**Intelligent architecture**

Intelligent architecture refers to built forms whose integrated systems are capable of anticipating and responding to phenomena, whether internal or external, that affect the performance of the building and its occupants. Intelligent architecture relates to three distinct areas of concern:

* Intelligent design;
* Appropriate use of intelligent technology;
* Intelligent use and maintenance of buildings.

***Intelligent design*** requires that the building design responds to humanistic, cultural and contextual issues; that it exhibits simultaneous concern for economic, political and global issues; and that it produces an artificial enclosure which exists in harmony with nature. Existing in harmony with nature includes responding to the physical laws of nature and the proper use of natural resources.

***Appropriate use of intelligent technology.*** The mere availability of a large variety of smart materials and intelligent technologies often results in their use in inappropriate situations. Integrating intelligent technologies with an intelligent built form that responds to the inherent cultural preferences of the occupants is a central theme in intelligent architecture. As an example, in areas where people place a high premium on operable windows for conservation of electricity, the most appropriate and efficient air- conditioning strategy for a building may be the use of thermal mass and night- time free cooling instead of a high- tech air- conditioning system. In other cases, the use of carefully selected electric lighting and environmental control strategies may be more appropriate.

***Intelligent use and maintenance of buildings***. Truly intelligent architecture incorporates intelligent facility management (FM) processes. For a design to be intelligent it must take into consideration the life cycle of a building and its various systems and components. Although an intelligent building may be complex, it should be fundamentally simple to operate, be energy and resource efficient, and easy to maintain, upgrade, modify and recycle. Materials and equipment that require complex maintenance and unhealthy cleaning agents, and building components that must be treated as hazardous waste in the recycling process (e.g. mercury in light- bulbs) would not be used in a fully developed intelligent architecture.

**Intelligent and responsive building façades**

The character of the building envelope will be affected dramatically by the development of intelligent buildings. Façades designed to integrate a host of emerging technologies will have an inherent ‘intelligence’ and be able to respond automatically, or through human intervention, to contextual conditions and individual needs. Intelligent façades currently can:

* Be centrally controlled while still providing the occupant with the ability to manually override the system;
* Change their thermophysical properties such as thermal resistance, transmittance, absorptance, permeability, etc;
* Modify their interior and exterior colour and/or texture;
* Function as communicating media façades with video and voice capabilities;
* Change optical properties and allow the creation of patterned glazing, providing
* the opportunity for dynamic shading and remote light control.

The development of the intelligent and responsive façade necessitates the redefinition of the terms ‘window’ and ‘wall’. With the introduction of new glazing and wall assemblies, what is ‘transparent’ may become ‘opaque’ with the flick of a switch. Central controls for intelligent façades will respond to climatic conditions by transforming the building envelope to optimize heating and cooling loads, daylight utilization, natural ventilation, and so on. Intelligent façades will transport daylight deep into a building’s interior and allow the occupants to determine the degree of luminous, acoustical and thermal comfort required along with the degree of visual and acoustical privacy provided by the enclosure.

Additionally, we can now imagine interior partitions that will allow the occupants to transform the aesthetic quality of their working environment whenever and however they choose.

The idea of the intelligent or smart system, originally applied to electrical, mechanical and aerospace systems, recently has been extended to include civil

structures as advances in sensing, networking and new materials have made continuous monitoring and control of structural functions a realizable goal.

By definition, the intelligent structure has the capability to identify its status and optimally adapt its function in response to stimuli. The major focus of the intelligent civil structure has been on two areas:

* Identification of structural behaviour or properties (e.g. deformation, energy usage or damage evaluation);
* Control of structural response to stimuli, whether external (e.g. wind or earthquake) or internal (e.g. acoustics or temperature variation).