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Creating a Vertical University in an Urban Environment



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A LEED accredited professional Christopher has been involved with planning and mixed-use globally for government, corporate, and institutional clients. Christopher is a member of the American Institute of Architects, the Urban Land Institute, and has been an active member in the CTBUH and has focused on the "urban habitat" issues that work together with the continuing development of the tall building which is changing the face of the globe. His has been widely published internationally and has earned repeated recognition from the American Institute of Architects.

Multi-function universities in tall buildings are still a rarity, but they are growing more common as institutions look for efficient and cost-effective ways to serve their urban students. This paper discusses the unique challenges of adapting the tall building model to accommodate the functions of an institution of higher education in metropolitan areas.

Universities are typically horizontal organizations of purpose-built structures, connected by their open spaces of quadrangles and courtyards. These connections are termed "out of class" spaces and are viewed as essential components of the university environment. Not only do they connect different buildings and components of the university, these spaces play an essential role in creating the social connection and discourse vital to the spirit of the university experience. In the best campus examples, open space connections create "neighborhoods" that enhance campus identity and character.

A vertical approach to connecting the components of a traditional university organization is rare. It is more common to see tall buildings used for single purpose university programs, primarily for student residential function. However there are recent examples that develop the multi-program vertical university model, combining the connective quality of the university environment while working within the parameters of the tall building model. These examples include the Mode Gakuen Cocoon

Tower in Tokyo, University Center for The New School in New York, and the Wabash Building for Roosevelt University in Chicago (see Figures 1, 2 & 3).

For a university or similar institution, the proper balance between needs and expenses must be considered when contemplating building tall. It is more expensive to build a tall building when assessing construction costs alone. The logic for building tall is optimized when density is required and land is scarce. Issues to consider in this approach include:

Financing

The financing of Institutional structures is different from that of commercial structures. A commercial development looks to selling or leasing space – a physical asset with both quantifiable and predictable revenue projections. For example, a well-planned and strategized high-rise residential structure will lease or sell residential units in alignment with specific market expectations. These revenue structures follow highly developed industry standards.

A university high-rise development is quite different. The product of an institution is a degree and not a physical asset. Classrooms, lecture halls, and laboratories are the infrastructure used to support the service provided. While a public institution has the advantage of support through government funding, both public and private institutions depend on the revenue streams developed from tuition and fees, room and board, donations from alumni, corporate sponsorship, and endowments. These potential revenue streams not only pay for the building, but also finance the overall operations of the Institution. In the United States an institution can use its non-profit tax status to raise tax-exempt bonds. Financing

“A tall building model for university programs should balance the functionally-driven program of a university with the efficiencies of the tall building model ... University buildings must retain their value through the life of the institution, therefore a strategy of adaptability to the future must be considered.”

will be dependent on investor confidence in the long-term sustainability of the Institution, which in the present business climate continues to be a huge challenge for the vast majority of universities.

For the University Center, New York and the Wabash Building, Chicago, the residential component was critical for the financing, providing measurable and consistent cash flow.

Program and Program Stacking

University buildings with multifunctional programs based on academic requirements are purpose-built structures, in contrast to commercial office developments, which are predominantly based on core and shell developments and tenant build outs. The common thread among vertical university programs is that they are all different. The Mode Gakuen Cocoon Tower is focused primarily on academic space; the New School University Center serves academic, residential, and commons spaces for the university as a whole (see Figures 4, 5 & 6). The Wabash Building is similar to the multi-use University Center, with the addition of student services, a student union, and offices for the university administration. In all cases the programming includes the “out of class” space for gathering,

meetings, group study, faculty interaction, and interconnection within the specific zones of the university. A tall building model has the potential to bring many different components of the university experience to one place, leading to positive interdisciplinary and social outcomes.

The stacking of functions in a vertical university is dependent on program, location, and connectivity to an existing campus. A program focused on academics, such as the Mode Gakuen Cocoon Tower, has a relatively uniform stacking similar to a commercial structure. However if the stacking is more heterogeneous, as is the case in the Wabash Building, then the stacking approach works as a strategy of stratification and juxtaposition, in which the degree of privacy is greater as one moves up the section of the building.

Planning

A tall building model for university programs should balance the functionally-driven program of a university with the efficiencies of the tall building model, the appropriateness and integrated relationship of structure, and the requirements of the mechanical and vertical transportation systems. University buildings must retain their value through the life of the institution, therefore a strategy of

adaptability to the future must be considered in the planning. Structural spans, floor-to-floor heights for the academic programs, and the potential for additional exiting for assembly occupancies require careful consideration. Interconnections between floors involve extensive code research and require smoke exhaust systems that will add to the expense of the project.

The site will have a significant impact on the planning both in terms of location and dimension. A freestanding site with access on multiple sides offers different opportunities than a mid-block site. Is the site large enough to allow a central core? Or must the core be offset to gain the spans necessary to accommodate the program? Is the site adjacent to an existing campus with requirements for connectivity between the existing and new facility?

The core element of the program is the classroom space. Institutions today are incorporating multiple pedagogies of instructional learning, which includes traditional delivery methods as well as collaborative and interdisciplinary group problem-solving, with many applications in both the academic research world as well as the “market” world. Instructional space



Figure 1. Mode Gakuen Cocoon Tower, Tokyo. © Orghi Dean



Figure 2. University Center for the New School, New York. © SOM



Figure 3. Wabash Building for Roosevelt University, Chicago. © VOA Associates

employs a combination of fixed configuration teaching spaces – such as tiered classrooms, lecture halls, and laboratories – and flexible classroom configurations featuring movable furniture, flexible data and power infrastructure, white boards, smart boards, and multiple projection capabilities to adapt to new methods of teaching through team collaboration. These varied needs are supported by the pre-function space of the corridors, which can be used for informal gathering as well as break out spaces for group projects.

Vertical Transportation and Circulation

Vertical transportation is a key component in the functionality of tall building structures. In both commercial and residential tall buildings, elevator banks are zoned to service specific levels that are possibly interconnected within zones, but not between zones. In most cases exit stairs are generally used for emergency access only. A university environment is much different, requiring interconnections between the different zones of residential and academic zones, as well as the student union and student services, and this drives the strategy of the core design.

Another important design goal is to encourage pedestrian connections within

zones to reduce the dependence on the use of elevators. The centralized core of the Mode Gakuen Tower leads into a series of connected three-story atriums (see Figure 7), which allow pedestrian access within the zones through the use of exit stairs. The New School connects these spaces within its academic podium vertically by a continuous and connected set of stairs that introduce outside views into interior spaces contiguously, creating a great sense of community (see Figure 8).

Structural Strategies

The structural strategies for vertical universities follow the traditions of tall buildings: steel, concrete, or a combination of both. The difference between university projects and traditional commercial structures is the requirement for long-span bay arrangements to accommodate the academic programs within the tower.

MEP Strategies

MEP strategies must address challenges found in a standard mixed-use development, including different occupancy requirements and the need for high ventilation rates for the assembly occupancies and laboratories. Energy efficiency is achieved in the Mode Gakuen through the use of high performance

envelopes and power obtained from cogeneration and district heating. For the Wabash Building the system as designed is 28% below ASHRAE standards with further carbon offsets through the university's commitment to purchase 72% of its energy from green power sources. Energy efficiency to the standards required for the AIA 2030 commitment may be difficult to achieve in metropolitan structures without the support of clean energy sources like district heating and cooling and off-site green energy systems. In metropolitan locations, the area required to develop renewable energy systems, whether it is geothermal or photovoltaic cells, is generally limited to or highly disproportional to the area being served. Despite this, given the funding and budgeting requirements of institutions, it is imperative to reduce operating costs as much as possible in the design approach to the building and its composite systems. A particular challenge of the Wabash Building was the need to take laboratory exhaust through the roof, which required offsets to coordinate with the different functions above the laboratory as well as to provide an alternative to providing a stack for lab exhaust.

Sustainability

Since vertical universities serve a single user

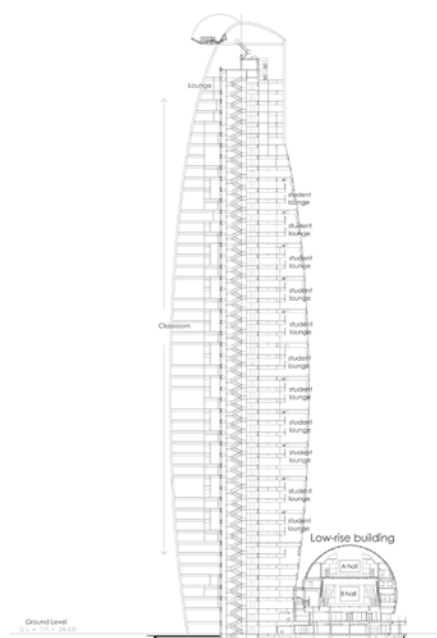


Figure 4. Cocoon Tower typical section. © Tange Associates

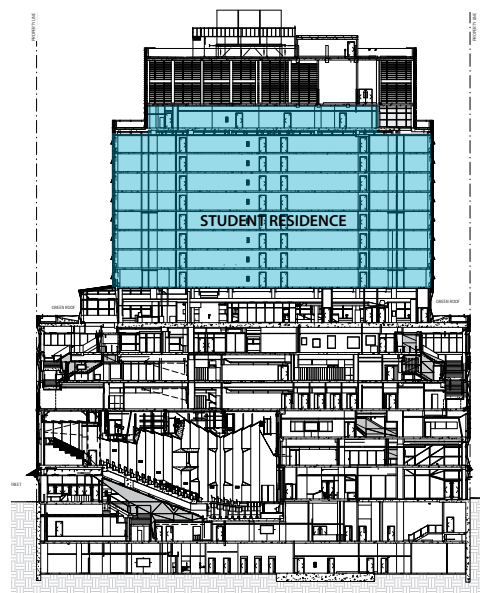


Figure 5. The University Center section. © SOM



Figure 6. The Wabash Building typical section. © VOA Associates



Figure 7. Cocoon Tower three-story atrium. © Tange Associates

that is also the owner and operator of the facility, a culture of sustainability can be instated and maintained which differentiates the Institution from commercial market developments. A sustainable approach goes beyond energy and resource conservation. University buildings are designed for the long term use and perpetuation of the Institution, which means that they must be both purpose-built and adaptable to change as the pedagogies, instructional methods, and academic focus evolve throughout the life of these structures. Another advantage in building tall in dense metropolitan environments is that the University can avail itself of the existing utility and public transportation infrastructure reducing even further their potential carbon footprint. The Cocoon Tower realizes substantial energy savings through being connected to the local district energy plant. The Wabash Building for Roosevelt University is certified LEED Gold and University Center for the New School is on track for the same certification.

Case study: Roosevelt University

Chicago's Roosevelt University is located at the central gateway of the Burnham Plan in the Auditorium Building, completed in 1890 by the "father of modern architecture" Louis Sullivan. The Auditorium building (see Figure 3 – foreground) is a landmark in the history of architecture. It was one of the first modern vertically organized mixed-use structures in America, combining hotel and office with the Auditorium Theater, world renowned for its



Figure 8. The University Center continuous stairs. © SOM

acoustics as well as its development of modern theater technology. Roosevelt University took ownership of this structure in 1947 and the Auditorium Theater has been the center of their campus ever since .

The Wabash Building for Roosevelt University, designed by VOA Associates and completed in 2012, is a 32-story, 143-meter-high expansion that responds to the growth in enrollment and the transition from a part-time commuter student base to a full-time traditional urban university. The program required new state-of-the-art large classrooms, science laboratories, administrative space, a student union, and residential facilities to improve the quality of academic instruction and student life. The university's decision to remain in the city, adjacent to their current home, on a site that was relatively small (1,607 square meters) with a program of 39,000 square meters, required a vertical approach to the expansion and a "campus" reorganization to better utilize, sustain, and continue the university's vital stewardship of the Auditorium Building and the world famous Auditorium Theater. The expansion project also included a provision from the City Landmark Committee to maintain and restore the landmark façade of the Fine Arts Annex façade, designed by a student of Louis Sullivan, Andrew Rebori, in 1924.

The Design

Given the size and constraints of the site, the traditional university organization was not possible. The design solution created a "servant-served" spatial relationship by

offsetting the core and support spaces to the north side of the site and placing the "served" spaces to the south (see Figure 9). This allowed for the maximum possible span to address the academic classroom and assembly spaces that were the core of the program, the multiple connections required on different levels to the adjacent Auditorium building and the maximum amount of light and view of the surrounding Burnham lake front park. To create a university environment, a series of vertically connected "neighborhoods" were created through atria and social space on each floor that make possible the "out of class" opportunities so important in the university experience. The neighborhood spaces beginning at the ground level include student services, student union, academic spaces, and student residential facilities. The "out of class" spaces are expressed through the visual connection between the "pre-function" space serving the classrooms and the views either east to the lake or west to the CBD (see Figure 10). The building form expresses these spaces and represents the transformational nature of the university experience.

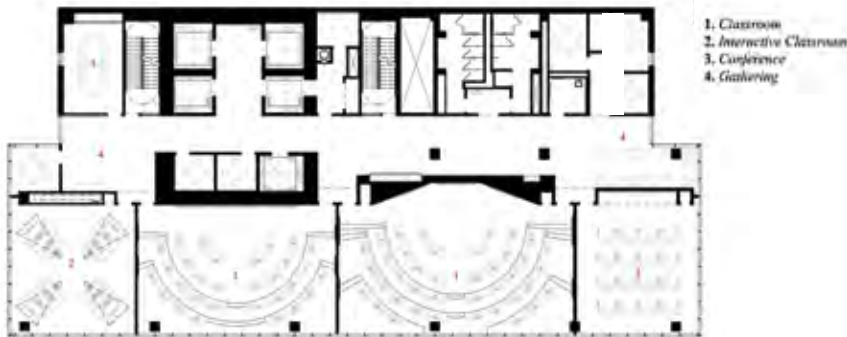
The Wabash building integrates the flexibility of the core and shell approach to a tall building and makes this the base of the design. This plan adapts to all of the functions, where the structure is "hung" to embrace the necessary connections to the Auditorium Building for the student union and student services program. The upper floors accommodate the residential program's decreased floor plate and also its mechanical requirements. The core expresses this through tapering with setbacks, while the served and public spaces in the different neighborhoods are expressed through a rhythm of bay projections on both the east and west sides that differentiate the zones of student services, student union, academic, and student residential spaces.

A monumental stair at the entrance lobby connects the student services and activity "neighborhoods," allowing for the critical connections to the existing Auditorium Building as well as linking the Wabash Street Lobby with the Michigan Avenue Lobby, connecting old and new. Above this zone the

1ST FLOOR PLAN: STUDENT SERVICES



10TH FLOOR PLAN: GENERAL ACADEMICS



27ST FLOOR PLAN: RESIDENTIAL SERVICES

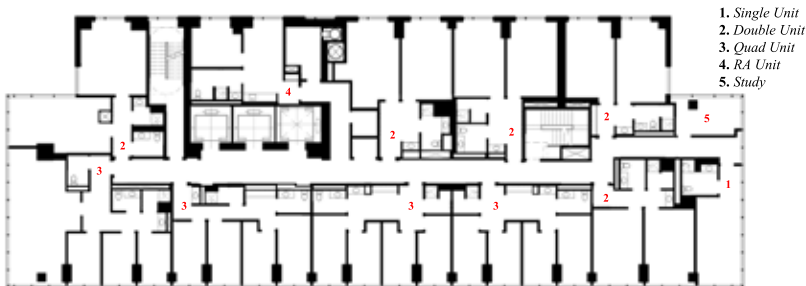


Figure 9. Wabash Building floor plans. © VOA Associates

academic core is connected by the exit stairs, which are oversized and connected visually to the pre-function “out of class” spaces through fire-rated glazing, which encourages pedestrian movement while still maintaining economy of use on this constricted site.

The quality of the spaces with their larger area and ceiling heights create a vertical sense of place and an engagement with the urban environment that is rare in tall construction (see Figure 11).

The Structure

A steel frame system with a concrete core was selected for its economy and adaptability to both the site conditions and the schedule. There were many challenges, including the foundation systems that employed the piles of the demolished former residence hall and the need to set back the structure from the foundations of the existing Auditorium Building to avoid settlement while also connecting to this existing landmark building on multiple levels. Although these issues were specific to the program and site conditions, the real significance is the ability to successfully integrate a tall building into an existing campus on a small 1,607-square meter site.

The central core has a significant impact on the design given the slenderness ratio of this structure which is 143 meters tall, while accommodating the vertical transportation critical to the day-to-day operation of this “campus.” The structure is offset from the north side of the existing Auditorium Building to avoid impacting the existing foundations (see Figure 12). The lower floor spaces are extended and hung from these columns to allow for the many interconnections with the Auditorium Building without introducing any additional loading on this existing structure. The upper floor spaces are aligned on a column grid that accommodates the changing program requirements that occur vertically in the design without transfer girders. To increase occupancy comfort due to the increased building accelerations as the structure rises due to the lighter weight steel framing, steel outriggers connected to the concrete core were added to improve building performance. Juxtaposed program



Figure 10. “Out of class” space. © VOA Associates



Figure 11. Student union space. © VOA Associates



Figure 12. Wabash Building structural diagram. © MKA Associates

stacking of different occupancies resulted in different framing conditions for each of the floors as well as serviceability issues, especially related to vibration and acoustic controls. The juxtaposed program stacking of different occupancies resulted in different framing conditions for each of the floors and serviceability issues, especially vibration and acoustic controls.

The MEP Systems

The mechanical floor was located mid height within the structure, serving the residential floors above it with a four-pipe system and a VAV system organized to fight the stack effect through the building. The exhaust air is based on the building pressurization, which is cost and operationally effective. Laboratory exhaust was a challenge requiring a dedicated exhaust from the laboratory floors on 7, 8 & 9 through the academic, administrative, and residential occupancies to finally exhaust through the roof employing a Hi-Plume dilution blower system. The system is designed for both intakes and exhaust to be taken through the north "servant space" envelope to ensure that the mechanical systems integrate with the overall language of the building.

In addition to the expansion, the mechanical system serving the Auditorium Theater, located in the basement of the former Herman Crown Center, needed to be replaced with an energy efficient conversion from a steam to a hot water system.

Circulation

The challenge with this small site was to contain the vertical transportation system in the most efficient core area possible (see Figure 9). This was accomplished by stacking the residential elevators within the same core above the elevators serving the academic, student union and student services floors. The lower bank of elevators services various student functions including the bookstore, student services, dining, and fitness facilities as well as providing additional service to the lecture hall floors resulting in six elevators servicing this floor. Large high-speed elevators maximize passenger movement. The academic core is serviced by four large elevators that also shuttle to the residential lobby. Efficiency is improved by bringing students from the outside at ground level to the various academic functions. These elevators then travel to the residential lobby to transport down to the same academic floors and then return to the ground floor to repeat the cycle. This is a unique concept compared to other mixed-use buildings where the population is separated based on function. Our approach allows this particular bank of elevators to multi task. When the academic functions shut down these elevators revert to shuttle service between the ground and the residential lobby via a computerized system that allows specific authorized users to override and maintain access to the academic and administrative floors.

Sustainability

The decision by Roosevelt University to build adjacent to their existing campus was based on the long term sustainability of the institution as well as the sustainability of their community. The University conserves resources through the development of a solution for an existing site that is relatively small and availing itself of the existing infrastructure, including public transportation.

The new addition sustains a cultural landmark, the Auditorium Building, bringing new life to this existing structure as well as to the area as a whole and continues the tradition of the institution as an underlying premise of the Burnham plan.

Conclusion

A vertically organized university within a metropolitan area is really an example of high performance urbanism. Existing examples are typically located within the nexus of public transportation. They have all taken relatively small sites and provided density, which in a normal university setting would require more embodied carbon, energy through more envelope, and travel to and from the different functions, as well as more land. Reducing the carbon footprint within city centers not only reduces the amount of energy expended for access to these institutions for the future, it also brings something larger to the city that goes beyond the commercial values of the marketplace.

In a time when buildings are designated as "signature" or "icons," these structures provide something more that is essential for livable cities. They are symbols of the values held by the community for the development of knowledge for the good of the community, the region and the country. An icon refers only to itself. A symbol refers to something abstract which has meaning that connects with the larger community and its aspirations. If predicted metropolitan growth does occur in the "knowledge and creative centers" of a region, then knowledge and creativity must be given legible expression within the metropolitan center. The university can be adapted to the tall building model and become emblems for future planned metropolitan growth. ■