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A Guide to Managing Safety-Critical Elements in Building Construction

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Foreword

Over recent years, following a series of major building failures culminating in the Grenfell Tower fire, significant concerns have been expressed by government, by members of the general public, and from within the industry itself, as to the consistent capability of the UK construction industry to deliver safe high-quality buildings. Whilst there are many examples of excellent practice in the industry, recent evidence has demonstrated a series of systemic weaknesses in relation to the structure of the industry, the competence of its workforce and its general approach to quality. Clients and members of the public should of course be able to rely on the consistent delivery of the required quality of all elements of construction, however, the immediate priority of the industry must be to focus on eliminating defects in those elements which have been seen as critical to the safety of users of buildings.

This Guide, jointly initiated by the CIOB and RIBA, has therefore been produced with the intention of increasing awareness across all sections of the industry of the need to bring a rigorous and structured approach to the design, construction and inspection of elements identified as potentially safety-critical. It promotes the development of a standard requirement and practice within the industry to provide appropriately certified recorded evidence of the full compliance of the installation of these elements both with the specified design and with all relevant statutory building regulations.

All those involved at any stage of the procurement, design and construction of buildings, from client to individual tradespersons on site, have a duty to ensure that each individual input contributes to the collaborative production of a safe and compliant installation that does not compromise the safety of future building users.

This Guide does not seek to address all elements of a building which, if defectively incorporated, could potentially cause injury to users but will focus particularly on those that recently have frequently been found to be defective and carry a high-risk to building users. In the following examples these defects are generally the result of inadequacies in the specification, design, installation and/or inspection;

- safe means of escape for occupants and access for fire-fighters together with associated materials, fixtures and fixings
- combustibility of cladding and insulating materials
- effective fire compartmentation including smoke control, firestopping, cavity-barriers and fire doors
- the structural integrity of masonry cladding panels and the proper incorporation of necessary brick accessories into them including fixings, bed-joint reinforcement, wind posts and ties
- the structural integrity of balconies

The manner in which current quality assurance processes are implemented in the industry has frequently been shown to be unreliable as proof of safe and compliant construction. There is an urgent need for the industry to invest in the development, and industry-wide application, of effective standardised safety and quality focussed installation, supervision, inspection and sign-off protocols, particularly in relation to the safety-critical elements identified in this Guide.

It is hoped that all parts of the industry will make use of this Guide, in applying immediate priority to addressing the need for assurance in relation to the safe and compliant construction and integration of all safety-critical elements. By successfully addressing these systemic issues, the industry would be taking a major step forward in both ensuring the safety of users in the buildings we produce and in restoring public confidence in our industry; an industry in which we can then all justifiably be proud to work.

Professor John Cole RIBA CBE

1. Purpose of this Guide.

1.1 The purpose of this Guide is to:

- identify Safety-Critical Elements in and around buildings
- outline systems that should be adopted to ensure that such Safety-Critical Elements are properly incorporated in the building.

1.2 The following definitions for a number of key terms have been used throughout this Guide:

- **Client**. The Client itself for the project or its agents or representatives.
- **Compliant**. Satisfying the requirements of the design and the building regulations.
- **CROSS**. Collaborative Reporting for Safer Structures UK - **www.cross-safety.org**.
- **Element**. Part of a building.
- **Evidence**. Information to be recorded and collected to prove that the construction complies with the design and specification. Evidence is subsequently to be incorporated in, or used to contribute towards the compilation of, the golden thread.
- **Guide**. This document.
- **Independent Inspection**. Rigorous scrutiny executed by a party that is not directly involved in the construction of the building.
- **Safety-Critical Element**. An Element, the failure, omission or incorrect installation of which, carries an unacceptable risk of causing a serious injury or fatality.

2. Scope of this Guide.

2.1 Many building Elements, if omitted, or incorrectly installed, have the potential to cause some harm. However, it is vital industry focuses its resources, on those key Elements, some of which are identified in this Guide, which should be designated as safety-critical.

2.2 Safety-Critical Elements identified are those that are considered to be of prime importance. The principles set out could be applied more widely than just to Safety-Critical Elements and readers are encouraged to think more broadly.

2.3 This Guide is applicable to all buildings.

2.4 This Guide does not cover temporary works. It focuses on actions or omissions before and during the construction of permanent works that could impact the safety of people in and around completed buildings.

3. Who should use this Guide?

3.1 Clients, their agents and those managing buildings.

3.2 Design teams (for example, architects, structural engineers, mechanical and electrical engineers, quantity surveyors, project managers, etc).

3.3 Clerks of works, building control bodies, competent persons.

3.4 Contractors and their site supervisors.

3.5 Specialist contractors responsible for specialist installations (for example façades, cladding systems, mechanical and electrical systems, fire stopping, structural steelwork, reinforced concrete, balconies, etc).

3.6 Product manufacturers (for example those producing resin anchors, cladding, pre-cast concrete, etc).

3.7 Educators who wish to equip students and other construction professionals with appropriate knowledge and upskilling.

3.8 Insurers.

4. How to apply this Guide. (also see appendix A and C)

4.1 Gain an understanding of the key principles that should apply to all construction and to Safety-Critical Elements in particular, by reading section 5.

4.2 Determine whether a part of a building is a Safety-Critical Element (not already covered by an industry established system) by applying the methodology set out in sections 7 and 8. Examples of how to do this are given in appendix B.

4.3 Decide what Evidence should be collected to prove Compliant construction of the Safety-Critical Element. Section 9 includes a list of typical items of Evidence. Appendix C gives a worked example.

4.4 Ensure that the key principles and processes are applied specifically to the Safety-Critical Element. See section 5 and appendices A and C.

4.5 Decide who should collect the Evidence. Appendix C gives a worked example.

4.6 Using a structured inspection plan, record, collect and circulate the Evidence. Appendix C gives a worked example.

4.7 Incorporate the Evidence in the golden thread. Appendix C gives a worked example.

5. The key principles and processes required to achieve Compliant construction.

5.1 This section provides a set of principles that should apply to all areas of construction but are of particular importance in relation to Safety-Critical Elements.

5.2 Clients should make sure that appointments for all design and construction teams specifically require, within the scope of duties of the appointee, the appropriate supervision, inspection, evidencing and sign-off of Compliant construction.

5.3 Before they are appointed, tenderers must be required to identify (in a way that can be measured) what resources they have allocated to these key activities.

5.4 Clients must require reports to be submitted at prescribed intervals by appointees to confirm the satisfactory undertaking and progress of these particular duties.

5.5 The nature, extent and form of Evidence that needs to be recorded and collected to prove Compliant construction must be specified in the tender documentation.

5.6 How information will be scheduled and incorporated into end users' systems must be defined in the tender documentation. Information must be fully accessible, readily understood and able to be managed and maintained by a building manager.

5.7 All information critical to the fire safety of people in and around the buildings should be specifically identified as such.

5.8 Before works commence, a clear and coherent process and inspection plan must be developed and be articulated to all involved in the project. The plan must, amongst other things:

- stipulate in advance of construction, the Evidence (see above) required. This is particularly important in areas that will be closed in
- identify who will be responsible for carrying out inspections and signing off all parts of the work that relate to any Safety-Critical Element
- include details of appropriate toolbox talks to be delivered to people just before they start work on or at interfaces with Safety-Critical Elements

5.9 The inspection plan must specifically identify the nature and amount of the planned resource. It must be sufficient to undertake the specified level of supervision and inspection.

5.10 Inspection, production of the specified Evidence, and sign-off, must be undertaken by named and appropriately qualified personnel at each level of the supply chain / construction team.

5.11 Sign-offs must be subject to monitoring, oversight and review by:

- senior personnel within construction companies
- other relevant members of the project team appointed with responsibility for seeing that the construction work is Compliant

- lead designer
- main contractor
- the Client

such that parties within each tier of the construction team each carry a degree of responsibility for the Compliant construction of the completed Element.

5.12 Design of any Element and the design of its interfaces with other elements must be complete and, where relevant, signed off prior to commencement of the construction of that Element.

5.13 No changes to the design or specification of the works are permitted without approval from the relevant designers, lead designers and the Client - and where appropriate, building control.

5.14 All current information relating to the design, specification and construction of any Element of the works must be issued in a timely manner to all relevant organisations and individuals involved in the project. This information normally comprises specification, drawings, details and manufacturer's instructions. Such information must be readily accessible to all operatives involved in the construction of that Element or involved in the construction of areas with which it interfaces.

5.15 All materials arriving on site must be examined and recorded as Compliant with the project specification prior to their incorporation into the works. Any concerns that such materials do not comply with regulatory requirements must also be recorded at that stage and passed on to the lead designer.

5.16 Prior to commencing work on site, the trade qualifications of all operatives must be checked and verified as appropriate for the element of work they are undertaking.

5.17 Safety-Critical Elements shall be subject to Independent Inspection.

5.18 Notwithstanding any Independent Inspection undertaken, all construction work, especially any work that will subsequently be closed in, must be:

- subject to detailed inspection and digital recording
- signed-off as approved by a responsible individual, competent to do so

5.19 Inspections should generally be undertaken during the course of the work and must not be left until the work is finished.

5.20 Standardised protocols should be established across the Industry for:

- the nature, form, regularity and extent of inspections
- the format of sign-offs and Evidence of Compliant construction required for Safety-Critical Elements

so that personnel moving from project to project and site to site undertake these critical activities in a consistent, structured and effective manner.

6. Industry Established Systems.

6.1 There may already be functioning and effectively applied systems in place that obviate the need for additional Independent Inspection of the installation of certain types of Elements. Examples are the following specialist single Elements:

- parts of electrical systems that are subject to testing such as fire, smoke and security alarms, emergency lighting, power and lighting systems
- sprinkler systems, excluding elements that provide physical support to them
- gas appliances and the pipework and infrastructure that serves them

6.2 However, there remains the existing requirement for those involved having appropriate accreditation and responsibility for the compilation of formally recorded Evidence of testing and certification within such systems.

6.3 It is essential that a comprehensive overall inspection is carried out prior to completion to ensure that the integration of such systems with other building elements, and any subsequent work in their vicinity, does not compromise the overall safety of the building to users.

7. Rationale used for designation of Safety-Critical Elements.

7.1 To be designated safety-critical in this Guide there must be an unacceptable risk that an Element that could fail, be installed incorrectly or be omitted, will cause serious injury or one or more fatalities. This is a qualitative assessment based upon experience. The use of numerical risk assessment procedures is not anticipated.

7.2 Users can apply this rationale to identify whether newly developed Elements or Elements that are not mentioned in this Guide are safety-critical.

7.3 The location of an Element and the consequences of its omission or failure will affect whether or not it is a Safety-Critical Element. It is possible that the same product may be a Safety-Critical Element in one context and not a Safety-Critical Element in another.

8. Examples of Elements that may be Safety-Critical Elements as defined in this Guide.

8.1 Elements that if they failed, were incorrectly installed or were missing, could impede escape from a building or accelerate spread of fire and smoke through the interior or up or around the exterior of a building.

- examples: fire breaks, cavity barriers, fire curtains, firestopping, fire doors, fire dampers, combustible materials used in the structure or as cladding systems, and any penetrations through or modifications to any of them

8.2 Fixings that prevent people falling or that secure items that themselves could fall from, blow off or cause collapse of a building.

- examples: guarding fixings, balcony fixings, restraint systems for maintenance, member connections in structural frameworks, wall ties, restraint ties, cladding fixings, fin fixings, brise soleil fixings, suspended ceiling fixings, fixings supporting services with fire-stopped penetrations through fire compartment walls, solar array mounts and adhesives

8.3 Elements that prevent instability or collapse.

- examples: certain reinforced concrete elements including reinforcement, tension rods and their connections, post-tensioning systems, beams and their supports including piers and posts, transfer structures, cantilevers, restraints to internal partitions, bed joint reinforcement, retaining systems

8.4 Elements that provide protection from, or could detrimentally interface with, hidden hazards.

- examples: radon barriers, gas-proof membranes that exclude harmful, explosive or flammable gases, underground elements such as foundations where they are close to cables, tunnels, cavities, gas mains or dangerous materials

8.5 Elements that provide protection from electrocution: however, please see section 6.

9. Evidence demonstrating Compliant construction.

9.1 The following are examples of Evidence that should be carefully recorded and collected to prove Compliant construction and subsequently be incorporated in, or used to contribute towards the compilation of, the golden thread. Not all of these examples will be relevant to every Safety-Critical Element:

- relevant parts of the specification used for the installation of the Element including its performance requirements and drawings marked to show where the Element(s) is/are installed
- manufacturer's instructions, packaging labels collected on site, product standard compliance details, product certificates, etc.
- purchase orders, invoices and delivery notes
- material inspection reports – for example, made when materials arrive on site
- records of installer/contractor personnel, including qualifications and experience
- details of benchmark samples or mock-ups prepared, together with approvals that they have been received
- reports on any initial briefing of the contractor/installer prior to construction of the relevant Element
- site works inspection reports
- uniquely numbered, dated and if necessary for identification purposes, geo-located, digital images and video logs. These are particularly important for elements that will be covered in (built into the building fabric and hidden from view)
- test results and their written interpretation
- reports from Independent Inspections (including third party installation certification schemes together with details of their accreditation)
- details of any future inspection and maintenance requirements for the Element
- sign-offs prepared by a designated individual confirming that, following inspection, the installation of the Safety-Critical Element has been found to be Compliant

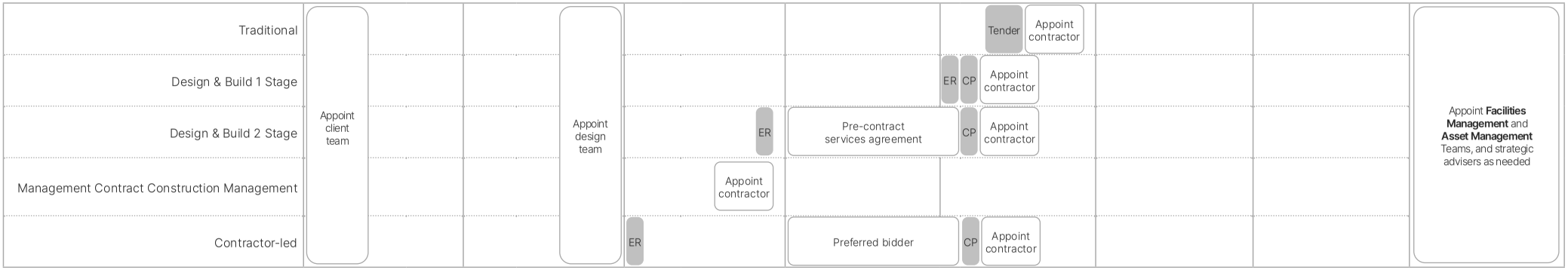
9.2 Where Evidence is to be obtained relating to Elements that are fixed many times in an identical fashion in a building, then an appropriate sample of the total number of fixed Elements should be inspected and reported upon. If fixing errors are identified in this sample then the sampling rate should be increased until fixing errors have been eradicated.

Appendices

Appendix A – Safety Critical Elements - Actions mapped to the RIBA Plan of Work 2020.

RIBA Plan of Work Safety Critical Elements Overlay	0 Strategic Definition	1 Preparing and Briefing	2 Concept Design	3 Spatial Coordination	4 Technical Design	5 Manufacturing & Construction	6 Handover	7 Use
Stage Outcomes (from 2020 edition)	The best means of achieving the Client Requirements confirmed *If the outcome determines that a building is the best means of achieving the Client Requirements, the client proceeds to Stage 1*	Project Brief approved by the client and confirmed that it can be accommodated on the site	Architectural Concept approved by the client and aligned to the Project Brief *The brief remains 'live' during Stage 2 and is derogated in response to the Architectural Concept*	Architectural and engineering information Spatially Coordinated	All design information required to manufacture and construct the project completed *Stage 4 will overlap with Stage 5 on most projects*	Manufacturing, construction and Commissioning completed *There is no design work in Stage 5 other than responding to Site Queries*	Building handed over, Aftercare initiated and Building Contract concluded	Building used, operated and maintained efficiently *Stage 7 starts concurrently with Stage 6 and lasts for the life of the building*
Safety-Critical Elements (SCE) Actions		Brief to stipulate that SCEs must be subject to independent inspection Consultant appointments to define responsibility for SCEs	Undertake review of SCEs as part of design risk assessment	Tender documents to define requirements for inspection and sign off of SCEs Tender documents to specify documentation required to evidence compliant construction Tenderers to evidence how they will achieve compliant construction	Design of SCEs to be checked to ensure accuracy and compliance with the relevant standards Any changes to design or specification of SCEs to be checked and approved	Prepare and agree plan for the supervision, inspection, sign-off and evidencing of compliant construction of SCEs Check that operatives working on SCEs are competent and qualified Carry out tool-box talks to communicate the plan to contractors, operatives. Record evidence of compliant construction Check that materials delivered to site meet the required specification and standards	Collate and issue evidence of compliant construction of SCEs in prescribed format	

Procurement Route



Appendix B – Examples of assessing whether an Element is a Safety-Critical Element.

B.1 Example 1 Cavity barrier in any location

Because a designer has specified it as part of a considered design, then it must be assumed that there would be a significant risk of a serious injury or fatality if it failed, was not present or was installed incorrectly and there was a fire. Therefore the cavity barrier is a Safety-Critical Element.

B.2 Example 2 All Elements that contribute towards fire and smoke compartmentation of a building

The compartmentation must be assumed to be part of a considered design, so there would be a significant risk of a serious injury or fatality if it was compromised by incorrect installation and there was a fire. Therefore the compartmentation in its totality is a Safety-Critical Element.

B.3 Example 3 A fixing securing a cladding panel to the exterior of a building 5m above external ground level

There would be a significant risk of a serious injury or fatality if it failed or was installed incorrectly. Therefore the fixing is a Safety-Critical Element.

B.4 Example 4 A masonry pier supporting beams that carry a one-storey masonry cavity wall over a domestic kitchen-diner

There would be a significant risk of a serious injury or fatality if it failed, was not present or was installed incorrectly. Therefore the masonry pier is a Safety-Critical Element.

B.5 Example 5 An in-situ reinforced concrete cantilever beam supporting a building façade

There would be a significant risk of a serious injury or fatality if it failed, was not present or was installed incorrectly. Therefore the in-situ reinforced concrete cantilever beam is a Safety-Critical Element.

B.6 Example 6 Wall ties and perimeter masonry restraints in a large external brick cavity wall panel

There would be a significant risk of a serious injury or fatality if they failed, were not present or were installed incorrectly. Therefore the wall ties and perimeter masonry restraints are Safety-Critical Elements.

B.7 Example 7 A membrane designed to exclude potentially explosive gases from a basement

There would be a significant risk of a serious injury or fatality if it failed, was not present or was installed incorrectly. Therefore the membrane is a Safety-Critical Element.

Appendix C – A worked example of the use of this Guide.

C.1 The Element being installed: cavity barriers in a 4-storey timber framed residential block

Using this Guide, designers determined that the Element was a Safety-Critical Element (see sections 7 and 8 and appendix B). Therefore the cavity barrier is a Safety-Critical Element.

C.2 Project inception

The Client, before appointing its team, stipulated to all interested parties that Safety-Critical Elements must be subject to Independent Inspection on this project. The design team was required to identify Safety-Critical Elements as the design progressed. They were also advised to consider what additional resource they might need should they be called upon to provide Independent Inspection of any of the Safety-Critical Elements.

C.3 Design

Design of the cavity barriers and their interfaces with the inner leaf, outer cladding, windows, cladding fixings, etc was completed by the project architect in close liaison with the selected cavity barrier manufacturer and was submitted for building regulation approval. The details were signed-off as Compliant by the relevant designers.

C.4 Tender - specification

This gave a specification (including product manufacturer) for the cavity barriers, fixing details including the manufacturer's instructions and layouts including elevations showing where they were to be incorporated in the building. It required the contractor to utilise the services of an installer approved by the manufacturer of the cavity barriers and required tenderers to include the services of a third party UKAS accredited installation certification scheme.

C.5 Tender – Evidence requirements

The tender also set out requirements for Evidence and that sufficient time should be allowed by installers to obtain this Evidence during installation, not afterwards. The Evidence to be submitted to the lead designer and main contractor, to prove Compliant construction and subsequently to be incorporated in the golden thread information concerning the building was set out as follows:

- Drawings marked to show where the Elements are installed
- Purchase orders, delivery notes and packaging labels collected on site
- Records of material inspection reports made when the Elements arrived on site
- A report on an initial meeting between the installer, the Third Party Installation Certification Scheme Operator (TPICSO), the cavity barrier manufacturer and the project architect prior to installation of the cavity barriers
- Records of installer's personnel, including qualifications and experience
- Site works inspection reports and sign-offs from the installation team and TPICSO
- Uniquely numbered, dated and if necessary for identification purposes, geo-located, digital images and video logs showing all of the cavity barriers before closing in

The tender also required the provision of information demonstrating the competence of the proposed cavity barrier installer, before the contract was awarded.

C.6 Tender action

The successful tenderer did not make any comment in their tender on the choice of cavity barriers. They confirmed that all related work would be undertaken by approved installers, how and when supervisory inspections would be undertaken and what evidence would be collected. They also confirmed that they had included for inspections and reports to be provided by a third party UKAS accredited installation certification scheme. They were appointed to construct the project.

C.7 Value engineering

The contractor wasn't used to working with the cavity barriers incorporated in the tender documents. The contractor normally used an alternative manufacturer of cavity barriers. The alternative cavity barriers were also cheaper than those named in the tender documents. The contractor asked the design team if they would sanction a change to this alternative manufacturer. The design team requested the following:

- Evidence demonstrating that the alternative manufacturer's product was equal or superior in all respects to the specified product
- Drawn details (of a quality similar to those already prepared) showing how the product would be fitted
- Details of the alternative product be carefully checked to ensure it would still interface appropriately with other elements of the building, and product details be submitted to building control and to the lead designer and Client to review and if appropriate, sign-off the change
- Confirmation that a four-week period (from receipt of all of the new details) required by the design team to undertake the necessary work would have no detrimental effect on the tender price or change to the project completion date

C.8 Inspection plan

After the choice of cavity barrier had been agreed and approved and before works commenced, the contractor, assisted by the approved installer, developed a clear inspection plan that was complemented by elevational drawings that were to be gradually colour coded as the installation progressed and was inspected. Details of this plan were circulated to the installer, the TPICSO, the main contractor's quality control team on site and the design team. All cavity barriers were to be inspected and photographed before being closed in.

C.9 Inspection by design team member

As an aside, a reinforced concrete cantilever had been identified by the design team as a Safety-Critical Element. The Client, as part of their appointment, commissioned the project structural engineer who designed the cantilever, to provide Independent Inspection. On a different project it could just as easily have been the main contractor appointing its own designers to carry out Independent Inspections of their own designs being built. This highlights the potential opportunity for designers to be commissioned to provide Independent Inspection, as they are often an available resource on projects.

C.10 Competence.

Well before construction of the cavity barriers started, in addition to the general health and safety qualifications required, the main contractor asked the approved installer to provide details of all operatives that would be involved in the installation of the cavity barriers, including their qualifications together with confirmation that they had appropriate training to be operating within the cavity barrier manufacturer's accredited installers' scheme.

C.11 Circulation of latest information

Two weeks before construction of the cavity barriers started, the main contractor circulated to the installer, the TPICSO, the main contractor's quality control team on site and the design team a set of all up-to-date documentation for the cavity barrier installation, including the manufacturer's instructions. This was provided as an electronic link that could be accessed using a mobile phone, tablet or PC.

C.12 Incoming materials inspection

The contractor had put in place a system whereby all materials arriving on site were examined and checked against the specification and drawings. If they matched then they were recorded as Compliant with the project specification. When the first batch of cavity barriers was delivered, the contractor's goods inward surveyor noticed that although the cavity barriers matched the specification, the specification did not identify their width but said "appropriate for the cavity width". In fact they were too narrow for the cavities into which they were being installed and therefore would not comply with the building regulations. A query was passed to the design team and the lead designer who agreed, and the project narrowly missed suffering a delay whilst the correctly sized cavity barriers were ordered.

C.13 Third party installation certification scheme operator (TPICSO)

The TPICSO met the main contractor, the installer, the cavity barrier manufacturer and the architect prior to installation of the cavity barriers.

- The TPICSO explained that initially, all cavity barriers must be inspected by its inspector prior to being closed in
- However, before undertaking a site inspection themselves, the specialist installer needed to undertake its own detailed check for Compliant construction and only then, when they had signed off that particular cavity barrier would the TPICSO carry out its inspection
- It was agreed that one operative and one supervisor from the specialist installers team would sign off each cavity barrier as work progressed
- The sign-off details from the installer needed to include uniquely numbered, dated and geo-located, digital images and video logs of each cavity barrier installed

C.14 Advice to operatives carrying out the installation

Just prior to the start of the cavity barrier installation, the main contractor set up a meeting with the operatives who would be installing the cavity barriers. They attended a toolbox talk on 'the dos and don'ts of cavity barrier installation' and were each given a card. The card said 'YOU WILL BE RESPONSIBLE FOR THE INSTALLATION OF A SAFETY-CRITICAL ITEM' and set out the evidence that the operatives needed to ensure was collected whilst they completed the task. It also set out 'hold points' where the operatives had to stop work until an inspection had been completed. Each operative had to sign for their card and keep it with them during the task.

C.15 Ongoing TPICSO inspections

- Once the TPICSO had personally reviewed around 10% of the cavity barriers to be installed, it reduced its frequency of inspection, however, still requiring the same evidence and sign-off from the installer
- Throughout the process, the TPICSO was sending reports to the main contractor and the lead designer, signing off the work that had been completed

C.16 Lead designer, main contractor

Both the lead designer and the main contractor were receiving and reviewing reports from the TPICSO, which gave them confidence that the cavity barriers were being installed correctly. Both saw some cavity barriers being installed during some of their periodic site visits.

C.17 Client

The Client's representative confirmed to the Client the details of spot checks that it was undertaking on site and ran through the results of checks that it had carried out to see that the level of supervision set out in the contract documents was being executed by both the design and the construction teams. The Client's representative also read reports provided by the TPICSO, which proved that the TPICSO was collecting comprehensive evidence concerning the cavity barrier installation at regular intervals. If there had been any doubt that any party was not delivering in accordance with the contract documents, then the Client's representative would have raised questions. However, that was not necessary on this project.

C.18 Incorporating the Evidence in the golden thread

On completion of the perimeter wall construction phase of the project the relevant designers reviewed the Evidence that had been submitted and were satisfied that reasonable measures had been taken to ensure that the cavity barriers had been correctly installed. The main contractor had drawn the same conclusion and the Evidence was added in readily accessible .pdf format to the golden thread information for the building, also being identified as 'critical to the fire safety of people in and around the building'.

Appendix D – Good practice.

D.1 Examples of installer certification schemes:

- Warringtonfire. warringtonfire.com/certification-services/fire-certification/firas
- IFC. ifccertification.com/certification/installer-certification.html
- BRE. bregroup.com/services/certification-and-listings/
- BM TRADA. bmtrada.com/certification-services/

D.2 Firestopping of service penetrations - best practice in design and installation Finishes and Interiors Sector Limited (FIS) 2020

- https://www.thefis.org/membership-hub/publications/best-practice-guides/firestopping-of-service-penetrations/

D.3 Association for Specialist Fire Protection (ASFP) 'Colour Books'

Guides on active fire curtains, fire resisting ductwork, fire dampers, coatings, fire resisting partitions, fire stopping, fire protection of structural steel, https://asfp.org.uk/page/Publicationslist

D.4 Quality Planning for Micro and Small and Medium Sized Enterprises

Technical Information Sheet, CIOB 2022 https://www.ciobacademy.org/product/quality-planning-for-micro-and-small-to-medium-sized-enterprises/

D.5 CIRIA C778 2019 Management of safety-critical fixings

Item Detail (ciria.org) (free to download)

D.6 The Construction Fixings Association (CFA)

https://www.the-cfa.co.uk

D.7 BS 8539:2012+A1:2021

Code of practice for the selection and installation of post-installed anchors in concrete and masonry

Appendix E – Consequences of Safety-Critical Element failure.

Figure 1. Incorrectly fixed cavity wall ties and omission of lateral restraint fixings.

Figure 2. Fire stopping / compartmentation omitted.

Figure 3. Inadequate fixings. Picture credit: West Midlands Ambulance Service

Figure 4. Inferior materials. Photo credit: **Yankeepapa13/CC BY-SA 4.0**

Notes

Notes

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