

## Why are concrete schools crumbling in the UK – and what can be done?

**Researchers say safety concerns over RAAC concrete in UK schools could be “the tip of the iceberg”.**

More than 100 schools and public buildings in the United Kingdom are facing closure because of reinforced autoclaved aerated concrete (RAAC), a building material used extensively throughout the country and in many others between the 1950s and 1990s.

*Nature* spoke to researchers about why the building material is causing safety concerns, and how they can be addressed.

### What is RAAC?

RAAC is a type of concrete, invented in the 1930s, that was used widely in the decades after the Second World War. Made of materials including cement, lime and sand, the concrete is heated to 200°C under high pressure, a process called autoclaving.

Aluminium flakes added before autoclaving react with lime to produce hydrogen, forming air bubbles. The resulting material is much cheaper and lighter than normal concrete, and less than half as dense.

“At the time, it was a bit of a wonder material,” says Christian Stone, a research scientist at Concrete Preservation Technologies in Nottingham, UK. “You get to use a sixth of the really expensive building materials.”

### Why is RAAC now unsafe?

Inside RAAC blocks, most commonly used in roofs, steel bars provide support. This steel is encased by a protective layer, often a mix of latex and cement, or sometimes acrylic powder, to prevent corrosion if water gets into the concrete’s pores. But over time, this reinforcement can erode. When this happens, the concrete can “fail catastrophically and suddenly”, says Alice Moncaster, a sustainable-construction specialist at the University of the West of England in Bristol, UK.

If water seeps into the concrete and comes into contact with the steel, it can cause the metal to rust and expand. And as the concrete absorbs carbon dioxide over many years, its pH drops, which also increases the risk of corrosion. Expanding iron can then push and crack the surrounding concrete, causing it to snap or fail. Overloading RAAC structures



Safety measures are being implemented at UK schools, such as this one in Scotland.

can also increase the chance of failure, says Chris Goodier, a construction specialist at Loughborough University, UK. “Like any material, if you overload it, it’s going to bend a bit more,” he says. “You’ll get long-term durability issues, and it will crack more.”

### What is happening at UK schools?

In 2018, a primary school in Kent suffered a RAAC failure, resulting in a collapsed ceiling. It happened on a Saturday and there were no injuries, but the incident sparked an inquiry by the Department for Education. Goodier says that most of the RAAC in the nearly 2,000 hospitals in the country has since been “made safe” with extra support, but the much larger number of schools — around 22,000 — presents a challenge. In mid-August, the UK Health and Safety Executive announced that RAAC is “now life-expired” and “liable to collapse with little or no notice”, leading to the closure of dozens of school buildings.

### Are other buildings likely to be affected?

In the United Kingdom, RAAC was used extensively in public buildings at a time when budgets and materials were tight. Philip Purnell, a materials specialist at the University of Leeds, UK, estimates that “between one and five per cent of public buildings built between 1950 and 1990 will have some of this material”.

Schools “are the tip of the iceberg here”, says Stone. “We’re going to find this in factories and office blocks. I bet it’s in airports and council offices. It’s going to be all that post-war reconstruction building.”

RAAC is also thought to be present in many buildings in Europe, Asia and North America. But damp conditions in the United Kingdom mean that RAAC’s durability issues have become apparent earlier than they would in most other places. “The UK is pretty much the wettest place in Europe, so it’s not surprising that it got to us first,” says Stone. “But it’s only a matter of time before the rest of the world starts facing problems.”

### What can be done to make buildings safe?

There are some short-term fixes that can be used to reinforce the concrete. “Depending on the weight of the [concrete] plank, a relatively short plank of timber support may be perfectly adequate,” says Stone. For longer planks, steel can be installed to provide support. But in the longer term, RAAC might need to be replaced. “This is not a bad material,” says Purnell. “It is behaving exactly as it would have been expected. This is a failure of maintenance, refurbishment and rebuilding.”

By Jonathan O’Callaghan