CHAPTER

1

INTRODUCTION AND CONTEXT

THE BASIC RELATIONSHIP

The fundamental relationship of construction to architecture is that construction uses its adaptive, flexible, and knowledgeable management and its highly skilled trade workers to faithfully construct the design professional's design concept—true to the owner's program, creative and aesthetically pleasing in nature, properly functioning, based on sound design and engineering principles—into well-crafted architecture, nothing deficient, nothing lacking.

Construction has a direct, unique relationship to architecture. But it takes some initial exploration to uncover and understand the essence of that relationship and its inner working within every project sequence. It is not something that appears and disappears; it is not specific to some projects and not others; it is rather a constant relationship that has various complexions, elements, and proportions.

DEFINITIONS

Construction can be defined in a straightforward, composite but easily understood manner, for example:

> *Construction*: The act or process of building or erecting something, especially a large structure such as a house, school, store, office building, road, or bridge; the process of developing a work project

> according to a systematic plan and by a definite program of carefully scheduled tasks, forming, ordering, and uniting materials by incremental means into a composite whole.

To this description of construction, we can juxtapose the following definition of the other aspect, architecture (from Cyril M. Harris's *Dictionary of Architecture and Construction*):

> *Architecture*: "The art and science of designing and building structures, or large groups of structures, in keeping with aesthetic and functional criteria."

It is quite striking that architecture is defined in terms of "building" and "science" (which includes engineering and technology). This shows the inherent dependency on construction as an integral part of producing architecture. Architecture needs construction, it appears, but not vice versa. But still there is a need to establish more about architecture overall, and in that aspect that is not construction.

Even in its definition, architecture is a rather murky and complex concept, difficult to grasp, and with several aspects that touch many things. Reality says that architecture is simply that which has been built. Within that are innumerable classifications and types of projects, and differing styles of architecture. Architecture is not a cohesive concept, nor a fixed body of work.

There are, of course, "paper architecture," rhetorical architecture, virtual architecture, and utilitarian architecture. These all have their particular use and place, but they should not be perceived to be the reality of architecture to any extent.

"Paper architecture" is the flat depiction of a project, perhaps in three-dimensional perspective, with a wealth of accoutrements and enhancements. But in the end there is a limit to the emotion of the piece, falling far short of experiencing the project in real time and hands-on. It is a dream, if you will, as flat as Queen Anne architecture (a festooned front façade on a mundane building hidden from view and behind it), and only as real as stage and movie background sets producing illusions but not reality.

"Rhetorical architecture" involves a belabored explanation of how the piece was conceived and/or built. It is a verbal explanation of the project delving into the intangibles, principles, and other hidden attributes that may have influenced the design and appearance but do not impact use and occupancy in any obvious ways.

"Virtual architecture" is that which resides within a computer and its wondrous software and modeling. Ever-evolving at a very rapid pace, this "architecture" is really design images in electronic form, manipu-

lated through use of the software, to allow one's eye to travel within, walk through, and experience the sense of the spaces and the surrounding structure. It is a great design tool that allows for change without a change order or eraser, and permits volumes of mutations to the design concept before settling on the final selection.

"Utilitarian architecture" is an array of projects, primarily engineering in nature and function, often rather austere, but nonetheless a form of architecture. (For an example of utilitarian architecture, see Figure 1-1.) Included here are industrial plants and factories, warehouses, communications centers, government buildings, boiler houses, wastewater treatment facilities, aircraft hangers, depots, stations, dams, navigational locks, and other often large and complex projects. In many instances, there have been very fine design statements made in these projects: very sleek, glassy industrial plants, boiler houses with picture windows to show off the multicolored (and squeaky-clean) equipment, et cetera. Perhaps stigmatized by the application of the terms "industrial" or "utilitarian," these projects nonetheless represent a form of architecture not to be discounted.

ELEMENTS OF ARCHITECTURE

Architecture involves a great many things, chief among which are the artistic and aesthetic phases of building construction. Architecture is concerned with the principles of design betterment (balance, scale,

Figure 1-1 Example of utilitarian architecture: projects directed more toward their function than toward design and construction making an architectural impact or statement. *Jeff Kramer.*

massing, proportion, rhythm, and unity). From the first preliminary idea to the approved design concept, the architect must be aware that careful and complete documentation of the project is necessary to enable its construction and to bring it to completion. The architect must be able to convert and express the intangible attributes of the design concept in a real, physical manner—that is, the project must be built with specific materials and techniques of construction and installation to accurately bring forth the design concept. What originates as a concept, through a process of documentation and construction, evolves and expands to become a full-size, real "thing."

The finished project can be a joy to the eye, but that wonderment of a building is composed of a tremendous amount of detail, parts, systems, and subsystems, all linked within the construction effort. Each element must be thought through to support and maintain the design concept and in no way detract from it. Once the design concept is created, it lives as an abstract, an intangible, a delicate balance of taste and function. The parts of this living concept are real and tangible.

CONTRACTOR'S POSITION

A compelling issue, not often addressed, is that of providing the contractor with some sense of understanding and buy-in into the design concept. Even the general contractor, who is positioned to have the best and most complete overview of the project, may lack insight into the creation and development of the design concept: why things were designed and incorporated as they were and what they contribute to the overall project scheme. Most contractors are actually more like subcontractors, in that they perform a particular portion of the project work almost in isolation.

It is most helpful if contractors can be brought to understand the project's design concept and how their skill and expertise is necessary to the project's success—not only to complete it properly, but in its continuing usefulness and appearance. Normally, though, a contractor does not have the luxury or benefit of insight into the design concept unless there is a negotiated contract whereby the contractor is brought on board early by the owner—preselected before completion of the contract documents. Or a construction manager (CM) may be contracted to provide design phase services, in the form of insight and advice on construction methods and materials. In neither case does the work of the contracting elements necessarily intrude on or disrupt the design process; their function is to provide added insight and information that, if used, will result in a project that is more refined and coordinated to

the benefit of all. It is really the owner who is the final decision maker as to how much and what information is incorporated into the project.

PROJECT DEVELOPMENT

Each project progresses through the architect's office in a set manner, in a series of planned stages—some imposed by contract, some to ensure the best job possible. However, producing the working drawings consumes nearly half of the architect's fee (the payment from the client to the architect). Obviously, if the professional devotes that much of the fee to this one phase, it gives strong credence to the conclusion that the drawings are most valuable in the construction of the facility. In fact, they are vital to producing the correct work in every aspect of the project. Thousand of decisions are made during the working drawing phase, and hundreds of thousands of items may be involved.

> A recent [2002] study designed to uncover how architects make product decisions yielded a particularly interesting fact: architects, on average, must select 1,500 products and make over 17,000 decisions on what is best for the project and the owner. That's 17,000 answers to 17,000 important questions. How big? How high? What color? What shape? What style? Moreover, what products will give the owner exactly what they have paid the architects to design? The list of questions about what products to incorporate in a project can be overwhelming for architects and their clients.
>
> from Dan Ouellette, "Selling Stone Products to Architects," *Stone World*, May 2003

Many architects treat this phase of the work in an offhanded manner; others try to ignore it completely; but it must happen (there is no shortcut). There is no easy way to convert the project from the original concept into a real structure without incorporating feet and inches and producing all the minute details of the working drawings.

RECENT CHANGES

The circumstances of architectural practice today are quite different from those of a few decades ago, and certainly different from the turn of the last century. In the long view, practice at the start of the twentieth century placed the architect in almost an elitist role, not by design or determination, but by the mere status assigned to the profession by

the general public. Most laypeople were not exposed to architects in their lives. There was nothing they could relate to that brought understanding to them regarding how architects worked, influenced their lives, and made their surroundings better.

The profession at that time was consumed by the need for near perfection, since the greater number of items in any building had to be individually designed and custom-made. Few items were stocked or made on production lines that produced an inventory of items ready for use. The profession was immersed in the need to document the project thoroughly and accurately, in almost an instructive manner. This involved teaching the manufacturers and fabricators how to fashion the parts, and teaching the trade workers on the job site how to put the building together so it would reflect the overall design concept.

For many reasons, the running of the years brought innovations in the construction and design industries. Construction followed the changing and progressive path of most industries throughout the years of this past century. It paralleled the development and changes that are so evident every day and in every aspect of life.

The profession maintained its cutting-edge mentality, with a core of professionals always breaking new ground, followed by others (usually more conservative, not necessarily less talented) who adapted, adjusted, moved to, and modified the work. Design styles changed, but so did the manner of documentation. Just as communication of all sorts has found marvelous new phases, equipment, and techniques through the years, so too have the construction industry and the architectural profession.

Modern 3-D computer modeling allows one to traverse a project, moving electronically through a project that exists only electronically. A very fine design device, which substantiates good features and exposes the bad, computer modeling nonetheless cannot meet the need for transposition to the real thing. That change is usually outside the ability of someone who is not trained or attuned to the virtual. Even the best and frequent use of computer games and programs does not necessarily acclimate the layperson to appreciate, via computer, what the final (real) project will be, how it will feel, and how it can be used.

Much is made of architecture as it is designed and built with avant-garde direction by what are called “signature architects” (or the emerging term “starchitects”). These projects are new, wondrous, revolutionary, cutting-edge design concepts of the most fertile minds of a relatively small group of daring architects worldwide, supported by a very limited number of clients. They are the results of a mindset to produce a new expression or “statement” about design or structure, or perhaps simply a new approach to a known type of building. (See Figure 1-2) These projects are small in number but widely published, highly touted, discussed, celebrated, and sometimes maligned. In contrast, there is a *prodigious*

Figure 1-2 Example of cutting-edge projects, at the other end of the architectural spectrum from utilitarian works. Walt Disney Concert Hall. *Alpen/Walker Images.*

array of projects—thousands—designed with high skill and innovative design concepts, and worked through talented hands, which please their clients, function extremely well, and are constructed for the long term. They are the vast and overwhelming body of work in architecture.

It touches our lives every day, in ways we may not perceive, whether in urban, suburban, or rural venues, not only in the aesthetics of the buildings surrounding them, but also in the spaces created by those buildings and the functions of both the buildings and the spaces—in schools, colleges, and universities; stores, shops, and malls; hospitals; churches; multifamily housing; some single-family housing; industrial and manufacturing facilities, and so on; sprawling or small; high-rise, multistory, or single story; highly active or subdued in function; complex or simple and straightforward.

For example, look at the wide variety of high-rise office buildings. While each functions well as office space, they look quite different. These projects receive a disproportionate amount of publicity, examination, discussion, analysis, rigorous comment pro and con—and often wide and lasting acclaim. They are the topic of seeming endless discussion that tries to justify the whole project and each primary part. They are celebrated by the profession of architecture; analyzed, criticized, and held as examples in schools of architecture; and held in wonder or high disregard by the general public, which knows only what it sees and not the nuances of good design and architecture.

Each of these projects is brought to fruition through the efforts of many who perform quite varied ancillary services and tasks, both in de-

Figures 1-3 to 1-5 A marked contrast in sizes, forms, style, designs, and construction among a selection of buildings, all with the same basic function—offices.
Figure 1-3 Empire State Building. *Corbis Digital Stock.*

Figure 1-4 Trans-American Building. *Photo Disc/Getty Images.*

Figure 1-5 New Swiss Re building in London; affectionately known as the "Gherkin." *Alberto Otero Garcia.*

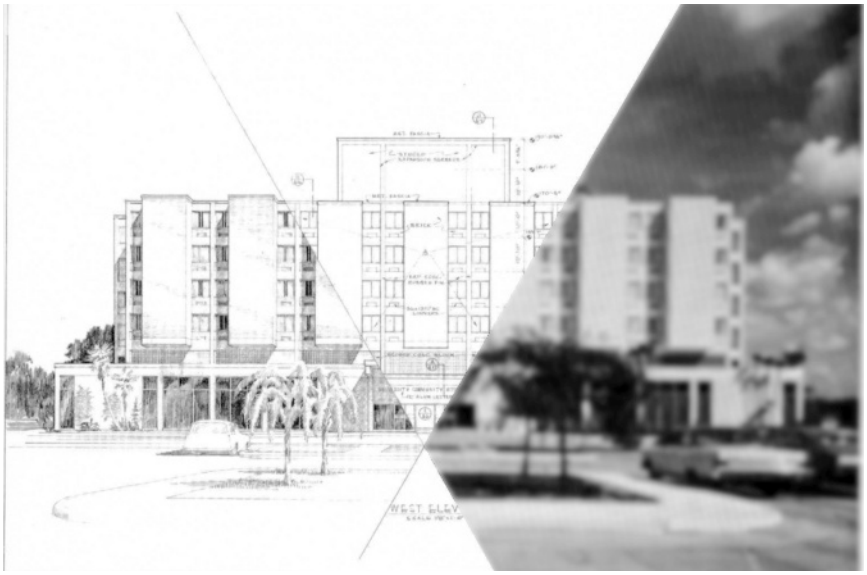

Figure 1-6 The sequence from design to built or completed project.

sign and in realization of the completed project. This is a sequence of tasks and events that creates and produces the finished project. It is, for want of a better word, the grunt work that transforms the creative design concept into the final reality: the process of "how it got that way." (See Figure 1-6.)

Architecture, then, is the result or the product of several sequences and efforts; the combination of many talents and skills; the real manifestation of a mental concept.

One point that needs clarification is this:

> Architecture is not exclusively equated to only the cutting-edge, innovative, eye-catching, unique projects. It exists and is continually produced over a far more vast array of images and configurations, in far-flung locations.

There is an overwhelming body of work produced by talented and dedicated architects who please their clients in less imposing and less publicized ways. Even the most visible signature architects have as a good portion of their total body of work, far less ostentatious projects (which help pay the bills and fill the time of staff between "big" jobs). It is not uncommon for a signature office to design warehouses concurrently with, or in the intervals between, more glitzy and prestigious projects. The world over, the profession of architecture is practiced with continual results that protect and enhance communities and improve the

lives of the occupants and users of the projects. The vast majority of the time, the general population is totally unaware of the work done by the architect and the daily impact it has on their lives, in so many ways and locations.

So, for the sake of discussion, let us set the premise that "architecture is the complete array of buildings and structures that have been, are being, or will be built, for human occupancy and use." We purposely avoid any discussion about styles, concepts, values, appropriateness, good-or-bad evaluations, or marginalization of projects. Our task is to relate how each of the projects has progressed from inception to completion—not *what* is built and not *why* certain designs, materials, and systems are used, but *how* projects are produced, from perceived needs to mental processes and images to "bricks and mortar"—that is, standing building stock.

THE AXIOM

Architecture is the manifestation of design
achieved through construction.

This is the fundamental and perhaps too simplistic (but true) axiom regarding the process that produces the world's architecture. This axiom holds in all climates, all cultures, all styles, all levels of expertise, and all levels of need. The intent is to address this axiom and to provide explanation of the several parts, how they interact, and how they feed one another, until the project is completed, occupied, and used. The process moves from the idea, through deciding what exactly to provide or construct, and then to producing the documentation for construction. Last but certainly not least is the cooperative process of construction: contractor and designer working to produce the project that the owner is anticipating.

Construction, for the most part, is nonjudgmental concerning architecture. Its task is the pragmatic conversion of a concept to a usable entity, whose design, style, and appearance have already been set by others.

Note that this axiom does not analyze a work as good, bad, or indifferent architecture—it merely states the path followed to produce architecture satisfactory to the client, to the profit of the contractor and the profit and reputation of the design professionals. No matter the type

or style of the structure, it still produces these byproducts and conveys these benefits to the various parties. Every project follows this path and produces its own set of results for each party involved. The ideal situation is that in which the needs of all parties are fully met by the finished project.

Some purists would indicate their strong displeasure and disdain at any work being referred to as architecture that falls short of their prescribed definition or perceptions. But the world is not so restrictive or simple. Architecture worldwide is a broad, expressive panorama of varied talents, all directed toward the singular goal of providing a project consistent with the needs and desires of the client. Certainly, some clients are more open to new ideas and images—to the more creative and imaginative and to the fact that their project may become more widely known for its image and status than its function. But many other clients seek practical solutions through an architectural effort quite different in intent—they seek problem solving, increased capacity, and other more practical results.

The final design concept and physical appearance of a project is an expression of the mutual desire and intent of the client and the architect. While the architect is engaged to work as an agent of the Owner, this is not a matter of subservience. Rather, the architect takes the programming that was mutually produced by the parties and interprets and adjusts it into a coherent design. Sometimes the client guides or even demands to direct the design effort. But more times than not, the client allows the architect to create one or more concepts. This is the direct impetus for innovative design, unique appearance, fashioning of materials, orientation, and distinctive image in each and every project—none replicating another (except where more mundane prototypical work is involved). Owners choose the one design concept/solution that is to their liking, and the rest of the project work is directed toward producing the project as depicted on the approved concept drawings (preliminary design drawings).

In view of the fact that the same type of talent, knowledge, and skill are required to produce the entire range of projects, the architectural process must vary with the desires of the client and the results anticipated. This in no way demeans the direction and work of any individual architect. Rather, it speaks to the specific challenge of each and every project and the flexibility required to resolve the issues and produce a meaningful design for the client. It also indicates that project parameters vary and change, over a very wide range—and differing project goals reflect the need to please and satisfy the client. But there is one leveling process that all projects must negotiate—the process of construction.

At some point, no matter the type of project, the status and talent of the architect, or the drama of its design, every project must traverse the construction sequence. Here the project—design and all—is turned over to the constructors for their execution of the requisite hands-on work. The route to producing architecture of any style, type, or level of design accomplishment is a collaboration of tasks, work items, and application of varied skills—some dangerous; some roughly hewn, back-breaking, and rudimentary; others dirty, greasy, oily, or awkward; still others labor-intensive, using human power in place of sophisticated machinery or technology. Projects cycle in stages where, at times, one wonders if the final project will ever match the original design concept—but most projects do.

In the construction process, the design professional is not relegated to the position of bystander, but there are various levels of participation. Therefore, it is necessary that professionals know, understand, and fully appreciate the extent of the project and the process of construction. There is need to be flexible, decisive, strong, instructional, and educational; a good manager; and to achieve the correct interface between client and contractor.

So, the next question is, how does the design concept of the designer for a new piece of architecture become a reality?

CONSTRUCTION

Looking through the various definitions of architecture there is usually mention of two aspects or elements—art and science/engineering/technology. Any architectural curriculum that does not include both is really not addressing the whole of the profession and its work. Regrettably, the continual diminution of time available in the academic process inhibits the ability to address both aspects of architecture. Even when breaking the definition into attributes, there is some specific wording and need not only for design of the project, but also for its erection. This in itself calls for an expansion of the design concept into construction terms and graphics, and the addition of personnel whose expertise involves intimate functional knowledge of construction systems, materials, the depiction and detailing of the same in various locations, and the full array of documentation required to construct the project.

Certainly the process beyond design involves a great many tasks and personnel. This includes the engineering disciplines, which are necessary to incorporate their expertise to augment the architectural work, and to bring everything from stability (structural engineering) to comfort (HVAC and electrical engineering) to the project. These disciplines,

too, must go through a period of analysis and design, which parallels and conjoins the architectural elements. They all are installed and activated within the proper context in the project through the various tasks involved with construction.

TOTALITY OF WORK

There is no doubt that, by any definition, architecture has two aspects—art and science/engineering/technology. In that context, architects would seem well advised to know about both. This is not to say that individual architects need to be experts in both, nor equally versed in both. It is to say, however, that both are necessary to create and realize architecture.

An architect may choose to become solely a designer, devoted only to the task of conceptualizing and creating designs and resolving owners' needs and demands, within a functional and attractive complex. But designers become far better with knowledge of building technology, engineering, and construction, so that they at least understand what more is required to present a finished and usable edifice to the client. To create an elitist attitude to the point of dispelling any linkage between design and construction is totally false and misleading.

The linkage between the two aspects is so essential, crucial, and important that it is virtually impossible to think of attempting separation. The most grandiose of designs lies fallow, unrealized, and in a questionable state if it is never constructed. A good example of this is the Illinois Tower, which Frank Lloyd Wright designed in the 1960s (see Figure 1-7). Although it was never built, it was Wright's contention that this project could be used to construct a building one mile high. He knew that many, many technological advances would be required; innovative concepts for access and evacuation would be necessary, among many others.

It is interesting to compare Wright's design with the reality of the World Trade Center towers (see Figure 1-8). How would the construction of the two projects compare? And more importantly, how would the mile-high building operate within the findings and analysis, done and in progress, about the WTC and its demise? Physically wildly demanding on the construction crews (working a mile high), the mere construction, let alone the numerous other considerations and accoutrements, would be daunting. And how would the health, safety, and welfare of the occupants and users be addressed?

In this exercise, it is quite evident that realization of a design concept is an important part of architecture and should be explored, taught,

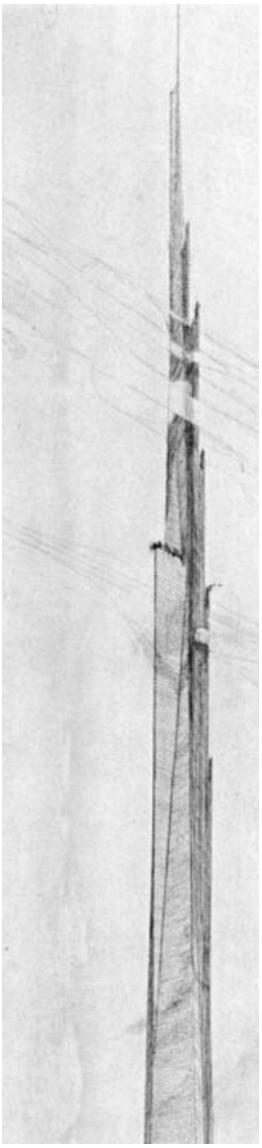

Figure 1-7 "Mile High" Illinois Tower, proposed and designed by Frank Lloyd Wright (never built) as an expression of both his vision and innovative spirit.

Figure 1-8 Although tragically destroyed, the design and construction of the World Trade Center towers is well documented and an excellent case study from which much can be learned. *PhotoDisc, Inc.*

integrated with, and become an intrinsic part of the project. Truly design and construction must be bonded together to ensure that each is pursued in the correct context and within proper bounds. One does not dominate the other. Rather, they must be cohabitants working back and forth in lockstep, to faithfully produce the wonders, nuances, and features of the design through the work of construction, using newly created forms, processes, and procedures where required. The design makes demands; the construction must produce the solutions to support and replicate the design.

> Concept and implementation must be seamlessly related if the built work is to be architecture and not just a building.
> *—J. Patrick Rand, FAIA, Distinguished Professor of Architecture, School of Architecture, North Carolina State University*

> . . . the act of architecture is not finished when the design is done, but when the building is built. However, most students see, and are taught, that a design is the end product.
> *—Gerald G. Weisbach, FAIA, Architect/Attorney, San Francisco, CA*

Construction is a team activity almost from the very start. Various players and combinations of players contribute to the team effort, some on a continual basis, some coming and going at various junctures. All are necessary to the success of any project.

This is perhaps best said by William Dudley Hunt, Jr., FAIA, who wrote in his book *Encyclopedia of American Architecture*:

> The construction team is the loosely knit, diverse group of individuals and organizations that performs the many functions necessary to bring buildings into being. Often thought of as only consisting of those who design buildings, and those who construct them, the building (construction) team is actually much more complex . . . *all* elements, including owners, are essential in transforming a need for a building from an idea to a completed structure.

Hunt distinctly observes and understands that buildings and other construction projects involve the resolution of many issues, result from many efforts and much personal expertise. Clearly, he indicates that no one person can execute any project plan in every aspect. And, clearly, he notes that while the collective definitions of buildings or building stock may be "architecture," that very name is a combination of two vital elements—art, and either engineering, science, or technology (all roughly equivalent)—yet another specific indication of "team."

It is quite evident that the concept of team is preeminent in the creation and production of architecture. Traditionally, and still now, the architect is the leader of the team, knowing more about the total project than anyone else. There has been some undercutting and diminution of this concept by the introduction of other tasks and professions. But it remains that the architect forms a team of consultants with varying engineering skills to produce the project. The many and multifaceted requirements of the owner/client require attention and resolution as part of the charge to the professionals and the success of the project. More and more, technology is so imposing and so convoluted that special and dedicated attention to certain phases of the project is absolutely essential. While the architect can set the overall design concept, it is essential that the architect form a team of the various engineering disciplines to incorporate the necessary additional designs of the many supporting systems in the project. Obviously, it is beneficial to all if this team consists of a group of highly compatible people who work well together and are expert in their respective fields. There is not time or room for contention within this group—it must be focused, coordinated, cooperative, and well directed.

The concept of team is crucial to the success of the project not only in the final product but also in the entire process, and in the correct interface between all portions, systems, and functions of the project. This concept pervades the project and really needs to be nurtured to ensure that all participants contribute—on time, with their best information and creativity, and in a fully cooperative manner. This is not a competitive situation, but one of total and full inclusion, cooperation, contribution, understanding, compromise, adjustment, and unity of purpose.

To support the concept of team in the execution of construction projects, the following excerpt is offered. This is taken from the 2004 report, "Collaboration, Integrated Information, and the Project Lifecycle in Building Design, Construction and Operation—WP-1202." This report was produced by the Architectural/Engineering (AE) Productivity Committee of the Construction Users Roundtable (CURT) (www.CURT.org).

"The goal of everyone in the industry should be better, faster, more capable project delivery created by fully integrated, collaborative teams. Owners must be the ones to drive this change, by leading the creation of collaborative, cross-functional teams composed of design, construction, and facility management professionals."

Toward that end the committee makes four recommendations and articulates a vision of the future:

"1. *Owner Leadership*: Owners, as the integrating influence in the building process, must engage in and demand that collaborative teams openly share information and use appropriate technology.
2. *Integrated Project Structure*: The building process cannot be optimized without full collaboration among all members of the design/build/own project.
3. *Open Information Sharing*: Project collaboration must be characterized by open, timely, and reliable information sharing.
4. *Virtual Building Information Models*: Effectively designed and deployed information technology will support full collaboration and information sharing and will lead to a more effective design/build/manage process."

A FULLY COLLABORATIVE TEAM EFFORT

Can it be that architecture exists only in the wonderfully creative minds of the designers, whose mental capacities, when triggered by project circumstances, then focus, hone, and crystallize random factors and considerations into a cohesive design concept—which is then translated onto paper or an electronic screen—but then does not appear again until the project is finished?

GENESIS OF ARCHITECTURE

Architecture is indeed founded in the minds of the designer, who has marvelous insight into and control of design theory, design principles, a sense of space, and the ability for the creation of forms that combine

the foregoing into a tasteful, attractive, and functional entity. Unfortunately, architectural design can all too easily be dismissed as fantasy, and unreasonable. But the function of design and designers is to provide new directions and perspectives—new schemes to solving problems. It is here that style becomes an adjective—where "what it will be" is a concern, along with how it will last, et cetera.

Here, rhetoric is both rampant and to some degree valid—better here to describe how or what is being done, than to try to explain later what was done (in a sense to justify or legitimize it).

The architecture then goes dormant and almost literally disappears. There is an on-going process in place to transform hazy concept into functional reality—to transform ideas, small-scale drawings (renderings), and models into hard and fast, full-scale work. What is called fantasy becomes reality through the ingenuity and innovation of skilled managers and trade workers who craft the design into a finished and functioning project. Despite what may be said or thought about design, it can and does become architecture, on a daily basis.

THE BLEND

The key to a successful project is the appropriate blending of design, construction, and management. No one of these should be given an inordinate role in the project—each needs the other in order to succeed. Each obviously has its place on every project site, but the preeminent issue is that the three elements be combined in an ongoing manner that produces the project through a communal or team effort.

This cannot be stressed enough. It is the absolutely correct way to approach a project, and every aspect of it, from the most insignificant and mundane to the most ostentatious and impressive. Fundamentally this is a matter of respect, which is either brought to the job site by the various personalities involved or is somehow developed. (It is impossible, though, to legislate or require that respect be shown to all others.) It may be that the project leader, whoever that may be, shows respect to others, and has developed such a method of operation that everyone is touched by the aura of that person and seeks to both please and work with that leader.

There are many situations similar to this, whereby the mere presence of a person can influence the attitudes and actions of others. Obviously, many actors carry an element of this, where they create such a mood that they move the audience to the emotion they seek. The same is a very helpful approach on the construction job site—not for mere emotion but to move all participants in a cohesive and single-minded

direction. Perhaps the best word is "inspirational." A "can-do" spirit, carefully and professionally applied, moves even the most reticent of participants. This is not the traditional "rah-rah!" approach, but rather a confident and knowledgeable spirit that best utilizes others in their particular way, for the best combined result. Perhaps the key is a flexible attitude in all parties, and a willingness to adjust to conditions and personalities—to give and take, not for selfish motives, but for a better presentation, work effort, and project.

There is a widespread, almost industry-wide distrust between designers and constructors. This is a most unfortunate, wholly unhealthy atmosphere that pervades many projects, at least to some degree. In some, it is so distracting that meetings become major, ferocious, disruptive arguments, and so confrontational that physical restraint must be used by one party on another.

In striving to protect their own self-interest, each group seems to feel that the other is intent on compromising its efforts. Certainly, no one believes that members of either group enters a project with a predisposition to create havoc, cause problems, harass, or take the other to nasty litigation. But this seems to be an unconscious belief.

Designers are agents of the owners and are hired to work the parameters of the project to the best interest of their client. They produce documents that set out a formal array of construction information and directions, within a legal framework that acts to retain proper status for all parties (including the contractors). There should be no intent to undercut or compromise the construction effort—this would be wholly foolhardy in that such actions directly inhibit proper and correct production of the project as the owner desires.

Contractors may feel burdened by how the project is designed, the documents, and the expectations put forth as to cost and timing. But all of this should be agreed to at the onset to meet the desires and needs of the client.

Designers, on the other hand, often regard contractors as those who can unfairly manipulate the project work or provide less than value in many aspects of the work (cheaper materials, less skilled labor at inflated prices, etc.). In addition, designers may see contractors as those who play on the normal range of shortcomings in any set of documents. By meticulously finding and taking advantage of all such loopholes (or so the perception goes), the contractor can create an added profit. Such shortcomings should have, in the designers' eyes, been found and exposed before the formal contract was signed, so they could have been resolved in a better manner.

In short, designers all too often view contractors as pseudo-predators who sacrifice and compromise the project for their own self-interest and

profit (not providing full value for dollar given). So long as this atmosphere exists (this perception is always there in one degree or another) and until both parties gain a good measure of confidence in each other and their actions, vying for position will be part of everyday work. Too many projects have become excruciating experiences with resulting animosity that lingers long after completion. So there is a distinct need for better understanding, on both sides, of the whole design-construction process.

The better understanding that young professionals have of construction processes and tasks, how field operations work, how individual materials and systems are fabricated and installed, and the direction and skill of the trade worker, the better the process of project production. And the reverse of this is also true. The contractor needs to respect the design process and the work done, as much as the designer needs to be respectful of the contractor.

THE NEED

Perhaps the first and highest need is for the complete understanding that construction is *necessarily* a team effort between design and construction, and totally noncompetitive. Aside from the actual physical building work, construction is a very complex interplay between quite varying perspectives and directions.

First, it is necessary that all parties put aside prejudice and other demeaning attitudes and accept the fact that the others are as necessary to the success of the project as they are. Design professionals bring a subjective aspect to the work. In any design situation there are many solutions to any problem. Part of this process is to come as close as possible to the needs and desires of the owner. This narrows the choice of solutions, to some degree, but still the professionals are needed to focus in on the one solution that solves the owner's basic problems. Design is a factor in developing concepts through thought processes that are not necessarily contained in written or graphic form. It is bringing many quite varied concepts and real things together to produce the new project (see Figure 1-9).

Figure 1-9 Design professionals bring a subjective aspect to their work, which brings creativity and innovation to projects to enhance their basic premise. *PhotoDisc/Getty Images.*

The contractors, in turn, bring a pragmatic approach to the project, along with their hands-on expertise. Fundamentally, the contractors have the ability to do anything required to execute the project. This is a tremendous advantage in creating a successful project. Often design concepts are so complex and so new that they challenge even the best of contractors. But contractors are quite adept at finding ways to manipulate their processes and meet those challenges. It is noteworthy, though, that design professionals are heavily (but not exclusively) creative and design oriented, while contractors are mostly pragmatic and less concerned with creativity, design, aesthetics, and other intangible project attributes. In essence, the prospects are limitless. Between the design professionals and the contractors, and given enough time, anything that can be conceived, designed, and documented can be built (so long as the client/owner has enough money to pay for the project and enough desire to own it).

However, in the work of both professionals and contractors, the ability to create and execute the work comes at a price—literally. Many projects are modified from their initial configurations simply because the execution of the concepts is so costly that the owner's budget cannot provide all the necessary funding. It is here that the construction managers and project managers in the various offices play a role in closing the circle of the project, finding the best blend of design concept, execution, and funding. With proper construction background, training, and experience, managers offer a special insight into the project work. Often they are able to offer alternative methods of construction, other materials, or design modifications that retain the essence of the original concept but in a more affordable form.

The marvel of construction is that within the contractual authority and responsibility for the "means and methods of construction" (per AIA Document A201, General Conditions of the Contract for Construction) is the ability to ascertain, determine, or establish a way to build and achieve every configuration, opening, attribute, profile, edge, image, detail, and construction required by the design concept.

While this ability parallels the knowledge of the design professional, it often surpasses that know-how and achieves well beyond anticipated ends. This, of course, may come with added cost and often added time for the effort. Still, the marvel of producing virtually anything that is part of a design is a credit to the ingenuity and expertise of the construction forces—administrative, supervisory, professional, and skilled.

BASIC RESPECT

It is fairly obvious that dominance is not the key issue—it is not a manner of who can make demands on others, or who can influence the owner

to the greatest degree, or who can force their will on others. It is rather a matter of respecting the work of others, working to meet the issues in a cooperative manner, and providing the owner with the project as close to the approved design concept as possible, within budgetary bounds.

Unfortunately, ego, anger, or past bad experiences too often influence the attitudes and actions of some of the parties. When these negatives come into play there is a project scenario that does not serve anyone very well. One's ego can be fed by being a part of a highly successful project—so why force an attitude on others that inhibits their work?

In the construction industry today, there are dynamics at work whereby construction projects are being executed in new, different, and often innovative ways. Things have and are changing quite dramatically. Sometimes, these changes are the root cause of new irritations, or they regenerate old wounds. Project work for the most part is constant, even though it changes somewhat from one project to another. It is the personnel and their relative roles that change for one reason or another.

DISPELLING THE ISSUE

The point often lost or ignored is that the deepest desire of the design professional is to produce a project as nearly perfect as possible for the client. To do this means to create a design concept that fits the owner's program and then to document that concept in a manner that conveys all the information required for faithful construction, in clear, complete and unequivocal terms. There should be nothing frivolous involved, nothing thrown in for no legitimate reason. And there certainly should be no intent, attempt, desire, or time to set out documents and terms that purposely impose on, attack, or seek to be adversarial to contractors. There should be no intent to penalize contractors or to do anything in a manner that will reduce their effectiveness or reduce their profitability (but some will still quibble over the level of profit).

The drawings are so commonly accepted and understood that they are seen as the primary and in some cases the only valid documents. But the truth is that the associated specifications are equally important, as they are purposely created to contain the information that simply cannot be displayed graphically. It may be that the volume of words is imposing and appears threatening, but this is not the intent of the design professional. Granted, there may be provisions for work to be done in a manner different from the norm, requiring adjustments in the contractor's procedure, but this is done for a reason. There is no inclination or desire to be adversarial in the documentation. They may appear to be strong, strange, and strident, but the goal is achieving the finest of projects for the client.

When contractors are merely given the task of doing such work, the practical side kicks in and may bring them to question why. If met by a strident answer, sparks can fly and the contractors may well feel put-upon when asked to try to do something new and different, outside the straight line of their expertise, and at their cost. While a contractor buy-in earlier in the process may help, that is rather difficult to achieve in the Design/Bid/Build (D/B/B) program, since the contractors are involved only after the design is fully developed and documented (what is, is what is required). Any buy-in is best restricted to methods and timing, since the basic design concept is already agreed upon by owner and design professional, and virtually firm. But input to better and/or quicker execution of the concept work is a valid place for the contractor to buy in, to become a more involved partner in the project.

Fast-forward now to the day when the project is sparkling clean, meticulously appointed, shiny, festooned perhaps in some colorful dressing, and ready for speeches, platitudes, and a ribbon-cutting. Here, marvelously, stands a new piece of architecture. True to a style; true to detailing, coloring, product selection, proportion; a good new example of design direction, a time period, or a designer's body of work.

But what occurred between these two idealistic, rather charming and inspirational events? Well, actually two periods of time or processes: documentation (of the design concept) and the actual work of construction. In the former is the work of transforming a design concept—an idea, a solution—into hard and fast construction information. A new lexicon is required, and what may have been hazy detail, unresolved and indistinct, now becomes distinct, directive, and instructional. To overcome the sense of being overwhelmed by a maze of tasks and information and of daunting intricacy, the process and progression needs to be understood. This is best done by working one's way through the entire process, at least at a basic level.

First, there is need for mutual agreement and understanding what exactly what we are talking about when we say "progression."

Progression: A successive sequence or series of continuous and connected work, events, or tasks in which each is related to its predecessor so as to produce a proclivity for action or a process of incremental movement toward an established goal.

In this definition, we have combined several aspects of progression into a single definition that addresses construction and architecture. Here there are really three separate processes within the progression addressed in this book (see Figure 1-10).

The design professional and the owner are active in the first (lefthand) portion as the project is formulated and documented. The contractor may have some very limited knowledge and direct participation, as may construction managers. However, this portion is traditionally the purview of the ownership as it is made to express its desires and requirements for the project or program and to oversee in general terms the creation of the design concept and its subsequent documentation.

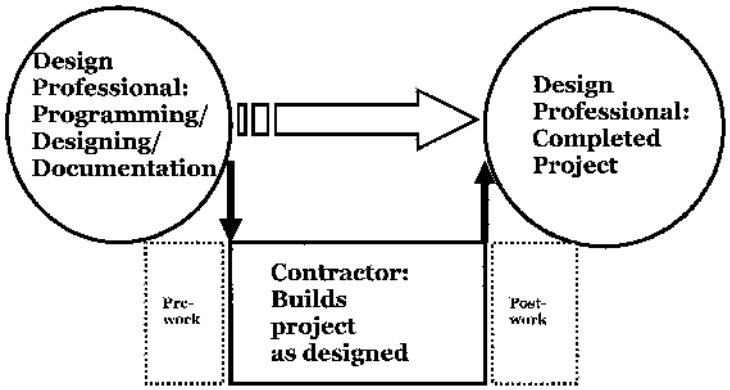

Figure 1-10 The participation of the design professional and the construction force. Note that the primary work of the professional is at the inception through documentation phases, and then at the completion of the project. Construction is the function that takes the documentation and builds the project, and makes it ready for owner occupancy and use.

Later, at the end of the project upon completion (the righthand portion), the design professional is again the preeminent party as the project closes down and the owner takes occupancy. From this point the design professional is the active outside party in further assessments, studies, reports, analyses, et cetera. The contractor may have a limited participation in the form of callbacks, et cetera, as noted.

The contractor and allied forces (subcontractor, suppliers, manufacturers, etc.) work between the extremes of project formulation and project completion (see Figure 1-11). Their work is executing the actual, hands-on construction work and creating the reality of the design concept.

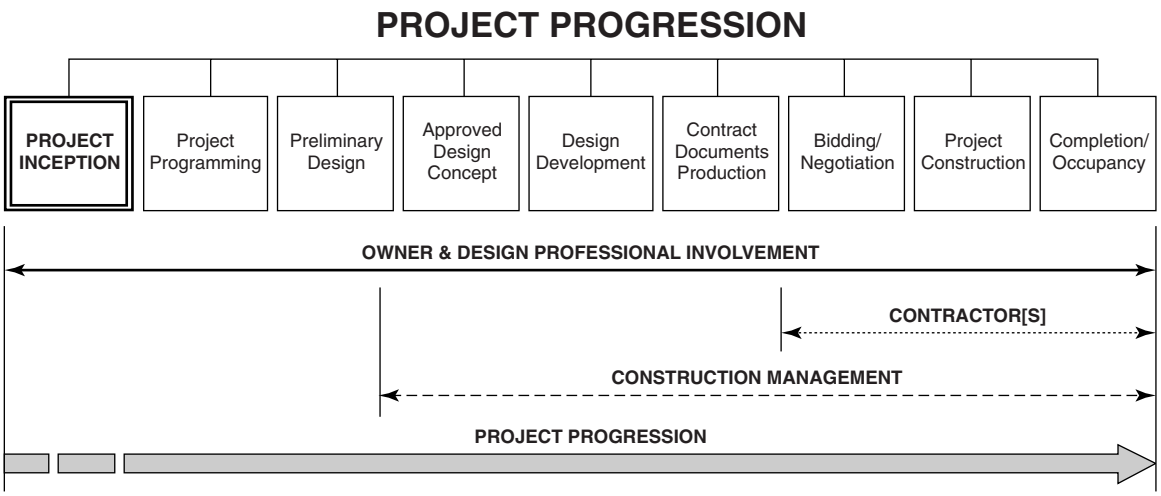

Figure 1-11 The overall scheme of the progression of a project.

This is perhaps the truer progression (as we defined it above) since the work must be done in a regulated format. The contractor's field superintendent is the person who, perhaps, has the best and deepest grasp of the progression required by the project and the work schedule. This person is acutely aware of the desired end result—a profitable project for the contractor, and a satisfied customer in the owner. Doing rework, or tearing work out due to its being out of sequence, is intolerable. It is simply to be not only avoided but "planned out" of any work progression or schedule to be used.

This work of planning out the work tasks, their relationship (what depends on other work, etc.), and the sequencing of personnel requires a skilled hand and great depth of knowledge of the construction process. And it is not just recent construction that has forced this new operation management.

In April 1930, construction of the Empire State Building began in New York City. This was a masterful project, innovatively done, in a time far before modern construction methods, materials, and technology (see Figure 1-12). This building was built in but twenty months and was the product of amazing innovation by the contractor, to sequence and facilitate the work process to allow for rapid and relatively easy construction. This is an excellent project that is well worth study due to the combination of the era of the project, the crude (compared

Figure 1-12 The Empire State Building was built in the record time (for its era) of 20 months. The contractors accomplished this through the creation of new procedures and details of construction designed specifically for the type of project and the schedule. *Lewis Wickes Hine, National Archives.*

to today's) equipment, techniques, methods, and technology available, and the insight of the contracting firm. (See *Building the Empire State*, by Carol Willis and Donald Friedman, published by Norton in 1998, which is based on actual field notes and journals written during construction.)

If necessity was ever the mother of invention, this was its premier example. There was terrific pressure to finish the building as soon as possible for both competitive and status reasons. Due to the Great Depression, workers were easily available, worked for minimal wages, and worked in such a manner that they literally put themselves out of work (by working so efficiently that they finished the project quickly and so rendered themselves unemployed in very bad economic times). The contractor was forced to create new methods for working higher than ever before, without benefit of traditional work equipment and processes, and in the heart of busy New York City. There were no tower cranes—only small jibs that were steam powered. Some supplies were delivered by horse-drawn wagons. How do you lay brick up to 100 stories high, from the outside of the building? Indeed, how do you build the entire complex of the exterior walls, from the inside? The challenges were monumental, but they had to be first accounted for to complete the building, and then fitted into the progression of work in their correct place at the correct times.

UNDERSTANDING THE PROGRESSION

The progression in every case, no matter the size, type, or complexity of the project, is a logical format of tasks—some performed in tandem, some concurrently, some in isolation. It is a matter of stepped procedures that follow a prescribed path appropriate to the project—a series of events that interface and build one upon the other until the project is finished. It is devoid of new work being installed at the wrong time—that is, before other required work is placed to support or form a place for the new work. The logic of this progression is within the contractor's purview and falls under the responsibilities of the contractor for construction means and methods. It is the planning, routing, and execution of work that moves design concept to finished project.

Construction and architecture are conjoined and inseparable. Each needs the other to accomplish their mutual goal. This is seen most easily in the progression of a typical project (with the understanding that conditions and requirements do change between projects and necessitate modifications in the process) from project inception to project completion, occupancy and beyond.

The intent of this book is to overview the whole project progression from the very beginning to the very end (and a little beyond). Within the discussion in this book, there are some primary issues that must be kept in mind:

1. Projects vary widely in both scope and complexity, and the discussion here is a generalized view that does not begin to address a project of some fixed parameters—it merely sets out the sequence of tasks.
2. There are a multitude of tasks within any given project and the extent and details of each can be quite simple or highly imposing. Each task or construction operation is a complex combination of ideas and conclusions and a massive amount of physical labor.
3. It is impossible to finish a block of work involving a given material, such as concrete, all at one time. For example, it is counterproductive to lay concrete sidewalks along with the concrete foundation, simply because both are concrete.

In addition, there is a tremendous array of information involved which could fill other books, and in many cases already has. We urge reference to the appendix on trade associations on this book's companion Website, www.wiley.com/go/constructionofarchitecture. The latter are narrow-scope, special-interest groups and organizations that can provide highly detailed information about a narrow range of products, work, materials, or training. Consult these resources for more information about any of the tasks mentioned or indicated in this text.

A warning: it is vitally important that the reader take this book as a matrix—an outline for work on construction projects. It should not be taken as an absolute process that occurs on *every* project *exactly* as written here. But it is critically important that readers stretch their minds to envision the complete spectrum of construction projects—from the smallest to the most extensive and massive. The progression is in each of these, in modified form, perhaps, but still present; it is not tied to any single type, size, or configuration of project. It is universal but flexible and necessarily adjustable to every project.

Within the construction industry, the range of projects in magnitude and complexity is enormous. Construction is not simply single-family housing, light commercial, high-rise, multiple building projects, et cetera, but also ranges to massive airports (e.g., Denver, Colorado, and Hong Kong, to mention a couple of recent projects), to awesome hydroelectric dams and power-generating projects, navigational locks and facilities, and so on (e.g., China's Three Gorges Dam project, the Niagara-Mohawk system at Niagara Falls, New York, and projects similar

to the Panama Canal). Also, it must be understood that construction is a worldwide industry where amazing projects can be located anywhere—in any time zone, country, and climate—and be of any size or capacity.

But what is also quite amazing is that the progression of each project, no matter the size, location, or complexity, is very much the same. What varies is the level of activity and effort involved, the length of time required, and the sheer magnitude of what must be accomplished. A small contractor may be deeply concerned about buying a new truck, but larger operation may be concerned about the continual purchase of large pieces of equipment for 24-hour-a-day operation, and the eventual scrapping of such equipment in an equipment graveyard (i.e., of totally worn-out units) on but one project.

EXAMPLE OF PROGRESSION FLEXIBILITY

Two identical buildings are to be built on
separate sites— one flat, the other quite hilly.
The work progressions for these projects are identical,

EXCEPT

more time, equipment, staff, operations, and effort are
required to grade and prepare the hilly site.

Table 1-1 is a short list of projects that have been built through history that challenged and stretched the talents and skills of the designers and workers. These, of course, are also part of the construction industry—the part that is rather hidden to laypeople, since they are never involved with or exposed to them. Humans tend to assimilate only what they experience, so we tend to see construction as houses, stores, offices, schools, et cetera. But there is much construction beyond these.

Research any or all of these (they all are well documented and fairly easily found) to better understand them and their construction progression.

It is quite obvious that the circumstances and demands of each project are unique and differ from those of other projects. Not only does each project have its own personality due to the imposed requirements, but also its overall context sets it apart. The renovation of an industrial plant, while maintaining production operations, is a far different project than a new building on an open site; a small low-rise building differs greatly from a hospital; a warehouse, while massive, is not nearly as complex as a school half its size; cold-weather construction varies drastically from hot-weather operations, and both may occur on a single project; high-end residential work is an altogether different problem than an industrial office building, which in turn differs from a high-rent

TABLE 1-1—EXAMPLES OF MASSIVE CONSTRUCTION PROJECTS IN VARIOUS HISTORIC ERAS

Pyramids at Giza (Menkaure, Khafre, and Khufu)
Parthenon
Pantheon
The Colosseum
Roman aqueducts
Pueblo Bonita
Aztec/Inca/Mayan pyramids/structures
Hagia Sophia
Notre Dame/Chartres/Cologne
Salisbury; Gothic cathedrals in Europe
Persian ziggurats
St. Paul's Cathedral
Houses of Parliament
St. Peter's Basilica, Rome
Great Wall of China
Empire State Building
Chrysler Building
Woolworth Building
Washington Monument
Westminster Abbey
Industrial plants that house aircraft construction or automobile assembly; long and convoluted production lines
Variety of high-rise buildings around the world: Taipei 101/ Sears Tower/Burj Tower (Dubai)
Aswan Dam in Egypt; Three Gorges Dam in China
Hoover and Grand Coulee dams in the United States

commercial office building. A single-family residence can cost upwards of $25 million, while a whole production plant can cost but $10 million. The variations are innumerable and across a wide spectrum—but each has its specific and special progression—a road map to its way of "being built."

In addition, a mere change in a wall system creates a different scenario for the project and different timing. It is both impossible and needless to list or describe each project sequence. Case studies of individual projects are available for closer, in-depth analysis.

For the sake of simplicity and since it is basically chronological, the progression discussed in this book is based on the mainstream and traditional Design/Bid/Build project delivery system. Other such systems will be discussed later, but the primary intent is to display the prevalent straight-line timing of the work progression as an educational tool. Certainly the other systems are valid and successfully used, but fundamental understanding lies in the basic simplicity of the work tasks in tandem in the D/B/B progression.