LITECAST REPORT

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1. Introduction

In 2013, Easy Panel Construction Co Ltd (Easy Panel) announced its new solution for modern real estate development projects “LiteCast”, a green construction material offering the benefits of precast concrete panels and 3D sandwich panel technology.

LiteCast is a lightweight precast concrete panel incorporating the Easy Panel™ technology within its core. This technology consists of a 3D welded high tensile steel matrix with an insulation core of EPS polystyrene. Application into LiteCast panels creates a lightweight product, as their manufacturing process requires less concrete than traditional methods. The polystyrene core offers outstanding thermal and acoustic insulating performance. The high quality precast concrete panels are cast with the Easy Panel embedded in the core to form the final product, giving it strength and high durability. Figure 3, on the next but one page, is a technical drawing of the product designed for a specific project, including connection joins, lifting points and shaped edges.

As illustrated in figure 1 and 2, panels can be delivered in a standard 1.2m x 3m size or customised to adapt to any buildings requirements.

An innovative and unique building material, LiteCast is a hybrid between Easy Panel sandwich panels and precast concrete panels. This building material, acknowledged by major building developers, presents the same advantages as precast concrete panels, being quick and easy to install, but only weighing around 50% of standard, solid precast concrete. Even so, it is applied with the same construction and installation methods as a standard precast panel. Moreover, this material was developed to be more environmental friendly than its substitutes. It is thus a high quality, lightweight alternative to standard precast concrete panels. LiteCast samples have passed multiple tests which concluded that the product complies with international construction standards. Finally its manufacturing process conforms to IS09001 criteria.

This report aims to highlight the advantages, and potential challenges of using the LiteCast technology. It will also discuss its technical characteristics. Finally it will clarify under what conditions LiteCast panels should be used and to where their use would be most suitable.

Figure 1: LiteCast bespoke panel samples (1,2m x 4,8m)

Figure 2: Customized precast concrete panels for housing

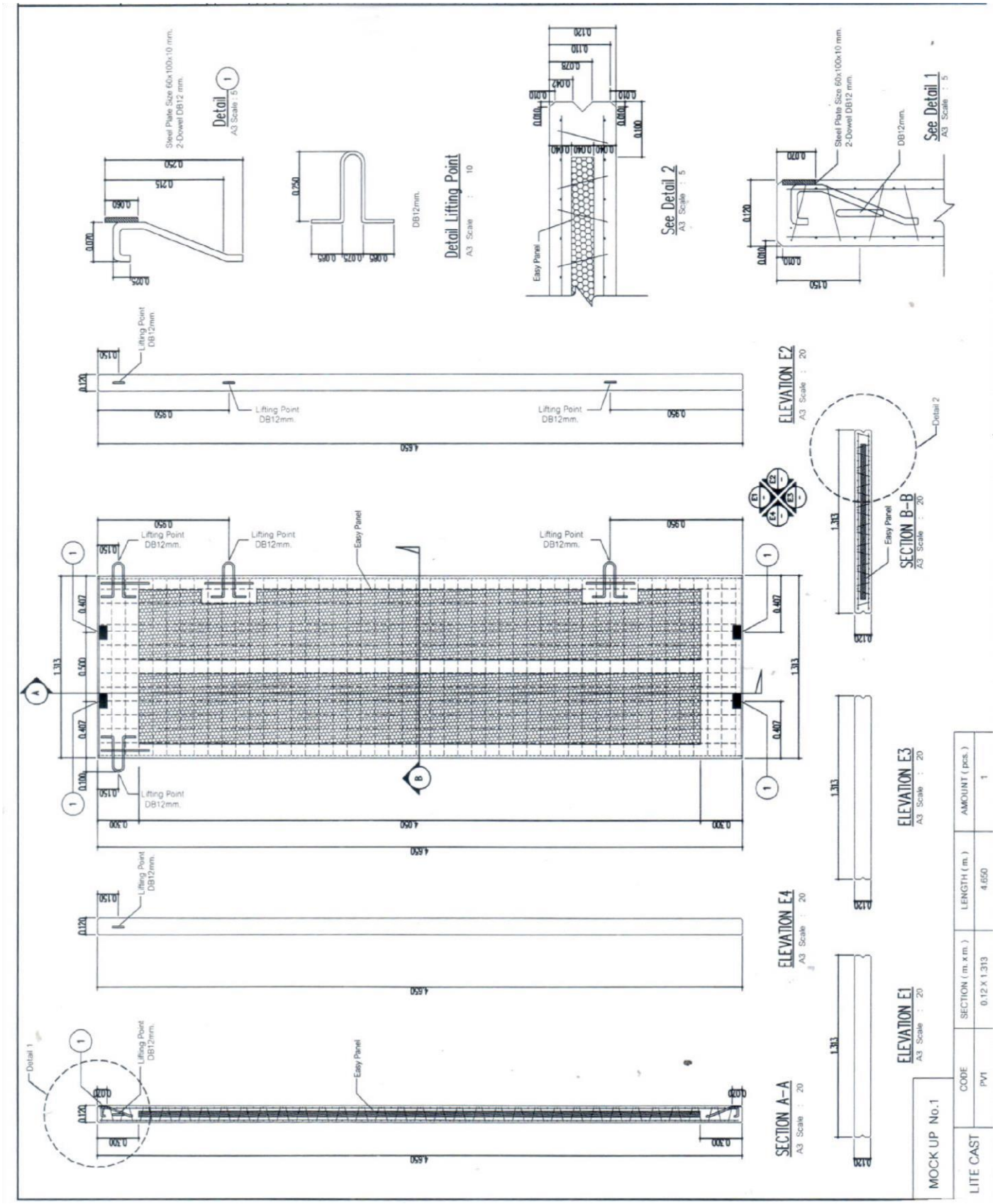

Figure 3: technical drawing of a bespoke LiteCast panel

2. Easy Panel Technology

The first element needed to build LiteCast panels is the Easy Panel technology. This sandwich panel construction technology was originally developed in the United States during the 1970s as a means of meeting the global need for energy efficient and low-cost housing. Since then the technology has evolved into a wildly accepted building method for both residential and commercial construction, offering numerous advantages over more

traditional building techniques.

The standard dimension for each panel is 3.0 metres long and 1.2 metres wide and weighs approximately 16 kilograms when it leaves the factory. In this technology two relatively thin but stiff high tensile 3mm steel wire meshes are connected by welded truss wires enclosing a lightweight EPS polystyrene insulation core. Figure 4 provides a good illustration of a finished Easy Panel panel for use within a LiteCast Panel Illustration of a finished Easy Panel panel for use within a LiteCast panel.

Figure 4: Easy Panel Technology

Figure 5: Easy Panel Project (5 stars villa)

The Easy Panel panel system is unique in providing a fast, economical and easy construction system for walls, houses, factories and large-scale buildings. It can be used in any part of a building's structure, including both load bearing or non-load bearing walls, floors, stairs and roofs. In addition, Easy Panel off cuts can be utilised for shelving, wardrobes, bath surrounds and many other applications. The highdensity polystyrene insulation in the middle of each panel is suspended within this welded wire matrix, providing both thermal and acoustic insulation in the finished building. The strength of these structures is excellent, due to the panels' precisely welded matrix of wire mesh on both sides and the concrete enclosing it. These structures have endured hurricanes with no water penetration or damage and earthquakes with no cracking whilst still providing a comfortable and energy-efficient environment for both residential and commercial applications. Figure 5 gives an

example of a project in which the Easy Panel technology was used. To build this luxurious villa, panels have been used in all parts of the construction.

Extensive materials testing in a variety of markets (including Asia, Europe and the USA) has proven that

three-dimensional sandwich panel building technology has many advantages, including lower construction cost, speed of construction completion, durability of the completed structure and the lower ongoing heating/cooling expenses. These benefits will be detailed in the following parts of the report.

Easy Panel, are confident that our products can provide considerable cost savings that can make many construction projects less expensive to build and bring them to completion more quickly than using traditional building materials and methods.

3. Type of concrete selected

The second element needed to manufacture LiteCast panels is high quality precast concrete. The Easy Panel is embedded within a precast concrete panel to give it the necessary strength and final form. Only the best construction grade concrete is selected to ensure durability and short manufacturing time (Portland Cement Type III). Figure 6 illustrates how concrete is applied on the Easy Panel technology to form LiteCast panels.

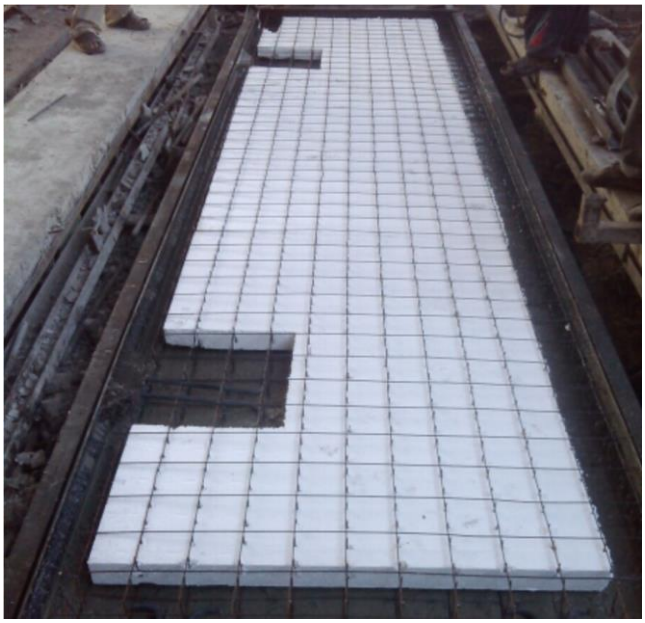

Figure 6: LiteCast panel production

4. The manufacturing process

The polystyrene core and steel wire meshes of the product are manufactured in an EasyPanel factory. These first pieces are then shipped to the concrete factory. There, the Easy Panel is enclosed by high quality concrete to form the final LiteCast panels.

Figure 7: Easy Panel's polystyrene block moulding machine.

The product gains its strength from the high tensile steel wire meshes which keep all pieces together and allows it to go through the most intense conditions.

The final product will then be sent to the building construction site where it will be installed the same methods as a traditional precast concrete panel. Finally, all the manufacturing processes comply with ISO 9001 standards ensuring high manufacturing quality.

5. Generic advantages of LiteCast panels

Using LiteCast panels in a construction project has multiple characteristics that make it a very suitable construction material. A set of tests has been conducted in collaboration with different institutes proving the technical benefits of our product. All test results are available and confirm that our products conform to the highest international construction standards.

These generic advantages can be classified in 4 different categories:

Fire resistance

Two different tests have been conducted to prove the fire resistance level of LiteCast panels. The first aimed to assess the resistance of the entire product under high temperature. It was conducted in Chulalongkorn University Test Facility (Bangkok, Thailand) on September 24th 2013. Test results showed that a sample of three panels assembled can resist the spread of flames and high temperatures up to

1110 C° for more than 3 hours and kept its structural integrity intact. Actually concrete performs well under fire conditions and other extreme conditions: it offers high fire resistance; it is very durable; and has very predictable characteristics in the way it performs under heat. It meets all protective requirements easily concerning protection and surface spread of flames (Glass,2000). Figure 8 illustrates how LiteCast

panels have been tested in Chulalongkorn University's facilities. One side of the sample was exposed to a high temperature furnace. Sensors were applied on this same side to take the required measurements.

Figure 8: Fire tests conducted on a sample of three LiteCast panels

The second test was conducted on the Easy Panel™ technology that forms the core of the final product. The core of polystyrene was treated with chemicals to make it non-flammable and fire resistant. Sandwich panels have been extensively tested and give excellent results. A 50mm thick Easy Panel could (thickness could differ according to local preferences), under the right construction conditions, resist about 90 FRL's (fire resistance levels). (Branz Appraisal, 2011).

Strength and durability

LiteCast panels are designed to assure strength and durability enabling the construction of large-scale buildings by using the same processes than with any classic precast concrete panels. To assess this characteristic, two series of tests have been conducted. The first one aimed to test the strength of the entire product under different conditions. 10 different tests have been conducted by the Asian Institute of Technology (AIT).

Figure 9: Impact test on a LiteCast panel

The sample had successfully passed all the tests of water absorption, dry density, compression, impact (by small and large bodies), perforation, crowd pressure, anchorage (pull-down and pull-out), and

eccentric downward loading and conformed to the highest international construction standards. After these tests we are confident that this material could resist to most types of natural disasters and reach a life expectancy exceeding 50 years.

The second series of tests were conducted on the Easy Panel technology. Its load capacity has been firmly tested by the Burapha University, Chonburi, Thailand, proving Easy Panel's™ supporting capacity by providing a compressive strength of 37± kg per cm2. A compressive test on an Easy Panel™ wall specimen showed its capacity to hold over 100,000 N (Newton's) on average. Also its bending capacity has been tested intensively, demonstrating Easy Panel™ bending capacity by resisting over 8,200 N (Newton's) of power. This high resistance come from the design of its core consisting of a complex matrix of high tensile steel wire mesh and connecting steel truss wires. The use of this strong material makes LiteCast a very robust precast sandwich panel and differentiates it from other construction
panels.

Insulation - Thermal & Acoustic

LiteCast panels offer strong thermal insulation properties both to retain heat or cold air within the building and keeps the heat or the cold from outside leading to significant energy savings from air conditioning or heating usage, depending on the climate. A great characteristic of concrete used is its absorption capacity to capture heat or cold and store for a longer time leading in the end to more temperature stability (Glass, 2000).

In LiteCast, the core layer of polystyrene also plays a role in addition to the insulation ability of concrete. The thick layer of polystyrene contributes greatly to the insulation capacity and gives great cooling or warming benefits. A test shows Easy Panel™ technology could lead to impressive insulation results under the right conditions with a potential R-value (a measure of thermal resistance) of approximately 1.2 for a 50mm panel (Branz Appraisal, 2011).

Concrete panels also provide good sound insulation, reducing the passage of noise from outside and improving the inner acoustic performance (Glass, 2000). In a LiteCast panel the two materials (concrete and polystyrene) will perform differently concerning sound. Different materials will be able

to filter a large frequency range of sounds making it cover a larger part of the frequency spectrum of sound resulting in improved sound insulation.

Both characteristics have been tested at Kasetsart University during August 2013 and show outstanding results.

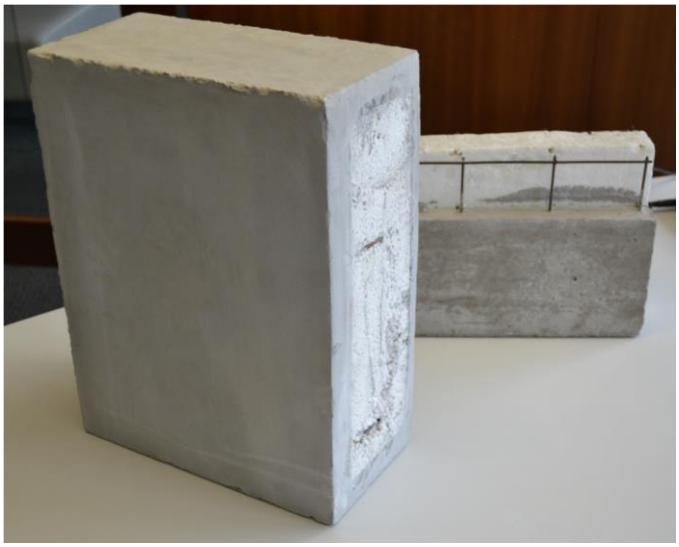

Figure 10: Transversal cut of a LiteCast panel

Figure 10 illustrates the final product transversal cut, displaying all different components that give such properties to the product.

Ballistic Properties

LiteCast panels are the first precast concrete to have passed Thai ballistic tests. On the 3rd of December, a sample of our product has been delivered at the Thai Military Explosives Factory, Nakhon Sawan, Thailand. The test consisted of shooting M193 bullets flying at 970 (+- 12) m/s from 3 different distances: 15m; 30m; and 60m. Testers fired 5 shots from each distance. Results showed that no bullet pierced or penetrated the

sample.

Figure 11: LiteCast sample fired at from a distance of 15m by M194 bullets **Environment friendliness**

Easy Panel makes sustainability and green development a priority in all its projects. For this reason, it offers only products that do not damage the environment (social or natural). Moreover, the company wants its products to be affordable for most construction projects. Indeed green construction materials are often put aside of the option list because of their high selling prices. Our company was able to develop a green product that would sell at a similar price to traditional precast concrete panel.

There are two reasons why LiteCast is more environmental friendly than its competitor products. First, by having a polystyrene core, a LiteCast panel needs far less concrete to produce the final product. Manufacturing concrete being a pollutant process, minimising its use, limits spill over into the environment. Moreover, this characteristic makes the product lightweight which reduces the energy required to produce, transport and for installation. In addition most of the waste in the production process is reused minimising losses of raw materials. Second, thanks to its strong insulation properties, energy consumption needed for heating or cooling is reduced. This could benefit countries in the long term if the use of this type of product becomes widespread, especially emerging countries which face energy distribution issues.

6. Implications of LiteCast construction

In addition to the generic technical advantages, using LiteCast has multiple strategic advantages. We strongly believe that this solution can bring better value for money than traditional precast concrete solutions. Buildings can be erected with the very same methods, at lower costs than traditional precast concrete and can benefit from the use of this superior technology. Advantages can be summed up in three different categories:

Standardisation

As LiteCast are precast panels, it brings multiple advantages of producing the panels offsite. It enables the building process to be simplified allowing a level of accuracy often higher than onsite building.

Standardisation makes the management and planning easier and therefore the accuracy is better without additional effort. It allows the use of standardised framed solutions, models and a simplified supply chain. From the whole process of design to construction, prefabrication improves the simplicity of the construction process. It allows us to lower the costs and price of our products, while maintaining high quality.

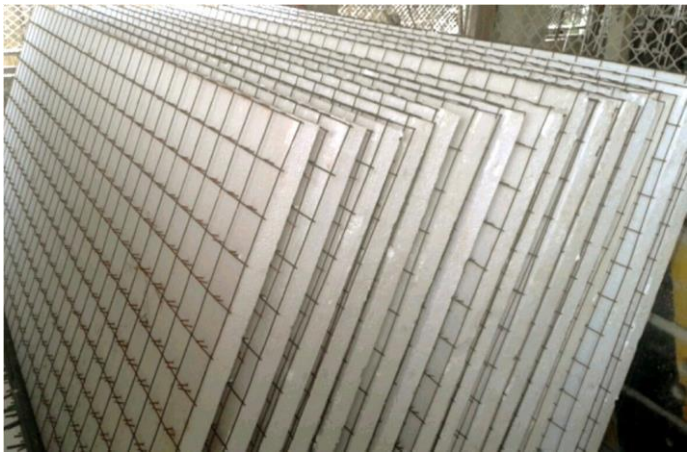

Figure 12: Batch of standard 1,2m x 3mEasyPanel™ panels waste

Efficiency

Using LiteCast panels allows higher efficiencies to be introduced in a project at multiple levels. First its manufacturing process focuses on minimising waste. Besides the cost and time advantage this brings, it is also a more environmentally friendly solution as less resources are being wasted. In addition, the standardisation improves the predictability of the project construction on the building site. It is easier to cope with risks. They can even be partly eliminated.

Figure 13: Lightweight and easy handling of a precast panel

Besides the advantage prefabrication brings, the lightweight of LiteCast panels brings some bene fits regarding human resources needed on the construction site. Indeed, using this solution requires less labour and fewer skills than traditional solutions, as it is less complex and easier to erect. It also minimises risks for workers as it is assembled in a factory and is easy to move around. Finally this reduced weight brings a great advantage in terms of transportation costs compared to traditional precast concrete. (Buildoffsite review, 2012)

Speed of construction

The standardisation of panel construction also brings tremendous time gains in the construction process. By simplifying the production process from the whole supply chain to the final stage of assembly makes the product less time consuming. Besides, a building can become operational much sooner using this technology and also be a cost-reducing factor, as it will minimise the resources required for construction. The use of machinery and labour (onsite) can be reduced.

For example, Figure 14 below illustrates a LiteCast project in Bangkok suburb which aims to install 32 LiteCast panels per day.

A faster production time implies a faster return on investment. For example, fast construction reduces the time a hotel can become operational, starts to make money and cash streams are rolling in. Benefits from a fast production, such as labour, rents, overhead and financing costs, will apply to all building purposes.

For property investors, the ability to greatly reduce the necessity to plan far in advance enables them to make better market predictions. Due to the strong fluctuations and the time lag between planning and implementation, it is fairly hard to accurately forecast what the market demands.

7. LiteCast selling points

Easy Panel operates under two types of business models to distribute LiteCast panels.

For large-scale projects, a two party's joint venture is formed between Easy Panel Ltd and a precast concrete manufacturer. Easy Panel will take the responsibilities of manufacturing the EasyPanel™ technology for the project and the precast concrete manufacturer will produce the precast concrete panels.

If the use of LiteCast panels is generalised, Easy Panel considers offering LiteCast panels under a franchising structure. By doing so, it will be able to reach a broader market. Moreover by manufacturing panels close to the site of construction, substantial savings can be obtained compared to transporting finished panels over great distances.

Easy Panel is currently working with government housing authorities, private real estate developers, major construction firms, construction material distributors and other partners to expand distribution of its innovative construction technology in a variety of global markets.

8. Pricing

One of the main advantages of LiteCast is that real estate developers have access to a superior green technology for a similar price to traditional products. Costs reduction will not be achieved on purchasing the product itself but later in the construction process. Indeed, because it is lightweight, transportation costs will be lower. As the product is less complex to handle, less skilled labour and fewer workers could be employed. Finally, thanks to its remarkable technical characteristics energy savings will be achieved during the occupation period as well as savings on maintenance costs.

9. Targeted Construction

As LiteCast panel are used for the same purpose as precast concrete panels, their target market is the same type of projects. These panels will be mainly used for the external structure of large-scale buildings such as residential buildings, office buildings, commercial buildings, including shopping malls, **Figure 15** below: Large scale buildings build with precast concrete governmental buildings, etc. However it could be adapted to any kinds of projects for internal or external construction. Also LiteCast is applicable for

prefabricated housing and provides massive savings in construction speed and required labour force.

10. Case Study: Central Plaza, Salaya

Easy panel is currently working on its first LiteCast project that will be executed by the end of January 2014. This 10,000 SQM project is the result of a partnership signed with CPN; the most accomplished retail developer in Thailand with 21 extremely successful shopping centres.

Figure 16: Central Plaza Salaya construction site

Easy panel is providing CPN with Litecast for the construction of its new prestigious shopping mall, Central Plaza Salaya. It is CPN's first themed-mall whose design is conceptualised under "Contemporary Botanical". The project is valued at 3.7 billion baht and is located in the most potential and strategic area of Western Bangkok. It is expected to be operational by the third quarter of 2014.

To carry out our first Litecast project, we are building 10,000 SQM of exterior LiteCast panels in partnership with a precast manufacturer, PST Concrete producing the Easy Panel core and more than 30 different shapes and moulds which have been designed specifically for this project.

Our current LiteCast project, valued at 13 million THB, represents a major step for the Company. Taking into account that each of CPN's malls are market leaders in their locations, we see this project as an opportunity to demonstrate our expertise in the field of construction throughout the ASEAN region. Moreover, the successful implementation

of this project could potentially generate more partnerships with the prime building contractors and CPN.

11. Conclusion

After discussing the different technical and operational characteristics of LiteCast panels, it shows that the product has four main advantages. First it offers a green eco-friendly end solution. Indeed, thanks to its outstanding thermal insulating capabilities and its lightweight, LiteCast is an energy saving and cost effective solution. In addition, by using less concrete than traditional solutions, LiteCast's manufacturing process has lesser impact on the environment than alternative traditional solutions. This advantage should not be underestimated, especially when knowing that any government will become eager to grant green projects with incentives.

Therefore, we strongly believe that developers will find higher satisfaction when using LiteCast rather than precast panels or other traditional construction methods. Indeed, they have now access to an innovative and unique building material for similar selling prices.

The third advantage of this product is similar construction time compared to standard precast concrete panels and also being much quicker than block work or other fill-in methods. Furthermore, as its lightweight, LiteCast is less complex to handle and transport compared to traditional precast concrete solutions. In our opinion this advantage will gain in importance with the growing labour shortage crisis that SE Asia is facing.

Finally, this product will allow building development projects to achieve a higher profit margin. As one LiteCast panel is approximately 50% lighter than a standard precast concrete panel, it will result in lower transportation and delivery costs and it will allow the use of lower capacity lifting cranes. Moreover, the buildings primary structure can be less substantial as a result of having less weight to support. Thanks to its higher insulating properties, using LiteCast will also result in much lower heating or cooling energy costs in the long-term for the end-user. Furthermore time to market will be greatly reduced due to a shorter delivery time.

12.References

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