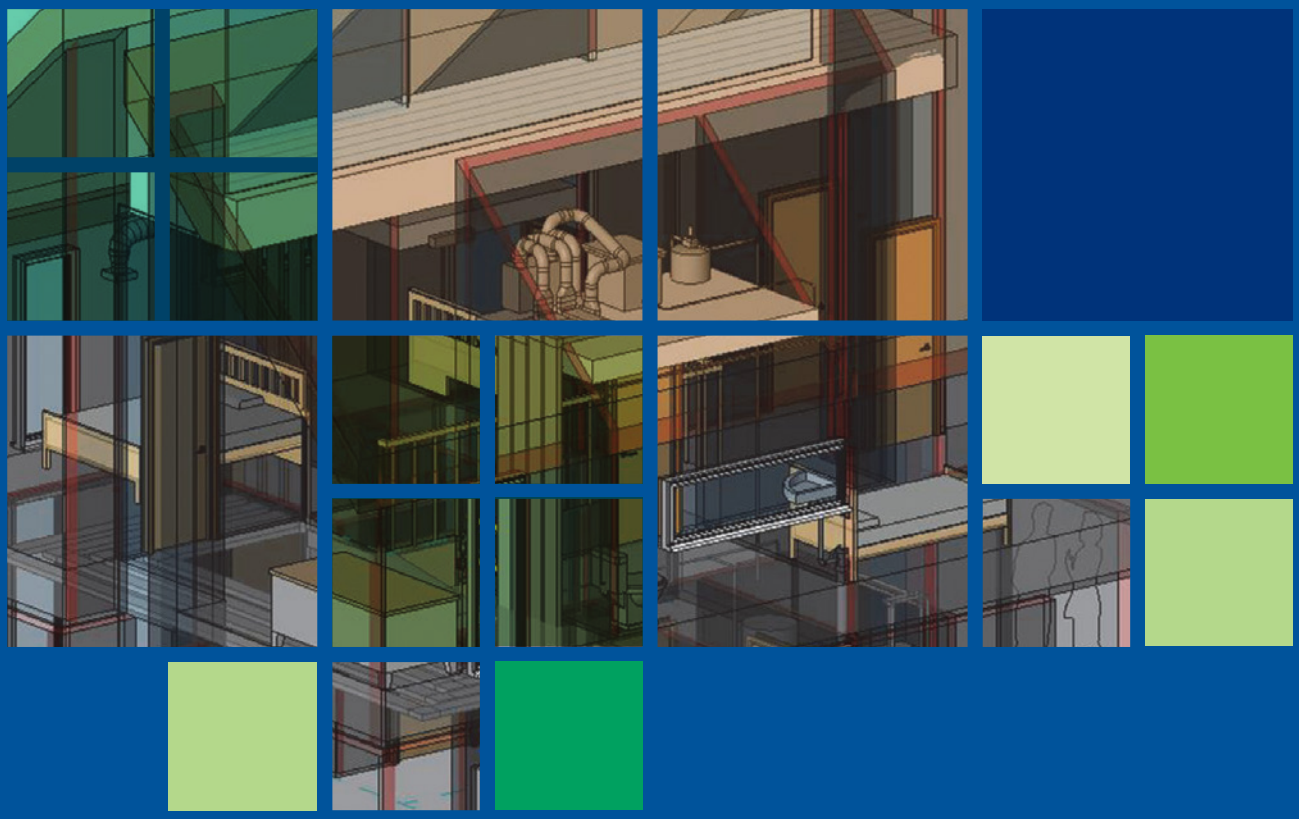
Building Information Modelling

An introduction for house builders



Informing the debate

NHBC Foundation
Housing research in partnership with BRE Trust

BSRIA

F 49

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Section 1 heading image	Image from a BIM model for two luxury houses. Hoare Lea.
Figure 1	Image from a BIM model for two luxury houses. Hoare Lea.
Section 2 heading image	Photograph BSRIA.
Figure 6	Image from a BIM model for services co-ordination. Hoare Lea.
Section 3 heading image	Photograph BSRIA.
Section 4 heading image	Photograph BSRIA.
Figure 8	Image from a BIM model for barn conversions. Hoare Lea.
Section 5 heading image	Photograph BSRIA.

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About the NHBC Foundation

The NHBC Foundation was established in 2006 by the NHBC in partnership with the BRE Trust. Its purpose is to deliver high-quality research and practical guidance to help the industry meet its considerable challenges.

Since its inception, the NHBC Foundation's work has focused primarily on the sustainability agenda and the challenges of the government's 2016 zero carbon homes target.

The NHBC Foundation is also involved in a programme of positive engagement with government, development agencies, academics and other key stakeholders, focusing on current and pressing issues relevant to the industry.

Further details on the latest output from the NHBC Foundation can be found at www.nhbcfoundation.org.

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Professor Steve Wilcox, Centre for Housing Policy, University of York

Contents

Glossary

AIM	Architectural Information Model. The model used by the architectural team during the project, combined with others periodically to form the federated model.
AVANTI	A research programme looking at collaborative working using ICT (information, communication and technology), funded by the Department for Trade and Industry.
BIM	Building Information Modelling. Also, often taken to mean Building Information Management.
BRIM	Bridge Information Model. The model used by the bridges team during the project, combined with others periodically to form the federated model.
BSI	British Standards Institution. BSI is the UK's National Standards Body (NSB), and represents the UK economic and social interests across all European and international standards organisations.
BSIM	Building Services Information Model. The model used by the building services team during the project, combined with others periodically to form the federated model.
CPIC	Construction Project Information Committee. An organisation which developed the Uniclass classification system, used widely throughout the construction industry.
Electronic paper	Electronic display technology designed to mimic the appearance of ink on paper. Also known as electronic ink.
FIM	Facilities Information Model. The model used by the facilities management team during the project, combined with others periodically to form the federated model. Also, it may be the model used by the FM once the asset moves into its operational phase.
iBIM	Integrated Building Information Model. This is the Level 3 version of the Level 2 'federated' model. Level 3 requires full interoperability whereas Level 2 simulates that through viewers and the management process.
IDM	Information Delivery Manual. This specifies when certain types of information are required during the construction or operation of an asset. See ISO 29481-1:2010 Building information model – Information delivery manual. Part 1: Methodology and format.
IFC	Industry Foundation Classes – a common data tool, developed by buildingSMART, for holding and exchanging data between different proprietary software applications.
IFD	International Framework for Dictionaries. A standard for terminology libraries. See ISO 12006-3:2007 Building construction – Organization of information about construction works. Part 3: Framework for object-oriented information.
ISO BIM	This is a general term relating to any material ISO (International Standards Organisation) produces relating to BIM.

Foreword

The rapid emergence of BIM (Building Information Modelling) over the past couple of years is unlikely to have escaped the attention of anyone working in the construction industry. The three letter acronym has become quite a buzzword as the use of BIM has grown rapidly, encouraged by Government as part of the solution to reducing its construction procurement and operation costs by 20%.

BIM is a process that improves the efficiency of organising and distributing information - or data - that is generated during the design and construction of buildings and infrastructure, and to make it available to all parts of the design and construction supply chain and to clients and end-users of the facility. The benefits of clearly defining and centralising data and information exchange rather than recreating it afresh at each stage of the procurement process should reduce time and costs, as well as improving quality.

Whilst the advantages to be gained by the application of BIM are already abundantly clear for large non-domestic projects, many working within house-building do not yet have an awareness of its potential benefits for their sector. This guide aims to fill this knowledge gap: it explains the BIM process and examines ways in which the house-building sector may use it to increase efficiency, and improve the quality of the product delivered to new home owners.

Rt. Hon. Nick Raynsford MP
Chairman, NHBC Foundation

Executive summary

Building Information Modelling (BIM) is a process for managing the information produced during a construction project, from the earliest feasibility stages right through design, construction, operation and finally demolition so as to make best and most efficient use of the data produced.

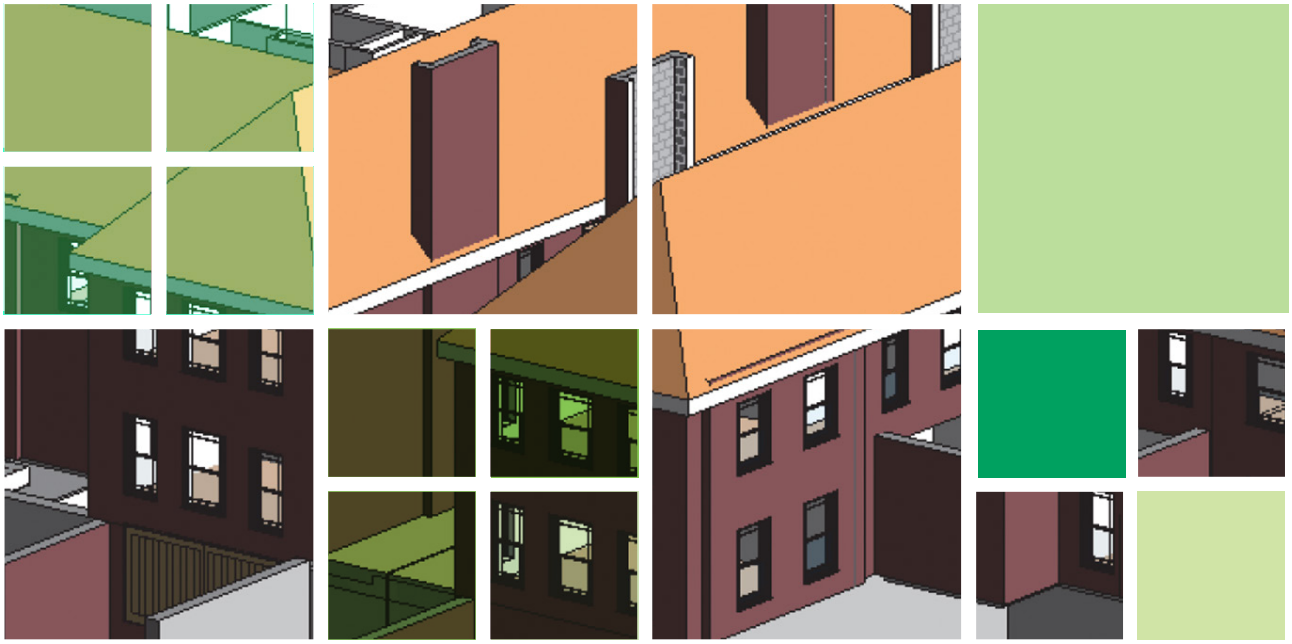
Although the awareness of BIM is starting to spread through the construction industry, driven in some large part by the UK Government's mandating its use on all of their construction projects by 2016, it has yet to make an impact on the house-building sector. Many involved in the sector are not aware of it, and most of those who have engaged with it so far don't see how it can benefit them in their daily work.

As part of the construction process, a wide range of documents are produced such as drawings and schedules. A suitable document management process should already be in place to control their generation and issue – this is part of the BIM process. As well as providing this framework for the management of documents and data, BIM can also produce images or objects in 3D models with the added ability to attach related data about performance, materials, quantities, etc.

The use of these models can increase efficiency and reduce errors with designs being able to be built in virtual terms before getting to site, and clashes resolved in the design office as opposed to on site. However, investment in time and money will be needed to enable house builders to make the most of what BIM can offer, and skill levels will also need to maximise the capabilities of the software.

If the house-building sector can find a way to get over the initial hurdles, BIM offers the prospect of improved efficiency and fewer errors, resulting in a better quality product for the home owners.

1 What is BIM?



1.1 Introduction

Building Information Modelling (BIM) is a term which seems to be everywhere in construction nowadays, and is being hailed as a tool for improved productivity and quality. However, it is important to understand what is involved in BIM, and how its use may affect the roles and tasks performed every day in design offices and on construction sites across the country.

There has been much interest in BIM, accentuated by the mandating of its use on Government construction projects. But its relevance to house building, where projects tend to be simpler, smaller and more repetitive, is not yet widely understood.

Building Information Modelling (or 'management', more appropriately) is about identifying the important information or data that is used throughout the design, construction and operation of buildings, or any other built asset, and managing it so as to make it useful to all those involved.

The concept is nothing new – document management systems (formal or informal) are commonplace on projects of all sizes and enable the managed flow of documents, or information, throughout the life of the project. BIM is simply a formalising of that process, driven in large part by the Government's mandating of the use of BIM on all its construction projects from 2016[1].

1. In March 2011 'A report for the Government Construction Client Group: Building Information Modelling (BIM) Working Party Strategy Paper' was published outlining possible benefits to be gained by using BIM. Measures for the adoption of BIM for use on Government construction projects were subsequently included in the 'Government Construction Strategy' published in May 2011. Both of these documents are available at www.bimtaskgroup.org.

1.2 The BIM process

So what is BIM? It's best thought of as a process to manage project information, and has three key elements:

- The labelling or naming of documents or data – this helps in tracking and finding the data throughout the life of the asset, and ensures all those working on the project follow the same procedures. A suitable process is described in BS 1192[2], which is already widely used for numbering drawings on many projects, and can form the basis of a system for use with BIM.
- The method for holding and manipulating the information and data generated. On many projects, this will involve the use of 3D BIM software tools (see Figure 1 below).
- The method for exchanging or issuing the data or information produced. This is done currently in a number of ways – drawings, schedules, etc, and this may continue to be the case. The difference is likely to be that this information will be generated from the model rather than by preparing the drawings or schedules separately.

The Government has its own requirements for delivering the BIM process on its projects, which are likely to include Government-funded housing or residential care schemes. Their aim is to increase efficiency and reduce costs in procurement through the adoption of processes such as BIM, and improve the level of information delivered to the end user.

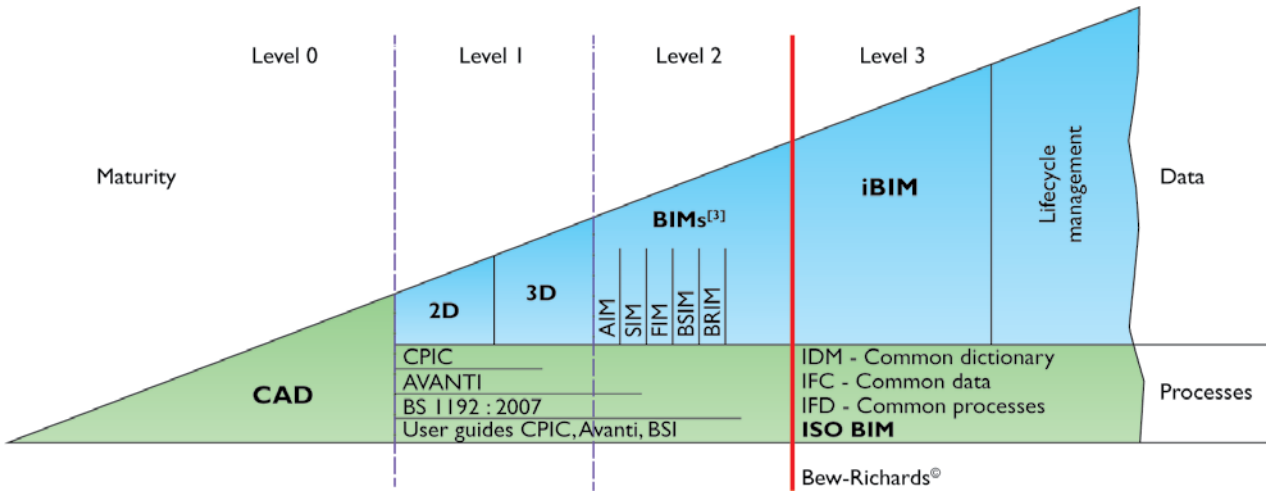
Figure 1 A BIM model image of two luxury houses

The key to the possible adoption of BIM for the house-building sector is to understand how it fits in with what the industry currently does, and to identify areas where it may be able to add benefit in terms of increased efficiency and reduced costs and/or time.

2. (i) BS 1192:2007 Collaborative Production of Architectural, Engineering and Construction Information - Code of practice, BSI. (ii) Buidling Information Management. A Standard Framework and guide to BS 1192, BSI (iii) PAS 1192-2:2012 Building Information Management - Information requirements for the capital delivery phase of construction projects, BSI.

1.3 The Government's BIM requirements

As mentioned earlier, the Government has recently mandated the use of BIM on all of its construction projects by 2016. This applies to all projects where the funding is provided by the Government, and not just those carried out directly for a central Government department. As well as mandating its use, they have also detailed the level of information or data to be provided. The red line in Figure 2 indicates the Government's target of achieving Level 2 BIM by its 2016 deadline, and progress to date has been encouraging. The figure also explains the various levels of BIM murity.



See Glossary for a definition of the terms used in this diagram

BIM Level	Description
0	Unmanaged CAD, probably 2D, with paper (or electronic paper) as the most likely data exchange mechanism
1	Managed CAD in 2D or 3D format using BS 1192:2007 with a collaboration tool providing a common data environment
2	Managed 3D environment held in separate discipline "BIM" tools with attached data
3	Fully open process and data integration enabled by "web services" compliant with the emerging IFC/IFD standards, managed by a collaborative model server

Figure 2 The four maturity levels of BIM

The third strand of the project information management process described earlier is the method for delivering the data to the intended users. This may be from the designer to the client, the client to the contractor, the contractor to the facilities management team, or any other combination of the parties involved in the project.

3. Many individual disapline BIMs may be produced. A sample is shown here but others may include landscape, infrastructure, envelope, etc.

The Government has prescribed the use of a spreadsheet-based method for this exchange as it's a commonly used and understood format. All the data contained in the model can be included in a series of spreadsheets known as COBie (Construction Operations Building Information Exchange). The COBie range contains around 700 sheets covering a wide variety of building elements as well as mechanical and electrical equipment, and can be used for scheduling. Spreadsheets are also available for other requirements such as room data sheets, and document and drawing registers.

Name	Value	Unit	AllowedValues
Construction Type	not defined	n/a	n/a
Operation Type	not defined	n/a	n/a
Parameter Takes Precedence	false	n/a	n/a
Sizeable	false	n/a	n/a
Reference	n/a	n/a	n/a
Acoustic Rating	n/a	n/a	n/a
Fire Rating	n/a	n/a	n/a
Security Rating	n/a	n/a	n/a
Is External	false	boolean	true , false
Infiltration	0	n/a	n/a
Thermal Transmittance	0	n/a	n/a
Glazing Area Fraction	0	n/a	n/a
Has Sill External	false	boolean	true , false
Has Sill Internal	false	boolean	true , false
Has Drive	false	boolean	true , false
Smoke Stop	false	boolean	true , false
Glass Layers	0	n/a	n/a
Glass Thickness 1	0	millimeters	n/a
Glass Thickness 2	0	millimeters	n/a
Glass Thickness 3	0	millimeters	n/a
Fill Gas	n/a	n/a	n/a
Glass Color	n/a	n/a	n/a
Is Tempered	false	boolean	true , false
Is Laminated	false	boolean	true , false
Is Coated	false	boolean	true , false
Is Wired	false	boolean	true , false

Figure 3 Extract from a COBie spreadsheet for a window

2 BIM in house building today

2.1 The perception of BIM in the house-building industry today

The perception of BIM in the house-building industry is that it is used mainly by large organisations on complex projects, and that its use in the housing sector is practically non-existent. Moreover, those organisations that have looked at the adoption of BIM processes did not see any relevance to house-building practices. These perceptions needed to be tested to see if they had any factual basis.

2.2 The current situation

To help inform the BIM debate in the house-building sector it was necessary to establish the current level of knowledge of BIM, so this could form a useful starting point from which to work. A simple questionnaire was created to help gauge the levels of awareness and understanding of BIM throughout 18 of the major house builders in the UK. Firstly, the companies were asked if they knew about BIM (see Box 1 below).

Box 1: House builders questionnaire	
1	Are you aware of the term 'BIM'?
2	Do you know what BIM is?
3	Do you use BIM?
4	Are you planning to use BIM in the future? If so, approximately when?

The results of this first activity were very clear – that the majority of the major house builders in the UK are currently not engaged in BIM; most either don't know of it, or have no plans to use it. Of this latter group, the majority have looked at it but could see no obvious application or benefit to their business in using it. It would seem that the perception prevailing in the industry at present – or at least part of it – is not without foundation.

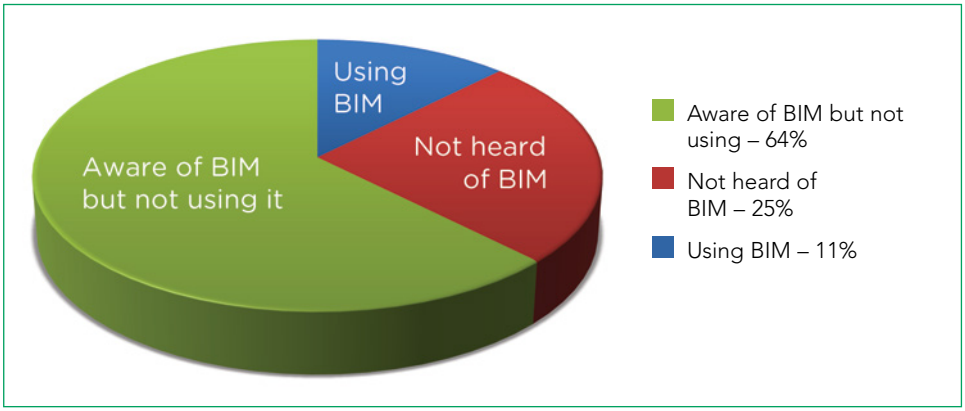


Figure 4 House builders' engagement with BIM

Those organisations that were using BIM were asked further questions about their level of BIM practices (see Box 2). The questions asked to the BIM practitioners were aimed at finding out what they knew about BIM, how they used it and what they used it for.

Box 2: Questionnaire to house builders already using BIM	
General	
1	How would you describe BIM?
2	What do you use BIM for?
3	Which types of project do you use BIM for?
4	Are there any types of project where you would not use BIM?
Document management	
5	Do you use a proprietary document management system?
6	Is its structure in accordance with BS 1192?
7	Do you have your own document management system/process?
8	Is it in accordance with BS 1192?
9	Do you use BS 1192 to number your drawings/documents/files?
Software platforms	
10	Which BIM platform do you use?
11	Which documents/information do you produce using BIM?
12	How do you issue your BIM documents?
13	Which format do you use to issue your BIM documents?
Supply chain	
14	Do you require any of your supply chain partners to use BIM?
15	If yes to 14, which members of the supply chain partners do you require to use BIM?
16	Which activities do you require your supply chain partners to use BIM for?
17	What assistance do you give your supply chain partners to help them comply with your BIM requirements?

The results obtained showed that the BIM practitioners used BIM in only limited ways, which included producing designs, drawings and schedules from the model. Generally the practitioners did not require their supply chains to engage with BIM, but issue information, generated from the model, via electronic files or hard copy.

There is a degree of familiarisation growing within the BIM practitioners. Many are adopting it gradually, and finding out how it can work for them through experience. This is against a challenging commercial environment due to the prevailing economic circumstances which often plays a large part in the BIM strategies the companies develop.

Having found the uptake of BIM was low amongst house builders, a further group of potential BIM users were questioned – the design professionals who work on housing projects – to see if their views of BIM were any different. It was hoped that this might help indicate whether others saw benefits in using BIM processes on house-building developments where they may already have experience from using such tools on other types of projects.

The results here were very different. Almost all of the architects and electrical and mechanical engineers approached were aware of BIM, and more than half were already using it. They were generally focused on the design activities, and in producing information for contractors' use.

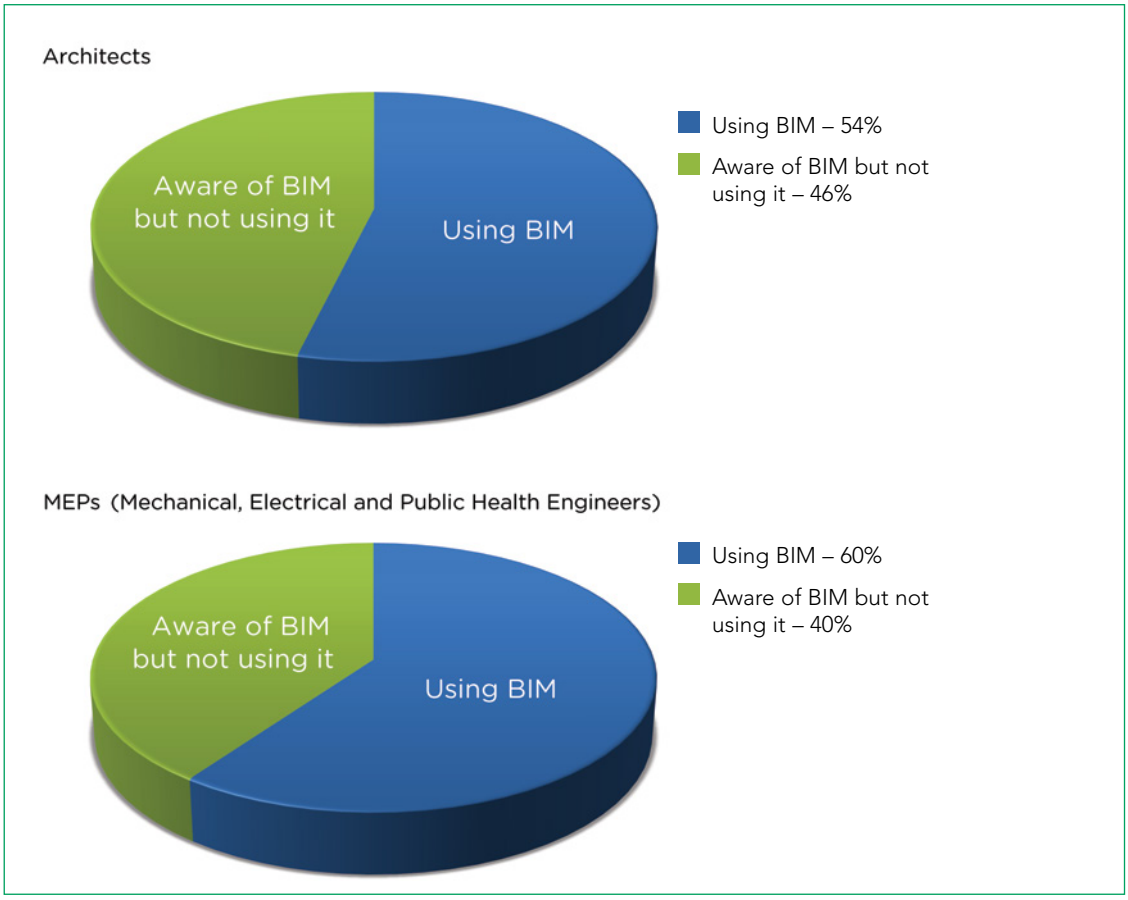


Figure 5 Design professionals' engagement with BIM

Some of the more advanced practitioners were integrating simulation and calculation software packages with their BIM software to help improve productivity and reduce errors. They had also used BIM on a variety of residential schemes, from one-off houses to large tower blocks, and found it particularly useful where complex spatial or co-ordination arrangements arose.

They often transferred and adapted the skills they learned using BIM on commercial projects for the house-building environment. This route to BIM in housing also made the financial impact less onerous for them as many of the development costs had been met on larger projects.

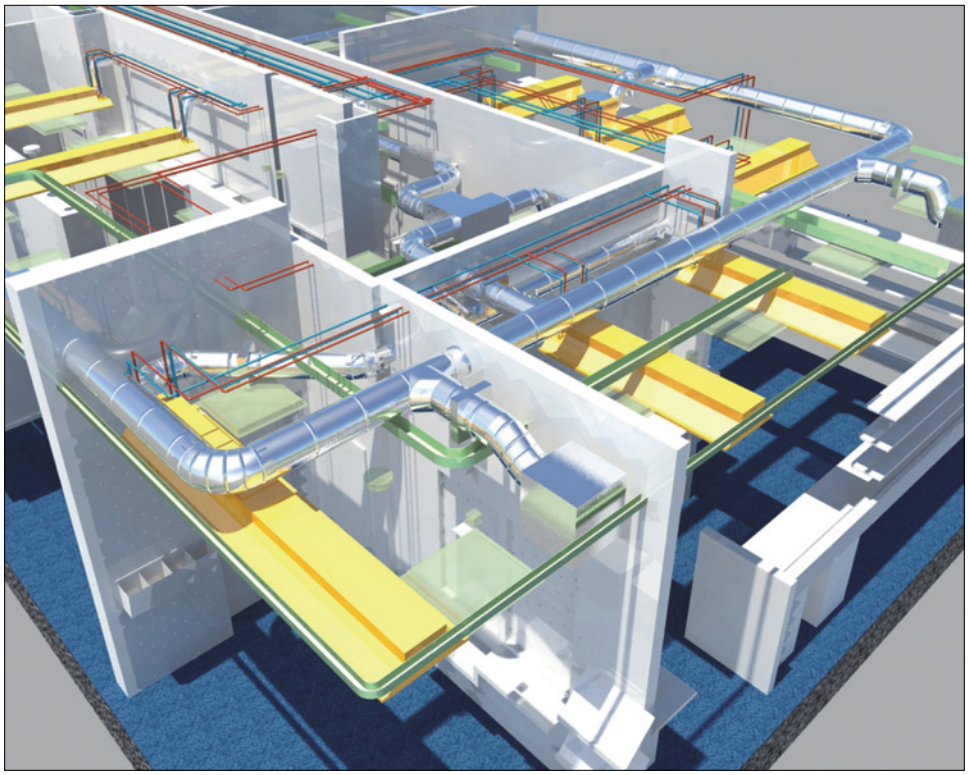


Figure 6 A BIM model used to co-ordinate mechanical and electrical services

Other key findings from the survey amongst BIM practitioners were:

- Document management : Although most of those questioned used some form of document management system, it was usually derived in house, and was not in accordance with the practices described in BS 1192.
- Software platforms : most practitioners were using the leading software product currently in the UK. Reasons for this were given as having a similarity with their CAD products from the same provider, and that other project team members were likely to be using it also, so making the transfer of data and models easier.

The supply chain questions (14 - 17) were not appropriate to the design professionals.

3 The implications of BIM for house building

3.1 Current processes

A vital part of any successful construction project is communication between the various parties – the client who has commissioned the work, the design team who put the client's requirements into a visible form, and the developer or contractor who turns the design into a usable asset.

As part of this process, a very wide range of information (see Box 3 for a comprehensive list) in the form of site surveys, design drawings, schedules, etc. is exchanged between the various project team members to communicate particular aspects of the project. This is the same regardless of the size or type of project – it's often just the number and complexity of the issues covered which change. For example, the nature of design details required for advanced multi-storey office complexes may be much more demanding than those needed for housing schemes where repetition is more common and design solutions are generally more simple and robust.

The design detail must be produced and then shared amongst the project team, in a manner that all can understand and implement. The production of such details can be time consuming, and need to be tried on site during construction.

Schedules are produced at various stages throughout the project, and are used for many different purposes. They may be used initially by the design team to give information about performance criteria of certain elements such as structural beams or the heating system components. These in turn may be sent to the suppliers for pricing prior to procurement, or to sub-contractors.

Box 3: Information type	
Briefing documents	Costing/supplier enquiries
General correspondence	Quotations
Feasibility studies	Requests For Information (RFIs)
Utilities and infrastructure reports	Tender/contract documents
Site surveys	Commissioning sheets
Ecology studies	Working drawings
Design drawings	O&M manuals
Specifications	Statutory certificates
Schedules	Local authority submissions and approvals
Programmes	Financial management

In order to organise and record these activities, processes must be put in place which are understood and followed by all parties. This may be by means of some form of document management system, either a bought-in proprietary software package or a simple in-house system that has developed organically with the business and suits the way it operates.

The nature of the process or document management system will vary depending on the nature of the project, and should be proportionate to the activities being carried out. It is unlikely that a small local house builder will have a system as complex as that being used by a large national builder, but the principles will be broadly similar – the control of the generation and issuing of information and documents so that they can be found when needed, and their status easily and reliably established.

3.2 How BIM relates to current processes

Although the BIM process can be seen simply as the structure of the document management system, it brings with it other advantages. It can act as the method for generating many of the commonly used documents such as drawings and schedules. The drawings can be produced with the BIM software tool in place of the more usual Computer Aided Design (CAD) products, and once generated the model can be used to provide other related documents or information.

For instance, a BIM software model can generate drawings representing any view through the model. As well as traditional plans and elevations, the model can produce sections, or 'slices', through any part of the building.

The model can also be used to generate schedules of items contained within the model – windows, doors, radiators, etc. - which can then be sent to suppliers and installers as normal. The benefit of producing the information straight from the model is that the schedules will accurately reflect which objects are in the model, and it doesn't rely on someone having to count the individual cases from drawings, with the associated risks.

Other information such as costs and time can also be attached or linked to objects within the model. For instance, a variety of window frames may be used on a project, and as well as the usual dimensional data, the cost of each frame size and associated installation time could be included. This data could then be reported in the materials or equipment schedules.

Where expertise allows, more complex models can be generated to include the site information as well as the construction data relating to the buildings. This can help with quantities for earth moving and landscaping, and also can be used to record site services and infrastructure such as main drains, roads and street lighting.

4 What can BIM offer to house builders?

The use of BIM can be considered in two aspects:

- the use of the process, and
- the software model.

Firstly, many of the requirements of a BIM process – the management of information generated and used on a project – is already adopted in house-building companies and on projects throughout the country, but is probably not known as such. It's just the normal document management procedures people use, but possibly in a more structured manner.

The second aspect is where there is potential for increased efficiencies, and reduced errors and costs. In its simplest form, the BIM software model can be used in place of the CAD drawing, but with the ability to add data or information if required. The level of information contained within the model, and hence what can be produced from it, can be built on with experience and as resources allow.

The model can initially be used as a replacement for the usual CAD tools, to produce drawings. As well as plans and elevations, this can in addition include assembly details or complex interfaces. Any drawing which would need to be produced as part of the normal project process should be able to be generated from the model. Once a little more information is added, the tools can then produce schedules of commonly used items such as windows, doors, radiators, etc. Quantities can also be derived from the model so the amount of bricks or roof tiles can easily be determined. Some suppliers are already producing details of their products in BIM form, so they can be added directly into a model with the associated product data attached. This is being seen with kitchen and joinery suppliers at present, but is expected to spread to other equipment as demand grows.

The modelling of complex technical solutions can enable difficult construction arrangements to be tried 'virtually' (the components can be assembled in the model) before getting to site, hence reducing potential costly reworking if the original solution doesn't work as it's simple to try something else in the model. Also, the spatial relationship of various building elements can be checked in the model and any clashes highlighted, again avoiding errors and reworking on site.

The data within the model can also be used to produce documentation for end users and maintenance teams. The various objects can have required maintenance information attached and so can generate maintenance schedules, manuals and user guides if necessary. This may be particularly useful where central plant and systems are used, but may also be of benefit to individual tenants or residents.

The use of BIM is suitable for all projects, but there is greater potential for increased efficiencies and other savings where the most use is made of the process and the model. It has been used successfully on single houses to multi-storey blocks of apartments, and experience seems to indicate that there were benefits on all types of developments.

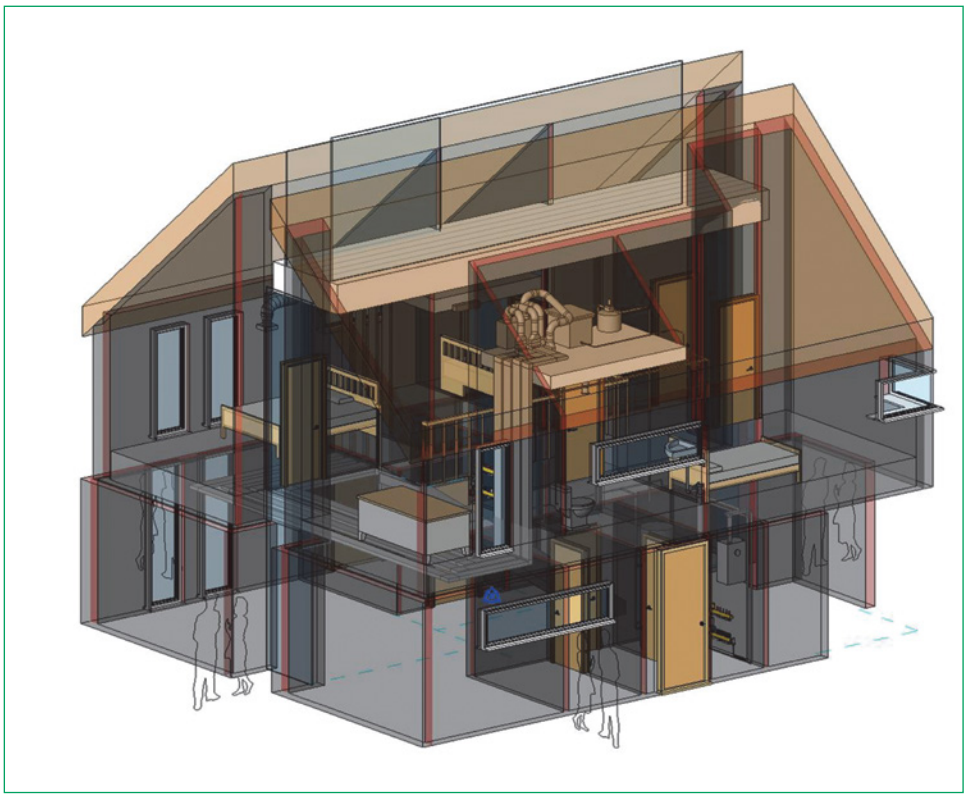


Figure 7 An example of a BIM model for a small development

The rate of uptake of this approach will depend on a number of factors. There are costs associated with providing new software and the hardware (i.e. PCs/workstations) to run it. A wide variety of BIM modelling software is available and, as would be expected, the number of features and ability of the software is reflected in the price. Also, some of the larger packages require higher specification hardware to support it than is commonly in use within the house-building sector.

The current availability of suitable BIM modelling skills is a factor currently being felt throughout the construction industry. Although the situation is steadily improving, it can be difficult to find suitably proficient staff, and it may be preferable to train existing employees instead. This is a further cost to be considered.

However, BIM is a tool to help improve the way things are done and its adoption should be considered within the existing working practices of each organisation, at a speed and in a way which compliments what they do and reduces the need for bureaucracy without a corresponding reduction in efficiency and performance.

5 Conclusions

The research undertaken indicates that the adoption of BIM amongst the UK house-building industry is not very widespread. This is due in part to a lack of knowledge on the subject, and also perceptions of the benefits to the business and the costs involved in providing necessary equipment and training to become proficient.

However, some BIM practitioners are seeing benefits in increased efficiency and reduced duplication and errors. To date these are mainly within the professional teams providing design input to the housing schemes, but some house builders are starting to use BIM, often with expertise learned from commercial projects.

There is no doubt from other areas of BIM adoption that this approach has the potential to realise significant savings to the house-building industry, but it is important that the industry is able to understand the principles of BIM and then identify how best to make it work for each individual organisation. An increased awareness may be facilitated on behalf of the sector by regional presentations or workshops, organised by industry bodies or associations.

6 Case study

CASE STUDY - Haggerston Phase 2

Stage D

The brief called for a 430 unit development across two land parcels and split into five separate blocks. Although individual BIM models were produced for each appartment block, the designers rationalised a number of elements which could be reused across the site. One such element was the standardised core layouts, which were linked into each block, allowing for quick revision of layout and ensuring no discrepancies between blocks.

Early massing studies from the BIM models were also used by the environmental team for daylighting and solar analysis.

Design options were used extensively, allowing the designers to present various options quickly to the client, without excessive abortive work. The use of up to date 3D imagery produced from the models was extremely effective at communicating design intent, both with the client and planners. Material quantity take-offs also assisted in decisions regarding façade treatment, as the ability to quantify the cost of materials directly from each design option allowed for accurate cost/value analysis by the client.

Extensive scheduling was used, specifically for quantifying unit types and tenures in the accommodation schedule. This allowed the project leader to confirm the unit mix accurately throughout the design phase to ensure the brief was being met.

Finally the site masterplan model combining all the appartment blocks was used to generate the visuals used for the planning application.

Quantifiable benefits:

- 3D visuals for design review
- Environmental analysis
- Accommodation scheduling
- Façade material options and quantity/cost take-off

Haggerston Phase 2: Block EF

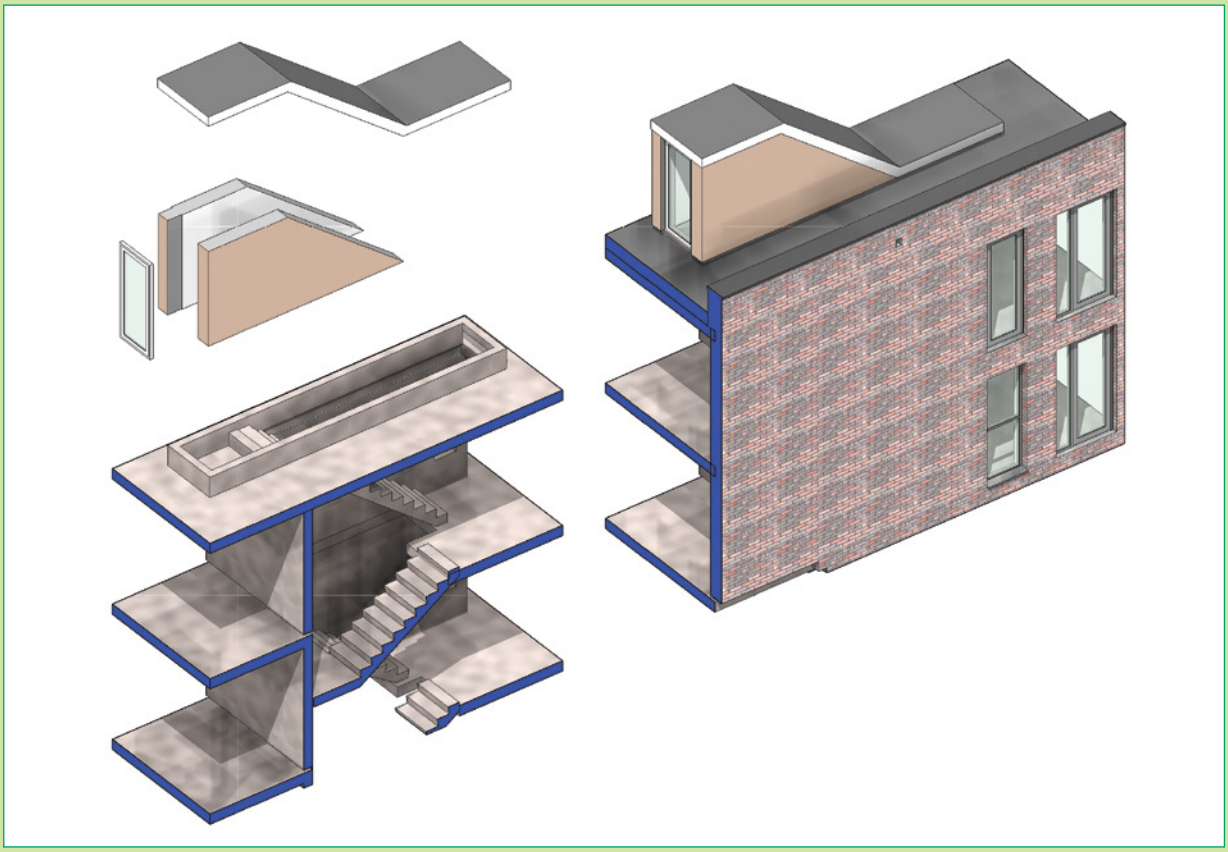
Haggerston Phase 2: Blocks J&L view from North

Haggerston Phase 2: Block C South West

The BIM model was used to 'explode' some construction assemblies to demonstrate the component parts and to help understand the work sequencing requirements.

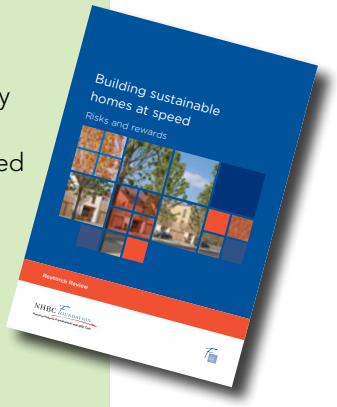
Information produced in such a way can be used for materials scheduling, as well as indicating which elements belong to particular trade or contract packages.

With elements such as stair cores, attribute data associated with various components or assemblies can assist with positioning during construction, and coordinating with other building systems.



NHBC Foundation recent publications

Building sustainable homes at speed: Risks and rewards



New construction techniques have presented the house-building industry with the opportunity to combine the benefits of building quickly and sustainably. House builders considering using innovative systems are faced with difficult judgements about whether these approaches can fulfil their objectives and produce durable, healthy, low-maintenance housing.

This research review gives a series of case studies of selected sustainable housing developments and highlights the risks of building sustainable homes quickly. ***NF 48*** February 2013

Lessons from Germany's Passivhaus experience

The Passivhaus movement in the UK is in its infancy, and while it has many enthusiastic advocates, others question its viability as a standard for volume house building. Worldwide, since the standard emerged from Germany in the late 1980s, some 37,000 Passivhaus buildings have been constructed.

This report examines the political, economic and social drivers, as well as the general attitudes, that have helped or hindered the uptake of Passivhaus in its birthplace. The German context is compared with that of the UK, and the relevance of Germany's experience to the UK is discussed. ***NF 47*** December 2012

Overheating in new homes: A review of the evidence

There is increasing evidence that new and refurbished properties are at risk of overheating, especially small dwellings and predominantly single-sided properties where cross ventilation is not possible. Further, there is evidence of overheating in prototype houses built to zero carbon standards, indicating a lack of cross ventilation in lightweight, airtight houses with little or no solar shading.

This report reviews this evidence, the causes of overheating and the consequences for health. It gives guidance on reducing overheating and calls for a universally accepted definition of overheating in dwellings and threshold temperature levels for use by planners, designers, builders and local authorities. ***NF 46*** November 2012

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NHBC Foundation publications in preparation

- Cellulose-based building materials

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Building Information Modelling – An introduction for house builders

In its drive to improve efficiency in construction procurement, the UK Government has mandated the use of Building Information Modelling (BIM) on its projects by 2016. The expectation is that the private sector will follow, and indeed BIM is already being used on an increasing number of projects across all market sectors and of varying size and complexity.

This report explains what BIM is, and outlines the Government's requirements. It assesses the house-building industry's current engagement of BIM, and looks at ways in which it might make the most of the opportunities BIM presents. Once the house-building industry understands the concepts of the BIM process its participants can make an informed decision on how it can be adopted to best suit their working practices. This brief publication aims to assist in that.

The NHBC Foundation has been established by NHBC in partnership with the BRE Trust. It facilitates research and development, technology and knowledge sharing, and the capture of industry best practice. The NHBC Foundation promotes best practice to help builders, developers and the industry as it responds to the country's wider housing needs. The NHBC Foundation carries out practical, high quality research where it is needed most, particularly in areas such as building standards and processes. It also supports housebuilders in developing strong relationships with their customers.

NF 49

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