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The Tall Building Strategically Reconsidered—Seattle 2030: The Post-Crisis Tower

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Abstract

The current perception of a post-COVID world is highly divisive and despairing. The "death of the tall building" is touted by prognosticators as a fait accompli. The concept of the city as a microcosm of commerce, urban living, culture, and civic uses has been put into severe doubt and paranoia. Density, mass transit and assembly uses are suddenly deemed as anathema to "normal" lifestyles, and the flight to the suburbs is touted as the new mantra.

This paper is an exploration of what a post-crisis vertical vision would reflect in urban America, responding to changing norms of the workplace, urban living, leisure, and transit. Its prototype is a hybrid 400-meter mass timber structure ensconced within a steel exoskeletal frame. With 90 percent of the tower comprised of mass timber, the 88-story structure would sequester carbon, reduce emissions, enhance structural performance and set new paradigms of the tall building as a modular, living-breathing machine, responding to the "new normal" of the contemporary urban condition.

Keywords: Biophilia, Carbon Footprint, COVID-19, High-Rise Office

Preface

In 1985, the venerable architecture critic Ada Louise Huxtable propounded the poetry and politics of the tall building in the book *The Tall Building Artistically Reconsidered*, itself a treatise on Louis Sullivan's 1896 essay "The Tall Office Building Artistically Considered." Yet today, the tall building sees no such odes to its form and existence; instead, it faces volleys of criticism from both public opinion, as well as from interest groups from across the environmental, political, social, and cultural spectra.

> "Any perceived structural limitations of a mass-timber supertall structure are alleviated by adopting a hybrid system of steel exoskeletal frames and concrete cores, with 90 percent of the tower's composition remaining timber."

Meanwhile, "2020," a number that has always been the symbol of perfect vision, is now forever tainted by disease and death. Invariably, when the current crisis recedes, however, life as we knew it will revert, continue, and thrive with some "new normal" changes and detours. The current paranoia, denigrating density and encouraging flight to suburbs by industry stalwarts and political leadership, is unfortunate, and tends to exacerbate an already tenuous situation.

The Post-Crisis era will force us to reconsider myriad issues we took for granted, even as late as January 2020. Wariness and denouncements expounded by pundits and prognosticators has cast doubt on several major institutions of society, delivering summary negative judgements on cities, density (often conflated with crowding), mass transit, workplaces, spectator sports, entertainment, elevators, tall buildings, and urban living. The residential and commercial real estate industries will undoubtedly be hit hard and contract substantially in the short term, but even as the "mitigation" phase and corrective actions are currently under way,

there exists a real threat of overreaction and throwing out the proverbial "baby with the bath water."

Post-Pandemic Predictions

The intent of this paper is to peek a decade into the future, incorporating the repercussions of this once-in-a-lifetime event, and envision what a future development in the form of tall buildings in urban America (or quite possibly Sydney, Singapore, Shanghai, or Seoul) may look like. Seattle 2030: The Post-Crisis Tower is one such exploration of how a new generation of tall buildings could respond, negate, or redefine the misperceptions of the relationship between density, height, and wellness, while creating viable, demonstrable and responsible solutions to post-pandemic concerns. Its intent is not to dwell in detail on technical feasibilities, zoning regulations, code applicability, construction variables, structural engineering, or socio-economic issues (although these are addressed generally); but instead to expound on the post-crisis relevance, and re-emergence of a building type that has awed and inspired humanity for eons.

Seattle 2030: The Post-Crisis Tower at a Glance

Planned for a city like Seattle (see Figure 1), an early epicenter of the COVID-19 pandemic in the US, the concept proposes a permeable 400-meter hybrid mixed-use tower—a "living-breathing" mechanism predominantly constructed of mass timber, negating the status quo of a hermetically sealed edifice through a biophilic approach, and addressing energy efficiency, climate change mitigation, healthy living, and re-evaluated typologies in a single gesture.

Substantial research has been conducted over the last decade regarding the structural and life-safety limitations or opportunities of mass timber (Olt 2018). In this case, any perceived structural limitations of such a supertall structure are alleviated by adopting

Figure 1. The post-crisis tower, proposed to rise in Seattle by 2030, would take on the lessons learned from the 2020 COVID pandemic, as well as incorporate biophilic and other sustainable principles. © 3MIX

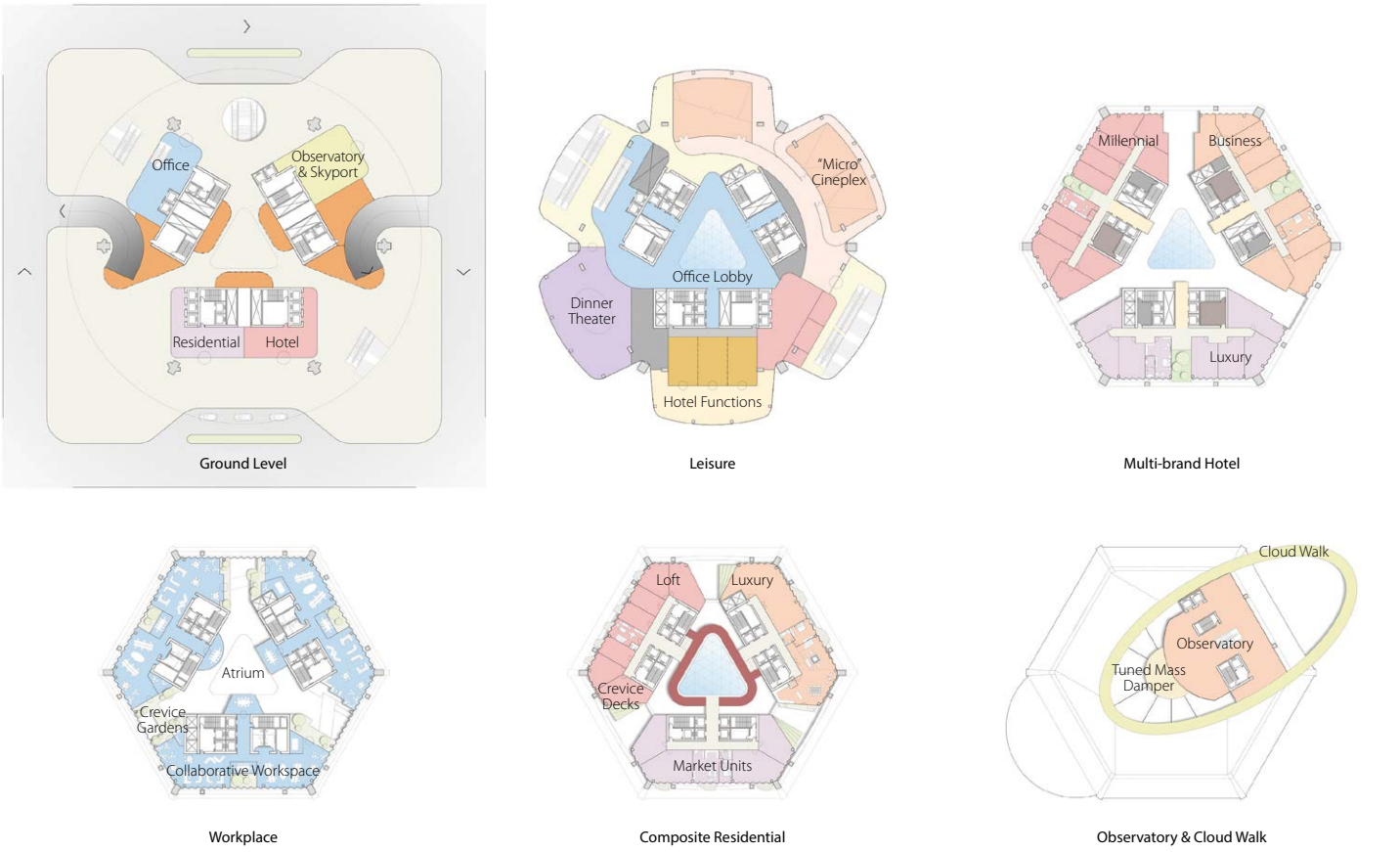

Figure 2. Plan views of the main programs/uses of the 400-meter tower. © 3MIX

a hybrid system of steel exoskeletal frames and concrete cores, with 90 percent of the tower's composition still remaining mass timber. Although not site-specific, the concept is suggested for a typical urban block in Seattle's downtown core. Rising 88 stories, the tower's tapered profile and spiraling pinnacle and a "cloud-walk" observatory define an iconic appearance, while its predominantly wood aesthetic exudes a warm and natural ambiance within this high-technology city. Its hexagonal configuration is defined by three interconnected sub-towers, with a central multi-storied void. It is divided into eight distinct "vertical blocks" by interstitial steel "diaphragm" floors. Over 150,000 square meters of varied and redefined mixed-use typologies (workplace, urban living, hospitality, and leisure) are accommodated within the structure. Residual "crevices" in between are expressed by cascading landscaped tiers and interconnecting bridges, creating beneficial wind dispersal and countering vortex shedding. The serrated façade allows for natural ventilation, and makes use of timber's relative lightness, its ability to sequester carbon, and its conceptual modularity, alluding to a socially responsible net-zero proposition that can morph and grow over time.

Programming

A primary focus of this exploratory study is on the programmatic constitution of the tower, and the way in which different uses will change and respond to future concerns of wellness, economy, and safety-consciousness.

To predict the programmatic components of a development like Seattle 2030, it's important to take cues from current real-estate metrics (pre and post-crisis)(WCRER n.d.) and extrapolate them a decade or so later, allowing for progressive modifications, transformation and incremental changes in behavioral patterns, rather than complete obliteration of "life as we knew it."

The tower's vertical configuration starts from a "walk-through" permeable base with entry lobbies for its distinct uses, followed by several levels of leisure and alfresco dining. Upper tiers, ranging from nine to 12 floors each, accommodate hospitality, workplace, and residential components, capped by an observatory and a futuristic air-taxi skyport.

The following attributes further define the evolution of various typologies and their manifestation within the tower.

The Workplace

Of all the typologies, the workplace predictably will be the most transformed. The success of work-from-home (WFH) initiatives, in addition to reducing physical space as a crisis response and cost-cutting measure, have ushered in a realization that the hermetically-sealed 2,500 square-meter floor plate with multiple tenants may be a thing of the past—with future tenants opting for smaller, decentralized venues for collaborating and ideating, as the crisis recedes.

The workplace component of Seattle 2030 (see Figure 2) is anticipated to be relatively

sparse compared to today's business trends, both in terms of area and occupancy. With smaller floor plates ranging from 700 to 20,000 square meters over 10 floors, the new workplace emphasizes flexibility, lower occupancy and inter-connectivity. This is achieved through accessibility to open-air atria, lushly landscaped vertical gardens (see Figure 3) with water-walls, skybridges, shallow lease depths with compact offset cores, and natural ventilation capability integrated into façade systems, creating varying venues for collaboration, ideation and spontaneity. Larger tenants could use two or all three sub-floor plates, connected via open or enclosed bridges, while glazed capsules cantilevered in the atrium allow for vertiginous views and experiences.

Urban Living

Density and vertical living within city cores with upscale facilities and cultural proximities will continue to be attractive despite the current resistance, especially in a tech-heavy and epicurean city like Seattle, where affordability is of prime concern. Renters and buyers will tend to opt for varying formats, ranging from micro-studios to cellular loft units to expansive penthouses, but with an overarching preference for natural surroundings.

The 2030 tower would respond to such needs and demands via varying formats, with approximately 350 units, in keeping with similar developments. Each of the stacked mass timber "districts" would accommodate a variety of living formats, (as previously seen in Figure 2) ranging from duplex lofts, to market-driven one- and two-bedroom units, to luxury penthouses on the top tier, each with expansively landscaped, cantilevered decks. Each skydeck level would accommodate shuttle elevator stops, community facilities (fitness, salons, multi-purpose, daycare), and be open to a cantilevered skypark (see Figure 4) incorporating off-leash pet areas, drone ports and urban farming. A spiraling bicycle ramp within the atrium would connect the floors and allow for aerobic "hill-climbs" for those inclined. The overarching residential component of Seattle 2030 would hence literally incorporate a metaphorical "Emerald City" in the air.

Hospitality

Besides being the segment most devastated economically by the pandemic, the hospitality industry continues to heroically adapt to changing demographics and wellness consciousness. Hotel chains may morph into newer, technology-driven typologies without summarily rejecting the norms of business and vacation needs.

The 2030 concept envisions three different tiers of one umbrella hotel brand (as

Figure 3. Workplaces would feature shallow floor plates and plenty of access to well-ventilated atria. © 3MIX

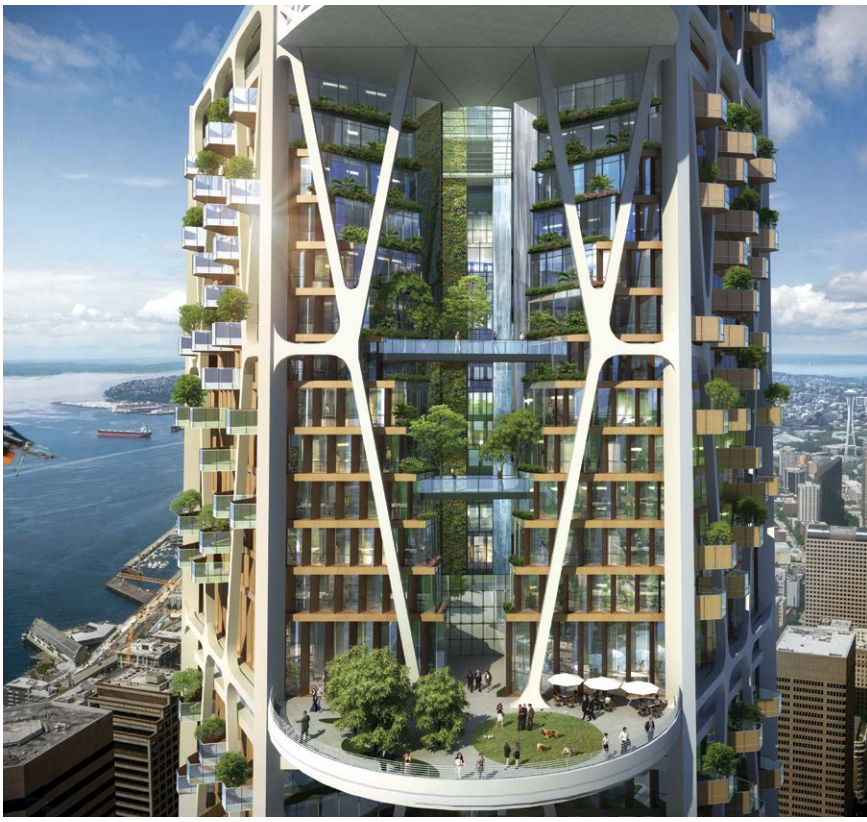

Figure 4. Each skydeck level is open to a cantilevered skypark. © 3MIX

previously seen in Figure 2)—business, luxury, and "millennial," allowing 275-plus keys to be split into the three sub-towers, effectively diversifying the target market while sharing back-of-house and reducing function areas at the podium level.

Leisure

Despite the projected "death" of the indoor mall and the cinema, people will still want the pleasures of dining out, and the big-screen experience will still be popular, albeit in modified micro-cineplexes with staggered seating. Restaurants and bars have borne the brunt of economic devastation but will doubtless adapt and evolve their DNA, especially in culinary cities like Seattle, with an increasing range of outdoor seating propositions.

The 2030 tower avoids traditional notions of an indoor retail center, with its highly porous and permeable base, populated by boutiques and cafés. Accessed by express escalators, the upper levels include a "micro" cineplex, a dinner theater (a popular scene in the city), and hotel functions (as previously seen in Figure 2), while cascading restaurants, cafés, and other F&B venues with an emphasis on alfresco dining appear on the upper floors, defining a European ambiance and urban energy, enabled by the region's benign climate and dry summers.

Below the podium, provision is made for a subterranean light-rail station access if such connectivity is available, minimizing need for car ownership and facilitating reduced parking requirements that also cater primarily to electric, hybrid or autonomous vehicles.

The crowning feature is an observatory and museum at the 85th floor, with a vertigo-inducing glass-floored "cloud walk" affording expansive views of the Puget Sound and Mount Rainier. A suspended pendulum tuned mass damper (TMD) and a futuristic air-taxi "Skyport" with vertical take-offs and landings (see Figure 5) serve as signature icons for the city.

Figure 5. The tower's pinnacle includes a glass-floored observation deck, a tuned mass damper on display, a perimeter "cloud walk", and a skyport for vertical take-off and landing vehicles. © 3MIX

Structural DNA, Mass Timber, and Hybridity

As noted earlier, the Seattle 2030 tower is proposed as a hybrid structure with 90 percent mass timber constitution, but reliant on a steel and concrete macrostructure for gravity and lateral loads. The modified steel hexagrid exoskeletal structure (consisting of six super-columns and diagonal struts connected to interstitial belt trusses) is attached to offset and inter-connected concrete cores every 50 meters by outriggers at the seven steel-framed "diaphragm" floors (see figures 6 and 7). Ten-to-12-story (45-meter-high) "districts" or vertical blocks are constructed of glued-laminated (glulam) timber columns and beams, and five-ply cross-laminated timber (CLT) floors (with an optional 50-millimeter concrete topping), supported by maximum nine-meter spans literally straddled within the resultant voids. Floor-to-floor heights ranging from 3.3 to 4.5 meters, depending on uses, allow for exposed wood construction (contingent on progressive codes), and a natural and warm aesthetic.

With a maximum width of 68 meters at the base, the tower has an aspect ratio of 6:1. The variegated "crevices" between the sub-towers serve as indented corners and mitigate vortex shedding, "confusing" the wind. Computational fluid dynamics (CFD) simulations done for similar tower configurations prove that the air bleeding through the multi-story void facilitates further breaking up of vortices. The relative lightness of the entire structure (as opposed to a stiff all-concrete structure) is countered by the inclusion of an exterior pendulum-type tuned mass damper (as previously seen in Figure 5) at the pinnacle of the tower, allowing periods of vibration

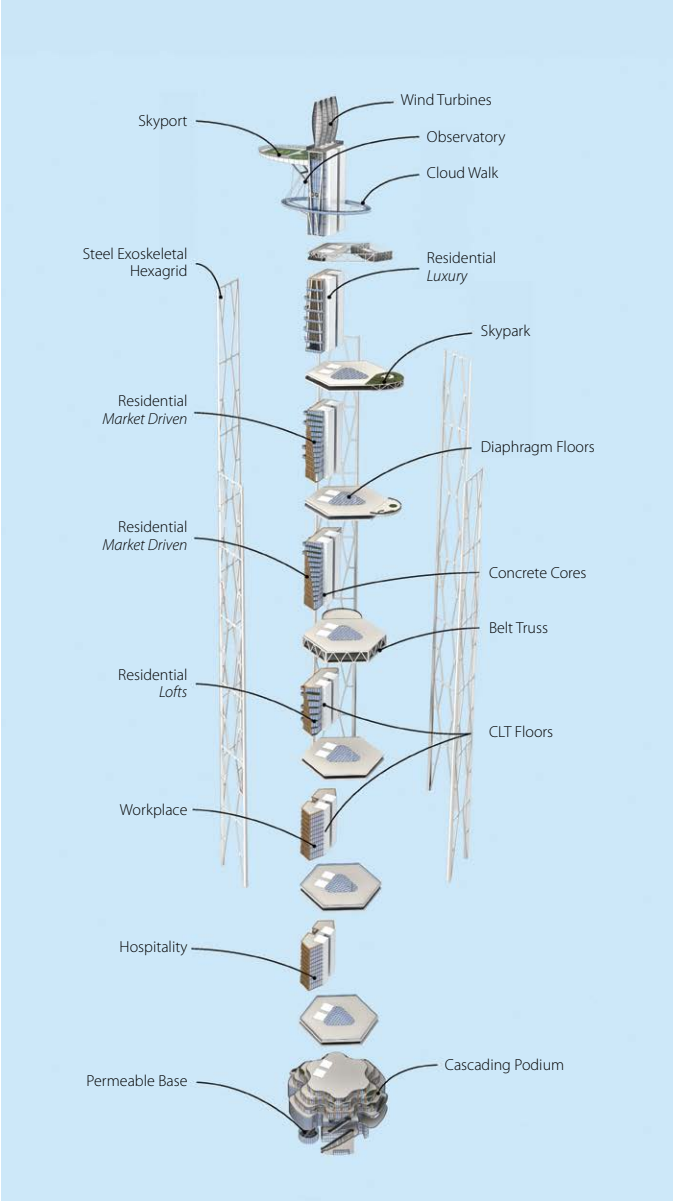

Figure 6. An exploded axonometric drawing reveals the main structural and programmatic components of the tower. © 3MIX

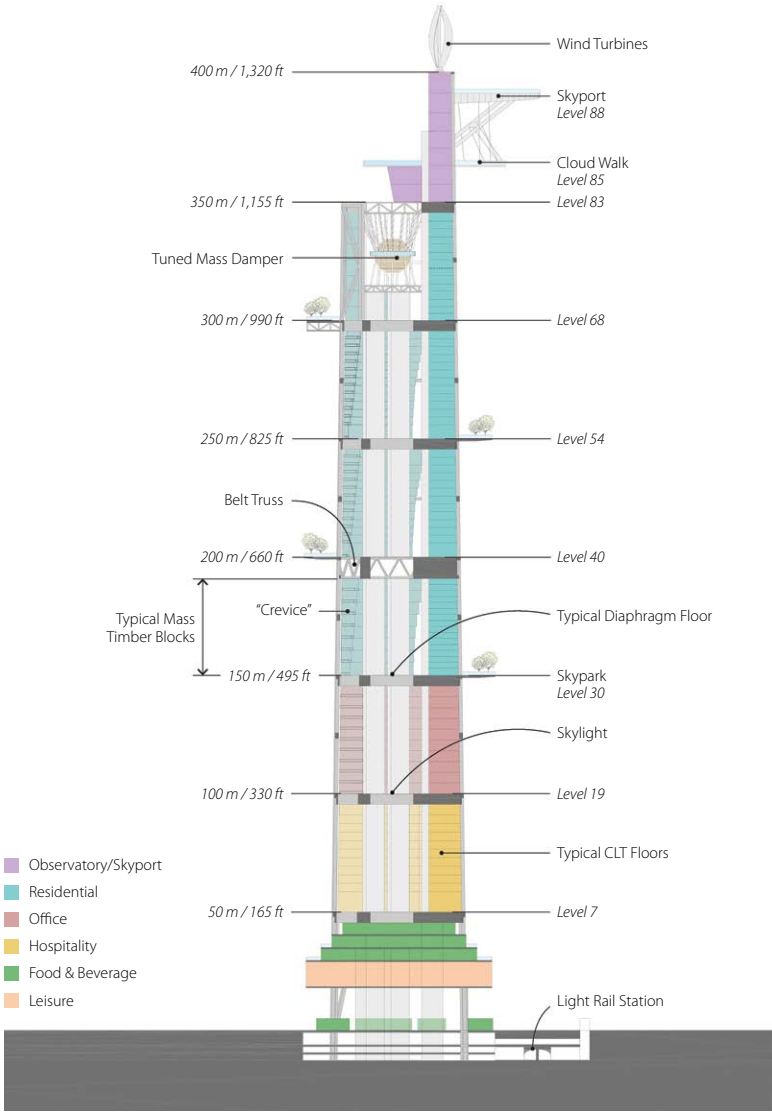

Figure 7. A section drawing shows programmatic divisions, major architectural features, and locations of diaphragm floors. © 3MIX

matching the sway periods of the building to which the damper is tuned.

Safety

The structural feasibility of the tall mass-timber building continues to be well-researched by the wood industry as well as climate-change champions, educational institutions, and architecture and engineering professionals (Mayo 2015, Harte 2017). Wood's comparative lightness allows for reduced foundation loads and costs, decreased embodied energy, and lower forces for seismic resistance. Several concepts have been developed for all-timber skyscrapers up to 300 meters, but the tallest structure approved and built to date in Norway remains of moderate height, just over 85 meters. This is primarily due to the skittishness of life-safety considerations, insurance restrictions and lagging codes.

Many jurisdictions in Europe, North America, and Australia have accepted the concept of "charring", essentially oversizing the structural dimensions of the wood members to suffice for a 2-hour rating in fires (Salminen & Hietaniemi 2017). The adoption of new codes in 2018 (with further revisions with an anticipated implementation by 2021)(Wood Works 2020) related to the construction of tall mass timber buildings of up to 18 floors by the State of Washington and the City of Seattle bodes well for a project like Seattle 2030, as it is essentially a series of stacked mid-rise towers within a robust non-timber structural system. An additional safety attribute of the tower is the inclusion of up to six stairs at each level (two in every sub-tower), ensuring safer exiting strategies, along with the possibility of aerial evacuation at the skypark levels.

Vertical Movement

Elevators are currently in the cross-hairs of the social-distancing conundrum. The mandate to restrict occupancy to four people in cabs with a capacity of 16 or more seems inherently unworkable for the tall building. The 2030 tower would accommodate a higher percentage of voice-controlled destination-dispatched elevators, allowing more and frequent trips without compromising handling capacities, waiting periods, and round-trip times, mitigating some of the issues confronting us today. The office elevators would be accessed via spacious lobbies to avoid queuing or crowding. High-speed shuttle elevators

> “The air bleeding through the multi-story void facilitates the dissolution of wind vortices, as well as providing additional ventilation.”

moving at 8 meters/second will access multiple skylobbies for different programs. A variation of the MULTI system from TK Elevator AG can be integrated into the four residential districts, with each tier having its own bank of elevators within the same shaft.

Smart Technologies

New technologies will leapfrog each other over a period of time much shorter than the potential construction duration of a tower like Seattle 2030. Smart technologies will regardless become omnipresent within such a structure, and include everything from touchless and voice-activated access, hygiene and logistics systems, digital reception and biometrics, enhanced filtration and humidity controls, continually monitored indoor air quality (IAQ), bipolar ionization, smart building management systems (BMS), etc. The trick is to ensure sufficient flexibility for modifications or supplementing current systems, as the tech industries continue to evolve at warp speed.

Informing Design with a Green New Deal

The concept of achieving sustainability goals via an overarching biophilic approach is the fundamental tenet of Seattle 2030. As the premise of mass timber buildings is to sequester carbon long-term, in this instance using sustainable species of wood, abundantly available in the Northwest, the concept interweaves the combined goals of green building, healthy living, disease prevention and reduced carbon emission. As poor indoor air quality and artificial lighting’s effects on human health are under more scrutiny now than ever, Seattle 2030, benefiting from a relatively benign coastal climate, strives to achieve the goals of naturally ventilated environments and abundant natural light penetration within tall buildings.

The serrated façade systems, facing both the exterior and towards the “crevice” gardens, allow for mechanically- or manually-openable panels (constituting 15 percent of the building’s perimeter), while the interior void is fully open-air, tempered by landscaping, strategic weather barriers, and human activity. Warmer air rising through the atria is naturally exhausted through the upper strata, and skylights within the voids allow natural light penetration without diminishing the perception of height, while also preventing stack effects. In addition, the predominantly dry construction and the comparatively speedier installation methodologies associated with mass timber reduce construction waste, shorten schedules, and positively contribute to the overall economics of the proposal.

This pursuit is consistent with the AIA 2030 Challenge, as well as the Seattle Living Building and 2030 Challenge pilots for all buildings to be carbon-neutral by 2030. The underlying precepts of reliance on natural ventilation, an abundance of natural light, and the lower carbon impact of mass timber all contribute to these goals.

Conclusion

Although Seattle 2030 remains in many ways a utopian concept to deal with newer challenges post-pandemic, it is grounded in realistic and achievable principles. Its primary goal is to encourage more aggressive thought leadership, whether creative, technical, or political, to solve the myriad challenges humanity will face in the coming years. There are no panaceas, just determination, and aggressive experimentations.

To recall Daniel Burnham’s most-recited quote from 1909, “Make no little plans. They have no magic to stir men’s blood and probably will not themselves be realized.” ■

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