SUMMARY

Late last year a construction journal featured the new C1 multi-storey building in Christchurch. Its consultants had recommended a steel primary structure and are quoted as stating, ‘It wasn’t going to be the cheapest solution by much, but it was going to be the quickest…’. This implication that steel construction is inherently faster and cheaper than concrete construction needs to be challenged. Mt Maunganui New World presents a case study wherein sophisticated use of concrete provided the only viable construction system for an extremely fast track project.

INTRODUCTION

The Mt Maunganui New World represents an excellent example of collaborative construction where the client, consultant team and contractor worked closely together to achieve the near impossible.

The existing Mt Maunganui New World was extremely small, and as a result of numerous expansions over many years had become cramped and unpleasant to shop in. It was old, tired and needed to be replaced. Furthermore in today’s competitive retail environment its small size meant that it was becoming increasingly difficult for it to service the local catchment to the standards expected of a New World supermarket.

PROJECT TIME FRAME

The project time frame was extremely short. Usually a supermarket of this size (>5000m² - over two levels) takes around 42-46 weeks to construct. For a variety of reasons approval to proceed was delayed and finally the ‘all go’ was given in mid-March 2006. Demolition could not begin until mid-April and the supermarket HAD to be open by mid-December 2006, in time for the pre-Christmas holiday trading – a construction period of just 34 weeks! And construction would take place through the wet-weather months of the year.....

DESIGN APPROACH

The design challenge of this project began with an extremely compact site. There was sufficient area for either a financially viable supermarket or the amount of carparking required to service a viable supermarket.

This immediately led to a two storey concept with the supermarket on the top level and carparking in the undercroft beneath it. Other design factors that shaped the final design outcome included:

- The site was a high profile corner on the main road into Mt Maunganui. We needed to architecturally address the corner and maximise the commercial advantage of the location.

- We needed to create a sense of ‘invitation’ into the building while at the same time allowing for a functional space which was light and pleasant to shop in. We had to get the public's heads around supermarket shopping one level above the ground. Transparency was recognised as being the means of doing this, resulting in a large glazed curtain wall on the south elevation. This immediately raised the issue that too much glazing can cause

---

1 Project Manager, Cement & Concrete Association of NZ
(Previously Associate and Senior Project Architect – Babbage Consultants Limited)
problems for certain kinds of supermarket stock requiring modeling of daylighting and careful control of sun ingress.

- The undercroft carparking needed to be perceived as easy to access and safe for customers to use. People had to be confident of getting a carpark otherwise they would go elsewhere. Again transparency and easy access would be the key.

- Being in a sea spray zone, durability and low ongoing maintenance costs would also place significant constraints on the construction materials used.

These basic design parameters began to shape the building, at which point the building's complexity multiplied. A two-storey supermarket began to raise many design issues which needed to be resolved efficiently and cost effectively:

- We needed to manoeuvre 40 tonne B-Train and 18m articulated delivery trucks from the main road up 3.2m to the retail level where they would be unloaded. At any given time there could be up to five or six vehicles on the upper deck (including two large trucks) and all needed to be able to move past each other to exit the delivery area. Noise and vibration associated with vehicle movements had to be addressed.

- We had to waterproof the loading deck to control stormwater and protect customer's cars below.

- We also needed to separate car and truck traffic entering and exiting the building for operational safety and efficiency.

- Town planning height controls meant that we had extremely restricted floor to floor heights. This had a significant impact on delivery truck ramp lengths/gradients and under-floor services reticulation and clearances.

- We had to provide enough structural flexibility for the operator to change retail displays without overloading the structural system.

- Physically we had very tight site constraints to build within. This significantly effected the construction sequence, therefore design had to take these into account.

**DESIGN SOLUTIONS**

We commenced the design process and immediately chose a concrete primary structure – only concrete would provide the stiffness we needed to cope with the truck movements and vibration at first floor level as well as achieve the bracing requirements for a building in an Earthquake 3 zone. The concrete structure also dealt with the fire separation requirements between floors. Pre-cast exterior walls were immediately chosen, not only for speed, durability and quality reasons but also for fire protection and noise control.

- To achieve program deadlines we needed to use as much prefabricated material as possible including:
  - Decorative precast structural wall panels.
  - Plain precast wall panels.
  - Precast shell beams.
  - Hollowcore planks for their span – dictated by the carpark layout. Hit and miss hollowcore wherever possible to make installation and running of services easier.
  - Steel mezzanine and roof structure.

- In-situ concrete would be employed for the foundations, carpark columns, the ramps floors, decks and undercroft carpark paving.
• Being in sea spray area, we chose an aluminium roof, again for durability and to reduce ongoing maintenance costs.

ARCHITECTURAL/STRUCTURAL OUTCOMES

Perhaps the most important factor behind the success of this project was that the client, design team and contractor came together at the commencement of the documentation phase to determine the methods of construction. This engendered a strong sense of team, all opinions were valued and collaboratively the construction methodology and sequence was agreed. Meetings were held weekly and at times almost daily. The main features of the structural and architectural outcomes of this documentation and programming exercise were:

• The foundations would be a combination of screw piles, pile caps and a matrix of interlocking ground beams to stiffen and support the main structure. The sandy soil conditions made screw piles the only viable option given our tight programme.

• The primary structure comprised in-situ columns and pre-cast shell beams. In some places the beams had to be boxed and cast in-situ to deal with curving ramps and set-downs.

• The construction of the floors had to meet high dead, live and point loads.

• The floor system was a combination of hollowcore, hit-and-miss hollowcore and in-situ concrete. The mezzanine was a concrete floor in steel tray on a steel structure.

• Precast exterior walls: These gave us speed of construction provided they arrived on schedule and were the major focus of the critical path. The precast perimeter panels also provided the support to the roof structure as perimeter internal columns could not be tolerated by the buildings use. They also provided texture to the public faces of the building. As it transpired, the quality of panels was so high that we were able to delete the internal lining to the retail hall. This recovered 4 weeks of programme and ensured we would open the store on time. The precast exterior cladding provided a durable and low maintenance exterior for the building.

• The steel roof structure was supported off the precast panels which then tied the whole structure together.

• Seismic bracing was provided by the two ramps, the lift shaft and the ‘corner’ we wanted to emphasise architecturally.

• Retail flexibility: The necessity for the Operator to be able to move displays, often having significant loads, became a major design challenge to be dealt with. The basement carpark was designed to provide maximum parking possible. However it wasn’t possible to move basement columns to suit retail-level point loads or layout.

Pile cap and screw piles.

Display flexibility is vital to all retail operations and a major structural challenge when the supermarket is above the carpark.

• Waterproofing: We had to get the vehicle deck waterproofed to protect the customers’ cars below. The problem was that trucks would tear up any applied surface. Our solution was to incorporate a waterproofing admixture to the concrete mix. Almost two years on, no issues in regard to leakage have been reported by the Operator.

CONSTRUCTION

Actual construction commenced in early May 2006. To maintain programme and achieve early closing-in, construction commenced at the east Tweed St frontage and then progressed along Maunganui Road. As the building edges were just 100mm
inside the two road boundaries this was only feasible construction methodology.

The installation of screw piles took just under three weeks after which construction of the pile caps and ground beams commenced. Owing to the friable nature of the sand conditions we were forced to lift the in-situ ground beams, a decision which later created havoc for the in-ground services.

At this point the coordinated delivery of precast components and the construction of in-situ elements became critical. Even a day’s delay impacted the critical path.

In-situ columns with first floor beams and hollowcore planks placed from Grids 8-11.

Inevitably there were delays in receiving the early planks and panels. This began to pressure the programme which was now being adjusted almost on the daily basis. Thankfully after four weeks the precast deliveries got into a reliable rhythm and the critical path was adjusted to allow for the revised delivery schedule.

However significant delays had already occurred and in the struggle to maintain programme the contractor was now starting and finishing each day under lights. Often concrete was being poured well before 8am but because of the cold temperatures not finally setting until late afternoon or early evening. The strength of concrete was later increased to assist the strength gain for the in-situ concrete. Adding to the challenges the weather had deteriorated as the project moved into the winter months.

Note that the tops of the cores have been cut out so as to reinforce and strengthen the ‘hit and miss’ hollowcore planks to stiffen the overall floor.

In large areas of the retail space we opened up the top of the hollowcore planks, adding reinforcing into the cavities and effectively turned them into beams. So doing stiffened the floor sufficiently to provide the retail display flexibility required by the Operator.

Variable wall-height shell beams – required to accommodate the chiller and freezer set downs.

Under the chillers and freezers a set-down of up to 350mm had to be created for the installation of insulation and the wear slabs inside them. The insulation also served to prevent condensation occurring on the underside of the floor. This meant the hollowcore planks had to be set at a number of different levels requiring the shell beams to be specifically designed to accommodate this. Additionally in-situ beams were required in a number of locations particularly in transverse situations. At all times a minimum clearance between structural elements and the carpark level had to be maintained at 2.3m, while retaining an acceptable aesthetic appearance when seen from below.
Erection of the first ‘decorative’ panels on the ‘corner’.

The erection of the first ‘decorative’ precast panels began a new momentum for the project, as with it came the erection of the structural steel roof and mezzanine frame. The frame installation trailed the erection of panels which followed closely behind the floors as they progressed along the site.

The precast walls secured the ends of the main rafters which in turn served to stabilise the top of the panels.

The main rafters penetrated the exterior walls to provide a covered delivery area and to stabilise the precast acoustic wall adjacent to the residential boundary.

The upper floor structure was a very clever piece of structural engineering using what could termed the ‘house-of-cards’ principle. Separate structural elements depended on each other to lock together and provide the stability necessary to tie the whole building collectively as one. Through the use of prefabricated elements the time from the erection of the first retail floor panels to the completion of the retail hall structure was just four weeks.

One month on, the retail space is virtually closed in and fit out has commenced.

Once the retail hall and back-of-house was closed-in attention turned to the areas off the critical path. These included delivery ramps, delivery decks and the undercroft carpark floor. The quality of concrete placing on the ramps and decks was superb and due credit must be given even for attention to details. For example, the specification had called for a broom finish to the truck delivery ramps. The placer took one look at the ramps said, “******* that, it will never last under trucks braking” and instead he ‘fan formed’ the surface. A better solution – illustrating that collaborative teams operate at all levels within a project.

Attention moved towards the non-critical path elements. Here the acoustic walls to the ‘up’ delivery truck ramp are being lifted.
Installation of underfloor insulation into the 'miss' cavities between hollowcore planks.

As mentioned above, the high quality of the 'decorative' precast panels saved us the need to strap and line the panels to the retail hall. However, this necessitated insulating the underside of the retail floor. The 'hit and miss' hollowcore floor system allowed insulation to be easily installed between planks and enabled the building to meet code requirements.

As part of the cost engineering on the project the QS had advocated an asphalt pavement to the undercroft carparking. The architect strenuously objected, arguing that asphalt represented a poor choice because of its ongoing maintenance needs and much shorter lifespan than concrete. The architect eventually prevailed and a superior solution was achieved for the owner. That said, pouring the concrete floor of the carpark with only 2.3m of headroom presented its own challenges.

As a result of the speed of construction, the retail floor didn’t have time to dry out naturally. Consequently it was necessary to seal the floor before the vinyl tiles were laid.

**THE END RESULT**

While supermarkets tend to be big boxes, with Mt Maunganui New World the building has established an engaging street presence, almost floating above the footpath. The glazed wall has successfully created the sense of transparency and invitation we sought as a design team. The project fully met the client’s needs and today stands as a successful retail operation.

The success of this project outside of the design and construction methodology was due in no small part to the commitment of all the stakeholders to the project. The client, designers, project manager, consultants and contractors from the outset collaborated as a team, working extremely hard together with the sole objective of achieving the opening date while not compromising quality.

Mt Maunganui New World also stands as a testament to fast concrete construction. For all the reasons above, concrete was the only viable construction system for this project. Its ability to be fabricated into a multiplicity of components off-site and its inherent plastic qualities on-site gave the project the speed and flexibility necessary for success. With innovative design and motivated, competent contractors, a high quality project was completed on time and budget.

The new supermarket opened for business on 15th December 2006.
ACKNOWLEDGEMENTS

One cannot talk of a collaborative construction project without acknowledging the individuals and organisations that made it all happen.

- Foodstuffs (Auckland) Ltd. Client. With thanks to the Store Development Division team.

- Pragmatix. Project Managers (probably the best around).

- Babbage Consultants Limited. Lead consultants providing architecture, structural engineering (Dr Victor Lam providing the innovative design), electrical, mechanical, geotechnical and surveying services.

- Savory Construction Ltd. Contractor. With particular thanks to the site foremen Scott Ardley and Kevin McGuire who worked insane hours to make it come together.

- BECA Tauranga. Civil engineering and town planning.

- Rider Hunt (now Rider Levett Bucknell). Quantity Surveyors.

- Refrigeration Consultants Ltd. Refrigeration (surprise!).

- Naulls Consulting. Fire engineers.

- Hegley Consultants. Acoustic advice

- All the sub-contractors

References

1 Christchurch’s First Tall Tower Steel Building in Years, Steel Construction New Zealand, November 2007, p 4