

CIRCULAR ECONOMY BUSINESS CASE STUDIES IN SOUTHEAST ASIA



Advance Prefab Company Limited

- Bangkok and Chonburi Province, Thailand
- Construction
- advanceprefab.co.th
- Analysis period: 2013-2023

Resource Efficiency through Prefabrication

Business Spotlight

Advance Prefab Company Limited (APC) was founded in 2013 as a subsidiary of Nawarat Patanakarn Public Company Limited, which has over 45 years of experience in civil engineering and construction in Thailand. APC was created to address construction material waste and other environmental issues by switching to precast concrete. For example, construction waste in prefabrication at the factory is approximately 0.5%–1%, compared to 5%–10% waste for on-site construction.

The company developed an environment-focused business by shifting to the prefabrication of construction products, especially to insulated sandwich wall panels (foam sandwiched between two concrete layers) and solid beams and columns. Benefitting from their knowledge of the local climate, the company adjusted the proportion of the mixture between the expanded polystyrene (EPS, a rigid, lightweight foam material) and concrete outer layers of the wall panels to resolve the problem of surface cracking caused by the tropical climate in Thailand. The resulting lightweight wall panel significantly reduces customer costs and the time needed for shipment and installation.

APC uses computerised programmes for optimised design and materials mix preparation, which has reduced cement waste by about 10% and iron wire waste by about 5%–10%.

To contribute to sector and national climate goals, the company has started shifting to hydraulic cement, a new benchmark for eco-friendliness that reduces CO₂ emissions by approximately 39 kg per metric tonne of cement substituted.

Even though prefabricated products like insulated sandwich wall panels can substantially reduce costs for customers while benefitting the environment in various ways, product uptake nevertheless remains low because prefabricated elements do not lend themselves easily to complex architectural building designs.

Keywords

Precast concrete, Low-carbon cement

Innovation

Product/service design, Manufacturing, Resource circularity, Resource efficiency

Context and baseline

Buildings are responsible for 39% of industrial CO₂ emissions, including 28% from energy use within buildings (operational carbon), such as electricity used for lighting, air-conditioning and other activities, and 11% from CO₂ emissions during materials production and construction. Concrete production, for example, emits 0.92 tonnes of CO₂/tonne through embodied emissions, while steel emits 1.4 tonnes of CO₂/tonne. Although steel products contain higher levels of embodied CO₂, construction uses more concrete than steel, making concrete the main source of carbon emissions in the construction sector.¹

Advance Prefab Company Limited (APC) was founded in 2013, with a registered capital of THB 400 million (equivalent to about EUR 10 million at the time), as a subsidiary company of Nawat Patanakarn Public Company Limited, which currently has over 45 years of expertise in civil engineering and construction. With design, production and construction technologies originating in Italy, APC has specialised in the production and delivery of precast concrete structures for industrial and commercial buildings and components for civil and infrastructure works. The precast concrete product is manufactured in the factory away from the project site using a mould and cured in a controlled factory environment. Once cured, the concrete elements are removed from the mould and prepared for shipment to the construction site for installation and assembly.²

APC designs their concrete with prefabrication technology for both standard and customised precast concrete products for industrial buildings, producing among others:

- precast column with loads designed in accordance with Thai Engineering Institute of Thailand
- prestressed concrete piles, tested and approved by Thai Industrial Standards Institute (code 396-2524) as well as standards from Thai Department of Highways
- double tees or TT slabs
- precast roof beams
- prestressed concrete girders.

As the early adopter of precast fabrication, APC addresses the issue of construction material waste, promotes recycling and reusing construction waste and materials, and supports environmentally friendly products and practices. The company participates in the Circular Economy in Construction Industry³ initiative in Thailand CECI⁴, coordinated by the Siam Cement Group (SCG) which brings together 38 businesses, representing developers/owners of the building/property, designers and consultants of the building/property, construction material suppliers, construction work contractors and construction/demolition waste managers. Some collaboration among CECI network members includes management of pile head waste by crushing and using to replace stones in pouring concrete or levelling the ground, reducing waste from pipe cuttings by having the manufacturer cut the pipes to the required length, and changing from wood pellets to plastic to increase the number of usage cycles.

In July 2022, the Thailand Cement Manufacturers Association with parties involved from government, professional, industrial and educational sectors, with the support of Ministry of Natural Resources and Environment, Ministry of Industry, Ministry of Transportation, Ministry of Interior, Ministry of Agriculture and Cooperatives and Ministry of Commerce, all agreed in a Memorandum of Understanding to collaborate to increase clinker substitution in cement and concrete to reduce greenhouse gas (GHG) emissions. The MoU aims to reduce CO₂ emissions by at least 300,000 tonnes by using environmentally friendly hydraulic cement. This blended cement contains alternative cementitious materials (such as fly-ash or slag) which partially replaces clinker to reduce GHG emissions while maintaining industrial standards.⁵



WALL PANEL (SANDWICH)



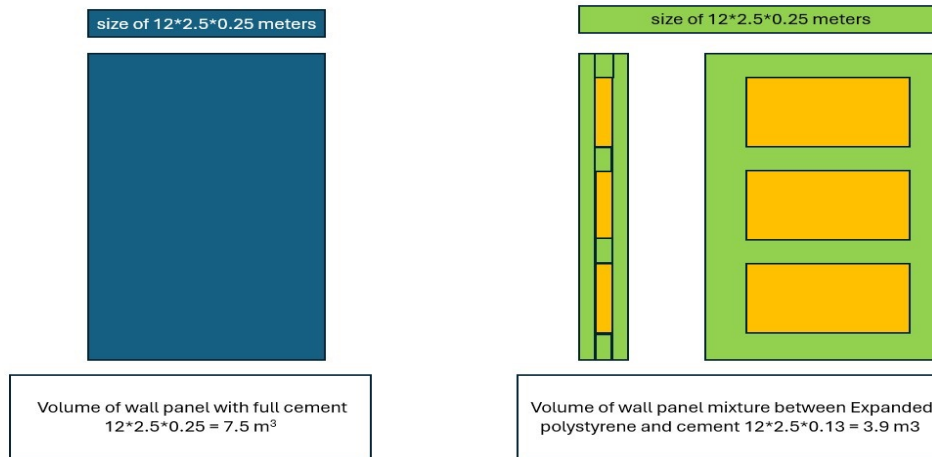
1 <https://risc.in.th/th/knowledge/ปูนซีเมนต์ไฮดรอลิก-hydraulic-cement-ช่วยลดโลกร้อนได้อย่างไร>

2 <https://nitterhouseconcrete.com/guide-to-precast-concrete/>

3 <https://www.scg.com/sdsymposium/2020/en/pillar/circular-economy-in-construction-industry-ceci-2/>

4 <https://www.facebook.com/CECIOfficialpage/>

5 https://www.thaicma.or.th/en/substitution/cement_industry/clinker-substitution#5



Innovation

During the first two years of operation, the company developed local production and application knowledge for their insulated sandwich wall panel. This expertise led to an adjustment of the mixture proportion between EPS, and increased cement use from 9.6 kg/m² to 20 kg/m², while increasing foam density to 90 kg/m². These adjusted mixtures helped to solve surface cracking of the insulated sandwich wall panels in Thailand's tropical climate.

The lightweight 30 m² insulated EPS foam-concrete wall panel (a sandwich of foam between two concrete slabs) uses 3.9 m³ of concrete compared to 7.5 m³ for a solid, all-concrete panel – a reduction of approximately 48%. This reduces material costs along with weight and the embodied GHG emissions of the panels and also significantly improves thermal insulation and reduces energy consumption for heating or cooling the buildings during their use phase. The lightweight wall panel significantly reduces shipment and installation costs.

APC reduces cement waste during production as the required cement volume can be accurately calculated, which helps to reduce about 10% of cement waste and/or overdosing. Small iron wire waste is also reduced by about 5%–10% by cutting precisely with computerised machines.

About 5% of concrete waste from the production, especially from slum press testing, is being recycled to produce walkway tiles and big tree pots. The company bought the required moulds to be able to produce these recycled products internally. These products are then donated to schools, temples, and communities.

Circular Economy impact

APC is contributing to the circular economy by using materials more efficiently (resource efficiency) and by recovering and reusing previously discarded materials (resource circularity).

The change from solid concrete wall panels to foam sandwich wall panels has significantly reduced concrete use, to achieve resource efficiency in its prefabricated product portfolio. A 25 cm thick sandwich wall panel uses 48% less concrete compared to a solid concrete panel of the same thickness; on the other hand, it does require 90 kg of EPS foam. In addition, the change from onsite concrete casting and construction to pre-casting in a well-managed factory environment with controlled production processes has significantly reduced waste, in terms both of concrete waste and forms and support structures. Material consumption as well as waste generation and disposal have been reduced (the remaining concrete waste is reduced to about 3% and metal waste to about 5%).

Resource circularity is achieved by changing from regular to hydraulic cement which has fly-ash and possibly other waste materials mixed in as partial substitute for cement clinker. During September 2023 to March 2024, the company used a total of 353.48 metric tonnes of hydraulic cement, which has a 39 kg CO₂/tonne cement lower carbon footprint.⁶ The avoided GHG emission from use of hydraulic cement during this period thus amounted to 13.78 tonnes of CO₂. The company also achieves resource circularity by recovering concrete waste from production and repurposing it for non load bearing products such as pedestrian tiles, tree pots and sewer pipes.

The prefabrication environment is managed with standardised procedures and inspections of prefab construction to greatly maximise resource efficiency and quality and reduce waste from bracing and formwork, excessive concrete, defects of products, packaging, and debris or repairs compared to onsite concrete pouring and construction. APC can better manage materials, reducing offcuts and utilising recycling processes more effectively. This leads to less waste compared to on-site construction, reducing the environmental impact, including noise and dust, and lowering disposal costs.

6 <https://ensyndrome.com/?p=1051>. Portland cement emits 910 kg-CO₂/T cement, whereas hydraulic cement emits 871 kg-CO₂/T cement

APC's average monthly capacity is 21,000 m³ of concrete. However, some infrastructure projects, such as bridge construction during certain periods up to 300 metric tonnes per month of hydraulic cement are required depending on clients' need, with an emission reduction of 11.7 metric tonnes of CO₂.

Business and market impact

The market for prefabricated concrete products is still developing despite continued growth. APC cannot sell the entire building as a package because it is not suitable for the climate and use in Thailand. Since the COVID-19 outbreak, there has been an adjustment to sales methods for certain building components and product improvements.

APC's main sales are in beams and columns; approximately 600 insulated sandwich wall panels or 18,000 m² are also produced yearly. The panels measure 12 x 2.5 x 0.25 (30 m²) and are composed of approximately 3.6 m³ of concrete weighing 8.64 metric tonnes. A 12 m transport vehicle can carry up to 30 tonnes of panels.⁷

Extensive marketing of APC products focuses on client advantages. In construction planning, clients gain from precast concrete structures produced in a steady flow in a controlled environment without weather delays, which results in predictable project timelines and consistent component quality. In general, prefabricated buildings can be produced 10%–30% faster than traditional buildings. APC advertises that prefab building lowers construction cost for clients, and new businesses or new buildings can be up and running about 15%–20% more rapidly, which means a shorter loan period for the clients. In addition, the prefabrication construction allows clients to scale up or down to meet varying levels of demand. APC products have wider width and length of beams, and column spans which results in more usable floor space.

In addition, instead of dumping into landfill, APC has adopted the recycling practices that turn some of their concrete and metal waste into useful structure such as sewer and drainage pipes at the factory sites and workers' communities.

Based on one customer's observations, using lightweight insulated sandwich wall panels reduces construction time by about 30 days compared to pouring solid concrete panels on site.

Stakeholders

APC has established partnerships with clients in many sectors, for example with the government for building a drainage tunnel with Bangkok Metropolitan Administration (BMA), with the State Railway Authority of Thailand (SRTA) for construction of a railway, with the Metropolitan Electricity Authority for building manholes, with the Mass Rapid Transit Authority (MRTA) on the purple line and the Laemchabang Port project, and with Chonburi Province for building a block drainage and foundation piles. The company has strong partnerships with the private sector on construction projects for oil and gas projects, car parks, commercial buildings, factories and warehouse, and others.

Collaboration and exchanges are maintained with the 38 construction and related companies connected in the Circular Economy in Construction Industry initiative to share experiences and develop partnerships. APC has joined several pilot construction projects to demonstrate how the circular economy works, for example by aggregating leftover concrete to be used in pavements.

For clients the prefab insulated sandwich wall panels are durable and standardised in use. Some of the characteristics of precast concrete buildings are superior fire-resistance and sound-attenuation. Reducing moisture and creating an energy-efficient environment are two other advantages because the sandwich panels are composed of two layers or facades of concrete separated by a continuous (edge-to-edge) layer of insulation foam with an ability to absorb and release heat.⁸



7 For example, the calculation of the project building has 120 wall panels and transports and installs 30 panels/day. There is a difference in production price of 819 x 120 = 98,280 THB/project, a difference in transportation price of 5,000 x 120 = 600,000 THB/project, a difference in installation price of 1,333 x 120 = 159,960 THB/project. Total cost reduction of 858,240 THB/project.

8 <https://www.enterpriseprecast.com/uploads/Image/Designer-Notebook-PDFs/High-Performance-Insulated-Precast.pdf>

Implementation

APC is a pioneer in the prefabrication business and has its customers' trust and a solid reputation, yet the company experiences fierce price competition from new market entrants.

Using hydraulic cement with lower carbon emissions for major structures may require about 10% more cement than non-hydraulic cement, according to the recommendation of the the Association of Thai Cement Industries⁹, and requires skilful production technology. Siam Cement Group (SCG), the largest cement producer in Thailand, already has a declared policy to stop producing non-hydraulic cement within 3–5 years, which will provide a strong incentive to influence public policy and client responsibility. Up to June 2024, APC had produced almost 1,750 m³ of hydraulic cement based concrete, equal to 33% of its total concrete production since it began using hydraulic cement.

Insulated sandwich wall panels have significantly reduced costs for customers and are highly effective in reducing onsite construction waste. However, the finished products are uniform and cannot accommodate specific requirements in architectural design. APC's total sales are relatively low, although over time they have been steadily increasing.

Different construction product standards between Thailand Industrial Standard (TIS) and the Department of Highways means that APC must conform to both standards.

9 <https://ensyndrome.com/?p=1051>

APC is facing a challenge in comprehensively calculating the circular-economy impact of their product. In 2020, the company joined 10 other construction companies to commission a carbon footprint study of their main concrete products by VGreen, Kasetsart University, with the support of the National Science and Technology Development Agency (NSTDA). In 2024 the company started to set up its own internal carbon accounting systems to establish a baseline in 2025 and subsequently drive emission reduction initiatives.

Takeaways

Timely and customised national standards are needed so that using circular-economy products such as sandwich wall panels become the norm in the construction sector. Advance Prefab Company would also benefit from operational and reporting guidelines and tools to improve its capacity to implement circular economy initiatives.



Acknowledgements

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