TILE INSTITUTE of AMERICA
1262 Bouquet Circle, Thousand Oaks, California 91362 Telephone: (805) 371-TILE (8453) Facsimile: (805) 371-8455

TIA's Client: 20160415

AquaBella/Main Street Art, Inc.
Mr. Brian L. Streadbeck
450 South Alpine Highway
Alpine, Utah 84004

Telephone: (714) 264-8269 Facsimile: (714) 685-0465
brian@msagallery.com

Tile: **Aqua Series**, multi-colored "**AQ-1203 Obsidian Blend**" glass body, fiber-mesh back mounted. Nominal size: 1" x 2" x ¼". Tile made in China.

Conditions: New tiles sent to TILE INSTITUTE of AMERICA in sealed manufacturer's boxes from client above and selected at random.

Surface Abrasion (*ASTM C 1027)

This test is for glazed tiles only. It is based on the **(PEI)** rating system (Porcelain Enamel Institute). A number of sample tiles are subjected to rotation with an abrasive material on their surface (contained in a cup). After a pre-determined number of revolution cycles, the specimen is removed. This is repeated for eight periods of cycle rotations; 100 rotations, 150, 600, 750, 1500, 2100, 6000 and 12,000. The tile that shows no wear at 12,000 rotations is then subjected to a staining test. If it passes the stain test, it is then classified as a grade 5 tile. Each piece is then compared in a viewing box to a new piece if there are no visible signs of wear it is considered to have passed to that level. There are six levels of tile durability that can be achieved by this test method, which are 0 to 5 (O to V).

PEI Classifications

CLASS 0 (O) - Tiles technically unsuitable for floors
CLASS 1 (I) - Residential and Commercial wall and bare foot traffic
CLASS 2 (II) - Wall and Residential bath floor, soft soled traffic
CLASS 3 (III) - All residential floors and Light Commercial
CLASS 4 (IV) - Medium Commercial, Light Industrial and Institutional
CLASS 5 (V) - Extra heavy traffic: Tile may be used nearly anywhere.

Requirements:

Test Results: **PEI 2**

Sincerely,

Gerald Halweg

Gerald M. Halweg, CTC, CSI, TTA.
President/CEO

Date: June 24-2016

TILE INSTITUTE of AMERICA

1262 Bouquet Circle, Thousand Oaks, California 91362 Telephone: (805) 371-TILE (8453) Facsimile: (805) 371-8455

TIA's Client: 20160415

AquaBella/Main Street Art, Inc.
Mr. Brian L. Streadbeck
450 South Alpine Highway
Alpine, Utah 84004

Telephone: (714) 264-8269 Facsimile: (714) 685-0465
brian@msagallery.com

Tile: **Aqua Series, multi-colored "AQ-1203 Obsidian Blend", "glass body"**, fiber-mesh back mounted. Nominal size: 1" x 2" x ¼". Tile made in China.

Conditions: New tiles sent to TILE INSTITUTE of AMERICA in sealed manufacturer's boxes from client above and selected at random.

Report of Tests

Specification: **LINEAR THERMAL EXPANSION (ASTM C 372)**

Standard Test Method to determine the linear thermal expansion of Tile. This method provides the means for establishing the necessary intermediate distances and widths of movement joints, which may appear in tile specifications. Measurement of thermal expansion is useful for predicting stress within joined materials or single materials under conditions of changing or non-uniform temperatures.

$\Delta L = L_0 (\alpha_L \Delta T)$

Where, L_0 is original length, L is the expanded length, α is length expansion coefficient, ΔT is temperature difference, ΔL is change in length.

Results: Coefficient of Linear Thermal Expansion 5 x 10^{-6} (in/in ΔT)

Recommendations: Historical testing has reported tile cracks can occur when the surface tiles move independently in excess of 0.015 inches from the substrate. (Compare 1/32 equals 0.03125). Some stresses are reduced by improved bonding mortars and grouts but are limited.

Hypothesis for geographic areas, having pools and spas, the temperature change can be 20°F to 120°F = a **ΔT** of 100°F. Given a tiled distance of 8 feet (96 inches) between specified movement joints for example.

Calculations: **ΔL =** (96)(0.000005x100) = 0.048 inches.

Therefore, with a temperature range of 100° F the amount of movement is 0.048 inches (three times greater than what is required to crack tile and twice as much as most clay bodied tiles).

Glass tile can have linear thermal expansion three times that of other types of tile, therefore tile expansion (movement) joints are mandatory.

Sincerely,

Gerald Halweg

Gerald M. Halweg, CTC, CSI, TTA. Date: June 25, 2016
President/CEO of TILE INSTITUTE of AMERICA