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HONG KONG TESTING CO., LTD.

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TEST PROPOSAL & METHOD STATEMENT OF DIMENSION STONE TEST

Client's Information

Client and Address : SMART WEALTH ENGINEERING LTD.
4/F, Henry Centre, 131 Wo Yi Hop Road, Kwai Chung, N.T., Hong Kong

Project and Address : Proposed Residential Development at Tsing Yi Town Lot 190 Sai Shan Road

Test Request : 1. Strength of Individual Stone Anchorages in Dimension Stone based on ASTM C1354/96
2. Flexural Strength Test of Dimension Stone based on ASTM C880-98

Stone Information :

Stone type and name	:	Aplin Grey / Green Classico / Nero Pepperino / Absolute Black / Royal Grey
Origin	:	Not Provided
Finish	:	Bush-Hammered / Lychee & Flamed / Flamed / Honed / Flamed
Color	:	Not Provided
Supplier	:	Smart Wealth Engineering Ltd.
Nominal specimen size	:	Anchorage : Kerf Bracket / Back Bracket 300mm x 350mm x 30mm / 300mm x 300mm x 30mm Flexural Strength Test : 100 mm x 350 mm x 30 mm

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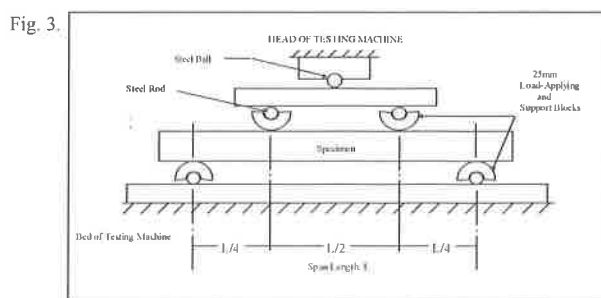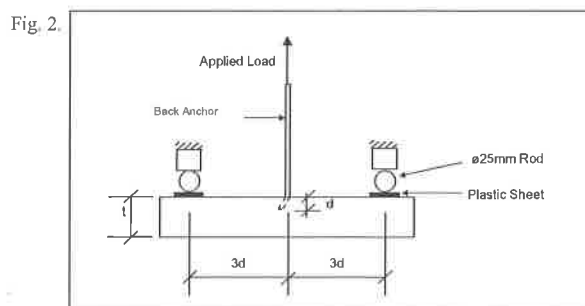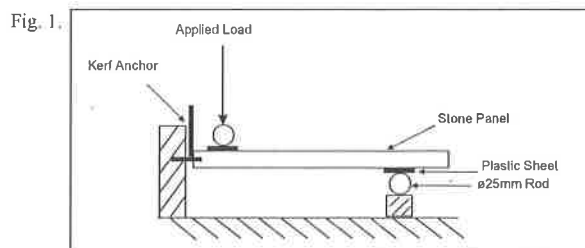Website : www.hktesting.com.hk
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Test Description

Stone Type	Anchorage Type	Test Item	Test Description	Test Menthod	Test Condition	Load Direction	Set - Up	Sample Rate
Aplin Grey / Green Classico / Nero Pepperino / Absolute Black / Royal Grey	Kerf Anchorage	1	Perpendicular Loading Test	ASTM C1354-96	Wet or Dry	Outward	See Fig. 1	6 nos. / 6 nos.
	Back Anchorage	2	Perpendicular Loading Test		Wet or Dry	Outward	See Fig. 2	6 nos. / 6 nos.
	--	3	Flexural Strength Test	ASTM C880-98	Wet & Dry	Outward	See Fig. 3	6 nos. / 6 nos.

Set Up :

Fig. 1.

Fig. 2.

Fig. 3.

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Test procedure

1.   Conditioning **

(Wet Condition)

1.1   Stone panel samples shall be preconditioned by immersing in water for 48 h at 22±2°C
Test specimens immediately upon removing from the bath, wiping the specimen free of surface water.
At the designer's option, stone may be tested in a dry condition.

(Dry Condition)

1.2   At the designer's requested, dry the specimens for 48h in a calibrated oven at a temperature of 60°C±22°C.
At the 46th, 47th and 48th hour, weigh the specimens to ensure that the weight is the same.
If the weight continues to drop, continue to dry the specimens until there are three successive
hourly readings with the same weight.

**   Conditioning depend on the test result of Flexural Strength Test to ASTM C880-98.

1.3   Inspect and record the specimens for any sign of damages.

2.   <u>Kerf anchor test</u>
2.1   For load perpendiuclar to the surface of the stone panel.
2.2   A rubber pad shall be used between the stone and the loading or restrain surface to avoid concentration of
stress in the surface of the stone sample.

2.3   A frame to support a stone sample with anchor in the side edge of the stone (kerf anchor) is shown in Fig. 1A.

t = thickness ; E = embedment ; a' = t ; L = 8t to 10t

Fig.1A
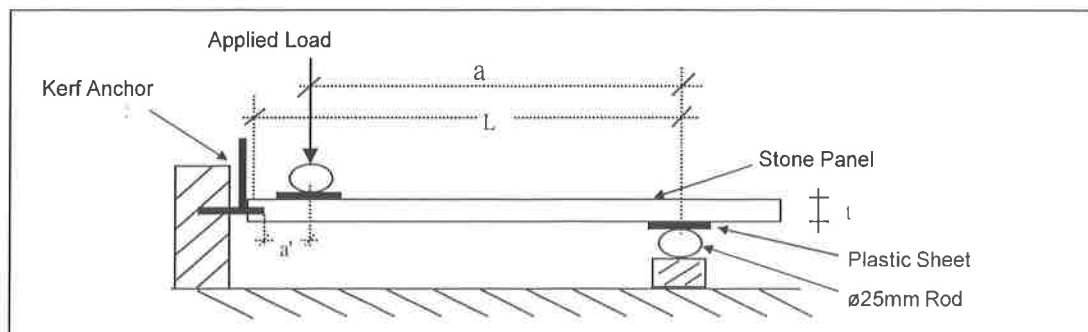
2.4   The test specimen will be supported at one end by the anchor. The anchor shall be attached to the support
frame in the same way it will be attached to the backup structure in construction. The sample of stone will
be supported at the opposite end by a 25 mm diameter rod.

2.5   The load from the testing machine will be applied to the stone sample through a 25 mm diameter rod,
located as close as possible to the anchor that supports the stone but at a distance not less than the thickness
of the panel.
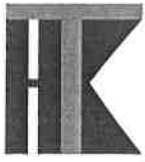
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2.6   Apply the load smoothly and at a rate of one-half the anticipated ultimate strength of the anchor assembly per minute.

2.7   Load each specimen until the anchor fails.

2.8   Observe and record the failure load and mode of each specimen.

2.9   Record failure mode as
   i)   Stone failure - record the failure stone-cone dimensions;
   ii)   Anchor failure - record the failure mode as anchor material failure;
   iii)   Anchor push/pull - record the failure mode as anchor push/pull-out from slot;
   iv)   Panel broke, test specimen broke.

2.10 Repeat 2.1 to 2.9 for all samples.

3.   Back anchor test (Test load perpendicular to specimen surface)
3.1   A frame to test a stone sample with anchor in back of the stone and the load applied in a direction perpendicular to the panel is shown in Fig. 2A. The sample of stone panel is held down while the upward load is applied through a single sample of anchor

Fig.2A
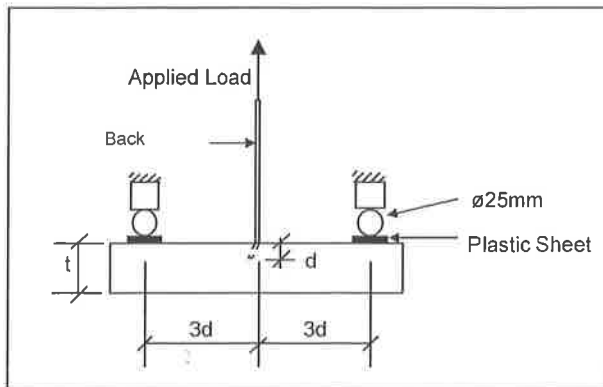
3.2   Apply the load smoothly and at a rate of one-half the anticipated ultimate strength of the anchor assembly per minute.

3.3   Load each specimen until the anchor fails.

3.4   Observe and record the failure of the load applied to each specimen.

3.5   Record failure mode as
   i)   Stone failure - record the failure stone-cone dimensions;
   ii)   Anchor failutre - record the failure mode as anchor material failure;
   iii)   Anchor push/pull - record the failure mode as anchor push/pull from slot;
   iv)   Panel broke, test specimen broke.

3.6   Repeat 3.1 to 3.5 for all samples.

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4.   Flexural Strength Test

Conditioning

4.1   Before testing the specimens in a dry condition, dry them for 48 h at $60 \pm 2°C$. At the 46th, 47th and 48th hour, weigh the specimens to ensure that the weight is the same. If the weight continues to drop, continue to dry the specimens until there are three successive hourly readings with the same weight. After removing the specimens from the oven, cool them to room temperature in a cabinet before testing them.

4.2   Before testing the specimens in a wet condition, immerse them in water for 48 h at $22 \pm 2°C$. Test the immediately upon removal from the bath, wiping the specimens free of surface water.

Procedure

4.3   Assemble the apparatus and place the specimen on the span supports and adjust the quarters point loading blocks into contact with the specimen.

4.4   Apply the load at a uniform stress rate of 4.14MPa to failure.

4.5 Repeat 4.3 to 4.4 for all samples.

Calculation

The anchor capacity is calculated by using the following formula, suggested by ASTM C1354 :

Kerf anchor

$R \qquad = W * a / L$
where :
R = anchorage system load, N
W = maximum load, N
a   = distance between applied load to 25mm diameter rod
L   = distance between anchor centre to 25mm diameter rod

Back anchor

$R \qquad = W$
where :
R = anchorage system load, N
W = maximum load, N

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Flexural strength, MPa:

$$\sigma = \frac{3WL}{4bd^2}$$

where :

W	=	maximum load, N,
L	=	span (10 d), mm;
b	=	width of specimen, mm; $b \geqq 1.5d$, and
d	=	depth of specimen, mm.

The average $\overline{\sigma}$ and standard deviation s are calculated from :

$$\overline{\sigma} = \frac{\text{sum of observed values}}{\text{number of tests}}$$

$$s = \frac{\sqrt{\text{sum of (observed value - } \overline{\sigma})^2}}{\text{number of tests - 1}}$$

- 6 -

- End -