REFINFORCED AUTOCLAVED AERATED CONCRETE (RAAC)
BRITISH ASSOCATION OF REINFORCEMENT GUIDANCE NOTE: SEPTEMBER 2023

INTRODUCTION

There is increasing concern over the structural stability and safety of Reinforced Autoclaved Aerated Concrete (RAAC). The Government has ordered over 100 schools to immediately shut buildings made with aerated concrete until inspection checks and safety work is undertaken.

RAAC is an aerated lightweight cementitious material with no coarse aggregate – a key ingredient for concrete. It is aerated using chemicals to create gas bubbles. This means that the material properties, strength and structural behaviour differ significantly from 'traditional' reinforced concrete. Indeed, the Standing Committee on Structural Safety (SCOSS) notes that: "Although called 'concrete', RAAC is very different from traditional concrete, and, because of the way in which it was made, is much weaker."

Aerated lightweight concrete

Schools, hospitals and various other public buildings from the 1950s to the mid-1990s were built using RAAC. It was withdrawn from British design standards in 2001 and is not included within current UK and European specification standards for concrete. Concern over potential structural problems resulted from the sudden partial collapse of a school roof in Kent in 2018. In May 2019 a SCOSS Alert, 'Failure of Reinforced Autoclaved Aerated Concrete (RAAC) Planks', recommended that pre-1980 RAAC planks are past their expected service life and consideration should be given to their replacement. In September 2022, the Office of Government Property sent a 'Safety Briefing Notice' to all Property Leaders, regarding the dangers of RAAC, stating that 'RAAC is now life-expired and liable to collapse'.

A 2023 National Audit Office (NAO) report found that the concrete had been confirmed in at least 65 schools in England after 196 completed surveys, with 24 requiring emergency action. According to the NAO, 24,000 school buildings - more than a third of schools in England - are past their estimated design lifespan. The number of schools at risk is expected to increase significantly when the results of surveys of 572 schools with suspected RAAC are completed by the Department of Education **(**DoE).

Meanwhile, some 22 NHS bodies have reported a significant amount of RAAC in their estates and the NHS plans to replace its seven most-affected buildings by 2030 through the New Hospital Programme.

RAAC DIFFERS FROM REINFORCED CONCRETE

Although also classified as a concrete and is visually similar, RAAC panels differ from traditional reinforced concrete structures in a number of ways:

- The concrete material is aerated giving it the benefit of being considerably lighter than traditional concrete. Typically, aerated concrete has a density of 600-800kg/ m^3 compared to 2400kg/m^3 for traditional concrete. The aerated nature and reduced density influences reduces compressive strength to typically, in the range of 2-5N/mm^2. This is much lower than traditional concrete.

- Flexural, shear, and tensile strengths are also similarly reduced compared with traditional concrete.

- Due to the aerated nature of the material, it will not form adequate bond strength with the reinforcement. The reinforcement within is also smooth and not ribbed. Tensile forces are therefore predominantly transferred to the reinforcement via transverse reinforcement bars being welded to the longitudinal reinforcement with bars over the bearings of the panels for end anchorage. The position and effectiveness of the transverse reinforcement over the bearing is critical to the shear capacity of the panels at their bearings.

- Unlike reinforced concrete, the aerated material is highly permeable. As a result, cover to the reinforcement does not protect against environmental conditions as with traditional concrete and the cover zone can be expected to be highly carbonated.

- The aerated nature and lack of coarse aggregate means that the elasticity and creep characteristics of AAC are substantially inferior to traditional concrete. This can have a detrimental impact on long term deflections of the RAAC panels.

Research from Loughborough University warns that it is RAAC from the 1950s, 60s and 70s that is of main concern, especially if it has not been adequately maintained. The research found RAAC examples where with bearings

(supports) which are not big enough or the steel reinforcement is in the wrong place. Both of these issues can have structural implications. Prolonged water ingress (not uncommon on old flat roofs) can also lead to deterioration. The research concluded that RAAC is still manufactured and installed all over the world and can be an appropriate construction material if properly designed, manufactured, installed, and maintained. Unfortunately, the current situation underlines that proper ongoing maintenance is often not the case for RAAC panels constructed in the 1950s, 60s and 70s.

Loughborough University is currently working the RAAC Study Group of the Institution of Structural Engineers (ISE) to provide updated RAAC guidance. Until then, ISE have established key actions for building owners/ managers:

- **Identification**
  Not all buildings built between 1960 to mid-90s will have RAAC. It is therefore important to establish if RAAC panels are present. Identification can be undertaken by an experienced estate/ maintenance manager/ or building owner together with a structural engineer.

- **Assessment** – Once it has been established that RAAC has been used, the building will need to be assessed to understand what, if any, risk there is and if any immediate temporary remedial work is required.

- **Solutions** - Competent structural engineers will need to evaluate all the information (which will include a detailed site inspection) and propose any necessary remedial or replacement works.

CONCLUSION

It is important to note that RAAC buildings are no more dangerous than any other building that has not been properly constructed or maintained. A key problem is that RAAC panels are often used for flat roofs, which if not maintained will become porous and leak. Water gets in and corrodes the steel reinforcement.

Similar problems will exist for steel, timber and other roof material types. All materials deteriorate much more quickly if installation or maintenance are inadequate. It is also important to note, that RAAC is not the same as traditional reinforced concrete. The composition of RAAC is very different and its 30-year design life is significantly less than reinforced concrete.

FURTHER READING

1. IP 10/96 - Reinforced autoclaved aerated concrete planks designed before 1980, BRE, 1999
2. SCOSS Alert – Failure of reinforced autoclaved aerated concrete (RAAC) planks, 2019
3. IP 7/02 - Reinforced autoclaved aerated concrete planks - test results, assessment and design, BRE, 2002
4. BS EN 12602 Prefabricated reinforced components of Autoclaved Aerated Concrete, BSI, 2016
5. Office of Government Property, RAAC safety briefing notice, 2022
6. Institution of Structural Engineers, Reinforced Autoclaved Aerated Concrete (RAAC) investigation and assessment – further guidance, ISE, 2023
7. Department of Education, Reinforced Autoclaved Aerated Concrete (RAAC): Identification guidance, 2023
8. NHS media fact sheet 01.09.2023, RAAC in the NHS, healthmedia.blog.gov.uk, 2023
9. National Audit Office, Condition of school buildings, 2023

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