The simple shape of the thermal envelope was compromised by the nature of the planning restrictions both on site lines, height and also aesthetics made junctions more complex. This together with a changing design, a structural engineer with no interest or knowledge in thermal design, led to a challenging build.

Junctions and joins were given careful attention to make sure operatives understood they they should be thermally broken.

The thermal design of the homes was based on a well insulated slab and 365mm Thermoplan single skin cellular insulation monolithic clay block walls with stone or render facing with U-value: 0.26 kWh/m²k (0.28) y = 0.05

The roof is slated over low timber content I-beam rafters, supported by timber trusses and steel purlins. I-beam timber joists also form the first floor. Warmcel recycled insulation is used throughout the roof and first floor.

Careful attention was given to selection and use of a complete build system design that reduced thermal bridging to a minimum. Construction details using ThermoPlan were calculated to an exceptionally low y-value = 0.024

**Geometric thermal bridges**

The simple shape of the thermal envelope was compromised by the nature of the planning restrictions both on site lines, height and also aesthetics made junctions more complex. This together with a changing design, a structural engineer with no interest or knowledge in thermal design, led to a challenging build.

Junctions and joins were given careful attention to make sure operatives understood they they should be thermally broken.

**Repeating thermal bridges**

The well insulated slab – two slabs of 75mm polystyrene with offset joints and 50mm polystyrene edge insulation – all were checked before pour, and the Thermoplan single skin wall system prevented the most common form of repeating bridge – the wall tie.

Junctions with steels were carefully detailed and extra insulation around the joints - included – thermal breaks.

The timber I beam rafters also reduce thermal bridging as the web reduces the flow of heat.

**Non-repeating thermal bridges**

Working with Peter Warm and NBT consult, an airtightness schedule and 37 point checklist was devised to make sure that all the following areas were checked:

- Completion of radon barrier
- First plank of first floor
- First steel purlins
- Final membrane roof sealing

Also included on the check list was ensuring the lintels contained the insulation before casting and were cast, at First floor – fully filled bearing, insulated ends of I beams and careful attention to ends and sealing of steel purlins.

**Rules to assist in the avoidance of thermal bridging at Bladon**

- Understand your subject
- Consider a build system or MMC with single skin wall – no additional insulation or wall ties
- Train design and construction staff
- Create a checklist for the development that defines the most likely points and stage in the construction process for loss of thermal performance
- Ensure that contractors take ownership and responsibility for thermal design on site.