PVC TEXTILE ARCHITECTURE, PROGRESSION AND ECOLOGICAL SUSTAINMENT

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Introduction

It is my pleasure to present this paper today on behalf of Serge Ferrari of France and Australian based company Innova International.

From the pioneer textile structures which were built more than 3 decades ago until today, the technology of textile architecture has covered a lot of ground and has gained in recognition and acceptance from building specialists and specifiers but also from the general public. The purpose of this presentation is to:

- identify what PVC membrane structures offer in terms of architectural and technical advantages
- illustrate the above points using the example of the Sepang Formula One racing circuit in Malaysia, one of the largest membrane structures built so far in PVC (Ferrari
- Fluotop T)
- introduce VINYLOOP , Ferrari's exclusive recycling technology, which should diminish concerns about PVC's ecological role.

Architectural and Technical Advantages

Architectural Advantages

Architects who have built once with fabrics come back to it for more projects. This observation is based on Ferrari's 20 year experience promoting the concept of textile architecture to the building industry (architect, engineers, end customers...) The main points architects emphasise are:

- Freedom of shape and enhanced creative options. The inverted double curvature is the way to achieve stability and to multiply design possibilities (HP, high points, saddle shapes, ridge and valley shapes...).
- Good light transmission in buildings for natural lighting effects.
- Softness of the built landscape in terms of aesthetic impression and expression.

Technical Advantages

Technical points should assist architects to convince clients that beside aesthetic and architectural appeal, PVC membranes offer tangible constructional and economic benefits such as:

Longer and larger pre fabrication phase in the factory (compared to conventional materials) which minimizes the time and risk on site. The work is less dependent on external weather conditions. Single panel dimensions can reach up to 1000 sqm/piece.

Overall quicker building time than conventional materials. On average we can say that once the design and studies have been completed, the civil work (foundations) can take place and in parallel (< masked> time) the steel and membrane fabrication is carried out. Once the concrete is dry (average 3 weeks) the erection of the steel and membrane can take place.

A PVC membrane structure can adapt and accept uneven grounds and anchoring points (different levels). Conventional materials face greater complexities and vagaries (being more rigid they usually require a levelled base).

Lightness: The frame weight / covered surface ratio is very favorable to PVC membrane structures. On average a membrane structure requires: 12 Kg of steel per sqm whereas a conventional building needs 25 to 30 kg of steel per sqm.

The PVC membrane allows larger free span than conventional materials.

The PVC membrane has a better resistance to corrosion than steel (GABON projects).

A double PVC membrane offers a thermal insulation solution whilst maintaining good light transmission. Example: BUTLIN projects (75,000 sqm of structures in UK for vacation resorts, a number of activities are carried out indoor with daylight environment: FERRARI PRECONTRAINT 1502 FLUOTOP T / PRECONTRAINT 702 inner membrane).

Flexibility: Subject to appropriate fabric selection, PVC textile buildings are dismountable, relocatable, modular, and extendable. This means more options and less risks for clients who exhibit short term visibility when making investment decisions.

Those advantages are well perceived by investors in emerging countries who seem ever eager to break new

economic and architectural records. This is especially the case with Malaysia which has chosen textile architecture for a number of high profile infrastructure buildings: Kuching and KL stadiums, KL Station Light Rail Transit System and more recently the new KL Formula One racing circuit.

SEPANG INTERNATIONAL CIRCUIT MALAYSIA FORMULA ONE GRAND PRIX

Location	Kuala Lumpur Malaysia
Client	Malaysia Airports Berhad
Architect	SAM Architect
Membrane engineering	BURO HAPPOLD
Fabricator & Installer	ALOM BUILDING SYSTEMS Sdn Bhd
Completion	Third Quarter of 1998
Material	Fluotop T membrane from Ferrari A total of 60,000 sqm of membrane were used
Structure	Westbury Tubular Malaysia
Special features	Banana leaves concept for the roof scheme (Grand Stand and VIP centre) and wavy & ribbon shape for the Welcome Centre
Dimensions	Grand stand panels: 10m x 22m each Welcome centre: 30 x 65m
Climatic conditions	Temperature regularly exceeding 35°C
Current level of humidity	85%
Average rain fall	200cm to 250cm

Project Description
Unarguably one of the best in the world, the 5,6 km Formula 1 racing circuit is the first to have a double frontage stadium-like grandstand, giving spectators a wide angle view of the race. Its "V" shaped grandstand design, allows spectators to view the race from two different angles. While the entire arena can accommodate 130,000 spectators, the grand stand alone has a 30,000 spectator capacity.

Project Achievement
In designing the Sepang International Circuit, the designers incorporated "Development Within The Jungle" as their main theme. For this, the design of the grandstand and the VIP roof use the "Banana Leaves" concept with steel trusses acting as the spine in reflecting this idea.

The building recently won the Outstanding Achievement Award at the IFAI convention in San Diego, USA.

VINYLOOP: RECYCLING OF PVC TEXTILE COMPOSITES
Clients make the textile choice with a high level of expectation about membrane longevity. The life expectancy of PVC membranes can exceed 25 years (AIRBUS examples and Baegert / Bureau Veritas study). In spite of long term durability the issue of end of life span recyclability has become a growing concern for architects, clients, and the Eco/Enviro industry and lobby groups. This issue has been systematically analysed and thankfully solved.

Reduction of waste in it's production processes has been a major concern and priority for Ferrari. The Ferrari R&D department in cooperation with chemical giant SOLVAY have developed a unique patented technology for recycling PVC textile composites : The Vinyloop process.

Description of the process
For a composite material made up of two mono materials, polyester fibers and flexible PVC, the simple grinding of membranes at the end of their life cycle does not enable re-use in existing industrial processes.
The Vinyloop process separates the polyester fibers from the PVC providing very clean raw materials through the following phases:

- Grinding
- Selective dissolution by solvent
- Separation of the fibers
- Precipitation of the PVC with additives
- Regeneration of solvents which are re injected into the recycling circuit

Re introduction of the raw material in industrial process
The cleanliness of the raw materials obtained through the VINYLOOP system allow them to enter various industrial processes such as:

- Injection moulding
- extrusion
- calendering
- The polyester fibers can also be widely used in the non woven industry.

A pilot plant is currently running and FERRARI is organizing to have a full scale industrial operation within two years.

Conclusion

PVC Textile Architecture has evolved from prestigious temporary events (Munich EXPO, BRISBANE 88, SEVILLA 92) to major customised infrastructure projects. To progress even further, the players (architects, engineers, general contractors...) should now be thinking about standardised, economical and rational solutions for a wide range of repetitive applications such as flexible partitions, silos, façade claddings, sky lights...
The longevity of high grade PVC materials accommodates those applications. Sophisticated computer tools now exist to master an almost infinite range of membrane designs.

PVC Textile architecture delivers superior aesthetics, architectural scope, technical performance, economic benefits, and now ecological and environmental sustainment through a mix of durability and recyclability.

The arguments for a strong PVC textile architectural future are empirically supported, rational, and compelling.