The newest addition to Cork's skyline.

THE ELYSIAN IN CORK REACHES NEW HEIGHTS

The Elysian development on the south bank of the River Lee in Cork is a milestone project, heralding the start of the move of development in Cork city towards the south docklands. Liam Luddy, Chartered Engineer and Director with Arup Consulting Engineers, a CPD Accredited Employer, offers an insight into the construction and delivery of the project

Displaying a confidence in, and commitment to, the future of Cork, O'Flynn Construction has created Ireland's tallest building as part of a landmark development at the southern entrance to Cork city. Formerly the site of a central sorting office and previously a railway terminus, the site now accommodates a mixed use development, incorporating 211 high-quality apartments; 4,000m² of retail space; 2,000m² of commercial office space; and 550 car parking spaces over three levels, including two basement levels. Arup Consulting Engineers provided full engineering design services for the Wilson Architecture scheme with construction by P.J Hegarty & Sons Limited.

Scheme overview

The three-acre site is located adjacent to Cork City Hall and at the main road entrance to Cork city from the south on the South Link Road. The scheme includes an 18-storey tower at the southwest corner of the site with 5/6-storey residential blocks on the perimeter surrounding a central elevated landscaped courtyard. The residential units are served by 11 individual lift/stair cores providing access from private car parking at basement level to each residential floor level, which ensures privacy, security and ease of access for all residents. High-quality landscaping, both within and surrounding the development, serves to define the quality throughout the scheme.

Planning permission

An application for planning permission was submitted to Cork City Council in October 2004. Following detailed submittals and consultation, and with some revision to the upper levels of the lower block, planning permission was granted in July 2005. There were no third party appeals and the project proceeded immediately to the detailed design and tender process, with the building works contract awarded in February 2006. Show apartments were opened to the public in early September 2008, just under four years after the planning application had been made.

Site conditions

The ground conditions on site comprised a varying thickness of fill over soft clay and silt, overlying gravel and sand (See Figure 1, page 88). Fill material consisted of a mixture of gravel, brick and concrete fragments along with old foundations from previous buildings on site. Several layers of peat were also encountered, along with old trees and branches preserved in these layers. Beneath the clay and silt was a mixture of gravel and sand overlaying bedrock of weak-to-strong limestone with evidence of karst weathering. The groundwater on the site was found to be tidal and to vary between 1.5mOD and 0.00mOD, influenced by the level in the adjoining River Lee.

A preliminary environmental investigation had determined that some of the upper fill layer had varying degrees of contamination, though none of it was heavily contaminated. For a development in Cork the current options for management of surplus excavated material are:

- disposal to a site with a Local Authority permit, under the Waste Management Act, to accept inert soil and stone for land reclamation;
- disposal to a landfill licensed to accept inert or non-hazardous waste soil; and
- export of waste soil for treatment/disposal.

To classify the 100,000m³ of excavated material as accurately

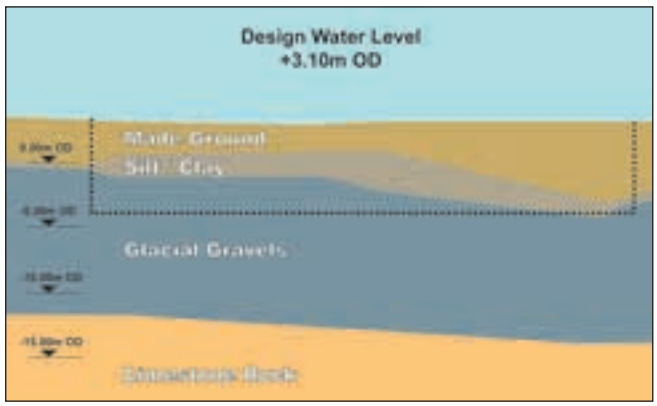

Figure 1: Earth cross section.

Figure 2: The 10m x 10m grids, which were subject to detailed investigation, classification, excavation and disposal.

Show apartments were opened to the public in early September 2008.

as possible, the site was divided into 10m x 10m grids, which were subject to detailed investigation, classification, excavation and disposal (See Figure 2).

Basement construction

The construction of a two-storey basement car park over the full area of the development involved the excavation to an average depth of 9m of approximately 100,000m³ of soil. Steel sheet piles were driven on the perimeter of the site to a depth of approximately 7m below the proposed lower basement level. The sheet piles were temporarily anchored at ground floor level and basement -1 level as the excavation progressed. The ground water level was lowered to bottom of excavation level by pumped wells installed around the perimeter, which at their peak discharged 400l/s to the River Lee. The pumping of the groundwater continued until there was sufficient building weight on the raft foundation to resist the upward groundwater pressure.

A raft slab, ranging in thickness from 1m to 1.7m was constructed on the sandy gravel formation and provides the foundations for the buildings. Seventy per cent ggbs was used as a cement replacement in the 16,000m³ of raft slab concrete with water penetration through the raft foundation slab prevented by an external waterproof membrane.

Additional support for the tower is provided by 900mm diameter piles installed under the raft slab, extending 14m down to rock. The perimeter sheet piles, propped by the basement and ground floor slabs, form the permanent basement walls. All the sheet pile joints are permanently sealed by continuous welding.

Structural scheme

The structural scheme chosen was based on a study of structural options carried out as part of the scheme design at planning stage. The objective was to optimise the structural grid to facilitate overlapping uses of basement car parking, ground floor retail and upper level apartments, and to deliver the most cost efficient solution.

The typical structural grid within the basement car park is 10.6m x 8m. This grid extends from the foundation through the car park and retail areas at ground floor to the soffit of the first floor slab. The first floor slab is subject to heavy loads as it acts as a transfer structure for the residential units and the central landscaped amenity areas. Based on the opportunity to accelerate programme and reduce reinforcement quantities the contractor proposed an alternative of a post-tensioned slab for the basement level slab, ground floor slab, and first floor transfer slab. Overall stability and building movement, is catered for by a series of movement joints thereby reducing the effects of thermal movement and shrinkage stresses. In addition, the movement joints serve to isolate the high rise tower from the adjacent lower level buildings.

The tower

The tower is approximately 25m x 20m on plan with a roof level of approximately 69 metres above adjacent ground level. The reinforced concrete core, located towards the centre of the tower, runs the full height of the building. The superstructure floor slabs are of reinforced concrete construction, generally with a flat soffit supported on the core walls and in-situ reinforced concrete columns. Party walls are constructed of solid concrete blockwork with perimeter liner walls and other internal walls of studwork construction. The tower is generally clad with a curtain wall type system filled with stone or glazing.

Foundations comprise a raft slab with compression and tension piles locally below the high-rise tower and the superstructure extends from basement for the height of the building without the requirements for a transfer structure. Floor slabs span between the central core walls and in-situ reinforced concrete columns positioned internally and on the perimeter of the building where the façade line changes direction. Lateral stability is provided by the in-situ concrete core and coupled shear walls located approximately at the centre of the tower on plan.

Building lateral stability analysis was carried out using OASYS GSA, Arup's in-house structural analysis software, to model the structural response of the stability walls under various load conditions.

The tower superstructure is separated from the adjacent low-level residential buildings by a bi-directional horizontal movement joint. The presence of this joint ensures that lateral deflection of the tower takes place without any resultant transfer of lateral load to the adjacent structures.

A number of temporary condition design checks were carried out. Of particular importance were the checks on the stability walls, which were formed using slip-form construction carried out on a continuous 24-hour basis, with the sliding shutter rising at a rate of approximately 3.5m in each 12-hour period.

East, west and south blocks

The dual aspect regular grid nature of the east, west and south residential areas lent itself to an efficient cross-wall construction. Above the first floor transfer slab the superstructure typically comprises a 150mm structural concrete screed on 100mm pre-cast concrete wide-slabs supported on cross wall construction. Cross walls are typically constructed of high strength block work – up to 30N/mm² in strength and, where feasible, the residential layouts were modified to ensure a vertically aligned path for load transfer.

North blocks

Due to the layout of the north, northeast and northwest blocks, the preferred construction was of in-situ reinforced concrete. Floor slabs above the level 1 transfer slab are typically 250mm thick and span between the core walls and in-situ reinforced concrete columns.

Building Services

The client brief was to provide state-of-the-art building services consistent with the high quality living experience of the scheme. In achieving this, the mechanical and electrical services set a new benchmark for this type of development.

Mechanical Services

Notable features of the mechanical services in the scheme include: ventilation and smoke extraction for 24,000m² of basement car parking over two levels; detailed co-ordination of utilities distribution to optimise the distribution routes and integrate with the architectural layout; tower central plant including vibration/acoustic treatment and integration of services and controls to attain maximum Building Energy Rating (BER) credits.

The apartment services were designed prior to the release of the BER software and methodology, however the inclusion of 'A' rated condensing boilers and zone control help achieve maximum BER heating credits.

The central heating and cooling plant supplies heat to and cools the 46 tower apartments via central heating and chilled water riser. The plant room at tower roof level houses three 500kW boilers, pumps and distribution pipework, with two 400kW air-cooled chillers located on the adjacent roof. The key benefits of utilising a central plant were the omission of boiler flues, efficiency increases inherent with a central plant, and the ability to provide cooling to all apartments economically. The heating and cooling systems are integrated with energy meters and thermal stations. The thermal station links the apartment services to the central plant and provides hot water to the fan coil unit, radiator heating and hot water calorifier. All energy meters are linked to a central automatic meter reading system to compile bills.

The penthouse apartments on the east/west/south blocks have concealed fan coil units installed utilising refrigerant heat pumps to providing heating/cooling to the apartments. Efficiency band 'A' gas condensing boilers provide the heating and hot water for the apartments.

The development has 24,000m² of basements over two levels. These basement levels are provided with a mechanical ventilation system to give day-to-day ventilation to remove car fumes and to provide smoke extraction in fire mode.

The scheme provided by HCPS Parking Ventilation Systems consists of exhaust and supply airshafts with induction fans used for air movement throughout the basements. A carbon monoxide monitoring system was installed, which allows for optional fan operation while maintaining indoor air quality. Computational fluid dynamics (CFD) analysis was undertaken to confirm the effectiveness of the scheme during design development stage.

Electrical system

Among the features in each apartment is a networked lighting system to allow control of a selection of lighting scenes in each room of the apartment. The system offers scene setting and dimming in bedrooms, hallways and living areas and the master control plate has an integral infrared receiver that allows control from a remote control.

Full connectivity is provided using an ISDN telephone system with Direct Dial Inward (DDI) and full 24-hour alarm on high speed broadband. A cordless telephone handset with colour monitor is provided in each apartment to allow communication with the external intercom and access control system. Furthermore, each apartment is provided with its own entertainment system including ready-to-go Sky, Sky+, Sky HDTV and Hotbird TV with pre-wired cabling and speaker jacks for surround sound. Full intruder alarm is provided to each apartment with connections to the concierge for local monitoring. The landlord electrical systems are designed to minimise running costs, maximise operational

Project Team	
Client:	O'Flynn Construction Limited
Architect	Wilson Architecture
Civil & Structural	Arup Consulting Engineers
Building Services	Arup Consulting Engineers
Quantity Surveyors	AKC, Chartered Surveyors, Cork
Planning Consultant	McCutcheon Mulcahy, Cork
Fire Consultant	Daire Byrne & Associates, Arklow
Façade Architect	Buro Happold
Main Contractor	PJ Hegarty & Sons Limited
Mechanical Contractor	BMD & Co Limited
Electrical Contractor	O'Sheas Electrical Limited

efficiencies and provide safe and secure management of communal areas within the scheme. It also includes full CCTV coverage, intruder alarm systems and access control for vehicles, alongside full BMS monitoring of all energy uses and control of the landlord lighting using an iLight Lighting Management system.

Consistent with the landmark status of the scheme, Arup's lighting engineers were also tasked with creating a lighting scheme that would bring the building to life at night.

The landscaped podium level garden of The Elysian incorporates a mixture of low-level and high-level bollards that illuminate the various pathways, with tree and feature up-lighters, LED step lights and Blue LED pathway marker lights. The waterfalls are enlivened with colourful lighting shows produced by Color Kinetics' LED lighting technologies. The combined effect is to create a night-time oasis in the heart of the city. Arup adopted energy efficient LED technology for the tower lighting to develop a scheme that provides longevity, networking and programming, while also alleviating frequent maintenance concerns and high heat output, which are characteristics of more traditional solutions. Using the ColorBlast Power core range from Colour Kinetics, the tower is ringed with 59 ColourBlast Powercore units and 11 ColourBlast Powercore units in the tower shaft. The tower mast is illuminated on both its north- and south-facing elevations using 400 individually controlled iColour Flex SLX nodes. The result is a tower and mast that create lighting effects, which sparkle and shimmer in the night sky with an array of interchangeable colours and light shows that will interact with the cosmopolitan city's events, holidays and festivals.

Conclusion

The combined overall effect of this unique engineering design is to deliver a contemporary scheme in a central city location. The newest addition to Cork's skyline, The Elysian is a testament to a confidence in urban development in Cork city and a living example of the future possibilities for our city. Φ

Liam Luddy is a Chartered Engineer and Director with Arup Consulting Engineers, based in the company's Cork office. His previous experience in construction and team management has given him a keen interest in the integration of all engineering disciplines to produce a holistic solution to engineering problems. With 23 years' experience in engineering consultancy, Liam is responsible for a team of engineers who have been involved in delivering some of Cork's most significant projects, including The Elysian, Douglas Village Shopping Centre, Orchard Gardens and Ballincollig Town Centre.