

Issue | 2005

Intelligent Glass Solutions

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22nd World Congress of Architecture UIA 2005
Istanbul, Turkey

The use of laminated stone glass in the designing of a curtain wall for the Etoile Shinsaibashi Building.



In December 2002, architect Kengo Kuma and Associates (KKAA) requested my collaboration in the design of an extraordinary office building on the historical main street of Osaka. KKAA's aims were to create a building that would be different both in appearance and atmosphere at the center of Osaka city, which would produce a complete change to the skyline in its contrast with the buildings around it. KKAA intended to use an Onyx stone, which has the highest permeability in the marble family, on the main façade of the building.

The building is L-shaped with total dimensions of 34.5m x 27.0m, comprising retail space on 1st and 2nd floor; office space from 3rd to 9th floor; and conference/event area space on the roof level. The total height of the building is 44.5m. The onyx stone was intended to cover all of the north, south and west frontages of the office floors; both the outside and inside facades of the event space at roof level; and certain areas of the north and south façade of the retail spaces.

In the early stages of the schematic design, KKAA planned to use stone of 32mm thickness that was to be inserted into a double glazing unit that would be braced and supported by a back mullion. The aim was to achieve a smooth continuity of a huge flat stone surface, by avoiding any protrusions on the exterior surfaces. On every 3rd panel there were to be tiles of fritted laminated glass with a stone pattern, which would serve as windows from the inside of the building but would maintain the uninterrupted appearance of stone from outside.

However, despite the relatively high permeability the 32mm thick stone, the light inside the building would still be severely restricted. Also, although KKAA believed thin stone to be the ideal material, it is in fact not suitable for structural purposes due to its brittle and unpredictable properties. It is also inconsistent in terms of quality and contains some impurities. But, because by laminating together the stone and the glass, the stone is reinforced, we thought that the stone could be made thinner. The surface of the onyx stone should not be exposed to external weather conditions as it is porous and collects dust and dirt so would not last as long as the building. So we concluded that it would be best for the stone to be covered and sandwiched in the glass.

We had to start our investigation promptly and soon discovered some laminated glass suppliers in France and Germany who have the technology and experience to laminate the stone and the glass with resin material. Even though they insisted that onyx is one of the most difficult stone to handle, they nonetheless felt they would be able to produce the laminated stone glass. So, after obtaining the approval of KKAA and the client, we proceeded with the idea of using the laminated onyx stone glass.

It was necessary to conduct large scale investigation and experiments to make sure the laminated stone glass would meet our performance criteria and requirements. We were constrained by a limited period of operation and were faced with the added difficulty that what we were attempting was unprecedented in Japan. In conjunction with



this, we had to complete our detail design and construction drawings. Therefore, we requested assistance from the façade consultant firm "FRONT" in order to develop a fuller and more effective team.

The curtain wall is a system designed to be unitized in two stages, with installation of the aluminum extrusions with structural silicon at four edges of the glass panel taking place in the factory, and then the fixing to the H-type painted steel mullion taking place mechanically on site. Continuous fluorescent lights are attached along the depth and width of the mullions which are concealed by the frosted glass.

Each unit is normally 0.9mX4.0m and there are 513 units (1913.6m²) of the laminated stone glass, and 168 units (628.3m²) of the printed glass making a total 681 units (2541.9m²).

Due to concern about the durability of laminated stone glass under the particular Japanese environmental conditions, it was necessary to examine the yellowish discoloration, cracks and de-lamination and to test the structural efficiency of the resin by conducting intensive experimental tests. Our anxieties were related to the aging and deterioration of the resin which is used for lamination between the stone and the glass. The project team made frequent visits to each supplier to inspect the factory and discuss how to optimize the products. After repeated precautionary examinations, we were satisfied that their products were of required quality and would be delivered on schedule. Only then, after confirmation

from the client, did we finally obtain the laminated stone glass

We decided to obtain all the stone from Pakistan, where we could procure large amount of onyx stone easily and where they can quarry good quality stone with low risk of color dispersion.

It did not prove to be realistic to procure stone of 4m length, so we compromised with slabs of 2m which could be spliced together to make one unit. Each of the slabs was closely inspected by a representative at the quarry, the factory and the field. If any defect such as crack, hole or bubble of the resin lamination was observed, it was replaced immediately.

The production sequence of the laminated stone glass developed as one that was innovative, unique and special. Firstly, 20mm thick stone was quarried out from the large stone block and was laminated with glass on both sides with resin. Secondly, the stone was split by a water jet cutting in at the intermediate position of the thickness in order to divide it into two sections. The exposed stone surface was grinded and polished until it reached our target of a 4mm thickness. Finally, after the stone had been dried sufficiently, the glass was laminated to the polished surface of the stone to complete the process and to produce the finished product. Because we were able to achieve a thickness of just 4mm, we were able to produce a laminated stone glass with extremely high permeability thus allowing excellent natural lighting.



Shop inspection

and simultaneously KKAA organized the mapping of each slab with the others and instructed the contractor regarding the location of each slab.

An actual scale mock up test was conducted to ensure that the performance of the curtain wall met our specified criteria. We also carried out a number of additional checks such as an impact resistance test, a lighting setting test and an exterior exposure test. All was finally completed to our satisfaction in November 2004.

The general impression of stone is that it is massive and compressive, but when it is transformed to its extremes of thinness, and by borrowing strength from the glass, it can demonstrate its hidden potential as a building material. By adding a carefully designed light weight steel structure, the stone brings a transparency and lightness to the façade which is in keeping with the cheerful atmosphere of the famous fashion street in Osaka. (Yoshinori Nito)

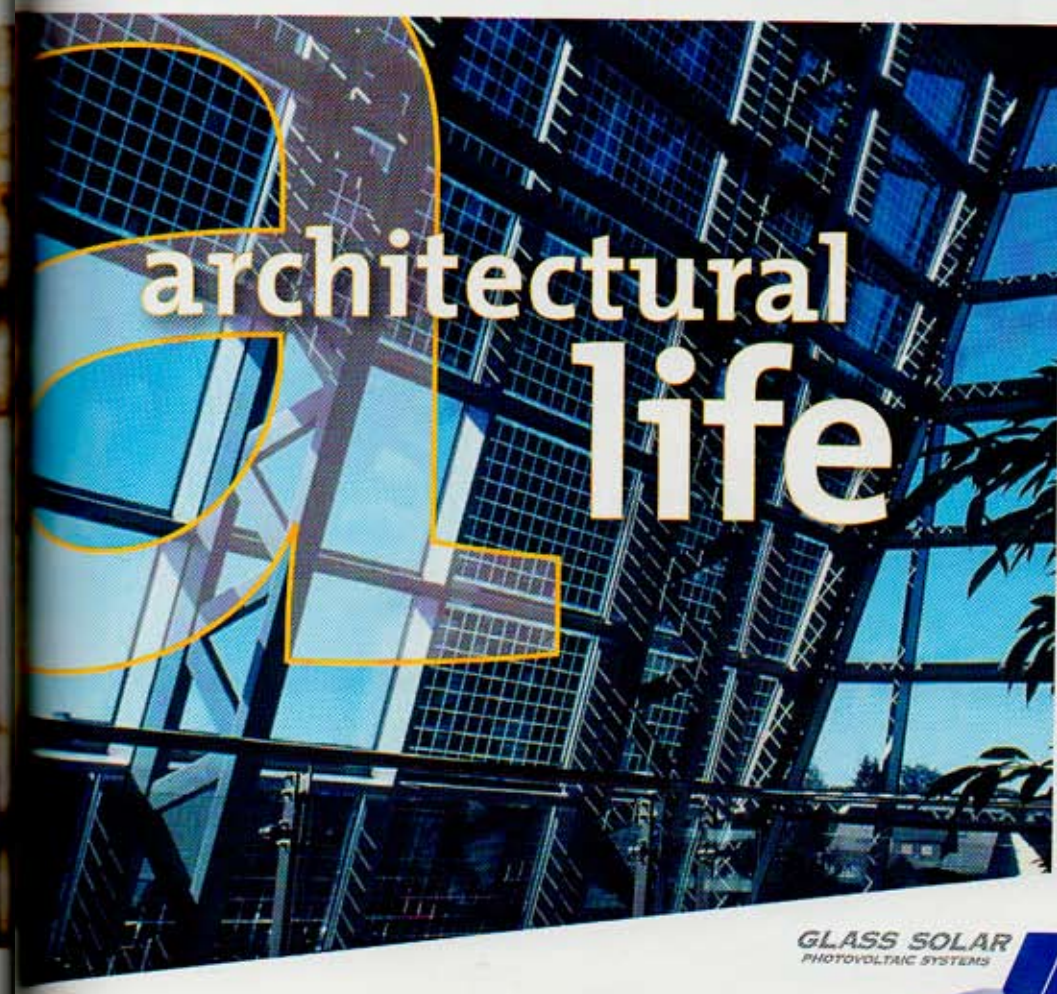
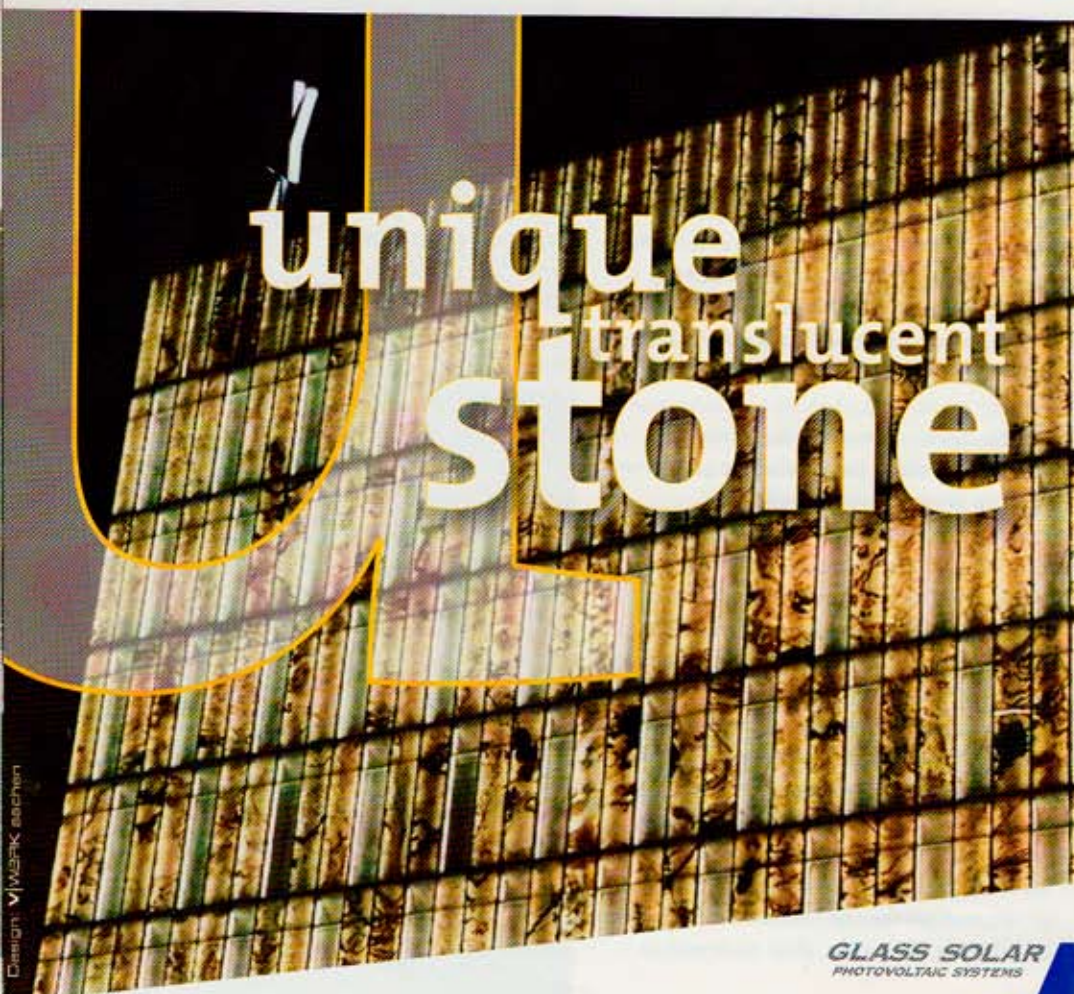
The design team visited the quarries and chose some of 20mm thickness stone slabs matching the intended design in order to create a standard of stone block and slab selections. After that, each stone slab was digital-scanned and transferred to KKAA in order to obtain the approval,



Osaka / Glass Façade Night View



RF Event space façade - Night
Photo: Yumi Fujikawa



realising the vision

elegance

daylighting

custom design

planning

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Entrance Lobby

LVMH Osaka "Etoile Shinsaibashi"

Credit

Name:

LVMH Osaka "Etoile Shinsaibashi"

Address:

1-9-17 Shinsaibashi-suji, Chuo-ku, Osaka-shi
Osaka-fu, Japan

Owner: Osaka Fudosan (LVMH)

Type:

Retail and office

Architect:

Kengo Kuma & Associates / Kengo Kuma,
Minoru Yokoo, Shigeyoshi Sugai

Façade engineer:

engineers network / Yoshinori Nito,
Yumi Fujikawa

Façade consultant:

FRONT Inc. / Marc Simmons

Building engineer:

Van Structural Design Studio / Shigeru Ban

Services engineer:

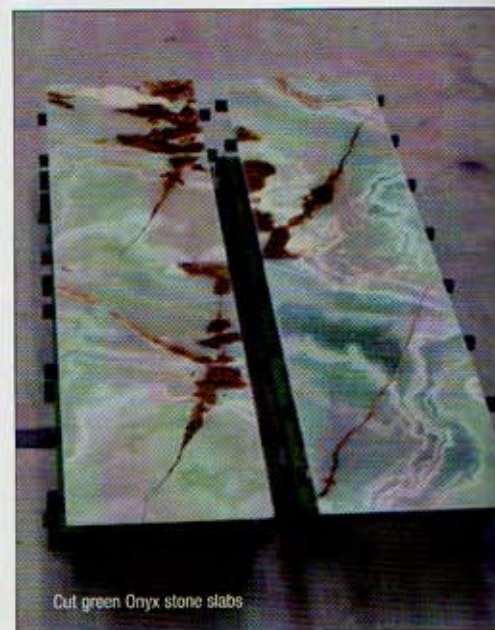
P.T. Morimura & Associates, Ltd / Yukimasa
Suzuki, Masahiro Sekiguchi

Project manager:

Mitsui Fudosan Co., Ltd.

Genera contractor:

Kajima Corporation



Cut green Onyx stone slabs

Curtain wall contractors:

Device + Sankyo Aluminium Industry Co.,
Ltd. JV

Glass supplier:

Saint-Gobain Glass Solar GmbH

Onyx stone supplier:

Paiotti s.r.l.