

BUILDERS' BOOK



An illustrated guide to building energy efficient homes













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

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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.

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- · Design and "As built" SAP
- · U-Value Calculations
- · Condensation risk analysis
- Guidance on Building Regulation compliance
- · Energy Performance Certificates
- · Predicted Energy assessments
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- · Thermal modelling
- · Impartial product advice

ACKNOWLEDGEMENTS

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

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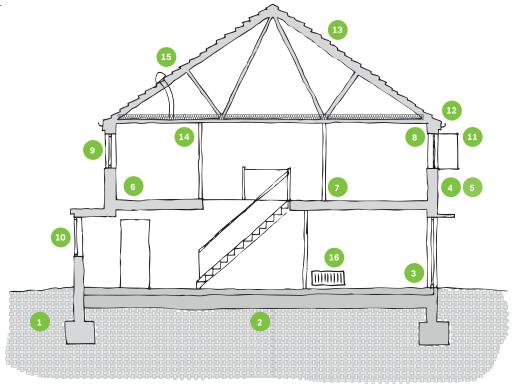
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INTRODUCTION

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.

This edition of the builders' book is for traditional masonry construction of new homes and extensions. It follows the construction phase of the house-building process, and is aimed at helping site personnel and trades improve quality of the end product. It also highlights areas where built environment professionals can improve the design.

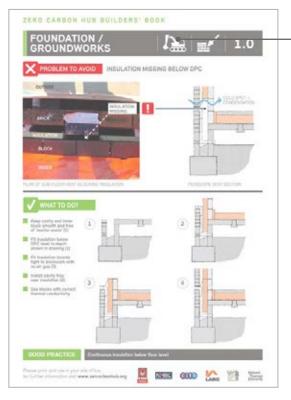
HOW TO USE THIS BOOK

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

۳



PLUMBER

R ELECTRICIAN

PLASTERER





WINDOW FITTER

ROOFER

DECORATOR

SUMMARY - TOP ISSUES LEADING TO POOR PERFORMANCE

Problems

Recommendations

- Different, lesser performing insulation fitted.
- Check insulation against design specification.
- Insulation not installed correctly gaps behind insulation around cavity closures. e.g. insulation cut short of reveals.
- Must be installed to BBA or manufacturer guidelines: no gaps, tight up against blockwork or roof/floor to ensure no air route behind insulation.
- 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.
- Check materials are same as design specification or discuss with architect/designer and site manager.
- Air leakage through small gaps in insulation, blockwork and plasterboard can lead to heat losses and condensation issues.
- Make sure insulation has no gaps and is sufficiently sealed at joints/ends.
- Ventilation fans not commissioned correctly.

 Domestic Ventilation Compliance Guide not followed.
- Check against design specification.

 Commissioning of fans should be completed by a competent person. e.g. BPEC Certification for Domestic Ventilation.
- Cold air blowing behind or through insulation. e.g. insulation floating off substrate.
- Fit insulation close to structure, and ensure it is windtight. Seal accordingly.
- Cold bridging: steel, concrete or timber structure going through insulation layer.
- Consult with design team. Designer to reduce cold bridges as Part L Building Regulations.
- Site damage of fragile materials including insulation, blocks and windows. Rain and mud will worsen performance of materials.
- Ensure that insulation and other fragile materials are not damaged by rain, wind and mechanical damage.
- Services: ducting, TV aerial, lights can all disrupt insulation in roof causing heat loss / cold spots.
- 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.
- Windows installed badly leading to airleakage and heat loss.
- Ensure correct windows installed with less than 10mm tolerance.

FOUNDATION / GROUNDWORKS

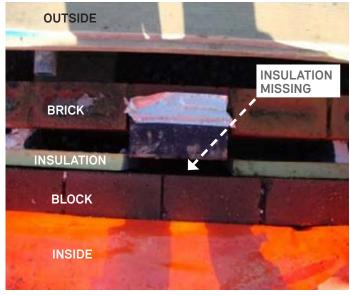


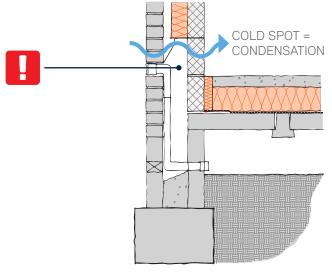


1.0



INSULATION MISSING BELOW DPC





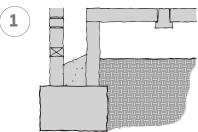
PLAN OF SUB FLOOR VENT BLOCKING INSULATION

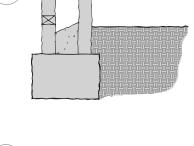
PERISCOPE VENT SECTION

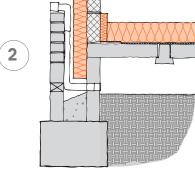


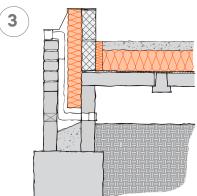
WHAT TO DO?

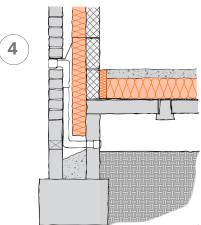
- Keep cavity and inner block smooth and free of 'mortar snots' (1)
- Fit insulation below DPC level to depth shown in drawing (2)
- Fit insulation boards tight to blockwork with no air gap (3)
- Install cavity tray over insulation (4)
- Use blocks with correct thermal conductivity











GOOD PRACTICE

Continuous insulation below floor level

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BEAM AND BLOCK FLOOR

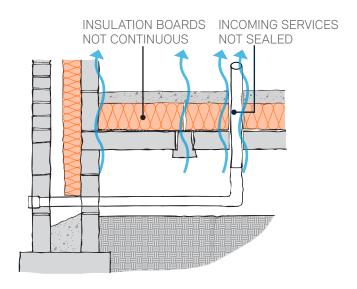


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GAPS IN FLOOR INSULATION



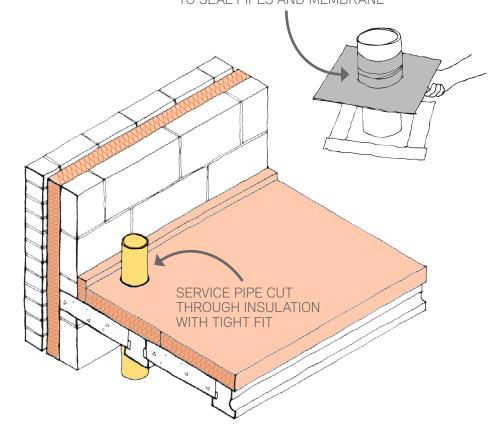




WHAT TO DO?

- Overlay floor insulation with a seperating layer (DPM) 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. If possible, 'core drill' hole to tight fit
- Restrain perimeter floor insulation to prevent 'floating' during screed pour
- Prevent screed bridging the perimeter insulation

WITH GAS MEMBRANES, USE PROPRIETARY TOP HAT UNIT AND TAPE TO SEAL PIPES AND MEMBRANE



GOOD PRACTICE

Fit insulation boards tightly and seal all penetrations

















DOOR THRESHOLD



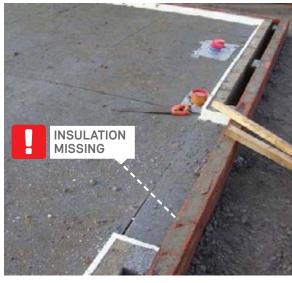




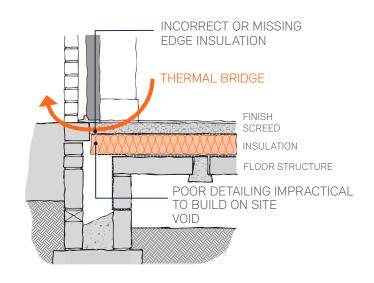
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MISSING EDGE INSULATION





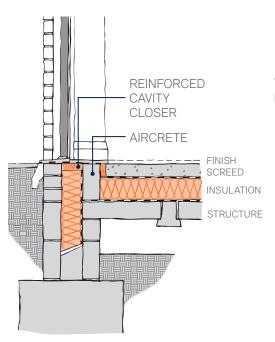




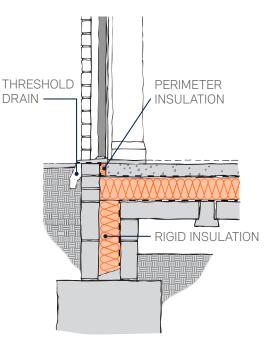
WHAT TO DO?

- 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
- Ensure airtight seal under door

OPTION 1REINFORCED CAVITY CLOSER



OPTION 2INSULATION AT DOOR THRESHOLD



GOOD PRACTICE

50mm thick insulation at door threshold or reinforced cavity closer

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CAVITY WALL

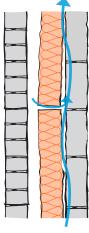




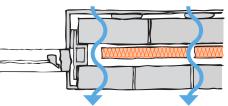
GAPS IN INSULATION





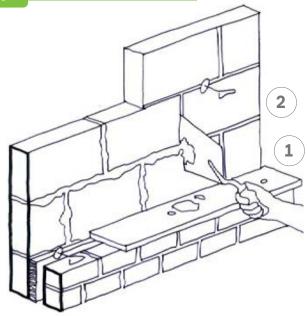


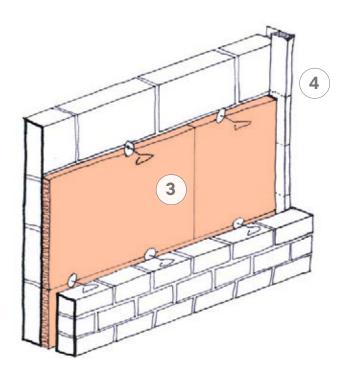
INSULATION NOT TIGHT TO WALL FACE DUE TO ROUGH SURFACE CREATED BY EXCESS **MORTAR**



GAPS BETWEEN ADJACENT BOARDS = HEAT LOSS

WHAT TO DO?





GOOD PRACTICE

- Protect cavity and insulation from mortar droppings
- 2 Smooth mortar joints to allow insulation board tight against block3 Install insulation tightly butted with no gaps
- Cut insulation tight to cavity closers, lintels and cavity trays















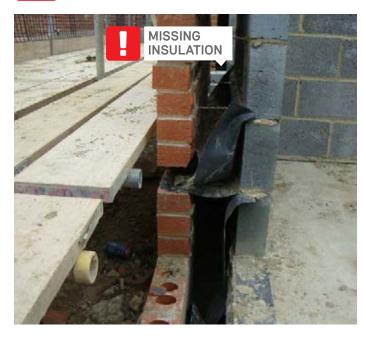


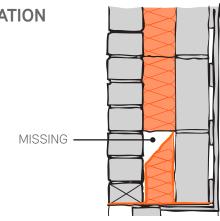
CAVITY WALL

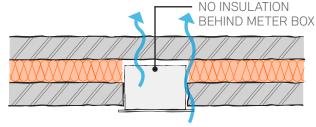








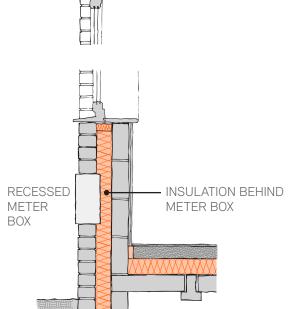






WHAT TO DO?

- 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
- Install cavity trays where needed





CUT INSULATION AROUND CAVITY TRAY

GOOD PRACTICE

Use preformed tray around complex junctions





INSULATION CUT BEHIND CAVITY

TRAYS











FLOOR JOISTS



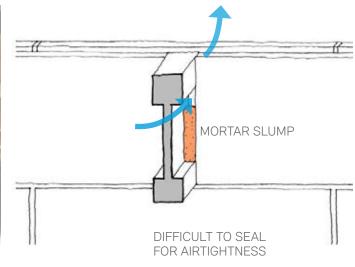




PROBLEM TO AVOID

AIR-LEAKAGE AROUND JOISTS



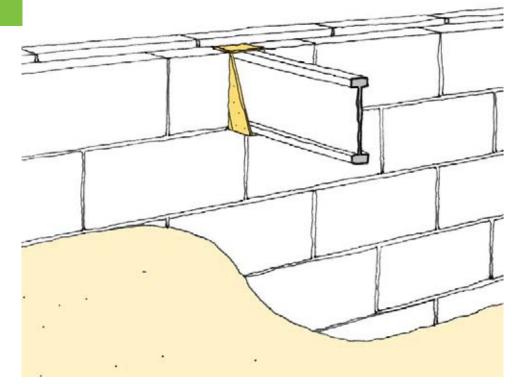


MORTAR WILL NOT BE AIRTIGHT AROUND JOISTS



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, joints fully mortared and then sealed using proprietary sealant



GOOD PRACTICE

Apply parge coat to party wall to ensure continuous airtightness line

















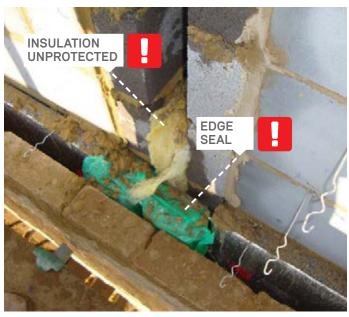
SEPARATING WALL



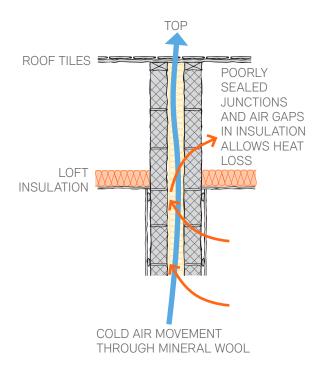
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INCORRECTLY SEALED PARTY WALL



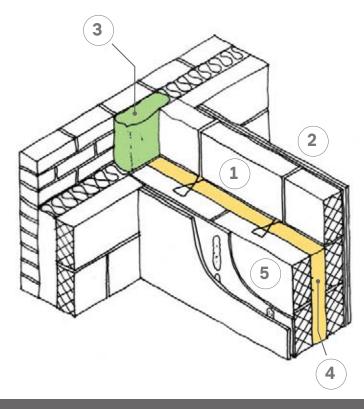






WHAT TO DO?

- 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















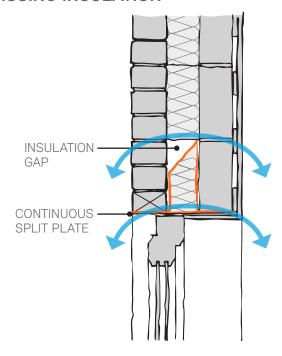
LINTELS





COLD BRIDGING & MISSING INSULATION





CONTINUOUS SPLIT PLATE CREATES COLD SPOT

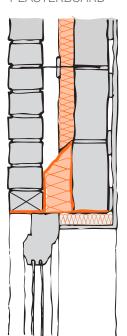


WHAT TO DO?

- 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
- Cavity trays to be installed as needed
- Check correct lintel is installed and value

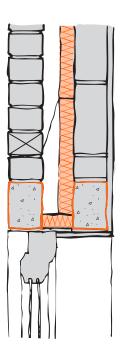
OPTION 1

CONTINUOUS LINTEL & INSULATED **PLASTERBOARD**



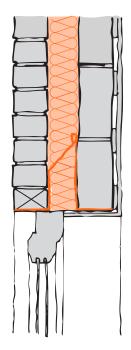
OPTION 2

SEPARATE LINTELS



OPTION 3

THERMALLY **BROKEN LINTEL**



GOOD PRACTICE

Fully insulated cavity closers to be used















WINDOW INSTALLATION

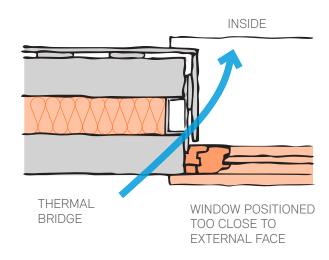


9.0



WINDOWS INSTALLED FORWARD OF DESIGN POSITION



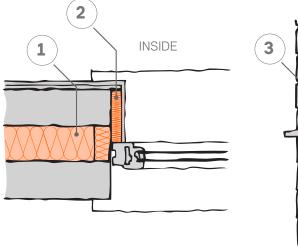


NO OVERLAP OF WINDOW AND CAVITY

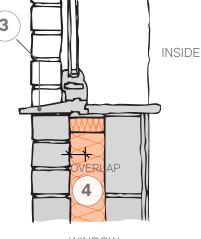


WHAT TO DO?

- Close the cavity with tightly packed insulation (1)
- Insulation to window reveal (2)
- Window fitter to provide cill to suit set back of frame (3)
- Less than 10mm tolerance between window frame and structural opening
- Overlap frame with cavity as much as possible minimum 30mm (4)
- Check trickle vent sizes as design
- Use continuous cavity closer







WINDOW CILL

GOOD PRACTICE

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

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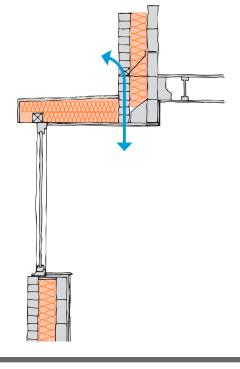
BAY WINDOWS





COLD BRIDGING





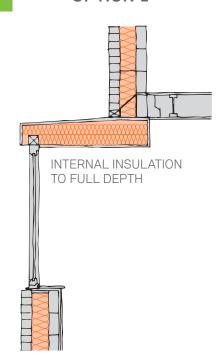
THICK FRAME AND POSTS INCREASES HEAT LOSS



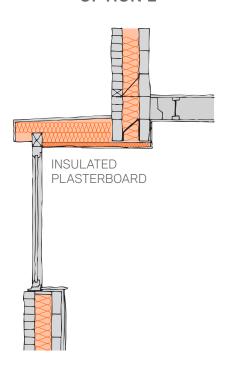
WHAT TO DO?

- Reduce cold bridges of steel or concrete or timber through insulation layer
- Continuous insulation inside
- Less than 10mm tolerance between window frame and opening

OPTION 1



OPTION 2



GOOD PRACTICE

Continuous insulation throughout bay window















PROJECTING WINDOWS







PROBLEM TO AVOID

COLD BRIDGING



COLD SPOT UNINSULATED STEEL & CONCRETE

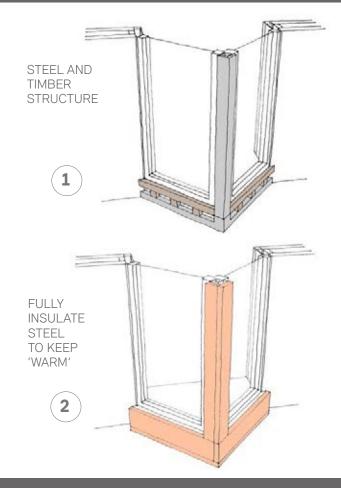
INSIDE

CONTINUOUS STEEL CREATES **COLD BRIDGE**



WHAT TO DO?

- Reduce thermal bridges of steel, concrete or timber through insulation layer
- Install continuous insulation outside structure
- If GRP structure, ensure sufficient thickness of continuous insulation as design
- Wrap insulation around steelwork
- Install thermal laminate plasterboard to inside face



GOOD PRACTICE

Design to wrap structure with insulation

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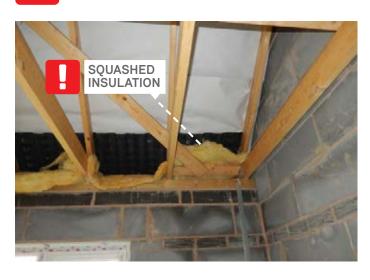


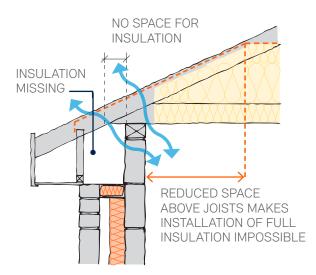
EAVES





NO INSULATION AT EAVES





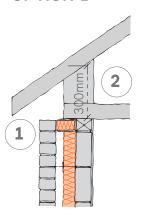


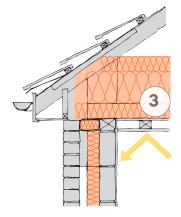
WHAT TO DO?

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

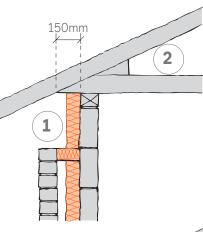


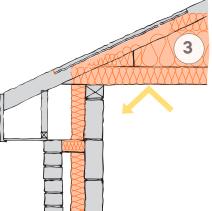
OPTION 1





OPTION 2





GOOD PRACTICE

Install insulation before eaves are inaccessible

















ROOF

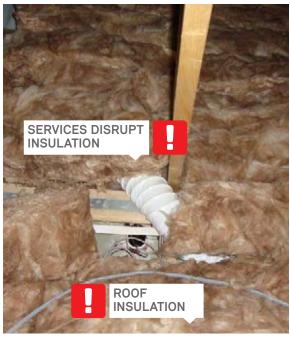




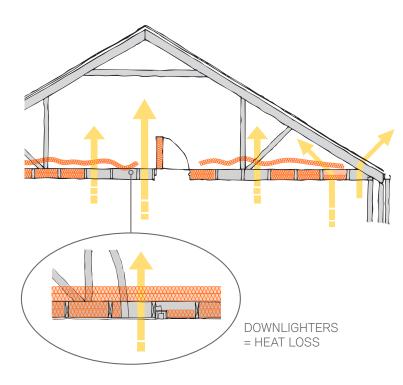




MISSING ROOF INSULATION



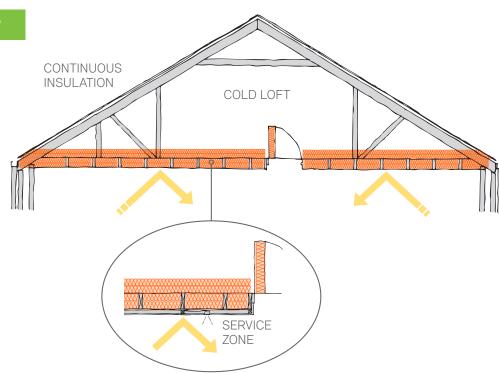




INSULATION DISTURBED BY SERVICES

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

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























AIR-LEAKAGE





NOT SEALING SERVICES



WHAT TO DO?

- 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 parge coat or plaster on block work to improve airtightness















VENTILATION







15.0



POORLY SPECIFIED AND INSTALLED DUCTWORK





EXI DUCT TOO LONG AND NOT SUPPORTED = FANS WILL BE NOISY / INEFFICIENT. VENTILATION COMMISSIONING NOT DONE CORRECTLY

WHAT TO DO?

- Install rigid ductwork for extract fans, and minimise use of flexi ductwork at final connection to 0.5m max
- 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





MEASURE AIRFLOW WITH APPROPRIATE DEVICE

GOOD PRACTICE

Specialist or manufacturer to commission fans

















HEATING / HOT WATER





HEAT LOSS THROUGH UNINSULATED PIPES



PRIMARY PIPEWORK NOT INSULATED



BOILER FLUE NOT SEALED



WHAT TO DO?

- Insulate all pipework to site specification and DHCG - minimum 25mm insulation to all primary pipework including valves and junctions
- 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













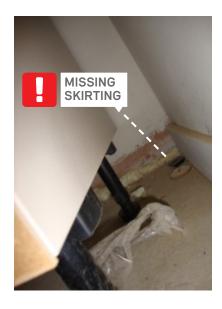


FINALS





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 parge 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















NOTE:

This guide is not a legal document and does not form part of a Building Regulations approved specification. It is for information and good practice purposes only. Consult your Building Control Officer for details on approved specification's and policy.

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