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Open Building: A New Paradigm in Hospital Architecture

Abstract | *Article*

This paper discusses a significant and innovative medical facility under construction in Bern, Switzerland. The 500,000-square-foot project—an addition to the Insel University Hospital called the INO—is being managed by the Canton Bern Building Department. The owner and the management team recognized, when the decision was made to build a major addition, that complex buildings such as this become "whole" only over time. They had come to realize, after many conventionally procured buildings, that it is impossible to design a project based on a fixed program of requirements because the program inevitably changes in response to new medical procedures, new regulations, and new market and insurance conditions. Recognizing these dynamics led to a decision to adopt an entirely new process for procuring the facility. A competition was held to select a design and construction firm for each of three distinct "levels." The primary level is intended to last 100 years and is expected to provide capacity for a changing mix of functions. The secondary level is intended to be useful for 20-plus years and the tertiary level for 5 to 10 years.

This project approach deals in new ways with problems of change and distributed design and construction responsibilities. As such, it represents a good example of "open building" theory and practice—an approach to facilities design and construction that is conventional in the office and shopping-center markets and, increasingly, in multifamily residential construction worldwide. The INO is the first known project to apply these principles rigorously in healthcare architecture. It therefore sets a new standard for adaptable medical facilities, offering an alternative paradigm for meeting critical needs in the field of healthcare architecture. The results of this innovation are being carefully studied with the objective of drawing lessons for U.S. practice.

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Background

In the past three decades (Prins et al. 1993; Brand 1994; Templemans Plat 1995; Kendall October 1999), facility managers and clients of commercial and office buildings in many countries have come to understand that dynamic societies require agile architecture. Two alternatives face clients with dynamic requirements:

1. Scrap and build practices: design and construction according to presumably "fixed" programmatic requirements, resulting in facilities requiring either expensive renovation when uses change and entangled systems must be upgraded or premature demolition when economical upgrading is impossible

2. Stock maintenance practices: design and construction according to analysis of both current requirements and provision for unknown future uses and technical upgrading. This is called "open building" among some practitioners internationally.

There is new evidence that stock maintenance practices are being applied with increasing frequency to medical facilities. A sharp departure from conventional functionalist thinking is increasingly recognized as a prerequisite to deliver sustainable built facilities of the scale, quality, and capacity called for in the medical campus of tomorrow. Designers, facility managers, and medical facility administrators are slowly adopting entirely new ways of working. The evidence of this is ubiquitous but not easy to name or recognize from the perspective of the functionalist thinking in which we have been trained to operate.

This paper reports on a project that may be among the first in the world to apply "open building" principles to the design of a large medical complex. Before introducing the project, however, it is useful to review a number of principles and problems facing all parties involved in healthcare architecture.

Basic Principles of the Behavior of Complex Environments

The "open building" strategy discussed here has its roots in the way ordinary built environments behave. An example

helps to illustrate the point.

Most cities have developed, spread out, declined, renewed in parts, refocused their sense of place and have become multi-nucleated. In all of this, the city is an example of a fine-grained "living fabric." Not surprisingly, no single party—private or public—controls the whole. Only a few owners (universities, medical centers, large corporate organizations, and governmental units being the most prominent) are large-scale, but even in these cases, internal control is hierarchically structured.

Most cities and towns represent, in a systemic way, how environments organize themselves. The city owns and maintains the streets and the city utilities, and it also mandates and enforces building regulations and zoning ordinances. Individual families and companies own individual lots on which they construct buildings. Some of the buildings are occupied by tenants who independently fit-out their own spaces to meet their preferences. Systemic principles are at work, even if they are not appreciated or are largely invisible at any given time.

This living fabric regenerates itself naturally and regularly, if unevenly. There is a certain order to the process. Parts can be replaced without excessively disturbing other parts. For example, buildings can be demolished and replaced by others without disturbing adjacent buildings or the street network. This is possible because all parties involved follow accepted conventions or rules, in which it is in everyone's interest to expand their own territory as far as possible, express their own values, and use personal resources conservatively in doing so, while avoiding conflict. In a healthy living fabric, there are no winners or losers but rather a dynamic balance in time.

There is a definite hierarchy at work that allows for change. The larger framework of streets sets the context for the properties on which individual buildings are constructed. We have experiences that show us that if the street network adjusts, the buildings situated in the spaces between the streets are affected. But the buildings can adjust without affecting the street network.

Lessons for Hospital Facilities Clients

This hierarchical structuring helps us to manage complexity. It also allows distribution of responsibility with minimal fuss and conflict. Some of the buildings we appreciate most—those most suited to agile regeneration—were, not surprisingly, organized in congruence with this hierarchical structuring. Built in the 19th century during the pre-functionalist or pre-Modernist period, these are among the buildings being saved and renewed today.

The reason they are being adapted is not, first of all, because of their style, although now we seem to want to preserve these historic buildings because the public, clients, and many professionals do not think the current profession or their clients can deliver better buildings. Built *by one party and one architect 100 ago, they are now owned by another party and are being adapted by other architects for new uses. They are valuable because they are lovable and because they have accommodation capacity.*

These buildings are models of the kind of buildings that hospital administrators increasingly expect from their architects and engineering consultants. Not only do they fit into a coherent urban pattern, but they are also simple to build and offer spaces of remarkable quality as well as spatial and technical capacity. Most important, they are not tightly integrated with programs of use—they are not defined "functionally." They are "open" buildings, sustainable in the large sense because they can accommodate change.

The Insel Hospital and the INO Addition

Figure 1: Part of the Insel University Hospital Campus

One such departure from the norm was the decision to construct a large new medical facility on the Insel teaching-hospital campus in Bern, Switzerland (part of which can be seen in Figure 1). As with all medical facilities, this project was planned under tight budgetary, regulatory, and environmental constraints. The story of this project is worth recounting because it represents the decision of a large client and its facility planners to alter the methods it had been using for decades in order to obtain a new facility to meet the future with more assurance (Building Futures Institute 2002).

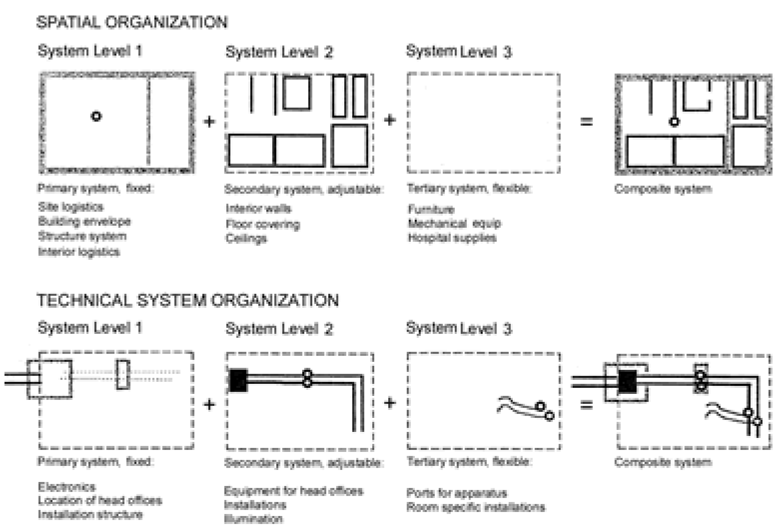
The Insel Hospital is a hospital for intensive care, emergency, and surgery. For several years, the facilities planning group of the Canton Bern Building Department (responsible for this major primary healthcare facility) tried to fix a program of uses so that a design team could produce construction documents for a major addition, called the INO. Each year, certain events prevented them from fixing the program: New medical procedures were introduced; a new head of surgery was hired who had new staffing, space, and equipment requirements; the market for services changed; new regulations were introduced; a pediatric facility was scheduled to be expanded, and so on.

As a result of these continual changes to the program, the facilities group found it impossible to get the needed addition. To solve the problem, the group adopted an entirely new planning process recommended by Urs Hettich, then architect and director of the Canton Bern Building Department. The client's demand for long-term utility value in the facility addition defined the most important aspect of *the new design and decision process: the ability to optimize adaptability in the face of changes in technical, social, or political circumstances.*

The traditional idea of delivering healthcare facilities has been that it is easier and more economical to optimize a construction project by comprehending the "whole" with all its interdependencies. But in very complex buildings like hospitals, the hospital administration had learned that it is never possible to do so—that such facilities are too dynamic and cannot be planned and built as if they are programmatically static. Rather, the "whole" emerges over time, incrementally. This means that large, complex buildings are never finished.
In recognition of these realities, the INO project was split into three systems, organized and conceived by expected life span:

- *Primary system (nearly 100 years)*
- *Secondary system and (nearly 20 years)*
- *Tertiary system (nearly 5 to 10 years)*

Figure 2 (below) illustrates the basic approach to managing this complexity.



ORGANIZATION OF DESIGN ON LEVELS
INO HOSPITAL . BERN, SWITZERLAND

The primary system determines the whole structure of the hospital and establishes conditions for developing the systems to follow. The interfaces are exactly defined. The independence of lower-level (secondary and tertiary) systems is as large as possible.

The Jury Process

Primary System
After an international publication and call for entries in 1997, 10 architecture teams were selected for the primary-system competition. One of the criteria for this invitation was that the design team had never designed a major

hospital project. The presentation requirements for the primary system were very open for the competitors except for the gross building area. A declaration of cost/capacity calculations and an ecology/energy analysis were required, but layout scenarios were not required for the primary system. In addition, the competitors did not receive space-planning templates. Some projects proposed for the primary system were totally empty; some showed spatial arrangements of departments and spaces. It was up to the competitors to show the quality of their "open building," and it was not a problem for the jury to abstract and to compare. The Canton Bern Building Department used layout scenarios of the expected surgery theatres in the jury examination process.

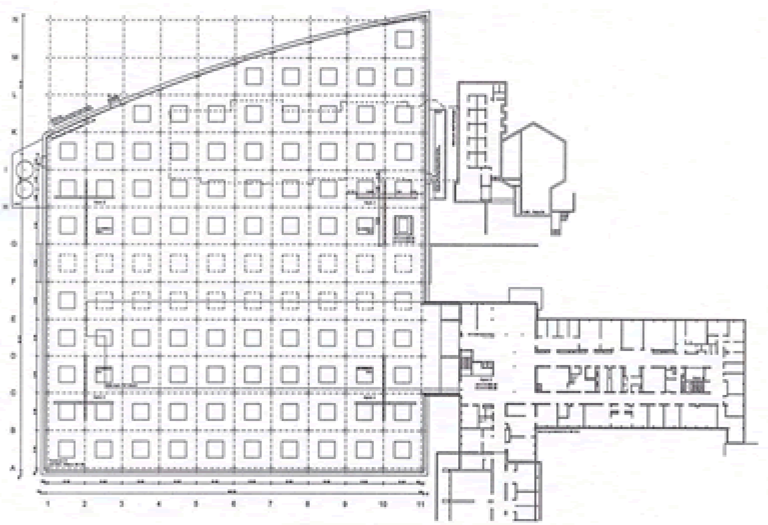


Figure 3: Plan of a typical floor of the primary system, showing an 8.4m x 8.4m structural grid. The primary-system architect was Peter Kamm and Kundig, Architects. This firm had designed one of the pioneering residential open-building projects in Zug, Switzerland, in 1973.

In this plan, fixed mechanical systems risers are placed in each quadrant. Fixed vertical circulation points are also located as part of the primary system.

One of the planning innovations of the primary system shown in Figure 2 is the placement of 3.6m-square "punch-through" opportunities in each structural bay. Each of these squares is a portion of the 20cm-thick concrete slab without reinforcing. This offers the possibility of vertical penetrations at any location in the floor plate for vertical circulation, mechanical systems, or light shafts (as shown in Figures 3 and 4).

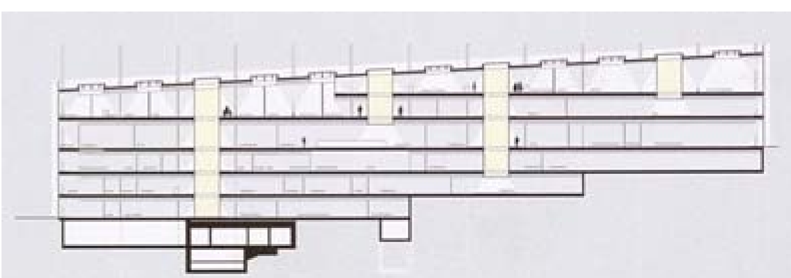


Figure 4: Building section showing one possible distribution of vertical light shafts

Figure 5: Phase 1 of primary system

Figure 6: West façade, showing double skin

Figure 7: Interior view of the top floor of the empty primary system, showing skylights, openings for light-wells to the floor below (on right of picture), and precast columns with four sleeves at the base of each column for possible vertical drainage piping. Also visible is the inner layer of the double skin envelope, showing operable wooden windows.

Secondary System

For the secondary system, the project managers demanded solutions for distribution of mechanical services and layout scenarios as well, showing typical patient paths. The competitors for the secondary system received documentation of the primary system and the layout templates of the existing hospital. Firms submitting proposals for the secondary system were required to demonstrate—with drawings—how, for example, their proposed fit-out systems could be deployed according to a range of programmatic scenarios within the given base building (already under construction).

Figure 8: One floor plan of the secondary system, designed by Itten and Brechtbuehl

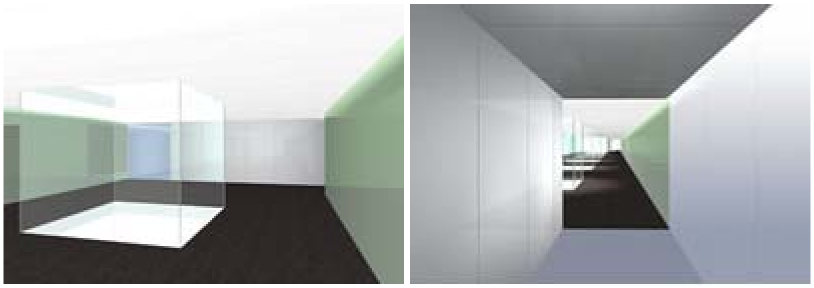


Figure 9: Interior perspectives of light-well lit corridors, part of the secondary-system design

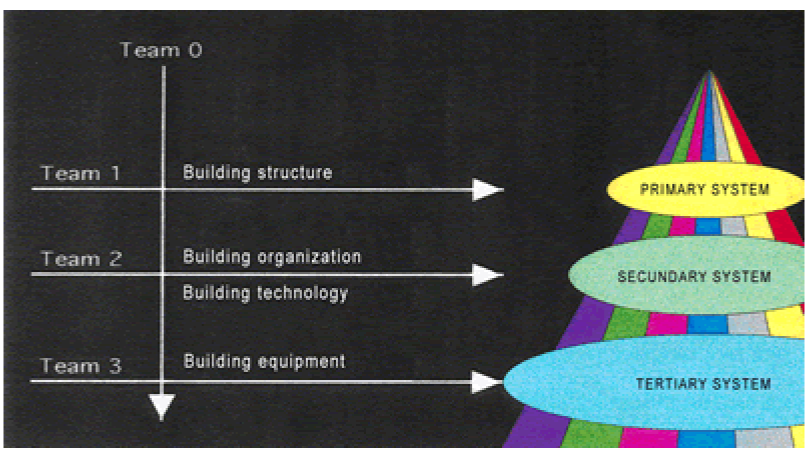
In both jury processes, competing proposals were expected to demonstrate a number of attributes: technical performance (building engineering, cost, ecology), serviceability (building structure/flexibility, function, construction timing, ecology), and architectural (formal properties).

This process—a radical departure from conventional procurement in hospitals but not in office buildings and shopping centers—was adopted to ensure that the building would avoid the rigidity so often resulting from conventional procurement methods.

The Organization of the Process

The division of the INO project into three major system levels also necessitated distinct and separate (but nevertheless coordinated) "decision bundles."

Figure 10: Organizational diagram for project management



Team O is the organizing team of project managers in the Canton Bern Building Department who must coordinate the design and construction activities. The other teams each have their respective level of decision making. As this report was being prepared, the Canton Bern Building Department was renegotiating the secondary-system contract after experiencing difficulties, expecting that installation to be completed by the end of 2005.

Principles of Work Restructuring

The idea of dividing a single large project into these packages differs from conventional project delivery methods and presents challenges, not all of which were foreseen. Neither design-build nor "fast-track" contracts mirror the "levels" or open-building approach, but both are compatible if they are organized by level as noted above.

An open-building strategy organizes the project in terms of the anticipated duration of value of a cluster of subsystems. It does so to avoid waste, to optimize boundary conditions, and to prepare the facility for long-term manageability in concert with anticipated changes.

These are also the principles advocated by Lean Construction (developed by the Lean Construction Institute), a production management-based approach to project delivery and a new way to design and build capital facilities. Lean Production Management has caused a revolution in manufacturing design, supply, and assembly. Applied to construction, it changes the way work is done throughout the delivery process: It links the objectives of the production system—maximize value and minimize waste—to specific techniques and applies them in a new project delivery process. Lean Construction is particularly useful on complex, uncertain, and quick projects. It challenges the belief that there must always be a trade-offs between time, cost, and quality.

Open-Ended Medical Architecture

This is one way of organizing an "open building strategy" for the design, construction, and long-term management of medical facilities. It is not necessary for different designers to be assigned to each level, but the strategy is particularly well suited to an institutional client that has long-term interests, that is subject to public scrutiny through state legislative action, and that also must remain competitive with similar institutions' quality-of-life and environment aspirations. Inevitably, firms other than the original design teams are called upon to renovate medical facilities. In principle, then, this project is not different.

The strength of this strategy is its alignment with the principle of variable life-cycle value of certain "clusters" of building elements and decisions—an accounting principle that corresponds to the behavior of large, complex facilities. In other words, change and adjustment occur on "levels" that cut across strictly technical systems and trade boundaries. For example, when a new illumination design is specified, it uses existing cable infrastructure "up to a point." When new partitioning is specified with an adjustment of offices, the design will seek to limit perturbations to contingent building parts in order to save cost and disruption (e.g., the floor and ceilings will likely remain undisturbed, while some of the electrical cabling buried in the partitions will be changed, but only "up to a point"). Accumulated knowledge about medical facility behavior under conditions of change should begin to teach us about the boundaries of such "levels." They are likely to *be cross-cutting, involving multiple trades and supply channels, and therefore calling for new logistics and working methods.*

Conclusions

As John Habraken (1998), Stewart Brand (1994), and others help us to see, the built environment is not static. Transformation is pervasive, operating on various timescales and at various "levels." We would be surprised if things were otherwise, and not only that, we would be out of work. It is, after all, the work of architects and other designers to help reach agreements about what should be built—thus changing the face of the built field.

But to a large extent our working methods are not yet congruent with this reality. We are only slowly recognizing transformation and stability as twin realities. Our teaching, our design and construction practices, and our analytical and accounting tools are not yet sufficiently organized in recognition of this. Product manufacturing is much more advanced. Lean Construction recognizes this reality, as does some pioneering engineering research.

The commitment of the Canton Bern Building Department and the INO Hospital to the open-building implementation is exemplary and should be applauded. Continued monitoring of the project is continuing and further reports will be made available in 2005.

Acknowledgments

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