

Precast in School and University Developments

تقنيات سابقة الصب بنمو تطوير المدارس و الجامعات

Over the last years, the United Arab Emirates (UAE) has deployed considerable efforts to further enhance its educational infrastructure, capitalising on the richness of the UAE's population diversity, to offer prestigious and internationally recognised education both for the future regional leaders and for its expatriate population. Gulf Precast, a UAE leader in precast manufacturing, has participated in the construction or refurbishment of twenty three schools and universities since 2000. This article explores why Precast is the construction technology of choice when it comes to school and university developments, and through the case study of the construction of the prestigious Paris Sorbonne University and New York University in Abu Dhabi, analyses difficulties faced and overcome.

خلال السنوات الماضية بذلت دولة الامارات العربية المتحدة جهودا معتبرة لتعزيز بنيتها التعليمية الأساسية وبالإستفادة من ثراء التنوع السكاني في الامارات العربية المتحدة لتطبيق مناهج مرموقة للتعليم و معترف بها دوليا و ذلك بالتنسيق لكل من قادة الاقليم بالمستقبل و لسكانها من المغتربين. شركة الخليج لسابقة الصب (جولف بريكاست) كشركة رائدة بدولة الامارات العربية المتحدة للمنتجات سابقة الصب شاركت في تنفيذ مجهودات الدولة التعليمية ببناء أو بتحديث ثلاثة و عشرون مدرسة و جامعة منذ عام ٢٠٠٠. هذه المقالة توضح السبب في أن تقنية الانشاءات باستخدام الصب المسبوق هي الخيار الأفضل عند ما يتعلق الأمر بتطوير نمو المدرسة و الجامعة و أيضا من خلال دراسة حالة بناء كل من جامعة باريس السوربون المرموقة و جامعة نيويورك في أبو ظبي بتحليل الصعوبات التي وجهت و كيفية التغلب عليها.

■ Dr Daniele Pfeffer Seraphim,
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When time is of the essence, Precast use significantly reduces risks of construction delay

Completion on time is of critical importance when educational construction is concerned. The doors must open in September without fail or the entire school year may be lost. This is even more critical for refurbishments which need to take place during the July/August break and be fully completed without any safety risk to the students, by the first days of September.

With a minimum of planning ahead by the main contractor, Precast construction can be invaluable to reach these stringent time requirements. While students are completing their school year without any disturbance, the concept design, structural calculations and detailed fabrication drawings are all finalised and approved. The production in the Precast factory has started and the stock of elements is building up, incorporating within the panels themselves all the necessary Mechanical, Electrical and Plumbing inserts which will allow easy connections. As soon as the school closes its doors for the summer



A Precast Factory stockyard

recess, the Precast erection starts, quickly assembling on site the already produced panels and handing over the construction site to the MEP contractor who plugs in equipment and utilities at the pre-defined locations. The Precast installation can be completed within less than a month.



The critical importance of aesthetics in the Paris Sorbonne University Abu Dhabi



The pigmented GFRC façade of the Paris Sorbonne University Abu Dhabi

When aesthetics is a cultural statement

Many foreign schools and universities are willing to participate in the UAE's educational strategy, setting up renowned educational centres targeting Gulf Region Arab students as well as the expatriate population. This is the case for example of the Paris Sorbonne University Abu Dhabi located on Reem Island or the New York University located on Saadiyat Island. These initiatives however, are not only a means to provide

educational alternatives to the already rich framework of the UAE, but also to promote the culture of the country they represent, and therefore to demonstrate excellence in all aspects, including outstanding educational infrastructure.

In order to meet this goal, the construction requires to be both functional and of high aesthetic value. The architectural aspect and its realisation are intended as a cultural statement.



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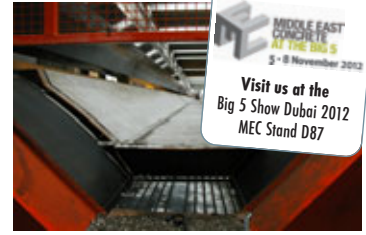
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Fixing GFRP elements on the steel envelope.



Windows sunk from the façade

The challenge of Paris Sorbonne University Abu Dhabi construction

Gulf Precast was awarded the Precast construction package of the Sorbonne University in August 2008, with a scope including the façade, the horizontal structure consisting of Prestressed beams and Hollowcore slabs, some decorative features such as several eccentric GRP cones, as well as the boundary wall. One of the main challenges of the project was the production of the pigmented envelope in GFRP and more specifically that of maintaining a consistency of colour throughout the 21,980 square meters of façade. Although the same pigment supplier was maintained through the 16 months of production, batches of pigment may result in colour variations which had to be strictly controlled to match the approved colour scheme. In order to obtain the intended rough finish, a light acid etching was applied on the produced elements, operation which also required strict control to homogenise the final façade appearance. From a technical point of view, all of the fixings were to be hidden, which entailed complicated mechanical fixing details. The erection works was also a challenge as the patterned façade was fixed on a steel structure one meter away from the in situ structural wall, including windows sunk in by around one meter from the GFRP frame. The fixing on the steel envelope meant that no depth variation could be absorbed through adjustments, and that the acceptable tolerance could not exceed a few millimeters.

The challenge of New York University Abu Dhabi construction

In 2012, Gulf Precast was asked to provide part of the façade, staircases and bridges

for the New York University development. Production and erection are currently under progress.

The façade of the university is of white concrete with exposed marble aggregates. After a number of trials, Gulf Precast incor-

porated white titanium powder within its mix design to obtain the required colour scheme. In order to achieve a façade as pristine as possible, all fixings are hidden. Strict quality assurance and quality control measures are deployed to ensure the



Façade element with white exposed aggregates



Preparation for casting of the second side of V shaped elements

colour consistency and avoid that any operations, including transport and site erection, may strain the white surface.

Another challenge is that many of the elements are of L or V shape. Prior to production, a number of tests were undertaken in the factory premises to decide the optimal way, from a quality point of view, to produce these shapes.

Any deep vertical casting of white concrete would have a negative quality impact as the marble chip distribution in the concrete matrix would be higher on the bottom part and lower on the higher one, thus affecting the aesthetics of the element after sand blasting. Therefore the following process was adopted:



A V shaped large element with recesses and white exposed aggregates surface on all sides



A 7.5 meter long element

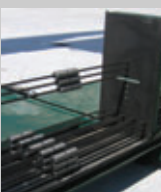
STRANDS PRESTRESSING UNIT



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STRANDS DE-TENSIONING UNIT

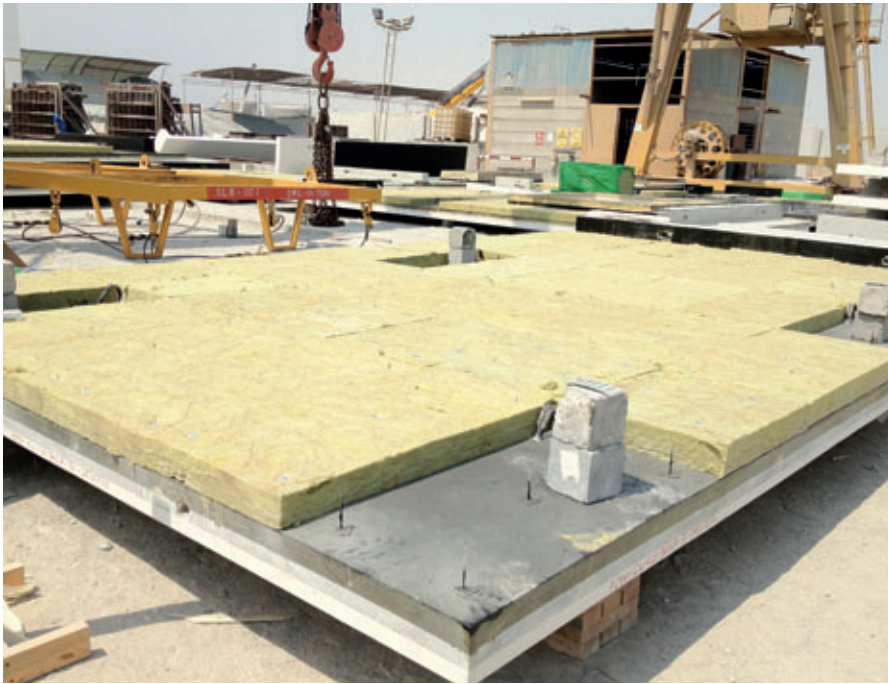


DE-TENSIONING CYLINDERS



MEASUREMENT SYSTEM FOR TENSIONING STRENGTH





Panel insulation in the factory stockyard



A panel ready for delivery

1. Horizontal cast of a 5 centimetres white concrete layer for the first side, leaving exposed steel reinforcement bars protruding.
2. Place this first side in an inclined position on a mould intended for the casting of the second side. Connect the protruding steel with the reinforcement intended for the second side.
3. Cast 5 centimetres of white concrete over the connected reinforcement, thus connecting the 2 faces of the V element.
4. Cast a layer of grey concrete over both horizontal and inclined surfaces, using an inclined shutter for the first side.

This technique, although time consuming, ensures that the fair face of both sides of the element receive an even distribution of the marble chips aggregates.

Further complications occur when recesses are required on several sides of these large V elements, or when the length of the element is reaching up to 7.5 Meters. It should be noted that this type of finish is generally not recommended for such large elements, as per the Precast Concrete Institute standards, and requires constant care and control throughout the production process.

The production process does not stop there however, as the elements are then sand-

blasted to reveal the white marble chips aggregates imported from an Omani quarry. They are then turned around to allow the contractor in charge of bitumen paint and insulation to perform his work within Gulf Precast's factory premises.

The weight of some of the elements is an additional issue, as the podium from which these elements must be erected cannot withhold the weight of a large crane. In order to overcome this difficulty, Gulf Precast decided to cast the largest of these panels using a 3 centimetres layer of white concrete to be sand blasted, completed with an additional layer of GFRC instead of the 12 cm grey concrete backing, which renders the elements lighter.

The architecture of the New York University is of New England inspiration and is one of the most technically challenging projects ever undertaken by Gulf Precast in its 28 years of UAE construction services. It will open its doors to students in September 2013, which is one of the reasons for adopting a Precast solution.

FURTHER INFORMATION



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