ARCHITETTURA PREFABBRICATA in una grande opera
CEMENTI COMPOSITI
CONNETTORI STRUTTURALI per i solai in legno
SPECIALE RICERCA E TECNOLOGIA - ICITE CNR
Prove in opera a Malpensa 2000 - Il radon in ambiente indoor - Informatica per la ricerca - Il fluage nei pannelli sandwich - Prodotti edilizi con aggregati riciclati
PROJECT MANAGEMENT'S POINT OF VIEW

On a second phase, two 16 stories, twin towers will be built. The foundations and up to the third floor will be ready with the first phase. These towers consist of a mixed concrete-steel structure, being the center core made of reinforced concrete.

The total investment for this project is estimated at 59,012,000 escudos (329 million USD); construction works started on November '93 and finished on September '97. The building is located at a maximum activity scenic area.

Precast Exterior Cladding: The exterior cladding of the building consists of 40,000 m² architectural, pigmented, precast concrete panels and 8,000 m² pigmented GRC composites. Subsequently, the panels are cladded with tile, natural and cast stone.

The average area of the concrete panels is about 9 m², and their thickness is 20 cm. The GRC panels are 15 mm thick.

Package 0245, consisting of the fabrication, supply and installation of the above mentioned exterior cladding (except natural stone), was awarded to the association of companies Patype by the amount of roughly 950 million escudos (62 million USD).

This association of companies was created for this job, and originally consisted of the association of the portuguese Rainha and the spanish Jossas groups.

The Project Management: The client Colombo S.A. chose to have a project management consortium of four specialized companies, being two of them large multinational companies of american origins, and two portuguese companies, well anchored into the portuguese construction and engineering circle.

This Consortium's task was to coordinate, manage and supervise the works of forty different packages and contractors.

Consortium and Precast Exterior Cladding

Why precast concrete exterior cladding? Where a solution for the cladding of such a large scale building had to be found, three main conditions had to be fulfilled:

1. Installation speed, in order to meet the schedule requirements;
2. Low or inexistent maintenance;
3. Good sound isolation.

Large size, 20 cm thick and pigmented concrete panels was the cladding

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L'OBRA COLOMBO A LISBONA

L'articolo di Cachadinha che segue è volutamente "di parte". Rappresenta infatti il punto di vista di una Direzione Lavori che si trova, suo malgrado, coinvolta e travolta dai problemi che pone l'utilizzo di un materiale nuovo (nuovo abnorme per la situazione locale). Si è quindi voluto sottolineare, con fotografie e disegni, più i problemi e le difficoltà incontrate in corso d'opera che i risultati (per altro assai rilevanti sul piano estetico e funzionale) raggiunti ad opera completata.

E' sicuramente utile e giusto che una rivista come L'Edilizia illustri le grandi opere realizzate - e sicuramente Obra Colombo è una grande opera - ma che faccia anche comprendere quanto lavoro, fatica e quanti tentativi ci siano dietro ai risultati. Oltre ai dettagli costruttivi sono quindi riportate foto "prima e dopo la cura", dettagli di produzione e problemi di produzione e montaggio.

Se si faceva la vera lista delle "grane" sorte nel corso dell'opera la rivista non basterebbe a contenere l'indice! Però il lavoro d'equipe tra i tecnici della direzione lavori (tra cui Cachadinha), della produzione e del montaggio, e il molto buon senso (alla fine i panecci sono stati opportunamente verniciati!) hanno consentito di arrivare in fondo quasi nei tempi previsti e in modo quasi soddisfacente. (Se trovate un tecnico che dica, alla fine di un'opera di tali dimensioni, che tutto è andato bene e che si sono rispettati i tempi ... strappategli la barba finita! Aveve trovato un politico che si finge tecnico).

All'opera hanno collaborato tecnici portoghesi, anglosassoni, spagnoli ed anche italiani. L'opera è oggi completa e funziona in modo egregio da oltre un anno.

Filiberto Finzi
solution that met these three requirements. The special architectural shapes, such as corners, would be achieved by utilizing lighter GRC panels.

Choice of the contractor Although the cladding solution chosen was the most adequate on a theoretical level, it had to be put into practice. At the time of bid out, the Portuguese market had little experience in the solution chosen. With such a demanding schedule and an constructive solution seldom utilized before, the main quality any contractor could have was credibility. This was provided by the examples of previous works of Star-of-Petronas in Spain and by the solid image of the Pavljocolate group in the Portuguese market.

The engineering phase This part of the works consisted mostly of the development and approval of the shop drawings necessary to the fabrication and installation of the panels. Simultaneously, the plant that was to produce both GRC and concrete panels was being built. The engineering achieved met the architectural criteria but proved to be insufficient on the technical aspects, such as:

- definition of the fixations to be used on each panel;
- definition of the reinforcement details of the concrete panels;
- definition of the concrete mix;
- definition of the procedures to guarantee a good quality of the final appearance, especially on what concerned uniformity of colours and their durability.

This, together with the fact that the plant had no time for experimentation and fine tuning of the production procedures, led to several problems that we will come back to later in this article.

The engineering phase started on January '96 and lasted for nine months, about the same time that took fabrication and installation.

The Construction phase

The concrete structure of Centro Colombo was originally awarded to an association of two large Spanish contractors by an amount of roughly 8,000 million escudos (55.5 million USD). However, works did not progress as expected, and after one year of construction the project was more than four months late, jeopardizing the opening date of the shopping center. This situation was unacceptable to the owner (clients), due to the economic consequences that a late opening would bring, both on rent losses and on fines by the shop tenants and owners.

Contractor change and schedule recovery Therefore, just one and a half years before the scheduled opening and with not more than 70% of the concrete structure done, the concrete structure's contractor was replaced by a medium size construction company belonging to Sonae, the major stock holder of the client Colombo.

As a result, an enormous effort to recover the lost time was made by the new contractor. This effort obviously reflected in the quality of the works.

The Portuguese code for concrete works, Repac, establishes as dimensional tolerance for large size structures +/- 2 cm. This was largely forgotten during the concrete structure works. The total amount of the corrections carried out at Colombo was over 15 million escudos and lasted as long as the installation works. Special teams had to be created by the project management to face this problem.

Preparation of works; lessons learned Pavljocolate focused during the first nine months of work on the approval by the architect of the shop drawings. Although the contract indicated that it was the contractor's responsibility to survey the existing concrete structure, this process started at the same time as works on site.

Other actions also proved to be wrong or inadequate:
1) The structural survey should have been done at the same time as the engineering phase was progressing. The final placement of the fixations proved to be the most effective survey and should be done as early in the process as possible. The project management should be informed about severe deviations at least two weeks prior to start of installation works in a new front.

2) Special care has to be put on the definition of the fixations for each area of the building, especially in countries with little tradition in
architectural pre-fabrication. The tolerances assumed during design for the concrete structure should assume minimal dimensional accuracy. In similar cases, the ideal tolerance should be ±/−5 cm.

3) On large buildings, installation procedures have to be changed according to the specific areas of the building and the variety of pieces to be installed. This is contrary to what current pre-fabricators are used to but should be considered, especially if the relation between pieces/mold is low. At Colombo, this value was as low as 9.

4) Shipment and logistics plans have to be done according to the real conditions on the field, and not based on previous works or general assumptions. Whenever coring of the existing concrete structure is involved, special care should be placed in reviewing the reinforcement density, water and power supply on site. If this part is neglected, it will be extremely time-consuming and resources consuming and productivity will decrease significantly.

5) Access to the front for cranes and trucks should be studied carefully and coordinated with other works.

6) Storage areas for panels should be studied and requested to the project management as soon as possible, in order to ensure that this is taken into consideration during scheduling and general coordination. Precast panel cladding is one of the activities that has higher needs of space on site. However, for optimization purposes and due to the fact that these type of jobs generally don’t have much space available, storage areas should be limited to a minimum area and time period possible. Therefore, the shipment of panels should be carried out in reverse sequence to the installation.

7) Special care has to be placed on scheduling and sequencing of the works. A general schedule with sequencing should be submitted to the project management early in the process to assure coordination with other works. When reparations and/or corrections of the structure are necessary, there should be 3 levels of scheduling:

- master schedule, for coordination with other activities;
- three week look ahead, in order to have areas clean and ready to be surveyed and marked by the topographers;
- two week look ahead, in order to guarantee that the areas will be corrected and repaired on time for installation.

The Design
The cladding of a large building demands a highly organized structure. The information flow between designers, surveyors on site teams and plant staff must be guaranteed even before work starts. In countries with little tradition in architectural precast, an experienced design consultant should be permanently on site.

The Schedule
Scheduling is extremely important to keep a good installation rhythm. The contractor must be able to adapt to sequence changes (inevitable in large scale buildings) and be sure their fabrication reflect these changes. A full stock yard can only make shipment harder and will not supply the pieces the site needs. Therefore, a senior scheduler, equipped with good software, is vital for the success of the job. This person has to stay in close contact with the project management.