ICF new build at Hall Lane, Bramhope

In autumn last year, Landmarks (UK), a Yorkshire-based developer of exclusive sustainable properties, chose insulated concrete formwork (ICF) for the construction of a magnificent four-storey family home, overlooking the glorious scenery afforded by this West Yorkshire valley. The property sits in a fairly steep bank spanning the full width of the site. The front façade comprises only 2.5 storeys, while the rear, which enjoys the views, has 3.5 storeys out of the ground. A range of luxury leisure facilities, including a large swimming pool, are housed in the lower basement floor. ***Jean-Marc Bouvier*** *of* ***Nudura*** *reports.*

Demolition of a 1960s-style detached house was followed by excavation of the site. Both the retaining wall and the lower slab had to be built at different stages. ICF components were needed to build a waterproof joint down the middle of the whole lower section. Triton TT Admix was added at time of batching for all concrete in the slabs and ICF walls. The water-resistant concrete was then vibrated until all voids were eliminated.

To achieve thermal mass, a full 250mm lower slab build-up comprised concrete above a membrane, which was laid over a Jackon Insulated 'Atlas' flat-bed raft system. Hollowcore planks were fitted at ground-floor level to give the retaining wall top lateral support and exposed thermal mass. All concrete joints are fitted with the TT Waterstop system, which enables concrete surfaces to resist hydrostatic pressure and stops water from entering the substructures (see Figure 3). Concrete was pumped into the

Figure 1 (above): The new build at Hall Lane, Bramhope overlooks the West Yorkshire valley.

formwork at a rate of 1.2m/h, which was then vibrated with pokers. Pour heights of 3.6m+ are feasible during a day.

Every concrete load arriving on-site has to be slump tested to make sure curing times in the formwork are not compromised. Slumps are required to be between 150 and 200mm. Quality control at this stage is essential as there are tight limits to the amount of water that can be added to the concrete on-site and early wet loads that exceed the 200mm slump must be refused.

Due to the damp Yorkshire climate, the external basement walls were treated with a minimum of two thin coats of TT vapour membrane, using an airless pump for speed of application. It's easy to check if there are pinprick holes in the initial layer, as the unique pale green formwork is easily visible.

Compliance

The criteria for the external walls differed below and above ground. For the basement, the walls needed to meet levels of strength to withstand the lateral pressures from the retained ground and waterproofing needed to meet BS 8102:2009[1]. In contrast, the ground and first floors must meet specific thermal values. So, to counteract the large expanses of glass overlooking the views, the walls were designed to meet stringent SAP assessment criteria.

Figure 2a and b (above and below): The basement level needs to withstand lateral pressures and meet waterproofing standards to BS 8102.

In God We Trust!

There's a saying at Nudura – 'In God we trust; all others bring data!', as it's a fact that ICF technology can meet and beat other forms of building enclosures hands down.

How? The layering of monolithic concrete between two continuous layers of 67mm-thick EPS foam offers unbeatable energy efficiency as it isolates the concrete and significantly reduces the flow of heat through the wall. By using ICF to construct the building enclosure, speed of shell build can be enhanced by typically 25%, saving up to 60% on labour.

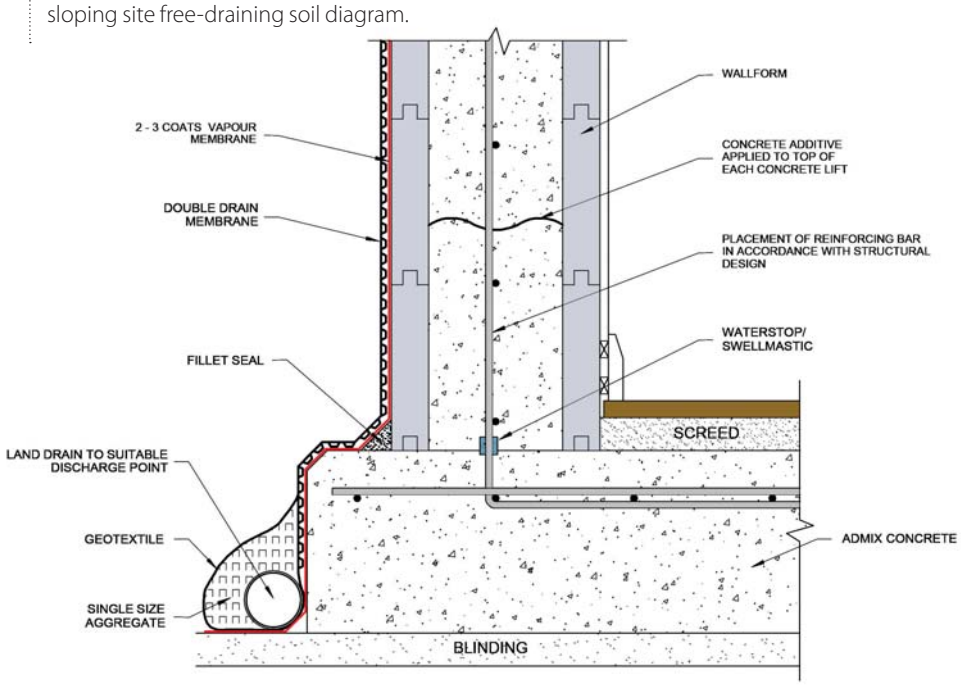
ICF concrete walls have a high storage capacity with low thermal conductivity, which provides the most useful level of thermal mass, helping to stabilise the internal temperature from day-to-night temperature fluctuations (see Figure 5).

This construction method eliminates air gaps, forming an airtight structure that enables building mechanical systems to heat, cool and ventilate more efficiently, creating a healthier living and working environment for occupiers. ICF also forms an effective sound barrier, with a sound reduction index of 51 and higher.

There's been some negativity in the market around air circulation and its quality in ICF buildings. The Nudura system was chosen as the preferred material for Oman's 2016 award-winning Higher College of Technology project, the GreenNest Eco House. The competition called for a construction of a comfortable, liveable home that is energy-efficient, eco-friendly and boasts marketable architectural design in a region where temperatures can reach 50°C (122°F) in the summer months. ICFs do not allow interstitial condensation to travel through walls. UK psi values stipulate that the '*f*' factor must be a minimum of 0.75. The Nudura system ranges between $f = 0.856$ and 0.969. The only condensation that can occur is generated by people themselves, which is addressed by a good ventilation strategy.

Aesthetically, ICF is ideal for both complex and curved structures. Needing minimal maintenance and repair, these ultra-sustainable buildings offer greater safety in terms of fire resistance and structures built in flood, hurricane, tornado and earthquake-prone zones.

Figure 3: Waterproofing for Grade 3 low-rise sloping site free-draining soil diagram.



Solution

The solution to maintaining the building line is both simple and unique. While building, 50mm inserts are slid into the inside of the outer face of the 203mm (8-inch) core block formwork, which reduces the amount of concrete from 203 to 152mm, while improving the thermal qualities of the wall from 0.24 to 0.18W/m^{2}K. In turn, 200m^2 of external window openings then meet the thermal standards required.

SAP calculations can be simplified by offering a full set of thermally modelled psi values and U-values can be driven down to 0.11W/m^{2}K if required, by using a 150mm insert system. The wall has excellent proven thermal values, coupled with a 'dew point' only 2mm from the external face, which eliminates the risk of unsightly black mould forming.

If a degree of airtightness greater than 1.2–1.5m^3/h/m^2 air permeability is required, the joints between window frames and the ICF can be taped. Specialist foam can be used to fill the fitting gap between frame and wall to easily meet PassivHaus Standards of 0.6 ACH (air changes per hour). To negate thermal bridging, all openings can be surrounded with polystyrene, also enhancing psi values.

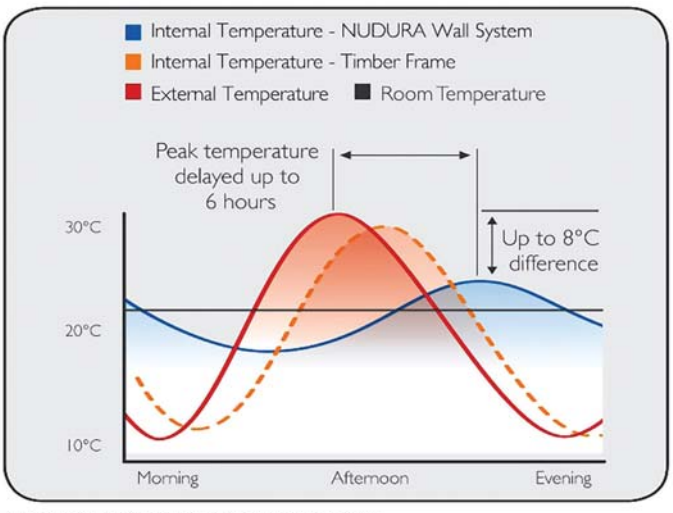
Aesthetics

The footprint of the house occupies much of the plot. Designed to maximise valley views, on every floor there are wide openings (supported by many steel beams) with bifolding doors, which open onto balconies. In open-plan designs, 152mm core of concrete gives the steel beams a solid base and offers the structural engineer ease of calculation.

The south-facing front elevation is finished in a traditional stone cladding and a thin coat render has been applied to the remaining sides. The use of two finishes was facilitated by full-height anchor points every 203mm, part of the unique Duralock system. ■

Reference:

1. BRITISH STANDARDS INSTITUTION, BS 8102. *Code of practice for protection of below ground structures against water from the ground.* BSI, London, 2009.



Based on no additional mechanical heating or cooling.

ICF education

Nudura's CPD event – An Overview of Insulated Formwork (ICFs): A Permanent Solution – has been approved by RIBA as part of its Core Curriculum programme. The seminar aims to cover an introduction to ICF, building applications, Code approvals and installation methods.

The Training Academy one-day installation course is led by a certified installation specialist and experienced ICF installer. The course breaks down the ICF installation process, common building scenarios and explains how unique accessory products help speed up installation. Trainers offer an open discussion style course with opportunities for Q&A.

Figure 4 (above): ICF concrete pour.

Figure 5 (left): Stabilising effect of thermal mass on internal temperature.