

# Polycarbonate Material of Future

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**Abstract:-** In this research paper we are going to evaluate how polycarbonate been an advance building material in today's world and its need to be taken up. The whole study in this paper revolved around the material property and its application in the field of architecture and in the field of construction. Its market approach and future scope of the material in India. Research also caters the various parameters on that basis polycarbonate material is defined to be more reliable material in construction and a better option for roof and façade treatment. Polycarbonates used in engineering are strong, tough materials, and some grades are optically transparent. They are easily worked, molded, and thermoformed. Because of these properties, polycarbonates find many applications. Polycarbonate material is kept on improving to sustain in the market and found out to be versatile and withstand the today's need of advance material.

**Keywords:-** Polycarbonate material, Flexible, Economical in terms of durability, Sustainable in terms of Energy consumption, Recyclable material.

## I. INTRODUCTION

Throughout the centuries, new and improved engineering techniques and materials have allowed us to shape the world we live in today. From the use of various construction, we have moved to masonry, casted iron, steel, concrete, reinforced concrete and more. In the last decade attention has shifted onto the use of new technologies to render both engineering processes and materials faster, cheaper and of higher quality. ways to minimize nature's damage.

Within this context significant leaps have been taken in the development of composite materials, within technology development, the used of plastic as a building material is becoming a trend in architecture. Thus, reusing plastic as a building material is one of the As we all become more conscious of the world around us and how our carbon footprints are contributing to the environment, attention has turned to plastics, reuse of used materials as one of the building materials is becoming a global trend in the world of architecture.

One of the most common plastics in use is polycarbonate due to its flexibility across a wide range of industries, as well as it's durability.

The uses of polycarbonate plastic it is commonly used in the medical industry, day to day products such as mobile phones and LED lighting, and probably most prominently, the building industry. It is of course used in technology and

there's a good chance you are holding or using something right now which contains polycarbonate.

As if the sustainability and eco-friendly benefits weren't enough, it's fair to say that polycarbonate plastic offers a multitude of applications. But on top of its environmental benefits and various uses, we should also consider how polycarbonate plastic is used to make people's lives easier.

Transparency, excellent toughness, thermal stability, and a very good dimensional stability make Polycarbonate (PC) one of the most widely used engineering thermoplastics.

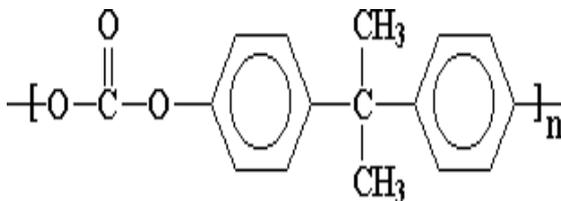
With the demand of lightweight and durable structure design with the combination of architecture and aesthetics is the new revolution and to achieve polycarbonate panels are used with the steel frame work. This combination is consider to be lightweight and fast form of construction in the field of architecture in seismic zone.

## II. NEED OF STUDY

- From an **Architecture point of view**, the light weight of the composite can result in lower construction costs and Polycarbonate is a thermoplastic, which means that it can be heated, cooled, and reheated again without any degrading effects. This means that it is 100% recyclable. Within technology development, the used of plastic as a building material is becoming a trend in architecture. It caused by plastic is one of the materials that difficult to decompose in nature. Thus, reusing plastic as a building material is one of the ways to minimize nature's damage and also it caused that reusing used plastic material.
- Buildings of structural steel have performed excellently and better than any other type of substantial construction in protecting life safety, limiting economic loss, and minimizing business interruption due to earthquake-induced damage.
- From a **Construction point of view**, this material can we use in façade, roof, long span structure. Also, it can be easily formed into a variety of shapes and structures and can be cold-bent on site to form a curved surface.
- From the **climate design viewpoint**, Polycarbonates can be designed to block ultraviolet radiation and provide 100% protection from harmful UV rays. Polycarbonate is used extensively in sports stadium roofs to protect fans from bad weather – and let the game go on – while allowing in natural light and saving energy at the same time.

### III. WHAT IS POLYCARBONATE

- The word "plastic" is freely used as a synonym for "polymer," but the meaning of "polymer" is based on the size of the cells while "plastic" is defined in relation to disability. a variety of three-dimensional shapes, usually by forming or melting extrusion processes. They retain their structure when disabling power is removed, unlike other polymers such as elastomers, which return to their original state, depending on their hot temper. Polycarbonate plastics are naturally occurring amorphous thermoplastic and lies under the group of thermoplastic material contain strong carbon bond in linear chain structure.
- This type of polymer is soft and flow upon heating and due to the property of thermoplastic it becomes hard on cooling and this cycle of melting and freezing repeated many times, which in result in formation of manufacturing polycarbonate material which is used by end user through heat fabrication techniques such as extrusion or molding.
- These materials are generally more resistant to high temperatures and better mechanical properties than those of less expensive thermoplastics materials and, therefore, are used in more demanding applications. Polycarbonates used in engineering are strong, heavy- duty, and some marks are obvious. They are easily operated, molded and thermoformed. Thanks to these structures, polycarbonates are found in many systems.



### IV. KEY FEATURES

- High strength to withstand impact and cracking
- High temperature resistance, which makes it ideal for applications that require interest
- A good measure of stability that allows it to maintain its shape in a variety of conditions.
- Good electrical installation facilities
- Inert living and easily renewable
- Excellent usability
- Transparency and visual clarity
- Flame retardation and fire efficiency
- It provides good electrical insulation properties over other material and doesn't affect by water or temperature.
- Polycarbonate is an amorphous thermoplastic that combines transparency with high temperature and impact resistance. No other engineering plastics has this structural combination.

### V. PROPERTIES OF POLYCARBONATE MATERIAL

#### A. Strength –

Polycarbonate has great potential to make it a proof against impact and cracking, as well as to continue to provide safety and comfort in applications that require high reliability and performance. The polymer has a thickness of 1.2 - 1.22 g / cm<sup>3</sup>, maintains a density of up to 140 ° C and is good up to -20 ° C. Also, PCs are almost non-breaking.

#### B. Optical Nature

By having an amorphous structure, the PC offers excellent optical properties. The index of clear polycarbonate extraction is 1.584.

#### C. Chemical Resistance –

Polycarbonate shows good resistance to chemicals and refined acids, aliphatic hydrocarbons and alcohol. chemical resistance equally against oil and grease. The PC is immediately attacked by refined alkalis, fragrant and hydrocarbons. Manufacturers recommend cleaning PC sheets with certain cleaning products that do not affect the chemical environment. it is sympathetic to the alkaline purifiers who abuse.

#### D. Light weight Material –

This feature allows unlimited possibilities for OEMs to create style compared to glass. The design also allows for increased efficiency, simplifies the installation process and reduces overall travel costs.

#### E. Transmittance –

A polycarbonate is a transparent plastic that transmits more than 90% of its glass-like light. Polycarbonate sheets are available in a variety of shades that can be customized depending on the end user application. Proper lighting design includes ensuring that the interior of the building receives the required amount of light. Therefore, it is clear that it is important to use panels that allow enough light to pass through. And polycarbonate panels provide the best opportunities for nature day lighting as a key component which in result one more step toward the sustainable building design and it not only allowed the light to enter into the built space buy also control the amount of light that enter the space as it is UV protected layer on it which plays a very important role in enhancing the transmitting property of the material.

#### F. Heat Resistance –

Offering good heat resistance, Polycarbonates are physically stable up to 135 ° C. The resistance to heat can be enhanced by adding flame retardants without affecting the visible structures.

#### G. Resistance to Shock –

It absorbs more shock than glass and is known for its high impact. Being prone to wear and tear of fragmentation, and shock, polycarbonate is highly preferred during construction.

Compared to GPR, glass, and acrylic, construction workers prefer to work polycarbonate as it can easily absorb shock and provide better resistance to hard surfaces such as branches and hail.

#### H. Protection from UV Radiation –

Polycarbonates can be designed to block ultraviolet radiation and provide 100% protection against harmful UV rays. Installation of UV Absorber protection prevents polycarbonate from exposure to UV rays which can lead to its rapid degradation and be responsible for subsequent yellow damage and damage to visible light energy. UV protection uses co-extrusion technology, in which a protective layer is produced to test the polycarbonate in the UV part of the sun's rays. With this technology, UV protection is made more resistant to weather and is less prone to damage by improper adjustment. Polycarbonate panel system is comprising of double layer of polycarbonate material with U-value of 0.16 which is achieved through layering.

### VI. APPLICATION

Polycarbonate is widely used in windows and ceilings to wall as it is highly effective thermoplastic material which has many features that provide very useful for different application, its durability and lightweight and sturdy has high optical clarity and its other properties such as high impact and extreme high temperature resistance and excellent heat resistance properties also play a major role in the application of the material in such places.

- Polycarbonate is one of the plastic materials which can easily undergo thermoforming process which in result gives variety of complex shapes. In terms of sheets polycarbonate found to be cold curved line like steel. Various polycarbonate construction techniques simplify many construction features, from fixed arches curves to flexible panels.
- Polycarbonate is used in glass handling - to strengthen prisons, guard booths, bank security, convenience stores, storm doors, hockey rink around and more. Polycarbonate is one of the best choices for safety application due to high impact resistance specially blasting and glazing-resistance.
- Polycarbonate is widely used on the roof of a stadium to protect sitting space from bad weather and UV radiation - and let the game continue - while maintaining natural light and also at the same time it saves energy.
- Another common use of polycarbonate is flat roof dome lights, curved for roofing.
- Polycarbonate provides strong inserts, with energy-saving beneficial in multi-wall format. Polycarbonate also provides protection from IR radiation and can increase energy efficiency when treated with solar control technology.
- From opaque cover panels to notes, drum barrels, stone lamps, flexible walls and signs, roofs and high ceilings, polycarbonate sheet products are designed and available in a wide range of sizes, structural strength and repair to meet LEED requirements.

### VII. SUSTAINABILITY OF POLYCARBONATE

- Polycarbonate could be a highly durable plastic that contributes significantly to the assembly of ecoefficient and sustainable use of the many important products. These products include lightweight parts for vehicles and construction materials, cellular communications, high-quality clothing and plant architecture, medical devices, multi-use packaging and modern virtual data storage, just to call some. Our modern life wouldn't be possible without plastic. In fact, polycarbonate plays a very important role within the environmental, social and economic dimensions of sustainable development.
- Lightweight polycarbonate is one of the advanced plastic materials which is used to reduce the self-weight of the building. The main advantages of light weight polycarbonate are reduction in dead weight, faster building rate in construction, lower haulage, handling cost. It is a high-durable material; strength and durability are equal to ordinary concrete slabs and brickwalls.
- Light transmitting polycarbonate also gives aesthetically beautiful surface for exterior and interior building structure. This concept not only delays with the building but with the people health and environment.

### VIII. CLIMATIC IMPACT

- Polycarbonate been well known as thermoplastic with great impact resistance and high temperature resistance capacity which make it withstand all kind of climatic condition. Which result in making polycarbonate as most sustainable material in today world.
- It can absorb sun heat and reflect back harsh sun ray's due to which it works as a good insulating as well as heat thermal material enhancing the useability of material in hot and dry climatic zone. As well as it works as temperature control material when used in cold region due to heat absorb property of the material.

### IX. ENERGY EFFICIENCY

- Polycarbonate been transparent material plays a key role in providing daylighting into the building which provide nature light and reduce the use of artificial light which result in the reduction of use of electric consumption and increase energy efficiency of the building which leads toward sustainable development. Use of daylighting is one of the best ways to achieve energy efficient building. Also, daylight is the nature source of light with lots of benefit in it.
- It's important in our modern lives, that we should be aware of the fact that how it is important to have designed well architecture which in turn would impact the psychological wellbeing of our future generation and should be implemented for the construction of institutional buildings. Thus, it is certainly true that natural light is a significant part of this, which is equally important.
- According to the world building design guidelines, daylighting is the controlled admission of natural light, direct light and diffused-sky light to reduce electric lighting

and save energy. As time goes on architects and designers are finding innovative new ways to factor day lighting into their design, both to save money and energy consumption.

## X. CONCLUSION

- From the above study we have come to a conclusion that been a plastic material polycarbonate proves to be one of the best advance building materials in today's time and due to the property of thermoplastic it has a plus point when it is used in the field of construction as it comes out to be lightweight as well as easy to handle. And through the parameters it is conclude that it is better than other plastic material in the market and polycarbonate is the upcoming advance material in the field of architecture. It is energy efficient as well as light transmitted material and on top of it also chemical resistance and UV protection which make it more reliable than any other material. And is multi useable such as in roofs, facades, stairs, interior,etc.
- It is technologically advanced and has a good chance of holding or using something currently containing polycarbonate. As if the sustainability and economic benefits were not enough, it is fair to say that polycarbonate plastic offers a wide range of applications.
- Polycarbonate in terms of suitability found out to be a highly durable plastic that
- contributes significantly to the assembly of ecoefficient and sustainable use of the many important products which is the demand of today's need for the development of any country. Today, polycarbonates are used in a wide range of commercial applications. In the construction industry, polymer-based materials are rapidly developing and widely used.

## REFERENCES

- [1.] Plastic\_material\_as\_building\_facade, n.d. *Plastic\_material\_as\_building\_facade*, s.l.: www.researchgate.net.archdaily, n.d. www.archdaily.com. [Online]
- [2.] Available at: <https://www.archdaily.com/776074/baan-nong-bua-school-junsekino-architect-and-design> [Accessed 22 9 2021].
- [3.] archdaily, n.d. www.archdaily.com. [Online]
- [4.] Available at: <https://www.archdaily.com/871475/dinosaur-theme-park-entrance-building-rimpf-architektur> [Accessed 22 9 2021].
- [5.] blog/everything-you-need-to-know-about-polycarbonate-pc, n.d. www.creativemechanisms.com. [Online] Available at: <https://www.creativemechanisms.com/blog/everything-you-need-to-know-about-polycarbonate-pc>

[6.] [Accessed 18 8 2021].

[7.] brettmartin.com, n.d. *brettmartin.com*. [Online]

[8.] Available at: <https://www.brettmartin.com/en-gb/plastic-sheets/plastics-in-profile/polycarbonate.aspx> [Accessed 5 9 2021].