in the introduction of new technologies in hospitals, technology acquisition at hospital level is usually controversial issue and there are only few formalized or standardized procedures that exist. In addition, there is an increased push from industry's and physicians' little or no role of technology assessment based on objective and evidence based practices but only in comparison to other hospitals that have such having such technology.

Presently, the Health Care Sector in the Arab Middle Eastern countries is experiencing a number of changes to include the following:

1. The public sectors are experiencing some reorganization for more effectiveness.
2. The Private Sector is picking up and is becoming in the forefront of health care delivery in a number of countries in the region.
3. Hospital accreditation is the trend for major hospitals in both the private and public sector some countries even have started local accreditations.
4. Private hospitals have a big competition among themselves to acquire the latest Health Care Technology without thorough analysis and assessment.
5. There is a big competition between private sectors to attract patients and provide better services.
6. Health care tourism within the region and or from out side the region and even from western countries is picking up with serious marketing efforts being taken place.
7. More collaboration between the public and private sectors.

However, cooperation and networking between the countries is lacking, with the exception of some efforts being done even minimal within the GCC Countries. Moreover, there is no systematic review for the needs of the community. As a result, you may find so many major types of technologies within closer proximities as such utilization rates are minimal. For example, it's not surprising to find more than 20 MRIs and 25 Catheterization labs within a major city and most of them are less than half capacity in utilization. You may even find a number of MRI's with 3 teslas within the same city and the same for hi tech nuclear medicine technologies such as PET scanners.

Future Outlook

In order to have an effective technology acquisition and utilization with an optimum outcome and cost-effective application and based on developed and some developing countries experiences the following is recommended:

1. There need to be a National Health Care Technology Policy and Strategy

The elements of a national policy should include HTA, planning, acquiring and Managing the technologies. This is in addition to political aspects that link it to national health reforms that do not change with cabinet reforms. Usually, Ministry of Health can be the leader and link of such policies or a National Health board for communication and planning purposes.

WHO in collaboration with a different member countries established models of National Health Care Technology policies. Models were incorporated in South Africa, Kenya, Brazil, countries. The national policy takes into consideration HTA, the national needs, priorities and resources.

2. There need to be an emphasis on implementation of HTA collaboration with other developed countries such as EunetHTA and programs established with collaboration with WHO.

3. It's important to network with regional countries with regard to HTA as well to net work with other world wide related societies and associations such as HTAi and INAHTA

4. The association of HTA and regulations at a regional level with world wide perspective will definitely help countries to optimize the use of technology while reducing wastes of resources.

Conclusion

With the advancement of Health Care, the introduction for new technologies has expanded rapidly to involve additional key professionals that include governmental officials, legislative officials and private healthcare executives. This expansion requires industries and suppliers to expand their marketing efforts from the clinical and marketing settings to evidence-based, financial focus and cost-effective justification for the justification of new technologies to advance heath Care.

HTA for medical devices in the Arab Countries is almost nonexistent. As a key stakeholder in healthcare, the medical device industry needs to influence HTA development to become an enabler of patient access to new medical technologies in the region. This is essentially important since the majority of technologies in the region are imported. A National Technology Policy with a strategy to achieve optimization with evidence based decisions is a key to organize a national and regional proper adaptation of new technologies. As such HTA will serve as a tool that helps to move toward this direction.

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Sustainable design for healthcare facilities

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Over the past decade the implementation of Green Buildings has grown exponentially as more building designers, contractors, owners, operators and maintenance engineer are seeing the benefits of Green Buildings. The integration and cooperation of all the building professionals has effectively reduced the use of our resources such as energy, water, building materials etc., and at the same time to reduce the operating costs while in many instances reducing the capital cost of construction and creating the best long term project value.

US Green Building Council developed LEED Green Building Certified, Silver, Gold, or Platinum Certification Ratings. Green Guide for Health Care can be used as a self-certifying guide for best practices in evaluating high performance sustainable building design, construction and operation of the facility. Healthcare projects present both challenges and opportunities in development of a sustainable facility. Some of the challenges are the 24/7 operation of the hospital, infection control, indoor air quality, energy and water use to name a few. Ongoing and growing research of the performance of building systems has provided many opportunities in achieving the goals of sustainable healthcare facilities. Sustainable design does not mean more cost; on the contrary, it could provide lower first cost but typically lower life-cycle cost.

The Middle Eastern countries have an extreme weather conditions with limited water resources. Every sustainable project should be analyzed based on the local environmental design conditions and available natural resources. United Arab Emirates, as an example, took an aggressive approach to be the leader in sustainable building design. Emirates Green Building Council and Abu Dhabi Green Buildings are outstanding resources in sustainable building design. The guidelines are primarily for residential and commercial building but the emphasis on energy water conservation and indoor air quality can be implemented in hospitals.

The recognition of sustainable building benefiting the environmental, economic and social conditions has been integrated into the fabric of the construction industry. Evaluation of hospitals from inception through construction and operations has to make economical sense especially when the life expectancy of a hospital is up to 50 years. The systems in question need to be evaluated for the first and operating costs. Systems with a payback of less than five years should be considered for implementation in the project while systems with payback beyond five years life cycle cost analysis should be considered on a case-by-case basis. Provisions for future connections should be made for systems that can be justified as the cost of i.e. fuel is at a point where it may become economically feasible to implement due to the rising costs of utilities.

INTEGRATED DESIGN PROCESS

During pre-schematic phase an integrated team involving the owner, building designer, contractor and users should set the target plan for sustainable design parameters. One of the tools used during the design is Building Information Modeling (BIM). BIM is an excellent tool in virtual construction of the building where all of the building systems are fully coordinated thus significantly reducing potential change

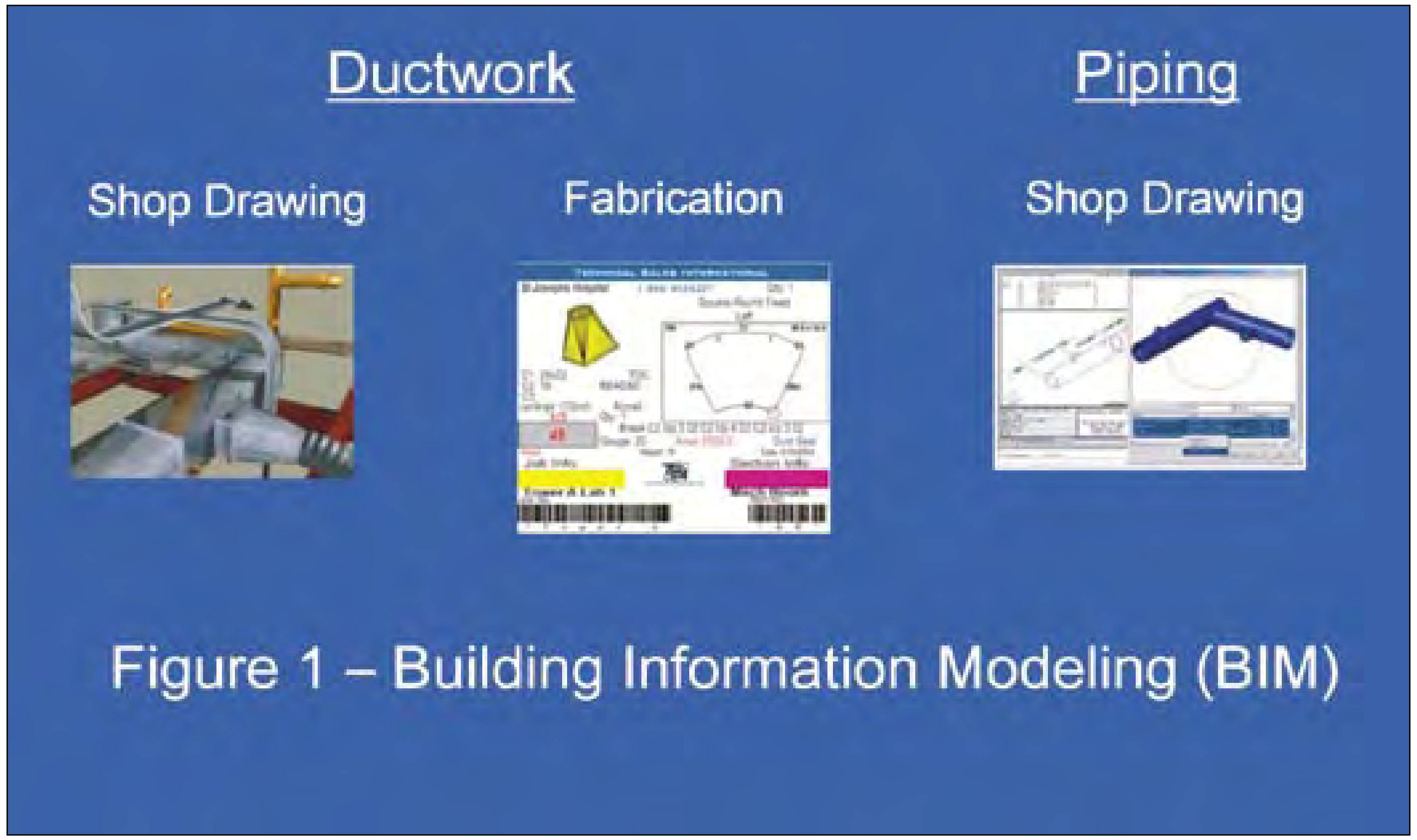

Figure 1 – Building Information Modeling (BIM)

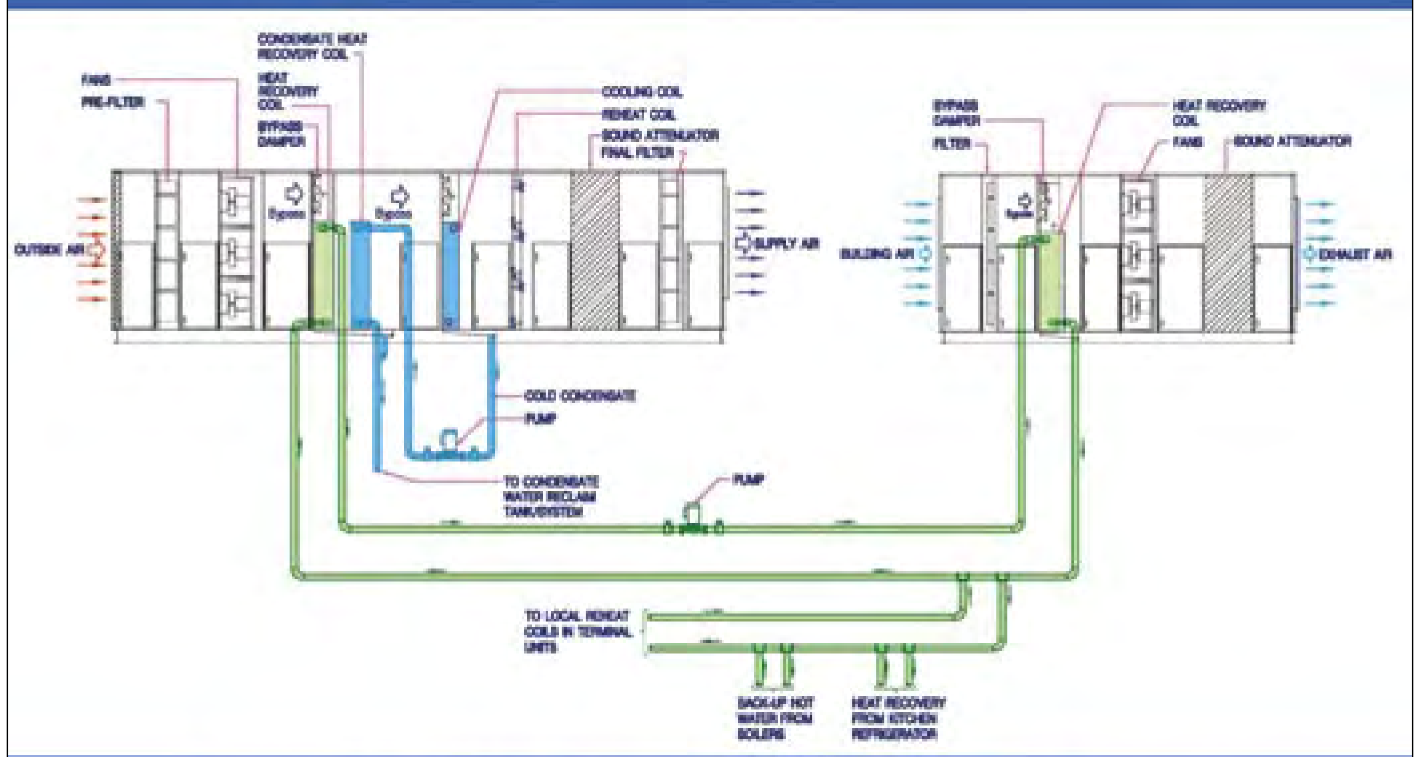

Figure 2 – 100% Outside Air with Heat Recovery

orders. BIM can also be used by the contractor to prepare the shop drawings and fabricate ductwork directly from the BIM generated drawing thus reducing waste of materials and saving time for the project. BIM can also help in spooling piping, for instance, to be fabricated off site for just-in-time delivery (Figure 1). The use of BIM can also help in simulation of the building conditions for energy modeling, selection of the curtain wall, glazing and other materials. Some hospital building owners claim up to five percent project cost savings due to the use of BIM.

WATER

Hospitals have a very high potable water use requirements. If one were to compare a hospital to a hotel of the same bed count, the potable water use of the typical hospital would be approximately three to four times that of the typical hotel. The high demand presents many opportunities for significant water savings.

Use of the high water efficiency fixtures and equipment is the most effective way in which a hospital facility can reduce its potable water usage. There have been many developments in the area of fixture and appliance efficiency in the recent years, allowing for reduced water use without affecting performance. Fixtures and water using appliances with at least 30% water use reduction as compared to conventional fixtures and equipment should be considered.

Monitoring of water usage is recommended to provide information on water consumption so that the users are encouraged to introduce water saving measures. Monitoring devices will also detect water leakage.

Another major way in which potable water usage can be reduced is through water recycling. The waste water from lavatories, showers, bathtub fixtures, mechanical drains, condensation from cooling coils as well as storm water are referred to as grey water are collected and treated for reuse. Code requirements prohibit any use of “grey water” within a hospital building, but treated grey water can be used to offset the demand for potable water for in the site irrigation.

As an innovative design feature, condensate from the cooling coils at about 16-20°C (60-68°F) can be piped to a pre-cooling coil in an air-handling unit, thus extracting cooling energy before it is recycled as grey water.

ENERGY

Hospitals are among the highest energy consuming buildings. Typically up to 50% of the energy is used for mechanical equipment and 20% for lighting. Energy efficient solutions through design innovations should be studied through energy modeling to optimize the building orientation and performance of the building skin considering integration of the mechanical and electrical systems with the building architecture.

Design of the mechanical HVAC systems in the Gulf Region is challenging due to the extreme ambient design temperature and humidity. The design parameters for hospitals are more stringent than for the commercial buildings. For example, ASHRAE recommended, design conditions for Dubai at 0.4% is 42°C db / 24°C wb (107°F db / 75°F wb) for hospitals and at 2% is 69.5°C db / 54.5°C wb (103°F db / 76°F wb) for non-hospital application. This requirement of higher ambient temperature alone increases the cooling load and equipment capacity due to the higher ambient temperatures.

The conventional approach to hospital HVAC design has typically been the three duct (supply, return and exhaust) air systems. Hospitals typically would require up to 50% outside air due to the minimum code air change requirements. Many of the hospital areas, such as emergency department, isolation rooms, bathrooms and soiled utility rooms, etc. must be exhausted. The conditioning of the outside air is one of the main contributors to the size of the air conditioning equipment. As a result, many design innovations have been studied in order to reduce the air conditioning load of the outside make up air. Innovations such as 100% outside air with heat recovery, conditioning of the make up air only with heat recovery, 100% outside air with heat recovery wheel to name a few are considered.

We have found the concept of 100% outside air with innovative design of heat recovery utilizing two duct systems to be the most practical and feasible based on the first cost, energy savings, better indoor air quality, lower use of materials and lower maintenance.

100% OUTSIDE AIR WITH HEAT RECOVERY

The concept of 100% outside system is illustrated in Figure 2. The heat recovery coils are placed in the supply air handling unit and other on the exhaust fan system with piping transferring water from one coil to the other. Assuming a summer design condition, as the building air is exhausted at about 24°C (75°F) the exhaust stream cool air energy is produced in the heat recovery coil transferring cooling energy to the water of the heat recovery coil. Then the cool water is circulated to the heat recovery coil in the air-handling unit supply air stream. The entering design air temperature in Dubai is 42°C (107°F) so as the air passes through the heat recovery coil would be cooled to about 29.5°C (85°F). This is a significant savings assuming for 100,000 CFM, this would be about 200-tons of refrigeration. Further enhancement of this concept is to pipe the heat recovery piping system directly into refrigeration system (i.e. chillers, freezers) gaining all the heat from the equipment instead of the evaporators as would typically be used.

In addition to recovery of heat from the exhaust air, heat recovered from the reheat coils at the air-handling units and from the re-heat coils in terminal units as well. Reheat is used in hospitals to temper the supply air since the volume of supply air is established by code based on air changes per hour and not only by cooling load.

For further energy savings the 100% outside air system allows the use of variable air volume to save energy where minimum outside air changes in the room as required by code can easily be met. The use of variable air volume could reduce the system capital cost due to the reduced sizing because of the diversity in shifting building cooling load as the sun moves around the building.

Hospital code allows reducing the volume of air to 25% when a room is unoccupied. Where occupancy sensors are used to turn off lights, in rooms such as treatment and operating rooms, the use of VAV allows reducing the volume of air to 25% saving fan and cooling energy many hours particularly at night.

DISPLACEMENT VENTILATION

The concept of displacement ventilation has been used in commercial applications for many years. Most of the commercial applications have used the under floor system where the diffuser is at the floor level supplying air into the space. Floor supply air diffuser is not allowed in hospitals. Code requires the supply register to be at least 8cm (3 inches) above finish floor. We have studied displacement ventilation for patient rooms for several years and have tested this concept in laboratories on three different occasions and found it to have a better first cost, indoor air quality, ventilation effectiveness and energy savings. Computational Fluid Dynamics (CFD) Modeling can also be used to analyze airflows and temperature distribution throughout the space as shown on Figure 3. The concept of displacement ventilation on patient room is to supply air near the patient head of the bed at 18.5°C (65°F) instead of the ceiling supply air of 13.0°C (55°F) with the same or lower volume of supply air thus saving chiller capacity and fan energy. Figure 4 illustrates the uniformity of room supply air with displacement ventilation.

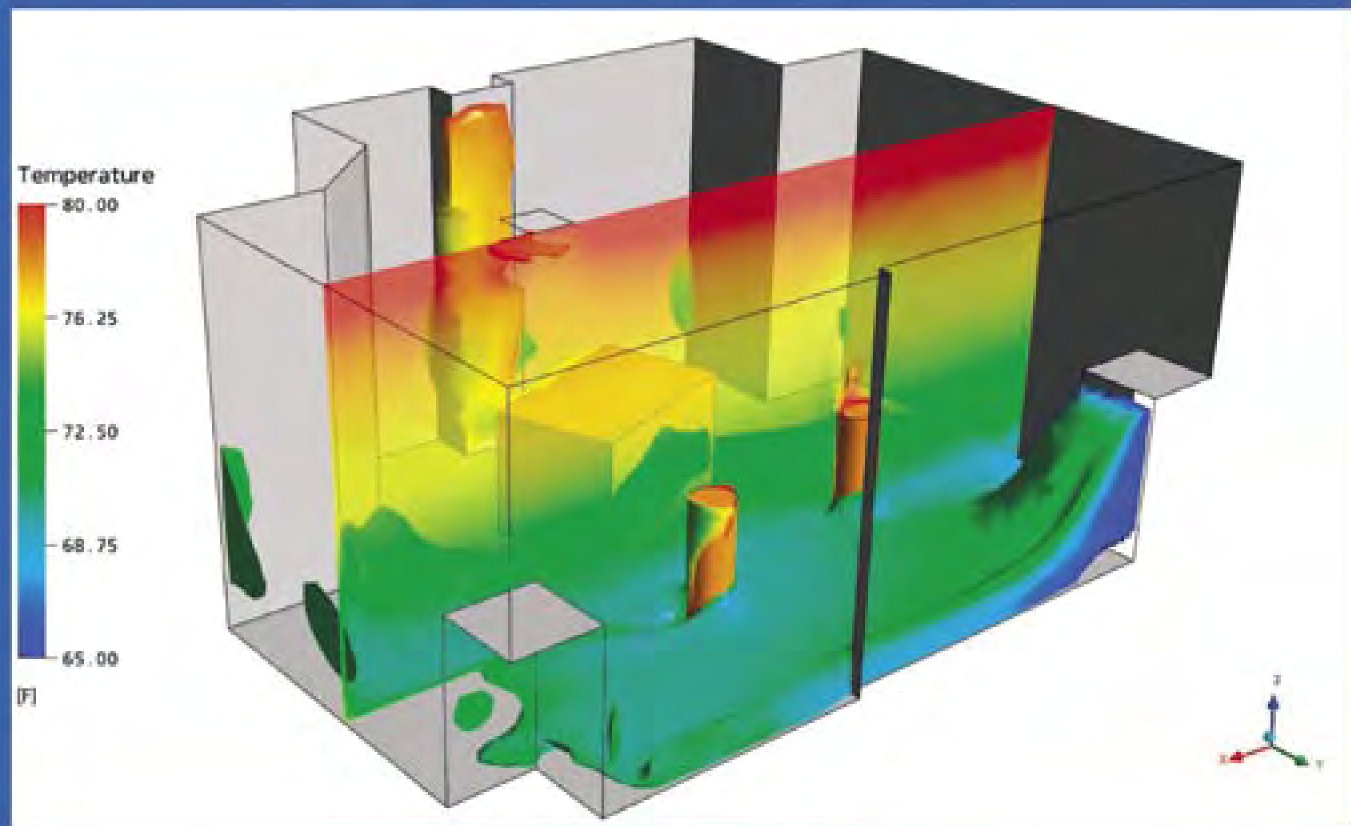

Figure 3 – CFD Modeling

Displacement Ventilation

240 CFM @ 7.2 AC/HR

Cooling: 18.0 °C Supply Air			
Height	Room	Window	Bath
9'-0"			
[illegible]	23.6	24.7	22.2
[illegible]	23.3	[illegible]	[illegible]
7'-0"	[illegible]	[illegible]	[illegible]
6'-0"	22.8	22.5	21.7
5'-0"	22.7	22.5	21.8
4'-0"	22.7	22.3	22.2
3'-0"	22.0	21.9	22.2
2'-0"	21.0	21.6	21.3
1'-0"			

120 CFM @ 3.6 AC/HR

Cooling: 18.0 °C Supply Air			
Height	Room	Window	Bath
9'-0"			
[illegible]	24.1	24.4	21.1
8'-0"	[illegible]	24.4	21.3
7'-0"	[illegible]	[illegible]	[illegible]
6'-0"	23.4	23.3	21.9
5'-0"	23.3	23.3	22.2
4'-0"	23.3	23.3	22.2
3'-0"	23.0	23.3	22.3
2'-0"	21.2	20.5	22.5
1'-0"			

Figure 4 - Room Temperature Profile

DOUBLE SKIN WALL

The concept of double skin wall has taken popularity in the recent years. The concept is implemented in mild to cold climates taking advantage of the solar energy creating warm space within the double skin wall and thus inducing air at the bottom of the double skin wall and discharging it at the top. The use of the double skin wall in the gulf region would not be feasible as described above due to the extreme hot and humid conditions. Instead, the mechanical systems can be designed such that the building exhaust air is discharged into the double skin space at a temperature slightly higher than the building air temperature. Discharging the exhaust air into the double skin space creates a defensive buffer zone reducing the transmission of heat into the building and minimizing the potential for condensation of the outer glass skin, as may be the case in the Gulf Region. The double skin wall will also reduce the noise transmission into the building. See Figure 5.

INDOOR AIR QUALITY

It is mandatory by code to provide minimum outside air into the various rooms of the hospital with set parameter for temperature and humidity requirements. The concept of 100% outside air system with heat recovery far exceeds the minimum code outside air ventilation requirements thus creating better indoor air quality reducing the accumulation indoor air pollutants and preventing spread of the MDR (Multiple Drug Resistant) air borne infection.

COMMISSIONING

Design of the hospital MEP systems is code driven with additional complex functional requirements. Most of the hospital systems need to operate 24/7 with specific code requirements for temperature and humidity tolerances, number of air changes per hour, room pressure relationships. There are stringent NFPA requirements for medical gases. Many of the MEP systems require emergency power. Low voltage systems that include Building Management System (BMS), temperature controls, IT, fire alarm, nurse call, paging, security, etc. are paramount to the hospital operations and are often the most difficult to commission for proper operation.

LEED and GGHC are becoming more prevalent and owners are seeing the benefits of a formal commissioning process. The commissioning process should start early at design phase and continue through construction to start-up and verification of proper system operation. Post construction services should continue through the first year of the hospital operation until the end of warranty period. Building Commissioning is a significant contribution to the proper operation of the hospital systems.

CONCLUSION

In the past decade, the MEP industry has been undergoing through transformation due to implementation of the sustainable building approach. The guidelines for the sustainable building design for hospitals is being set by the US Green Building Council "LEED", Green Guide for Healthcare and local to UAE is Emirates Green Building Council and for Abu Dhabi the Abu Dhabi Green Buildings. These are excellent guidelines for implementation of Green Building. These guidelines encourage and initiate innovation for the new designs. We encourage every design professional to integrate principals of the sustainable design into their practice. Based on these innovations where we can deliver lower buildings first cost and more energy efficient that will benefit the hospital, local community and the region at large.

Figure 5 – Double Skin Wall Ventilation