Sustainable Pathways for Clay Brick: Reuse, Recycling, and Repurposing in Construction

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Introduction

Clay Brick in NYC Infrastructure

Clay bricks are rectangular building materials made of fired clay, a material composed of silica, alumina, lime, iron, manganese, sulfur, and phosphates. The manufacturing process entails grinding or crushing the clay in mills, mixing it with water, shaping and texturing the mix, followed by drying and firing to achieve the highest strength and durability (Mamlouk & Zaniewski, 2017, p. 363).

Clay is low-cost to extract, process, and produce. It is also highly durable, can bear heavy loads, and it is not flammable, thus enhancing the safety and longevity of structures. Identifying beneficial use pathways for clay bricks is important because it will maximize its economic, environmental, and structural advantages and reduce the overall ecological footprint of the built environment (Muntari & Windapo, 2021).

Clay brick is used in a multitude of ways throughout New York City's infrastructure and buildings, making it even more necessary to find sustainable ways to recycle and reuse it. In vertical infrastructure, such as rowhouses, brownstones, and tenements, clay bricks were used in older buildings as a form of load-bearing masonry (New York City Department of Buildings [NYC DOB], 2013). In horizontal infrastructure such as sidewalks and plazas, clay bricks are used as pavers and set either on a sand bed or on a mortar bed, according to NYC Department of Transportation standards. They are also used as structural pavers when bedded over a compacted aggregate base to support heavier loads (New York City Department of Buildings [NYC DOB], 2003). Recognizing its integral role in New York City's built environment highlights the need for circular approaches that extend the life cycle of clay brick materials through reuse and recycling.

Clay Brick in the Waste Stream

Solid waste management has become more critical as landfills are reaching capacity, with thousands scheduled to close within the next few years. In New York City, construction and demolition waste (CDW) accounts for more than 60% of the total waste stream, including the fill materials. Although clay brick is not reported as a standalone category, it is included within the fill material section, which takes up approximately 35% of the city's total solid waste stream by weight. The NYC Department of Design and Construction reports that New York City generates approximately 19,500 tons of fill material per day, which includes concrete, brick, stone, asphalt, and soil. This corresponds to an annual fill material generation of 19,500 tons/day x 365 days/year ≈ 7.1 million tons/year. Thus, New York City produces about 7 million tons of masonry (fill) material annually, which includes clay bricks, as part of its construction and demolition waste stream. Clay bricks enter the waste stream during demolition, renovation, or construction activities within the building. When old structures are torn down or walls are removed, the bricks are treated as CDW (Department of Design and Construction, 2003).

There are three main pathways for clay bricks to end up as waste. One waste pathway involves sorting waste into material categories, such as metal, wood, masonry, and cardboard, before transporting it to recycling facilities. There, bricks are crushed and repurposed as fill, aggregate, or alternative daily cover at landfills. Another way involves the same sorting process, but the materials will be permanently disposed of in a landfill. The final pathway involves sending materials directly from the demolition or construction site to a landfill without any sorting process. The most common path for clay bricks to enter the waste system is through the typical CDW flow (Mckay et al., 2021).

NYC Restrictions

In New York State, the Department of Environmental Conservation (DEC) enforces strict regulations under the DEE-14 Enforcement Policy to control what qualifies as legal Construction and Demolition (C&D) waste. This ensures that only clean, uncontaminated materials can be disposed of in C&D landfills, and mixing non-C&D waste, including garbage, asbestos, and medical and industrial waste, is prohibited. Brick, concrete, and other masonry, including clay brick, are accepted at C&D sites (New York State Department of Environmental Conservation, 1989). Those who violate these requirements may face fines, tickets, or legal action for attempting to gain from the lower disposal costs associated with C&D landfills. This policy also governs how New York City handles C&D waste, since all city processing facilities must comply with DEC classification and landfilling requirements.

At the federal level, the Federal Acquisition Regulation (FAR) 52.223-10 requires contractors to implement waste-reduction programs that emphasize the recycling and reuse of construction materials (Federal Acquisition Regulation, 2024). This influences NYC public works that receive federal funding, requiring contractors to document waste-reduction efforts. Similarly, New York State's Senate Bill S4720 further advances waste management goals by requiring contractors to recycle or reuse at least 50% of the debris generated on construction/demolition sites (New York State Senate, 2023).

In New York City, masonry and brick debris are handled under the Department of Sanitation's Construction and Demolition Waste Management Guidelines (DSNY, 2023), which mandate that contractors sort materials and send them only to approved locations. While the city follows broader NYSDEC Part 360 rules, it faces real challenges, such as limited space for sorting and a limited number of facilities dedicated to cleaning bricks. This leads to most brick waste in NYC being used as aggregate rather than being reclaimed.

Material Properties

Physical, Chemical, and Morphological Properties

Physical

Clay bricks are commonly characterized by strength, density, and water absorption, all of which are influenced by gradation and porosity. Standard brick dimensions are 240 x 115 x 75 mm, with a compressive strength of 18.64 MPa, and a water absorption of 11.5% (Klak, Saleh, & Tais, 2022).

Bulk density accounts for the mass of a brick per unit volume, including its pores. High-density bricks feel heavier and tend to be stronger and less porous, while low-density bricks are lighter and absorb more water. Clay brick density ranges from 1.44 g/cm^3 to 1.63 g/cm^3 (Heniegal et al., 2020). The drop in density as clay bricks become more porous corresponds to higher porosity, which allows bricks to absorb more water. Water absorption for a standard clay brick is roughly 11-12% (15-20% for higher-porosity bricks), closely aligning with the influence of bulk density.

Chemical

The chemical composition of clay brick is dominated by silica (SiO_2) and alumina (Al_2O_3), with minor amounts of iron oxide, calcium oxide, and alkalis. These components influence the brick's durability once it hardens. A typical clay sample contains ~60% silica and ~21–26% alumina, while iron oxide averages 2–5% and calcium oxide 2–3% (Johari et al., 2011; Heniegal et al., 2020).

When silica exceeds the optimal range, porosity increases and strength decreases. When it's below the range, the brick loses durability (Heniegal et al., 2020). Alumina contributes to plasticity, allowing the clay to be shaped and molded without cracking. However, excessive amounts can increase shrinkage and cracking during drying and firing processes. Iron oxide influences the color, with more iron producing a redder/ browner color. Calcium and alkalis act as fluxes, melting at lower temperatures, helping the rest of the material effectively fuse together. This allows the brick to densify more easily, which improves its strength.

These chemical factors directly tie to how a brick behaves in service. Bricks with balanced silica–alumina contents densify more effectively, resulting in lower porosity, higher strength, and improved resistance to the effects of NYC's freeze-thaw cycles. Conversely, unfavorable chemical ratios (specifically high alkali content) retain more pores, and the absorption of excess water makes the brick vulnerable in low temperatures.

Morphological

Morphology refers to the minerals present in clay bricks, the size and distribution of pores, and the arrangement of particles after firing. Bricks contain crystalline phases such as kaolinite, montmorillonite, illite, quartz, and calcite (Heniegal et al., 2020; Johari et al., 2011). Kaolinite and montmorillonite increase plasticity but also cause uneven shrinkage and cracking as water evaporates. Illite helps lower the firing temperature, while quartz provides rigidity but can make bricks brittle in excess. Calcite aids densification but, if unevenly distributed, expands during firing and creates cracks (Heniegal et al., 2020; Johari et al., 2011).

Property	*Why It Matters*	*Most Affected Reuse Option*
Density and Porosity	Higher porosity lowers density and strength, but improves insulation and permeability.	Crushed Brick as Aggregate in Concrete; Porous Ceramic Insulation; Permeable Pavement Layer
Water Absorption	Controls the amount of moisture a brick or crushed particle retains. High absorption can weaken mixes and reduce freeze-thaw durability	Crushed Brick as Aggregate in Concrete; Permeable Pavement Layers
Strength Variability	Fired clay bricks vary in compressive strength depending on composition, firing temperature, and age, affecting whether the material can be reused.	Crushed Brick as Aggregate in Concrete; Clay Brick Powder in Geopolymer
Freeze-Thaw Durability	Water trapped in pores expands at freezing temperatures, causing cracking (low-density bricks are at higher risk).	Clay Brick as Aggregate in Concrete; Permeable Pavement Layer
Chemical Composition	The balance of silica and alumina affects strength and porosity. Excess alkali or calcium oxide increases cracking and water absorption.	Clay Brick Powder in Geopolymer; Porous Ceramic Insulation

Mortar Contamination	Leftover mortar impacts surface texture and grading, reducing bond strength and making cleaning difficult before reuse.	Deconstruction to Repourpose Bricks
Morphology	The mineral phases and pore distribution control bonding, density, and cracking behavior.	Clay Brick Powder in Geopolymer; Porous Ceramic Insulation

Table 1. Key Material Properties of Clay Bricks and Relevant Reuse Pathways

Conditions of Clay Bricks

The long-term performance of clay bricks relies on how they respond to environmental stressors. In New York City, where the freeze–thaw cycle is highly relevant, along with heavy rainfall, de-icing salts, and airborne pollutants, deterioration becomes significantly more likely (Azevedo et al., 2015). The relationship between porosity and mechanical performance in bricks is similar to what's seen in concrete. Bricks with higher porosity are especially vulnerable, since pores act as weak zones where cracks can begin and spread due to moisture. Finer-grained bricks, with more porous boundaries, tend to deteriorate faster under wetting and drying cycles (Zhang et al., 2021).

Efflorescence also serves as an indicator of condition. It occurs when soluble salts inside a brick dissolve in water and then crystallize on the surface as the water evaporates, leaving behind a white deposit. Though this is not a sign of deterioration, the presence of oxides such as calcium and iron in the brick can serve as an early warning sign (Heniegal et al. 2020).

Common Recovered Forms of Clay Bricks

Recovered clay bricks from demolition sites can be found in several physical conditions, each influencing their reuse potential.

- *Whole Bricks with Mortar Residue*: These are often intact units recovered through careful deconstruction, but may require cleaning before reuse if mortar remains attached.
- *Broken Brick Rubble*: These partial fragments from regular demolition are too damaged to be reused as bricks and can instead be crushed and used as recycled aggregate.
- *Mixed Masonry Debris*: This blend of brick, concrete, and mortar is to be sorted and processed before reuse. It's often sent for crushing to make secondary aggregates.
- *Powdered or Crushed Brick*: These small particles are produced by grinding/ crushing bricks, typically reused as additives in cement, geopolymers, etc.

Standards Relating to the Recycling of Clay Brick

The reuse, recycling, and repurposing of clay bricks are primarily regulated by American Society for Testing and Materials (ASTM) standards C67, C62, and C216. When sampling and testing reclaimed brick, ASTM C67 is used to evaluate the physical properties. This standard defines testing procedures for evaluating compressive strength and absorption (ASTM International, 2021). The bricks are then compared to specifications for their intended performance, either structural, using ASTM C62, or facing, using ASTM C216. ASTM C62 covers load-bearing building brick and sets minimum requirements for compressive strength, absorption, and weather resistance (ASTM International, 2017). ASTM C216 does something similar but for facing bricks (veneers) (ASTM International, 2022). Overall, the performance of the clay bricks is tested by standards outlined in ASTM C67, and if they meet the requirements in C62 or C216, they can be reused. If they marginally meet the requirements, they can be reused in a decorative, but not structural manner. If they fail all the requirements, then the clay bricks are meant to be recycled as aggregate.

In general, clay bricks themselves are not considered hazardous and do not pose significant health risks under normal conditions. Because they are baked at very high temperatures, they burn off carbon and sulfur, making them chemically stable and non-toxic once produced. However, health and environmental concerns exist during the demolition, deconstruction, and manufacturing processes. (*Fired Clay Brick - Endeavour Centre*, 2021).

Most environmental hazards arise from manufacturing processes, such as the brick kiln process. The gases produced during the product, such as particulate matter, fluoride gases, and total organics (methane and ethane), are emitted as air pollutants (P S & D S, 2022). A heavy amount of CO_2 is burned during the production, releasing toxic gases into the atmosphere (Nicolaou et al., 2024). Another way is through the mining process. The excavation of clay causes groundwater to burst to the surface, causing erosion and turbidity in nearby water conditions. It causes mine waste and sulfates to be mixed with wetland soil, which causes contamination of water and nearby sediments (P S & D S, 2022).

The brick kiln process not only causes environmental damage, but also poses health risks (Nicolaou et al., 2024). The workers experience respiratory health and musculoskeletal disorders, which affect muscles, bones, nerves, and soft tissues and cause pain, inflammation, and limited mobility. Though clay bricks themselves pose minimal risk, their manufacturing and extraction processes can generate toxic air emissions and cause environmental damage. (Tavakol et al., 2025).

Beneficial Use Options

Clay Brick Power in Geopolymer

Description and Purpose

One way clay bricks can be used is in geopolymer production. When waste clay bricks are collected from construction and demolition sites, they are crushed into small aggregates and ground into waste clay brick powder (WCBP), which typically ranges from 8 µm to 300 µm. Since crushed clay brick contains amorphous aluminosilicate, silica (SiO_2) and alumina (Al_2O_3), it becomes an essential source as a geopolymer precursor. When WCBP is mixed with alkaline activators, such as sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3), it undergoes geopolymerization, forming a geopolymer binder. After curing, the geopolymer binder can be used to produce geopolymer mortar, concrete, or blocks. In this process, WCBP can be used alone as the primary source material for geopolymer applications or combined with other precursors such as fly ash, ground-granulated blast furnace slag, or metakaolin (Shaila Sharmin et al., 2024).

The primary purpose of this application is to reduce reliance on ordinary Portland cement, lower embodied carbon in masonry materials, and redirect brick waste from landfills.

Processing and Testing

Effective use of WCBP in geopolymer applications requires processing and quality control. Clay bricks must be separated from mixed waste C&D waste stream, and the residual mortar attached to bricks must be mechanically removed. Bricks are crushed and ground using jaw crushers and ball mills to achieve the median particle size, typically with median diameters below 125 µm for enhanced reactivity. Particle size distribution is controlled to ensure consistent reactivity and packing density. Durability of the bricks created from geopolymer will be tested through water absorption, sulfate resistance, and freeze-thaw testing, which is critical for cold climates (Shaila Sharmin et al., 2024).

Key Benefits

Compared to the traditional clay bricks, geopolymer bricks result in significantly lower embodied energy, which is the total energy consumed during a brick's life cycle, including the manufacturing, transporting, and installing process. Geopolymer bricks generate less greenhouse gas with a significant decrease in CO_2 emissions due to avoiding high-temperature kiln firing. Reusing clay brick waste also reduces the demand for extracting natural resources, particularly the mining of raw clay (Zia et al., 2023).

Feasibility and Limitation

However, the durability of geopolymer bricks in different environments has not been fully validated and requires more testing (Shaila Sharmin et al., 2024). Geopolymer bricks are weaker due to the different thermal qualities compared to typical red clay bricks. The heat storage capacity and thermal conductivity of geopolymer bricks do not align with those of traditional clay bricks, which may limit their suitability for applications requiring specific thermal performance (Zia et al., 2023).

In New York City, WCBP-based geopolymer materials are most realistically suited for non-structural or semi-structural applications, such as precast pavers and sidewalk units. These are repeatable, modular units that can be manufactured off-site under controlled curing, which geopolymers often need. However, feasibility is constrained by limited space for on-site stockpiling and high labor costs for brick separation and de-mortarting. Permitting for alkaline activator handling and the lack of standardized NYC specification further restrict immediate larger scale deployment of geopolymer bricks.

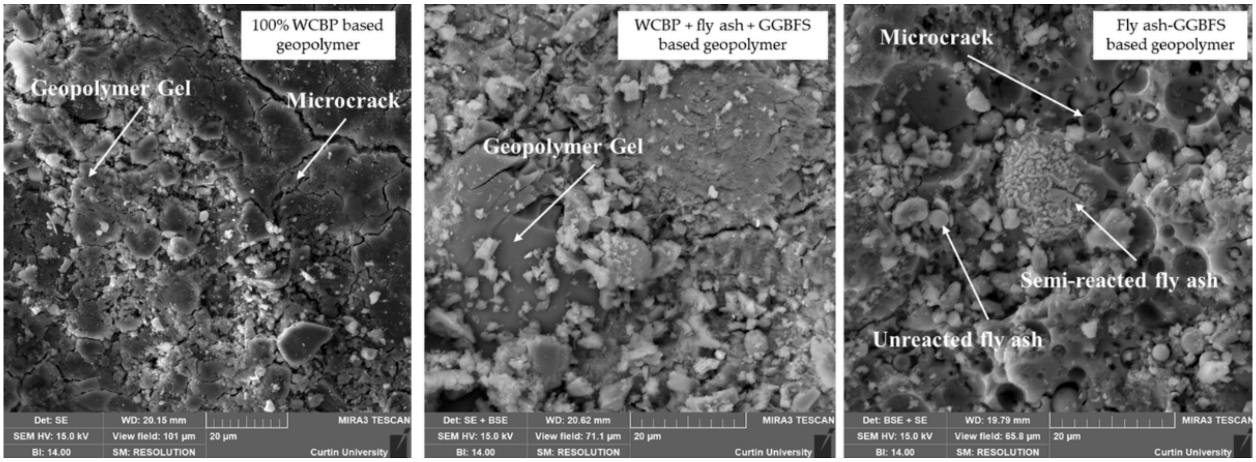

Figure 1. Effects of combining WCBP with fly ash and slag

Clay Brick as Aggregate in Concrete

Deconstruction and Purpose

Crushed clay brick can be used as a recycled fine or coarse aggregate in concrete mixtures, promoting the circular use of construction materials and reducing waste sent to landfills. This practice helps limit the production of new material, reduces disposal volumes, and supports NYC’s broader goals for more sustainable construction.

Preprocessing and Testing

Before use, bricks are collected, cleaned, and crushed to the desired size, then sieved and washed to remove dust and achieve a similar gradation to natural aggregates (Klak et al., 2022). Laboratory testing commonly measures density, absorption, particle strength, and pozzolanic activity. In finer forms, recycled brick powder (RBP) can replace a portion of cement due to its pozzolanic properties, attributed to its high silica content (approximately 60%) and alumina content (approximately 18%) (Hu et al., 2024). These reactive oxides allow RBP to contribute to the formation of calcium silicate hydrate (C–S–H) gels during curing, which strengthen and densify the concrete.

Key Benefits

Using crushed brick aggregate offers environmental and structural advantages. Mixes with crushed brick are denser and less likely to absorb water or chemicals, since the fine particles react with the cement to fill pores and make the concrete more compact. This strengthens the concrete, helps prevent cracking, and improves its ability to withstand harsh or freezing environmental conditions (Hu et al., 2024).

Feasibility and Limitations

Despite the benefits, the variable strength, higher water absorption, and inconsistent particle quality of recycled brick make it challenging to standardize concrete performance. These issues stem from differences in firing temperature, mortar contamination, etc. Mix design adjustments and water control are therefore essential to maintain consistent workability and strength.

In New York City, crushed brick aggregate could realistically be used in non-structural concrete for sidewalks, curbs, or as base material in permeable pavement and fill layers. However, large-scale usage makes it increasing difficult for contractors who have limited space on job sites for sorting brick waste. Most crushing and cleanies facilities are located outside the city which increases hauling distance and cost. While not yet specifically approved under NYSDEC Part 360 Beneficial Use Determinations, this reuse pathway supports circular construction goals by minimizing landfill disposal and encouraging sustainable material recovery in concrete manufacturing.

Deconstruction to Repurpose Brick

Description and Purpose

Bricks are usually demolished long before they reach the end of their life cycle, making deconstruction one of the most beneficial ways to repurpose them. During the deconstruction process, a major challenge is separating the bricks from cement-based mortar without breaking them. Deconstruction techniques include the saw-cutting method, in which a saw cuts along bends and perpendicular joints, and the punching method, in which a mechanical punch drives bricks out of the masonry block after the initial cut (Zhou et al., 2020).

Preprocessing and Testing

To reuse whole bricks they first must be carefully recovered to avoid damage and then the mortar must be removed. The bricks are then cleaned and sorted so that bricks with visual damage and cracks can be disposed of. Next, the compressive strength and durability are tested under ASTM standards and only bricks that meet the required performance and durability criteria are approved for reuse in new construction or paving applications.

Key Benefits

One of the benefits of deconstruction is the lower energy use and carbon emissions compared to producing new bricks. Reclaiming bricks uses less than 1% of the total energy required to manufacture new bricks (Zhou et al., 2020). There are three reuse options for reclaimed bricks: direct reuse of ceramic bricks, reuse of bricks as brick slips (thin brick panels), and reuse of masonry wall sections as complete units. Their test results show that reusing 1 m^2 of bricks yielded an environmental gain of 85%-86% (1.9-2.1 mPt) (Devos et al., 2024).

Feasibility and Limitations

NYC could use reclaimed brick from deconstruction in horizontal infrastructure, such as sidewalks and public plazas. It can also be used for bike lanes, schoolyards, and other uses that do not require much structural or compressive strength. In vertical infrastructure, they can be used for facades and low-rise buildings.

One of the primary limitations of using reclaimed bricks is their lower compressive strength compared with newly produced bricks. The presence of mortar contamination further weakens mechanical performance (Devos et al., 2024). Typically, old mortars on the bricks are difficult to remove and may cause higher porosity, lower density, and lower compressive strength. A clean removal of mortar from reclaimed bricks is essential for them to match the mechanical properties of new bricks. However, this limitation can be addressed by reinforcing the brick through infilling its internal recesses, such as the frog. Because frogged bricks contain indentations that reduce their structural integrity, the infills help compensate for lost material and restore compressive strength, making the reclaimed bricks more viable for reuse (Zhou et al., 2020).

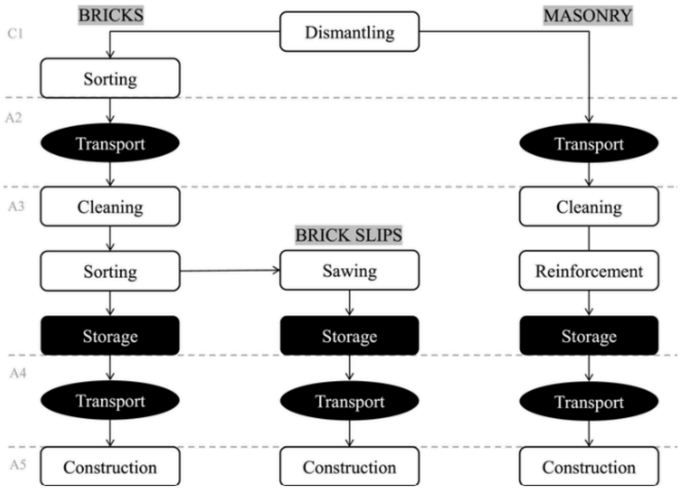

Figure 2. Process for determining which bricks can be reused and their approved applications (Devos et al., 2024)

Figure 3. Failure modes of bricks. (a) reclaimed perforated brick without infill (b) reclaimed perforated brick with infill (c) frogged new brick (d) reclaimed frogged bricks (Zhou et al., 2020)

Permeable Pavement Layer

Description and Purpose

Permeable concrete can be made with crushed brick aggregate replacing part of or all of the natural coarse aggregates. The concrete has open pores that allow rainwater to pass through into the sub-base and soil below. Materials such as crushed bricks can be used in permeable concrete pavement bases, supporting the "sponge city" concept, promoting water absorption and drainage (Cai et al., 2020). Using crushed brick as a recycled aggregate promotes circular use of materials and helps manage stormwater by reducing surface runoff and promoting infiltration.

Preprocessing and Testing

Reclaimed bricks that are intended to be used in porous pavement must undergo a series of preprocessing and testing steps to ensure adequate performance. When bricks are first collected from C&D waste they are inspected and any damaged or visually contaminated units are removed. Any attached mortar then needs to be removed and the cleaned bricks are crushed to the required aggregate size. Those aggregates are then sorted to achieve a uniform particle size, to minimize particles that could clog the pores of the permeable pavement. Trial permeable concrete mixes are prepared and the permeable concrete is tested for permeability, porosity, compressive strength and durability, and only the mixes that meet the strength and infiltration requirements are approved for use in porous pavement applications (Muda et al., 2023).

Key Benefits

A study was conducted on cement-treated permeable concrete containing crushed brick as aggregate. It was found that concrete with crushed brick dries faster and has lower shrinkage. Crushed brick slightly reduced strength but was still within acceptable limits. Most importantly, the permeability performance was good (Cai et al., 2020). Overall, using crushed brick in permeable concrete reduces construction and demolition waste, reduces carbon footprint through recycling and local sourcing, and promotes stormwater infiltration.

Feasibility and Limitations

NYC would be able to use permeable pavement in sidewalks, parking areas, bike lanes, parks, and plazas, and in fact, it is already being used in a variety of ways throughout the city. It is suitable for places with less traffic but overall can be a powerful tool for sustainable flood mitigation. However, when using crushed brick, careful mix proportioning is needed to maintain a balance between strength and permeability, as crushed brick has higher water absorption, which impacts the overall concrete mix design (Ali & Rashid, 2025). Additionally, the use of permeable pavement is constrained by subsurface conditions and oftentimes needs underdrains and maintenance plans to function effectively. Overall, using crushed brick within permeable pavement can help to make the life cycle of clay brick more sustainable and less wasteful.

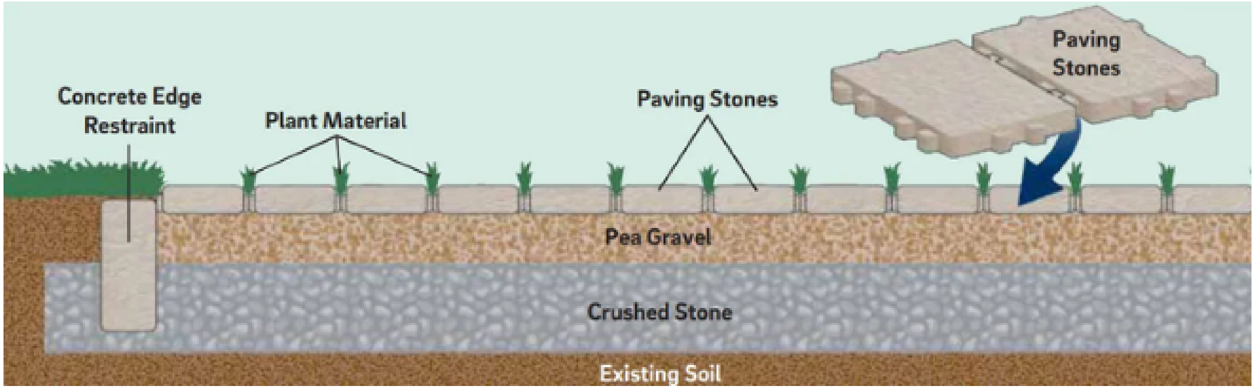

Figure 4. Basic Layers in Permeable Pavement

Porous Ceramic Insulation

Description and Purpose

Porous ceramic insulation can be made using recycled clay brick powder or other fine waste materials to create lightweight, insulating construction materials. This reuse method focuses on improving thermal performance while reducing waste, ultimately making buildings more energy-efficient.

Preprocessing and Testing

Crushed brick is first cleaned and then ground into a fine powder, which is mixed with additives. These additives include foaming agents or other organic wastes, which burn away during firing, resulting in a porous structure. Testing typically includes measuring density, compressive strength, porosity, and thermal conductivity to ensure the material meets both building and insulation requirements.

Key Benefits

The materials have significantly lower thermal conductivity than regular clay bricks, making them helpful for keeping buildings warmer in winter and cooler in summer. These bricks are also lighter, reducing the energy and fuel required for installation. Bricks with a waste content of roughly 7.5% were approximately 25% lighter, had 22% greater insulation, and achieved a compressive strength of around 11 MPa, which meets building standards (Andiç-Çakır et al., 2021). Recycled brick powder used in porous ceramics improved thermal insulation, reaching values as low as 0.13 W/m·K, roughly 5-8 times that of an ordinary brick (Oluwagbenga & Oladayo, 2020).

Feasibility and Limitations

However, drawbacks and limitations exist. A high waste content can make bricks too porous, increasing water absorption and thereby decreasing strength. In New York City, such materials could be used in non-structural wall panels or facade systems where weight reduction and thermal efficiency matter the most. However, this reuse method is not yet approved under NYSDEC Part 360 Beneficial Use Determinations, meaning additional testing and certification are necessary before it can be implemented in New York. Production in NYC may face challenges such as limited space for firing kilns and higher energy costs. Despite these constraints, this approach aligns with the idea of circular construction since it reuses demolition and agricultural waste to create new, energy-efficient materials rather than adding to landfill waste.

	Part 360/BUD Status	Citation	Source
Geopolymers	Not a BUD Pathway	NA	Not Listed on Site Below
Aggregate Usage	Predetermined	360.12(c)(3)(viii)	(*Beneficial Use Determinations (BUDs)*, 2025)
Deconstruction	Unclear	NA	Not Listed on Site Above
Permeable Pavement	Predetermined	360.12(c)(2)(xi)	(*Beneficial Use Determinations (BUDs)*, 2025)
Ceramic Insulation	Not a BUD Pathway	NA	Not Listed on Site Above

Table 2. Part 360/BUD Status of Clay Brick Reuse Options

NYC Specific Context

Relevant Policies, Programs and Requirements

Policies

Three central policies would determine which beneficial pathways for clay bricks in NYC would be approved. The first is NYCEDC Circular Design and Construction Guidelines. This is a city guidance document that prioritizes deconstruction, on-site reuse, and reducing carbon emissions (*CLEAN and CIRCULAR: Design & Construction Guidelines*, n.d.). This document explicitly encourages reusing materials to lower embodied carbon and lays guidelines for how clay bricks can and should be disposed of. The second policy that would have to be followed would be the DSNY and NYC C&D rules. This outlines how construction and demolition debris from professional projects must be handled, and it must be dealt with by and through registered facilities (*Construction Debris - DSNY*, 2025). Finally, everything must also be compliant with Local Law 97, which is focused on operational emissions (NYC buildings, 2019). Reusing clay bricks reduces embodied carbon for renovations, and it can support owners seeking long-term compliance with this law. Collectively, these policies shape which reuse pathways are feasible and reinforce material recovery as a practical strategy for meeting NYC's sustainability goals.

Pilot Programs

As proposed by the New York City Economic Development Corporation's Clean and Circular: Design & Construction Guidelines, the most common approach to circular design and sustainable construction in NYC is deconstruction and reuse. This guideline makes circular construction an enforceable requirement within public-sector developments in NYC. A required deliverable under the guideline includes: identifying materials to be salvaged before demolition, defining reuse, recycling, or disposal pathways, and including material inventories, logistic planning, and tracking metrics. Through this plan, NYCDEC prioritizes deconstruction over demolition to preserve material value and reduce embodied carbon (*CLEAN and CIRCULAR: Design & Construction Guidelines*, n.d.).

The guideline also requires a Circularity Audit during the design phase to inventory existing building materials and assess feasibility prior to construction or deconstruction. Through this plan, deconstruction is treated to be planned during the project designing phase before the construction begins. The guideline identifies masonry (including brick) as a focus material and is highlighted for its reuse and remanufacturing potential through direct reuse or downcycling into aggregate for new construction (*CLEAN and CIRCULAR: Design & Construction Guidelines*, n.d.).

One key barrier faced through this guideline is that deconstruction is more labor and time consuming compared to the regular demolition, and there are limited local markets and storage for reclaimed bricks. But some incentives of using deconstruction include: guaranteed demand for circular practices, embodied carbon reduction, and more job creation (*CLEAN and CIRCULAR: Design & Construction Guidelines*, n.d.).

One of the current projects going on in NYC is the SPARC Kips Bay project for Hunter College Brookdale campus, aiming to reduce embodied carbon and waste (*CLEAN and CIRCULAR: Design & Construction Guidelines*, n.d.). As part of that plan, the existing building on the Brookdale campus is scheduled for deconstruction rather than standard demolition. By doing this, they aim to salvage as many reusable materials as possible, including bricks (McKniff & Joons, 2025).

The Reuse Innovation Center was announced in NYC to improve access to salvaged building materials. The Reuse Innovation Center offers building deconstruction, building salvage, and material recycling services to support a circular life cycle for construction materials (Center, 2020). The existence of this center suggests a growing institutional support for reclaiming construction materials, including potential pathways for reclaimed clay brick.

While clay bricks have been widely used as a construction material, New York City has shifted away from its use for the new constructions. In contemporary NYC buildings, brick is used primarily as exterior veneer or facade cladding. Structural systems in new construction are now dominated by reinforced concrete and steel. As a result, clay brick's importance in NYC construction has shifted from primary structural material to non-structural material, increasing the importance of recovery and reuse of brick from existing buildings.

Requirements

NYC demolition sites are typically found in urban areas, offering little or no extra space to sort, clean, or store reusable materials like brick on site. The NYC Department of Design and Construction (DDC) states that space at sites is at a premium (NYC Department of Design and Construction, 2003). The lack of space and the task's demanding nature make it hard. In addition, NYC's recycling infrastructure focuses mainly on concrete and asphalt, but not on brick reuse or ceramic processing. This would require setting up new kilns, sort yards, or reuse centers. On top of that, very few facilities currently can crush or process bricks into powder or aggregate. This discourages private processors from investing in equipment or space for brick recycling.

Potential Incentives, Barriers and Open Questions

Local Law 97 sets carbon-emission limits on large buildings in New York City, encouraging the use of low-carbon or recycled materials (NYC Buildings, 2019). This is where reused clay brick comes in—helping projects meet compliance targets while reducing embodied carbon. In addition, reusing bricks can help construction projects reduce tipping fees and support LEED certification under the *Materials and Resources* category by diverting waste and increasing the project's recycled content. LEED is a national green building rating system that rewards projects for reducing waste and incorporating recycled or reused materials. Credits earned in this category contribute to the project's overall certification level, improving its sustainability rating and market value (Urban Green Council, 2023)

Though numerous incentives exist, several barriers remain. Under *6 NYCRR Part 360*, crushed or powdered brick is not yet covered by a formal Beneficial Use Determination (BUD), meaning it remains classified as solid waste. This creates legal and financial uncertainty for processors and contractors looking to reuse the material (New York State Department of Environmental Conservation, 2023). Additionally, since NYC's recycling network primarily focuses on concrete and asphalt, there is limited infrastructure to process clay brick. As a result, most brick waste must be transported to upstate or out-of-borough facilities, increasing both costs and carbon emissions from long-distance hauling and heavy truck transport (New York City Department of Design and Construction, 2003).

Conclusions

Based on this review, several beneficial use strategies for clay bricks appear particularly viable for New York City. Direct reuse of whole bricks offers the most immediate environmental and economic advantages and is one of the easiest to implement. Using crushed brick as aggregate in concrete or permeable pavements also shows promise, particularly for non-structural applications and stormwater management systems. Permeable pavement, in particular, is becoming more prevalent in NYC, especially as flooding becomes more of an issue, making this option one that will not only reduce the carbon footprint of clay bricks but also help NYC the most in the future. These approaches align with circular construction principles and NYC sustainability policies.

Both direct reuse of whole bricks and the use of crushed brick in concrete or permeable pavement are feasible options for New York City, provided they are applied in appropriate contexts. Reusing whole bricks is particularly practical in NYC due to its large stock of historic masonry buildings. Using crushed brick in concrete and permeable pavement is also viable, especially for sidewalks, plazas and stormwater management infrastructure, where structural demands are lower. As NYC continues to expand green infrastructure to address flooding and sustainability goals, crushed-brick permeable pavement offers high long term potential.

Significant challenges and knowledge gaps for these practices still remain. The mechanical and chemical performance of reclaimed or processed bricks can vary widely depending on prior use. Additionally, limited infrastructure for sorting, crushing, and processing bricks within NYC, and the lack of research on the behavior of porous ceramic products under NYC conditions, pose future obstacles for these solutions.

Material properties and conditions play a central role in determining the potential for beneficial use. Compressive strength, density, water absorption, chemical composition, and morphology dictate whether a brick is suitable for structural reuse and aggregate applications. In conclusion, while NYC faces barriers, targeted strategies that consider material properties, processing requirements, and local policies can maximize the beneficial use of clay bricks.

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