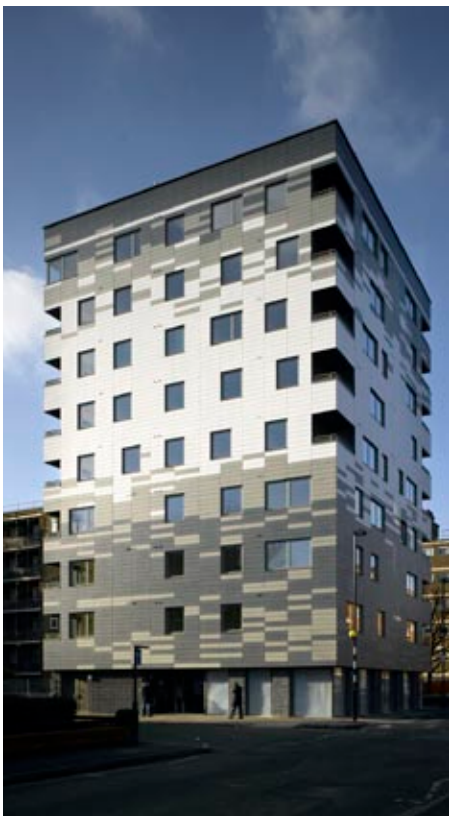
Stadthaus, 24 Murray Grove, London

Eight storeys of apartments featuring cross-laminated timber panels



Project information

Completion date:	2009
Building type:	Multi-storey apartment block
Location:	Hackney, London
Client	Telford Homes PLC and Metropolitan Housing Trust
Architect:	Waugh Thistleton Architects
Structural Engineer	Techniker
Main Contractor:	Telford Homes
Timber supplier and erector:	KLH UK
Timber elements:	Solid wood panels for floors, roof, internal and external walls, lift and stair cores
Timber species:	Spruce
Awards	Wood Awards 2008
	Timber in Construction Awards 2008
	Timber Journal Awards 2008

Introduction

There is nothing in the building regulations that prohibits high-rise timber buildings, although the practical limit (and current code limitation) for stud wall timber frame is seven storeys. The Stadthaus (German for townhouse) is – with eight floors of timber structure – the tallest habitable timber building in the world. And architects and structural engineers are already working on timber buildings that will be considerably taller.

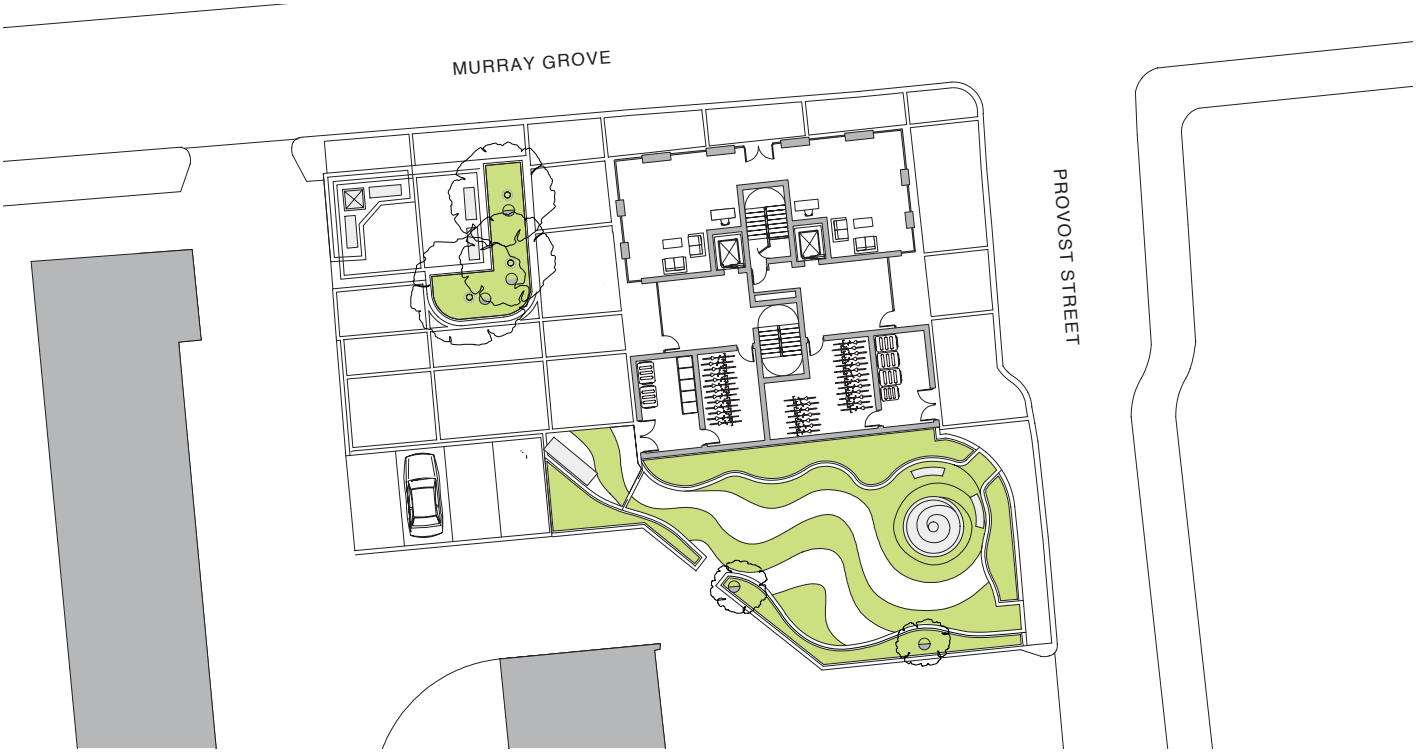
The building is insulated and airtight beyond UK requirements. Mechanical ventilation of all rooms includes a heat recovery system that retains 70% of the heat that would normally be lost when return air is expelled. Photovoltaic (PV) panels on the roof generate a modest supply of renewable energy.

With sustainability high on the agenda, the design meets the Lifetime Homes standard and includes a green-wall wrapping on the southern elevation of the building to encourage local biodiversity. A variety of new shrubs and trees will create an ecologically sustainable 'pocket' park.

The development includes a landscaped playground for children on the south side, which parents can overlook from half the apartments.

The unusual feature is the cross-laminated timber (CLT) panels used as load-bearing walls and floor 'slabs'. There are no beams or columns anywhere and the structure is amenable to openings being created in walls with relative ease. The architects and engineers had prior experience of CLT, gained through a variety of low rise housing, commercial, educational and industrial projects. Their interest in using CLT arose from an 'environmental' position and a desire to make timber more readily accepted in the UK, especially for tall structures that have hitherto been feasible only with inorganic building materials such as concrete, masonry and steel.

Site Plan



Building description

The Stadthaus, comprising 29 apartments (in 1, 2, 3 and 4-bedroom designs), is effectively divided into two sections that are independently owned, accessed and serviced. The floor plans show how this is achieved. The local residents association has an office at ground level and the Metropolitan Housing Trust has apartments on levels 1, 2 and 3. Levels 4-8 are privately owned. Level 4 marks a change in floor layouts and external elevations.

The building was assembled using a unique structural system pioneered by KLH in Austria, using timber strips glued together (using formaldehyde-free adhesive) in perpendicular layers to form the panels. The bonus with CLT is its tremendous contribution to making construction sustainable. It lowers the energy used in construction, reduces heat loss during occupation by improving insulation and airtightness, and it is also very easy to demolish and recycle at end of life.

There were minimal wet trades in bathrooms and kitchens, and therefore little need to dry out the building. Windows and doors were fitted early to weatherproof the building.

Even the façade, inspired by the work of artists Gerhard Richter and Marcus Harvey, employs wood. Eternit manufactured the 5,000 panels (each 1200mm x 230mm) made up of 70% waste timber. The architects designed the façade by firstly recording the changing light and shadows formed on the vacant site by the surrounding buildings and trees. Then they modelled the pattern through a sun-path animation and, finally, wrapped the pixilated and blurred image around the building. The balconies and windows punctuate the rhythm of the abstract image.

Being a residential construction, the building satisfies building insurers and comes with an NHBC certificate of insurance of the construction itself.

Cross-laminated timber panels

Although commonly used in Continental Europe, cross-laminated timber is a relatively new product in the UK. CLT is the main form of solid wood panels (not all solid wood panels are cross-laminated).

Cross-laminated timber is produced from industrially dried spruce boards which are stacked at right angles and glued together over their layer surfaces in 3, 5, 7 or more board layers. The panels are used as large wall, floor and roof elements, and are manufactured with precision cut-outs for doors, windows and building services.

KLH manufactures three grades: non-visual quality, industrial visual quality and domestic quality for living spaces. In the UK, KLH offers panels up to 14m long and 2.95m wide (limited by transport restrictions).

The solid wood panels make a substantial contribution towards lowering the building's carbon footprint. The designers calculated that had the building been of conventional reinforced concrete construction, it would have incurred an additional 124 tonnes of carbon generated during construction. Adding this to the 188 tonnes of carbon sequestered (locked away) in the 900m^3 of timber in the structure results in a total offset of some 310 tonnes of carbon. This gain, combined with the building being better insulated and more airtight than the Building Regulations demand, convinced the local planning authority to

[Continued page 3]

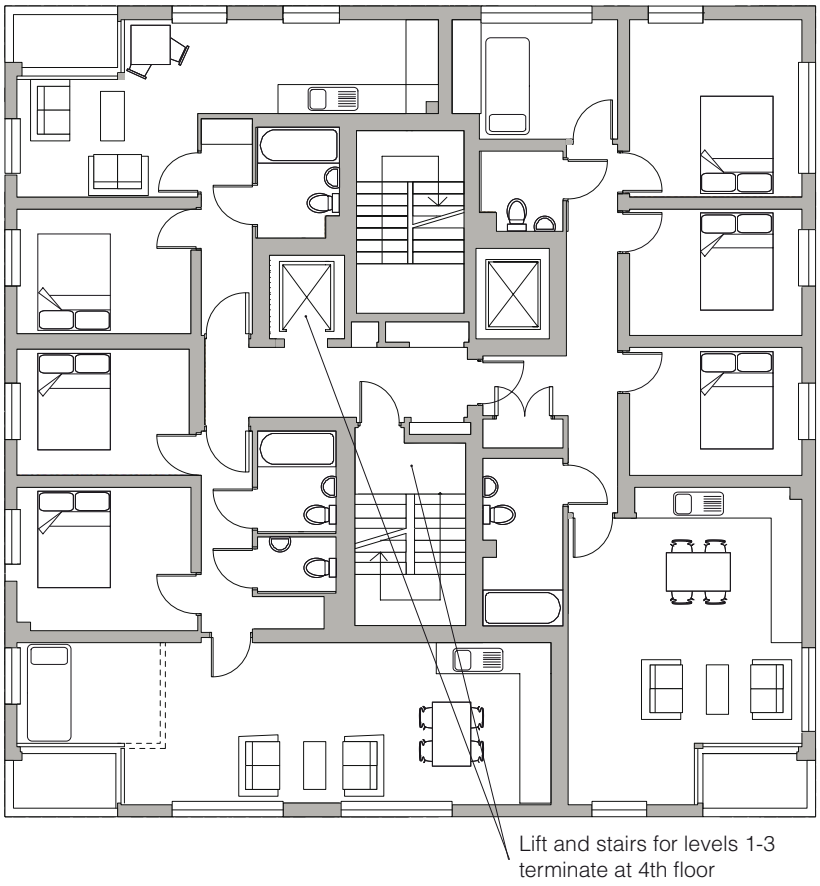
Cross-laminated timber panels (cont.)

grant a dispensation from the 'Merton' rule that normally requires at least 10% of the energy used during occupation to be generated onsite. Thus, the designers avoided having an in-house combined heat and power plant or ground source heat pump (which would have occupied part of the basement) and left most of the roof space as an amenity. However, the development does include modest PV generation to power lights in common areas and the water booster pump, saving expenses that would otherwise be met by charges on occupants.

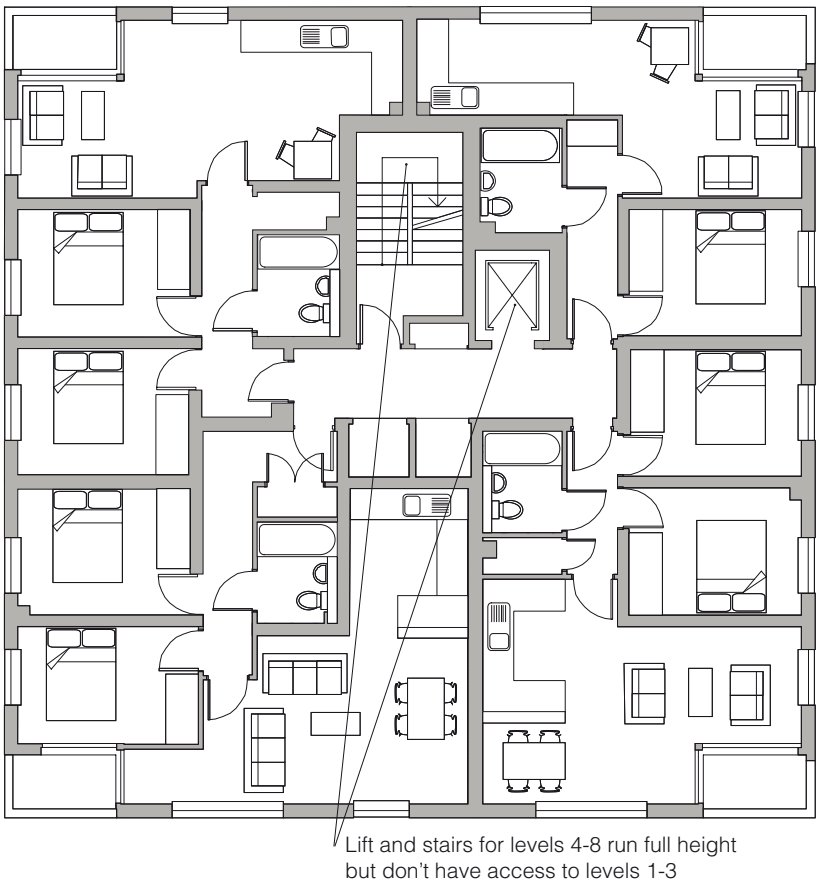
The CLT structure comfortably achieved the required fire resistance. The structural engineer allowed for charring to achieve 60-minutes fire resistance and achieved 90-minutes fire resistance by adding plasterboard.

The 128mm wall met the thermal resistance of U = 0.13 W/m²/K with just 100mm of insulation.

Third floor plan (apartments for tenants of Metropolitan Housing Trust)



Fifth floor plan (apartments for private owners)



Structure

The tower is a cellular structure with apartments in a honeycomb pattern around a central core. The load-bearing elements (lift shafts, stairwells, all external and some internal walls) provide exceptional resistance to progressive collapse and good acoustic separation between apartments and lift shaft.

Although timber would be feasible for the ground floor walls, the structural engineers opted for reinforced concrete. They felt it would better accommodate the dramatic difference in layout between ground and first floor, and that it would be easier to ensure good damp proofing with a concrete sub-structure. Concrete provides a level threshold for the timber, at either ground or first floor level.

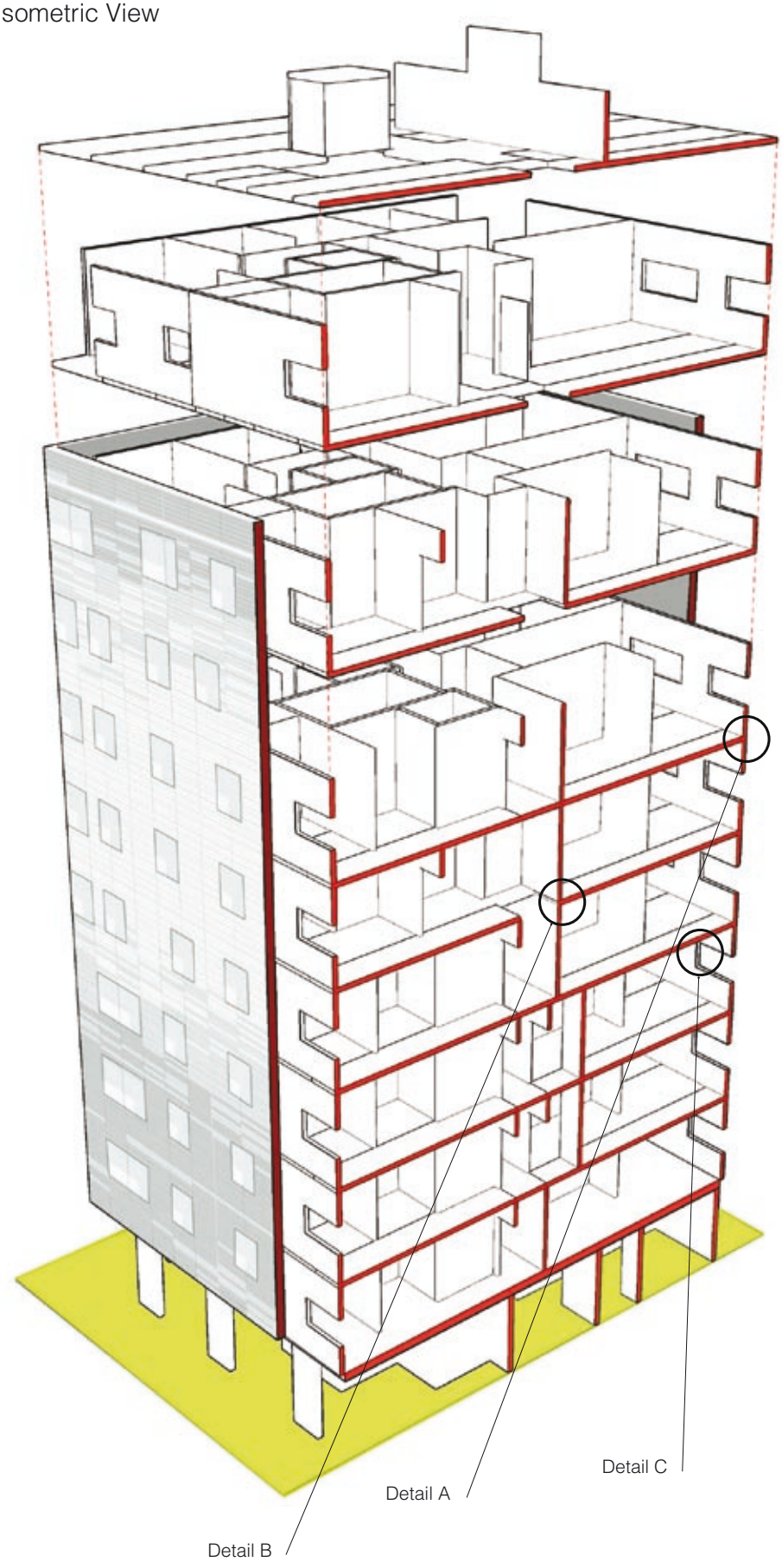
Each of the panels was prefabricated, including cut-outs for windows and doors. As the panels arrived on site, they were immediately craned into position, dramatically reducing time on site. The eight-storey timber structure was assembled in eight weeks. The entire nine-storey structure was up in nine weeks. The contractor used a 'platform construction' configuration, which means they set each floor on the walls below, and then another storey of walls was raised and so on up the building. Screws and angle plates secured the joints. Stresses are generally very low throughout the structure although, at points where cross-grain pressures are high, screws were added to reinforce the timber locally. Progressive collapse is avoided by providing sufficient redundancy so that any single elements can be removed.

The untreated timber relies on the building envelope for protection from damp and rot. While installation in wet weather was inconvenient, it had no effect on the panels because the system releases moisture readily as it dries.

Maintaining a high acoustic performance for the Stadthaus was an important design consideration. Acoustically, timber buildings have traditionally been classified as 'poor' when compared with reinforced concrete and masonry. But CLT panels have a significantly higher density than timber frame buildings. They provide a solid structural core on which different, independent and separating layers can be added. The layer principle overcomes any sound transfer issues. With a consistent and economic layering strategy of walls with joints in front of the party walls, floating floor build-ups and suspended ceilings, the designers achieved sound reduction and thermal performance that exceed UK requirements.

[Continued page 5]

Isometric View



Structure (cont.)

Although more expensive than an equivalent reinforced concrete frame, CLT brought significant overall savings by making a radical cut in the building programme. For example, an equivalent concrete building was estimated to take 72 weeks, whereas the CLT solution required only 49 weeks. The erectors brought a large mobile crane, which eliminated the need for a tower crane that would normally be needed for a concrete structure. Scaffolding was needed to fix the cladding, but not to erect the wood structure. The CLT structure represented three days' production at KLH's factory. And the rapid installation played an important role here. The four-man Austrian crew was on site three days a week and accomplished the entire superstructure erection in 27 working days, over nine weeks.

The contractor was delighted with the +/- 5mm tolerance achieved with the timber construction, compared with the 10mm normally expected in concrete structures. The consequence of tight tolerances is the ease of fitting the structure together, its good airtightness and the ease of fixing cladding.

Floor-to floor movement due to moisture and creep is estimated to be 3mm, which gaps in finishes can tolerate. Also, by avoiding concrete cores, there is not the differential movement to resolve between concrete and timber that occurs with conventional timber frame.

Early indications are that the solid timber is making a significant contribution to thermal mass, as indicated by modest fluctuations in temperature.

Installation of building services has proven easier than expected and future projects might expect better prices as this experience is taken into account. Cables and pipes were generally surface mounted with simple screw-fixed straps. The plasterboard was installed on metal tophat sections. In contrast, Austrian practice takes advantage of the factory's ability to cut chases for service runs. Hence, they would normally fix the plasterboard directly to the CLT panels.

Another encouraging conclusion is that CLT is evidently well suited to infill construction. This is because, when compared to other materials, the CLT site is less disruptive to neighbours on account of the rapid construction and quieter building activities using lightweight power tools. These tools pose a lower hazard to operatives' health than the heavier equipment needed to drill into concrete, masonry and steel structures.

Wall panel anchored to floor panel.

Typical internal wall arrangement.

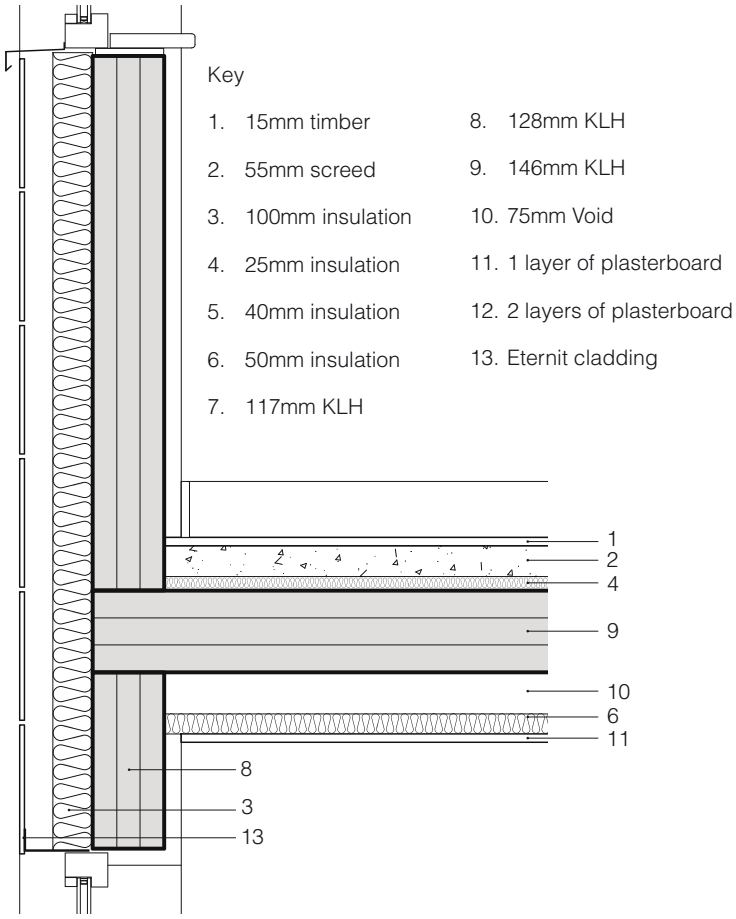
Floor panel installation.

Floor panel installation.

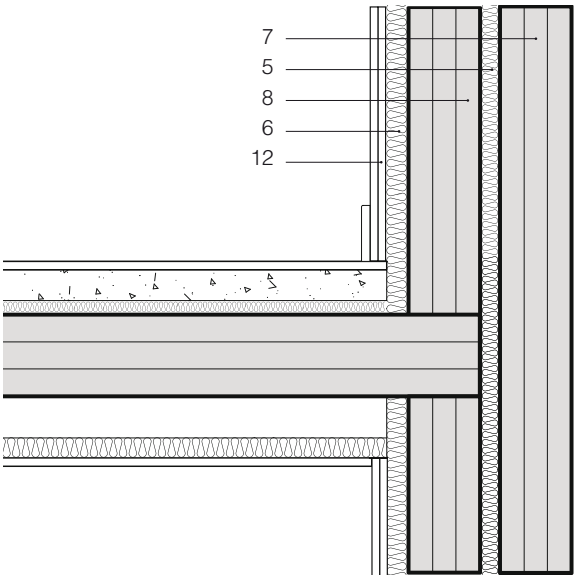
Self-drill woodscrews installed using lightweight power drivers.

Easy fixing of services to ceiling.

Detail A:
Section at external wall



Detail B:
Section at lift shaft



Drawings not to scale

5000 Eternit panels, comprising 70% wood waste clad the building.

Detail C 'Section of Window Opening'.

TRADA Technology

Stocking Lane
Hughenden Valley
High Wycombe
Buckinghamshire
HP14 4ND (UK)

t: +44 (0)1494 569600
f: +44 (0)1494 565487
e: information@trada.co.uk
w: www.trada.co.uk

© TRADA Technology Ltd 2009

Credits: Construction drawings and photos - Waugh Thistleton Architects
Page 1, Page 5 (Easy fixing of services to ceiling), Page 6 (5000 Eternit panels) - Will Pryce
Page 4 (isometric) and Page 6 (Detail C) – Techniker Consulting Structural Engineers