9 Construction and quality assurance

Mark Siddall

INTRODUCTION

With a sound design already in place, exemplary standards of on-site quality assurance are required in order for buildings to perform appropriately. This means diligence and excellent standards of craftsmanship must be employed at all times. For a project to be completed successfully, with minimised costly rework and remediation, experience suggests that there is a learning curve that needs to be addressed. This learning curve is not confined to the site office; it affects all trades on site.

An Airtightness Team, comprising two Airtightness Champions, two Sealing Operatives also including the Site Manager, on the Erneley Close project. Photo: Paul Jennings

KEY STAGE DESIGN REVIEWS

Structured reviews, preferably with the contractor, that interrogate a design are hugely beneficial, particularly for less experienced project teams. These reviews analyse each and every aspect of the design and the construction. Key characteristics:

- they are not simply 'compliance reviews' – they dig into the details and examine the buildability, sequencing and construction programme
- their purpose is to identify and expose risks that could impact upon project delivery
- they allow the project team the opportunity to formulate strategies that resolve the risks in an open and collaborative fashion.

TRAINING OF SITE OPERATIVES (TOOLBOX TALKS)

On some building sites, traditional attitudes can be entrenched and effort must be made to bring all site operatives on board. Each trade, from foundations to roof, has a part to play in the successful completion of a project. One of the best techniques is to hold a series of toolbox talks that all site personnel are required to attend. New or replacement personnel should also receive an induction. Typically, these toolbox talks examine each detail, the sequence in which it will be constructed, the technologies that will be used when forming the detail, and trades that will impact upon the successful completion of the detail.

An atmosphere of collaboration helps these talks to work best and allows any sceptics to voice their concerns. Inviting sceptics to speak up is vital because:

- they may have a valid point and the sessions create an opportunity to address relevant concerns
- there is an opportunity to address their concerns and to bring them on board
- in the most extreme cases there is the opportunity to identify people that will obstruct the success of the project. They can then be replaced by more appropriate trades people.

GOOD PRACTICE EXAMPLE

PHPP calculations suggested that the design had the potential to satisfy the Passivhaus Standard. The challenge lay in the actual implementation of the delivery process.

A series of Key Stage Design Reviews, training of the dedicated, on-site Quality Assurance Champion, toolbox talks and site inspections and feedback underpinned the successful completion of the Certified Passivhaus homes at St. Mary's, Oldham. The result of these processes resulted in buildable details and simplified construction processes.

Site manager Anthony Kavanagh says: *'Compared to the Code 6 homes that are also on site I would prefer to build to the Passivhaus standard. The construction details that we have developed with Mark are proving to be far more practical and easier to build.'*

Training of site operatives, undertaking detailed site inspections, provision of robust feedback and the inclusion of a dedicated, on-site quality assurance champion are all constituent parts of a successful delivery process. This chapter outlines those areas that require specific attention.

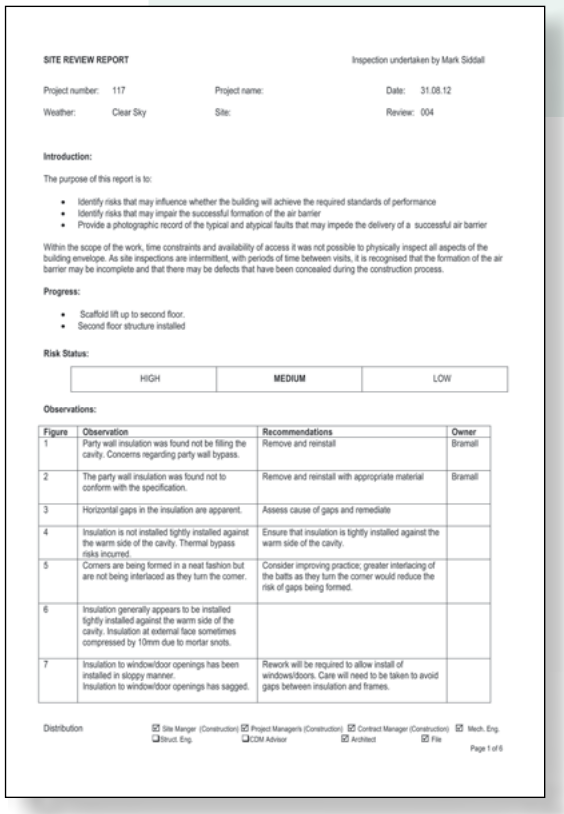
A DEDICATED, ON-SITE QUALITY ASSURANCE CHAMPION

The role of a dedicated, on-site Quality Assurance Champion is to make sure that the building satisfies its airtightness target. The role is to also help ensure that the correct insulation system is installed properly. This means ensuring that:

- the interface between insulation products has a good butt joint
- the insulation is encapsulated between the air barrier and the wind barrier
- the wind barrier system is completed in accordance with the design intent.

Their role is also to:

- organise and arrange pressure tests
- arrange for timely toolbox talks for all trades
- review the buildability of the air barrier, wind barrier and insulation systems – this means reviewing the sequencing of the build process and considering where challenges may arise before they become an obstacle
- undertake day to day site inspections of the work and instruct remediation as required
- ensure that only the specified materials are used in the construction i.e. avoid ad hoc substitutes, without prior consultation and agreement with the designer.



SITE REVIEW REPORT

Inspection undertaken by Mark Siddall

Project number: 117 Project name: Date: 31.08.12

Weather: Clear Sky Site: Review: 004

Introduction:

The purpose of this report is to:

- Identify risks that may influence whether the building will achieve the required standards of performance
- Identify risks that may impair the successful formation of the air barrier
- Provide a photographic record of the typical and atypical faults that may impede the delivery of a successful air barrier

Within the scope of the work, time constraints and availability of access it was not possible to physically inspect all aspects of the building envelope. As site inspections are intermittent, with periods of time between visits, it is recognised that the formation of the air barrier may be incomplete and that there may be defects that have been concealed during the construction process.

Progress:

- Scaffold lift up to second floor.
- Second floor structure installed

Risk Status:

HIGH	MEDIUM	LOW

Observations:

Figure	Observation	Recommendations	Owner
1	Party wall insulation was found not be filling the cavity. Concerns regarding party wall bypass.	Remove and reinstall	Bramall
2	The party wall insulation was found not to conform with the specification.	Remove and reinstall with appropriate material	Bramall
3	Horizontal gaps in the insulation are apparent.	Assess cause of gaps and remediate	
4	Insulation is not installed tightly installed against the warm side of the cavity. Thermal bypass risks incurred.	Ensure that insulation is tightly installed against the warm side of the cavity.	
5	Corners are being formed in a neat fashion but are not being interlaced as they turn the corner.	Consider improving practice; greater interlacing of the batts as they turn the corner would reduce the risk of gaps being formed.	
6	Insulation generally appears to be installed tightly installed against the warm side of the cavity. Insulation at external face sometimes compressed by 10mm due to mortar snots.		
7	Insulation to window/door openings has been installed in sloppy manner. Insulation to window/door openings has sagged.	Rework will be required to allow install of windows/doors. Care will need to be taken to avoid gaps between insulation and frames.	

Distribution ☑ Site Manger (Construction) ☑ Project Manager/s (Construction) ☑ Contract Manager (Construction) ☑ Mech. Eng. ☐ Struct. Eng. ☐ CDM Advisor ☑ Architect ☑ File

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Example of Site Report used by Mark Siddall for a Passivhaus development.

SITE INSPECTIONS AND FEEDBACK

Detailed site reports that support a useful, practical and fully functional feedback loop are invaluable. Discussing the contents of the reports with site managers, rather than simply handing over the document, is critical to establishing this feedback loop. The key thing here is the fact that, compared to standard practice, a closer working relationship is required for Passivhaus projects.

Site inspections may be made by the design team and Passivhaus Designer/Consultant on a periodic basis. For this reason, the site reports they produce are only a snapshot in time. The best site reports also record the lessons learned from the site visit so that they may be fed forward to subsequent phases of the project and for future projects.

don't

- **hope for the best**
- **fail to plan for success**
- **rely upon standard industry practice when planning construction programmes**
- **forget to undertake site inspections and feedback**

do

- **allow time for planning (it will pay back in the future)**
- **agree and undertake key stage design reviews with the Passivhaus Designer and Passivhaus Certifier**
- **train site operatives**
- **ensure that there is a dedicated, on-site Quality Assurance Champion**
- **remediate mistakes ASAP (when you still have the chance).**
- **adopt the Passivhaus Overlay for the RIBA Plan of Work**

CORE COMPONENTS OF A PASSIVHAUS PROJECT MANAGEMENT CHECKLIST

By failing to recognise the boundary between a certification process and the design and construction process, individual projects are at risk and may encounter difficulties. In part this may be because the industry has become used to certification systems that are less rigorous and have permitted this gap to go unobserved.

Listed below are the major components that are included on a Passivhaus Project Management checklist. Each component, and its constituent sub-components, should be coordinated with relevant BS EN standards. When a building is to be certified it is vital that this checklist is developed and agreed with an approved Passivhaus Certifier.

Photographic evidence of the construction should be gathered at key stages by appropriate members of the design and construction team. The Passivhaus Designer/Consultant should assist with agreeing the regime for compiling evidence, on a project specific basis.

TRAINING/TOOLBOX TALKS (PRE-START)

- Site storage
- Workmanship
- Activities to be undertaken
- Sequencing of activities

Ductwork protected from site debris during storage.

AIRTIGHTNESS – MATERIALS AND WORKMANSHIP

- Primary air barrier system
- Window installation
- Service penetrations

Air barrier installed in a manner that allows easy inspection and remediation during construction.

INSULATION INSTALLATION – MATERIALS AND WORKMANSHIP

- Walls, roof, floor, windows
- Junctions
- Services

Check construction tolerances. Insulation is encapsulated tightly between internal and external leaf to avoid thermal bypass.

SERVICES – MATERIALS AND WORKMANSHIP

- MVHR unit installation
- MVHR ductwork & silencers
- DHW
- Pipes and plumbing
- Heat sources
- Controls

Ductwork protected from site debris during installation.

WINDTIGHTNESS – MATERIALS AND WORKMANSHIP

- Primary wind barrier system
- Window installation
- Service penetrations

Wind barrier installed in a manner that allows easy inspection and remediation during construction.

BUILDERS' WORK

- Joinery (door over/undercuts etc)

Air transfer provision is checked against design drawings and specification.

CASE STUDY: Closeburn Passivhoos

Above and left: the completed homes. Images: Tom Manley Photography

Below: under construction. Image: John Gilbert Architects

These three homes at Castle Crescent, Closeburn are the first community-owned Passivhaus homes in Scotland. They are owned in perpetuity by the Closeburn community, via Nith Valley Leaf Trust, and rented to people with a local connection, on an affordable basis.

Closeburn Passivhaus was the first project to benefit from the development of a construction method designed to lower costs, improve quality, speed up construction on site, and to be replicable at scale. In summer 2019 the team of John Gilbert Architects and contractor Stewart and Shields worked together to build a full-size Passivhoos prototype in a factory unit in Port Glasgow. This allowed them to develop the stick built timber frame, test the sequence of construction and discuss further simplification of the airtightness layer. It was used to train all of Stewart and Shields apprentices and staff. Site meetings allowed the team to refine details to enable the houses to be built quicker and better on site.

The I-joist timber frame with airtight OSB internally was insulated with mineral wool plus 50mm of phenolic insulation board externally. Balloon frame construction avoided a thermal bridge at the first floor to external wall junction. The timber frame construction and timber cladding reduced embodied carbon of construction, and embodied carbon calculations measured progress in line with RIBA 2030 challenge targets. Tenants moved into their new homes in 2020, and Passivhaus certification followed a few months later.