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The Use of Multi Car / Single Well Lift Systems To Add Value

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INTRODUCTION

The goal of any passenger lift system design for modern buildings is to meet the required performance criteria whilst occupying the minimum amount of valuable floor space. Nowhere is this goal more relevant than in the development of major speculative office buildings where every additional square metre of space that can be made available as lettable area is a constant focus of any competent design team.

This paper focuses on the added value a multi car / single well lift system brought to the development of The St Botolph Building, a large speculative office development in the City of London that was completed in 2010.

BACKGROUND

Office development in London during the start and middle of the last decade was an exciting time where speculative buildings were easily funded and driven through planning and construction fast to meet the burgeoning demand from a booming global economy.

Property developers, particularly speculative ones, are nevertheless focused on maximizing the value of their schemes and one of the key drivers to value is lettable area. Put simply the more space there is in an office building that can be let to tenants and generate rental income, the more value there is to the developer.

The St Botolph Building is a prime example of the type of high-end, speculative office development that characterized the London market last decade. The site is located at the Eastern boundary of the City of London in Aldgate, and was originally to be the home of a 52 storey tower which would have been the first building in the City to offer over 1,000,000 ft^2 of lettable office space.

The developer's appetite to undertake such a project speculatively, without a pre-let tenant, was however somewhat abated and the scheme reverted to a more modest building that had received planning permission back in 1999.

The vertical transportation consultant for the project was Grontmij, formerly Roger Preston & Partners, whose design team was led by the author.

THE CHALLENGE

The St Botolph Building is not a tall building standing as it does some 60 m above street level; it is however still a large building offering over 500,000 ft^2 of lettable area with some of the thirteen above ground floorplates in excess of 40,000 ft^2.

With a requirement to occupy the building at a theoretical density of one person per 10 m^2 NIA less 15% absenteeism (equivalent to 1 person per 11.7 m^2 NIA), the lifts need to serve around 5000 people and deal with a theoretical morning peak flow rate approaching 750 people per five minutes.

As is always the case with large office buildings the main passenger lifting strategy is very important to define the building's cores and determine the net lettable areas.

Initial lift traffic analyses (completed to the general recommendations of the British Council for Offices 2005[1] and the Chartered Institution of Building Services Engineers CIBSE Guide D 2005[2]) showed the building required two groups of conventional single deck passenger lifts; a group of eight and a group of six, operating in a high / low peak time zoned configuration.

Although this approach is conventional and with many precedents, we wished to innovate and explore options to reduce the space taken by the lift cores and thus increase the net lettable area for our client.

Working in close conjunction with both the developer and the architect, the vertical transportation consultant team initially reviewed a double-deck option before discounting it as too energy hungry in off peak traffic, requiring too much space for the headroom and machine room and being ill-suited to the variable floor to floor heights that existed in the base of the building to accommodate future trading floors.

The team then turned to consider other ways of getting more lift performance from less space.

THE OPPORTUNITY

Multi car lift systems take their design lead from double-deck lifts in as much as they feature two lift cars operating in a single well, but then evolve the concept by running both cars independently. This configuration has many potential advantages when compared with double-deck. Independent cars are lighter and therefore require smaller machine sizes with commensurately lower energy consumption; headroom and machine room space requirements become more appropriate to smaller building forms and variable floor heights can be accommodated with ease.

Various lift manufacturers are known to be researching and developing multi car / single well systems though ThyssenKrupp's TWIN is the only system that has currently reached the global marketplace. The first such system was installed on a pilot project at Stuttgart University in 2002 since when more than 100 installation have been commissioned around the world.

The key opportunity however was all about space, and when initial analysis of The St Botolph Building suggested a multi car solution could potentially return more than 30,000 ft^2 back to net lettable (at an estimated, amortized value to the scheme of more than £4M), it quickly became apparent that a further analysis of the potential value of the system to the project was more than justified.

The developer was rightly focused on understanding all the issues around adopting such an innovative system in their building. The benefits were clear; more space to let. Potential risks were predominantly commercial in selecting a solution that could only be provided by one supplier but there was also a need to understand the safety credentials of the system, to test the market's acceptance of multi car systems and their prerequisite full destination control, and to consider the architectural requirements of the system particularly with respect to two lobby levels.

Detailed lift traffic analysis showed that the conventional, single deck, two groups of eight and six solution could be replaced with a single multi car group of 16 cars running in a single core of eight wells.

Detailed due diligence over the next few months concluded in January 2007 with the developer's commitment to use a multi car system in The St Botolph Building and create what has become the largest single group of multi car lifts currently operational anywhere in the world.

DELIVERING TWIN

By this stage the architect had started to explore the opportunities that the multi car core solution could provide and were looking to place the lifts in a central atrium extending the full height of the building and, just to add to the challenge, all the cars were to be scenic wallclimbers.

An expansive reception area greets people entering the building where escalators transport passengers up and down to two lift lobbies at upper and lower ground respectively. 16 wallclimbers operate in eight lift wells; the upper cars are 1600 kg / 21 person running at 2.5 m/s, the lower cars also 1600 kg / 21 person running at 2.0 m/s. In peak traffic periods the upper cars serve from the upper ground lobby to a “high” zone at levels 8 to 13 inclusive, the lower cars from the lower ground lobby to a “low” zone at levels 1 to 7 inclusive. The system is full destination control via bespoke lobby terminals.

Less abled people and those not wishing to use the escalators travel to the lower ground lobby via a shuttle lift which also descends further to link with the basement car park and cycle parking.

The need to provide unhindered access for all created another challenge for the design team. To comply with the system’s rigorous safety requirements, the cars must remain a minimum distance from each other at all times. This not only defines the floor-to-floor height between the main lobby levels but also means the lower cars cannot access the top two floors of the building. With less abled passengers arriving at the lower ground lobby it was therefore necessary to find some way of getting an upper car to serve the lower ground floor.

This was achieved by creating a “virtual pit”, a deeper than normal pit that allows four of the lower car to travel down beneath the lower ground floor level sufficiently for the upper cars to serve the lower ground lobby and thereby provide lift service to the upper two floors of the building. The use of the “virtual pit” is determined automatically by the destination control system. Special service buttons are located on select call panels at all floors allowing the control system to recognise a call from a less abled person and provide lighter loaded cars, extended walking time allocations and slower door times.

Safety was a key area for the due diligence and design development process to focus on. It was clear from the outset that any independent multi-car system could not comply with the fundamentals of the EN81-1 code as it currently exists, so the manufacturer had secured Notified Body approval from the German TÜV to demonstrate compliance with the Essential Safety Requirements of The Lift Directive. At the request of the project team this approval was also subsequently assessed and ratified by LRQA in the UK.

The system calls for many unique design characteristics including:

i) A special door lock safety circuit as most landing doors are served by both cars.

ii) An electronic collision prevention device system that uses as its basis the intelligence of the destination control to prohibit car movement that would result in the cars needing to move within a pre-defined distance from each other.

iii) Independent position controllers that communicate with each other and constantly check the position of the cars in the well. Car position is determined via a laser barcode system for enhanced, consistent accuracy. Should the position of the cars breach the pre-defined safety space, an emergency stop will be initiated on both cars simultaneously. In the unlikely event that this fails to bring the cars to a stop, safety gear will be applied, again to both cars simultaneously.

iv) The collision protection system is calibrated on a site-specific basis such that in any loading and speed condition the safety space on the roof of the lower car is always in accordance with the requirement of EN81-1.

v) Colour coding of major components to provide differentiation between the upper and lower cars. This colouring is most prevalent in the machine room and pit but also extends to the car roofs and bases as part of the architectural aspirations.

As with all good design in today's world, energy efficiency was embedded and allowed the building's BREEAM assessment to take both available credits for energy efficient vertical transportation design. The escalators feature variable speed running, automatically slowing to a reduced speed during periods of no traffic to conserve energy and extend lifetime. The destination control system constantly monitors actual demand and minimises the number of cars required to be in service to maintain predefined average waiting times. The intelligent control system cycles the cars taken out of service so that hours in service are balanced across the group. The bespoke destination control screens feature automatic power down during periods of inactivity, again to conserve energy consumption and extend screen lifetime.

SUMMARY

The St Botolph Building is a global landmark that clearly demonstrates the real value that the adoption of an innovative multi car passenger lift system can deliver. Such a successful outcome is founded on many variables such as economic climate, developer's appetite for risk, architectural design, etc., but for many substantial commercial developments multi car systems should be considered as a viable option to deliver

REFERENCES

[1] British Council for Offices, *Guide To Specification.* BCO, London (2005).

[2] The Chartered Institution of Building Services Engineers, *Transportation systems in buildings CIBSE Guide D.* CIBSE, London (2005).

About the author

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Adam Scott is a Technical Director at Grontmij, the fourth largest multi-disciplinary engineering consultancy in Europe. He heads up the specialist Vertical Transportation group and has worked in the lift industry for the last twenty years. He is a past Chairman of the Chartered Institution of Building Services Engineers (CIBSE) Lifts Group and continues to represent CIBSE on the British Standards Institute (BSi) MHE/4 committee. He recently chaired the CIBSE Guide D Steering Committee in the production of the latest 2010 edition and was part of the Vertical Transportation Technical Committee for the 2009 edition of the British Council for Offices (BCO) guide to specification.