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NATIONAL PRECASTER

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Change of Address

Readers should please note that the National Precast Concrete Association Australia has re-located. Details are –

Postal address for all correspondence:
PO Box 774 Warners Bay NSW 2282
Telephone/Fax: 049 42 7210

PRESIDENT:
R (Bob) Attwater Auscore Pty Ltd

EXECUTIVE DIRECTOR:
Ivor Jones

GETTING THE MOST OUT OF PRECAST

One of the most important provisions in a precast concrete supply contract is that period of time known as 'lead-time'.

It is the period of time provided to the precast manufacturer to allow for the preparation and approval of shop drawings and mould and possibly prototype manufacture prior to full scale production.

Lead-time is an activity which cannot be effectively compressed and to over-run lead-time will impair production, delivery and hence construction.

True production can be increased utilising shift work and additional moulds but at a cost.

The world is turning to precast construction as a building form which can reduce much of the uncertainty often associated with construction projects. The perceived advantages are widely documented yet recognition is slow; they may include:

- A certainty of quality, in terms of strength, durability and appearance.
- A near guarantee of delivery on time.
- A fixed price.
- Site difficulties are largely transferred to the precast plant where the facilities and experience exist to resolve the problem.
- Erection on site requires only minimal personnel numbers. The labour content is, in effect transferred to a more controlled and congenial workplace.

Clients wishing to use the unmatched flexibility and economy of precast construction need to consider some of the issues which make for smooth sailing during a contract term.

These may include:

- Allow adequate lead-time; all precast manufacturers have the experience to adjudge what is adequate lead-time based upon project size and complexity, choice of materials, types of finishes, mould numbers required and the complexity of manufacturing moulds.
- Take advantage of the industry's willingness to give a guide price and offer comment upon feasibility. The time for this approach is ideally at the conceptual stage. It may avert a need otherwise for extensive (and expensive) re-design to comply with the project budget. Manufacturers advertise their willingness to provide information to designers and

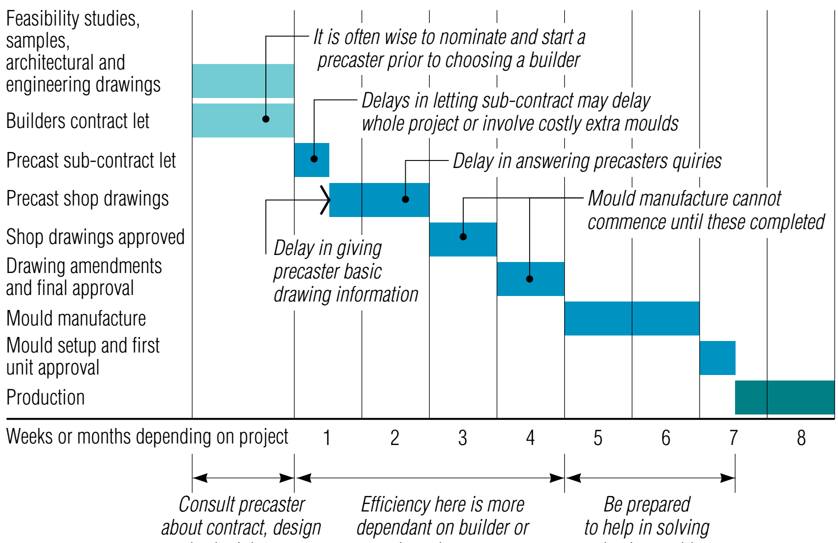

FIGURE 1

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contractors at any stage in the design process.

Additionally, they take responsibility for that part of the design contract relating to precast manufacture, handling, delivery and fixing. They do not, however, aspire to becoming de-facto designers and being required to produce near total design solutions. Nor can they be expected to accept responsibility for certification of any part of the construction process over which they have no control.

- Answer queries during the lead-time period promptly and so ensure that shop drawings are approved and mould manufacture begun on schedule. Remember, one possibility of delay is the need for additional moulds which are expensive items.
- Avoid re-designing the wheel. The industry has a wealth of well-tried and tested standards, most of which are encompassed in Australian Standards and other recognised publications such as the Concrete Institute of Australia Recommended Practice *Precast Concrete*. An example would be the acceptable levels of tolerances for dimensions and shape.
- Take the trouble to visit the factory to look at the first units. Be prepared to discuss any problems practically and to play a part in evolving solutions which may involve you in compromise – to do otherwise may be inviting a continuance of the problem through the construction period. Very seldom will technical problems arise on a job once manufacture is established.

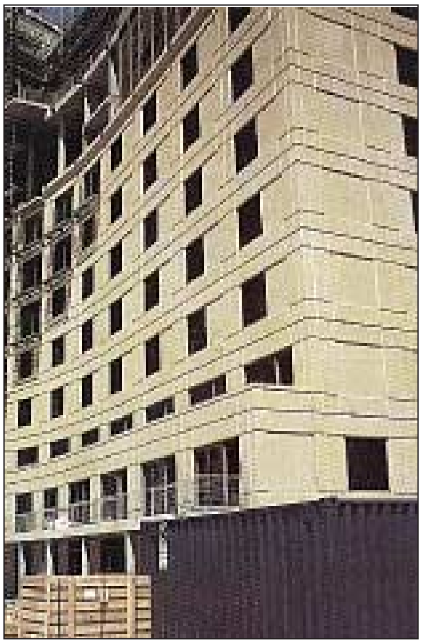
  Figure 1 gives an indication of the activities involved in a new precast project.

  Times will vary according to the availability of information and the size and complexity of the job.
- The better the quality of documentation, the more successful will be the outcome. It is indeed sad to realise that notwithstanding all the emphasis on management and communications in the past two decades, indifferent levels of liaison are still a significant stumbling block in producing harmony between players in a contract.

Despite all the above, many precast concrete projects run quite smoothly and in these instances much credit must go to the designers and head contractors.

But the issues raised here are serious and are occurring at an increasing rate, particularly the issue of inadequate project documentation.

SURFACE FINISHES



A QUALITY CLASS 2 FINISH, AIDED BY GOOD ARCHITECTURAL DETAILING *(Courtesy Sydney Harbour Casino Pty Ltd)*

This is the first in a series of brief articles which are intended to assist in developing an awareness of the basis of choice and the characteristics of a variety of surface finishes for precast concrete.

Whilst surface finishes have been, broadly speaking, associated with architectural precast concrete (wall panels, columns and beams) there is an increasing requirement for structural elements such as bridge members to have some level of surface finish specified.

The basis for surface finish documentation is Australian Standard AS 3610–1995 *Formwork for Concrete* supported by AS 3610 Supplement 1 (Blowhole and Colour evaluation charts) and AS 3610 Supplement 2–1996 *Formwork for Concrete, Commentary;* these documents frequently tempered by an historical approach of client/designer and manufacturer to the use of various sample panels.

AS 3610 defines five classes of surface finish, Class 1 being exceptionally demanding, certainly unlikely to be achieved over large areas and between elements. Consequently, the standard defines it as being suitable for use in very special features, generally in small areas, in buildings of a monumental nature.

Class 2 is intended for external and internal facades where it is possible to view the facade in detail. Many specifiers appear to believe that Class 2 is readily achievable for no other reason than it is one class removed from the nigh impossible Class 1. Nonetheless, a Class 2 finish is still an exceptional quality requiring very substantial input by the designer and the precaster.

A Class 3 finish also specifies good visual quality when viewed as a whole.

The essential differences between Classes 1, 2 and 3 are the type, number and dimensions of permitted surface defects including:

- face deflection
- blowholes
- face steps and undulations
- flatness
- shape – squareness
- dimensional tolerance.

Additionally, there are Classes 4 and 5. Class 4 is intended for surfaces which are to receive thick applied coatings such as cement render, whilst Class 5 finishes are intended for surfaces which are totally concealed such as the reverse face of a retaining wall.

As a general statement, the precast concrete manufacturer has little conflict with AS 3610 and its supplements. Problems occur however, with clients' interpretation, particularly the selection of Classes. There is a tendency to select Class 1 simply because it is the best possible finish often regardless of the application and available budget. Recent instances involving the selection of Class 1 finishes for precast seating elements for a stadium grandstand and similarly for a marine jetty are classical examples of overkill.

The standard is a quality guidance document but no document could possibly eliminate the subjective component of surface finishes and colour control. This is highlighted in the attitudes of clients and designers to the inspection of concrete surface finishes. A factory or warehouse facade, for example, may be specified as Class 2 (probably over the top) or, more realistically, a Class 3 finish. Assuming the latter choice, AS 3610 (Table 3.3.1) requires 'good visual quality when viewed as a whole'. 'As a whole' implies to this writer viewing the facade from such a distance as to see the entire or substantial area of the facade. Rarely would this be likely any closer than say 10 m to the facade yet, on innumerable occasions, the inspection takes place at less than an arm's length from the surface. The document is good, the interpretation variable and often unrealistic.

Specifiers should read the Commentary (AS 3610 Supplement 2) to appreciate the realistic and practical concerns of the documents drafting committee, eg a comment from C.3.3. of the commentary highlights this: 'the size of each concrete element, the details of its shape, reinforcement arrangement and access for concrete placement must be compatible with concrete pouring, its free movement and thorough compaction. Thin sections, congested reinforcement and large pours all inhibit the consistent achievement of quality of finish. For example, the shape of precast bridge girders, combined with the limitation on concrete access, due to ducts and reinforcement makes the achievement of high quality surface finish almost impossible'.

The requirement for control of surface finishes is essentially satisfied by visual inspection, determining compliance with the appropriate Class in terms of physical surface defects. This should be done at the earliest possible time following stripping from the mould, thus allowing any remedial treatment such as patching or the filling of blowholes to be done quickly, in turn allowing the colour of any patching, etc to be closer to that of the unit.

Work subject to further finishing, ie sandblasting, acid-etching, bush hammering and the like will invariably require additional inspection following treatment to determine compliance with required depth of texture, uniformity, distribution of aggregate, etc.

Also, in practical terms, it is necessary when assessing the units prior to additional finishing to consider if existing variations from the required Class of finish may be eliminated or minimised by that subsequent treatment.

Prior to the introduction of AS 3610, architectural precast manufacturers relied heavily upon the use of sample panels as the means of negotiating a contract and controlling production.

This approach is still widely used by architectural practitioners and precast manufacturers. Specifiers may have a requirement for, say, a Class 2 finish and still introduce the use of sample panels.

Broadly, the methods involve:

From a small panel, around 300 x 300 mm a preliminary evaluation is made on issues such as:

- matrix colour (cement type grey/off white/white and sand colour and source);
- coarse aggregate type and source (where aggregate exposure is planned);
- additionally, some expectation of the degree of surface texture or depth of aggregate exposure may be made.

It must be remembered that such a size panel can provide only a 'ball-park' indication of the appearance of production panels.

To further explore the design requirements larger sample panels possibly 600 x 600 mm may then be prepared.

Given client and designer agreement, full-size, typical panels may be manu-factured. Assuming suitability, these panels will remain at the precast plant as reference panels, probably being incorporated into the project during the closing stages of construction.

Frequently, the client or designer may go straight from the 300 mm^2 preliminary evaluation sample panels to initial full-size panels.

Due to the almost certain need to specify the cement type and quantity, together with specific aggregates, concrete for which surface finishes Class 1, 2 and 3 are specified will be Special Class Concretes (AS 3600–19.1.8).

It is pertinent here to mention the issue of colour control of precast elements. In practical terms, 'colour control' is all about ensuring that panels or other elements for a project have some degree of uniformity of colour and that any divergence falls within a pre-determined range. Supplement 1 (Appendix B) AS 3610 provides a tonal scale of some ten colour tones ranging from an extremely light grey to near charcoal and is intended to represent the many shades of grey which may be encountered with the use of grey cements. Having selected a shade, the range of variations is controlled by the choice of surface finish nominated, ie:

Class	Minimum tonal range
1	4 tones
2	5 tones
3	6 tones

Recognising the extreme complexity of achieving colour control the drafting committee has provided the opportunity for assessors to exercise discretion. An example, explained in the commentary states (C3.5.4), 'There may be situations where the subject work will be accepted, even though elements have tonal variations outside those recorded. Examples could include:

a) some elements slightly darker (or lighter) overall than the specified tone, but with the overall effect acceptable, and
b) some elements with local dark (or light) patches of colour which do not detract from the overall appearance.'

These comments highlight the remaining need for some subjectivity.

In work where the aggregates are exposed (water-washing, polishing and sand-blasting) the major concerns for colour uniformity are the uniformity of aggregate size and distribution and uniformity of the cement matrix together with depth of exposure.

Assessment of colour uniformity of the panels prior to such treatments may offer little information.

In summary, some of the important issues relating to surface finishes and colour control are:

- If using AS 3610 in documentation then take the trouble to read it first together with the Commentary which sets out the thinking and intent of the drafting committee.
- Like most documents it requires some level of interpretation; be realistic in that interpretation.
- Don't use the document as a cudgel in an attempt to obtain unrealistic quality. Design and quality detailing are still the prime requirements for quality appearance.
- Avoid the tendency to require the best; be realistic in terms of the status of the project and, importantly, the budget available.

In the next issue, the topics will include:

- Finishes directly off the mould, and
- Face-up casting, water-washed exposed aggregate finishes.

NEW PRESIDENT

At its AGM in November 1996, members of NPCAA elected Robert (Bob) Attwater, Managing Director of Auscore Pty Ltd based at Tyabb, Victoria as NPCAA President.

The Association looks forward to Bob's stewardship during the next two years which are guaranteed to provide the industry with new challenges, but importantly, new opportunities.

Members placed on record their thanks to retiring President, Godfrey Smith, Directors and all members who had contributed to the well-being of NPCAA. Ed

Quality Assurance Policy Statement

The Association supports, encourages and advises members in their efforts to achieve and satisfy clients' quality and quality assurance requirements. This Association and its members are committed to providing real quality and quality assurance to users of precast components in accordance with the specification requirements for each project.

RUNNING TO TIME

The project, to replace an existing 80 year old structure was undertaken by Bridge Gangs of Railway Service Authority (RSA) Northern Division.

Regularly, this newsletter makes reference to the issue of risk minimisation and the influence that precast concrete construction can have by virtue of off-site manufacture, control of time and budget.

These advantages of course are only realised if client and contractor provide planning and resources to utilise and maximise these advantages. A recent example of such quality application occurred on this bridge replacement project near Moree. Briefly, the programme required six months advertising of track closure and work was divided into three sequences:

- pre-occupation activities;
- occupation activities;
- post-occupation activities.

Pre-occupation activities included:

- delivery to site of fill material;
- delivery to site of precast box culverts 17 no uniculverts, 1.5 m wide x 1.675 high x 4.5 m long, each weighing 18 tonnes;
- delivery to site of gabions and rock;
- co-ordinate provision of impermeable site welded membrane;
- partial disassembly of existing bridge;
- diversion of water-course to allow working area and reduce soil moisture content.

Occupation activities included:

- demolition of existing structure;
- excavation of base to –0.5 m and placement of 50 mm sand bed;
- place and site-weld, impermeable plastic membrane, cover with 50 mm sand bed;
- prefabricate track panels (rails, ties);
- place fill material and finish with 50 mm sand levelling bed;
- place culverts; 17 no commencing at 14.00 hours, completed by 16.30 hours;
- restore embankments;
- place gabions;
- place prefabricated track panels and temporarily plate in position;
- carry out preliminary track alignment.

Completion provided for the opening of the line, the first train being the Country Link Xplorer at approximately 20.00 hours, slightly over 36 hours after site work commenced.

Post-occupation activities included:

- place ballast to full design profile;
- re-surface track to design line and level;
- adjust and weld track;
- complete gabions;
- provide cut-off side walls beside culverts;
- install rock protection mattresses to floodway culvert aprons.

This project vividly illustrates the value of quality pre-planning, detailing activities, ensuring adequate manpower and lifting resources.

To demolish and replace this structure in around 36 hour working period places great credit upon Railway Services Authority and emphasises the value of precast concrete construction methods.

The editor is grateful to David Hyne of Project Management – RSA (Northern Division) for supplying details of the project.

Design and documentation was by Connell Wagner, Consulting Engineers. ■

09.00 HOURS SATURDAY
DEMOLITION OF THE EXISTING STRUCTURE UNDERWAY

17.00 HOURS SATURDAY
ONGOING SITE CLEARANCE

10.00 HOURS SUNDAY
SUB-BASE PREPARATION

14.00 HOURS SUNDAY
BASE COMPLETED, UNITS BEING PLACED

15.30 HOURS SUNDAY
PENULTIMATE UNIT BEING LOCATED

16.30 HOURS SUNDAY
FINAL UNIT PLACED

READY FOR BALLAST, TIE AND RAIL PLACEMENT. NOTE CAST-IN RETAINING KERB AND PREFIXED GALVANISED FOOTWAY.

APPROXIMATELY 20.00 HOURS SUNDAY EVENING
OPENED TO TRAFFIC

HAVING THE RIGHT CONNECTIONS

The design, scheduling and placement of conventional steel reinforcement in concrete is highly labour intensive. Over the last 20 years there have been many improvements in construction efficiency through the introduction of new technology but methods of reinforcing have remained largely unchanged.

Previous work in the development of ‘Studrail’ convinced design engineers at Alan H Reid of the scope and need to seek further development and refinement in reinforcement detailing.

They recognised that the replacement of bends, hooks and cogs with end-plates improved anchorage, confinement and ductility and provided very significant improvements in constructibility. They reasoned that if the same ideas could be incorporated into every reinforcing job then concrete structures could be designed with greater flexibility, better constructibility and with improved structural integrity. Elimination of the hooks and cogged bars dramatically reduces steel congestion. The concrete can be placed and vibrated more easily and quickly and with better quality control.

The Reidbar system provides the answer. Reidbar is rolled with a threaded deformation pattern. Highly efficient anchorage is achieved using plate-nuts which are screwed onto the ends of the bars. Reidbar reinforcement is assembled like a plumbing system using straight bars and fittings rather than individually bent bars. This dramatically reduces design and scheduling difficulties. The bars may be coupled end to end at any position which improves speed of assembly, improves confinement, reduces congestion, gives good end cover control and eliminates the costs due to mistakes. Savings in formwork are realised by elimination of starter bars protruding through the forms. A further spin-off is that staining of the concrete face due to reinforcement being left exposed for a period of time is eliminated.

Reid’s now have available a comprehensive range of fitments serving the precast manufacturing industry, cast insitu concrete and rock and soil stabilisation. Indeed, from the construction industry’s viewpoint, it could be called a ‘bar for all seasons’ wherever a threaded steel bar can be utilised.

In anticipation of the change to 500 MPa grade steel, Reidbar complies with the anticipated requirements of the new grade.

Among the significant benefits which Reidbars offer engineers and constructors is the potential to dramatically reduce congestion and constructibility problems.

How?

- Reidbar is grade 500 requiring 20% less steel than conventional 400 grade bars.
- Reidbars can be coupled end to end, eliminating congestion resulting from lapped bars. This, in turn, may provide for a marginal reduction in concrete thickness.
- Reidbars can be fully anchored by using a screw-on footplate rather than a hook or cog.

The first two features are immediately obvious, however it is the third which provides the most powerful method of reducing congestion, improving confine-ment and performance.

The use of headed reinforcement was pioneered by Studrail technology for shear reinforcing around columns in flat plate flooring systems.

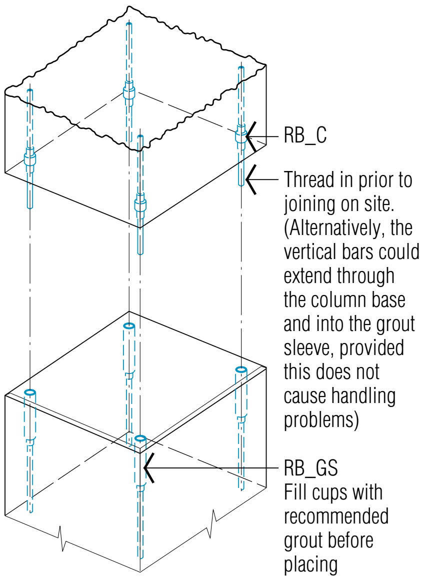


FIGURE 1 PRECAST COLUMN ELEMENTS

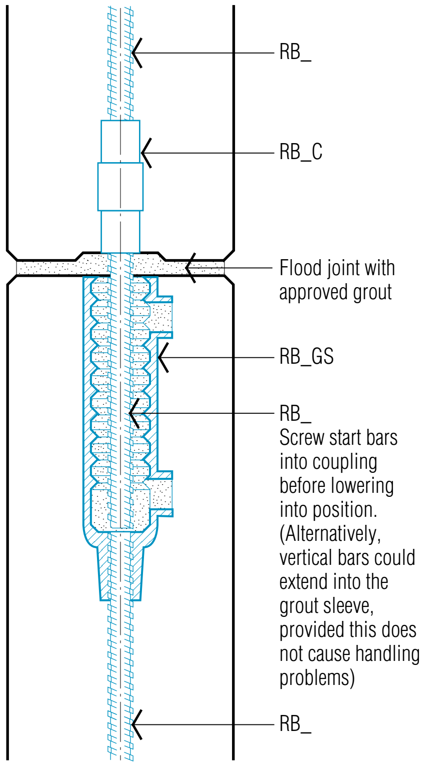


FIGURE 2 HORIZONTAL JOINT – PRECAST LOADBEARING WALL PANELS

Reid have been researching and working with Studrail technology for over five years in a wide variety of jobs. They realised that one of the principal benefits of fully anchoring the reinforcement with an anchor plate on the end has been that it provides an open structure which does not interfere with the other reinforcement. This greatly simplifies concrete placements and compaction by reducing congestion.

The anchorage efficiency of Studrail reinforcement is more than twice that of hooked bars or stirrups in thin panels. They soon realised that the same principles can be applied to every other reinforcing bar. Not only is anchorage developed by compression in a very short distance but also the use of anchored bars can dramatically simplify the scheduling, bending, placement and tying of the bars and free up the structure for concrete placement.

When standard hooks or cogs are used (the normal detail) then the starters are seldom fully anchored in accordance with construction code requirements. Research has shown that hooked bars in thin panels slip at the bends and cannot fully develop. This is precisely the same problem which stirrups suffer when used in flat plate flooring systems and why Studrails excel.

The following example demonstrates the efficiency of this new method of reinforcement:

- In a 150-mm-thick wall a standard hook develops only 50% of the yield strength of a 12 mm, 400 grade reinforcement bar.

- In the same 150-mm wall a 12-mm 500 grade Reidbar fitted with a foot-plate (or threaded insert) and embedded to a depth of 95 mm develops the full breaking strength of the bar in concrete of 25 MPa.

There have now been numerous jobs where Studrails have been used in congested areas for shear reinforcement as an alternative to hooked or cogged bars. The simplicity of the Studrails saved many hours of fitting and tying hooked bars.

Kinhill Engineers and Transfield used the open structure and anchorage efficiency of Studrail technology for reinforcing in the walls of the Essor Concrete Gravity Structures in the Bass Strait Oilfield. The reduction in congestion simplified reinforcement installation and improved construction speed.

Recent research by Dr J M Ingham of Auckland University and others at the University of California has shown that this type of anchorage (even when used without confinement steel) provides superior performance to bent bars used with conventional confinement steel.

The logical solution for all construction applications was a threaded reinforcing bar onto which ‘Anchor plates’ could have been fitted, ie Reidbar.

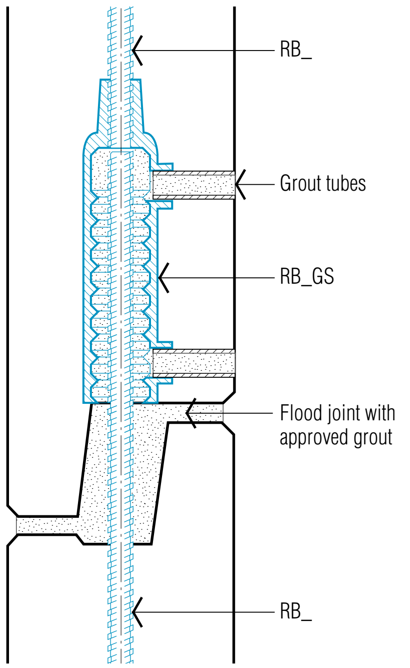


FIGURE 3 HORIZONTAL JOINT – REBATED PRECAST WALL PANELS

Reidbars may be fully anchored in the same way as Studrails using the purpose designed foot plate. The bars are cut to length and a footplate fitted to each end. The footplates may be fitted without special tools at the jobsite, where the advantage of inserting a bar through the reinforcement cage and then fitting the plates can be very useful in congested situations.

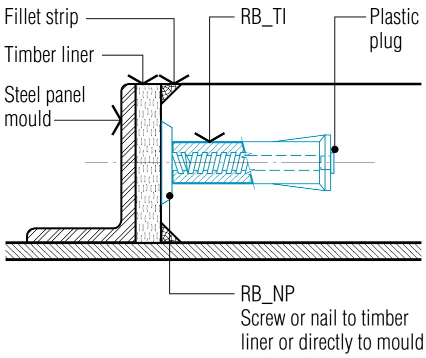


FIGURE 4 THREAD INSERT TO EDGE OF PANEL

Alan H Reid have concluded an agreement with Smorgon ARC to produce Reidbar. Designers wishing further information should contact:

Alan H Reid Pty Ltd on
telephone (02) 9672 1919 or
fax (02) 9672 1711

The product is available from branches of Smorgon ARC.

Some of the applications of Reidbar to precast concrete are shown here.

Abbreviations used in Figures 1 to 4:

RB_ Reidbar
RB_C Reidbar coupling
RB_GS Reidbar grout sleeve
RB_NP Reidbar nailing plate
RB_TI Reidbar threaded insert

COMPUTER PROGRAM AVAILABLE

AT LAST! A COMPUTER PROGRAM TO DESIGN PRESTRESSED, HOLLOW-CORE CONCRETE FLOORS.

You can select 80% of the precast concrete planks you need from load tables, but it's the other 20% that cause all the problems.

Or did, until now!

Now there is a computer program called PCP4 to design exactly what you need. In less than ten minutes it will create a report that summarises:

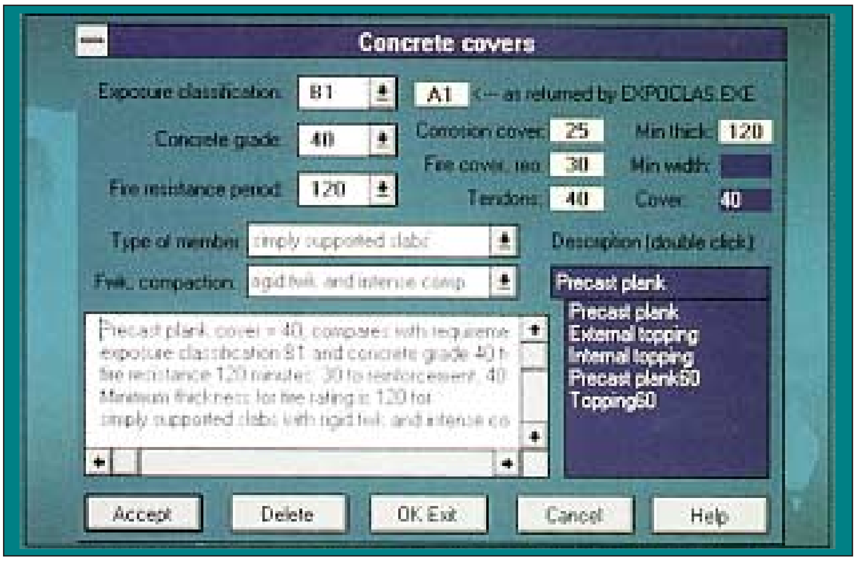
- exposure classification, creep and shrinkage values;
- concrete covers for durability and fire rating;
- bending moments and shear forces;
- 124 values relevant to precast, hollow-core design.

PCP4* performs hundreds of calculations and lets you select the right plank from all the planks produced Australia-wide by members of the NPCAA, and it costs just $395.

To order your copy of PCP4 or for more information, phone Engineers' Compendium on 048 62 1295.

PCP4 is sponsored by the National Precast Concrete Association Australia and may also be ordered from any of its members.

* *Requires IBM or compatible 486 or better PC with 8 MB RAM, VGA colour, Windows 3.1 or later.*



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