Passivhaus Object Documentation

Richmond Hill Primary School, Clark Crescent, Leeds, Yorkshire, LS9 8QF

United Kingdom

Project ID: 2753

Project Designer - Space Architecture **www.spacegroup.co.uk**
PHPP, envelope design and detailing – David A Savage
Project Architect – Carinna Gebhard
Client/Owner: Leeds City Council, Built Environment, Children's Services
Main contractor: Interserve Construction Ltd
Building Services: Hoare Lea
Structural and Civils: Billinghurst George & Partners
Passivhaus Certification: Warm Associates
SIPs Contractor: McVeigh Ltd. (Hemsec Panel Technologies)
Windows and Curtain Walling: AM Profiles (Gutmann windows and Raico curtain walling).

The project formed part of an existing design and build framework agreement under an earlier Building Schools for the Future PFI procurement. The project comprised a new build three form entry primary school plus nursery and ASC (Autistic Spectrum Condition pupils) Unit. Total number of pupils including staff – 762 persons.

Treated Floor Area: 3,454.1m² (Passivhaus standard)
Gross Internal Area (GIFA): 4010m² (UK standard)

U-value exterior wall - 0.11 W/(m²K)	PHPP Specific space heating demand – 10.6 kWh/(m²a) - monthly method
U-value roof - 0.07 W/(m²K)	
U-value floor slab - 0.06 W/(m²K)	PHPP Specific primary energy demand – 112kWh/(m²a)
Average U-value windows - 0.97W/(m²K)	
Heat recovery – 80%	Final Pressure Test - 0.25h^{-1}

2.2 Short Description of Construction

The building is a combination of two and single storey steel framed with timber SIPs panel construction to walls and roof. All envelope options were thermally modelled and SIPs panels offered the best solution in terms of performance whilst reducing risk and optimising quality control. Balancing the educational needs and requirements together with the most efficient envelope design were the biggest challenges. However the 'Form Factor' increased the need for improved U-Values.

The contractor imposed a strict quality control regime on site during the construction of the airtight envelope. Great care was taken during the ground works to ensure all rigid insulation boards (EPS and Foamglass) were neatly and tightly fitted. The envelope sub-contractors were involved early in the process and established a 'buy in' to the Passivhaus principles. A 'permit to penetrate' procedure was instigated for all following trades and sub-trades to ensure that the integrity envelope was not compromised.

Special features: BREEAM Very Good rating. Fully sprinklered building to meet insurer's requirements, no requirement for renewables to be utilised and a specific requirement for no bio-mass to be adopted. All curtain walling and window glazing to meet Secured by Design standards.

Abnormals: Contaminated ground and piled foundations up to 25 metres deep. Re-provision of rugby league club pitch, associated fencing and spectator barriers.

2.3 Pictures of Elevations

SIPs installation complete and window installation ongoing.

Completed school viewed from south west

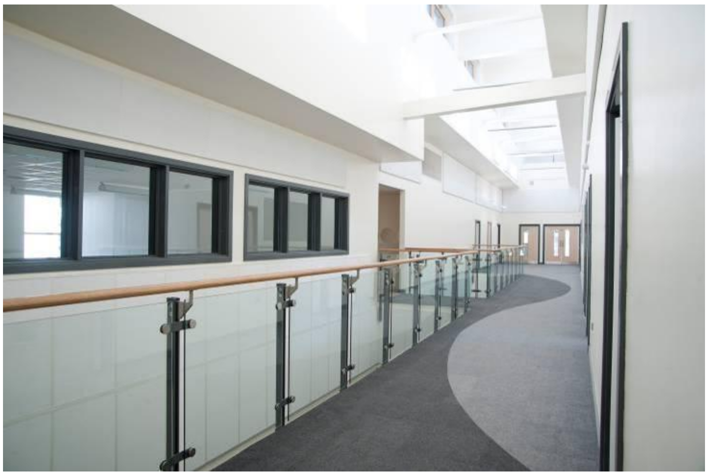
SIPS panel erection February 2012


Completed school viewed from south east


Early Years Courtyard

South Facade

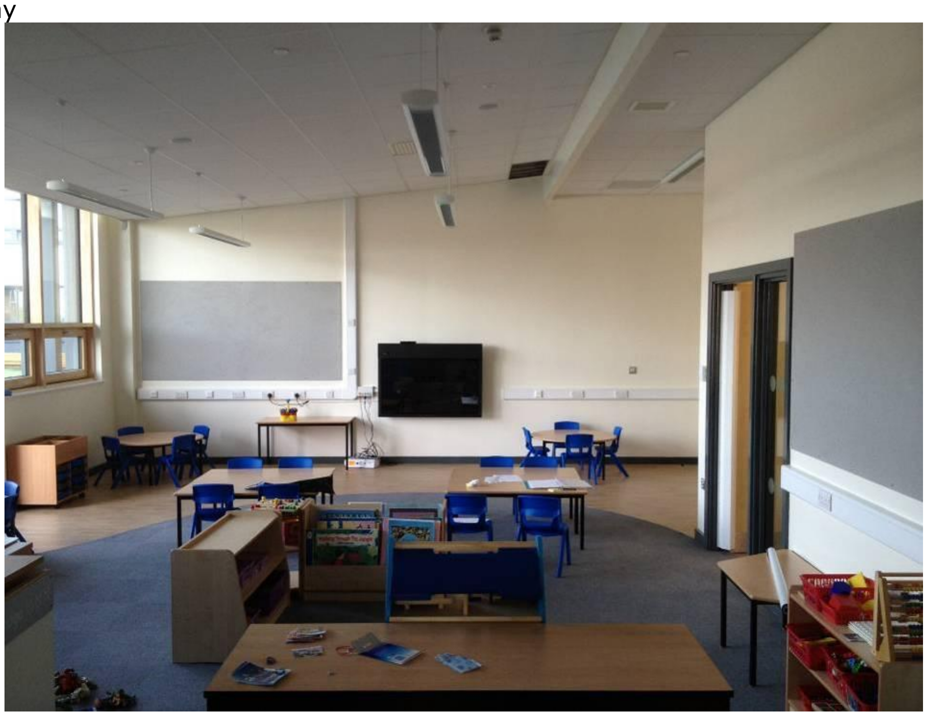
2.4 Pictures of Interiors



First Floor Gallery and break out space

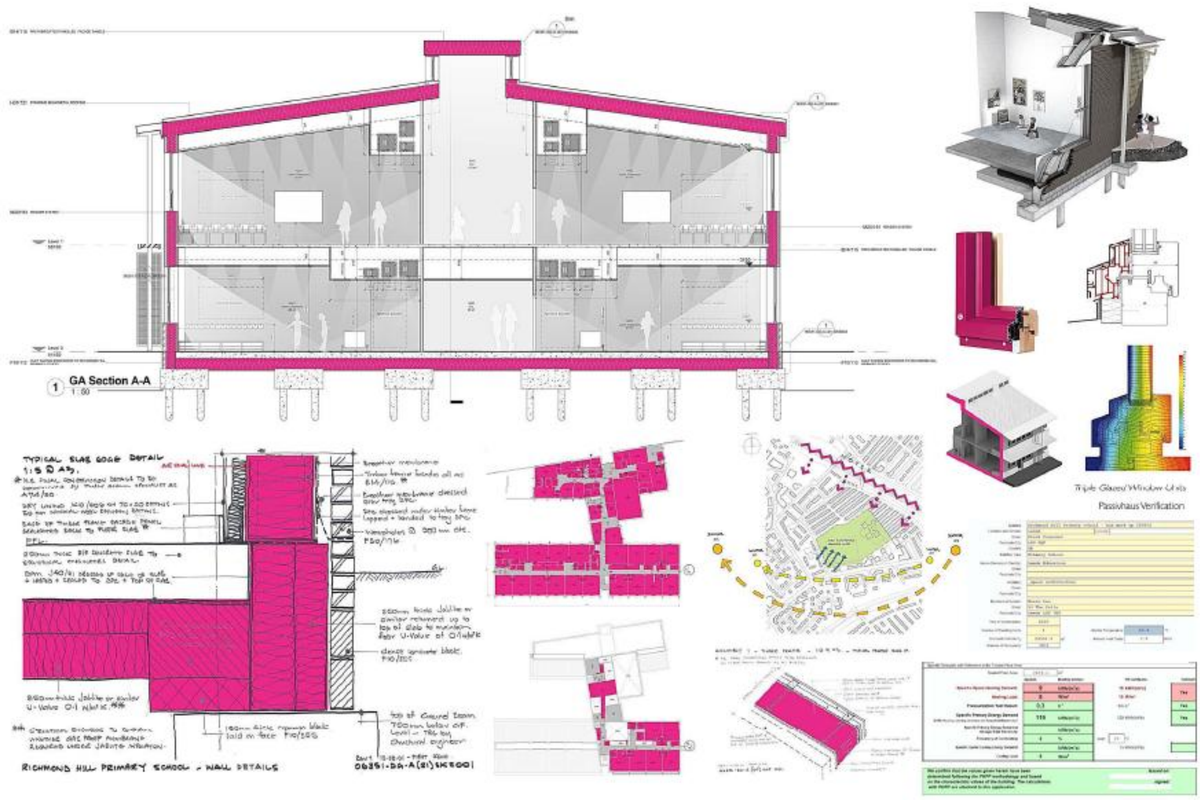
Ground Floor Group teaching spaces

Practical Bay

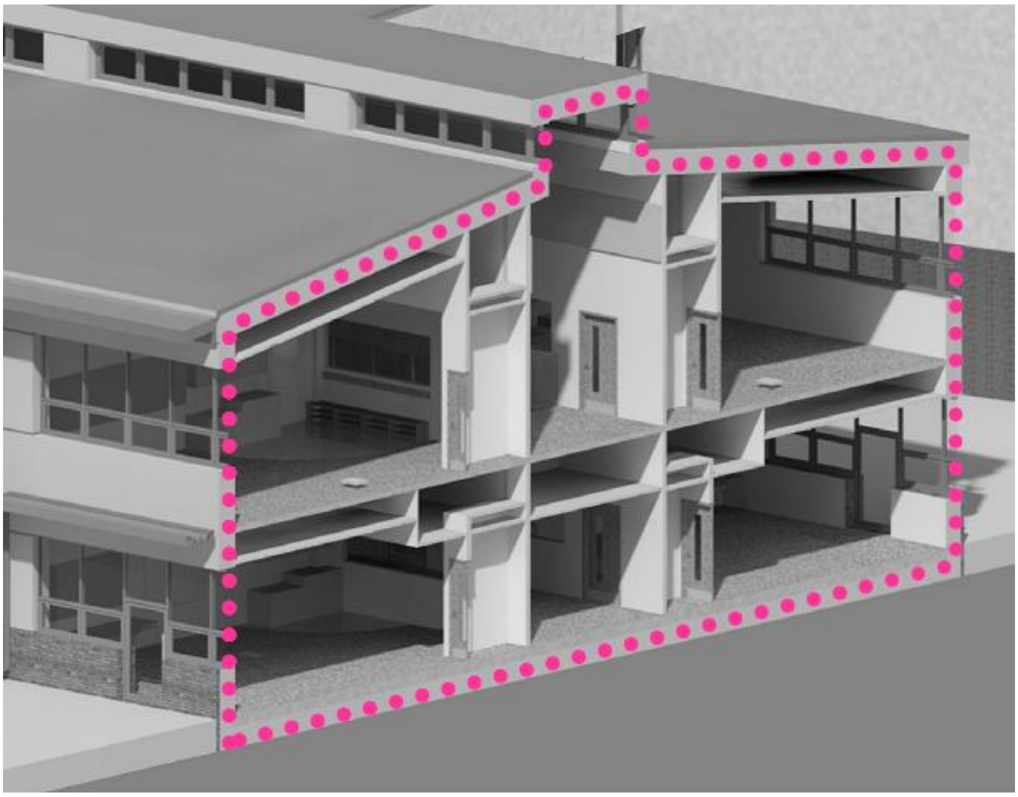


Teaching space

2.5 Cross Sections

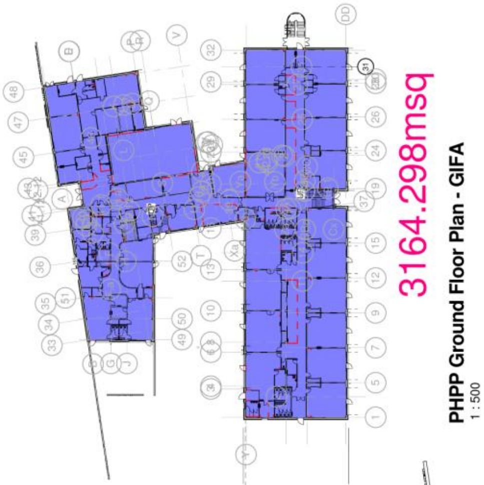


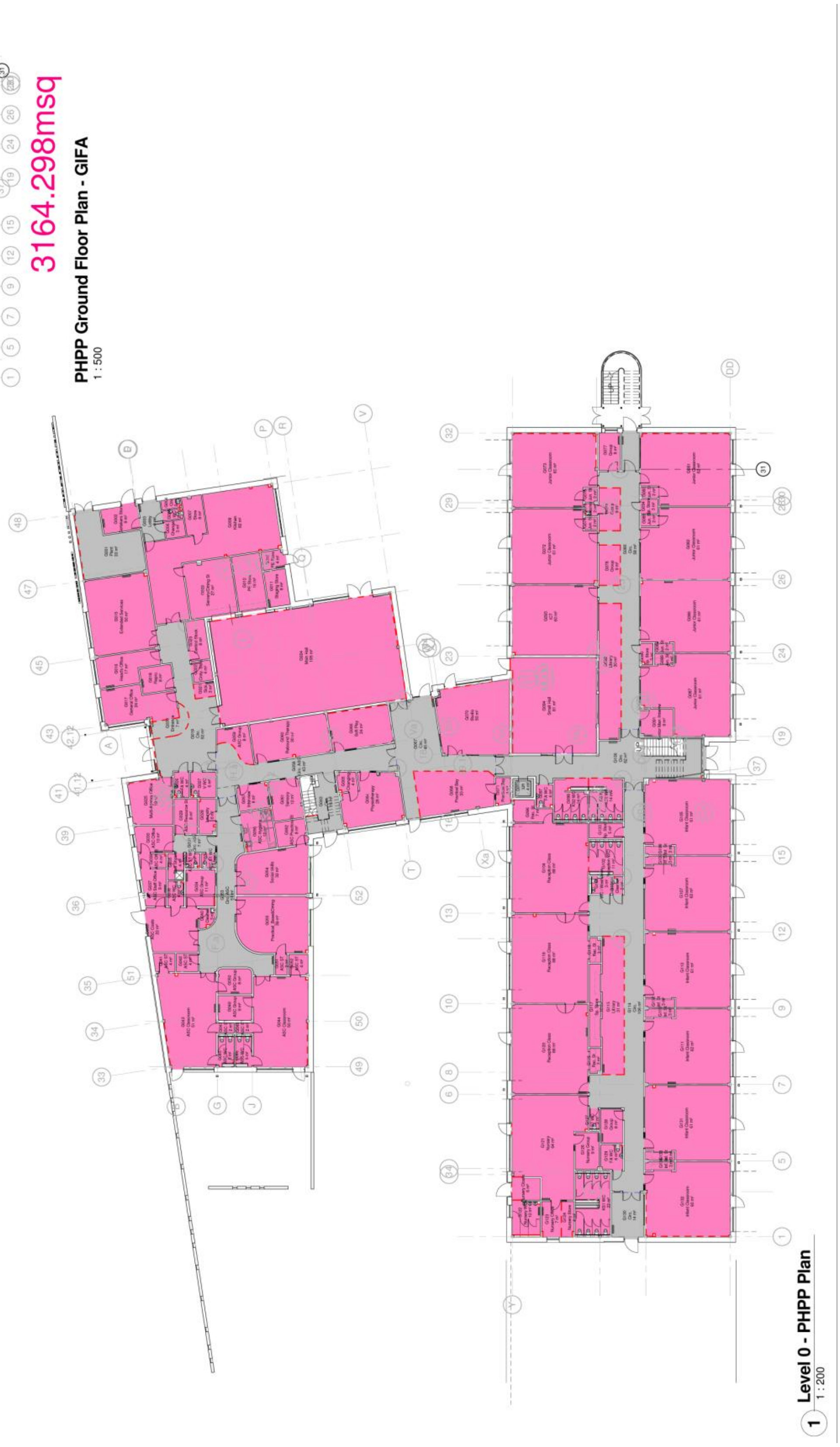
Stage D Schematic design presentation illustrating Passivhaus principles



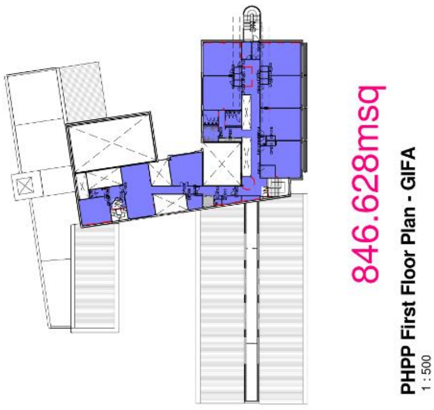
Cut away of REVIT model indicating the air seal line and integration of ceiling bulkheads for ventilation ducts and services.

2.6 Floor Plans





Ground Floor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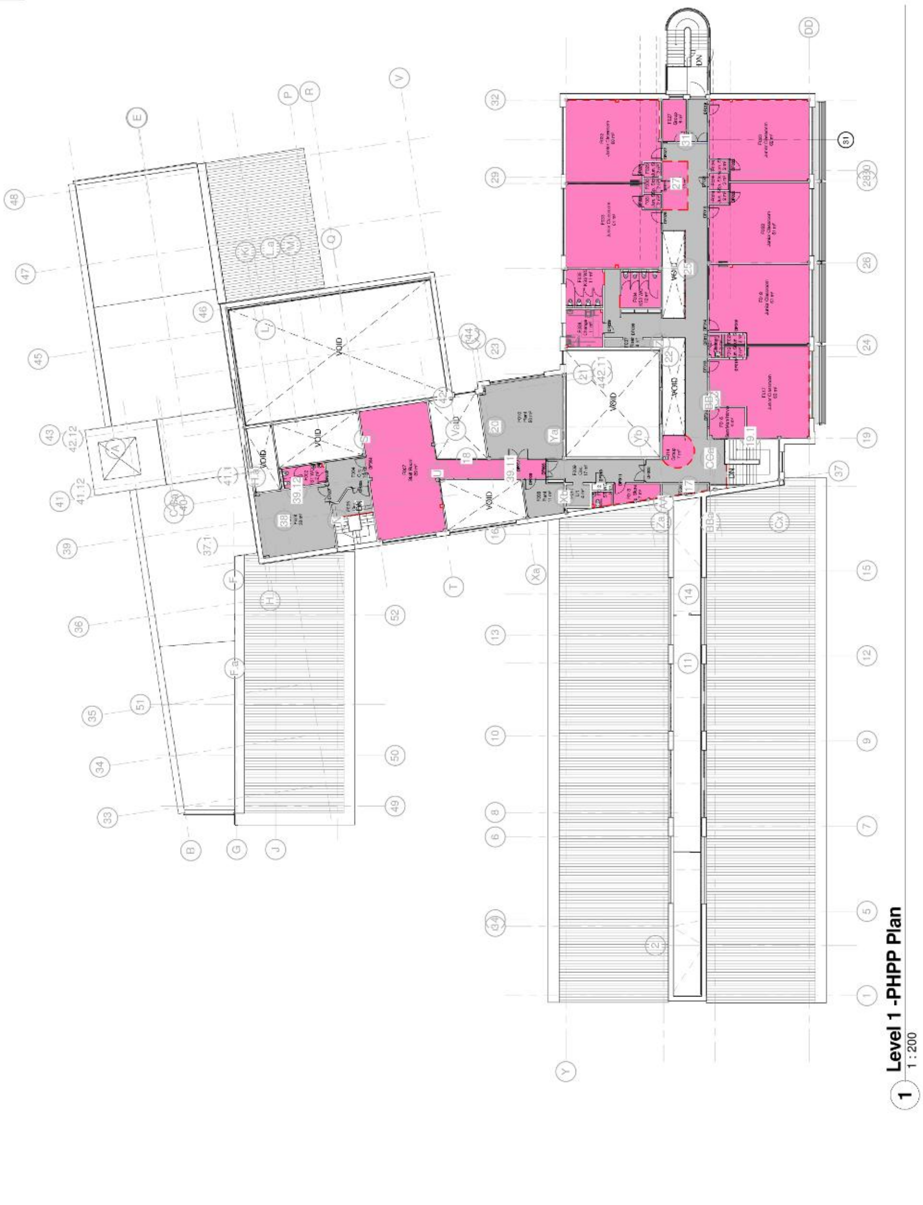
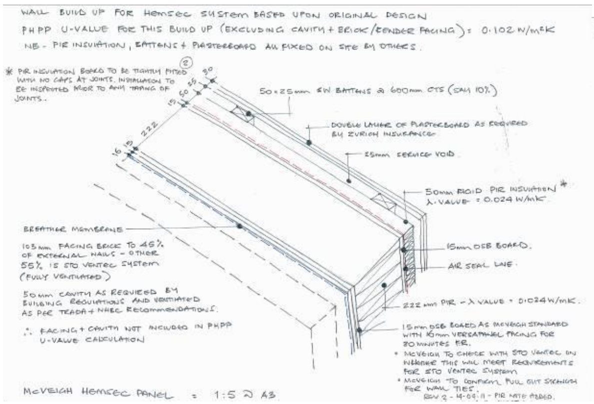
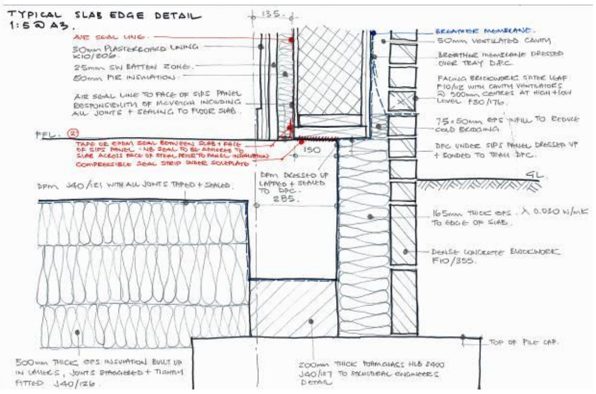
PHPP First Floor Plan - GIFA
1 : 500

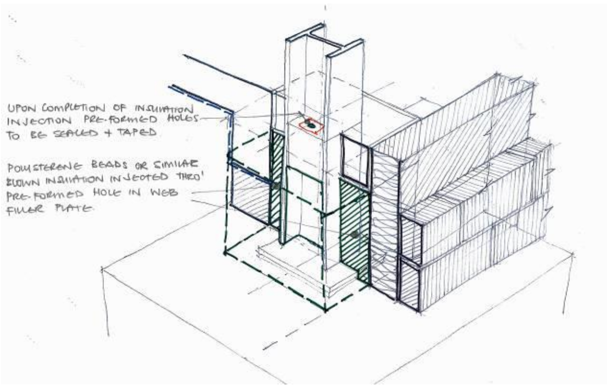

VOID
Level 1 -PHPP Plan
1 : 200

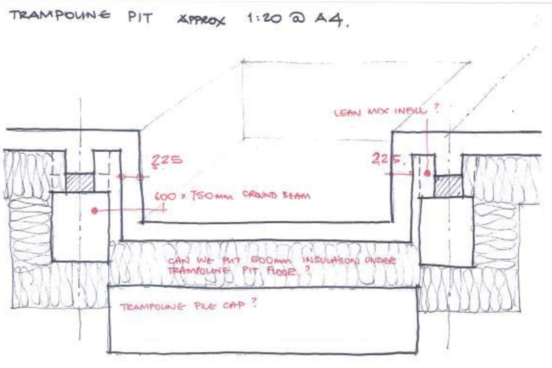
First Floor

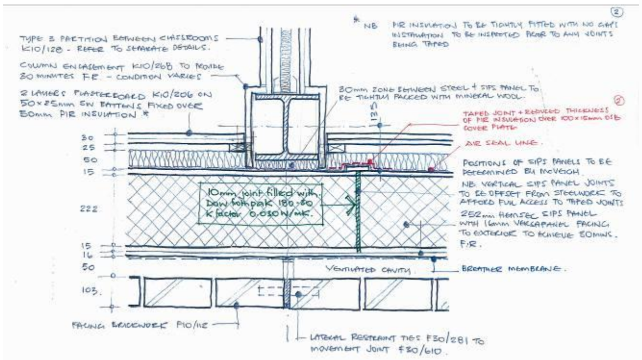
2.7 Construction Details

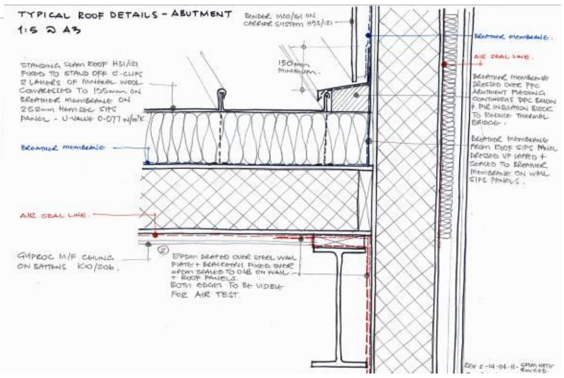








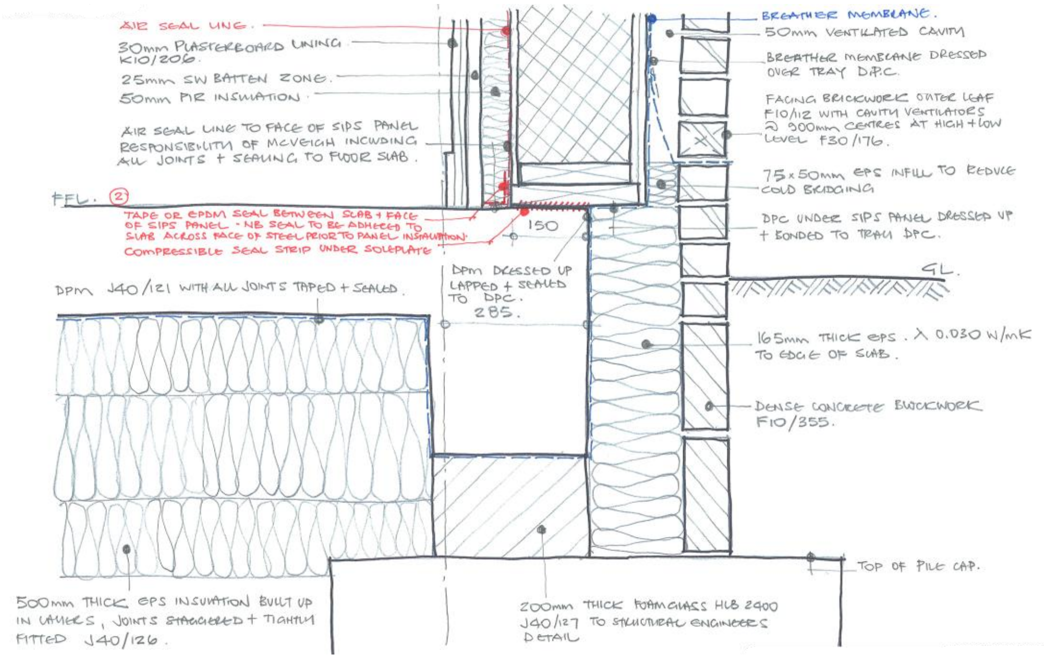




2.7.1 Detailing

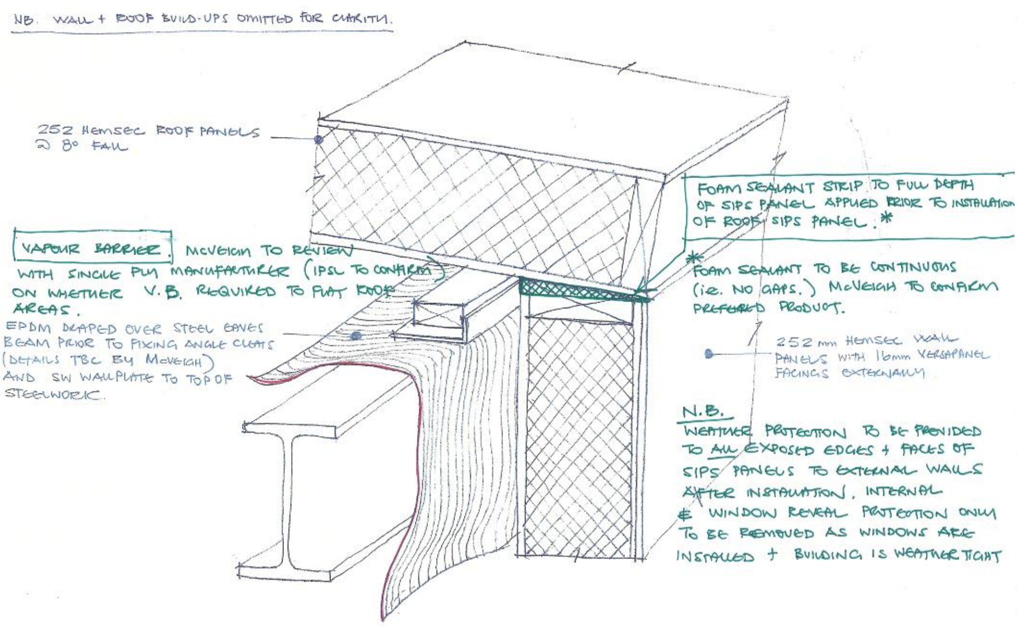
‘God is in the details’ or alternatively ‘the devil is in the details’. Over 1000 sketches / details produced to refine and incorporate the various client requests, manufacturers and specialist’s information or needs. More than 50 iterations of the PHPP calculations produced to incorporate differing conditions, materials and systems. Perhaps too many ‘what ifs’

2.7.2 Slab edge / ground beam



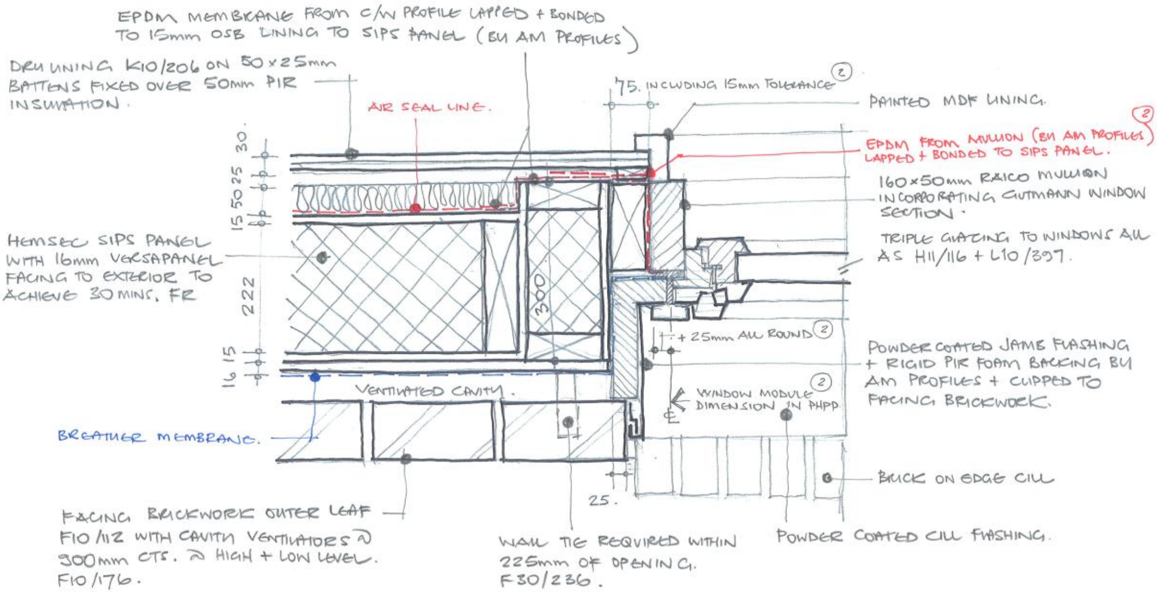
Varying conditions to perimeter of slab edge and incorporation of a load bearing thermal insulation between slab edge and ground beam presented the greatest challenge in terms of thermal bridging.

2.7.3 Eaves Detailing

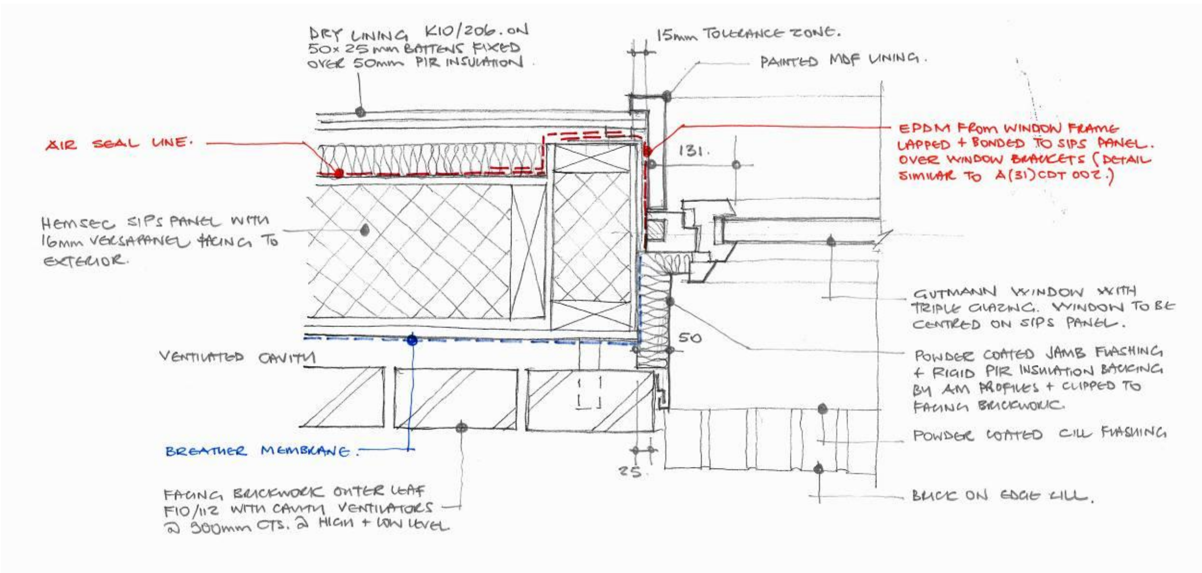


Sequencing of operations agreed with envelope contractors to ensure that EPDM seals are incorporated at the correct stage and fully sealed post installation.

2.7.4 Window Detailing



Gutmann window in Raico curtain walling system



Gutmann window in masonry opening

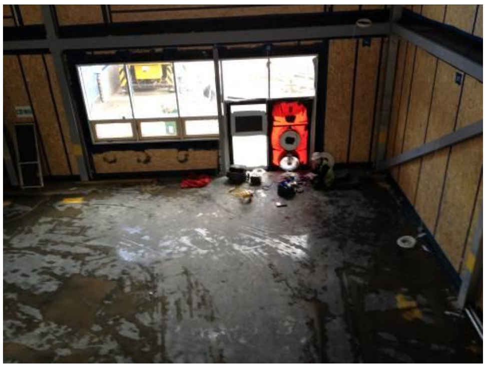
Sequencing of operations, scope of works and responsibilities agreed with envelope contractors to ensure that EPDM seals are incorporated at the correct stage and fully sealed post installation. Ancillary flashing and trim fixings were designed to allow the external wall finish to be installed / erected after windows were installed into SIPs and fully air tested.

2.7.5 Description of the air tight envelope

The SIPs panel system allowed the airtight envelope to be erected very quickly and to a high degree of quality control. This enabled the windows and curtain walling to be installed in advance of external facings.

An initial air test was carried in February 2012 on the single storey KS1 block which produced a result of 0.41 air changes – i.e. 33% improvement on PH minimum requirement. A full (SIPs) envelope test was then carried out in March 2012 and the test result was 0.20 air changes.

The final air test was carried out in July 2012 when the internal fit out was completed established an air change rate of 0.25 or the equivalent of 0.5 $m^3/m^2/hr$. This test was carried out with the MVHR systems in place with no additional temporary sealing carried out.



hrs SERVICES LIMITED

AIR PERMEABILITY TEST CERTIFICATE

This is to certify that an air tightness test was carried out at:

RICHMOND HILL PRIMARY SCHOOL
CLARK CRESCENT
LEEDS
LS9 8QF

The test was carried out on 10.07.12 in accordance with ATTMA TS1.

The following air permeability was determined at 50Pa:

$0.50m^3/(h.m^2)$

Client: Interserve

UKAS TESTING
2587

Name	Position	Signature	Date
Ruth Harrison	Reports Manager	R Harrison	12.07.2012

To be read in conjunction with relevant test report

Page 10 of 10
Richmond Hill Primary School HRS
Air Test Report 109430 20120710

HRS Services Ltd
81 Burton Road
Sheffield S3 8BZ

Tel 01142723004
altas@hrsservices.co.uk

Photographs of second stage air test in March 2012 and air test certificate for final stage air test.

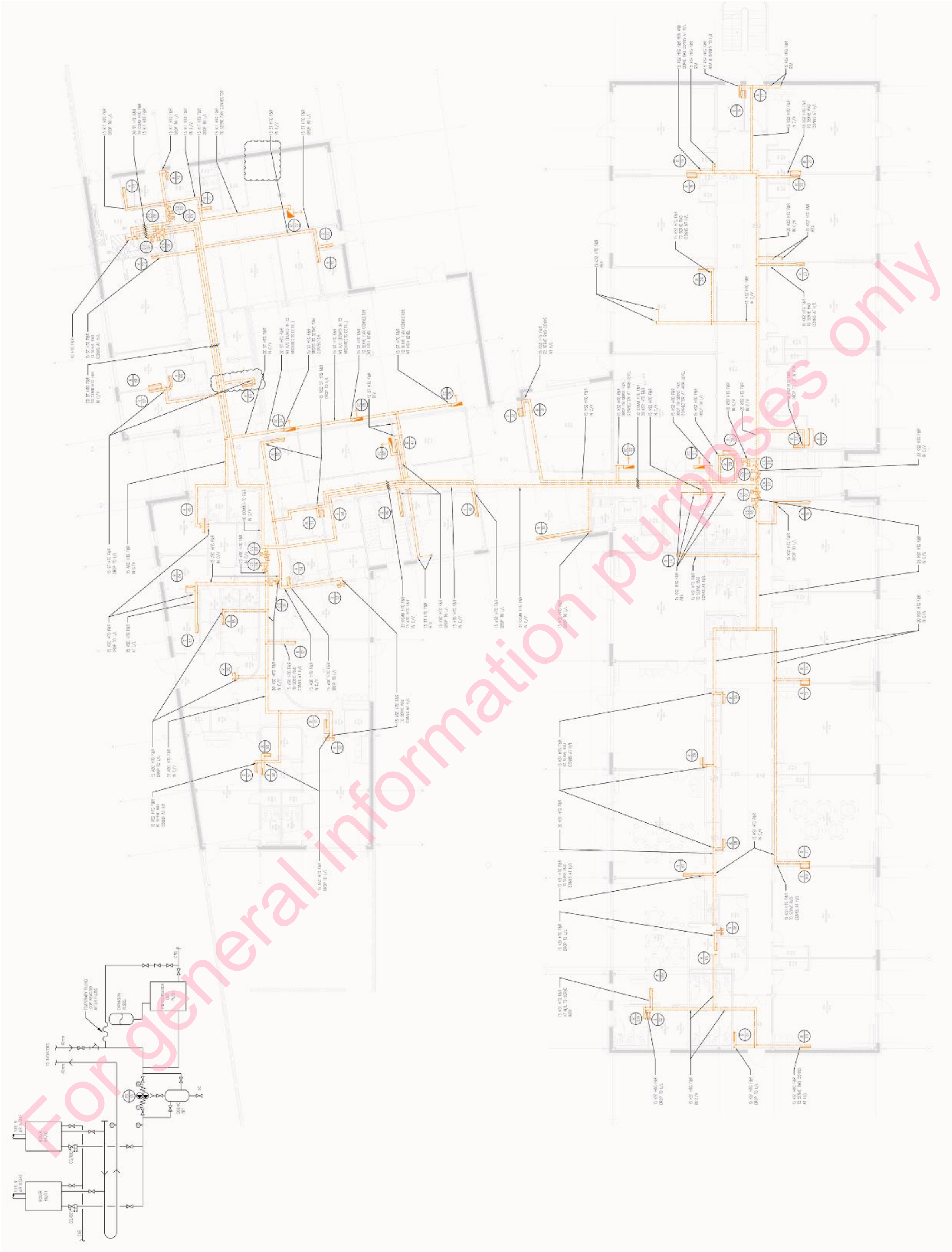
2.7.6 Ventilation duct layout

The building was zoned for the ventilation of the building accommodation with two first floor plant rooms and internal roof plant containing MVHR Units that served the teaching spaces, communal areas and Kitchen. Supply and return ducts were located in Classroom bulkheads with ductwork sizes and routes arranged for optimum performance.

2.7.7 MVHR installation

The MVHR units were located within the thermal envelope and immediately adjacent to the external envelope to minimise any heat losses. The Kitchen was provided with its own dedicated MVHR to deal with gas cooking and other equipment catering for all of the school.

2.7.8 Heating system

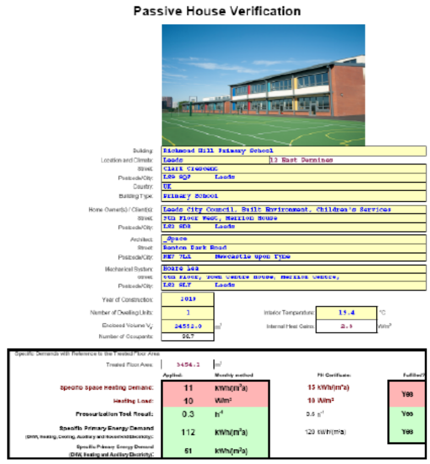


Centralised high efficiency gas fired boilers located in the Ground Floor Plant Room provide heating via low temperature radiators fitted with low surface temperature covers. The same boilers also provide hot water regulated by point of use thermostatic mixing valves. Sinks to classrooms and toilet areas were centralised along the central spine and stacked vertically to minimise pipe runs.

2.8 PHPP results

The biggest 'risk' identified for the contractor was the air tightness of the envelope as described above. In reality we exceeded expectations in terms of air tightness such that it took the pressure off other envelope performance issues such as thermal bridging via the piled foundations. The other and perhaps more pressing issue was the Primary Energy Demand and the following factors that could prejudice achieving the 120kWh/(m²a):-

- Sprinkler system requirements for heating the storage tank and the pump house.
- ICT equipment requirement for teaching (hardware performance and overhead projectors).
- All pupil wash basins to have a hot water supply (not typical in European Schools).



2.9 Construction costs per treated floor area:

The total contract cost including abnormals was £8.7 million (approx. €10.7 million based on current exchange rates). Excluding abnormals the total cost was £8 million (approx. €9.8 million) which equates to £2,316/m² (approx. €2.842/m).

2.10 Cost for the building

Based upon the total cost excluding abnormals the cost per square metre based upon GIA (4010m²) which is the UK standard method equates to £1,995/m² (approx. €2,448/m²).

2.11 Year of construction

Design commenced early in 2010 and the building handover was achieved in September 2012.

2.12 Architectural Design

Meeting the educational needs for the teaching spaces and the ASC unit dictated the ground floor footprint and as a consequence it was not possible to optimise the building form by adopting a full two storey building. Other factors that needed to be taken into consideration and incorporated into the design were existing ground contamination issues, Planning constraints, Sport England recommendations, Secured by Design and fire / insurers requirements.

2.13 Building Services

The manufacturer of the MVHR units (80% efficiency) obtained confirmation of certification during construction such that the 12% reduction was not a factor, albeit the Specific Heat Demand could have been achieved in light of the level of air tightness achieved. The building arrangement was such that the possibility of naturally ventilating during the summer months was not an option and consequently the ventilation system is designed to run all year.

2.14 & 2.15 Structural Considerations

The ground conditions presented a major challenge in terms of minimising thermal bridging via the ground beams and piled foundations. Foamed glass insulation was incorporated at each ground beam location to minimise thermal losses and these were modelled to establish the Ψ values incorporated into the PHPP.

A structural steel frame was adopted for the superstructure as this was considered to offer the greatest user benefits in terms of 'future flexibility'.

2.16 User Experience

The building has only recently achieved completion but senior leadership have been consulted during the design as part of a DQI process. The feedback from the client, staff, parents and pupils after handover has been positive.