Interim Report to Communities and Local Government Building Regulations Division under the Building Operational Performance Framework

AIRTIGHTNESS OF BUILDINGS — TOWARDS HIGHER PERFORMANCE

Interim Report D3 — Assessments of design and pilot site data

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Reference Number: CI 61/6/16 (BD2429)

Milestone number: L2 D3

Interim Report D3 — Assessments of Design and Pilot Site Data

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Signature	Signature	Signature
Date: May 2004	Date:	Date:

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Executive Summary

1 This report reviews the progress that has been made on assessing the design drawings and the site survey data that have been obtained for the selected sites.

2 The design assessment and site survey protocols have been piloted on one of the selected sites and modified as appropriate. In addition, an Airtightness Rating has been incorporated into both of the protocols. This rating is a judgement based upon the following: the extent to which the design as specified is likely to achieve an airtight construction; and, the extent to which the specification can or will be achieved on site. The higher the rating, the greater the chance that the specification will be achieved on site and the greater the chance that the dwelling will be airtight. The rating will be used to rank the selected dwellings against one another.

3 Drawings have been received from three of the five developers. Design assessments have been undertaken for 10 of the selected dwellings and site surveys have commenced on 12 of the dwellings. The main points that have been obtained from the drawing assessments and site surveys are as follows:

a) There is considerable variation in the way in which the information relating to air leakage is presented in the submitted drawings. In the case of two of the developers, the majority of the information is textual material which is contained within a general arrangement drawing and very little reference is made to any other drawings. This contrasts with the approach adopted by one of the other developers, where some reference to air leakage is made within the general arrangements drawings, but the majority of the textual and graphical information on air leakage is contained within various standard details that are drawn to a scale of 1:10 and indicate explicitly where sealing work has to be undertaken. Although we are yet to see how the information contained within the drawings is used on site, it is expected that the greater the amount of detail on airtightness that is presented within the drawings, the higher the levels of airtightness that will be achieved.

b) All of the drawings submitted state that they have been amended to comply with Approved Document L1 or are designed in accordance with Robust Details (DEFRA, 2001).

c) None of the drawings contains an explicit air leakage target other than a general reference to Approved Document L1 or Robust Details.

d) None of the drawings makes reference to a higher standard of air leakage than that contained within Approved Document L1.

e) None of the dwellings submitted identifies the location of the air barrier either within the text or on the drawings. In addition, none of the drawings states that the air barrier should be continuous around the envelope.

f) It has been inferred from the submitted drawings that the construction principle used to achieve airtightness within all of the dwellings is the airtight internal cladding approach (see Elmroth and Levin, 1983 and Carlsson, Elmroth and Engvall, 1980).

g) All of the drawings that have been submitted identify areas where attention to detail is required on site to achieve airtightness. In some cases, this will be very difficult to achieve. For instance, applying sealing around the perimeter of plasterboard linings to external walls and openings with continuous ribbons of plaster.

h) For two of the developers, the drawings state that the timber I-beams that are used to support the intermediate floors are built into the internal leaf of the external wall, sealed with mortar, and then sealed using a mastic sealant. Site observations indicate that in a number of cases, the mastic has only been partially applied around the bottom flange and the web of the timber I-beams. In addition, since the mastic sealant has been applied after the floor finish has been installed, it is very difficult or impossible to seal the top flange of the timber I-beams.

i) For two of the developers, the timber I-beams that are used to support the intermediate floors are offset from the inner leaf of the external/party wall to allow services to be run from one floor to the next. In a number of dwellings this offset is so small that it is not possible to seal the area between the joist and the external/party wall using mortar and mastic sealant. The result is that in a number of the dwellings, it is possible to see through the cavity to the external brick skin.

4 There appears to be real practical problems achieving certain specifications on site. This may be attributable to a lack of foresight during detailed design or a lack of understanding by the operatives that undertake this work on site.

Introduction

5 This report is milestone D3: Assessment of the Design and Pilot Site Data of the Communities and Local Government Project reference CI 61/6/16 (BD2429) *Airtightness of Buildings — Towards Higher Performance* (Borland and Bell, 2003).

6 The aim of this report is to summarise the progress that has been made on assessing the design drawings and the site data that have been obtained for Phase 1 of the above project (tasks 2.1.3 and 2.1.4 of the project proposal). Details of the developers, the sites and the dwellings that are participating in this phase of the project are set out in Table 1.

Developer	Type of development	Type of construction	Selected dwelling types
Developer A	Combination of private and social housing	Dry-lined masonry cavity, partial fill	• A 2-storey 3 bedroom mid terrace with an internal floor area of 83 m^2. • A 3-storey 3 bedroom mid-terrace with an internal floor area of 117 m^2. • A 2½-storey 3 bedroom end terrace with an internal floor area of 117 m^2. • A 2-storey 3 bedroom semi-detached with an internal floor area of 81 m^2. • A 2-storey 4 bedroom detached with an internal floor area of 118 m^2.
Developer B	Private housing	Dry-lined masonry cavity, full fill	• A 2-storey 4 bedroom detached property with an internal floor area of 129 m^2. • A 2½-storey 5 bedroom detached property with an internal floor area of 164 m^2. • A 2½-storey 3 bedroom detached property with an internal floor area of 149 m^2. • Two 2-storey 3 bedroom detached properties with an internal floor area of 100 m^2.
Developer C	Private housing	Dry-lined masonry cavity, full fill	• Two 2-storey semi-detached properties with an internal floor area of 69 m^2. • A 2-storey end terrace with an internal floor area of 61 m^2. • Two 2-storey mid-terraces with an internal floor area of 71 m^2.
Developer D	Private housing	Steel frame	• A 2-storey 3 bedroom semi-detached property with an internal floor area of 72 m^2. • Two 2-storey properties with an internal floor area of 91 m^2. • A 2-storey 3 bedroom detached property with an internal floor area of 84 m^2. • A 2-storey 3 bedroom detached property with an internal floor area of 102 m^2.
Developer E	Social housing	Wet-plastered masonry cavity, partial fill	• A 2 bedroom apartment with an internal floor area of 58 m^2. • Two 2 bedroom apartments with an internal floor area of 57 m^2. • Two 1 bedroom apartments with an internal floor area of 43 m^2.

Table 1 Details of selected sites and dwelling types.

Design Assessment and Site Survey Protocols

7 As previously stated in deliverable D2: Developers, sites and protocols (see Johnston, Miles-Shenton and Bell, 2004) a design assessment and a site survey protocol has been developed In order to assess the design and construction phases of each dwelling type. The design assessment and site survey protocols are based upon the checklisting approach developed by the BRE (see Webb and Barton, 2001 and Webb, Barton and Scivyer, 2001). Both of these protocols have been piloted on one of the selected sites (developer A) and modified as appropriate in order to collect the relevant data. The main difference between the developed protocols and the BRE checklists are as follows:

a) The BRE checklists were originally developed for non-domestic buildings. These checklists have been modified to ensure that they can be used to assess domestic buildings.

b) The BRE use qualitative information from their checklists as input into an air leakage predictor tool. This is a quantitative tool that uses the qualitative information to estimate an air leakage index and air permeability. The protocols developed for this project adopt a different, but complimentary approach. Qualitative information obtained from the protocols will be used to define a number of individual qualitative 'Airtightness Ratings'. These ratings will assess a number of aspects of the dwellings construction that were identified within the literature review as having an influence on air leakage (Johnston, Wingfield and Bell, 2004). For instance, the type of internal wall finish, the method used to construct the intermediate floors and whether service penetrations are sealed or not. The individual airtightness ratings will be based upon a five-point scale (see Appendix 1), and provide a rating for each aspect of construction which is a judgement based upon the following: the extent to which the design as specified is likely to achieve an airtight construction; and, the extent to which the specification can or will be achieved on site. The higher the rating, the greater the chance that the specification will be achieved on site and the greater the chance that the dwelling will be airtight. The individual airtightness ratings will then be used to determine an overall airtightness rating for each dwelling, which will use the same five-point scale as the individual ratings. Although the same rating system will be used, the overall rating for the dwelling will not simply be a mathematical value that has been derived from an average of all of the individual ratings. The reason being that different aspects of the dwellings construction will make different contributions to the dwellings overall air leakage rate. For instance, it is well documented that the use of plasterboard dry-lining is likely to contribute significantly more to air leakage than loft hatches (see Stephen, 2000). Instead, the overall rating for the dwelling will be a qualitative judgement that is based upon all of the individual ratings, the influence that various aspects of the construction are likely to have on the dwellings overall air leakage and previous site experience. In order to maintain transparency, it is felt important that the overall dwelling rating is not converted into a quantitative measure of airtightness, for instance an air leakage index or air permeability value. Rather, the qualitative rating will be used to rank the selected dwellings against one another and to refine our judgements about the various factors that contribute to airtightness. The airtightness ratings that are obtained from the design assessments will be preliminary ratings. These ratings will be modified as appropriate, based upon the information that is obtained from the site surveys. Once the dwelling is complete, the final ratings will then be compared against actual pressure test data. It is important to note that this approach to rating airtightness is developmental. It will be modified accordingly throughout the project and the final report will discuss its usefulness in providing guidance on design assessment methods for building control officers.

8 All of the information obtained from the developed protocols will be stored on the Microsoft Access based project database (see Johnston, Miles-Shenton and Bell, 2004).

9 Drawings have been received from three of the five developers (developers A, B and C). Design assessments have been completed for 10 of the 25 selected dwellings (five from developer A and five from developer B). Site surveys have commenced on 12 of the 25 selected dwellings (five from developer A, five from developer C and two from developer E). A typical example of a completed design assessment and a Stage 1 site survey are contained within Appendices 1 and 2.

Interim Results of the Design Assessments and Site Surveys

10 This section summarises the progress that has been made to date on the design assessments and the site surveys and presents the interim results.

11 The main points that have been obtained from the completed design assessments can be summarised as follows:

a) There is considerable variation in the way in which the information relating to air leakage is presented on the submitted drawings. In the case of developers B and C, the majority of the information on air leakage is textual material, which is contained within a general arrangement drawing and very little reference is made to any other drawings. In these drawings it is not always clear where or why sealing work has to be undertaken. This contrasts with the approach adopted by developer A, where some textual information on air leakage is referred to within the general arrangement drawings, but the majority of the textual and graphical information on air leakage is contained within various standard detail drawings that are referred to within the general arrangement drawings and are common to more than one house type. The majority of the standard details are drawn to a scale of 1:10, and indicate explicitly where sealing work has to be undertaken. Although we are yet to see how the information contained within the general arrangement and standard detail drawings is used on site, it is expected that the greater the amount of detail and information on airtightness that is presented within the drawings, the greater the chance that higher levels of airtightness will be achieved.

b) All of the drawings submitted state that they have been amended to comply with Approved Document L1 or are designed in accordance with the DEFRA and DTLR Robust Details (DEFRA, 2001).

c) None of the drawings contains an explicit air leakage target with the exception of a general reference to Approved Document L1 or Robust Details.

d) None of the drawings makes reference to a higher standard of air leakage than that contained within Approved Document L1.

e) None of the dwellings submitted identifies the location of the air barrier either within the text or on the drawings. In addition, none of the drawings states that the air barrier should be continuous around the envelope.

f) It has been inferred from the submitted drawings that the construction principle used to achieve airtightness within all of the dwellings is the airtight internal cladding approach (see Elmroth and Levin, 1983 and Carlsson, Elmroth and Engvall, 1980). For all of the dwellings that have been assessed, it has been assumed that the plasterboard dry-lining will form the principle air barrier.

g) All of the drawings that have been submitted identify areas where attention is required to very specific construction activities on site to achieve airtightness. In a number of instances, this attention to detail will be very difficult to achieve on site. For instance, the drawings indicate that the perimeter of all of the external walls and openings should be sealed with continuous ribbons of plaster. In our opinion, this would be very difficult to carry out, as practical difficulties would mean that without careful site supervision, the process of sealing the perimeter of the dry-lining could be missed out entirely, and it would be difficult to check compliance after the dry-lining was in position. In addition, none of the drawings describes this process in any detail and does not say, for example, how wide or thick the adhesive ribbons should be, or how far they should be from the perimeter.

12 The site surveys are intended to be completed in three separate stages (see Johnston, Miles-Shenton and Bell, 2004). These stages are as follows:

a) **Stage 1: During intermediate floor construction.** This will enable inspection of the method of supporting the intermediate floors and enable any potential leakage problems to be identified.

b) **Stage 2: During dry-lining/wet plaster phase.** This will enable inspection of the internal leaf of the external walls, the application of the dry-lining, inspection of window/wall junctions, inspection of service penetrations, etc.

c) **Stage 3: Completion**. This will enable identification of any potential leakage areas that have not been picked up during the ‘snagging’ process.

13 In addition to completing the site survey protocol, data on the site will also be collected and recorded using photographs, sketches and audio/video tape.

14 So far, only Stage 1 site visits have been undertaken on 12 of the 25 selected dwellings. These visits have resulted in the generation of approximately 250 photographs. The main points that have been obtained from the site observations are detailed below.

a) For developers A and B, the drawings state that the timber I-beams that are used to support the intermediate floors are built into the internal leaf of the external wall, sealed with mortar, and are then sealed using a mastic sealant. Site observations indicate that there is considerable variation in the way in which the silicone mastic has been applied on site, and in a number of cases, the mastic sealant only appears to have been applied to areas where the mortar has been missed out (see Figure 1). In addition, since the mastic sealant is applied after the intermediate floor finish has been installed, it is very difficult to seal the top flange of the timber I-beams with sealant. There is a risk that in areas where the mastic sealant has not been applied, the mortar seal will crack as the timber shrinks and the mortar dries out, resulting in a number of air leakage paths.

b) For developers A and B, the timber I-beams that are used to construct the intermediate floors are offset from the inner leaf of the external/party wall to allow services, such as electrical cables, to be run from one floor to the next. In a number of cases the offset is so small that it is not possible to apply mortar and mastic to the area between the joist and the external/party wall in order to seal this junction. In some cases, this has resulted in gaps of approximately 38 mm x 240 mm extending through the full thickness of the inner leaf of blockwork (see Figure 2).

c) Both of the above observations suggest that even when specific operations are specified within the drawings and the operatives attempt to undertake these operations, there can be real practical problems achieving the specification. This could be attributable to a lack of understanding by the operatives as to why they are undertaking a particular task or a lack of foresight in the detailed design stage, resulting in awkward gaps in the construction that are very difficult to fill.

Figure 1 Partial application of mastic sealant (developer B).

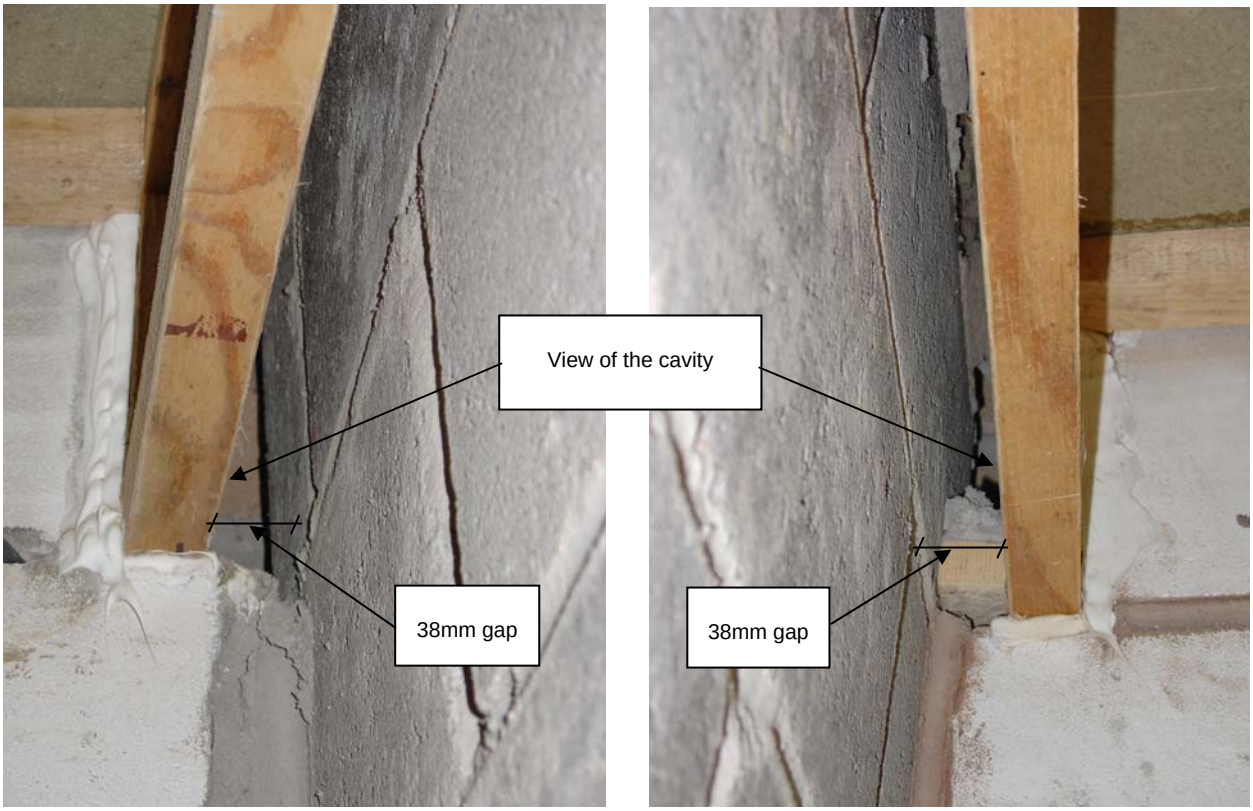

Figure 2 Gaps between the joist and the external/party wall (developer A).

Conclusions

15 This report reviews the progress that has been made in assessing the design drawings and the site data that has been obtained for the selected sites and presents interim results.

16 An analysis of the design assessments and site surveys indicates that there is a considerable difference in the way in which the developers present information on air leakage to those on site and the level of detail that this information contains. The presented information varies from the use of general arrangement drawings that contain general textual material, to sets of detailed 1:10 scaled drawings that indicate explicitly where sealing work has to be undertaken.

17 There is also considerable variation in the work that has been undertaken on site to achieve a particular specification. Site observations illustrate that a mixture of approaches have been undertaken to achieve the same specification. This suggests that the operatives undertaking this work do not fully understand the importance of the detail.

18 The site observations have also identified areas where there appears to have been a lack of foresight in the detailed design stage. This has resulted in specifications that are practically very difficult to achieve.

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Appendix 1

Example of a completed design assessment protocol

Design assessment protocol

Name of assessors: Dominic Miles-Shenton
Dr David Johnston

Date of assessment: 6th April 2004

Dwelling details		
Site reference	C236/7	
Plot No.	236/7	
Location	Omitted to maintain anonymity	
Address	Omitted to maintain anonymity	
Developer	C	
Development type	Private	~~Social housing~~
Development size	278 (total number of units)	
Programme start date	Unknown	
Programme end date	Unknown	
Drawing reference		
Type of drawings submitted	General arrangement drawings that make very little reference to any other drawings.	
Other details	Mixture of 6 house types (mid-terrace, end-terrace, semi-detached and detached properties). Site is developing on a speculative basis	

Dimensions & Build Form	**YES** (√)	**NO** (√)	**Notes**
Ground floor area	71		m²
Total envelope surface area	203		m²
Volume	167		m³
No. of storeys	2		
Type of dwelling: Detached		✓	2 Bedroom
Semi-detached		✓	
Mid-terrace	✓		
End-terrace		✓	
Apartment		✓	
Construction type: Masonry cavity full fill	✓		100mm cavity, filled with blown mineral fibre. Fibre is to be injected through the inner leaf.
Masonry cavity partial fill		✓	
Timber frame		✓	
Position of air barrier	The position of the air barrier is not identified within the drawings. Inferred from the drawings that the construction principle used to achieve airtightness is the internal airtight cladding approach (plasterboard dry-lining).		
Other details			

Ground floor	**YES** (√)	**NO** (√)	**Notes:**
Construction type: Concrete slab on ground *Airtightness Rating	_	✓	
Concrete suspended *Airtightness Rating	✓ 4		Concrete beam & concrete block, 50mm sand/cement screed. Micro-Porous Floor Insulation Membrane (Foil Type) (laid below beams) as underfloor insulation. The concrete beam & block floor should provide an excellent air barrier provided that all of the service penetrations through it are sealed.
Timber T&G *Airtightness Rating	_	✓	
Timber butted *Airtightness Rating	_	✓	
Is air barrier continuous between ground floor & external walls? *Airtightness Rating		✓ 0	Continuity of the air barrier between the ground floor and the external walls is essential to prevent air leakage at this junction. The junction between the wall and the floor should be sealed prior to the fixing of the skirting boards. There is little evidence from the drawings that this is understood.
Are service penetrations sealed? *Airtightness Rating	✓ 4		Drawings contain a note stating that all pipes/cables passing through ground floor are to be sealed with close fitting plasterboard and mastic sealant. Sealing these penetrations is essential as they can be a significant route for air leakage.
Other details			

External walls	**YES** (√)	**NO** (√)	**Notes:**
Construction type: Masonry cavity full fill	✓		100mm facing brick, 100mm cavity filled with blown mineral fibre (fibre is to be injected through the inner leaf), 100mm 4.2N standard concrete block. Drawings do not specify that or how the holes that are used to inject the mineral fibre into the cavity will be sealed. It is essential that these holes are adequately sealed prior to the commencement of the plasterboard dry-lining, to prevent air leakage.
Masonry cavity partial fill		✓	
Timber frame		✓	
Internal finish: Dry-lining	✓		9.5mm plasterboard on dabs with a 3mm Gypsum skim finish. Drawings state that all gaps between dry-lining and masonry at the perimeter of door/window openings and wall to floor and wall to ceiling junctions are to be sealed with continuous ribbon of plasterboard adhesive. In our opinion, this is very difficult to achieve. In addition, none of the drawings describe this process in any detail and do not say, for example, how wide or thick the adhesive ribbons should be, or how far they should be from the perimeter.
*Airtightness Rating	1		
Wet plaster		✓	
*Airtightness Rating	–		
Other		✓	
*Airtightness Rating	–		
Are service penetrations sealed?	✓		Drawings contain a note stating that all pipes/cables passing through walls are to be sealed with close fitting plasterboard and mastic sealant. Sealing these penetrations is essential as they can be a significant route for air leakage.
*Airtightness Rating	4		
Other details			

External windows & doors	**YES** (√)	**NO** (√)	**Notes:**
Are windows/doors draught-stripped? *Airtightness Rating	✓ 4		Drawings state that all windows are to be PVCu double glazed with double sealed opening casements and external doors are to be fully draught sealed.
Are window/door frames sealed to external wall internally? *Airtightness Rating	✓ 3		Drawings state that sealant is to be applied to front and back of frame. However, the drawings do not specify how this is to be achieved. It is essential that the junction between the window/door frame and the plasterboard dry-lining is sealed, as it can be a significant route for air leakage.
Are window/door frames sealed to external wall externally? *Airtightness Rating	✓ 3		Drawings state that sealant is to be applied to front and back of frame. However, the drawings do not specify how this is to be achieved.
Are window sills/door thresholds sealed to external wall internally? *Airtightness Rating	✓ 3		Drawings state that sealant is to be applied to front and back of frame. However, the drawings do not specify how this is to be achieved. It is essential that the junction between the window sill/door threshold and the plasterboard dry-lining is sealed, as it can be a significant route for air leakage.
Are window sills/door thresholds sealed to external wall externally? *Airtightness Rating	✓ 3		Drawings state that sealant is to be applied to front and back of frame. However, the drawings do not specify how this is to be achieved.
Do windows contain trickle vents?			Unknown.
Other details	Background ventilation requirements of 8000mm^2 in habitable rooms and 4000mm^2 in kitchen / bathroom / utility room are specified. However, the drawings do not specify how this will be achieved.		

Intermediate flooring	**YES** (√)	**NO** (√)	**Notes:**
Construction type: Timber joist	✓		18mm T&G moisture resistant flooring grade chipboard glued to joists and with glued joints, on regulated softwood joists.
*Airtightness Rating	4		Drawings do not indicate how the junctions between the flooring panels are to be sealed. It is essential that the junction between the floor panels is sealed, as it can be a route for air leakage.
Timber I beam		✓	
*Airtightness Rating	_		
Concrete		✓	
*Airtightness Rating	_		
Method of support at external wall junction: Built-in	✓		Drawings state that all joists are to be built solid into walls, bearing 90mm into wall, with all joints filled solid with mortar and sealed with mastic as SDL 274.
*Airtightness Rating	1		It is essential that built-in joists are sealed to the inner leaf of the external wall, as it can be a significant route for air leakage.
Joist hangers			Trimmed joists to be on joist hangers fixed to trimmer
*Airtightness Rating	_		
Is external wall/intermediate floor junction sealed?		✓	Continuity of the air barrier between the first floor and the external walls is essential to prevent air leakage at this junction. The junction between the wall and the floor should be sealed prior to the fixing of the skirting boards. There is little evidence on the drawings that this is understood.
*Airtightness Rating		0	
Are service penetrations sealed?	✓		Drawings contain a note stating that all pipes/cables passing through ceilings are to be sealed with close fitting plasterboard and mastic sealant.
*Airtightness Rating	4		Sealing these penetrations is essential as they can be a significant route for air leakage.
Other details			

Ceiling junction	**YES** (√)	**NO** (√)	**Notes:**
Is air barrier continuous between ceiling & external walls? *Airtightness Rating	✓ 4		Drawing state that all gaps between dry-lining and masonry at the wall to floor and wall to ceiling junctions are to be sealed with continuous ribbon of plasterboard adhesive. In our opinion, this is very difficult to achieve. In addition, none of the drawings describe this process in any detail and do not say, for example, how wide or thick the adhesive ribbons should be, or how far they should be from the perimeter.
Is air barrier continuous above partition walls? *Airtightness Rating		✓ 0	Concrete block ground floor internal partitions and timber stud partitions to upper floor. Continuity of the air barrier at ceiling level is essential to prevent air leakage. The junction between the timber stud partitions on the upper floor and the ceiling should be sealed, as the junction can be a significant route for air leakage.
Are service penetrations sealed? *Airtightness Rating	✓ 4		Drawings contain a note stating that all pipes/cables passing through ceilings are to be sealed with close fitting plasterboard and mastic sealant. Sealing these penetrations is essential as they can be a significant route for air leakage.
Is the loft hatch draught-stripped? *Airtightness Rating	 _		Unknown. Insufficient detail contained within drawings.
Is loft hatch sealed to ceiling? *Airtightness Rating	 _		Unknown. Insufficient detail contained within drawings.
Other details			

Overall airtightness rating = 2

*Airtightness Rating:

This figure is based on the 5 point scale illustrated below. The rating provided is a judgement based on the following:

- The extent to which the design as specified is likely to achieve an airtight construction, and
- The extent to which the specification can or will be achieved on site.

5 4 3 2 1

|----------|----------|----------|----------|

Certainty Probable Possible Unlikely Highly Unlikely

Ratings on this scale are determined by a number of factors, including the experience of the assessment team and knowledge evolved from previous visits to this particular site and/or developer.

APPENDIX 2

Example of a completed site survey protocol

Site survey protocol

Name of assessors: Dominic Miles-Shenton
Dr David Johnston

Date of assessment: 12th May 2004

Dwelling details		
Site reference	B79	
Plot No.	79	
Location	Omitted to maintain anonymity.	
Address	Omitted to maintain anonymity.	
Developer	B	
Development type	Private	~~Social housing~~
Development size	86 (total number of units)	
Programme start date	Unknown.	
Programme end date	Unknown.	
Drawing type and reference	General arrangement drawings that make very little reference to any other drawings/details.	
Other details	Mixture of 16 different house types (flats, town houses, semi-detached and detached)	

Dimensions & Build Form	**YES** (√)	**NO** (√)	**Notes**
Total floor area	129		m^2
Total envelope surface area	285		m^2
Volume	327		m^3
No. of storeys	2		
Type of dwelling: Detached	✓		4 bedroom
Semi-detached		✓	
Mid-terrace		✓	
End-terrace		✓	
Apartment		✓	
Construction type: Masonry cavity full fill	✓		75mm cavity, filled with cavity foam to BS5617 and 5618. Foam is to be injected through the inner leaf.
Masonry cavity partial fill		✓	
Timber frame		✓	
Position of air barrier	The position of the air barrier is not identified within the drawings. Inferred from the drawings that the construction principle used to achieve airtightness is the internal airtight cladding approach (plasterboard dry-lining).		
Other details	At the time of this initial site visit, construction of this plot was at the second lift stage with intermediate floor in place and blockwork up to eaves level. Photograph B 79/1 - plot on 12-May-04, at the time of the visit.		

Ground floor	**YES** (√)	**NO** (√)	**Notes:**
Construction type: Concrete slab on ground *Airtightness Rating	✓ 4		150mm, well compacted and blinded hardcore, 1200 gauge visqueen DPM, 50mm thick polystyrene insulation and 100mm concrete with power float finish.
Concrete suspended *Airtightness Rating	 _	✓	The concrete beam & block floor sjould provide an excellent air barrier, provided that all of the service penetrations through it are sealed effectively.
Timber T&G *Airtightness Rating	 _	✓	
Timber butted *Airtightness Rating	 _	✓	
Is air barrier continuous between ground floor & external walls? *Airtightness Rating	 -	✓	Continuity of the air barrier between the ground floor and the external walls is essential to prevent air leakage at this junction. The junction between the wall and the floor should be sealed prior to the fixing of the skirting boards. There is little evidence from the drawings that this is understood.
Are service penetrations sealed? *Airtightness Rating	✓ 3		Drawings state that all boxing for concealed services is to be sealed at floor level. Sealing these penetrations is essential as they can provide a significant route for air leakage.
Other details	Details to be in accordance with details set out by DEFRA & DTLR Robust Details		

External walls	**YES** (√)	**NO** (√)	**Notes:**
Construction type: Masonry cavity full fill	✓		102.5mm facing brick, 75mm cavity filled with cavity foam to BS5617 and 5618 (Foam to be injected through the inner leaf), 100mm block inner leaf. Drawings do not specify how the holes that are used to inject the mineral fibre into the cavity will be sealed. It is essential that these holes are adequately sealed prior to the commencement of the plasterboard dry-lining, to prevent air leakage.
Masonry cavity partial fill		✓	
Timber frame		✓	
Internal finish: Dry-lining *Airtightness Rating	✓ 1		9.5mm plasterboard and skim on plaster dabs. Drawings state that all gaps between dry-lining and masonry walls at the edges of all openings through external walls to be sealed with continuous bands of fixing plaster. In our opinion, this is very difficult to achieve. In addition, none of the drawings describe this process in any detail and do not say, for example, how wide or thick the adhesive ribbons should be, or how far they should be from the perimeter.
Wet plaster *Airtightness Rating	_	✓	
Other *Airtightness Rating	_	✓	
Are service penetrations sealed? *Airtightness Rating	✓ 3		Drawings state that all service pipes penetrating into hollow constructions or voids to be sealed. Sealing these penetrations is essential as they can provide a significant route for air leakage.
Other details	Details to be in accordance with details set out by DEFRA & DTLR Robust Details B 79/15,25 - internal blockwork		

External windows & doors	**YES** (√)	**NO** (√)	**Notes:**
Are windows/doors draught-stripped? *Airtightness Rating	✓ 4		Drawings state that all opening elements of windows, doors and rooflights are to draught stripped with an approved sealer.
Are window/door frames sealed to external wall internally? *Airtightness Rating	✓ 3		Drawings do not explicitly identify whether this needs to be added, but do state that all construction details are to be in accordance with robust standard details. The robust details state that sealant should be applied to the front and back of the frame. It is essential that the junctions between the window/door frame and the plasterboard dry-lining and the window sill/door threshold and the plasterboard dry-lining are sealed, as these can be a significant route for air leakage
Are window/door frames sealed to external wall externally? *Airtightness Rating	✓ 3		
Are window sills/door thresholds sealed to external wall internally? *Airtightness Rating	✓ 3		
Are window sills/door thresholds sealed to external wall externally? *Airtightness Rating	✓ 3		
Do windows contain trickle vents?	✓		Where indicated on plan
Other details	Details to be in accordance with details set out by DEFRA & DTLR Robust Details B 79/2 – front door threshold B 79/3,13,14 – cavity closure at windows		

Intermediate flooring	**YES** (√)	**NO** (√)	**Notes:**
Construction type: Timber joist *Airtightness Rating	 –	✓	22mm moisture resistant chipboard on engineered joists. Drawings do not indicate how the junctions between the flooring panels are to be sealed. It is essential that the junction between the floor panels is sealed, as it can be a route for air leakage.
Timber I beam *Airtightness Rating	✓ 3		
Concrete *Airtightness Rating	 –	✓	
Method of support at external wall junction: Built-in *Airtightness Rating	✓ 1		Drawings state that all joists are to be built-in to external walls in accordance with drawing no. PH/BJE rev A. It is essential that built-in joists are sealed to the inner leaf of the external wall, as it can be a significant route for air leakage.
Joist hangers *Airtightness Rating	 –		
Is external wall/intermediate floor junction sealed? *Airtightness Rating	 –	✓	Continuity of the air barrier between the first floor and the external walls is essential to prevent air leakage at this junction. The junction between the wall and the floor should be sealed prior to the fixing of the skirting boards. There is little evidence on the drawings that this is understood.
Are service penetrations sealed? *Airtightness Rating	✓ 3		Drawings state that all boxing for concealed services is to be sealed at floor and ceiling levels and service pipes penetrating into hollow constructions or voids are to be sealed. Sealing these penetrations is essential as they can provide a significant route for air leakage. Drawings do not specify how the holes that are used to inject the mineral fibre into the cavity will be sealed. It is essential that these holes are adequately sealed prior to the commencement of the plasterboard dry-lining, to prevent air leakage.
Other details	Details to be in accordance with details set out by DEFRA & DTLR Robust Details B 79/4-12,16-19, 21-24 – built in joists B 79/20 – intermediate floor edges		

Ceiling junction	**YES** (√)	**NO** (√)	**Notes:**
Is air barrier continuous between ceiling & external walls? *Airtightness Rating	✓ 4		Drawings do not explicitly identify whether this junction needs to be sealed, but do state that all construction details are to be in accordance with robust standard details. The robust details state that sealant continuous ribbons of plasterboard adhesive should be applied to fix the dry-lining at the perimeter walls.
Is air barrier continuous above partition walls? *Airtightness Rating	 –	✓	Continuity of the air barrier at ceiling level is essential to prevent air leakage. The junction between the timber stud partitions on the upper floor and the ceiling should be sealed, as the junction can be a significant route for air leakage.
Are service penetrations sealed? *Airtightness Rating	✓ 3		Drawings state that boxing for concealed services is to be sealed at floor and ceiling levels and service pipes penetrating into hollow constructions or voids are to be sealed. Sealing these penetrations is essential as they can provide a significant route for air leakage.
Is the loft hatch draught-stripped? *Airtightness Rating	✓ –		Drawings state that loft access is to be draught striped with approved sealer.
Is loft hatch sealed to ceiling? *Airtightness Rating	 –		Unknown, insufficient detail contained within drawings.
Other details	Details to be in accordance with details set out by DEFRA & DTLR Robust Details		

Overall dwelling airtightness rating = 2

*Airtightness Rating:

This figure is based on the 5 point scale illustrated below. The rating provided is a judgement based on the following:

- The extent to which the design as specified is likely to achieve an airtight construction.

and

- The extent to which the specification can or will be achieved on site.

5 4 3 2 1

|----------|----------|----------|----------|

Certainty Probable Possible Unlikely Highly Unlikely

Ratings on this scale are determined by a number of factors, including the experience of the assessment team and knowledge evolved from previous visits to this particular site and/or developer.