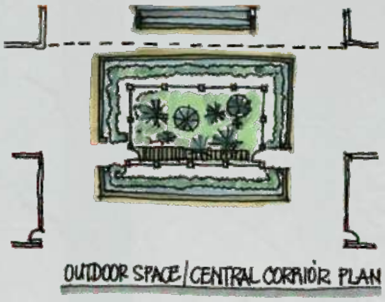
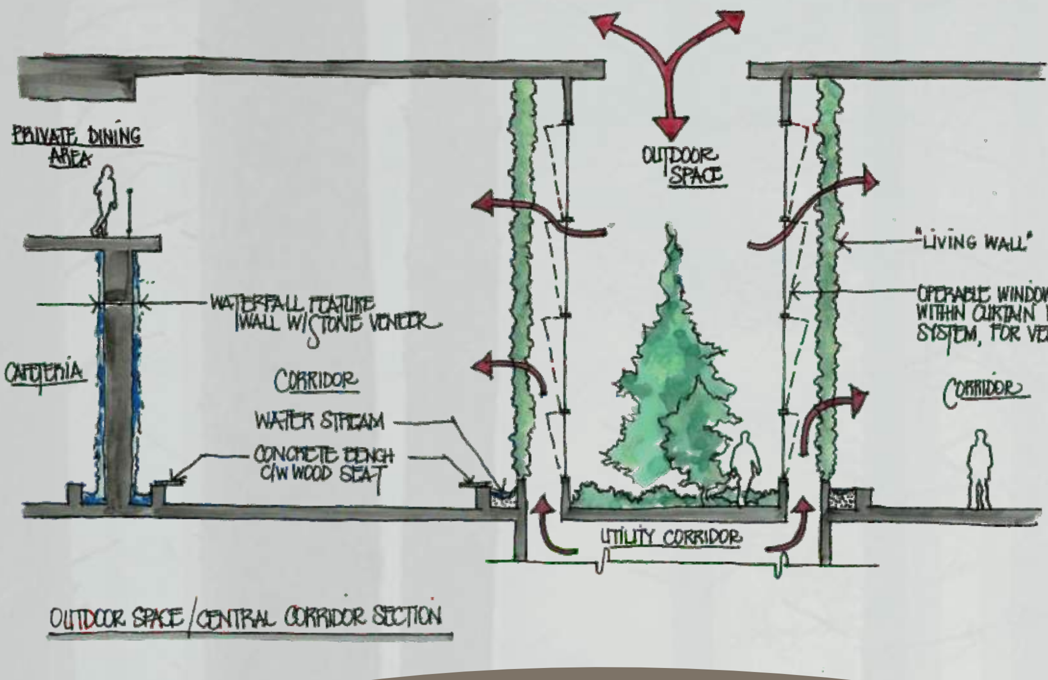
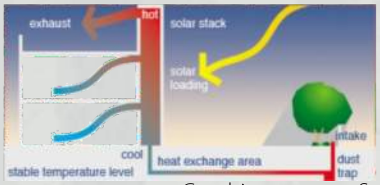
Energy Efficiency and Interactive Buildings

White Paper and Case Study







Graphics courtesy Sahuri and Partners Architects

Mechanical
Electrical
Communications
Lighting

Audiovisual
Security
Risk
Commissioning

Partners from concept to completion

The Interactive Building and its role in Energy Management and Energy Efficiency
By: The Hidi Group Inc.

The Interactive Building is a natural evolution of the Intelligent Building, depending on sensory feedback from systems of all descriptions.

So what, exactly, is an "interactive" building? First of all, an Interactive building is an "Intelligent Building". A property developer in Hong Kong once told us that the definition of an Intelligent Building is a building that is 'fully leased, because if it is not fully leased, it is a dumb building'. That flip - but not inaccurate comment aside - the answer, of course, depends largely upon to whom the question is posed. There are several distinct definitions of what comprises an intelligent building. At a minimum, intelligent buildings are comprised of supervisory systems that 'knit together' the multiple systems of a modern building . This could include the ability to sense comfort levels within a given space and make appropriate modifications. Also included could be the ability to effectively monitor fire and life safety subsystems and to react in an efficient, effective manner to any situation reported by the subsystem. Clearly, there are variations in building intelligence levels, with the highest levels making the term "Interactive" appropriate. Buildings which have been designed to take advantage of structured cabling as well as spatial, environmental and utility monitoring will be more intelligent than those that utilize only integrated systems and semi-structured cabling.

Generally, interactive buildings are engineered and designed for low consumption of utilities (water, power, gas), affording lower tenant and building management costs. The interactive building takes advantage of integrating separate "islands" of intelligence (data processing, telecommunications, audio, video, television, wireless networks, paging, fire and life safety, security, building controls, etc.) for efficiency and marketability. Accommodating the rapid and efficient change of technology to enhance worker productivity is yet another interactive building design goal. Happy workers are more productive workers.

The interactive building is one in which sensors of many different types adjust the building to meet the immediate –and long term-needs of the users and operators. These sensors are arranged into various networks that return information from each room in the building and from exterior surfaces. Examples of sensor types currently available include temperature, humidity, human occupation, light, heat (and heat sources), vibration & position, pressure and vacuum , water detection, smoke & gases and sound. These sensors help the building to 'interact' with both its external environment and with the users needs within the building. Rapid development and miniaturization/cost reduction of sensors and associated low-cost wireless-mesh control networks, have enabled the evolution of intelligent buildings into interactive buildings. Sensors by themselves do not make the building "interactive". There needs to be computational power and software programs deployed that direct that sensor input to produce a desired result. The intelligence is in the programming of the sequence of operation.

Interactive buildings accommodate different technologies and provide a full complement of hardware and software controls for managing the systems necessary to provide the contemporary commercial or residential space with appropriate technology. These systems include power, telephone, heating and air-conditioning, environmental management, building management, personnel management, security management, etc. An interactive building must also dedicate environmental and spatial requirements for system hardware. Further, the interactive building must provide the thermal quality, physical safety and security, air quality, acoustic quality, visual quality and building integrity that prevents premature obsolescence. Finally, the interactive building must accommodate the ever changing technological advances supporting current and long-term tenant environments. This is accomplished by the planning and implementation of pathways and spaces within the buildings that support multiple generations of technology 'refresh' as they become necessary. These 'smart spaces' are the backbone behind the interactive building.

Considerations for Minimal Energy Use

In the broader context of what it means to create and enable Energy Efficiency and Energy Management in any building project, we use the following list of considerations to determine which is suitable and cost effective for the project:

1. Climate - climate drives every decision
2. Daylight harvesting – use as much of the daylight as is possible to reduce lighting loads
3. Lighting Controls – microzoned with occupancy and daylight sensors and dimmable control
4. Fresh and Sea Water condenser cooling – if a body of water is nearby, use it to cool the building through heat exchangers
5. High performance glazing and fixed shading
6. Dynamic exterior shading – prevent the suns heat from heating up the building, unless it is desireable
7. Double-skin exterior walls creating chimney ventilation
8. Geo-thermal heating/cooling using ground-source heat pumps
9. Full Building Automation System controlling every system in the building, with Integrated controls for all systems
10. Variable Speed motor drives
11. Condensing gas boilers
12. Absorption chillers – especially cost efficient if there is a supply of steam nearby such as is available near a geo-thermal vent or as part of a co-generation system.
13. Ice Thermal Energy Storage – take advantage of cheaper night-time electricity costs by building ice at night and melting it during the day.
14. Heat re-claim chillers
15. Radiant heating and cooling
16. Waste heat from Industrial processes
17. Photo-Voltaic and Wind generation of electrical power
18. Passive Solar for hot-water generation
19. Micro-turbines – especially useful when well-head gas is available
20. Demand-control ventilation – only provide ventilation where there are people!
21. Underfloor Air distribution
22. Energy-Star appliances
23. Favourable building orientation – position buildings to be shaded or exploit natural wind currents or reduce surface area to the sun.
24. Rainwater harvesting
25. Gray/Black water harvesting and re-use
26. "Kyoto" cooling for Data Centres
27. Water efficient plumbing fixtures
28. Sensor networks, especially mesh wireless sensors
29. Personal Environmental controls
30. Heat Recovery Ventilators
31. "Living roof's and living walls"
32. Operable windows
33. Use exterior and high-efficiency insulation to prevent exterior heat or cold from penetrating to the occupied interior
34. Choice of materials that have low life-cycle costs and are re-cycleable.

Case Study

These considerations are in addition to energy-efficient methods that the Architect will employ in a project. LEED certification is certainly a consideration as well. The Architect, Owner and Hidi Rae work together during the Conceptual Design phase so as to set the direction for the project. An example of this collaboration on a project is the current work that Hidi is doing with Sahuri and Partners Architects for a large residential and office development for Total Energy in the Oil Sands of Northern Alberta, Canada. Good design and energy modeling at an early stage can result in beautiful and comfortable low-energybuildings even in the most extreme of climates . This project is in Fort MacMurray, Alberta, where the temperature is below 0 degrees Celsius for 5 months of the year, and with extended periods when it is –20 deg C or colder. Although this is quite the opposite of the high temperature environments of the Middle East, the considerations and design principles to accommodate low energy use in these extreme climactic conditions are very similar to the techniques needed for projects in the Gulf or other extreme climate locations.

The Athabasca Community Village described herein is a collection of buildings including a large low-rise residential and sports/entertainment compound, an office building and three mid-rise residential blocks. The area enclosed by the buildings is in the region of 100,000 sq.m, accommodating over 1500 personnel. The project is designed to accommodate both long-term and short term workers employed by Total Energy in their Oil Sands mining and processing operations. Total Energy desired a beautiful complex that was easy to maintain and that had as a goal a 'zero-carbon footprint'. As a result of this brief, the project includes many of the items in the list of considerations presented above.

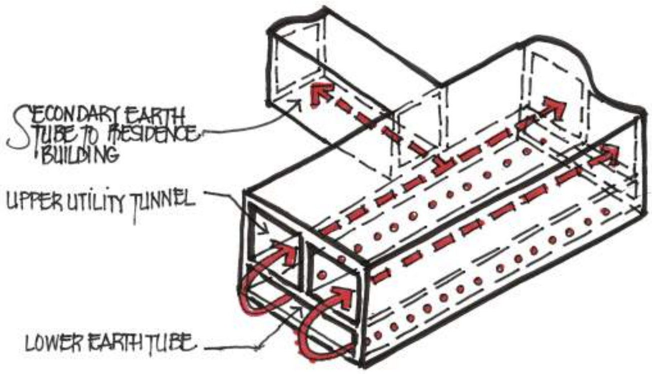
This is a good example of an interactive building project, where form and function are beautifully expressed.

TOTAL

ATHABASCA COMMUNITY VILLAGE

Graphics courtesy Sahuri and Partners Architects

AIR DISTRIBUTION
POTABLE WATER DISTRIBUTION
GRAYWATER
BLACK WATER
FIRE SUPRESSION
POWER DISTRIBUTION
IT & COMMUNICATION
SERVICE / MAINTENANCE ACCESS

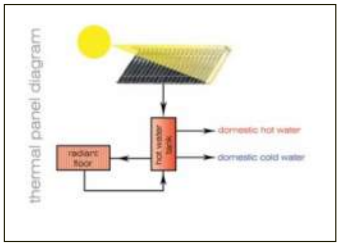


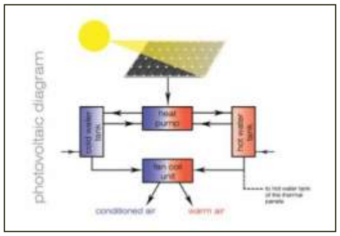
- Earth tunnels are ventilation shafts below grade that utilize ground temperature to pre-condition interior air
- Earth tubes have the potential to temper air +/- 8-10 degrees from the source air temp without heating or cooling
- Unified Resource Systems Network creating efficiency on all levels
- Central distribution of air, water, power, communications access

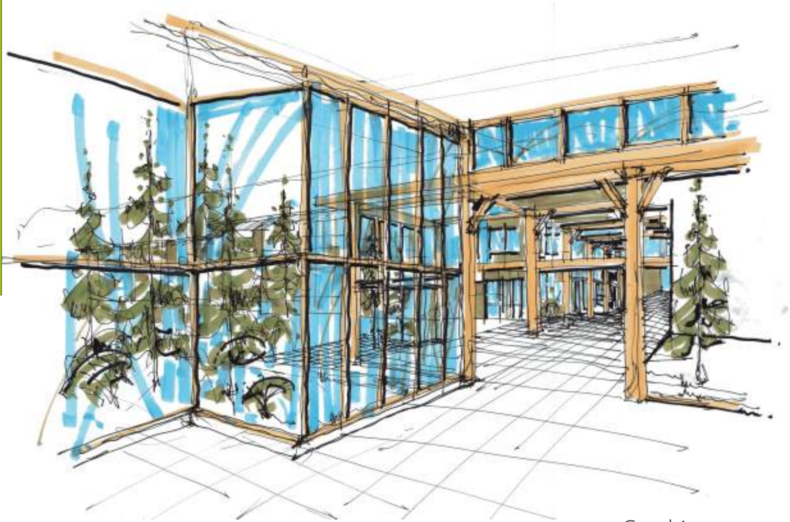
SECONDARY EARTH TUNNEL

ELECTRICAL

- Photovoltaic roof mounted array will support approximately 70 percent of the common area lighting
- Integrated occupancy and daylight controls
- High efficiency lamps and lighting design strategies
- Daylighting will be maximized throughout the facility without compromising thermal performance







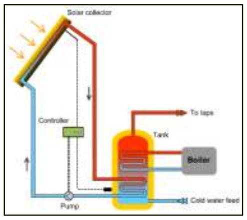
ELECTRICAL GENERATION & ENERGY MANAGEMENT

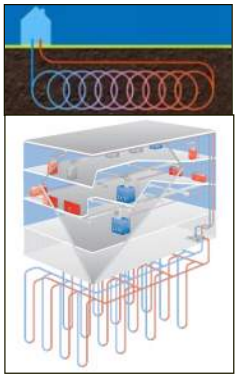
Graphics courtesy Sahuri and Partners Architects

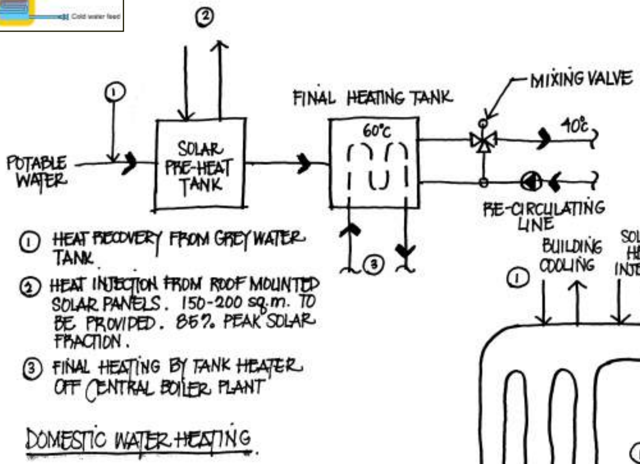
MECHANICAL SYSTEMS

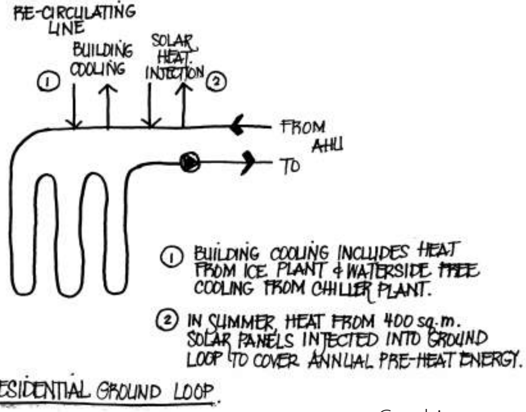
- Grey water and rain water collection storage and treatment
- Non-potable water used for toilet / urinal flushing and irrigation
- Black water treatment and combined energy extraction system
- Solar hot water heating for pre-heating water and to offset fossil fuel consumption
- Thermal storage ground loop
- Arctic corridor continues natural ventilation, semi-conditioned air circulation and green roof amenities
- Green planted wall components in the arctic corridor neutralize air pollutants and odors
- Water efficiency will be heightened through fixture and grey water re-use

MECHANICAL SYSTEMS OVERVIEW



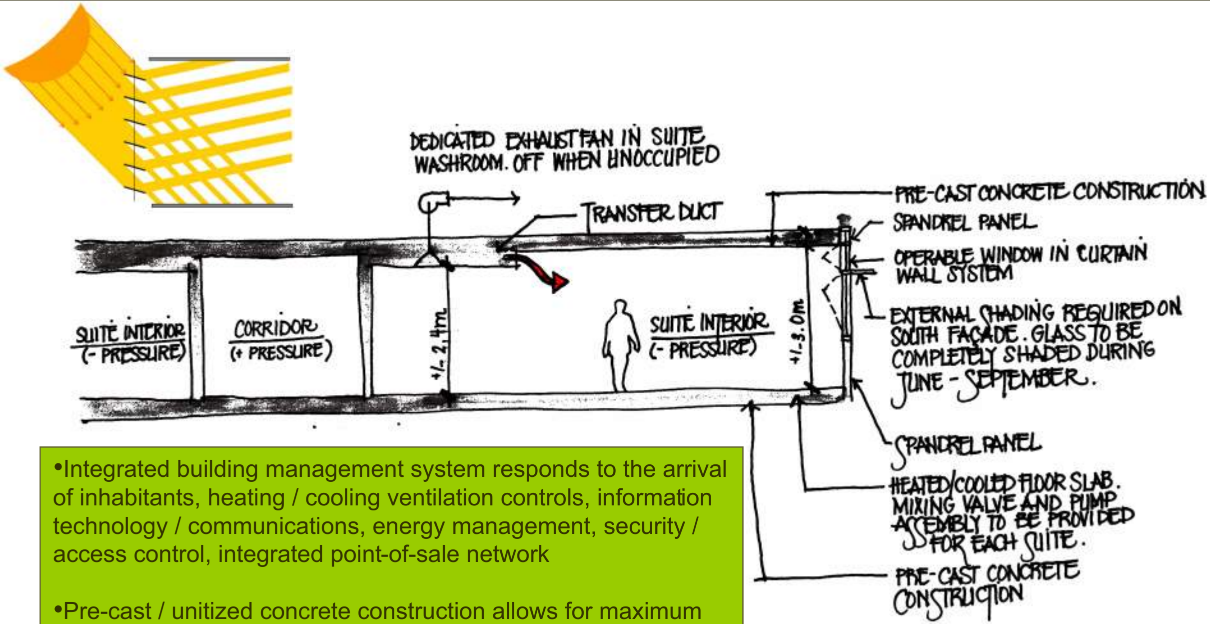






THERMAL STORAGE ENERGY MANAGEMENT

Graphics courtesy Sahuri and Partners Architects



•Integrated building management system responds to the arrival of inhabitants, heating / cooling ventilation controls, information technology / communications, energy management, security / access control, integrated point-of-sale network

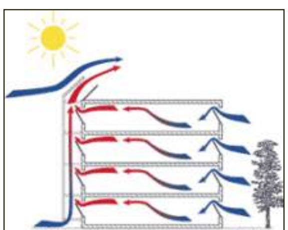
•Pre-cast / unitized concrete construction allows for maximum on-site construction efficiency

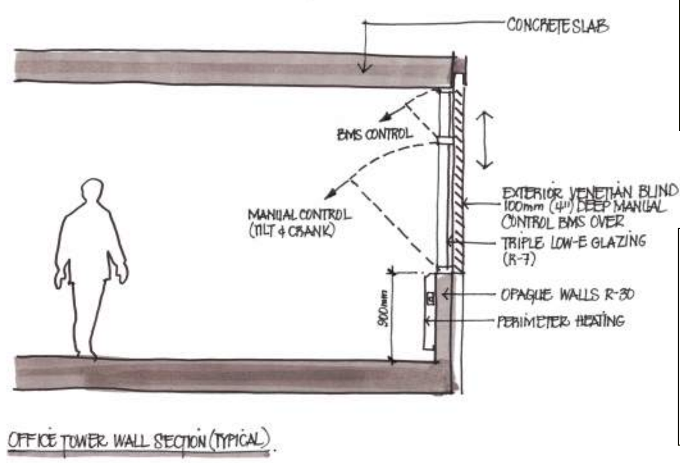
•Thermal mass characteristics of concrete minimize demands placed on mechanical systems reducing energy usage and prolonging mechanical system lifespan

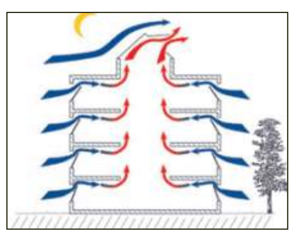
DAYLIGHT HARVESTING, STRUCTURAL AND BMS

•PASSIVE SYSTEMS
- •Natural ventilation captures easterly winds
- •Orientation to South
- •Shading on West and South facades to minimize solar heat gain
- •Potential with this program element is to create a net zero carbon emissions building

•ACTIVE SYSTEMS
- •Heat recovery – renewables, photovoltaic, low-e glazing







PASSIVE AND ACTIVE ENERGY MANAGEMENT

Graphics courtesy Sahuri and Partners Architects

About The Hidi Group Inc:

When you entrust a project to Hidi, you will experience partnership from concept to completion. As a full service Mechanical, Electrical, Lighting, Commissioning, Audiovisual, Security and Communications consulting firm, we have amassed an extensive portfolio of work on some of the finest properties for leading architects and developers in North America, Europe and Asia. Since 1975, we have provided practical, effective solutions for diverse needs and budgets in the residential, commercial, retail, healthcare, hospitality, and institutional sectors. The breadth and depth of our team's expertise place us in the ideal position to partner with you on your entire range of projects, including the most challenging, while maintaining an exceptional level of quality and service.

Sustainability

Reducing the environmental impact of your buildings is an important priority for Hidi and we introduce sustainable elements early in the project through our integrated design process. This process implements the most suitable design strategies, identifies the optimum systems and engages the entire design and ownership team in the project's sustainability goals. We are committed to creating healthier and more comfortable and efficient buildings that leave minimal environmental footprints. By getting involved at the earliest stages, we are able to integrate creative design options that are based on the latest developments in building systems. At the same time, we never lose focus on occupant and owner needs.

Our firm is a proud member of the Canada Green Building Council, and many of our staff members are Leadership in Environment and Energy Design (LEED®) Accredited Professionals.


Niagara Fallsview Casino

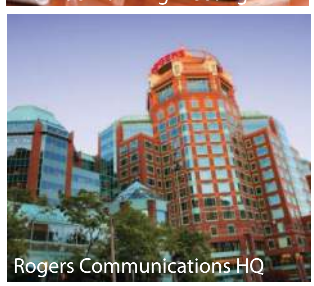

Minto Midtown -LEED Gold


Hidi Rae Planning Meeting


Ritz-Carlton Hotel & Tower, Toronto


Al Rayyan, Sharjah, UAE


Norman Manley Airport, Jamaica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