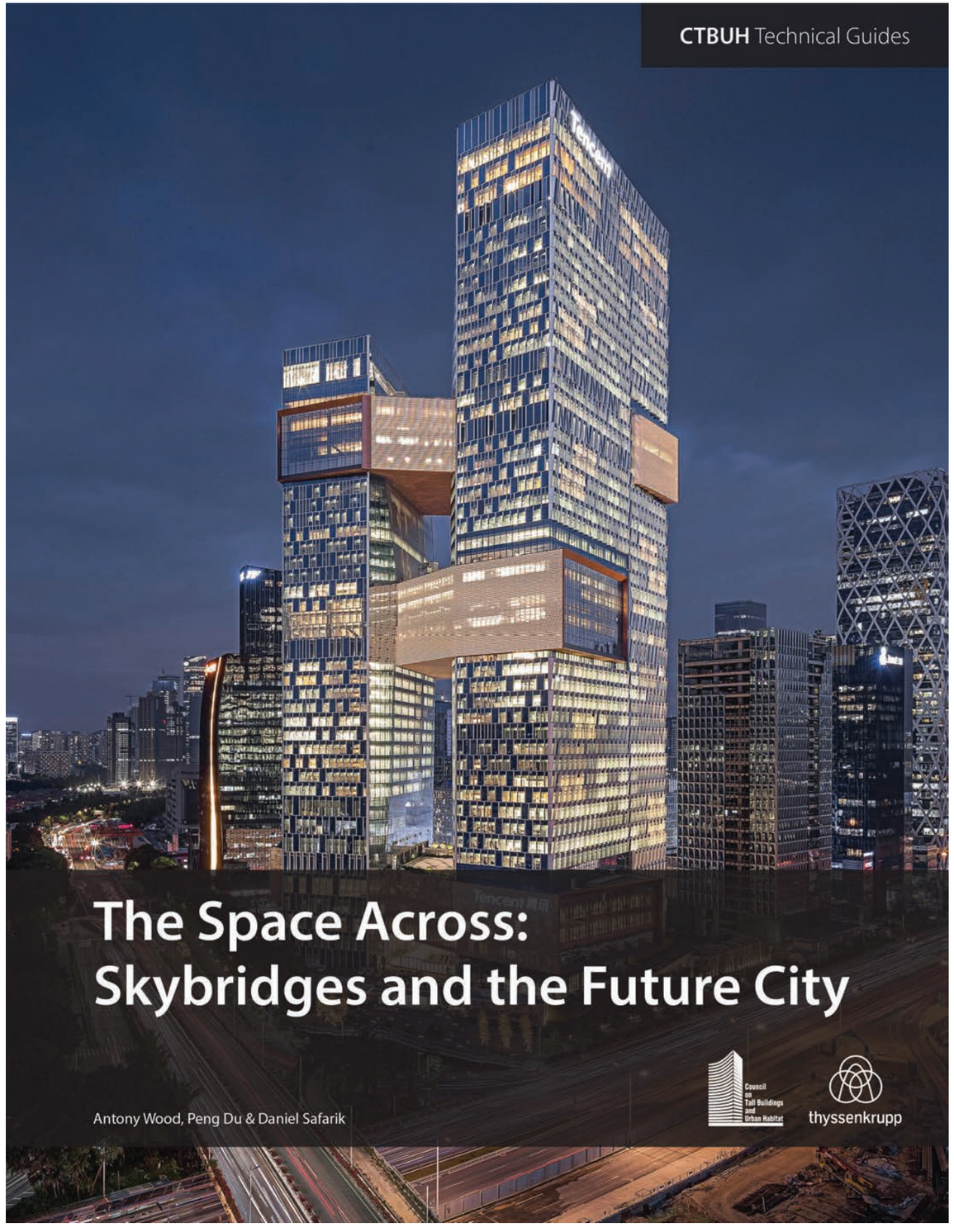


GLOBAL CASE STUDIES AND TRENDS GAINING TRACTION

The State of the Art and Potential Futures of Skybridges

Antony Wood
CEO
Council on Tall Buildings and Urban Habitat

This article contains extracts from the **CTBUH Technical Guide The Space Across: Skybridges and the Future City**, the culmination of a research project generously funded by thyssenkrupp Elevator (see Figure 1).
The Guide can be purchased at **https://store.ctbuh.org/technical-guides/245-the-space-across-skybridges-and-the-future-city.html**

Introduction

Throughout the 20th, and now the 21st century, the world has clearly seen a push towards greater height and urban density in our major urban centers, the ground-pavement level remains almost exclusively the sole physical plane of connection. As the world rapidly urbanizes, greater thought needs to be expended on how horizontal space can be developed at height, particularly as public space is increasingly at a premium, energy consumption remains high and concerns about the effects of density and isolation on physical and mental health take new precedence.

An idea that began as an early 20th-century solution to a different set of urban problems – namely the introduction of the automobile and new forms of motorized mass transit – may be passing into a new era today, as its practicality becomes more evident.

Skybridges, generally enclosed spaces linking two or more buildings at height, have been with us since the Bridge of Sighs was completed in Venice in the early 1600s. But as cities have grown into megacities, skybridges have taken a huge jump in relevance and scale, as evidenced by projects like Raffles City in Chongqing, China, at which the largest skybridge is some 296 meters long – longer than the height of any the skyscrapers to which it attaches.

Superlatives add drama to the story, but the real essence lies in examining the qualitative aspects of skybridge projects of all scales. The CTBUH research team studied 15 skybridges in detail, and came to some interesting observations.



Figure 2. Highlight Towers, Munich, completed in 2004, includes skybridges that are well-integrated with the strict geometry of the adjoining towers. The original design called for the possibility that the skybridges could be demounted and moved from floor to floor according to need. Image credits: Both images © Rainer Viertlboeck

Benefits of Skybridge Construction, and Standout Examples

At the most basic level, skybridges offer easier access to functions shared between towers, thus increasing the viability of those functions and reducing the need of occupants to return to the ground for essentials. Those skybridges devoted purely to circulation increase the efficiency of a group of tall buildings by connecting upper floor plates. The most common and salient advantage has come from connecting the elevator transfer lobbies of those buildings, such that reaching the upper half of the adjacent tower is almost as easy as doing so in the tower in which the journey begins. This reduces congestion in ground-floor elevator lobbies and allows the developer to build two substantial buildings on a relatively small lot. The "enclosed circulation" skybridges seen in cases such as Highlight Towers, Munich and Petronas Towers, Kuala Lumpur are particularly elegant (see figures 2 and 3).

At Highlight Towers, for instance, the near-transparent use of glass and structure makes for a highly integrated architectural expression, while also providing a practical means of expanding tenancies between the two buildings. In fact, the bridges were originally designed to be movable from floor to floor according to need, though to date they have never been moved from their original positions.

In addition to having once held the title of World's Tallest Building(s), from 1998 to 2004, the Petronas Towers continue to be superlative in the skybridge category. The Petronas skybridge is the third-highest skybridge studied in this research project (and the world's 13th-highest), and at 58.4 meters, has the longest individual span of any in the research group. It is located at 170 meters above the ground floor, which places it at 37.6 percent of the height of the towers. This is closer to the midpoint of occupancy than would appear to be the case, due in part to the decorative crown structures that complete the towers; the skybridge's positioning at the 41st and 42nd floors makes it easily reachable for occupants of the 88-floor towers.

In addition, one of the main positive side-effects of utilizing the skybridge for evacuation in the Petronas Towers (other than significantly improving evacuation efficiency for the full evacuation of a single tower) is that it allowed the omission of an additional fire stair that



Figure 3. The Petronas Towers, Kuala Lumpur, completed in 1998, have an ingenious two-level skybridge positioned between them, which provides an observation deck and circulation between the elevator lobbies of the adjoining towers. Image credits: © Alex Block (cc by-sa)

would have been needed in each tower from the skylobby to the ground floor. This translated into significant costs savings and improved earnings potential by creating more usable area.

A higher level of usage intensity occurs when the skybridge not only connects similar or related amenities in two adjacent towers, but actually contains the amenities itself. Then it becomes a destination as much as a means of circulation, potentially increasing its value. This is the fundamental proposition of the "enclosed programmatic" skybridge, which can range from an exercise room, as at Daesung D3 City, Seoul (see Figure 4); to a lap pool, such as at American Copper Buildings, New York City (see Figure 5); to tens of thousands of square meters of public and semi-public attractions, as at Raffles City Chongqing (see Figure 6).

In corporate headquarters, such as Tencent Seafront Towers, Shenzhen (see Figure 7), the campus-like amenities traditionally afforded to sprawling Silicon Valley companies have been "flipped" to the vertical, appropriately for the urban context and site constraints, including dramatic interior gathering spaces and recreational facilities, such as a rock-climbing wall, basketball court and running track.

There are additional benefits that have come to light, which are not quite as obvious, but are fundamental to the cost-benefit ratio of constructing the project in the first place. For instance, skybridges can offer redundancy and alternative routings for services provision. Note

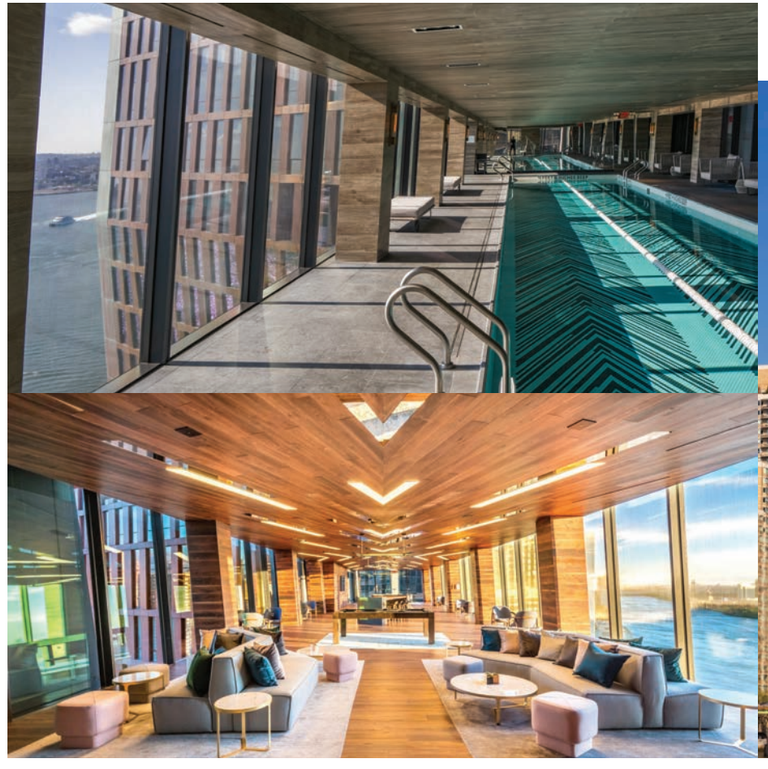
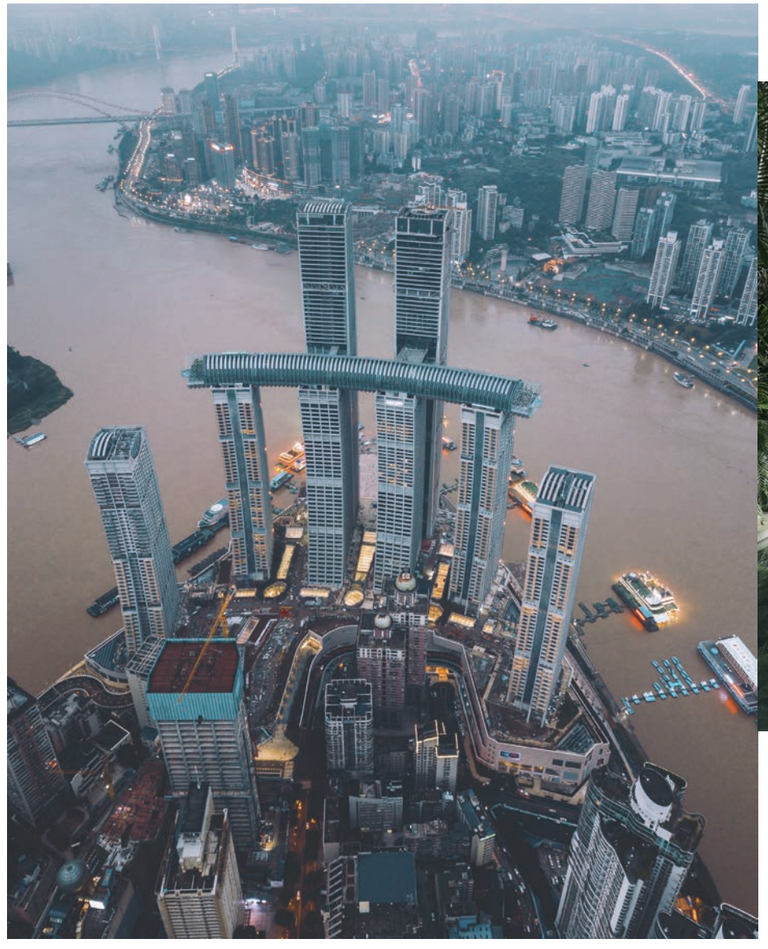




Figure 5. The American Copper Buildings, New York City, completed in 2017, feature a three-floor skybridge (a) that contains, from bottom to top, a mechanical floor, (b) a lap pool (which allows people to swim from one tower to the other) and (c) a lounge. The use of the bridge as mechanical space allowed the addition of a private pool on the roof of one of the towers, where mechanical equipment ordinarily would have been located. Image credits: (a) © Jeff Goldberg; middle (b) © Jeff Goldberg; (c) © Max Touhey.

the example of American Copper Buildings, where routing services through the skybridge saved a considerable amount of space on the adjoining building rooftops, making way for a revenue-producing private pool on the roof of one of the towers, where normally MEP equipment would have been housed.

There is also a strong justification for deploying skybridges as quasi-urban networks, as was the case at Linked Hybrid, Beijing (see Figure 8). The skybridges at Linked Hybrid are critical components of the strategy of making a multi-dimensional, porous community. Connecting the predominantly residential buildings at floors 12 to 17, there are eight bridges linking nine buildings; each is independently programmed with a unique function, which in some cases spills over, or is shared with a portion of the floor plate of the building to which it is attached. They embody the concept of "enclosed programmatic" skybridge, in that they serve as destinations within themselves, as much as – and in the final analysis, perhaps even more so – than circulation.



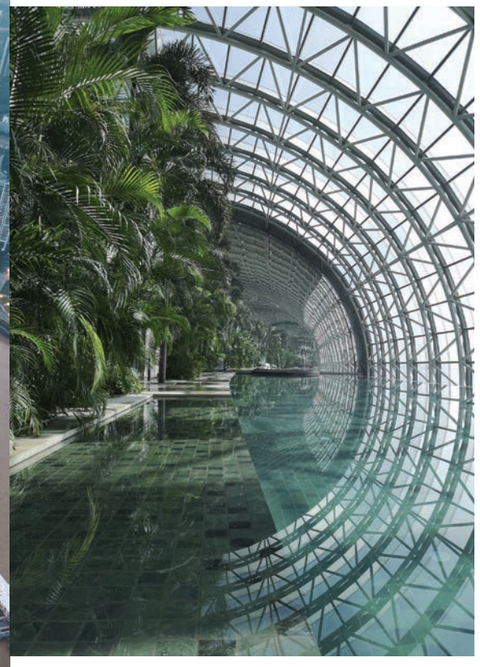
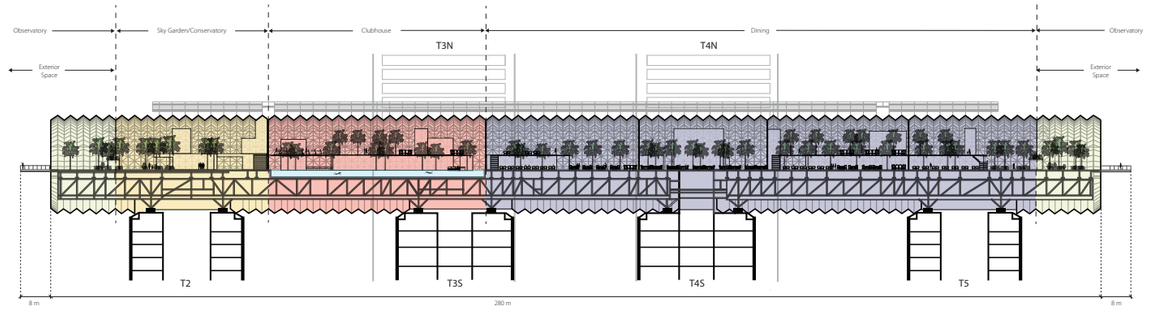
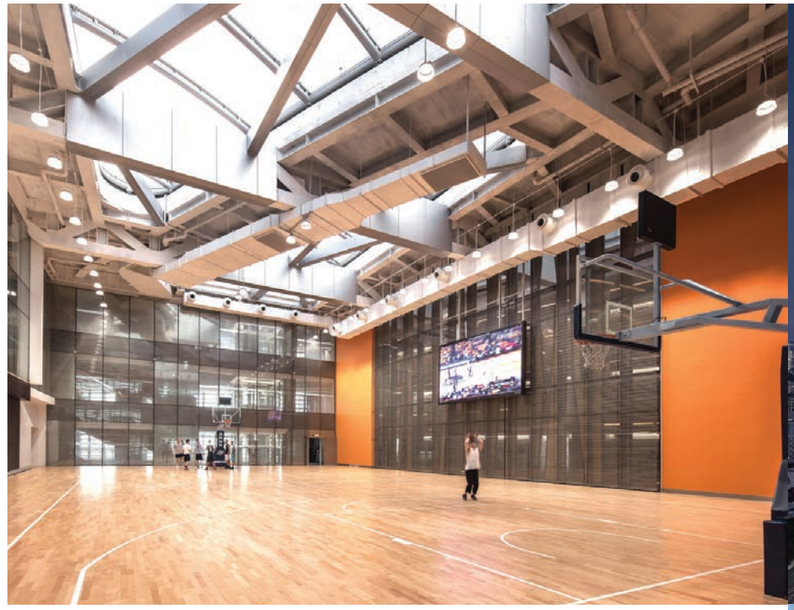


Figure 6. The "Crystal" skybridge at Raffles City, Chongqing, completed 2019, contains more than 10,000 square meters of amenities at more than 200 meters in the air. Included within is a curving infinity pool, gardens, restaurants, observation decks, and a gym. Image credits: Overall view © EJay Photography, courtesy of Safdie Architects; Section drawing © Safdie Architects, redrawn by CTBUH; Interior view © Safdie Architects



GLOBAL CASE STUDIES AND TRENDS GAINING TRACTION





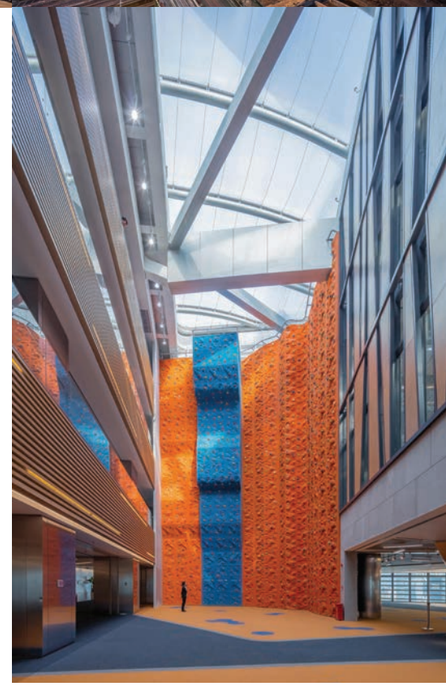


Figure 7. Tencent Seafront Towers, Shenzhen, completed 2017, provides a vertical campus for China's largest technology company (a), including two skybridge "links" containing amenities such as (b) a climbing wall and (c) a basketball court. Image credits: (a) TJAD; (b) TJAD / Shao Feng Architectural Photography Studio; (c) Yijie Hu

Evaluation

In large part, evaluation of the skybridge project comes down to the intent of the design and to what degree it was implemented. This is a question that should be considered at both the urban and building scale, if not at several levels in between.

The urban scale in particular is a driving force in nearly all skybridge projects. By connecting buildings at height, an opportunity is created to form an urban gateway, a way of framing the city in a new perspective and guiding residents and visitors through a portal from one context into another. This is certainly the case in super-scaled projects such as Raffles City Chongqing, which is positioned at the intersection of two significant rivers at the most visible point in the city.

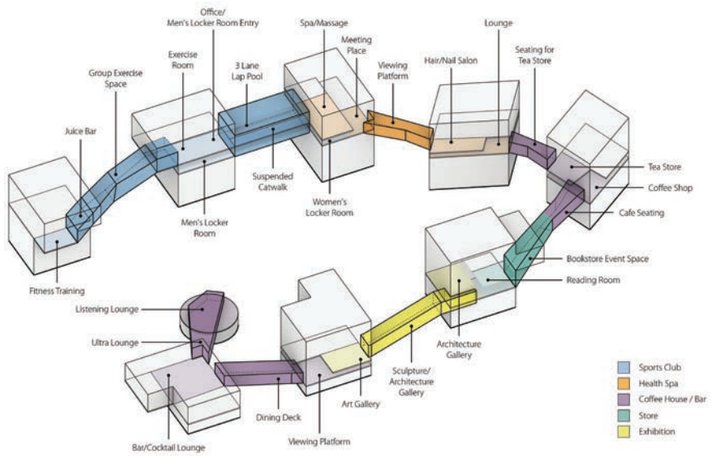
But it is also evident in smaller-scale projects, such as Concord CityPlace Parade, Toronto (see Figure 9), where an otherwise typical high-rise development acts an instrument of site repair, as it uses its skybridge as a guidepost to pedestrians crossing between an area of the city's downtown and its developing lakefront, which are separated by high-traffic road and rail corridors. In these cases, the symbolic gesture of invitation represented by skybridge-linked projects, in which its composition and silhouette is perhaps the most salient factor—is clearly evident. Skybridge projects placed at prominent locations in the urban context are best positioned to exploit the potential of the typology.

With respect to usage and programming, the experience of the skybridge from the inside can be evaluated along a number of dimensions, with the overarching question being, "Do I know that I am in a skybridge, and that this space plays a special role in this building complex?" To the extent that the answer is "yes," we can locate some exemplars in the case of virtually all of the "enclosed programmatic" skybridge projects, though some individual spaces and bridges are stronger in this regard than others. The bridge at Concord CityPlace, for example, goes the extra mile to emphasize the special nature of the enclosure, by inserting glass flooring (see Figure 10).

Meanwhile, some of the interiors of the Linked Hybrid skybridge network sometimes seem designed to obscure the fact that they are soaring through the sky between buildings, as others emphasize it (see Figure 11). Linked Hybrid ranks among the most elaborately developed projects in our research. In its ambitious gesture of creating a unique and porous experience within the framework of urban China's walled compounds, it has succeeded in inspiring dozens of projects around the world. The conception of the skybridge network as analogous to a public



Figure 8. Linked Hybrid, Beijing, completed in 2009, connects eight residential buildings and a hotel with a continuous series of programmed skybridges, with functions ranging from a lap pool to film production studios. Image Credits: Top: © Steven Holl Architects Shu He; Middle and Bottom: © Steven Holl Architects, redrawn by CTBUH



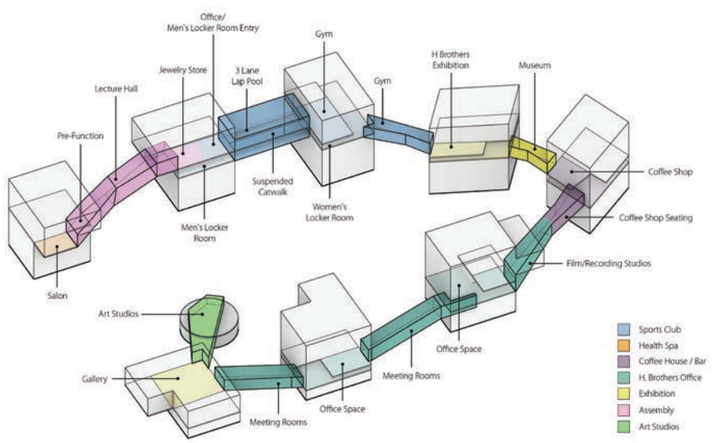




Figure 9. The urban gateway formed by the skybridge at Concord CityPlace Parade in Toronto, completed 2013, is at least as significant to the overall design as the experience of the bridge from the interior. Image Credit: © Concord Adex

street with access to mixed uses, however, seems to have been compromised by the decision to rent out large segments to private companies that limit or bar access to the general public and even to residents. To be fair, the project was designed without a great deal of clarity from the client regarding the operation and leasing strategy. It was conceived at a time of rapid growth in China, with many developers venturing into the business for the first time. Secondly, the leasing of the bridges was not complete until many years after completion of the project.

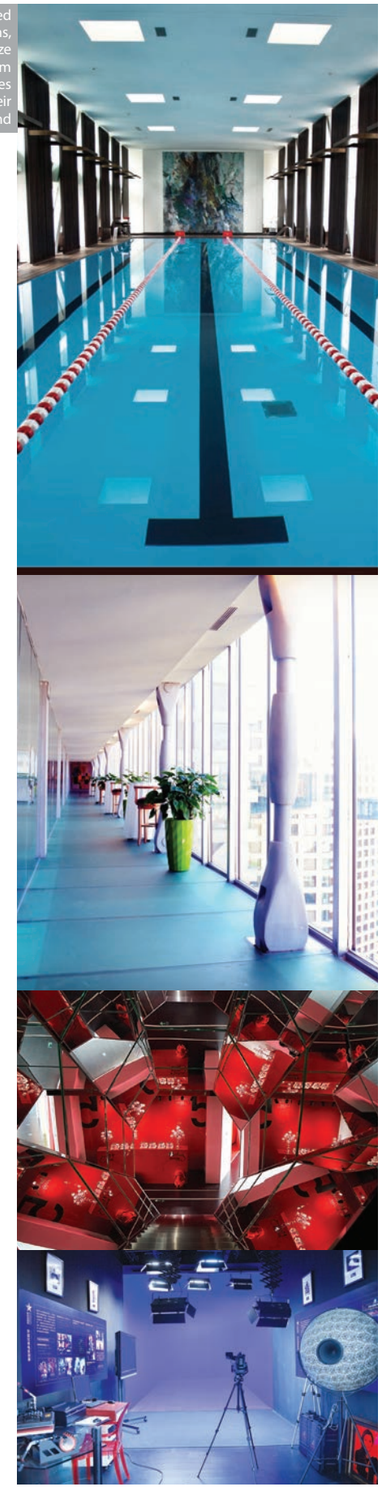
A skybridge that maximizes its potential as a symbol or architectural feature at multiple scales; that performs a critical structural role that adds or returns leasable space to the project; that makes the most of its positioning between two towers as a host for interesting and unique programming, and that capitalizes on that positioning to provide efficient movement and great views, could be considered "successful." Unquestionably, the final judgment on the appropriate proportion of functions, and what makes a "successful" skybridge-connected project, is a subjective one, into which the qualitative evaluation must also be factored.

It seems there is not one central dimension of analysis that supersedes the others, and it may not be ideal to have a final "score" that ranks skybridges in terms of their overall quality. The purpose of this research is to understand the full potential of skybridges as more than objects



Figure 10. The interior of the skybridge at Concord CityPlace Parade has glass flooring to emphasize the unique character of a space suspended in the sky between towers. Image Credit: © Talia Shipman

Figure 11. The interiors of the skybridges at Linked Hybrid, Beijing comprise a huge range of functions, some of which, such as its lap pool (a and b), emphasize the views and sense of spaciousness that comes from being in a skybridge. Others, such as studio spaces (c and d), almost seem designed to obscure their location. Image Credits (all): © Modern Land



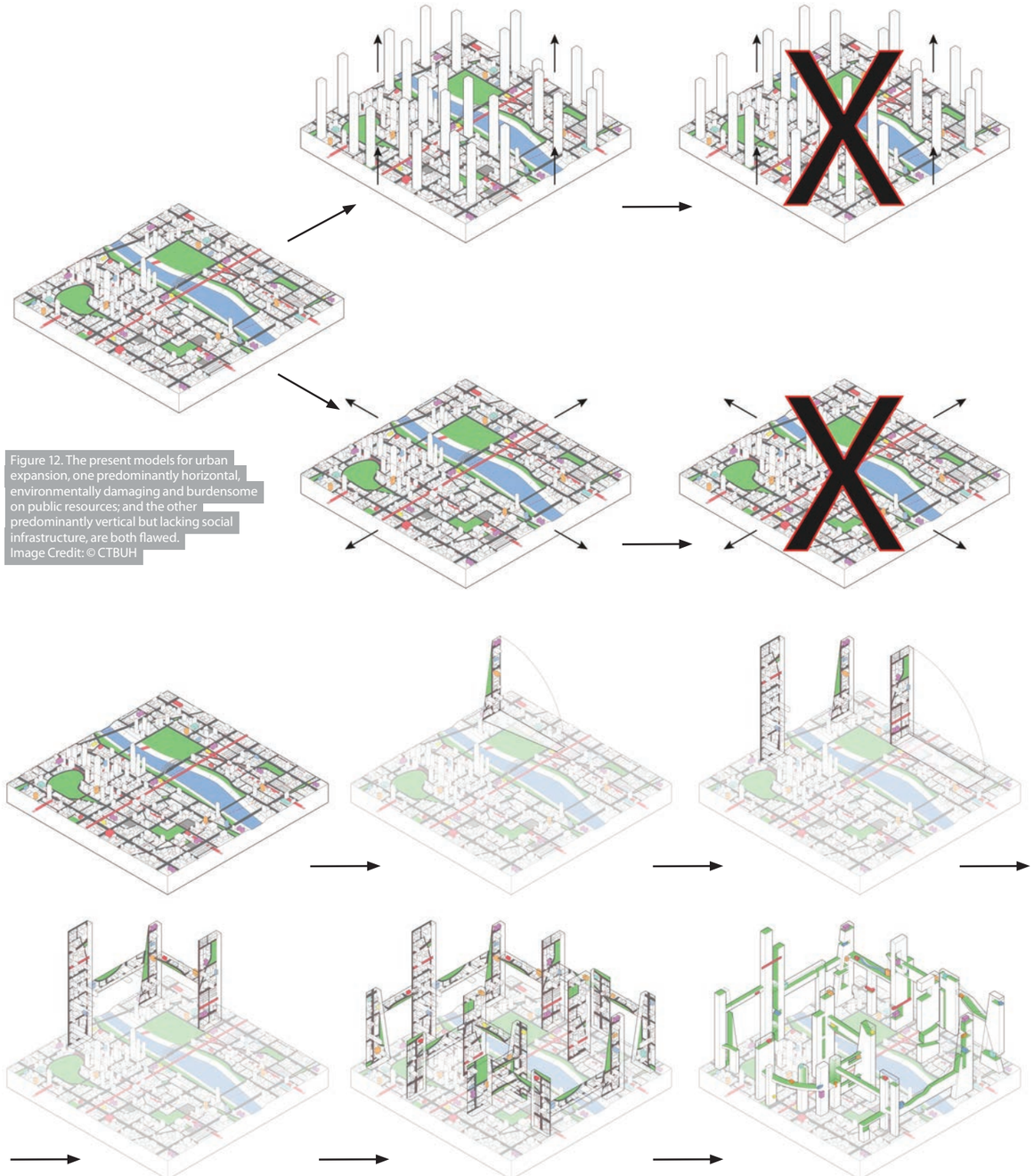


Figure 12. The present models for urban expansion, one predominantly horizontal, environmentally damaging and burdensome on public resources; and the other predominantly vertical but lacking social infrastructure, are both flawed. Image Credit: © CTBUH

Figure 13. In future cities, all types of infrastructure—utilities, transportation and social, especially parks and other public spaces—can be transferred and replicated on planes many floors above the ground with skybridges serving to connect them. This could have vast implications for supporting high density, while reducing energy consumed to travel, not only horizontally, but vertically. Unprecedented public-private cooperation will be needed to achieve this. © CTBUH

in space or utilitarian corridors, but as "habitat" in large-scale projects, and beyond this, potentially, in cities. To that end, those projects which seem to be taking advantage of all the dimensions of skybridges, at multiple scales, from both the interior and exterior, are getting the most value out of the considerable engineering and construction work (and thus cost) that goes into constructing skybridges in the first place. In a phrase, it seems to be about "fulfillment of potential."

Where might this potential take us next?

Three-Dimensional Urban Growth

By 2050, nearly 70 percent of humanity—some seven billion people—will live in cities, up from 55 percent today (UN 2018). To accommodate this urban influx of more than 214,000 people per day, the world will need to build the equivalent of a new city of 1.5 million people each week.

If cities concentrate perhaps 10 or 100 times more people in a given area through building tall, there is both a need and a potential to replicate the infrastructure at the ground plane up in the sky, including the parks and the sidewalks, the schools and the hospitals, and other public/civic functions needed to support urban life. It is the position of the authors that the ground plane should be considered as a duplicable layer of the city, which needs to be replicated—at least in part—at strategic horizons within and between buildings in the sky; not as a replacement of the ground plane but as an addition to it. Every tall building would then need to be considered as a vital element in an overall, three-dimensional urban framework, rather than as a stand-alone icon superimposed on a two-dimensional urban plan. The typical urban plan divides the horizontal realm of public infrastructure (water, power, sewer, transport, and social) from the vertical realm of private space (tall buildings of all typologies) (see Figure 12a).
As cities expand, current approaches generally bifurcate into vertical expansion (upper) or horizontal expansion (lower). The upper model (see Figure 12b) is generally a more efficient allocation of space, but the responsibility for extending infrastructure skywards remains with the private sector, which does not always have a commercial interest in providing the most supportive framework when it comes to public goods such as access to natural ventilation, daylight, park facilities, etc. The lower model (Figure 12c) is essentially the condition of post-war North America, public subsidy of inefficient and environmentally damaging infrastructure that ultimately drives more urban sprawl.

Both of these independent models should be rejected (see Figure 12d). Instead, cities should "flip" their infrastructure vertically, and connect tall buildings horizontally at height, creating new spaces for living and working, and conduits for services, increasing density and vitality, and limiting unsustainable sprawl. all types of infrastructure—utilities, transportation and social, especially parks and other public spaces—can be transferred and replicated on planes many floors above the ground, with skybridges serving to connect them (see Figure 13). This could have vast implications for supporting high density, while reducing energy consumed to travel, not only horizontally, but vertically. Key to the success of this proposition is a radically new level of integration and cooperation between governments and private entities, as well as a more comprehensive interpretation of "infrastructure."

The primary obstacle to this kind of connectivity is not technological; it is political and economic. At present, very few developers see the "upside" of connecting their projects to those of others, absent guidance from government on how public rights-of-way and utilities will be threaded through these interconnections, and how public access will be provided and controlled. There are significant liability issues presented when a skybridge extends between two private buildings over a public right-of-way.

And, there would likely need to be a "critical mass" achieved in terms of development of high floors of multiple connected buildings before there could be any profits to share. Here again, taxation and code incentives will need to be deployed to entice the initial set of developers to take on the risk in any given market; it is a certainty that, as with many large-scale developments of the recent past, a heavy public investment might also be required. Like any great change to urban geography, to become reality it would require the political will that stems from a frank reading of public needs and desires, and urbanization trends that are broadly deemed to improve quality of life and the competitiveness of cities.

Antony Wood, PhD, has been Chief Executive Officer of the Council on Tall Buildings and Urban Habitat since 2006, responsible for the day-to-day running of the Council and steering in conjunction with the Board of Trustees, of which he is an ex-officio member. His tenure has seen a revitalization of the CTBUH and an increase in output and initiatives across all areas. Based at the Illinois Institute of Technology, Chicago, Wood is also a Research Professor in the College of Architecture, and a visiting professor of tall buildings at Tongji University, Shanghai. An architect by training, his field of specialty is the sustainable design of tall buildings. His PhD focused on skybridges and their potential for a more significant role in cities, which forms the basis of this Guide. Prior to joining the Council and IIT, Wood was an Associate Professor/Lecturer in Architecture at the University of Nottingham from 2001–2006.

