NOTES ON OPEN BUILDING

Stephen Kendall / Philadelphia / November 2016

(With thanks to John Habraken, Frank Bijdendijk and many others for their numerous contributions to the content of these notes)

BASE BUILDINGS AS A NEW KIND OF INFRASTRUCTURE

A significant literature exists addressing infrastructure, such as road networks, water, sewer, electricity and communications networks. All serve multiple users and frame conditions for use. In such large capital assets, whose design and use stretch over large territories and over long periods of time, it is entirely normal that decisions are hierarchically organized and distributed (higher level decisions frame lower level decisions, but lower levels have a measured freedom within those constraints). No single design team is responsible for the entire infrastructure system, initially and certainly not over time.

In large buildings, we see a tendency to separate a “base building” from its’ “fit-out.” This is also called “core and shell” and “tenant work.” Whatever the words used, the distinction is increasingly conventional around the world, and is mirrored in real property and building industry practices, methods and incentive systems. Witness shopping centers and office buildings as prime examples. Now we see healthcare facilities and housing adopting this infrastructure model. This way of investing in built infrastructure already constitutes a substantial market, which in turn has given rise to increasingly profitable and well-organized supply chains serving the demands for tenant fit-out. Both base buildings and fit-out include investors, finance companies, product manufacturers, design and engineering firms, construction companies, and a host of others.

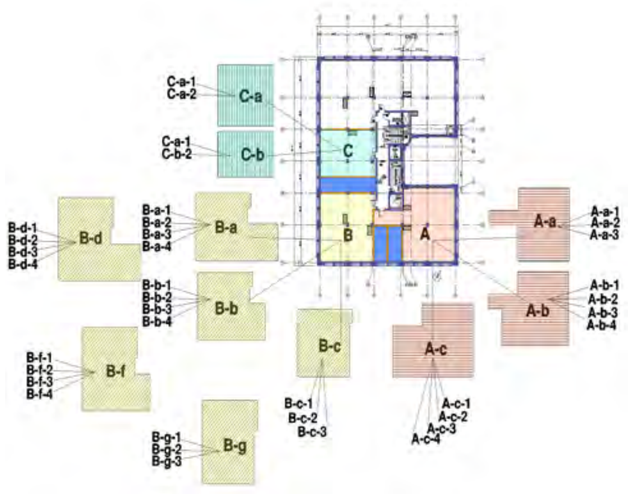
This is happening because of a convergence of three dominant characteristics of contemporary built environment. First is the increasing size of building projects, sometimes serving thousands of people. Second is the dynamics of society, where use is increasingly varied and changing. Third is the availability of and demand for an increasing array of equipment and subsystems. In this new reality, it makes no sense to simultaneously decide on both the base building and the fit-out, because the user-level – the fit-out - will inevitably change. Social trends toward individualization of use make functional specification increasingly personalized. Greater complexity and variety of the workplace demands adaptation by the use of architectural components with shorter use-life, such as partitioning, ceilings, bathroom and kitchen facilities, specialized equipment and so on.

The separation of base building and fit-out includes utility systems as well. Adaptable piping and wiring systems on the fit-out level, for example, connect to their counterpart and more fixed main lines in the base building, which themselves connect to the higher level infrastructure serving the entire city. In this reality, we see a significant contrast between what is decided on the user level, and what is decided for the long-term investment and functionality of the building. This distinction is not strictly technical, but is better understood as happening on “levels of intervention” as is always the case when we compare infrastructure with what it is serving. In the case of buildings, the comparison has multiple dimensions, including:

BASE BUILDING	FIT-OUT
Longer-term use	Shorter-term use
Shared-service related design	User-related design
Heavy construction	Lightweight components
Long-term investment and financing	Short-term investment and financing
Equivalent to real estate asset	Equivalent to durable consumer goods

Release of the tension between conflicting demands on the small and the large-scale is the most important aspect of this trend. As is usually the case, release of tension makes for new energies and innovation. While new economic and regulatory frameworks are needed, the emergence of the base building as infrastructure is already pointing to several new developments. One is the emergence of a distinct fit-out industry, already visible for office and retail facilities, but now emerging for residential and healthcare assets. Another is making net-zero buildings easier to build, because fit-out components – those that consume energy and are particularly related to eco-effects - can be separated and clearly aligned with individual responsibility.

The emergence of the base building as infrastructure invites clear recognition and active development. The resulting impacts on real estate and architecture will – or can be – significant. But the problems we face in working with this trend to produce high-quality results are not trivial. We need reorientation of professional attitudes and methods, and changes to accounting and management. The time may therefore have come to establish a more explicit platform for study and development of what seems to have come not as a new design idea, but as a new reality to be taken seriously.



CAPACITY – A BASIC OPEN BUILDING CONCEPT

CAPACITY means that something can accommodate something else, often an unknown something. In architectural terms, a building that offers capacity will have a "higher level" configuration of spaces and physical forms that can accommodate a variety of configurations on a "lower level." That means that the configuration on the lower level can change without forcing change on the higher level, but a change on the higher level will force an adjustment to the lower level. This is the principle of infrastructure design.

Sometimes the word FLEXIBILITY is used to describe this idea. But that word does not give the right image when we are talking about inhabited built form. If our goal is a resilient and sustainable building stock that retains long-term asset value, we have to recognize that buildings of all kinds change, part-by-part, some faster than others. Open Building experts like to use the word CAPACITY to explain this. This suggests openness to variety and change, within constraints, understanding that the future cannot be predicted. The challenge we face is that while we should not try to predict the future, we nevertheless have the responsibility to make provision for what we cannot foresee.

In Open Building, the "whole" of a building is divided into two or three levels of decision-making. I say "decision-making" because the idea of capacity is that decisions about changeable parts should not drive (but can influence) decisions about long-lasting parts. Those making decisions about a container with good capacity will design it so that those (others) making decisions about what goes inside have good choices, not only one good choice and several not-so-good choices. There are conventional names for these decision-making levels:

• The higher level is often called the **BASE BUILDING, CORE & SHELL or PRIMARY SYSTEM**. This is the long lasting part – the structure, public circulation system, dedicated spaces for common mechanical systems to be deployed, the façade, and so on. This part should last 100 years.
• The lower level is the **FIT-OUT, INFILL or SECONDARY SYSTEM**. This includes the more changeable parts, which can change without forcing a change to the Base Building. This includes layout of spaces, designation of functional groupings, mechanical systems required to support (changing) occupant requirements, and so on. This part can last variously, from 10 to 30 years and is sometimes related to a generation of users.
• In many cases, a third or lower level is useful to describe the decisions concerning fixtures, equipment and various finishes. This is often called **FF&E**, at least in the commercial market. This is the bundle of decisions that is in many respects independent of the FIT-OUT. This allows upgrading without difficulty of the parts that are most closely related to daily living, like electrical appliances and furniture. This level is especially important in buildings expected to accommodate hospital or laboratory uses or other equipment-intensive uses, but is also a reality in office buildings, retail stores and houses. This is the world of IKEA, for example.

In general, OPEN BUILDING organizes design decisions on these "levels" of decision-making. They correspond to conventional distribution of responsibilities in real estate development and management – it is therefore not new at all. A building owner may be in control of the Base Building, while individual office tenants or dwelling unit occupants may each control their own FIT-OUT and FF&E, designed by their own designers, who are usually different from the design team of the base building, and installed by firms often different from the contractor building the base building.

Of course some parts of base buildings can change without causing disruption of other parts. For example in some building construction, the façade or building skin can be removed and replaced without effecting the skeleton. But often, changing the façade requires altering the room layouts because partitions meet the façade in certain places and form a dependency relation. In other building designs, the façade is structural and only the windows in the façade can change. A big question is whether the party occupying space behind the façade can control "their" part of the façade. This is normal on the ground level of commercial buildings worldwide, but what about on upper floors? There are other examples, but these may make the point clear. These decisions are both cultural and technical in nature.

An OPEN BUILDING, therefore, is one in which the FIT-OUT cannot determine the BASE BUILDING, but one in which the BASE BUILDING is prepared to accommodate a variety of changing FIT-OUT over time.

REACTIVATING THE BUILDING STOCK

A number of years ago, the American Institute of Architects published a report indicating that a substantial % of architectural commissions in the future would involve renovation, remodeling and additions to existing structures. Similarly, a US Census report indicated that in most years for the last decade or two, as much money was invested on renovation and remodeling as was invested in new construction. I have heard that the same is true in most European countries as well as in Japan. The tipping point in Japan came around 1990. Then, in 2008, the Japanese legislature passed a law providing incentives to developers to build 200-year housing, and tens of thousands of units have been built under this law.

China expects to turn a similar corner in a few decades, after an unprecedented spurt of new construction, demolition of obsolete buildings, and replacement with new buildings over the past fifty years. But the "scrap and build" economy there will not last forever, as a number of government reports make clear.

Statistics are hard to obtain about how investments in remodeling and renovation are made. For example, no municipality collects statistics on the number of building permits granted for "infill" renovation. Instead, they collect data on permits by trade, in which it is impossible to determine which of the work is infill work and which is work on the base building.

Frank Bijdendijk, former director of the not-for-profit housing corporation Stadgenoot (Citizen) in Amsterdam, recently argued in a keynote lecture for the Open Building conference in Zürich in 2015 that the renovation of the individual dwelling unit is a necessary condition for a sustainable living environment. He said "…the existing built environment is both socially and economically important. The key for value preservation socially as well as economically lies in the sustainable use of that stock. People make buildings for people. Real estate in use has value; unused real estate is worthless." He also discussed four barriers to progress in achieving a sustainable process of building stock reactivation, as follows:

"Firstly, we have to look at the ownership rights in real estate. *This is based on the principle that everything above and below a piece of land and that associated with it is the property of the landowner. Within real estate practice this also applies to everything attached to it. So at first glance it might seem that it is difficult to reconcile full ownership over the infill of the user. We could determine juridical constructions that solve this problem in part. But for an adequate and universally usable legal separation of ownership of base building and infill, many legislative changes are necessary."*

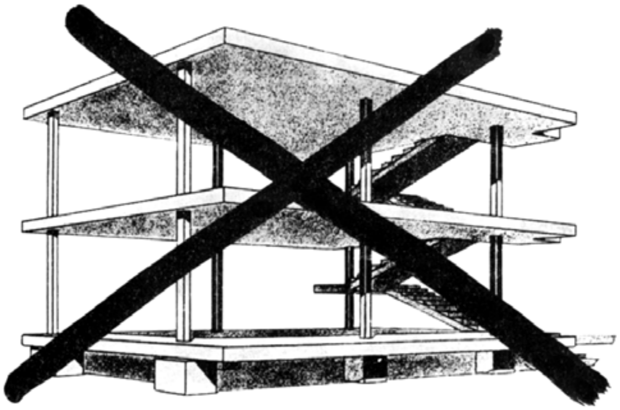
"Secondly, we have to consider environmental law (or regional planning). *This gives local Government the ability to determine land use. An exhaustive list of permitted uses can therefore stand in the way of allowing a much-needed use for the land in question. It would be better to have a list of things that are* ***not*** *possible so that there is unlimited space for everything else. That is much wiser in a dynamic society, in which no one knows what will happen or what the requirements are in the market."*

"Thirdly, we have to consider the building codes and regulations. *One of the most pressing questions that may arise from the application of building regulations is what are the standards that apply to renovations? Are they the same standards applied new construction or are they the same standards that prevailed in the initial development of the real estate? The latter seems more reasonable than the first. Because existing buildings undergoing renovation or transformation having to adopt new build standards are often unenforceable.*

"A fourth category of regulations that we have to consider are shaped by the legislation that covers gas, water, electricity as well as the connection requirements of utility companies. *The legislation and connection requirements give the utility companies a kind of monopoly position. And there might be significant complications making this very costly in terms of user-flexibility*."

"The degree to which all of these regulations work prohibitively is not only an objective truth as a direct result of the content of the rules themselves, but also depends to a large extent, on the smoothness with which they are applied. And that is a subjective truth. Because it is also evident within the current legislation, regulations and local ordinances that a lot is possible with good will. But if this good will is lacking, there are countless opportunities to greatly reduce user-flexibility. Even on that point there is still a lot to do. On the one hand we need to work on raising awareness on the enforcement of regulations, on the other hand we have to work hard to be convincing and to put forward convincing arguments."

These challenges, being faced in every country, point to the urgent need for international exchange of experience.



(From Habraken, John. 3R's for Housing)

RESISTING THE TEMPTATION TO MAKE EMPTY BASE BUILDINGS

How can architects learn to resist the temptation to make empty, column free and neutral base buildings, thinking that this is what open building (or flexibility) is all about?

Not unrelated is the question of how can we help develop an understanding about which architectural form (and systems) to FIX, and which form (and systems) to LEAVE OPEN FOR VARIATION as part of infill decisions made by others, and changing over time?

Here we face a difficult reality. Architects have been taught to prefer no constraints, thinking that this gives them freedom. We have failed to teach an understanding that constraints stimulate creativity and imagination. Experience in teaching students in many countries for 35 years has shown me that students think that an empty space without columns or walls is attractive to users. The fact is that students everywhere like empty space, because they believe it gives them more freedom to do what they like! Practicing architects frequently express the same wish.

We have consistently operated on the assumption that floor plans are essential to designing. We develop a "brief" or "program of functions," with required areas and equipment per space, and expect this to lead to a building design. Most know instinctively that this is a false premise, and is especially wrong for buildings that will undergo change.

The second reality is that in large, fast-moving projects, the base building architect does not design the infill. Design responsibility is distributed initially, and over time. And in other project types, such as multifamily residential buildings, clients constantly change their minds, making design difficult when floor plans are accepted as drivers of architectural decisions.

In designing resilient base buildings, it makes a great deal of sense to offer strong form and structure (not neutral column free space) that offer opportunities for varied and changing inhabitation. This is important and possible, because patterns of use (function) are not infinitely variable and because change is not easy or devoid of challenges. Changing something in the built environment takes time, resources, energy and very often agreement among various agencies, neighbors, and others. We need form that enables change, but that at the same time establishes architectural character and solidity.

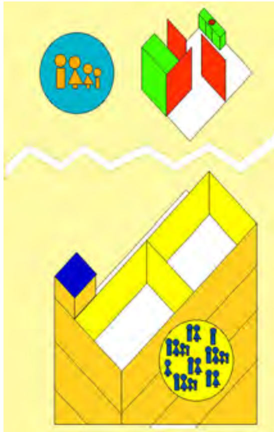
It is clear that the problem lies in what we have failed to teach and honor in our recognition of excellence in practice. We have failed to introduce students to a study of types, believing erroneously that architects invent types. It is true that over time, entirely new typologies emerge. But it is also true that we (architects) don't invent them. They emerge out of social consensus and take time to take root and become familiar, at which time, many variations of a "new" type appear without fanfare.

Types have certain spatial principles while each instance of that type differs, no two being exact copies. A given type can be realized in different material systems and in different "styles." We are talking about positive space/form structure, not functional distribution.

How, then, do we know what form/space structure to offer in the design of base buildings? Types that have endured for generations, or even centuries, are good examples of buildings with strong spatial structure that become rooted in a local culture. There are examples all over the world. Studying them offers excellent examples to borrow from in our teaching and practice.

Absence of such knowledge among architects is equivalent to a doctor not knowing the way the human body works. We would never want to go to such a doctor. So if we want to contribute to the quality of the built environment, we need to know how it works, not only how we WANT it to be.

Even if a building will have a future including housing, offices, a school, medical facilities or a hotel, it is not necessary to make column-free empty buildings. Here, too, a clear spatial structure with roots in the local climate and culture helps everyone find space for inhabitation and use. Again, study of long-lasting buildings under conditions of change gives important lessons.



DWELLING UNIT AUTONOMY

(Images courtesy of John Habraken)

Years ago, Christopher Alexander wrote an essay in which he used the phrase "autonomy-withdrawal syndrome" to characterize what he observed to be a dystopian tendency in suburban neighborhoods for people to withdraw behind their front doors, separating themselves from community life. He put forward environmental design ideas that he called "patterns" to overcome this withdrawal. He wished to find the delicate balance between privacy and community. Later, I read John Habraken's work and found another insight into the way dwelling environments take form and transform over time, and a similar recognition that healthy and sustainable built environment was always the result of a nuanced balance of actions by individuals and communities.

I think it is fair to say that experts in producing and managing built environment and laypeople alike have no difficulties, everywhere in the world, in understanding the concept of dwelling unit autonomy, even if they do not use those words. The image of the freestanding house (the image on the left) comes to mind as the most familiar example of this. This means simply that a dwelling – under the control of a single household - can be made or changed or removed without disturbing its neighbors, while remaining connected to and dependent on the public sphere (streets, parks, public utilities), that is, interacting with minimal friction with what is shared with neighbors and paid for by everyone using this shared infrastructure. But in this case, autonomy does not mean withdrawal.

The single-family dwelling remains the most familiar and sought-after of all dwelling types, because it offers the most unencumbered autonomy. This can take the form of the detached dwelling (behind walls or set in a garden without walls), the row/terrace/townhouse, or the courtyard house. Certainly this is the favorite kind of project for architects, where they can let loose their creativity and imagination with minimal constraints.

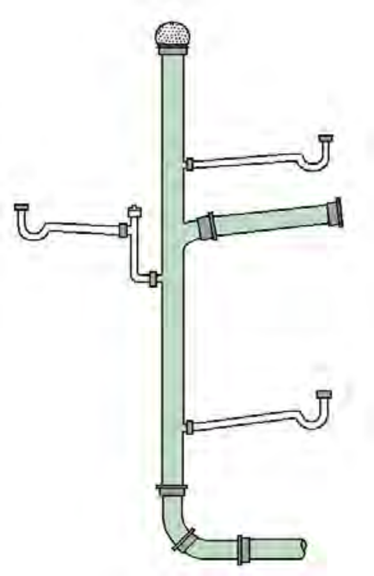
But what about the millions of households who live in more dense urban settlements, the kind extolled famously by Jane Jacobs? What is the balance there, between privacy and public-ness, between "what is mine" and "what is shared," between autonomy and entanglement? The idea of dwelling unit autonomy is decidedly more difficult to deliver in the image to the right. Here, the household - and the space its actions make into a dwelling unit - relates to the larger community of which it is a part in a different and more complex way.

The complexity arises because of at least two factors:

The first factor is legal. It is becoming increasingly clear that a crucial issue to sort out for Open Building implementation is "divided control or ownership." I.E. How does it work when part of a real property asset is built and owned by one party, and the many parts and spaces served by it (or that occupy it) – variously called FIT-OUT or INFILL - are installed and owned by other parties? How does this divided control effect design decision-making processes, developer risk, construction and long-term financing, building construction and fit-out, and facility management? What are the implications in the law of this division of control? What is actually included in "personal property" or "real property" in these instances? When an object is not "integral" to the building, what is it in the eyes of the law and what does "integral" mean?

These issues seem to have been settled in situations in which several parties lease space in a building infrastructure owned by another party. The matter is also somewhat settled in condominium projects, although it is well known that this kind of real estate is plagued by lawsuits. It is also settled practice that public infrastructure – e.g. streets and utilities owned by a municipality – support land owners on whose properties buildings are constructed and that attach their utility systems to the public utilities. Divided control is not new, yet this reality is too often not matched by sensible design and technical methods.

The second factor is technical. Multi-floor, multi-occupant buildings with bathrooms and kitchens requiring mechanical, electrical and plumbing services distributed across a floor plate have not settled the problem of dwelling unit autonomy. Conventional practice now calls for the drainage pipes serving one dwelling unit to penetrate structural/fire separation floors to be suspended above dropped ceilings in dwelling units below. This makes no sense at all, causes entanglement during planning (clients change their minds constantly about unit mix and layouts), management complexity in construction trade sequencing, and rigidity during the life of the asset. This is contrary to what logic would have us believe - that renewal of the building (to new standards, life-styles, etc.) would be optimized if one-unit-at-a-time could be upgraded without disturbing the neighbors. This is what dwelling unit autonomy would enable. Best-practice examples around the world show us how. Perhaps the pain of hiring lawyers to overcome the deficiencies of current practices will increase enough in time to make us learn from those examples.



DRAINAGE DRIVES ARCHITECTURE

Architectural design and building construction in every country depend on knowing where toilets and showers are. That is, until now.

Background
Plumbing infrastructure, being critical for public health and sanitation, has made architectural decision-making subservient to drainage systems and therefore fixed floor plans. This practice is now making the production of a sustainable building stock very difficult, since our buildings are subject to short and long-term change of programs of use and layout, and because control of change is distributed among many parties. These notes focus on these issues and how to overcome them.

The Problem Defined
Water traps and horizontal greywater drainage pipes for showers and bathtubs of all materials and sizes are placed either within the floor structure (e.g. in wood or steel truss structures), installed and accessible from the space below, or they are placed in a ceiling plenum of the space below (e.g. in concrete slab construction). Toilets can be either bottom discharge or rear discharge, but if the toilet is bottom discharge, the horizontal black water line from the toilet is placed either within the floor structure (such as above) or in the ceiling plenum of the space below (also as above).

The problem this note addresses has to do with entanglement, both technical and territorial. Technical entanglement is easy to understand, but territorial entanglement may be a new idea. A "territory" is a space and everything within it, separated legally and in terms of fire separation from adjacent territories above, below or laterally. A territory also signifies a space the admission to which is controlled by the occupant of the territory, whether the space is owned or leased. Clearly, territories can be and are included in other territories the large and more complex the building is. Territorial entanglement means, therefore, a situation in which occupants of two adjoining territories have competing interests in something they are both involved with, a situation that can lead to conflict.

The role that drainage piping presents in this story is most evident in multiple-occupancy, multi-story buildings, but is also generally a problem. The drain lines described above, serving the fixtures in one occupant's territory, should first of all not be "buried" in concrete. This follows the principle that parts of a building with an expected short life should not be buried or entangled with parts that are expected to have a long life. Nor should the parts belonging to one party enter another territory before entering "public" territory. For example, drainage pipes for showers, bathtubs and toilets are usually in the ceiling space (concealed or not) of another occupant's territory. This constitutes both technical and territorial entanglement. This technical and territorial entanglement causes problems when interests one-above-the-other differ, when, for example, the party controlling the "upstairs" territory changes the position of the plumbing fixtures in its territory, or needs to repair the drainage pipes serving these fixtures.

This may not seem difficult when the spaces one above the other are leased to different parties by a party controlling both, or when the spaces constitute one unified territory (such as a row or townhouse, or in two-floor residential units in a multi-story building) owned entirely by one party. Entanglement is a problem even in the case in which floor plans on different floors must change, in a building entirely under the control of one party such as in a hospital or a school.

Problems also arise during design and even during construction, when decisions about floor plans change. The entanglement described forces a dependency between "territories" that does not contribute to decision flexibility. It only brings conflict.

One Basic Solution
There is one basic solution to the problem noted above: install the horizontal black and greywater drainage pipes connecting fixtures to the buildings' common drainage piping **inside** the territorial boundaries of the space where the plumbing fixtures are located.

For this purpose, several technical solutions exist, provided by a variety of companies, and are in use:

a) "High" raised open-plenum floors (on pedestals of various kinds), placed on the base building's fireproof structural floor, high enough to accommodate drainage pipe slope required for gravity drainage.
b) "Upside-down" floor structure, in a part of or across the entire floor plate, in which a fireproof separation is positioned below (rather than above) the structural beams (steel, wood or concrete), with beams deep enough to accommodate drainage pipe slope required for gravity drainage. In this solution, a floor suitable for occupant loads is placed after pipes are installed (but can be opened for maintenance).
c) "Thin" open-plenum floor on pedestals, using a "zero-slope" greywater drainage system developed in Japan (Haseko+Bridgestone+Nomura Real Estate); or a 10cm floor "mat" in which "zero-slope" greywater drain pipes can be securely placed (www.infillsystemsus.com). Both use the principle of "sucking siphon to assure drainage flow). In both cases, either low-profile water traps or waterless waste valves (http://www.hepvo.com) can be used.

In evaluating these solutions, consideration must be given to several factors, including:

a) The number and position of the base building's more permanent vertical pipe shaft(s)
b) The impact on building height (which may be negligible, since a space is needed for horizontal drainage piping in any case, either in the ceiling plenum or in an under-floor plenum)
c) The possibility of solution useful for both new construction and for reactivating older buildings
d) First cost and long-term return-on-investment
e) The cost-value of avoiding conflict, both technical and territorial, initially and over the long-term
f) The cost-value of simplified design and construction management accruing from a strategy of disentanglement.

THE IDEA THAT OPEN BUILDING COSTS MORE IS A RED HERRING

It seems to me that the claim that Open Building costs more is largely a red herring. This assertion is brought about by confused thinking tied up in short-term perspectives, as well as an obsolete understanding of the way built environment comes into being and sustains itself.

What is preferred does not cost more. My iPhone 7 cost more than my previous iPhone, but I bought it anyway. I moved to Philadelphia to be closer to my children, and it cost more than staying in the town where I used to live, but we moved nonetheless.

When was the last time that anyone argued that since fire-resistive buildings cost more, we should not build to meet fire codes, or that good indoor-air quality and energy efficiency costs more, so we should not seek those qualities in our building stock? When great fires consumed Western cities in the 17th, 18th and 19th centuries, building regulations were gradually changed to require fire-resistive construction – to save lives and property. Insurance companies were certainly players in the story, but so were social reformers, politicians and ordinary citizens. Many solutions were – and continue to be - devised to meet this basically social imperative. Yes, cost matters, but the widespread consensus that fire-resistant construction should not be optional led to new standards of building performance. Everyone had to meet those “higher” standards, which have stimulated continuing innovation to find effective solutions, cost being one of the criteria for evaluation.

The same social consensus has emerged regarding earthquakes, floods and other natural disasters, and in some countries, bomb shelters are being constructed to protect society from the man-made disaster of war. Mitigating these disasters has become acceptable, even though they all cost more now, sometimes massively more, to save money (and lives and other intangible values) later.

Now we are going through the same process in respect to energy efficiency, sustainability and resiliency. With some people still believing that climate change is a hoax, there is a seemingly inexorable trend toward spending more money on net-zero buildings, energy efficient cars, and so on. Surely this costs more in some ways, but in other ways, these developments will “cost less” in the long term.

The issue here is not a matter of design (there are good and bad examples of office buildings and shopping centers everywhere) or technology (many solutions exist and more will be invented). The issue is a social issue – an issue of shared values. When enough people want something, that something suddenly does not cost more. At that point, these shifts in values become accounting issues. That is, new columns or rows are inserted in spreadsheets, to define what is accounted for, and by whom, when. This is fundamentally a social, not a technical question. It is a question of attitudes, habits and skills, more than one of hardware.

I like to use the example of office buildings or shopping centers - both of which are conventional and ubiquitous examples of open building – to explain why the assumption that open building costs more is bogus. When was the last time that office buildings and shopping centers were argued to be "more expensive?" Developers never start with floor plans when they give a pro-forma to the design team. Design teams “make form” based on criteria other than floor plans, focusing on other values and other architectural and engineering skills.

There is still the question of quality and durability of base buildings. An office buildings’ “core and shell” can be of high quality, or not. It can be built to last for 75 years, or 30 years. It can be well or poorly built. But in any case, they will be open buildings because the floor plans of inhabited spaces do not drive the base building’s design.

The next challenge for office buildings is to make inhabited spaces more clearly autonomous. In detail, this means assuring that the mechanical, electrical and plumbing subsystems serving a given occupancy do not pass through other occupancies (ceilings) on their way to the buildings’ common service spaces.

The next frontier in open building implementation is in healthcare facilities and buildings with mixed uses and those with dominant residential occupancy. International examples show that these sorts of real property investments - following open building principles - do not cost more now, and will save money in the future.

OPEN BUILDING IN HEALTHCARE FACILITY DESIGN

Hospitals, like cities, are never finished. In the best cases, architectural infrastructures retain value and maintain coherence over many decades of change – interior layouts mutate, evolve and alter in response to the dynamics of the healthcare field and additions are made to the original buildings. In the worst cases, architectural infrastructure falls out of favor, and is found incapable of accommodating varying cycles of change with the result that entire facilities, after several stages of functional downgrading, have to be demolished because they lack the capacity to change.

The fourth dimension in architecture is so ordinary and obvious that it is not understood as meriting serious study - except occasionally as a subject of historians. Either that, or the complexity of change has foiled those who want to take its measure. One difficulty is that the changes in buildings occur at various rates and under quite complex patterns of control, and are often inside, thus escaping the main architectural discourse. In addition, the changes that need to be understood are often interdependent – a change of one part necessitates change of another part - producing perturbations that are disruptive, costly, often dangerous and very difficult to account for and measure.

There are, however, signs of institutional learning. Clients are beginning to demand that their design and engineering teams do more than talk about "flexibility." One important example is the Inselspital Hospital, in Bern, Switzerland. It is one of the largest and oldest hospitals in Switzerland. For several years, the planning group of the Canton Bern Office of Properties and Buildings, responsible for all state buildings in the Canton, tried to fix a program of uses for a major 50,000 square meter addition, called the INO. It needed to replace an existing building housing the intensive care, emergency and surgery departments. Various events prevented this work from being finished: new medical procedures were introduced every year; a new head of surgery was hired with new staffing, space and equipment requirements; a change in the market for services occurred; new regulations were introduced; the pediatric facility was scheduled to be expanded; and so on.

As a result, the client found it impossible to get the needed addition underway. To solve the problem, the planning group, led by Chief Architect Giorgio Macchi, adopted an entirely new planning and management process, and just as important, convinced the Cantonal government to accept the new paradigm. The demand for long-term utility value defined the most important aspect of the new process: the ability to assure optimized adaptability and long-term asset value in the face of changes in technical, social or political circumstances. This was a convincing argument.

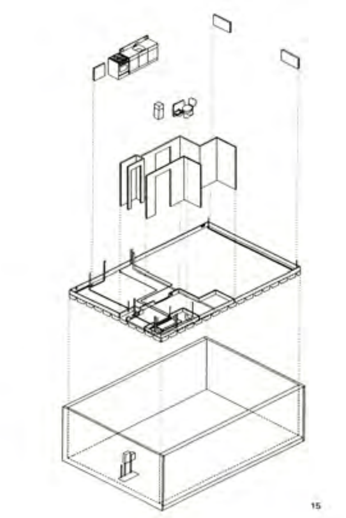
The traditional idea of delivering health care facilities up to that time had been that it is easier and more economical to optimize a construction project by comprehending the whole as a unity, with all its inter-dependencies. But in very complex buildings like hospitals, the client now understood that it is never possible to do so. They had learned that projects within their scope of responsibility are now too dynamic to be planned and built as if they are somehow programmatically static. Rather, the "whole" will come into existence over time, in an incremental way.

In recognition of these realities, the INO project and its process were split into three separate "systems," organized and conceived according to their expected life spans (corresponding to the three images above):

- Primary system or base building (100 years)
- Secondary system or fit-out (20 years)
- Tertiary system or fixtures and equipment (5 -10 years)

These systems levels are independent of any specific technical solutions. In the case of the INO hospital project, a separate design team was selected to design each system by means of separate invited competitions. This procurement approach produced a base building architecture that constrains but does not determine the selection and configuration of elements on the fit-out level. It has no MEP systems in it (mechanical, electrical and plumbing). Therefore, the fit-out level (secondary system) is free to change without forcing the base building level (primary system) to adjust. It is, in short, a change management and decision deferment strategy in which buildings are prepared with an in-built capacity for change – change both during the planning and implementation stages, but also into the future.

All projects procured by the Canton Bern Office of Properties and Buildings now follow this model. The INO Hospital remains a controversial project that caused many parties to change their habits of practice. Despite those difficulties this approach is now standard practice for the Office of Properties and Buildings, and more than 20 other projects including a prison and several university buildings have successfully followed this procurement model.



AN INFILL INDUSTRY

Application of the distinction between base building and fit-out in the residential market, is based on the same principles we see at work everyday in office buildings and shopping malls. It is important because it affects an even larger market whose potential is not yet understood or exploited.

We understand that industrial manufacturing is most effective and dynamic where individual users are directly served. This is evident in the automotive, electronics and telecommunications sectors, all of which have learned to be very sensitive to individual demand. The potential market for residential fit-out is at least as large as that of the automobile industry. Designing base buildings understood as 'infrastructures for living and working' will stimulate the evolution of a distinct fit-out industry that will itself accelerate innovation and distribution of new fit-out product/services and systems.

In Japan, the first formal fit-out system (NEXT INFILL or ECOCUBE), targeting the activation of post war residential apartments as well as newly built base buildings, was launched in the market ten years ago. Now, other companies offer competitive product/solutions. These services are finding use in the re-activation of the existing stock of well situated and technically sound apartment and office buildings needing to be upgraded and adapted to new living and working standards. Technical sub-systems and products that can be integrated in partial or full fit-out system "packages" are increasingly available in the international building supply channels. In China, highly advanced infill systems have entered the market, installing tens of thousands of units per year, in both social housing and the luxury condominium and villa markets.

In general, it is becoming clear that the creation of a genuine, certified fit-out industry is not a technical or industrial design problem. Necessary material subsystems and components like partitioning, bathroom and kitchen equipment, piping and wiring are available. What is needed is the introduction of new kinds of businesses to meet new demands. Some may employ installation teams modeled on the "work cell" familiar in automotive manufacturing. In the case of fitting out an empty space in a prepared base building, such a trained team will bring in all the ready-to-assemble parts – organized off-site in boxes and bundles – and install everything before handing over a finished space with a users manual. This will avoid the disruptive sequencing of subcontractors now producing so much inefficiency, disruption and quality control problems in conventional building practice. Backed up by sophisticated data-management and logistics, we will see a remarkable combination of efficiency and customization at a range of price points.

It is important that the legal and economic frameworks needed for the emergence of such an industry are put in place by local and national government bodies, and by the financial companies that understand the market potential. For example, building regulations in some countries require that bathrooms and kitchens be placed exactly above each other in multi-story residential buildings. Such laws are a reaction to poor quality control in conventional construction and the lack of understanding of how to do otherwise, and need to change to help stimulate the implementation of the infill strategy for sustainable, adaptable residential architecture.

The distinction between the long-term asset and the shorter-term equipment and fit-out in residential construction can also be harnessed for the detached or attached (row-house) market. Building an architectural shell distinct from dwelling units' inside layout and equipment may follow the same separation as already noted. The same fit-out industry that can deliver "ready-to-assemble" product bundles to large buildings can serve these house types as well. Here too, large development projects encompassing many detached or attached units can benefit from the availability of fit-out businesses offering competitive fit-out systems and services.

Roughly speaking, the cost of a complete fit-out system for a dwelling unit is in the order of the cost of the cars its occupants use. This shows the magnitude of the shift an infill industry offers - an entirely new industry of impressive scope, based on industrial manufacturing of parts and delivering what is best called a durable consumer good. In this perspective the trend towards base building infrastructure also allows the building industry to effectively come to terms with industrial production in its most creative and responsive mode.

TEACHING OPEN BUILDING

What I have learned from 35 years of teaching architecture focused on open building can be summarized as follows, in the form of a recommendation to my fellow architectural educators:

Spend time teaching your students to handle types, patterns and systems, independent of functional "programs of use." With this knowledge, students will be ready to make architecture suited to 21st century realities when you teach them open building skills. If you don't have time to do both, focus on the first, because the first is the kind of deep architectural knowledge needed to cultivate built environment; open building skills can be learned in two weeks.

I have come to understand this after 35 years in architectural education during which my focus has been on what I thought was the prize: teaching open building – capacity analysis, distributed decision-making and systems separation – three fundamental skills needed to produce a sustainable building stock ready for change.

After these thirty-five years, teaching in the United States, Europe, South Africa, Indonesia, Japan and China, I have come to see that smart and inquisitive students can quickly learn the specific design skills of open building. But without knowledge of types, patterns and systems, they invariably produce less than satisfying architecture. They simply are less well prepared to handle architectural form than they should be, open building or not.

I would recommend to those interested in types, patterns and systems to read and use Conversations with Form, by John Habraken, Andres Mignucci and Jonathan Teicher and to refer to a related website: www.thematicdesign.org. There are other good sources but this is an excellent place to start.

There are several issues in teaching open building that nevertheless touch directly on skills in handling form. The trick is to build these workshops and the exercises in them out of the highest quality architectural context the students are familiar with in their immediate surroundings. This is the fun of doing the workshops, and this makes the exercises enjoyable for the students. Skill building and practicing to improve the skills can be fun. It combines both creative and analytical processes.

First, how can architecture students learn to resist the temptation to make empty, column free base buildings, thinking that this is what open building is all about? A second temptation students must learn to resist is to make what I have often heard students and professionals call "neutral" or "flexible" building. I'm never sure quite what this means, and when asked, students generally don't have a good answer, and when they produce design proposals, they are never "neutral" or "flexible" in any case. That idea is, to most students, simply a natural counterpart to column-free and unobstructed "empty" buildings. Not unrelated is the question of how can we help develop an understanding about which architectural form (and systems) to FIX, and which form (and systems) to LEAVE OPEN FOR VARIATION as part of infill decisions made by others, and changing over time? At the same time that the question of fixing public circulation arises, we would do well to introduce the question of mechanical systems distribution, both in the FIXED and VARIABLE categories.

I have learned that in a two-week workshop, with upper-level undergraduate or graduate- level students, students can produce reasonably good results and can articulate what they've learned, but they have to work hard. I can do this both for the design of new buildings and the reactivation of existing buildings.

We need more people doing this teaching. I don't understand why more people are not offering such workshops, both to students of architecture and to practicing professionals. It is not mysterious, or particularly difficult. But it is very necessary.

Two-week workshops can be used in standard semester-long academic schedules, either as a module inside a studio, in an "intersession" period between semesters, or in the summer. Actually, these workshops and the exercises I use in them are similar in nature to exercises assigned in structural engineering workshops; they progress from simple "moves" with many constraints, to more complex moves with fewer constraints. All are done without reference to specific functions, just like in structural design skill building.

For practicing architects, a one or two-day intensive workshop with homework will do the job.

I would like to propose a teacher-training program, to teach architectural educators how to do it. Suggestions are welcome in setting up such a program.

AN INTERNATIONAL OPEN BUILDING COUNCIL

During the past few decades, what is formally known as Open Building has progressed through several stages of development. A substantial literature now exists chronicling these developments in the English, Dutch, Japanese, Chinese, French, German, Spanish and Finnish languages.

Initially, what is now called Open Building constituted of a set of speculative principles and aspirations first articulated by John Habraken in the early 1960's in the Netherlands (who later was Head of the Department of Architecture at MIT). That speculation led to research, followed by a number of projects built on the recognition that human habitation has always and will continue to sustain itself by gradual but constant change, and that inhabitants have a crucial role to play. In the second stage, open building began to be initiated by clients – certainly in office and retail markets where this practice has long been conventional and unremarkable – but increasingly in housing and healthcare facilities. In the third stage, open building came to be public policy. During all three stages, research (in academia, government and industry) and teaching has continued on a wide range of open building issues – including design methods, finance, building technology, and user engagement.

Open Building now constitutes a coherent set of principles and practices, taking account of new technical and organizational forces at work in contemporary built fields. Open Building offers a number of tools for practitioners to use in guiding the built environment's continued transformation, among which are

- *Separation of long-lasting parts of a building from parts that will change more quickly*
- *Capacity analysis, to assure that a robust base building will be able to accommodate changing functions*
- *Distribution of responsibility across levels of intervention such as urban design, base buildings and fit-out*

An international open building network has been operating since 1996 as a commission under the umbrella of the CIB (International Council for Research and Innovation in Building and Construction). It has advocated and supported Open Building implementation through yearly conferences, publications and teaching. The network, of approximately 350 people from twenty-five countries, includes architects, developers, government officials, academics and researchers.

The network is now moving toward a more formal and professional organization with these objectives:

- *To be **THE** international source of information on open building research, education and practice*
- *To support members – both academic and non-academic – who are committed making open building conventional*
- *To accelerate open building research and to provide support to local practitioners and researchers*
- *To make it understood that open building is essential to a sustainable built environment*

The new network's activities will bring benefits to:

Society:	*Built environments embodying continuity and stability, yet accommodating change*
Owners/investors:	*Real property assets that retain value and meet changing demand*
Developers:	*Decision flexibility and enhanced control of development processes*
Designers & Builders:	*Clarified responsibilities and services, and management of complexity*
Inhabitants:	*Individual responsibility and control of their immediate environment*

Open Building practices recognize the responsibilities of professionals to the production of sustainable built environment. But they also recognize the varied roles that professionals of all kinds play alongside ordinary citizens, in the cultivation of built environment. The application of Open Building principles therefore invites fundamentally new opportunities in the practice of urban design, architecture, and project management, along with building technology, finance, regulation, and engagement with users and intermediate social institutions. New challenges also await professional education and training, and research.

The new Council will be a non-profit organization with a management and funding structure appropriate to its mission and its international scope. Its members will come from many professional and academic disciplines, from users and user groups and from investors/clients. Membership fees and funds from individuals, companies and organizations will assure financial stability and continuity.