above basements

Apply:
- Classes of robustness measures shown in the sketches below

2.6 Considerations where the ground floor storey may be excluded in accordance with 2.2 (iii)
The minimum robustness measures required to the part of the building above the ground floor storey depend on the total number of storeys and the robustness measures applied to the ground floor storey. The following examples illustrate the appropriate robustness measures to be applied. The annotation “KE” refers to key elements and means that all the structural elements (and their connections) of the ground floor parking storey (including any plant room, lift pit) should, in accordance with the relevant British Standard code for design, be capable of withstanding:
- a design ultimate load of 34 kN/m² from any direction, and
- the reaction from any attached building components that are also assumed to be subject to a design ultimate loading of 34 kN/m².
Examples 17-20:
Single occupancy houses (where the ground floor storey may be excluded in accordance with 2.2 (iii))

Apply:
- Classes of robustness measures shown in the sketches below.

Examples 21-25:
Flats (where the ground floor storey may be excluded in accordance with 2.2 (iii))

Apply:
- Classes of robustness measures shown in the sketches below
2.7 Conversions, alterations and extensions (i.e. existing buildings – change of use and/or building work)

The application of Requirement A3 is dependent on consideration of the following aspects of the project, as defined in The Building Regulations:

- material change of use of the building
- building work to be undertaken.

(i) Material change of use

Regulation 5 states that: there is a material change of use where there is a change in the purpose for which, or the circumstances in which, a building is being used, so that after the change
(a) the building is used as a dwelling, where previously it was not;
(b) the building contains a flat, where previously it did not;
(c) the building is used as a hotel or a boarding house, where previously it was not;
(d) the building is used as institution, where previously it was not;
(e) the building is used as public building, where previously it was not;
(f) the building is not a building described in Classes I to VI in Schedule 2, where previously it was (i.e. it was previously exempt);
(g) the building, which contains at least one dwelling, contains a greater or lesser number of dwellings than it previously did;
(h) the building contains a room for residential purposes where previously it did not;
(i) the building, which contains at least one room for residential purposes, contains a greater or lesser number of such rooms than it did previously; or
(j) the building is used as a shop, where previously it was not.

Where a material change of use takes place, Regulation 6 requires works to be carried out to ensure compliance with A3, but only in the case of categories (c), (d), (e), and (f) above. Similar works are not required due to a change of use involving categories (a), (b), (g), (h), (i) or (j), but additional works and/or checks on the structure may be necessary where “building work” is being undertaken (see 2.7(ii) below).

Example 26:
5-storey house converted to 5-storey hotel is a category (c) change of use, for which Regulation 6 requires work to be carried out to ensure compliance with A3.
Apply:
- Class 2B robustness measures to the whole building

Example 27:
4-storey house converted to 4-storey flats is a category (b) or (g) change of use, for which Regulation 6 does not require work to be carried out to ensure compliance with A3 unless ‘building work’ is carried out as defined in ii) below.
(ii) **Building work**

For the purpose of possible implications for A3, “building work” means:
- the extension of a building, including construction of additional storeys, or
- the material alteration of a building.

An alteration is “material” if the work would at any stage result
- in a building not complying with A3 where previously it did, or
- in a building, which before the work commenced did not comply with A3, being more unsatisfactory in relation to A3.

**Regulation 4** requires that
- the building work shall be carried out so that it complies with A3, and
- after the work has been completed, the whole building which is extended or to which a material alteration is made, complies with A3 or, where it did not previously comply with A3, is no more unsatisfactory in relation to A3 than before the work was carried out.

**Note:** a building whose Class increases during the course of building work, is likely to be less satisfactory in relation to A3 after the work because the change in Class brings with it a requirement for a higher level of robustness measures for the building.

**Example 28:**
3-storey flats extended to 4-storey flats. **The Class of the building after the work is the same as it was before.** Therefore the robustness measures required for the building as a whole have not changed and so potentially it is no more unsatisfactory in relation to A3 than before the work was carried out.

**Apply:**
- **Class 2A** robustness measures to the new storey and check that if the existing building previously complied with A3 it still complies after the work, or, if it did not previously comply, the work does not involve alterations resulting in the existing structure being more unsatisfactory in relation to A3.

**Example 29:**
4-storey flats extended to 5-storey flats. **The Class of the building after the work is higher than it was before.** Therefore the robustness measures required for the building as a whole are greater and so potentially it is more unsatisfactory in relation to A3 than before the work was carried out.

**Apply:**
- **Class 2B** robustness measures to the **whole building**.

**Note:** examples 28 and 29 are intended to illustrate the application of Requirement A3 due to building work rather than a material change of use. However, the results would be the same if the examples combined a change of use involving categories (a), (b), (g), (h), (i) or (j), such as a warehouse being converted to flats, with the extended number of storeys.