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Intelligent buildings – Architecture vs. Technology

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Paper presents the perception of intelligent building from electro-technical point of view in field of Hong Kong's definition of building intelligence. Paper briefly describes the movement from electronically overfilled building into green – source efficient intelligent building and emphasizes the fact, that architectural concept should be closely tied up with technology and vice versa.

Animal structures in nature (termitary, hives etc.) are characterized by ingenuity and high optimality; they use efficiently natural elements of their own surroundings. These buildings do not need any equipment or control system, whiles provide ideal conditions for the survival of individuals living in them. Human structures are responsible for the largest share of primary energy sources consumption (about 42 percent) therefore actively influences the destruction of the environment. None of the higher animals ravage environment in which it lives.

The marketing label "intelligent building" is often associated with luxury villa, stoned with electronics, allowing the management and administration of nearly all processes joined with the use of the building from air conditioning, heating, lawn watering to automatically food ordering. When we take a look around, we need to determine the intelligent building as a building, which affords high quality indoor environment with minimal consumption of resources and minimal impact on the environment [1][2]. This fact is confirmed by the Energy performance of building directive (2002/91/EC), which was established due to the high negative impact of buildings on the environment and not because of purposeful energy saving. (Mentioned directive was innovated by SEP Directive 2010/31/EU strategy known as "20-20-20″)

The proposed process for intelligent/resource efficient building in all subsystems determines the path of sustainable living on earth for all human beings. Above all technical proposals, solutions are always a man as the creator and user. Savings, efficiency and friendly approach to the environment will always depend on awareness of needs and of our self and also will depend on our relationship to our surroundings/nature. Each one of us can always choose which path to take, either create a building in harmony with nature, according to their natural requirements or a building with a lot of untapped features and spaces, which are contributing to the wasting of resources and destruction of our nature.

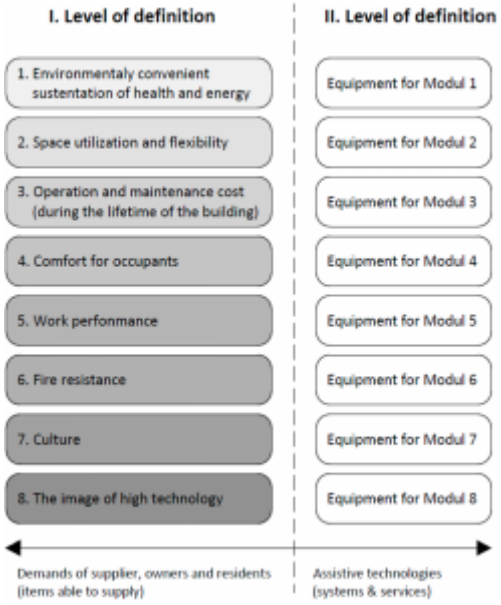
Building intelligence?

Inappropriate architecturally and technologically designed building with superb control technology will still be a poor building with excellent control. This building will have still worse characteristics as a building with optimal design (construction, orientation, used material, well design technology) without control system (or with a simple CS). It is therefore evident that in mentioned context, intelligence is afforded by optimal building architectural design concept and technology. The control contributes to the second level of building intelligence supplementing architectural concept.

This fact reflects the Hong Kong definition of intelligent buildings, which defines it as:

Intelligent building is designed and implemented by appropriate selection of quality environment modules to meet user demands, and building appropriate equipment is chosen to achieve long-term value of building. [3]

This two-level definition, the 1st level includes demands of supplier, owners and residents, the 2nd level includes technologies and management control and is consisting of eight modules



All eight modules form represent the first level of definition. On the second level are some numbers of key elements or devices that can be expanded. To each of the key modules are assigned equipment in an appropriate order of priority. [4]

Environmentally convenient sustentation of health and energy

Properties of the architectural concept:

Represent materials, structures and processes that are environmentally friendly and are source-efficient throughout the life cycle of the building, from material excavation, construction, production, operation, maintenance, renovation and demolition. [5]

Adaptive… devices and technologies:

Represent the “soft” construction process, the production of materials and

technologies, implementation of active structure elements (photovoltaic windows / walls, energetic roof, etc.).

Space utilization and flexibility

Properties of the architectural concept:

The concept allows flexibility, versatility, mobility and elasticity. Quick and inexpensive reconstruction of spaces disposition (change layout – e.g. company hired the entire floor, it needs to adapt the spaces as quickly as possible and also as cheap as possible)

Adaptive devices and technologies:

Evidence of rooms functionality filling, the adaptation of technology (especially HVAC) in terms of flexibility (floor heating is better than convection heating, etc.), "smart" wiring etc. All elements quickly response to owner change

Operation and maintenance cost (during the lifetime of the building)

Properties of the architectural concept:

The disposition, shape and mass of the building optimally use heat gains and heat loss (reduce heating costs, reducing air conditioning requirements). Maximum use of daylight and the elements (energies) of environment (utilization of rainwater and so on). Optimal suggested pipes (water, gas, HVAC etc.) to achieve the shortest distance and avoid unnecessary losses.

Adaptive devices and technologies:

Efficient HVAC (electricity – saving lamps, the combination of natural and forced ventilation … water – saving shower heads, thermostatic mixing … heating – good source of heat energy, thermo regulators, renewable energy and energy environment – solar collectors, heat pumps.) Automated external blinds. Control system integrating the various subsystems with corresponding logic control.

Comfort for occupants

Properties of the architectural concept:

Using natural materials that ensure quality internal environment, layout space, daylight, and psychological and ergonomic factors of architecture. Proper building connection on the existing infrastructure for example: communication network.

Adaptive devices and technologies:

The optimal rate of intelligence comfort / discomfort, simplicity and purposefulness of control and system interface. Multimedia and other services (audio – visual center, electronic shopping…). Central and remote control. Operational control and using the telephone or any other functions requested by users.

Work performance

Properties of the architectural concept:

Acceptation of the users diversity (different sense, physical and mental limitations – e.g. barrier free) multisensorial presentation. Use “green elements” as the active part of the building (green outdoors or indoors (atrium) influence favorably and lasso as a barrier – acoustic, dust, etc.).

Assistive devices and technologies:

HVAC qualifying creating high quality and productive efficiency of the internal environment, the required air exchanges, thermal comfort. Elimination of sick building syndrome and related illnesses (SBS – sick building syndrome, BRI – building related illness) – adapting the control system (change of homogeneous conditions of the internal environment) automation of operations and services, communication networks, local operating networks, connectivity etc.

Fire resistance

Properties of the architectural concept:

Materials, layout, minimization of critical bottlenecks (escape paths – scenarios simulation), and compliance with standards for fire safety (STN 730821, STN 730833, STN 920201, STN 730861), etc.

Assistive devices and technologies:

EPS, IB subsystems adapt to fighting a fire, lighting of escape routes, changing the ventilation system in case of fire, radio. Call for help, people evacuation…

Culture

Properties of the architectural concept:

The use of traditional design and construction, heating systems (brick oven), and traditional passive solar shading systems (roof overhang – shade in summer, light in winter)

Assistive devices and technologies:

Equipment and technology respecting cultural traditions and nature of people. Using proper technology and the corresponding level of control system.

The image of high technology

Properties of the architectural concept:

“An image” of architectural concept. The unique design.

Assistive devices and technologies:

High-end technology. HVAC latest technology, control and multimedia systems.

Architecture vs. technology

The ration of transparent and nontransparent areas, building orientation, dispositional solution, shape factor, the choice of materials and other factors significantly influence the performance of buildings. It is clear that the key word during creating intelligence building has an architect, but it is nevertheless necessary to consider the building as a whole, i.e. the synergistic combination of architectural and construction technology, because many cases in practice demonstrates a situation where the architect created building with nice design and interesting disposition, but with small or almost no matter to the technology, whose implementation is often necessary to achieve the required quality of the indoor environment (especially for office buildings). As a result, problems often occur when the implementation of technologies or control system requires additional demolition or construction work (whether in new or renovated buildings) only because the fact, that architect underestimated the requirements resulting from use of mentioned technologies.

Intelligent, source and energy efficient building

The building as a productive and cost effective space must reflect the source and energy efficiency as well as economic reasonability of the whole as well as in parts (building construction, technical equipment, services – control and their interrelationships).

Optimal design of the building must include requirements in the areas of electrical engineering, computer science, engineering, building services, psychology, sociology, architecture, ergonomics, and many other disciplines. This proposal therefore represents very difficult optimization problems. Just optimal proposal is most apparent in the energy requirements of buildings (influence building impact on the environment).

It is necessary to emphasis the fact that inappropriately designed (architecturally and technologically) building concept with superb control of technologies will still be poor building, with excellent control, proving worse characteristics than the building with optimal proposition without control system (or with a simple control system). Therefore is essential that architectural concept should be tied up closely with technology and vice versa.

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