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Risk Topic – September 2023

Managing Risks from Reinforced Autoclaved Aerated Concrete (RAAC) in Buildings

Recent events have highlighted the significant risks associated with RAAC presence in buildings. RAAC building products were installed in many public and commercial premises in the UK between the 1950s and 1990s, with a predicted lifespan of 30 years. It means that the products are now beyond their indicated in-service lifespan. There is real concern that failure to take effective steps to prevent or mitigate RAAC risks is liable to result in serious risk to life and business interruption. People responsible for building safety are being urged to act now to prevent RAAC-related incidents within their portfolio.

This risk insight aims to summarise current advice for building owners, managers, surveyors, and other property professionals responsible for safety within buildings that may contain RAAC. This advice has been developed with reference to guidance issued by the Institution of Structural Engineers Study Group and RAAC studies published by the Collaborative Reporting for Safer Structures UK (CROSS-UK)[1]. Links to further sources of guidance and information are also provided throughout this document.

Use of RAAC

RAAC was commonly used in roof panels in flat roofs and pre-cast wall panel construction and can be found in many hospital, industrial and educational buildings in the UK., Ireland and Europe. It has also been used in Australia, New Zealand and South Africa. The product was used for its lightweight, thermal, fire and mould-resistant properties, and the addition of steel reinforcement bars allowed for construction of larger structural building elements. RAAC was also supplied in the form of lightweight modular blocks.

The product is similar in appearance to concrete and is also known under several common proprietary brand names such as ‘Siporex’, ‘Durox’, ‘Celcon’, ‘Hebel’ or ‘Ytong’.

Sometimes described as a ‘foamed mortar’, it is much less dense than concrete and, shown in cross section, has an aerated appearance (sometimes likened to an Aero chocolate bar) due to the hydrogen gas bubbles formed by the chemical reaction between aluminium powder, lime and water. During production, the foaming process causes the volume of the product to significantly increase. The gas bubbles in the product then evaporate, and heat/pressure curing is applied to the mixture to complete the process. The resulting product is a much lighter weight alternative to concrete.

However, RAAC **does not** have the same structural strength of concrete, and recent failures have highlighted the urgent need to address collapse risk associated with the use of these building materials. RAAC should not be confused with aerated autoclaved concrete (or ‘AAC’) which is still in use in the construction trade today. AAC is used as a lightweight, eco-friendly building material which provides insulation (for example, to inner skin walls), and fire- and mould-resistance, minus steel reinforcement bars.

Recent Cases

Earlier this summer, the Department for Education (DfE) initially ordered four schools to close due to RAAC in their ceilings. This follows previous warnings of potential failure, including a case of sudden partial collapse of a classroom roof in Gravesend, Kent in 2018 which occurred on the weekend when fortunately, no one was present in the room. Since then, the DfE has closed more school buildings, resulting in disruption to the education sector. The Standing Committee on Structural Safety (SCOSS) has compiled several reports of issues with RAAC in other types of premises which have not resulted in failure but contained sufficiently problematic defects to warrant further action[2]. Press coverage of RAAC has highlighted widespread prevalence of RAAC across the public and private sectors, with reports of hospital buildings with roof support struts due to RAAC since at least 2021. It is now known presence in many public and private buildings, including well-known sites in the UK.

Although a current high-profile issue, RAAC is not a new problem and many safety alerts and reports have already been issued by various government offices and industry bodies over the years to highlight the risks[4] [5] [6] [7].

Common Issues

Due to safety concerns, production of RAAC in the UK. was discontinued in 1982. To date, failures have mainly occurred in roof planks, although defects identified in wall panels and floor planks indicate that similar failures are possible. RAAC products may be affected by variation in manufacturing quality as well as factors affecting degradation of the performance of RAAC over time. Described as a 'postcode lottery' with no certainty without investigation as to whether a building may contain RAAC, it is critical that there is good awareness of RAAC, and the risk of structural failure in affected buildings.

Unlike concrete, RAAC is more liable to break under compression, has much higher deflection rates and the reinforcement bars may corrode due to ingress of water to the product. To enhance protection of the bars against corrosion, a bituminous or cement latex coating was added. However, the coatings are also liable to fail over time. Corrosion may also occur in the absence of degradation of the bituminous coating. Due to the significant deflection possible in RAAC, certain conditions may lead to water affecting the product. For example, bowing of the roof surface may result in water ponding which in turn may increase the net roof load and deterioration of the roof membrane. Any resulting water penetration may cause corrosion of the steel rods.

RAAC does not readily adhere to the reinforcement rods which means that spalling and cracking of the planks is very likely, which is liable to compromise the strength of the product.

It is important to note that, although there may be key warning signs of RAAC deterioration (such as deflection or cracking), sudden unexpected failure is also possible.

Risk-based Approach

It is important that customers take a proportionate, risk-based approach when determining how best to identify and manage RAAC in their buildings. By carrying out data-led risk analysis, clients can be reassured about accurate identification of RAAC in affected buildings, accounting for risk factors such as building age, type (e.g. school or health premises), structural data, as well as timeline, type and locations of building works.

Identifying RAAC

Firstly, confirm whether the building portfolio includes premises (or parts of premises) constructed during the predominant period of RAAC installation in the UK (i.e., typically 1950 –

1990s, although be aware that RAAC has been identified in building construction materials as early as 1930s). This may be done by checking original building designs and drawings (where available), as these may indicate use of RAAC and the locations. Similarly, where building or refurbishment work has been carried out, it is advisable to consult building plans as well as the Planning Portal for projects that required regulatory approval.

Then, establish the extent of RAAC presence within buildings of relevant age.

Some RAAC planks may be covered by suspended ceilings. Where it is safe to do so, ceilings should be opened up to check for RAAC. However, methods of inspection involving disruption of building materials liable to damage or disturb RAAC should be avoided.

Managing the Risks

If RAAC is confirmed, it will be necessary to carry out a risk assessment of the building and its use. The RAAC assessment should determine the risk priorities and remedial action to be taken, where necessary.

Estates guidance[8] has been published by the Department for Education to assist local authorities, governing bodies, trusts and others responsible for education establishments with the assessment, management, and remediation of RAAC. The Local Government Association (LGA) has also published advice on steps to take as part of reassurance measures to confirm the ongoing safety of buildings with RAAC[9].

RAAC assessments should be carried out by qualified personnel such as chartered structural engineers with relevant experience in the investigation and assessment of reinforced concrete structures. For help in RAAC assessments, some IStructE Chartered and Incorporated Members can assist with assessing your structure and RAAC risk management solutions, but you should confirm they have the necessary competence with RAAC before proceeding. A competent structural engineer/surveyor will be able to determine an appropriate inspection frequency following the initial assessment. A RAAC register should be established as part of a RAAC management plan, listing the location and condition of all RAAC material in the building.

The management plan should include regular monitoring of the building and RAAC condition as an essential part of the safety regime. **Maintenance and inspection regimes** will need to be regularly reviewed. Any reduced maintenance (e.g. due to budget cuts) is a particular red flag where RAAC is concerned, and checks should determine whether there may be any significant impact on building safety due to changes in building upkeep programmes.

As part of the building inspections, regular visual checks should aim to identify signs of common defects (see further below).

Good roof practices should be adopted which may be confirmed by suitable inspection regimes. The LGA recommends that these include, for example:

- Checks to ensure free drainage of water from the roof areas
- For internal surfaces, use of breathable paints to allow moisture evaporation from the products
- For external surfaces, coatings that provide a moisture barrier to protect the product from water penetration
- Minimising roof loads where possible
- Maintaining the condition of roof membranes to prevent water ingress.

Where building works are planned or have been completed, check that the roof loads are not increased as a result.

Any addition of roof plant should be carefully assessed against the risk of increasing loading and strain on RAAC roof materials.

In the unfortunate event of an incident, there will undoubtedly be a focus by regulators and insurers on what was known at the time of, and prior to, any failure of RAAC. Therefore, records should be kept of all inspection findings, remedial action plans and any corrective action taken.

In some cases, the costs of repair bills have been significant, with one school trust reporting £1.9 million in costs for the school to safely remain open[11]. Responsible persons will need to ensure that sufficient funds are available to cover the cost associated with managing RAAC. The UK government has indicated that funding will be available to cover the cost of any temporary closure of school sites but there is currently no similar provision for other types of buildings, or those sites that can be repaired without closure.

Identifying Defects

The Royal Institution of Chartered Surveyors (RICS) has identified several types of defects that may be cause for concern[12]. These include:

- Signs of strain on the product such as cracking, or transverse cracking (i.e. extending perpendicular to the reinforcement)
- Any deflection greater than 1/100th of the span
- Bearing widths of less than 40mm
- A ≥20mm deflection difference between adjacent planks
- Previous or current roof water leaks
- Water ponding on roofs
- Signs of reinforcement corrosion (note: these may not always be visible)
- Changes in roof covering affecting loading or roof temperatures
- Lack of tension reinforcement that extends to plank ends (which may otherwise lead to sagging)

In some cases, laboratory analysis of planks may be necessary to identify the material composition and extent of carbonation which may lead to cracking. An expert surveyor will be able to confirm whether this is required as part of the condition assessment.

Some planks may be hidden behind suspended ceilings. Although mostly used on flat roofs, they have also been identified in pitched or sloping roofs. It may be possible to detect any exposed RAAC plank/panel ends, but don't make assumptions.

Defect Reporting

Contingency plans should be put in place where material defects may result in the need to close any part of the building. The decision to shut premises (or parts of premises) must be balanced against consideration of the particular use of the building and any other risks to persons that may be introduced through closure, such as may be the case in critical care wards in hospitals. In many cases, initial precautionary closure may be appropriate pending further detailed investigations. Taking a risk-based approach will help ensure that all risk factors are given due consideration. Speak to your underwriter if further guidance is required.

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Conclusion

Zurich provides employer's and public liability insurance for a significant number of customers who may be affected by RAAC liability exposures in their portfolios. The claims landscape does not currently reflect the full extent of the issue, and whilst injury from RAAC risks has been avoided to date, analysis of cases of RAAC failure indicates that inaction is only likely to see further incidence and increased costs associated with claims. There is also emerging evidence of significant risks of unexpected failure and thus it is imperative that proactive steps are taken to understand the RAAC risk profile of buildings to manage them effectively.

Zurich Resilience Solutions can help by:

- Providing general Built Environment Asset Management Liability Reviews for policy holders and non-policy holders
- Reviewing Building Inspection Regimes to identify liability exposures and improvements
- Providing risk insights and assurance
- Training for clients in Claims Defensibility and/or Inspection Regimes

References

1. Collaborative Reporting for Safer Structures UK (CROSS-UK) (cross-safety.org)
2. Failure of reinforced autoclaved aerated concrete (RAAC) planks (cross-safety.org)
3. Condition of school buildings - National Audit Office (NAO) report
4. Defence Infrastructure Organisation (2019)
5. Structural Safety Information and Reports | CROSS UK (cross-safety.org)
6. IP 10/96 Reinforced autoclaved aerated concrete planks designed before 1980, BRE - Publication Index | NBS (thenbs.com)
7. Office of Government Property: RAAC Safety Briefing Notice | Local Government Association
8. Reinforced autoclaved aerated concrete: identification guidance (publishing.service.gov.uk)
9. Information on Reinforced Autoclaved Aerated Concrete (RAAC) | Local Government Association
10. Reinforced Autoclaved Aerated Concrete planks - The Institution of Structural Engineers (istructe.org)
11. RAAC: Schools forced to close due to concrete ceilings (schoolsweek.co.uk)
12. Identifying problematic RAAC planks | Journals | RICS

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