CIDB MALAYSIA

TECHNICAL OPINION

SUBMITTED TO CIDB MALAYSIA | SEPTEMBER 2013

TECHNICAL OPINION REPORT

PRODUCT
ECO Lightweight Composite/Concrete Wall

APPLICANT
Green Enhancement Sdn. Bhd.

CIDB MALAYSIA

CONSTRUCTION INDUSTRY DEVELOPMENT BOARD
Tingkat 10, Menara Dato' Onn,
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CREAM
Construction Research Institute of Malaysia

CONSTRUCTION RESEARCH INSTITUTE OF MALAYSIA
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FOREWORD

Construction Industry Development Board (CIDB Malaysia) is a statutory body enacted under the Act 520 in 1994. Its mission is to develop Malaysian Construction Industry towards global competitiveness. To support that mission, a number of functions were formulated and one of them is to encourage the improvement of construction techniques and materials. Under that function, CIDB is to carry out assessment and appraisal of innovations of any kind of product and technology related to construction and to publish its finding, in the form of Technical Opinion.

This Technical Opinion will provide a reference to the relevant / interested parties in the construction industry. CIDB assess innovation based on application and evaluation by its Technical Opinion. Applicants may use it as a supporting document for regulatory and approving authorities, architects, engineers and others in dealing with the new products and technologies.

This Technical Opinion is prepared on behalf of CIDB by The Technical Expert Panel on construction products, construction material and technology in Construction Industry. The Technical Expert Panel was set-up by CIDB and its members are drawn from experts that represent relevant sectors in the construction industry.

This Technical Opinion has been modelled based on international recommended practice.

CIDB Technical Expert Panel Committee for ECO Lightweight Composite Wall

Technical Expert Panel

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GENERAL PROVISIONS

The purposes of this report are to assist respective parties concerned both applicant and granting approval authority, includes specification and also use of the subject. This report shall not be considered as approval.

Special note should be taken of the provisions and limitations set out and the period of validity of the Technical Opinion.

Technical Opinion is initially given a term of validity of three (3) years from the date of issue in the expectation that, after that period, the subject will no longer be an innovation. They can be reviewed within the first (12) twelve months and again as necessary during the life of the products or system described in the document. The limitation on the validity of the opinions should not be interpreted as implying a similarly limited life expectancy of the products or system described in the Technical Opinion. However, if experience shows poor overall standard of quality or performance of the product, the Technical Opinion will be withdrawn.

The legitimacy and validity of the Technical Opinion can be verified at office of CIDB Head Office.

CIDB and the Technical Expert Panel shall accept no responsibility for the quality and performance of the products.

Disclaimer

While every effort is made to ensure accuracy of the information presented in this report, neither the Technical Expert Panel nor its Secretariats or CIDB can accept responsibility for any loss or damage incurred in connection with the use of the contents.

Definition

Technical Opinion Programme:	A programme that initiated by CIDB with the aim to evaluate products, materials, components or system with regard to, but not limited to IBS. It normally covers wide range of innovative products to be used in local construction industry
Technical Expert Panel:	Individuals selected based on their expertise in lightweight concrete, Industrialize Building System (IBS), and composite wall.
ECO Lightweight Composite / Concrete Wall:	A composite wall systems that use high density autoclaved Calcium Silicate board in-filled with lightweight aerated concrete.

Abbreviation

ASTM	American Standard Test Method
BS	British Standard
BS EN	European Standard with UK Annex
CIDB	Construction Industry Development Board
CREAM	Construction Research Institute of Malaysia
ELCW	ECO Lightweight Composite / Concrete Wall
GESB	Green Enhancement Sdn Bhd
ISO	International Standard Organisation
IBS	Industrialized Building System
MS	Malaysian Standard
OPC	Ordinary Portland Cement
PTAC	Perunding TAC
QA	Quality Assurance
QC	Quality Control
STC	Sound Transmission Class
SIRIM	Standards and Industrial Research Institute of Malaysia Berhad
UBC	Uniform Building Code
UKM	Universiti Kebangsaan Malaysia
UNITEN	Universiti Tenaga Nasional

Symbols

g	gram	kPa	kiloPascal
dB	decibel	hrs	hours
K	Kelvin	W	Watt
kg	kilogram	mm	millimetre
cm	centimetre	m	metre
mm^2	millimetre square	cm^2	centimetre square
m^2	metre square	cm^3	centimetre cube
m^3	metre cube	%	percentage
N	Newton		

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1.0 IDENTIFICATION

1.1 Name of Product

ECO Lightweight Composite / Concrete Wall (ELCW)

1.2 Country of Origin

Raw Material (Calcium Silicate)	: China
Other material and Fabrication	: Malaysia

1.3 Dates of Evaluation

29th March 2013	:	First meeting of Technical Expert Panel and presentation from the Applicant
29th April 2013	:	Second meeting of Technical Expert Panel
3rd June 2013	:	Third meeting of Technical Expert Panel and site visit
15th July 2013	:	Fourth and final meeting of Technical Expert Panel

1.4 Purpose

The purpose of ECO Lightweight Composite / Concrete Wall (ELCW) is to provide alternative from traditional masonry wall to using composite wall in construction.

1.5 Applicant & Address

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	Fax	:	03 – 6272 7021
	Emel	:	genhance@gmail.com

1.6 Manufacturer & Address

Green Enhancement Sdn Bhd
Lot 1905, Jalan Kuari,
Kampung Baru Kuang,
48050 Kuang,
Selangor Darul Ehsan,
Malaysia

2.0 DESCRIPTION

2.1 General Description of Product

ECO Lightweight Composite / Concrete Wall (ELCW) system is a system consisting of high density autoclaved Calcium Silicate Board in-filled with lightweight aerated concrete. The product is manufactured and supplied by Green Enhancement Sdn Bhd (GESB).

2.2 Element of Product

2.2.1. ECO Board

ECO Board is manufactured from pure quartz powder and quick lime together with Ordinary Portland Cement (OPC) under high temperature and autoclaved under high pressure.

2.2.2. ECO Lightweight Aerated Concrete Infill

ECO Lightweight Aerated Concrete Infill is a patented non-toxic lightweight mortar containing no gas-forming chemicals and sand and aggregate – free.

(Note: Please contact Applicant for further details)

2.3 Usage Application

ECO Lightweight Composite / Concrete Wall used as an alternative from traditional masonry wall in building and house construction. The composite wall system uses high-density autoclaved calcium silicate board complete with lightweight aerated concrete infill.

2.4 Usage Limitation

It is more suitable for internal partition and non-load bearing wall only.

(Note: Please contact applicant for further details.)

2.5 Usage Advantages

The advantages of using ELCW System are as follows:

- Superior surface finish with completed wall is ready for painting, tiling, carpeting and other architectural finishes.
- Superior fire rating with a minimum rating exceeds 4 hours.
- Superior thermal insulation because the aerated concrete contains cementations compound that provides up to 10 times thermal insulation.
- Provides adequate sound insulation as tested to ISO 140-3: 1995.

2.6 Summary of Performance Comparison

The summary of performance comparison between ECLW and other types of wall is shown in Table 2.1:

Table 2.1: Summary of Performance Comparison

Summary Of Performance Comparison : Unreinforced Masonry Wall			
Characteristics	Type		
	ECLW - **102mm thickness**	Solid Concrete - 115mm thickness	Clay Brick - 115mm thickness
[1] Density – *kNm^{-1}*	2.14 ***superior lightweight floor loading***	7.25	6.75
[2] Fire-rating – *hrs*	4 hours minimum ***superior fire-rating***	3-4	1.0
[3] Acoustic Insulation – *STC dB*	41-43 ***superior sound absorption***	40-45	35-40
[4] Thermal Insulation – *m^2 K/W*	1.02 ***superior thermal resistance class***	0.064	0.19
[5] Shrinkage movement – mm/m	-0.2 ***superior drying shrinkage stability***	-0.7	+1.8
Conduit, piping & internal fixtures	Concealed before infill ***superior versatility***	Concealed before infill	Hacking and re-plaster thereafter
External fixtures	Rotary drill, conventional concrete anchor ***superior versatility***	HD rotary drill, conventional concrete anchor	Light duty / chemical anchor only
Installation	20~25m^2 /man-day ***superior speed***	10~15m^2 /man-day	4~7m^2 /man-day

[1] based on a typical 3000mm height wall

[2] in accordance with BS 476 : Pt4 SIRIM Test Reference J20111280260 (Report No.2011FE0338) – ECO wall sample returns the highest fire-rating class under prevalent construction type & category

[3] STC index ASTM E90 measured as a sound absorption index in dB – the higher the index the better the absorption properties (tested in accordance with ISO 140-3 :1995)

[4].Thermal resistance measures the insulation properties – the higher the value, the better the insulation properties

[5] Shrinkage movement up to 1 year to occur : reference of shrinkage from Australian Masonry Manual

Note: This statement is as claimed by the Applicant. The applicant does not provide all the relevant certification on the comparative results upon request. For further details, please contact the Applicant. Refer to Appendix A – ECO Lightweight Wall, A Technical Brief.

2.7 Installation Method

2.7.1. *Method Statement*

Prior to installation, the following steps are taken as mentioned in the Method of Statement. The installation procedures are as follows:

2.7.1.1. GI Framing Installation

i. Marking out the wall position
ii. Install top and bottom GI Guide Rail (Head and Bottom Track) with 40 mm raw plug 3 nos at 1220 mm spacing centre to centre
iii. Mount vertical GI Framing Rail (Stud) and check for verticality
iv. Mount fit – out framing for doors, window, mechanical and electrical openings.

2.7.1.2. ECO Board Installation

i. Position and fix internal ECO Board to GI framing and check for verticality
ii. Position and fix external ECO Board to GI framing and check for verticality

2.7.1.3. ECO Lightweight Infill Concreting

i. Install custom metal form (330 x 1220 mm) against completed ECO Board
ii. Install horizontal bracing with MS channel at 450mm vertical run ready to fix tie-rods
iii. Fix 3 layers of 350 mm (in length) tie-rods (3nos 10Φ at 450mm spacing centre to centre)
iv. Mix ECO Lightweight Infill concrete with measured water quantity to form a consistent mortar.
v. Aerated foam is then injected into the lightweight mortar mix and pumped through aeration machine for concreting purposes

(Note: Refer to Appendix B – ECO Lightweight Composite / Concrete Wall Installation and Procedures)

2.8 Technology / Skill Required

The system allows the reduction of skilled labours to effectively and efficiently install this system with average installation wall of 20 to 25 m^2 / man – day.

2.9 Special Conditions for Usage and Installation

2.9.1. Storage

Dry storage area is required.

2.10 Inspection and Maintenance

Upon completion of concreting works, the following procedural works and inspections are required to complete the installation of the system. The procedures are:

2.10.1. Striking off metal form

i. Striking off is consistent with the requirement of a normal concreting works for side-form. However, an 18-hour set is recommended before the metal form is completely removed.
ii. Tie-rods are removed thereafter and duly grouted with conventional mortar mix.
iii. Boards are inspected for any hollow by drilling the board to expose the lightweight infill and injecting suitable liquid-based adhesive. The drilled holes are re-grouted after the inspection.

2.10.2. In-filled Mortar Mix

i. The purpose of this procedure is to clean and tidy up any in-filled mortar during concreting.
ii. Any damaged surface shall be treated ready for architectural treatment to ensure the smoothness of the wall surface.
iii. A 50mm joint fibre tape (typically Fiberglass Mesh which is suitable for drywall) to be applied over the treated joint before a final skim coated is applied to ensure all board joints are flushed with plaster-based compound.

2.10.3. Final Surface Inspection

i. Final surface inspection is crucial in order to ensure consistency.
ii. Surface is ready for final architectural treatment 7 days after installation.

(Note: Refer to Appendix B – ECO Lightweight Composite / Concrete Wall Installation and Procedures)

3.0 BASIS OF APPRAISAL

3.1 Check on Document Received from Green Enhancement Sdn. Bhd.

Copies of the following documents were received from GESB to confirm appraisal of the products.

3.1.1. Test report on the material:

The test reports on the material can be referred in section 4.2

3.1.2. Detailed Illustration of ELCW

Detailed illustration of ELCW is attached in Appendix C

3.1.3. Method statement

Method statement to apply ELCW system is attached in Appendix B

4.0 STANDARDS, SPECIFICATIONS AND TESTS.

4.1 Material Standards and Specifications

4.1.1. The Technical Composition for Material Aspect

The applicant does not provide the technical composition for material aspect upon request. For further details, please contact the Applicant

4.1.2. The Technical Properties for the System

The technical properties for the system are shown in Table 4.2:

Table 4.2: ECLW System Technical Properties

No.	Property	Technical Data	Compliance of Standard
1.	Thickness	102 mm and 150 mm	N/A
2.	Density	600 - 750 kg/m^3	N/A
3.	Fire rating	minimum 4 hours	BS 476 Part 21
4.	Water cement ratio	maximum 0.48	BS 8110 Table 3.4
5.	Minimum cement	450 kg/m³min	UBC 1997 Table 19-A-2 & 4
6.	Thermal insulation	0.18 m² k/W	ISO 8990
7.	Sound Insulation	STC 41~43 dB	ASTM E90

(Note: Refer to Appendix D – ECLW System Catalogue)

4.2 Type of Tests

The following type of tests has been carried out by the applicant in accordance with acceptable International Standards. The tests are shown in Table 4.3:

Table 4.3: Type of Tests

Element	Type of Test
ECO Board (without infill)	i. Compressive Stress Test ii. Fire Propagation Index Test iii. Surface Spread of Flame Test iv. Dimensional Stability Test v. Apparent Density Test vi. Dimension and Tolerance Test (Length and Width) vii. Flatness and Squareness Test viii. Water Absorption Test
Element	**Type of Test**
ECO Light Weight Concrete Wall System	i. Compressive Strength Test ii. Fire Resistance Test

(Note: Refer to Section 4.4 for Test Results and Section 6.1 for Reference Standards used)

4.3 Additional Test Conducted

Green Enhancement Sdn. Bhd is to notify to the Technical Expert Panel Committee on any additional test conducted (if any) other than those mentioned in 4.2.

4.4 Summary of Test Results Provided by Green Enhancement Sdn Bhd.

The following test results have been summarised from the documents provided by the Applicant.

4.4.1. Compressive Stress Test

Five (5) pieces of samples with specimen size of 200 mm x 200 mm x 6.0 mm were received by SIRIM Sdn Bhd. The results are shown in Table 4.4:

Table 4.4: Compressive Stress Test

Type of Test	Reference Standard	Average Results	Unit
Compressive Stress at 10%	BS EN 826 : 1996	1.807	kPa

Note: [1.] Refer to Appendix E (1) – Test Report for Compressive Stress Test

[2.] Declared value by manufacturer.

4.4.2. *Fire Propagation Index Test:*

Fire Propagation Index test was conducted by SIRIM QAS International Sdn Bhd on three (3) pieces of ECO Board. The measured size of sample is 225 mm x 225 mm x 6.19 mm. The results are as shown Table 4.5:

Table 4.5: Fire Propagation Index Test

Type of test	Reference Standard	Index	Results	Unit
Fire Propagation Index	BS 476 : Part 6 : 1989	Sub-index i1	1.4	N/A
		Sub-index i2	0.7	N/A
		Sub-index i3	0.5	N/A
		Fire Propagation Index , I	2.6	N/A

(Note: Refer to Appendix E (2) – Fire Propagation Index Test)

4.4.3. *Surface Spread of Flame Test*

Surface spread of flame test of the product was conducted by SIRIM QAS International Sdn Bhd. Six (6) pieces of ECOBoard with measured dimension of 270 mm x 885 mm x 6.24 mm were tested with the smooth face side exposed to the specified heating condition of the fire test. The results are shown in Table 4.6:

Table 4.6: Surface Spread of Flame Test

Reference Standard	Classification	Unit
BS 476: Part 7 : 1997	Class 1	N/A

(Note: Refer to Appendix E (3) – Test Report for Surface Spread of Flame Test)

4.4.4. *Dimensional StabilityTest*

Dimensional Stability Test Report was issued by SIRIM QAS International Sdn Bhd. The method used is BS EN 1604: 1996. The results are shown in Table 4.7:

Table 4.7: Dimensional Stability Test

Reference Standard	Requirements	Test Results (Average)	Unit
BS EN 1604: 1996	Relative changes in length : not exceed 1.0%	0.04	%
	Relative changes in width: not exceed 1.0%	0.03	%
	Relative changes in thickness: not exceed 1.0%	0.46	%

Note: [1.] Refer to Appendix E (4) – Test Report for Dimensional Stability Test

[2.] Declared value by manufacturer.

4.4.5. *Apparent Density Test*

Apparent Density Test Report was issued by SIRIM QAS International Sdn Bhd as part of the thermal insulation requirements. The results are shown in Table 4.8:

Table 4.8: Apparent Density Test

Reference Standard	Average Results	Unit
BS EN 1602 : 1997	1232.0	kg/m^3

Note: [1.] Refer to Appendix E (5) – Test Report for Apparent Density Test

[2.] Declared value by manufacturer.

4.4.6. *Bending Strength Test*

Determination of bending strength test report was issued SIRIM QAS International Sdn Bhd. A total of ten (10) samples were tested with specimen size of 80 mm x 150 mm x 6 mm. The test results are shown in Table 4.9:

Table 4.9: Bending Strength Test

Reference Standard	Direction	Average Results	Unit
BS EN 826: 1997	Parallel direction	9135.9	kPa
	Transverse direction	9689.8	kPa
	Mean Bending Strength	9412.9	kPa

Note: No test should be less than the declared level of 5000 kPa

Note: [1].Refer to Appendix E (6) – Test Report for Bending Strength Test

[2.] Declared value by manufacturer.

4.4.7. *Dimension and Tolerance Test*

This test was performed SIRIM QAS International Sdn Bhd to compare the actual dimension with the declared dimension. The test results are shown in Table 4.10:

Table 4.10: Dimension and Tolerance Test

Reference Standard	Specification	Average Results	Unit
BS EN 822: 1994	Length: + 3 mm - 3 mm	2440 (0 mm)	mm
	Width: + 3 mm - 3mm	1220 (+1 mm)	mm
	Thickness: + 3 mm - 2 mm	6.150 (0 mm)	mm

(Note: Refer to Appendix E (7) – Dimension and Tolerance Test Report.)

4.4.8. *Flatness and Squareness Test*

The test was conducted on three (3) ECOBoard by SIRIM QAS Sdn Bhd. The test results are as shown in Table 4.11:

Table 4.11: Flatness and Squareness Test

Properties	Reference Standard	Deviation Specifications	Results	Unit
Squareness i) length and width ii) thickness	BS EN 824: 1994	Not exceed 6 mm/m Not exceed 6 mm	0 0	mm/m mm
Flatness	BS EN 825: 1994	Not exceed 6 mm	1.0	mm

(Note: Refer to Appendix E(7) – Flatness and Squareness Test Report)

4.4.9. *Water Absorption Test*

The test report was issued by SIRIM QAS International Sdn Bhd. The test results are shown in Table 4.12:

Table 4.12: Water Absorption Test

Reference Standard	Water Absorption (Average Results)	Unit
BS EN 1609: 1997	2.4	kg / m^2

Note: [1].Refer to Appendix E (8) – Test Report for Water Absorption Test

[2.] Declared value by manufacturer.

4.4.10. *Compressive Strength Test*

The test was conducted on three (3) cubes of concrete specimens by SIRIM QAS International Snd Bhd. The test results are shown in Table 4.13:

Table 4.13: Compressive Strength Test

Properties	Reference Standard	Average Results	Unit
Compressive Strength	MS 26 : Part 2 : 1992	3.5	N/mm^2

(Note: Refer to Appendix E (9) – Compressive Strength Test Report)

4.4.11. *Fire Resistance Test*

The wall partition system with dimensional size of 3000 mm x 2960 mm x 101 mm was tested for Fire Resistance Test by SIRIM QAS International Sdn Bhd. The test results are as shown as in Table 4.14:

Table 4.14: Fire Resistance Test

Fire Resistance Test	Reference Standard	Results	Unit
Integrity	BS 476: Part 22: 1987	250	minutes
Insulation		250	minutes

(Note: Refer to Appendix E (10) – Fire Resistance Test Report)

4.4.12. *Sound Insulation Test*

The wall system was installed to test opening and sound insulation test was performed by SIRIM QAS International Sdn Bhd. The test results are as shown as in Table 4.14:

Table 4.14: Sound Insulation Test

Test	Reference Standard	Results	Unit
Sound Insulation Test	ISO 140-3: 1995	42	dB

(Note: Refer to Appendix E (11) – Sound Insulation Test Report)

5.0 DESIGN

5.1 Illustration of ECO Lightweight Composite / Concrete Wall

Detailed technical drawing of ELCW System is attached in Appendix C – Detailed Illustration of ELCW.

5.2 Structural Design Analysis

Design analysis and calculation is not provided by Applicant

Please contact Applicant for further details

5.3 Design Capacities

Design capacities is not provided by Applicant

Please contact Applicant for further details

6.0 COMPLIANCE TO INTERNATIONAL/ MALAYSIAN STANDARDS

6.1 Product Tests Standard

A series of tests performed were in compliance with International Standards and equivalent. The standards are shown in Table 6.1:

Table 6.1: Standards for All Type of Tests Reported

No.	Type of tests reported	Standard *(Reference from documents received from the Applicant)*
1.	Compressive Stress Test	**BS EN 826 : 1996** Thermal insulating products for building application – Determination of compression behaviour
2.	Fire Propagation Index Test	**BS 476 : Part 6: 1989** Fire Test on Building Materials and Structures Part 6: Method of Test for Fire Propagation for Products
3.	Surface Spread of Flame Test	**BS 476: Part 7 : 1997** Fire Test on Building Materials and Structures Part 7: Surface Spread of Flame Test
4.	Dimensional Stability Test	**BS EN 1604: 1996** Thermal insulating products for building application – Determination of dimensional stability under specified temperature and relative humidity.

5.	Apparent Density Test	**BS EN 1602 : 1997** Thermal insulating products for building application – Determination of apparent density
6.	Bending Strength Test	**BS EN 826 : 1997** Thermal insulating products for building application – Determination of bending behaviour
7.	Dimension and Tolerance Test	**BS EN 822 : 1994** Thermal insulating products for building application – Determination of length and width
8.	Squareness Test	**BS EN 824 : 1994** Thermal insulating products for building application – Determination of squareness
9.	Flatness Test	**BS EN 825 : 1994** Thermal insulating products for building application – Determination of flatness
10.	Water Absorption Test	**BS EN 1609** Thermal insulating products for building application – Determination of short term water absorption by partial immersion
11	Compressive Strength Test	**MS 26 : Part 2: 1991** Method of testing concrete. Part 2: Method of testing hardened concrete**.**
12	Fire Resistance Test	**BS 476: Part 22: 1987** Methods for determination of the fire resistance of non-load bearing element of construction
13	Sound Insulation Test	**ISO 140 – 3 : 1995** Acoustics Measurement of Sound Insulation in Buildings and of Building Elements

7.0 QUALITY ASSURANCE / QUALITY CONTROL

7.1. QA / QC plan

QA / QC plan is not provided by Applicant

Please contact Applicant for further details

8.0 VALIDITY OF OPINION

8.1. Condition

The Technical Opinion Report given here was based on International and Malaysian Standard. All results and test reports were issued from Accredited Laboratories. The assessment is only focusing on the performance and quality of ECO Lightweight Composite / Concrete Wall System (ELCW) product but not on the structural performance of the system.

Should this Technical Opinion Report and the Applicant's claims were inconsistent, the relevant approved standards should be of precedence The recommendations are based on and limited to available information provided by the applicant.

8.2. Recommendations from Technical Expert Panel

The recommendations are made after a thorough evaluation was conducted by the Technical Expert Panels. The recommendations are:

a) It is more suitable for internal partition and non-load bearing wall only.
b) The non-toxic claims of the infill mortar should be verified with approved test standards.

8.3. Withdrawal

In the event of non-compliance to International Standards or any other equivalent standards will lead to withdrawal of this opinion.

8.4. Term of Validity

The recommendation is valid for three (3) years from the issuance of this Technical Opinion Report subject to the validity of the existing Test Certificates. This report is valid from **September 2013 to August 2016.**

9.0 APPROVED OPINION ABSTRACT

ECO Lightweight Composite / Concrete Wall (ELCW) System is manufactured and supplied by Green Enhancement Sdn Bhd. The product complies with the Specification of Malaysian and International Standards as stated in the report.

The Technical Expert Panel is in the opinion that this ECO Lightweight Composite / Concrete Wall (ELCW) System generally is suitable to be used in Malaysia provided that it complies with the terms and conditions mentioned in this report.

Prof. Ir. Dr Zuhairi Abd. Hamid
Chairman
Technical Expert Panel

Prof. Dr. Muhammad Fauzi bin Mohd Zain
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Ir. Tan Ah Chai
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Technical Expert Panel

September 2013

10.0 BIBLIOGRAPHY

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2.	GESB. (2013 b).	ECO Lightweight Composite / Concrete Wall Installation and Procedures
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9.	GESB. (2013 i).	Apparent Density Test Report
10.	GESB. (2013 j).	Bending Strength Test Report
11.	GESB. (2013 k).	Dimension and Tolerance Test Report
12.	GESB. (2013 l).	Water Absorption Test Report
13.	GESB. (2013 m).	Compressive Strength Test Report
14.	GESB. (2013 n).	Fire Resistance Test Report
15.	GESB. (2013 o).	Sound Insulation Test Report
16.	GESB. (2013 p).	Company Profile of GESB
17.	GESB. (2013 q).	Presentation slides
18.	GESB. (2013 r).	Installation Pictures

APPENDIX A

ECO LIGHTWEIGHT WALL – A TECHNICAL BRIEF

ECO Lightweight Concrete Wall

A Technical Brief

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Contents

1.0 INTRODUCTION

1.1 Product Brief

ECO Lightweight Concrete Wall system uses the best technology can offer : high-density autoclaved calcium silicate board complete with state-of-the-art lightweight aerated concrete infill. It is essentially a composite wall replacing traditional masonry wall.

Where **ECO Board** provides the perfect cast-in form for a perfect external finish, the aerated concrete infill provides the ideal bonding with **ECO Board** and returns good mechanical strength and superior thermal, sound and fire-rating performance.

1.2 Product Benefits

ECO Lightweight Concrete Wall is a breakthrough in the science of lightweight concrete technology. It is totally inorganic and incombustible with properties designed to exceed the industrial norms :

- ✓ Superior surface finishes
  - Completed wall ready for painting, tiling, carpeting and other architectural finishes.
- ✓ Superior fire-rating
  - ECO Lightweight Concrete Wall comes with a minimum fire-rating exceeding 4 hours and is also designed for load-bearing.
- ✓ Superior Thermal & sound insulation
  - ECO patented lightweight mortar contains modified cementitious compound provides remarkable thermal insulation up to ten times while the acoustics properties exceeds that of the conventional brickwall.
- ✓ Superior weather-resistant
  - ECO Lightweight Concrete Wall exceeds UBC 1997 & BS 8110 under extreme exposure with cement content exceeding 500kg/m^3.

2.0 PRODUCT CHARACTERISTICS

2.1 ECO Board

ECO Board is manufactured from pure quartz powder, quick lime together with OPC under high temperature and autoclaved under high pressure to achieve the standards that commensurate with international accreditation. Low carbon and a focus on green building material remains the pursuit that compels the production of quality that exceeds the highest industrial standards.

- ✓ Asbestos-free
- ✓ Global Manufacturer Certificate Accreditation
- ✓ ISO9001 – 2000 Quality and Management System Certification
- ✓ ISO1182, GB 8624-1997 & BS 476 Industrial Grade Certificate
- ✓ SGLS Environmental Standard & Certification Accreditation

2.2 ECO Lightweight Aerated Concrete Infill

ECO Lightweight Aerated Concrete Infill is a patented lightweight mortar containing no gas-forming chemicals or agents, sand and aggregate-free and completely non-toxic.

The air-entrained discontinuous cellular structure provides remarkable thermal insulation up to ten times while the acoustics properties exceeds that of the conventional brickwall.

- ✓ Ultra-fine low density wall - up to 30% brickwall loading
- ✓ Sand-free construction
  - Patented mortar producing highly stable air-entrained mortar mix and no gas-forming chemicals or agents.
- ✓ Ultra low water / cement concrete mix
  - Complies with UBC 1997 & BS 8110 under extreme exposure
- ✓ Superior fire-rating
  - Fire-rating exceeding 4 hours (minimum)
- ✓ Superior thermal & sound insulation
  - Provides remarkable thermal insulation up to ten times that of conventional brickwall
- ✓ Superior versatility & construction speed up to five times that of conventional brickwall

2.0 PRODUCT CHARACTERISTICS

2.3 Summary of Performance Comparison

Summary Of Performance Comparison : Unreinforced Masonry Wall

Characteristics	Type		
	ECO Wall - **102mm thk**	Solid Concrete - 115mm thk	Clay Brick - 115mm thk
[1] Density – *kNm^{-1}*	2.14 ***superior lightweight floor loading***	7.25	6.75
[2] Fire-rating – *hrs*	4 hrs minimum ***superior fire-rating***	3-4	1.0
[3] Acoustic Insulation – *STC dB*	41-43 ***superior sound absorption***	40-45	35-40
[4] Thermal Insulation – *m^{2}K/W*	1.02 ***superior thermal resistance class***	0.064	0.19
[5] Shrinkage movement – mm/m	-0.2 ***superior drying shrinkage stability***	-0.7	+1.8
Conduit, piping & internal fixtures	Concealed before infill ***superior versatility***	Concealed before infill	Hacking and re-plaster thereafter
External fixtures	Rotary drill, conventional concrete anchor ***superior versatility***	HD rotary drill, conventional concrete anchor	Light duty / chemical anchor only
Installation	20~25m^2/man-day ***superior speed***	10~15m^2/man-day	4~7m^2/man-day

[1] based on a typical 3000mm height wall

[2] in accordance with BS 476 : Pt4 SIRIM Test Reference J20111280260 (Report No.2011FE0338) – ECO wall sample returns the highest fire-rating class under prevalent construction type & category

[3] STC index ASTM E90 measured as a sound absorption index in dB – the higher the index the better the absorption properties (tested in accordance with ISO 140-3 :1995)

[4].Thermal resistance measures the insulation properties – the higher the value, the better the insulation properties

[5] Shrinkage movement up to 1 year to occur : reference of shrinkage from Australian Masonry Manual

APPENDIX B

ECO LIGHTWEIGHT COMPOSITE / CONCRETE WALL - INSTALLATION AND PROCEDURES

ECO Lightweight Concrete Wall Installation & Procedures

1. INTRODUCTION

ECO Lightweight Concrete Wall system uses the best technology can offer : high density autoclaved calcium silicate board complete with the state-of-the-art lightweight aerated concrete infill. It is essentially a composite wall replacing traditional masonry wall:-

- ✓ **ECO Board** provides the perfect cast-in form for a perfect external finish.
- ✓ Aerated concrete infill providing the ideal bonding with **ECO Board** and returns good mechanical strength and superior thermal, sound and fire-rating.

2. CHARACTERISTICS AND PROPERTIES OF ECO LIGHTWEIGHT CONCRETE WALL SYSTEM

Some of the salient characteristics and properties using **ECO Lightweight Concrete Wall** system include:

- ✓ Fast, simple and fuss and sand-free construction
- ✓ Superior surface finishes
- ✓ Superior thermal, sound & fire-rating
- ✓ Ultra-fine low density wall resulting in significant savings in floor loading
- ✓ Superior weather-resistant, with low water-cement ratio
- ✓ Superior moulding and re-sizing possible by simple cutting tools

3. INSTALLATION PROCEDURES

The installation of ECO Lightweight Concrete Wall system involves the following steps:-

3.1 GI Framing Installations

- Marking-out the wall position
- Install top and bottom GI Guide Rail (Head & Bottom Track) with 40mm rawl plug @ 3nos/1220mm
- Mount vertical GI framing rail (Stud) @ 1220mm with 20mm screws to position & check for verticality
- Mount fit-out framings for door & window, M&E openings etc with 20mm screws to position

3.2 ECO Board Installation

- Position and fix internal ECO Board to GI framing with 20mm screws to position @ 150mm & check for verticality
- Repeat for external ECO Board

3.3 ECO Lightweight Infill Concreting

- Install custom metal form (330x1220) against completed ECO Board
- Install horizontal bracing with MS channel @ 450mm vertical run ready to fix tie-rods
- Fix 3 layers of 350mm tie-rods (3nos 10Φ @ 450mm per layer)
- Mix ECO Lightweight Infill concrete with measured water quantity to form a consistent mortar. Aerated foam is then injected into the lightweight mortar mix and pumped through aeration machine for concreting purposes.

4. POST-INSTALLATION PROCEDURAL WORKS & CHECKS

Upon completion of concreting works in accordance with item 3.3, the following procedural works & checks are required to complete the works, being :-

4.1 Striking-off Metal Form

- Striking-off is consistent with the requirement of a normal concreting works for side-form – however, an 18-hour set is recommended before the metal form is completely removed.
- Tie-rods are removed thereafter and duly grouted with conventional mortar mix.
- Boards are checked for any hollow – drill board to expose the lightweight infill and inject suitable liquid-based adhesive (typically tiling adhesive liquid compound); drilled holes re-grouted thereafter.

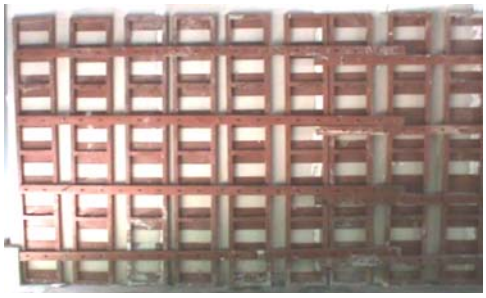
4.2 Extruded Mortar Mix

- To clean and tidy up any extruded mortar during concreting.
- To ensure wall surface is smooth; all damaged surface shall be duly treated ready for architectural treatment thereafter.
- To ensure all board joints to be duly flushed with plaster-based compound (typically ASG Stopping or skim compound), thereafter, 50mm joint fiber tape (typically Fiberglass Mesh for drywall suitable) to be applied over the treated joint before a final skim coated is applied.

4.3 Final Surface Check

- Final surface check to ensure consistency.
- Surface is ready for further architectural treatment (painting, tiling etc) typically 7 days after the concreting works. However, it remains the responsibility of the architectural applicator to ensure surface compliance unique to the finish-type thereof.

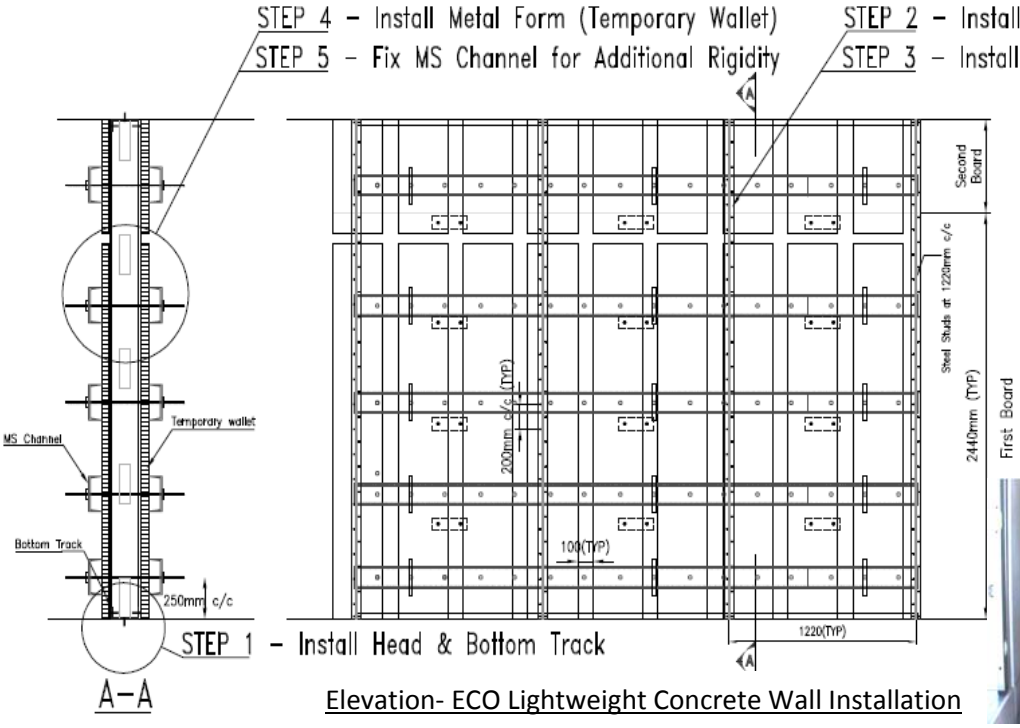
5. SIMPLE GUIDE TO THE INSTALLATION OF ECO Lightweight Concrete Wall



Step 4 - Install Metal Form

Step 5 - Fix MS Channel

Step 2 - Install GI Stud



Elevation- ECO Lightweight Concrete Wall Installation

Step 3 - Install ECO Board

And Finally, No Fuss Concreting

Step 1 - Install Bottom Track

Appendix – SIRIM Certificate No. 2011FE0338 : 4Hr Fire-Rating

SIRIM QAS International Sdn. Bhd.
No. 1, Persiaran Dato' Menteri, P.O. Box 7035, Seksyen 2, 40700 Shah Alam,
Selangor Darul Ehsan, MALAYSIA.
Tel: 03-55448485 Fax: 03-55443454 http://www.sirim.my
(Company No: 410334-X)

MS ISO/IEC 17025
TESTING
SAMM NO. 231

TEST REPORT

REPORT NO.: 2011FE0338	PAGE 1 OF 27

Applicant/ Manufacturer	:	**GREEN ENCHANTMENT SDN. BHD.,** Lot 37672, Jalan 3/37A, Kawasan Industri Taman Bukit Maluri, 52100 Kepong, Kuala Lumpur. (Attn.: Mr. Tey Chee Keong)
Product	:	**ECO Lightweight Wall System**
Reference Standard/ Method of Test	:	BS 476: Part 22: 1987 Methods for determination of the fire resistance of non-load bearing elements of construction Clause 5 – Determination of fire resistance of partition
Description of test specimen	:	A symmetrical non-load bearing ECO lightweight wall partition system consisted of Galvanized Iron U – channel (known as top track, bottom track and metal stud) and both sides were fitted with a single layer of 6.1 mm (*t*) Calcium Silicate board. The void sections were then infilled with mixed lightweight concrete with compositions of chemical compound (ECO Foam), cement and water. The overall size of the wall partition system during the test was 3000 mm (*h*) × 2960 mm (*w*) × 114 mm (*t*) and was constructed at the laboratory for the purpose of testing on the 29th September 2011. Full description of the test construction of the ECO lightweight wall partition system is detailed in Page 5 of this test report. Based on the test conducted, the ECO lightweight wall partition system satisfied the requirements of the **BS 476: Part 22: 1987** for the period stated below : **Integrity : 250 minutes** **Insulation : 250 minutes** The test was terminated after a period of 250 minutes of test at the request of the applicant.
Date of test	:	02.11.2011
Date received	:	21.09.2011
Job No./ Ref No.	:	J20111280260 / SQAS/FPS/15/1-3
Issued date	:	14 DEC 2011

Approved Signatories:

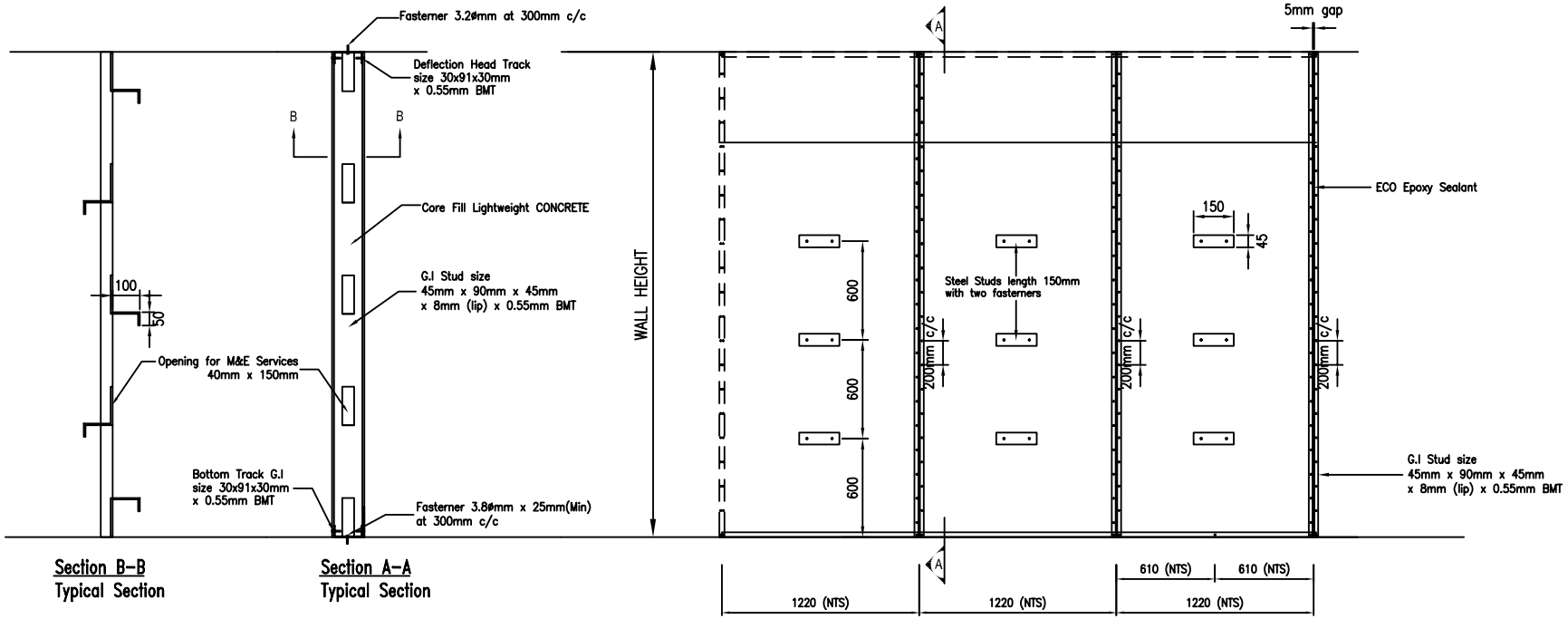
KAMARULZAMAN BIN MAT ZIN
Testing Executive

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION

ZAINI AHMAD
Group Leader
Fire Protection Section
Testing Services Department
SIRIM QAS International Sdn. Bhd.

APPENDIX C

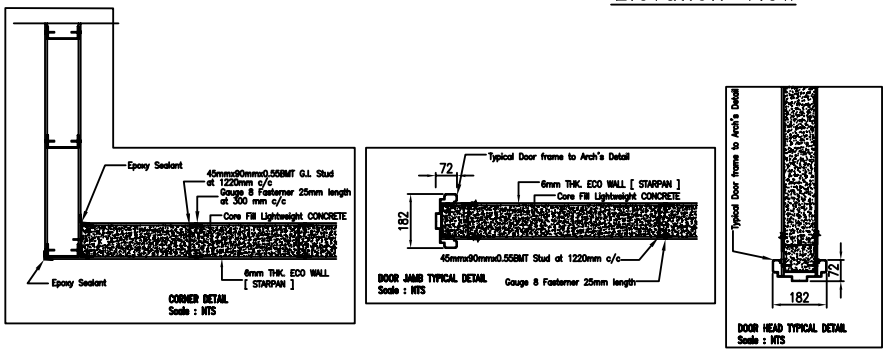
DETAILED DRAWING OF ELCW



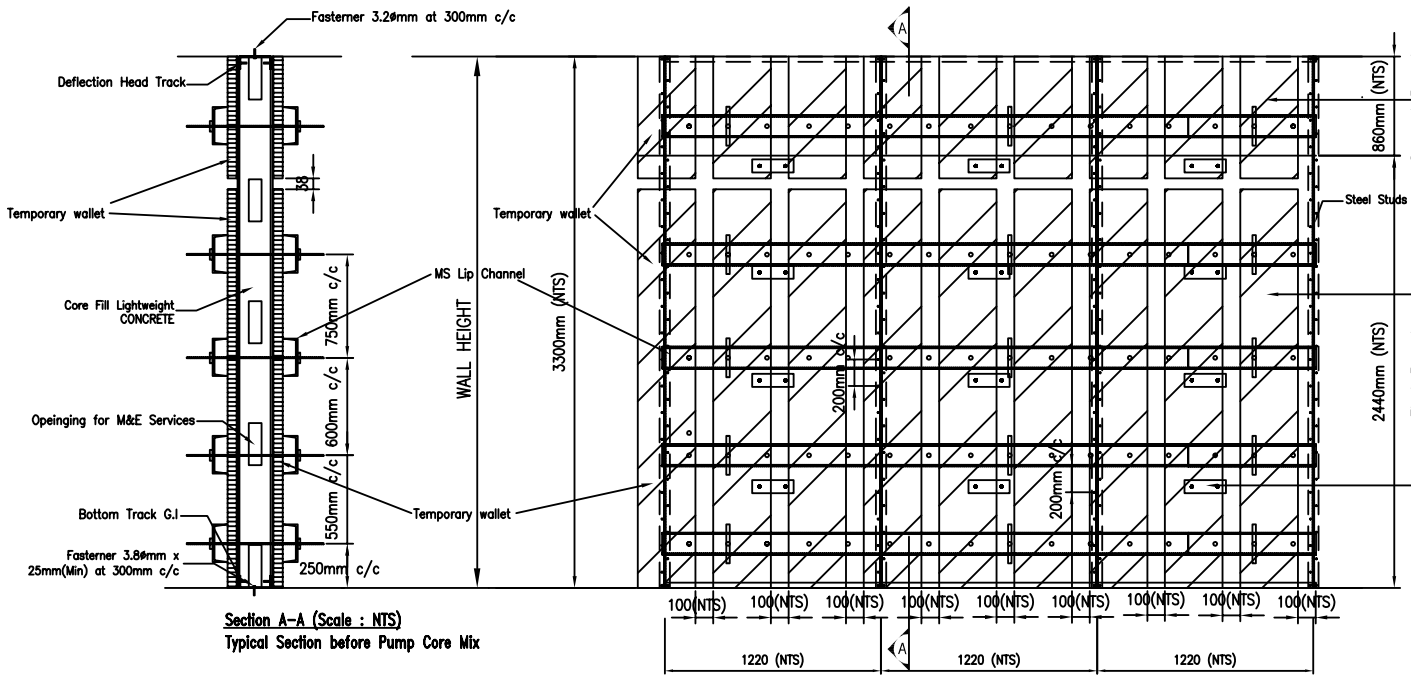
Section B-B
Typical Section

Section A-A
Typical Section

Elevation View

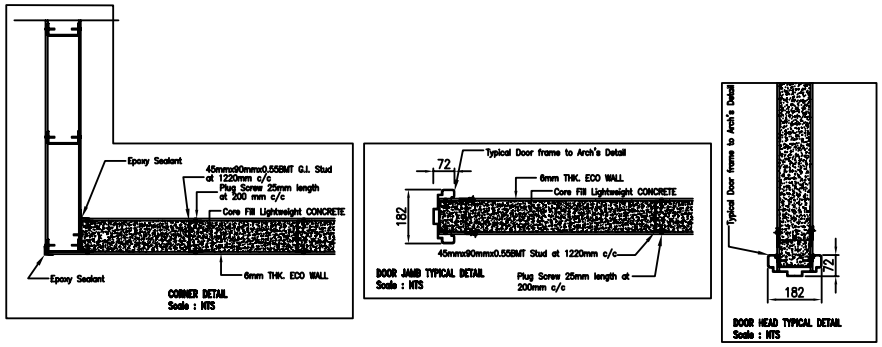


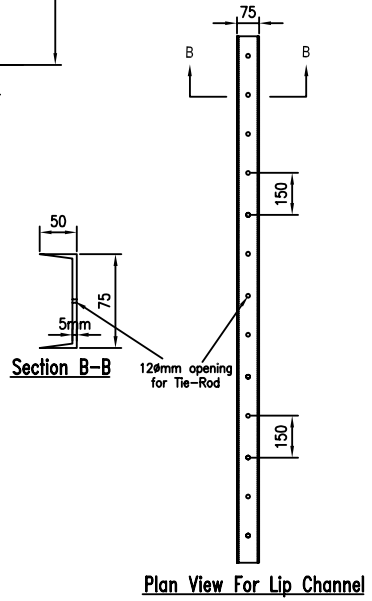
DETAIL FOR INTERNAL ECO WALL 102MM THICK



Section A-A (Scale : NTS)
Typical Section before Pump Core Mix

Elevation View

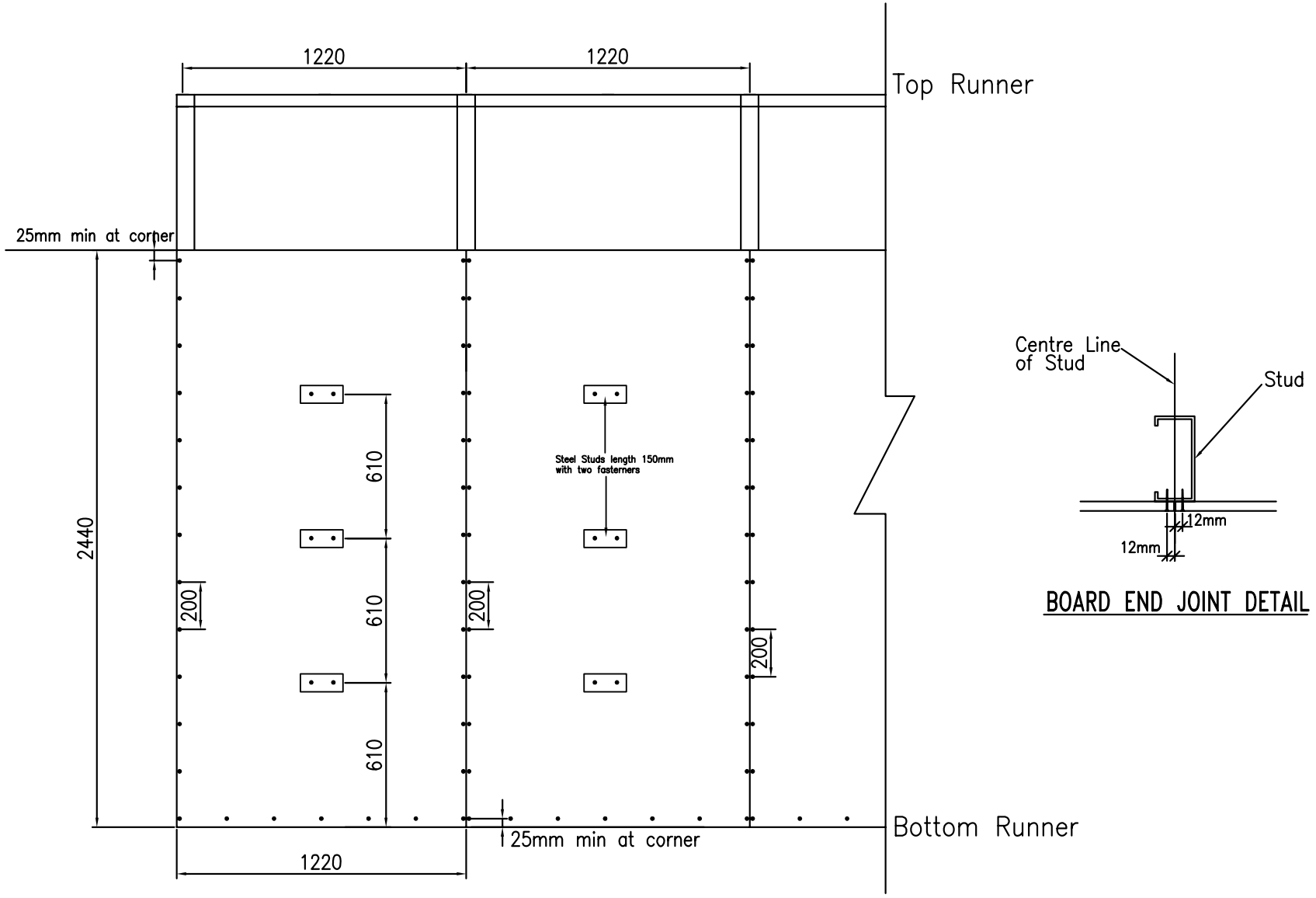




Section B-B

Plan View For Lip Channel

DETAIL FOR INTERNAL ECO WALL 102MM THICK



SCREW FIXING (VERTICAL)

BOARD END JOINT DETAIL

APPENDIX D

ELCW SYSTEM CATALOGUE

GREEN ENHANCEMENT SDN BHD (894167-K)

ECO Lightweight Concrete Wall

THE FUTURE IS ECO

Bright Idea Brilliant Solution

ECO Lightweight Concrete Wall

THE FUTURE IS ECO

ECO Lightweight Concrete Wall system uses the best technology can offer: high density autoclaved calcium silicate board complete with state-of-the-art lightweight aerated concrete infill. No fuss, no mess, and wall-perfect every time. ***The future is ECO.***

Superior Product

- High quality product
- Low water-cement system
- Sand-free construction
- Superior construction speed
- Ultra-fine low density wall

Superior Performance

- Superior surface finishes
- Superior fire-rating
- Superior thermal & sound insulation
- Superior weather-resistant

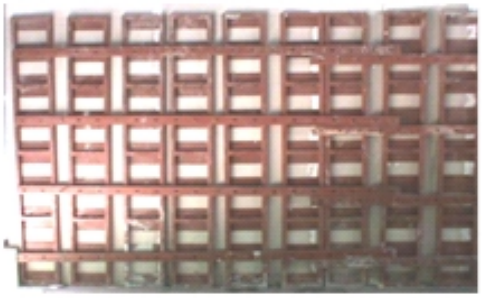
Specification - 102mm, 150mm thk

Description	**Characteristics**	**Compliance**
Density (kg/m³)	600 ~ 750	
Fire-Rating	4 hrs min	BS 476 Part 21
w/c ratio	0.48 max	BS8110 Table 3.4
Min Cement	450 kg/m³min	UBC 1997 Table 19-A-2 & 4
Thermal Insulation	0.18 m² k/W	ISO 8990
Sound Insulation	STC 41~43 dB	ASTM E90

ECO Lightweight Concrete Wall

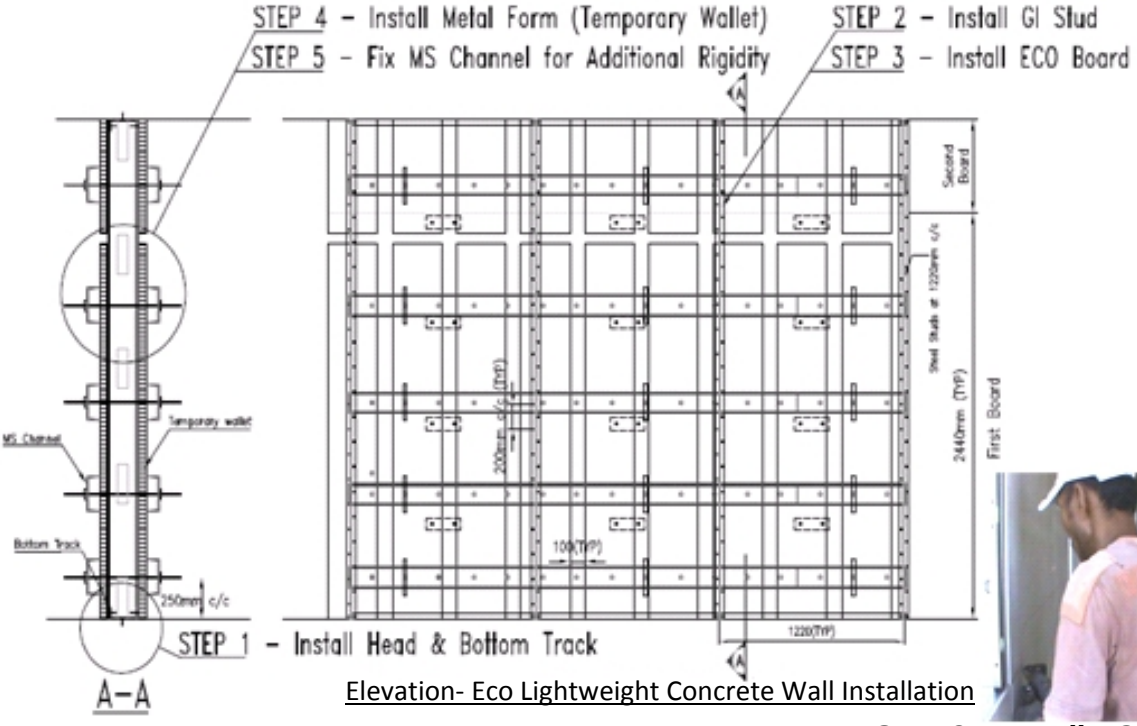
THE FUTURE IS ECO

Guide To The Installation of ECO Lightweight Concrete Wall



Step 4 - Install Metal Form
Step 5 - Fix MS Channel

Step 2 - Install GI Stud



Elevation- Eco Lightweight Concrete Wall Installation

Step 3 - Install ECO Board

And Finally, No Fuss Concreting

Step 1 - Install Bottom Track

Certification & Compliance

ECO Board

Global Manufacturer Certificate Accreditation

ISO9001 - 2000 Quality and Management System Certification

ISO1182, GB 8624-1997 & BS 476 Industrial Grade Certification

ECO Lightweight Concrete Wall System

Patent No. PI 2011002175

Fire Rating to BS 476

Sulphate & chloride - resistance, extreme exposure compliance to UBC 1997 Table 19-A-2 & 19-A-4, BS 8110 Table 6.1 & 6.2

Report No. BB/ECOWALL/1570/2010
Report No.2010CBD061
Report No.2011CB0835
Report No.2010FE0370
Report No.2011CB3176
Report No.2011FE0338

KW Tan +6012-304 3330

GREEN ENHANCEMENT SDN BHD (894167-K)
Lot 37672, Jalan 3/37A
Kawasan Industri Taman Bukit Maluri
Kepong, 52100 Kuala Lumpur
tel : +603-6274 7969 **fax** : +603-6272 7021 **email** : genhance@gmail.com

THE FUTURE IS ECO

APPENDIX E

TEST REPORT

from SIRIM QAS International Sdn Bhd

1. Compressive Stress Test
2. Fire Propagation Index Test
3. Surface Spread of Flame Test
4. Dimensional Stability
5. Apparent Density Test
6. Bending Strength Test
7. Dimension and Tolerance Test
8. Water Absorption Test
9. Compressive Strength Test
10. Fire Resistance Test
11. Sound Insulation Test

SIRIM QAS International Sdn.Bhd. (Company No.: 410334-X)
No.1, Persiaran Dato' Menteri, P.O.Box 7035, Section 2,
40700 Shah Alam, Selangor Darul Ehsan, Malaysia
Tel. no: 03-5544 5853 / 5544 5854
Fax. no: 03-5544 5886

TEST REPORT

REPORT NO.: 2011CB6118	PAGE : 1 OF 2

Applicant	:	GREEN ENHANCEMENT SDN BHD Lot 37672, Jalan 3/37A, Kawasan Industri Taman Bukit Maluri, 52100 Kepong Kuala Lumpur
Manufacturer	:	Nil
Product	:	Ecoboard
Reference Standard/ Method of test	:	BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products - Specification
Description of sample	:	Five (5) pieces of Ecoboard were received for testing. Brand: ECO Size of specimen: 200 mm x 200 mm x 6.0 mm
Date received	:	27th October 2011
Job no./Ref. no.	:	J20111266118/SQAS/CCST/T.REC/CSL/09
Issued date	:	25 JAN 2012

Approved Signatories

.....
(HANON NAZIR MOHD BASIR)
Senior Technical Executive

.....
(YM RAJA NOR SIHA BT. RAJA ABD. HANAN)
Head
Civil & Construction Section
Testing Services Department

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

7.0 CONDITIONS RELATING TO THE USE OF SIRIM QAS INTERNATIONAL TEST REPORT

7.1 A Test Report will be issued in respect of Testing Services conducted and shall relate only to the Sample actually tested. SIRIM QAS International makes no warranty whatsoever and the Applicant shall not represent in any manner that any duplication or mass production of the Product is same as the Sample actually tested or that SIRIM QAS International has tested any of the duplicated or mass produced Product.

7.2 The Test Report shall not be amended, changed, varied or modified in any manner whatsoever by the Applicant or otherwise.

7.3 If the Test Report is to be furnished to any third party or to the public, each such Test Report shall be furnished in full, legible and in its entirety.

7.4 The Test Report shall not be reproduced and shall not in any manner be used for any advertising purposes or whatsoever without written approval from the Managing Director of SIRIM QAS International of No. 1, Persiaran Dato' Menteri, Building 8, Section 2, P.O. Box 7035, 40700 Shah Alam, Selangor Darul Ehsan.

7.5 Further or in the alternative, it is strictly forbidden unless with prior written approval from the Managing Director of SIRIM QAS International, to represent in any manner whatsoever that SIRIM and/or other SIRIM's subsidiaries has endorsed, approved or validated the Product of the Applicant in any manner whatsoever.

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7.7 In the event the Applicant is found in breach of this provision, SIRIM QAS International, SIRIM and/or other SIRIM's subsidiaries without prejudice to any other right and remedies may take whatever action necessary including but not limited to:

a) Informing and placing a notice in the media;
b) Obtaining an injunction from Court (cost on a solicitor-client basis to be borne by the Applicant);
c) Refusing to accept any further Product for Testing Services from the Applicant or whosoever related to the Applicant, whether subsidiary or otherwise;
d) Instructing the Applicant to withdraw and recall the advertisement, statement or document in question and advertise a clarification and apology to SIRIM QAS International, SIRIM and/or other SIRIM's subsidiaries twice in a national publication of SIRIM QAS International's choice at the Applicant's sole cost; and
e) Informing or lodging a report pertaining the Applicant's Test Report with the relevant authorities.

7.8 In the event of an investigation from any third party concerning the Applicant's Test Report, SIRIM QAS International may disclose the same for purposes of such investigation.

7.9 If such approval is obtained from the Managing Director of SIRIM QAS International, the Applicant may only include the phrase. "A sample of this product has been tested by SIRIM QAS International... (Test Report No) ... (dated) .... (for what test) ... (to which standard)" or such similar words which stress that only the Sample was actually tested.

7.10 Certified true copies of the Test Report may be issued upon request by the Applicant upon payment of the relevant fee.

TEST REPORT

REPORT NO.: 2011CB6118	PAGE : 2 OF 2

TEST RESULT:

Product	:	Ecoboard
Brand	:	ECO
Size of specimen	:	200 mm x 200 mm x 6.0 mm
Method of Test	:	a) BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products – Specification b) BS EN 826: 1996 Thermal insulating products for building application – Determination of compression behaviour

Clause	Test Method/Requirement	Test Results	Remark
4.3.4	Compressive stress or compressive strength	Compressive stress at 10% 1) 2.010 kPa 2) 1.572 kPa 3) 1.833 kPa 4) 2.011 kPa 5) 1.608 kPa **Mean:** 1.807 kPa	Declared value by manufacturer

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

25 JAN 2012

SIRIM QAS International Sdn. Bhd.
No. 1, Persiaran Dato' Menteri, P.O.Box 7035, Seksyen 2, 40911 Shah Alam, Selangor Darul Ehsan
MALAYSIA
Tel: 03-55446465 Fax: 03-55446454 http: //www.sirim.my
(Company No: 410334-X)

TEST REPORT

REPORT NO.: 2011FE0352	PAGE 1 OF 4

Applicant/ Manufacturer : **GREEN ENHANCEMENT SDN. BHD.**
Lot 37672, Jalan 3/37A,
Kawasan Industri Taman Bukit Maluri,
52100 Kepong
Kuala Lumpur,
(Attn: Mr. Tey Chee Keong)

Product : **CALCIUM SILICATE BOARD**

Reference Standard/ Method of Test : BS 476: Part 6: 1989
Fire Test on Building Materials and Structures
Part 6: Method of Test for Fire Propagation for Products.

Description of Test Specimen : 3 pieces of Calcium Silicate Boards.

Size of Specimen	:	225mm × 225mm × 6.19 mm (measured thickness)
Brand	:	ECO
Nominal Thickness	:	6.0 ± 0.3 mm
Nominal Density	:	1100 – 1200 kg/m^3
Measured Density	:	1185 kg/m^3

The specimens were tested with the smooth face side exposed to the specified heating condition of the fire test.

Date Received : 03.11.2011

Date of Test : 14.12.2011

Job No./ Ref No. : J20111280292 /SQAS/FPS/15/1-5

Test Result :

Subindex i1	Subindex i2	Subindex i3	Fire Propagation Index (I)
1.4	0.7	0.5	2.6

Issued Date : 28 DEC 2011

TESTING SERVICES DEPARTMENT FIRE PROTECTION SECTION SIRIM QAS INTERNATIONAL SDN BHD

.....
WAN MOHD KHAIRI WAN YAHYA
Testing Executive

.....
ZAINI AHMAD
Group Leader
Fire Protection Section
Testing Services Department
SIRIM QAS International Sdn. Bhd.

7.0 CONDITIONS RELATING TO THE USE OF SIRIM QAS INTERNATIONAL TEST REPORT

7.1 A Test Report will be issued in respect of Testing Services conducted and shall relate only to the Sample actually tested. SIRIM QAS International makes no warranty whatsoever and the Applicant shall not represent in any manner that any duplication or mass production of the Product is same as the Sample actually tested or that SIRIM QAS International has tested any of the duplicated or mass produced Product.

7.2 The Test Report shall not be amended, changed, varied or modified in any manner whatsoever by the Applicant or otherwise.

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7.4 The Test Report shall not be reproduced and shall not in any manner be used for any advertising purposes or whatsoever without written approval from the Managing Director of SIRIM QAS International of No. 1, Persiaran Dato' Menteri, Building 8, Section 2, P.O. Box 7035, 40911 Shah Alam, Selangor Darul Ehsan.

7.5 Further or in the alternative, it is strictly forbidden unless with prior written approval from the Managing Director of SIRIM QAS International, to represent in any manner whatsoever that SIRIM and/or other SIRIM's subsidiaries has endorsed, approved or validated the Product of the Applicant in any manner whatsoever.

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a) Informing and placing a notice in the media;
b) Obtaining an injunction from Court (cost on a solicitor-client basis to be borne by the Applicant);
c) Refusing to accept any further Product for Testing Services from the Applicant or whosoever related to the Applicant, whether subsidiary or otherwise;
d) Instructing the Applicant to withdraw and recall the advertisement, statement or document in question and advertise a clarification and apology to SIRIM QAS International, SIRIM and/or other SIRIM's subsidiaries twice in a national publication of SIRIM QAS International's choice at the Applicant's sole cost; and
e) Informing or lodging a report pertaining the Applicant's Test Report with the relevant authorities.

7.8 In the event of an investigation from any third party concerning the Applicant's Test Report, SIRIM QAS International may disclose the same for purposes of such investigation.

7.9 If such approval is obtained from the Managing Director of SIRIM QAS International, the Applicant may only include the phrase. "A sample of this product has been tested by SIRIM QAS International... (Test Report No) ... (dated) .... (for what test) ... (to which standard)" or such similar words which stress that only the Sample was actually tested.

7.10 Certified true copies of the Test Report may be issued upon request by the Applicant upon payment of the relevant fee.

TEST REPORT

Product : CALCIUM SILICATE BOARD

Brand : ECO

Nominal Thickness : 6.0 ± 0.3 mm

Measured Thickness : 6.19 mm

Nominal Density : 1100 – 1200 kg/m^3

Measured Density : 1185 kg/m^3

Date of Test : 14.12.2011

	Temperature Rise Above Ambient (°C)				
Time (Min.)	Calibration	Specimen A	Specimen B	Specimen C	Specimen Average
0.5	14	15	15	16	15
1.0	17	20	21	21	20
1.5	21	24	25	25	25
2.0	24	29	29	29	29
2.5	27	33	33	33	33
3.0	31	37	37	37	37
4.0	61	66	64	61	64
5.0	94	103	100	98	100
6.0	119	126	127	121	124
7.0	136	144	143	142	143
8.0	153	161	160	160	160
9.0	166	175	176	176	176
10.0	180	188	189	190	189
12.0	200	211	211	214	212
14.0	213	227	228	233	229
16.0	224	239	241	245	241
18.0	232	245	249	255	250
20.0	240	254	257	263	258
Subindex 1		1.3	1.4	1.6	1.4
Subindex 2		0.8	0.7	0.5	0.7
Subindex 3		0.4	0.5	0.6	0.5
Index of Performance		2.5	2.6	2.7	2.6

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION
SIRIM QAS INTERNATIONAL SDN BHD

28 DEC 2011

TEST REPORT

REPORT NO.: 2011FE0352	PAGE 3 OF 4

Date of Test : 14.12.2011

No. of Specimen Tested : 3 nos.

The Fire Propagation Index **I is 2.6** for the Calcium Silicate Board with known density of 1185 kg/m^3 and measured thickness of 6.19 mm.

The Subindex i1 is **1.4**

The Subindex i2 is **0.7**

The Subindex i3 is **0.5**

The test results relate only to the behavior of the test specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

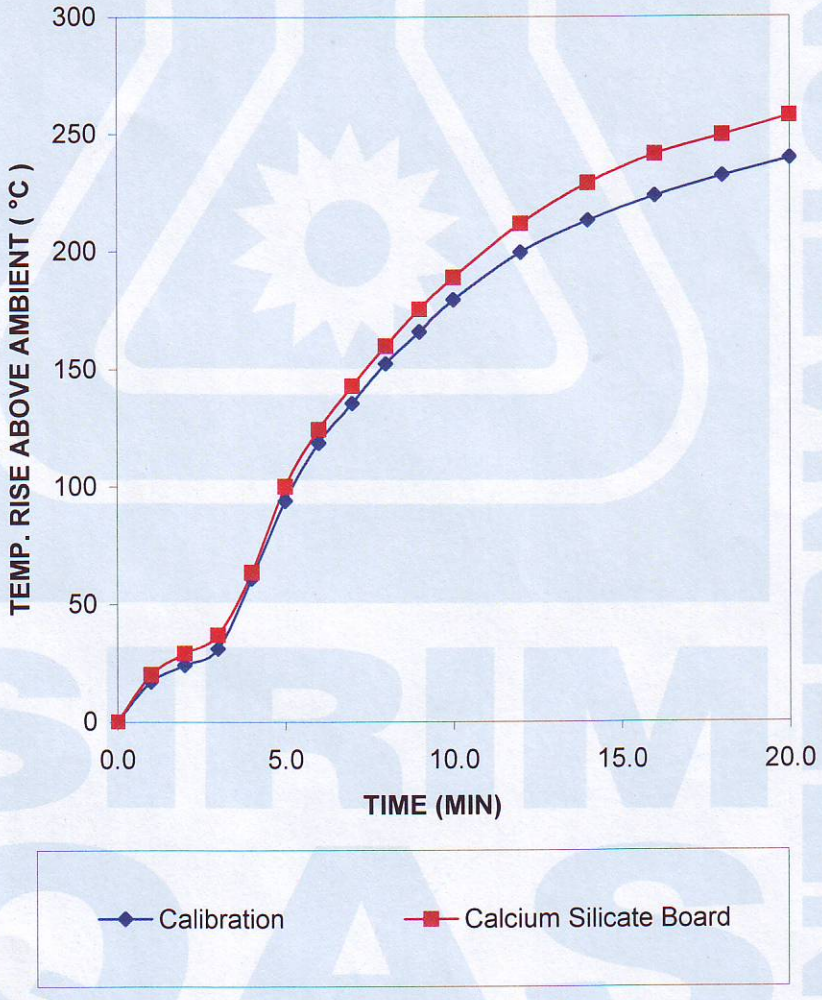
TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION
SIRIM QAS INTERNATIONAL SDN BHD

28 DEC 2011

TEST REPORT

REPORT NO.: 2011FE0352	PAGE 4 OF 4

Product	:	CALCIUM SILICATE BOARD			
Brand	:	ECO	**Nominal Density**	:	1100 – 1200 kg/m^3
Nominal Thickness	:	6.0 ± 0.3 mm	**Measured Density**	:	1185 kg/m^3
Measured Thickness	:	6.19 mm	**Date of Test**	:	14.12.2011



TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION
SIRIM QAS INTERNATIONAL SDN BHD

28 DEC 2011

SIRIM QAS International Sdn. Bhd.
No. 1, Persiaran Dato' Menteri, P.O.Box 7035, Seksyen 2, 40911 Shah Alam, Selangor Darul Ehsan
MALAYSIA
Tel: 03-55446465 Fax: 03-55446454 http: //www.sirim.my
(Company No: 410334-X)

TEST REPORT

REPORT NO.: 2011FE0353	PAGE 1 OF 3

Applicant/ Manufacturer : **GREEN ENHANCEMENT SDN. BHD.**
Lot 37672, Jalan 3/37A,
Kawasan Industri Taman Bukit Maluri,
52100 Kepong
Kuala Lumpur,
(Attn: Mr. Tey Chee Keong)

Product : **CALCIUM SILICATE BOARD**

Reference Standard/ Method of Test : BS 476 : Part 7: 1997
Fire Test on Building Materials and Structures
Part 7: Surface Spread of Flame Test.

Description of Test Specimen : 6 pieces of Calcium Silicate Boards.

Size of Specimen	:	270mm × 885mm × 6.24 mm (measured thickness)
Brand	:	ECO
Nominal Thickness	:	6.0 ± 0.3 mm
Nominal Density	:	1100 – 1200 kg/m^3
Measured Density	:	1224 kg/m^3

The specimens were tested with the smooth face side exposed to the specified heating condition of the fire test.

Date Received : 03.11.2011

Date of Test : 17.11.2011

Job No./ Ref No. : J20111280293 /SQAS/FPS/15/1-6

Test Result : **Classification of Surface Spread of Flame Test** : **Class 1**

Issued Date : 28 DEC 2011

.....
WAN MOHD KHAIRI WAN YAHYA
Testing Executive

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION
SIRIM QAS INTERNATIONAL SDN BHD

.....
ZAINI AHMAD
Group Leader
Fire Protection Section
Testing Services Department
SIRIM QAS International Sdn. Bhd

7.0 CONDITIONS RELATING TO THE USE OF SIRIM QAS INTERNATIONAL TEST REPORT

7.1 A Test Report will be issued in respect of Testing Services conducted and shall relate only to the Sample actually tested. SIRIM QAS International makes no warranty whatsoever and the Applicant shall not represent in any manner that any duplication or mass production of the Product is same as the Sample actually tested or that SIRIM QAS International has tested any of the duplicated or mass produced Product.

7.2 The Test Report shall not be amended, changed, varied or modified in any manner whatsoever by the Applicant or otherwise.

7.3 If the Test Report is to be furnished to any third party or to the public, each such Test Report shall be furnished in full, legible and in its entirety.

7.4 The Test Report shall not be reproduced and shall not in any manner be used for any advertising purposes or whatsoever without written approval from the Managing Director of SIRIM QAS International of No. 1, Persiaran Dato' Menteri, Building 8, Section 2, P.O. Box 7035, 40911 Shah Alam, Selangor Darul Ehsan.

7.5 Further or in the alternative, it is strictly forbidden unless with prior written approval from the Managing Director of SIRIM QAS International, to represent in any manner whatsoever that SIRIM and/or other SIRIM's subsidiaries has endorsed, approved or validated the Product of the Applicant in any manner whatsoever.

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7.7 In the event the Applicant is found in breach of this provision, SIRIM QAS International, SIRIM and/or other SIRIM's subsidiaries without prejudice to any other right and remedies may take whatever action necessary including but not limited to:

a) Informing and placing a notice in the media;
b) Obtaining an injunction from Court (cost on a solicitor-client basis to be borne by the Applicant);
c) Refusing to accept any further Product for Testing Services from the Applicant or whosoever related to the Applicant, whether subsidiary or otherwise;
d) Instructing the Applicant to withdraw and recall the advertisement, statement or document in question and advertise a clarification and apology to SIRIM QAS International, SIRIM and/or other SIRIM's subsidiaries twice in a national publication of SIRIM QAS International's choice at the Applicant's sole cost; and
e) Informing or lodging a report pertaining the Applicant's Test Report with the relevant authorities.

7.8 In the event of an investigation from any third party concerning the Applicant's Test Report, SIRIM QAS International may disclose the same for purposes of such investigation.

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7.10 Certified true copies of the Test Report may be issued upon request by the Applicant upon payment of the relevant fee.

TEST REPORT

Name of Applicant : GREEN ENHANCEMENT SDN. BHD.

Product : CALCIUM SILICATE BOARD

Brand : ECO

Nominal Thickness : 6.0 ± 0.3 mm

Measured Thickness : 6.24 mm

Nominal Density : 1100 – 1200 kg/m^3

Measured Density : 1224 kg/m^3

Date of Test : 17.11.2011

Requirement

The flame spread on any specimen of the sample shall not exceed the limit assigned for the class with the proviso that for one specimen only in the sample the flame spread may exceed this limit by the tolerance shown.

Classification of Surface Spread of Flame

Classification	Flame Spread at 1½ min		Final Flame Spread	
	Limit (mm)	Tolerance for one specimen in sample (mm)	Limit (mm)	Tolerance for one specimen in sample (mm)
Class 1	165	25	165	25
Class 2	215	25	455	45
Class 3	265	25	710	75
Class 4	Exceeding Class 3 limits			

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION
SIRIM QAS INTERNATIONAL SDN BHD

28 DEC 2011

TEST REPORT

REPORT NO.: 2011FE0353	PAGE 3 OF 3

Test Results

Product : CALCIUM SILICATE BOARD

Brand : ECO

Nominal Thickness : 6.0 ± 0.3 mm

Measured Thickness : 6.24 mm

Nominal Density : 1100 – 1200 kg/m^3

Measured Density : 1224 kg/m^3

Date of Test : 17.11.2011

Specimen No.	1	2	3	4	5	6
Spread of flame at 1½ minutes (mm)	0	0	0	0	0	0
Distance (mm)	Time of spread of flame to indicated distance (minutes . seconds)					
75	-	-	-	-	-	-
165	-	-	-	-	-	-
190	-	-	-	-	-	-
215	-	-	-	-	-	-
240	-	-	-	-	-	-
265	-	-	-	-	-	-
290	-	-	-	-	-	-
375	-	-	-	-	-	-
455	-	-	-	-	-	-
500	-	-	-	-	-	-
525	-	-	-	-	-	-
600	-	-	-	-	-	-
675	-	-	-	-	-	-
710	-	-	-	-	-	-
750	-	-	-	-	-	-
785	-	-	-	-	-	-
825	-	-	-	-	-	-
865	-	-	-	-	-	-
Time of maximum spread of flame (minutes . seconds)	-	-	-	-	-	-
Distance of maximum spread of flame (mm)	0	0	0	0	0	0

TESTING SERVICES DEPARTMENT FIRE PROTECTION SECTION SIRIM QAS INTERNATIONAL SDN BHD

Conclusion

In accordance with the class definition specified in the standard, the test results show that the sample tested has a Class **One** Surface Spread of Flame.

The test results relate only to the behavior of the test specimens of a product under the particular conditions of test; they are not intended to be sole criterion for assessing the potential fire hazard of the product in use.

28 DEC 2011

SIRIM QAS International Sdn.Bhd. (Company No.: 410334-X)
No.1, Persiaran Dato' Menteri, P.O.Box 7035, Section 2,
40700 Shah Alam, Selangor Darul Ehsan, Malaysia
Tel. no: 03-5544 5853 / 5544 5854
Fax. no: 03-5544 5886

TEST REPORT

REPORT NO.: 2011CB6119	PAGE : 1 OF 2

Applicant	:	GREEN ENHANCEMENT SDN BHD Lot 37672, Jalan 3/37A, Kawasan Industri Taman Bukit Maluri, 52100 Kepong Kuala Lumpur
Manufacturer	:	Nil
Product	:	Ecoboard
Reference Standard/ Method of test	:	BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products - Specification
Description of sample	:	Five (5) pieces of Ecoboard were received for testing. Brand: ECO Size of specimen: 200 mm x 200 mm x 6.0 mm
Date received	:	27th October 2011
Job no./Ref. no.	:	J20111266119/SQAS/CCST/T.REC/CSL/09
Issued date	:	31 JAN 2012

Approved Signatories

.....
(HANON NAZIR MOHD BASIR)
Senior Technical Executive

.....
(YM RAJA NOR SIHA BT. RAJA ABD. HANAN)
Head
Civil & Construction Section
Testing Services Department

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

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7.10 Certified true copies of the Test Report may be issued upon request by the Applicant upon payment of the relevant fee.

TEST REPORT

REPORT NO.: 2011CB6119	PAGE : 2 OF 2

TEST RESULT:

Product	:	Ecoboard
Brand	:	ECO
Size of specimen	:	200 mm x 200 mm x 6.0 mm
Method of Test	:	a) BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products – Specification b) BS EN 1604: 1996 Thermal insulating products for building application – Determination of dimensional stability under specified temperature and relative humidity

Clause	Test Method/Requirement	Test Results	Remark
4.2.3	Dimensional Stability The test shall be carried out after storage for 48 hrs at (23 ± 2) °C and (90 ± 5) % relative humidity. a) Relative changes in length & width: not exceed 1.0 % b) Relative changes in thickness: not exceed 1.0 %	<u>Relative Changes in Length</u> 1) 0.04 % 2) 0.05 % 3) 0.02 % **Mean: 0.04 %** <u>Relative Changes in Width</u> 1) 0.04 % 2) 0.03 % 3) 0.03 % **Mean: 0.03 %** <u>Relative Reduction in Thickness</u> 1) 0.22 % 2) 0.77 % 3) 0.38 % **Mean: 0.46 %**	Declared value by manufacturer

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

31 JAN 2012

SIRIM QAS International Sdn.Bhd. (Company No.: 410334-X)
No.1, Persiaran Dato' Menteri, P.O.Box 7035, Section 2,
40700 Shah Alam, Selangor Darul Ehsan, Malaysia
Tel. no: 03-5544 5853 / 5544 5854
Fax. no: 03-5544 5886

TEST REPORT

REPORT NO.: 2011CB6115	PAGE : 1 OF 2

Applicant	:	GREEN ENHANCEMENT SDN BHD Lot 37672, Jalan 3/37A, Kawasan Industri Taman Bukit Maluri, 52100 Kepong Kuala Lumpur
Manufacturer	:	Nil
Product	:	Ecoboard
Reference Standard/ Method of test	:	BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products - Specification
Description of sample	:	Five (5) pieces of Ecoboard were received for testing. Brand: ECO Size of specimen: 100 mm x 100 mm x 6.0 mm
Date received	:	27th October 2011
Job no./Ref. no.	:	J20111266115/SQAS/CCST/T.REC/CSL/09
Issued date	:	18 JAN 2012

Approved Signatories

.....
(HANON NAZIR MOHD BASIR)
Senior Technical Executive

.....
(YM RAJA NOR SIHA BT. RAJA ABD. HANAN)
Head
Civil & Construction Section
Testing Services Department

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

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7.10 Certified true copies of the Test Report may be issued upon request by the Applicant upon payment of the relevant fee.

TEST REPORT

REPORT NO.: 2011CB6115	PAGE : 2 OF 2

TEST RESULT:

Product	:	Ecoboard
Brand	:	ECO
Size of specimen	:	100 mm x 100 mm x 6.0 mm
Method of Test	:	a) BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products – Specification b) BS EN 1602: 1997 Thermal insulating products for building application – Determination of apparent density

Clause	Test Method/Requirement	Test Results	Remark
Annex D	D.9 Apparent density No mean value of a product should deviate by more than 10 % from declared value.	Apparent density 1) 1233.9 kg/m^3 2) 1216.7 kg/m^3 3) 1245.2 kg/m^3 4) 1234.7 kg/m^3 5) 1229.6 kg/m^3 **Mean:** 1232.0 kg/m^3	Declared value by manufacturer

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

18 JAN 2012

SIRIM QAS International Sdn.Bhd. (Company No.: 410334-X)
No.1, Persiaran Dato' Menteri, P.O.Box 7035, Section 2,
40700 Shah Alam, Selangor Darul Ehsan, Malaysia
Tel. no: 03-5544 5853 / 5544 5854
Fax. no: 03-5544 5886

TEST REPORT

REPORT NO.: 2011CB6116	PAGE : 1 OF 2

Applicant	:	GREEN ENHANCEMENT SDN BHD Lot 37672, Jalan 3/37A, Kawasan Industri Taman Bukit Maluri, 52100 Kepong Kuala Lumpur
Manufacturer	:	Nil
Product	:	Ecoboard
Reference Standard/ Method of test	:	BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products - Specification
Description of sample	:	Ten (10) pieces of Ecoboard were received for testing. Brand: ECO Size of specimen: 80 mm x 150 mm x 6.0 mm
Date received	:	27th October 2011
Job no./Ref. no.	:	J20111266116/SQAS/CCST/T.REC/CSL/09
Issued date	:	18 JAN 2012

Approved Signatories

.....
(HANON NAZIR MOHD BASIR)
Senior Technical Executive

.....
(YM RAJA NOR SIHA BT. RAJA ABD. HANAN)
Head
Civil & Construction Section
Testing Services Department

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

7.0 CONDITIONS RELATING TO THE USE OF SIRIM QAS INTERNATIONAL TEST REPORT

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7.10 Certified true copies of the Test Report may be issued upon request by the Applicant upon payment of the relevant fee.

TEST REPORT

REPORT NO.: 2011CB6116	PAGE : 2 OF 2

TEST RESULT:

Product	:	Ecoboard
Brand	:	ECO
Size of specimen	:	80 mm x 150 mm x 6.0 mm
Method of Test	:	a) BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products – Specification b) BS EN 826: 1997 Thermal insulating products for building application – Determination of Bending Behaviour

Clause	Test Method/Requirement	Test Results	Remark
Annex D	D.8 Bending strength No test results should be less than the declared level: 5 000 kPa	Parrallel direction 1) 9462.5 kPa 2) 8889.9 kPa 3) 9281.0 kPa 4) 9406.5 kPa 5) 8639.5 kPa **Mean:** 9135.9 kPa Transverse direction 1) 10702.6 kPa 2) 10869.7 kPa 3) 8821.5 kPa 4) 8709.0 kPa 5) 9346.4 kPa **Mean:** 9689.8 kPa **Mean Bending Strength:** 9412.9 kPa	Declared value by manufacturer

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

18 JAN 2012

SIRIM QAS International Sdn.Bhd. (Company No.: 410334-X)
No.1, Persiaran Dato' Menteri, P.O.Box 7035, Section 2,
40700 Shah Alam, Selangor Darul Ehsan, Malaysia
Tel. no: 03-5544 5853 / 5544 5854
Fax. no: 03-5544 5886

TEST REPORT

REPORT NO.: 2011CB6120	PAGE : 1 OF 3

Applicant	:	GREEN ENHANCEMENT SDN BHD Lot 37672, Jalan 3/37A, Kawasan Industri Taman Bukit Maluri, 52100 Kepong Kuala Lumpur
Manufacturer	:	Nil
Product	:	Ecoboard
Reference Standard/ Method of test	:	BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products - Specification
Description of sample	:	Three (3) pieces of Ecoboard were received for testing. Brand: ECO Nominal size: 2440 mm x 1220 mm x 6.0 mm
Date received	:	27th October 2011
Job no./Ref. no.	:	J20111266120/SQAS/CCST/T.REC/CSL/09
Issued date	:	18 JAN 2012

Approved Signatories

.....
(HANON NAZIR MOHD BASIR)
Senior Technical Executive

.....
(YM RAJA NOR SIHA BT. RAJA ABD. HANAN)
Head
Civil & Construction Section
Testing Services Department

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

7.0 CONDITIONS RELATING TO THE USE OF SIRIM QAS INTERNATIONAL TEST REPORT

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d) Instructing the Applicant to withdraw and recall the advertisement, statement or document in question and advertise a clarification and apology to SIRIM QAS International, SIRIM and/or other SIRIM's subsidiaries twice in a national publication of SIRIM QAS International's choice at the Applicant's sole cost; and
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7.10 Certified true copies of the Test Report may be issued upon request by the Applicant upon payment of the relevant fee.

TEST REPORT

REPORT NO.: 2011CB6120	PAGE : 2 OF 3

TEST RESULT:

Product	:	Ecoboard
Brand	:	ECO
Nominal size	:	2440 mm x 1220 mm x 6.0 mm
Method of Test	:	a) BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products – Specification b) BS EN 822: 1994 Thermal insulating products for building application – Determination of length and width

Clause	Test Method/Requirement	Test Results	Remark
4.2.2 4.2.2.1	Dimension and tolerance Linear dimension No test result shall deviate from the declared values by more than tolerance:- Length: ± 3 mm Width: ± 3 mm Thickness: + 3 mm - 2 mm	<u>Length</u> 1) 2440 mm 2) 2440 mm 3) 2440 mm **Mean:** 2440 mm (0 mm) <u>Width</u> 1) 1220 mm 2) 1220 mm 3) 1220 mm **Mean:** 1220 mm (+ 1 mm) <u>Thickness</u> 1) 6.168 mm 2) 6.149 mm **Mean:** 6.150 mm (0 mm)	Complied

QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

18 JAN 2012

TEST REPORT

REPORT NO.: 2011CB6120	PAGE : 3 OF 3

TEST RESULT:

Product	:	Ecoboard
Brand	:	ECO
Nominal size	:	2440 mm x 1220 mm x 6.0 mm
Method of Test	:	a) BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products – Specification b) BS EN 824: 1994 Thermal insulating products for building application – Determination of squareness c) BS EN 825: 1994 Thermal insulating products for building application – Determination of flatness

Clause	Test Method/Requirement	Test Results	Remark
4.2.2.2	Squareness a) The deviation from squareness of board on length and width, Sb, shall not exceed 6 mm/m b) The deviation from squareness of boards on thickness, Sd, shall not exceed 2 mm	0 mm 0 mm	Complied
4.2.2.3	Flatness The deviation from flatness, Smax shall be not exceed 6 mm	1 mm	Complied

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18 JAN 2012

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40700 Shah Alam, Selangor Darul Ehsan, Malaysia
Tel. no: 03-5544 5853 / 5544 5854
Fax. no: 03-5544 5886

TEST REPORT

REPORT NO.: 2011CB6117	PAGE : 1 OF 2

Applicant	:	GREEN ENHANCEMENT SDN BHD Lot 37672, Jalan 3/37A, Kawasan Industri Taman Bukit Maluri, 52100 Kepong Kuala Lumpur
Manufacturer	:	Nil
Product	:	Ecoboard
Reference Standard/ Method of test	:	BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products - Specification
Description of sample	:	Five (5) pieces of Ecoboard were received for testing. Brand: ECO Size of specimen: 200 mm x 200 mm x 6.0 mm
Date received	:	27th October 2011
Job no./Ref. no.	:	J20111266117/SQAS/CCST/T.REC/CSL/09
Issued date	:	18 JAN 2012

Approved Signatories

.....
(HANON NAZIR MOHD BASIR)
Senior Technical Executive

.....
(YM RAJA NOR SIHA BT. RAJA ABD. HANAN)
Head
Civil & Construction Section
Testing Services Department

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

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TEST REPORT

REPORT NO.: 2011CB6117	PAGE : 2 OF 2

TEST RESULT:

Product	:	Ecoboard
Brand	:	ECO
Size of specimen	:	80 mm x 150 mm x 6.0 mm
Method of Test	:	a) BS EN 14306: 2009 Thermal insulation products for building equipment and industrial installations – Factor made calcium silicate (CS) products – Specification b) BS EN 1609: 1997 Thermal insulating products for building application – Determination of Short term water absorption by partial immersion

Clause	Test Method/Requirement	Test Results	Remark
4.3.7	Short term water absorption by partial immersion	Short term water absorption by partial immersion 1) 2.3 kg/m^2 2) 2.2 kg/m^2 3) 2.2 kg/m^2 4) 2.3 kg/m^2 5) 2.4 kg/m^2 **Mean:** 2.4 kg/m^2	Declared value by manufacturer

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

18 JAN 2012

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40911 Shah Alam, Selangor Darul Ehsan, Malaysia
Tel. no: 03- 55445853/55445854
Fax. no: 03-55445855

TEST REPORT

REPORT NO : 2010CBD061	PAGE : 1 OF 2

Applicant	:	FIRE PROTECTION SECTION TESTING SERVICES DEPARTMENT (Attn : En. Hanafi Bin Mohamad)
Manufacturer	:	GREEN ENHANCEMENT SDN. BHD. No.25, Jalan 3, Taman Industri Pandan Indah, Kuala Lumpur.
Product	:	Concrete Cubes
Reference Standard/ Method of test	:	MS 26 : Part 2 :1991 Method of testing concrete Part 2 : Method of testing hardened concrete. Section One : Method for determination of density Section three : Method for determination of the compressive strength of Concrete cubes.
Description of sample	:	Three numbers of Concrete Cubes were received for testing through Fire Protection Section (Ref. No. : J20105060223, Dated : 26/08/2010) Size of specimen : 100 mm x 100 mm x 100 mm Casting Date : 23.03.2010
Date received	:	26th August 2010
Job no./Ref. no.	:	JD2010504061(SQAS/CCST/T.REC/CSL/02)
Issued date	:	21 SEP 2010

Approved Signatories

SIRIM QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

(HANON NAZIR MOHD BASIR)
Senior Technical Executive

(YM RAJA NOR SIHA RAJA ABD. HANAN)
Group Leader
Civil & Construction Section
Testing Services Department

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TEST REPORT

REPORT NO.: 2010CBD061	PAGE : 2 OF 2

TEST RESULT :

Product : Concrete Cubes
Method of Test : MS 26 : Part 2 : 1991
Method of Testing Concrete
Part 2. Method of Testing Hardened Concrete
Section One : Method for determination of density
Section three : Method for determination of the compressive strength of Concrete cubes.
Casting Date : 23.03.2010

COMPRESSIVE STRENGTH OF CONCRETE CUBE

Specimen Reference	Density (kg/m^3)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	760	4.0	**3.5**
2	760	2.5	
3	760	3.5	

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21 SEP 2010

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TEST REPORT
FOR
FIRE RESISTANCE TEST

SIRIM QAS INTERNATIONAL SDN.BHD.
Building 14, SIRIM Complex
1, Persiaran Dato' Menteri
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Tel: 03-55446465 Fax: 03-55446454 http: //www.sirim.my
(Company No: 410334-X)

MS ISO/IEC 17025
TESTING
SAMM NO. 231

TEST REPORT

REPORT NO.: 2011FE0338	PAGE 1 OF 27

Applicant/ Manufacturer	:	**GREEN ENCHANTMENT SDN. BHD.,** Lot 37672, Jalan 3/37A, Kawasan Industri Taman Bukit Maluri, 52100 Kepong, Kuala Lumpur. (Attn.: Mr. Tey Chee Keong)
Product	:	**ECO Lightweight Wall System**
Reference Standard/ Method of Test	:	BS 476: Part 22: 1987 Methods for determination of the fire resistance of non-load bearing elements of construction Clause 5 – Determination of fire resistance of partition
Description of test specimen	:	A symmetrical non-load bearing ECO lightweight wall partition system consisted of Galvanized Iron U – channel (known as top track, bottom track and metal stud) and both sides were fitted with a single layer of 6.1 mm (*t*) Calcium Silicate board. The void sections were then infilled with mixed lightweight concrete with compositions of chemical compound (ECO Foam), cement and water. The overall size of the wall partition system during the test was 3000 mm (*h*) × 2960 mm (*w*) × 114 mm (*t*) and was constructed at the laboratory for the purpose of testing on the 29th September 2011. Full description of the test construction of the ECO lightweight wall partition system is detailed in Page 5 of this test report. Based on the test conducted, the ECO lightweight wall partition system satisfied the requirements of the **BS 476: Part 22: 1987** for the period stated below : **Integrity : 250 minutes** **Insulation : 250 minutes** The test was terminated after a period of 250 minutes of test at the request of the applicant.
Date of test	:	02.11.2011
Date received	:	21.09.2011
Job No./ Ref No.	:	J20111280260 / SQAS/FPS/15/1-3
Issued date	:	14 DEC 2011

Approved Signatories:

.....
KAMARULZAMAN BIN MAT ZIN
Testing Executive

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION

.....
ZAINI AHMAD
Group Leader
Fire Protection Section
Testing Services Department
SIRIM QAS International Sdn. Bhd.

7.0 CONDITIONS RELATING TO THE USE OF SIRIM QAS INTERNATIONAL TEST REPORT

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Applicant : **GREEN ENCHANTMENT SDN. BHD.**

Summary : A specimen of a symmetrical non-load bearing ECO lightweight wall partition system has been subjected to a test in accordance with BS 476: Part 22: 1987 – Clause 5, to determine its fire resistance performance.

A symmetrical non-load bearing ECO lightweight wall partition system (said to be **'ECO'** brand) consisted of galvanized iron U – channel of size 30 mm × 91 mm × 30 mm × 0.59 mm (*t*) (known as top track, bottom track) and C – channel of size 45 mm × 90 mm × 45 mm × 8 mm (*lip*) × 0.59 mm (*t*) (known as Metal stud). The galvanized iron U – channel were fastened to the top and bottom side of the test frame and C – channel was fastened to the one side of the test frame using plastic wall plug and screw of size M4 × 32 mm (*l*) at spacing shown in Figure 5. The metal studs were also slotted vertically into the top and bottom track at 40 mm from the free edge, followed by 520 mm, subsequent 1220 mm c/c and then screwed at each end using self drilling screws of size M3 × 21 mm (*l*).

The galvanized iron framework was fitted on both exposed and unexposed side with a single layer of 6.1 mm (*t*) Calcium Silicate board (said to be **'ECO'** brand) with known density of 1223 kg/m^3. Five pieces of Calcium Silicate board, size varies from 520 mm – 2440 mm (*w*) × 550 mm – 2440 mm (*l*) on the unexposed and exposed side were joined to each other by screwed to the framework using self-tapping screws of size M3 × 21 mm (*l*). The screw spacing was 150 mm c/c horizontally and vertically (refer to Figure 4). Nine pieces of metal stud (150 mm long) were also fitted horizontally and screwed (refer Figure 4) in between the board.

The void sections between the boards were then infilled with mixed lightweight concrete comprised of the following compositions:

No.	Material Compositions	Mix Ratio
1.	Chemical Compound (ECO Foam)	1 cup (200 ml) of chemical mix with 30 cups (200ml) of water
2.	Cement	50 kg
3.	Water	25 kg

The average compressive strength of the mixed lightweight concrete was found to be 3.2 N/mm^2‡ (refer to **SIRIM Test Report No.: 2011CBD118 dated 24th November 2011**). The mixed lightweight concrete was filled through the cavity which was provided at the top section.

The gap between the perimeter of the ECO lightweight wall partition system and test frame and at the joints between boards were finished off with mix lightweight concrete and **SheetRock All Purpose Joint Compound** respectively.

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION
SIRIM QAS INTERNATIONAL SDN. BHD.

‡ Test marked "sub-contracted but not accredited"

14 DEC 2011

The overall size of the ECO lightweight wall partition system during the test was 3000 mm (h) × 2960 mm (w) × 114 mm (t) with 40 mm vertical gap along one edge to provide no lateral restraint to specimen.

The ECO light weightwall partition system satisfied the performance requirements specified in Clause 5 of BS 476: Part 22: 1987, for a non-load bearing wall partition system, for the following periods

Integrity : 250 minutes

Insulation : 250 minutes

The test was terminated after a period of 250 minutes at the request of the applicant.

Date of Test : 2nd November 2011

TESTING SERVICES DEPARTMENT FIRE PROTECTION SECTION SIRIM QAS INTERNATIONAL SDN BHD

14 DEC 2011

1. PURPOSE OF TEST

To determine the fire resistance of a non-load bearing ECO lightweight wall partition system when tested in accordance with BS 476: Part 22: 1987 'Methods for determination of the fire resistance of load bearing elements of construction: Clause 5 – Determination of the fire resistance of partition'

2. TEST SPECIFICATION

BS 476: Part 22: 1987 states that the fire resistance of the specimen is the time, expressed in minutes, to failures under the following criteria;

2.1 Integrity

2.1.1 In general, a failure of the test construction to maintain integrity shall be deemed to have occurred when collapse or sustained flaming for more than 10 seconds on the unexposed face.

2.2.2 Under criteria for impermeability, failure shall be deemed to have occurred when one or other of the following conditions prevail:

a) where cotton pad test is performed, flames and/or hot gases cause flaming and glowing of the cotton pad
b) where the use of cotton pad is not suitable, failure shall be deemed to have occurred when either:

- the ∅6 mm diameter gap gauge can penetrate a through gap such that the end of the gauge projects into the furnace and the gauge can be move in the gap for a distance of at least 150 mm: or
- the ∅25 mm diameter gap gauge can penetrate a through gap such that the end of the gauge projects into the furnace

2.2 Insulation

Failure shall be deemed to have occurred when one of the following occurs:

a) if the mean unexposed face temperature increases by more than 140 °C above its initial value
b) if the temperature recorded at any position on the unexposed face is in excess of 180 °C above the initial mean unexposed face temperature
c) when integrity failures as defined in 2.2 occur

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION

14 DEC 2011

3. DESCRIPTION OF TEST SPECIMEN

Inspection was carried out during the construction of the ECO lightweight wall partition system to verify on its design, dimensions and materials used. The construction was arranged and carried out by the applicant and its agent.

3.1 Test Specimen Construction

A symmetrical non-load bearing ECO lightweight wall partition system (said to be **'ECO'** brand) consisted of galvanized iron U – channel of size 30 mm × 91 mm × 30 mm × 0.59 mm (*t*) (known as top track, bottom track) and C – channel of size 45 mm × 90 mm × 45 mm × 8 mm (*lip*) × 0.59 mm (*t*) (known as Metal stud). The galvanized iron U – channel were fastened to the top and bottom side of the test frame and C – channel was fastened to the one side of the test frame using plastic wall plug and screw of size M4 × 32 mm (*l*) at spacing shown in Figure 5. The metal studs were also slotted vertically into the top and bottom track at 40 mm from the free edge, followed by 520 mm, subsequent 1220 mm c/c and then screwed at each end using self drilling screws of size M3 × 21 mm (*l*).

The galvanized iron framework was fitted on both exposed and unexposed side with a single layer of 6.1 mm (*t*) Calcium Silicate board (said to be **'ECO'** brand) with known density of 1223 kg/m^3. Five pieces of Calcium Silicate board, size varies from 520 mm – 2440 mm (*w*) × 550 mm – 2440 mm (*l*) on the unexposed and exposed side were joined to each other by screwed to the framework using self-tapping screws of size M3 × 21 mm (*l*). The screw spacing was 150 mm c/c horizontally and vertically (refer to Figure 4). Nine pieces of metal stud (150 mm long) were also fitted horizontally and screwed (refer Figure 4) in between the board.

The void sections between the boards were then infilled with mixed lightweight concrete comprised of the following compositions:

No.	Material Compositions	Mix Ratio
1.	Chemical Compound (ECO Foam)	1 cup (200 ml) of chemical mix with 30 cups (200ml) of water
2.	Cement	50 kg
3.	Water	25 kg

The average compressive strength of the mixed light weight concrete was found to be 3.2 N/mm^{2‡} (refer to **SIRIM Test Report No.: 2011CBD118 dated 24th November 2011**). The mixed compositions were filled through the cavity which was provided at the top section.

The gap between the perimeter of the ECO lightweight wall partition system and test frame and at the joints between boards were finished off with mix lightweight concrete and **SheetRock All Purpose Joint Compound** respectively.

3.2 The drawings illustrated in Figure 3 to Figure 8 show the dimensions and details of the test specimen.

3.3 The test specimen was installed onto a refractory concrete lined steel frame with the vertical edges, top and bottom edge were subjected to conditions as it would have in practice.

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION

‡ Test marked "sub-contracted but not accredited"

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4. CONDITIONING OF THE TEST CONSTRUCTION

Prior to test, the test construction was kept in the laboratory proper in ambient atmosphere condition for a period of 34 days.

5. FIRE RESISTANCE TEST

5.1 Date of Testing

After the ECO lightweight wall partition system had been seasoned, the fire resistance test was conducted on the 2nd November 2011.

5.2 Witnesses of Test

The test was witnessed by the following representatives from Green Enchantment Sdn. Bhd.;

1. Mr. Tan Kok Wei
2. Mr. Slew Kok Loon
3. Mr. Tay Chee Keong

5.3 Test Method

a) The test was conducted in accordance with the procedure specified in Clause 5 of BS 476: Part 22: 1987.

b) The ambient temperature at the beginning of the test was **27.7 °C** and on completion of the test was **30.9 °C**. The temperature and pressure conditions were controlled to the limits defined in Clause 3.1 and 3.2 of BS 476: Part 20: 1987.

c) Throughout the test, observations were made on the exposed and unexposed faces of the test specimen. In addition, observations were made of any sustained flaming on the unexposed face of the test specimen. Gap gauges were available to evaluate compliance's with the requirements for imperviousness as defined in the BS 476: Part 20: 1987.

TESTING SERVICES DEPARTMENT FIRE PROTECTION SECTION SIRIM QAS INTERNATIONAL SDN BHD

14 DEC 2011

6. TEST RESULTS

6.1 The graph in Figure 1 shows the actual temperature/time curve of the furnace heating conditions in relation to the standard temperature/time curve.

Table 1 shows the actual mean furnace temperature and of the standard furnace temperature as defined in Clause 3.1 of BS 476: Part 20: 1987. In addition the table shows the percentage differences between the areas under the standard curve and the areas under the actual curve compared with the percentage tolerances allowable within the standard.

6.2 The graph in Figure 2 shows the mean and maximum temperature rise recorded on the unexposed face of the test specimen as determined by the five thermocouples. The thermocouples were fixed approximately at the center of the specimen and at the center of the four quadrants of the specimen and two additional thermocouples to record the individual maximum temperature.

Table 2 shows individual and mean temperature of the unexposed face of the specimen. In addition, the table shows the increase in mean temperature and maximum temperature rise at various time intervals.

6.3 Table 3 shows the deflection of the ECO lightweight wall partition system measured at mid-height.

6.4 Observations are made during the test on the general behavior of the test specimen and these are given in APPENDIX 1 to this report.

6.5 Photographs of the test are shown in **Photo 1** to **12**.

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION
SIRIM QAS INTERNATIONAL SDN BHD

14 DEC 2011

7. EVALUATION AGAINST THE PERFORMANCE CRITERIA

The performance of the specimen was judged against the following criteria of BS 476: Part 20: 1987.

7.1 Integrity

It is required that there is no collapse of the specimen, no sustained flaming on the unexposed surface and no loss of impermeability. **These requirements were satisfied for 250 minutes after which the test was discontinued.**

7.2 Insulation

It is required that the mean temperature rise of the unexposed face shall not be greater than 140 °C and the maximum temperature rise shall not be greater than 140 °C.

At **250 minutes** of test, the mean temperature rise and maximum temperature rise above the initial mean temperature on the unexposed face of the partition system were **47 °C** and **61 °C** respectively.

8. CONCLUSIONS

The ECO lightweight wall partition system satisfied the requirements of the BS 476: Part 22: 1987 for the following period:-

Integrity : 250 minutes

Insulation : 250 minutes

The test was terminated after a period of 250 minutes at the request of the applicant.

9. LIMITATIONS

9.1 The results only relate to the behavior of the specimen of the element of construction under the particular conditions of test; they are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they reflect the actual behavior in fires.

9.2 The test results relate only to the specimen tested. Appendix A of BS 476: Part 20: 1987 provides guidance information on the application of the fire resistance tests and the interpretation of test data.

Application of the results to assemblies of different dimensions or incorporating different components should be subjected to re-verification.

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION
SIRIM QAS INTERNATIONAL SDN BHD

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APPENDIX 1

Observations made during the test

E – Observations from exposed face

U – Observations from unexposed face

TIME (min.)	TEST FACE	OBSERVATIONS
0	-	Test commenced.
10	U	Slight steam released from the top edge of the partition system.
11	U	Slight steam released from the free edge of the partition system.
13	E	Multiple cracks are observed on the surface of the board.
17	U	Hairline cracks are observed at joint at the middle part of the partition system.
25	U	Steam released continuously from the top edge of the partition system.
40	U	Steam released continuously from the side edges of the partition system.
50	U	There are no significant changes.
60	U	The partition system still maintains its integrity and insulation.
70	U	Steam released from the edges has reduced.
80	U	Steam released from the edges has stopped.
95	U	There are no significant changes.
110	E	Severe cracks are observed on the surface of the board.
120	U	The partition system still maintains its integrity and insulation.
135	E	Part of board has dropped.
150	U	Slight square shapes darkening are observed on the surface board.
160	U	There are no significant changes.
175	E	Half area of board has dropped.
180	U	The partition system still maintains its integrity and insulation.
195	U	Square shapes darkening observed on the surface board become clearer.
215	U	The partition system is vibrating
230	E	Almost whole area of board has dropped.
240	U	The partition system still maintains its integrity and insulation.
250	-	Test terminated as per request.

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TABLE 1 : **SPECIFIED AND ACTUAL RECORDED FURNACE TEMPERATURE**

TIME (mins)	STANDARD FURNACE TEMPERATURE (°C)	ACTUAL FURNACE TEMPERATURE (°C)	AREA UNDER STANDARD CURVE (°C)	AREA UNDER ACTUAL CURVE (°C)	PERCENTAGE DEVIATION	SPECIFIED PERCENTAGE TOLERANCE (+ or -)
0	20	31				
1	349	355				
2	445	462				
3	502	513				
4	544	546				
5	576	576				
6	603	603				
7	626	628				
8	645	646				
9	663	667				
10	678	681	5302.0	5352.0	0.9	15
12	705	703				
14	728	729				
16	748	748				
18	766	763				
20	781	783				
22	796	794				
24	809	806				
26	820	822				
28	832	831				
30	842	839	15490.0	15478.0	-0.1	10
35	865	864				
40	885	882				
45	902	902				
50	918	918				
55	932	929				
60	945	946				
65	957	959				
70	968	967				
75	979	980				
80	988	986				
85	997	996				
90	1006	1009				
95	1014	1014				
100	1022	1024				
105	1029	1028				
110	1036	1033				
115	1043	1048				
120	1049	1048				

TESTING SERVICES DEPARTMENT
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TABLE 1 : SPECIFIED AND ACTUAL RECORDED FURNACE TEMPERATURE

Continued from previous page

TIME (mins)	STANDARD FURNACE TEMPERATURE (°C)	ACTUAL FURNACE TEMPERATURE (°C)	AREA UNDER STANDARD CURVE (°C)	AREA UNDER ACTUAL CURVE (°C)	PERCENTAGE DEVIATION	SPECIFIED PERCENTAGE TOLERANCE (+ or -)
130	1061	1063				
140	1072	1075				
150	1082	1081				
160	1092	1090				
170	1101	1102				
180	1110	1107				
190	1118	1115				
200	1126	1126				
210	1133	1136				
220	1140	1140				
230	1146	1145				
240	1153	1154				
250	1159	1160	231537.5	231522.5	0.0	5

TESTING SERVICES DEPARTMENT
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TABLE 2 : **UNEXPOSED FACE TEMPERATURE OF THE ECO LIGHTWEIGHT WALL PARTITION SYSTEM**

TIME (mins)	THERMOCOUPLE NO.							MEAN TEMP. (°C)	TEMP. RISE ABOVE MEAN TEMP. (°C)	
	T1 (°C)	T2 (°C)	T3 (°C)	T4 (°C)	T5 (°C)	T6 (°C)	T7 (°C)		MEAN TEMP.	MAX. TEMP.
0	29	29	28	28	29	29	28	29	0	0
10	29	29	28	29	29	29	28	29	0	0
20	29	29	28	29	29	30	28	29	0	1
30	30	30	30	30	30	33	28	30	1	4
40	34	33	34	34	33	38	29	34	5	9
50	41	40	41	42	39	48	31	41	12	19
60	51	50	50	53	48	61	34	50	21	32
70	61	61	61	63	58	72	38	61	32	43
80	69	69	70	70	66	79	44	69	40	50
90	74	74	75	74	70	62	51	73	44	46
100	78	77	79	77	74	63	58	77	48	50
110	79	79	81	78	76	84	65	79	50	55
120	80	80	82	79	77	84	70	80	51	55
130	81	80	82	79	77	83	73	80	51	54
140	80	79	82	79	76	83	76	79	50	54
150	79	78	81	77	76	83	78	78	49	54
160	78	78	80	77	76	83	79	78	49	54
170	77	77	79	76	75	82	80	77	48	53
180	77	77	80	76	75	83	82	77	48	54
190	77	77	79	76	75	83	83	77	48	54
200	77	76	79	75	74	84	83	76	47	55
210	76	75	78	74	72	84	82	75	46	55
220	75	74	77	74	72	85	81	74	45	56
230	78	77	79	76	75	87	83	77	48	58
240	78	75	80	75	74	89	82	76	47	60
250	77	74	80	75	73	90	81	76	47	61

Note : 1) Thermocouples T1 to T5 were used to assess the ability of the ECO lightweight wall partition system to satisfy the mean unexposed surface temperature criterion.

2) Thermocouples T1 to T7 were used to assess the ability of the ECO lightweight wall partition system to satisfy the maximum unexposed surface temperature criterion

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TABLE 3 : **RECORDED DEFLECTION OF THE ECO LIGHTWEIGHT WALL PARTITION SYSTEM TOWARDS THE FURNACE**

TIME (mins)	MEASURING POINTS				
	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
10	3	5	8	7	7
20	7	8	9	12	7
30	6	9	11	13	8
40	8	9	13	15	20
50	8	8	11	13	8
60	9	8	11	12	9
70	7	6	10	12	6
80	6	5	10	11	6
90	7	7	11	11	6
100	6	7	11	11	5
110	5	7	10	12	6
120	7	5	10	8	6
130	3	4	9	11	7
140	3	4	10	12	7
150	3	5	9	10	7
160	2	4	10	8	7
170	0	5	10	8	7
180	0	5	9	8	7
190	-3	1	11	7	7
200	-3	2	11	5	7
210	-3	2	11	5	7
220	-2	4	10	8	13
230	-2	4	10	8	12
240	-2	4	10	8	12
250	-2	4	10	8	12

NOTE: 1) Positive (+) values indicate movement towards the furnace
2) Negative (-) values indicate movement away from the furnace

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FIGURE 1: ACTUAL FURNACE TEMP./ TIME CURVE

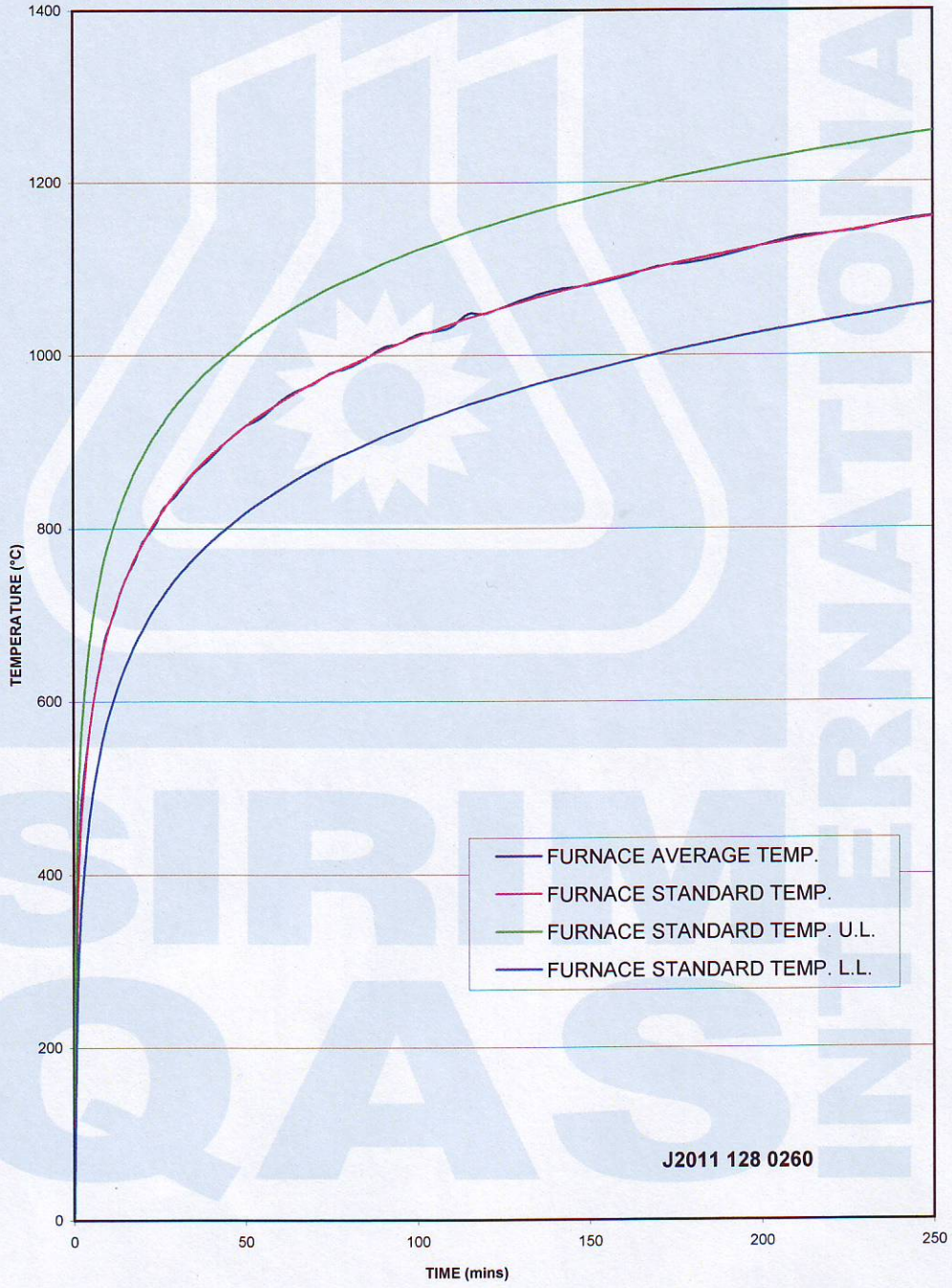

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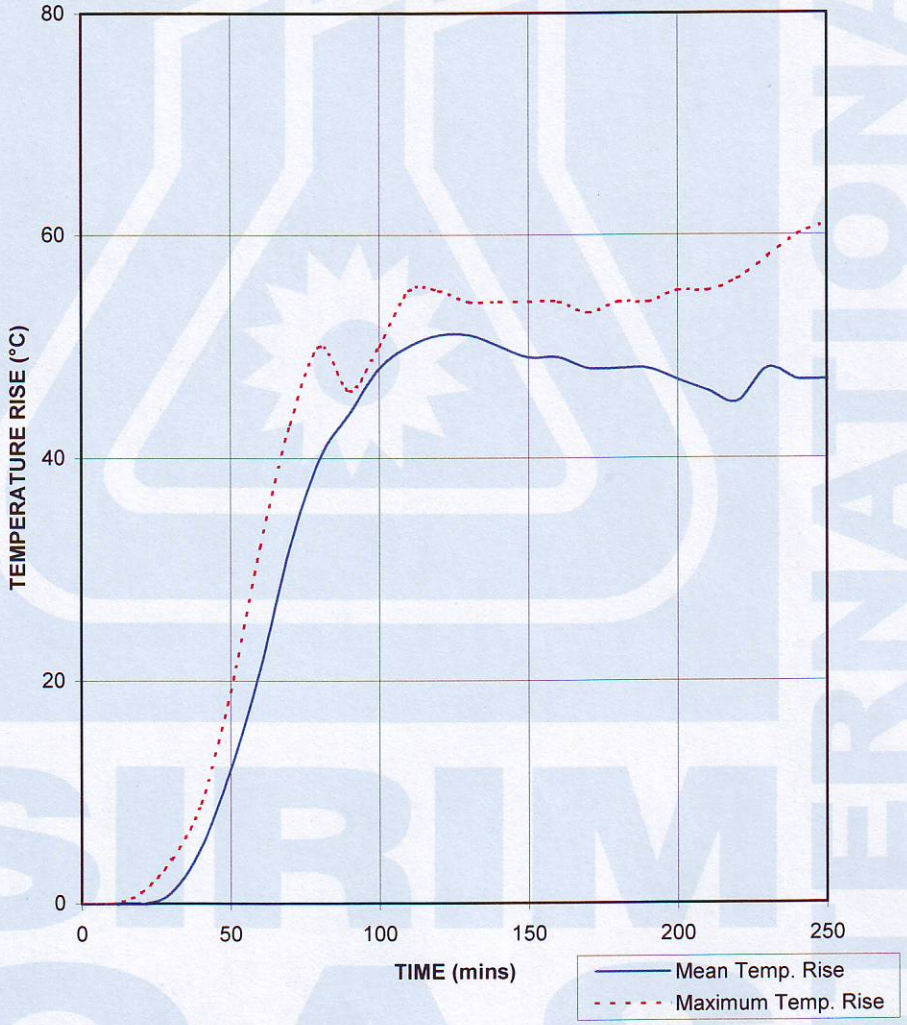
FIGURE 2. UNEXPOSED FACE TEMPERATURE CURVE
Temperature rise above initial mean temperature



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SIRIM QAS INTERNATIONAL SDN BHD

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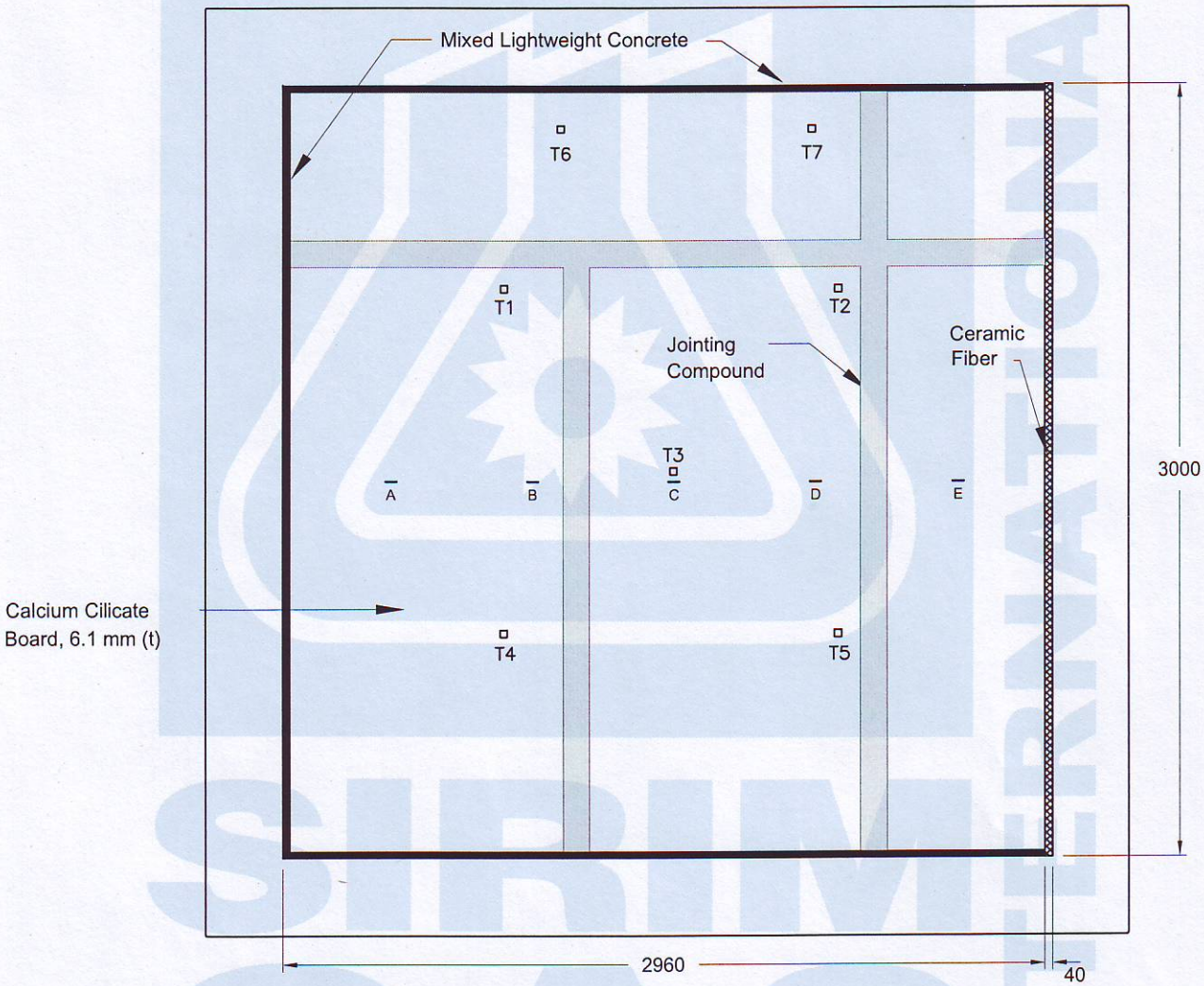

UNEXPOSED FACE

(▫) Thermocouple Points on the Unexposed Face
(–) Position for Deflection Measurements

NOTE:
1) All dimensions are in mm
2) Drawing not to scale

Figure 3: GENERAL ARRANGEMENT OF THE ECO LIGHTWEIGHT WALL PARTITION SYSTEM

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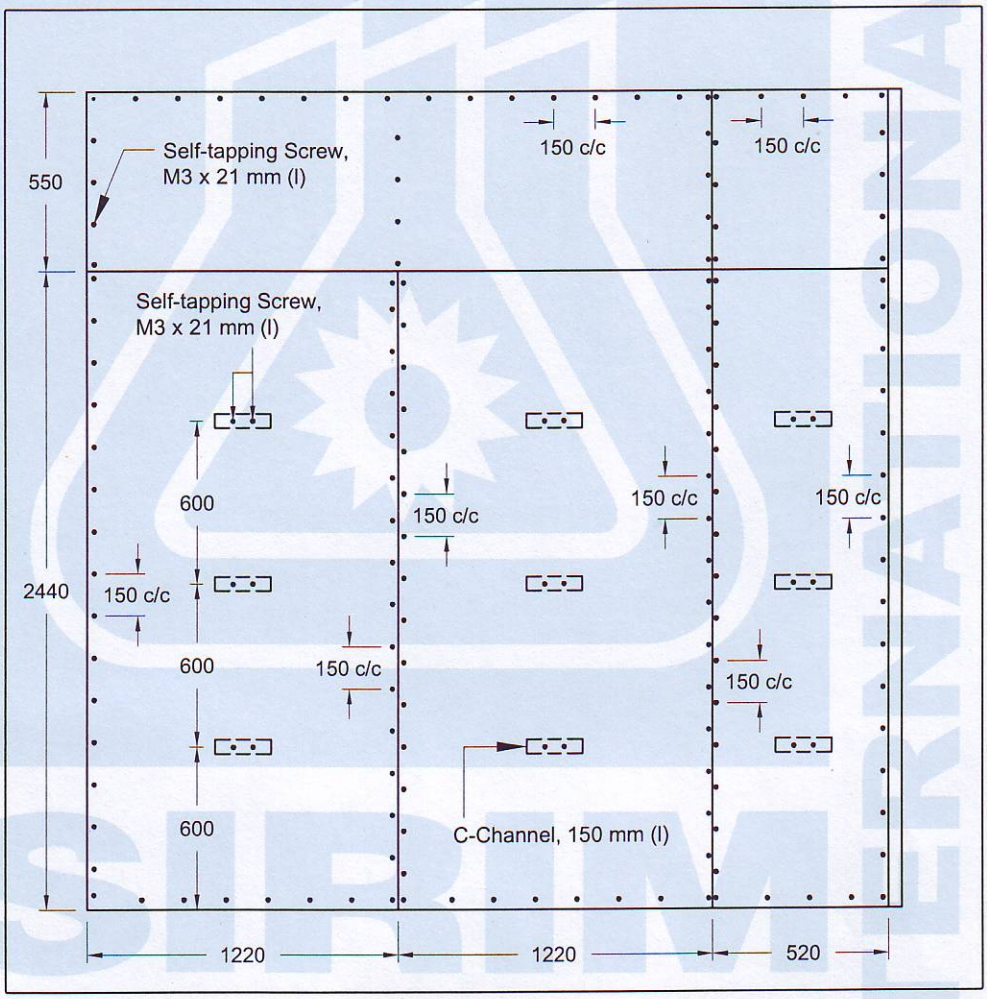

UNEXPOSED FACE

(▫) Thermocouple Points on the Unexposed Face
(–) Position for Deflection Measurements

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION

NOTE:
1) All dimensions are in mm
2) Drawing not to scale

Figure 4: GENERAL CONSTRUCTION OF THE ECO LIGHTWEIGHT WALL PARTITION SYSTEM

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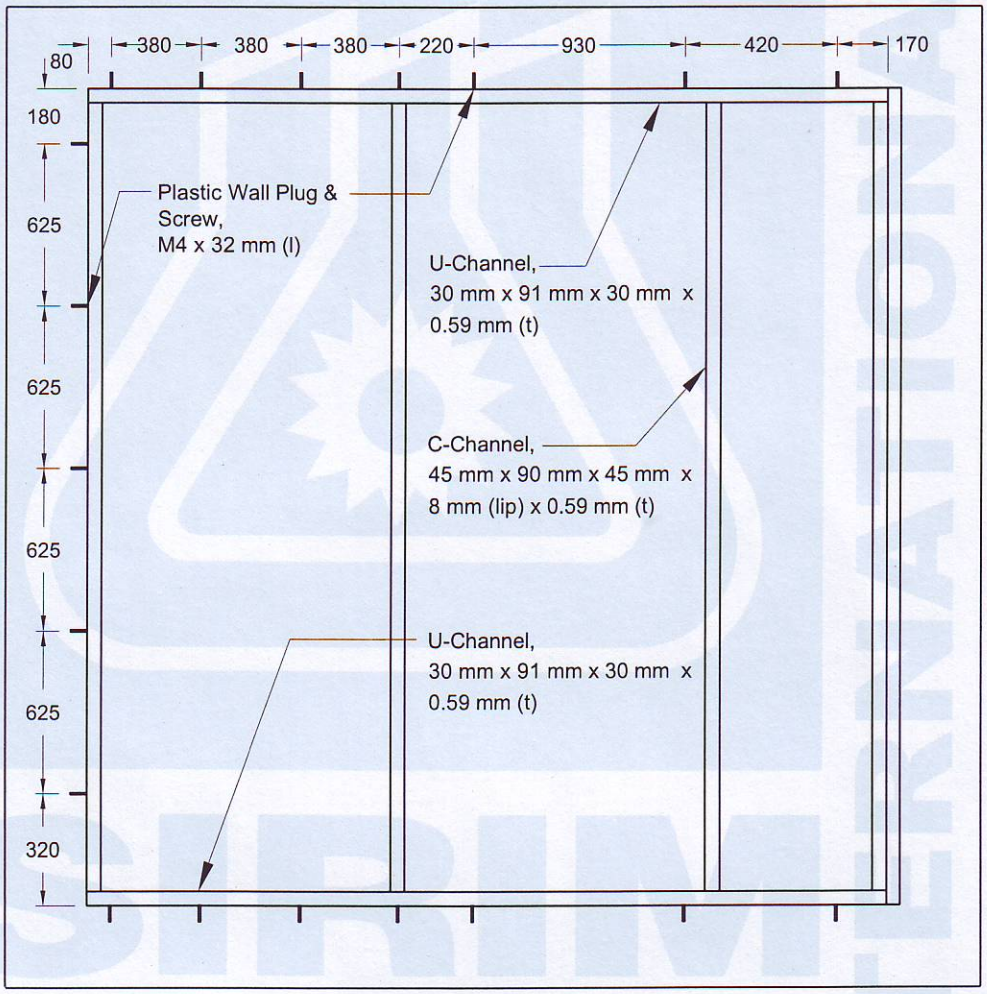

UNEXPOSED FACE

TESTING SERVICES DEPARTMENT FIRE PROTECTION SECTION SIRIM QAS INTERNATIONAL SDN BHD

NOTE:
1) All dimensions are in mm
2) Drawing not to scale

Figure 5: ARRANGEMENT OF THE GALVANIZED IRON FRAMEWORK

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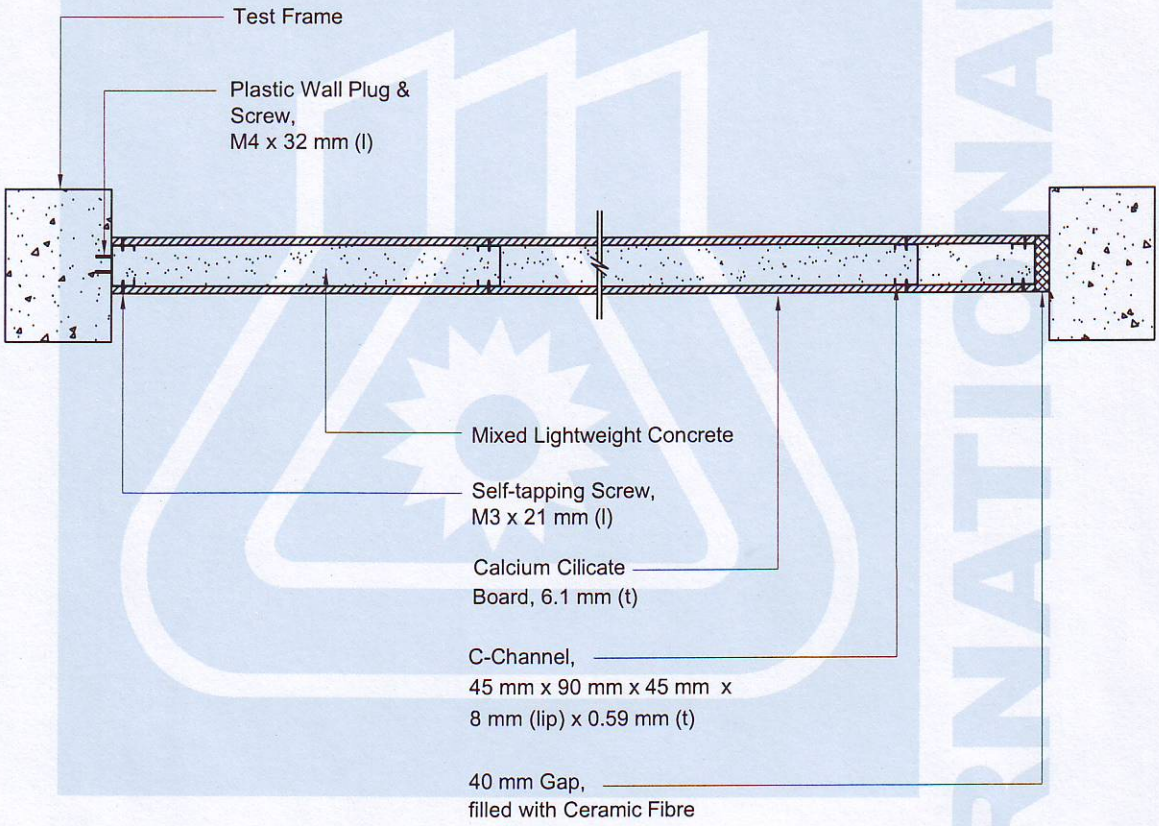

NOTE:
1) All dimensions are in mm
2) Drawing not to scale

Figure 6: HORIZONTAL SECTION OF ECO LIGHTWEIGHT WALL PARTITION SYSTEM

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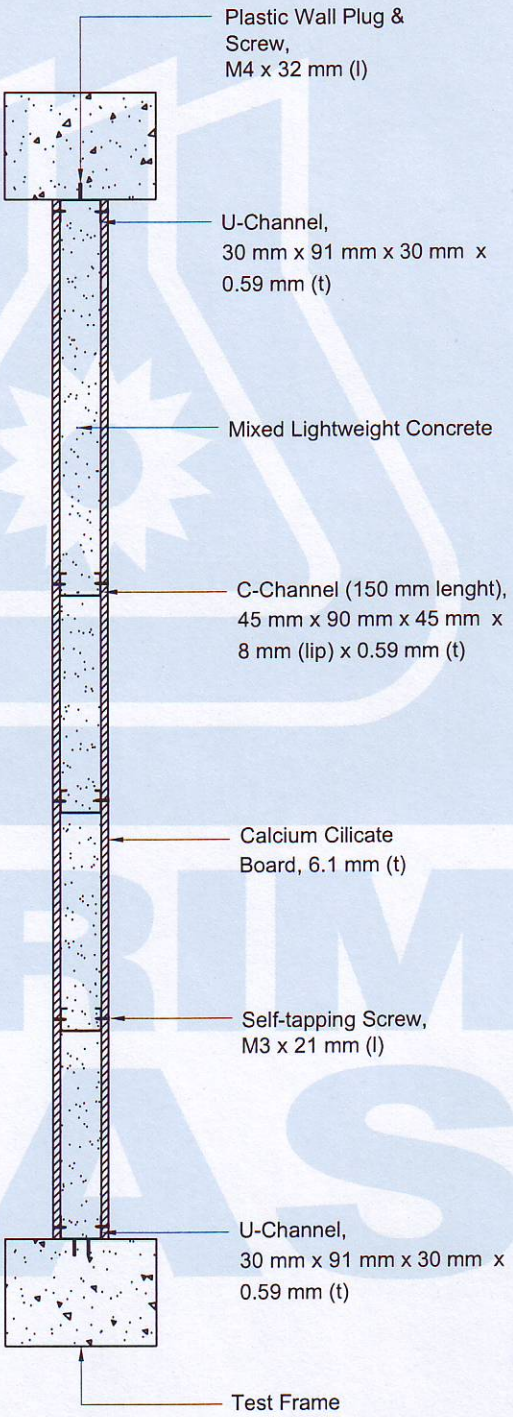

TESTING SERVICES DEPARTMENT FIRE PROTECTION SECTION SIRIM QAS INTERNATIONAL SDN BHD

NOTE:
1) All dimensions are in mm
2) Drawing not to scale

Figure 7: VERTICAL SECTION OF THE ECO LIGHTWEIGHT WALL PARTITION SYSTEM

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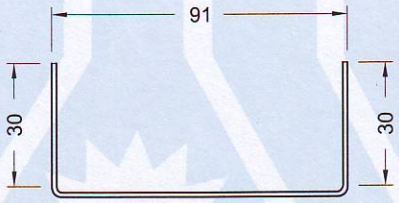
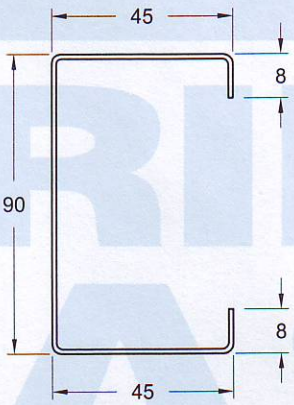


Thickness: 0.59 mm

U - Channel (Top and Bottom Track)



Thickness: 0.59 mm

C-Channel (Metal Stud)

TESTING SERVICES DEPARTMENT
FIRE PROTECTION SECTION

NOTE:
1) All dimensions are in mm
2) Drawing not to scale

Figure 8: DETAILS OF GALVANISED IRON FRAMEWORK

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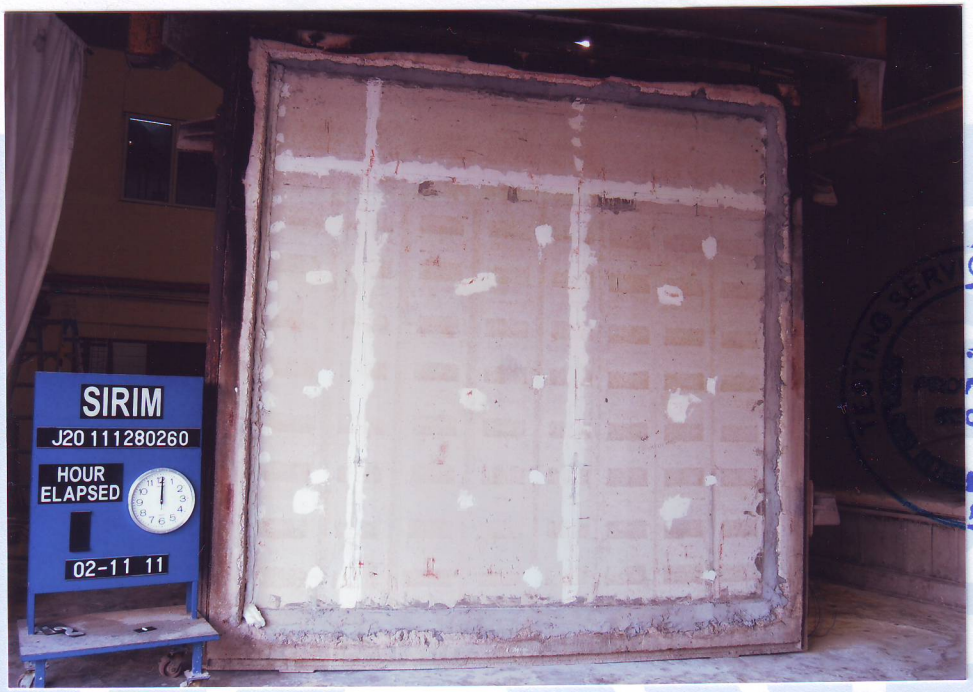

Photo 1: The exposed face of the partition system before the test

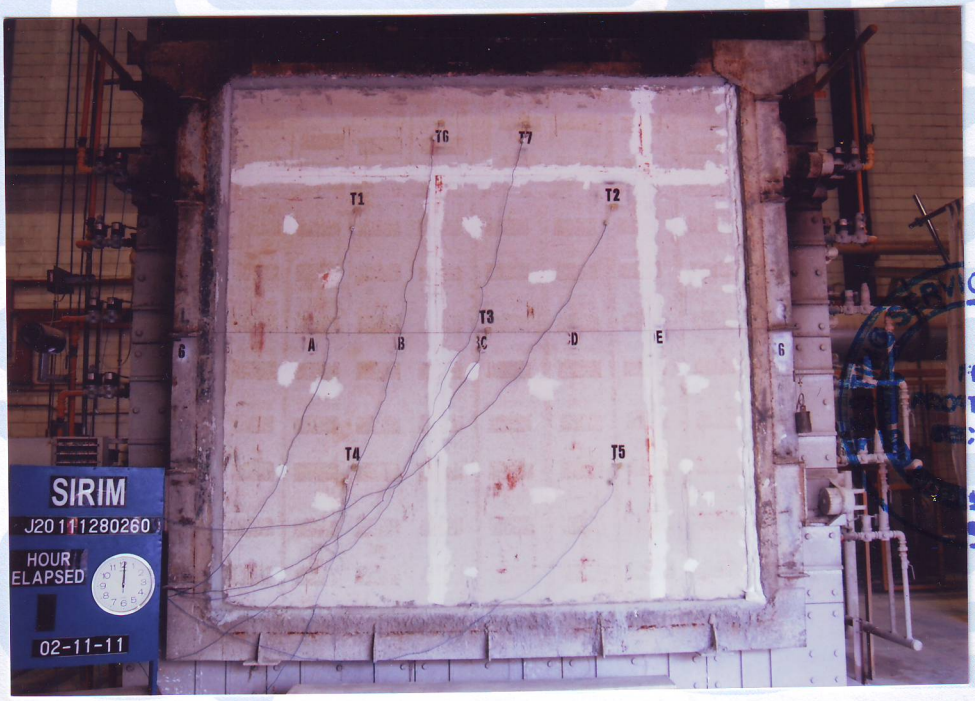

Photo 2: The unexposed face of the partition system before the test

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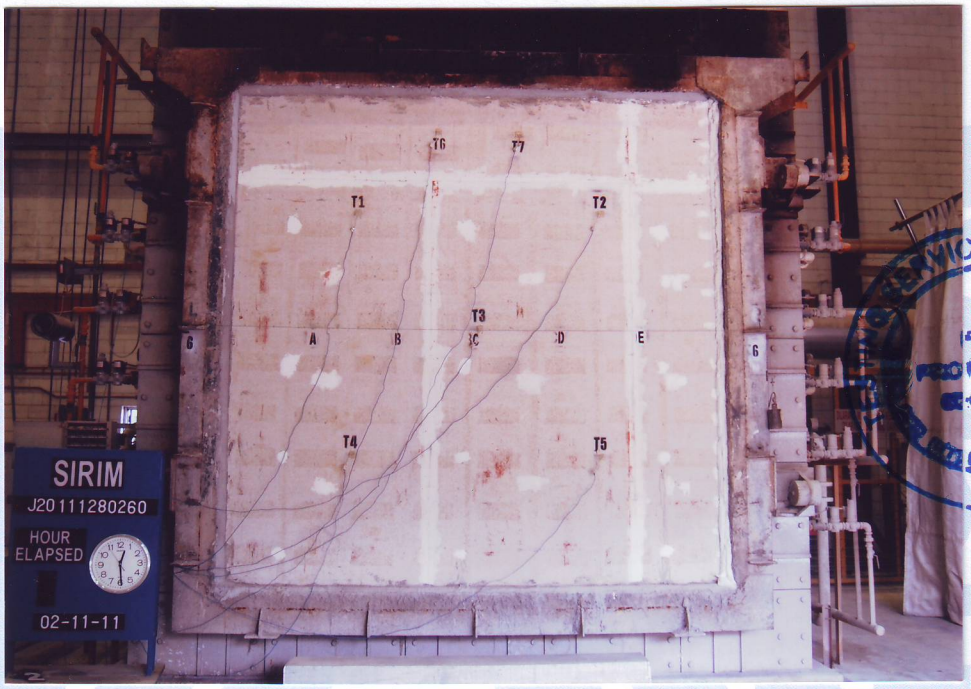

Photo 3: At about **30** minute of test

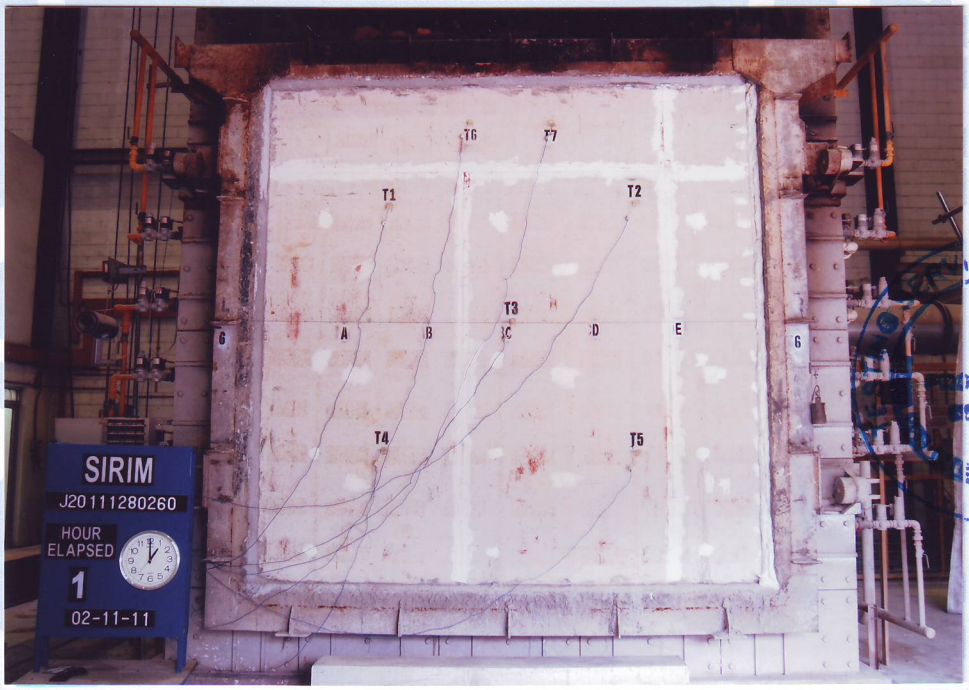

Photo 4: At about **60** minute of test

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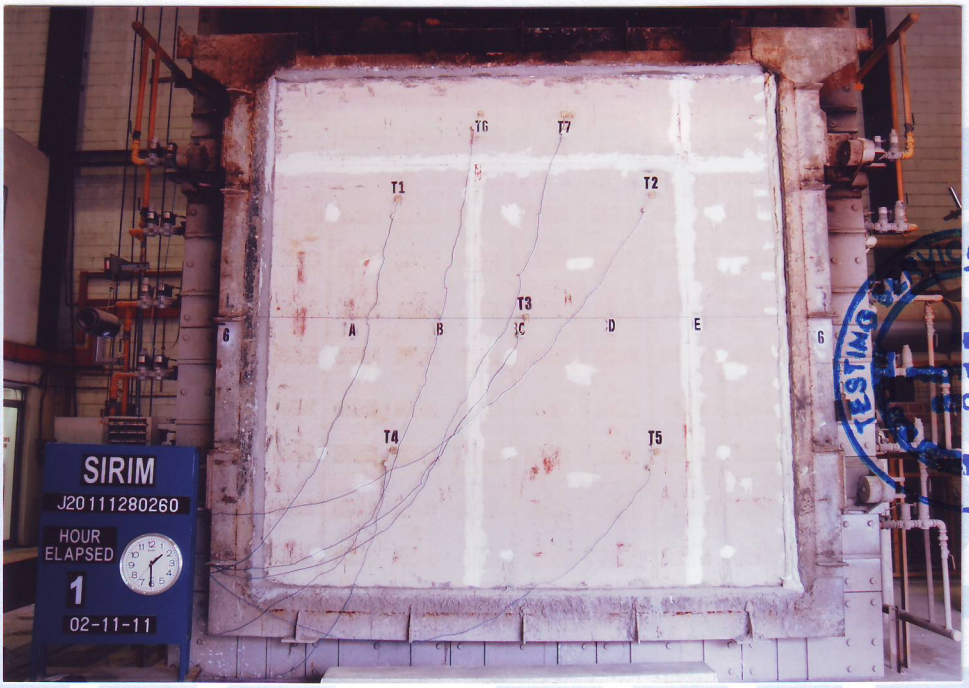

Photo 5: At about **90** minute of test

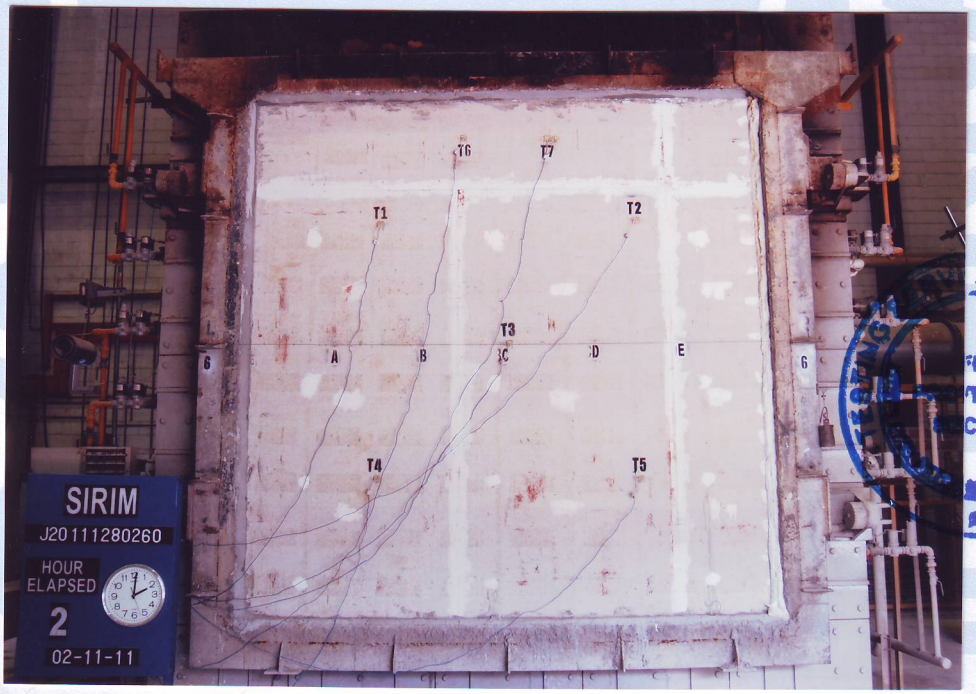

Photo 6: At about **120** minute of test

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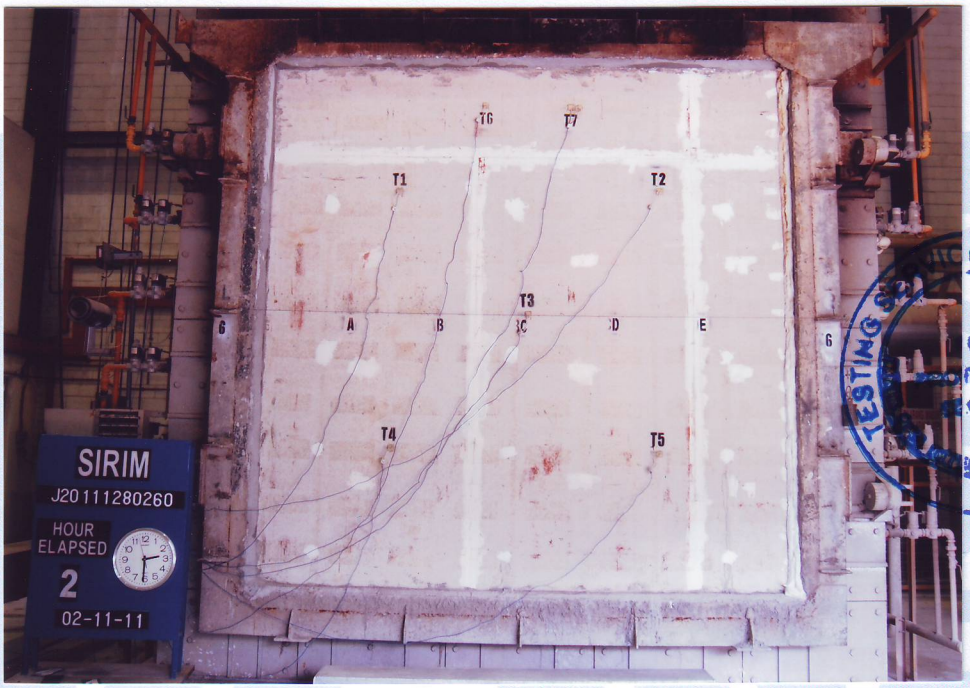

Photo 7: At about **150** minute of test

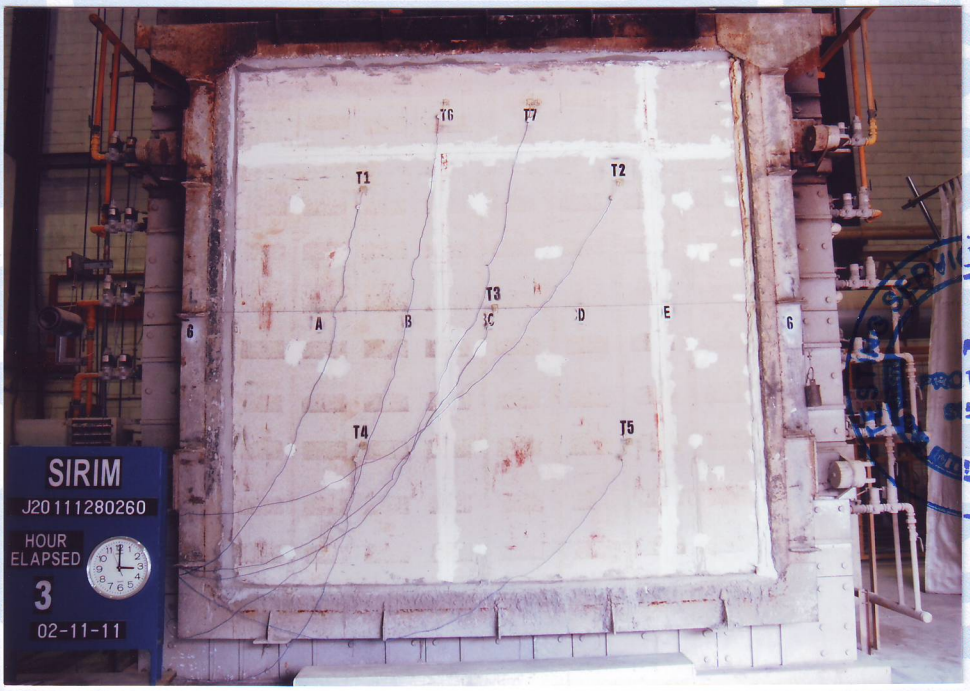

Photo 8: At about **180** minute of test

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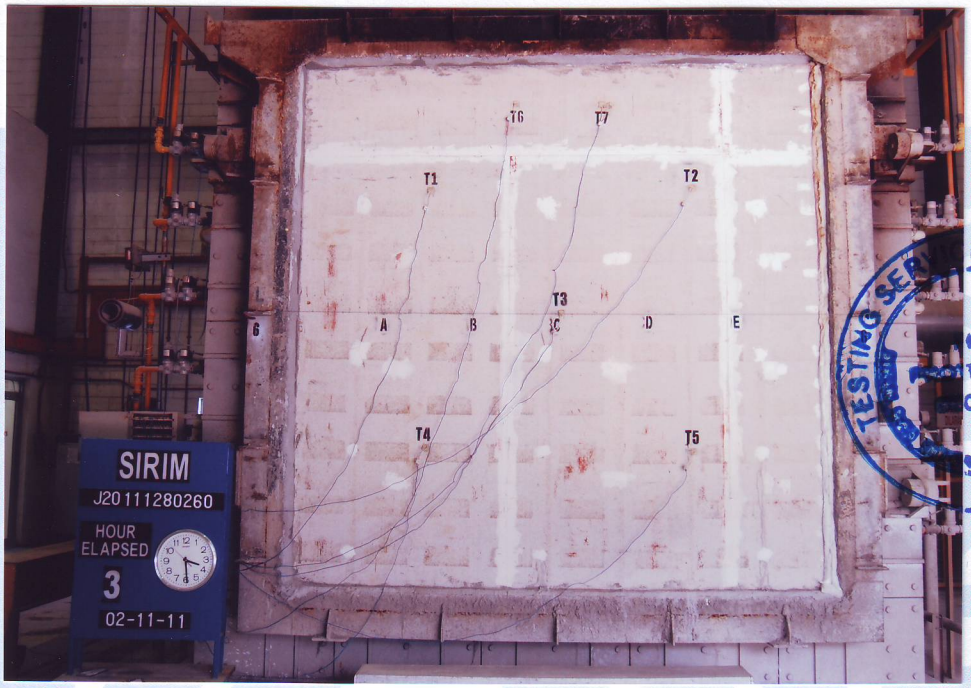

Photo 9: At about **210** minute of test

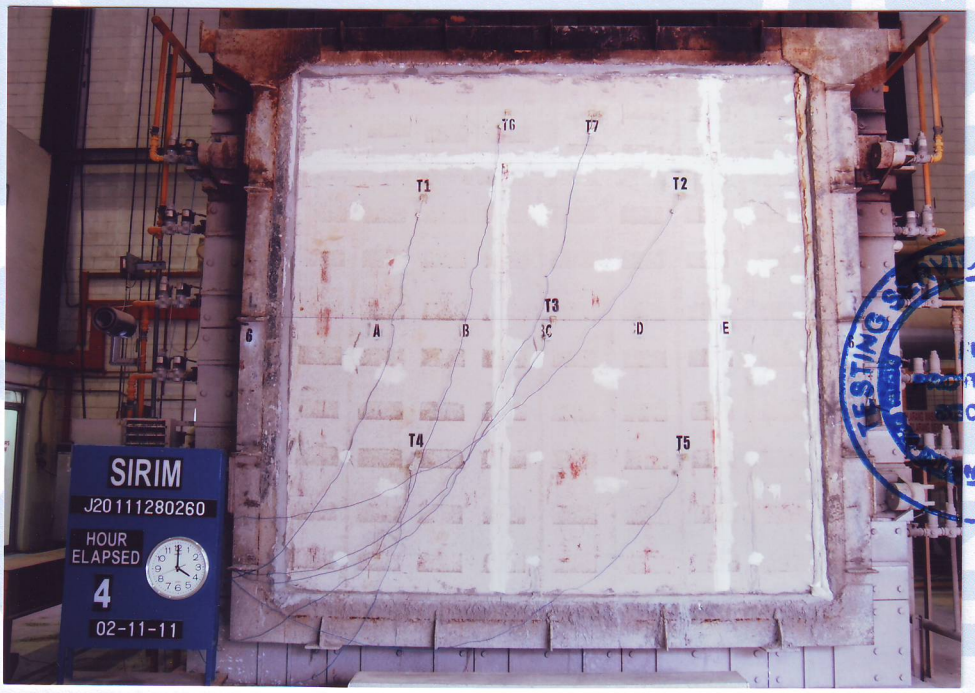

Photo 10: At about **240** minute of test

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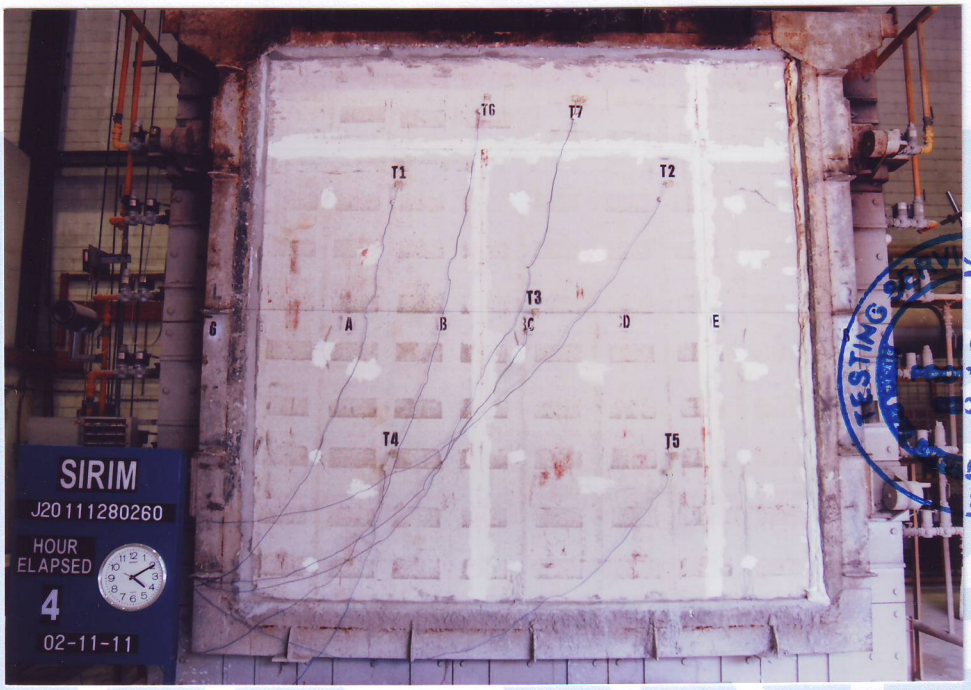

Photo 11: At about **250** minute of test

Photo 12: The exposed face of the partition system after the test

14 DEC 2011

SIRIM QAS International Sdn.Bhd. (Company No.: 410334-X)
No.1, Persiaran Dato' Menteri, P.O.Box 7035, Section 2,
40700 Shah Alam, Selangor Darul Ehsan, Malaysia
Tel. no: 03- 55445853/55445854
Fax. no: 03-55445886

TEST REPORT

REPORT NO.: 2011CB2215	PAGE : 1 OF 4

Applicant. : UAC BHD
No. 10, Menara UAC,
12, Jalan PJU 7/5,
Mutiara Damansara,
47800 Petaling Jaya,
Selangor Darul Ehsan.

Manufacturer : UAC BHD

Product : Light Weight Wall System

Reference Standard/ Method of Test : ISO 140-3:1995
Acoustics-Measurement of Sound Insulation in Buildings and Of Building Elements
Part 3: Laboratory Measurements of Airborne Sound Insulation of Building Elements

Description of Sample : The sample was Light Weight Wall System, was installed to the test opening by the applicant. The installation covered the whole of test opening with the dimension of 3.60 m width x 2.80 m height.

Brand : UCO Arc Wall System
Density : 800 kg/m^3

Date Received : 26th April 2011

Job No / Ref No. : J20111262215 / SQAS / CCST / T.REC / BPL / 17

Issued Date : 02 JUN 2011

Approved Signatories

(FAIZ MOHD YUSUF)
Senior Technical Executive

QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

(YM RAJA NOR SIHA RAJA ABD. HANAN)
Head
Civil & Construction Section
Testing Services Department

7.0 CONDITIONS RELATING TO THE USE OF SIRIM QAS INTERNATIONAL TEST REPORT

7.1 A Test Report will be issued in respect of Testing Services conducted and shall relate only to the Sample actually tested. SIRIM QAS International makes no warranty whatsoever and the Applicant shall not represent in any manner that any duplication or mass production of the Product is same as the Sample actually tested or that SIRIM QAS International has tested any of the duplicated or mass produced Product.

7.2 The Test Report shall not be amended, changed, varied or modified in any manner whatsoever by the Applicant or otherwise.

7.3 If the Test Report is to be furnished to any third party or to the public, each such Test Report shall be furnished in full, legible and in its entirety.

7.4 The Test Report shall not be reproduced and shall not in any manner be used for any advertising purposes or whatsoever without written approval from the Managing Director of SIRIM QAS International of No. 1, Persiaran Dato' Menteri, Building 8, Section 2, P.O. Box 7035, 40911 Shah Alam, Selangor Darul Ehsan.

7.5 Further or in the alternative, it is strictly forbidden unless with prior written approval from the Managing Director of SIRIM QAS International, to represent in any manner whatsoever that SIRIM and/or other SIRIM's subsidiaries has endorsed, approved or validated the Product of the Applicant in any manner whatsoever.

7.6 The use of SIRIM QAS International, SIRIM or other SIRIM's subsidiaries logo and/or words such as "SIRIM: Tested and Proven" and similar representations are strictly forbidden in any manner whatsoever without the prior written approval from the Managing Director of SIRIM QAS International.

7.7 In the event the Applicant is found in breach of this provision, SIRIM QAS International, SIRIM and/or other SIRIM's subsidiaries without prejudice to any other right and remedies may take whatever action necessary including but not limited to:

a) Informing and placing a notice in the media;
b) Obtaining an injunction from Court (cost on a solicitor-client basis to be borne by the Applicant);
c) Refusing to accept any further Product for Testing Services from the Applicant or whosoever related to the Applicant, whether subsidiary or otherwise;
d) Instructing the Applicant to withdraw and recall the advertisement, statement or document in question and advertise a clarification and apology to SIRIM QAS International, SIRIM and/or other SIRIM's subsidiaries twice in a national publication of SIRIM QAS International's choice at the Applicant's sole cost; and
e) Informing or lodging a report pertaining the Applicant's Test Report with the relevant authorities.

7.8 In the event of an investigation from any third party concerning the Applicant's Test Report, SIRIM QAS International may disclose the same for purposes of such investigation.

7.9 If such approval is obtained from the Managing Director of SIRIM QAS International, the Applicant may only include the phrase. "A sample of this product has been tested by SIRIM QAS International... (Test Report No) ... (dated) .... (for what test) ... (to which standard)" or such similar words which stress that only the Sample was actually tested.

7.10 Certified true copies of the Test Report may be issued upon request by the Applicant upon payment of the relevant fee.

TEST REPORT

REPORT NO.: 2011CB2215	PAGE : 2 OF 4

Sample : Light Weight Wall System

Test Method : ISO 140-3:1995
Acoustics-Measurement of Sound Insulation in Buildings and Of Building Elements
Part 3 : Laboratory Measurements of Airborne Sound Insulation of Building Elements

Reverberation Room : The test laboratory consists of two interconnected reverberant chambers. The source room (Chamber 1) has a volume of 202.2 m^3, and a total surface area of 209 m^2. Receiving room (chamber 2) has a normal volume of 268 m^3 and total surface area of 253 m^2.

Instrumentation :
1) B&K Sound Source Type 4224
2) B&K Rotating Microphone Boom Type 3923
3) DELL Latitude with Pulse Software
4) B&K Type 3560C Front-end
5) B&K Acoustic Calibrator Type 4231

Test Procedure : The test has been conducted in general conformance with the ISO 140–3 :1995 Acoustics-Measurement of sound insulation in buildings and of building elements. Part 3: Laboratory measurements of airborne sound insulation of building elements. ISO 717-1:1996 Acoustics-Rating of sound insulation in buildings and of building elements. Part 1: Airborne sound insulation.

The test specimen was installed in the opening between two reverberation rooms. An approximate diffuse sound field had been produced and measured in one room designated as the source room or transmitting room.

The sound reduction index (in dB) had been calculated in accordance with ISO 140-3: 1995 Section 3.2 Equation (5) at one-third octave centre frequency from 100 Hz to 5000 Hz. The calculated sound reduction index data was compared with the standard reference contour to obtain a single number weighted sound reduction index (R_w).

$$R = L1 - L2 + 10 \log (S/A)$$

Where,

L1 = Average sound pressure level in source chamber
L2 = Average sound pressure level in receiving chamber
S = Area of test specimen
A = Sound absorption coefficient

Test Opening : The dimension of the completed test opening for the measurement of sound transmission loss in compliance with ISO 140 Part 3, with 3.60 meter height and 2.80 meter width. The maximum test area, based on measured dimension is 10 m^2.

QAS INTERNATIONAL SDN. BHD. Civil & Construction Section

02 JUN 2011

TEST REPORT

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Test Setup

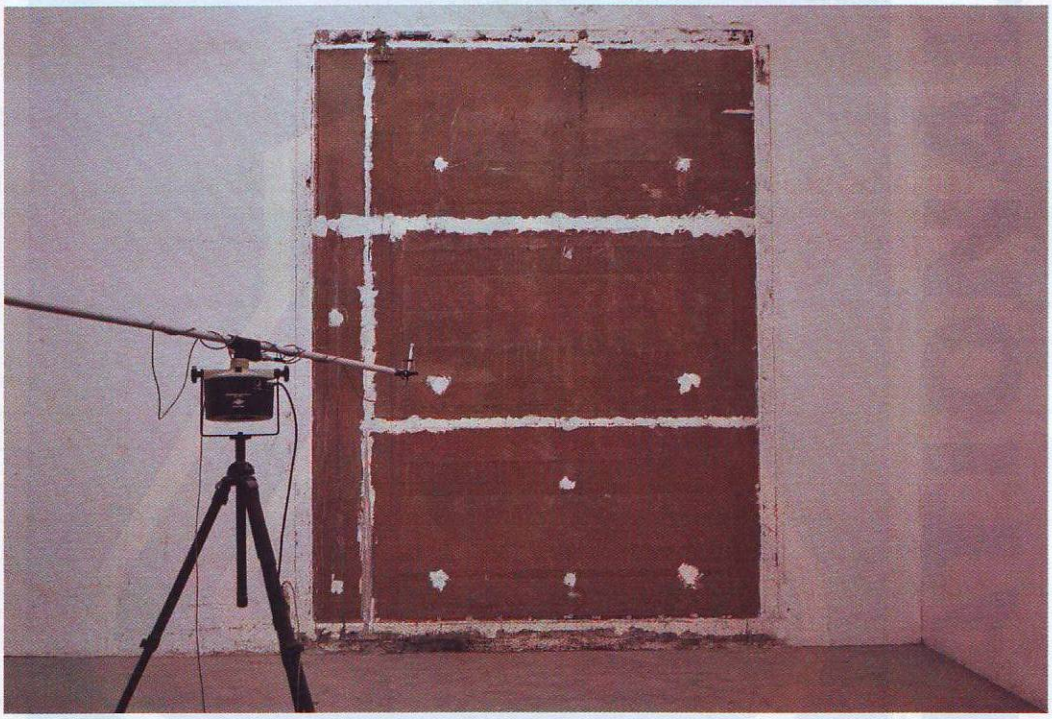

Photo 1: Test setup in Receiving Room

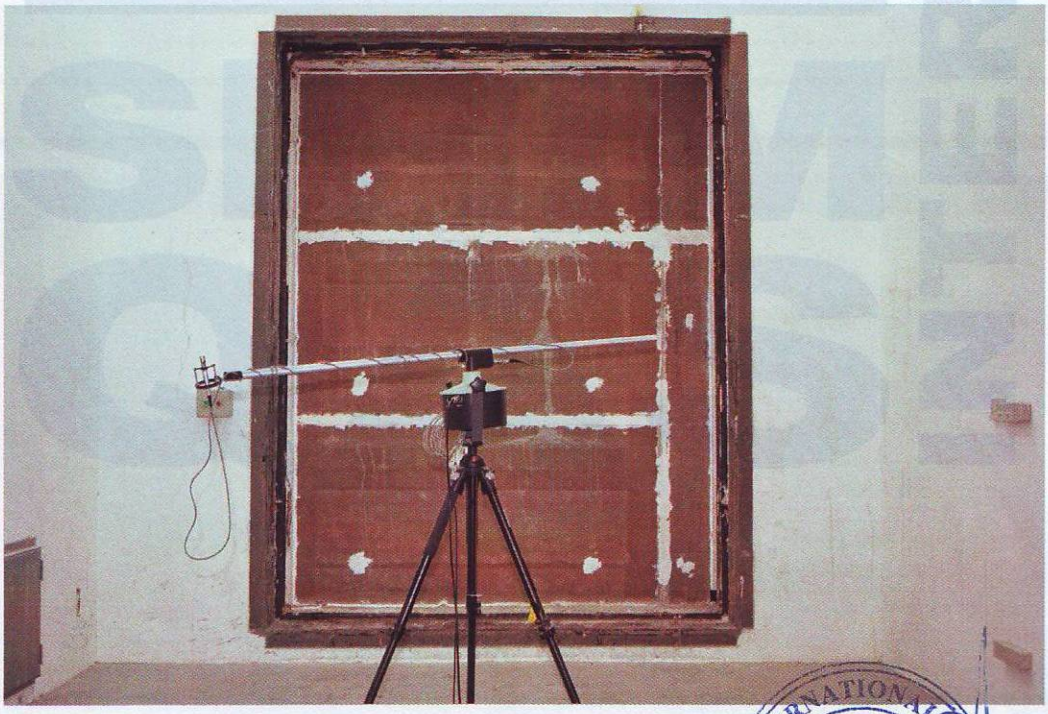

Photo 2: Test setup in Source Room

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TEST REPORT

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Sample : Light Weight Wall System
Brand : UCO Arc Wall System
Density : 800 kg/m^3

Test Condition : Temperature = 27.0 °C Humidity = 68.5 %

Table 1 : Sound Reduction Index Determination of Light Weight Wall System

Frequency (Hz)	**Sound Reduction Index (dB)**	**Reference (dB)**
100	33.7	23.0
125	35.6	26.0
160	34.8	29.0
200	33.3	32.0
250	34.0	35.0
315	34.6	38.0
400	33.4	41.0
500	36.2	42.0
630	38.6	43.0
800	41.1	44.0
1000	43.0	45.0
1250	45.4	46.0
1600	47.0	46.0
2000	47.2	46.0
2500	47.6	46.0
3150	48.6	46.0
4000	48.0	46.0
5000	48.0	46.0
R_W	**42dB**	

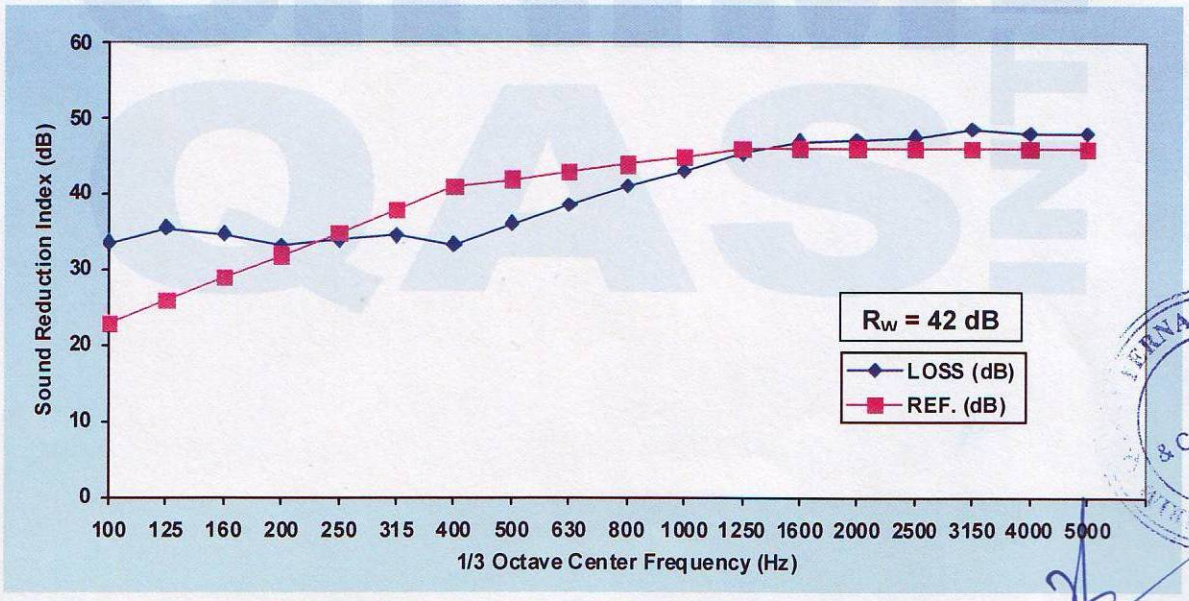

Figure 1: Sound Reduction Index for Light Weight Wall System

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APPENDIX F

SITE VISIT PHOTOS

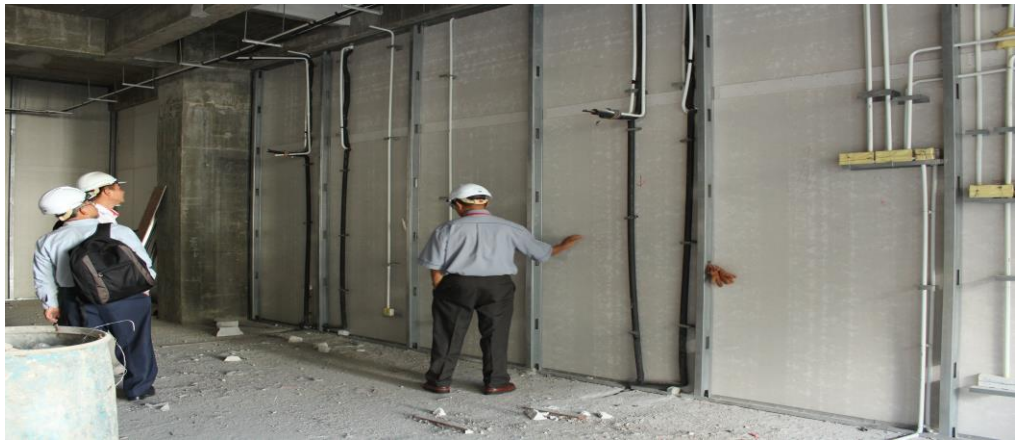
Date : 3rd June 2013

Day : Monday

Address : Near Building Jaya 33, No 1.
3, Jalan Semangat, Sek. 13,
46100 Petaling Jaya,
Selangor Darul Ehsan

APPENDIX F: SITE VISIT PICTURE

Picture 1:
Technical Expert Panels arrived at the site for a technical visit.



Picture 2:
The panels are evaluating the product, ECO Lightweight Composite Wall.

Picture 3:
The finished product complete with M&E installation

Picture 4:
Surface of the wall.