# New Aesthetic Possibilities for Precast Concrete

## New stains and moulds promise lasting traditional finishes and creative surface treatments

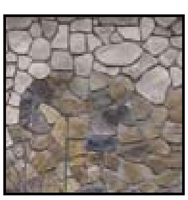
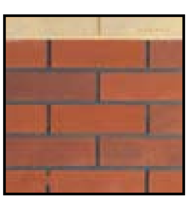
A building or structure façade is an advertisement for the designer or architect, as well as the occupant. It can also be a popular landmark and depending on the location of the building its initial visual impact can be considerable. The use of a patterned or textured precast concrete façade allows the architect and designer to produce subtle nuances of light and shadow on the building, while ensuring a practical, economical and long lasting façade.

## Mould liners for unlimited precast concrete design expression

Flexible and re-usable mould liners for architectural precast units can assist in increasing the aesthetic appeal, enhancing architectural expression and in integrating structures with their surroundings. They give architects and designers the freedom to realise unlimited ideas in their designs. The applications are almost endless because nearly any image in standard graphic formats, including photographs, can be used.

According to Reckli Australia and New Zealand's Managing Director John Joveski, the use of elastic RECKLI®-formliners for texturing the exposed face of precast concrete surfaces has attained a high degree of acceptance because of its quality and ease of use.

Some of the company's recent projects include The Ballarat Performing Arts Centre, noise walls for the Mitcham-Frankston Freeway, the Orang-utan Enclosure at Melbourne Zoo, the 40-level Neo200 Melbourne Apartments, Mount Buller Chalet, Footscray Police Station, noise walls for the Albury-Wodonga Bypass in NSW, new Emergency Wing ramp walls at Hobart Hospital, and noise walls for the Rockingham to Mandurah Railway Line in WA.

*Reckli has over 185 standard patterns (or specials made to order) on display at its Melbourne showroom.*


*Reckli formliners were recently used to create decorative and functional wall panels for the new Euroborg soccer stadium in the Netherlands. More than 400 circular windows, arranged at random, make an immediate connection with soccer. The sharp edges along the heights and depths of the pattern on the window cheeks are remarkable: no bleeding, no barbs – a perfect finish.*

*"The elasticity of the formliners removes the risk of damage to the hardened concrete, allowing even intricate detail from photographs to be used on concrete – and the finished effect is always impressive," says Mr Joveski.*

"Image data is electronically transferred onto sheet materials. A surface pattern can be created on any finished precast surface, with the finished detail varying from fine to coarse, depending on the resolution of the image used. The system ensures the benefit of re-usable, flexible and consistent impressions," he says.

## The right combination for visual possibilities

Tony Watling, Managing Director Nawkaw Australia, explains: "The formliner moulded finish on precast concrete panels provides a surface that is ideal for the Nawkaw colour finishes. Many textured forms such as brickwork, stone walls, masonry, blockwork, slate stones, tiles, or sandstone are readily cast into the surface via a formliner. Once the concrete is cast and cured, our colour technicians apply the penetrating masonry stains in a layering process over the panel. This coloring process can be applied in the manufacturers' factory or on the construction site, depending on the project. The resulting finish is authentic and always indistinguishable from traditional brick, block or stonework etc."

Application of the system to precast concrete panels gives outstanding results for long term colour consistency. It is designed to be permanent and not require maintenance, and in fact is guaranteed to last a minimum of 25 years. The system is suitable for feature walls, and as well, allows precast elements to be combined with masonry and other materials, while being given a uniform appearance regardless of the underlying material. This development allows designers to explore enhanced levels of creativity.

*Application of stain transforms moulded precast into brickwork.*

The system is also suited to rectifying the appearance of precast concrete where a fire may have stained the concrete surface, or where there may have been graffiti attack. In some cases, new precast concrete must exactly match existing surfaces (such as the variegated appearance of natural stone) – this system allows for visual match. Because the match to existing surfaces is accurate, it is hard in some cases to justify the additional cost of materials such as natural stone over that of precast. The system can also be used to highlight decorative elements within precast concrete façades, or to accentuate shallow reveals to provide a much deeper appearance without adding cost and weight to the precast concrete panels that conventional deep reveals may incur.

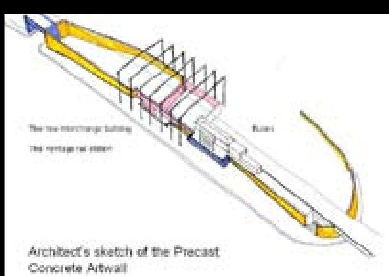
Contact details for Nawkaw and Reckli can be found on page 6.

(continued from page 1)

## 'Magic in Precast' transforms the new Parramatta Transport Interchange

Creating durable, complex and accurate moulds drew on all the precaster's previous experience. A combination of steel, polyurethane, timber and concrete was used to manufacture different mould components. The moulds were built at the precaster's in-house mould fabrication workshop. The intricate pattern work and fine tooling was outsourced to local CAD CAM equipped suppliers who were able to use the precaster's shop drawings and produce components to the required level of accuracy. Careful planning and innovative manufacture techniques were utilised to enable panels of different shapes to be cast at any location on the master moulds.

The concrete mix used Harcourt granite and the faces of the panels were finely polished to provide a prestigious reconstituted granite appearance. In addition to the 60 Artwall panels, a further 54 plain panels were cast and polished with this granite mix, along with a series of stair treads, cappings and wall cladding elements.



Architect's sketch of the Precast Concrete Artwall

*Over a 3,250 square metre site, the Parramatta Transport Interchange now connects the north and south sides of Parramatta previously divided by the railway line.*

The contour grooves, rivers and cup recesses were acid washed to enhance their visual appearance and to soften the contrast with the highly polished face. Highly developed polishing techniques were required to minimise chipping around the edges of the intricate series of grooves and rebates in the panel face.

The ceramic cups were fixed to the panel using an epoxy paste in the precast factory prior to delivery. In addition to the 12 colours, there were three depths of ceramic cups to allow a degree of variation through the depth of the wall. All 7,200 ceramic cups (yes over seven thousand) were located to a predetermined pattern that was documented by the precaster's in-house shop drawing team. Located at seemingly random locations throughout the project are a special series of 87 white glazed cups containing the name and portrait of historic local identities.

The finished product is a striking example of the high quality that can be achieved using precast concrete when careful design, meticulous planning and skilful execution are engaged on a complex and challenging project. As is often the case, the high level of effort required to produce a successful outcome is never evident in the final product, however the efforts are justified in the finished product. To help amortise the pre-planning required for the 60 Artwall panels, an order for a further 34 panels was let at the conclusion of the job for the next stage of the project. These additional panels have recently been erected alongside the original order, forming a continuous civic fabric to the Interchange giving it a legible and memorable character.

| | |
|---|---|
| **Project:** | Parramatta Rail Station |
| **Client:** | Transport Infrastructure Development Corporation |
| **Managing Contractor:** | Bovis Lend Lease (initial project) |
| **Managing Contractor:** | Ward Civil & Environmental Engineering (stage 2) |
| **Precast Supply:** | Precast Concrete Products P/L |
| **Artwork Designer:** | McGregor Westlake Architecture |

**Breaking News – Sydney, June 29, 2006**
**Parramatta Transport Interchange Wins RAIA Premier's Award – NSW**

The Parramatta Transport Interchange has won the 2006 New South Wales RAIA Premier's Award. On behalf of NSW Premier Morris Iemma, Minister for Planning Frank Sartor said that the "world-class' interchange 'encourages commuters to enjoy their arrival in the centre of Parramatta". He went on to note that he was "... very heartened to see design quality of this level occurring in western Sydney". About the Premier's Award: The RAIA Architecture Awards are the most prestigious architecture awards in Australia. The Premier's Award is given to a project that, in the consideration of the Premier, has contributed to the advancement of architecture.





N P C A A

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# 'Magic in Precast' transforms the new Parramatta Transport Interchange

Precast concrete in radiant colourful designs features in the newly completed $100 million Parramatta Transport Interchange that provides improved transport services and facilities for the growing population of Western Sydney – supporting Parramatta's development as a major employment and commercial centre – second only to Sydney CBD.

The new Parramatta Transport Interchange links Parramatta Station, one of the busiest on the CityRail Network with buses, taxis, coaches and private vehicle kiss and ride. The interchange incorporates the historic Parramatta Railway Station, which has been the main avenue for passenger and freight services through western Sydney for nearly 150 years. The location of the new bus interchange adjacent to the station and the construction of new underpass pedestrian connections have made accessing transport services much easier and safer for pedestrians. The pedestrian experience is enhanced by the colourful precast public Artwalls that signify the arrival to the commercial and retail hub of the city.

Delivering 'magic in precast' for the Artwalls turned out to be one of the most challenging projects yet undertaken by Brisbane based Precast Concrete Products. This involved the manufacture of highly finished and intricately patterned panels that seem to change in appearance for the passerby as if by some magical effect.

The most striking feature of the erected panels is the myriad of colourful cast-in ceramic disks. This is superimposed on an intricate pattern of grooves that reflect the contours of the surrounding landscape. Running through the contour pattern are a series of deeper reliefs resembling rivers at the lowest points of the landscape.

**Precast was good for a number of reasons**

***Referring to the Artwalls, Peter McGregor of McGregor Westlake Architecture said: "Other than loving concrete as a finish for it's robust, enduring materiality it offered great potential for creating sculptural relief in a myriad of forms. It was also the perfect foil for the rich polychromy of the vitreous enamel cups. Precast offered the usual potentials of prefabrication such as control of a high quality finish, which we were able to achieve and a minimisation of site work which was generally encouraged by the architects, client and builders.***

***After casting, each panel was acid etched to give the cast relief a unified finish, which was then highlighted by the 800 grit polished finish. The choice of Harcourt granite aggregate was because of its subtle reflective properties, which were revealed in the polished surface. The polished finish also negated the use of anti-graffiti paint," he said.***

All 60 Artwall panels were cast from three master moulds. Great care was taken to ensure that the edges of each mould lined up closely to the adjacent mould, so that when panels were erected the contour lines and rivers flowed seamlessly throughout the wall. However to reduce the repetition that may result in only three patterns, the design contained enough symmetry to enable the patterns to be turned upside down whilst still matching the adjacent panel. As a result approximately 20 panels were cast in each master mould, 10 of which were cast right way up and 10 cast upside down. The complex side matching required to achieve seamless joints was aggravated when panels of non-typical width and height were required. Narrow and short panels had to be accurately cast in a unique location on the master mould to ensure the pattern lined up. *(continued on page 6)*

## The meaning behind the Artwall design

The precast Artwalls feature a unique design, created by a local Sydney artist, that reflects the elements of transport/landscape/heritage of the area. The design embodies the importance that public transport has played in the development and growth of Parramatta city. The wall combines a fine grained relief pattern, loosely representing landscape, with a 'super graphic' grid of vitreous enamel cup inserts, imposed upon it. The 'landscape' relief was designed, (much like wall paper), as a seamless repeat pattern, using three master moulds that were flipped to create a 22 metre repeat module. The super graphic overlay is arranged almost as a separate layer, evoking the ebb, flow and diurnal energy of the interchange whilst defining station entries and bridge underpasses. The design includes a series of lines, coloured dots, and historical photos. The lines represent the paths of the Parramatta River and the rail line through the landscape. The dots represent the flow of people through the transport hub of Parramatta.

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# Technical Basics No. 2 – Sound Impact Properties of Precast Concrete

by Peter Knowland & Paul Uno

## Introduction

The previous edition of National Precaster (May 2006) addressed the air-borne sound properties of precast concrete i.e. the transmission and insulation of air borne sound from outside noise sources to interior environments, where precast cladding and glazing were the predominant building materials used in construction.

This paper will look at the role which precast concrete plays in controlling the effect of impact sounds on concrete. The criteria is quite different to that used in air borne sounds and therefore must be analysed separately in accordance with standard procedures, documented guidelines and Australian Codes.

## Structure Borne Sounds

This refers to sound which either impacts on or vibrates directly on the structure and then travels through it.

Such sounds are typically experienced by people in units or offices, where one person's ceiling is the other person's floor.

In the case of floors, examples of this type of noise include footsteps from people walking on floors above, scraping chairs on floors, furniture being moved, vibrating clothes dryers, washing machines and dishwashers. This is especially worse when those people above are running rather than walking (as the impact sounds are usually louder and more frequent) on their floors and in particular if those floors are bare, rather than covered with a soft resilient material such as carpet with rubber underlay. In the case of walls, impact sounds could include people merely closing cupboards and drawers in wall-units attached firmly or butting up to walls. Other structure-borne sounds in floors and walls are often due to water hammer (i.e. fluctuating pressure waves in pipes) that often cause the energy to be released via the fixings of those pipes to walls and floors.

Impact sounds are also experienced in an industrial environment – examples include vibrating machinery, service pipes and dropped objects such as tools. In this case it is always preferable to provide damping materials (such as rubber pads and soft mountings) in order to minimize the transfer of energy from the vibrating machine or pipe into the structure and therefore reduce the structure-borne impact sounds. The solution however may not always be this simple, as the noise source path may be obscure.

Construction materials or forms of construction that provide good air borne sound insulation may not necessarily provide good insulation against impact sounds. This is especially the case where 'higher mass' is a key parameter in limiting the transfer of air borne noise from one wall (or floor) surface to the other side. This parameter has an influence with concrete floors as a thick concrete floor may transmit less impact sound, but overall this is a very complex situation as the span of the floor can be a significant factor as well as the energy stored within the floor as is the case with prestressed floors. The law of diminishing returns comes into effect so constructing a thicker more massive concrete wall may not afford any extra noticeable benefit when impact sounds are the key issues.

In the case of impact sounds, one of the key considerations is 'separation'. 'Separation' refers to providing a soft or resilient material between two layers with few rigid connections tying the construction together (thus the preference for floating floors and air gaps between panels).

## Floating and Non-Floating Floors

Many forms of precast flooring elements are available in the marketplace for residential, industrial and commercial applications (such as hollowcore, beam and infill systems and solid pre-stressed and reinforced slabs *). Examples of these types of precast element are shown below. The methods by which these panels may be improved to deal with structure borne sound is addressed later in this paper.

***Beam and infill system***

***Solid reinforced slab*** *(sacrificial formwork)*

*Hollowcore flooring*

** For more information on flooring systems go to www.npcaa.com.au/html/PRODUCTS-Flooring.html and www.npcaa.com.au/html/RESOURCES-Flooring.html. For specific product information and suppliers go to www.npcaa.com.au/html/Precaster_ProductGuide/GuideTo.html.*

### Floating Floors

As mentioned in the previous section, one method of reducing the effects of impact noise from hard surfaced floors (e.g. tiled concrete) is to provide a floating floor. A floating floor is a load-bearing slab that is supported by a structural floor, but is isolated from it by resilient and sound absorbing support materials such as rubber (see Figure 9.17 from Precast Concrete Handbook Ch.9). The floating slab is more effective if it is relatively heavy (50mm to 100 mm thick) and does not contact the building structure (thus the need to caulk and seal air gaps). If penetrations such as pipes and ducts are necessary in the slab, the penetration must not form a rigid connection between the slab and the walls. The floating floor system has the potential ability to provide a high order of sound impact isolation.

**Figure 9.17**

*Floating Floors and Plasterboard either Direct-Fixed or on Furring Channels Attenuate Direct and Flanking Transmission of Airborne and Impact sound.*

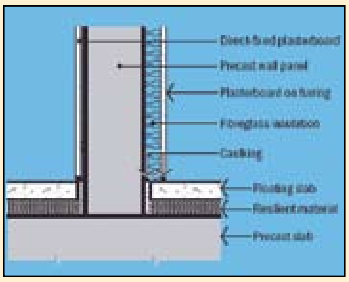
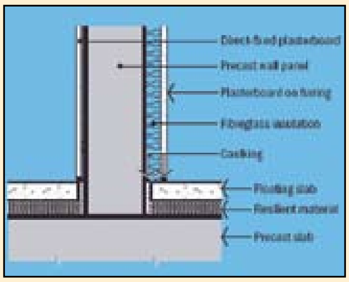


**Figure 9.11**

*A Resiliently-Suspended Ceiling in a Concrete Building Reduces Direct Sound but not Flanking Sound.*



A further improvement can be obtained using a resiliently supported ceiling with insulated ceiling space (as shown in Figure 9.11 from Precast Concrete Handbook). The improvement obviously depends on the method of support, the cavity depth, the weight of the ceiling/floor, and the amount of sound absorbing material in the cavity. The ceiling has to be a continuous sheet (not individually suspended tiles). This type of insulation also provides noise protection to the upper room, from noises generated in the room containing the suspended ceiling – thus minimising complaints from neighbours.

### Non-Floating Floors

If a floating floor is not an option then the best method of insulating the floor against impact sound is to provide soft resilient floor coverings. Any hard surfaced material, whether it be polished concrete or tiled concrete will produce a low impact sound insulation. The quantification of this will be covered later in the paper.

The best option is to cover the hard floor with quality carpet and a rubber or hairfelt underlay. This system laid on a reasonably thick floor, say 200mm, provides a very high degree of impact isolation that is difficult to better by other systems.

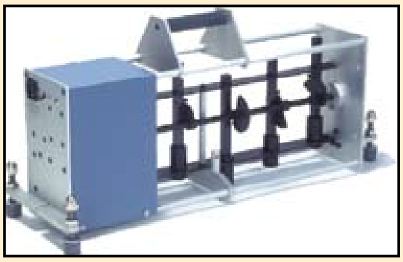
Modern living has become excited with hard floor finishes such as stone, tiles or timber boarding. These floor covering systems applied without some form of resilient layer to separate them from the concrete slab provides an unsatisfactory performance in terms of impact sound isolation. Acoustic consultants are being kept in business by ever increasing matters dealt in either the courts or tribunals where people have unthinkingly ripped up the carpet and replaced it with a hard floor finish. There are resilient layers that can be installed between these various hard floor finishes and the concrete floor. These can provide a reasonable degree of impact isolation but in the end rarely approach the performance of a high quality carpet and underlay.

A system that can also be used is thick rugs or non-chloride based magnesite type floor corking. In the early 1960's and late 1970's magnesite (a combination of calcinated magnesite, talc, ground silica and sawdust all mixed together with a solution of magnesium chloride) was a very common intermediary material between the carpet and the concrete however in subsequent years due to time and humidity, the chlorides diffused into the concrete below causing rusting of top layer reinforcing and delamination of concrete surfaces.

## Impact Noise Measurement and Test Standards

As mentioned earlier and in the May 2006 edition of National Precaster, the test methods adopted for air borne sounds (such as STC, Rw etc) do not apply to impact testing (although up to recent times, the earlier requirements for impact did necessitate a higher Rw value – around 55 dB – than those required for air borne sounds).

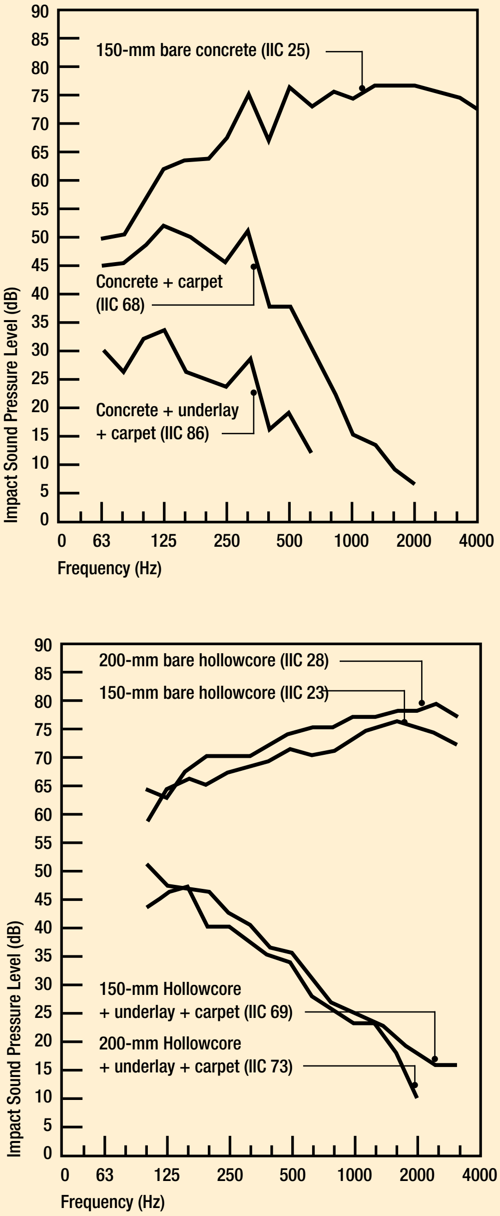
The key test criteria for impact sound in structures for many years in Australia and the World was the Impact Insulation Class (IIC) method. This method involved the use of a standardised tapping machine (see photo), whereby the unit would be placed on the floor (or sometimes even the wall via a plate and support structure although this system has been demonstrated to be highly inaccurate) and then turned on. Five rubber-tipped steel hammers – each weighing 0.5kg – would drop from a height of 40mm and impact the surface in question at an operating frequency of 10 Hz (i.e. each of the five hammers in series at two impacts per second). This conformed to the following overseas Standards – ISO140, EN 20140, ASTM E492.



Since this was the governing system for impact testing in Australia up to 2004, many manufacturers have been slow to update their product datasheets and still quote IIC values for their tested building products. Due to the fact that the Precast Concrete Handbook was released in 2002, it too quotes the impact capacity of precast hollowcore panels in terms of IIC values (see figure 9.16). This information was based on a 1974 paper by the Portland Cement Association [3], which itself was based on work by Beranek & Newman in 1963 for the American Federal Housing Authority.

**Figure 9.16**

*Tapping Machine Data for a 150-mm Concrete Floor, Tested Bare, with a Carpet, and with a Carpet and Foam Underlay,* (From CPCI[9.10]) *Similar Data is shown for 150- and 200-mm Hollowcore Floors* (After PCI[9.11])




The Association of Australian Acoustical Consultants released a document in 2002 titled *"Acoustical Star Rating for Apartments and Townhouses"* (now version 9.4 May 2005) whereby the IIC impact rating system was replaced with a new system called the 'Weighted Standardised Impact Sound Pressure Level L NT, W (see extract on page 4). This document is also in accordance with ISO140-7 and rated in accordance with ISO 717.2. It is also now quoted in the Building Code of Australia (BCA).

| 3. Intertenancy Activities | | 2 Star | 3 Star | 4 Star | 5 Star | 6 Star |
|---|---|---|---|---|---|---|
| (a) Airborne Sound Insulation for walls and floors | | | | | | |
| between separate tenancies | $D_{nT,w} + C_{tr} \geq$ | 30 | 40 | 45 | 50 | 55 |
| between a lobby/corridor & bedroom | $D_{nT,w} + C_{tr} \geq$ | 30 | 40 | 40 | 45 | 50 |
| between a lobby/corridor & living area | $D_{nT,w} + C_{tr} \geq$ | 25 | 40 | 40 | 45 | 45 |
| bedroom walls within a tenancy | $D_{nT,w} + C_{tr} \geq$ | 25 | 30 | 35 | 40 | 45 |
| (b) corridor, foyer to living space via door(s) | $D_{nT,w} \geq$ | 20 | 25 | 30 | 35 | 40 |
| (c) Impact Isolation of Floors | | | | | | |
| between tenancies | $L_{nT,w} \leq$ | 65 | 55 | 50 | 45 | 40 |
| between all other spaces & tenancies | $L_{nT,w} \leq$ | 65 | 55 | 50 | 45 | 40 |
| (d) Impact Isolation of Walls | | | | | | |
| between tenancies | | No | Yes | Yes | Yes | Yes |
| between common areas & tenancies | | No | No | Yes | Yes | Yes |

This system works in reverse to the IIC system in that the better the impact isolation, the lower the $L_{NT,W}$ (obviously the lower the values of $L_{NT,W}$, the better the star rating for the unit or townhouse in question). Fortunately the AAAC have provided a means of relating the older IIC values to the new $L_{NT,W}$ values, so that designers can compare building product datasheets quoting the older IIC ratings for the various building products (e.g. precast concrete flooring panels). The relationship can approximately be expressed as

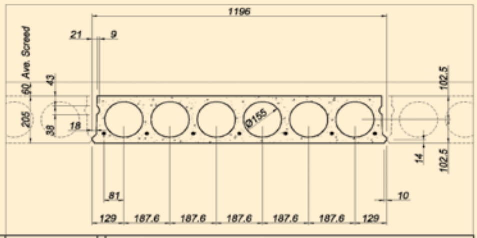
$$L_{NT,W} = 110 - IIC$$

Since this system relates directly to sound pressure levels rather than a difference between impact levels and a reference IIC contour line, the smaller the $L_{NT,W}$ (i.e. the smaller the sound pressure levels) the better the impact rating of the unit being tested.

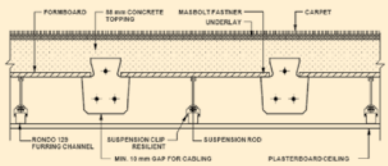
Example: referring to Figure 9.16, the 200 mm bare hollowcore panel had an IIC of 28 whilst the same panel with underlay and carpet had an IIC of 73. In the new rating system this translates to $L_{NT,W}$ of 82 vs 37 for bare vs carpet with underlay, thus the lower the $L_{NT,W}$ value the lower is the impact noise issue.

A good example of how product manufacturers have adopted this system in with the previous system can be seen in the tables above.

## Typical Hollowcore Sound Insulation Systems




| Component | Details of Options | Floor Code | $R_w$ (STC) | IIC (Impact Insulation) | $L_{NTW}$ (Impact Insulation) |
|---|---|---|---|---|---|
| Hollow Core | 205 Hollow Core Plus 60mm Structural Screed | HCC | 58 | 28 | 82 |
| | Plus: Parquetry Flooring | HCC + P | 53 | 53 | 57 |
| | Plus: Parquetry Flooring + Soft FibreBoard | HCC + P + SF | - | 57 | 53 |
| | Plus: Carpet | HCC + C | - | 54 | 56 |




Rw (STC) 59 IIc 70+

Figure 6.4.2e: Sound Insulation System 3

## Typical Ultrafloor Sound Insulation Systems

| TYPICAL ULTRAFLOOR SOUND INSULATION SYSTEMS | | Basic Floor | SOFT Floor Surface | | | HARD Floor Surface | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Component | Details of Options | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Ultrafloor | Standard (min 86mm thick) | Y | Y | Y | Y | | | | | | |
| | Set-Down (min 88mm thick) | Y | | | | Y | Y | Y | Y | Y | Y |
| Floor Covering | Carpet with underlay | | Y | Y | Y | | | | | | |
| | Tiled onto screed + resilient layer | | | | | Y | Y | Y | | | |
| | Tiled onto floating floor + insulation fill | | | | | | | | Y | Y | Y |
| Ceiling | Standard-mounted plasterboard | | Y | | | Y | | | Y | | |
| | Resilient-mounted plasterboard | | | Y | | | Y | | | Y | |
| | Resilient-mounted + plasterboard + insulation fill | | | | Y | | | Y | | | Y |
| Sound Insulation Ratings | Rw (STC) | 53 | 67 | 59 | 65 | 57 | 59 | 65 | 59 | 61 | 65+ |
| | IIC (Impact Insulation) | 30 | 70+ | 70+ | 75+ | 60 | 62 | 65 | 65 | 67 | 70 |
| | $L_{nTw}$ (Impact Insulation) | 80 | 40- | 40- | 35- | 50 | 48 | 36 | 35 | 33 | 40 |

The overall acoustic appraisal with respect to air borne sound insulation as well as impact insulation can thus be represented in tabular form similar to the following table which is reproduced from the Ultrafloor technical manual.

| ULTRAFLOOR SYSTEM | Rw | IIC |
|---|---|---|
| Basic Ultrafloor system with standard plasterboard ceiling | 53 | 45 |
| Carpet with underlay added to basic floor and standard ceiling | 57 | 70 |
| Carpet (w underlay) + resilient-mounted ceiling with insulation fill | 65 | 75 |
| Tiled over resilient layer with std plasterboard ceiling | 57 | 60 |
| Tiled over floating floor with insulation fill + std plasterboard ceiling | 59 | 65 |
| Tiled over resilient layer with resilient-mounted ceiling Δ | 59 | 62 |
| Tiled over floating floor with insulation fill + resilient-mounted ceiling Δ | 61 | 67 |



## Summary

In conclusion, it can be seen that building inhabitants today are not only concerned about noise intrusion into their living space from air borne noise sources such as neighbours' speech and music, they are also concerned about impact from structure borne sounds such as neighbour physical movements and their appliance vibrations.

To counteract these effects, practical building elements such as precast concrete floors and walls need to have insulated barriers attached to them to limit the energy transfer from one side of the panel to the other. These barriers should be in the form of soft, resilient coverings with no stiff connectors to structural elements. In this way the precast panels can provide effective and practical structural advantages such as load bearing capacity as well as the equally important parameters associated with noise control in the form of resistance to air borne sound transmittance and minimisation of the effects of impact sound transference.


*References:*

*(1) Precast Concrete Handbook, Sept 2002*

*(2) Acoustical Star Rating for Apartments and Townhouses, Association of Australian Acoustical Consultants, version 9.4, May 2005*

*(3) "Acoustics of Concrete in Buildings", Portland Cement Association, 1974, Frank A. Randall Jr*

*(4) Ultrafloor Technical Manual, Sept 2002*

*(5) "Concrete in Energy Efficient Design & Noise Control" by Paul Uno, TN62, CCAA, 1993*

*(6) Peter Knowland & Associates (Acoustic Consulting Engineers)*