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Slab junctions between conditioned and unconditioned spaces

A question often received by the BRANZ helpline is about thermally separating adjacent reinforced concrete slabs where one is in a conditioned space and the other is not. In short, we're working on it!

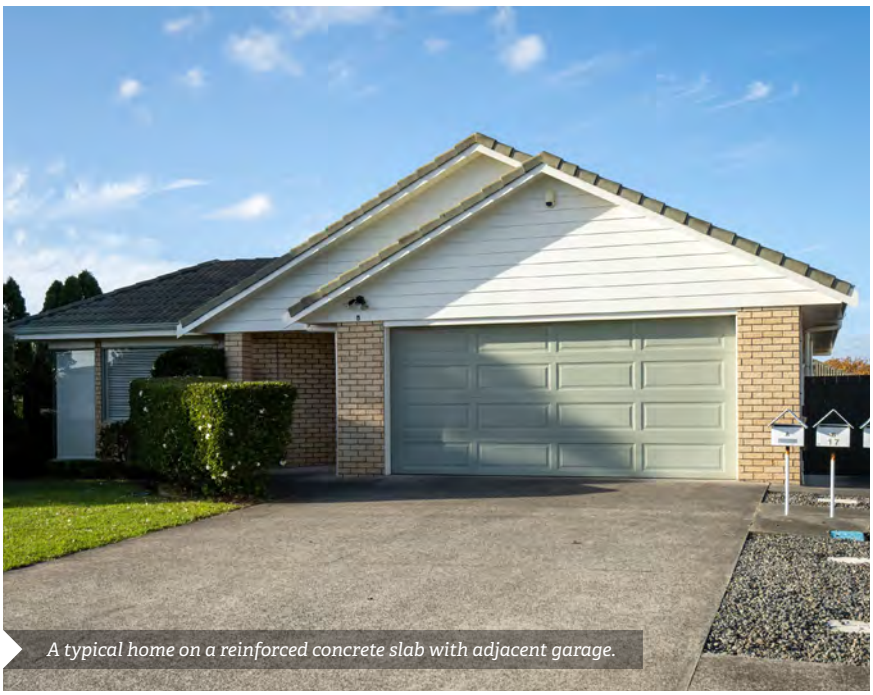
Since the introduction of the revised H1 requirements last year, there has been a keen awareness about the different treatments of conditioned and unconditioned spaces in buildings. This comes to a head particularly at the junctions where these spaces meet.

A common scenario

We are commonly asked about the familiar occurrence of a residential reinforced concrete floor slab with an adjacent internal access garage. The habitable dwelling will be a conditioned space – with heating, ventilation and insulation – while the non-habitable garage will typically be unconditioned and uninsulated.

The queries are mostly about the junction of the two adjacent reinforced concrete floor slabs. If one is in a conditioned space while the other is not, how do we thermally separate the two to improve the energy efficiency of the building?

There are several possible variables with this scenario. Are the slabs laid with just one pour or are they constructed with two separate consecutive pours? Is the finished floor level (FFL) the same or is there a step down to a lower garage?



A typical home on a reinforced concrete slab with adjacent garage.

Vertical slab edge insulation not a solution

If the floors are built with one single pour, how can the slabs be thermally separated but still be structurally integral?

In *Build* 201, the article *More on H1* briefly discussed the advantages of vertical slab edge insulation. It noted that R1.0 slab edge insulation was optimal and only minimal improvements in heat loss reduction are achieved with a higher R-value. R1.0 can be achieved with XPS insulation material approximately 20 mm thick.

However, if used between the two slabs, the insulation material on its own will provide no effective structural connection between the slabs. And if we create two structurally separate concrete floor slabs, in an earthquake, the two slabs might move together and apart repeatedly, with destructive effects on the integrity of the building. To counter this, there would normally be heavy deformed steel bars (starter bars) cast into each of the slabs to help them maintain their position.

Problems with starter bars and blocking materials

The R-value of a steel starter bar is far lower than the concrete body of the slab and the steel will act as an extremely efficient thermal bridge – transferring heat from the warmer slab in the conditioned habitable spaces of the dwelling through to the colder garage slab in the unconditioned zone. This is obviously the opposite of what we are trying to achieve.

There have been various attempts to use a third material – such as timber blocking – to physically maintain the space between the slabs without transferring heat. These have been introduced and promoted over the years then later withdrawn as unsatisfactory.

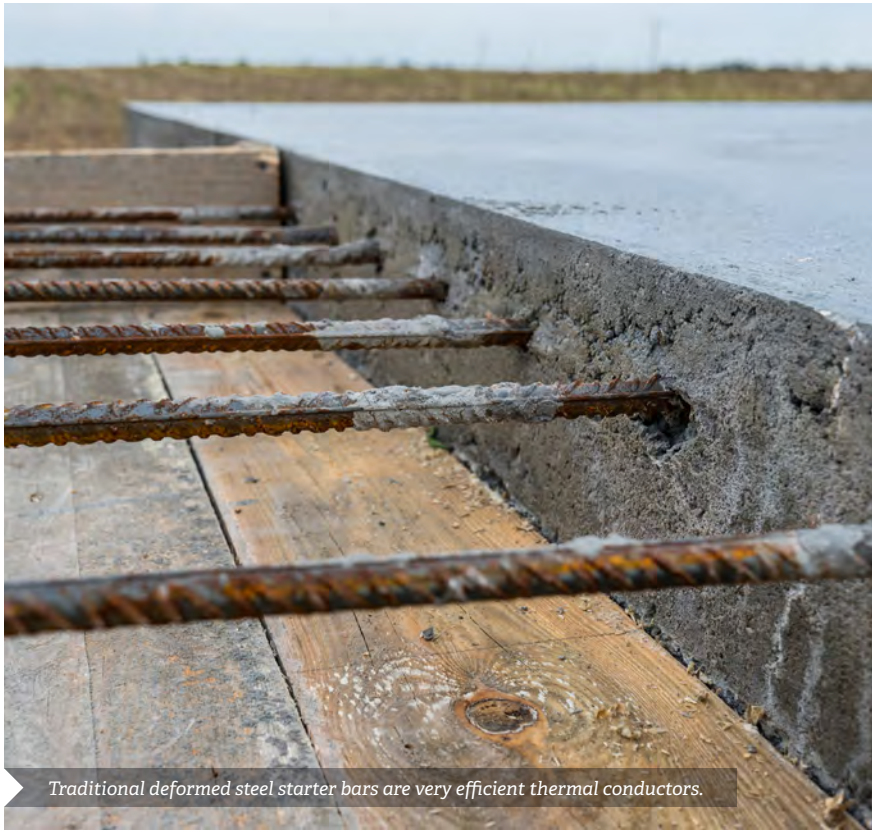
I have seen an extra foundation built to the edge of the garage slab adjacent to the dwelling, with the starter bars cast into each of the two footings well below the plane of the floor slabs and below the bottom edge of the vertical insulation sheet.

However, building a second reinforced concrete foundation (that is otherwise unnecessary) will incur considerable extra labour and material costs and probably additional design costs for the specific engineering required.

The most common slab configuration I notice nowadays uses the same FFL in the dwelling and attached garaging. It probably makes economic sense to keep the configuration simple, but the thermal separation challenges remain.

Experiences in my practice

My practice has been commissioned to design many provincial rural homes over the years, and the brief rarely specifies single-level slabs – instead opting for a definite step down to a lower garage FFL.



Traditional deformed steel starter bars are very efficient thermal conductors.

We have only designed one farmhouse to date with slab edge insulation. The main dwelling had piped hot water heating to the slab as did the zone immediately adjacent in the garage where new lambs were temporarily kept, so it was perhaps more a semi-conditioned space. I confess that I used the starter bars to penetrate the insulation material but my primary concern was that the in-slab hot water pipes didn't fail!

The role of urban garages does seem to be evolving into a storage area, a workshop or hobby room or even a home office or other non-vehicular space. Several of our recent new house projects have specified full perimeter wall insulation to the living areas and the garage – usually also with full wall insulation between those two zones., in anticipation of these changes of use.

It is difficult to meet the full thermal requirements for the garage with garage doors being notoriously non-airtight, but there is a lot of work being undertaken to eliminate this shortcoming. Our most recent new home design was undertaken with the expectation that the garage will eventually be converted to a carer's flat and the garage door replaced with a standard domestic door and window joinery unit.

Potential innovations

There are some interesting new innovations being considered.

BRANZ has been looking at non-metallic mesh and reinforcing bars for use in concrete. These include fibreglass and other synthetic materials with far higher R-values than conventional concrete reinforcing products and I'm excited that the solution to this problem may be imminent.

Fibreglass has been used in the past in concrete with variable results, but we are considering new-generation products for use in concrete in totally new ways.

I can't conclusively answer the question about thermal separation of the slabs, and I would like to hear from any *Build* readers with their ideas and thoughts on this topic. It's a small detail but has the potential to be another step forward in the construction energy efficiency quest.