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Review

A Review of the Application of Synthetic and Natural Polymers as Construction and Building Materials for Achieving Sustainable Construction

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Abstract: With the advancement of human society, more construction and building materials are required to produce sustainable construction. The advancement of polymer materials and their use in building construction has been improved. Compared to inorganic materials, polymer materials offer numerous superior qualities and may also be modified to increase their usefulness. Additionally, although bio-polymeric materials have effectively supplanted many conventional materials in various relevant disciplines, their applications in construction, including building façades and so on, have been quite limited up to now. Nowadays, most architects and engineers find it challenging to choose materials due to the proliferation of new materials and the market availability of various manufacturing techniques. This emphasizes the necessity of adopting a unique scientific strategy for the materials selection process to assist in picking the most suitable materials for the necessary civil application rather than following an obsolete traditional selection path that depends mostly on prior subjective personal experiences. This review article has identified critical concerns, inspired more study, and provided crucial insights into the prospective field of synthetic and natural construction and building polymeric materials towards sustainable construction.

Keywords: sustainable construction; synthetic polymer; natural polymer; construction materials; building materials

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1. Introduction

Throughout history, the construction industry has made substantial progress in developing ecologically conscious constructions. The advancement of environmentally sustainable building methods is closely tied to the advancements made in utilizing different construction and building materials (CBMs). Construction work often has significant negative impacts on the environment and sustainable economic development, such as degradation of the environment, depletion of resources, and waste generation. Selection of sustainable building materials is an important strategy in sustainable construction [1]. Sustainability in construction encompasses various aspects, from site selection to material quality assessment and decision-making processes [2]. Scholars have developed numerous methodologies and decision-making models to address these challenges [3]. For instance, Peldschus et al. [4] highlight the criticality of selecting the right construction site, leveraging game theory to provide insights into competitive decision-making processes. Quality assessment of construction materials and evaluation of technologies' performance and mechanisms to apply them are essential [5]. Effective decision-making in sustainable construction management requires considering multiple criteria and stakeholders' preferences [6]. Erdogan et al. [7] developed a multi-criteria decision-making model integrating the Analytic Hierarchy Process (AHP) method to facilitate informed decision-making processes. Furthermore, Turskis et al. [8] present a model for prioritizing heritage value in urban cultural renovation projects, facilitating decision-making processes that balance stakeholder interests and environmental considerations. Advancements in multi-criteria decision-making methods contribute to robust decision-support systems for sustainable construction practices [9]. Keshavarz Ghorabaee et al. [10] introduce an extended evaluation method, demonstrating its effectiveness in handling complex decision-making scenarios. Moreover, Turskis et al. [11] propose a fuzzy WASPAS-based approach to identify critical information infrastructures essential for the sustainable development of EU countries, contributing to their sustainable development objectives. Integrating advanced methodologies and decision-making models is essential for promoting sustainability in construction and construction materials, offering valuable insights for enhancing environmental, economic, and social performance in construction projects. Selection of sustainable building materials is an important strategy in sustainable construction [1]. The components that make up a building can be classified as structural, decorative, or one of several other subtypes. Diverse types of coatings, paints, plating, veneering, ceramic tiles of varying colors, and glass with unique effects are all examples of materials that may be used for decorative purposes. Wood, bamboo, stone, cement, concrete, metal, brick, ceramics, glass, and engineered plastics are all used in construction [12]. In recent years, there has been a discernible growth in the production of innovative bio-polymeric materials derived from renewable biomass, which is anticipated to reach 7.8 million tons by 2019. The usage of bio-polymeric materials in the field of building facades has not yet exceeded expectations [13]. In contrast to traditional facade materials, bio-polymeric materials may dramatically lower the building facade's carbon footprint and help minimize the amount of construction and demolition waste thrown into landfills each year by providing more ecologically beneficial end-of-life alternatives. The discovery of innovative biological raw materials is predicted to rise [13,14]. This will aid in the protection of natural resources, the preservation of landfill space, a decrease in pollution levels, and the reduction in building weight and energy consumption. As a result, the development of innovative screening approaches and selection strategies will be required shortly as new material families with advanced chemical compositions and novel characteristics emerge [13].

Polymer materials have superior properties compared to inorganic materials, including anti-corrosion, waterproof, sound insulation, wear resistance, heat insulation, light weight, antiseismic activity, bright colors, electrical insulation, and suitable strength. With the continuous advancement of material science and technology, the industry will be able to exploit the application potential of polymer materials. Polymer materials are widely utilized in the construction industry due to their exceptional qualities. Examples of polymer materials include the insulating layer of water supply pipes, drainage pipes, wire and cable, and the substance used for wall insulation [12–14]. Polymers, particularly plastics, have been extensively used in the building industry in recent years. Polymer-based CBMs are characterized by their superior strength and weight performance, resistance to corrosion, stability in various environmental conditions, insulating properties, and cost-effectiveness. Although polymer-based CBMs offer significant benefits compared to traditional materials, they also come with notable drawbacks, including flammability and smoke toxicity. However, the utilization of additives or the amalgamation of plastics with other substances enables the enhancement of superior qualities. The recent discoveries enable the assessment of the caliber of polymer-based CBMs. The durability of the material is also influenced by its quality [15]. The construction sector has widely utilized synthetic and natural polymers [16–26]. Figure 1 illustrates a diverse range of synthetic and natural polymers employed as CBMs, whereas Figure 2 showcases the various applications of these polymers. Polymer materials are commonly used in the construction of buildings, bridges, industrial structures, and other types of civil engineering infrastructure. Over the past few years, polymers have had a growing impact on the development of new structures and the upkeep of deteriorating infrastructure [27–31]. This study seeks to emphasize significant issues, promote further investigation, and offer enlightening details regarding the possible use of natural and synthetic polymeric materials for sustainable construction. A summary of new investigations on synthetic and natural polymers in the construction industry is given in the following parts of this study. In addition, in the present review, the most relevant polymeric applications for sustainable construction are evaluated in detail. In this vein, the Google Scholar, Scopus, and Web of Science databases were adopted for this study to review. A considerable number of outstanding publications on construction materials were reviewed to identify related prestigious topics. "Polymer", "sustainable material", and "materials" in combination with "construction" were searched in the field of "topic". At the time of preparing this paper, the oldest document dated back to 1980, and the newest was from 2024. No limitation was adopted in terms of time to reach a complete analysis and comprehensive interpretation. It is worth noting that the reduction in the number of publications in 2024 compared to the previous year is because the number of articles only represents 6 months. Results were also limited to "English" in terms of language. In addition, most literature reviews on construction management have only covered journal articles.

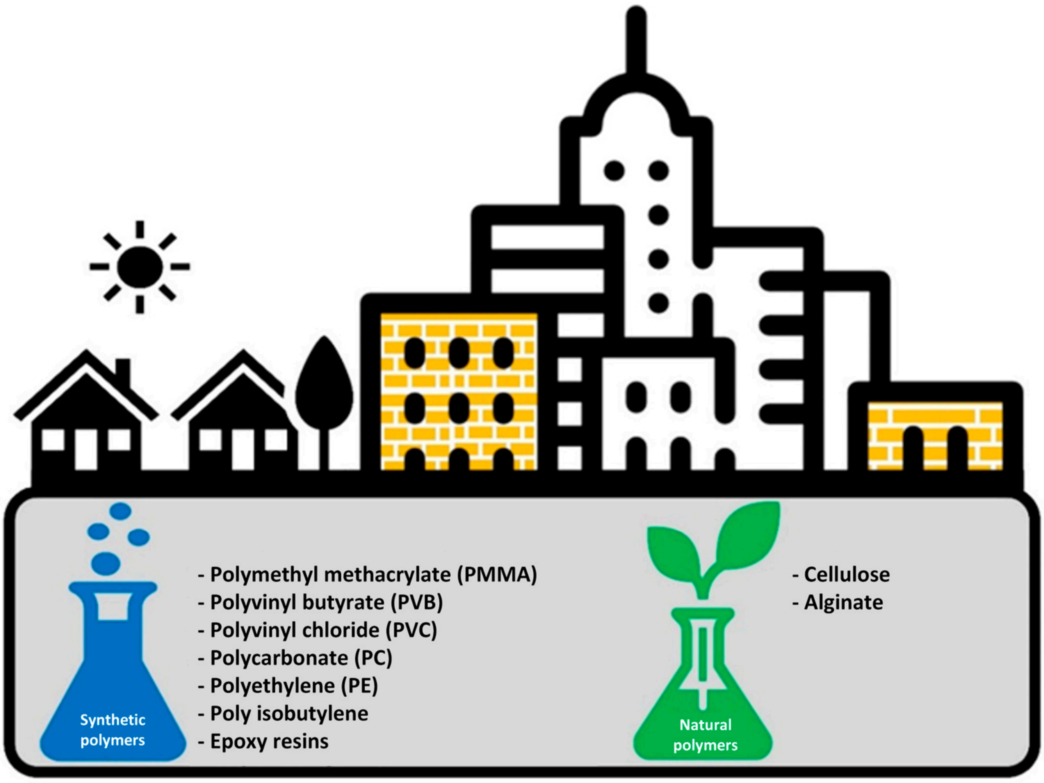

Figure 1. Different synthetic and natural polymers as CBMs.

Figure 2. Different applications of synthetic and natural polymers as CBMs.

2. Synthetic and Natural Polymers as Construction and Building Materials

Polymers are both synthetic and natural substances. Polymerization is the transformation of monomers, or "building blocks", into polymers. In addition to chemicals obtained from petroleum, chlorine, hydrochloric acid, fluorine, nitrogen, oxygen, and sulfur are used in the production process. In all plastics, additives include plasticizers, pigments, solar radiation stabilizers, preservatives, and fragrances. Plastic is composed of organic compounds with a high molecular weight that may be liquefied and poured into certain molds [15]. Any dosage form uses polymers as necessary excipients. They should be trustworthy, affordable, non-toxic, etc. There are two basic types of polymers: synthetic and natural. Due to their potential environmental uses, synthetic and natural biodegradable polymers have garnered much more attention recently. Various industries, including building, agriculture, and pharmaceutical packaging, use biodegradable materials. In recent years, there has been increased interest in biodegradable polymers. Synthetic and natural polymers are the two main forms of biodegradable polymers [32].

Both manufactured and naturally occurring chemicals can be used in the production of biodegradable polymers. In applications that are only intended to be transitory, polysaccharides originating from plants (such as cellulose, alginate, and dextran) and polymers produced from animals (such as collagen, silk, and chitosan) that have an inherent capacity to be broken down by enzymes have been applied. These compounds typically have intrinsic bioactivity, which when taken may result in an immunogenic reaction; nevertheless, they may also demonstrate a significant amount of variance from batch to batch. Synthetic polymers, on the other hand, tend to exhibit more predictable physical characteristics and patterns of degradability that may be chemically changed in addition to the increased level of biological inertness. The ester bond in synthetic biodegradable polymers like polylactide (PLA), polycaprolactone (PCL), and polyglycolide (PGL) makes hydrolytic degradation possible. Cleavage sites on the polymer backbone can be an amide, thioester, anhydride, carbonate, urea, urethane, imide, or imine bond when the circumstances are physiologically safe. Both chemically and enzymatically, these moieties can be broken down using the process of hydrolysis. Most of the research that has been carried out on biodegradable polymers thus far has been on hydrolysable connections, which are connections that break down when exposed to physiological water conditions [16]. Even though there have been reports of enzymatic cleavage of carbon–carbon bonds and the possibility of hydrolysis of other moieties (sulfonamides, phosphonates, and others) by a catalytic acid or base, there are no instances of enzymatic cleavage of carbon–carbon bonds [16]. Synthetic and natural polymer materials are extensively used in the construction industry [33–36]. One study investigated replacing traditional reinforcement with natural polymers such as bamboo pegs to improve the bonding ability of concrete. Using discarded glass powder and glass polymer in concrete reduces global warming concerns and promotes a sustainable society [37]. Due to their advantages outweighing their drawbacks, composite materials are used; for example, glass and natural polymers are combined to improve the mechanical qualities of concrete [38]. Concrete's mechanical qualities are improved when bamboo is used in place of some of the traditional reinforcements [39]. Glass polymer-reinforced plastic (GFRP) is used instead of structural steel as the primary bar, stirrup, and shear reinforcement for GFRP plates [40]. Shear reinforcement in polymer-reinforced polymer (FRP) composites improves strength, stiffness, and corrosion resistance [41]. Another study investigated the use of synthetic reinforcement made from recycled thermoplastic polymers and natural palm polymers [42]. Steel-reinforced polymer (SRP) composites are more susceptible to fatigue than reinforced concrete, according to the findings of one study [43]. As a result, natural and synthetic polymers are extensively used in several sectors of sustainable construction. Figure 3 illustrates the benefits of different polymers as CBMs [12].

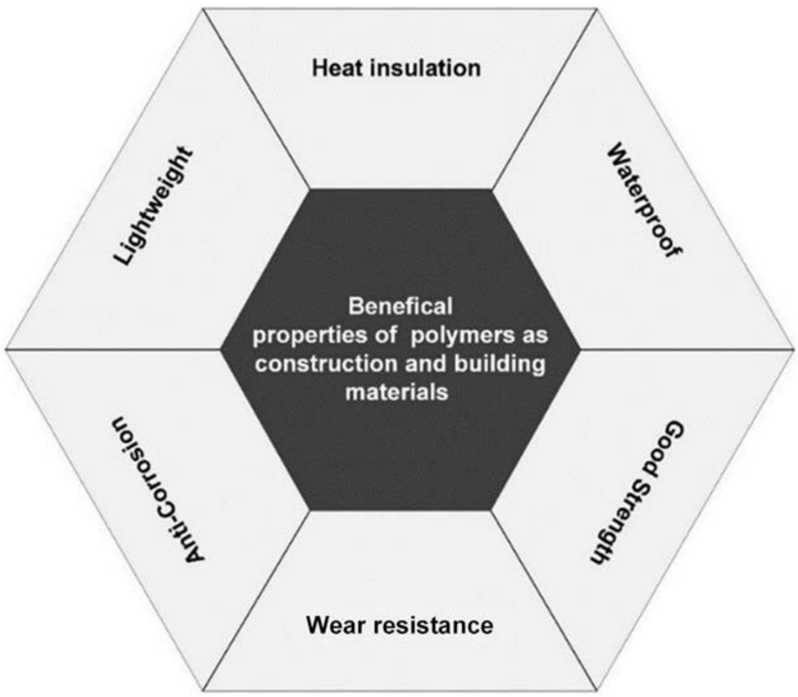

Figure 3. Beneficial properties of different polymers as CBMs [12].

2.1. *Poly(methylmethacrylate(PMMA))*

PMMA stands for poly (methyl methacrylate), which is a type of fabricated polymer that is generated from the methyl methacrylate monomer. Additionally, it is referred to by the IUPAC names poly[1-(methoxycarbonyl)-1-methyl ethylene] and poly(methyl 2-methyl propanoate), respectively [44]. Otto Rohm, a German scientist, produced the concept of PMMA for the first time in 1934, about the same time as British chemists Rowland Hill and John Crawford discovered PMMA in the early 1930s [44,45]. Because of its high impact strength, low weight, resistance to shattering, and simplicity of manufacture, PMMA is frequently used as a substitute for inorganic glass. PMMA is also an optically clear (transparent) thermoplastic [44,46]. The ability to withstand abrasion and exposure to the environment are both highly desirable qualities. The nearby methyl group hinders the polymer structure from packing tightly in crystalline form and from freely spinning around the C-C bonds, both of which are necessary for the structure to function properly (CH_3). Because of this, scientists eventually determined that PMMA is an amorphous kind of thermoplastic. PMMA had its first significant use in the construction of airplane windows during World War II [44,47]. Previous studies have shown that PMMA may be used successfully in buildings since it is an appropriate material for this purpose [48–54]. According to the findings of one researcher, Poly Methyl Methacrylate Polymer Concrete (PMMA-PC) is a CBM that has been used for overlays and possesses superior mechanical properties, making it a potential alternative to ultra-high-performance concrete (UHPC) for use in field joints. Comparing the structural performance of PMMA-PC and UHPC for longitudinal field joints in bridge deck bulb tee girders was the goal of the study in [55]. According to another piece of research, superhydrophobic poly(methylmethacrylate)-SiO_2 nanocomposite films (also known as PMMA-SiO_2) with a micro–nano hierarchical structure can be manufactured even in the absence of low-surface-energy components. The self-cleaning and waterproof properties of the resulting PMMA-SiO_2 nanocomposite coatings for outside building walls, exterior automotive coverings, sanitary items, and other products proved to be promising [56]. According to one study, eicosanoid–stearic acid (EA-SA) eutectic nano-capsules were created by using UV-photoinitiated emulsion polymerization. These nano-capsules were then enclosed in polymethyl methacrylate (PMMA). Using various characterization methods, researchers investigated how different preparation processes affected the thermal properties and particle size distribution (PSD) of the final product. However, the latent temperatures of capsules dropped when there was a rise in the concentration of both monomer and initiator. The kind of emulsifier that is in an emulsion affects the phase change characteristics and PSD of EA-SA and PMMA. Manufacturing of nano-capsules helped reduce the issue that PCMs had with excessive cooling. As a result, this substance possesses the requisite qualities for applying it in the construction of thermal storage CBMs [57]. As a result, polymethyl methacrylate (PMMA) was previously considered a potential CBM for environmentally friendly structures.

2.2. Poly(vinylbutyrate(PVB))

Polyvinyl Butyral, often known as PVB, is a polymer with great mechanical and optical clarity. It has been extensively used as an interlayer material for laminated glass in the construction industry, where it has proven to be particularly useful. When making laminated glass, it is a frequent practice to use a transparent polymer interlayer to glue the two sheets of glass together throughout the manufacturing process. The composite pane, which has low shear stiffness, transmits lateral stresses through its two glass plies before the glass fails. After the glass has broken, the tensile force is borne by the PVB interlayer that joins the shattered glass shards, while the glass ply itself is solely responsible for bearing the compressive stress. The study and design of laminated glass against common quasi-static and low-rate dynamic loadings are not as well understood as the behavior of a laminated pane under high-rate dynamic loadings, such as blast and impact. This is because the study and design of laminated glass are more straightforward. Several studies on the behaviors of laminated glass have been described [58–61]. Glass is frequently used in building windows and structural façades. Traditional monolithic glass panes, on the other hand, provide minimal resistance, especially against high pressures such as impact and air blast loads, as glass is a brittle and delicate material. The collapse of glass windows frequently results in significant fatalities because the fragmented glass fragments caused by blast loads are sharp and fly at high speeds. Blast-resistant glazing has been studied since World War II. There have been several retrofit solutions offered [62]. As an interlayer material for laminated glass, polyvinyl butyral (PVB) has seen widespread application because it is very ductile and adheres well to the glass. This helps reduce the risk of injury posed by broken glass shards. As a direct response to the growing dangers posed by terrorist attacks and the effects of debris, the use of PVB laminated safety glass has been expanded beyond quasi-static loading regimes and into impact and blast loading regimes. According to one study, a broad variety of strain rates were used to experimentally examine the mechanical properties of PVB. It is discovered that PVB acts as a hyperplastic material under quasi-static tensile stress, and the loading rate affects material properties. When subjected to dynamic loading, PVB reactions exhibit a time-dependent nonlinear elastic characteristic. As the strain rate rises, PVB ductility decreases [59].

Numerous numerical methodologies have been applied to mimic the responses that laminated glass windows produce [63–66]. Wei et al. [63] developed a three-dimensional finite element model that consisted of a viscoelastic material model for PVB and an elastic model for glass. Hooper et al. [64] developed a two-stage model (pre-crack and post-crack) by supposing that glass breaks in a millisecond. The Johnson–Cook model that takes strain rate dependency into account is one of the most common models used in numerical simulations to simulate the overall behavior of laminated glass. Experiments conducted over the years on PVB material have provided conclusive evidence of the significance of the strain rate effect. When subjected to static or quasi-static stress, PVB displays viscoelastic behavior; nevertheless, it demonstrates elastoplastic or even brittle behavior when subjected to dynamic loading [62]. Reproducing layered glass with an elastoplastic material model for PVB and an elastic material model for glass was accomplished by Larcher et al. [65] using dynamic testing data and an elastic material model for glass. In another work [66], the delamination behavior of polyvinyl butyral (PVB) laminated glass was investigated using a cohesive zone model (CZM) with an isotropic bilinear traction–separation (T–δ) law under quasi-static stress. PVB has been used as window glass in environmentally friendly structures because it possesses exceptional mechanical qualities.

2.3. Poly(vinylchloride(PVC))

Regnault discovered vinyl chloride (VC) in 1835, and the polymer was first detected in 1838 [67]. To produce the white powdery substance known as PVC, Baumann reported the polymerization of several vinyl halides, including VC, using sunlight in 1872 [68]. The 1930s saw the development of stabilizer usage [69–73]. Due to its exceptional mechanical and physical qualities, PVC is one of the most widely used polymers in the world today. However, compared to other common polymers like polyethylene and polystyrene, PVC's fluidity and heat stability are subpar [69,71]. Most PVC is created using radical polymerization. However, radical polymerization of VC produces molecules with various structural flaws and isomeric forms. These elements are crucial for PVC users because they affect the completed product's mechanical qualities, color, and processing behavior, the thermal stability of the polymer, and the crystallinity. The nature of the side reactions that occur during polymerization is revealed by defect studies [69,72]. Along with the inclusion of additives including plasticizers, thermal stabilizers, lubricants, fillers, and other polymers, many efforts have been made to enhance the substandard qualities of PVC [72].

The one type of thermoplastic that is most frequently used in building construction is polyvinyl chloride (PVC). The primary properties of PVC are resistance to rips, low cost, and resilience to water and certain chemicals. Many polymers have excellent water and vapor resistance and strong thermal insulation qualities when formed as foams. Plastic can pose as a sealer under the guises of paint, sheeting, paper, sealing strips, and masking tape. The three polymers used to make sheeting are PVC, poly-isobutylene, and polyethylene. Sheeting can be used as a vapor barrier, moisture-proofing, or damp-proofing for foundations [15,73]. Foam made of polyvinyl chloride (PVC) is a decent substitute for wood and is frequently used in the construction sector. To encourage the use of PVC foam in the construction industry, a researcher explored the properties of PVC foam materials in various areas as well as important future research and development directions [74]. In addition, they study and describe the use of PVC foam materials in domains such as thermal insulation materials, concrete forms, and resilient flooring. Although rigid vinyl foam is already used in products such as profiles, sheets, and foam core pipes, it is still uncommon in applications such as house siding and other wood replacements. Another study compares the end-use capabilities of vinyl foam and its potential as a wood substitute. The impact of certain types of formulation components on density, surface quality, and other physical attributes is addressed, as are comparisons between the various extrusion techniques and formulations [75]. Through practical and analytical analyses, a different study proposed and verified a novel ductile design approach for confined concrete-filled polyvinyl chloride tubular (CCFPT) columns. It is a novel design idea for building ductile columns in seismic areas [76,77]. As a result, PVC is an appropriate polymer and a popular CBM for sustainable construction.

2.4. Polyamides(nylons)

In addition to being well known for fiber used in the construction industry and other sectors, polyamides (also known as nylons) are important technological polymers. The materials discussed are amorphous nylon, nylon-4,6, nylon-6,6, nylon-6,9, nylon-6,12, nylon-12, nylon-11, and various semi-aromatic nylons. Physical features include crystallinity, thermal parameters, moisture absorption, electrical properties, and flammability. Chemical features include hydrolysis or polycondensation, thermal deterioration, oxidation, and UV aging [78]. Polyamide fibers can take on several shapes in civil construction projects depending on the purpose for which they are intended. Polyamide fibers are utilized as micro- and macro-fibers, fibrillated fibers, and monofilaments for concrete internal reinforcement [79]. Previous research has revealed many features and applications of this polymer in the construction industry [79–86]. Using these fibers sparingly, Walton and Majumdar showed that the composite's impact resistance is significantly improved while its tensile or flexural strength is little affected [79]. Clarifying the performance of synthetic fiber-reinforced concrete has become crucial due to increased industry interest in using it. The article in [80] discusses the properties of numerous synthetic fibers, including polyamide, and the behavior of concrete reinforced with each of these fibers. The post-peak decrease is steeper for nylon than for steel fiber according to Kurtz and Balaguru's comparison of the load–deformation behavior of rapid-hardening concrete reinforced with nylon six and steel fibers [81]. The strength characteristics of concrete reinforced with polyamide fiber have been examined by Song et al. The polyamide fibers claimed to have a marginally higher ability to disperse themselves throughout the concrete when compared to polypropylene fibers, dispersing the unfavorable stresses over a larger volume of concrete and enhancing the properties of the concrete in the plastic and hardened states [82].

Fibers, particularly nylon, are essential components in creating a wide variety of structures, including roadways, bridges, nonstructural gratings and claddings, structural systems for industrial supports, buildings, long-span roof structures, tanks, and thermal insulators. In geotechnical and environmental applications where non-mechanical qualities are of the utmost significance, fibers and textile structures are frequently used as CBMs. Fibers and fibrous structures are the primary CBMs, as evidenced by examples such as barriers and retaining walls, road construction, road overlaying, erosion control of steep slopes, shore protection, construction of waste landfills, architectural membranes, and offshore applications. Other examples include dams and retaining walls. In these applications, polyamide fibers, namely polypropylene and polyester fibers, are used to an excessive degree [83]. Nylons are therefore applied in various civil engineering applications, such as creating sustainable bridges and roads.

2.5. Polycarbonate (PC)

Engineering thermoplastics are highly sought-after for various uses worldwide. Society prefers polycarbonate as a synthetic thermoplastic for various uses. It is an example of an amorphous thermoplastic. It possesses special moldable mechanical, thermal, optical, and electrical characteristics. It has numerous industrial applications including civil engineering, construction, and electronics [87]. By focusing on the thermal insulation system, a novel category of polymer heat and thermal conductivity creates a significant advancement in sustainable construction, including creating concrete panels that combine polycarbonate with concrete. Concrete panels made of polycarbonate may be an excellent heat insulator. The most crucial factor in changing a building system to a green building design is energy efficiency [88]. According to certain studies, this polymer has been used in several civil engineering disciplines [88–93]. Different purposes and restrictions affect modern building construction. Design decisions must take energy efficiency and environmental issues into account in addition to robustness, comfort, and cost-effectiveness. CBMs made of polymers can be used in place of or in addition to conventional CBMs such as bricks, concrete, metals, wood, and glass. Plastic materials offer several characteristics including light weight, the ability to be molded into intricate designs, durability, and the requirement of little maintenance. Plastic materials come in various forms, hues, and textures and do not necessarily need to be painted. They are immune to microbiological assault and metallic corrosion and are resistant to heat transmission and moisture dispersion. In the building construction sector, polymeric materials, notably thermoplastics (such as polycarbonate glass), have various structural and nonstructural uses [89]. The assessment of precast concrete sandwich panels (PCSPs), the connection of concrete panels to walls or roofs using polycarbonate panels, and simple temperature insulation in concrete panels are all topics of another piece of research [88]. The usual characteristics of plastic glazing materials, such as polycarbonate, were introduced by Blaga [81]. According to research conducted in the past, plastics are used in construction because of the multiple design choices that they offer in terms of light transmittance, color, and form. Additionally, plastics have low heat conductivity compared to other CBMs [82]. Another researcher has developed a multiscale simulation that links the development of materials at the microscale, the design of component structures at the mesoscale, and the evaluation of the thermal insulation of the entire building at the macroscale. This was carried out to encourage the sustainable development of housing in a society that produces small amounts of carbon. The purpose is to evaluate the interaction between regional material research and global objectives. One of the most difficult aspects of the simulation involved a novel polycarbonate glass with a covering of scratch-resistant resin containing hollow silica nanoparticles [92]. One researcher [93] created glass with polycarbonate glazing. Polymers are used in a variety of structural and nonstructural applications in the building industry; around 18% of the United States' plastic use occurs in the building and construction industry [89,94]. Plastic smart windows are quickly becoming one of the primary components of the next generation of highly energy-efficient buildings. The manufacturing of low-cost and lightweight electrochromic (EC) devices that will be included in such buildings is an important consideration. For this reason, one study focused on developing ITO-coated polycarbonate (PC) structures that could serve as transparent and conductive plastic supports using a deposition process that occurred entirely at room temperature. Radiofrequency magnetron sputtering is used to generate indium tin oxide (ITO) thin films under a variety of different deposition circumstances without the need for the substrate to be heated or for the polymer surface to be activated [95]. As a result, this thermoplastic polymer is frequently used in construction to create sustainable structures.

2.6. Polyethylene (PE)

Polyethylene (PE), although having the most fundamentally straightforward structure of any polymer, is responsible for the production of the greatest quantity of plastics by weight (repetition of CH_2 units). PE's most appealing properties are its low cost, good electrical insulation across a wide frequency range, exceptionally high chemical resistance, exceptional processability, toughness, and flexibility. Thermoplastic polymers such as PE have frequently used materials crucial to every part of our existence. A robust end-of-life management strategy is required due to the ubiquitous creation of plastic garbage. This thermoplastic polymer is mostly found in durable goods such as CBMs. Applications for plastics vary widely because of their unique characteristics [96]. Given the wide range of PE kinds and grades discussed thus far, it should not be surprising that PE now controls the polymer market. PE's qualities are what made it so popular for many packaging and construction applications. PE foam is used in concrete, brick, and block construction as an expansion joint filler or as an insulator in structures [97]. CBMs have been made using this polymer [98–105]. PE powder has been used as a multifunctional and cost-effective construction element in foam concrete to boost thermal insulation. This would solve the issue of energy consumption and satisfy the demand for energy efficiency in buildings [98]. According to the findings of a second researcher, the study of concrete that incorporates polymers such as fibers, resins, and aggregates did not start until the very last decade of the twentieth century. Raw plastic, PE, was used for specific purposes and it was most frequently used in the form of granules. Plastic aggregates derived from various sources, including the shredding of recycled plastic bottles, were applied in the production of such concretes [99]. Increasing numbers of researchers are interested in developing thermally insulated lightweight concrete (TI-LWC) for structural purposes. The reason for this interest is the desire to limit the emissions of greenhouse gases and the consumption of energy. The described study was conducted to develop TI-LWC, although only a few studies have been conducted to create LWC. To create the described TI-LWC, PE beads were used [100]. One study discusses fire resistance, one of the main problems preventing the widespread adoption of composite construction in high-rise buildings. In this work, a method for improving the fire resistance of multilayer composite sandwich panels—made of PE foam core and GFRP composite facets—was introduced [102]. Lightweight concrete with PE foam waste included has been made with a volume proportion of 30% by Perevozchikov et al. [103]. They produced lightweight concrete with densities between 1592 and 1840 kg/m^3 and compressive strengths between 2.31 and 8.44 MPa by adjusting the water and cement concentrations. Given the obvious financial benefits, it made sense to apply recycled PE, particularly for polymer concrete, which has an endless market in civil engineering applications for green buildings.

2.7. Poly-Isobutylene (PIB)

Poly-isobutylenes (PIBs) are a very flexible class of saturated aliphatic polymer material, although they are manufactured in far fewer numbers than other common polymer commodities. Because of their low reactivity, PIB materials exhibit excellent chemical resistance to strong oxidizers (such as ammonium hydroxide, peroxides, and hydrochloric acid), corrosives (such as sulfuric acid and diluted hydrofluoric acid), and harsh chemicals (like *n*-methylpyrollidone). The low dependence on temperature, the high degree of inelastic spreading, and the low dependence on viscosity set it apart from other polymer materials. Furthermore, the high rates of structural relaxation are responsible for the extremely unique and rare structural relaxation temperature. As a result, PIBs have numerous important commercial uses, including as raw materials in the production of lube additives, metalworking fluids, adhesives, and various construction industry materials such as sealants [106]. Consequently, PIBs have been used as CBMs in a range of civil projects [107–111]. One study examines the properties of a specific sealing system applied in warm edge glazing units as well as the causes of damage that may occur to such a system. The effectiveness of the dual-seal PIB/silicone system was of primary interest. This glass is frequently used in the modern curtain walls and tops of commercial buildings and shopping centers [107]. The findings of laboratory and field experiments conducted to establish the displacements of insulating glass seals are given in Watson et al.'s study. The authors concentrated on figuring out how frequently thermoplastic sealing, specifically dual seals with PIB, would be displaced [108]. Studies on the incoherent inelastic neutron scattering of poly-isobutylene, the least brittle polymeric glass-forming material yet discovered, were conducted. When the temperature is greater than the glass transition, a fast dynamical process is found in a frequency range of around 500 GHz, almost unaffected by the relaxation. According to the data, this fast dynamical process can be inelastic and devoid of relaxational or quasielastic features. This emphasizes how important it is for glasses' vibrational behaviors to alter close to the glass-transition temperature [109]. According to another study, plasticized poly-isobutylene and other polymer materials are now used in the construction industry overseas. However, this material lacks the elasticity and suppleness needed to adapt to changes in structural components brought on by temperature changes. The best waterproofing materials for this purpose are elastomers [110]. One piece of the study suggests that the lifetime of buildings can be increased by applying double sealants comprising adjacent silicone and poly-isobutylene sealants. In a double-sealed connection, the inner sealant is often a silicone sealant. The outer polyisobutylene sealant is commonly used for buildings [111]. As mentioned before, this polymer has been applied in construction to create sustainable construction.

2.8. Polypropylene (PP)

Due to its low density, polypropylene (PP) became popular quickly. Extrusion and injection molding are two methods for converting PP, and it is chemically resistant. Propylene can catalyze the production of polypropylene. Elevated temperature resistance is one of the key characteristics of PP, making it ideal for trays, funnels, buckets, bottles, carboys, and instrument jars used in clinical contexts. Free-color polypropylene is strong. Consequently, new polypropylene grades are necessary for some applications, and the study of such grades must continue so that we always have the best alternative to meet the needs of our evolving society [112]. Multiple scientists have tried using this polymer in construction [113–121], particularly in concrete. One study found that the performance of FRC was affected by the type of fiber utilized in its construction. The advancement of hydrophobic polypropylene (PP) fibers in FRC can improve the material's tensile and flexural properties, resilience, and fracture resistance. The effects of long (38.1 mm) PP fibers on the workability, compressive strength, and flexural strength of concrete at concentrations of 0.20%, 0.25%, and 0.30% are the focus of [113]. In a separate study, 0.20, 0.25%, and 0.30% content by weight of three distinct PP fibers were used. Strengths in both compression and flexure were determined. The findings demonstrated that the compressive strength decreased significantly with increasing fiber size, even though it was still superior to the sample that served as a control. The compressive and flexural strengths of the concrete were both significantly impacted by the length of the PP fibers that were included in the mix [114]. Despite its relative immaturity, polypropylene fiber-reinforced concrete has impressive mechanical strength, stiffness, and longevity. Incorporating polypropylene fibers into concrete helps cut costs while making the most efficient use of the material. In this study, the behavior, applications, and performance of polypropylene fiber-reinforced concrete are dissected in detail [115]. Though Thirumurgan and Siva Kumar found that adding polypropylene fibers made the concrete less workable, they found that high-range water-lowering additives helped restore the material's pliability [116,117]. As the fiber content of polypropylene fibers in concrete rises, its workability decreases, as reported by Patel et al. [118]. The use of polypropylene fibers in fly ash concrete was a topic of study by Murahari and Rama Mohan Rao [119]. According to Jianzhuang Xiao et al. [120], polypropylene fibers may be applied to control plastic shrinkage and fresh and hardened concrete properties. Shotcrete polypropylene (PP) fibers have been used for years to reinforce and stabilize buildings and foundations. However, recently, there has been a shift towards using waste materials in cement-based combinations to make greener products. There has been a rise in the popularity of eco-friendly construction, which has led to an increase in the number of inquiries about how engineers and architects may use eco-friendly materials [122]. This polymer is therefore widely used as a structural component in several environmentally friendly infrastructure developments.

2.9. Polystyrene (PS)

Crystal polystyrene, general-purpose polystyrene, and other trade names all refer to the same amorphous polymer that is very transparent, odorless, and rigid yet brittle [123]. Besides its use in concrete, this polymer is also found in various CBMs [124–130]. Polystyrene is being applied in sustainable materials because of its low density and great thermal efficiency, according to one researcher. Lightweight aggregate concrete can be made using this material instead of coarse aggregate (LWAC). Expanded polystyrene (EPS) is a common substitute for aggregates in concrete due to its light weight and low thermal conductivity [124]. Adeola's and Soyemi's work on expanded polystyrene concrete is noteworthy. They used EPS as an aggregate replacement in the range of 5 to 30% to evaluate its impact on the concrete's workability and mechanical properties (5% interval). They argued that the concrete became less workable as the proportion of EPS substitution increased [125]. Foamed concrete's fire retardancy, thermal conductivity, and compressive strength were all studied by Sayadi et al., who looked at the effects of EPS particles at EPS volumes ranging from 0 to 82%. Therefore, they concluded that concrete mixes with low EPS volume and high cement content created higher fire endurance [126]. Another study found that the moisture content and thermal conductivity of CBMs were the two most relevant thermal transfer factors. Insulating materials play a larger role in the energy and moisture balance of a building than any other building component. Studies of expanded polystyrene thermal insulation materials of varying mass densities are presented here, and their results for thermal conductivity and water sorption are discussed [127]. The physicomechanical qualities of lightweight bricks made from cement kiln dust (CKD) and poly(styrene) (PS) are suitable for use in subsequent construction applications, with or without the inclusion of additives that increase the materials' properties, as was achieved in separate research [128]. Mild steel bars were used to reinforce the same specimens in both sets of tests [129]. Another study reported that lightweight concrete using expanded polystyrene beads (EPS-LWC) has been extensively used in both structural and nonstructural contexts [130]. Several green CBMs have been developed using this polymer.

2.10. Polyurethane (PU)

Polyurethane is a very prevalent polymer molecule that belongs to the plastic family (PU). To protect, strengthen, and restore civil engineering infrastructure, PU and its variants have become more popular over the past decades. Castable elastomers, stiff and flexible foams, coatings, fiber, adhesives, sealants, thermoplastics, and millable gum are all examples of PU materials used in this context. To tailor its mechanical properties to the requirements of specific applications, PU shows promise as a versatile and adaptable material. Because of its critical binding qualities with various substrates and its self-supporting feature that does not require extra adhesive, PU may be easily manufactured using basic techniques and applied to a variety of surface types [131]. Otto Bayer and colleagues at I.G. Germany's Ferbenindustri discovered the first PUs in 1937 [132]. This polymer is used as a structural component in various construction applications [132–139]. Magnesium oxide (MgO) board and stiff polyurethane foam (PUF) reinforced with glass fibers are the components of a newly created prefabricated wall system, and its structural behavior is discussed by one researcher. Finally, the findings support the viability of applying this composite wall system in residential modular construction [133]. Mohamed et al. note that the increased demand for modern structural systems can be attributed to their greater longevity and reduced maintenance needs over their service lives. Sandwich composite structures are of particular interest due to their many attractive features including light weight, high strength, resistance to corrosion, long lifespan, and ease of construction. In this study, new-generation two-part thermoset polyurethane resin systems are used as matrix materials in the vacuum-assisted resin transfer molding (VARTM) process to create three distinctive designs of glass-reinforced composite sandwich structures: boxes, trapezoids, and polyurethane rigid foam [134]. A sandwich composite approach using PU foam and concrete has been developed by Hradil et al. [135] to extend the longevity of walls by decreasing rainwater infiltration. The flexural performance of an innovative hybrid composite floor plate system with a polyurethane (PU) core, glass fiber-reinforced cement (GFRC) outer layer, and steel laminates was studied by Abeysinghe et al. In addition to other structural benefits [136], a developed slab system has a weight reduction of 50–70% compared to conventional composite slabs. Flexural behavior and potential as a replacement for concrete panels were investigated by Fam and Sharaf [137] in sandwich panels with a PU foam core and glass fiber-reinforced skins and ribs in various configurations. Lee and Lee [138] investigated a PU foam core reinforced composite system comprising plywood, triplex, mastic, and steel sheets. Gong et al.'s research centered on developing low-grade hardwood laminated railway ties that met North American performance criteria. No. 3B common-grade wood, mostly hard maple and, to a lesser extent, yellow birch, were glued together using a two-component polyurethane structural adhesive to form sixteen joints [139]. Therefore, because of technological developments and the versatility of PU, new uses for PU have significantly increased in recent years, especially in environmentally responsible structural and infrastructural applications.

2.11. Cellulose

The most well-known and in-demand source of cellulose is plants, but it is also necessary for bacterial, fungal, algal, and even animal systems to function during their life cycles. The evidence for the structure of cellulose came from two different directions: traditional organic chemistry on the one hand and early polymer investigations on the other [140]. Cellulose $(C_6H_{10}O_5)_n$ may form linear chains with hundreds to over nine thousand glucose units joined by 1-4 glucosidic linkages, making it an organic polymer that is most frequently found in nature and a key component of natural fabrics like cotton and wood [141].

Fabrics are a common and time-tested choice for residential construction. There has been an increase in the number of projects using fiber-reinforced composites. Fiber-reinforced concrete, concrete retrofitting, concrete jacketing, and the internal and external reinforcement of composite concrete structures all make extensive use of fibers and fibrous structures. Fibers like AR-glass, carbon, and aramid are of uttermost value in these novel applications because of their high strength, high modulus, and capacity to compete with standard structural CBMs [79]. In contrast to synthetic materials, natural fibers have poor mechanical properties and cannot be used in engineering construction [83]. This natural polymer's application as a CBM has been detailed in previous research [83,142–148]. Civil engineers have used cellulosic textiles as reinforcing components in cement-based composites [142]. Cementitious composites that use hemp textiles as reinforcement have been applied, as reported by Hakamy et al. Hemp fabric has a tensile strength of 591–857 MPa, an elastic modulus of 38–58 GPa, and a density of 600 kg/m^3 [143]. Yan et al. wrapped flax fabric FRP composites around plain concrete (PC) and coir fiber-reinforced concrete (CFRC) to examine their compressive properties. Wrappings made of flax fiber-reinforced plastic (FFRP) increased the final compressive strength [144]. Tensile properties of manually laid-up flax fabric/epoxy and glass fabric/epoxy composites were compared by Assarar et al. [145]. Research has shown that flax composites can have a tensile strength of up to 380 MPa, making them competitive with epoxy composites that also include glass fiber for reinforcement [145]. Jawaid et al. investigated epoxy composites that used both jute cloth and oil palm fiber (EFB) as reinforcing materials. It was found that the tensile characteristics of hybrid composites may be enhanced by adding additional jute fabric to the mixture. They theorized that oil palm/jute hybrid composites could replace synthetic composites in construction, transportation, and aerospace with the right amount of engineering [146]. Sustainable construction uses for cellulosic fiber include the strengthening of concrete, masonry, and wood structures.

2.12. Alginate

Alginate is a polyelectrolyte and biopolymer that is thought to be biocompatible, non-toxic, immune-suppressive, and biodegradable [149]. Alginates must be seen as a family of copolymers [150]. CBMs have been prepared using alginate [151–156]. The use of sodium alginate emulsions for asphalt concrete modifiers was mentioned in one search result [151]. Another goal of this study is to stabilize soils using natural polymers and fibers to create composite CBMs that are sustainable, non-toxic, and obtained locally. As a bonding agent in the composite, alginate (a natural polymer derived from the cell walls of brown algae) has been applied [152]. One study found that extending the lifespan of asphalt surfaces might be accomplished by increasing the material's inherent capacity to repair itself. Calcium alginate capsules encapsulating rejuvenators for asphalt mastic have been created and shown to be effective in providing localized crack healing [153]. Green concrete has emerged as a crucial factor in recent years, according to another study. Durable concrete is crucial to a building's capacity to withstand the elements and remain standing. Long-term viability was diligently pursued as the end goal. All these measures contribute to the "greenness" of the concrete project by reducing energy use and fossil fuel ash. Marine brown seaweed is a naturally occurring biopolymer that may be found along the shore and has several benefits, such as improved soil stability, heat capacity qualities, and carbon dioxide fixation. The cell walls of sea brown algae secrete a natural hydrogel known as alginate. It is used in cases like unfired clay bricks, internal curing agents, admixtures that boost viscosity, etc. One research study investigates the potential of alginate-based seaweed as a natural polymer in concrete [154]. Previous research reports that civil engineers have always been interested in learning more about how to enhance soil quality. Another study aims to promote the use of sodium alginate biopolymer as a sustainable material for fortifying dunes [155]. Another study examines the viability of treating weak cohesive subgrades using a sodium alginate biopolymer, particularly when subjected to repetitive traffic loads for pavement construction applications [157]. Alginate is therefore one of the most used CBMs for long-lasting civil infrastructure.

2.13. Epoxy Resins

The term 'epoxy resin' is used to refer to both the prepolymers and the cured resins. The prepolymers are named thus because they contain reactive epoxy groups. The cured resins undergo a complete reaction of all their reactive groups, resulting in the absence of epoxy groups. However, they are still referred to as epoxy resins [158]. Epoxy resin has garnered significant interest from researchers, particularly in the realm of building materials, due to its exceptional characteristics such as high strength, strong adhesion, adjustable setting time, chemical resistance, and impermeability. Multiple researchers have examined different features of epoxy resin-based concretes and compared their qualities to those of traditional Portland cement concrete [159]. Research cites epoxy resins as materials for construction and building purposes [160–163]. Epoxy resin exhibits significant potential for incorporation into masonry mortar and concrete as a binding agent, either in conjunction with traditional Portland cement or alone. One review demonstrates that epoxy resin possesses exceptional qualities when used without Portland cement, as the presence of water required for the hydration of Portland cement hinders the cross-linking process of epoxy resin. The performance of epoxy resin-based mortar and concrete exhibited significant variations based on factors such as the characteristics and type of epoxy resin and hardener, the amount of each component used, the concentration of the hardener, and the specific methods employed for mixing the composition and curing the material. A formulation based on epoxy resin has been created and successfully employed for the repair and maintenance of buildings. Epoxy resin demonstrates its exceptional ability to repair civil constructions [159]. The growing popularity of epoxy adhesives can be attributed to the diverse formulations available, offering a wide range of properties both before and after curing. This versatility makes them suitable for bonding various substrate materials in a wide array of applications and conditions. Additionally, the typical range of operating temperatures and the minimal shrinkage during curing make epoxies particularly advantageous for use in civil engineering [164]. Wood composites, such as plywood, composition board, and laminated beams, are commonly used in various applications within a building, including kitchen and bathroom cabinets, structural and decorative paneling, engineered wood flooring, and ceilings. These composites are created by blending wood and wood particles with polymeric adhesives. The adhesives commonly used in these applications belong to the phenolic class. A phenolic resin is normally created through a condensation reaction between phenol or a substituted phenol and formaldehyde. Curing occurs at a high temperature. These adhesives provide intrinsic fire resistance, low smoke production, excellent dimensional stability, resistance to deformation, strength, and resistance to solvents. Epoxy resin systems and polyvinyl acetate (white glue) have superior strength compared to resorcinol and formaldehyde (RF) and demonstrate greater tolerance towards structural manufacturing faults [165]. Epoxy resins are predominantly utilized in civil engineering to adhere composite materials, specifically carbon fiber-reinforced polymer (CFRP) strips and sheets, to concrete, metallic, or timber substrates. Typically, two-component epoxy resins are combined at the location where they will be used and need a specific amount of time to cure in order to provide adequate strength and stiffness [166]. Table 1 displays the assortment of polymers employed as CBMs, with corresponding references ranging from [166–178]. Table 2 presents the mechanical properties of polymers utilized as CBMs, with references spanning from [113,131,142] to [179–188].

Table 1. Diverse polymers used as CBMs [166–178].

No.	Polymer	Result	[Ref.]
1	Poly(methyl methacrylate (PMMA)	To produce high-performance light-transmitting concrete, specific quantities of Portland cement, polymethylmethacrylate (PMMA) optical fibers, silica fume, fine aggregate, polycarboxylate superplasticizer, silica powder, and water were mixed. The concrete was then put through a series of tests to determine its optical and physical properties.	[167]
2	Polyvinylbutyrate (PVB)	Both the safety of PVB-laminated glass and its behavior after it has been broken are highly dependent on the interfacial adhesion that exists between the interlayer and the glass. By increasing the thickness of the PVB layer, it is possible to improve the maximum force and energy absorption capacity of the laminated glass.	[168]
3	Polyvinylchloride (PVC)	The mechanical, confinement, and deformability qualities of thin-walled polyvinyl chloride (PVC) tubular specimens filled with concrete are discussed along with their other applications in civil and building construction.	[169]
4	Polyamides(nylons)	The orthotropic steel that makes up the bridge's wearing surfaces also serves as the bridge's abutments.	[170]
5	Polycarbonate (PC)	This study provides a greater understanding of the thermal and optical behavior of the polycarbonate panels and a collection of important data for precise studies in building integration, proposing that these systems may be a viable alternative to traditional windows in commercial buildings.	[171]
6	Polyethylene (PE)	The purpose of this research is to provide a comprehensive literature review on the engineering performance of recycled high-density polyethylene (HDPE) aggregates, fibers, and cementitious materials that are utilized in concrete. In conclusion, this research is the first of its kind to describe and evaluate the status of the mechanical and durability performance of recycled HDPE as a sustainable CBM.	[172]
7	Polyisobutylene	The insulated glass unit is installed into the window frame (or sash, in the case of operable windows) and secured with a glazing stop.	[173]

Table 1. *Cont.*

No.	Polymer	Result	[Ref.]
8	Polypropylene (PP)	The compressive and flexural strengths of concrete that was produced with rice husk ash (RHA) as an additional cementitious ingredient were evaluated. As a result, polypropylene (PP) fibers were applied to reinforce RHA-based environmentally friendly concrete.	[174]
9	Polystyrene (PS)	Expanded polystyrene (EPS) concrete was mixed using a premix process analogous to the sand-wrapping approach to create a lightweight, low-strength material with high energy-absorbing qualities. EPS concrete has poor workability and reduced strength because the hydrophobic surface and light weight of the EPS beads cause them to segregate during casting.	[175]
10	Polyurethane (PU)	The behavior of the three different methods that can be used to reinforce concrete bridge girders is compared here. One technique involves using carbon fiber-reinforced polymer (CFRP) sheets that have already been pre-impregnated with a water-activated polyurethane (PU) matrix.	[176]
11	Cellulose	Denser and more robust composites were produced by including silane, which functioned as a bridge between the cellulosic fiber surface, the fumed silica, and the cement matrix.	[177]
12	Alginate	This research aims to construct multinuclear Ca–alginate microcapsules with a rejuvenator for the self-healing of bituminous binder by integrating the alginate micro-emulsion technique with the droplet's microfluidic technology.	[178]
13	Epoxy resins	The glass transition of commercially available epoxy resins used for structural strengthening of concrete members for instance by means of carbon-fiber reinforced polymer (CFRP) strips	[166]

Table 2. Mechanical properties of the different polymers used as CBMs [113,131,142,179–188].

No.	Polymer	Result	[Ref.]
1	Poly(methylmethacrylate (PMMA)	The tensile strength is about 58.07 ± 3.14 MPa.	[179]
2	Poly(vinylbutyrate (PVB)	When considering dynamic loadings, such as impact or blast loading, the strain rate effect of PVB is of relevance. This research explored the strain rate impact in various strain rate ranges, including 0.07 s^{-1}–89 s^{-1}, 0.0067 s^{-1}–118 s^{-1}, 0.2 s^{-1}–400 s^{-1}, and 0.008 s^{-1}–1360 s^{-1}.	[180]
3	Poly(vinylchloride (PVC)	The tensile strength is equal to 63.67 N/mm^2.	[181]
4	Polyamides(nylons)	The tensile strength of nylon-6, nylon-66, nylon-11, nylon-12, and nylon-46, respectively, is 83 MPa, 80 MPa, 48 MPa, 66 MPa, and 100 MPa.	[182]
5	Polycarbonate (PC)	The reported tensile strength of low-viscosity, molding, and extrusion-grade PC ranges between 62.7 and 72.4 MPa. Nonetheless, the maximum tensile strength measured in this experiment was 58.8 MPa.	[183]
6	Polyethylene (PE)	The tensile strength of polyethylene is 2610 MPa.	[184]
7	Polyisobutylene	Tensile strength is about 1.7–2.5 MPa.	[185]

Table 2. *Cont.*

No.	Polymer	Result	[Ref.]
8	Polypropylene (PP)	Tensile strength at break is about 4500–6000 psi.	[113]
9	Polystyrene (PS)	Tensile strength is about 5000 MPa and tensile modulus is 80,000 GPa.	[186]
10	Polyurethane (PU)	The tensile strength of commercially available polyurethane (PU) ranges from 20.7 to 65.5 MPa, and this polymer has a greater strain capacity and cut-and-tear resistance.	[131]
11	Cellulose	Cotton has a relative density of around 1.5–1.6 g/cm^3, a tensile strength of 287–800 MPa, and an elastic modulus of 5.5–12.6 GPa.	[142]
12	Alginate	The wet tensile strength ranged from 0.166 g d^{-1} at 16 mPa·s to 0.494 g d^{-1} at 994 mPa·s.	[187]
13	Epoxy resins	The tensile strength of epoxy resin is about 8 MPa.	[188]

3. Conclusions and Perspectives

Engineering fields such as communication, acoustics, architecture, and structure are now included in the broad and multidisciplinary study of sustainable construction. Owners, contractors, suppliers, and building users all participate in it [187]. The past several years have seen a significant amount of research on sustainable construction [189–202]. In this context, polymer-based CBMs have seen increased application in recent years in the field of construction engineering [203–209]. Polymer-based CBMs offer significant benefits over conventional CBMs when functional additives are added to these polymers or when these polymers are added to traditional CBMs like concrete and mortars. Concrete and other CBMs can acquire good mechanical strength, quick curing times, strong adhesive qualities, resistance to abrasion and weathering, waterproofness, and great insulating qualities by adding polymers. FRPs can transform the prefabrication construction industry and offer appropriate housing for the expanding population, and their integration into prefabricated structures benefits both the structural and nonstructural components [210]. Polymer-based CBMs will have increased and expanded applications in the field of construction engineering due to their ability to provide sustainable building. The authors thoroughly analyze important subjects in this article, promote further research, and offer significant insights into the prospective domain of sustainable construction using natural and synthetic polymeric materials for building construction. Additional research is required to gain a deeper understanding of how various components can be incorporated into polymers to enhance their advantages as CBMs and encourage sustainable construction practices. Enhancing the mechanical properties, moisture resistance, and durability of these CBMs can be achieved by implementing advanced surface modification techniques on different polymers.

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