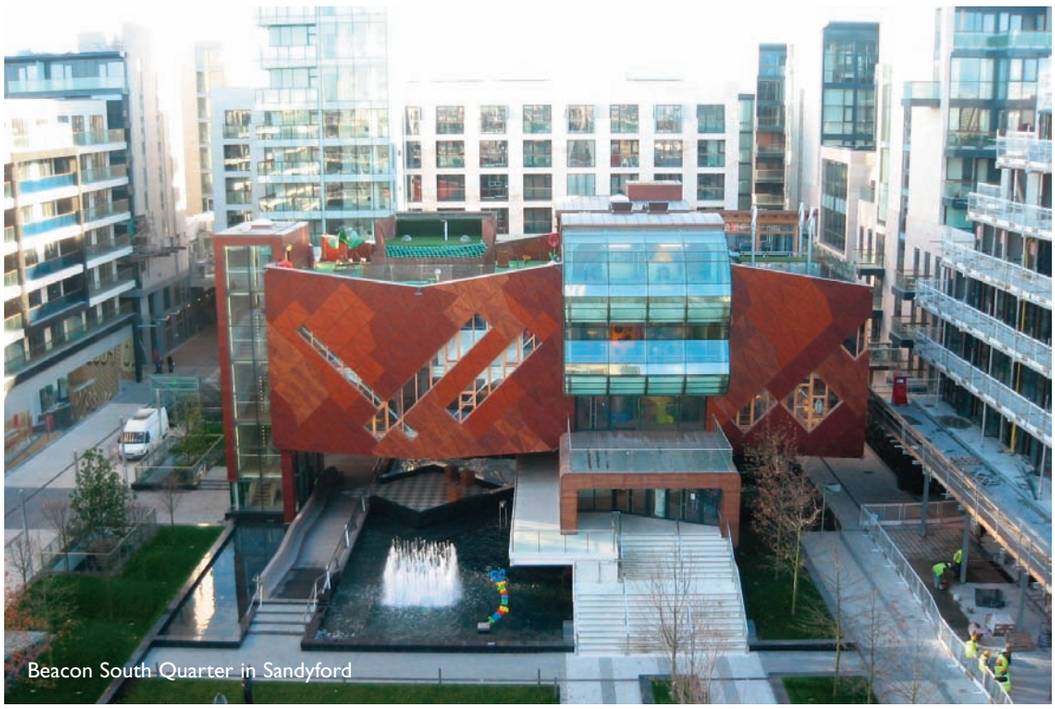
Beacon shines in Sandyford

Beacon South Quarter is symbolic of the construction expertise available to modern Ireland. The Structural Engineer Tim Murnane and his team at Michael Punch and Partners had to utilise all his skills to produce such a prestigious development.



Beacon South Quarter in Sandyford

Add this aspiration to a development that has a footprint equivalent in size to the Great Pyramid of Giza; which was easily the largest manmade object on earth for the best part of four millennia - surpassed in height only in the 14th Century by Lincoln Cathedral in England.

Beacon South Quarter is one of the largest - and most prestigious - mixed use developments in the country. It is the latest phase of the redevelopment of Sandyford Industrial Estate in South County Dublin, with over 23,000 square metres of retail outlets, 7,700 square metres of office space, 11 blocks of luxury apartments, and parking for 2,300 cars. Beacon South Quarter will offer a combination of living space, shopping and recreation on a scale that is not only representative of modern Ireland, but in fact sets new standards for this type of development in this country.

One of the apartment buildings is in the top five tallest in the country, with two levels of basement and 18 floors. But it is not just the scale that makes this impressive, it is the vision to have a community attraction built in – and the innovative architecture and engineering that made it possible.

The Regional director at Michael Punch and Partners, Tim Murnane was the lead Structural Engineer for the project. He said, "The challenges were not just restricted to the permanent structure; but in the stability of the temporary phases during its construction.

"To successfully deliver the project, we were presented with a significant number of complex engineering challenges that had to be solved; triple-level basements within a few metres of a major public road containing a gas pipeline, long span retail units beneath up to eight levels of residential buildings, a towering 18 storey residential block and the unique 'Imaginosity' children's museum with its challenging spans and cantilevers."

The five-hectare basement to the primary structure is entirely founded on granite rock, which varies from highly weathered to extremely hard. Due to the density of the development, the basement footprint had to be maximized to ensure car parking could be optimized.

The result was a 14 metre deep triple-level basement which extended as close to the site boundary as possible. Hence, innovative temporary works solutions had to be incorporated into the design to achieve the client's requirements.

Tim Murnane said, "The basement was three levels, about 14 metres. Around the site everything was live; there were adjacent roads that had traffic on them. One of these had a 40-bar gas main serving Dublin, so they were very sensitive to our groundworks.

"If anything were to go wrong with this pipe there would be major implications. We did not have the luxury of keeping the basement a "safe" distance away from the road; we had to maximize the use of the space that we had. The basement had to be pushed to the edge of the road – so right behind the hoarding we had a 14 metre drop. The challenge put simply was to stop the road falling into this hole."

Here was where the innovative temporary work solutions were required. Any movement of the gas pipeline and it could potentially explode. It was not the easy option. It is the structural engineer's job in conjunction with the contractor to work out these issues.

Precast concrete offered the solution for the basement structure, which was introduced from Belgium and involved triple-height, high strength columns (95 N/mm2), prestressed beams and hollowcore slabs.

The retaining walls have a 180mm precast concrete facing panel which acts as permanent formwork for the concrete poured in behind, to form a composite watertight retaining wall. The reinforcement is pre fixed to the rear of the precast panels and hence this innovation reduced the amount of on site reinforcement fixing. This method achieved the necessary high quality standards that the client required, without prolonging the time and manpower on the site.

An 18 storey residential tower includes two levels of basement. The structural solution here consists of in-situ reinforced concrete columns, slabs and cores. The cores were constructed using innovative jump forming techniques, constructed in a time that was 'very efficient'. The floor slabs quickly followed behind and the contractor was able to achieve a very impressive turnaround time; each floor in less than a week.

In the development as a whole, there was a temporary phase in the building of the 18 storey tower (including the two levels of basement) that would be critical in terms of structural stability. In this case the structural engineer had to be heavily involved with how the contractor was going to build the development. In essence the means by which the building was going to be constructed by the contractor had to be fundamentally incorporated into the structural design solution.

Tim Murnane said, "There are not yet too many structures of this size in the country. Hence, it is even more important than normal to have close liaison between engineers and builders when such a structure is so tall.

"Typically, when a building is being designed the focus of the structural engineer is on the permanent structure in its final operational condition. In essence, all the structural engineering is geared towards when

the building is occupied for say a windy night…and it is stable in these conditions."

Some buildings can become unstable in the temporary phase when they are under construction, unless they are very carefully designed and reviewed. With the construction of a tall building - and where the contractor is jump forming - it is very important that the consulting engineers are aware of the contractors proposed construction proposals and if necessary appropriate limitations are put on them to avoid such instability.

If the contractors were to go outside of these then the building could become unstable. In Beacon South Quarter for example the walls could only go a certain number of levels ahead of the floors. Those were the constraints on the contractor.

Tim Murnane stressed that what was most important was that effective communication occurred between the designers and the builders so that the potential instabilities did not occur at any time during a project of such a scale. The consequences of not working collaboratively in this manner are too extreme as buildings do collapse with consequent severe repercussions.

The standard industry practice of forming core walls is where concrete is poured wet into wooden/ steel/fibre glass shutters that form a mould for a wall or other feature. In a normal situation after one level /lift of a core wall has been poured, the concrete for the floor overhead is then poured and then construction moved on to the next level/lift of walling and so on. It is common when building a tall structure for a process known as "jump forming" to be used. With this system, after building one level/lift of walls, the mould is jacked up to build the next level/lift of walls; in effect concentrating on walls and ignoring floors. This "jump forming" system shortens the time it takes to build a tall building. But it was here that the structural engineering came in - there is a limit on how many levels of walls can be constructed ahead of the floors which brace them. A structural analysis determines this.

Basement Construction; showing the triple height columns & precast retaining walls

Structurally the core was analyzed using the latest 3D finite element modeling software, which resulted in a design solution that was highly efficient.

From an engineering perspective was there a chance to play? To use some creative expression of the range of skills? Murnane agrees, though conservatively qualifies the term 'play' as for the want of a better expression.

"There were many challenging elements throughout the development but ultimately providing structural solutions as part of a design team on such an exciting scheme was the real opportunity to "play". Specifically, there were many significant cantilever structures, long spanning structures and highly complex transfer structures which demanded innovative approaches".

"Younger (and perhaps not so young alike) members of the community can come and enjoy what the Imaginosity building gives; it is somewhere to play and to get an experience, in a way it is not unlike Dublin Zoo in its attraction. It is somewhere to have fun.

"Children come here to have fun; it was one of the client's aspirations to make this one of the top attractions in Dublin. It is hoped that it will become the second most visited children's venue after the

zoo – something that stimulates children is a gift to the community."

Engineering skills were used to make something that is not an everyday structure – and from an architectural perspective. It is not a building you see in too many places, it marks the development out.

The Imaginosity Children's Museum is a separate project within the overall Beacon South Quarter development. The outcome is unquestionably something of an architectural masterpiece.

From a structural engineering perspective, the building includes a host of structural engineering innovations. A clear span of 15 metres is achieved by a truss structure over two stories; while a striking 7.5-metre cantilever supporting two floor levels is achieved using MacAlloy bars tied back to the primary structural frame. Glulam timber beams, supported at intermediate floor levels and braced with stainless steel bars, facilitate the inspiring 'bubble' glazing to the front of the museum.

Other interesting engineering design challenges included the dynamic-vibration modeling of the structure and the provision of lateral stability through the floor slab.

The Children's museum is a community offering; while the rest of the project is a more conventional mixed development, built with a commercial pay back in mind. The Children's museum is giving something back to the community on this vast 13 acre site.

Beacon South Quarter sets out to inspire all those who visit it through its mix of uses and high quality design. The structural engineering challenge was to ensure that these principles could be delivered through appropriate engineering design solutions which reflected the client's brief.

Tim Murnane is confident that these ambitious aspirations have not only been met, but surpassed, and all those who visit this new urban centre will enjoy the outcome long into the future. He said, "It is the biggest single project that I have worked on in Ireland.

Imaginosity

"It tested the full range of structural engineering skills; from three levels of basement to 18-storeys which is considerable in an Irish context. It is extremes. There are not many Irish buildings that go much beyond this; it pushes the extremes in terms of ambition, scale, and quality.

"To resource this job pushed things to extremes. There were three major contractors working together on this. Two of the biggest contactors in the country needed to work together with one of the biggest in the world to be able to take on this project.

"It's only being completed on a phased basis so it is too early for awards; but I'm sure there will be a few prizes along the way."

Client:	Landmark Developments
Civil / Structural Engineers:	Michael Punch and Partners
Architect:	Traynor O'Toole
Mechanical and Electrical Engineers:	Ethos Engineering
Quantity Surveyor:	Davis Langdon PKS
Main Contractors:	John Paul Construction, PJ Hegarty, Laing O'Rourke