BUILDERS’ BOOK

An illustrated guide to building energy efficient homes
ACKNOWLEDGEMENTS

The Zero Carbon Hub is very grateful to the following contributors/organisations for their involvement in developing this good practice guide.

Author:
Tom Dollard, Pollard Thomas Edwards

Project Advisors:
Sarah Downes, Ben Griggs, Rob Pannell, Zero Carbon Hub

Graphic Design:
Communications Group, Pollard Thomas Edwards

Steering Group:
Richard Bayliss, CITB
Chris Carr, Federation of Master Builders/Carr & Carr Builders
Darren Dancey, Crest Nicholson
Roger Holdsworth, Pollard Thomas Edwards
Mike Leonard, Modern Masonry Alliance
Paul McGivern, HCA
Andrew Orriss, SIG Plc
Richard Partington, Studio Partington
Graham Perrior, NHBC
John Slaughter, Home Builders Federation
Stacey Temprell, Saint Gobain
Barry Turner, LABC

CONTACTS

Further copies of this guide are available as a PDF download from www.zerocarbonhub.org

Or contact us:

Zero Carbon Hub
Layden House
76-86 Turnmill Street
London EC1M 5LG
T: 0845 888 7620
E: info@zerocarbonhub.org

Pollard Thomas Edwards
Diespeker Wharf
38 Graham Street
London N1 8JX
T: 020 7336 7777
www.pollardthomasedwards.co.uk

SIG360 Technical Centre
is a service offering that focuses on helping customers deliver energy efficient buildings.

Central to SIG360 is an easily accessible impartial team of technical specialists, who draw on over 55 years of experience and an extensive range of products in providing the most cost effective build, suited to your preferred building style.

Support and services include:
• Design and “As built” SAP
• U-Value Calculations
• Condensation risk analysis
• Guidance on Building Regulation compliance
• Energy Performance Certificates
• Predicted Energy assessments
• Energy statements
• Thermal modelling
• Impartial product advice
CONTENTS

Introduction
How to use this book
Summary - Top Issues Leading to Poor Performance
Site Posters - Fabric and Services

1  Groundworks
2  Beam and Block Floor
3  Door Threshold
4  Cavity Wall
5  Cavity wall
6  Floor Joists
7  Separating wall
8  Lintels
9  Windows
10 Bay windows
11 Projecting windows
12 Eaves
13 Roof
14 Dryline / Plaster
15 Ventilation
16 Heating / hotwater
17 Finals
INTRODUCTION

The builders’ book is a good craftsmanship guide that highlights key construction details when building a new home, and good practice for delivering them. During multiple site inspections, these details were most commonly identified as requiring further guidance. The book aims to improve the quality of new homes built, especially with regards to comfort levels and energy bills. It helps builders improve site processes to deliver better performing homes and reduce the risk of condensation and mould growth, excessive heat loss and failure to meet building regulations.

HOW TO USE THIS BOOK

The bulk of the book is made up of site posters that highlight areas of the build in a normal construction sequence.

The site posters can be printed out A4 or A3 size in colour and used as site guidance for site management and trades. They should be used as toolbox talks for trades and at site inductions. The site posters can also be used as design documents and included in specification documentation.

NOTES:
All photographs are taken on building sites. “What to do guidance” is compliant with building regulations and NHBC standards. Diagrams comply with LABC registered construction details www.labc.co.uk/registration-schemes/construction-details

ICONS FOR DIFFERENT TRADES ON SITE POSTERS

GROUND WORKER
BRICKLAYER
CARPENTER
PLUMBER
ELECTRICIAN
PLASTERER
WINDOW FITTER
ROOFER
DECORATOR
### SUMMARY - TOP ISSUES LEADING TO POOR PERFORMANCE

<table>
<thead>
<tr>
<th><strong>Problems</strong></th>
<th><strong>Recommendations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Different, poor performing insulation fitted.</td>
<td>Check insulation against design specification.</td>
</tr>
<tr>
<td>Insulation not installed correctly – gaps behind insulation around cavity closures.</td>
<td>Must be installed to BBA or manufacturer guidelines: no gaps, tight up against blockwork or roof/floor to ensure no air route behind insulation.</td>
</tr>
<tr>
<td>Product substitution for poorer materials: blocks, insulation, windows, lintels, boiler, controls, fans, windows, doors and lights all affect the energy efficiency of a new home.</td>
<td>Check materials are same as design specification or discuss with architect/designer and site manager.</td>
</tr>
<tr>
<td>Air leakage through small gaps in insulation, blockwork and plasterboard can lead to heat losses and condensation issues.</td>
<td>Make sure insulation has no gaps and is sufficiently sealed at joints/ends.</td>
</tr>
<tr>
<td>Ventilation fans not commissioned correctly. Domestic Ventilation Compliance Guide not checked.</td>
<td>Check against design specification. Commissioning of fans should be completed by a competent person.</td>
</tr>
<tr>
<td>Cold air blowing behind or through insulation.</td>
<td>Fit insulation close to structure, and ensure it is windtight. Seal accordingly.</td>
</tr>
<tr>
<td>Cold bridging: steel, concrete or timber structure going through insulation layer.</td>
<td>Consult with design team.</td>
</tr>
<tr>
<td>Site damage of fragile materials including insulation, blocks and windows. Rain and mud will worsen performance of materials.</td>
<td>Ensure that insulation and other fragile materials are not damaged by rain, wind and mechanical damage.</td>
</tr>
<tr>
<td>Services: ducting, TV aerial, lights can all disrupt insulation in roof causing heat loss / cold spots.</td>
<td>Check insulation in roof is continuous after all services have been installed. Ensure services in service zone to stop this. Label importance of insulation for homeowner.</td>
</tr>
<tr>
<td>Windows installed badly leading to airleakage and heat loss.</td>
<td>Ensure correct windows installed with less than 10mm tolerance.</td>
</tr>
</tbody>
</table>
**PROBLEM TO AVOID**

**INSULATION MISSING BELOW DPC**

**WHAT TO DO?**

1. Keep cavity and inner block smooth and free of ‘mortar snots’ (1)
2. Fit insulation below DPC level to depth shown in drawing (2)
3. Fit insulation boards tight to blockwork with no air gap (3)
4. Install cavity tray over insulation (4)
5. Use blocks with correct thermal conductivity

**GOOD PRACTICE**

Continuous insulation below floor level
**PROBLEM TO AVOID**

GAPS IN FLOOR INSULATION

- AIR GAP

**WHAT TO DO?**

- Overlay floor insulation with a separating layer to prevent screed bleeding through joints
- Fit horizontal floor insulation tight with no gaps between boards
- Install perimeter floor insulation down to the base of concrete floor and tight to blockwork
- Cut through insulation layer with no gaps
- Restrain perimeter floor insulation to prevent ‘floating’ during screed pour
- Prevent screed bridging the perimeter insulation

**GOOD PRACTICE**

Fit insulation boards tightly and seal all penetrations
**PROBLEM TO AVOID**

MISSING EDGE INSULATION

- **INSULATION MISSING**
- **SCREED BRIDGING THRESHOLD**

**WHAT TO DO?**

- Follow the detail drawing or speak with Architect / technical team
- Install a thermal break at the threshold – at least 25mm high performance insulation
- Install damp proof membrane, gas membranes and separating layer as necessary
- Overlap door with cavity by at least 50mm

**GOOD PRACTICE**

50mm thick insulation at door threshold or reinforced cavity closer
CAVITY WALL

PROBLEM TO AVOID: GAPS IN INSULATION

WHAT TO DO?

GOOD PRACTICE

1. Protect cavity and insulation from mortar droppings
2. Smooth mortar joints to allow insulation board tight against block
3. Install insulation tightly butted with no gaps
4. Cut insulation tight to cavity closers, lintels and cavity trays

Please print and use in your site office, for further information www.zercarbonhub.org
PROBLEM TO AVOID
MISSING INSULATION

WHAT TO DO?
- Install rigid insulation behind steel beams, cavity trays, meter boxes and subfloor vents or any other elements bridging cavity
- Blown or injected insulation, ensure this reaches the whole wall with no gaps
- Adjust drill pattern for tight spots, cavity trays and inject below DPC

GOOD PRACTICE
Use preformed tray around complex junctions
**FLOOR JOISTS**

**6.0**

**PROBLEM TO AVOID**

AIR-LEAKAGE AROUND JOISTS

MORTAR WILL NOT BE AIRTIGHT AROUND JOISTS

**WHAT TO DO?**

- Joists on hangers will reduce air leakage and heat loss
- Fully seal hangers with plaster to retain airtightness
- If joists need to be built in, then end caps should be used and sealed using propriety sealant

**GOOD PRACTICE**

Apply parge coat to party wall to ensure continuous airtightness line

Please print and use in your site office, for further information [www.zerocarbonhub.org](http://www.zerocarbonhub.org)
**SEPARATING WALL**

---

**PROBLEM TO AVOID**

**INCORRECTLY SEALED PARTY WALL**

- **INSULATION UNPROTECTED**
- **EDGE SEAL NOT UNDER COMPRESSION**
- **POORLY SEALED JUNCTIONS AND AIR GAPS IN INSULATION ALLOWS HEAT LOSS**
- **COLD AIR MOVEMENT THROUGH MINERAL WOOL**

---

**WHAT TO DO?**

- Ensure fully filled mortar joints (1)
- Keep insulation and cavity protected from weather and mortar snots (2)
- Install party wall edge seal under 15mm compression (3)
- Install mineral wool to fully fill cavity (4)
- Parge coat for improved airtightness may be required (5)
- Refer to robust details for acoustic requirements www.robustdetails.com

---

**GOOD PRACTICE**

Cavity should be fully filled with edge seal at wall end and roof junctions

---

Please print and use in your site office, for further information www.zercarbonhub.org
LINTELS

PROBLEM TO AVOID
COLD BRIDGING & MISSING INSULATION

CONTINUOUS BASEPLATE CREATES COLD SPOT

WHAT TO DO?

- Install fully insulated cavity closers tight with cavity and insulation
- Cut insulation tight around lintel and cavity tray
- Install lintels that minimise heat loss with non continuous baseplates or thermal breaks
- Improve energy performance by using separate lintels or thermally broken lintels

GOOD PRACTICE
Fully insulated cavity closers to be used
**WINDOW INSTALLATION**

**PROBLEM TO AVOID**

WINDOWS INSTALLED FORWARD OF DESIGN POSITION

**WHAT TO DO?**

- Close the cavity with tightly packed insulation (1)
- Insulation to window reveal (2)
- Window fitter to provide non standard large cill (3)
- Overlap frame with cavity as much as possible - minimum 30mm
- Check trickle vent sizes as design
- Less than 10mm tolerance around window frame and structural opening

**GOOD PRACTICE**

A large overlap with cavity will improve thermal performance. For improved airtightness, use air barrier tapes between the window/door and structure
PROBLEM TO AVOID
COLD BRIDGING

WHAT TO DO?

- Reduce cold bridges of steel or concrete or timber through insulation layer
- Continuous insulation inside
- Install slimmer frames to be more energy efficient
- Less than 10mm tolerance between window frame and opening

OPTION 1
INTERNAL INSULATION TO FULL DEPTH

OPTION 2
INSULATED PLASTERBOARD

GOOD PRACTICE
Continuous insulation throughout bay window
**GOOD PRACTICE**

Design to wrap structure with insulation

---

**WHAT TO DO?**

- Reduce thermal bridges of steel, concrete or timber through insulation layer
- If timber structure, ensure less than 15% timber content or continuous insulation outside structure
- If GRP structure, ensure sufficient thickness of continuous insulation as design
- Wrap insulation around steelwork
**EAVES**

---

**PROBLEM TO AVOID**

**NO INSULATION AT EAVES**

- **SQUASHED INSULATION**
- **NO SPACE FOR INSULATION**
- **REDUCED SPACE ABOVE JOISTS MAKES INSTALLATION OF FULL INSULATION IMPOSSIBLE**

---

**WHAT TO DO?**

1. Install rigid insulation to top of the wall plate (1)
2. Truss design to accommodate space for insulation at eaves - 300mm is best practice (2)
3. Lay mineral wool insulation into eaves (3)
4. Cut insulation around eaves lintels (4)

---

**OPTION 1**

- 1
- 2
- 3

**OPTION 2**

- 1
- 2
- 3
- 4

**GOOD PRACTICE**

Install insulation before eaves are inaccessible
ROOF

MISSING ROOF INSULATION

PROBLEM TO AVOID

WHAT TO DO?

- Install roof membrane in line with the design i.e. breathable or standard with ventilator
- Install continuous insulation across the roof and into the eaves
- Insulate eaves before roof is closed up
- Use insulation support box above down-lighters to maintain insulation thickness and prevent burn
- Install loft hatch with appropriate insulation thickness

GOOD PRACTICE

Cross lapped insulation checked at final inspection before handover
**PROBLEM TO AVOID**  AIR-LEAKAGE

- Foam fill all penetrations/gaps before drylining
- Stagger ceiling boards and over door openings to minimise future cracking
- Mark continuous ribbon of adhesive to be applied around all openings, along the top and bottom and at internal and external corners of walls, and over service chasers

**GOOD PRACTICE**  Use a parget coat or plaster on block work to improve airtightness
**VENTILATION**

**PROBLEM TO AVOID**
POORLY SPECIFIED AND INSTALLED DUCTWORK

- **FLEXI DUCT TOO LONG**
- **DUCTWORK NOT CONNECTED**

**WHAT TO DO?**

- Install rigid ductwork for extract fans, and minimise use of flexi ductwork
- Installer to commission fans to part F domestic ventilation compliance guide
- Commissioning sheets to be provided to site manager
- Check noise of fan is not excessive
- Check ducts to outside are fully insulated
- Clearly label the ventilation controls

**GOOD PRACTICE**
Specialist or manufacturer to commission fans

Please print and use in your site office, for further information [www.zercarbonhub.org](http://www.zercarbonhub.org)
HEATING / HOT WATER

PROBLEM TO AVOID
HEAT LOSS THROUGH UNINSULATED PIPES

WHAT TO DO?

- Insulate all pipework to site specification and DHCG - minimum 25mm insulation to all primary pipework
- Fully seal all holes and gaps under/behind kitchen units
- Fully seal all holes and gaps in wet rooms (under/behind bathroom units, bath and shower)
- All control valves are clearly labelled, providing information about the valve function
- Refer to Domestic Heating Compliance Guide from - www.planningportal.gov.uk

GOOD PRACTICE
Pipe insulation continuous around the full length and secured in place
**FINALS**

**PROBLEM TO AVOID**

**AIR LEAKAGE AS SEALANT DOES NOT LAST**

**WHAT TO DO?**

- Check insulation in roof is continuous and installed correctly at eaves.
- Do not rely on sealant as an air barrier – build tight and parget coat or plaster instead.
- Trim all doors to achieve a clear gap between finish and door of 10mm; 25mm where no floor covering provided.
- Inform SAP assessor of sales extras fitted that were not included in the design or specification e.g. fireplace, downlights, electric radiator.

**GOOD PRACTICE**

Final inspection to use eyeball test to pick up on missing insulation. Notify SAP Assessor of changes to original design.