



RESEARCH ARTICLE

USE OF POLYSTYRENE FOR CONSTRUCTION OF HOUSE

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ABSTRACT

This paper proposes the study of a method to implement a new technique regarding using polystyrene in construction of structure wall for housing which includes not only construction of bungalow but also building upto four floors as well as row houses whichever is necessary. This technique comes handy since polystyrene panels which contains two set of galvanizing welded mesh where vertical mesh forming waves result in creating reinforced concrete micropillars once the panel is coated with concrete (this technique has been used successfully to reinforce historic or artistic buildings). It is a system which is used to construct storey upto G+3 with single panel and multiple storey with double panel but it is yet to be tested according to Building Codes.

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INTRODUCTION

Using different and innovative technique for construction purposes to overcome the issues cause during old techniques and there processing has helped civil engineer to work on new alternatives regarding how to replace or modify old methodology by newer, lighter, smaller and better version. Use of polystyrene is one of the prospect of better future in the field of construction across the world. The system is composed of a factory made panel of wave shape polystyrene covering both sides by a electro welded zinc coated square mesh, which in turn are connected by 40-50 connectors per m2 resembling a 3-dimensional hyper static reinforcement steel. The panels are assembled on site and in situ poured concrete (double panel, floors, stairs) and shotcreted concrete (single panel) to realise the different elements of the system:

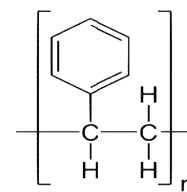
- Vertical structure wall
- Horizontal structure wall
- Cladding walls
- Internal walls

The structure here is casted monolithically joining each unit of construction elements such as beam slab column and walls where as foundation for using this technique can be same as of our conventional bases used in our regular buildings.

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A polystyrene is a material which is synthetic polymer made up of styrene. It is clear hard in nature.

Properties of polystyrene are:



Chemical formula - $(\text{C}_8\text{H}_8)_n$

Density - 0.96-1.04 gm/cm³

Melting point - 240 °C (464 °F; 513 K)

Solubility in water - insoluble

Soluble in acetone - non-soluble

Thermal conductivity - 0.033 W/(m·K) (foam, ρ 0.05 g/cm³)

Another name - Thermocol.

The significance of polystyrene is it has a unique quality of melting under temperature above 100 C instead of burning hence it is a good option for using it as a construction material.

Objective

Present scenario of using materials for construction such as cement, sand, bricks, siporex for walls are tedious. Not to forget conventional methods consume lots of time to get erected.

Usually the daily limit of constructing a wall is limited to 1.5 m in lift for all structures. To avoid the heat of hydration from cement and to cool it down without getting any severe crack during construction time. Whereas using polystyrene has no such implication as they are ready to use product and do not need to cool down.

Polystyrene also light in weight approximately ¼ of weight of normal brick wall.

It gives lower utility costs.

It is earthquake resistant (monolithic structure resist breaking in a singular unit)

It is versatile- flexible in design.

It is storm resistant.

It is superior in strength

PROPOSED SYSTEM AND METHODOLOGY

The system is composed of factory made panels of polystyrene of undulated shape usually wave in sight. This are then covered up by using electro welded zinc coated mesh wire which are connected by 40 connectors per meter square. For different unit such as floor and staircase double panel are used with concrete poured.

For unit such as cladding wall, walls and partition walls are usually made by using single panel with shotcrete.

Installation

- According to the soil bearing capacity and loading condition suitable foundation is made.
- Then the provision of slab grad is provided on which whole structure is to be erected.
- Now according to the detail drawing and plans centre line are marked where this polystyrene are to be erected.
- Then the panels are placed all the panels are complied together by using binding wire where panels are supported by 8mm mild steel bars at the spacing of 30mm – 40mm alternatively. This bars are placed inside the slab up to 2 inches at least for support.
- Provision for plumbing and electrification are done by melting the E.P.S by hot gun later first slab is provided and shotcrete i.e first plaster by help of mason is done two layers of shotcrete is provided from top to bottom (roof to floor) than the curing is done for approx. 3 days.
- Plastering and finishing is done by skilled labour in prospect of providing smooth finishing.

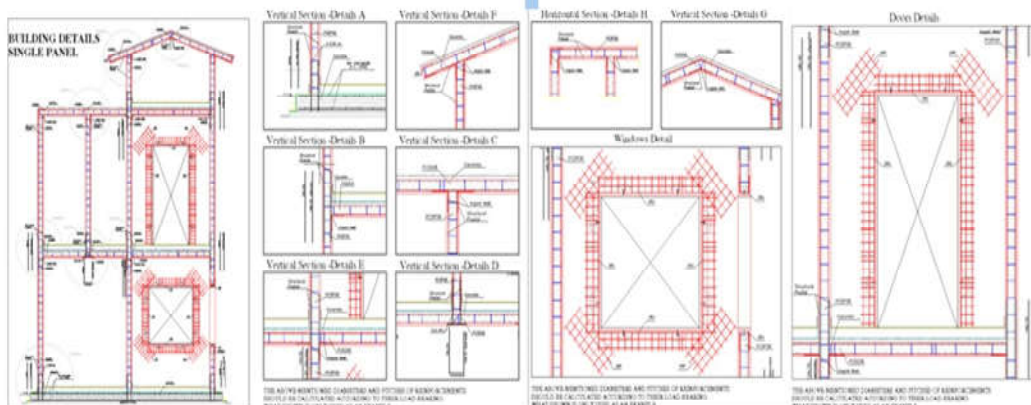
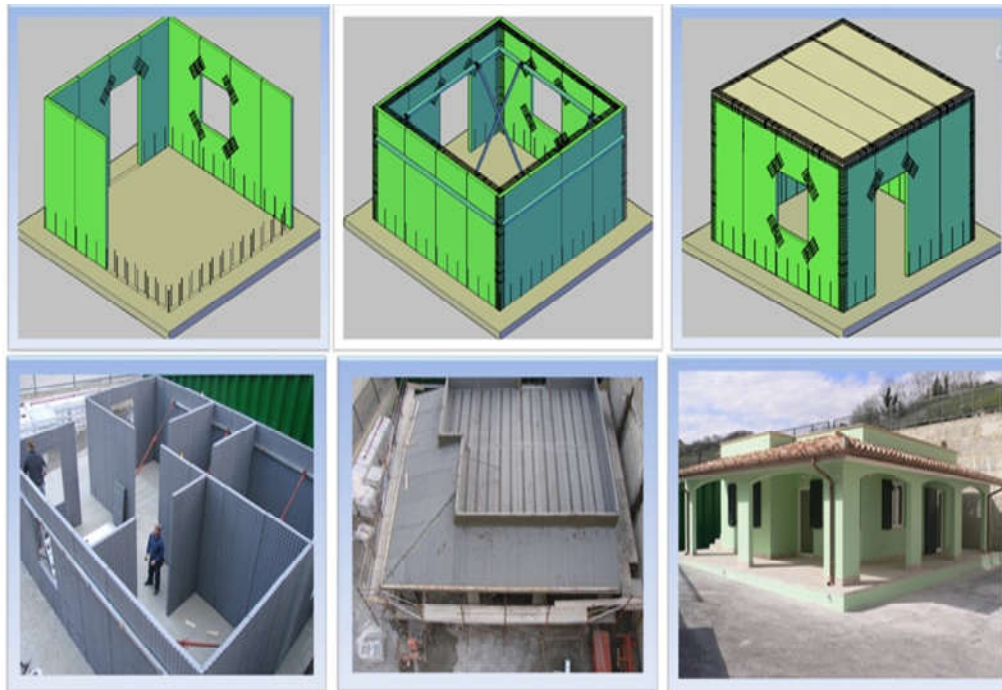


Fig 1. Analogous picture of whole setup

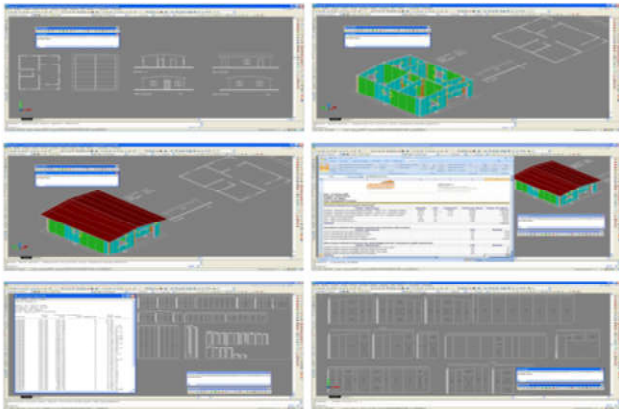


Fig. 2. Plan of installation



Fig. 6. Cutting of panels



Fig. 3. First layer of plastering

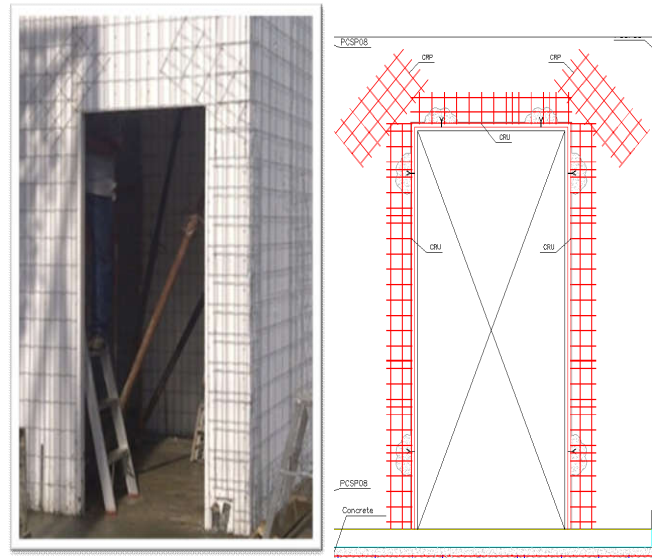


Fig. 7. Provision for doors (plan and section)



Fig. 4. Shotcrete by machine



Fig. 5. Finishing of last layer

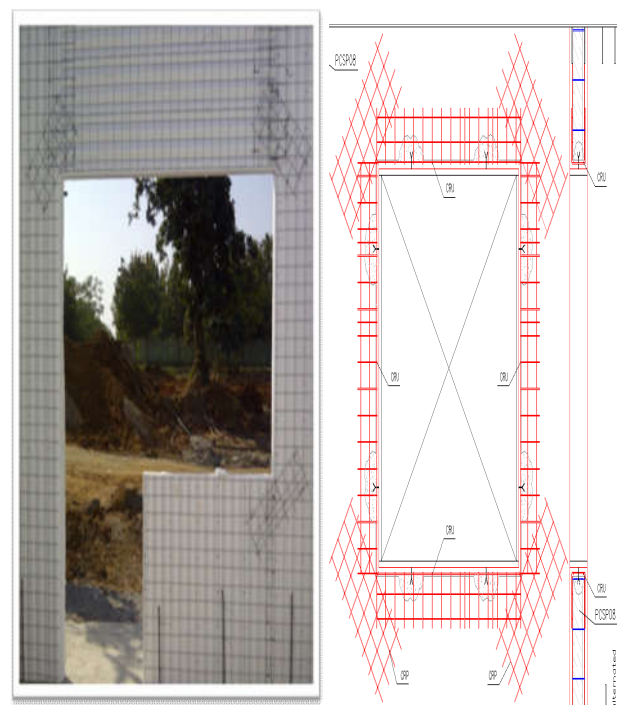


Fig. 8. Provision for windows (plan and section)

Test on polystyrene wall

Bullet Test



Fig. 9. Bullet test do not penetrate instead just caused a minor dent

Sound proof test

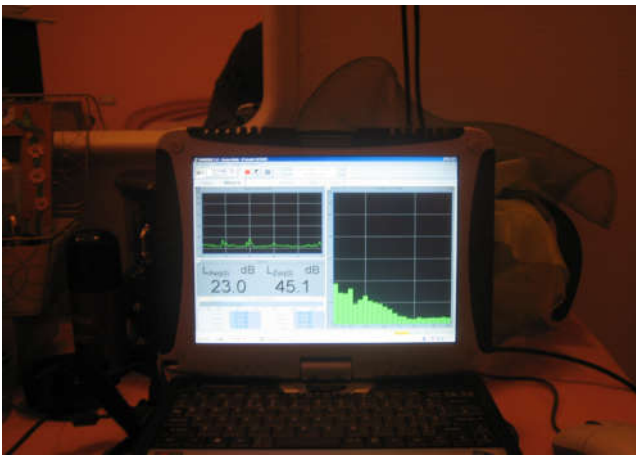


Fig. 10. Test result showing minimal sound transparency

Mechanical test (compression)



Fig. 11. Compression test result in bending at 700 KN

Significance

Implementation of this modern innovation will not only help people who are struggling to achieve their goals of having their own shelter but also it will improve our housing technique as it is fast less labors and effectively implemented without wasting heavy investment on machinery to moves construction materials and labor to carry them to the site.

It will improve housing scheme to certain level. Earthquake resistant structure are totally required in areas where tectonic plates are highly present. In India areas such as north east part as well as western provinces of Gujrat has had already suffered from losses of house and property due to earthquake. This structure is constructed monolithically which during tremors only vibrate as a whole unlike other structure where all the unit are cast individually resulting in movement all together and nullifying the effect of the same. Another reason for its use is since in this panels thermal bridge is absent which means the temperature differences will always be maintained in cooler as well as in hot humid conditions helping in saving energy and reducing global warming effects on our mother earth.

Future Scope

Using polystyrene will definitely change the perspective of housing department as well the world economy. It will recuperate the energy we lose while using materials which consume a lot of energy and releases heat which is unhealthy for our environment. Labor cost cutting is one of the advantage this has since each panel weigh less then or at least approx. few brick estimated 5 max. whereas panel are of full size covering single wall therefore transporting it to site will not be a headache and subsequently requirement of labor for such work will be cut. Talking about fire break this material made from polymerization has the property of melting at high temperature instead of burning which is what any department will ask for while choosing their construction technique. For rehabilitation during emergencies or natural calamities construction of shelter is time consuming which is solved by this material as it is made in factory and different sizes are available for constructing of temporary houses which can be done within 2-3 days. Just installation, fitting and shotcrete is required to be done on site no limitation on lift up to 1.5m. Partition walls cladding wall of existing structure can be constructed by using polystyrene instead of using brick walls to reduce wall load in any structure it is light weight in nature (floats in water) hence a good option for this purpose. This product is factory made and can be available in different sizes as per requirement reducing tediousness.

Conclusion

Polystyrene wall is a monolithic structure and it is only the structure whose bottom floor wall is connected with top floor wall. Its construction time can be reduced by significant amount over the conventional method of construction resulting in cost saving. Also, Manpower requirements (especially skilled laborer's) are optimized as the panels are manufactured in the factory and transported to sites for erection. Training of unskilled labour can be undertaken to replace the traditional form of construction. Polystyrene panels can be carried, handled and placed in position by a single workman without the use of hoist or lifting equipment. This simplifies and accelerates the construction process and no particular skilled labour is required while at the same time labour output is increased. The materials use in the panels have excellent insulation properties against heat and cold and external noises. The concrete applied to the closely connected panels and reinforced by the wire netting forms a monolithic structure which excludes any possibility of cracking. The absence of cracks totally eliminates the problem of water leakage so commonly encountered in prefabricated building system. As fire barrier, the system panels have passed fire tests in accordance with the relevant standards of various Government

Authorities throughout the world. Tests carried out in Malaysia, Australia and Italy showed that the panels complied with the minimum requirement of 2 hours fire resistance as stipulated in the local building by-laws. The features on the panels act as guides to the finish level of the concrete surface. A good level surface can be achieved without the use of skilled labourers. Moreover, with no signs of the chases for utilities being visible, the concrete surface will be uniform and superior in quality and appearance. The proposed building system provides many opportunities for imaginative building design. The panel is about 2/3 the weight of an equivalent half brick wall with plaster both sides. Saving of up to 20% of construction time compared with conventional method of construction.

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