REPORT ON

EVALUATION OF THE

STONETILE SYSTEM

Prepared for
Kuelker Developments Ltd.
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By

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1.0 INTRODUCTION:

Hardy BBT Limited was retained by Mr. Peter Kuelker of Kuelker Development Ltd. to conduct a program to evaluate the Stonetile cladding system. The stonetile system is an innovative cladding system designed by Kuelker Development Ltd. to compete with the existing cladding systems on the basis of performance and cost.

The evaluation program, conducted by Hardy BBT Limited, was part of the development process of the stonetile system. The program consisted of testing and studying the suitability of:

a) The material used in the system
b) The installation methods
c) The performance as a cladding system

2.0 DESCRIPTION OF STONETILE SYSTEM:

The stonetile system consists of concrete tile with two embedded steel inserts which are fastened to the substrate. The tile is produced in two sizes of 450x300x16 mm and 450x450x16 mm, and in various finishes and colours.

The fasteners are made of 0.5 mm thick, 25 mm wide galvanized steel strips. These strips are punched out to have a spine 6 mm wide and 3 mm deep and gang nails protruding into the concrete. The gang nails are embedded in concrete during casting. The top of the fasteners protrude about 10 mm above the tile with a hole for a screv that vill fasten the tile to the substrate. The bottom part of the insert protrude about 5 mm belov the tile so that it will slide into the fastener of the tile belov it. Steel channels made out of 30 gauge galvanized metal are provided at the base and top. These channels are perforated to ensure adequate ventilation between the tiles and the substrate.

Detailed drawings of the stonetile wall system attached as Appendix 'A', were submitted by Kuelker Development Ltd. and revieved by Hardy BBT Limited.

3.0 MATERIALS:

3.1 Concrete:

The concrete used to cast the stonetile vas designed to meet the following specifications:

Compressive Strength	20 MPa
Air Content	5 - 7%
Slump	100 mm

The following mix proportion vas used to achieve the above specification:

	kg/m^2
Cement	335
Water	185
Aggregate - Coarse	878
Aggregate - Fine	799

Superplasticizer and an air entraining agent were used to achieve the design slump and air content. Polypropylene fibre vas added to this concrete at a dosage of 0.95 kg/m3 in order to increase the flexural strength and reduce the shrinkage cracking of the concrete. All the material used in producing this concrete conformed to CAN3-A23.1 - "Concrete Materials and Methods of Concrete Construction".

The durability of the concrete to freeze thav cycles will be achieved by entraining 5-7% air.

Tiles of different colours were obtained by adding colouring pigments supplied by IHASCO - International Marble and Stone Company Ltd. These pigments are widely used in stucco and have been acceptable for external application.

3.2 Grout:

Grout used in this system was supplied by Akrilon as a pre-mixed, pure acrylic, putty-like plaster.

Acceptable durability of the acrylic based plaster was proven by others in independent test programs.

3.3 Fastener:

The fasteners were made from 0.5 mm thick and 25 mm wide galvanized steel. The length of the inserts was determined by the size of the tile and the length of extensions of the fasteners above and below the tile.

The fasteners were tested for corrosion resistivity under salt spray in accordance with ASTM B117. Four weeks of exposure of the fasteners to salt spray at 35 °C did not show any signs of corrosion. The test indicate that these fasteners have adequate corrosion resistance.

A force of 72 Kg was required to pull out both fasteners from the tile. This force is much higher than the dead and wind loads to which this tile will be subjected.

3.4 Screws:

The screws used in this system were stainless steel, and will be non-corrosive. The stainless steel screws 12 mm in length, were found to have sufficient holding power to sustain the wind and dead loads to which these tiles will be subjected.

4.0 INSTALLATION:

4.1 Substrate:

Stonetile should be fastened to a substrate. The substrate must be wood or chipboard with a minimum thickness of 10 mm.

4.2 Venting::

The space between the tile and the substrate along with the perforated channels at the bottom and top allovs circulation of air. This will significantly reduce the amount of moisture condensing between the tile and the substrate.

4.3 Drainage:

The air space between the stonetiles and substrate vill control through-vall penetration of rain. The stonetiles act as an open rain screen preventing rain vater from reaching the sheathing paper. Water reaching this space vill cling to the inner surface of the cladding material and flov dovnvard vhere it will be drained out through the perforated base channel.

4.4 Sheathing Paper:

Sheathing paper must be applied to the substrate, before the stonetiles are installed. The function of the sheathing paper vill be to provide a second barrier to the entry of wind and rain. The sheathing Paper used must be a product approved by the Canadian Construction Materials Centre.

Sheathing paper should be vater-resistant but does not have to be vapour resistant. In fact, the sheathing must be permeable enough to permit the escape of vater vapour that may penetrate the vall cavities from the interior of the structure.

4.5 Control Joints:

As each tile is fastened to the substrate, the movement of that tile as a result of shrinkage and temperature change must not be cumulative or transferred to the adjacent tile. Rather such movement must be absorbed by the joints around the tile. The movement of each tile due to change in moisture or temperature vill be so small that it can be absorbed in the grout joint around the tile. The narrov tapered section of the edge of the tile has been designed to break off to accommodate any unexpected significant movement, alloving the grout tile and joint system to remain in tact.

Therefore it was concluded that control joints to accommodate the movements due to shrinkage or change in temperature vere not necessary in the stonetile system.

4.6 Opening Details:

Proper sealing must be provided between the stonetile system and any columns, doors, or vindovs. Flashing must be provided above all openings. The sealing component and the flashing material must be products approved by the Canadian Construction Materials Centre.

5.0 PERFORMANCE WITH RESPECT TO WIND LOADS, AIR LEAKAGE AND WATER PENETRATION:

The Stonetile cladding system was installed on a 2 metre square wall section to evaluate the performance of the Stonetile system under wind load and test for air leakage and water penetration. The wall section tested was constructed from 2 x 4 inch structural lumber and 10 mm thick plywood.

5.1 Structural Performance Under Wind Loads:

The wall section with the stonetile system was subjected to a pressure equivalent to a windward and leeward wind velocity of 230 km/hr. This test was conducted in accordance with ASTM Procedure E330. The stonetile system did not show any signs of failure under this wind load.

5.2 Air Leakage Test:

An air leakage test was conducted on the stonetile wall system in accordance with ASTM Procedure E283. The air leakage was found to be 0.04 $\ell/s/m^2$. This value is much below the industry accepted air leakage rate of 0.305 $\ell/s/m^2$.

5.3 Water Penetration:

A water penetration test was conducted on the same wall section in accordance with ASTM Procedure E331. After 30 minutes of water spray under the specified pressure there was no sign of water penetration through the stonetile system.

5.4 Vapour Permeance:

Vapour permeance of the stonetile was determined in accordance with ASTM Procedure E96. The water vapour permeance of the tile was found to be 1.7 perms. The vapour permeance of the stonetile is not significant as the water vapour will be vented from the space between the tile and the substrate.

5.5 Absorption:

The absorption values of stonetile system are expected to be in the same order as the absorption value of concrete with similar water/cement ratio. Past experience and published research has shown that such concrete could have absorption values in the range of 3 to 6 percent.

6.0 COMPARATIVE STUDY WITH OTHER AVAILABLE SYSTEMS:

The stonetile system was compared with existing cladding systems such as wood, vinyl, aluminum, brick and stucco with respect to endurance and performance as a cladding material.

6.1 Endurance:

The stonetile system was stronger than other existing cladding materials. With adequate air entrainment a stonetile will be at least as durable as the above mentioned systems.

Some of the problems associated with moisture movement in other wall cladding systems, such as warping of wood panels, shrinkage cracking of stucco and efflorescence in brick system will not be present in the stonetile system. This is due to the venting provided between the tiles and substrate by the stonetile system.

The stonetile system is also expected to be much more resistant to external impact forces than the vinyl or aluminum cladding system.

6.2 Performance:

The stonetile system screens the water away from the wall while with a wood, stucco, or masonry system, the water will permeate to the wall by absorption.

6.3 Maintenance:

Replacing a damaged stonetile was reported to be much easier than repairing stucco or replacing aluminum or vinyl cladding.

7.0 CONCLUSION:

In conclusion, based on endurance and overall performance the stonetile system was found to be a highly potential cladding material.

We trust this information meets your requirements. If we may be of any further service please contact the writer at your convenience.

Yours truly,

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The Association of Professional Engineers, Geologists and Geophysicists of Alberta

VARIOUS TYPES OF EXTERIOR SIDINGS THAT HAVE HAD A SIGNIFICANT MARKET SHARE FOR A PERIOD OF TIME OVER THE LAST 100 YEARS.

Material	Description	Specific Problem
Wood	Horizontal ship lap	Need periodic painting
Wood	Horizontal bevel siding	Need periodic painting
Wood	Shingles	Splitting, needs painting
Wood	Vertical channel	Splitting, twisting, painting
Masonite	12" horizontal	need painting
Masonite	Double 5" ship laps	needs painting
Aluminum	9" horizontal bevel	Not sound proof, denting
Aluminum	Double 5" ship lap	Not sound proof, denting
Asphalt	Brick pattern on fibreboard	Curling, seam problems
Asbestos	3/16" X 18" X 18" tiles	Becomes brittle, health hazard
Stucco	California style	Cracking, cleaning
Stucco	Floated finish	Cracking, cleaning
Stucco	Spanish style finish	Cracking, cleaning
Stucco	Skip trowel finish	Cracking, cleaning
Vinyl	Siding 8"	No sound proofness, deforming, becomes brittle
Vinyl	Siding double 4"	No sound proofness, deforming, becomes brittle
Brick	Various sizes and textures	High cost
Acrylic Stucco	Various Textures	Base may crack

NOTES: All sidings, except brick and some of the vinyl and aluminum siding, were regularly installed without adequate venting systems.