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Welcome to Technical Extra 22

Construction quality remains a key area of focus and has been an area of heightened interest in the media over recent months.

If you’ve been able to attend one of our Building for tomorrow (Bft) seminars this spring, you’ll have heard first-hand about one of the new approaches we’re taking to help the industry focus on construction quality. Construction Quality Reviews (CQRs) explore the root causes leading to defective construction. They seek to unlock the key reasons that defects occur, challenging us all to identify where improvements can be made, not just in construction but also in design and procurement. We’ll be discussing CQRs, and providing feedback on what they’re telling us, in future editions of Technical Extra.

In January, the new Standards Chapter 6.11 ‘Render and rendering systems’ became effective. In this edition of Technical Extra, we look at how careful consideration of accommodating movement at the design stage can significantly improve long-term durability.

A new British Standard is expected later in the year for dry-fix roof products. Ahead of this being published, we focus on some of the issues we have seen in relation to dry-fix verges, highlighting key areas to consider when specifying and installing these systems.

Chapter 8.3 ‘Mechanical ventilation with heat recovery’ (MVHR) was introduced into NHBC Standards in 2014. We recently undertook a survey of over 200 sites to help assess how the chapter is being implemented and identify areas of focus. We discuss the findings.

1 January 2017 saw the introduction of new Approved Documents in England and Wales. ‘Part R – Electronic communications’ introduces a new requirement for the provision of in-building physical infrastructure which enables copper or fibre-optic cables or wireless devices, capable of delivering broadband speeds greater than 30 Mbps, to be installed. Scotland also has very similar provisions. In this edition, we summarise these requirements for new homes.

Other articles in this edition include requirements for service penetrations through external walls and guidance in relation to overheating, balconies and avoiding cladding failures. We also highlight the latest publications from the NHBC Foundation, including ‘The gender and age profile of the house-building sector’ (NF75), providing insight into age and gender diversity within the industry.

Finally, in February, NHBC launched the MMC Hub, an online resource for offsite and other non-conventional construction. This new area of the website contains in-focus sections on NHBC’s requirements for various types of building systems, including panelised and volumetric. It provides free access to MMC research from the NHBC Foundation and other industry organisations, along with a list of current building systems that are accepted as meeting NHBC Standards. To make it simpler for MMC manufacturers, there is an online application facility for them to submit their systems and sub-assemblies for an assessment to determine whether they satisfy the requirements of NHBC Standards. Access the MMC Hub at www.nhbc.co.uk/mmchub.

I hope you find this edition of Technical Extra, and the additional information it highlights, to be of benefit.

Mark Jones
Business Development Director (Acting)
Accommodation of movement in rendered walls

Introduction

Standards 2017 introduced Chapter 6.11 ‘Render and rendering systems’, which became effective for new homes where the foundations begun on or after 1 January 2017. The chapter forms an integral part of our ongoing campaign to reduce defects in external walls. The chapter was developed following in-depth analysis of claims data that revealed rendering to be an area where improvement can be made.

In this article, we look at how, with a bit more consideration at the design stage and a few relatively minor changes to our approach, we can better accommodate movement in external walls and significantly improve the long-term durability of the render.

Guidance

When we think of a rendered home, the image that may come to mind is that of an aesthetically pleasing façade with a clean, crisp finish. Whilst this may be the case at handover, the rigours of exposure to external conditions can soon start to test the durability of the render. In a relatively short period of time, poor design detailing can be laid bare, resulting in associated damage.

One type of damage causing particular concern is small hairline cracks caused by movement in masonry backgrounds. While such cracks are unlikely to have an adverse effect on the weathertightness or structural capacity of the home, they are often conspicuous, particularly when they appear in what is intended to be a decorative feature.

There are numerous reasons why slight movements can occur in external walls, including thermally induced movement causing shrinkage/expansion, deflection and creep.

The amount of movement in a masonry wall can be influenced by a number of factors, such as the size and positioning of openings, density of masonry units, geometry of rendered panels, exposure conditions of the site and orientation of the building.

With so many influencing factors, accommodating movement is a complicated issue. To get it consistently right and avoid unsightly cracking, the way movement is accommodated needs to be considered at the design stage.

To help cut through the complexities and to provide practical advice to designers, NHBC Standards have, for some time, contained guidance for the correct positioning of movement joints in masonry walls. Recognising the increased consequences related to cracking in rendered walls, the recent Chapter 6.11 introduces additional specific guidance for the building designer.
Table 3 on page 4 of the chapter, reproduced below, provides simplified guidance for the correct spacing of movement joists covering a range of different block densities.

<table>
<thead>
<tr>
<th>Category</th>
<th>Normal movement joint spacing</th>
<th>Maximum distance of joint from restrained end, i.e. corners</th>
<th>Suction control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-density aircrete</td>
<td>Specialist advice from the block and render manufacturer should be sought</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal-density aircrete</td>
<td>6m</td>
<td>3m (half normal spacing)</td>
<td>Yes</td>
</tr>
<tr>
<td>Ultra-lightweight aggregate</td>
<td>6m</td>
<td>3m (half normal spacing)</td>
<td>Not generally required</td>
</tr>
<tr>
<td>Lightweight aggregate</td>
<td>7.5–9m</td>
<td>Half normal spacing</td>
<td>Not generally required</td>
</tr>
<tr>
<td>Dense aggregate</td>
<td>7.5–9m</td>
<td>Half normal spacing</td>
<td>Not generally required</td>
</tr>
</tbody>
</table>

Movement joints should be continuous through the render and background (including any horizontal beads), and made weathertight with an appropriate seal. The other challenge for the designer is positioning the joint so that it does not pass through rigid wall components, such as lintels or bed joint reinforcement.

Movement joints are just part of the solution. In alignment with PD 6697:2010 ‘Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2’, austenitic stainless steel bed joint reinforcement conforming to BS EN 845-3 should be placed above and below openings to help distribute tensile stress. The reinforcement should be placed in the first two courses of the external leaf above and below any opening. Where possible, the reinforcement should extend 600mm beyond the opening.
Accommodation of movement in rendered walls

Guidance (continued)

The increased popularity of render onto board backgrounds, typically used in conjunction with framed construction, has also been acknowledged in Chapter 6.11.

Where the board is attached to timber framed buildings via timber battens or a bespoke support system, consideration needs to be given to the accommodation of movement at each floor zone.

This can be achieved by forming a horizontal joint to accommodate movement. The joint should typically be 10mm where the floor is formed with I-joists and 15mm for timber joists. The joint should be detailed in accordance with the system manufacturer’s recommendations to be weathertight and allow for movement.

With the number of technical challenges involved, coupled with a desire to position movement joints in unobtrusive locations, clearly this can be a complex issue that should be integrated into the design process. Further guidance can be found online in NHBC’s Technical Guidance Documents, available at: www.nhbc.co.uk/builders/productsandservices/techzone/nhbcstandards/technicalguidancedocuments.

You need to...

- Be aware of the changes introduced in Chapter 6.11 of NHBC Standards 2017 edition relating to render onto masonry and render onto board backgrounds that affect you.
- Ensure that the accommodation of movement to rendered parts of the home is considered at design stage.
Introduction

Chapter 8.3 ‘Mechanical ventilation with heat recovery’ (MVHR) was introduced into NHBC Standards in 2014. To help assess how the chapter is being implemented, NHBC recently undertook a survey of over 200 sites using MVHR. The survey looked at six key areas: design and drawings, installation, ducting, air transfer, testing and commissioning, and handover to the homeowner. The findings and actions for each of these areas are discussed below.

Guidance

Design and drawings

Finding: a third of sites surveyed either had no drawings on site or relied on general arrangement (GA) drawings.

Action: ensure that designs are available on site and include comprehensive plot-specific information to enable correct construction. It is unlikely that GA drawings will be sufficient unless the development is made up of identical apartments. Even then, details, such as the type of duct and how it is jointed, should always be available.

Installation

Finding: for the installation of fan units and ductwork, 41% of MVHR fan units and 39% of ducts were installed by a BPEC certified contractor. However, it was unclear whether the remainder of the installers were trained in accordance with another suitable scheme.

Action: ensure that contractors installing the MVHR fan units and ducting are trained in accordance with the BPEC or another suitable scheme.

Finding: 25% of all the sites surveyed reported that the fan unit was installed outside the insulated part of the home (for example, in a loft).

Action: ensure that, when fan units (or any part of the system) are installed outside of the insulated parts of the home, the components are insulated properly and robustly in order to meet the design performance of the system. The fan unit should also be accessible for maintenance.

Ducting

Finding: flexible ducting adversely affects the performance of the MVHR system. A significant proportion of sites either used an unspecified type of duct, or had no drawings or specifications to refer to, making it unclear if it was suitable for the application. In addition, 14% of sites reported that rigid or semi-rigid duct was not used as the main duct type, and a further 6% reported that flexible duct was used as the main type. Finally, 25% of sites reported that flexible duct was used to form bends.

Action: ensure that the correct type of duct is specified and suitable for its intended use, and that the specification is available on the drawings on site, and installation is as per the specification.

Note: guidance in NHBC Standards states that flexible ducting should be limited to no more than 300mm and should only be located adjacent to fan units and air valves.
**Mechanical ventilation with heat recovery (MVHR)**

**Guidance (continued)**

**Air transfer**

Finding: doors should be trimmed to allow for adequate air transfer. Over a third of all sites surveyed did not trim doors to the required amount. Where doors are under trimmed, this causes issues with air transfer and, where doors are over trimmed, this could cause draughts or issues in relation to fire-resistance requirements.

Action: ensure that doors are trimmed to allow for good air transfer throughout the home. There should be a minimum of 7,600mm² undercut in all internal doors above the floor finish. For example, a 760mm width door should have an undercut of 10mm. The gap between the unfinished floor and underside of the door should also take into account NHBC Standards Chapter 9.1 A consistent approach to finishes.

Finding: 27% of all sites surveyed reported that background ventilation was in place where it shouldn't have been; for example, the presence of trickle vents in windows where they were not required. The inclusion of trickle vents in windows where they are not required will reduce the performance of the MVHR system.

Action: ensure that where necessary, windows are ordered and supplied without trickle vents, and that they are installed in the correct locations.

Finding: a considerable number of MVHR sites surveyed had air valves (extraction and supply) positioned incorrectly.

Action: ensure that, air valves located on the wall are positioned a maximum of 400mm from the ceiling, and those that are located on the ceiling are positioned a minimum of 200mm from a wall.

Note: air valves should be positioned on the opposite side of the room from door openings.

**Testing and commissioning**

Finding: previous investigations (e.g. Zero Carbon Hub and ‘Ventilation in New Homes, 2016’) found the commissioning of MVHR systems to be problematic. NHBC’s survey showed some improvement, but indicated this should still remain an area of focus.

Action: ensure that upon completion, the system is checked to ensure that it is clear from dirt or dust that may have accumulated during construction (including filters); commissioned to confirm performance; and adjusted using the air valves and controls to achieve the correct balancing and flow rates (where this is not possible, the completed system should be checked to ensure that it complies with the design).

Finding: 15% of sites surveyed had inadequate or no labelling on controls.

Action: ensure the appropriate use of labelling.

**Handover to the homeowner**

Finding: finally, in reference to how information on the MVHR system is provided to homeowners, it was found that a third of sites surveyed could improve their handover processes.

Action: ensure that the end user is provided with clear and detailed information and instructions in a format intended for a non-technical user. The information pack should contain:

- The commissioning certificate
- User instructions for the system and controls
- A user-friendly description and explanation of the system (including the location of components)
- Details of routine maintenance
- Method of cleaning ductwork (where required)
- Guidance for the use of summer bypass and boost settings (where installed)
- Contact details for the manufacturer and installer
- Details of the installed system, including part numbers
- Details of any maintenance and service agreements.

In addition, it would be beneficial to provide the end user with a verbal/visual demonstration, and make an electronic copy of the information pack available via the NHBC Home User Guide (HUG). Further information is available in NHBC Foundation publication ‘Home Comforts: guidance on using ventilation, heating and renewable energy systems (NF68)’, available at [www.nhbcfoundation.org](http://www.nhbcfoundation.org).

**You need to...**

- Review the important learning highlighted by the survey in each of the six key areas: design and drawings, installation, ducting, air transfer, testing and commissioning, and handover to the homeowner.

- Ensure opportunities to improve MVHR systems in all areas highlighted are considered within your designs and construction processes.
Part R - Electronic communications

Introduction

Part R - Physical infrastructure for high-speed electronic communications networks (of the Building Regulations) introduces a new requirement for the provision of in-building physical infrastructure which enables copper or fibre-optic cables or wireless devices, capable of delivering broadband speeds greater than 30 Mbps, to be installed. The requirement applies in both England and Wales to new buildings and to existing buildings that are subject to major renovation works. The supporting guidance in Part R took effect on 1 January 2017. Similar provisions apply in Scotland under Standard 4.14 (in-building physical infrastructure for high-speed electronic communications networks).

Part R does not apply to work subject to a building notice, full plans application or initial notice submitted before 1 January 2017.

In-building physical infrastructure is the physical infrastructure in buildings (such as ducts and cable trays) intended to host elements, or enable delivery, of high-speed broadband networks.

Requirements

New buildings

The statutory guidance refers to the need to provide only the in-building physical infrastructure from the service provider’s access point (or common access point in blocks of flats) to the occupier’s network termination point. Subject to additional considerations for fire safety in blocks of flats described below, it is not a requirement under Part R to provide any network cabling or equipment. The provisions are so that, in future, high-speed electronic communications networks can be more easily installed. Infrastructure external to the building to deliver this is not required under Building Regulations.

Houses and single occupancy buildings

For houses and single occupancy buildings, as a minimum to satisfy Building Regulations, a duct through the external wall should be provided at the location of the intended entry point for the broadband service; typically, this will be facilitated by the installation of a conduit. This should be covered externally with a suitable capping or temporary seal to prevent the entry of moisture and vermin.

Any installation with additional features will be acceptable, such as:

- A fully wired and operational broadband service
- A fully or partly wired, but not operational, broadband service
- Back boxes ready to receive network access/termination faceplates, with or without lead-in cables installed.

Flats

For blocks of flats, ducting is required (via cable trays and/or ducts which may be within riser shafts) between the intended location of the common access point for the building and the location of the network termination point in each home. Typically, the common access point will be located in a service cupboard.
Part R - Electronic communications

Requirements (continued)

From that location, ducting or cable trays need to be installed, typically located in service risers, so that broadband cabling may, in future, be distributed throughout the building. From the service riser, into each individual home, provision needs to be made to allow for the entry of broadband cabling, typically by horizontal ducting firestopped at the entry point to each home.

As Building Control need to be satisfied under both Part B and Part R before authorising a final certificate, it is necessary for the broadband installation to be advanced to a point where both requirements are capable of being satisfied. As ducts for cables need to be firestopped as they pass through compartment walls, this can only be practically assured once cabling is in place.

Therefore, in each home, as a minimum, the back box ready to receive the network termination faceplate should be in place together with the broadband ‘lead-in’ cables coiled in-situ ready for connection to the home network termination faceplate and the building common access point. The entry point to the home, together with the lead-in cables, should be suitably firestopped.

Any installation with additional features will be acceptable, such as:

- A fully wired and operational broadband service
- A fully or partly wired, but not operational, broadband service.

Major renovation works to a building

Part R applies in cases where existing buildings are already equipped with the in-building physical infrastructure for broadband. Where structural modifications occur to the whole or a significant part of that infrastructure, the building should be made no less compliant with the minimum provisions of Part R on completion of the work.

Buildings situated in isolated areas

The requirements do not apply to buildings that are in isolated areas where the prospect of high-speed connection is considered too remote to justify equipping the building with high-speed-ready in-building physical infrastructure or an access point.

One way to demonstrate this is to provide evidence that the area is so isolated that no duty is placed on a communications provider (under the Electronic Communications (Universal Service) Order 2003) to meet the full cost of installing a telephone line to the building.

Satellite and wireless communications

The vast majority of future installations will be hard wired to a service provider’s network. However, the design of in-building physical infrastructure should take account of satellite and wireless technologies, where proposed, and provide evidence that network speeds can be met.

You need to...

- Provide in-building physical infrastructure in new buildings so that, in future, high-speed electronic communications networks can be more easily installed.
- For existing buildings, ensure that, where structural modifications are carried out to the whole or a significant part of the in-building physical infrastructure, the building is made no less compliant with the minimum provisions of Part R on completion of the work.
Service penetrations through external wall constructions of residential buildings

Introduction

A question that is frequently asked is: ‘what should be done in terms of closing openings around service penetrations where they pass through external cavity walls?’. The Building Control Alliance (BCA) Technical Guidance Note on service penetrations through external wall constructions of residential buildings provides best practice guidance in respect of how to treat openings formed when passing services through external cavity walls.

Service penetrations through external walls can take several forms, including waste pipes, ventilation fan outlets and boiler flues. External wall constructions also vary considerably: internal leaves are generally formed from masonry, timber framed or lightweight metal framing systems, suitably lined to offer the required amount of fire resistance, whilst the variety of external finishes is much larger and includes many bespoke cladding systems, as well as traditional brickwork.

It is important that a distinction is made between penetrations by thicker walled PVCu pipes complying with BS 4514:2001 or BS 5255:1989 (generally used for drainage systems) and lightweight thermoplastic ventilation ducts. The fire performance of these two systems is affected both by the robustness of the thicker walled material as well as the expectation that a drainage pipe will not be open to the fire compartment in the same way that a ventilation duct may.

Similarly, for steel boiler flue penetrations, no further measures are generally required, as long as firestopping around the flue is of good quality. However, if the flue is made of any other material, the guidance above for PVCu pipes should be followed. See also BCA Technical Guidance Note 10 ‘Installation of boiler flues and ventilation perforations in external timber framed walls and other such structures’.

Requirements

It is clear from research that the likelihood of a fire spreading within a wall cavity is affected by the:

- Size of the opening
- Air flow within the cavity (risk of the ‘chimney effect’ in large vertical cavities)
- Amount of combustible material in the cavity
- Thickness/type of duct or pipe wall which penetrates through the fire-resistant wall linings.

Assuming that the internal wall linings provide the appropriate duration of fire resistance (generally 30 minutes for three-storey houses and two-storey flats, rising to 60 minutes for taller buildings - Table A2 of Approved Document B volume 2) and that firestopping around the pipe is undertaken to a good standard (and to the same standard of fire resistance as the wall), it is considered appropriate to apply a performance criterion (in line with Table A1 of AD B2) for the service penetration of 30 minutes for integrity and 15 minutes insulation. Note, however, that this assumes that the wall cavity is closed elsewhere in line with Section 9 of AD B2.
Service penetrations through external wall constructions of residential buildings

Requirements (continued)

Whilst it is difficult to obtain any specific test data, it is possible to offer the following generic guidance for the most common types of penetrations using thermoplastic pipe/duct materials:

<table>
<thead>
<tr>
<th>Method of construction</th>
<th>Masonry walls formed from two leaves, each of which is at least 75mm thick</th>
<th>Timber frame (including SIPs) with masonry outer leaf at least 75mm thick</th>
<th>Lightweight steel frame with masonry outer leaf at least 75mm thick</th>
<th>Lightweight steel frame with any other cladding finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-fire rated ventilation duct</td>
<td>Non-fire rated ventilation duct</td>
<td>Non-fire rated ventilation duct</td>
<td>Non-fire rated ventilation duct</td>
<td>Non-fire rated ventilation duct</td>
</tr>
<tr>
<td>Two leaves of masonry, each of which is at least 75mm thick, ANY insulation in cavity</td>
<td>☢️</td>
<td>☢️</td>
<td>☢️</td>
<td>☢️</td>
</tr>
<tr>
<td>Inner lining of at least 1 x 12.5mm plasterboard – NO combustible insulation in cavity</td>
<td>☳️</td>
<td>☳️</td>
<td>☳️</td>
<td>☳️</td>
</tr>
<tr>
<td>Inner lining of at least 1 x 12.5mm plasterboard – combustible insulation in cavity</td>
<td>☳️</td>
<td>☳️</td>
<td>☳️</td>
<td>☳️</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Not applicable</th>
<th>Indicates protection needed via protective sleeves or fire seal where the penetration exceeds 40mm diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>☢️</td>
<td>This scenario is limited to a maximum 110mm diameter unprotected opening</td>
<td>Indicates no restriction on duct size and no requirement for cavity barrier around the duct</td>
</tr>
</tbody>
</table>

What does this mean for you?

Where protection is needed, this can typically be provided using one of the following three methods:

**Cavity closed around the duct**
These are likely to be installed during construction/erection of a framed building. It should be ensured that a tight seal is made between the cavity closer and the rear side of the outer leaf/cladding.

**Use of a fire-rated duct or sleeve**
Correctly installed, the use of a fire-rated duct or sleeve (generally steel of a minimum of 0.5mm) will maintain the compartmentation between the room and the cavity.

**Use of a proprietary fire collar**
The manufacturer’s installation details on placement and fixing of the collar should be followed closely.

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**You need to...**

- Ensure the building complies with Building Regulation B3(4) and that penetrations through the external wall structure are either of an acceptable size or suitably fire protected.
- Be aware that different wall constructions pose a higher level of risk of fire spread between compartments.
**Dry-fix verge systems**

**Introduction**

In Technical Extra 21, we examined how the performance of pitched roofs appears to be improving and areas where ongoing focus will continue to raise standards.

The article highlighted that a new British Standard is currently being drafted for dry-fix roof products. This is welcome news, as a robust method of assessing dry-fix roofing products being brought onto the market is needed, particularly when an increasing proportion of sites are moving to dry-fix systems.

We hope the new British Standard will be available later this year. In the meantime, this article highlights key areas to consider when specifying and installing dry-fix verge systems.

**Guidance**

**Fixing of ‘eaves closure unit’**

Depending on the design, it can be particularly difficult to fix the eaves closure unit adequately. NHBC’s claims department has seen numerous instances where these have become dislodged and, in some instances, impacted on the stability of the intermediate dry-fix verge units.

Generally, we have seen fewer issues where a bargeboard is present, as the eaves closure unit can be securely fixed to the bargeboard. The problem generally arises where the eaves closure unit has been installed directly against the brickwork (either with no fixings or utilising a ‘wire, nail and hook’ arrangement).

In the majority of cases, manufacturers have a specific detail for securing the eaves closure unit. Where a detail does not exist, it is advisable to seek clarification from the manufacturer to ensure compliance.

**Fixing of intermediate dry verge units**

Typical failures are due to poor installation - examples include:

- Tile battens not extending far enough beyond the outer edge of the wall or bargeboard
- Inadequate fixings, i.e. attempting to nail into the end grain of timber battens without a batten clip
- Eaves closure unit not installed correctly.

Any of these, or a combination, may lead to failure of the dry verge systems caused by imposed wind loads and wind uplift.
Dry-fix verge systems

Guidance (continued)

Staining of gable walls
This issue relates to the gable wall becoming saturated, stained and potentially at risk from frost damage.

Items that may contribute to this include:

- Dry verge systems not fitted in accordance with the manufacturer’s recommendations
- Roof defect, i.e. roof dipping at edges causing excessive water run-off
- Design of dry verge system, i.e. water shedding against the gable from each verge unit.

To minimise the risk of water dripping from the underside of the verge units and staining the gable wall, a number of points should be considered (note: these may impact on the design and product selection).

The dry verge system should either:

- Be positioned off the wall (e.g. tile batten overhang)
- Have an integral design feature (e.g. nibs) that keep the verge unit away from the wall
- Have an integral design feature (e.g. drainage channels) that divert water away from the wall.

Where dry verge units come in long lengths, water collected within the unit should be safely discharged at the lower end, preferably into the roof guttering. Special care needs to be taken at any joints between each length to ensure continuation of the drainage into the lower unit.

Finally, in addition to the above, to minimise the risk of water staining further, a number of manufacturers recommend the use of a bargeboard, particularly where flat tiles are specified, as they can shed more water onto the verge than rolled tiles.

You need to...

- Follow the relevant manufacturer’s installation guide/fixing instructions.
- When using dry systems, it is vital to ensure that the correct system is specified for the pitch and that the tile and dry system components are compatible.
**Overheating in new homes**

**Introduction**

After a few days of hot weather, internal temperatures of homes can become excessive.

Unable to escape from extreme heat during the day and elevated temperatures at night, even healthy people can experience discomfort and heat-related effects on their health. For more vulnerable occupants, such as infants, the elderly or sick, the risk of severe heat stress, including potentially fatal heatstroke, is greater. This is often because they have less resilience to heat and may be physically unable to follow recommended precautions. In addition, they are more likely to be at home during the day and be exposed to peak daytime temperatures.

With a perfect storm of climate change, urbanisation, an ageing population and increased insulation standards in new homes, the incidence and impacts of overheating are expected to increase. Research by DECC in 2013 found that 20% of the 2,616 English households surveyed said they already had “difficulty keeping one or more rooms cool during the summer months”.

**Guidance**

**What is overheating?**

The term ‘overheating’ is generally used to describe when temperature conditions in a building reach a level that may cause occupants to feel uncomfortable or heat stressed. The cause of overheating is complex and not a simple measure of maximum temperatures. Humidity, internal to external temperature differences, timing and duration can all affect the perception and impact of overheating. Long continuous periods of noticeably above-average indoor temperatures in homes are also thought to be a significant factor affecting people’s health.

Overheating does not always only happen in summer, nor is it exclusively a problem for ‘new’ homes, though for the purposes of this article, new homes are the focus.

Although the finer detail of what constitutes overheating has yet to be universally agreed, guidance exists. Current design guidance aims to support house builders in minimising overheating in new buildings. The Chartered Institution of Building Services Engineer’s (CIBSE) ‘Guide A: Environmental Design’ (2015) sets out temperature thresholds and defines overheating as being when these temperatures are exceeded for more than a given percentage of time. Further guidance is currently being developed by CIBSE to interpret the advice specifically for new homes. However, looking at data recorded by researchers in homes of a range of ages, we know that internal temperatures can significantly exceed these limits during heatwaves. The housing health and safety rating system (HHSRS) provides advice for assessing the risk of overheating in existing homes, and suggests that severe health impacts become more likely at temperatures above 25°C.

**More information**

NHBC Foundation has produced a number of documents on overheating NF44 ‘Understanding overheating – where to start’ and NF46 ‘Overheating in new homes – a review of the evidence’, which can be accessed at www.nhbcfoundation.org.

The Zero Carbon Hub has also produced a body of work on this issue, which can be found at www.zerocarbonhub.org.

**Who should read this:** Technical and construction directors and managers, architects, designers and site managers.
Overheating in new homes

Guidance (continued)

What can house builders consider?

Overheating risk factors
Buildings or rooms which are more likely to overheat include those that:
- Are west or south-west facing
- Have communal heating with inadequately insulated pipework
- Have larger than average glazed areas compared with floor area
- Are small single-aspect flats (especially upper floors)
- Have limited purge ventilation/restricted window opening
- Are located in urban areas where external temperatures will be higher.

What can house builders consider?

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- Have limited purge ventilation/restricted window opening
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Things to incorporate or avoid

Solar shading and shutters
Many external shading devices and shutters are available (including automated systems). These can work well to reduce the heating effect of the sun. Blinds and curtains are less effective but still beneficial.

Cooling and ventilation strategies
Enabling a home to have an effective passive cooling strategy (including purge ventilation) has many benefits, particularly if it can utilise cross-ventilation through the home. However, correct operation of the ventilation system relies on occupants understanding how it should be used.

Heat-reflective finishes
Light external finishes on homes, and reflective roofs or green roofs, play a part in keeping temperatures down.

Planting
Longer term, plants can provide valuable shade and cooling effects for individual homes. Deciduous trees, vines and climbers have been used very effectively to reduce overheating risk, and can also contribute visual interest and biodiversity.

Occupant guidance
Providing guidance to occupants on how to use their homes optimally during heatwaves, possibly via Home User Guides, may help to reduce problems.

Orientation
Avoid orienting homes with significant glazing on the west face without incorporating shading. Low evening sun in summer, in particular, can exacerbate overheating problems.

Window design
A delicate balance is needed to select the optimum frame factor, coatings and number of glazing layers to minimise overheating risk without compromising other performance factors. NHBC Foundation research is underway into the impact of different window factors on building performance.

Thermal mass
Builders could consider introducing thermal mass with night-time purge ventilation.

You need to...
- Consider the points highlighted in this article and be alert to possible upcoming changes in regulations.
- Refer to ‘Understanding overheating – where to start, at an early stage’ (NF44).
Introduction

Historically, balcony claims have been low in terms of numbers, with less than 100 being recorded each year between 2009 and 2011. However, this number has more than doubled in recent years. In both 2015 and 2016, NHBC expenditure on Balcony repairs has been in excess of £4m.

Guidance

So what has been going wrong?

A review of repairs suggests the issues relate to:

- Corrosion/decay/rot
- Weatherproofing/waterproofing
- Poor detailing
- Drainage.

Analysis of a number of high-cost claims highlighted that as-built details were not in accordance with NHBC guidance and/or the designs originally submitted.

To get a greater understanding of what is currently happening on site, NHBC undertook a detailed survey of balconies constructed during 2016 across 637 sites. Although there were positive findings, unfortunately these were outweighed by a number of areas of concern (mirroring the claims analysis), namely:

Design/provision of information

It’s been six years since NHBC provided guidance for accessible thresholds to balconies. Although not suitable for all situations, the series of principles, guidance notes and sketches provided a good steer as to how to achieve an accessible threshold successfully.

One of these principles was to allow designers to reduce the balcony upstand to 75mm (measured from the balcony drainage layer to the underside of the projecting sill) where additional measures (such as enhanced drainage) are also provided. Unfortunately, 15 sites had reduced this dimension to less than 75mm, which clearly is unacceptable.

As a number of recent claims have shown, it is important to have the latest construction drawings (including all critical details) available on site and ensure that any amendments are agreed with NHBC. Unfortunately, 58% of sites lacked these details and 13% changed the balcony design without agreement.

Structure

NHBC Standards ask that balconies are only constructed with suitably durable materials and, for a number of years, has restricted the use of timber for some critical elements.

Recognising the importance of getting this right, revised guidance has been introduced in Standards 2017 that further restricts the use of timber in balcony construction.

Waterproofing

On a number of sites, a ‘zero-falls system’ had been adopted; however, there was no third-party certification to confirm that the system was suitable. It is imperative that waterproofing layers should be subject to specific third-party assessment where the roof has no falls.

Please also note that, if the waterproofing system includes a thermoplastic single-ply membrane, it should also have third-party certification or meet BS EN 13956:2012.
Balconies – are you building them correctly?

Guidance (continued)

Drainage
Seventeen percent of sites had incorrect drainage arrangements. Chapter 7.1 ‘Flat roof and balconies’ contains detailed guidance for balcony drainage design, including a number of options for situations where there are accessible thresholds.

Guarding
The survey also highlighted some sites where the balcony guarding was too low. It is important to ensure that the guarding is non-climbable and is set at an adequate height as outlined in the Building Regulations.

Further guidance and next steps
In order to assist the industry to reduce the number of defects to balconies, the following guidance and initiatives have been introduced:

- Revised guidance has been introduced in Chapter 7.1 ‘Flat roofs, and balconies’, regarding timber in balcony constructions (7.1.4).

Timber in balconies should be limited to elements which are supported by materials other than timber. Timber should not be used for:

- gallows brackets supporting a balcony
- posts or columns supporting a balcony
- guardrails or their support
- cantilevered decks or joists
- infill joists.

Decking boards should be specified and fixed in accordance with either:

- guidance from the Timber Decking and Cladding Association
- the engineer’s design, in accordance with Technical Requirement R5.

Chapter 7.1 ‘Flat roofs and balconies’

- A new technical guidance document has been introduced clarifying where timber can be used in construction of external decking, balconies and terraces to which people have access (available at www.nhbc.co.uk/builders/productsandservices/techzone)
- The NHBC Risk Guide on balconies has been updated to reflect the change in Chapter 7.1.4 (available at www.nhbc.co.uk/builders/productsandservices/techzone)
- Our inspection service has already undertaken 145 consultative inspections on sites where balconies are present and will continue to do so, with balconies being one of the 12 focus areas for this initiative.

Importantly, the direct interventions highlighted to the builders during these visits mirror the issues highlighted in the claims data at the start of this article.

You need to...

- Ensure projects that include balconies meet NHBC’s Technical Requirements, paying particular attention to drainage, weatherproofing/waterproofing and the detailing of critical elements.
- Follow the guidance within TG 71/02 – ‘Timber balconies and terraces’ to ensure compliance when using timber.
- Ensure that the balcony Risk Guide is completed and available on site.

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Guidance and good practice

NHBC Foundation

Who should read this: Technical and construction directors and managers, architects and designers.

Introduction

Supporting the industry with high-quality research and practical guidance, all NHBC Foundation reports are available to download free of charge at www.nhbcfoundation.org.

Guidance

‘The challenge of shape and form: understanding the benefits of efficient design’ (NF72)

The energy and carbon requirements of Building Regulations do not explicitly give credit for housing designs with lower heat loss areas or more efficient shapes. Yet, through a better understanding of these issues, designers and developers can significantly reduce the energy consumption of new homes, potentially at little or no extra cost. In addition, some efficient designs can provide better comfort conditions for occupants and reduce the amount of construction materials needed. This report explains the issues and discusses ways that designs can be improved.

Achieving lower energy consumption through more efficient shape and form does not have to lead to bland or monotonous housing designs. The report discusses how the most inefficient design features can often be avoided or replaced by alternatives which are still architecturally interesting.

‘The advantages of new homes’ (NF73)

This fully illustrated guide sets out the advantages of buying a new home. It uses consumer-friendly images and commentary to compare new with old and highlight the key potential benefits for buyers of new homes.

The guide is based on an NHBC Foundation survey of people who had recently moved into a new home and were asked what they considered the advantages to be. The advantages outlined include the obvious ‘ready to move in’ and ‘everything is new’, but the energy efficiency advantages - both in terms of cost savings and improved comfort - are also included. Reference is also made to the safety, security and acoustic advantages of new homes.

The images from this guide are available for use in house builders’ own promotional material as a free download.
‘Affordable homes: residents’ views of quality’ (NF74)
This research, jointly supported by the NHBC Foundation and the Homes and Communities Agency (HCA), investigates residents’ views on the quality of affordable new homes. It measures resident satisfaction after three to four years of occupation, evaluating a wide range of design aspects.

Through comparison with the findings published in the HCA Quality Counts reports (which investigate residents’ views of their homes shortly after they have moved in), this research found enduring high satisfaction levels for key aspects of the design, such as size, interior layout and security. It does, however, also draw attention to some opportunities for improvement in areas such as ventilation, storage and parking.

‘The gender and age profile of the house-building sector’ (NF75)
This report, based on the quarterly Labour Force Survey and interviews with house builders and senior commentators, provides current insights into age and gender diversity within the house-building sector. It identifies challenges to improving diversity, highlights initiatives underway and gives recommendations for reducing the over-reliance on an ageing male workforce.

You need to...
- Take a look at www.nhbcfoundation.org and utilise the guidance in the design and construction of your new homes.
Avoiding cladding failures

Introduction
Since 2013, NHBC has spent over £10m repairing cladding-related failures, at an average cost of circa £40,000. This guidance draws upon NHBC’s claims experience as well as common pitfalls identified during our technical checking processes.

Guidance
Through our technical reviews and on-site inspections, NHBC has identified a number of reoccurring issues in relation to cladding and curtain walling that need to be avoided or carefully considered. These include changes of design not being notified to NHBC, substitution of materials and products, lack of suitable information being available on-site, lack of quality assurance on-site, and the off-site and on-site testing of curtain walling systems not being a true representation of what is being built.

To address these, consideration should be given to the following:

- Where the design is changed (including material substitution) after NHBC has reviewed it, NHBC should be made aware of these changes as soon as possible.
- Clear drawings with sufficient detail should be available on-site to enable work to be carried out in accordance with the design. The design and specification information should be issued to all appropriate personnel, and include a full set of drawings, a schedule or revisions, the manufacturer’s specification, specific details of all interfaces, fixing schedules, the manufacturer’s recommendations for ancillary items and details of the on-site testing regime.
- Suitable quality assurance processes should be used. Curtain walling and cladding systems should be installed by operatives who are competent, are familiar with the system being installed, and hold a certificate confirming that they have been trained by the system manufacturer, supplier or installer. Systems should be completed in accordance with the design and allow for the completed wall to be within tolerances given in NHBC Standards Chapter 9.1 ‘A consistent approach to finishes’. Furthermore, NHBC’s inspection experience has highlighted the need for site managers to be fully aware of the systems being installed and how they need to be installed.
- Suitable air and water testing of the ‘prototype’ curtain system should be carried out (off-site) on panels that are of a similar size and configuration to those used on the building. To help ensure that the on-site assembly is correct, particularly the robustness of interfaces and junctions, hose testing, in accordance with the CWCT standard, should be undertaken to determine resistance to water penetration. For further information, see NHBC Standards Clause 6.9.17.

NHBC’s claims experience has identified the following specific areas of failure: fixing of cladding systems, detailing around openings, installation of gaskets and seals, and detailing of interfaces between different systems. These are discussed in detail on pages 21-23.
Avoiding cladding failures

Guidance (continued)

Fixing

Cladding failures
One of the most common causes for cladding failures relates to inadequate fixing of mechanically fixed systems. Fixings should be suitable for their specific use, durable and in accordance with the manufacturer’s recommendations, which should be supported by test evidence and calculations. Fixings should have the correct embedment, spacing and edging distance; have suitable locking nuts and washers; and be installed to the correct torque settings.

This example shows cladding panels distorting as a result of failure to follow the manufacturer’s fixing recommendations. The panels were designed to be fixed with an allowance for small amounts of expansion and contraction. The fixing method used on-site failed to take account of expansion and contraction, which has resulted in warping and twisting of the panels.

Brick slip systems
Brick slip systems should be specified and fixed in accordance with the manufacturer’s recommendations.

In this example, brick slip cladding fell off a number of properties due to a failure of the membrane at the fixings. The manufacturer specified fixing the membrane at a maximum of 400mm centers horizontally and 300mm centers vertically. The fixings observed were at 400mm horizontally but were installed at 800mm vertically. The brick slip cladding remained adhered to the membrane.

Stone veneer cladding
In this example, the stone veneer cladding was not fixed sufficiently. An adhesive which was only suitable for internal use was used to fix the system, and the mechanical fixings were not durable.
Avoiding cladding failures

Guidance (continued)

Installation of gaskets and seals

Another common cause of curtain walling and cladding-related failures is inadequate installation of gaskets and seals to glazing. Curtain walling systems should be sealed with preformed factory-moulded ‘picture frame’ type vulcanised ethylene propylene diene monomer (EPDM) or silicone internal gaskets. Gaskets and sealants should be used to resist the flow of air from the outside to the interior surface of the curtain walling system and in accordance with the manufacturer’s recommendations.

Particular attention should be given to the interfaces between the curtain walling system and the walls, roof, doors, windows and cladding system. Glazing, including insulating glass units, should be in accordance with Chapter 6.7 ‘Doors, windows and glazing’ of the Standards. Extruded rubber gaskets should comply with BS 4255 or be assessed in accordance with Technical Requirement R3 of the Standards. Sealant and tapes should be selected and applied in accordance with BS 6213 and BS EN ISO 11600. Sealant used in locations where differential movement may be expected should be either one or two part-polysulphide, one part silicone, one or two part-polyurethane, or a material assessed in accordance with Technical Requirement R3.

In some cases, the workmanship involved in the installation of systems appeared to be an issue, as highlighted by the photos.

It is worth noting that, typically, factory-made joints are likely to perform better than site-made joints.

Detailing around openings

Cladding failures were also observed as a result of a lack of sufficient detailing and care around openings. These types of failures typically resulted in water ingress, as shown here.

Damp proofing should include cavity trays (with stop ends where necessary) at the base of the system, above openings, and above cavity barriers, interfaces and other interruptions to the cavity, where necessary. The failure to include sufficient damp proofing around openings and workmanship were two issues identified.
Avoiding cladding failures

Guidance (continued)

In example 1, the workmanship was the main cause for concern. Water was entering through cedar wood cladding into a room above a carport. The reason for the water ingress was that nails securing the external trim had punctured the cavity tray.

Example 2 highlights the issue of water ingress due to a lack of detail around openings. In this case, missing vertical DPCs and cavity trays to window and door installations in three apartments caused significant water ingress and costly remedial work.

Detailing of interfaces between different systems

Detailing of interfaces between different cladding systems was a further area where failures tended to occur. The design should indicate the contractor responsible for constructing interfaces. Interfaces should be carefully designed and detailed to be weather resistant and prevent moisture reaching parts of the wall that could be adversely affected. The design should take account of differing profile characteristics, movement, continuity of insulation, vapour barriers and breather membranes, tolerances and deviations, the erection sequence and planned maintenance.

In examples 3 and 4, there was a lack of trays and sufficient detailing at the interface between the cladding system and insulated render system below. This resulted in water penetration to the properties below.

Other examples

Further examples of the types of issues identified from NHBC's claims experience included:

- **Firestopping missing from the entire wall of an insulated render cladding system:**
  - Materials used for cavity barriers and firestops shall be capable of producing adequate resistance to fire and smoke. For further information on 'avoiding common fire safety issues', see Technical Extra 19.

- **Water ingress due to the use of a 'bespoke' cladding system with a lack of movement joints, causing cracking, as well as the use of a very weak 'porous' mortar mix:**
  - Curtain walling and cladding systems should have certification confirming satisfactory assessment, undertaken by an independent technical authority. Where applicable, testing should be in accordance with the Centre for Window and Cladding Technology (CWCT) standard for systemised building envelopes (or a suitable alternative acceptable to NHBC).
## Avoiding cladding failures

### Guidance (continued)

### Inadequate materials being used for their environment, causing corrosion:
- Curtain walling and cladding systems shall provide satisfactory durability (subject to routine inspection and maintenance). The system should be designed to avoid the need for disproportionate work when repairing or replacing individual components. In addition, primary components should provide satisfactory in-service performance for the design life of the building, and secondary components should provide satisfactory in-service performance for a minimum of 25 years. The system should be designed with corrosion-resistant and adequately protected materials.

### Water ingress due to the lack of a drained and ventilated cavity to an insulated render cladding system with a timber framed backing wall:
- Timber frame backing walls for insulated render systems should have a cavity between the wall and the insulation which is a minimum of 15mm wide and drained and ventilated (NHBC Standards Chapter 6.9 Curtain walling and cladding page 13).

### A site-wide issue of water ingress due to substitution of materials for ‘similar’ materials to those specified in the design:
- This highlights the consequences of design changes and material substitution not being fully considered or understood. Proposals for design changes or material substitutions should also be discussed with NHBC.

### You need to...

- Ensure that curtain walling and cladding systems have certification confirming satisfactory assessment by an independent technical authority.
- Provide damp proofing, including cavity trays with stop ends at the base of the system, above openings and above cavity barriers, interfaces and other interruptions to the cavity, where necessary.
- Ensure that the curtain walling and cladding systems provide satisfactory durability, i.e. primary components provide satisfactory in-service performance for the design life of the building (60 years) and secondary components provide satisfactory in-service performance for a minimum of 25 years.
- Carry out suitable off-site testing of the ‘prototype’ curtain walling system on panels that are of a similar size and configuration to those used on the building.
- Communicate any design changes to NHBC as soon as possible.
- Indicate the contractor responsible for constructing interfaces on the design.
- Ensure that the necessary design and specification information is clear and made available to relevant personnel on-site.
- Ensure systems are fixed in accordance with the manufacturer’s recommendations.
- Carry out suitable on-site testing to determine resistance to water penetration, including hose testing a representative sample of the finished installation in accordance with the current CWCT standard.
- In general, ensure that suitable quality assurance processes are in place at each stage of installation, that curtain walling and cladding systems are installed by competent operatives, and installed to achieve design tolerances and established standards, and that the site management is fully aware of the system and how it needs to be installed.
Technical news

Performance standards for building control bodies

The English and Welsh governments have published revisions to the Building control performance standards, which come into force on 1 April 2017. The standards, first published in 1996, apply to all building control bodies (BCBs) across England and Wales, both local authorities and Approved Inspectors, and help them deliver a comprehensive and consistent service in carrying out their statutory building control functions.

Overall, there are no major changes to the majority of the existing standards set out in the document. However, following publication of the All Party Parliamentary Group on the quality of new homes report ‘More homes, fewer complaints’, the following changes have been made:

- A new requirement has been added for inspections requiring BCBs to include, as a minimum, certain information in their site inspection records
- BCBs will be required to provide inspection records to the building owner, if requested, for all building work that has been issued with a final certificate
- Where the BCB’s client is not the building owner, BCBs should take reasonable steps to ensure that the building owner is made aware of whether the local authority or an Approved Inspector is carrying out the building control function.

The new standards come into force on 1 April 2017.

Building Regulations Guidance Note for access to dwellings

NHBC’s practical guide for access to dwellings has been updated in line with the recent revisions to Approved Document M in England. The guide provides clear pragmatic guidance for builder customers on how to demonstrate compliance for category 1 homes. Where the guide is followed, it will also demonstrate compliance with the guidance in Wales for ‘all dwellings’.

Copies of the free guide are one of the resources available through Building Regulations Plus on NHBC TechZone www.nhbc.co.uk/techzone.

Technical Guidance Documents

Technical Guidance Documents provide advice and acceptable solutions on a wide variety of construction issues that have been raised with NHBC over the years. Additional guidance has now been added, along with updates of some of the previous documents. The additional/revised guidance includes:

- Timber balconies and terraces
- Rodding access to soil and vent pipes
- Gaps around windows
- Electrical accessories in partitions
- Paths for refuse removal
- Gable ladder restraint
- Compartment walls between garages
- DPC trays to rendered walls.

All Technical Guidance Documents are included as supporting documents for the relevant chapters in NHBC Standards Plus. A complete list of all Technical Guidance Documents is also available on the website:

www.nhbc.co.uk/builders/productsandservices/techzone/nhbcstandards/technicalguidancedocuments

Further updates are planned, so please check the website regularly.
NHBC offers a range of training and development options.

Building for tomorrow 2017

BfT runs until the end of April 2017, and we’re currently offering three for two on all delegate bookings.

New for 2017

We’ve added an event in central London specifically for house builders who are working on high-rise projects. The event in Westminster takes place on Thursday, 27 April 2017.

For more information on this year’s events, visit www.nhbc.co.uk/bft.

Dedicated MMC Hub for UK house builders

A new online resource centre has been launched by NHBC to keep the house-building industry informed of the latest developments in modern methods of construction (MMC).

The website lists current building systems that NHBC has accepted as meeting its Standards. It also has an online application facility for manufacturers to submit their MMC systems and sub-assemblies for an assessment to determine whether they satisfy NHBC Technical Requirements, as well as answers to frequently asked questions.

The site provides free access to MMC research from the NHBC Foundation and other industry organisations, alongside in-focus sections on various types of building systems, including panelised and volumetric.

To access the MMC hub, visit www.nhbc.co.uk/mmchub.

NHBC working with the private rental sector

NHBC is an experienced partner in managing development risk for major rental and mixed-use schemes. NHBC has set standards and worked with contractors and developers to identify and manage development risk and protect their assets from major defects for 80 years.

We have been involved in some of the most complex and iconic residential projects over that time, providing a coordinated approach through a dedicated team. This gives you unrivalled technical experience, design reviews, commercial building control, development-specific inspections and insurance against structural defects to protect your asset.

For more information on how NHBC can support you and your clients in delivering PRS schemes, please visit www.nhbc.co.uk/prs.
Training events

NHBC/APS Management of Pre-Construction Health and Safety – three days
This is for those who wish to act as CDM advisers to clients, principle designers and contractors or construction safety Practitioners. Upon completion of the course and successfully passing the required APS membership criteria, candidates may apply for membership of the association.

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CITB Temporary Works Co-ordinator – two days
This is designed to assist those who have responsibility for managing all forms of temporary works on site. It is also designed to ensure that senior management and those engaging with contractors are confident and have an ‘assessed’ standard of knowledge on the subject.

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Defects Prevention – three days
This course is our primary technical programme for site managers. It covers the requirements of the NHBC Standards and construction best practice for all major areas of home building construction.

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Defects Prevention Hot Topics – one day
This course is a slimmed-down variant of the three-day course and covers the areas of house-building construction where NHBC most commonly see defects. Walking through the requirements of the NHBC Standards and exploring construction best practice.

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Managing Timber Frame Construction - one day
This updated course provides managers and quality controllers with the knowledge required to manage/inspect timber frame construction effectively.

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For more information or to book, visit www.nhbc.co.uk/training.

NHBC TechZone
Free, fast access to house-building standards and regulatory information:
- NHBC Standards Plus
- Building Regulations Plus in England and Wales
- NHBC technical support
- Technical news and events
- NHBC apps.

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