Endorsed by

Concrete Society

CLIMATE GROUP CONCRETE ZERO

UK LCCG
Accelerating UK Concrete Decarbonisation

mpa The Concrete Centre

Using calcined clay in construction

Practical guidance for specifying, procuring and delivering calcined clay concrete in the UK

September 2026

Published by

Useful Simple Trust

Plot 15, Brent Cross Town

Executive summary

Calcined clay offers a practical opportunity to increase the range of low-carbon cementitious materials available to UK building and infrastructure projects, supporting a more resilient UK supply chain and potentially creating green jobs.

The UK construction industry needs more scalable routes to reduce the embodied carbon of concrete. The carbon footprint of concrete is dominated by clinker content, and to date the reduction of clinker content has relied on using a limited number of mainstream supplementary cementitious materials[(1)].

The opportunity is significant. The UK benefits from a wide range of suitable clay resources, including naturally occurring clays, excavated materials and industrial by-products, which creates a strong basis for domestic supply. The regional availability of clay across the UK could support a stronger domestic (and potentially even more localised) cementitious materials market, **improving resource security and circularity, reducing transport distances and making better use of local materials.** Once embedded at scale in UK supply chains, calcined clay is expected to become a cost competitive supplementary cementitious material[(2)] and to improve resilience by reducing exposure to international material price shocks.

(1) concrete.org.uk | (2) rmi.org

Calcined clay is not a novel material. It is a proven supplementary cementitious material with nearly 100 years of use, including major infrastructure such as the Golden Gate Bridge, and is compatible with existing UK mainstream standards including BS EN 197 and BS 8500 when correctly specified, supplied and tested.

However, despite its long track record, scale-up potential and technical credibility thanks to efforts in recent years, calcined clay is not yet widely used in UK construction. Adoption is constrained by a supply-demand deadlock: suppliers are less likely to invest without clear demand, while project teams are less likely to specify calcined clay where supply, familiarity and delivery routes are not yet established. Breaking this cycle requires practical action across the value chain, not only further technical evidence.

This guidance document sets out how calcined clay can be adopted in UK construction today. It sets out where calcined clay can be applied across common elements, clarifies stakeholder roles, and provides clear direction on specification, procurement and delivery. The emphasis is on early engagement with supply chain, performance-based specifications, and coordinated action across clients, designers, contractors and suppliers to avoid unintentionally excluding a material that is already compliant with UK standards.

The contributors to this paper are UK industry leaders who have brought together their **direct experience of trialling and delivering calcined clay** in real projects. This document ends with a set of significant case studies demonstrating successful application in practice. Together, the guidance and examples provide a credible, delivery-focused pathway to normalising calcined clay in UK construction.

Precast barrier made with calcined clay concrete | EUREKA project

This paper is written for everyone involved in delivering construction projects who wants to know how to use calcined clay. It is structured around the main roles in the delivery process — clients, designers, main contractors, concrete placing subcontractors, and concrete suppliers — and focuses on the practical steps each can take to enable adoption. It is intended to be used as a collaborative tool that teams can use to bring the right people together, at the right time, with the right information. Calcined clay can be proposed by any part of the project team, but successful adoption depends on coordinated action across the value chain.

Contributors

Claire Ackerman, CEO, Concrete Society
Will Arnold, Head of Sustainable Materials, Useful Simple Trust
Paul Astle, Decarbonisation Lead, Ramboll
Ben Azoula Victory, Independent Concrete Consultant, Love Concrete
Nina Cardinal, Technical Strategy Director, Heidelberg Materials UK
Sam Carlsson, Sustainability Lead, Derwent London
Andrea Charlson, Head of Sustainability, UK Concrete & The Concrete Centre
Simon Chudley, Technical Director, LKAB
Fragkoulis Kanavaris, Global Lead - Concrete Materials, Arup
Jon Knights, Materials and Durability Lead, HS2
Cassandre Legalliard, Product Manager, Holcim
Chris Martin, Group Head of Engineering, Barratt Redrow
Ana Pavlovic, Lead R&D Engineer, Laing O'Rourke
Oana Sala, Principal Consultant, Expedition Engineering
Dr Andrew S Smith, Head of Technical & Materials Development, Forterra
Joanna Starkie, Sustainable Materials Specialist, PA Consulting
Apostolos Tsoumelekas, Lead Materials Engineering Manager, Skanska
Gareth Wake, Director, British Ready-Mixed Concrete Association (MPA)
Hong Wong, Professor of Concrete Materials, Imperial College London

Key relevant terms

Term	Working definition
Clinker	The main carbon-intensive component of Portland cement. Made by heating raw material to about 1,450°C in a kiln which releases carbon from both fuel and material itself. Reducing clinker content is one of the main ways to reduce the embodied carbon of concrete.
Binder	The cementitious material in a concrete mix including cement and SCMs (see entry below).
Cement	Any binder produced in a factory and delivered to the producer (e.g. CEM I, CEM II, CEM VI etc.)
Portland cement	A mixture of clinker and gypsum, also known as CEM I. The most clinker-intensive cement type.
Supplementary cementitious material (SCM)	Materials such as GGBS, fly ash, calcined clay etc., which can be used to partially replace Portland cement in concrete.
Calcination	The heating process used to activate suitable clay materials. Temperature, duration, grinding and kiln conditions influence the reactivity of the final material.
Calcined clay	A clay material that has been heated to activate its pozzolanic properties, allowing it to react in concrete and partially replace Portland cement. Also known as activated clay.
Pozzolanic properties	The reactive properties activated in suitable clays through calcination, allowing the material to contribute to cementitious performance.
Concrete specification	A contract document that communicates the project's concrete requirements (e.g. strength class, minimum binder content etc.) to the supply chain.
Permanent condition requirements	The requirements in the concrete specification that concrete must meet in its final condition, usually defined by the designer. These may include strength, exposure class, durability, design life and appearance where relevant.
Construction requirements	The requirements in the concrete specification that concrete must meet during construction, usually defined by the contractor. These may include early-age strength, consistence and consistence retention, pumpability, striking time.
Early-age strength gain	The rate at which concrete develops strength shortly after casting. This is important for striking, propping, lifting, demoulding and programme requirements.
Fresh-state behaviour	The properties of concrete before it hardens, including workability, consistence retention, pumpability and placing behaviour.
Rheology	The flow and workability characteristics of fresh concrete. Calcined clay can increase water demand and affect workability, which can be managed through mix design optimisation and admixture selection.
Consistence retention	The ability of fresh concrete to retain its workability over time – with consistence retention before placement typically being of most importance to those involved in producing, delivering and placing the concrete.

Contents

Introduction

The embodied carbon of concrete – one of the most widely used UK construction materials – is dominated by the clinker (Portland cement) content of the cementitious binder. Reducing clinker content is therefore one of the main ways in which project teams can reduce embodied carbon and support the UK's transition towards net zero by 2050.

Calcined clay is a proven supplementary cementitious material with significant potential for wider use in UK construction. It is produced by heating suitable clay materials to activate their pozzolanic properties, allowing them to react within cementitious systems and partially replace clinker. Where appropriately specified, tested and supplied, calcined clay can contribute to lowering the embodied carbon of concrete while maintaining the required technical performance. Calcined clay has been in use by the construction industry for many years, with an early example being its use in the construction of the foundations for the Golden Gate Bridge in the 1930s.

Calcined clay is of particular interest in the UK because clay resources and clay-bearing material streams are widely available domestically. Potential sources include naturally occurring clays, excavated arisings from major infrastructure projects, and reclaimed clay-containing materials such as brick fines or other clay-rich by-products. This availability gives the potential for calcined clay to become a scalable cementitious material option for UK projects, supporting more resilient domestic supply chains, better use of available resources and wider adoption of lower carbon concrete.

...more resilient local supply chains, better use of available resources and wider adoption of lower carbon concrete.

In the UK, calcined clay can be used in concrete where the cementitious material and concrete specification comply with relevant standards, including BS 8500 and associated cement standards. As with other SCMs, the concrete mix is developed based on a combination of permanent condition requirements defined by the designer, such as exposure class, strength, durability and appearance, and construction requirements defined by the contractor, such as early-age strength and consistence retention. The properties of the calcined clay material are also dependent on the source, as mineralogy and processing can influence the clay's properties, such as early-age performance. These factors can be tested early on to characterise the material properties and inform the mix design.

Importantly, calcined clay is expected to be cheaper to produce than Portland cement once it has scaled beyond a certain point. Research by the Rocky Mountain Institute for LC3, a cement using limestone and calcined clay, notes a 33% reduction in operating costs due to reduced fuel use given lower production temperatures and a return on investment of less than 10 years for a new clay calciner or as short as a few months for areas with local clay availability and high clinker import costs. If the UK construction industry can succeed in providing sufficient firm demand for calcined clay, we can reach a tipping point at which the country's clay supply becomes normalised and optimised in the supply chain, thereby reducing costs and protecting the industry against overseas price shocks.

...calcined clay can become highly cost competitive in the UK

With today's available sources, current early movers are now selling calcined clay domestically. This is a positive indicator that calcined clay can become highly cost competitive in the UK, subject to cost of capital on new manufacturing facilities, securing clay feedstock, and so on. From a batching plant perspective, at the time of writing, calcined clay-based concrete is still very much a 'special order'. However, continuing the large strides in admixture development in recent years, and the growing know-how amongst technical managers at batching plants running early pilots gives strong potential to substantially bring down the cost of calcined clay concrete per tonne; provided the demand is sufficient to establish it as business as usual within both binder supply chains and ready-mix and precast plants.

Back to contents page

1. Elements and applications

Calcined clay is a code-compliant supplementary cementitious material (SCM) which can be used across a wide range of concrete applications, in both binary and ternary cement combinations, provided the concrete meets the relevant project requirements. This section identifies potential entry points for using calcined clay and highlights the practical considerations that may affect early adoption.

Applicability will be influenced by the project's concrete specification requirements, as discussed further in section 3.

Where can calcined clay be used?

Calcined clay concrete is covered by the British Standards and so can be used in most standard situations. Note that more extreme exposure classes will lead to some restrictions (e.g. marine concrete applications, freeze-thaw or carbonation applications) needing more specialist input. The table below identifies possible entry points for first-time users of calcined clay, but it should be stressed that a far wider range of uses is available than just these. Entries are presented alphabetically, as priority depends on project context.

Example entry points	Reasons for consideration and use
Backfill, blinding and mass concrete	Early-age strength gain is often less of a constraint in these applications, enabling higher SCM proportions in the cement. Large volumes are often involved, providing good supply chain learning and cost data for future projects.
In-situ permanent works (e.g. foundations, slabs, walls)	Broad applicability within standard BS 8500 exposure, strength classes and workability. Familiar territory for project teams, with no unusual specification requirements. Ideal for building team confidence with calcined clay mixes before moving to more specialist applications.
Manufactured concrete products (e.g. masonry units, aggregate blocks)	Product standards are performance-based, meaning the finished product must meet specified mechanical criteria, rather than a prescriptive binder composition. This gives manufacturers greater flexibility in mix design and a straightforward route to introducing calcined clay provided the finished product meets the relevant performance requirements. Note: bespoke products such as façade panels require early engagement with the manufacturer due to production cycle and demould strength requirements, and consideration of aesthetics.
Soil stabilisation / ground improvement	Potential application where calcined clay is used in combination with lime and/or cement to improve soil performance. Similarly to the backfill category, this is a useful entry point as early-strength requirements are less restrictive and the large volumes of materials can help the supply chain to build experience in using the material.
Temporary works (e.g. working platforms, enabling works)	Performance requirements are typically less restrictive, providing more flexibility for mix development. Programme pressure is lower, making it easier to accommodate any mix optimisation without risk to critical milestones, and providing an opportunity for the supply chain and the contractor team to gain experience with the product (such as batching, transportation, placing, performance).

Key considerations across all applications of use

The following factors may be considered when using calcined clay concrete. They do not prevent its use, but may influence mix design, supplier engagement, testing or construction planning.

Fresh-state behaviour

Calcined clay typically has a higher water demand than Portland cement. Workability can be ensured through proper mix design and development, as well as through the use of admixtures in some circumstances.

Early-strength gain

Early-age strength development depends on the source clay, clay reactivity, calcination process, replacement level and overall mix design. Some UK clays may be less reactive than higher-grade clays available overseas, which could result in slower early-strength gain, especially if used at higher replacement levels. However, the variability above also means that other clays can achieve strength more quickly. Early supply chain engagement is recommended to understand what is possible and how any early-strength gain issues can be overcome.

Material variability

Like all cementitious materials, the performance of calcined clay depends on the mineralogy of the source clay and the calcination process. Parameters such as calcination temperature, duration, grinding, and kiln conditions influence reactivity. This type of variability is not unique to calcined clay, and BS 8615 provides the testing and classification framework to ensure consistency of supply. Invariably, it is prudent for suppliers to select clays from a single source to ensure consistency of product properties and colour range per project.

Colour

The use of calcined clay in concrete typically results in a more natural, earthy tone compared with conventional grey concrete (though it is possible to produce grey calcined clay concrete if needed). In many cases, this will be a positive attribute. The colour will vary depending on the clay source and calcination conditions, but should remain broadly consistent when the same clay source and production conditions are used. This has no bearing on structural performance but should be considered for architectural applications. Sample panels or trial pours are recommended in cases where colour matters, and consistency of clay supply will be required if consistency of colour is important.

Colour may be particularly relevant when calcined clay concrete is proposed for repairs or extensions to existing concrete, where the new concrete may need to match the existing colour. For repairs, it is generally recommended to use cement made from the same source material as the original concrete. In any case, calcined clay concrete is not expected to be a common repair material.

2. Engaging stakeholders and the value chain

Embedding calcined clay into a UK construction project is not primarily a technical challenge — it is one of coordination, confidence-building and shared intent across the project value chain.

The process for incorporating calcined clay into a project is broadly similar to that used for other code-compliant SCMs. It is underpinned by appropriate design, enabling concrete specification, early supplier engagement and a well-planned collaborative delivery approach.

Naturally, introducing any unfamiliar material into established practice requires time, care and the involvement of the right people at the right stages. While projects may encounter challenges along the way, each one provides valuable learning that helps build confidence and capability for future applications.

This section sets out the practical role of each part of the value chain.

For more specific guidance on specification refer to section 3.

For guidance on procurement and delivery refer to section 4.

When to engage

The single most important principle is to engage relevant parties early. Intent set at briefing stage may be lost during procurement if the supply chain has not been consulted before contract award. The table below maps when each party should be engaged across the project lifecycle.

Project Stage	Key Engagement Actions
Briefing (RIBA Stages 1–2)	Client sets the low-carbon concrete intent, and identifies calcined clay as a material option to be considered. Early input from designers, contractors and concrete suppliers to be sought to test feasibility and signal potential demand. Cost consultant and project manager to be briefed on potential cost, programme, procurement and assurance implications. As stated throughout this guidance, calcined clays are standard-compliant, meaning that this should not require insurer engagement. However, if insurers are to be informed, this should be done as early as possible.
Design Development (RIBA Stages 2–3)	Design team and architects consider calcined clay as part of the developing concrete strategy and identify suitable elements or applications. Draft or outline specification wording to encourage calcined clay where standards allow and avoid unnecessary restrictions (see Section 3). Initial engagement with contractors and concrete suppliers to be undertaken to test availability, sourcing route, likely applications, early strength requirements, fresh-state requirements, admixture compatibility, trial needs and other initial project constraints.
Detailed Design (RIBA Stage 4)	Final specification documents to clearly include calcined clay requirement/intent, and avoid any conflicting requirements that might preclude its use (see Section 3). Contractors and concrete suppliers to be engaged before the specification is finalised, in order to test and confirm practical delivery requirements. Calcined clay intent should be carried through into the tender documents, including relevant specifications, drawings, schedules and pricing documents.
Procurement (RIBA Stages 4–5)	Main contractor carries the calcined clay requirement/intent into procurement packages and supplier discussions and contracts. Concrete suppliers confirm availability, sourcing route, batching capability, testing and other project requirements. Supplier to start developing mix designs. If needed, concrete placing teams are engaged to gain familiarity with the material behaviour.
Construction (RIBA Stage 5)	Final mix designs are confirmed and any trials completed if required to build familiarity. Site teams and placing teams are briefed on fresh-state and early-age characteristics before placement.

Roles and responsibilities

Clients

The client sets the tone for the entire project and is the key enabler in delivering calcined clay concrete.

- **Commit to procuring calcined clay cements generally:** Initiatives such as the Innovate UK Advanced Market Commitments programme can be used to grow industry demand for lower carbon concrete materials such as calcined clays.[1]
- **Challenge the design team early:** Ask structural engineers, architects, façade engineers (and wider team members such as the cost consultant) from the outset whether low-carbon concrete mixes, such as calcined clay, have been considered as the default, and what levels of clinker replacement are achievable.
- **Facilitate early, and continual, supply chain engagement:** Bring the design team, main contractor, concrete supplier (and, if relevant, other subcontractors and clay suppliers) into the conversation early, so that availability, compliance, cost, programme, testing and practical delivery requirements can be agreed before procurement decisions are fixed. Enable the main contractor to build flexibility into procurement by supporting them in enabling concrete mix redesign during the process if this is advantageous to the project.
- **Commit to sharing learnings and data:** Enable the design and construction team to capture and share relevant data from the use of calcined clay, where appropriate, to help accelerate wider industry learning.
- **Ensure requirement/intent in appropriate documents:** Intent to use calcined clay must appear not only in the sustainability specification, but also permanent and temporary works' documents such as the concrete specification, so that it can be clearly understood and costed by the contractor.
- **Carry intent through to procurement:** When engaging contractors and subcontractors, set clear targets, update specifications accordingly and, where possible, bring designers, contractors, and suppliers together to define a viable solution before procurement is finalised. Require proposed concrete mixes to be confirmed by the contractor and designer, and reviewed by the sustainability consultant or client team before approval.
- **Set minimum requirements in the brief:** Decarbonisation pathways can be set using minimum universal classification codes or LCCG ratings as a baseline.[2] [3] This does not need to be all-or-nothing, the goal is to establish a minimum ambition level and encourage ambition above it where suitable. Ensure these are supported by an overarching decarbonisation strategy within the organisation.
- **Plan for cost, programme and assurance requirements from the outset:** Engage the cost consultant and project manager early, and ensure they coordinate with relevant supply chain members, so that cost and programme requirements are understood and accounted for. This should include any additional coordination, testing, trial mixes, sample panels or assurance work needed before procurement and delivery decisions are fixed.

Insurance and assurance considerations

Calcined clay materials are fully code-compliant when used within the scope of the relevant standards, and should not carry a higher risk profile than any other code-compliant concrete composition. Additional insurance or assurance requirements should only be considered where specific risks are identified.

Where insurers need to be engaged, a pragmatic approach should be taken, with clear discussion of which additional requirements need to be fulfilled and what evidence is needed to support approval.

(1) iuk-business-connect.org.uk | (2) The UK Low Carbon Concrete Group - LCCG Market Benchmark
(3) theclimategroup.org/our-work

Design engineers and architects

Designers are key in normalising and rendering calcined clay technically viable through design decisions, specifications and performance requirements.

- **Consider calcined clay as a preferred option, not an exception:** Consider it alongside other SCMs from the outset of mix design. We need design engineers to be pushing for calcined clay as they are likely to be more informed around concrete than most clients.
- **Collaborate early with the wider team to maximise the advantages offered by calcined clays:** Aim, for example, to obtain buy-in on the expected colour palette from the architect, to maximise the chance of the concrete becoming a key part of the design approach.
- **Translate the client's calcined clay ambition into clear technical requirements:** Work with the client early on, in order to understand their carbon, cost, programme and assurance priorities, and translate these into clear performance-based requirements for the project. If working client-side (e.g. in the Client Management Team), review mix designs and technical submissions to ensure that proposals have been implemented.
- **Work with the contractor and concrete supplier:** Work with the main contractor, specialist subcontractors and concrete supplier before the permanent works specification is finalised to confirm whether calcined clay mixes are available, commercially viable and practical to deliver, as well as connecting calcined clay suppliers to the project-specific supply chain. The ready-mix concrete industry works to specifications, so early engagement helps confirm whether suitable mixes are available, compliant and commercially viable.
- **Avoid unnecessary restrictions:** Fixed SCM replacement percentages, maximum binder contents and narrow cement class clauses can inadvertently exclude calcined clay, even where it is fully code-compliant. Specify performance outcomes such as strength class and exposure class, propose calcined clay as a preferred SCM, and then work with the supplier to propose a compliant mix. Further guidance on specification is provided in section 3.
- **Provide demand visibility where possible:** Where calcined clay could be used across several elements, phases or projects, share this information with suppliers early. Clear demand signals can help suppliers understand the potential market and support investment in testing, supply and delivery capability.
- **Include a below-the-line calcined clay alternative:** Alongside the baseline concrete options, include a calcined clay alternative for pricing at tender. This ensures the supply chain is required to obtain a real price, providing the client with a direct comparison of cost, programme and carbon. To avoid overpricing due to uncertainty, the request should be supported by early supplier engagement, clear performance requirements, indicative volumes and an opportunity for suppliers to clarify assumptions before pricing. Where appropriate, trial batches or phased adoption can also help reduce perceived risk.
- **Specify calcined clay in the appropriate documents:** Calcined clay must appear in the structural engineer's general notes page, basis of design, concrete specification, and Employer's Requirements — clearly enough that it can be understood and costed by the contractor and passed unambiguously through the supply chain.
- **Share relevant data:** Capture and share relevant data from the design and use of calcined clay to help accelerate wider industry learning, such as concrete specifications and other relevant information.

Back to contents page

Main contractor

The main contractor ensures that the calcined clay concrete intent set at design stage survives from tender through to delivery. They are best placed to bring in the concrete supplier and the team responsible for placing the concrete, whether this is delivered in-house or by a concrete-placing subcontractor. The key responsibility is to bring the relevant parties into the conversation early enough to confirm availability, compliance, constructability, cost, programme and assurance requirements.

- **Propose calcined clay where suitable:** Where the client or designer has not specifically requested calcined clay, the main contractor should still consider whether it could be proposed as a compliant alternative. The contractor is likely to have control over the temporary works requirements and there is real potential to be growing the use of calcined clay on this aspect of concrete use which often gets overlooked and will not be specified by the design engineer employed by the client.

- **Coordinate with the client and designer early:** Work with the designer and client to understand the client's intent, support in defining the concrete specification requirements, and other project requirements. Advise and be clear about programme and cost implications (if any) to the client where appropriate. Share construction requirements early on as well to avoid driving up carbon in concrete above that of the permanent requirements.

- **Build flexibility into procurement where possible:** Where calcined clay supply is still developing, consider procurement routes that allow early supplier engagement, alternative compliant mixes, phased trials or future substitution once supply becomes available. This can help avoid excluding calcined clay simply because it is not available in large quantities at the start of procurement.

- **Engage concrete suppliers early:** Speak to concrete suppliers early on, along with concrete technologists, to understand which concrete mixes are available, compliant with the concrete specification and commercially viable, and to support operational (product placing) requirements. If needed, allow for trials before the main works so the delivery team can gain familiarity with the material. Ensure transparency during this process.

- **Engage the concrete placing team early:** Whether concrete placing is delivered in-house or by a concrete placing subcontractor, bring them into the conversation early to confirm practical constraints or requirements such as constructability, and placing methods, and ensure that they have the appropriate capability to place the proposed mixes successfully.

- **Include calcined clay options in procurement packages:** Ask suppliers to price the concrete package in a way that includes calcined clay, whether or not this has been included in the designer's specification. Be open about cost and programme impacts so clients can make informed decisions.

- **Carry the intent through to delivery:** Ensure the calcined clay concrete requirements set during design are included in tender packages, supplier discussions, final mix selection and site delivery, rather than being lost during procurement or replaced with standard concrete.

- **Enable early engagement across the delivery chain:** Facilitate early engagement between designer, supplier, and delivery chain so that requirements, specifications and delivery requirements are aligned.

- **Monitor and share relevant data:** The contractor has a key role in collecting and sharing data that reflects the materials delivered and used on site. Capture and share[3] relevant data with industry, from the design and use of calcined clay to help accelerate wider industry learning, such as supplier availability, cost, batching, placing, testing, site records and programme impacts.

(3) Routes to sharing information include the Lower Carbon Concrete Group | ConcreteZero
Advancing Concrete Decarbonisation Group (AC-DG) | Infrastructure Client Group Concrete Decarbonisation Accelerator

Concrete-placing subcontractor

The concrete-placing subcontractor is closest to the material on site and is responsible for ensuring that the mix can be placed, finished and cured successfully.

- **Propose calcined clay where suitable:** Even if the client, designer or main contractor has not specifically requested calcined clay, the concrete-placing subcontractor can still propose it as a compliant material.

- **Coordinate early with contractor, designers and concrete supplier:** Work with the main contractor and, where relevant, the concrete supplier and design team to highlight any practical constraints that may affect placing. This may include constructability, sequencing or helping define fresh and early-age performance requirements clearly (consistence retention, pumpability, striking etc). Share lessons and experience from other projects, where relevant.

- **Record and share site feedback:** Capture practical lessons from delivery and placing and share with the main contractor, designer or client for future use where required and relevant.

- **Provide realistic cost and risk information:** Price the works based on the expected placing, finishing, curing and programme requirements, and clearly identify any risks or assumptions to the main contractor. This allows the main contractor to make proper allowance in the tender and avoid late cost or programme issues.

- **Support trials where needed:** Take part in early trial mixes where appropriate to confirm that the concrete can be placed and finished successfully, and to enable the team to become familiar with the material.

- **Track concrete mixes:** Collate all relevant data post-pour, and use a concrete mix tracker with clearly labelled designs, so location of use can be tracked, and mixes can influence future works.

Plot 15, Brent Cross Town

Back to contents page

Concrete suppliers

The concrete supplier is responsible for developing and supplying a compliant concrete that meets the project's technical and practical requirements. They take responsibility for the concrete composition, production and its performance. Suppliers are a critical enabler of uptake. Demand signals can unlock supplier investment in silo capacity, process capability and new blend development. Calcined clay can already be supplied today.

- **Engage early with project teams:** Work with clients, designers, contractors and concrete placing teams to understand volumes and applications and enable use of calcined clay.
- **Share test data to build confidence:** Provide test data, compliance information and previous project experience where available to help structural engineers and specifiers build confidence in calcined clay performance.
- **Include calcined clay options in tender submissions:** Where calcined clay concrete is available, include it as below-the-line options in tender submissions whether or not they were requested, so they are visible for client consideration.
- **Consider regional or plant-level adoption:** Beyond individual projects, also consider the potential for regional or plant-level adoption of calcined clay concretes as a primary SCM offering, particularly in areas where concrete supply is more geographically constrained. Consistent deployment across multiple projects from a single plant can provide the demand certainty needed to justify investment and move toward cost parity. Set-up in this way will also bring the ability to respond quickly and cost-effectively to requests for calcined clay concretes on future projects.
- **Build relationships with calcined clay suppliers:** Develop relationships with calcined clay suppliers so that suitable materials can be provided when requested.
- **Work collaboratively with admixture suppliers:** Admixture technology for calcined clays is constantly improving, and collaborating closely with suppliers will ensure that up-to-date options are available for tailored admixture formulations to improve dosage efficiency for calcined clay mixes.

Note that constituents of the concrete may come from different sources (including supply of calcined clay), but that the concrete supplier is responsible for combining them. Some concrete suppliers, particularly larger suppliers, may have their own supply of calcined clay.

Although the guidance is mainly focused on ready-mixed concrete, calcined clay can also be introduced through precast and manufactured concrete products. This can play an important role in scaling demand, particularly where products are standardised, manufactured repeatedly and procured in volume. Where there is sufficient demand, precast and manufactured product suppliers should consider whether calcined clay could be introduced into their product ranges, and work with clients and delivery teams to develop suitable products and share risk in delivering initial batches of calcined clay products.

Clay extraction (top) and samples (bottom) | EUREKA project

Back to contents page

3. Specification

Specifications play a key role in enabling the use of calcined clay. They refer to the contractual project documents that define what the contractor and supply chain are expected to deliver. These documents may relate to client requirements (such as low-carbon targets, LCCG decarbonisation expectations, decarbonisation standards and concrete delivery strategies), Employer's Requirements (generally developed with the designer in line with the client requirements including concrete specifications, drawings and other notes that define specific requirements for concrete), and other associated schedule or pricing documents which could impose further requirements for concrete.

For calcined clay to be used in practice, the specification needs to do more than set a general low-carbon ambition. It must create a clear route for calcined clay mixes to be proposed, assessed, priced and accepted, where technically suitable and commercially viable. Overly prescriptive or narrowly worded specification clauses can inadvertently exclude calcined clay even where it is fully code-compliant.

Calcined clay can be specified through BS 8500 with typically around 30% replacement and levels as high as 55% permitted in some designations.(1) It is defined as a permitted cement constituent in BS EN 197-1 and BS EN 197-5, and its material quality is controlled through BS 8615. The appropriate percentage of calcined clay in the binder for an application should be determined by the concrete supplier based on the application, exposure class, strength development requirements, material source and overall mix design.

(1) Indicative calcined clay replacement ranges include around 6–20% for CEM II/A-Q, 21–35% for CEM II/B-Q and up to 55% for CEM IV/B-Q. Ternary blends with limestone fines are also available through multi-component designations such as CEM II/A-M (Q-L), CEM II/B-M (Q-L) and CEM II/C-M composite cements, CEM V etc.

(2) Detailed requirements for natural pozzolana and natural calcined pozzolana are covered in BS 8615-1, while BS 8615-2 covers high-reactivity natural calcined pozzolana. Material characteristics and reactivity testing requirements should be reviewed by the project team and concrete producer where relevant. Further information can be found here: Standardisation of low clinker cements containing calcined clay and limestone: a review by RILEM TC-282 CCL | Materials and Structures | Springer Nature Link.

(3) Further guidance on specifying lower carbon concrete is provided by Concrete Zero. Available at: theclimategroup.org

Broadgate Tower

Key principles

The following principles apply when writing or reviewing concrete specifications. They are intended to keep the specification performance-based, code-compliant and flexible enough to allow calcined clay to be proposed where appropriate.

Although the specification is primarily led by the designer, it is enabled through collaborative action across the wider project team. For role-specific actions that support these principles, refer to section 2.

Encourage the use of calcined clay where standards allow

The specification should clearly state that calcined clay-containing cements should be used (or may be proposed) where they comply with the relevant standards and meet the project's performance, durability, construction and carbon requirements.

- Encouraging the use of calcined clay, where standards allow, ensures direct engagement with the supplier about its potential for use.
- Such encouragement makes it a visible and acceptable option in the specification. Without an explicit reference, the contractor or concrete producer may default to familiar cements even where calcined clay cements could meet the project requirements.

Include calcined clay in all issued documents

- Ensure that the intent for using calcined clay appears in – and is consistent across – the structural engineer's concrete specification, general notes drawing, Employer's Requirements, and any other requirement documents relating to concrete. These are the documents that the contractor and supply chain build to.

Address colour only where appearance matters

- Calcined clay may influence concrete colour depending on the clay source and calcination process. This is not a structural performance issue, but it may be relevant for exposed, architectural, precast, repair or colour-sensitive applications. Refer to section 1 Elements and applications for further colour considerations.

Specification

Engage the supplier to optimise the specification before it is finalised

Before the specification is finalised, review it with relevant supply chain input to confirm that the proposed requirements can realistically enable the use of calcined clay.

- This enables the use of calcined clay by identifying and modifying where possible specification wording that may be unclear, too restrictive or difficult to deliver before it is issued for tender, and by confirming availability, compliance, admixture compatibility, trial requirements and batching constraints, etc.
- Continue to liaise with the supply chain throughout. A feedback loop between the designer/specifier and the contractor/supplier is beneficial as it enables the specification to be refined through the design and construction process.

Avoid unnecessary technical requirements that restrict the use of calcined clay

The specification should only include technical requirements that are necessary for the application, design, durability, construction method or programme.

- This enables the use of calcined clay by avoiding constraints that may unnecessarily limit the ability of the concrete producer to optimise the mix. For example, early-age strength, striking, propping, lifting, stressing, demoulding, consistence retention or other construction-related requirements should be specified only where they are genuinely needed. Where the design and construction sequence allow, requirements should be set in a way that gives the producer flexibility to develop a calcined clay-containing mix while still achieving the required concrete performance.

Specify for performance, not prescription

The specification should define what the concrete must achieve, rather than unnecessarily prescribing the composition.

- This enables the use of calcined clay by giving the concrete producer enough flexibility to design a mix around the specific clay source, application, exposure class, strength development profile and construction requirements.
- The specification should set the required performance criteria such as strength class, exposure class, durability requirements, and embodied carbon requirements, and should avoid fixing replacement percentages, narrow cement classes or prescribed binder combinations, unless there is a clear technical or programme reason for this.
- Allow compliant supplier cement products where relevant.

Common accidental pitfalls

The following clause types could frequently block the use of calcined clay, and should be reviewed and amended:

Pitfall	Recommended remedy
Fixed SCM content/ maximum total binder content	Replace with a potential range of % calcined clay to be used, along with the performance criterion the clause was intended to achieve, such as a durability requirement, embodied carbon targets, resource efficiency and other project requirements. Ensure calcined clay is not unintentionally restricted.
Overly conservative or unoptimised strength class	Review whether the specified strength is appropriate for the application, rather than defaulting to an overly conservative strength class. Carbon should be considered at element level, accounting for both cementitious content and total concrete volume. In some cases, a higher-strength mix may reduce concrete volume; in others, a lower-strength mix may reduce cement content.
Unnecessary strength gain requirements	Review whether the early-age strength gain class genuinely reflects loading, striking and propping requirements, and specify strength class compliance at later ages (e.g. 56-days) where the programme enables more flexibility for the use of calcined clay.
Narrow cement class or combination clauses	Open the specification to the full range of BS 8500-compliant cementitious approaches, and only narrow where there is a specific reason to restrict it.
Excluding alternative SCMs by omission	Include calcined clay explicitly, or a provision permitting alternative SCMs which conform to the relevant standards or project requirements.

Example specification clause

The following example, taken from a live UK project, illustrates how the use of calcined clay can be enabled through a concise, non-prescriptive clause:

> “Preference should be given to mixes that include calcined clay, whether binary or ternary mixes, where reasonably practicable.”

Alongside the performance requirements, specification clauses should be written in a way that it can create a clear route for calcined clay to be proposed, assessed, priced and accepted. Depending on the engagement with supply chain, the clauses could be left broad or more detailed with input from contractor and available suppliers. Requirements may also include embodied carbon criteria, such as the static GCCA Global Rating, Universal Classification, or based on dynamic performance using LCCG benchmarking.

Specification

Summary checklist for specification

- [ ] Calcined clay is explicitly encouraged where compliant with relevant standards and project requirements.
- [ ] The specification is performance-based and avoids unnecessary prescriptive requirements.
- [ ] Unnecessary technical or project constraints are reviewed, removed where possible, and clearly justified where retained.
- [ ] Requirements are included in Employer’s Requirements and other documents to effectively inform and enable the supply chain.
- [ ] The supply chain is engaged to help optimise the specification before it is finalised, with availability, batching constraints, trial mix requirements and compliance route all checked.
- [ ] Tender and pricing documents include a clear route for calcined clay to be proposed and priced.
- [ ] Colour and finish implications are considered where appearance matters.

Advanced route to adoption: using waste clays

On projects generating clay-rich material from excavation or tunnelling, there is a potential route to calcine that material and use it as an SCM within the project’s own concrete supply or other projects. This is particularly relevant in large-scale infrastructure projects (e.g. HS2), where sufficient volumes are available to support assessment, processing and use.

Pursuing this route requires early assessment of the clay’s mineralogy, material trials and testing, and, similarly, of other uses of calcined clay project-specific mix design and trials. Not all clays are suitable, as some clays may not yield a reactive material regardless of processing conditions. Early engagement with a specialist is recommended.

Viability of reclaimed clays should be assessed at wider supply chain level. This should include the carbon impact of transporting clay to a calcination or grinding facility, comparison with suitable clay sources closer to existing processing infrastructure, and the commercial model needed to process and place the material into concrete supply chains.

Further reading on waste clays:

Zhou et al. (2017) explore the use of calcined excavated waste clay as a supplementary cementitious material, including the potential to convert construction excavated material into a useful low-carbon concrete constituent. Available at: sciencedirect.com

Reclaimed Calcined Clay for Low Carbon Cements (Re-C3) examines the potential to use reclaimed clay-rich materials in low-carbon cement systems, including the practical considerations relating to material characterisation, processing and performance. Available at: cement.mineralproducts.org

HS2 Learning Legacy (2024) describes the transformation of London clay into calcined London clay (CLC) for use as a supplementary cementitious material in concrete mixes, providing a UK infrastructure example of how excavated clay can be assessed and developed as a construction resource. Available at: learninglegacy.hs2.org.uk

4. Procurement and delivery

Procuring calcined clay concrete requires earlier and closer engagement with the supply chain than is typical for conventional concrete. As the UK market continues to develop, availability is not yet universal, and project teams that engage their concrete supplier at the specification stage, rather than at procurement, will be better placed to secure supply, agree logistics and avoid programme risk.

The actions described in this section should be initiated before the specification is finalised.

Step 1: Engage the supply chain early

The most important step is to involve the concrete supplier before the specification is finalised and well before the contract is signed. Early engagement allows the supply chain to:

- Confirm availability of calcined clay supply and, where needed, arrange dedicated storage at the batching plant.
- Assess whether an additional silo is required and whether this is feasible at their facility.
- Enable the supply chain to arrange transport or import of the material to the local batching plant.
- Develop and trial the concrete mix design ahead of the construction programme.
- Identify any admixture adjustments needed to optimise fresh-state performance.

Key topics to cover with the supplier:

- **Availability and logistics:** Confirm that the supplier can source calcined clay (imported or UK-produced) and can arrange silo capacity. Discuss lead times and minimum volume requirements.
- **Carbon implications:** Request material EPDs or third-party verified embodied carbon data for proposed concretes. Confirm that calcined clay will result in an overall reduction in clinker content, not being added alongside existing Portland Cement (CEM I).
- **Admixture compatibility:** Calcined clay can affect rheology and water demand, which may require adjustment to admixture type and/or dosage. This is a mix-design matter for the concrete supplier to resolve. Many admixture suppliers are actively developing products tailored to calcined clay systems and are willing to work with concrete suppliers to optimise solutions.
- **Constructability/construction requirements:** Involve the concrete contractor in these discussions so that fresh and early-age requirements, consistence class and open life expectations are agreed before production begins.
- **Trial mixes:** These are standard practice with all concrete design, and should not be seen as a burden unique to calcined clay. Agree whether project-specific trials are needed, particularly for applications where early strength gain, pumpability or workability retention are critical. Mock-ups or sample panels should also be considered where appearance or finish is important (as with all concrete), such as precast façades or exposed concrete. However, these may not be required for lower-visibility applications such as slabs.

Back to contents page

Step 2: Understand routes to procurement

Calcined clay can be introduced into a concrete mix via two main routes, similar to any other SCM, and the concrete supplier will advise which is most appropriate given their setup:

- As a factory-produced blended cement: calcined clay is combined with clinker (and typically limestone) at the cement plant and supplied as a single blended product. This simplifies batching and quality control.
- As a separate addition at the batching plant: calcined clay is delivered and stored separately, then introduced at the mixer alongside other cementitious materials. This offers greater flexibility in mix proportioning but requires additional silo capacity.

Project teams do not typically need to source calcined clay directly, and do not need to 'choose a route'. Communicate requirements clearly such as applications, volumes, programme milestones, carbon or performance targets, and allow the supply chain to determine the most appropriate route.

Step 3: Confirm storage and logistics

Silo availability at the batching plant is often a significant practical constraint. Where a plant is operating at full capacity, introducing an additional material requires either installation of a new silo or reallocation of an existing one. This should be raised with the concrete supplier early on, as silo procurement and installation can take several months and require additional capital investment and planning permission.

Where silo constraints cannot be resolved at the preferred plant, options include using an alternative plant with available capacity or deploying a temporary on-site silo or mobile batching unit. The concrete supplier is best placed to advise on the most practical solution depending on location, volume and programme.

Step 4: Sources of supply

Calcined clay is available in the UK through domestic producers and as imported material from European and other international suppliers. UK production capacity is growing but remains limited, and imported material, predominantly from continental Europe, is currently the more common route to market. As UK demand grows, this will signal the need for UK production, storage and batching capabilities. By specifying calcined clay today, a project is contributing towards this demand signal, pushing the country towards a tipping point at which calcined clay becomes normalised in the UK supply chain, as has already happened in several other countries overseas.

The geographic location of the project can influence logistics and lead times.[1]

(1) For further information on production facilities and market availability, refer to the Concrete Society Discussion Document on Calcined Clay

Step 5: Site and workforce familiarisation

For teams using calcined clay for the first time, some familiarisation with its fresh-state behaviour is beneficial, particularly when using a new source of clay. Trials may be useful in order to build confidence in a mix, but this can also be achieved just with briefing and supervision on-site during the first pour. Pre-construction trials, carried out with the concrete supplier and concrete placing contractor or teams before work begins on site, are the most effective means of building familiarity with the material and confirming that the mix performs as required under site conditions. Ensuring site supervisors and operatives are engaged, consulted and briefed on these characteristics in advance will help to avoid unnecessary concern during placement.

Step 6: Sharing information

Teams should endeavour to share their trial data as openly as possible with the wider industry, as this will help to build momentum for more widespread calcined clay usage.

Summary checklist for procurement and delivery

- [ ] Concrete supplier engaged before specification finalised
- [ ] Supply source confirmed (domestic or imported)
- [ ] Silo availability confirmed at batching plant
- [ ] Trial mix programme agreed
- [ ] Placing contractor engaged and consulted on fresh and early-age state characteristics
- [ ] EPDs or embodied carbon data requested
- [ ] Lead times and logistics confirmed
- [ ] Site team familiarisation planned

Back to contents page

Further reading

Basavaraj et al. (2026), Environmental impacts of thermally activated clays for low carbon cement production

Dai et al. (2026), Effect of sodium sulphate on the rheology, reaction kinetics and early-age strength of limestone calcined clay cements (LC3)

Hafez, H., et al. (2022), 'LC^3 in Codes and Standards'. International Cement Review

Kanavaris, F., et al. (2023), 'Standardisation of low clinker cements containing calcined clay and limestone: A review by RILEM TC-282 CCL'. Materials and Structures

Low Carbon Concrete Group (2022), Low Carbon Concrete Routemap.

Papakosta, A., et al. (2024), 'Transformation of London Clay into Construction Resources: Calcined London Clay (CLC) as Supplementary Cementitious Material (SCM) in Concrete Mixes'. HS2 Learning Legacy

The Climate Group (2024), Decarbonising the UK Concrete Industry: Closing the emissions gap report 2024

The Climate Group (2025), ConcreteZero Specification Guidance: How the Specification Process Can Drive Down Emissions Associated with Concrete

The Concrete Society (2025), Discussion Document 51: Calcined Clay Benefits and Adoption for UK Concrete

Tole et al. (2026), Impact of the mineralogy of low–purity clays on their suitability as supplementary cementitious materials

Zhou, D., et al. (2017), 'Sustainable Infrastructure Development Through Use of Calcined Excavated Waste Clay as a Supplementary Cementitious Material'. Journal of Cleaner Production

Extraction of site-won London Clay | Ex-Clay project

Back to contents page

Case studies

ACDG project
©Matt Chisnall

ACDG

Accelerating Concrete Decarbonisation Group

Project Date: March 2026
Location: Kilnbridge Yard, Canning Town, London
Client: ACDG – led by Derwent London
Designer: ACDG – led by HTS
Contractor: Kilnbridge

The Accelerating Concrete Decarbonisation Group (ACDG) is a developer-led, industry-wide initiative focused on bridging the gap between lower-carbon concrete supply, specification requirements and market demand. Its 35 collaborators include developers, structural engineers and contractors working with established concrete-industry groups and suppliers to unlock the enormous potential of lower carbon concrete solutions through prototyping and testing lower-carbon concrete mixes.

Progress to date includes: a three full-scale prototypes completed in March 2026 by Kilnbridge; a 12-month testing programme coordinated by Love Concrete, and test data shared openly with ACDG collaborators.

Concrete supplier: Capital Concrete
Calcined clay supplier: LKAB Minerals; UK-sourced material

Volume placed: 16 m^3 for each mix, including the prototype construction, hot boxes and samples required for the testing programme.

Calcined clay mix designs reported:
Mix 1: CEM IV-B (Q): 60% Portland cement and 40% calcined clay. (Approaching the max calcined clay within limits)
Mix 3: CEM V-A (S-Q): 40% Portland cement, 30% GGBS and 30% calcined clay (UK sourced)

Application and use case:
Element types: Base, wall, column and slab prototypes
Exposure class: XC3/4

Why calcined clay was selected

Calcined clay is seen by the ACDG as a strong candidate for a UK-sourced supplementary cementitious material (SCM). Although it is permitted within codes and available, its supply is not consistent and adoption remains limited.

In some cases, calcined clay mixes progressed to procurement but were not pursued because late questions about shrinkage and other performance issues could not be resolved within the project programme. To help overcome these barriers, ACDG built full-scale prototypes that people could see and touch, demonstrating the material's workability, performance and appearance compared with traditional concrete.

©Matt Chisnall

Performance

- **Fresh properties:** Upon delivery, the two calcined-clay mixes (CEM IV and CEM V) appeared sticky and dry when discharged, with an initial sheen suggesting significant bleeding. In practice, they held water well, had good flow, achieved the required S4 slump and showed no bleeding.
- **Placement:** The operatives placing and vibrating the concrete reported that it behaved similarly to conventional concrete, aside from its colour.
- **Finish and colour:** The fresh concrete had an earthy appearance and dried to a light terracotta colour.
- **Strength and wider performance:** The 12-month testing programme is ongoing. Initial results were reported as promising, but full strength, shrinkage, creep and durability metrics will be shared when the verified results become available.

Challenges and solutions

- **Testing capacity:** No single laboratory could undertake the complete test scope across all three mixes. Multiple laboratories were therefore used, coordinated by Love Concrete.
- **Testing framework:** Flex 350 is evolving, and parts of the test programme had to vary from its requirements. This included the number of batch tests and the omission of half-sealed drying-shrinkage and creep tests, which are not required by the existing British Standards. The project will feed this back to Flex 350.
- **Programme and novelty:** The prototypes were delivered to a tight programme, and with mixes such as CEM V, which had not previously been poured in the UK, suppliers needed sufficient time to test and iterate before prototyping.

Procurement and delivery

An established procurement route for calcined clay is not yet consistently available. A supplier may need to empty and clean an existing silo before dedicating it to calcined clay, adding time and cost. Early engagement should reduce this risk and allow the required storage arrangements to be incorporated into the programme.

For the ACDG prototypes, Capital Concrete mobilised quickly, cleaned a silo and ordered the calcined clay product it had already been trialling and for which it had established data. The silo was ready for supply within one week.

Contacts:
Samantha Carlsson, Sustainability Lead, Derwent London;
Benjamin Lesser, Head of Design & Innovation, Derwent London.

Further information: ACDG

©Matt Chisnall

Key lessons for the industry

- Identify appropriate applications early, engage the supply chain from the outset and include calcined clay explicitly in the specification so that it can be priced and programmed during procurement.
- For initial adoption, use it within proportions allowable by code.
- The feedback from contractors placing, and witnessing, the concrete pour has been promising - although colour may differ, these calcined clay mixes behaved like traditional concrete during the pour.

Back to contents page

Broadgate Tower

Project date: 2026
Location: 20 Primrose Street, City of London
Client: British Land
Architectural designer: Buckley Gray Yeoman

Structural designer: HTS
Main contractor: BAM Construction
Concrete contractor: Getjar

Broadgate Tower is a 34-storey office building within British Land's Broadgate campus in the City of London. The building is being refurbished, including the addition of a three-storey extension and terrace to the front of the building. Nine office floors are being refurbished to Cat A standard, together with the associated toilets and lift lobbies. Plant improvements are being undertaken throughout the building while existing services remain operational on occupied tenant floors.

The pilot was implemented through collaboration between British Land, BAM Construction, Getjar, and Heidelberg Materials, and included design coordination, procurement planning, cube testing, and onsite delivery methodology. A concrete mix containing calcined clay as a replacement for 30% of the cement content was used for a 10m^3 plant deck slab at Level 33, forming the base to newly delivered air source heat pumps.

Product/supplier: Heidelberg Materials
Source: Imported from Heidelberg Materials' Kunda works in Estonia
Mix design: 30% cement replacement with calcined clay

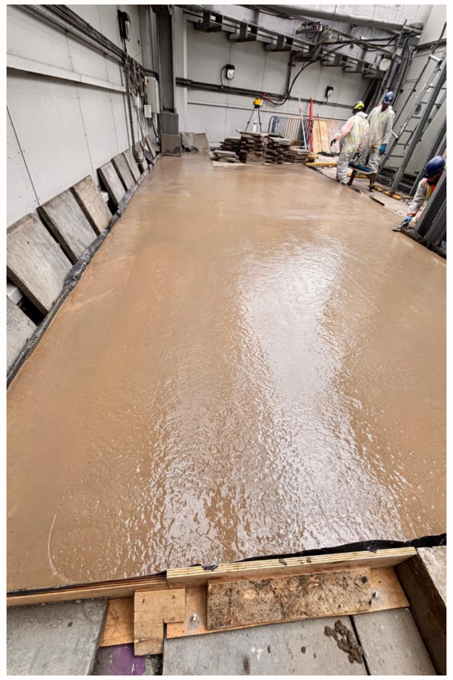
Concrete class: C32/40
Volume placed: 10 m^3
Element type: Plant deck slab at Level 33

Why calcined clay was selected

The aim of the Broadgate Tower trial was to accelerate the practical adoption of calcined clay concrete in permanent works, providing a scalable pathway to reduce embodied carbon from cement where traditional by-product supplementary cementitious materials (SCMs), such as ground granulated blast-furnace slag (GGBS) and pulverised fuel ash (PFA), are increasingly constrained.

Calcined clay offers a viable alternative to more common SCMs that can support a project's embodied-carbon reduction goals, the decarbonisation of a high-impact Scope 3 material and wider net-zero objectives.

This trial was chosen to support resilience against the declining availability of traditional by-product SCMs by enabling an alternative SCM route that can potentially be scaled and replicated in future projects. The trial hopes to provide a client-led demand signal and verified performance evidence to increase supplier confidence and encourage investment in alternative low-carbon concrete products, helping accelerate wider industry uptake.



Contacts: **Saranya Sasindran,** Sustainability Consultant, Cundall; **Carl Baker,** Senior Sustainability Manager, BAM.
Further information: britishland.com

Challenges and solutions

- **Cost uplift:** At the time of the trial, calcined clay carried a cost uplift of approximately 23% over CEM I. It was anticipated that greater market demand and production at scale would bring the cost closer to other comparable concretes (e.g. with GGBS/PFA).
- **Sourcing and logistics:** The project relied heavily on securing calcined clay, as limited market demand meant UK concrete suppliers could not readily match supply. Importation, quality testing, pre-blending and storage capacity at concrete plants presented additional challenges.
- **Programme and testing:** Cube testing timescales were managed within the programme by BAM and Getjar and were not considered to be a barrier to implementation. Scaling up mixes, both in terms of volume and improved mix proportions, could be achieved with appropriate upfront planning.
- **Confidence and evidence:** Confidence to proceed was supported by Getjar's experience and test data from previous trials. Data generated at Broadgate Tower is available to Getjar and Heidelberg Materials to support further development of calcined-clay-concrete mixes.
- **Placement logistics:** Concrete was transported to Level 33 using lifts and mortar tubs. Although the mix was considered likely to be suitable for conventional concrete pumping, this was not tested during the trial.

Procurement and delivery

The calcined clay was supplied by Heidelberg Materials from its Kunda works in Estonia, where kiln capacity was available. At the time of the trial, Heidelberg Materials was also considering future supply routes involving sources in Luxembourg, Belgium and Ghana. Responsible sourcing requirements would need to be considered for any future imported material.

Early-age strength was comparable to traditional lower-carbon mixes, supporting timely removal of formwork and onward construction.

Performance

- **Material conformity:** A sample of calcined clay produced at Heidelberg Materials' Kunda works in Estonia was received and tested to determine conformity with BS 8615-1.
- **Strength gain:** The concrete achieved strength above the specified requirement over the 28-day period. An average compressive strength of 52 N/mm^2 was achieved, compared with the required 40 N/mm^2 at 28 days for the C32/40 mix. At seven days, the strength development of the 30% calcined clay mix was comparable to that of a similar concrete mix containing GGBS instead of calcined clay.
- **Workability:** Getjar was unable to place the concrete through the delivery line. Mortar tubs were therefore filled and the ready-mix concrete was placed from these instead. Qualitatively, the workability appeared normal and was similar to that of a mix containing 30% GGBS. No abnormalities were noted compared with a standard mix.
- **Open time:** The recorded maximum open times were 108 minutes for Pour 1, 151 minutes for Pour 2 and 59 minutes for Pour 3.
- **Curing:** The concrete cured at a similar rate to a comparable 30% GGBS mix.
- **Finish and colour:** The concrete initially had a brown to reddish-brown colour, which became more subtle as it cured.

Key lessons for the industry

- Calcined clay supply should be secured as early as possible through engagement with concrete contractors, suppliers and processors.
- Placement, testing and programme requirements should be agreed with the supply chain during mix development and procurement planning.
- Access to previous trial data can build confidence in using unfamiliar materials, while sharing new performance data can support their wider adoption.

Back to contents page

EUREKA

Industrial Trial

Project Date: November 2025
Location: Laing O'Rourke Centre of Excellence for Modern Construction
Precast manufacturer: Laing O'Rourke
Research collaborator: University of Leeds, British Geological Survey, University of Bath, and Imperial College London
Funding: Engineering & Physical Sciences Research Council (EPSRC)

The EUREKA (Engineered UK Clays for Production of Low-Carbon Cements) project investigated widely available UK clays as supplementary cementitious materials (SCMs) to reduce concrete's carbon footprint. Laboratory-based research has identified several local clay resources that can deliver the fresh, mechanical and durability performance required for partial Portland cement replacement, offering a scalable alternative to constrained traditional SCM supplies.

To bridge laboratory research and commercial adoption, the EUREKA team partnered with Laing O'Rourke on a full-scale industrial trial. Approximately 700 kg of quarried clay was industrially calcined and incorporated into concrete at Laing O'Rourke's precast facility, producing two vehicle crash-barrier units. The trial demonstrated the feasibility of integrating UK-sourced calcined clays into established supply chains—a critical step towards large-scale deployment of low-carbon cements supporting the industry's net-zero ambitions.

Product/supplier: The clay used was a low-purity mixed mineralogy clay obtained from a Wienerberger quarry near Durham and calcined in the UK
Mix design: A C40/50 mix with C II/C-M (Q-L) containing 56% CEM I, 33% calcined clay and 11% limestone at 360 kg/m^3 binder content.
Volume placed: Two 0.55 m^3 precast units, approximately 1.1 m^3 in total
Element type: Precast vehicle crash barriers

Why calcined clay was selected

The clay was selected because its mineral composition—including its total clay content and the ratio of 1:1 to 2:1 clay minerals—is representative of materials found across many of the UK geological locations surveyed by the EUREKA project. Its kaolinite content is below the commonly cited minimum of 40% of the total mineralogical content, while its reactivity, measured using the R3 test, falls within the moderate range. It therefore provided a useful representation of an average locally available UK clay, rather than a specialist high-kaolinite source.

Case studies

Challenges and solutions

The principal technical challenge was the concrete's rheology. Stability was affected by the high admixture dosage required to achieve an initial slump-flow of more than 600mm. Working with Chryso Saint-Gobain, the admixture supplier, the team developed a two-part admixture package that reduced the total admixture dosage by 23% while maintaining the initial slump-flow and improving the rheology.

The limited quantity of calcined clay available for the laboratory work, batching trials and manufacture of the demonstration units meant that only two batching trials (more than 10 mixes) could be completed. These trials were needed to adjust the admixture dosage from laboratory to production scale. Key specialists from across the business were present during the batching trials and manufacture of the units, allowing the necessary adjustments to be made on site.

Procurement and delivery

The calcined clay was produced as part of the EUREKA research project, with the demonstration units forming part of its final industrial trial. Limited material availability restricted the size and number of precast units.

The calcined clay was hand-dosed into the mixer during batching (unacceptable for larger production volumes). Wider adoption would require consideration of storage and dosing arrangements, including dedicated, additional, or split-silo capacity and associated capital investment.

Following demoulding, the two precast units have been stored under different exposure conditions, (including carbonation and chloride penetration). Durability testing of extracted cores is planned after one year.

Contacts:
Ana Pavlović, Lead R&D Engineer, Laing O'Rourke;
Hisham Hafez, Lecturer in Civil Engineering materials, University of Leeds;
Clive Mitchell, Industrial Minerals Geologist, British Geological Survey;
Hong Wong, Professor, Imperial College London.

Back to contents page

Performance

- **Mix development:** A higher admixture dosage was initially required to achieve the target consistence class, but scaling up to batching trials required a reduced dosage to avoid affecting stability. (NB: This effect is not exclusive to calcined-clay concrete)
- **Workability:** The target initial slump-flow was achieved in all but the final batch, where admixture adjustment was too conservative to maintain stability.
- **Open time:** This was under 60 minutes, which was acceptable for the trial, but improvement would be needed for wider precast or in-situ use.
- **Placement:** Minor intervention using immersion (poker) vibrators was required, unusual for Laing O'Rourke's typical precast mixes, resulting from the final conservative admixture adjustment.
- **Finish and colour:** Only blowholes on vertical surfaces were noted at demoulding; no remedial work was needed. Finished units were light terracotta.
- **Strength gain:** Early strength development was slower than typical LOR precast concrete mixes, delaying demoulding age from day one to day two. This would need improvement for wider adoption. Later compressive strengths at 28 and 56 days were satisfactory.

Key lessons for the industry

The full-scale industrial trial demonstrated the feasibility of manufacturing precast concrete units using UK-sourced calcined clay. The process from clay extraction to precast manufacture was completed within two months.

Clear performance requirements, effective communication and close supply-chain collaboration are essential when moving from laboratory testing to industrial production, particularly where time, material availability and logistics are constrained.

Ex-Clay

Excavation waste London Clay utilisation in concrete applications

Project Date: 2024–2025
Location: HS2 London Tunnels, London
Client: HS2 Ltd
Designer: Arup Typsa STRABAG Joint Venture (Design House JV)
Main / Concrete Placing Contractor: Skanska Costain STRABAG Joint Venture (SCS JV)

As part of High Speed 2 (HS2), one of the UK's largest infrastructure projects, the London Tunnels project is expected to generate approximately 5 million m^3 of excavated material through tunnelling and related operations, the majority of which is London Clay. An innovative approach for the high-value repurposing of the excavated clay has been developed, in which the London Clay is treated and used in concrete as a replacement for Portland cement.

In project-specific concrete mixes, up to 55% of the Portland cement can be replaced with Calcined London Clay while maintaining the onerous requirements associated with a 120-year service life. This results in major reductions in the embodied carbon of concrete while promoting the high-value waste utilisation.

Concrete supplier: Tarmac Ltd.
Source: Site-won material from the mining operations of the Northolt Tunnels East structure
Mix design: 35% Calcined London Clay (CLC) and 15% limestone fines within the binder
Volume placed: Approximately 15 m^3
Element type(s): Temporary-works heat box and part of a permanent maintenance-tunnel walkway
Exposure class: X0

Why calcined clay was selected

The project sought a higher-value use for London Clay excavated during tunnelling. The HS2 London Tunnels project is expected to produce more than 5 million m^3 of excavated material, most of it London Clay.

Initial research into beneficial uses included exploratory work on using the material as lightweight aggregate and as a supplementary cementitious material (SCM), replacing Portland cement in concrete. The SCM route was selected for further investigation because it was considered to offer the greatest benefit to the project and the wider construction industry.

Challenges and solutions

The project sought to activate a large quantity of London Clay. However, the high moisture content of the tunnel arisings, the timescales associated with the funding application and wider programme constraints made it difficult to identify a suitable facility in the UK that could dry, calcine and grind the material.

In collaboration with the Ex-Clay consortium team, an appropriate facility was identified in Denmark where the clay had to be shipped for processing. The clay was dried, calcined, ground and packaged at the same facility.

Procurement and delivery

Early engagement with the supply chain is key. The project was seeking to activate its own source of clay within a constrained timeframe, which made identifying an appropriate processing solution more difficult.

Engagement and collaboration with the supply chain enabled the team to identify a suitable facility and proceed with processing the London Clay.

Contacts:

Apostolos Tsoumelekas, Project Lead;
Fragkoulis Kanavaris, Technical Lead;
Athina Papakosta, Sustainability & Carbon Lead.

Further information:

learninglegacy.hs2.org.uk – calcined clay and lightweight aggregate | learninglegacy.hs2.org.uk – calcined clay and scm in concrete mixes

Back to contents page

Performance

- **Mix development:** The mix underwent several stages of optimisation. Admixtures suitable for calcined clay-containing concrete were developed and their dosages adjusted to meet the project's placement operation requirements.
- **Workability:** The workability generally worked in the project's favour, with only minor on-site adjustments required when necessary.
- **Setting time:** Testing during the permanent-works pour recorded an average initial setting time of approximately 7.5 hours and an average final setting time of approximately 10.5 hours.
- **Strength gain:** The concrete's strength development was as expected for a similar C20/25 concrete mix.
- **Finish and colour:** The fresh concrete was brown and became lighter as it dried. This had no effect on the works, as there was no specific colour requirement for the structure being cast.
- **Technical performance:** The mechanical and durability properties were investigated and confirmed the concrete's suitability for structural applications.

Key lessons for the industry

- Understanding the placement and durability requirements, and communicating these clearly to the supply chain, is essential. The concrete should be developed to meet these requirements, with the operational and placement requirements treated as key factors in the mix-development process.

- Early collaboration with the supply chain is vital to the successful procurement and placement of calcined-clay-containing concrete.

- Contractors seeking to gain experience with the material should assess the risks associated with the available concrete elements and identify a suitable low-risk application. This can provide a practical demonstrator and an opportunity for the project team and supply chain to gain experience.

Plot 15, Brent Cross Town

Project date: 23 April 2026
Location: Brent Cross Town, London
Client: Related Argent
Designer: Whitby Wood (Stage 4); Fairhurst (Midgard)
Main contractor: Midgard
Placing contractor: JRL

Plot 15 is a mid-rise residential development within the wider Brent Cross Town masterplan, which is being delivered through a joint venture between Related Argent and the London Borough of Barnet.

The project used calcined-clay-containing concrete in a permanent suspended slab as part of its commitment to reducing embodied carbon and supporting the development of the UK supply market. A further calcined clay concrete pour is planned for Q1/Q2 2027, covering approximately 25% of the Plot 201 ground floor slab (c. 400 to 700 m³).

Concrete supplier: Capital Concrete
Calcined clay supplier: LKAB Minerals
Admixture supplier: Sika
Mix design: C50/60 CEM II/B-Q containing 30% calcined clay
Material source: Damaged brick sourced from a UK clay brick manufacturing plant
Volume placed: 35 m³
Element type: Permanent suspended slab
Exposure class: XC3

Why calcined clay was selected

Related Argent supports the wider adoption of calcined clay concrete as a means of reducing embodied carbon and supporting the development of the UK supply market. Increasing demand could help expand supply, reduce costs and enable the material to be used at greater scale.

Research undertaken by the project team identified calcined clay concrete as one of the lowest-carbon code-compliant concrete options available. The existing relationship with Capital Concrete, and its work to make lower-carbon concrete more widely available, also supported the development and delivery of the trial.

Performance

- **Delivery and workability:** The concrete was supplied from Capital Concrete's Cricklewood facility, less than ten minutes' drive from the site. Slump testing at the batching plant confirmed the required S4 consistence.
- **Working time:** The stated working life was approximately 2.5–3 hours. Each load was placed within approximately one hour.
- **Placement:** The concrete was placed using a mobile concrete pump. No pumping issues were reported.
- **Finish:** The placing team were able to finish the slab using a float to the required standard without any issues.
- **Strength gain:** The C50/60 concrete achieved a mean strength of 54 MPa after seven days. Laboratory testing indicated that characteristic strength was achieved after 14 days. The 28- and 56-day laboratory results substantially exceeded the specified strength, indicating potential to refine the mix.
- **Colour:** The fresh concrete was light brown with a pink tinge and became a faint light pink as it cured.

Challenges and solutions

Persistence from Related Argent, supported by Capital Concrete, LKAB Minerals and Love Concrete, was the key enabler. The process used to address the concerns included:

- Ensuring that calcined clay concrete was specifically identified in the 2024 Gateway 2 specification, giving the Building Safety Regulator visibility of its proposed use; however, no issues were expected, as CEM II/B-Q is a fully codified cement.
- Securing internal support from Related Argent's Construction Director and Senior Development Manager and Midgard's Managing Director.
- Completing CAR and LDI insurance checks, as this was understood to be the first suspended slab in the UK and application in a residential building.
- Holding a kick-off meeting with Capital Concrete, LKAB Minerals, Midgard, JRL, Love Concrete, Whitby Wood and Fairhurst, with an agreed period during which concerns could be raised.
- Sharing relevant Re-C3 and Concrete Society papers and contacting the authors to clarify specific statements.
- Investigating concerns raised about shrinkage.
- Preparing a specification-compliance note through Love Concrete as an additional assurance measure, including a review of product approvals and declarations.
- Completing shrinkage and compressive-strength testing through Initivo, coordinated by Love Concrete.
- Holding informal discussions with Jon Knights, Pete Winslow and Gareth Wake to provide additional technical assurance and build confidence within the project team.
- Offering a batching-plant trial and a visit to the ACDG demonstrator.
- Procuring the concrete once the assurance process had been completed.
- Attending and monitoring the pour throughout to capture practical feedback.

The process demonstrated that code compliance alone may not provide sufficient reassurance when a material is unfamiliar. Sharing the supporting evidence, responding openly to concerns and completing project-specific testing were important in building confidence across the project team.

Procurement and delivery

The trial was first conceived in April 2024 but could not be delivered until April 2026 because calcined clay concrete was not initially available. During this period, an additional piling rig accelerated construction, meaning that most of the originally targeted slabs had been completed before the material and mix were available. The volume of the trial was therefore significantly reduced.

Capital Concrete did not have a silo dedicated to calcined clay, so an existing silo was cleaned before production. A three-week lead-in period was required, but this did not affect the construction programme.

The concrete was batched at Capital Concrete's Cricklewood facility and transported a short distance to the site.

Contacts:
Tim Hoyland, Environmental Manager, Related Argent;
Jack Sundhu, Technical Director, Capital Concrete;
Simon Chudley, Technical and R&D Director, LKAB.

Further information:
relatedargent.co.uk/places/brent-cross-town | capitalconcrete.co.uk | lkabminerals.com

Key lessons for the industry

- It's like pushing treacle uphill, be persistent, explain everything in an 'A means B means C' fashion, listen to concerns and use evidence to alleviate those concerns.
- Agree the principle of sharing learning from the outset.

Back to contents page

Double Deck

LC3 at EPFL

Project date: May 2026
Location: Lausanne, Switzerland
Client: EPFL
Designer: Dominique Perrault Architecture (DPA)
Architect: Itten+Brechbühl SA Lausanne
Contractor: Induni & Cie S.A

Double Deck is an ambitious project to adapt and extend EPFL's teaching and learning infrastructure in response to the needs of a growing student population while preserving its educational excellence.

The project includes the construction of a new building on EPFL's Esplanade and the renovation and modernisation of the existing Coupole building. The new teaching hub will provide flexible spaces designed to support current and future educational practices.

The project has used LC3 (Limestone calcined clay cement), a new type of cement that is based on a blend of limestone and calcined clay.

Product / supplier: JuraCime
Source: Switzerland
Replacement level/mix design: 36–50%
Concrete volume: Approximately 6,000 m^3

Why calcined clay was selected

LC3 was developed at EPFL under the leadership of Professor Karen Scrivener, providing the project with a strong scientific foundation and access to leading technical expertise. Its performance has already been demonstrated through several projects, supporting confidence in its suitability for practical applications.

LC3 also offers significant carbon-reduction potential compared with conventional cement. Its use therefore aligned with EPFL's commitment to sustainability and the project's objective of reducing embodied carbon.

Prestressing

The project is reported as the first construction site in Switzerland to combine LC3 concrete with prestressing. Reduced creep was expected, with testing being undertaken at the EPFL laboratory to verify performance.

Procurement and delivery

Concrete was produced using an on-site batching plant. Laboratory testing was used to calibrate the plant and optimise the cement dosage while achieving the specified concrete quality.

Performance

- **Workability:** The concrete was more cohesive and sticky than conventional concrete. A superplasticiser was required to achieve good workability and uniformity.
- **Open time:** The concrete set more rapidly, resulting in a shorter working time.
- **Strength gain:** Early strength development was rapid. Monitoring was required for applications such as prestressing.
- **Finish:** A good, uniform surface was achieved, with no significant cracking when the concrete was properly managed.
- **Colour:** The concrete had a slightly different tone from conventional concrete
- **Structural design:** No major effects on the structural calculations were identified at the design stage. Creep, shrinkage and modulus of elasticity were expected to be broadly comparable with conventional concrete.

Challenges and solutions

As mentioned above, the main challenges were the more cohesive and sticky nature of the LC3 concrete and its shorter working time, which were managed through the use of an appropriate superplasticiser to achieve the required workability and uniformity.

Rapid early strength development also required monitoring, particularly for applications such as prestressing. When these properties were properly managed, the concrete achieved a good, uniform finish without cracking.

Contacts: **Marta Paternain Martinez**, Project Manager, EPFL;
Bruno Assunçao and **Quentin Gameiro,** Construction Managers.
Further information: epfl.ch

Key lessons for the industry

Laboratory testing and plant calibration can help optimise cement content while maintaining the concrete design specification.

The effects of LC3 on creep, shrinkage and stiffness should be verified when it is used in prestressed elements.

Back to contents page

Endorsed by

Concrete Society

CLIMATE GROUP CONCRETE ZERO

UK LCCG Accelerating UK Concrete Decarbonisation

mpa The Concrete Centre

Published by Useful Simple Trust (incorporating Expedition Engineering, Useful Projects and Useful Studio), with report steering, coordination and production led by:

Oana Sala, Principal Consultant
Will Arnold, Head of Sustainable Materials

We are also grateful to the following for their review:

Expedition Engineering (part of Useful Simple Trust):
Bruce Martin, Associate Director;
Mike Sefton, Associate;
Pete Winslow, Director

University of Bath:
Prof. Susan A Bernal, Professor of Sustainable Construction Materials

Published by

Useful Simple Trust