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Authors: Antony Wood, Professor, University of Nottingham
Philip Oldfield, Professor, University of Nottingham

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Bridging the Gap: An Analysis of Proposed Evacuation Links at Height in the World Trade Centre Design Competition Entries

Antony Wood[†] and Philip Oldfield

School of the Built Environment, University of Nottingham, Nottingham NG7 2RD, England

[†] Corresponding Author: Tel: (00 44) 115 9513111; Fax: (00 44) 115 9513159; E-mail: awood@ctbuh.org

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Abstract: The 9/11 collapse of the World Trade Centre Towers has created the largest single retrospective analysis of tall building design in the past 40 years. In no field is this more relevant than in the field of evacuation. The case for an 'alternative' design solution for tall building evacuation – allowing horizontal evacuation at height through skybridge linkages – has already been made. However, to many people – and despite the real advantages as exemplified in built examples such as the Petronas Towers – the skybridge seems a purely fantastical proposition, with no relevance beyond isolated, one-off scenarios. This paper analyses the skybridge links of the numerous re-design proposals for the World Trade Centre Towers, with the aim of establishing their advantages and how they could be incorporated into tall building design in the future.

Keywords: Tall buildings, Design, Evacuation, Skybridges

Introduction

The terrorist attacks on September 11th 2001, resulting in the collapse of the World Trade Centre towers have arguably created the largest single retrospective analysis of the design of tall buildings in the past 40 years. All aspects of tall building design – safety systems, structural systems, façade materials, siting and layout – are being questioned, and significant research has and continues to be undertaken in the quest to validate and improve the viability of the high rise.

In no field is this more relevant than in the field of tall building evacuation. Significant advances have been made in investigating the opportunities for the improvement of existing systems such as stairs, and the viability of 'new' systems, e.g. the use of elevators in the event of fire (CTBUH, 2004). Another of these 'alternative' systems is the use of horizontal evacuation at height through 'skybridge' linkages between towers. The case for the skybridge, including the historical precedent and study of tall buildings currently employing skybridges, has already been made (Wood, 2003). However, to many people – and despite the very real advantages as exemplified in built examples such as the Petronas Towers – the skybridge seems a proposition from the realms of fantasy, with no relevance beyond isolated, one-off scenarios.

It is interesting then that, of the seven official proposals for the World Trade Centre re-design competition sponsored by the Lower Manhattan Development Corporation and the Port Authority of

New York and New Jersey (Stephens, 2004), five of the designs proposed include some form of linkage at height between towers. In addition, many of the 'unofficial' proposals also incorporated some form of skybridge.

What all these proposals – and especially the five of the seven 'official' submissions – show is that, far from the idea of the skybridge being purely a fictional notion, it is actually a very real solution for improved evacuation efficiency. Evacuation efficiency now is at the cutting edge of new tall building design. This paper analyses the skybridge connections in each of the proposals, before drawing conclusions on the role of physical connections at height in tall building design.

Background to the World Trade Centre Design Replacement Proposals

The many varied proposals for the replacement of the World Trade Centre (WTC) Towers in New York mark an important watershed in the evolution of tall building design. In the same way that the Chicago Tribune Tower competition of 1922 (Tigerman, 1981) is established as a seminal snapshot of tall building design thinking internationally at the time, so will the year of frenzied design activity following September 11th, 2001 be viewed as a 'stock take' of early 21st Century design thought in the field of the high-rise.

For the purpose of this study, it is necessary to categorise the many thousands of design proposals for the WTC replacement submitted, to place the case studies examined in this paper in context. The design proposals can be categorised into three areas:

- (i) The 'Official' entries, as managed by the Lower Manhattan Development Corporation and the Port Authority of New York and New Jersey (seven team entries, first submitted in December 2002 – see Stephens, 2004).
- (ii) The 'Unofficial' entries, as organised by organisations such as *New York Magazine* (September 2002), *New York Times Magazine* (September 2002) and the Max Protech Exhibition (January 2002): "A New World Trade Centre: Design Proposals" (Protech, 2002).
- (iii) 'Independent' proposals created by individuals / organisations but outside any 'set' competition or organising structure.

For reasons of quality/depth of subject, the emphasis of this paper is on category (i) above.

Official Proposals

Team Peter Eisenman, Charles Gwathmey, Steven Holl and Richard Meier.

Perhaps the most obvious skybridges in any of the official competition entries were those proposed by the 'New York' team led by Richard Meier *et al.* The design created two grid-like structures perpendicular to each other, the first grid composed of three vertical towers and four levels of horizontal connecting elements running north-south along the site, the second grid of two vertical towers orientated east-west, with the same four levels of horizontal connecting elements (see Figure 1).

In this scheme large areas of the World Trade Centre site is designed as external public space as the five towers' footprints only occupy about a quarter of the site. However, this small urban footprint has not restricted the inclusion of large open floor areas at higher levels, as the horizontal skybridge elements of the scheme are super floors. These large linear floor plates, spanning between the vertical towers, offer space suitable for trading floors,



Figure 1: Design Proposal, Richard Meier Team - View across the Hudson River (© Richard Meier *et al.*, from Stephens, 2004; used by permission of the copyright holder)

conferences, community facilities and skylobbies. This approach is far from unique in tall building design and is utilised in many built examples which are often arch-like in shape so as to minimise the tower's footprint whilst still incorporating larger floor areas above (examples include the Shanghai Stock Exchange Building by WZMH Architects and La Grande Arche de La Défense by Johann Otto von Spreckelsen). The obvious and more commonly used alternative to this solution is to construct the larger floor plates as a podium below the towers – a structurally simpler and cheaper option, but at the expense of the open public realm.

One could imagine that the vast size of the super floors in Meier *et al.*'s proposal, the full width of the building, may actually have a detrimental effect on this extra ground floor area, in a manner similar to the numerous elevated concrete highways around the world, cutting out the light and limiting the view from beneath them. However, the lowest of the super floors occurs at over 79 meters above the ground, much higher than typical elevated roads, so in fact below them monumental gateways are created, directing pedestrian flow into the site, whilst above them – on top of the skybridges – terraced skygardens offer recreation and views out to the city.

Each horizontal connecting element is three storeys in height, with many of the floor plates planned simply as an extension of the open-plan office space that is present in the vertical elements of the design. This offers a more varied range of tenant occupancy programmes than available in typical towers, where one is often restricted to occupying a series of floors in vertical sections.

"A tenant could occupy a typical horizontal floor plate or lease spaces that are arranged vertically, or staggered, or even looped around one of the voids." (Nordenson and Riley, 2003)

The top and second-from-bottom horizontal elements incorporate skylobbies where horizontal non-emergency circulation between towers is possible. Double-decker express lifts would transport occupants from the ground floor to these large open skylobbies where occupants can move into adjacent towers to local elevators. However, this incorporation of skylobbies and new tenant arrangements raises the important question of security as the horizontal circulation from adjacent towers means the entry of occupants to any particular tower is no longer restricted to the ground plane. Since the skylobby level also contains public facilities there would be the need for reception desks and security barriers between the express lift lobbies (that provide vertical transportation to the public areas) and the local lift lobbies (that provide vertical transportation to the private office floors). Within the two sky-links that do not contain a skylobby, at least one of the three floors would also need to incorporate some form of protected corridor connecting the cores, allowing for a horizontal escape route, whilst still securing the surrounding office environment.

In terms of impact on evacuation, this arrangement of vertical towers and horizontal skybridges offers a multitude of evacuation routes, thus improving evacuation efficiency significantly. Multiple routes of evacuation in both the vertical and horizontal plane are offered, as the super floors link together the individual cores containing vertical escape systems (see Figure 2). Peter Eisenman has acknowledged how important this benefit is to the public post September 11th, as exemplified by discussions with schoolchildren, who seemed only to be interested in how one would escape in the event of an emergency:

"Safety, psychologically, is the most important thing for these

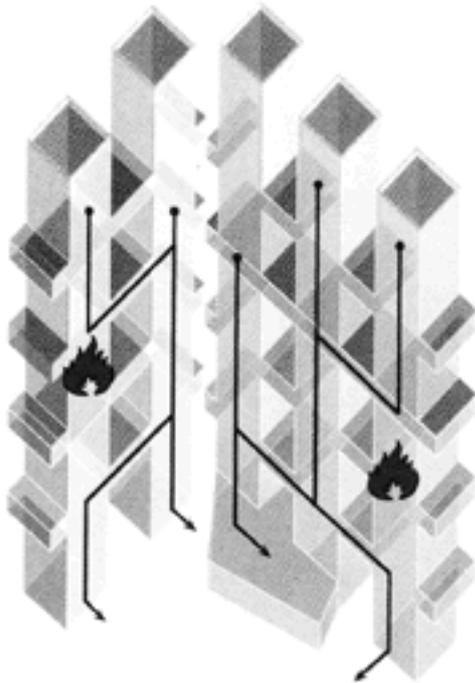


Figure 2: Richard Meier Team – Life Safety Diagram (© Richard Meier et al., from Nordenson & Riley, 2003; used by permission of the copyright holder)

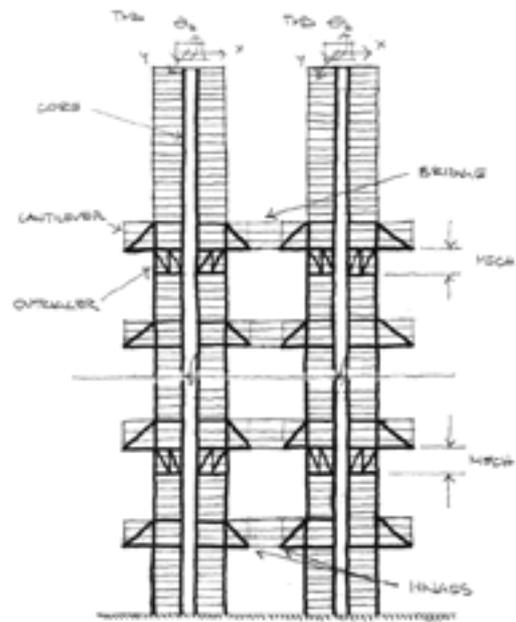


Figure 3: Richard Meier Team – Structural Strategy (© Richard Meier et al., from Nordenson & Riley, 2003; used by permission of the copyright holder)

kids. One kid said, “Suppose five planes hit at once, then what would you do?” We couldn’t answer the question. But that was clearly in their minds, and was clearly in our minds as a pragmatic solution.” Peter Eisenman (from the Architectural League, 2003)

Structurally this scheme requires major interventions in the mega-structure to create its clearly defined super floors that span large distances. A concrete core with perimeter columns, cross-braced in the short direction supports each vertical tower with the super floors spanning between sets of four diagonally braced cantilevers. These would also support the super floor ends (see Figure 3). A hinged outrigger system allows for movement between tower and bridge caused by lateral wind loads. However, despite the architects’ strong intentions to provide improved safety with the collapse of the existing towers firmly in mind, what would happen if a similar catastrophic event caused only one of the proposed towers to collapse, could these substantial skybridge connections bring down the second and third tower with it? The structural connections between tower and skybridge would need to introduce a shearing function to prevent this.

Team THINK – Shigeru Ban, Frederic Schwartz, Ken Smith and Rafael Viñoly

The THINK team proposed three schemes: The Great Room, Sky Park and The World Cultural Centre. The latter of these three made it to the final round of the LMDC competition where it would eventually finish runner-up to the scheme by Daniel Libeskind Studio. The World Cultural Centre design consisted of two open-latticework towers, circular in plan, built around the footprints of the original twin towers. These structures create a

‘site’ for cultural buildings to be inserted, including memorials, a museum, conference centre, performing arts centre and viewing platforms, all designed by different architects.

These cultural buildings are connected between the two latticework towers by a series of twisted, abstracted skybridges, whose purpose is largely to create additional cultural space and to tie the towers together symbolically (see Figure 4). Unlike the Meier *et al.*, scheme, these skybridges are organic, slender and positioned more arbitrary. For example the uppermost skybridge, a distorted ramped form, connects the two wings of the ‘9/11 Interpretative Museum’ at the approximate places the two planes hit the original World Trade Centre towers, as opposed to connecting the shortest possible distance between cores for evacuation efficiency.

Despite their conceptual nature, each skybridge links together cores positioned in both towers, therefore allowing for evacuation egress between them. However, each of the cultural buildings within the towers is serviced by their own separate cores, positioned on the tower’s perimeter. Unfortunately, while this makes for efficient vertical circulation, it restricts the potential of the skybridges in respect to multiple routes of evacuation offered. The reason being one cannot use a skybridge to cross over to the adjacent tower in an emergency, unless one is within that programme’s distinct circulation core.

Team Foster & Partners

“We propose to celebrate New York’s positive spirit with a unique twinned tower – the most secure, greenest and tallest in the world. This is a huge responsibility: human safety must be paramount.” Foster and Partners (from Sudjic, 2003)

Following the collapse of the World Trade Centre Towers,



Figure 4: Design Proposal, THINK Team - View across the Hudson River (© THINK, from Stephens, 2004; used by permission of the copyright holder)

Foster and Partners, like many other groups (most prominently NIST, 2005), commissioned a comprehensive study into safety in tall buildings, the findings of which informed their official design proposal. One of the major criticisms of tall buildings to come out of this frenzied research post September 11th is their continuing reliance on stairs to evacuate people from significant heights. For example, a survey at Canary Wharf amongst tenants revealed that around 15% of staff would have difficulties walking down multiple flights of stairs due not only to disability, but also to age, injuries, medications, obesity etc., (Bressington, 2006). From a safety point of view, the single plane of connection (the ground floor) means bringing all evacuees down to this level, which requires the longest accumulative time of individual evacuation journeys and the maximum number of stairs. Foster and Partners' WTC proposal challenges this by creating twin towers that subtly converge in three places along its height at what the architect calls the 'kissing points'. The lower two of these points offer horizontal evacuation between the towers (the uppermost kissing point is just a structural connection), therefore breaking the towers down into three segments. The vertical travel distance occupants' would experience in an evacuation would therefore be reduced by two-thirds as they could evacuate to a kissing point level before moving into the adjacent tower via a sky-link. Here they could take advantage of one of the primary benefits offered by skybridges, they could descend by elevator in the 'safe' tower, thus greatly speeding up evacuation times (since elevators are not currently able to be used in the event of fire within the tower at risk, under most international codes – see Howkins, 2001).

The skybridge created at the centre of the three kissing points is an open air-terrace, offering the radical possibility of evacuation by air succour. Furthermore, this terrace offers external recreational space to the office worker, a rarity in typically air-conditioned high-rise buildings. Structurally the proposal is similar in concept to Foster's recently completed, award-winning Swiss Re Tower in London (see Nordneson & Riley, 2003) with central concrete cores

and a perimeter structural diagrid. However, by conjoining the towers at three points, they are able to resist wind loads collectively allowing for an overall more slender structure potentially reducing the cost of the diagrid members.

Team Skidmore, Owings & Merrill (SOM), with SANAA *et al.*

"The dream of 'cities in the sky' in which the horizontal dimension is treated as importantly as the vertical dimension is now fast becoming reality." (Abel, 2003)

This design team (consisting of SOM, SANAA, Michael Maltzan Architecture, Field Operations, Tom Leader Studio *et al.*,) proposed nine crooked towers scattered across the whole World Trade Centre site, connected at various levels by orthogonal skybridges, creating what the architects describe as a "vertical city". The SOM team didn't want to restrict public interaction to just the base of the towers, instead opting to return the 16 acres of public space lost to the tower's footprints with 16 acres of public sky gardens, and a further 16 acres of cultural spaces located in horizontal 'strata' across the scheme.

"Connected by aerial platforms, the towers host elevated gardens and cultural facilities that expand and displace the site's public realm to upper floors and to an archipelago of landscaped rooftops." (Giovannini, 2003)

Built in a series of phases, the nine towers would appear as the market demands. As they emerge, they will be joined together by orthogonal skybridges at varying levels to connect and expand the public realm between the towers. This will enable the bridges themselves to become cultural spaces, sky gardens, public terraces and even museums or libraries, floating between the towers.

The sporadic planning of these skybridges, located at varying levels in order to allow users to experience the site from different heights, is not ideal in respect to the towers' evacuation efficiency and security. One needs to apply careful planning when considering the vertical positioning of skylobbies and subsequent connecting skybridges. For example, if utilising a single sky link, it would make sense to position it at the centre of gravity of the total building occupants – the position of further sky links should also split the occupancy equally as with the Meier *et al.*, and Foster proposals. In the SOM scheme, many skybridges are located close to the ground floor plane, or at the peak of the towers, meaning the majority of occupants would have to travel significant distances vertically, or worse, evacuate up the tower, in order to move horizontally to a 'safe' tower. Furthermore, where horizontal connections incorporate public facilities the placing of skybridges and skylobbies should occur at the lift transfer-floors. This would allow for direct public access to the skylobbies via express lifts, without jeopardising access to the private floors above and below the skylobby. Local lifts in secure lobbies would allow access to these areas.

United Architects – Foreign Office Architects, Greg Lynn FORM, UN Studio *et al.*

The United Architects team (consisting of Foreign Office Architects, Greg Lynn FORM, Kevin Kennon Architects, Reiser + Umemoto RUR Architecture, Imaginary Forces NYC, UN Studio, *et al.*,) proposed arguably the most radical design of the

competition: a series of five crystalline towers, leaning into one another and fusing together at around 240 meters high, creating what seems to be a single cathedral-like building.

Where the towers collide, they create what the architects describe as a skyway (see Figure 5). This consists of five continuous floors of public amenities linking all five towers, with gardens, retail areas, a sports centre, conference centre, broadcast centre and a 'sky memorial' where people can look down from their elevated position upon the sunken footprints of the original World Trade Centre towers. In conceiving this skyway, United Architects have transferred some of the public activity that normally occurs at the ground floor interface and lifted it 240 meters into the air to the heart of the building, drawing people in to visit this immense public space and in doing so creating a 'city in the sky'.

"I think it's a mistake to think solely two-dimensionally, as though the ground plane were the only repository for public space. It belongs in many places, including the sky." Kevin Kennon (from the Architectural League, 2003)

Although one may view the scheme as a singular colossal structure, the five towers that combine to create it are, in fact, structurally independent. Constructed individually in phases from 2006 to 2012, a concrete core and diagonally braced structural skin supports each tower. However, by connecting the five towers their collective structural strength becomes far greater than their structural strength individually, allowing the overall building to resist massive forces.

Along with increased strength comes increased safety. The creation of the skyway forms a horizontal evacuation link spanning all five towers, conjoining together all their individual cores and escape routes (see Figure 6). This permits evacuation paths from any individual stairwell in any tower to any other stairwell in an adjacent tower in a manner similar to that found in the scheme by Richard Meier *et al.*

"The conjoined towers, unlike the traditional vertical tower with its unitary vertical systems, offer multiple routes of escape and fire-fighting access following vertical and, if necessary, horizontal routes." (Nordenson & Riley, 2003)

Although this horizontal evacuation link only occurs in one place unlike some of the other designs, it still unites 29 distinct

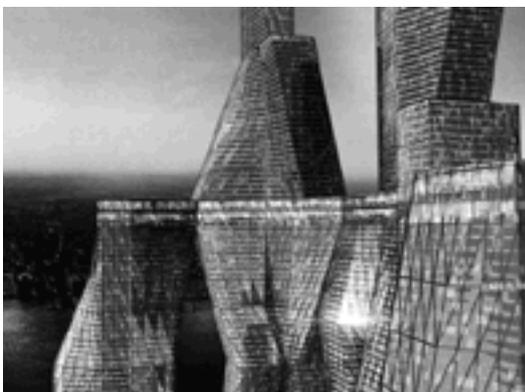


Figure 5: Design Proposal, United Architects Team - 'Skyway' (© United Architects, from Nordenson & Riley; used by permission of the copyright holder)

stairwells and 43 areas of refuge in what the architects describe as the safest building in the world (Sudjic, 2003). Linking services through the skyway, allowing improved safety features such as sprinkler systems supported by multiple sources of water pressure would also be possible.

"Reliability and the need for redundancy of suppression systems should be assessed with respect to credible threats. Water supply system design may, for instance, include a looped system [or] dual system...for added robustness and redundancy." Meacham, 2006

Current thinking proposes sprinkler redundancy by using two separate rises, often sited in opposite corners of the building core. This approach is utilised in the replacement 7 World Trade Centre, designed by SOM, with each riser supplying alternative floors ensuring that if one fails no two consecutive floors will be without water (Hart, 2005). However, by conjoining five separate towers the United Architects' proposal would advance the ideas of redundancy and diversity far beyond the dual-riser approach, offering increased separation between water sources, multiple routes for sprinkler water and the ability to still supply water to a tower when its core had been severed.

Comparisons: Other Urban Scale Case Studies

Whilst the events of September 11th and the subsequent tall building analysis in its aftermath have created, in many ways, a unique architectural scenario – that requiring several buildings on an urban scale – there have historically been similar design competitions held that, perhaps unsurprisingly, have seen a number of skybridge proposals amongst the submitted entries. The one unifying element across these competitions is that they have required the design of a number of buildings, often high-rise,

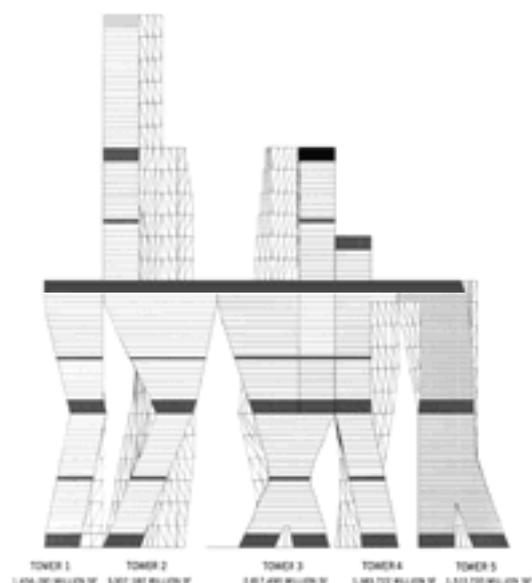


Figure 6: United Architects – Section (© United Architects, from Nordenson & Riley, 2003; used by permission of the copyright holder)



Figure 7: *Duxton Plain Public Housing International Design Competition, ARC Studio Architecture + Urbanism Singapore (© ARC Studio Architecture + Urbanism Singapore, from Abel, 2003; used by permission of the copyright holder)*



Figure 8: *European Central Bank, Coop Himmelb(l)au (© Stefan Laub, www.laublab.com; used by permission of the copyright holder)*

over a significant area of land. Two such examples are the 2001 Duxton Plain Public Housing International Design Competition of Singapore and the European Central Bank Competition of Frankfurt - the winning designs of both included skybridges. In the Duxton Plain competition (see Figure 7), ARC Studio Architecture + Urbanism Singapore proposed a series of high-rise blocks connected by park-bridges incorporating two 400m running tracks at the 26th and 48th storey (Urban Redevelopment Authority, 2002). Coop Himmelb(l)au (see Figure 8) proposed two slim twisted towers either side of a glazed atrium, linked together by a variety of skybridges for the European Central Bank Competition (Ingeborg & Schmal, 2005).

Perhaps then, it is in these large-scale urban schemes, where a series of close-knit skyscrapers are simultaneously conceived, designed and constructed, that the skybridge becomes most plausible. The skybridges are an integral part of the initial vision for the building aesthetically, operationally, psychologically and constructionally. In these situations, the owner of the various towers is common; therefore, the responsibility of security and maintenance within the skybridges and the surrounding floor area is clear. Substantial skybridges (the full width of the floor plate) become possible because the links at height are intrinsic with the schemes structural strategy, such as those in the Richard Meier and United Architects WTC proposals. This would not be the case if simply retrofitting a skybridge link between towers designed and constructed separately, which is one of the greatest challenges facing the possible retrospective incorporation of skybridges with existing buildings.

The Existing Skybridge Network of Hong Kong

Over the past 40 years, in the Central district of Hong Kong, a vast skybridge network at first floor level has evolved, to the point where today, one can ascend on to this network at the western extremity of the Macau Ferry Terminal Building, and alight at the eastern extremity of Pacific Place/the Citic Centre. In doing this, one has traversed a route that spreads for some seven kilometres and brings into contact approximately 40 buildings, most

of which house non-public functions (offices, bank headquarters, hotel lobbies, etc). Originally set up to encourage hotel guests to circulate through retail areas in separate buildings, the network now provides a pleasant shaded pedestrian environment which diminishes pedestrian congestion at ground level - a great advantage in one of the world's most densely populated cities. The skybridge network is unlike the streets below in that it is privately owned and operated, ensuring high levels of security and cleanliness. It is also a built example of the alternative routing and possible redundancy of services proposed in many of the WTC schemes discussed. For example, some buildings utilise pipes installed within the skybridges to transport seawater (used as air-conditioning coolant), connecting services from building to building over street level at a much lower construction cost than digging trenches in the street.

Hong Kong also has great potential for the incorporation of skybridges at height, both in future developments and retrospectively linking existing towers. The city's high urban density has resulted in towers of very close proximity and since building regulations require refuge floors every 25 storeys (from the 25th floor level up), these refuge floors often exist at exactly the same horizon level within tower clusters (see Figure 9). Since the refuge floors are by regulation completely vacant, linking them together with short-spanning skybridges would offer improved evacuation efficiency without loss of saleable floor area. These skybridges, if retrospective, would only be simple circulation devices as opposed to full width 'super floors' the like of which are proposed in the various WTC schemes. Enabling circulation between the towers in non-emergency mode could encourage the provision of commercial/community facilities in the subsequent vacant space, since the option for evacuees to move horizontally rather than wait would significantly reduce the actual refuge area requirement. The precedent of an existing low-level network also resolves the ownership and public-private challenges posed by skybridges in Hong Kong.

The retrofitting of skybridges would not be easily achievable in many cities due to the physical separation of towers, ownership issues, planning constraints and the like. However, the case study of Hong Kong offers further possibilities for the incorporation of links between towers at height, demonstrating their potential beyond design competitions such as the World Trade Centre re-design.



Figure 9: The presence of common level 'refuge floors' in tower clusters in Hong Kong (image by author).

Conclusion

As we can see from the breadth and range of the World Trade Centre proposals from some of the top architectural practices across the globe, the concept of connecting towers at height through skybridges is no longer a fictional notion belonging to the realms of fantasy. On the contrary, it has been incorporated in many of these schemes as a very real proposal for increased circulation generally, and increased evacuation efficiency specifically. Furthermore, the provision of skybridges has revealed itself to have a positive influence on many other aspects of tall building design: structural robustness, possible letting configurations and redundancy of service supplies to name but three.

It is disappointing that the Freedom Tower - the final replacement for the World Trade Centre - rejects the benefits of these physical links at height and instead utilises three extra-wide, pressurised staircases to allow for occupant evacuation, with one staircase dedicated solely for fire-fighter access (see Figure 10). This approach is simply an extension of historical thinking on evacuation, the problems of which have already been made apparent through the events of 9/11. The final Freedom Tower proposal does nothing to further alternative solutions on the debate. The increased provision of existing strategic elements (stairs, lifts etc) also results in a substantial impact on the lettable floor area.

"It is speculated that if future buildings were required to be designed for simultaneous evacuation under current egress design practises, there will be a building height beyond which stairs would occupy such a large portion of the floor area that such buildings would be impractical." (Kuligowski & Bukowski, 2004)

This highlights a further advantage of the skybridge – the potential for floor space savings. By incorporating skybridges and offering an alternative, horizontal route of egress, the simultaneous evacuation of towers could be possible without the need for additional stairs

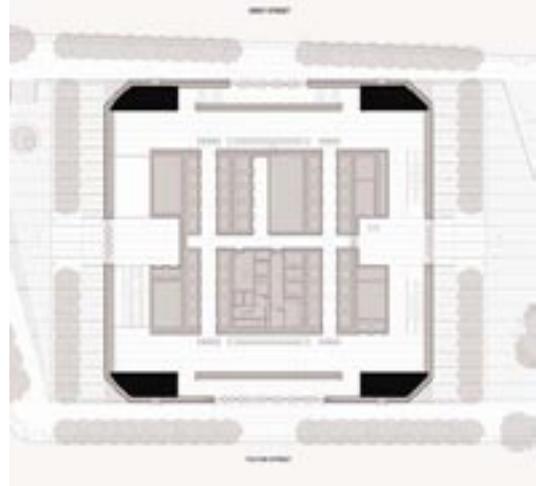


Figure 10: Freedom Tower - Ground Floor Plan with staircases shaded. (by author; used by permission of the copyright holder)

and lifts. The addition of a double-height skybridge in the Petronas Towers for example, allowed the omission of an additional fire stair that would have been needed in each tower from the skylobby to the ground floor – 42 storeys in each tower (Pelli & Crosbie, 2001). This would be a significant financial incentive to developers to employ skybridges in tall buildings. This advantage - the possible offsetting of increased costs for constructing skybridges against the potential cost-savings from increased lettable floor area, improved evacuation efficiency and increased structural strength of the building as a whole – would benefit from future research. The effect on circulation and evacuation flow of differing configurations of skybridges is another area in which studies need to be undertaken.

Despite the benefits brought in evacuation efficiency, the WTC proposal skybridges are far-removed from the banal, utilitarian corridors they could have been. In almost all cases, the skybridge has been elevated from its role as a circulation device, to become a key element in both the architectural language of the scheme and the intended experience of the building user. These new schemes, through connection, project the Tall Building as a complimentary piece in the urban jigsaw. For the first time since the fantastical 'city in the sky' proposals of the likes of King, Ferris and Lang (see Wood, 2003), we are finally seeing real 'urban' solutions for the Tall Building – high rise that are concerned with the impact on the city, the quality of urban space created, and the experience of the building user. The skybridge is an essential part of that step forward.

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