# Properties and Applications of *Lafarge GTEC Aqua Board*

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# EXECUTIVE SUMMARY

This report details the properties of Lafarge GTEC *Aqua Board* which have been determined through testing and verified through the SCI Assessed scheme.

Lafarge GTEC *Aqua Board* is a gypsum-silicon board that has been especially designed for use in external sheathing applications subject to wind pressure and potential exposure to moisture during construction.

Applications for which Lafarge GTEC *Aqua Board* is suitable are also presented in this report; these include:

- External Insulated Façade Systems (with cavity)
- External Insulated Façade Systems (no cavity)
- Direct Render Systems (with cavity)
- Sheathing board to Brickwork cladding
- Sheathing board to Brick slips (with cavity)
- Sheathing board to Brick slips (without cavity)
- Sheathing board to Rainscreen cladding.

Lafarge GTEC *Aqua Board* is available in the following markets and with the following product names:

- UK (known as GTEC Aqua Board, GTEC Aqua-R Board or GTEC Render Board.
- Germany (known as LaHydro)
- France and Italy (known as PregyWAB)
- Poland and Romania (known as Nida Wab)
- Turkey (known as Boardex)
- Korea (known as Aqualock)
- North America (known as Weather Defense).

# Contents

# 1 Introduction

## 1.1 Aqua Board

*Lafarge GTEC Aqua Board* is a gypsum-silicon board that has been especially designed for use in external sheathing applications. *Aqua Board* (see Fig 1) is an orange-coloured, taper-edged board manufactured to BS EN 15283-1: 2008[1].

The boards are available with nominal dimensions of:

- Width - 1200 mm
- Length - 2400, 2700 or 3000 mm
- Thickness - 12.5 or 15 mm.

**Figure 1.1 Lafarge GTEC Aqua Board**

The board was developed by *Lafarge* to compete with products, such as cement boards, cement particle board, calcium silicate board, magnesium oxide board and specialist boards designed to provide weather resistance in permanent and temporary conditions. *Aqua Board* is a gypsum-silicon board which is lighter and easier to cut, fix and handle than alternative products.

The technical performance properties of *Aqua Board* include:

- Water resistance
- Mould resistance
- Fire resistance
- Sound insulation
- Impact resistance.

*Lafarge GTEC Aqua Board* has been developed by the Lafarge Gypsum Division and it is available in the following markets:

- United Kingdom (as GTEC Aqua Board, GTEC Aqua-R Board or GTEC Render Board)
- Germany (as “LaHydro”)
- Italy and France (as “PregyWAB”)
- Poland (as “Nida Wab”)
- Romania (as “Nida Wab”)
- Korea (as “Aqualock”)
- North America (as “Weather Defense”).

## 1.2 Independent verification

‘SCI Assessed’ is an assessment scheme to provide independent validation of data provide by product manufacturers. The SCI Assessed mark is the guarantee that all steps leading to the performance data offered by the supplier are satisfactory and that the results can be used with confidence.

*Lafarge GTEC Aqua Board* has under gone extensive testing to determine its performance characteristics, both as a board alone and when the board is used in a particular cladding system.

Data relating to the testing and application of *Lafarge GTEC Aqua Board* in external sheathing applications has been through the SCI Assessed scheme. The following sections of this report present the *Aqua Board* performance data that has been SCI Assessed.

# 2 Board Properties

## 2.1 General and mechanical properties

### Density

The density of *Aqua Board* was determined following EN 520:2005[2]. Tests were carried out on 12 samples of 12.5 x 300 x 400 mm board. The tests were conducted by VHT Versuchsanstalt für Holz-und Trockenbau (the Laboratory of Wood and Drywall) in Germany in 2008 [Ref. 3].

**The mean density from the 12 tests = 910.7 kg/m$^3$.**

### Flexural strength

The flexural strength of *Aqua Board* was determined following EN 520[2] and EN 12467[16]. Tests were carried out on 10 samples of 12.5 x 300 x 400 mm board. The tests were conducted by VHT Versuchsanstalt für Holz-und Trockenbau (the Laboratory of Wood and Drywall) in Germany in 2008 [Ref. 3]. Tests were conducted to determine the longitudinal flexural strength (i.e. load perpendicular to machine direction) and the transverse flexural strength (i.e. load parallel to machine direction).

**The mean longitudinal flexural strength from the 10 tests = 6.98 N/mm$^2$.**

**The mean transverse flexural strength from the 10 tests = 3.13 N/mm$^2$.**

### Modulus of Elasticity

The modulus of elasticity of *Aqua Board* was determined following EN 789:2004[4]. Tests were carried out on 10 samples of 12.5 x 300 x 400 mm board. The tests were conducted by VHT Versuchsanstalt für Holz-und Trockenbau (the Laboratory of Wood and Drywall) in Germany in 2008 [Ref. 3]. Tests were conducted to determine the longitudinal modulus of elasticity (i.e. load perpendicular to machine direction) and the transverse modulus of elasticity (i.e. load parallel to machine direction).

**The mean longitudinal modulus of elasticity from the 10 tests = 3220 N/mm$^2$.**

**The mean transverse modulus of elasticity from the 10 tests = 2950 N/mm$^2$.**

### Impact Resistance

The hard body impact resistance of *Aqua Board* was determined following EN 1128:1995[5]. Tests were carried out on 10 samples of 12.5 x 310 x 310 mm board. The tests were conducted by VHT Versuchsanstalt für Holz-und Trockenbau (the Laboratory of Wood and Drywall) in Germany in 2008 [Ref. 3].

**The mean impact resistance from the 10 tests = 13.4 mm/mm.**

### Pull through resistance of fixings

The pull-through resistance of fixings in *Aqua Board* was determined following BS EN 1383[6] (except moisture content and density were not determined). The tests were conducted by British Board of Agrément (see Ref 7).

**The mean pull-out resistance (8.4 mm screw head) = 11.9 N/mm$^2$.**

**The mean pull-out resistance (8.3 mm screw head) = 12.5 N/mm$^2$.**

**The mean pull-out resistance (8.2 mm screw head) = 12.3 N/mm$^2$.**

## 2.2 Reaction to fire

The reaction to fire of *Aqua Board* was determined following EN 13501-1:2007[8]. The tests were conducted by MPA BAU HANOVER (Construction Materials Testing) in Germany in 2008 [Ref. 9].

**The full classification for reaction to fire = A2 – s1,d0.**

## 2.3 Thermal performance properties

Thermal conductivity and thermal resistance values are based on generic values for gypsum boards. No specific testing for *Aqua Board* has been carried out.

**The thermal conductivity = 0.25 W/mK.**

**The thermal resistance for 12.5 mm board = 0.05 m$^2$K/W.**

**The thermal resistance for 15 mm board = 0.06 m$^2$K/W.**

## 2.4 Vapour permeability properties

The water vapour resistance and water vapour resistance factor of *Aqua Board* were determined by following the test procedure given in BS EN ISO 12572: 2001[10]. The tests were conducted by the BRE in 2007 [Ref. 11].

**The mean water vapour resistance for 12.5 mm board = 0.69 MNs/g.**

**The mean water vapour resistance factor for 12.5 mm board = 11.**

## 2.5 Moisture resistance properties

### Water absorption

The water uptake and surface water absorption of *Aqua Board* were determined by following the test procedure given in EN 520[2]. The tests were conducted by VHT

Versuchsanstalt für Holz-und Trockenbau (the Laboratory of Wood and Drywall) in Germany in 2008 [Ref. 3] and CSTB [Ref. 12].

**The water uptake from 2 hours immersion = < 3%.**

**The surface water absorption from 2 hours Cobb test = < 100 g /m$^2$.**

### Dimensional stability

The dimensional changes associated with changes in relative humidity (swelling and shrinkage) were determined following EN 318:2002[13]. The tests were conducted by VHT Versuchsanstalt für Holz-und Trockenbau (the Laboratory of Wood and Drywall) in Germany in 2008 [Ref. 3].

**The dimensional change in the longitudinal direction from 20°C/30% RH to 20°C/65% RH = 0.10 mm/m.**

**The dimensional change in the longitudinal direction from 20°C/65% RH to 20°C/90% RH = 0.15 mm/m.**

**The dimensional change in the transverse direction from 20°C/30% RH to 20°C/65% RH = 0.13 mm/m.**

**The dimensional change in the transverse direction from 20°C/65% RH to 20°C/90% RH = 0.11 mm/m.**

## 2.6 Mould resistance properties

The mould resistance of *Aqua Board* was determined by applying ASTM D 3273[14]. The tests were carried out by Northeast Laboratories Inc. (USA) in 2007 [Ref. 15]. The test results are reported using a scale of zero to ten, with ten representing no mould growth on the surface.

**The mould growth resistance of the front face = 10.**

**The mould growth resistance of the back face = 10.**

## 2.7 Aging properties

The aging properties of *Aqua Board* were determined by carrying out wet and dry cycling tests in accordance with EN 12467: 2004[16].The tests were conducted by VHT Versuchsanstalt für Holz-und Trockenbau (the Laboratory of Wood and Drywall) in Germany in 2008 [Ref. 3] and by ITB (Building Research Institute), Poland. The results are expressed as the ratio of flexural strength of the aged board to the flexural strength of the un-aged board.

**The aging ratio in the longitudinal direction after 5 cycles = 0.98.**

**The aging ratio in the longitudinal direction after 25 cycles = 0.83.**

**The aging ratio in the transverse direction after 5 cycles = 0.98.**

**The aging ratio in the transverse direction after 25 cycles = 0.79.**

## 2.8 Summary of Properties

Table 2.1 presents a summary of the properties of *GTEC Aqua Board*.

**Table 2.1 Summary of *Aqua Board* properties**

| Topic | Description | Performance |
|---|---|---|
| General | Density | 910.7 kg/m$^3$ |
| Mechanics | Flexural strength longitudinal direction | 6.98 N/mm$^2$ |
| | Flexural strength transverse direction | 3.13 N/mm$^2$ |
| | Elastic modulus longitudinal direction | 3220 MPa |
| | Elastic modulus transverse direction | 2950 MPa |
| | Impact resistance (at 20°C/65%RH) | 13.4 mm/mm |
| Fire | Reaction to fire – Euro class | A2-s1,d0 |
| Thermal | Thermal conductivity | 0.25 W/mK |
| | Thermal resistance (12.5 mm board) | 0.05 m$^2$K/W |
| | Thermal resistance (15 mm board) | 0.06 m$^2$K/W |
| Permeability | Water vapour resistance (12.5 mm board) | 0.69 MNs/g |
| | Water vapour resistance factor | 11 |
| Moisture resistance | Water uptake (2 hrs immersion) | < 3 % |
| | Surface water absorption (2 hrs Cobb test) | < 100 g/m$^2$ |
| | Dimensional change (20°C/30%-65%RH), longitudinal direction | 0.10 mm/m |
| | Dimensional change (20°C/65%-90%RH), longitudinal direction | 0.15 mm/m |
| | Dimensional change (20°C/30%-65%RH), transverse direction | 0.13 mm/m |
| | Dimensional change (20°C/65%-90%RH), transverse direction | 0.11 mm/m |
| Mould | Mould resistance | No mould growth |
| Aging | Ratio of aged strength to un-aged, longitudinal, 5 – 25 cycles | 0.98 – 0.83 |
| | Ratio of aged strength to un-aged, transverse, 5 – 25 cycles | 0.91 – 0.79 |

For comparison, properties of alternative boards that may be used are presented in Table 2.2. The properties that are not shown concern the ease of cutting and fixing, which are similar to conventional plasterboard.

**Table 2.2 Comparison of board properties**

| Description | Cement fibre board 12.5 mm | Calcium silicate board 12.5 mm | Magnesium oxide board 12.5 mm | Cement particle board 12.5 mm | OSB/3 12.5 mm | Aqua Board 12.5 mm |
|---|---|---|---|---|---|---|
| Density (kg/m$^3$) | 1200-1500 | 900-1350 | 980-1100 | 1250 | 630-650 | **910.7** |
| Mass per area (kg/m$^2$) | 15.0-18.8 | 11.3-16.9 | 12.3-13.8 | 15.6 | 7.9-8.1 | **11.4** |
| Water uptake, % of mass<br>2 hr immersion<br>24 hr immersion | <br>4-10%<br>12-25% | <br>9%<br>18-22% | <br>-<br><26% | <br>-<br>- | <br>-<br>15% | <br>**2%**<br>**6.5%** |
| Size variation, mm/m<br>20oC, 30% to 90% RH | 1.0 | 1.2 | 2.5 | 0.9 | 1.8 | **0.15** |
| Flexural strength longitudinal (12.5mm board) (N/mm$^2$) | 10.5 | 6.0-10.5 | 18-20 | 13 | 20 | **6.98** |
| Flexural strength transverse (12.5mm board) (N/mm$^2$) | 10.1 | 9.5-13.8 | 18-20 | 13 | 10 | **3.13** |
| Elastic modulus longitudinal direction (MPa) | 6900 | 6000 | 6045 | 4800 | 3500 | **3220** |
| Elastic modulus transverse direction (MPa) | 6700 | 6000 | 6045 | 4800 | 1400 | **2950** |
| Reaction to fire – Euro class | B | A1 | A1 | A2 | D | **A2** |
| Thermal conductivity (W/mK) | 0.23 | 0.13-0.35 | 0.22 | 0.23 | 0.13 | **0.25** |

Note: Data for products (except *Aqua Board*) are obtained from publicly available data. Specific products within each category may have slightly different properties to those present above.

# 3 System Performance

## 3.1 Hygrothermal properties with render

The hygrothermal properties of two wall constructions using *Aqua Board* with render were determined by testing in accordance with UEAtc (The European Union of Agrément) MOAT No. 22[17]. The two wall systems tested are shown in Figure 3.1. Wall 1 is a direct render system where the render is applied directly to the sheathing board (for Direct Render Systems, the GTEC Aqua Board can be substituted by the GTEC Aqua-R boar or the GTEC Render Board which have improved properties). Wall 2 is an External Insulated Façade System (EIFS) where a layer of rigid insulation is fixed to the sheathing board and then the render system is applied to the rigid insulation.

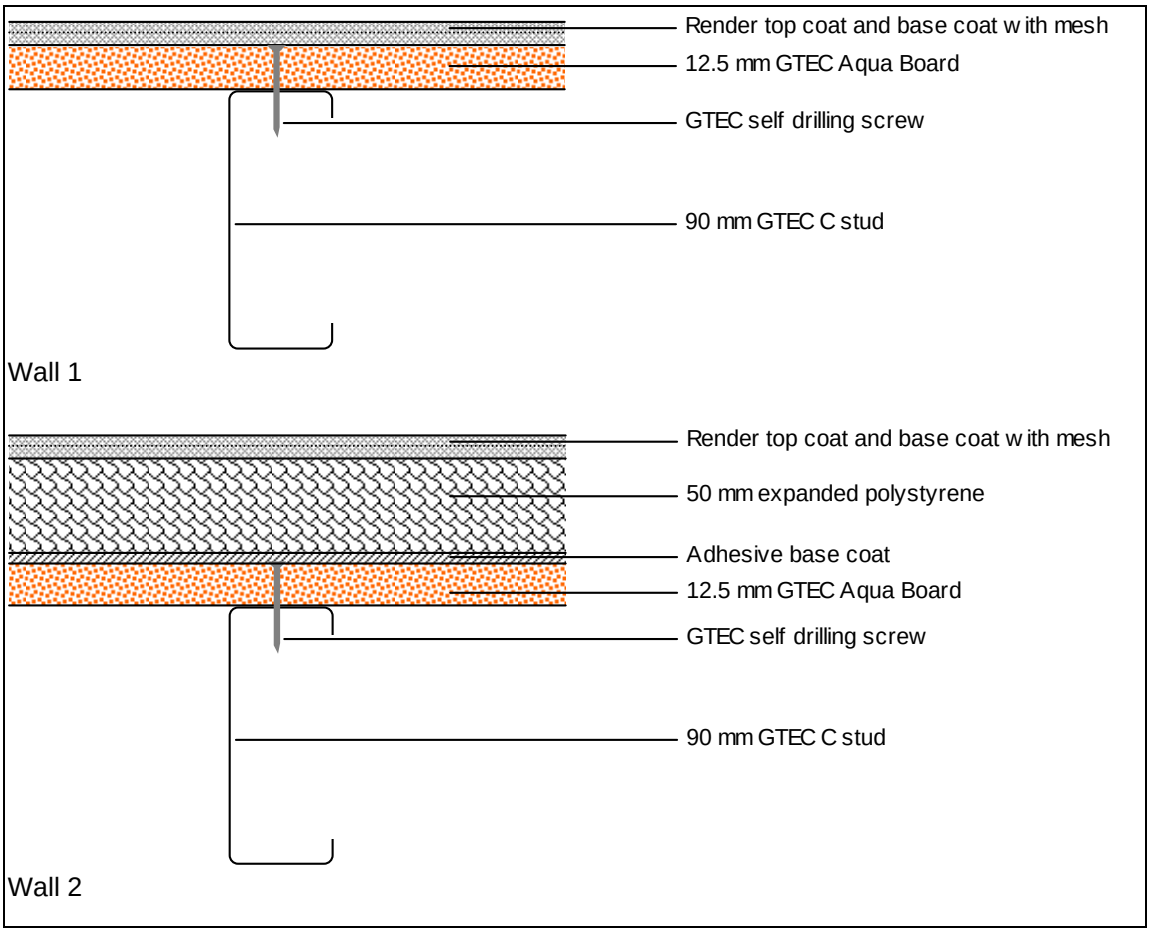



**Figure 3.1 Wall systems with *Aqua Board* and render**

The tests consist of heat / moisture cycles and freeze / thaw cycles. The tests were carried out by BBA in 2009 [Ref. 18].

**The results for wall 1:**

**Heat / moisture: After 140 cycles no cracks or visible damage.**

**Freeze / thaw:** **After 20 cycles no visible damage.**

**The results for wall 2:**

**Heat / moisture:** **After 140 cycles no cracks or visible damage.**

**Freeze / thaw:** **After 20 cycles, no significant damage.**

## 3.2 Fire resistance

Walls incorporating *Aqua Board* have been tested to determine their fire resistance. Four wall constructions have been tested. The

### Fire test 1

The load bearing wall construction shown in Figure 3.2 was tested in accordance with BS 476[19] by Chiltern International Fire in 2008 [Ref. 20]. The results are given below.

**Integrity = 44 minutes.**

**Insulation = 44 minutes.**

**Load bearing = 44 minutes.**

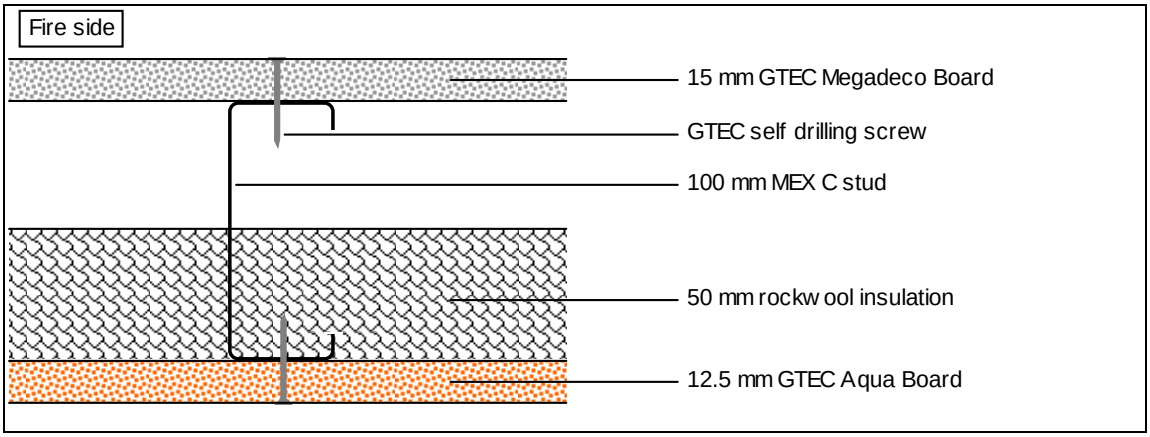



**Figure 3.2 Load bearing wall for fire test (08020)**

### Fire test 2

The partition wall construction shown in Figure 3.3 was tested in accordance with BS 476 by Chiltern International Fire in 2008 [Ref. 21]. The results are given below.

**Integrity = 59 minutes.**

**Insulation = 54 minutes.**

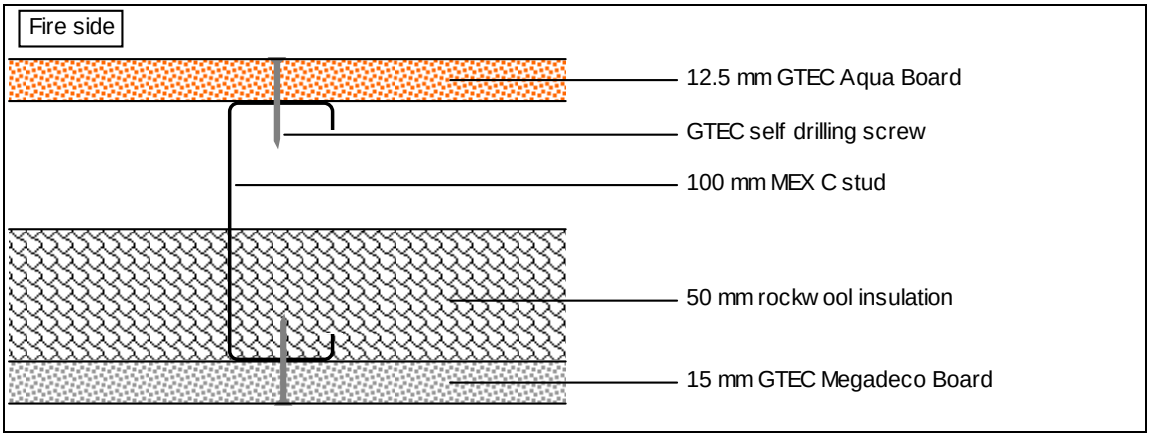



**Figure 3.3 Partition wall for fire test (08041)**

### Fire test 3

The partition wall construction shown in Figure 3.4 was tested in accordance with BS EN 1364-1[22] by Chiltern International Fire in 2009 [Ref. 23]. The results are given below.

**Integrity = 85 minutes.**

**Insulation = 74 minutes.**

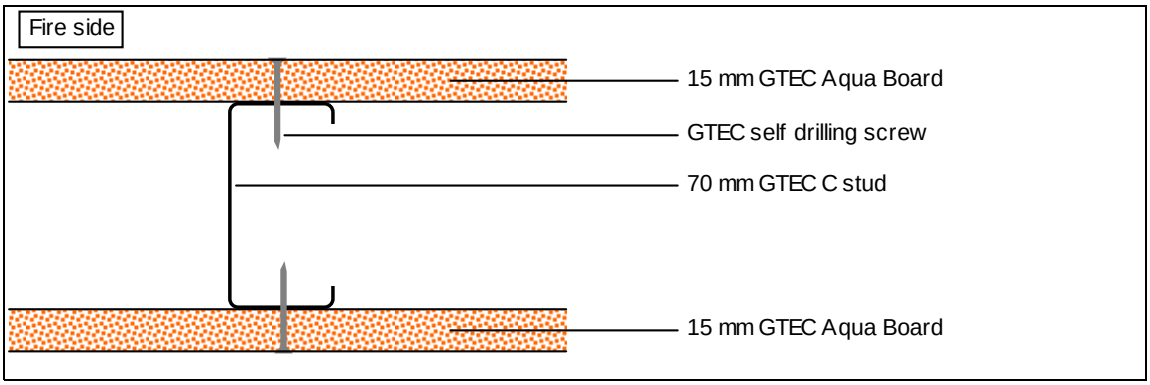



**Figure 3.4 Partition wall for fire test (09075)**

### Fire test 4

The partition wall construction shown in Figure 3.5 was classified in accordance with EN 13501-2[24] by Efectis (France) in 2009 [Ref. 25]. The results are given below.

**Classification: EI = 60 minutes.**

**Integrity = 70 minutes.**

**Insulation = 70 minutes.**

The same wall was tested to EN 1363-1 and EN 1364-1 [Ref. 26]. The results are given below.

**Integrity = 80 minutes.**

**Insulation = 70 minutes.**

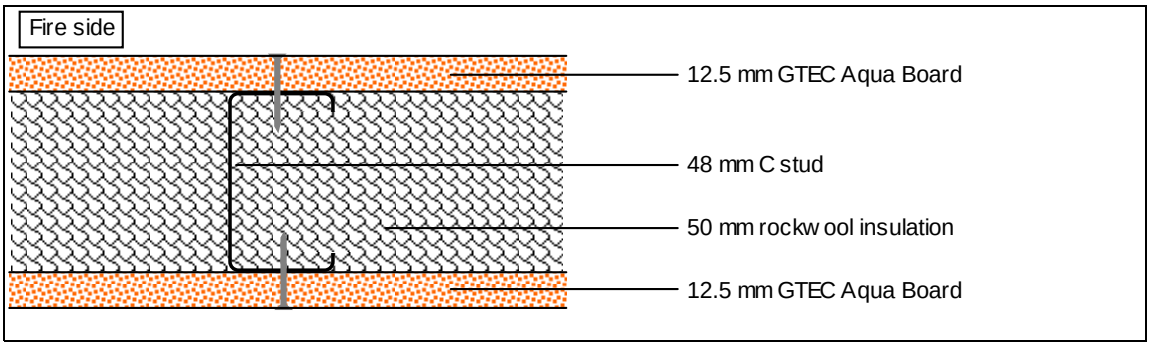



**Figure 3.5 Partition wall for fire test (09-V-142)**

## 3.3 Strength properties

### Robustness to damage

The durability of a partition wall constructed with *Aqua Board* (see Figure 3.6) was tested in accordance with the strength and robustness requirement of BS 5234 Part 2[27]. The tests were carried out by University of Salford in 2009 [Ref. 28].

**The partition achieved the performance grade "Severe Duty".**

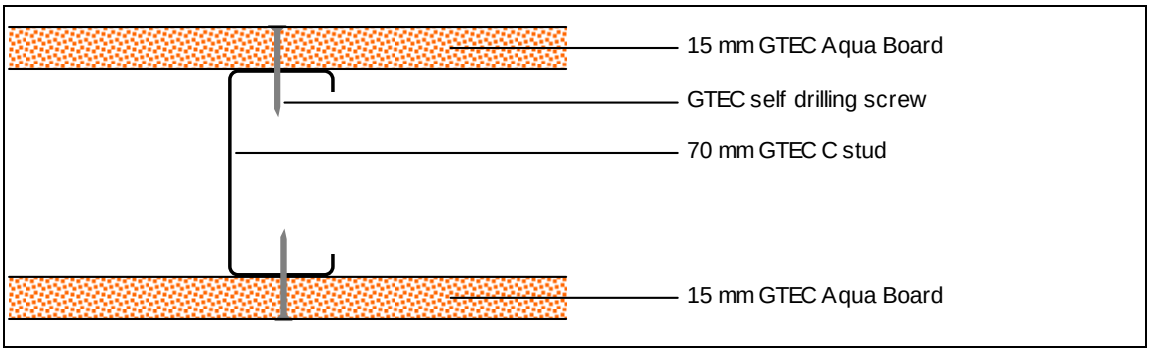



**Figure 3.6 Partition wall for BS 5234 testing**

### Impact resistance

The impact resistance of a partition wall constructed with *Aqua Board* (see Figure 3.6) was tested in accordance with UEAtc (The European Union of Agrément) MOAT No. 43[29]. The tests were carried out by University of Salford in 2009 [Ref. 30]. The results for the partition are given below.

**Safety Impact (External & Internal) = Pass all classes.**

**Retention of Performance (External & Internal) = Pass all classes.**

### Impact resistance with render

The hard body impact resistance of the two wall systems shown in Figure 3.1 was tested in accordance with ETAG 004[31]. The tests were carried out by BBA in 2009 [Ref. 18]. The most amount of damage from six tests is given below.

**Wall 1: Impression made on rear of panel.**

**Wall 2: Render indented, cracked around circumference.**

### Racking resistance

The racking resistances of wall panels 2.4 m wide by 2.4 m high with the cross-section shown in Figure 3.7 were tested BRE in 2007 [Ref. 32]. The racking resistance obtained from testing is specific to the test arrangement including; steel frame members, spacing of board fixings, connections between steel frame members and holding down details of the panel. However, the results obtained are given below for information.

The tests were carried out according to BS EN 594[33]. The details of the test results quoted below are; 2.4 m x 2.4 m panel, using 100 mm SFS studs, 1.2 mm thick, 1 layer of 12.5 mm *Aqua Board* one side, fixed with 32mm GTEC self drilling screws at 150 mm centre distance, Zero vertical load.

**Ultimate strength Fmax =12.3 kN**
**Mean racking stiffness R = 835 N/mm**

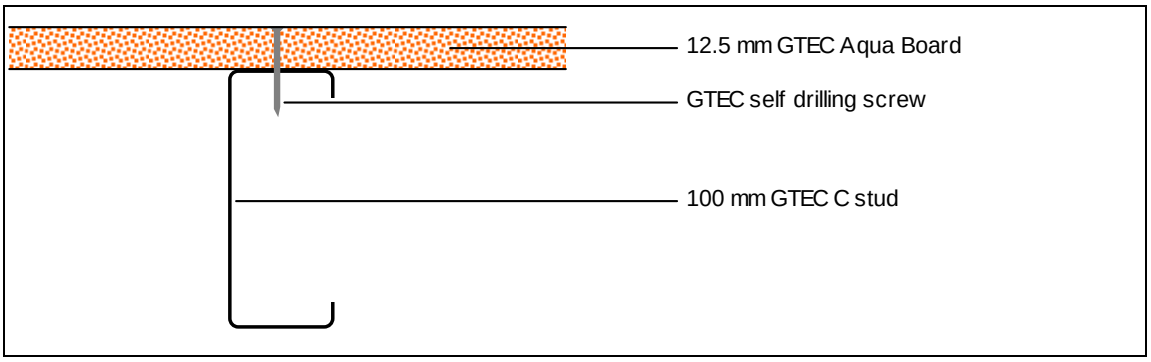



**Figure 3.7 Panel cross section for racking tests**

### Wind load resistance

The wind load resistance of the wall system shown in Figure 3.8 was tested in accordance with ETAG 004[31]. The tests were carried out by BBA in 2009 [Ref. 34]. The maximum suction sustained by the board and render system is given below; above this load the *Aqua Board* failed around its fixings to the steel frame.

**Wind suction sustained by board and render system = 4.0 kN/m$^2$.**

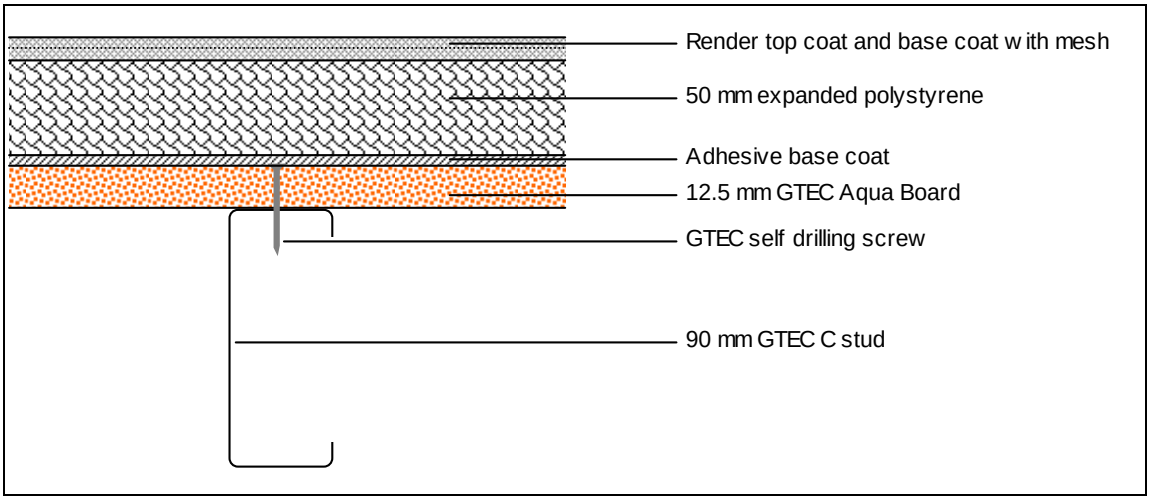



**Figure 3.8 Panel cross section for wind suction tests**

Design wind pressures / suctions depend upon many factors including building geometry, location, altitude, surrounding physical features etc. However, typical values would be expected within the range of 0.6 kN/m$^2$ to 2.0 kN/m$^2$. The suction sustained by the Lafarge board and render system is significantly within the upper value.

## 3.4 Sound insulation

The sound insulation of wall systems including *Aqua Board* were tested in accordance with BS EN ISO 140-3: 1995[35]. The tests were carried out by University of Salford (Acoustic Test Laboratory) in 2009 [Ref. 36].

### Sound test 1

The wall construction shown in Figure 3.9 was tested for sound insulation; the results are given below. Note: Ctr is a reduction to the standard sound reduction to take account of low frequency sound.

**Rw (C, Ctr) = 45 (-3, -10) dB.**

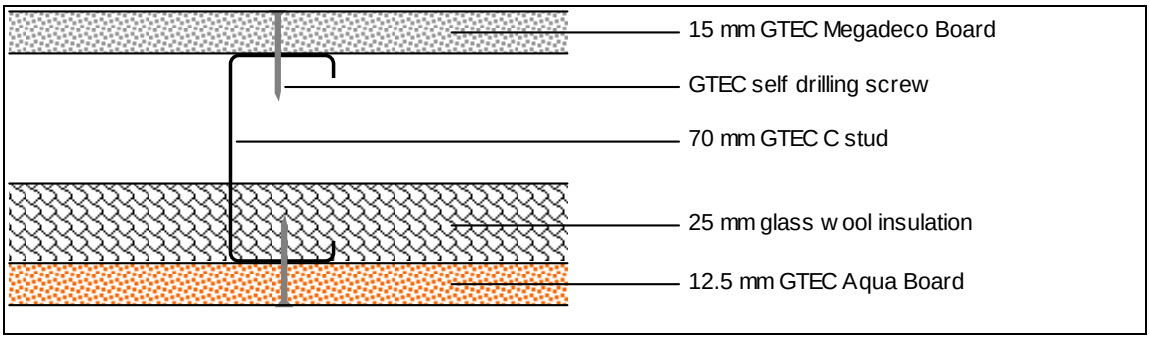



**Figure 3.9 Wall for sound test 1**

### Sound test 2

The wall construction shown in Figure 3.10 was tested for sound insulation; the results are given below.

**Rw (C, Ctr) = 50 (-1, -6) dB.**

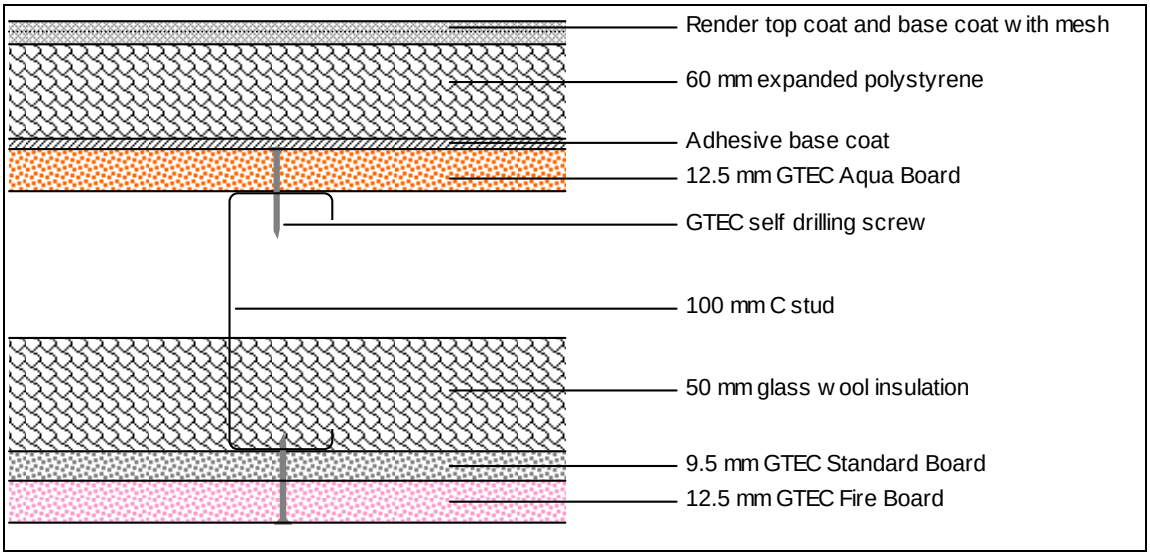



**Figure 3.10 Wall for sound test 2**

### Sound test 3

The wall construction shown in Figure 3.11 was tested for sound insulation; the results are given below.

**Rw (C, Ctr) = 48 (-2, -8) dB.**

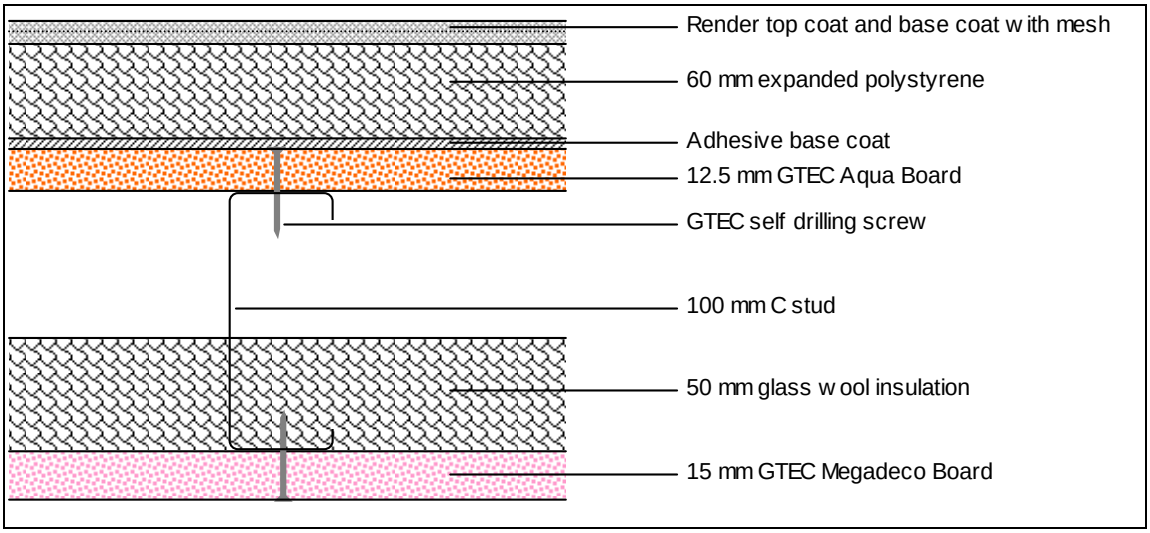



**Figure 3.11 Wall for sound test 3**

### Sound test 4

The wall construction shown in Figure 3.11 was tested for sound insulation; the results are given below.

**Rw (C, Ctr) = 53 (-4, -11) dB.**

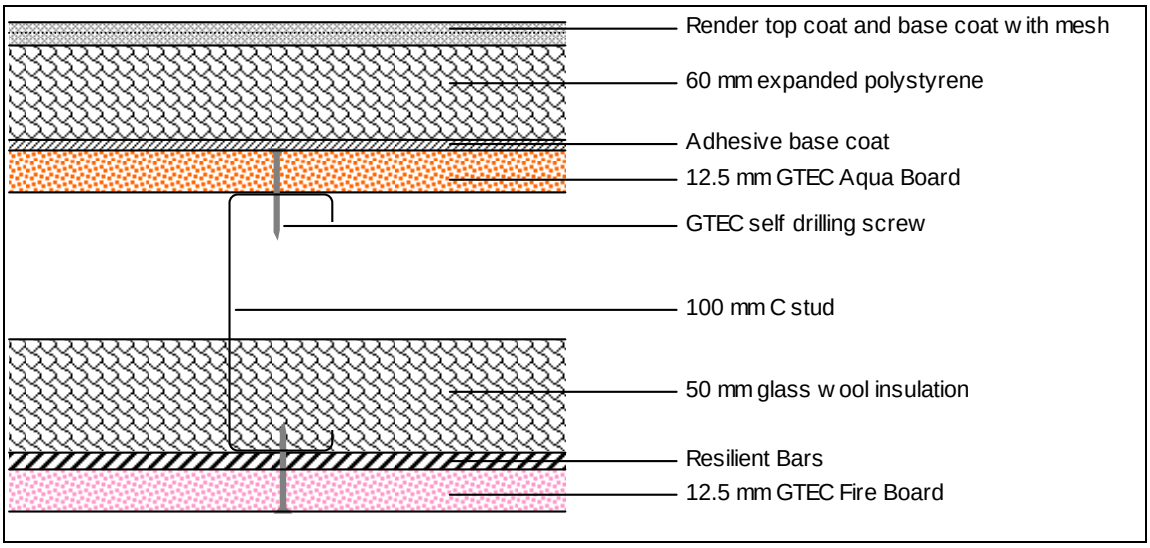



**Figure 3.12 Wall for sound test 4**

## 3.5 Summary of wall performance

Table 3.1 presents a summary of the performance properties for systems with *GTEC Aqua Board*.

**Table 3.1 Summary of performance properties for systems with *Aqua Board***

| Topic | Description | Performance |
|---|---|---|
| Hygrothermal properties | Wall 1 – Direct render system – Heat / moisture cycles | No cracks or visible damage after 140 cycles |
| | Wall 1 – Direct render system – Freeze / thaw cycles | No visible damage after 20 cycles |
| | Wall 2 – EIFS – Heat / moisture cycles | No cracks or visible damage after 140 cycles |
| | Wall 2 – EIFS – Freeze / thaw cycles | No significant damage after 20 cycles |
| Fire resistance | Fire test 1 – Load bearing wall | Integrity 44 min<br>Insulation 44 min<br>Load bearing 44 min |
| | Fire test 2 – Partition wall | Integrity 59 min<br>Insulation 54 min |
| | Fire test 3 – Partition wall | Integrity 85 min<br>Insulation 74 min |
| | Fire test 4 – Partition wall | Integrity 70 min<br>Insulation 70 min |
| Durability | Partition wall - Strength & robustness grade | Severe Duty |
| Impact resistance | Partition wall – Safety Impact | Pass |
| | Partition wall – Retention of performance | Pass |
| | Wall 1 – Direct render system – Resistance to hard body impact | Impression made on rear of panel |
| | Wall 2 – EIFS system – Resistance to hard body impact | Render indented, cracked around circumference |
| Racking resistance | *Aqua Board* clad light steel panel – Basic racking resistance | 1.94 kN/m |
| Wind load | Wall 2 – EIFS system – Resistance to wind suction | 4.0 kN/m$^2$ |
| Sound insulation | Sound test 1 – Separating wall | Rw (C, Ctr) =<br>45 (-3, -10) dB |
| | Sound test 2 – EIFS system wall (with fire board and standard board) | Rw (C, Ctr) =<br>50 (-1, -6) dB |
| | Sound test 3 – EIFS system wall (with *Megadeco* board) | Rw (C, Ctr) =<br>48 (-2, -8) dB |
| | Sound test 4 – EIFS system wall (with resilient bars) | Rw (C, Ctr) =<br>53 (-4, -11) dB |

Due to the large number of variables within a wall 'system' it is not possible to have a meaningful comparison table of performance for systems using different sheathing boards based on publically available data.

# 4 Applications

Based on the performance data presented in Sections 2 and 3, *GTEC Aqua Board* may be used in the following external sheathing board applications.

## 4.1 External insulated façade systems (EIFS)

### External Insulated Façade Systems (with cavity)

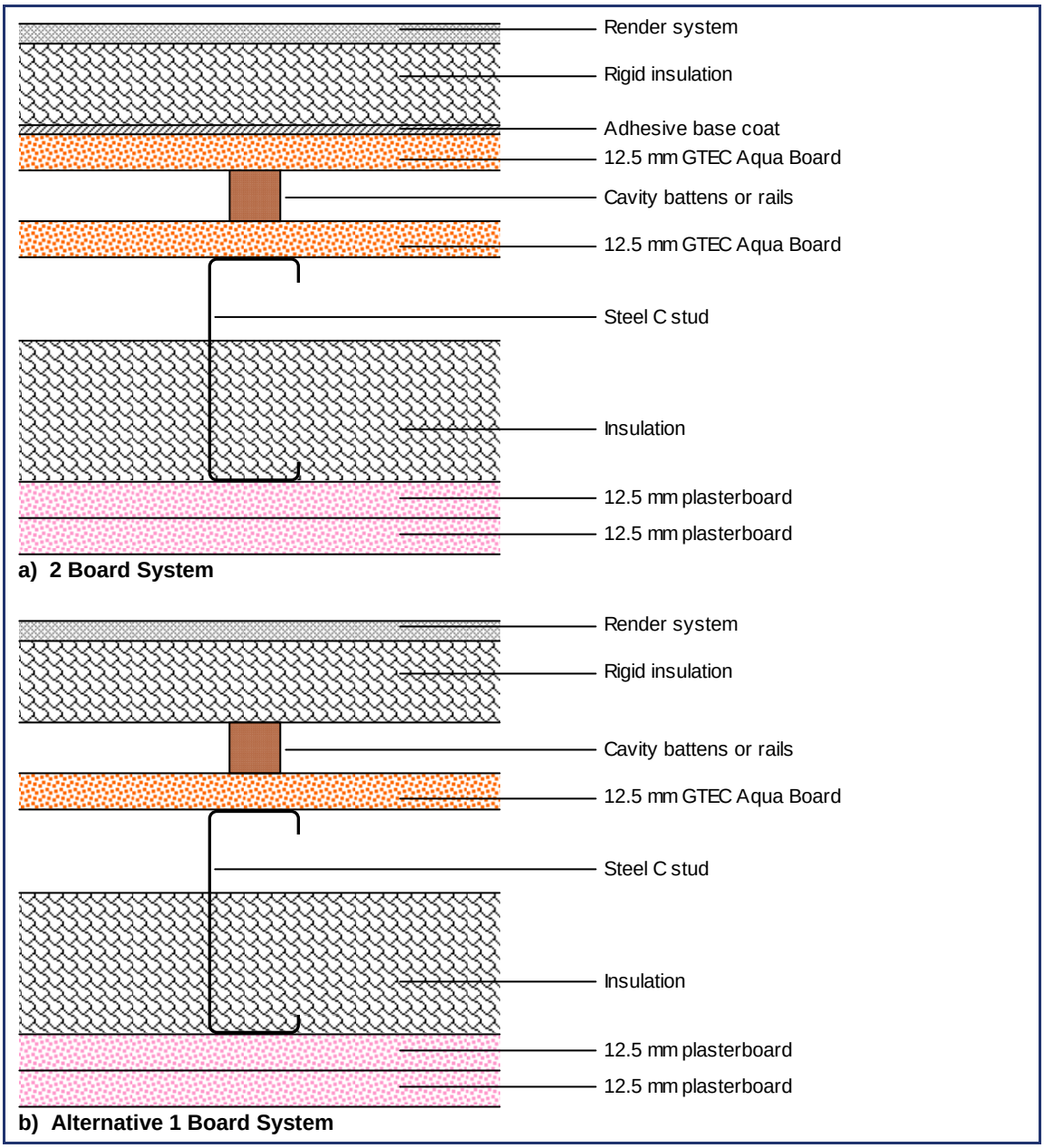



**Figure 4.1** ***Aqua Board used as external sheathing board with EIFS with cavity***

Note: Internal lining can be either single or double layer, standard boards or fireboards.

### External Insulated Façade Systems (no cavity)

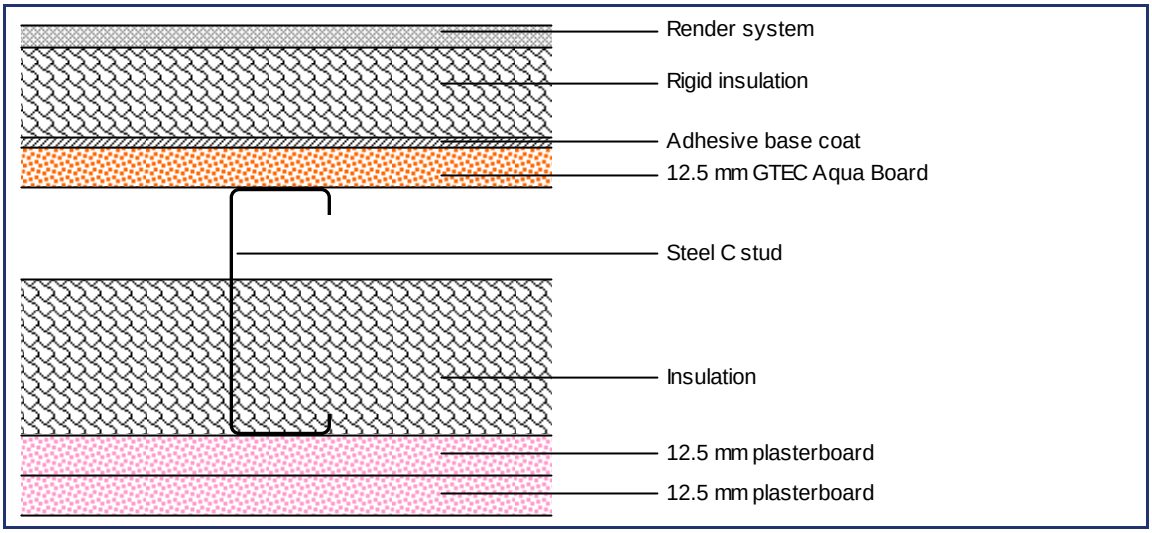



**Figure 4.2** ***Aqua Board used as external sheathing board with EIFS***

Note: Internal lining can be either single or double layer, standard boards or fireboards.

## 4.2 Direct render systems

### Direct Render Systems (no cavity)

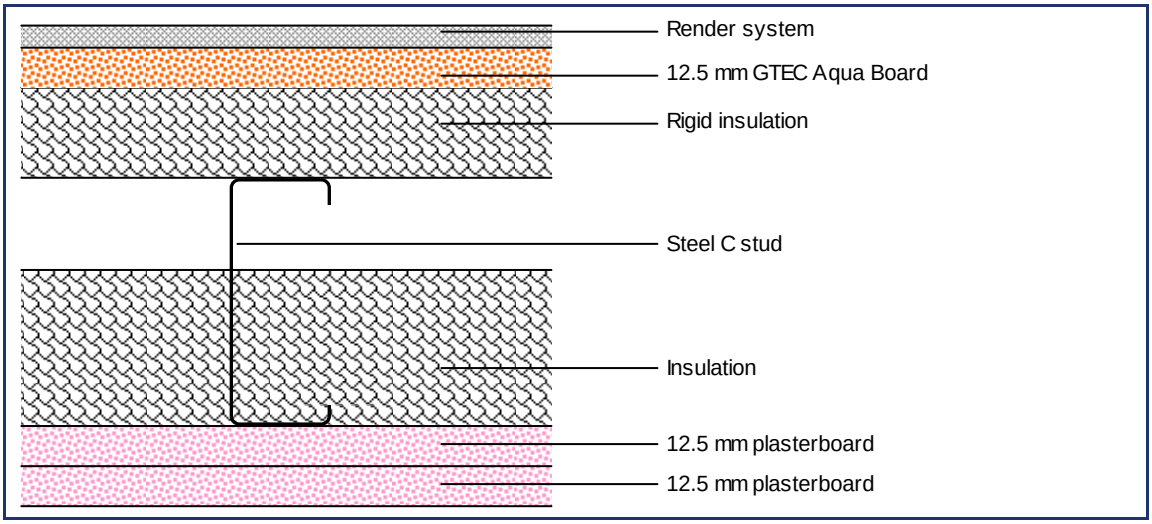



**Figure 4.3** ***Aqua Board used as external sheathing board with EIFS with cavity***

Note: Internal lining can be either single or double layer, standard boards or fireboards.

### Direct Render Systems (with cavity)

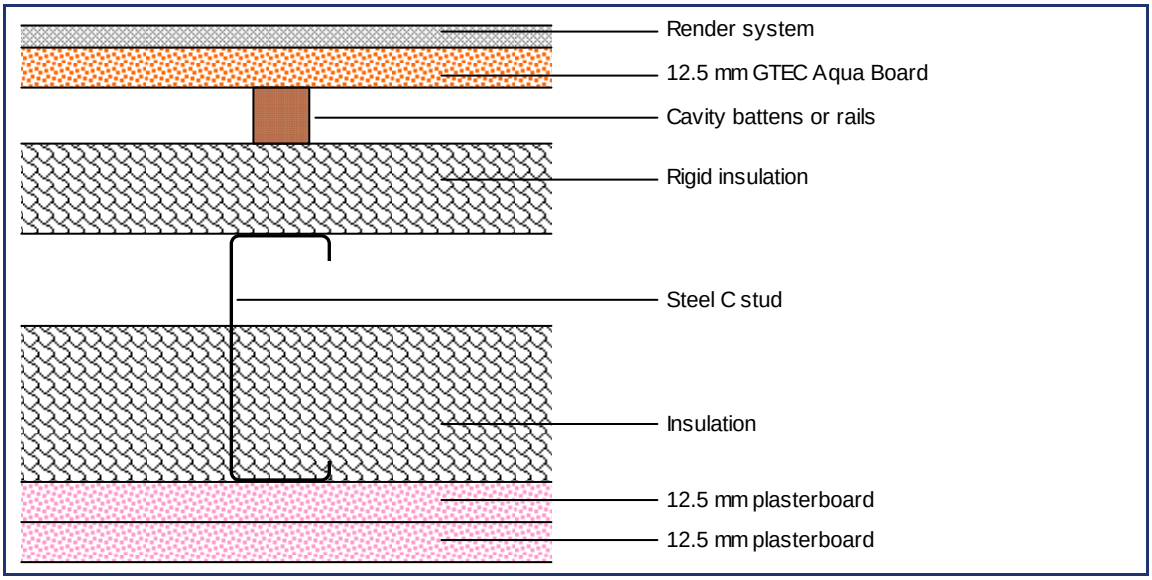
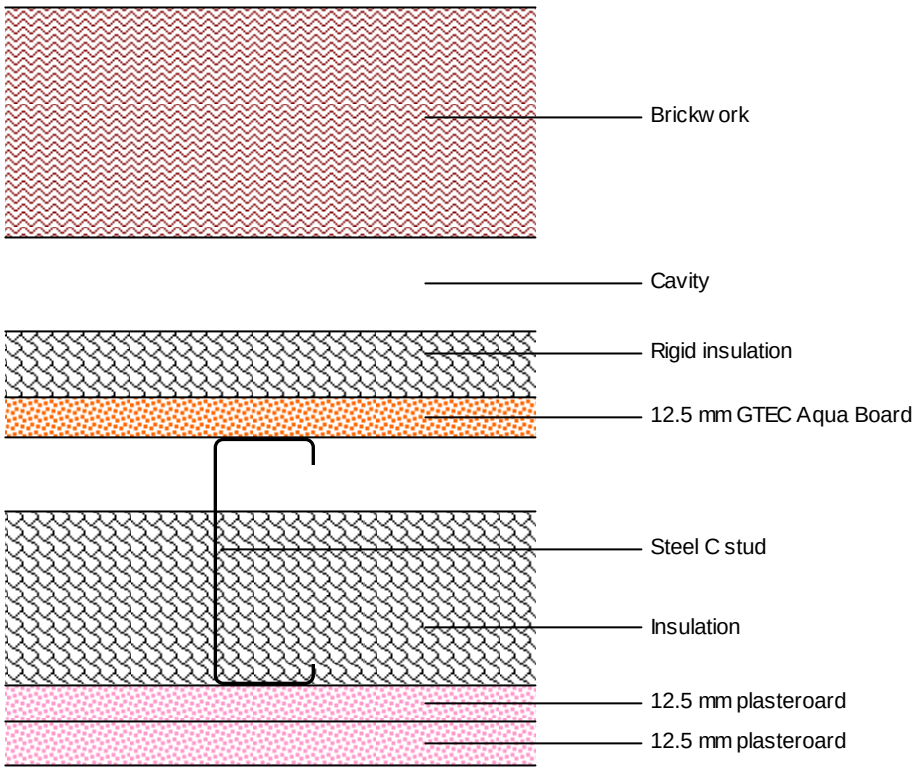



**Figure 4.4** ***Aqua Board used as external sheathing board with EIFS with cavity***

Note: Internal lining can be either single or double layer, standard boards or fireboards.

## 4.3 Other claddings

### Brickwork cladding




Note:
Brickwork wall ties (not shown) are fitted into vertically 'runners' that are fixed, through the Aqua Board, directly to the steel C stud.

**Figure 4.5** ***Aqua Board used as external sheathing board with brickwork cladding***

Note: Internal lining can be either single or double layer, standard boards or fireboards.

### Brick slips (with cavity)

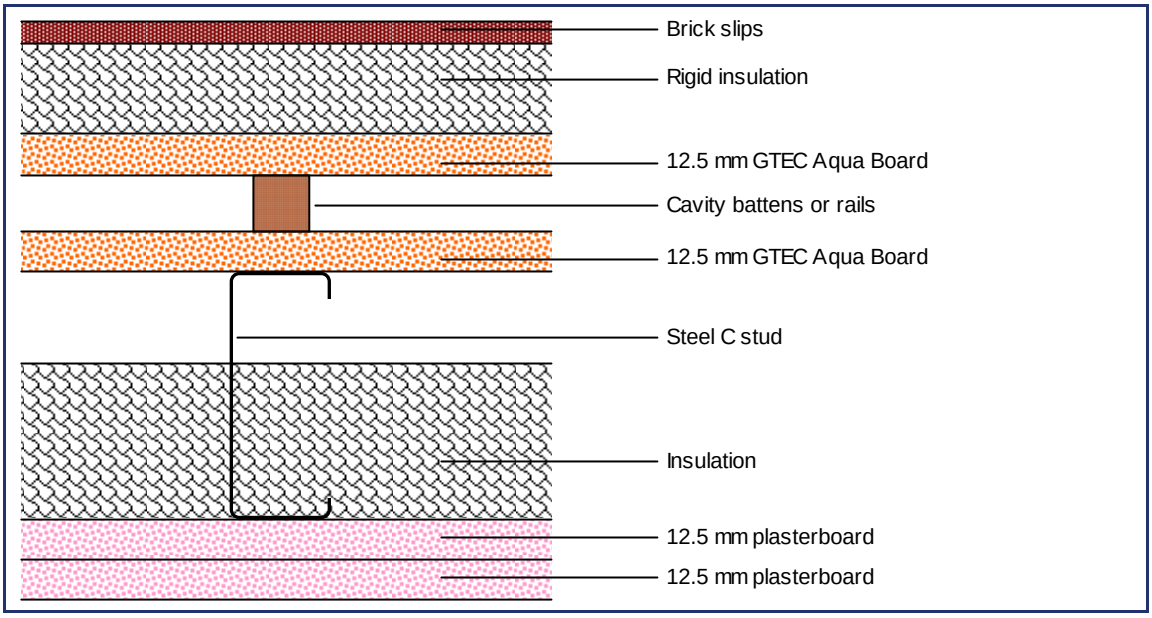



**Figure 4.6** ***Aqua Board used as external sheathing board with brick slips***

Note: Internal lining can be either single or double layer, standard boards or fireboards.

### Brick slips (without cavity)

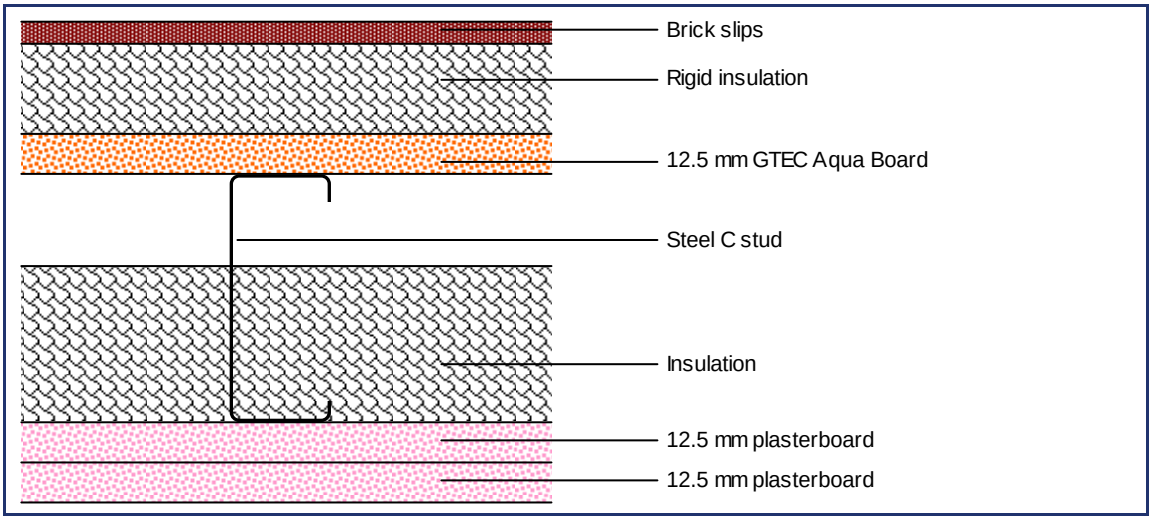



**Figure 4.7** ***Aqua Board used as external sheathing board with brick slips***

Note: Internal lining can be either single or double layer, standard boards or fireboards.

### Rainscreen cladding

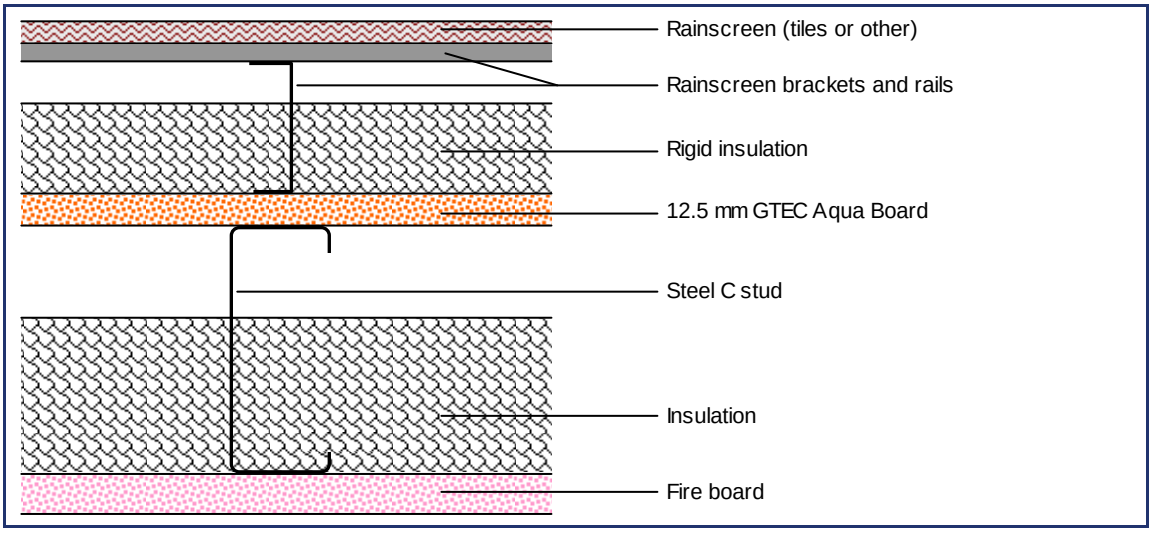



**Figure 4.8 *Aqua Board* used as external sheathing board with rainscreen cladding**

Note: Internal lining can be either single or double layer, standard boards or fireboards.

# 5 Regulations

## 5.1 Sound

Part E of the Building Regulations for England & Wales deals with the resistance to the passage of sound in buildings. The regulations require that buildings must be constructed so that:

- The transmission of sound is limited form other parts of building and adjoining buildings
- Reverberation of sound in common parts of a building is limited
- Acoustic performance of schools is suitable.

The acoustic insulation provided by external walls is not directly covered by Building Regulations. Buildings such as schools, hospitals and office buildings may require a certain level of acoustic insulation from the external wall to limit the amount of external noise (e.g. traffic noise) from entering the building. The requirement will depend on the building type and the external noise levels; typical values of required noise reduction are 45 to 55 dB.

## 5.2 Fire

Part B of the Building Regulations for England & Wales deals with fire safety. The regulations require that buildings must be constructed so that if a fire occurs:

- The occupants are able to escape to a safe place.
- Fire spread over the internal linings of the walls and ceilings is inhibited.
- Stability is maintained for a sufficient period to allow evacuation of the occupants and access for fire fighting.
- Fire spread within the building and from one building to another is kept to a minimum and satisfactory access and facilities are provided for fire fighters.

One of the main reasons for providing external walls with fire resistance is their proximity to the site boundary. As the distance to the site boundary increases, the proportion of the wall area that may be unprotected also increases. Any part of an external wall not having the required fire resistance, such as a window, should be regarded as unprotected when assessing the adequacy of the distance of the wall from a site boundary.

External walls should either meet the guidance given Tables A1 and A2 of Approved Document A.

The required fire performance for the external wall will depend on the building size, use and proximity to a boundary. If the wall is less than 1m from the boundary then fire performance is required from inside to outside and from outside to inside. If the wall is more than 1m from the boundary then fire performance is only required from inside to outside.

Insulation values of 15 minutes to 60 minutes are typical but higher values may be required in some cases.

Integrity and load-bearing values of 30 minutes to 60 minutes are typical but higher values (up to 120 minutes) may be required in some cases.

For an external wall 2m from a boundary on a 4 storey residential building, insulation must be greater than 15 minutes, integrity and load-bearing must be greater than 60 minutes.

Depending on the building size, use and proximity to a boundary there are requirements for the external surface of an external wall. For example where a building is less than 18m tall and closer than 1m to a boundary, the external surface must be European Class B or better.

## 5.3 Thermal Insulation

Part L of the Building Regulations for England & Wales deals with energy efficiency and thermal insulation.

The 2006 revision of Approved Document L differs from the previous approach in that building designers are required to demonstrate an improvement in energy performance compared with the requirements of the 2002 Regulations, but they are given the freedom to choose how to achieve this improvement. The energy performance is quantified in terms of the CO2 emissions associated with the operational energy requirements of the building.

New Approved Documents for Part L were published in March 2010 and will replace the current editions on 1 October 2010. These new documents continue the trend of reducing the operational energy used in buildings. Many of the changes in the new documents are aimed at improving compliance and more clearly distinguishing between requirements and guidance.

The energy requirements are a function of many aspects of the building design, such as the detailed design of the cladding, the availability of natural light and the type and efficiency of building services installed.

Typical requirements for external walls are U-vales of 0.25 $W/m^2K$ and below.

## 5.4 Protection against moisture

Protection against moisture is covered by Regulation C2 of Part C of the Building Regulations for England & Wales.

The systems incorporating Aqua Board resist the passage of moisture from the ground and from weather. Any water collecting in a cavity due to rain or condensation will be removed by drainage and ventilation with the provision of suitable detailing.

## 5.5 Durability

Durability is in part covered by Regulation 7 – Materials and Workmanship. Durability is also addressed by specific requirements (e.g. NHBC Standards) and is covered by system certifications. The durability of the systems incorporating Aqua Board is included in the BBA Certificates that have been obtained.

The durability of light steel framing in a range of different applications and environmental conditions is presented in SCI publication P262 (Second Edition)[37].

## 5.6 BBA Certification

Two external wall systems incorporating Aqua Board have BBA Certificates (Certificate Number 10/4725 Product Sheet 1 and Product Sheet 2). These BBA Certificates describe how the systems can satisfy the Building Regulations in the UK. The key factors assessed are:

- Strength and stability
- Performance in relation to fire
- Weather tightness
- Water absorption
- Durability.

# 6 Case Study

## 6.1 Residential Development, Farnborough, Surrey

Aqua Board was used successfully as an external sheathing board on a project in Farnborough, Surrey in 2009 (see Figure 6.1).

**Figure 6.1 Residential Development, Farnborough, Surrey**

A 3 storey residential building in light steel framing was built over a Sainsbury's supermarket in Farnborough, Surrey. The residential part consists of 72 apartments for private and social housing which were constructed in load bearing light steel framing. The upper floors are supported on a composite steel-concrete podium and one of the design criteria was for a lightweight, robust super-structure that minimised the load on the podium level. The load-bearing facade system uses *Thruwall*, which consists of 100 mm deep x 1.6 mm thick steel C sections (by Advanced Cold Formed Steel Sections), which supported the Aqua Board, external insulation and render. Balconies were also introduced, which are supported by square hollow section posts integrated into the facade walls.


**Figure 6.2 Wall detail showing build up of layers**

The internal structure uses light steel cross-walls using 100x1.6 C sections which support 300 mm deep C section floor joists that span up to 6m. The cross-walls were braced to resist wind loads (see Figure 6.3).

A novel 50 mm deep composite floor system using Lafarge's *Gyvlon* floor screed was placed on shallow steel decking and achieved the stiffness, acoustic insulation and fire resistance requirements, whilst still using a lightweight construction technology. The light steel framing was installed at rate of one floor every 2 weeks.

The Aqua Board provided a weather tight building envelope early in the construction process. The *Gyvlon* floor screed was then placed in dry internal conditions off the critical path. No movement joints in the facade were required and a high degree of surface accuracy was achieved. It was completed in early 2010. A view of the residential building over the roof of the extended podium is shown in Figure 3.4.

**Figure 6.3 Internal light steel bracing and external walls sheathed with Aqua Board**

**Figure 6.4 Residential building over the roof of the extended podium**

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