THE PHYSICAL BODY IN CONSTRUCTION RELATED MATTERS

Richard Rivin, AIA

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When dealing with a new or existing engineering structure, it is both appropriate and instructive to make a comparison with the human body, in order to understand the elements and functions involved.

From a forensic engineering standpoint, this comparison is adaptable to almost any building. It allows non-technical professionals and laymen to visualize building systems in three dimensions. It creates an understanding of the integrated role which many building systems and components have in the overall success of any building. It also emphasizes the importance of good maintenance practices to the anticipated life of a typical building.

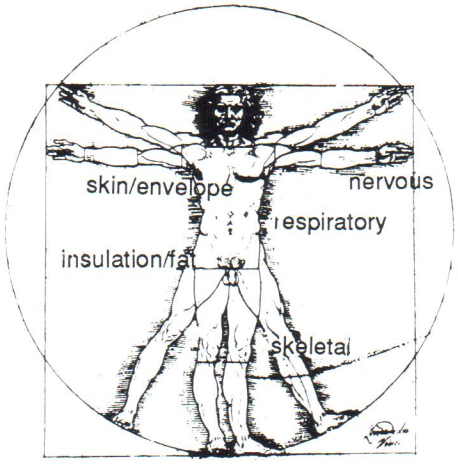
Categories

Generally, buildings fall into two major construction categories: horizontal construction and vertical construction. Horizontal construction one and two-story structures and may be compared to "shorter" and "wider" human physical prototypes, while vertical construction concerns itself with mid-rise or high-rise structures, and may be compared with "taller" and "thinner" human prototypes. No matter which category of building is under consideration, however, certain traits remain, which may be likened to the human physical condition.

For example, it is a fact that all buildings "move," all buildings "breathe," and all buildings "age" in place. The design and construction process must in all cases consider this "movement," this "breathing" and this "aging."

On an even more rudimentary level, the following human body systems have direct counterparts in an occupied building.

As the bones of a human provide the structural framework for transmitting the loads from the dead weight of softer body tissues to the ground, so the structural



Anatomical Systems

Leonardo Da Vinci

framework of a building carries its other loads to the ground.

Human bones have special fastening and connective tissue, which enable both static and dynamic (moving) loads to be accomodated. Although movement of a building is almost invisible to the naked eye, it is constantly occurring, primarily due to climatic influences such as temperature and atmospheric wind movement. For this reason, the connections between skeletal structural members in a building are specially designed and fabricated to resist and/or to accomodate the movement.

The skeleton of a human body may have locations where ligaments and tendons are "strapped" to individual bones or bone joints to support surrounding tissue. In a similar manner, metal straps, wire hangers, and threaded rods are attached to the skeleton in a building, to support ductwork, metal lathe, insulation and other interior components.

In the human body, air is brought into and exhausted from the bloodstream by a complex organization of pressurized containers (lungs) and passageways with access to the outside environment (nostrils, throat, mouth, etc.) In addition, the entire surface area of the human body contains thousands of pores, which assist in the temperature and humidity control in the body by automatically opening and closing, based on the relationship between internal and external conditions.

Within a building, an analogous system of ventilation and temperature and humidity control, is provided by means of a mechanical system. It is the function of the mechanical system to provide air exchanges and air quality control, via components which include pumps, piping, ductwork and exterior air intake and exhausts.

In addition, the building mechanical system must take in to account for the thousands of hairline cracks around windows, doors and other exterior envelope penetrations, which allow conditioned air to escape constantly from the building's exterior skin.

It is the primary function of the human body's envelope of skin to protect the internal portions of the body from exterior contamination and other normal environmental hazards (wind, rain, sun, etc.) Similarly, the envelope of a building, which includes roof and wall systems, must protect the interior of the building from the exterior environment. Furthermore, just as interruptions in the body's skin and special features (fingernails, eyes, hair, mouth, etc.) must be carefully organized to allow for no gaps in the overall envelope, so too must a building's exterior interruptions or penetrations (roof vents, windows, wall louvers, electrical receptacles, etc.) be carefully crafted to prevent gaps in the skin.

Insulation System: A human's layers of fatty tissue, in addition to other functions, also provide some measure of thermal insulation, which help maintain a constant temperature for the body's internal organs.

Nervous System: Various messages and sensory impulses are distributed between

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The Specialty Contractor: Working with architects to meet each project's unique requirements.

Andy Drozda

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Architects will not only rely on professional consultants, but will also rely more and more on the specialty contractors who may become known as "consulting practitioners"

Construction, the oldest of industries, impacts all mankind. When man left the security of his cave dwelling, ceased his nomadic wanderings and in settling, dug ditches to irrigate fields, felled trees to bridge rivers, built dwellings of sun-dried clay brick, and quarried stone for temples honoring his gods, he began the work of construction.

Over the centuries, financing, design, engineering, contractual relationships, building products, construction techniques, and purposeful use have required ingenious approaches to meet society's demands. Handsome, efficient, and affordable structures constructed in less time were the result.

Each facet of a construction project, from its conceptual stage to ultimate use, has become highly specialized. The business of construction evolved as each stage gave birth to contractors who concentrated in their own specialty. Today even small construction projects have many specialty contractors engaged as subcontractors to a general contractor. Major projects are frequently administered by a construction manager who oversees a general contractor and as many as three to four tiers of specialty subcontractors.

Such diverse specialization, together with the accelerated pace of development and improvements within the specialties, poses serious problems for architects and designers. It becomes humanly impossible to keep abreast of these technological changes. Yet the architect bears the burden of designing efficient and affordable structures, usually under demanding schedules.

Since the wider use of new and improved building products and services are so actively promoted by specialists, one solution to the architect's dilemma has been to tap the resources of particular specialists during the conceptual phase of project development. As practitioners in construction, specialists aggressively market their products and services for their economic survival and for the improvement of their industry.

An example of one specialist's continuing experience is that of David Allen Company in Raleigh, North Carolina. In existence since 1920, this firm has developed into one of the largest ceramic tile, mosaic, terazzo, and stone contractors in the nation. They readily attest to the dramatic changes resulting in the dynamic growth of its industry.

Except for wood and earth, tile and stone are the oldest building materials. In contrast to Europe, the per capita consumption of tile and stone in the United States has been and continues to be small, resulting from a number of factors. This imbalance is changing. Ceramic tile, for instance, was once a building material limited primarily to restrooms, swimming pools, some flooring and paving areas, and decorative accents, but now has almost unlimited applications.

The creation and manufacture of various colors, textures, finishes, sizes, and shapes of tiles, together with technological advances in the development of efficient installation methods, setting and bonding materials, and aggressive promotion has expanded the use of tiles in exterior and interior applications where use and arrangement are limited only by the architect's imagination. These developments have increased the United States' consumption of glazed, mosaic, and quarry tile. The Tile Council of America forecast an increase from 500 million square feet in 1977 to over one billion square feet in 1989.

Marble and granite, nature's most beautiful and durable building materials, have also experienced an explosive rebirth in the United States, rivaling that of the tile industry. Until recently, conventionally installed stone was heavy, expensive, and slow to erect. Further, the industry suffered from a severely diminished labor pool of skilled stone masons. To save a dying industry, sophisticated equipment has been developed that enables stone to be cut to a veneer thickness as thin as 3/8", depending, of course, on the integrity and size of stone units desired. The reduction of weight translates into reduction of dead load, saving structural and foundation costs as well as freight costs.

Having eliminated weight as a deterrent to the use of stone, systems for the installation of "thin" stone had to be developed. Numerous systems evolved such as "strongback panels" (a steel truss frame to which stone is mechanically attached); stone veneer bonded to precast concrete panels; glass fiber reinforced cement panels; galvanized steel diaphragm panels (stone set into aluminum "stick frames"); and curtain wall systems. For systems other than those requiring mechanical attachments, sophisticated bonding materials such as latex modified portland cements and structural silicones are used.

These systems have revitalized the stone industry in North America. They reduce building and foundation costs, are lighter in weight, and are manufactured under quality controlled shop conditions employing semi-skilled labor. The systems are erected faster than conventionally installed stone. Statistics published by the Marble Institute of America indicate that for a period from 1980 to 1987, use of finished marble increased 824 percent and demand for granite rose more than 2,100 percent!

These are just two examples of the changes in the use of building materials and their application. Multiplied by the hundreds of other facets and components making up a construction project, these changes challenge the architectural profession in many ways.

Owners today are more discriminating, more knoweledgeable, and more involved in their projects than ever before. Architects not only design the building but also provide a total service to their client. A well integrated design may involve landscaping, exterior facilities, signage, interior design, fabrics, furniture, communica-

tion systems, maintenance consideration, and possibly even financing concepts and marketing. Such a design, of course, must focus on and be responsive to the image the client wishes to project. This is accomplished by firms that are committed to staff training and expansion or that work in concert with other firms in providing a complete design.

Such a massive undertaking will lead to architectural firms specializing in specific market areas. In fact this trend is now under way.

In addition to this change in the expanded services architects will be expected to provide their clients, the manner in which projects advance through design and construction is undergoing change. More and more projects are now a fast-track design and build concept or are priced and budgeted as designs are already under way. With these concepts, there is need for constant communication during design development among owner, architect, general contractor, and specialty contractors.

The role as specialty contractors such as David Allen Company, will become increasingly important. In an effort to satisfy the architect's design, they are acutely aware of the latest materials, applications, and services. The general contractor, of course, will coordinate the sequence and scheduling of the various components of construction to establish a time frame for completion.

In meeting the ever-increasing demands being made on the architectural profession, coupled with the continuing changes in all aspects of construction, the position of the specialty contractor becomes more important. Architects will not only rely on professional consultants, but will also rely more and more on the specialty contractors who may become known as "consulting practitioners." As construction becomes even more sophisticated and complex, what is experienced tomorrow will be as different from today as today is from yesterday.

Andy Drozda is Director of Marketing and Manager of the Prefabricated Panel Department of the David Allen Company with offices in Washington, Orlando, and Raleigh.

The Human Body

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the brain and bodily extremities by a specialized system of nerve fibers, similar to the way the power, illumination, and communication signals are distributed between a main service and control station and the individual spaces in a building.

As a matter of interest, the subdivision of specialized messages and impulses into separate "control zones" in a building is similar to the way a body's signals are separated into "left-hand" and "right-hand" brain functions.

Circulation System: Even though a physical structure may not actually circulate blood to digest food products and create energy and growth as in a human body, there are certain system parallels, if we consider the building users as the nourishment for a building. To "use" a building, occupants must be able to circulate through the building.

The paths for circulation in a building In order to produce a successful building project, the above comparisons can assist in taking a "holistic" look and well-managed approach to any construction-related issue. In addition, when the necessity of problem solving for a building project does occur, a system by system analysis can become a logical way to approach a reasonable solution.

Note: Richard Rivin, an architect and experienced construction document analyst is a consultant to the legal community

Directory of Corporate Properties and Facilities Executives

In January 1989, a new directory will profile over 600 major corporations and facilities organizations. Titled The One List, the directory will be "the first comprehensive listing of corporate decision makers regarding the sale, lease, purchase, development and operations of real property and facilities," according to Donna M. McCourt, Editor and Publisher.

Each of the more than 600 companies will be profiled with a full-page entry describing the scope of its facilities operations and a forecast of capitol programs and facilities operating expenditures through 1992. In addition to a listing of key corporate staff responsible for facilities, engineering, construction programs and real estate, the directory identifies executives responsible for the programs in major business units and subsidiaries. A six member research team has compiled the up-to-the-minute information.

According to the editorial consultant, Martin C.P. McElroy, the growing attention companies are giving to the real estate assets and capitol programs coupled with the trend toward decentralization of large corporate organizations has made The One List a necessity. "Few companies can describe even their own facilities organizations accurately. There is widespread demand for a roadmap of corporate property management structures." McElroy is Director of Corporate Planning and Development for a leading national construction firm. He has served as management consultant to numerous major corporations' property and facilities staff.

The One List will be marketed by mail to corporate executives, consultants, developers, brokers, architects, engineers, contractors, facilities consultants and others serving corporate property and facilities needs. For more information on obtaining The One List, contact publisher Donna M. McCourt at the Brendan Group, Inc., 16824 Kercheval Place, Suite 210, Grosse Point, MI 48230, 313/882-2860 or 1-800/727-5478

Marvin Windows Unveils "Computer Aided Design" Software

Marvin Windows maintains its commitment to architectural service and support with the introduction of its "Computer Aided Design Program," designed to work in conjunction with AutoCAD.

The interactive program gives architects not only a detail and specification manual on computer disc, but also a flexible array of functions for designing and detailing windows and doors with speed and simplicity.

Marvin Windows' Computer Aided Design Program replaces the manual labor involved in drawing and detailing windows and doors with only a few keystrokes. Using functions like stretch, copy and rotate, architects can create images onscreen instead of just imagining them.

For more information on Marvin Windows' Computer Aided Design Program, contact Cheryl Bowles, Plunkett-Webster Distribution, PO Box 803, Apex NC 27502, 800/845-6160.