UPDATING A HOSPITAL BUILDING. A TASK FOR INNOVATION DESIGN

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ABSTRACT

Refurbishment of a hospital, especially located in a historical building, is a task that goes far beyond a standard framework of architectural practice. A concept of modularity in the architecture of the late nineteenth and early twentieth century was only just to happen, building system installations and technical equipment appeared as the simplest solutions. Inscribing complex functional solutions into such a space is an interesting design challenge. Besides of classical architectural design problems, there are several factors that should be considered – ongoing changes in functioning of the health-care system, growing social needs and expectations, expanding possibilities of implementation, both in terms of medicine or medical technology and hospital environment.

What is sometimes referred to as an innovation in health-care architecture is under constant change and development. It happens the changes are introduced by leaps and bounds, thanks to breakthroughs in medicine or as a result of constant progress in medical technologies. These changes and their impact on architectural design can be a fascinating subject itself. Construction of a hospital from a scratch, taking into account the possible development of knowledge, is a complex and complicated task. It becomes even more complicated when we deal with a hospital located in a historic building.

Entering a building on a list of heritage or historical objects does not rule out completely the possibility of its expansion, adaptation or modernization for purposes related to health care. The need for functioning health-care facility in the existing place, albeit at the expense of far-reaching changes in its historical fabric, is the supreme value – at least the location in an urban system that's something that cannot be ignored. A hospital complex formed in this way will retain all its existing advantages and will provide adequate space meeting the requirements of modern medicine.

Key words: hospital architecture, innovation hospital, hospital modernization

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1. INTRODUCTION – A SHORT HISTORY OF KWIDZYN HOSPITAL

Figure 1. The earliest known photograph of the hospital building – probably 1900s.
Photo courtesy: dr Justyna Liguz

History of county hospital in Kwidzyn (Pomorskie voivodship, Poland) dates back to the late nineteenth and early twentieth century (then Marienwerder, Westpreußen, Germany). It was built on a suburbia of town as a three-storey, detached building, with fully recognized local building tradition – a massive and ornamental brickwork, dominant sloping and tiled roof, with modest but still strong details.
Unfortunately, with loss of documents relating to hospital's early years during the turmoil of World War II, the very few is known about its founding, functioning, layout and medical profile. The only note describes its location in the southern part of town, just opposite the catholic cemetery (a city park nowadays) and gives the number of available 150 beds in the early 1930s and in 1937 increased to 200 beds.
In the 1930s the county-city hospital had two parts: main building at Rospitzer St. (now Gen. Jozef Haller St.) and a private part (now Jozef Pilsudski St.). The 1937 renovation and expansion merged these two parts of the hospital. Hospital operated on first and second floor of the main building as the two major female and male wards. There was no distinction among medical specialities, besides short-stay patients (so-called "weekend patients"), children and newborns; only infectious diseases were treated in a separate building.
It should be noted that the development of a new wing of the hospital did not take place by simple duplicating the existing spatial solutions – architectural character of newly constructed pavilions was quite different: block size, elevation divisions (and perhaps therefore a functional internal divisions) suggest that it was a modern and

contemporary solution, with influences of then European architectural movements. One might even say – it was an innovative hospital modernization.

Figure 2. The 1930s modernization and extension. Photo courtesy: dr Justyna Liguz

The World War II was gracious to the hospital, as there was no damage. At the end of May 1945, the hospital welcomed its first civil patients, and at the end of this year it was renovated. In December, in order to obtain greater financial capacity, it was transformed from the city to the county hospital.
Starting with the 1990s there has been ongoing process of converting an ownership of the hospital (as many in Poland), from public to private one. Innovative for those times, a form of servicing in which the hospital was able to provide efficient and effective management, as well as public access to health-care system. Despite of these assumptions, the common inability to provide fully accessible solutions led to a break-through: the initial idea to build a brand new hospital in a nearby village had been abandoned. So, in 2007, the local authorities decided to upgrade and modernize the existing hospital complex.

2. DESIGN SOLUTIONS

2.1. Initial design assumptions

In 2008 the project team led by professor Andrzej Kohnke proposed a project of hospital modernization and expansion. The basic idea was to prepare the facility to serve the county of 80 thousands inhabitants, to optimize a profile of medical services and provide proper spatial solutions and to adapt the hospital building to

current requirements of health-care regulations. While the first assumption requires no comment, the other two need some explanation.

Figure 3. Inner courtyard, contemporary view

When speaking of optimization I mean these tasks:

- Correction of bed wards capacities (after analysis of county disease statistics) – verifying its capacities and planning spaces for more specialized wards.
- Ensuring adequate solutions for advanced medical procedures, i.e. by designing new operating theatre (OT, 1st floor, marked with "F" on Fig. 6), intensive care unit (ICU, 1st floor, marked with "H" on Fig. 6), laboratory (ground floor, marked with "D" on Fig. 5) and delivery (2nd floor, marked with "G" on Fig. 7); these departments have been placed in the new wing of the hospital.
- Improving intra-hospital communication – existing hospital complex consists of several buildings, constructed on different ground levels, with different floor heights thus a simple connection is impossible. To solve this problem there is a central communication hub, with a system of ramps, staircases and lifts, connecting every part of the hospital. The hub, adjacent to inner courtyard, acts as a main vertical axis, guiding people with their flow through the building.

Figure 4. New hospital lay-out as designed, ground floor; key: A – communication, B – technics, magazines, C – pharmacy, D – laboratory, E – emergency department, K – outpatient; green dashed line – first building, red dashed line – 1930s extension, blue dashed line – 1970s and 1980s extension

2.2. Detailed solutions

As mentioned above, the detailed functional programme has been prepared after analysis of the county disease structure, with several recommendations given by the hospital's authorities. The existing functional structure has been preserved – there are five basic bed wards (distinguished because of their medical specialties, including ICU) with a more developed system of specialized nurse units. At now, there are 178 beds in the hospital, compared to 213 beds in the new layout.

Figure 5. New hospital lay-out as designed, 1st floor; key: A – communication, B – magazines, F – operating theatre, H – intensive care unit, I – observation unit, J – administration, L – radiology; green dashed line – first building, red dashed line – 1930s extension, blue dashed line – 1970s and 1980s extension

Thus the structure of hospital bed wards has been set as follows:

- Internal medicine 60-bed ward including cardiology and neurology, organized as 3 nurse units (number of beds has been slightly decreased from 64). Total area of the ward is 972 sq. m.
- Surgical and orthopaedic 58-bed ward, with 2 nurse units and an intensive care and observation unit. There is no change with a capacity of the ward; its area is now 992 sq. m.
- Obstetrics and gynaecological ward with 20-bed obstetrics nurse unit (with a rooming-in system), neonatology 28-bed nurse unit and gynaecology 12-bed

nurse unit. It is the most changed and redesigned ward – the whole its structure has been reorganized; it has been directly connected to enlarged and modified delivery. Total area of the ward is 997 sq. m (excluding the delivery).
- Children 24-bed ward with 2 nurse units with area 545 sq. m.
- Anaesthesiology and intensive care unit 5-bed ward with total area 207 sq. m. Additionally, there is 6-bed observation unit at the existing hospital emergency department.

Diagnostic and procedures departments of the hospital are as follows:
- Out-patient clinic with 10 consulting rooms (for internal, surgical and social medicine, gynaecology, pneumology, oncology) supported by 5 treatment rooms), with total area 360 sq. m.
- Laboratory (excluding bacteriological laboratory, area 180 sq. m), operating theatre (area 406 sq. m), delivery (area 259 sq. m), cardiology diagnostics (area 60 sq. m), endoscopy (area 97 sq. m). Because of the close location to other facilities there is no need for planning a rehabilitation department.

There are no changes in the ED layout, as it has been rebuilt recently, as well as the radiology. Despite of some minor errors in layout of these departments the decision has been adopted, as intra-hospital connections have been sufficient. The ED is directly (vertically) connected to the ICU, which is adjacent to the operating theatre; both have direct access to cardiac diagnostics. In terms of medical procedures it is the optimal solution, as a path of the ED or ICU patient is reduced to minimum.

3. HOSPITAL INNOVATIONS

Innovation, understood as an implementation of the widespread and common use of new solutions and ideas, plays a special role in medicine. Continuous improvement of living standards and consequently improvement of society's health is the very basic task of the modern civil state. Building an efficient and modern (i.e. applying the most advanced science and technology) health-care system requires cooperation of many participants, with a wide range of expertise. Collaboration of physicians, architects, biotechnology engineers, health-care management professionals and many others is crucial when planning network of health-care facilities. Results of such cooperation could be turned into a high quality health-care environment. From this point of view creating a modern hospital can be seen both as an architectural innovation, to build the environment (defined as a medical workplace and patient care environment) absorbing the new solutions and as structural innovation.
One of the conditions for proper planning and design of such a solution is to prepare a spatial frame which ensures the functioning of the health-care building in a long time period, resistant to changes over time. There are several items allowing such flexibility – hospital's internal structure meant as a system of its construction and installation elements, and its open functional lay-out. Obviously, no one can predict developments of medical technologies, nor forms of hospital organizations, but the accepted framework for architectural and functional solutions depends on how far

the building will be ready and open to changes and innovations – it can be assumed that the primary task for innovative hospital design is to determine appropriate functional, spatial and technical solutions.
The article attempts to define the conditions and architectural ways of implementing innovative hospital model. The main considerations are of architectural (functional and compositional solutions) and technical (construction and installation) nature. Although undoubtedly of great importance, urban factors or management of health-care system stay out of the scope of this discussion.

3.1 Construction and installation system
As long as progress in medicine is closely associated with advances in technologies, the ease of their introduction is the essence of innovative solutions in hospitals. This means not there are only financing and management issues, it is also a matter of flexible functional layout based on appropriate construction and installation grid – as the continuous implementation of further elements increases the complexity of the system and so complicated. Adoption of appropriate design solutions is a key element in achieving an efficient hospital building. These elements include:

- Construction and installation module or grid, closely associated with functional layout. The grid can be considered as a basis for the planning of hospital units.
- Distribution of installation systems (water supply, plumbing, ventilation and air-conditioning, medical gases, wiring system, communication, etc.) as a central or a distributed system, through installation shafts, technical floors or combination of both systems.

The adoption of relevant construction modules is the first step in resolving technical issues. Another is the adoption of energy-saving solutions – the larger the building (with functional complexity, extensive technical equipment, huge numbers of users), the greater demand for energy, the greater amount of wastes, etc. Consequently, the greater the demand, the more complex the installation system and more space is required for such distribution. Proper recognition of these issues and the introduction of appropriate technical solution lead to an innovative design.

3.2 Spatial layout of a hospital
The history of the development of hospital architecture gives us a picture of the current and dominant trends in the design of a hospital. It is worth noting there are always innovative solutions, and it is a matter of time when we would verify them. In Western Europe, starting with a monastic hall building, through pavilion hospital to present-day health-care complex, all these were considered then as innovative.
The fundamentals of hospital planning and designing (and most of the building types as a matter of fact) have been already thoroughly discussed and described. As mentioned above, the functional layout set by a construction grid is the basic tool for coordinating function and construction. A multi-span layout dominates at diagnostic or treatment departments, while a two- or three-span layout prevails at bed wards (as often seen in historic hospitals). The first one allows obtaining a functional block with two or more internal corridors, but at the cost of lack of illumination of some of

the rooms. In return, we can be confident that we will properly solve the complex functional dependencies, with the correct connections to other hospital departments, with good zoning and access control – but for the price of readability of the space and dehumanization, establishing an anonymous space, posing difficulties in spatial orientation. The second one works well in a set of small, low complex assemblies or as a basis for single-use department. This system leads to establishing radial layout with separate functional blocks and an extensive inner communication network. Of course, there are a lot of possible combinations; a "tower" is one of them – with an inner corridor system reduced to minimum thanks to use of vertical communication. When there are one or two extensive ground floors with diagnostic and treatment departments, set in a multi-span grid, with a vertical block of hospitalization wards based on a two- or three-span grid, we have got a regular modern hospital building. Of course, this does not mean that these are the only possible solutions and in such configurations. Theoretically, adopted grid can take any form, from the simplest, rectangular, to a grid based on other geometric figures, the completely free form.
Issues related to the design of functional layouts can be grouped in such categories:

- Layouts of bed wards, providing both the isolation and privacy for patients as well as easy access to treatment and diagnostic departments and the correct relationship with the outdoor recreation areas and easy access of visitors.
- Functional optimization of treatment and diagnostic departments, with a special role of implementing new technological solutions.
- System of intra-hospital communication, interior public spaces, green areas and inner courtyards as elements of way-finding.

3.3 Hospital architecture

Issues described in the literature as "innovative" are not the hospital architecture specialities – any action leading to build and implement energy-efficient or pro-ecological facility, using the local tradition, should be regarded as legitimate and worthy of promotion. The problem arises when we ask ourselves the question: what architecture can be regarded as innovative in relation to the exclusive category of health-care facilities? Apart from issues arising from medical technology (which from the facilities' user point of view need not be obvious), these issues can be reduced to the following assumptions:

- Social expectations of high quality hospital architecture and environment: the pursuit of "individualization" of space by creating high standard bed wards with single- or double-bed rooms, the use of human scale in architectural solutions, strong focus on creating space for a "well-being", implementing local and traditional construction solutions.
- Humanization of hospital procedures by creating a friendly space to the patient or by the introduction of green zones, building architecture in contact with water, adequate use of colour, placing the interior decorative elements.
- Ease of orientation by creating a communication axis running through and connecting the hospital public spaces (atriums, courtyards) with the use of natural lighting (skylights, corridors running along the inner courtyards).

Figure 6. Views of the hospital, as designed

The above solutions may lead to the creation of human-scale hospital architecture and environment. The hospital interior, besides its purely medical or technological status, can play a therapeutic value, spatial harmony leads to the humanization of technology and patient well-being.

4. CONCLUSION

The creation of an extensive, comprehensive health-care system requires not only the political, social or organizational will, not only the relevant medical, technical, economical knowledge, it requires above all a huge financial effort. In conditions of economic deficiency or even failure, it is impossible to set up a proper system of complementary elements. One can argue that such a full and available for all system can never arise, in any economic and social conditions. One of the critical factors is the rapid depreciation of a hospital building – its infrastructure, medical equipment, or even medical knowledge. Period of several years, devoted to planning, design and

implementation of a hospital investment means that the primary functional or organizational assumptions may change at the time of hospital opening.
Implementation of innovative solutions should be preceded by determining the strategy of health-care system and defining tasks for each of its elements. Quality and quantity of elements of the system depends on local conditions, especially on access to other health-care facilities (meant as a time factor, it is assumed that access to a county hospital emergency department should take no longer than 15 minutes). In polish conditions, with a system of universal health insurance, the State take on the role of coordinator, managing the development of network of:

- Hospitals with various degree of specialization, with particular emphasis on the role of academic hospitals as centres of highly specialized medical services and county hospitals as primary care, creating thus a network of public hospitals.
- Specialty hospitals as a medium level of medical care, both public and private, intended to serve as regional centres.
- One-day hospitals based on the full diagnosis and therapy, but without any hospitalization department, supported by rehabilitation facility.
- Automated hospitals, designed for innovation in fields of robotics, automation and telemedicine, preferably as university hospitals.
- Mobile hospitals as part of a system of rapid response to mass threats, for example in case of a disaster (based on field military hospitals).

The basic role in the system should play the network of public county and university hospitals; it is the only way to comply with the constitutional provision of universal access to the health-care. Such a network should be the basis and starting point in creating new supporting solutions. Without ensuring that basic infrastructure every effort to build innovative solutions could be seen only as novelties or curiosities, not as a real innovation. Considering all of these issues, the county hospital in Kwidzyn can fulfil its role as a medium size, primary element of the health-care system and to meet this role it requires a thorough expansion of the facility, with a total reorganization of the way it operates.
Objectives achieved in the outlined design solutions can be divided into several categories, according to the previously discussed issues:

- Structural and functional system: The structure of the historic building has been preserved and features that do not require flexibility (susceptibility to transformation) are entered into it without any major changes. This applies mainly to administration and bed wards (with minor adjustments to meet high standards). These functions are indicated in Fig. 4 and 5 with dashed lines. Complete transfer of diagnostic and treatment departments to newly designed wing and connecting their functional system to the construction module allow future flexibility. This applies especially to the laboratory (D on Fig. 4), central sterilization (B on Fig. 4), operating suite (F on Fig. 5) and delivery room (not show, the top floor). Thus solutions for the further development of the hospital have been separated and leaving the historic building with traditional hospitalization wards.

- Intra-hospital communication: Expansion of the hospital by adding more items to the already complicated system may result in the creation of functional arrangement far beyond the scale of human perception. Using a construction and support module as a design module helps to organize hospital layout and to make it possible to obtain a relatively simple functional system. Central communication with a vertical core allows creating of radial corridors system. This solution reduces to minimum access to patient care areas in all hospital departments (marked with A or light-gray colour in Fig. 4 and 5). Despite the extent of the hospital layout all functions related to direct patient services are grouped around this communication core. Additionally, spreading corridors open up to three internal courtyards; in one of them there is left nearly 100-year-old tree. It emphasizes the natural landscape of the courtyard, but also it is a part of orientation.
- Building architecture: Extension of the historical building is always controversial. The basic question always refers to the scale of intervention into the existing fabric of the building; how much new action preserves the original layout or how changes it. In the case of the hospital in Kwidzyn the function as an aim has prevailed. Analyses of the potential ways to achieve this goal without significant interference with the historical building have led to the conclusion that it is a difficult task, if at all feasible. The scale of the original building (Fig. 1) does not fit in the requirements of modern medicine, although it is possible to maintain hospitalization functions. On the other hand in the modern hospital bed wards stay in the minority. It has been therefore decided to refer to the architecture of the inter-war expansion (Fig. 2). Retaining the scale and height of the original building it has led to a result in which historical background for takes its part in a contemporary solution (Fig. 6).

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