The importance of Integrated approach for **BUILDING SYSTEM DESIGN**

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Architecture is an act of creation, which brings into existence, a design, a form, a function and a structure. Buildings system design is a complex process, which gives birth to a building connecting us with our past and representing our greatest legacy for the future. They provide shelter, encourage productivity and embody our culture. But they also consume about 50% of the country's energy and material resources. In the past, we have addressed this issue by analyzing the individual components and subsystems of each building and optimizing them separately, but now it is necessary for the people responsible for the building design to interact closely throughout the design process. So the most important aspects in building system design are:-

* Energy concepts (concepts of thermal comfort, heat transfer in buildings, etc.).
* Climate (climatic zones and impact of climate on building design).
* Site planning (site selection and assessment, site analysis, site development and layout, planning, site infrastructure, landscaping, construction management, exterior lighting, drainage systems, and pavement designs).
* Building envelope (heat transfer across walls, windows, roofs, and other building elements).
* Building systems (basic concepts in lighting, space conditioning, and water-heating).

The holistic or integrated approach to buildings system design asks the members of the planning, design and construction team to look at the materials, systems and assemblies from many different perspectives. The design is evaluated for cost, quality-of-life, future flexibility, efficiency; overall environmental impact; productivity and creativity and how the occupants will be enlivened. The goal is to create buildings that are responsive, responsible, and defensible. Toward that end, buildings must be competently planned; functionally adequate; appropriate in form; cost- effective; constructible; adaptable and durable.

A holistic approach does not mean that the client, architects, engineers, contractors and consultants simply need to talk or attend their traditional meetings. It means everyone involved in the use, operation, construction and design of the facility must fully understand the issues and concerns of all the other parties so as to create a successful high-performance building.

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So, an 'integrated approach' to building design involves the judicious use of resources and application of efficiency measures. Future buildings should reflect the above concerns by providing and/or adopting the following measures:-

Improved building envelope and system design.

Water conservation and efficiency measures.

Energy conservation and efficiency measures.

Increased use of renewable energy resources.

Reduction or elimination of toxic and hazardous substances in facilities, processes, and their surrounding environment.

Improved indoor air quality and interior and exterior environments, leading to increased human productivity and performance and better human health.

Efficient use of resources and materials.

Selection of materials and products that minimize safety hazards and cumulative environmental impacts.

Increased use of recycled content and other environmentally preferred products.

Salvage and recycling of waste and building materials created during construction and demolition.

Prevention of generation of harmful materials and emissions during construction, operation, and decommissioning/demolition.

Implementation of maintenance and operational practices that reduce or eliminate harmful effects on people and the natural environment

Reuse of the existing infrastructure, identification of facilities near public transport systems, and consideration of redevelopment of contaminated properties.

In conventional academic facility design, efforts to reduce operational and maintenance costs often focus on energy efficiency. Sustainable design is much more than that. When a design team looks at the process holistically, it is looking at not only individual energy-efficient systems, but also the impact of building placement, orientation, and architectural and systems design on the facility's energy-use patterns.

For example, reducing high heating and cooling costs starts with optimal building orientation with respect to the sun. This takes advantage of natural windscreens in the form of hills and wooded areas to correctly size the heating and cooling equipment. Only then does the approach consider specific systems, such as windows. The solution to reduce energy use may call for setting the plane of a window back from the edge of the building under an overhang to reduce the solar gain, as well as specifying an energy-efficient window system. In contrast, a narrow focus on energy-efficient systems might focus only on the window system, losing sight of the additional savings in resources and operational expenses that can be gained by effective sitting, orientation and design of the facade. This also can yield savings on the capital costs of HVAC equipment required for the building: by limiting the solar gain on the building, the cooling load is reduced, and thus the size of the equipment required is also reduced.

The choice of a mechanical system, might, for example, impact the quality of the air in the building, the ease of maintenance, Global Climate Change, operating costs, fuel choice, and whether the windows of a building are operable. In turn, the size of the mechanical system will depend on factors such as, the type of lighting used, how much natural daylight is brought in, how the space is organized, the facility's operating hours, and the local microclimate. A simple improvement to diminish the energy load is use of light-colored roofing materials that reflect sunlight and reduce heat gain. A more holistic approach takes into consideration building orientation, as well as the roofing system and materials, and yields even greater benefits. A step further is use of green roofs roofing systems that integrate low-growing local or regional native plants, which under normal conditions do not require additional water or a lot of maintenance. Green roofs not only provide effective building insulation from the soil layer, but also reduce rainwater runoff into the storm sewer system. Providing a restored habitat through the use of green roofs is another benefit; they also reduce the "heat island" effect of the building and offer a natural area for users to relax, meet or study.

So through a systematic analysis of these interdependencies, a much more efficient and cost-effective building can be produced. Therefore the importance of this approach is to design the building as an interactive system of materials and components. For example, the amount of natural light brought into a building to improve occupant well-being will affect the electric lighting design, which will affect the heating load on a building, which will affect the size of the mechanical cooling/heating system. The building's long term operations and maintenance cost (life-cycle cost) is also considered in the goal of high performance.

So the aspects of an integrated approach to Building System Design can be phased out in the following stages:-

THE PLANNING STAGE

The planning aspect which needs to be analyzed are elements of site planning such as the location, topography, water bodies, vegetation, ground character, climatic data analysis, etc.

Water absorbs relatively large amounts of radiation. They also allow evaporative cooling. As a result, during the daytime areas around water bodies are generally cooler. At night, however, water bodies release relatively large amounts of heat to the surroundings. This heat can be used for warming purposes.

The existing vegetation or the natural resources available in the site should be properly studied and analyzed as it would affect the air movement, radiation, relative humidity and daylight. Vegetation and trees in particular, very effectively shade and reduce heat gain. It also causes pressure differences, thereby, increasing and decreasing air speed or directing airflow. They can, therefore, direct air into a building or deflect it away.

Depending on the ground surface, incident radiation can be absorbed, reflected or stored and reradiated later. In other words, radiative heat gain could either be decreased, Increased during the daytime or increased during the nighttime.

The climatic data regarding the temperature, humidity, rainfall should be taken into consideration and it should guide while laying the building at the site, the form of the building, its orientation, building materials to used, etc.

THE DESIGNING STAGE

The aspects of Designing stage would include the building form (Plan and Roof forms), surface area to volume ratio, building orientation, fenestration pattern and configuration.

The plan form of a building affects the airflow around and through it. It could either aid or hinder natural ventilation. The perimeter to area ratio of the building is an important indicator of heat loss and gain. It, therefore, plays a role in ventilation, heat loss and heat gain. The surface area to volume (S/V) ratio (the three dimensional extrapolation of the P/A ratio) is an important factor determining heat loss and gain. The roof can be used as *a* source of daylight: The buildings form and overhangs also affect air movement patterns. They can either increase or decrease the scope for natural ventilation.

The building orientation determines the amount of radiation it receives. The orientation, with respect to air patterns, affects the amount of natural ventilation possible. The fenestration pattern and configuration involve the area, shape, location and relative positioning of the windows. This would affect the air movement, daylight and glare indoors. If unshaded, the area would also affect radiative heat gain.

THE CONSTRUCTION STAGE

The construction process can have a significant impact on environmental resources. Environmentally conscious construction practices can markedly reduce site disturbance, the quantity of waste sent to landfills, and the use of natural resources during construction. It can also minimize the prospect of adverse indoor air quality in the finished building. In addition to yielding environmental benefits, all of these actions can lower project costs. Use of low-impact building materials, minimization of transport costs for building materials, use of salvaged building materials, use of materials with potential for future recycling should be integrated into the construction process.

THE MAINTENANCE STAGE

Building operations and maintenance (O&M) significantly impact a building owner's costs, and affect the internal and external building environment. Used routinely, these practices can lead to substantial economic and environmental benefits such as reduced energy consumption, better indoor air quality, resource efficiency, and occupant satisfaction. Building O&M plays several important roles. It should maintain proper building temperature and humidity; promote the ventilation, dilution, and removal of airborne contaminants; and provide other important environmental conditions, such as appropriate lighting and acoustics. It should also ensure the safety and cleanliness of building systems so that they do not generate pollutants and hazards.

So the adoption of the integrated approach for Building System Design would play an important role in achieving lower maintenance costs, reduced operational energy, lower emissions of air pollution, healthier and more productive occupants, less material usage, and longer building life which would in turn help in creating a sustainable environment for our future generation to come.

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