**Piezo and Sustainable Building Structure.**  It’s time to explore the innovative sustainable technologies based on unique energy Piezo materials, which produce clean, sustainable, without any chemistries’ involvement, electricity no matter sun is shining, or wind is blowing. [Piezoelectric materials](https://www.sciencedirect.com/topics/engineering/piezoelectric-material), as unique Energy materials from Perovskite group are capable of transforming **mechanical strain and vibration energy into electrical energy with the important reverse effect.** **These properties allow opportunities for world-wide applications** ( including -the most demanding - Climate Changing conditions’ applications ( mainly Transportation, Buildings, Different Industries**) implementing renewable and sustainable energy through UNIQUE PIEZO Materials (first piezo was introduced to us by Nature as Quartz) with the clean**[**power harvesting**](https://www.sciencedirect.com/topics/engineering/energy-harvesting)**and self-sustained smart sensing. Such approach will be extremely beneficial for Buildings for significant reduction not only the GHGs emissions, but also all kinds of dangerously toxic PM pollutants. The benefits of piezoelectric energy include simple configuration, high efficiency in generating electricity from ambient mechanical energy sources, being pollution-free, flexible and compact in size, and having abundant availability.**

In recent years, many techniques have been proposed and applied to improve the piezoelectric capacity of cement-based composite, namely admixture incorporation of different kinds of cement with developed different piezo materials. (e.g. [lead zirconate titanate](https://www.sciencedirect.com/topics/materials-science/lead-zirconate-titanate), barium [zirconate](https://www.sciencedirect.com/topics/materials-science/zirconates) [titanate](https://www.sciencedirect.com/topics/engineering/titanate), [carbon particles](https://www.sciencedirect.com/topics/materials-science/carbon-particle), steel fibers, many others ) and physical treatments (e.g. thermal heating and electrical field application). The successful application of piezoelectric materials for sustainable Buildings development not only relies on understanding the mechanism of the [piezoelectric properties](https://www.sciencedirect.com/topics/materials-science/piezoelectric-property) of various building components, but also the latest developments and implementations in the building industry, which illustrate the research efforts to develop new construction materials with high [piezoelectricity](https://www.sciencedirect.com/topics/materials-science/piezoelectricity), energy storage capacity and chosen type of cement. The latest techniques for utilizing the piezoelectric materials in energy [harvesters](https://www.sciencedirect.com/topics/engineering/harvester), sensors, and actuators for various building systems are extremely beneficial for Clean , Sustainable Buildings. With advanced methods for improving the cementitious piezoelectricity and applying the material piezoelectricity for different building functions, more renewable and sustainable building systems are anticipated.

**Building structures are constructed for the purposes of residential, official, and commercial activities, all of which make great contributions to the socio-economic development of a nation.** During their life cycle, buildings demand a large amount of energy, including the direct energy consumed during construction, operation, rehabilitation, and eventually demolition, as well as the indirect energy required for manufacturing the building's materials and components [1], [2], [3]. From recent literature [4], [5], it is estimated that building energy has been reported to occupy about 35% of total energy consumption worldwide. Additionally, CO2 emission and now different kinds of very toxic PM pollutants from the building industry is responsible for 40% of the total amount of carbon dioxide emitted worldwide [6]. Considering the energy challenges and environmental problems associated with building construction, it is essential to balance the advantages and disadvantages of using energy in buildings and to develop various schemes of achieving sustainability. Self-sustaining building systems thus seek to minimize their negative impacts on the environment through consuming fewer resources, mainly, such as materials, energy, water and so on. Among these resources, energy consumption is the primary concern, as it is associated with the entire building life- cycle and different emissions. Building energy consumption can be compensated by on-site generation infrastructures or reduced by self-sustained building components. Recently, as one of competitive for cement **- timber** has been increasingly recognized as an environmentally friendly resource and renewable building material. Construction of timber building is conducted within industry plants where little production and processing energy is required. Furthermore, timber buildings allow carbon dioxide storage, performance reproducibility and fast assembly, and their market trend is growing. To promote the application of timber building as a robust alternative to traditional infrastructure, acoustic and vibration emissions and management for timber building have recently been studied. Different prediction approaches, laboratory and field measurements, numerical analyses, and surveys assessing the response of large-scale wooden lightweight structures have been summarized and compered. A big factor in this decision will **be Coast and the Environmental Impact. Which will win? It is now on the table.** Disadvantages of Timber (Wood)- Wood construction is more likely to support the growth of mold, mildew, asbestos, and other toxic microorganisms. It also houses bugs and animals within the walls due to its natural makeup. Concrete is stronger and does not house anything that can potentially ruin your health or compromise your safety. Cost isn’t the only big deciding factor in a building material’s selection. With the increase in demand for sustainable, climate-resilient buildings, the construction industry has now put an almost equal amount of importance **on the environmental impact of a material.** There are no clear answers on just how well it performs yet, as mass timber construction has its own sustainability threats to worry about**. For piezo materials/sensors it does not really matter – to be embedded with chosen type of cement (as an ingredient in concrete and acts as its binding agent) or with timber.** To deal with sound insulation and reduction, the vibration energy harvesting technique is recommended for diminishing the impact of noise in lightweight timber buildings [10]. Such technique can be implemented by using piezoelectric materials, further promoting the development of renewable and sustainable Buildings. **Piezoelectric Materials provides motivation for scientists and engineers to develop a sustainable concrete structure with low life energy demand. This kind of material features the capacity to convert mechanical strain energy into electrical potential, and vice versa, to turn an applied electrical energy into mechanical strain**. On the other hand, piezoelectric materials can harvest mechanical energy (usually from ambient structural vibration) in the form of electrical energy which powers the associated electronic devices [11**]. Many researchers have recognized that ambient vibration is a very attractive source of energy (with density estimated in the range from 50 to 250 μW/cm3), and it is easily accessible and ubiquitous in structural fields at the micro-scale level** [12], [13], [14], [15]. **Piezoelectric material as a mechanical-to-electrical generator in building structures can save a portion of operating energy that is particularly used for indicator lighting, electrical heating for water, and ventilation. Compared to fuel-burning devices (e.g. microturbines), the use of energy technology from piezoelectric material can address issues related to noise, exhaust, and safety. On the other hand, piezoelectric material-based sensors can be inserted into construction material so that the smart building structures have the capacity for conducting real-time and on-line damage detection [16]. The smart sensing function is low-cost and energy-saving and predicts the remaining useful life of a Building structure.**

### Overall- the fundamentals and applications of Piezoelectric materials for the Buildings structure – expose the real efforts to achieve the renewable and sustainable energy for the Building Industry. Numerous approaches have been demonstrated that effective improvement the piezoelectric properties of cement-based material was achieved. This promotes the application of construction material with high piezoelectricity in building systems. Utilizing piezoelectric materials can harvest vibration energy from various sources. This not only recovers energy for various purposes but also reconciles the potential damage caused by vibrations.

### Sustainable buildings should be environmentally responsible and resource-efficient throughout their life cycle. Piezoelectric materials allow more sustainable building components due to harvesting energy from structural strain and vibrations, less consumption of energy, and fewer carbon dioxide emissions and different PM pollutants. Compared to other materials, piezoelectric materials are more easily incorporated into construction materials and building systems. This paper systematically reviews a wide band of studies on energy-piezo materials and their advantages.

## All related publications can be provided.

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