RESIDENTIAL TILT-UP CONSTRUCTION

CEMENT AND CONCRETE ASSOCIATION OF AUSTRALIA
CAVENDISH COURT

LOCATION – 47 Cavendish Avenue,
Devon Park SA

CLIENT – SA Housing Trust

ARCHITECT – Rod Roach

STRUCTURAL ENGINEERS – TMK & Associates

ELECTRICAL SERVICE – Main Seacombe Electrical

HYDRAULIC SERVICE – Doherty Plumbing

QUANTITY SURVEYORS AND LANDSCAPE ARCHITECTS –
SA Housing Trust

PROJECT MANAGER – Paul Ogden –
SA Housing Trust

DEVELOPER AND BUILDER – Alpine Constructions
Pty Ltd

TILT-UP ACCESSORIES SUPPLIER – TJ&H Agencies

PRECAST CONCRETE – Walling Systems

COST – $840 000

COST/m² – $700 approximately

The increasing use and sophistication of tilt-up precast concrete techniques as a
collection method for commercial, industrial
and residential development convinced the
South Australian Housing Trust to use tilt-up
techniques to build this townhouse
development. It has proved to be successful in
determining that time- and cost-savings could
be achieved with no detriment to the quality
of the housing and no loss of acceptance by
the tenants or the wider community.

The development consists of fourteen
houses, eight are of two storeys with two
bedrooms, there are four three-bedroom
two-storey high houses of two different
designs and another two are of one-storey
construction with two bedrooms. Each house
has private gardens front and rear and secure
parking for one car.
The Trust's decision to undertake this pilot development using tilt-up techniques was influenced by the increasing acceptance of the method in a wide range of development. Apart from the obvious advantages of strength and fire resistance provided by concrete construction, was the attraction of the significant time and cost savings.

The developer/builder was able to guarantee a maximum price for the project by appointing the architect, engineer, concrete walling contractor and hydraulic and electrical contractors at the design stage and to complete the works within six months under a design and construct contract.

Wall panels are 150 mm thick overall including horizontal decorative grooving, and were cast with F82 central reinforcement and Y20 edge bars. Some panels required additional reinforcement for the lifting operation.

The largest panels used are the two-storey party and end walls which are approximately 10 x 7 m high at the ridge and were cast on site. Panels used in the opposing direction to these extend only to the first floor window sills and are 3.25 m high with timber stud wall above. Panels used for the one-storey houses are only 2.5 m high. These smaller panels were factory cast as their dimensions made them easier to transport.

The two-storey high panels were designed to cantilever above first floor level with the timber first floor detailed to act as a diaphragm. The base of each panel has a simple pinned connection to a shallow edge rebate in the raft footing. Plates welded to plates cast into the panels were bolted to the footing. This rebate was sized sufficiently to allow for ease of erection and was subsequently concreted.

Wall panels were specified to be cast of 32 MPa concrete to achieve the required 25 MPa strength at the time of lifting, although the contractor used 40 MPa concrete in some cases to achieve earlier lifting times.

Conventional mix design, slump and water cement ratios were used with no additives required.

Panel to panel connection was by means of plate welded to cast-in plates. Joints were sealed with a polysulphide sealant and foam back-up rod selected to accept suitable paint finish.

The maximum weight of panel was 23 t and all panels were lifted by a 90 t capacity crane in three days.

Concrete walls were lined internally with batten-fixed foil-back plasterboard, with internal partitions of conventional timber studwork also lined with plasterboard. Roof construction is of conventional timber trusses sheeted with 'Colorbond' roofing.

Externally the precast wall panels have horizontal grooves at 600 mm centres above a tiled dado-line with the concrete coated with a high build, long life paint finish. Decorative cantilever canopies shade living room windows and provide shelter to front doors.

The use of tilt-up construction techniques at Cavendish Court has convinced the South Australian Housing Trust of the time and potential cost savings offered by the technique and they intend using it for more developments to provide attractive low-cost housing.

Photographs by DON BRICE of MILTON WORDLEY AND ASSOCIATES
CHESTER STREET TERRACES

LOCATION - Chester Street, Christchurch, NZ
CLIENT - Terrace Housing Developments Ltd
ARCHITECT - Warren and Mahoney Architects Ltd
CONSULTING ENGINEERS
STRUCTURAL - Alan Reay Consultants Ltd
ELECTRICAL - Byelectric Design
PROJECT MANAGER - Alan Reay Consultants Ltd
BUILDER - Hanham & Philip Contractors Ltd
TILT-UP ACCESSORIES SUPPLIER - Ramset
PRECAST CONCRETE MANUFACTURER - Precision Precasting (Canty) Ltd
COST/m² - $NZ750 approximately
Tilt-up construction techniques have been used increasingly in New Zealand, paralleling the Australian experience, and in this medium density residential development on an inner-city site in Christchurch tilt-up panels were used for all walling in the eight row houses, garages and even the dividing fences. Wall panels were painted internally and externally eliminating the need for linings and the panels have cast-in detailing to suit the terrace-style of the development which harmonises with its Edwardian surroundings.

The dividing walls between houses were cast on site to enable them to be cast and lifted into position as one unit and were cast on the 100-mm ground floor slab which incorporates cast-in heating cables. All electrical cabling and fittings were cast into the concrete walls using PVC conduit with lifting eyes located in areas concealed by the finished structure. End walls have an external layer of Styrofoam to provide thermal insulation.

External wall panels on the north and south faces were cast off-site to speed construction and to permit efficient re-use of the steel form which incorporated the detailed rebates and recesses which pattern the street frontage.

Panels were up to 150 mm thick and the maximum weight was 14 t. Panels were lifted by a 60 t capacity crane with two cranes required for the largest panels. Erection proceeded from the east end to the west and took five working days.

Panels were propped, levelled and braced with panel to panel connection providing temporary angle cleats until upper floor construction was completed.

The precast concrete suspended floors for each unit were cast off-site as a single unit with the lower surface formed to a high standard to allow painting as a finished ceiling, and incorporating ducts and recesses for lighting. Each floor panel was designed to be lowered in place after the perimeter walls had been erected and fixed together, to avoid any double handling or realigning. Services were laid over the precast slabs and an insitu concrete topping placed to finish the floor and tie the structural components together.

Stairs were designed to be similar at each level, so that a total of sixteen precast stair sections were cast from one mould.

Garage and fence wall panels were cast on site on the garage floorslabs, tilted, and lifted into place.

A feature of the Chester Street frontage is the large moulded concrete gutter at the eaves. The concrete mix included a waterproofing additive, so that no additional lining was required to form the gutter.

Internal exposed surfaces are painted with an acrylic paint system. External walls are painted with a cement based paint applied with a brush to give a heavy texture and accentuate the masonry style of the building.

The almost total use of precast concrete for all structural components of this development indicates the potential of this system which provided the required fire and sound separation between houses and the benefits of low maintenance, security and rapid construction.

Photographs by ANDREW JOHNSTON
This privately funded development of thirteen one- and two-bedroom units, designed for the elderly or retired, has been built on a sloping wooded site with views over the Derwent River and is convenient to medical and community services, and to local shops.

The development was carefully detailed to obtain the maximum economy from the tilt-up concrete construction methods used to build the structure of these cottages, while also providing attractive living units that would appeal to their occupants.

Due to the sloping terrain and the consequent difficulty of providing suitable casting beds for the panels and also influenced by the superior finish achievable under factory conditions, the panels were factory cast.

Panels vary in size with the largest being 6.7 x 3.0 m and all are 125 m thick. They were to be compatible with available mobile craneage and ranged in weight between 4.5 to 6.5 t. The wall panels are patterned externally by 25-mm deep horizontal grooves that stop short of the end walls reminiscent of quoin and by vertical grooving above and below openings. 123 panels were cast including cross foundation walls.

To overcome the poor soil conditions 600 mm diameter auger holes were drilled down until suitable bearing was found at a maximum depth of 3.6 m. The excavations were filled with mass 20 MPa concrete and dowels were cast-in.

Panels were edge lifted into position, located over the dowels cast into the footing pads, and bolted together at the top with galvanised plate connectors. Due to the small number of panels and their size, only two or three bracing props were required.

Despite difficult weather conditions two pairs of units were easily erected in a day. Joints between panels were designed to be 15 mm wide and sealed with 'Sikaflex 15 LM'.

Floor construction then proceeded. Owing to the sloping site suspended slab floor construction was necessary and 130 mm
Concrete slabs on permanent 'Bondek' formwork are supported on shelf angles bolted to the precast wall panels.

Most internal faces of the precast panels are lined with foil-backed plasterboard on metal furring channels for insulation. Exterior wall panels with large window opening were lined internally with glue-fixed plasterboard. Internal partitions were stud framed plasterboard. Services were concealed behind the plasterboard.

Externally the precast panels were finished with Granosite applied coatings in two colours, with the change occurring at floor level to reduce the apparent height of the panels.
KENT TOWN
TOWNHOUSES

LOCATION – Grenfell Street, Kent Town
BUILDER – Classic Constructions
ENGINEER – Zafiris and Associates Pty Ltd
TILT-UP CONSTRUCTION – Stevlyn Constructions

This pair of townhouses was a 1992 HIA Homes of the Year award. Their mirror image plans having living areas downstairs and two bedrooms, one with ensuite, bathroom and study upstairs. Separation is provided to the two living areas downstairs by an internal courtyard.

All external walling was built of tilt-up precast concrete panels which are patterned by quoins and window surrounds to reflect the detailing of the surrounding Edwardian cottages.
ROW HOUSING AT CARLTON

DEVELOPER—Central Equity Limited
ARCHITECTS—Span Group
ENGINEERS—Bonacci Winward
PRECAST CONCRETE WALL PANELS—Advanced Precast Pty Ltd

SITE PLAN
Central Equity is a property development company which has concentrated on defining segments of the property market displaying a potential for greater than normal growth. They have recently shifted their area of interest from the refurbishment and redevelopment of city office buildings to the medium density affordable-housing sector. Most units are sold prior to completion. Each development is tendered to a select regular panel of builders and a fixed-price, fixed-term contract sought. Substantial pre-sale of units prior to the letting of tenders minimises risk.

Each development completed or currently under construction uses precast concrete wall panels selected for their economy and the speed they provide to construction.
Completed developments include: Drummond Court, Carlton comprising 26 single-level new apartments with eight two-storey apartments provided in the restored Princess May Building which was formerly the Children's Hospital; and Rathdowne Gardens, North Carlton comprising 19 new two-bedroom terraces, two new three-bedroom terraces, 12 new one- and two-bedroom apartments, 24 one- and two-bedroom apartments provided in a converted three-storey warehouse; and five restored existing Victorian terraces. In addition historic buildings on site, formerly the North Carlton Engine House and Tram Shed built for the Melbourne Tramways Trust, were refurbished to provide covered car parking.

Projects under construction include: Miller Park – 58 apartments at North Fitzroy; Nicholson Park – 36 apartments at Brunswick East with brick external walling to harmonise with the locality; Drummond Terrace – 53 apartments at South Carlton; and Coventry Gardens, South Melbourne consisting of 112 terraces and apartments to be built surrounding a large central garden in which there will be a swimming pool, gymnasium, tennis court and barbeque.

The new housing at Rathdowne Gardens consists of mainly two-bedroom units in two rows running parallel to Rathdowne Street with two three-bedroom houses facing Mary Street. They have been built with concrete ground floor slabs and timber upper floors with all external walling of 150-mm thick factory-cast precast panels. Panel size was generally one storey high and up to 12 m long weighing 15 t. Services are accommodated in the floor slab, or in the internal stud frame walls and fitments, and taken to the upper floor via a vertical service duct. All concrete walls are uninsulated but lined internally with adhesive-fixed plasterboard. The roof framing is of timber and sheeted with pre-coloured metal decking and the ceiling is insulated.

External wall detailing in the form of architraves, pilasters and string courses were all cast as part of the main panel. However, the canopies above each front door were cast from glass reinforced concrete (GRC). The buildings were then rendered and painted.
At Drummond Court the new apartments are arranged in two rows of terraces, one on two levels and the other on three. All the apartments have two bedrooms and the construction is similar to that described for Rathdowne Gardens except that concrete floors are used throughout and garaging is provided at the north and south ends of the new construction. External columns supporting entrance canopies are of precast concrete, and applied moulding in the form of canopies or pilasters is of compressed fibre sheet. An applied finish was grooved to provide detail and then painted.

The new two and three storey high buildings have been constructed using 125 and 150 mm thick precast wall panels with a textured paint finish. Panels are again generally one storey high by up to 12 m long and weigh 15 t.

Upper floors consist of 180 mm thick reinforced flat slabs. The flat slab system has the advantage of flat soffits so the plasterboard ceiling can be adhesive fixed direct to the slab. Over the carpark areas a 180-mm thick banded slab system with 400 x 2400 wide band beams was chosen to accommodate the extensive planting above with minimal structural depth and excellent serviceability characteristics.

Both buildings have conventional raft and pad footings founded into the stiff clays.

Photographs by JOHN GOLLINGS
SUGGESTED DETAILS

Precast concrete walling should embrace the principle of loadbearing, single-skin construction. Joints between panels should have an external face-seal of flexible sealant with appropriate backing rod. This should also be used between the panel base and footing in the case of integral footings. Suggested connection details are set out here along with some treatments of windows and parapets. (These details are adaptations of those appearing in the February 1992 issue of Constructional Review and in the Precast Concrete for Medium Density Housing (G69) reprint from it published in May 1992).

FORCES TO BE RESISTED

The top of the wall usually experiences lateral movement against which it must be braced. The base of the wall can experience forces in any direction which must be resisted.

ROOF TRUSSES AS TOP BRACING

Examples of where required.

CROSS WALLS AS TOP BRACING

Examples of where required.
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