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Diversity and Change in Vertical Urbanism
垂直城市的多样性和变化


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Moshe Tzur在以色列理工大学学习建筑与城市规划并获得建筑学学士学位 (最高荣誉)。在40年的建筑、城市设计和城市规划的实践中，他曾在三十多个国家开展项目。他擅长于大型城市项目和综合体建筑的设计，包括办公楼、高密度住宅和一体化商业、工作和居住环境。他在垂直城市设计方面的卓越创新使得他成为以色列著名的大型城市建筑设计师。

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Abstract

The living city is ideally composed of elements in an ecologically dynamic relationship with the urban environment. Environmental function measured over time constitutes a seminal characteristic of a viable and sustainable urbanism. The tower form, and particularly the residential tower form, must be pre-designed in order to offer a high degree of flexibility and adaptability. Flexibility provides the ability to produce individualized and variable spatial layouts in order to accommodate the individual programs of users. In addition, flexible design can also provide adaptability, or the ability to adapt to spatial, functional and technological changes over time. The predesign of the tower's plan form, structure, core design and envelope design predetermines the ability to achieve flexibility. Through case studies it is demonstrated that the sustainable urban function of the tower must be time sensitive, and can be achieved only through a research-based understanding of the foundations of flexibility in tower design.

Keywords: Flexibility, Variability, Adaptability

摘要

从理想的角度来说，组成一座居住城市的元素能在生态上同城市环境保持动态的关系。随着时间推移所衡量的环境功能构成了一个可行和可持续城市主义的创新特点。楼房形态，尤其是住宅楼的形态都必须预先设计，从而实现更高的灵活性和适应性。灵活性能够提供设计个性化、可变的空间布局能力，从而满足用户的个性化需求。此外，灵活的设计还能提供适应性，换言之，就是能够随着时间的推移适应空间、功能和技术变化的能力。对楼房的平面图、结构、核心设计和外墙设计就预先决定了楼房是否具有灵活性。通过案例研究，本文论证了楼房拥有的可持续的城市功能必须具有时间敏感性，只有通过开展研究，理解关于楼房设计灵活性的基础知识，才能够实现上述目标。

关键词: 灵活性、可变性、适应性

Introduction to the Flexibility of Vertical Urbanism

Flexibility and Sustainability in Vertical Urbanism

Flexibility constitutes one of the main contributors to the sustainability of vertical urbanism. The living urban environment is one that maintains its durability over its natural life cycle. Durability is an attribute measured by many factors such as the maintenance of physical performance in, for example, the performance of structural elements under a time-related variety of loading conditions, or the climatic performance of the environment.

Among the performative constituents of sustainability we can distinguish the maintenance of both physical sustainability (strength, climatic performance) and functional sustainability. Functional performance over time and the ability to continually perform functionally over the life cycle of buildings is a fundamental condition of environmental sustainability.

垂直城市灵活性介绍

垂直城市中的灵活性和可持续性

灵活性是实现垂直建筑可持续性的关键要素之一。一个有活力的城市环境要在其自然生命周期内维系自身的耐久性。而耐久性是一项通过多种因素衡量的属性，衡量因素包括物理性能的维持，例如结构部件在与时间相关的不同负荷条件下的性能，或是环境的气候性能。

在构成可持续性的多个性能要素中，我们可以区分出对物理可持续性 (强度、气候性能) 和功能可持续性的维持。随着时间推移而展现的功能性能和在建筑物整个生命周期内继续发挥功能的能力就是环境可持续性的基础条件。

正如垂直城市对物理性能提出了独特的要求，垂直城市是否也会对功能灵活性提出独特的要求? 这类要求是否可以定义并阐明? 如果可以，这些要求能否在未来建筑物的灵活设计中给我们提供帮助? 我们能否针对在环境方面获得成功的高层建筑设计建立起一套理论? 这些都是本文将要探讨的研究课题。

Does vertical urbanism impose unique requirements upon functional flexibility as it does upon physical performance? Can such requirements be defined and explicated, and if so, can they assist us in the flexible design of future buildings. Can we, in fact establish a theory for the environmentally successful practice of flexible design in tall buildings? These are among the set of research questions that are addressed in this paper.

Does vertical urbanism in its major functional types constitute a special case of flexibility that might enable the establishment of future design principles and methods for flexible vertical urbanism? Once having established the theoretical and taxonomical basis for the research, it is applied in the analytical presentation of four recent projects that have been designed in our practice: two urban residential towers and two office towers. Through this analysis certain paradigmatic strategies of flexibility in vertical urbanism begin to emerge.

Flexibility as Variability and Adaptability: Basic Definitions

Flexibility is a general attribute that defines the ability of the environment to satisfy functional requirements while also providing provision for diversity and change (Kronenberg, R. 2007). This generally also is taken to include the provision of appropriate spatial relationships, circulation requirements and environmental conditioning in a manner that is non-deterministic in the sense that alternative arrangements and functional uses are also possible as well as the potential for change over time.

Flexibility as a general concept thus possesses two generic sub-classes: variability and adaptability. Variability is the ability to provide for design diversity, for example, of apartment types and individual choice of layout and furnishing. Adaptability is the ability to accommodate functional or technological changes over time within the life cycle of the building. Strategies of flexibility in design have two dimensions: space, as the field of functional activity; and the dimension of time as the temporal dimension in which functions evolve, or change over time. In order to rationalize these concepts architects have conventionalized time cycles for various common functions. For example, in residential design: short cycle change is the daily or weekly functional routine; life-cycle change is variation due to the family cycle; long term change are major transformational changes such as those due to changes in spatial or technological norms.

Theoretical Concepts

The history and theory of modern architecture until today is rich in the explication of concepts, methods and forms that are related to architectural flexibility. Concepts such as "open form" and "universal space" are deeply embedded in modernist thought and design practice (Schneider, T. and Till, J. 2007).

Generic space (Leupen, B., et alia, 2005) is perhaps one of the central theoretical concepts that emerged from early European modernism and has continuously evolved to germinate new concepts and forms. Variously termed, the "open plan", "universal space", "equi-potential space", and others, generic space describes the indeterminate planning characteristics of the institutionalized separation of space, supporting structure (supporting planes), building envelope (skin), and light-weight interior partitioning (separating planes) – each of which component can be manipulated in design. Coupled with this independence of the four major elements is the attempt to produce the structure-free general space that establishes a first principle of architectural flexibility.

垂直城市的几个主要类别能否构成灵活性的特别案例，也许能使得我们建立未来灵活垂直城市的设计原理和方法？一旦确立了研究的理论和分类基础，我们就利用这一基础对其我们近期设计的四个项目进行了分析，这四个项目包括两幢城市住宅楼和两幢办公楼。通过分析，关于垂直城市灵活性的一些范例式的策略得以成型。

包含可变性和适应性的灵活性: 基本定义

灵活性是一个一般属性，用于定义环境在满足功能性需求的同时又能提供多样化和变化的能力 (Kronenberg, R. 2007) 。灵活性通常还包括能够提供合适的空间关系、满足通行要求和进行环境调节，灵活性不应具有确定性，也就是说应拥有能够接纳其他安排，实现功能用途，并能够提供随着时间而改变的潜力。

因此，灵活性作为一般概念包括两个子类: 可变性和适应性。可变性指的是能够提供多样化设计 (例如，公寓类型的多样化设计) 和对房间布局以及家具陈设进行个人选择的能力。适应性指的是能够在建筑物的生命周期内随着时间的推移适应功能和技术变化的能力。设计所蕴含的灵活性策略有两个维度: 空间维度指的是功能性活动的场所，而时间维度指的是功能历经时间所产生的演化和改变。为了能够实现这些概念，建筑师们制定了各类通用功能的时间周期。例如，在住宅设计中，短周期变化指的是每日或每周的功能性活动，而生命周期的变化指的是由于家庭周期而发生的变化，长期变化则指的是重大的转型性变化，例如，由于空间或技术规范的变化而发生的变化。

理论性概念

直至今日，现代建筑的历史和理论对与建筑灵活性相关的概念、方法及形式都有丰富的阐释。例如"开放形式"和"通用空间"等概念已经深深地根植于现代主义者的思想和设计实践中 (Schneider, T. and Till, J. 2007)。

类属空间 (Leupen, B., et alia, 2005) 也许是从欧洲早期现代主义中出现的中心理论概念之一，并不断演化，催生了新的概念和形式。类属空间有不同的叫法，例如"开放平面"、"通用空间"、"等位空间"等，类属空间用于描述对空间、支撑结构 (支撑平面) 、外墙结构 (表皮) 和轻型室内分隔墙 (分割平面) 等可以在设计中操作的元素进行分割时存在的平面不确定性。运用这相互独立的四大要素，建筑师们力图建立起不受结构制约的一般空间，而这是确立建筑灵活性的首要原则。

结构主义空间 (Valena, T., ed., 2011) 是建立在分割建筑物主要结构构件的经典理论之上，一方面确保支撑需求得到合理满足，另一方面又能对可变性和适应性进行优化。结构主义空间指的是通过对具有灵活性的"深层结构"进行模数化来实现灵活性的现象。

代谢派空间 (Koolhaas, R. and Olbrist, H.U., 2011) 推动着结构模式向复杂的几何和三维城市形态转变。代谢派空间重新强调了垂直城市以及其对多功能多维度空间的内在要求。这里强调的是类属分割 (原则一) 和支撑结构设计 (原则二) 可以共同运用，创建能够在本质上适应时间推移 (原则四) 的垂直城市 (原则三) 。在这样的情况下，对组成要素的分割方法是全新的，即被分割的元素具有的不是建筑属性，而是城市属性 (楼房、桥梁、居住单元等) 。

从逻辑上来说，垂直城市的下一步定义就是指在平面型态、叠加型态和功能性用途上均是可变的。因此，原则五就将混合建筑纳入垂直城市之中。

Structuralist space (Valena, T., ed., 2011) builds upon the classical distinction of the separation of the major components of architecture in such a way that the requirements of support can be rationalized while also enabling – in fact optimizing – variability and adaptability. Structuralist space is the phenomenon of flexibility achieved through the patterning of a "deep structure" that supports flexibility.

Metabolist space (Koolhaas, R. and Olbrist, H.U., 2011) evolves structural patterning towards complex geometrical and three-dimensional urban forms. This includes a new emphasis upon the vertical city and its intrinsic requirement of multi-functional and multi-dimensional space. The emphasis here is upon the insight that generic separation (principle 1) and the design of supporting structure (principle 2) can be employed together to create vertical urbanism (principle 3) that is intrinsically adaptable over time (principle 4). In this case, the separation of the elements is new; the elements separated are not architectural, but urban (multiple towers, bridges, dwelling cells, etc.).

The next logical step in the definition of vertical urbanism is that it is variable both in plan form, in superposition form, and in functional usage. Thus principle 5 introduces the hybrid into vertical urbanism.

Method, Form and Flexibility

Methods for the Generation of Form and Flexibility

Each of the basic concepts and principles of design flexibility as they have evolved from architecture to vertical urbanism is also characterized by particular approaches to design (see Valens, T., 2011). These design methods also have implications for establishing the relationship between form generation and flexibility creation in vertical urbanism.

Three-dimensional structural patterns are the fundamental basis all of the structured design practices that have been presented in the previous section. These architectural patterns are generally created as a "deep structure", or three-dimensional pattern. The pattern of the deep structure can be can be created by a two or three-dimensional diagrammatic pattern such as stripes or a cellular diagram, or by a three-dimensional operation such as twisting.

The pattern of the deep structure can be represented graphically or in a physical model as an underlying and generic structure. This representation can function as a medium of design. Zoning structures employed to generate plan types are one of the well-known graphical design media in flexible housing design (Schneider, T. and Till, J, 2007).

Representation, Form Generation, Flexibility

The graphical representation of zones is both a formal (generative) medium and a functional (notational) system. In the work of Habraken and the SAR (Habraken, et alia, 1974) it is also a medium of flexible design and adaptable housing. The graphical diagram distinguishes between plan zones of function (zones) and zones of flexibility (margins). This graphical method has frequently been applied in urban design and in the creation of a system of flexible housing for vertical urbanism. In two of the case studies described below, it is demonstrated how zoning has been exploited as a medium of flexibility in vertical urbanism.

Generative design in computation may be considered an analogy to the graphical representational methods that we have described. Generative design exploits rule-based design in the algorithmic operations of form creation. Such algorithmic practices can be most effectively applied to create spatial and structural orders as described

方法、形态和灵活性

生成形态和灵活性的方法

设计灵活性的基本概念和原则在从建筑学向着垂直城市演化的过程中也具备了特定的设计方法的特征 (Valens, T., 2011) 。这些设计方法对在垂直城市中建立形态生成和灵活性创造之间的关系产生了影响。

三维的结构模式是本文前述的所有结构化设计实践的基础。这些建筑模式通常都以所谓的"深层结构"或三维模式所建立。深层结构模式可以通过二维或三维的图表所建立，例如条纹、单元图，或者对三维结构进行扭转之类的操作。

深层结构的模式可以通过图形进行展示，或者通过实体模型进行展示，例如底层结构和一般结构。这种展示就可以成为设计的工具。用于制定平面类型的分区结构也是在灵活性房屋设计领域中众所周知的图形设计工具之一 (Schneider, T. and Till, J, 2007) 。

展示、形态生成和灵活性

分区图示既是一种正式的 (生成性) 工具，也是一种功能 (名义的) 系统。在Haabraken的作品中和SAR理论中 (Habraken, et alia, 1974) ，图示也是展示灵活设计和可适应房屋的媒介，这种示意图可以用以区分功能平面区 (区域) 和灵活区 (边缘) ，这种图形方法经常被应用于城市设计和为垂直城市创建灵活房屋系统的过程中。下述的两个案例研究展示了如何利用分区作为垂直城市的灵活性的媒介。

计算机生成设计可以用于比喻我们之前所描述的图示法。生成设计在运用算法生成形态时利用了基于规则的设计。这些算法实践可以最有效地应用于空间和结构秩序的建立，也就是前述的结构主义范式。参数化设计是一项具有潜力的新兴技术，用于试验生成化的结构主义设计。在下述案例研究中展示了一个利用电脑生成的"扭曲"的结构，该结构呈现出楼层平面的多样性以及其他各类的灵活性。

这一扭曲的结构被应用在一个正在进行中设计项目上，这是位于特拉维夫一幢新办公楼的设计项目。这也是我们目前正在进行的研究的一部分，即研究建立类型的先例、电脑形态生成的新潜力和在垂直结构中实现灵活性这三者之间的关系。

可适应住宅: 能够实现灵活居住的多户住宅结构的原型

适应和改变的权利

适应指的是环境拥有能够随着时间变化适应功能变化的能力。构建动态的环境很久以来都被列为现代建筑的重要目标之一。但是处于多住户的住宅楼里，灵活性和可适应性就成为基本而关键的设计问题。随着时间推移的适应性就是能够在家庭周期内适应变化，从而应对长期和短期的变化。

将多户住宅设计为居住的机器

这个项目通过空间改造，实现功能上的适应。例如，这一住所经过改造，可以为一对夫妇、一对夫妇加一个孩子、一对夫妇加两个孩子、一对夫妇加一个孩子和一个孙子女等家庭结构提供居住场所。应用包括空间和技术在内的多种策略以实现适度的适应性。由于变化变得更加频繁，技术相比于空间就成为更加重要的适应工具。

空间结构和适应技术

为了确保这一流程的有效进行，功能分区的空间结构只需要进行模糊的分割，为通过可移动板材技术实现分割留下可能性。Be'eri Nehardea大楼 (图1) 具有不规则的外形从而优化了各个方向上的观景视野。不规则的垂直结构向外延伸 (覆盖更多的外部区域，

above as structuralist paradigms. Parametric design is an emerging technique of promise for employing generative structuralist design generation experimentally. In the case studies below one example of the computational generation of a "twisting" structure is demonstrated that generates floor plate diversity as well as other classes of flexibility.

The twisting structure has been applied in an ongoing design project for a new office building in Tel Aviv. It is part of our ongoing research into the relationship between building type precedents, the new potential of computational form generation and the achievement of flexibility in vertical urbanism.

The Adaptable Dwelling: Prototype for Flexible Living in Multi-Family Structures: Be'eri Nehardea Tower, Tel Aviv

Adaptation and the Right to Change

Adaptation is the ability of an environment to adapt to programmatic change over time. The dynamic environment has long been one of the important objectives of modern architecture. It is within the dwelling in the multi-family housing block that flexibility and adaptability become an essential and critical design problem. The provision of adaptability over time is the means to adapt to changes in the family cycle in response to both long-term and short-term changes.

The Design of Multi-family Housing as a Machine for Living

This project provides for adaptation in functional accommodation through spatial transformation. For example, the dwelling can be transformed to provide for a couple; for a couple and one child; for a couple and two children; for a couple with one child and one grandchild, etc. Various strategies, both spatial and technical can be applied in order to achieve appropriate degrees of adaptability. As the time-scale of change becomes more frequent, there is a priority of technique over space as a medium of adaptability.

Spatial Structure and Technologies of Adaptation

In order for this process to work, the spatial structure of zones must provide an ambiguity of subdivision that can be activated by the technology of the moving panels. The Be'eri Nehardea Tower (Figure 1) has an irregular contour that optimizes views in all directions. The irregular vertical section expands in area (adding additional external zones, margins) to maximize the adaptability of the interior floor plans. In this case, the irregularity (in both plan and section) of the tower also provides a high degree of variability of dwelling types.

The Dynamic Machine as a System

The dwelling finishes and details have been designed as a system of panels in order to accommodate the moveable elements within a total environmental system. Be'eri Nehardea combines the two design traditions of structured space and metabolist space. It provides for adaptability of the plan to accommodate short-term functional changes (Figures 2 & 3). This is one of our first steps towards a program of adaptable dwellings within Israeli high-rise housing.

Figure 1. Be'eri Nehardea Tower Tel Aviv (Source: Amit Geron, Photographer)
图一. 特拉维夫市的Be'eri Nehardea大楼 (来源: Amit Geron，摄影师)

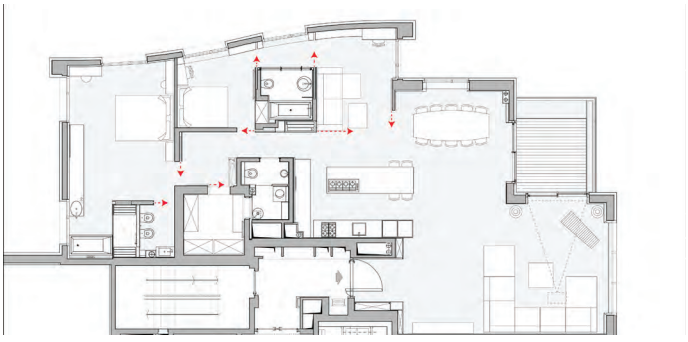


Figure 2. Apartment Adaptability Options (Source: Moshe Zur Architects & Urbanists)
图2. 公寓适应性选择 (来源: 建筑师与城市规划专家Moshe Zur)

Figure 3. Plan Adaptation and Program Change (Source: Moshe Zur Architects & Urbanists)
图3. 平面的适应性与功能变化 (来源: 建筑师与城市规划专家Moshe Zur)

The Design of the Internal Core and the Provision of Variability and Adaptability Through the Zone of Transition: Remez 6 Tower, Tel Aviv

The Flexibility of the U-Zone of Functional Space

Remez 6 Tower (Figure 4) is a unique residential tower due to its location in the city of Tel Aviv and to its plan orientation to the dominant direction of the sea view. The tower has a plan form that locates the building core opposite the main view side, creating a U-Shaped zone of flexibility. The structural spans are from the internal core to the external envelope. There is no internal structure and the function zone is essentially a zone of open space with complete planning flexibility.

Remez 6 Tower is also unique in that all floors are essentially single-ownership flexible lots. Subdivision of these lots are then within the province of the family. This flexibility of subdivision has resulted in each floor being different in plan organization. The dominant condition is subdivision into two apartments, one large and one smaller. However, there is a great variety of plans that are possible within the underlying structure of the plan. Enhancing this flexibility is the design of the zone of transition (the elevator lobby) that enables variety in the public/private partition location, the point of entrance (s) and the flexible subdivision of the plan into several dwellings.

Flexibility of the Core Design: Transitions From Public to Private Space

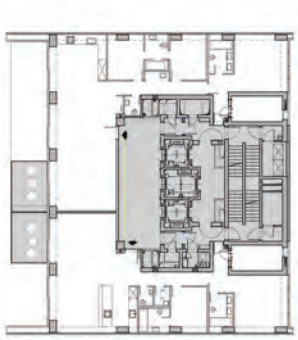
The asymmetrical layout of the tower core provides multiple possibilities of circulation to a variety of potential entrance points. Essentially there are two access spaces on opposite sides of the elevator cores: public access and service access. This creates a ring of access space around the elevators that provides for multiple entrance possibilities.

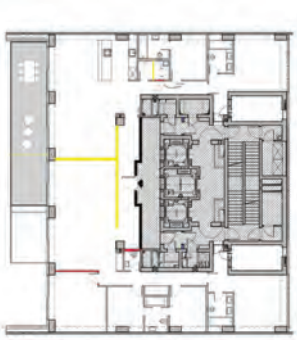
Given this level of access flexibility, the public lobby is, in effect, a potential part of the floor plan of the dwelling(s). It is a flexible zone of transition that can be internal private space or external, semi-public space. As a consequence of this degree of open planning this zone of transition has enabled a wide variety of plan applications throughout the tower.

The systematic planning method of the Remez 6 Tower has introduced a high level of variability in design due to its introduction of a design principle of flexible zoning. The zoning system provides a free zone of open, structure-free planning. In addition the core design provides flexibility of access points in such a way that the lot can be subdivided freely by the family into multiple separate dwelling plans. Furthermore, the provision of a transitional internal zone of public or private usage contributes to a high level of variability/adaptability of the plans over various time cycles.

The illustrations (Figures 5 & 6) represent the diagram of core and field layout at the Remez 6 Tower. Flexible access is represented by multiple arrows and the zone of transition (elevator lobby) is also identified. A support structure is not merely a skeleton, but a uniquely zoned organization of polyvalent space. Remez 6 proves this design proposition regarding the ability to design for flexibility through the application of well-structured space.

Figure 4. Remez 6 Tower (Source: Yael Engelhart, Photographer)
图4. Remez 6大楼 (来源: Yael Engelhart，摄影师)





Figures 5 and 6. Subdivision and Alternate of Plan at Zone of Transition (Lobby) (Source: Moshe Zur Architects & Urbanists)
图5与6. 过渡区的平面细分 (大厅) (来源: 建筑师与城市规划专家Moshe Zur)

即边缘)，从而尽可能提升内部平面的适应性。在这个案例中，大楼在平面和截面上的不规则性能够为户型的多样化提供更高的自由度。

作为系统存在的动态机器

住宅的表面装饰和细节被设计成一套面板系统，从而能够容纳在一个整体环境中的移动构件里。Be'eri Nehardea融合了结构化空间和代谢派空间的两大设计传统，实现平面的适应性，适应短期的功能变化 (图2和图3) 。这是我们为了实施以色列适应性高层住宅项目而迈出的第一步。

内部核心设计和通过过渡区实现可变性和适应性: 特拉维夫REMEZ 6大楼

功能性空间中U字区的灵活性

Remez 6大楼 (图4) 是一幢独特的住宅楼，这是因其座落于特拉维夫并面朝大海。大楼的平面图将大楼的核心部分放在主要景色的对面，创建了一块U字型的灵活区域。这一结构从内部核心筒伸展至外墙。大楼不存在内部结构，而功能区本质上就是一块开放的空间，能够在平面上实现完全的灵活性。

Remez 6大楼之所以独特，也是因其所有的楼层都是灵活的区域，且所有权单一。对这些区域如何进一步划分完全由持有家庭决定。因为能够灵活地进一步划分，因此每一层楼的平面都不一样。大部分的设计都将这块区域划分为两套公寓，一套大一套小。但是在平面的底层结构范围之内，每一楼层的平面设计都有

The Flexibility of the Dynamic Envelope: Sarona Tower, Tel Aviv (Joint Design with Architect David Azrieli)

Dynamic Diversity

The Sarona Tower development includes an office building rising from a mixed-use base (Figure 7). The tower is composed of two masses. At the base, these masses are aligned according to the existing street pattern. The masses twist as they rise in order to provide each office floor with differing orientations to urban views and multiple visual orientations (Figure 8).

Sarona's floor plans are relatively structure-free and provide both for open plan offices as well as partitioned offices in a variety of layouts. The twisted movement of the tower provides a unique floor plate geometry for each floor, granting a distinctive character to the various floors (Figure 9). With respect to office building design, the geometric medium has been established as a source of variety and distinction, both of which are attributes for commercial functions. Furthermore, the twisted tower, itself, provides an iconic image that creates a visual foundation for branding.

Tower Clusters and Interstitial Zones: The Bridge Floors of Ha'arbaa Towers

Clusters, Bridges and Hybridization of the Office Tower

Ha'Arbaa Towers are a pair of office towers located at the terminus of an urban plaza (Figure 10). The tower's composition includes shifting overlapping masses every several floors. This device creates rooftop balconies along the tower's height. The tower cluster also provides opportunities for upper-level bridge connections (Figure 11). These connectors occur at locations in which other unique urban functions (restaurants, galleries, etc.) can be integrated within the tower (Figure 12).

This approach to the structuring of flexibility though interstitial space provides a unique potential approach to hybrid vertical urbanism deriving from geometric patterns of dual, or multiple structures.

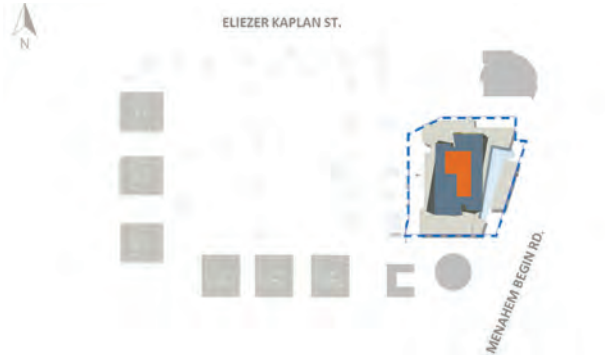


Figure 7. Sarona Tower: Shifted Geometry in the Urban Context (Source: Moshe Zur Architects & Urbanists/with Architect David Azrieli)
图7. Sarona大楼: 城市背景中的体量旋转 (来源: 建筑师与城市规划专家Moshe Zur及建筑师David Azrieli)

Figure 8. Sarona Tower in the Urban Context (Source: Model by Luxigon, Paris)
图8. 城市背景下的Sarona大楼 (来源: 巴黎Luxigon建模渲染)

Figure 9. Sarona Tower: The Floor Plan Evolves Geometrically (Source: Moshe Zur Architects Urbanists /with Architect David Azrieli)
图9. Sarona大楼: 平面根据几何形体变化 (来源: 建筑师与城市规划专家Moshe Zur及建筑师David Azrieli)

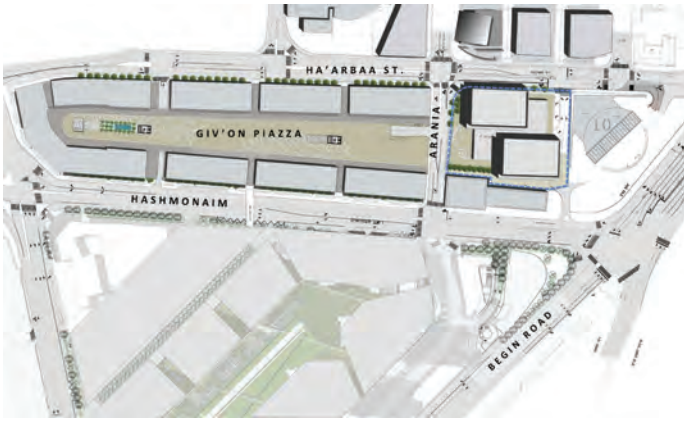


Figure 10. Urban Situation of Ha'Arba'a Towers (Source: Moshe Zur Architects Urbanists)
图10. Ha'Arba'a大楼周围城市肌理 (来源: 建筑师与城市规划专家Moshe Zur)

很多可能性。要提升这样的灵活性，就需要设计过渡区 (候梯厅)，实现多样的公共/私人区域划分、多种可能的入口点以及能够将平面灵活地分割为几套住宅。

核心筒设计的灵活性: 从公共空间到私人空间的过渡

大楼核心筒区域的不规则布局提供了多种可能的流线，以及各种可能的入口点。本质上在电梯核芯筒对面有两个入口空间: 公共入口和服务入口。这创建了一个围绕电梯的环型入口空间并提供了多个入口的可能性。

基于入口选择的灵活性，公共大厅事实上就有可能成为户型平面的一部分。这一灵活的过渡区域可以是内部私密空间，也可以是外部半公共空间。得益于这种开放式的布局，该过渡区能够使得整幢大楼从上到下获得不同的平面排布方式。

因为遵循了灵活分区的设计原则，Remez 6大楼的系统性平面规划方法将高度的可变性融入设计中。分区系统建立了一块开放、无结构的自由空间。除此之外，核心筒设计还实现了入口的灵活性，使得持有家庭可以随心所欲地将整块区域进一步分割为多个独立的户型平面。另外，因为划出了一块供内部和外部使用的过渡区，进一步提升了大楼平面在不同时间周期内的可变性和适应性。

如图 (图5和图6) 展示了Remez 6大楼核心筒示意图和基地规划图。灵活的入口用多个箭头表示，过渡区 (候梯厅) 也被标识出来。支撑结构不仅仅只是建筑骨架，同时也对多个空间进行了独特的分割。Remez 6大楼证明了关于通过结构合理的空间实现设计灵活性的设计主张。

Figure 11. Ha'Arba'a Towers: Study of Multiple Skybridges at Sky Lobby Floors (Source: Moshe Zur Architects & Urbanists)
图11. Ha'Arba'a 大楼: 空中大厅楼层的多天桥研究 (来源: 建筑师与城市规划专家Moshe Zur)

Figure 12. Ha'Arba'a Towers :Plan of Skybridge ((Source: Moshe Zur Architects & Urbanists and Armani Casa)
图12. Ha'Arba'a 大楼: 天桥平面 (来源: 建筑师与城市规划专家Moshe Zur与Armani Casa)

Future Research on the Flexibility of Vertical Urbanism

A Theory of Form, Structure and Flexibility

The four classes of flexibility that have been identified and explored represent four scales of flexibility design from the micro to the macro. These "levels of flexibility" that have been illustrated are:

- Basic Unit Form and Zoning: variability and adaptability in dwelling or office design;
- Floor Plate Form and Zoning: core design and functional space relationship creates an intermediate zone of flexibility;
- Tower Morphology: building design and floor plate relationships as a source of variability;
- Multiple Tower Morphology: skybridges in tower clusters as a macro medium for functional flexibility and hybrid towers.

While these four levels of flexibility in vertical urbanism have been presented in four separate case studies, they obviously can co-exist in one work of vertical urbanism. Furthermore, it appears that based upon the research-based work of our office on the subject of form generation and flexible design in vertical urbanism, these generalizations regarding strategies can apply to both housing and office design. Certainly, the interaction of "levels" of design can provide an operational model for design as well as a theoretical model for design research.

动态外墙的灵活性: 特拉维夫的Sarona大楼 (同建筑师David Azrieli共同设计的作品)

动态多样性

Sarona 大楼的开发包括在多用途底楼之上盖一幢办公楼 (图7) 。大楼由两个体块组成，底楼在位置上跟现有街道对齐，体块上升的同时也在扭转，为每个办公层提供不同角度的城市景观和多种视觉方位 (图8) 。

Sarona的平面布局相对而言不受结构限制，既可以设计成开放的办公室，也可以按照多种布局对办公室进行分割。大楼的扭转能够为每一层楼都提供独特的地板几何形状，给不同的楼层赋予不同的特征 (图9) 。就办公楼的设计而言，几何图形被应用以呈现多样性和独特性，这两者都是商业功能的特征。此外，扭转的大楼本身就有一个标志性的外形，能够在视觉效果方面为品牌建设打下良好基础。

楼群和间隙区: Ha'Arbaa 大楼的连接桥面

办公楼楼群，桥梁和两者的结合

Ha'Arbaa大楼是双子楼，坐落于一片城市广场的中心 (图10) ，这座大楼的构架是每隔几层楼，体块会稍作移动，保持一部分重叠，这种设计沿着大楼外墙向上开辟了多个屋顶阳台。这一楼群还为设计高层的连接桥梁提供了可能性 (图11) 。连接桥梁可以设独特的城市功能 (餐厅、美术馆等) 来与大楼进行整合 (图12) 。

这种通过间隔空间实现结构灵活性的方法能够提供了一种独特的潜在方法，实现从双结构或多结构的几何模式到混合功能的垂直城市的转变。

垂直城市灵活性的未来研究

形态、结构和灵活性的理论

已经被定义和研究过的灵活性的四个类别代表了从微观到宏观的灵活性设计的四个尺度，已经阐述过的"灵活性"包括:

- 基本单元形态和分区: 住宅和办公楼设计的可变性和适应性;
- 建筑平面形态和分区: 核心筒设计和功能区关系创建灵活性的过渡区;
- 塔楼形态: 建筑设计和楼层之间的关系成为可变性的来源;
- 楼群形态: 楼群中的空中桥梁可视为功能灵活性和混合式塔楼的宏观媒介。

尽管我们通过独立的案例展示了垂直城市中灵活性的四个层次，但这四个层次可以在垂直城市中的一幢建筑物中共存。此外，根据我们事务所对垂直城市形态生成和灵活设计进行的研究，这些通用的策略可以应用在住房和办公楼的设计中。当然，这四个设计层面之间的互动也能够为设计提供可操作的模型，为设计研究提供理论模型。

层次这一个概念也为垂直城市象征主义的建立提供了方法，在Ha'Arba'ad大楼的案例研究中，存在着第五个设计层次: 也就是"垂直多层单元"或者说是楼层集群。这在塔楼的结构设计中是一个长期存在的重要设计理念。垂直多层单元的概念也为研究"混合式塔楼"或"混合式楼群"提供了新的方向。

The concept of levels also provides a method of creating a typology of vertical urbanism. In the case study of Ha'Arba'a Towers there also exists a fifth design level: that of the "vertical multi-floor unit", or the cluster of floors in section. This has long been an important design concept in the structural design of towers. The concept of the vertical multi-floor unit also offers new potential for research on "hybrid towers" or "hybrid tower clusters".

The idea of the morphology of vertical urbanism provides a research-based orientation to design that can be a productive medium for approaching the complex set of research questions related to sustainability. This constitutes our first steps towards research-based design as a model for the collective establishment of an institutional orientation for CTBUH research initiatives. The identification of key issues such as theories and methods of flexible design appears to us to be an essential condition towards a collective research agenda.

垂直城市形态学的理念为设计提供了基于研究的视角，这种视角可以成为帮助我们有效地解决有关可持续性的一系列复杂的研究问题的媒介。我们致力于利用基于研究的设计模型帮助CTBUH的研究计划建立起机构性的导向，我们以上的研究就是我们朝着这个目标迈进的第一步。在我们看来，建立灵活设计的理论和方法是实现共同研究的必要条件。

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