

*This press release is an English translation of LIXIL Corporation's press release issued on October 3, 2012 in Japan

LIXIL's Face Bricks Used for Preservation and Restoration of Tokyo Station's Landmark Red Brick Building

LIXIL recreated the color and condition of historical face bricks using original manufacturing techniques.

Tokyo, Japan (October 3, 2012) -- Japanese housing equipment and building materials manufacturer LIXIL Corporation (Head Office: Chiyoda, Tokyo; President and CEO: Yoshiaki Fujimori) is engaged in the construction project to preserve and restore Tokyo Station's Marunouchi-side Building, which is designated as an Important Cultural Property by the Japanese government (Construction project owner: East Japan Railway Company). LIXIL successfully recreated historic face bricks^{*1} used on the landmark Tokyo Station's landmark building (known as the Red Brick Building). LIXIL's face bricks are used on the outside walls of the 3rd floor, including the domed roofs at the north and south ends of the building, all of which were destroyed during World War II (Approx. 400 thousand face bricks were used).



*1: Face bricks and exterior wall tiles: Often used for brick buildings constructed during the Meiji-Taisho era in Japan (from late 19th century to early 20th century). Face bricks are thin bricks placed on the structural brick walls to decorate them. In later times, "tiles" installed on reinforced concrete structure buildings became popular construction materials. Since the manufacturing method and usage of face bricks and tiles are same, "tile" has been used to describe both materials since 1922.

In 1914, Tokyo Station's Marunouchi-side Building was constructed based on the design by a renowned Japanese architect Kingo Tatsuno. The Red Brick Building is a classic Meiji-Taisho era Western style building. With domes at the north and south ends of the building, its imposing figure has been a symbol of the gateway to Japan's capital city, Tokyo. During the war in 1945, the original station building lost its 3rd floor, including the domes at the north and south ends, thereby becoming the 2-story building which many Japanese people are familiar with.

Making full use of its extensive expertise and knowledge in ceramic production, LIXIL took on the challenge of producing red face bricks that would aesthetically harmonize with the original face bricks on the 1st and 2nd floors of the station building. LIXIL selected to partner with Akai Tile Co., Ltd. a Japanese tile manufacturer (Head Office: Tokoname, Aichi; President: Yuji Akai) for this project. LIXIL and Akai Tile have collaborated on many projects to restore various historic buildings in the past. The test production for this project started in 2003. LIXIL and Akai began the full scale production of the face bricks in 2010 after 7 years of trial and error. Over 15,000 face bricks were manufactured during the trial production phase of this large project.

LIXIL will continue to actively participate in tile restoration projects so as to protect and preserve Japan's valuable architectural heritage for the next generation.

-Reference Information-

Tokyo Station Marunouchi Station Building Face Brick Restoration

The red face bricks decorating the exterior walls of the Marunouchi Station Building are the symbol of Tokyo Station, the entrance to Japan's capital. When the building was originally constructed, five manufacturers took part in the production of the face bricks. Color tones of the red face bricks inevitably varied due to differences in the raw materials and kiln temperatures used during production. Today's modern ceramic technology makes it difficult to recreate the color variances caused by turn-of-the-century production. The authentic recreation of such production conditions proved the greatest challenge in this project.

In order to reproduce the exterior of Tokyo Station as it was 100 years ago, LIXIL spent seven years in repeated trials to achieve aesthetic harmonization between the new face bricks and those of the original construction.

1. The Greatest Challenge: Recreation of Distinctive Color and Subtle Color Variation

(1) Reproduction of the Original Red Brick Color

• Securing Raw Materials

In the early stage of the project, a decision was made to use the red soil of Japan's Chita Peninsula, the same material used as the main ingredient of the face bricks at the time of the station building's construction. However, it was expected that the difference in the location and timing of mining would result in differences in chemical composition of the soil leading to considerable variation of color. This meant that even if test production was approved, difficulties could be encountered in reproducing the same color during the full-scale production. To prevent such a problem, the 100 tons of the red soil required for full-scale production was secured before test production commenced.

• Arranging Production Condition of the Kiln

The required "bright red color" cannot be recreated using modern-day firing temperatures (1,200 to 1,250 degrees Celsius). The same kiln temperature used at the time of the original station building construction (1,000 to 1,100 degrees Celsius) needed to be replicated. Akai Tile, an experienced restorer of historic tiles, made a courageous commitment to dedicate one of their production kilns to this project in order to meet this challenge.

(2) Recreation of Color "Variation"

The color variation of face bricks at the time of the original station building's construction was the inevitable result of many factors involved in the face brick production such as; the mining of raw materials, kiln firing temperatures, and conditions in the manufacturing plants., According

to the records of the original construction, even though strict standards were applied to face brick production in order to achieve color uniformity, the acceptance rate was a mere 40%. Now color uniformity is far more manageable thanks to the vastly advanced modern kiln technology. However, this project required production conditions to be controlled so that color variation was intentionally created. This was an enormous challenge. Firing conditions and raw material formulas were repeatedly adjusted and tested. The color tones of all the trial samples were measured (colorimetrically analyzed) and recorded. Over 50 conditions were tested and approximately 100 samples were produced for each of those conditions. To prepare for full-scale production, large lot production was also tested. Ultimately, 15,000 samples were produced before the production conditions were finalized.



▲ Measurement work



▲ Face bricks re-creating color variation
(3rd floor part)

2. After Completion of Full-Scale Production

After the decision was made to start the full-scale production in 2010, the color tones were measured again at the project site which confirmed conditions for full-scale production. Based on the results, it was decided to use three different conditions for the face brick production and mix placement of the face bricks on the exterior walls of the station. It was also decided to produce face bricks for corner areas combining manual production with normal production processes. Approximately 400,000 tiles were produced during the full scale production from late 2010 to early 2011. Although the full-scale production was completed within 2 weeks, it was the result of 7-years of testing and trial production.

(1)Flow of Production and Supply of Materials

Project Owner: East Japan Railway Company (JR East)

Architectural Design: JR East, Tokyo Construction Office / Tokyo Electrical Construction & System **Integration Office;** Tokyo Station Marunouchi-side Building Preservation and Reconstruction Design Joint Venture (JR East Design Corporation / JR East Consultants Company)

Supervision: JR East Tokyo Construction Office / Tokyo Electrical Construction & System Integration Office; JR East Design Corporation

Construction: Tokyo Station Marunouchi-side Building Preservation and Reconstruction Design Joint Venture (JV of Kajima Corporation, Shimizu Corporation and Tekken Corporation)

Tile Installation: Fuji Yougyou Co., Ltd.

Tile Sales: Dinaone Corporation

Tile Production: LIXIL Corporation / Akai Tile Co., Ltd. (manufacturing partner)

(2)Initial Construction: Building Profile

Construction Completion: 1914

Structure: Steel reinforced bricks

-Brick Manufacturers-

Structural Bricks: Japan Bricks Manufacturing Company

Face Bricks: Five companies including Shinagawa Refractories Co., Ltd. and Torii Pottery Manufacturing

-Amount of Bricks Used-

Structural Bricks: 8.33 million bricks

Face Bricks: 940 thousand bricks

■ Akai Tile Co., Ltd.

Headquarters: 1-9 Kitaooneyama, Kanayama, Tokoname, Aichi, Japan

Company Establishment:: February 1955

President: Yuji Akai

Business Areas: Manufacturing and sales of exterior wall & floor tiles, interior tiles, and special purpose tiles

Major Restoration Projects Participated:

- Chamber Building of the Industry Club of Japan (Registered Tangible Cultural Property, Tokyo Prefecture, 2001)
- Church of San Francesco (Milan, 2008), etc.