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Planning for Change: Hospital Design Theories in Practice

Abstract | Article

Architectural change was a major feature of the 20th-century hospital. The rapid speed of medical research in all fields required changes in the typical hospital environment in cycles of as few as 5 or 10 years. This is remarkable, given that most hospital structures were typically designed to last 50 to 100 years.[1] Because the process of design and construction is both long and expensive, planners faced the challenge that many new hospitals are out of date the moment they open.[2] One of the challenges facing the architecture profession in the 21st century, therefore, is how to design a flexible hospital to suit unpredictable future needs.

In the last three decades, a fundamental shift has taken place away from highly centralized, large-scale hospitals toward smaller, decentralized healthcare facilities.[3] New trends in healthcare design such as sustainable strategies, the use of nature as a therapeutic modality, and the influence of information technologies, have diverted attention away from the issue of change, yet the need to plan the hospital for future, ever-changing needs remains. New medical technologies, too, have changed society's expectations of hospital environments. Stays are shorter, most patients and visitors arrive by automobile, and the demand for homier, regionally inspired architectural imagery has increased dramatically.

This article documents the theories and approaches of hospital planning for change as a context for the healthcare projects of Zeidler Partnership Architects, perhaps Canada's best-known healthcare architects. It explores an iconic hospital, McMaster Health Sciences Centre in Hamilton, Ontario, and documents its evolutionary process over the last three decades. The article analyzes the architectural intentions of the McMaster project through the seminal text, Healing the Hospital: McMaster Health Sciences Centre: Its Conception and Evolution. It is here that the project's main designer, Eberhard Zeidler, Hon. FAIA, declared that the hospital was "never to be finished." In addition, the project explores the firm's current model for healthcare design, a paradigm shift in this highly specialized field.

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Introduction: Theories and Approaches of Hospital Planning for Change

Change over time is a constant feature of architecture, yet the pace of change and its intensity are much greater in hospitals than in any other type of building. Changes in all areas of healthcare—scientific, operational, technical, and social—necessitate frequent changes in the typical hospital environment that often result in complexity of function and neglect of aesthetic quality. Because the changes occur rapidly, it has become almost impossible to predict future needs. The challenge is to anticipate as far as possible where changes are most likely to occur, to plan in advance for hospital expansion, and to provide maximum flexibility in design.

Figure 1. A 19th-century surgical amphitheater at Massachusetts General Hospital, compared with a 21st-century ZEUS "Intelligent" operating room.
(Sources: Richard A. Miller. "Hospitals: The Race with Change." *Architectural Forum* 120 (1964): 80, and Bobbi Bennnett Photography. 24 April 2003.)

Eberhard H. Zeidler, Hon. FAIA, has been fascinated with the notion of time in architecture throughout his prolific career. In his practice as well as in his writings, Zeidler highlights the importance of hospital flexibility and demonstrates how to achieve it. All of the approaches to planning for change that were identified in this study—master plan, expansion methods, and design for flexibility—touch Zeidler's approach to healthcare design. Some of these approaches were found to be more

effective than others over the years, and some were developed to respond to changes in the economy, politics, and society.

Master planning remains a basic tool in planning for an unknown future, yet its success depends on the client's understanding of architectural ideas and the willingness of successive hospital authorities to honor the architect's original vision. In terms of providing expansion possibilities, horizontal expansion is preferred to vertical expansion because it is more economical, although it requires large areas of land and consideration of walking distances. A concern for maximizing flexibility continues to be achieved by modularity, full or partial interstitial spaces, and the separation of functions.

Hospital Change in Practice: McMaster Health Sciences Centre in Hamilton, Ontario

The McMaster Health Sciences Centre (MHSC) in Hamilton, Ontario, designed in 1972 by Craig, Zeidler, & Strong Architects, commemorates an important moment in hospital design. To keep a step ahead of the rapid changes taking place in medicine, Zeidler created an infinitely flexible space, deliberately designed never to be finished. This utopian vision, a concept of ever-changing architectural form, is demonstrated clearly in MHSC's design, function, and image as a prototype of the "plug-in machine" modern hospital. While critics rejected the high-tech mechanical image of the hospital, others understood Zeidler's intentions and appreciated his achievement. Even today, 30 years after the building was completed, its presence is powerful.

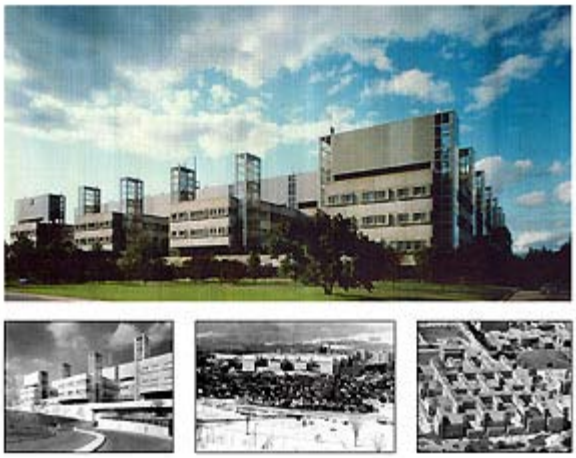

Figure 2. A view of MHSC's front elevation, a view of MHSC in the context of its community, and an aerial view of MHSC. (view larger PDF)
(Source: Zeidler Partnership Architects)

MHSC's original master plan defined the hospital's location, form, and function, and it determined the future development of the hospital in two phases. Located on the campus of McMaster University, the center combines accommodation for medical and health sciences, education, and research, with a 418-bed hospital and extensive facilities for outpatient treatment. The building was designed as a compact, four-level structure with a parking level

Access and Beyond
James G. Easter Jr., Assoc. AIA, FAAMA, President and CEO, Easter & Mason Healthcare Consulting Corp.
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HOSPITALity: Surgery Center Design for People, Not Procedures

Charles A. Huber, Assoc. AIA, Hobbs & Black Associates Inc.
John S. Barker, AIA, Hobbs & Black Associates Inc.
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below and the possibility of an additional fifth level in the future. This megastructure complex features an immense building area of 1,716,500 square feet, built at a total cost of approximately $70 million.

One of MHSC's most important design principles was growth. All the building components of MHSC were planned in advance for horizontal expansion and for vertical expansion of a fifth floor (Figure 3). The structure of the building was designed to support the extra weight, and mechanical and electrical systems were installed to support any function that would be located on the additional floor. Even the elevators and stairs were raised to the level of the fifth floor. In addition, as part of the construction and development process, some areas in the building were left unfinished to accommodate inward growth.

Despite Zeidler's efforts to design in advance for future expansion, MHSC did not expand as he envisioned. Changing hospital administrations and political and economic conditions diluted and diverted the implementation of the original master plan. In 2002, McMaster University prepared a new campus master plan that redefined the boundaries for the MHSC site and limited its options for expansion. When additional space was needed, the Hamilton Health Sciences Corporation chose to invest in a new building, constructed near the hospital, rather than to complete MHSC's fifth floor (Figure 3). As a result of this policy, no subsequent change has been made to the building's volume. The exterior form of MHSC that was envisioned as a living, growing organism has remained static since it was built in 1972.

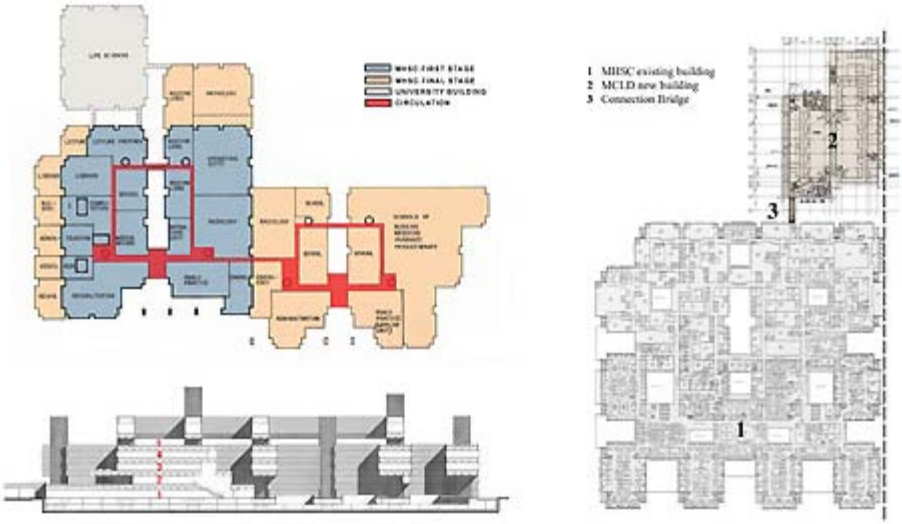

Figure 3. (view larger PDF) On the left, MHSC original master plan from 1972: schematic plan of MHSC's option for horizontal expansion in two phases and a section of MHSC indicating the option for vertical expansion of a fifth floor. On the right, MHSC in 2002: the location of the new McMaster Centre for Learning and Discovery and its connection bridge to MHSC. (Source: NORR Limited, Architects & Engineers, and ZPA)

MHSC was also designed to provide an infinitely flexible space.

Zeidler designed a modular structure that separates each part of the building into permanent and nonpermanent elements. He introduced the term "servo system" to identify the permanent frame of MHSC, an integration of the structure with the primary electrical and mechanical services, which various functions may be plugged into. Zeidler's approach was to incorporate interstitial spaces throughout the entire complex (Figure 4). Besides organizational, structural, and time-saving intentions, the idea was to reduce the adaptation costs that are often more excessive than the original cost of the building.

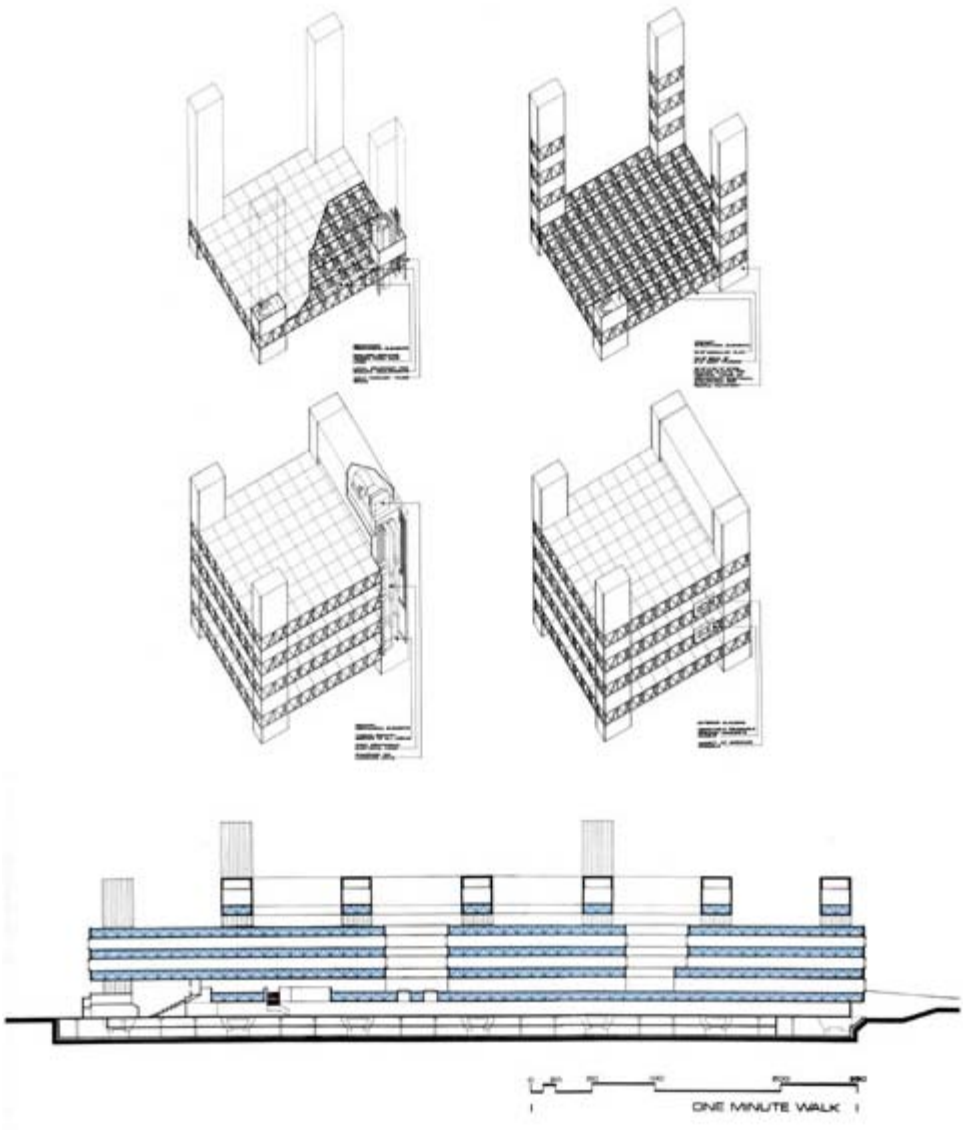

Figure 4. (view larger PDF) MHSC's servo system and a section through the full interstitial floors. The servo system is a fully three-dimensional matrix that appears as if it was envisioned in the computer age. The "plug-in machine" has a concept that fits software applications and processes, yet all its drawings were crafted freehand. (Source: ZPA)

To study whether these flexibility methods were efficient, I conducted a survey of MHSC's changes since it was built in 1972. The changes examined are classified into five types: completion

of construction, renovation of space, expansion of function, addition of function, and relocation of function. The information gathered in the survey is demonstrated on MHSC's four floor plans, identifying the changes by type, year, and location (Figures 5 and 6).

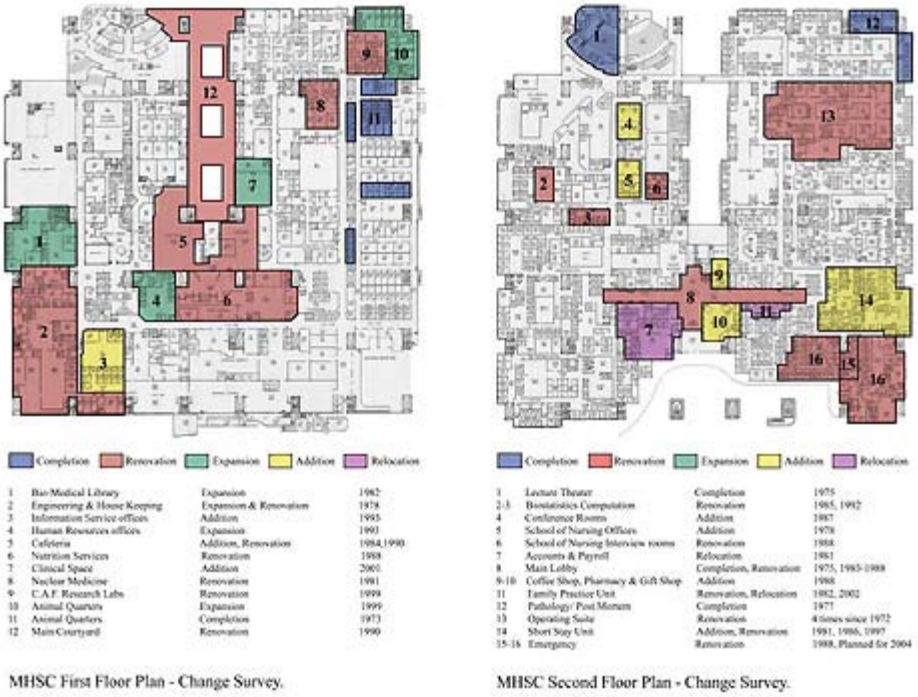

Figure 5. MHSC first- and second-floor plans—change survey. (Source: the author) (view larger PDF)

Figure 6. MHSC third- and fourth-floor plans—change survey. (Source: the author) (view larger PDF)

Many changes to MHSC's physical plant were the result of the advance of medicine over the years. For example, a short-stay unit was added in 1981 on the second floor, as advances in analgesia techniques facilitated day-case surgery. Since its addition, the short-stay unit has been renovated twice to support the development of new treatments. Another example: the operating suites that have been renovated four times since 1972, averaging a major renovation about every 7.5 years. This pace of change resulted from rapid progress in surgical techniques and the development of new equipment over the last three decades.

In addition to the changes resulting from advances in medicine, some of the MHSC changes related to trends in hospital design since the 1980s. The addition of a coffee shop, pharmacy, and gift shop in the main lobby in 1988 is part of the trend to integrate commercial activities within a hospital space. The frequency of renovations in MHSC's interior spaces is probably the result of Zeidler's attempt to make all elements that infill the infrastructure dispensable, changeable, and enjoyable, so that none of those applied secondary elements alter or interfere with the infrastructure.[4]

Zeidler's concept that form does not follow function has been shattered, as many of MHSC's changes were made so that the form does indeed follow the function. For example, the inpatient units that were all designed to be basically the same have been renovated to adjust each unit to address specific needs. The different activities and procedures of the pediatrics, medical, psychiatric, and surgical inpatient nursing units demanded a different design of their central service area. The same process can be seen in the research labs, as changes of function required renovations of the lab's form and interior design.

MHSC was designed to express the unique qualities of its structural-mechanical system, the servo system, and the unpredictable nature of its functions. The exterior wall system—a structural frame and cladding system designed to allow an arrangement of window panels to suit future interior planning changes or expansions independent of the structural system—is a sad reminder of this unfulfilled vision. Because MHSC did not expand and no interior change required modification of the openings, the wall system remained unused and its concrete panels have aged through drainage-water stains.

Another example of Zeidler's unfulfilled vision is the current condition of MHSC's esplanade and courtyards. While the esplanade was designed as a key connection between the university and the hospital and as a recreational escape, today it is abandoned. The courtyards on the third floor were designed to provide natural lighting, ventilation, and diversity as an orientation element, yet they subsequently became uninviting and depressing spaces. Instead of providing a sense of escape, the courtyards create a sense of oppression.

MHSC, which was designed never to be finished, did not change in accordance with the original vision. The building did not follow its intended master plan, the expansion possibilities were not fulfilled, and the interior redevelopment was limited in scope. In this way, the vision that had intended to create an infinitely flexible and dynamic structure resulted in a static monument.

Still, the importance of this project cannot be underestimated. MHSC is now an icon in the history of the modern high-tech hospital. Its bold design, which continues to raise many tough questions, denies any compromise in the expression of its utopian concept. It has stimulated the transition toward the postmodern hospital.

The Evolution of Zeidler Partnership Architects (ZPA) Healthcare Design

The evolutionary process that took place over the last 30 years includes not only changes in MHSC but also changes in its designer's approach to healthcare design. Since the 1970s, ZPA projects have been marked by the transition from the concept of the modern hospital to postmodern healthcare facilities. The firm has become a recognized leader in this specialized area of design and has served more than 40 healthcare and life-science clients. Projects include large and small complexes, and the kind of work undertaken ranges from major new hospitals to renovations and additions.

A comparison of ZPA healthcare projects clearly illustrates the ongoing development of their design (Figure 7). The plans and sections of the MHSC in Hamilton, the Walter C. Mackenzie Health Sciences Centre in Edmonton, the Hospital for Sick Children in Toronto, and the Ontario Cancer Institute affiliated with the Princess Margaret Hospital in Toronto are in the same scale and sequence of time, facilitating a comparative understanding of the typology of a hospital's volume, public spaces, and circulation. The comparative typology of a hospital's development reveals the move from megastructure to more-bounded facilities, the reduction in the construction of interstitial floors, the transformation of outdoor courtyards and esplanade to an interior atrium, and the development of a circulation system from a closed-ring corridor to an open system of corridors surrounding and crossing the atrium.

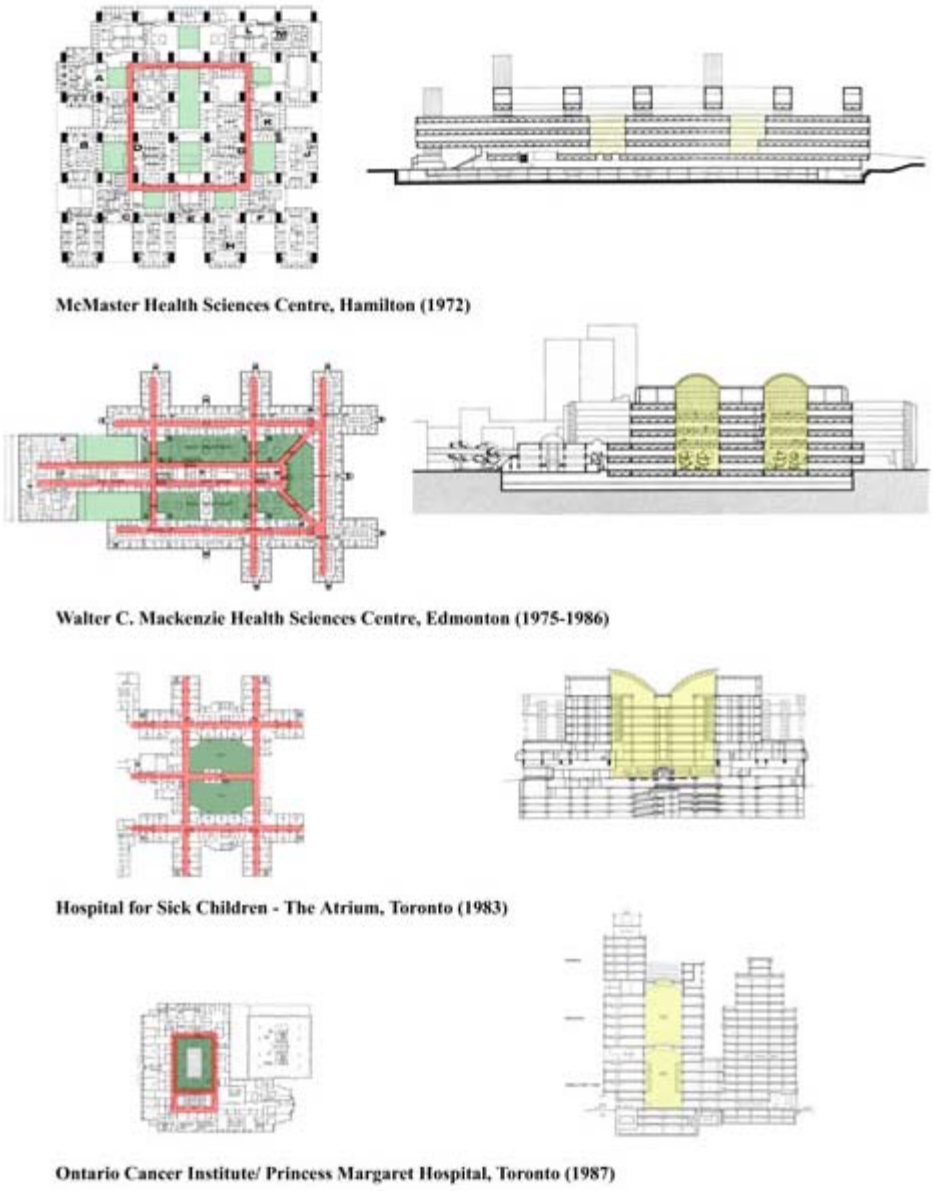

Figure 7. The typology of the volume, public spaces, and circulation of three ZPA healthcare projects, in comparison to MHSC's earlier design. (Source: the author) (view larger PDF)

A Healthcare Center for the 21st Century

ZPA's recent design for the William Osler Health Centre (WOHC) in Brampton, Ontario, illustrates the firm's current approach to hospital design for change. Although ZPA was not the winning team in this competition, the project has since become its new model for healthcare design and has been called "a healthcare centre for the 21st century."

ZPA designed the project through the debundling system, which divides the hospital into groups of similar functions that are related to each other and share the same structural and mechanical system. The objective of this system is to create clear organization, cost-effective management, options for expansion,

and enhanced flexibility for future design options. Consequently, the hospital is divided into three bundles: the diagnostic/treatment block, the ambulatory-care block, and the inpatient block (Figure 8). As a result of the debundling system, the hospital has been set up as a healthcare village, where the blocks are separated into buildings and the atrium serves as the village "Main Street."

The primary public space, a single spine that connects the three blocks, was envisioned as an atrium that will provide simple, clear circulation with shorter travel distances while the major departments will be both visible and accessible from it. The design includes retail spaces, food facilities, and even a staff day-care center at the main level.

Surprisingly, ZPA designed the hospital only for horizontal expansion, in contrast to MHSC's design that provides horizontal, vertical, and infill expansion opportunities. The main reason is that the hospital site is large enough to allow horizontal expansion, which does not require extra investment in the primary phase of construction and will not interfere with the occupied floors during construction. In addition, an interstitial floor was designed to be built only in the diagnostic/treatment block, where it is most needed, located above the diagnostic imaging and emergency units and beneath the operating suites (Figure 8). The interstitial floor is designed to be two floors high in order to contain large mechanical systems and to allow continuity of horizontal connections between the operating suites and the inpatient units on the fourth floor.

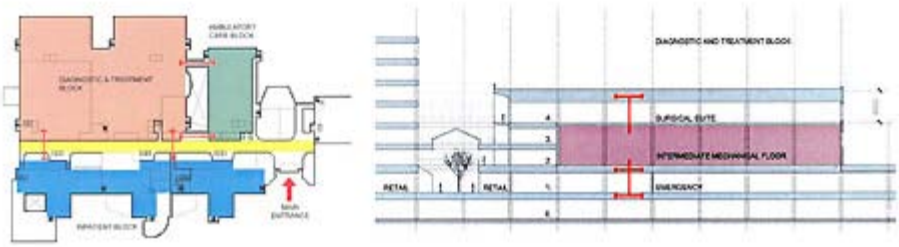

Figure 8. Scheme of the WOHC hospital debundling system and the location of the two-floors-high interstitial floor. (Source: ZPA) (view larger PDF)

Conclusions

The changes made to MHSC corresponded to changes in ZPA's ongoing progress in healthcare design, as planning for change has itself undergone change. A comparison of MHSC with ZPA's new model of healthcare design reveals this continuous evolution in approaches to planning for change in the form of master planning, expansion, and design for flexibility. It also clearly illustrates a paradigm shift. The notion of the machine hospital has been transformed into a healing healthcare campus; the technological approach has been exchanged for a holistic one; the megastructure has been reconstituted through a series of separate or confined structures; and the labyrinthine corridors

and the abandoned esplanade and courtyards have metamorphosed into an open, light, green atrium.

This study has revealed a conflict between the expression of the idea of flexibility in hospital design and the expression of a healing environment. The current trend of creating a community setting in the public space of the hospital and a domestic atmosphere in the patient units has replaced the modernist goal of developing the high-tech functions of the hospital. This transformation is the shift from the modern machine hospital to the postmodern healthcare campus. Can a hospital truly combine the technological with the human?

The future will bring about many more changes in hospitals. Zeidler believes it all but axiomatic that the further the health sciences advance and the more fluid changes in technique become, the more complex the physical environment will become and the more problematic it will become to modify such environments.[5] Furthermore, the changing expectations of our society, which sees the hospital environment as a reflection of healthcare delivery, will continue to transform our conceptions of the hospital. As the future remains unknown, planning for change is still, more than ever, one of the great challenges facing the hospital designer.

Notes

[1] Zeidler, Eberhard H. Healing the Hospital: McMaster Health Science Centre: Its Conception and Evolution. Toronto: Zeidler Partnership, 1974: 7.

[2] James, W. Paul, and William Tatton-Brown. Hospitals: Design and Development. London: Architectural Press, 1986: 5.

[3] Verderber, Stephen, and David J. Fine. Healthcare Architecture in an Era of Radical Transformation. New Haven: Yale UP, 2000: 126.

[4] Zeidler, Eberhard H., and J.F. Mustard. "McMaster: A Rebuttal." Architectural Forum 139.3 (1973): 57.

[5] Zeidler, Eberhard H. "Designing for the Unknown Future." Business Quarterly 37.3 (1973): 28.

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