Code for Sustainable Homes

Case studies

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December 2010
Department for Communities and Local Government

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Background

The Code for Sustainable Homes (the Code) was introduced in England in April 2007 as a voluntary national standard to improve the overall sustainability of new homes by setting a single framework within which the home building industry can design and construct homes to higher environmental standards. Where it is used the Code also gives new homebuyers information about the environmental impact of their new home and its potential running costs.

The Code measures the sustainability of a home against nine design categories, rating the 'whole home' as a complete package. The design categories are:

- energy and CO_2 emissions
- water
- materials
- surface water run-off
- waste
- pollution
- health and wellbeing
- management
- ecology

The Code uses a rating system to communicate the overall sustainability performance of a home. A home can achieve a sustainability rating from one to six stars depending on the extent to which it has achieved Code standards.

One star is the entry level – above the level of the Building Regulations; and six stars the highest level – reflecting exemplar development in sustainability terms.

Assessment procedures are based on BRE Global Limited's EcoHomes System which depends on a network of specifically trained and accredited independent assessors. Currently BRE Global Limited and Stroma Accreditation Limited can offer training and accreditation of Code assessors.

More information about the Code is available on our website: www.communities.gov.uk/thecode

Introduction

As part of the on-going process of learning from developments being built to the Code standards and to disseminate the information about building sustainable homes, Communities and Local Government has commissioned Jones Lang LaSalle to research and develop a third set of case studies[1] on some of the developments being built to the Code standards.

The case studies cover a range of housing types, using a variety of different build systems or materials and a range of development sizes, from small to large development sites.

The research has helped further develop and improve the operation of the Code. The case studies also include key learning points that should help those who decide to build to Code standards.

Overview of development types

The projects included in this report are:

- Primula Court, urban social housing to Code Level 3 by Crest Nicholson for East Thames Housing Association.
- Slade Park, urban social housing to Code Level 3 by Berkeley Homes for A2 Dominion Housing Association.
- Butterfields, urban social housing to Code Level 3 by Miller Homes for Orbit Housing Association.
- Dalston Square, urban social housing to Code Level 3 by Barratt Homes for Circle Anglia Housing Association.

The majority of the projects included within the study were medium scale sites, consisting of between 42 and 82 units. However, one of the projects, Dalston Square consisted of 244 homes in the first phase of a development of a total of circa 550 homes.

The case studies cover a range of building types including:

- semi-detached and terrace homes
- flats and apartments
- coach house and link units

[1] The first set of case studies were undertaken by the Good Homes Alliance and were published in March 2009. The Code for Sustainable Homes: Case Studies. This document can be downloaded from the Communities and Local Government website: www.communities.gov.uk/publications/planningandbuilding/codecasestudies
(ISBN 9781409811954).
The second set of case studies were undertaken by Jones Lang LaSalle and were published in March 2010. The Code for Sustainable Homes: Case Studies Volume 2. This document can be downloaded from the Communities and Local Government website: www.communities.gov.uk/publications/planningandbuilding/codecasestudiesvol2
(ISBN: 9781409822127)

The projects also included a range of tenures and procurements types, however, due to the current economic conditions, all of the units built to the Code were social housing units for rent and sale.

For information on projects that include private sale units built to the Code, please see the first two case study publications[2].

Construction and build systems

The sites in this report represent a range of build systems and construction processes that might be adopted by other developers at all scales and sizes:

- brick and block masonry walls with a fully or partially insulated cavity
- reinforced concrete frame

There are a number of other build systems that can be used to construct Code homes that were not examined for this publication, these include:

- timber frame with orientated strand board cassettes
- timber frame with a cavity wall of cement particle board outer sheath and brick external cladding
- timber frame with a cavity wall of concrete external block and insulating internal block
- timber frame with pre-fabricated solid cross timber laminated panels and external insulation
- structural insulated panel system (SIPS) with additional insulation
- unfired, insulating clay blocks, with or without external insulation
- timber frame with pre-cast concrete panels
- off-site construction and modular construction

For information on projects built using a number of these construction methods, please refer to the previous two case study publications.[3]

Unlike the previous two case study publications, the majority of projects included within this study did not represent the first time developers had built to the Code for Sustainable Homes. The same was also true for the developer's employees working on the projects, the majority of whom had worked on a Code housing development before. Unlike a number of the projects featured in the first two case study publications, where build systems were prototypes and were used as opportunities to learn about new skills and design processes required to work with the Code, all the

[2] *The Code for Sustainable Homes: Case Studies.* This document can be downloaded from the Communities and Local Government website: www.communities.gov.uk/publications/planningandbuilding/codecasestudies (ISBN 9781409811954).

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case studies in this publication use standard systems such as brick and block cavity walls that were adapted to meet Code requirements.

Working with the Code for Sustainable Homes

The developers in this study were familiar with using the Code and both the developers and their advisors reported they found the assessment and certification processes required to work with the Code easier than their initial experiences.

The majority of the developers had chosen to adopt the Code standards in order to meet formal planning or funding requirements, in particular to create a housing development for a housing association client. The majority of the case studies had originally intended to include elements of private sale housing which were not to be built to the Code. Unsurprisingly, these projects required re-design in order to meet the Code and feedback from developers is that developments planned to be built to the Code from the outset are easier to build.

In one of the case studies, communal sustainability features, such as communal heating system and green roofs, were also included in the specification for private sale units, even though the units themselves were not designed to the Code.

Sustainability approaches & technical performance

The sustainability approaches adopted on most of the projects were fairly similar, which is to be expected given the formal requirements within the Code for energy- and water-efficient buildings. Most of the projects focused on high-quality, highly insulated building shell with low air permeability that took maximum advantage of passive solutions before adding active or low carbon or renewable features:

- high levels of insulation
- low levels of air-permeability
- passive solar design strategies
- low energy lighting
- the use of environmentally benign materials
- low water use sanitary ware

The schemes also included low carbon or renewable energy such as photovoltaic cells, biomass boilers, combined heat and power systems, heat recovery systems and heat pumps.

Two of the projects also incorporated innovative metering equipment and arrangements enabling future post occupancy monitoring, which will help provide feedback on the actual performance of different systems during occupation.

The technical performance of the components of each project varied according to the Code level achieved: low-e double glazing and wall U-values from 0.16 W/m^2K to 0.35 W/m^2K at Code Level 3. Air permeability test results were also in line with expectations ranging from 3 $m^3/h@50\,Pa$ up to 7 $m^3/h@50\,Pa$ at Code Level 3.

All of the projects were able to obtain a standard 10-year building warranty.

Scheme implementation

All developers in this study were using the Code for Sustainable Home for at least the second or third time and these developments were therefore used as opportunities to build on the experience of initial Code projects and refine their designs and strategies required to work with the Code.

Where new systems and materials were used, all of the developers undertook some research into how these would work and visited demonstrations of the products and systems. Despite this, most of the developers still encountered design and/or construction difficulties at some point. Most of the developers reported that in future they would undertake greater research and testing of any new systems or approach. The most common problems for those who used new systems and approaches were:

- sourcing and installing new energy systems
- use of new energy systems by owners and clients

The developers who used solar photovoltaics reported fewer difficulties with energy systems as the output is automatically fed into the grid if not used by residents, however, the installation and management of heat generating systems was found to be more complex and developers reported that additional design, management, investigation and training was required for these new systems.

The projects attracted varied reactions from their local planning authorities. In most cases, the sustainability performance was well received, but different requirements were applied in terms of aesthetic. Some projects adopted a traditional vernacular design approach, whilst others adopted a more modern aesthetic, demonstrating that it is possible to achieve Code Level 3 using a variety of different design approaches.

Costs, value and buyer/occupant feedback

The build costs, excluding land costs and fees, ranged from £900 to £1,700 per square metre. It is difficult to find a benchmark figure against which these can be compared, as the costs vary so much by building type, the standard of finish, the target market and particularly by capital costs such as basement car parks and energy systems. The recent case studies have indicated that the costs of building to Code Level 3 have remained stable since the last case study publication with a range of £3,000 to £4,000 per unit the most commonly reported uplift.

The uplift included both the additional costs for materials, systems and features. Most of the developers had experience of using sustainability technologies before and where they used systems or technologies for the first time, these were often installed in order to meet the requirements of housing association clients.

The developers reported that they expect to reduce the additional costs on the next and future projects, as the requirement for additional research, training and development systems would be reduced, and the supply chain for products and systems would become better developed and more sophisticated. In addition, they also reported that they should achieve greater build efficiencies through better integration of the sustainability requirements within the design, and through greater focus on accurate construction of the design details. Build costs would also be significantly reduced if there is a reduction in cost of sustainable and renewable technologies (such as air recovery units and photovoltaic panels) through an expanded supply chain.

Key lessons

A number of lessons can be drawn from these case studies of Code homes. Firstly, it is clear that Code compliance can be achieved using a wide range of build systems. The Code can also be used on a wide range of building types, from flats/apartments through to houses. Furthermore, the Code can be a valuable tool for any type of project, whether private or social housing, and covering rental, affordable and private sale properties.

It seems that there has also been an increase in understanding in building to the Code, with developers conducting training and raising awareness to provide staff with greater confidence and understanding in implementing the Code. All the developers also expressed a large amount of pride and satisfaction in delivering sustainable homes by using the Code.

In more technical terms there are a number of common lessons about how best to achieve Code compliance:

- code is achievable on small to large scale projects
- a high quality, highly insulted building shell that has low air-permeability and makes best use of passive solutions seems to be the most successful and straightforward approach
- code design criteria should ideally be incorporated from the earliest design phases of a project in order to understand the overall design implications and avoid the need to re-do work and the associated delays
- a code assessor should be included in the project plans from the outset and throughout the entire project process, including site meetings
- the build systems and the design approach should be integrated from the earliest design phases
- renewable energy technologies and other innovative technologies should be integrated into the overall design concept from the earliest design phases

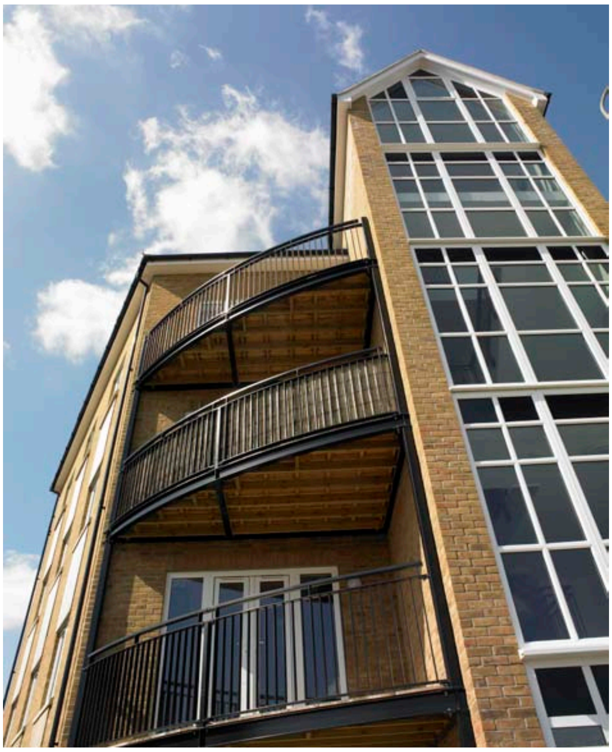
- it is important that evidence is gathered for the post-construction certification as early as possible during the construction process
- owner and resident training in new energy systems is key to ensure their successful implementation

Case study 10

Primula Court, Chelmsford, Essex

CSH Level:	Level 3
Development Type:	42 homes consisting of 12 one bedroom flats and 30 two bedroom flats
Construction Type:	Reinforced concrete frame to ground and part of the first floor. Traditional brick and block masonry walls above podium, cavity walls, timber frame pitched truss rafter and tile roofs
Key Sustainability Features:	Communal gas boiler heating system, evacuated tube solar thermal installation, high levels of insulation, low energy lighting, low water use sanitary ware, mechanical ventilation and heat recovery system (MVHR)
Procurement Method:	Design and Build contract (Crest Nicholson principal contractor) for housing association client (East Thames Housing Association)

Primula Court



Introduction

Primula Court is a development scheme in a highly accessible location, close to Chelmsford Town Centre, the mainline railway station and a newly constructed bus station. Crest Nicholson, on behalf of East Thames Group, have transformed the site into a high quality sustainable urban development and shown how it is possible to achieve Code for Sustainable Homes Level 3 on a constrained brownfield site, the character of which leant itself to the construction of a high density, flatted development.

The site was formerly a car dealership, with large areas of hard standing and some contamination as a result of an onsite petrol storage tank. Development of the site began with remediation and was completed in October 2009 following an 11-month build period. All 42 homes have now been occupied. The development was originally intended to include a mixture of private sale and affordable homes, however, in response to economic circumstances and demand in the local area, the entire scheme to Code Level 3 was offered as a 100 per cent affordable scheme to a housing association.

Thirty-five of the homes on the development were offered through a 'rent now, buy later' scheme, which was the first scheme of its kind to be delivered in Chelmsford Borough and provided a new way for people to take a first step into home ownership. Under this scheme, eligible applicants are able to rent a brand new apartment at a discounted rent for a period of up to five years, enabling them to save for mortgage deposits and legal fees which they can use to purchase a share in the property when they can afford to do so.

"We are very pleased with the uptake for these new homes. There is clearly a demand for good quality housing like Primula Court in Chelmsford. The central location, along Rainsford Road, ensures that residents will be able to benefit from all of the shopping and leisure facilities and excellent transport links within the town centre. My thanks go to East Homes and Crest Nicholson for all their hard work in partnership with the Council."

Councillor Duncan Lumley, Chelmsford Borough Council
Cabinet Member for Housing

Construction and build system

The homes have been constructed using a combination of a reinforced concrete frame to the ground floor and part of the first floor, and traditional masonry construction above. The external walls were constructed as a cavity wall with an external brickwork skin, a fully filled cavity containing blown bead EPS insulation, and an internal skin of lightweight aggregate blocks, finished using standard plasterboard on dabs. Externally, red bricks and render have been used.

The floors are concrete slab over an acoustic insulation layer, and the roof was constructed using pitched timber truss with concrete interlocking tiles. The mineral wool insulation used in the roof was laid in two layers in order to achieve the required U-value.

Exterior of Primula Court

Sustainability features

A range of sustainability features were integrated into the development. As well as high levels of insulation, the units were designed to maximise passive solar design and day lighting, which was achieved through careful unit depths and maximisation of the number of windows facing south east and south west.

The development contains three 200 kW communal boilers located in a ground floor building, making access and maintenance easier than if they were in the basement. This will also facilitate connection of the scheme to any future community or district heating systems. The development also features 19 evacuated tube solar thermal panels and a central mechanical ventilation and heat recovery system (MVHR).

Gas and water use are metered centrally, with the housing association billing occupiers, whilst electricity use is metered individually for flats. The use of a solar thermal heating system feeding directly into the communal heating system, allowed this approach to metering. The landlord supply is separately metered for communal lighting and the basement car park ventilation system, allowing both more detailed understanding of the landlord's energy consumption and also the ability to adjust service charges according to whether residents own a car parking space.

Evacuated solar tubes at Primula Court

The ecology of the site was improved by incorporating soft landscaping where previously the site was predominantly covered by hard surfacing. All timber used was 100 per cent Forest Stewardship Council (FSC) certified. The scheme also incorporates 100 per cent cycle storage – one space for each dwelling.

The site itself, and each dwelling offers security to "Secure by Design" standards, 100 per cent low energy lighting, internal and external waste recycling facilities, and fittings are designed to give a water consumption less than 105 litres per person per day.

Technical performance

External fabric

293 mm cavity wall consisting of an external brickwork skin, 90 mm cavity fully filled with blown bead insulation and an internal skin of 100 mm aggregate blocks, finished using standard plasterboard on dabs. U-value of 0.35 W/m^2 K.

Roof

Pitched timber truss, concrete interlocking tiles, 300 mm quilt insulation laid in two layers with the first of 150 mm laid between ceiling joists with second layer of 150 mm laid at 90 degrees to cover ceiling joists. U-value of 0.16 W/m^2 K.

Floor

200 mm concrete slab with a 65 mm floating screed over an acoustic layer. U-value of 0.25 W/m^2 K.

Doors and windows

A rated hermetically sealed double glazed uPVC windows. 24 mm units with low E glass. U-value of 1.6 W/m^2 K.

Air permeability

The target set was 5 m^3/h@50 Pa which was achieved by all units during the final air permeability tests. This compares with the requirement of only 10 m^3/h@50 Pa in the 2005 Building Regulations.

Scheme implementation

The development was completed in a challenging timescale of 11 months, and no delays were caused as a result of the need to achieve Code Level 3. This efficient build process was a direct result of the developer investing considerable additional time at the design stage on pre-planning a Code strategy, with an integrated project team process involving the external design teams, and the Code assessor. The developer undertook a review of all of its operational processes, and incorporated additional activities both for costing and discharging Code certification from land purchase, through planning, design, and build to handover. This heavy upfront commitment of time and resource is essential to ensuring well designed spaces, and in particular to meeting the audit trail required by the Code post-construction review process in place at the time the development was completed, although the developer recognises that these requirements have subsequently been streamlined.

The developer felt that the installation of a communal heating system can be managed most effectively when the design of the system is completed by the installation company, rather than by a separate mechanical and electrical (M&E) consultant as it is critical that the whole system is correctly designed and installed, and maintained when serving all units in a development. The complementary heating from solar thermal tubes was East Thames preferred system for ease of operation and maintenance. All build systems have conventional building warranties issued by the National House Builders Council (NHBC).

Working with the Code for Sustainable Homes

This is one of the first complete schemes for which the developer has achieved or is in the process of achieving Code Level 3 certification. It was the second scheme completed by the technical manager for the contractor to Code Level 3, the first scheme being a small number of houses built to Code Level 3. As expected, there was a greater ease of building to the Code on the second development, although, the larger number of units and flats represented new, but ultimately, rewarding challenges.

For example, the location of water butts and composting facilities needs to be more carefully considered on flatted developments. In this case, both were located so as to be accessible for residents as well as the landscape maintenance company who use the collected rain water for the plants, and place gardening waste in the composter.

The experience of installing a communal heating system supported by a solar thermal installation was also positive and a strategy the developer would consider using on other developments. This approach was also found to have additional benefits of helping to achieve air tightness targets as communal heating pipework requires less service penetrations than individual boilers in each flat, e.g. there is no need for a vent in each unit.

The technical manager for the scheme, along with a number of colleagues, had completed the code assessor training. An external assessor still had to be employed for efficiency in handling the large amount of required paperwork and also afforded independent verification of compliance. The technical manager found code assessor training was essential to ensure a cost effective design approach tailored to the developers strengths, and to ensure that BRE assessor updates to requirements and processes (particularly detailed design drawings and procurement specifications) were captured early in the design process, and critically to ensure a coordinated compliance with the Code across all company functions – a role which a Code assessor cannot undertake. To ensure robust and accurate specification for the approach to communal heating, the technical manager visited a communal heating scheme in Austria and the BRE Innovation Park.

Costs and value

The homes were built for social housing and were not intended for sale. The developer estimates that an additional uplift of £3,000 to £4,000 per unit was required in order to achieve Code Level 3, compared to a standard unit built to Building Regulations.

Buyer/occupant feedback

All 42 units on the scheme have been completed and the development has been occupied for a number of months.

The developer's normal customer service and support is in place during the standard one year period. Regular site visits are also undertaken by the developer and their sub contractor to monitor the performance of the communal heating system.

The housing association owners will also run a session for residents to raise concerns.

"I've been living in my two-bed apartment for two weeks now so I'm starting to get settled in. My apartment is spacious and really well designed. I'm looking forward to the summer when I'll be able to use my balcony and get out into the communal garden."

Jonathan Murdoc, Resident

Lessons learnt

The main lessons learnt from the development have been:

- Having an in-house Code assessor is an effective way of ensuring that the Code requirements can be achieved. The developer felt it was essential that key technical staff were trained and skilled in the Code assessor role.
- The site manager may require particular support in overseeing the build process and detailed placement of items, for example internal washing lines, in addition to the normal quality checks and tests.
- Review all operational processes, and incorporate additional activities both for costing and discharging Code certification from land purchase, through planning, design, and build to handover to ensure compliance with the Code.
- An internal management process, guided by the technical function, which co-ordinates and owns the process internally, and ensures the Code assessor's input is integrated appropriately throughout the development process should be created to ensure compliance with the Code.
- Code Level 3 can be achieved on constrained high density/high rise developments.
- If a scheme is being built for a client that will retain an interest in the development once it is completed (in this case a housing association), they should be actively involved in the specification of products so that they can understand the long term requirements and costs to operate and maintain equipment and services.
- Solutions to achieve Code Level 3 on one development can be used on other developments. For example, the positive experience of installing a communal heating system supported by a solar thermal installation means that the developer will have experience when considering this solution on future developments.

- Spatial requirements for new technologies within the dwelling must be considered early on during detailed design, and carefully balanced with internal storage requirements. For example, on future developments utilising MVHR the developer would locate the MVHR units within kitchen areas as opposed to hallway cupboards to maximise the useable space for the customer.

Breakdown of points

	Percentage of category score achieved	What is covered in the category
Energy	51	Energy efficiency and CO_2 saving measures
Water	66	Internal and external water saving measures
Materials	62	The sourcing and environmental impact of materials used to build the home
Surface water run-off	100	Measures to reduce the risk of flooding and surface water run-off which can pollute rivers
Waste	100	Storage for recyclable waste and compost, and care taken to reduce, reuse and recycle construction materials
Pollution	75	The use of insulation materials and heating systems that do not add to global warming
Health and wellbeing	33	Provision of good daylight quality, sound insulation, private space, accessibility and adaptability
Management	88	A Home User Guide, designing in security, and reducing the impact of construction
Ecology	55	Protection and enhancement of the ecology of the area and efficient use of building land

The figures above are from the post-construction certificates for the units. A range of points were achieved by different units on the development. The above table provides an example of the performance of one home on the development.

Design team

Client: East Thames Group

Contractor: Crest Nicholson

Developer: Crest Nicholson

Engineer: Scott Wilson

Architect: Terence Wynn Partnership/Graphik Architecture

Energy Design Consultants: AA Energy Consultants

Case Study 11

Slade Park, Headington, Oxford

CSH Level:	Level 3
Development Type:	72 homes consisting of 15 one bedroom flats, 25 two bedroom flats, 9 three bedroom flats, 18 three bedroom houses and 5 four bedroom houses. 48 homes built to Code Level 3
Construction Type:	Standard masonry construction, cavity walls, timber frame pitched truss rafter and tile roofs
Key Sustainability Features:	Solar photovoltaic roof tiles, SEDBUK A Rated boilers, high air tightness, mechanical ventilation, advanced heating controls, low energy lighting, low water use
Procurement Method:	Development Agreement (Berkeley Homes principal contractor) for housing association client

Slade Park

Introduction

The Slade Park development is on a former Territorial Army Centre site on the edge of Oxford in a residential suburb. Due to the presence of two universities in Oxford and its large student population, Berkeley Homes redeveloped the site to provide a mixture of residential housing and dedicated student housing. The entire site was developed with sustainability in mind and the residential buildings achieved Code for Sustainable Homes Level 3, showing how the Code can still be achieved across mixed use and mixed tenure sites developed by multiple partners.

The site had been used as a barracks for 70 years and consisted of a number of brick buildings with tile roofs built in the 1950s that were not suitable for conversion to residential homes. They comprised vehicle storage sheds, a drill hall, offices, cadet centre, car park and eight houses and were vacated by the TA as part of a move to a barracks in Abingdon. A large collection of historical items were also removed from the site with a view to displaying them in an appropriate museum.

The residential housing on the site has been designed as affordable housing which is to be managed by A2 Dominion Housing Association, having originally been designed to also include private sale homes. The partnership between the developer and the housing association resulted in the provision of much needed affordable housing in the area and ensured that all the housing was built to Code Level 3 as part of the Homes and Communities Agency (HCA) funding requirements.

"Berkeley Homes (Oxford & Chiltern) Limited are pleased to have delivered one of the first major schemes in Oxford to achieve Code Level 3. A detailed pre-analysis of all the technical options available and our close working relationship with the code assessors were instrumental in the successful delivery of the units. We hope that the sustainability initiatives implemented on site will have a positive benefit for the environment and the future residents."

Sam Williams, Land Manager, Berkeley Homes (Oxford & Chiltern) Limited

Construction and build system

The development has been constructed using traditional masonry construction.

The external walls of the flats were constructed as a cavity wall with an external brickwork skin, Partial filled cavity containing 100 mm celotex insulation 50 mm clear cavity, and an internal skin of light density blocks, finished using standard plasterboard on dabs. Externally, facing brick was used with grey interlocking tiles on the roof.

The ground floor of the flats was a suspended beam and block floor with 130 mm insulation and 75 mm screed layer. The roof was constructed using pitched timber truss and concrete interlocking tiles, with 500 mm mineral wool insulation between joists and cross-laid.

The external walls of the houses were cavity walls with facing brick, a cavity partial fill with 50 mm celotex and an inner skin of construction blocks, finished with dabs and plasterboard.

Ceilings are constructed with wooden rafters with friction fitted insulation between rafters.

The student accommodation was constructed using a modular off-site construction system.

Slade Park during construction

Sustainability features

The mix of flats and houses on the site required a tailored approach for each building type; however a number of sustainability features were incorporated across the entire scheme.

Both the flats and houses had solar photovoltaic shingle roof tiles installed, an innovative form of solar power which were used to not only provide the required renewable energy for the scheme but also replaced existing building materials (i.e. roof tiles) and provided a more aesthetically pleasing finish.

The wider scheme also incorporated a number of sustainability features, including enhanced sound insulation achieving a 5dB improvement on sound proofing from Part E of the Building Regulations, internal waste recycling bins and Lifetime Homes.

Private and communal external space was also provided for residents, which was felt to be particularly important due to the mix of uses on the site. During construction, the site was registered with the Considerate Contractors Scheme due to the proximity to existing residential development. Upon completion all residents were provided with Home User Guides.

Houses

The houses incorporated a number of sustainability features specifically due to their design as three-storey homes. For example, the houses incorporate thermostatic radiator valves (TRVs) and a weather compensator which can offer fuel saving benefits by taking into account the outside temperature and reducing the boiler heat output accordingly. Zone control heating was also provided to allow control of heating across the different rooms and floors of the house.

Some of the houses also had rooms within the roof space which incorporated detailed insulation of 97 mm timber studs filled with 100 mm insulation between studs and specifying a high U-value roof light.

Flats

The flats meanwhile included different sustainability features, starting with a higher air tightness target taking advantage of their built form. The more air tight design meant that there was a need for mechanical ventilation and a MVHR (mechanical ventilation and heat recovery) unit with insulated ducting was installed to provide ventilation and to recover heat.

A high efficiency combi-boiler (SEDBUK rating of 91.3%), low energy light fittings, low water use fittings were also installed.

Roof with integrated solar photovoltaic tiles at Slade Park

Technical performance

External fabric

300 mm cavity wall consisting of an outer brickwork skin, 100 mm cavity filled with 50 mm celotex insulation and an internal skin of 100 mm blocks, finished using standard plasterboard on dabs. U-value of 0.32 W/m^2 K. External fabric of flats upgraded to achieve a U-value of 0.16 W/m^2 K through the use of a 100 mm insulated cavity.

Roof

Plasterboard to underside of trusses with 150 mm thick mineral wool insulation between joists and an additional layer of 150 mm thick mineral wool cross-laid over joists. U-value of 0.14 W/m^2 K. Roof of flats upgraded to achieve a U-value of 0.08 W/m^2 K through the use of an additional 200 mm of insulation. Mixture of solar PV and concrete tiles.

Floor

Suspended beam and block ground floor with 75 mm celotex insulation and 75 mm screed. Average gross internal floor area of 35.9 square metres. U-value of 0.21 W/m^2 K. Floor of flats upgraded to achieve a U-value of 0.13 W/m^2 K through the use of 130 mm of celotex insulation.

Doors and windows

Composite front door with a U-value of 1.3 W/m^2 K. uPVC windows; argon filled with 'low-e' coating. U-value of 1.5 W/m^2 K. Roof lights with a U-value 1.4 W/m^2 K. Flat doors to communal areas specified to achieve a U-value of 0.6 W/m^2 K.

Air permeability

7 m^3/h@50 Pa achieved on houses. Flats specified to achieve 3 m^3/h@50 Pa.

Scheme implementation

The scheme is nearing completion and some of the homes have been awarded Code Level 3 interim certificates and 22 units have been awarded post-construction certificates, with the remainder due for completion in May 2010.

The developer reported that the implementation of the scheme was not affected by the mix of tenures on the site and the site conditions this created.

The majority of the features used to achieve Code Level 3 were supplied and installed by Berkeley's normal subcontractors. This principle extended to the installation of the solar PV tiles which were installed by the roofing contractor as part of their normal roofing contract and a specialist roofing contractor was not required. The wiring of the electrical installation of the system was also undertaken by the normal electrical subcontractor. The only specialist contractor required on the entire development was to connect the solar PV tile systems to the grid.

All build systems have conventional building warranties issued by the National House Builders Council (NHBC).

Working with the Code for Sustainable Homes

The residential element of the scheme comprises of a mixture of flats and houses and a distinguishing feature of the development was that different strategies were adopted to achieve Code Level 3 for each building type. The existence of two different Code strategies on the same scheme required careful management, such as clearly defined flat and house specifications, however multiple strategies was ultimately an approach the developer found effective and one that could be replicated on larger, multiple phase developments.

A hierarchy of Code categories was created, identifying 'easy wins', and consideration was also given to alternative or 'back up' strategies. This provided the option for the strategy to be easily adjusted in response to changes to the project, product supply issues, client requirements and so on without the need for extensive re-design. This proved a useful approach in relation to the solar PV tiles, the installation of which was dependent on obtaining funding through the low carbon buildings programme. If the 50 per cent funding for this installation was not obtained, air source heat pumps (ASHP) were to be used and the scheme was able to progress whilst the grant application was progressed.

As part of the project management of the development, the gathering and submission of evidence was allocated to specific members of the project team. A decision was also made to submit all evidence electronically, reducing the amount of paper waste generated by the project.

Costs and value

As it is still under construction, final cost data is unavailable for the scheme.

Buyer/occupant feedback

The completed units have only just recently been occupied by the housing association's tenants and until all the units are complete and occupied the feedback from residents is limited. However, further monitoring of the performance of the homes is intended to be undertaken by the developer in the future during the one year defect period.

A full handover pack was provided to residents including standard information on how to use the home and information on the Code elements, such as the solar PV system.

Lessons learnt

The main lessons learnt from the development have been:

- Code Level 3 can still be achieved across mixed use and mixed tenure sites.
- Code Level 3 can still be achieved on sites developed by multiple development partners and achieving Code Level 3 is not dependent on a whole site being in single ownership.
- Adopt different strategies for different unit types (flats and houses), particularly for achieving the energy element of the Code. This recognises the different features of the different units and their likely occupiers, for example floor area, number of storeys, space available for sustainability features and so on.
- Achieving Code Level 3 requires effective supply chain management, for example, incorporating sustainability into normal sub-contracts reduces the need for specialist sub-contractors and conflicts regarding responsibilities.
- Developers should carry out a full review of Code points and adopt a 'back up' strategy as changes can be required to the scheme in response to supply or funding issues, particularly with specialist low carbon or renewable energy systems.

Breakdown of points

	Percentage of category score achieved	What is covered in the category
Energy	51	Energy efficiency and CO_2 saving measures
Water	50	Internal and external water saving measures
Materials	75	The sourcing and environmental impact of materials used to build the home
Surface water run-off	100	Measures to reduce the risk of flooding and surface water run-off which can pollute rivers
Waste	85	Storage for recyclable waste and compost, and care taken to reduce, reuse and recycle construction materials
Pollution	75	The use of insulation materials and heating systems that do not add to global warming
Health and wellbeing	66	Provision of good daylight quality, sound insulation, private space, accessibility and adaptability
Management	100	A Home User Guide, designing in security, and reducing the impact of construction
Ecology	33	Protection and enhancement of the ecology of the area and efficient use of building land

The figures above are from the design stage assessment and are subject to final approval/certification. A range of points were achieved by different units on the development.

The above table provides an example of the performance of one unit on the development.

Design team

Client: A2 Dominion Group

Contractor: Berkeley Homes (Oxford & Chiltern) Ltd

Developer: Berkeley Homes (Oxford & Chiltern) Ltd

Architect: Berkeley Homes (Oxford & Chiltern) Ltd

Energy Design Consultants: NHBC Services Ltd

Case Study 12

Butterfields, Bilton Road, Rugby

CSH Level:	Level 3
Development Type:	82 homes, comprising 27 one and two bed homes and 55 two and three bed homes
Construction Type:	Standard masonry construction, cavity walls, timber frame pitched truss rafter and tiles roofs
Key Sustainability Features:	Air Recovery Heat Systems, onsite water drainage, onsite ecological enhancement measures, low energy lighting, Secured by Design products
Procurement Method:	Design and Build contract (Miller Homes principal contractor) on behalf of Orbit Housing Association

Butterfields

Introduction

The Butterfields site is located in Rugby and was formerly a garden nursery which had reached the end of its useful life. The site itself was named "Butterfields" due to the large number of buildings designed by William Butterfield in the 19th century, including much of the famous Rugby School. However, the site was close to public transport links with bus services operating along Bilton Road providing access into Rugby town centre and its mainline railway station. This made the site a sustainable location for residential development and Miller Homes, in partnership with Orbit Housing Association, have therefore transformed the site into a new residential community built to Code Level 3.

The site was originally planned to include a mixture of private sale and social housing and construction on site had begun on this basis. However, following an agreement reached with Orbit Housing Association, it was decided to revise the scheme to provide 100 per cent social housing. This resulted in the scheme being constructed in two distinct sections; one section that had been partially constructed and required revision and another section that had not yet started on site. A mixture of apartments and houses have been completed and awarded a Code design stage certificate and are occupied. The remainder of the development is due for completion in July 2010.

"Butterfields was the first Code compliant site undertaken by the West Midlands Region of Miller Homes, and thus posed many new challenges. The key to the development's success was the early establishment of all aspects of the specification, and it's subsequent clear communication to all parties."

Mark Waplington, Commercial Director, Miller Homes

Construction and build system

The development has been constructed using traditional masonry construction.

The external walls of the flats consist of a brickwork outer leaf, a cavity and internal structural blocks, finished with dabs and plasterboard.

The floors of the flats are a proprietary beam and block construction made of prestressed concrete beams covered with a structural concrete screed.

The roof was constructed using pitched timber trusses with glass fibre insulation between and over purlins. Ceilings consist of a single layer board incorporating a vapour control membrane, fixed to underside of the roof structure.

Insulated panels used for windows and doorways at Butterfields

Sustainability features

The key feature of the site is that it demonstrates that it is possible to achieve Code Level 3 without the use of renewable energy technology and this is the only case study site where renewable energy technology has not been used. The external fabric of the flats and houses is identical, demonstrating that differing strategies for the building fabric of these types of property are not essential.

Low carbon technologies have however been used in the form of exhaust air heat recovery systems, with different systems used for the flats and houses.

A key sustainability feature of the scheme was the installation of a sustainable urban drainage system (SUDS). This included a crate system and attenuation tank to reduce surface water run off into the Sow Brook and the creation of a green space area around the brook to provide defence against flood water. A permeable surface was installed on the central car parking area, with a 1 in 12 slope from buildings and gardens downwards to the car park.

Flats incorporating rain water butts, clothes drying facilities and nesting boxes at Butterfield

As a former garden nursery, the site was found to have some existing ecological value and this was preserved and enhanced through the creation of new areas of greenspace and the creation of an area of greenspace around the Sow Brook. The scheme also incorporated bird boxes under roof eaves for nesting swallows and also a bat nesting space in the roof of one of the blocks of flats.

The scheme also included a number of 'coach house' units where homes are constructed over a drive or over an internal garage. These units required additional insulation to ensure that building fabric targets were achieved and a plasterboard bonded to a higher performance expanded polystyrene insulant was therefore specified.

Technical performance

External fabric

Brickwork outer leaf (103 mm), injected insulation (90 mm) and high density blocks (100 mm) finished with 12.5 mm plasterboard on 10 mm adhesive. U-value 0.30 W/m^2K.

Roof

Minimum 400 mm thick glass fibre insulation in one 100 mm layer between rafters and one 300 mm layer, cross laid in opposite directions to achieve U-value of 0.11 W/m^2K. Roof insulation lapped with wall insulation to limit air leakage. Sloping ceilings received 100 mm insulation between rafters, maintaining a minimum 50 mm air gap between insulation and underside of roofing felt. Insulation on the underside of rafters which consists of a composite board of 55.5 mm CFC-free foam insulation and 9.5 mm plasterboard with integral vapour check to achieve U-value of 0.20 W/m^2K.

Floor

Concrete beams with polystyrene block infill insulation covered with a concrete screed. U-value of 0.25 W/m^2K.

Doors and windows

PAS24 doors. Windows are 4.16.4 mm hermetically sealed argon filled double glazed units with Low E soft coat glazing to achieve a U-value of 1.5 W/m^2K.

Air permeability

6 m^3/h@50 Pa target. 3 m^3/h@50 Pa achieved.

Scheme implementation

Work began on site with the clearing and crushing of the existing buildings on site, including a substantial car park, and much of his material was crushed and used as pile matting. Substantial work was required on site to create flood defences around the Sow Brook that runs through the site.

To achieve Code Level 3, a number of amendments were made to the original specification for the scheme, which was originally intended to be predominantly private sale units. The change in specification involved undoing some flooring work that had been completed, however, increasing the specification, even once the project had started on site, was achievable. The main difference between the units was the installation of heat recovery systems. Two different heat recovery systems were used due to different power requirements between flats and houses and the availability of space in the units.

The installation of the heat recovery units in the flats proved to be a challenge on site as it was difficult to manoeuvre them through the communal stair areas due to their size and a manufacturer's requirement that they are not tilted beyond 45 degrees. The developer would therefore phase the installation of these units at an earlier stage than other heat or energy equipment (e.g. boilers).

All build systems have conventional building warranties issued by the National House Builders Council (NHBC).

"The specification was derived with input from many sources, and directly benefited from other works undertaken by Miller Homes at both a divisional, and regional level. Drawing on this resource and knowledge soon demonstrated that varied solutions are available to any given scenario, and that, as new technologies continue to be developed, further alternatives will be available for future sites, which will assist in terms of both delivery and cost."

Mark Waplington, Commercial Director, Miller Homes

Working with the Code for Sustainable Homes

This development was not the first scheme the developer has built to the Code, having built to different levels of the Code using different construction technologies and technologies at its Miller Zero development, included in the second case study publication.[4]

The developer worked closely with the housing association to adjust the specification of the homes to achieve the Code and to ensure that the solutions proposed were acceptable in terms of cost and maintenance.

There were some installation issues with some of the heat recovery units which had to be resolved. For example, installation and maintenance manuals were not available in English and the manufacturer did not provide a UK help line or office to provide support. Although these issues arose and were resolved with this specialist product, all other products used to achieve compliance with Code Level 3 were sourced from the developer's normal supply chain.

[4] The second set of case studies were undertaken by Jones Lang LaSalle and were published in March 2010. The Code for Sustainable Homes: Case Studies Volume 2. This document can be downloaded from the Communities and Local Government website: www.communities.gov.uk/publications/planningandbuilding/codecasestudiesvol2 (ISBN: 9781409822127)

Secure cycle storage at Butterfields

The air tightness targets on the development were achieved by careful onsite management, such as ensuring the full perimeter of rooms are skirted, for example behind bath panels or kitchen units, and ensuring that service penetrations are appropriately sized and sealed.

A Code assessor was appointed on the project and the developer found it was useful for them to also complete the energy performance certificates (EPCs) for the development and provide guidance on other sustainability areas, such as co-ordinating the ecological survey of the site.

Costs and Value

The scheme was built as an all-affordable scheme, therefore, data on sales values is not available.

In terms of the cost, the uplift to building to Code Level 3 per unit varied from approximately £4,000 for apartments to approximately £5,750 for houses. This equates to an average uplift of approximately £5,400 per plot, £6.58 per sq. ft. or £70.87 per m^2.

Buyer/occupant feedback

Through an on-going onsite presence and liaison with the housing association clients, the developer has received a number of pieces of occupant feedback, particularly regarding the air heat recovery units.

An issue that has arisen is that the units are incredibly quiet and generate minimal noise when in operation. The units also do not have a visible display confirming when they are in operation. Residents have therefore expressed concern that the units were not working, however, inspections revealed the systems were working correctly. Additional information and training for residents will therefore be incorporated into future developments.

A further issue that arose with the heat recovery units was that they generate moisture during their normal operation which is expelled through an external pipe. A number of residents had reported this as leaks, which resulted in a plumber being called to visit the site when an electrician to examine the unit would have been more appropriate. Education of residents and also repairs operators or managers is therefore also recommended.

Further monitoring of the performance of the homes is intended to be undertaken in the future during the one year defect period.

Lessons learnt

The main lessons learnt from the development have been:

- Different strategies can be used on the same site to achieve Code Level 3 on different unit types.
- Certifying units to Code Level 3 means that the tenure of homes can be more easily adjusted in response to economic circumstances.
- Changing the specification of a scheme once it has started on site is possible.
- Giving careful consideration to detailing of non-standard flat types, for example coach house units or units over garages, helps to ensure Code Level 3 energy requirements are achieved on all units.
- Training residents, occupiers, housing managers, repair line operators and repair managers in the sustainability features of homes avoids unnecessary repairs call outs and ensures that systems are used properly.
- Obtain resident and buyer feedback on their new homes as this provides a valuable source of information on sustainability features or products used and lessons for future developments.

Breakdown of points

	Percentage of category score achieved	What is covered in the category
Energy	48	Energy efficiency and CO_2 saving measures
Water	66	Internal and external water saving measures
Materials	87	The sourcing and environmental impact of materials used to build the home
Surface water run-off	25	Measures to reduce the risk of flooding and surface water run-off which can pollute rivers
Waste	85	Storage for recyclable waste and compost, and care taken to reduce, reuse and recycle construction materials
Pollution	0	The use of insulation materials and heating systems that do not add to global warming
Health and wellbeing	66	Provision of good daylight quality, sound insulation, private space, accessibility and adaptability
Management	77	A Home User Guide, designing in security, and reducing the impact of construction
Ecology	88	Protection and enhancement of the ecology of the area and efficient use of building land

The figures above are from the design stage assessment and are subject to final approval/certification. A range of points were achieved by different units on the development. The above table provides an example of the performance of one house on the development.

Design team

Client: Orbit Housing Group

Contractor: Miller Homes (West Midlands) Ltd

Architect: Miller Homes (West Midlands) Ltd

Energy Design Consultants: Energy & Design Ltd

Case Study 13

Dalston Square, Hackney, London, E8

CSH Level:	Level 3 (Affordable homes)
Development Type:	553 homes consisting of a mixture of 1 to 6 bed units, private and affordable housing and mixed use classifications of A1,A2, A3, A4, B1, D1 and public library
Construction Type:	Reinforced concrete frame construction
Key Sustainability Features:	Energy centre, biomass boiler, Communal heat distribution system, green roofs, innovative metering
Procurement Method:	The London Development Agency, in partnership with the landowners (London Borough of Hackney and Transport for London), selected Barratt Homes as the developer of the site

Dalston Square

Introduction

Dalston Square is a major regeneration scheme and will deliver more than 500 new homes including affordable housing, a new library and public archive, an underground station and transport interchange and shopping amenities transforming one of the most deprived areas of London. The entire scheme consists of a number of residential towers, some of which are over 20 storeys in height. The development will also see the delivery of the most significant area of public open space in Hackney for 100 years in the form of a brand new fully pedestrianised public square that will provide seating, performance space, market space, art installations, gardens, cycle parking and play areas.

The scheme comprises two sites owned by the London Borough of Hackney and Transport for London. In 2005 the London Development Agency (LDA) and Design for London developed a masterplan for the redevelopment of the two sites in conjunction with Arup. Under the masterplan, EcoHomes Excellent, the highest level of the standard available at the time was specified for the development. With the launch of the Code for Sustainable Homes in 2007, the affordable units on the scheme for Circle Anglia Group have been designed to meet Code Level 3 in order to comply with Homes and Communities Agency (HCA) funding requirements.

Phase 1 of the project is due for completion in May 2010 and contains a total of 244 units across five blocks. Phase 2 of the project is due for completion in October 2012 and contains a total of 309 units.

"Dalston Square is an exemplar Barratt development. The site teams have adapted well to the communal biomass technologies and are expecting these, along with other CSH requirements, to become normal practice on projects such as this going forward."

Dr Jacquelyn Fox, Head of Sustainability, Barratt Homes

Construction and build system

Due to the development's height, the development has been constructed using reinforced concrete (RC) frame construction.

The external walls are constructed using a mixture of brick types (standard, engineering and specials), a partially filled cavity and an internal lightweight steel framing system finished with two layers of plasterboard. Externally, a mixture of facing bricks, aluminium flashing and composite rain screen cladding were used.

The floors of the flats are reinforced concrete types with a screed layer on insulation.

The roof was constructed using in situ and pre-cast concrete treated with a water proof coating and finished with a mixture of paving slabs, timber decking and green roofs.

Ceilings are a made up of a ceiling lining on a suspended steel frame.

Phase 2 of the Dalston Square site under construction

Sustainability features

An energy centre with a combined heat and power system with a biomass fuelled boiler provides power to the library, commercial units and housing. The energy centre was a joint Barratt–E.ON initiative and is the centre piece of the development's sustainability strategy.

The onsite energy centre located in the basement comprises of a biomass boiler with a 7-tonne storage area, back up gas boilers, a combined heat and power system and a storage cylinder capable of providing one day's supply in the event of an emergency. The system is designed so that the biomass boiler provides 25 per cent of energy required, the CHP system 34 per cent and the remainder is delivered by the gas boilers.

The biomass boiler receives a weekly delivery of wood chips which are delivered to the basement store from a van via a pressurised pipe system. The energy centre is monitored as part of a wider building management system (BMS) and E.ON undertake weekly maintenance and monitoring visits of the system.

Individual units have a heat exchanger and hot water cylinder in the hallway cupboards. The hot water cylinder provides additional back up. Heating and hot water is controlled by a standard control panel. E.ON takes responsibility for metering through an energy services company (ESCo) agreement and residents are billed individually for the energy they use through a remote metering system.

The energy centre at Dalston Square

The scheme has a combination of green and brown roofs. The green roofs were installed by the general roofing contractor on the development to increase the biodiversity of the development. Generous balconies, communal terraces and winter gardens are also provided as part of the onsite amenity of the scheme.

The site has an onsite sustainable urban drainage system (SUDS) comprising of an attenuation tank and egg crate filter system.

A large number of products were also sourced from within the UK including the glass and sanitary ware and 90 per cent recycled blocks were used.

Technical performance

External fabric

50 mm rigid polyurethane (PUR) foam board insulation. U-value of 0.23 W/m^2 K for walls, 0.29 W/m^2 K for a brickwall with a column and 0.27 W/m^2 K for the rainwater cladding.

Roof

In situ and pre-cast concrete insulated with 150–180 mm extruded polystyrene (XPS) inverted roof board insulation. U-value of 0.16 W/m^2 K. Terraced roofs achieve a U-value of 0.2 W/m^2 K.

Floor

Concrete floor with 130 mm rigid insulation. U-value 0.25 W/m^2 K.

Doors and windows

uPVC double glazed windows with treated glass on the internal pane. U-value of 1.9 W/m^2 K.

Air permeability

Design stage target of 7 m^3/h@50 Pa.

Scheme implementation

Work began on Phase 1 of the site in November 2008.

During the initial demolition phase, a large amount of materials from the previous buildings on the site (including a theatre and car park) were crushed on site and reused in the development, such as for piling mats.

The energy centre was one of the first elements to be constructed and the boilers and combined heat and power units were moved into position through the underground car park. A delay in the installation of the communal hot water cylinder in the energy centre caused some problems as work had to carry on above where it was to be installed in line with the construction programme. This meant it had to be manoeuvred into position around completed building work, and at approximately two storeys high, this proved a challenge on site. In future, the developer would ensure that it was installed as early as possible, allowing it to be lifted into the energy centre by a crane.

Whilst work is on site, extensive measures have been taken to manage waste, including creation of a dedicated temporary waste store housing a compactor and storage for seven separate types of waste (metal, glass, mixed timber, plastic, plasterboard, inert, cardboard). Under the next phase of the development, there is also an intention to separate out the timber waste for recycling as wood chip pellets for the onsite biomass boiler.

The air tightness target on the scheme was achieved through careful management, including defining a continuous air tightness barrier line in the units on the detailed construction drawings with a coloured dashed line, enabling site staff to clearly identify the areas where gaps should be kept to a minimum and where insulation and sealant should be used to avoid air leakage.

Phase 2 of the site is due for completion in 2012.

All build systems have conventional building warranties issued by the National House Builders Council (NHBC).

Working with the Code for Sustainable Homes

The site is one of the first schemes the developer has built to the Code and the site also has a rare combination of units which are built to the EcoHomes and Code for Sustainable Homes standards.

The units built to these standards are in separate blocks as well as mixed blocks and no issues were reported by the developer in working with the two systems. In fact, the developer found the two standards were highly compatible and only a small number of water saving items were required in order for the affordable units to achieve Code Level 3. A single assessor was used to assist with compliance with both standards.

No issues arose with achieving Code Level 3 on the 20-storey tower.

The energy centre model used to achieve the energy requirements of the Code was successful and one that the developer is already replicating on another high rise, high density scheme in London which is also being built to Code Level 3 and one they would expect to use to achieve higher level of the Code.

The green roofs installed as part of the ecological requirements under the Code were planted in autumn 2009 are being monitored to ensure the sedum has seeded properly and to see if any re-seeding is necessary following the winter period.

Some issues were reported with the quality of water saving taps included in the development to reach Code Level 3 as a number were found to leak, however, this was an individual manufacturer issue that was resolved by switching products.

Costs and value

The build cost excluding land costs and fees was circa £1,700 m^2.

The costs of the energy centre was included in the build cost for all units on the scheme and the uplift for achieving Code Level 3 from EcoHomes Excellent was only circa £220. This cost was made up of basin taps 3 l/min restrictor, kitchen taps 3 l/min restrictor (all units) and an additional cycle parking space for 38 units.

Completed one bedroom flats are currently being marketed on the development for £290,000 to £310,000 and the onsite sales representatives have reported interest amongst buyers in the sustainability features of the project and no concerns expressed amongst buyers regarding the communal heating system.

Buyer/occupant feedback

Seventy per cent of the 244 units being built under Phase 1 have been completed and occupied.

Barratt are undertaking extensive onsite monitoring of the units as they will be maintaining a construction and sales and marketing presence on site until 2011. Customer satisfaction with units is closely monitored and recorded in the site office and an exceptionally high average satisfaction score of 91 per cent has been recorded amongst the first residents on the site.

The energy centre is remotely monitored by E.ON, allowing for immediate fault detection and monitoring of the efficiency of the system.

The system has been operating for one year without any major faults and no issues have been reported with selling the system to buyers with no boiler maintenance or repair costs for residents.

The site has also been used by other regional divisions within the Barratt group as a case study, with site visits arranged for staff, and a model for how to potentially achieve Code Level 6 on a development in Bristol.

Lessons learnt

The main lessons learnt from the development have been:

- Code Level 3 is achievable using reinforced concrete frame construction.
- Code Level 3 is achievable on extremely high rise/high density sites (over 20 storeys).
- Building Code Level 3 homes is compatible with building homes to EcoHomes within the same development, and within individual buildings or blocks.
- Solutions to achieve higher levels of the Code at one development can be replicated on other developments.
- Provide communal and individual hot water stores as part of communal heating systems installed to achieve higher levels of the Code as this provides extra reassurance for buyers, residents and building managers as they provide an element of back up heating.
- Communal heating distribution systems not only assist in achieving higher levels of the Code but have a number of benefits for developers during construction, including fewer service penetrations of the external fabric and lower space requirements than individual boilers.
- Energy service company (ESCo) arrangements and partnerships with energy companies have advantages to contractors (transfer of management and billing issues) and tenants (lower energy costs, no repair and maintenance costs, remote metering, no risk of carbon monoxide build up).

Breakdown of points

	Percentage of category score achieved	What is covered in the category
Energy	62	Energy efficiency and CO_2 saving measures
Water	50	Internal and external water saving measures
Materials	16	The sourcing and environmental impact of materials used to build the home
Surface water run-off	100	Measures to reduce the risk of flooding and surface water run-off which can pollute rivers
Waste	57	Storage for recyclable waste and compost, and care taken to reduce, reuse and recycle construction materials
Pollution	25	The use of insulation materials and heating systems that do not add to global warming
Health and wellbeing	42	Provision of good daylight quality, sound insulation, private space, accessibility and adaptability
Management	56	A Home User Guide, designing in security, and reducing the impact of construction
Ecology	100	Protection and enhancement of the ecology of the area and efficient use of building land

Design team

Client: London Borough of Hackney and Transport for London

Contractor: Barratt Homes plc

Architects: Goddard Manton Architects

Energy Design Consultants: Bespoke Builder Services Ltd

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