Department for Education

Older Buildings Research Programme

A study into post-war buildings in the education estate

July 2026

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Executive summary

With over 22,000 schools and colleges in England, the education estate includes almost 70,000 buildings and supports over 10 million children, young people and adult learners. In late 2024, DfE commissioned the Older Buildings Research programme (the research programme) which aimed to improve DfE's knowledge about education buildings from the post-war period (1945-1990) and potential structural issues that may arise as they age.

DfE procured a multidisciplinary consortium combining expertise in engineering, surveying, academic research, data science and analytical skills to deliver a research programme which included:

- An academic literature review and desk review
- Conceptual modelling
- A fieldwork programme in a targeted sample to gather information about relevant visual indicators of potential structural deterioration, characteristics and evidence of structural deterioration ('parameters')
- Data extraction from a wide range of reports to gather information about relevant parameters from a wider sample of education settings
- Analysis of data and fieldwork findings to identify the trends about structural issues in the post-war education estate

During the post-war period, new approaches to construction were introduced and innovative materials and construction methods were used. Improved understanding of buildings constructed during this period will help DfE to target resources most effectively and support Responsible Bodies to manage and maintain these buildings.

The research found that the strongest factor affecting the condition of structural elements is expected to be maintenance history, irrespective of the structural materials or arrangements. The structural integrity of buildings was generally better than anticipated from the visual indicators of deterioration to structural elements such as water ingress and condition issues. No construction materials or structural arrangements previously unknown to DfE were found. No new building safety risks associated with the materials or structural arrangements studied were found. While some post-war building designs are more susceptible to deterioration and require proactive management and maintenance, the most important factor affecting structural condition is expected to be maintenance.

The Education Estates Strategy sets out how we will support all Responsible Bodies to proactively manage their estates effectively through clear standards, making it easier for Responsible Bodies to access guidance, tools and information; and supporting them to collect estates data and adopt digital tools. Responsible Bodies' understanding their buildings and how to maintain them is key to delivering a high-quality estate and preventing issues materialising that can disrupt education. We will also continue to collect information, commission and undertake research into the structure of buildings across the estate so that we can continue to target resources at settings in the most need.

Glossary

The table below gives definitions of terms that are used frequently in this report.

Term	Definition
Building structure	Load bearing elements that transfer gravity and horizontal forces applied to the buildings to ground. Includes: suspended roof and floor structure, ground bearing floor structures, beams, columns, walls and foundations/footings. These are most likely to be concrete, steel, timber or load bearing masonry.
CDC	Condition Data Collection – a programme funded by DfE to visit every government-funded school in England to collect data about the condition of their buildings. The CDC1 programme ran between 2017 and 2019, and a successor CDC2 programme ran between 2021 and 2026.
Characteristic	Property of a building or block that is fixed. These can pertain to specific block features, such as pitched versus flat roofs, or broader setting-related factors like geographic location or age.
Design life	The period a building or place is expected to remain functional, durable, and fit for purpose, as determined through its design, materials, and construction.
Education estate	Schools and colleges funded by DfE
Education settings	A collective term for school and college buildings in the education estate
Existing DfE data	CDC reports, Responsible Body report (including condition surveys, structural surveys, surveys of specific features such as roofs), programme bids, RAAC surveys
FE CDC	Further Education Condition Data Collection – a programme funded by DfE to visit every government-funded further education (FE) college in England to collect data about the condition of their buildings.
Industrialised construction	A prefabricated, system-based approach to building that uses standardised components and innovative techniques to reduce construction time and material costs, commonly associated with post-war “system-built” developments.

Term	Definition
In-situ concrete	Concrete that is formed and poured in its final position within the building (on site), rather than being prefabricated and assembled.
Parameter	Collective term for characteristic, indicator or issue
Precast concrete	Concrete elements manufactured in advance (typically off-site) and then assembled as part of a building system.
Responsible Body	Responsible Body is a term used to refer to those responsible for the oversight and management of the school and college estate, alongside individual schools. There are approximately 2,800 Responsible Bodies for schools and colleges. These include: • multi-academy trusts • single academy trusts • local authorities • voluntary-aided school bodies • church trustees (including dioceses) • non-maintained special schools and • FE and sixth-form college corporations For a full definition of Responsible Body see Annex C in the Education Estate Strategy.
Rationalised traditional construction	A hybrid building method that combines traditional and non-traditional construction techniques to speed up the building process
Structural deterioration	An adverse change in the condition of a building’s structure (including footings, foundations, structural portions of load bearing walls, structural floors and subfloors, primary roof structure, lift shafts, and structural columns and beams) that which reduces its strength, stability, or ability to perform as intended.
System build	A non-traditional building method that uses industrialised prefabricated components and modular construction methods.

Term	Definition
Traditional construction	Traditional non-industrialised building methods, including steel/concrete/timber frame and masonry.
Visual indicator	A visible condition indicating the possibility of structural deterioration materialising or being present.

Background

Introduction to the estate

With over 22,000 schools and colleges, and almost 70,000 buildings across England, the education estate supports the outcomes, health and wellbeing of over 10 million children, young people and adult learners. It is essential that the education estate is safe, suitable, sustainable and sufficiently sized so that it can support opportunity for all learners, from early years to post-16.

Whilst the government has overall stewardship of the education estate through programmes, funding and guidance, the management and ownership of the estate is complicated with approximately 2,800 Responsible Bodies. Responsible Body is a term used to refer to those responsible for managing school and college estates. Responsible Bodies have the local knowledge of their estates and play a key role in managing their estates including conducting regular inspections and maintenance to ensure safety compliance is maintained.

School and college buildings vary significantly. The Condition Data Collection 1 (CDC1) programme which ran between 2017 and 2019 showed that there is large variation in the condition of the estate across the country. DfE is currently analysing updated data as part of Condition Data Collection 2 (CDC2) which will conclude later this year. Preliminary findings show that while there has been improvement in individual buildings, schools and colleges, there has been continuing deterioration in the overall condition of the estate.

Schools and colleges built during the post-war period represent a significant proportion of the estate. Based on CDC analysis, 43% of the school estate by size and 30% of the college estate were built between 1940 and 1980, and many[1] of these post-war buildings 'system-built' blocks constructed between 1940 and 1980 which are now beyond their estimated initial design life.

During the post-war period, new approaches to construction were introduced using industrialised prefabricated components and modular construction methods, known as 'system builds'. Immediately after World War II there was an urgent need for school building as part of the reconstruction activities and to accommodate a growing school age population due to increased birth rate and the raising of the school leaving age. To meet this need, a range of innovative, and sometimes untested prefabrication structural components and arrangements were brought to the market. Some of these were developed by groups of local authorities who formed 'consortia' while others were developed by private bodies. The benefits of these systems were that they would

[1] Based on analysis of Condition Data Collection 1 and data from Condition Data Collection 2 for over 90% of schools using an estimate of the cost of returning construction types identified during Condition Data Collection 2 visits to a good condition grade.

improve cost and programme efficiency and could use unskilled labour to erect buildings on site more quickly.

While buildings with these structural components and arrangements continue to perform adequately in the majority of cases, they require increased maintenance to keep them in good condition.

DfE recently published an Education Estates Strategy which sets out how we can achieve an education estate that supports opportunity for all through a shift to more proactive management, long-term strategic maintenance and renewal of the existing estate. This is alongside building and rebuilding where renewal is not possible, and in the local areas where it is needed. Ensuring that education is safe is a key strategic principle embedded in the strategy.

Background to the research

In 2023, DfE set out to undertake a programme of structural surveys in 200 schools to improve its understanding of the common structural components and arrangements in the education estate and to horizon scan for future safety issues that may present themselves as the estate continues to age. The challenges of commissioning intrusive structural inspections centrally and significant advances in artificial intelligence led DfE to reassess the methodology and commission a research programme including more limited intrusive surveys augmented with information extracted using AI from DfE held reports. The research collected more limited direct evidence from intrusive surveys augmented with information about a wide range of education settings from existing sources. The methodology for the research programme is described in more detail later in this report.

The programme was designed to complement DfE's Condition Data Collection programme which provides a consistent evidence base about the condition of buildings across the education estate. However, the CDC surveys are not invasive - only visible condition is inspected. Nor are they intended to replace more specialist structural surveys.

Scope, outcomes and limitations

Aims

The project's aims were to:

- improve DfE's knowledge about the structural arrangements and components used in the post-war education estate.
- establish the potential extent and severity of any structural safety risks posed by these structural arrangements and components.
- identify whether future changes in environmental conditions were likely to alter the severity of any potential structural safety risk that were identified.

The project's outcomes will support delivery of the Education Estates Strategy. DfE will use findings from the project to:

Manage the estate

- improve its guidance to Responsible Bodies who are responsible for managing post-war buildings.
- identify building characteristics that should be recorded by Responsible Bodies as part of pilots in 2026-27 to test the approach of Responsible Bodies collecting their own data and using digital tools in line with common standards before national rollout planned from autumn 2027.

Improve and renew the estate

- support delivery of condition programmes, helping to ensure that investment is prioritised appropriately

Build and rebuild the estate

- support decisions when selecting settings for programmes, ensuring selection criteria are based on rigorous technical evidence

Limitations

The size and complexity of the education estate means it has not been possible to investigate all post-war structural arrangements and components in the programme. It is the role of Responsible Bodies to ensure their buildings are maintained so they can operate safely. DfE provided all settings where fieldwork was carried out with the survey findings for them to consider in their future maintenance[2]. The programme was designed to give a broad overview of the estate, rather than to identify building specific issues.

To get a statistically significant sample of all post-war buildings would have required survey works in at least 4,000 buildings. This would have been disproportionately costly and disruptive.

Other key limitations of the research include:

- All survey works were carried out in accordance with DfE's guidance on asbestos management. The findings of the research do not have any impact on this guidance which will be unchanged.
- The research examined buildings at a point in time. As set out later, further systematic data collection and analysis is required to determine a building's performance over time.
- The research drew from data previously held by DfE (for example technical reports and applications to capital programmes) and information gathered during the study rather than a random sample of buildings. The reports varied in purpose and scope and did not all include structural information relating to the whole building. Reports and information held by Responsible Bodies may hold further insight into the estate.
- The extraction from reports did not differentiate between levels of severity. Structural deterioration could therefore cover a spectrum of condition from early signs of deterioration to more advanced changes in the condition of structural elements.

[2] At the time of publication, a small number of non-intrusive surveys are completing final quality assurance checks before being shared with schools.

Methodology

General approach

To meet the objectives and aims of the Older Buildings Research, the research programme needed to develop a detailed understanding of a large and highly complex estate. Traditional methods used by structural engineers to investigate buildings using surveys and laboratory testing would give information on specific settings. However, findings from one setting could not simply be applied elsewhere in the estate. To establish an understanding across the wider estate, the research needed to augment individual survey and test results.

The programme designers drew a parallel between this challenge and that in soil mechanics of establishing ground conditions in large earthworks such as railway embankments. In these cases, soil testing at discrete locations can be carried out, however, there can never be sufficient testing to determine ground characteristics at all points along the embankment. Similarly, when assessing structural issues across the education estate, although surveys and material tests can be carried out at individual education settings, surveys and tests at buildings with all structural arrangements and components is not feasible. In both cases, available test data must be extrapolated to understand the characteristics and issues more widely.

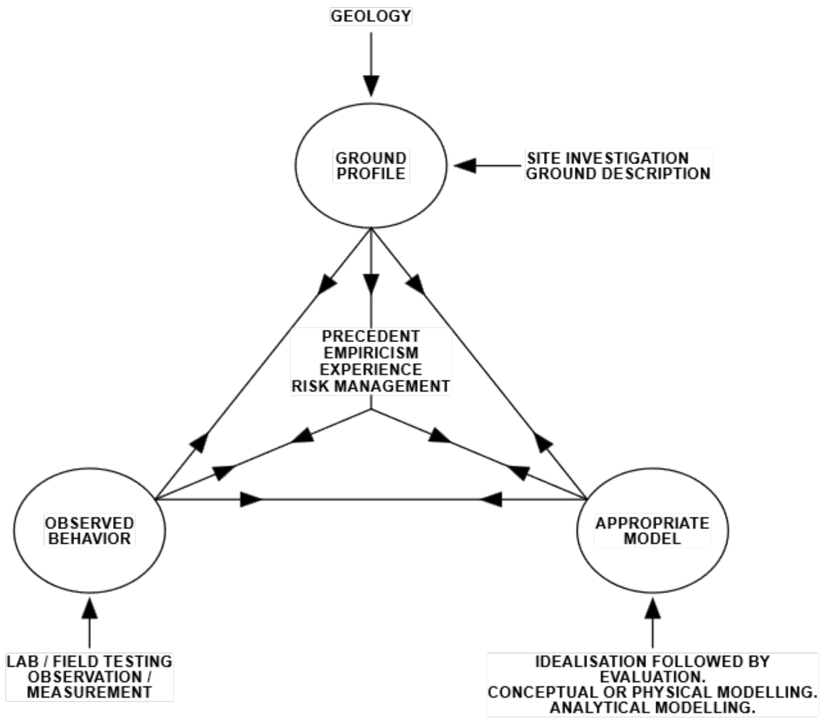
The research methodology therefore adopted the principles of soil mechanics investigations, specifically, the model posited by Professor Burland in 1987 that was later adapted in 2008. The model, known as the “Geotechnical Triangle” sets out four “distinct but interlinked” considerations. These are:

- Understanding the ground profile.
- Measuring or observing the behaviour of the ground.
- Predicting behaviours
- Applying judgment based on precedent (also referred to as “well-winnowed experience”)

Importantly, these four considerations are all interlinked, rather than being linear, as shown in Figure 1.

These four considerations provide the building blocks for ground investigation, and soil mechanics in general. They were considered appropriate in the design of this research programme given the similarities around scale and variability described above. The table below sets out how key parts of the research programme were analogous to Burland's considerations above.

Figure 1: Burland Triangle – Principles of Assessment



Comparing key stages in Burland methodology with key activities in Older Building Research project

Burland consideration	Equivalent older buildings activity
Understand the ground profile	A desktop study and literature review to identify common structural materials, arrangements and identify what data is required to improve understanding of whether these may have particular characteristics and visual indicators that affect the structural performance of a building, and where physical testing is required to collect this data, a conceptual model
The measured or observed behaviour of the ground.	Undertake a fieldwork investigation programme designed to understand the link between visual indicators, characteristics and evidence of structural deterioration in buildings, and to identify issues which require further investigation
Analytical prediction using appropriate models.	LLM extraction and analysis to identify trends in existing data already held by DfE by turning previous reports into structured data
Well-winnowed experience	Apply existing knowledge of issues in the estate and engineering judgement to test trends and fieldwork findings

Desk study, literature review and conceptual model

The research consortium used their engineering experience and knowledge of the education estate to establish an initial list of parameters that may affect the structural performance of a building. These parameters included:

- Building characteristics
- Visual indicators of possible structural deterioration
- Direct evidence of deterioration of structural elements

Engineers completed a desk study of available literature to identify the predominant structural arrangements and components used in the post-war period including system builds and industrialised component parts (rationalised traditional construction) used in the education estate. The literature covered:

- reliability theory
- descriptions of different system-builds and industrialised products used in DfE estate, in other sectors and other countries
- mechanisms of deterioration of existing structures
- anticipated changes in loading of structures due to climate change.

For the most common types of system build, the available construction drawings were reviewed, and the areas that appeared to present a greater likelihood of structural deterioration were identified.

From this literature review, visual indicators of possible structural deterioration and key building characteristics across the estate were identified. They were reviewed against the original list of parameters to assess their significance. The research then decided whether site-based fieldwork would be required to collect information about the indicators and characteristics or if information could be obtained from existing data. Quantitative analysis was used to evaluate the prevalence of the shortlisted parameters within existing DfE data.

Fieldwork selection

The research programme designed a fieldwork programme to establish evidence of deterioration at a given block and where possible, to correlate these issues with the blocks, characteristics and visual indicators (see above).

Testing the strength of the correlation between visual indicators and evidence of structural deterioration would help determine how far these visual indicators could be used to establish the likelihood of structural deterioration in other locations without the need for intrusive works. The fieldwork would also provide rich data on the nature and condition of structural materials and construction types to identify materials or structural arrangements used in the post-war estate which may be particularly susceptible to deterioration.

The research programme selected a targeted sample of fieldwork blocks to cover a range of building characteristics and to target blocks where a relatively high number of visual indicators were understood to be present. Fieldwork would test whether those visual indicators reliably indicated the presence of related structural issues. Blocks were selected based on a desk review of data held by DfE and the Responsible Body; and included a selection of blocks scheduled for demolition under the Schools Rebuilding Programme (SRP).

Fieldwork delivery

The research programme designed a programme of tests for each education setting. Tests were informed by desk studies and scoping visits. The research programme then commissioned surveys to understand the location of any materials containing asbestos. Final decisions about where to open up and carry out tests were informed by the asbestos results to ensure opening up was completed in accordance with DfE's guidance on asbestos management.

To minimise any disruption to the schools' operation, contractors completed the structural surveys during school holidays. Where tests were required, this included opening up to expose the structure and making good after the tests were complete. Test results from the surveys, including off site tests, were then analysed (see Analysis and Findings below).

Report extraction and analysis

DfE holds a significant volume of unstructured data relating to the characteristics, visual and structural condition of education settings, including survey reports and application evidence. To translate these reports into a structured format which could be analysed, the research programme developed and tested Large Language Model (LLM) prompts using GPT-4. Structured information relating to a range of building characteristics, visual indicators and deterioration of structural elements organised by block was extracted. Data from different reports relating to the same block was merged. The dataset was then combined with climate data and CDC data about building characteristics. This dataset gave access to structural information about a much wider set of education settings than we could have surveyed directly. The data was analysed to identify trends to look for linkages between characteristics, visual indicators and evidence of structural deterioration (see data extraction findings below).

Analysis and findings

Desk study and literature review

Construction types

The desk study reviewed existing literature to determine common construction materials and structural arrangements used in post-war education buildings. Based on the literature, buildings could be defined as being in one of three categories:

- System builds
- Rationalised traditional construction (RTC)
- Traditionally constructed buildings

The desk study primarily focused on system build and rationalised traditional construction because:

- The bespoke design of system-build means their behaviour and vulnerabilities are less well understood than the other construction types listed
- System-builds and forms of RTC were designed using innovative arrangements that were sometimes untested
- System builds were often developed for the education estate, so are less well covered by wider research into historic construction. For example, extensive research already exists on buildings using traditional construction arrangements and materials, the findings of which are common across different building uses.
- Should any design issues in system builds or RTC be identified, they would be repeated across many buildings and therefore would therefore pose a greater risk in the estate

Causes of structural deterioration

The desk study set out to identify causes of structural deterioration, using the concept of reliability theory as a starting point. In structural engineering, reliability theory is used as a measure of the loads applied to a structure compared to the structure's ability to resist these loads. The structure can become distressed as the loads approach the resistance and if loads exceed resistance, failure will occur.

To identify potential reasons for distress, the desk study therefore looked for ways in which either:

- load applied to the structure increases
- resistance of the structure decreases

Load increase

In a well-managed building, where the use of spaces does not change significantly, the maximum loads applied by either by the building components[3], or the occupants and fixtures[4] do not vary significantly. For example, even if the subject being taught in a classroom changes, the maximum weight of occupants and fittings is broadly similar. The 'dead loads' and 'live loads' that a building should be designed to are set out in design codes of practice for many years. Therefore, except for changes in use, it's unlikely that these loads will increase during a building's life. Where there is a significant change in the use of a space, e.g. a classroom becomes a storeroom or photovoltaic panels are installed on a roof, then more consideration is required as the loads applied may increase. 'Change of use' became a parameter that was investigated as part of the LLM extraction process and fieldwork to see if there were any links with structural deterioration.

One area where changes in load can be expected is where environmental conditions alter, for example changes in wind and snow loads or thermal effects. The short-term nature of the study mean that longitudinal data could not be recorded over time. However, as climatic conditions vary across England, comparing parameters between similar buildings in different locations may demonstrate their response to different environmental conditions. Third party climatic data was used to identify whether there were links between particular climate conditions and evidence of structural deterioration. Analysis confirmed previously understood principles that high numbers of days with high rainfall, high numbers of cold days (below 4 degrees) and/or fewer hot days (above 26 degrees) make deterioration of structural elements more likely.

Resistance decrease

The causes of decrease in the resistance to loads are more varied and were a greater focus of the desk study. They include deterioration of structural elements due to weathering and corrosion and unplanned or undesigned alterations to the structure (for example, forming openings in walls without advice from a qualified engineer). Resistance decrease is closely linked to the maintenance history of a building. One of the research programme's aims was to identify if there were any materials or structural arrangements which were particularly susceptible to such deterioration.

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[3] Known in structural engineering as 'dead loads' or 'permanent actions'.
[4] Known as 'live loads' or 'variable actions'.

Building parameters

Having identified the buildings to focus on and the principles that cause structural deterioration, the research team sought to identify which parameters of a building may be the most significant contributors to structural deterioration. These fell into three categories:

- Building characteristics
- Visual indicators of possible structural deterioration
- Direct evidence of deterioration of structural elements

Based on the literature review, and through workshops a list of parameters was created. Using the amended Burland principles above, the fieldwork programme and data extraction process were then designed to investigate the significance of these parameters to establish their significance on the integrity of the building and their ability to indicate whether structural issues may be present in other buildings.

The list of building parameters investigated through fieldwork and extracted from existing data are listed in Annex A.

Large Language Model (LLM) extraction

As described above, data regarding the presence of structural deterioration, building characteristics and visual indicators of structural deterioration was extracted from building reports and combined with characteristics information from CDC and climate data. See Annex A for a list of the parameters extracted from the reports.

The reports used for the extraction were all held by Responsible Bodies of the settings covered. They were often commissioned by Responsible Bodies as part of their ongoing maintenance programme[5]. It is the role of Responsible Bodies to ensure their buildings are maintained so they can operate safely, including reviewing the information they hold to determine appropriate maintenance actions.

The extraction of data from the reports did not differentiate between levels of severity. Structural deterioration could therefore cover a spectrum of from early stages to more advanced changes in the condition of structural elements. The extraction and analysis was designed to give a broad overview of the estate, rather than to identify building specific issues.

[5] The reports were provided to DfE by Responsible Bodies or in the case of RAAC survey reports, shared with Responsible Bodies.

Trends in the data

Within the dataset, water related visual indicators were the most widespread. These included: water ingress; weatherproofing damage to the roof; damage to rainwater goods; ponding on the roof; and weather proofing damage to the external façade. Evidence of structural deterioration was identified in a relatively small number of the overall sample.

The visual indicators were present in both blocks with structural deterioration and without. It is therefore difficult to use the presence of visual indicators alone to predict whether structural deterioration has occurred.

However, analysis looking at the relationship between several characteristics, indicators, climate conditions and structural deterioration was used to confirm some high-level trends. These trends are in line with engineering expectations and reinforce some well understood principles.

Concrete material degradation (concrete spalling; cracking to concrete structural elements; and reinforcement corrosion) was more likely to occur in buildings:

- Constructed in the earlier post-war period than those in the later post-war period
- In multistorey buildings than single storey buildings
- In regions with higher numbers of days with high rainfall
- In regions with higher numbers of low temperature days (below 4 degrees) and lower number of high temperature days (above 26 degrees)

Steel corrosion to the structural elements was more likely to occur in buildings:

- In regions with higher numbers of days with high rainfall
- In regions with higher numbers of low temperature days and lower number of high temperature days

The likelihood of specific types of structural deterioration was understandably closely correlated to the construction material used in the structural elements (e.g. concrete spalling, cracking and reinforcement corrosion was more likely to occur in concrete framed buildings). Understanding what the building components are made of is an important element of understanding how they will behave over time.

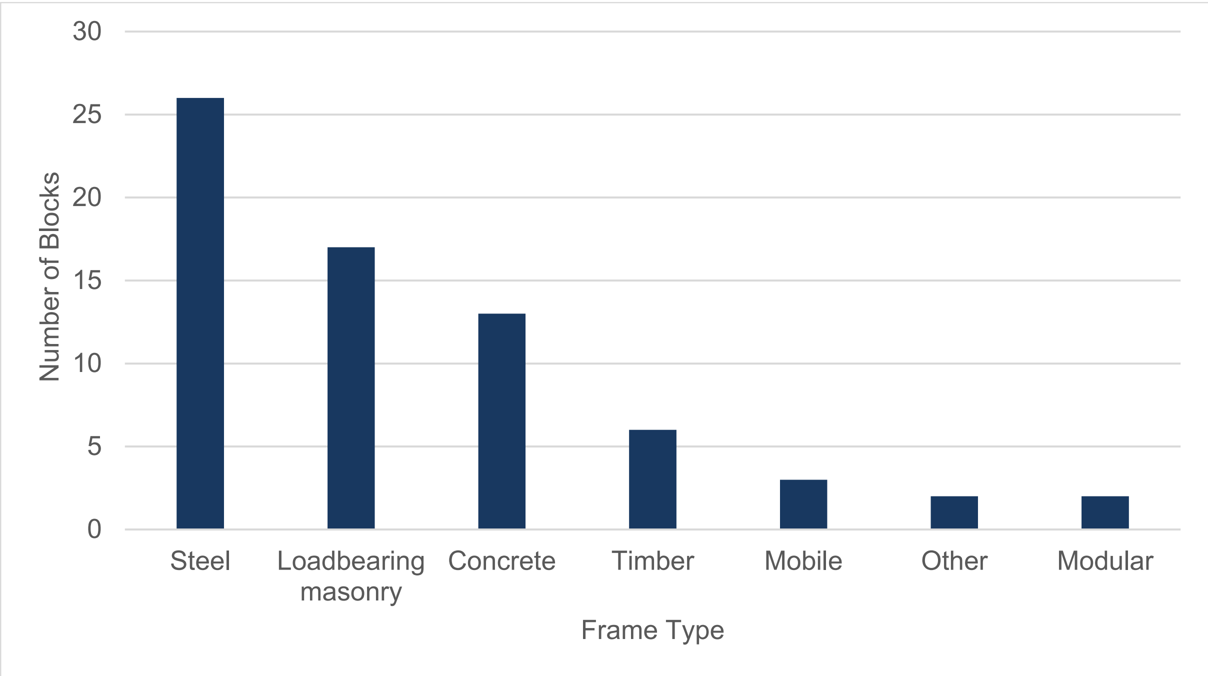
Fieldwork

The research team designed a programme of fieldwork to establish the significance of the building parameters identified during the desk study. A range of survey techniques were used, including qualitative visual assessment, dimensional surveys, material sampling and laboratory testing.

The programme comprised surveys of 70 teaching blocks across 62 settings. In total, over 190 tests across more than 340 locations were carried out.

The fieldwork blocks included a range of primary structural frame types:

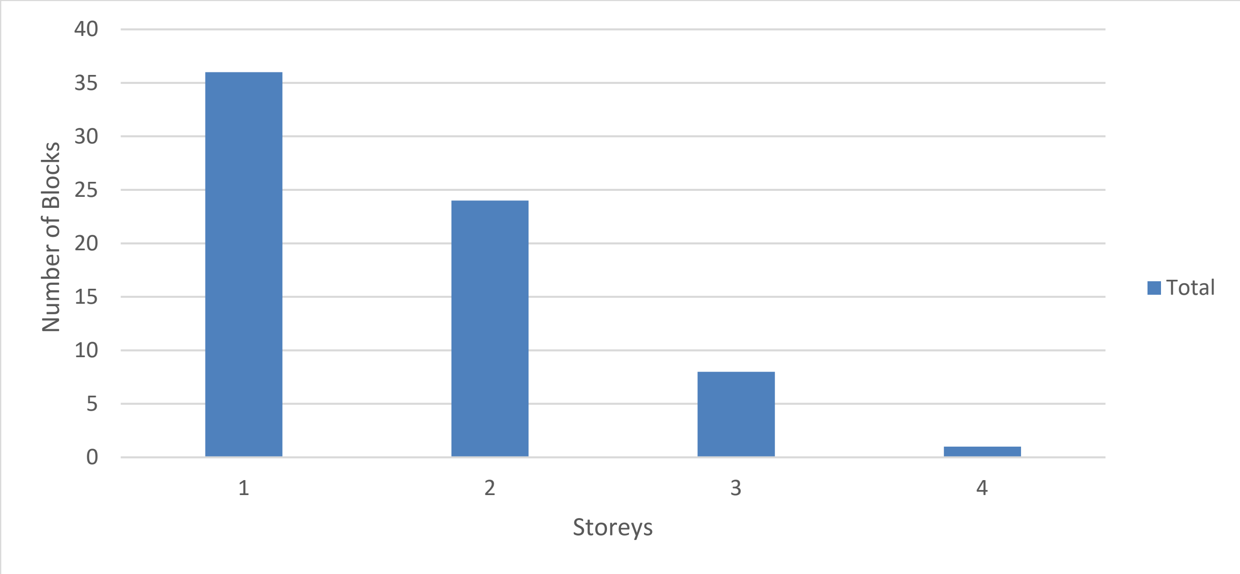
Figure 2: Bar chart showing number of fieldwork blocks with primary structural frame types based on CDC data



Of 70 blocks, 40 were system blocks including CLASP (steel frame) and SCOLA (steel frame), Derwent (timber frame) and Lancashire Heavy (concrete frame), based on engineering assessments of available evidence.

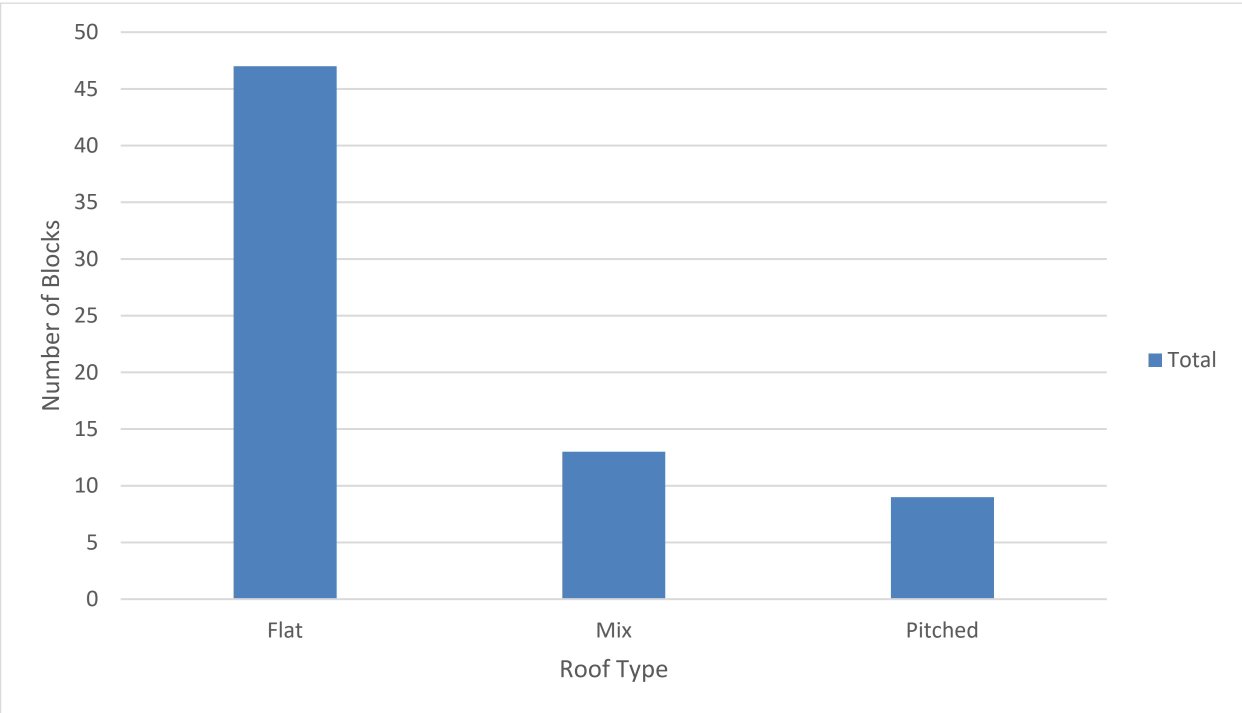
Like much of the school estate, most blocks in the sample were one or two storeys in height.

Figure 3: Bar chart showing number of fieldwork blocks by number of storeys, based on CDC data



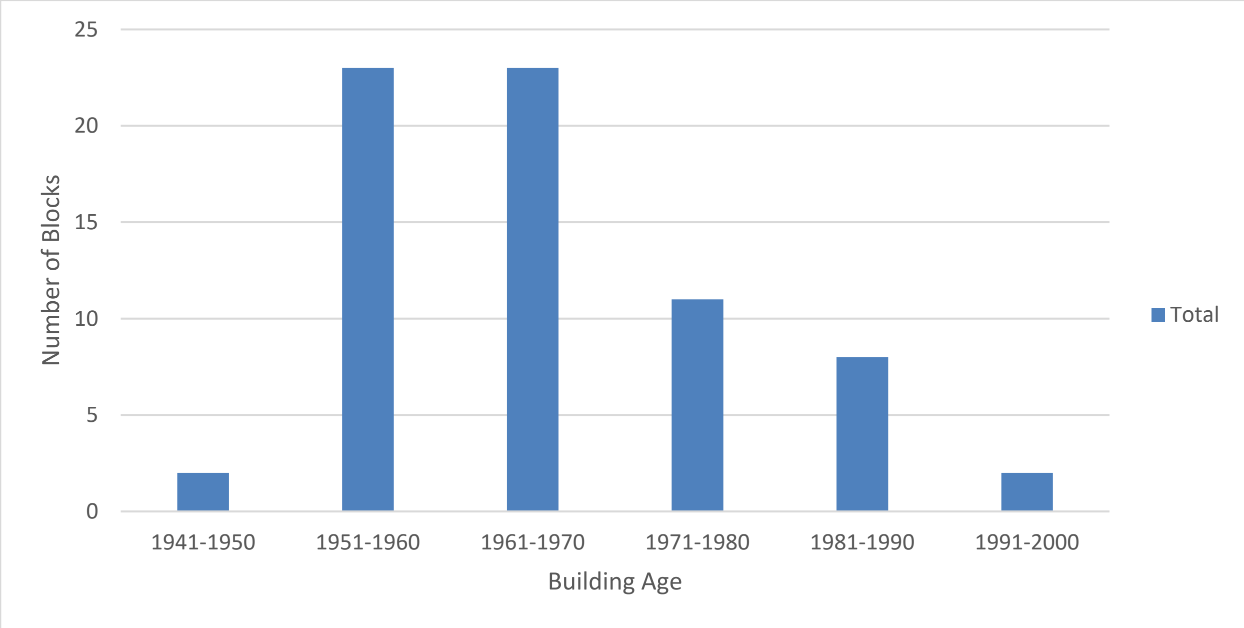
The overwhelming majority of blocks surveyed had a flat roof.

Figure 4: Bar chart showing number of fieldwork blocks with flat roof, mixed roof and pitched roof, based on CDC data.



Based on CDC data, the majority of blocks dated from the 1950s and 60s, with comparatively few from the 1970s and 1980s. This may be a consequence of selection based on condition.

Figure 5: Bar chart showing number of fieldwork blocks by decade of construction, based on CDC data.



Within the roofs, the most common material encountered was woodwool. Other roof constructions included conventional timber joisted roofs, timber ply web, concrete slabs and a high-density cement board better known as Tonkindek. 53% of the blocks were single stories. Upper floors in multistorey blocks were constructed from a range of materials including pre-cast concrete planks, timber, and in-situ concrete.

Key findings from the fieldwork

The key findings of the fieldwork aligned with the findings from the LLM analysis, these were:

- Finding 1: The structural integrity of buildings was generally better than anticipated from the presence of visual indicators such as water ingress
- Finding 2: The strongest factor affecting the condition of structural elements is expected to be maintenance history, irrespective of the structural materials or arrangements
- Finding 3: No construction materials or structural arrangements previously unknown to DfE were found. No new building safety risks associated with the materials or structural arrangements studies were found
- Finding 4: Some post-war building designs are more susceptible to deterioration and require proactive management and maintenance

Finding 1: The structural integrity of buildings surveyed in the fieldwork was generally better than anticipated from the information reviewed during fieldwork selection

Buildings were selected for fieldwork based on observations recorded in the reports held on record. The programme prioritised those which upon review of DfE and Responsible Body held data, had a high number of visual indicators and might therefore be expected to be in the worst condition or to have structural deterioration to maximise the value of each building being surveyed. However, although condition issues were present in the finishes (e.g. ceilings tiles and floor or wall coverings), once these were removed, the structure was found to be in a condition expected for its age.

During the selection process, evidence of water ingress was particularly common. However, the hypothesis that structural deterioration would be present in the majority of these cases was disproven during fieldwork. Steelwork corrosion, where present in structural elements was generally limited to being on the surface, rather than having affected the structural integrity of the building.

The reasons for this were not immediately clear, however it may be because water ingress takes place over a short period of time (e.g. during poor weather), resulting in extensive staining and damage to internal finishes but the structure is not saturated for a long period so is not severely affected. Or it may be that the water ingress prompted the Responsible Bodies to make repairs.

Instances where water ingress had led to more extensive deterioration were generally limited to the base of vertical structure (columns) where they meet the ground floor slab. This is thought to be because water has been trapped in external walls and falling, under gravity, from wherever it has entered[6]. By contrast, although the LLM review showed an overwhelming number of issues with the coverings and weatherproofing of flat roofs, the underlying structure in those tested during fieldwork was not in an unexpectedly poor state. This is possibly because ventilation around the roof structure allows the elements to dry, before long term damage occurs.

Finding 2: The strongest factor affecting the condition of structural elements is expected to be maintenance history, irrespective of the structural materials or arrangements.

The most significant factors affecting a building's condition are its:

- use (in this case as a school or college)

[6] DfE provided all settings where fieldwork was carried out with the survey findings for them to consider in their future maintenance. Where deterioration was most extensive, actions had been or were taken by Responsible Bodies to address this. At the time of publication, a small number of non-intrusive surveys are completing final quality assurance checks before being shared with schools.

- construction types (materials and arrangements and common construction defects for a given construction type)
- environmental factors (for example, rainfall, prevalent wind direction)
- maintenance history.

The study has controlled for use by focusing on education settings only. Throughout the fieldwork, and in the LLM analysis, there were very few significant trends between evidence of structural deterioration and building characteristics or location. This leads to a conclusion that the maintenance history, which is unique to a setting irrespective of construction type or location, is the strongest indicator of whether structural deterioration is likely.

As described above, evidence of water ingress was widely present in buildings in the fieldwork sample and LLM analysis. While this did not always directly correlate with structural deterioration, there was plenty of evidence that structural elements had been affected by water. As described previously, post-war construction used innovative and sometimes untested structural materials and arrangements. The short supply and expense of materials in the post-war period meant that structural elements were working at high utilisation. In rare, innovate construction arrangements, there is the potential for small amounts of corrosion due to water ingress to significantly affect a structure's ability to resist the loads applied to it. However, no instances of such corrosion were identified during the research. Nevertheless, this emphasises the importance of Responsible Bodies commissioning regular condition surveys, and where issues are identified, to ensure the appropriate steps are taken to maintain their buildings to protect and prevent deterioration of structural elements.

Finding 3: No construction materials or structural arrangements previously unknown to DfE were found. No new building safety risks associated with the materials or structural arrangements studies were found.

The primary structural material recorded in the existing reports was used as one criterion to select buildings for fieldwork. In some cases, there was no record of the construction materials for the floors or roofs. This information is not routinely collected by CDC as it is a visual, non-intrusive survey and other reports that were available may not have recorded it. Nevertheless, during the fieldwork no new construction materials or structural arrangements were identified that DfE was not aware of. Similarly, during the fieldwork no new building safety risks were identified that DfE was previously unaware are of. This demonstrates that DfE's existing processes for horizon scanning for emerging risks are working well.

The previously known structural arrangements with associated structural risks encountered during fieldwork were:

<u>Proprietary timber 'ply web' components</u>

These were found in one setting. As already set out in DfE's Managing Older Buildings guidance these components are commonly found in post-war construction and were a predecessor to engineered timber joists used in construction today. Glue and / or nails are used to join the elements together. It is important that bearing details and splices are regularly inspected for signs of water ingress and that flat roofs are well maintained, e.g. roof finishes are regularly repaired and gutters regularly cleared to ensure that rainwater can drain freely so the likelihood of water ingress, which would affect the glued and nailed joints is minimised.

Large Panel Systems (LPS)

There are extremely few LPS buildings in the school estate, however one was included in the fieldwork to understand whether there were any issues evident. The survey work that was undertaken found no signs of distress or deterioration. As with all buildings of this age, it is important that they are maintained well and that buildings are managed carefully. The known issues with LPS buildings relate to the 1968 explosion and partial collapse of Ronan Point in Newham and subsequent changes to the Building Regulations in 1970. These changes incorporate the concept of robustness, whereby structures much include measures so that an accidental even does not cause disproportionate damage to the building.

Finding 4: Some post-war building designs are more susceptible to deterioration and require proactive management and maintenance

The fieldwork encountered buildings with design details that by modern standards and code requirements make them more susceptible to deterioration of the structure without proper maintenance and management. These included:

- Detailing in cladding that was prone to trapping water within a small, poorly ventilated spaces, enabling more deterioration to occur
- Roof trusses with upturned channels that would tend to capture leaking water rather than allow it to drip away freely.
- Roof steelwork which was continuous between the internal environment and external roof overhangs which may cause warm, moist indoor air to condense on the cold steel surfaces and gradually cause deterioration

It is essential that Responsible Bodies regularly monitor their post-war buildings and take steps to effectively maintain them.

As described above, buildings constructed before 1970 post-war designs, did not require the principles of structural robustness to be considered. Whilst not an explicit requirement, many building from this period will inherently meet robustness requirements due to their size and construction type. There is no requirement for education buildings constructed prior to 1970 to be upgraded to meet current requirements.

All aging buildings require careful monitoring and maintenance, particularly where robustness principles may not have been adopted, this includes frequent inspection of their buildings as part of ongoing maintenance maintained effectively. Effective risk management should also be used to minimise both the likelihood and consequence of accidental damage to the building. Advice for this will be included in the updated Managing Older Buildings as described in Conclusions and next steps.

Conclusions and next steps

Importance of Responsible Bodies understanding their buildings

Responsible Bodies are responsible for the safe operation of their buildings. Understanding what the building components are made of, their construction design and subsequent alterations is fundamental to this. We will update guidance to support Responsible Bodies understand their buildings. This includes updates to DfE's Managing Older Buildings guidance to:

- emphasise the importance of Responsible Bodies understanding what their buildings are made of. This should include holding historical records such as construction drawings and records of works and alterations; photographic records, regular condition surveys; and structural assessments where appropriate.
- expand on common post-war system builds to include SCOLA buildings
- expand on common construction types to include:
    - Tonkindek, a composite concrete roof material found in Cornwall
    - additional advice on folded plate timber ply roofs
    - historic design practices that should be considered during maintenance (specifically structural robustness and overloading)

In Autumn 2026, Responsible Bodies for all schools in the education estate will be asked to complete their first annual return on how they are meeting the School Estate Management Standards. This annual return will prompt Responsible Bodies to review whether they hold and commission the information required to understand their buildings, including regular condition surveys and structural assessments where appropriate.

Data and digital transformation to expand structural data collection

As set out in the Education Estates Strategy, we will support Responsible Bodies to collect data on their estates with the ambition for all Responsible Bodies to be collecting and sharing data by 2029-30. To build a more complete understanding of the structural condition of the education estate, DfE will explore collecting more data about the structure of education settings. We expect to test through pilots in 2026-27 Responsible Bodies collecting and reporting data that includes, where feasible, limited structural information.

As set out in the Education Estates Strategy we will introduce two-way data sharing by 2028 providing both Responsible Bodies and DfE better insights on the estate. We will support Responsible Bodies to share information from condition surveys and structural assessments they commission. This will support DfE to continue to better understand the range of construction types and components in the education estate; and the prevalence and significance of different structural issues. DfE will continue to explore the use of LLMs alongside machine learning to support our understanding of structural deterioration and the factors affecting this. Responsible bodies remain responsible for maintaining and ensuring their buildings are safe and should act or seek further advice about issues raised by their own surveys and assessments.

Continuing fieldwork

We will pilot carrying out surveys of buildings that are due to be demolished. Prior to demolition, finishings are typically removed to expose the structure of the building, providing an ideal opportunity to learn about the structure without disruption to an operational school. Depending on the results of the pilot, we will look to introduce pre-demolition surveys in blocks being demolished as part of SRP.

Targeting of resources to buildings with highest structural need

As set out in the Education Estates Strategy, we will select a further 250 schools and sixth form colleges for the School Rebuilding Programme by early 2027. Places will be prioritised for schools and sixth-form colleges in the worst condition and in the local areas where places are needed now and in the future. Selection is based on the condition need of the buildings, with priority given to those with structural risks and issues.

As we continue to collect more consistent, longitudinal and comprehensive data about the structural condition of the education estate we will continue to develop our analysis to help target resources most efficiently to the buildings with the highest need.

Annex A – Building parameters recorded

The list below are the parameters that were recorded through LLM extraction and from the settings visited during the fieldwork programme

- Basement (presence of)
- Block Age
- Ground floor construction materials
- Roof construction material (i.e. the roof 'deck' rather than a description of the insulation and waterproof covering)
- Upper (suspended) floor construction material
- Evidence of cracking or spalling
- Evidence of damage to rainwater goods (gutters etc.)
- Evidence of damage to weatherproofing
- Evidence of deterioration to steelwork (e.g. damage to coverings, corrosion
- Evidence of historic structural movement, including due to subsidence
- Evidence of ponding on roofs
- Evidence of timber decay (i.e. rot)
- Evidence of water ingress and leaking pipes
- External cladding material
- Historic changes in use
- Historic flooding
- Horizontal stability system
- Primary structural frame material
- Number of stories (maximum on per block)
- Cavity walls – presence of
- Presence of types of concrete prone to deterioration (e.g. carbonation, high alumina cement, alkali silica reaction)
- Previous structural alterations, including the addition of new floors and previous remediation
- Roof form (flat / pitched)
- System build construction
- Type of foundation
- Use of beam and block construction
- Use of precast concrete elements
- Use of timber roof trusses

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