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The *Journal of Construction Education* (ISSN 1522 8150) was founded in 1996 by the Associated Schools of Construction, an association of 105 international colleges and universities with construction education programs. The purpose of the *Journal* is to provide an important process necessary for the preservation and dissemination of manuscripts that report, synthesize, review, or analyze scholarly inquiry. The *Journal* is an important way of our focusing international attention on and contributing to the understanding of the issues, problems, and research associated with construction education and training. The recognition of scholarly work within the realms of curriculum information, contemporary educational practices, educational research and instructional application development within construction departments, schools and colleges, and industry are the reasons for the *Journal's* existence. The *Journal's* mission is to provide construction educators and practitioners with access to information, ideas, and materials for improving and updating their understanding of construction education and training. It is also intended to help its constituency become more effective in developing the talents of learners within construction programs. This *Journal* is not only a living textbook of construction education, but also a perpetual and dependable learning source for construction professionals whether they are within academia or within industry. The *Journal* will be published tri-annually (Spring, Summer, and Fall issues). The divisions of the *Journal* include invited and editorially reviewed Book Reviews and Teaching Profiles, and blind peer reviewed Educational Practice and Research Manuscripts.



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**Editorial**



**Educational Practice Manuscripts**



**Educational Research Manuscripts**



**Other**

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# Editorial
# Annual *Journal* Entries

**Kenneth C. Williamson III**
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Annually, the following report provides the reader with an analysis of manuscripts submitted for review and publication. The *Journal* tracks those issue items that might indicate changes in the ways authors communicate bulk information to their readership. This is the seventh year of the Journal, and this review continues to include in the statistics addressed in the previous issues.

## Journal Vital Statistics

*Number of manuscripts accepted vs. rejection.* There were twelve manuscripts published during the past year. Twenty-four manuscripts were submitted for review, twelve were rejected as not being acceptable for publication and one was an invited manuscript. This provides the Journal with a fifty-two percent rejection rate. This is a twenty-two percent increase to that reported in previous years (see Figure 1).

Figure 2 demonstrates the rejections rates for the years 1998 through 2002. The years 1996 and 1997 were not included in that there were only two submissions and it is felt that these two years would skew the data in the Journal's active years. The average rejection rate for the *Journal* is 37.81%. There is a significant increase in the rejection rate in 2002 as compared to the years 1999 through 2001.

*Average number of pages per published manuscript.* There was a change in the number of pages per manuscript. The average was 9.75, which was a positive change of 0.88 from the previous year.

*Average number of images, tables, and appendices.* Within this volume, images averaged 3.25 images per manuscript that is 0.18 more than that of the prior year. Tables increased 0.03 per manuscript to an average of 0.83. Attachments increased from 0.27 per manuscript to 0.33. Figure 3 is a graph of the statistics from 1996 to 2002.

## Web Site Vital Statistics

Figure 4 illustrates the hits received on the index page of the *Journal* for each month for 2001 and 2002. The 2002 data illustrates that the *Journal's* usage has evened out between those months that were previously demonstrating little usage. This probably indicates a readership external to the membership of the ASC.

Figure 5 illustrates the where browsers are going within the *Journal* for the same time period. The manuscript archive received 26.25% of the browsing volume. An interesting statistic is the 15.66% value for the reviewer-listing page. This indicates that readersare interested in the identity of our reviews. This should provide an effective argument for Review Board membership. Two addition observations are the style guide and definitions pages. It seems that the authors are attempting to not only meet the requirements of manuscript submission but are more interested in understanding the purpose and mission of the*Journal*.

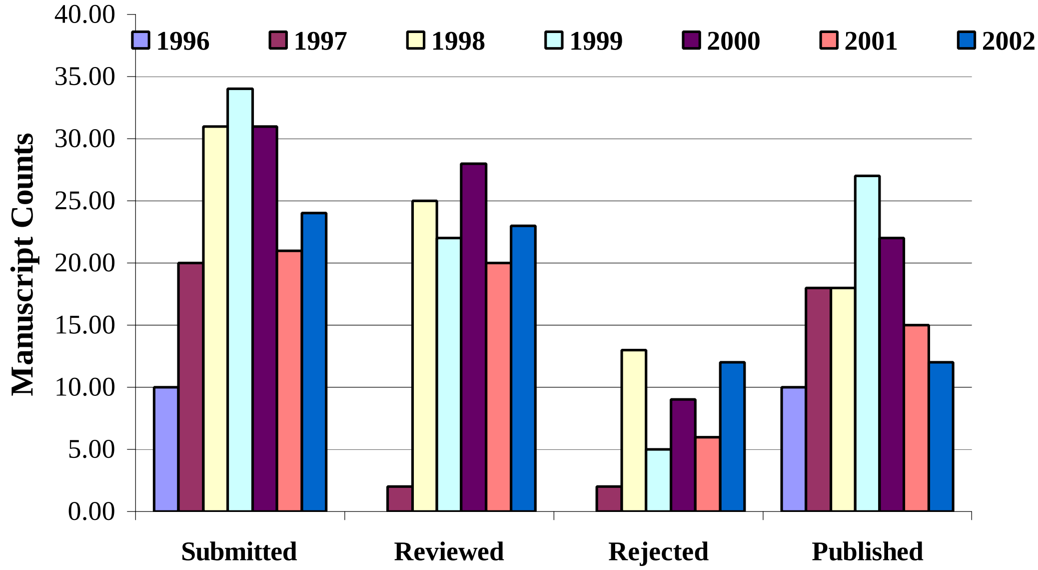


*Figure 1.* Publication and Submission Data

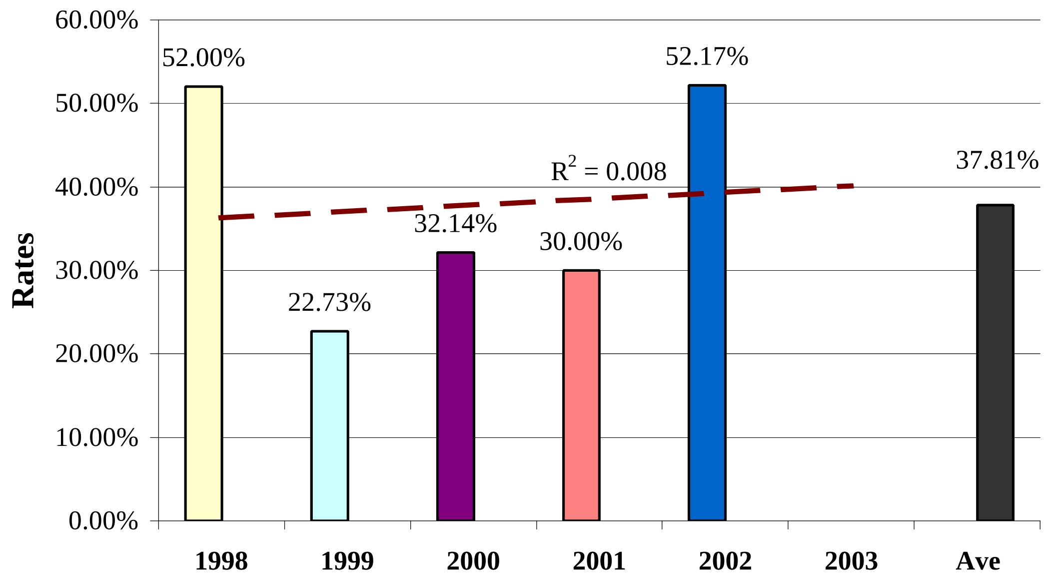


*Figure 2.* Rejection Rates Data

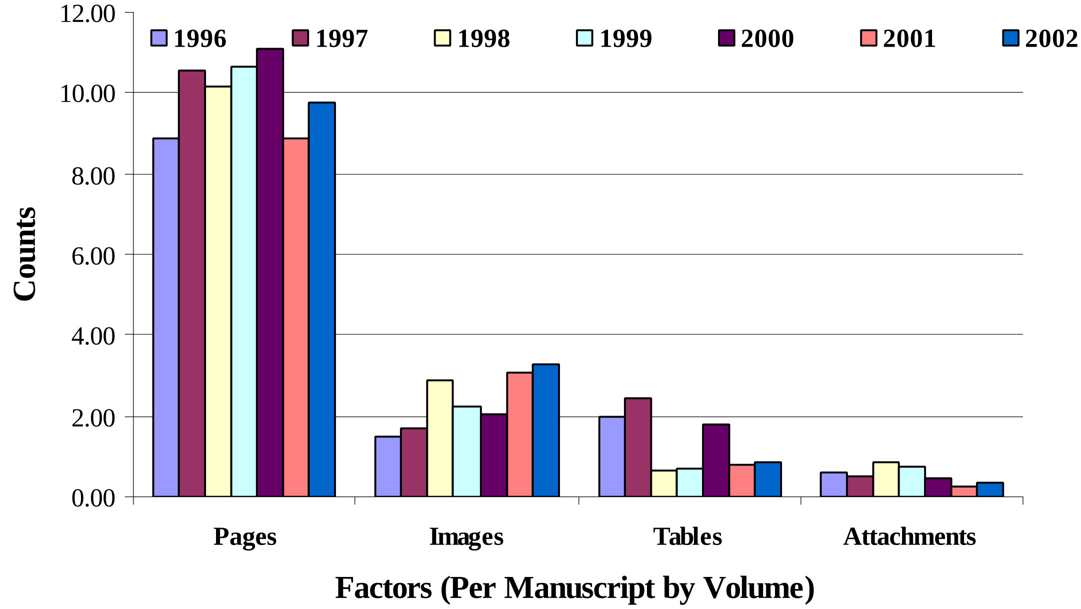


*Figure 3.* Manuscript Description Data

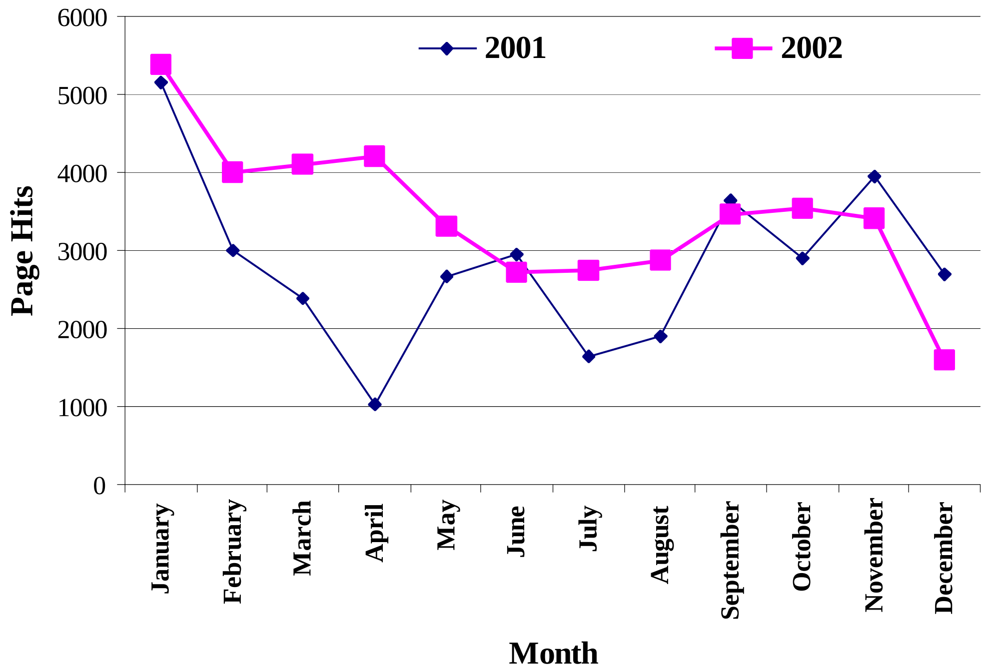


*Figure 4.* Journal Web Site Hits

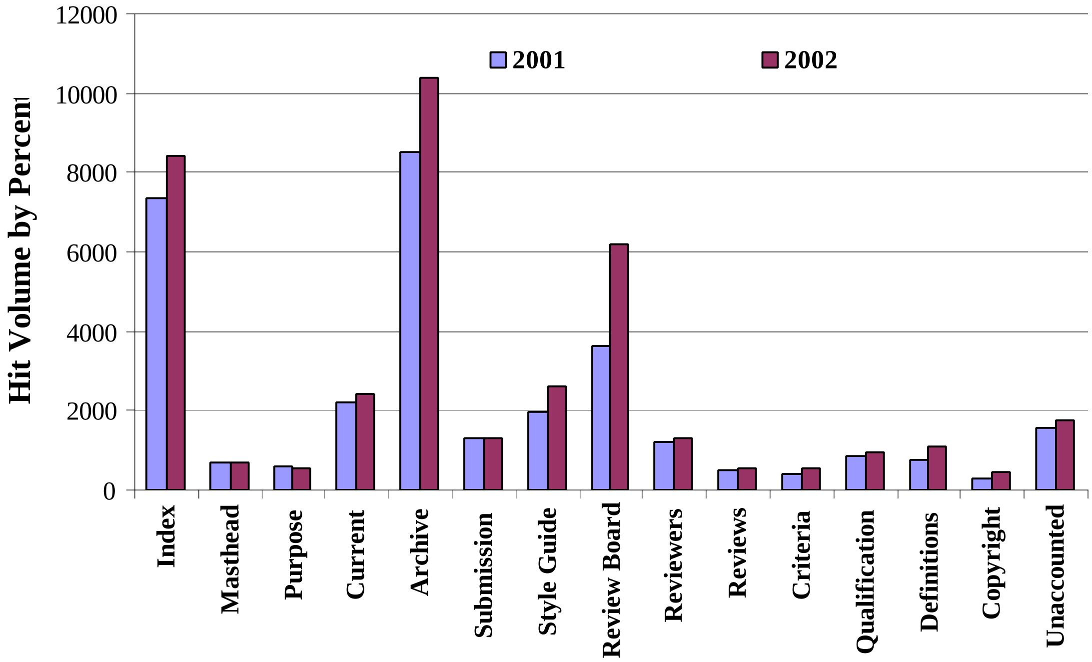


*Figure 5.* Hits by Page Category

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1522-8150/01/$3.00/Educational Practice Manuscript

# What Should We Teach About Design -Build Contracts? A Learning Module

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The popularity of the design-build method of project delivery is increasing in the United States. There are important differences between design-build and the more traditional method of design-bid-build. Getting the details right in the contracts can make the difference between success or failure. Professional organizations publish standard form contracts to assist their constituents to create accurate and comprehensive contracts. This paper identifies which standard form contracts are available and some important issues to consider when negotiating any construction contract. It is written to be used as a learning module for any course related to design-build.

**Key Words:** Design-Build, Contracts, Construction, Agreements

## Introduction

A contract is an agreement between two or more parties to do something (or refrain from doing something) and is enforceable by law. Contracting is fundamental to the construction industry. Constructors are commonly called contractors. They contract with an owner to construct something. Architects and engineers are also contractors except they typically provide documents instead of buildings. (However, this is changing, as more designers get involved with design-build.)

Contract law is an important study in the legal profession, and many lawyers specialize in this area. Although lawyers can be an important asset in contract negotiations, owners, builders, and designers should have the knowledge and skill to negotiate a favorable contract. Their future and livelihood depend on it.

Design-build is a method of project delivery that is growing in popularity. It differs from traditional design-bid-build in that the owner contracts with one party to provide design and construction. More owners are being attracted to the idea of single-point responsibility. It is very likely that many design or construction graduates will get involved with design-build in one way or another. What should the schools be teaching about design-build, especially about design-build contracts? This paper discusses standard-form contracts and important issues that should be considered when drafting any design-build contract. Of course, construction contracts may address many issues, but the following should be considered essential: liability and indemnity, licensing and registration, insurance and bonds, dispute resolution, ownership of design and documents, liquidated damages, warranties, changes in the work, differing site conditions, and termination for convenience. All construction graduates should have a basic understanding of these issues and how they can influence design-build contracts. With this in mind, the objectives for this learning module are as follows:

- Help students and design-builders understand the advantages of using standard form contracts.
- Help students and design-builders select the most appropriate standard form contracts.
- Familiarize students and design-builders with some of the most important issues so they can negotiate a fair and equitable contract.

## Standard Form Contracts

Why use standard form contracts? Simply stated, they are the most equitable and comprehensive contracts readily available. It is true that a few government agencies and very large design-build firms have drafted their own documents, but most design-build firms rely on standard form contracts (Quatman, 2001). Four organizations publish standard form contracts for design-build in the United States. A variety of international standard form design-build contracts are available. The Federation Internationale des Ingenieurs-Counseils (FIDIC) is an association of consulting engineers based in Switzerland whose forms are widely used in developing countries and are recognized by the World Bank (DBIA, 1999). The Joint Contracts Tribunal for the Standard Form of Building Contract (JCT) has published documents used in the United Kingdom, and the Engineering Advancement Association of Japan (ENAA) has published a new model contract for power plant construction (DBIA, 1999). The scope of this paper is limited to documents published in the United States.

Standard form contracts have two characteristics that should be mentioned here. One is that they are written as a set or "family." They share underlying assumptions and language and should not be interchanged. Two, they reflect the viewpoint of their parent organization. That is not to say that they are biased to the point of being unfair. They are intended to be as fair as possible, but they do have a point of view. Contractors tend to use documents published by the AGC; architects tend to use documents published by the AIA; and engineers tend to use documents published by the EJCDC. Responding to the rapid growth in design-build, a new organization was created in 1993 called the Design-Build Institute of America (DBIA). According to its own literature, it is dedicated to building consensus and working directly with both design and construction professionals. The DBIA now, too, publishes design-build contract documents.

This paper identifies various factors that may help determine which set of contract documents is most appropriate for a particular project. Of course, all of the articles in a written agreement can be modified in the supplemental conditions. A review of the four domestic organizations and their documents follows.

### *The American Institute of Architects (AIA)*

The American Institute of Architects has been publishing contract forms for over a hundred years. The AIA has been publishing standard contracts forms longer than any other professional organization (Haviland, 1994). Before 1978, the AIA considered it unethical for architects to construct any project they had designed (Quatman, 2001). This was consistent with the Institute's view that architects should represent owner's interests in a fair and impartial manner without any vested interests of their own. This prohibited architects from participating in design-build. The Institute has since reversed its policy and in 1985 published a "family" of design-build standard contract forms. They were updated in 1996 (AIA, 1999). There are three agreements in this family with two parts to each agreement. They are listed as follows:

- A191 Standard Form of Agreement Between Owner and Design/Builder
- A491 Standard Form of Agreement Between Design/Builder and Contractor
- B901 Standard Form of Agreement Between Design/Builder and Architect

Part 1 of the agreements is devoted to preliminary design and budgeting. Part 2 is devoted to final design and construction. After Part 1, the owner may accept the preliminary design and proceed to Part 2; negotiate revisions to the proposal and proceed to Part 2; or reject the proposal and terminate the agreement. If the parties decide not to proceed to Part 2, then the owner cannot use the preliminary design documents without the architect's written permission. (Figure 1 shows the relationship of the documents.)

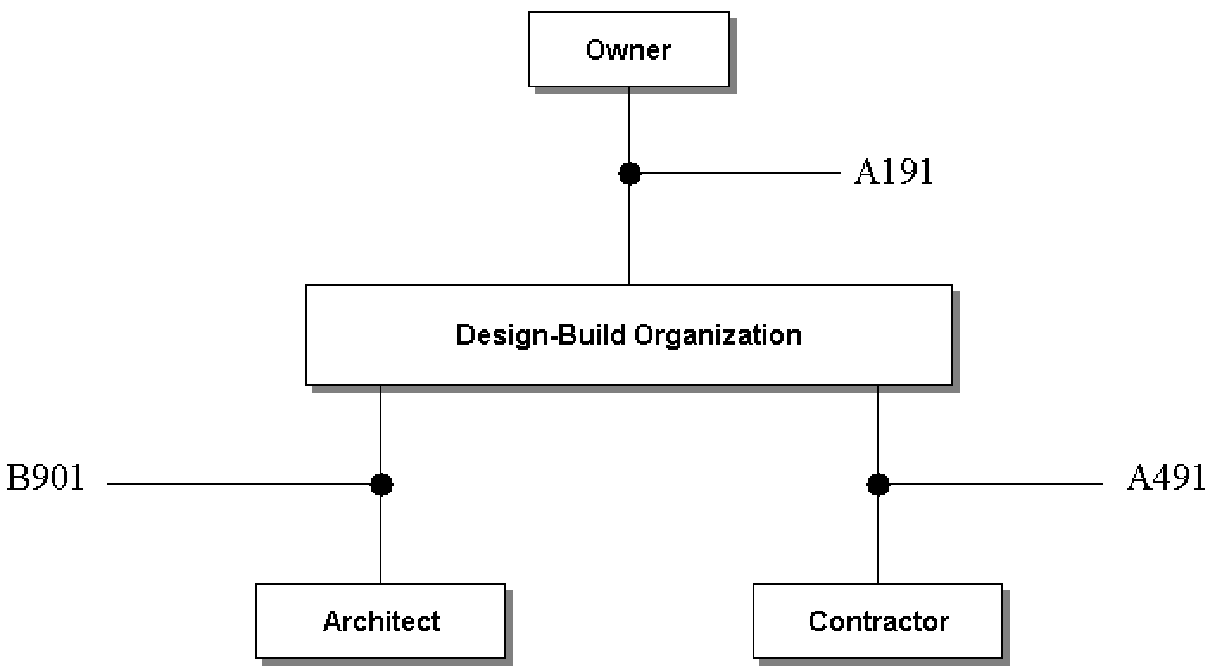


*Figure 1*. AIA Design-Build Contracts

### *The Associated General Contractors of America (AGC)*

The Associated General Contractors of America first published design-build documents in 1993. They were revised in 1999 (AGC, 1999). The AGC was the first to publish design-build documents (Quatman, 2001). The AGC documents are very user friendly and easy to read. Unlike the AIA and EJCDC, the AGC did not inherit a contract language from previous documents (DBIA, 1999). This allowed the use of fresh, easy to understand language, rather than "legalese." A task force consisting of constructors, attorneys, design-builders, and other stakeholders in the construction industry wrote the documents. Every attempt was made to create a set of documents that would be fair and equitable. The set of design-build documents fit together very neatly. The documents emphasize a team relationship philosophy.

Agreements between the owner and design-builder provide for a guaranteed maximum price or lump sum. The contractor-subcontractor agreements allow for the contractor and subcontractor to share the risk of owner payment or for the contractor to assume the risk of owner payment. The documents are listed below: (Figure 2 shows the relationship of the documents.)

- 400 Preliminary Design-Build Agreement Between Owner and Design-Builder
- 410 Standard Form of Design-Build Agreement and General Conditions Between Owner and Design-Builder (Where the basis of payment is the cost of the work plus a fee with a guaranteed maximum price)
- 415 Standard Form of Design-Build Agreement and General Conditions Between Owner and Design-Builder (Where the basis of payment is a lump sum based on an owner's program including schematic design documents)
- 420 Standard Form of Agreement Between Design-Builder and Architect/Engineer for Design-Build Projects
- 450 Standard Form of Agreement Between Design-Builder and Subcontractor (Where the design-builder assumes the risk of owner payment)
- 455 Standard Form of Agreement Between Design-Builder and Subcontractor (Where the design-builder and the subcontractor share the risk of owner payment)
- 460 Standard Form of Agreement Between Design-Builder and Design-Build Subcontractor (Where the subcontractor provides a guaranteed maximum price and the design-builder assumes the risk of owner payment)
- 465 Standard Form of Agreement Between Design-Builder and Design-Build Subcontractor (Where the subcontractor provides a guaranteed maximum price and where the design-builder and subcontractor share the risk of owner payment)

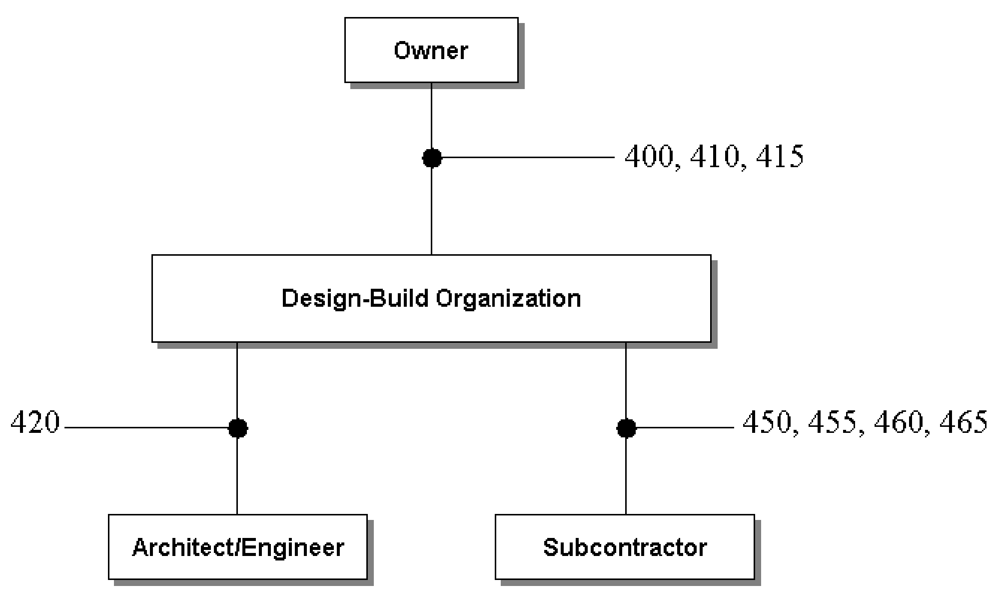


*Figure 2.* AGC Design-Build Contracts

*The Engineers' Joint Contract Documents Committee (EJCDC)*

The Engineer's Joint Contract Documents Committee was formed to provide a coordinated set of contract documents for the three professional engineering associations-the National Society of Professional Engineers (NSPE), the American Consulting Engineer's Council (ACEC), and the American Society of Civil Engineers (ASCE). The EJCDC design-build documents were published in 1995 (EJCDC, 1995). The design-build documents are similar to the design-bid-build documents to provide a sense of continuity. However, the language may be more detailed and comprehensive than required for some projects (DBIA, 1999).

According to the EJCDC contracting guide (1910-42), the EJCDC contemplates that a design-builder may be any one of the following:

- A single entity capable of providing both design professional and construction services with its own forces.
- A joint venture of an engineering firm and a contractor.
- An engineer or a contractor, providing either design professional or construction services respectively, itself, and providing the other through an appropriate sub-agreement.
- A construction manager, developer or entrepreneur that subcontracts to obtain both design professional and construction services.

The owner is expected to provide a set of "conceptual documents" to include in the RFP. Anticipating that some owners may not have the expertise to prepare these documents, the EJCDC prepared an agreement for an owner's consultant (1910-43). The documents are listed as follows: (Figure 3 shows the relationship of the documents.)

- 1910-40 Standard General Conditions of the Contract Between Owner and Design-Builder
- 1910-40-A Standard Form of Agreement Between Owner and Design-Builder on the Basis of a Stipulated Price
- 1910-40-B Standard Form of Agreement Between Owner and Design-Builder on the Basis of Cost Plus
- 1910-41 Standard Form of Sub-agreement Between Design-Builder and Engineer for Design Professional Services
- 1910-43 Standard Form of Agreement Between Owner and Owner's Consultant for Professional Services on Design-Build Projects
- 1910-48 Standard General Conditions of the Construction Sub-agreement Between Design-Builder and Subcontractor
- 1910-48-A Standard Form of Construction Sub-agreement Between Design-Builder and Subcontractor on the Basis of a Stipulated Price
- 1910-48-B Standard Form of Construction Sub-agreement Between Design-Builder and Subcontractor on the Basis of Cost Plus

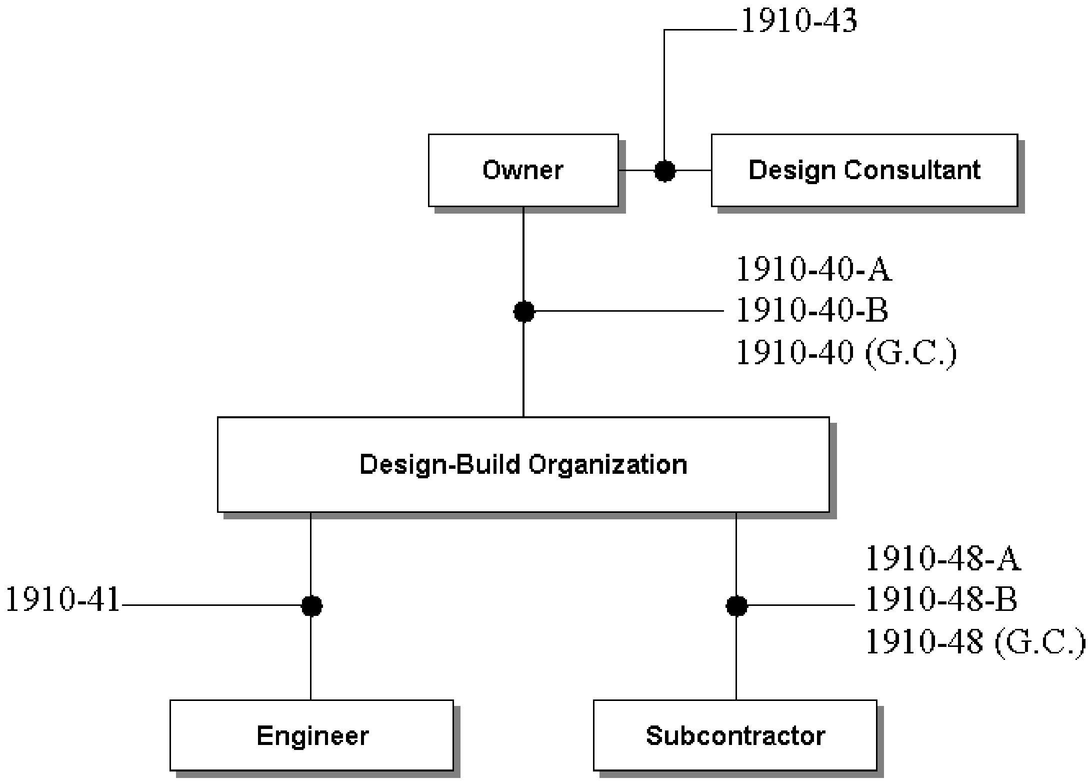


*Figure 3.* EJCDC Design-Build Documents

*The Design-Build Institute of America (DBIA)*

The DBIA's mission is to promote the best design-build practices (DBIA, 1999). The DBIA published design-build contract documents in 1998 and 1999 to fulfill that mission (DBIA, 1999). It is the DBIA's view that contract documents promoted by the professional associations discussed above are overly protective of the interests of their constituents (DBIA, 1999). Beginning in the 1980s, studies began to promote a more sophisticated view to allocating risk in construction (CII, 1980 & Levitt, 1980). These studies promoted the idea that risks belong with the party who is best able to evaluate, control, and bear the cost of the risk. The DBIA has adopted this view. The DBIA documents are easy to read and attempt to establish a balanced and unbiased relationship among the parties to the contract. (Figure 4 shows the relationship of the documents.)

- Contract for Design-Build Consultant Services
- Standard Form of Preliminary Agreement Between Owner and Design-Builder
- Standard Form of Agreement Between Owner and Design-Builder, Lump Sum
- Standard Form of Agreement Between Owner and Design-Builder, Cost Plus with an Option for a Guaranteed Maximum Price
- Standard Form of General Conditions
- Standard Form of Agreement Between Design-Builder and Designer
- Standard Form of Agreement Between Design-Builder and General Contractor, Cost Plus with an Option for a Guaranteed Maximum Price

- Standard Form of Agreement Between Design-Builder and General Contractor, Lump Sum
- Standard Form of Agreement Between Design-Builder and Design-Build Subcontractor, Cost Plus with an Option for a Guaranteed Maximum Price
- Standard Form of Agreement Between Design-Builder and Subcontractor, Lump Sum

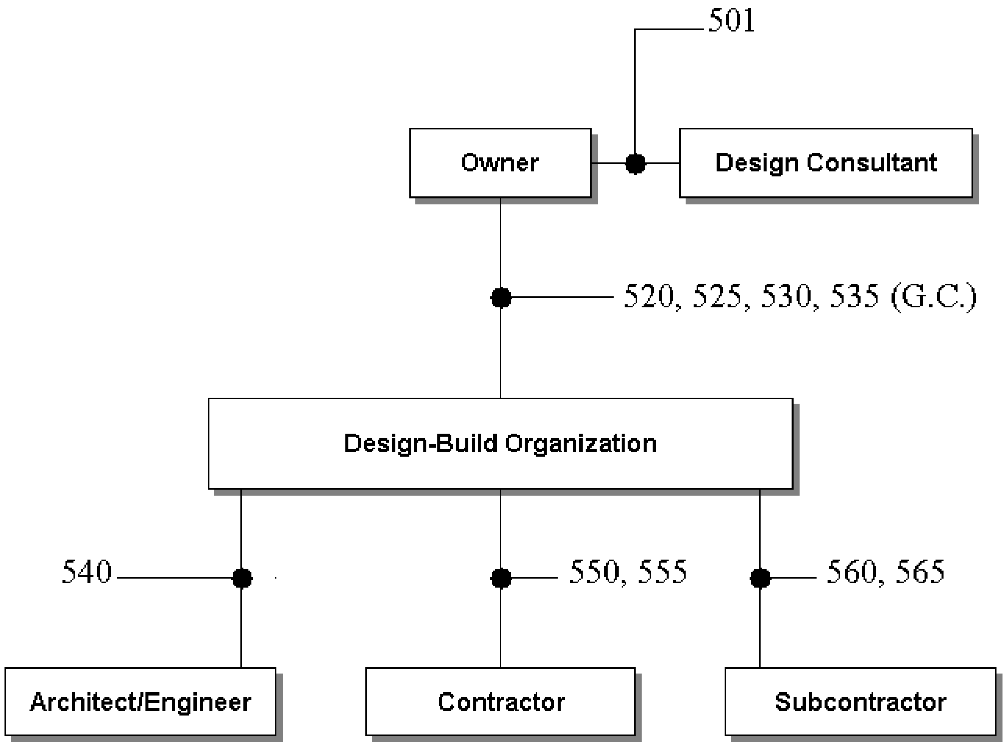


*Figure 4*. DBIA Design-Build Contracts

## Important Contractual Issues

Some issues in construction contracting are so important and so central to the way we conduct business that they are addressed again and again in the contract documents. Or, as some parties learn the hard way, they are not addressed or not addressed comprehensively enough. The following issues represent recurrent themes in all of the standard form contracts; however, each family of documents may approach them differently.

The following issues do not represent a comprehensive list. They do represent a core subject matter with which all students interested in construction management and contracts should be familiar. All standard form contracts can be amended with supplemental conditions and should be appropriate to the unique situation of each project. These issues are discussed in the context of design-build.

*Liability and Indemnity*

According to Webster's dictionary, liability is an obligation according to law, and indemnity is an exemption from a liability (Merriam-Webster, 1991). They are important techniques in allocating risk and are closely linked. All the standard form contracts try to define the responsibilities of the parties. One of the best ways to limit liability is to carefully write the scope of the work. This is important to all construction projects, but especially design-build. The scope of the work is unique to all projects and cannot be included in the standard forms.

Most design-builders seek and obtain limitations of liability (Loulakis & Fisher, 1995). This is usually done in two different ways-one, by limiting types of damages (such as consequential or indirect) and two, by placing a general ceiling on damages (Loulakis & Fisher, 1995). All the standard forms limit consequential damages. An example of consequential damages is if a roof leaked and damaged essential processing equipment that shut down the entire facility. Consequential damages can far exceed direct damages. Specific limitations on damages are referenced by law (to the controlling jurisdiction), listed in the supplemental conditions, or included in the insurance certificates. Competent legal and insurance counsel should write these instruments very carefully.

Indemnity provisions are sometimes referred to as "hold harmless" provisions. They have a long history in the construction industry, and courts routinely uphold them (DBIA, 1999). There are three basic types of indemnity (DBIA, 1999):

- **Broad Form** - This form of indemnity makes the indemnitor liable for all loss regardless of who is at fault. Many states prohibit this form of indemnification.
- **Intermediate Form** - This form of indemnity makes the indemnitor liable for all loss only if it is fully or partially negligent.
- **Limited Form** - This form of indemnity makes the indemnitor liable only for the losses due to its own negligence.

All of the standard contracts require the design-builder to indemnify the owner, but only in the limited form. Any risks beyond the limited form are probably not covered by insurance.

Two other areas of indemnity addressed by the standard contracts are for patents and hazardous wastes. It is logical and fair that the design-builder should not be responsible for patent infringements for work that is specified by the owner. All of the standard forms adopt this view, but only the AGC and DBIA forms specifically require the owner to indemnify the design-builder for any patented work specified by the owner. The DBIA forms address patent rights in the most comprehensive way.

Since the owner typically owns the site, the standard forms require the owner to indemnify the design-builder for any hazardous materials discovered on site. Nevertheless, it is still in the design-builder's best interest to examine the site and check the records of the appropriate environmental agency before bidding on any project. In addition, the EJCDC and the DBIA documents indemnify the owner for any hazardous materials brought on site by the design-builder. These may include glues, solvents, paints, and materials used to service HVAC equipment. Hazardous wastes found on the site may include asbestos, leaking storage tanks, or materials from a preexisting dump site. Waste is considered hazardous if it is listed under the Resource Conservation and Recovery Act (RCRA) (Cushman & Taub, 1992).

### *Licensing and Registration*

The Constitution of the United States grants the states extensive authority to protect the "health, safety, and welfare" of the American people. It is by this authority that the states license and regulate professions such as architecture, engineering, law, medicine, plumbing, and so forth. Many, but not all, states require construction contractors to be licensed (Cushman & Taub, 1992). This affects design-build in a profound way because contracts by unlicensed persons to perform services requiring a license are not enforceable (Cushman & Taub, 1992). If a contract is not enforceable, the design-builder might not get paid. Licensing laws vary considerably from state to state. Anyone contracting design-build services should thoroughly investigate the pertaining laws in the state where the project is located. The complexity of licensing and professional registration may work to slow down the trend to provide national and global design-build services.

All of the standard forms require the design-builder to contract with a qualified design professional to perform the design services. However, the design professional is a subcontractor to the design-builder, and the design-builder is responsible for all design errors and omissions. The owner considers the design-builder to be the designer whether the work was done in house or contracted out. This is a fairly simple arrangement, but state licensing laws can be very complex. For instance, even though all covertures have the appropriate registration, is the joint venture licensed to provide design services? Do all of the principals in a corporation have to be licensed or just a percentage? These questions and others should obviously be very thoroughly researched.

### *Insurance and Bonds*

Insurance and bonds for the construction industry are very complex subjects. This paper addresses these issues very broadly and focuses on how they are presented in the standard design-build contracts. Two excellent references for those who want more information are the chapter on insurance and bonding in William Quatman's book, Design-Build for the Design Professional (1999), and Document 221 in the DBIA's Design-Build Manual of Practice (1999).

Not many years ago, contractors and designers had difficulty getting insurance and bonding products for design-build. This has changed considerably, and many insurance companies and sureties have created new products for design-build. In 1999, 100 percent of design firms were able to acquire professional liability insurance for design-build projects (Quatman, Braswell, & Martinez, 1999). Insurance providers recognize that design-build is here to stay, and that claims may actually decrease with this delivery system.

Five common products for managing risk on construction projects are:

- *Professional Liability or Errors and Omissions (E&O) Insurance* - protects the designer from claims made due to negligence, errors, and omissions in providing services.
- *Commercial General Liability (CGL) Insurance* - protects the builder from claims for bodily injury or property damage.
- *Builder's Risk Insurance* - protects the insured's property interests in the work during construction.
- *Performance Bond* - provides a guarantee to the owner that the builder will complete the work and fulfill all contractual obligations.
- *Payment Bond* - provides a guarantee to the owner that the builder will pay all subcontractors and suppliers.

There are many other products available, and it is imperative that all parties to the contract seek expert legal and insurance counsel. An important difference between design-build and more traditional methods is that the owner will seek protection provided by E&O insurance and CGL insurance from one design-builder. It is typical for an owner to require the designer to carry specific limits of professional liability insurance. These limits are often set by the owner in the prime design-build contract and then referenced in the design subcontract. For instance, AIA B901 only states that the architect can recover any insurance costs from the design-builder over and above what the architect normally carries; AGC 420 has blanks to fill in the limits of insurance for each type of coverage; and EJCDC 1910-41 and DBIA 540 state that all insurance required of the engineer or designer shall be listed in an exhibit. E&O insurance policies typically have a list of exclusions, which can include anything from faulty workmanship, failure to advise about insurance, pollution, and design-build projects (DBIA, 1999). Architects and engineers should find an appropriate strategy to cover this "gap" in coverage when participating in design-build projects.

Before 1986, commercial liability insurance was known as "comprehensive" liability insurance. Unlike E&O insurance, CGL does not cover any costs related to defective work. This is typically self-insured. It does protect the design-builder form losses due to (a) bodily injury and property damages to a third party, (b) personal injury, and (c) medical payments (DBIA, 1999). The main difference between CGL and E&O is that CGL insurance is written on an occurrence basis which means that claims made after the policy period are covered. All design-builders should have general liability insurance. The standard-form contracts approach to CGL insurance is similar to E&O insurance. AIA A191 specifically requires the design-builder to have liability insurance, but does not specify how much, except it should meet minimum limits required by law. AGC 410 and 415 requires the design-builder to have liability insurance and provides blanks for the limits. The EJCDC and DBIA documents are mute on this issue but provide for the inclusion of an exhibit with all of the insurance requirements.

Builder's Risk protects the named insureds from losses due to damage to the structure and building materials. Because the owner typically owns the site, it might be cheaper for the owner to provide this policy; however, the design-builder would be advised to take the lead in this matter because it so directly affects the design-builder's interests (Quatman, 2001). The AIA and AGC documents require the owner to maintain all-risk property insurance. The EJCDC and DBIA documents refer insurance requirements to an exhibit or schedule.

Bonds are different from insurance in that they are credit transactions rather than a transfer of risk. This means the design-builder's personal property (including home) can be used as collateral (DBIA, 1999). This can act as a deterrent to small architectural or engineering firms going into design-build. A payment bond guarantees the owner that trade subcontractors and suppliers will be paid so they will not file liens on the property. A performance bond guarantees the owner that if the builder defaults on the contract, then the surety will complete the builder's obligations to the owner under the contract. Surety companies have had to make an adjustment to design-build. Sureties now have to guarantee design as well as construction. Because of the success of design-build, bonds are now generally available to design-builders. It should be said, however, that any attempt by the surety to reduce their exposure for the owner would probably reject design liability because it compromises the attraction of design-build. The AGC publishes performance and payment bond forms for both situations-where the surety guarantees the design and where the surety does not guarantee the design.

Nearly all public work is required by law to be bonded (Quatman, 2001). However, many private owners elect not to require bonding. Bonding is an expense, and the owner must decide if that expense is justified. Therefore, the standard form documents are not committed to this issue. AIA A191 is silent. The AGC documents provide paragraphs about bonding, but leave the choice to the owner. The EJCDC and DBIA documents again refer to an exhibit created by the owner.

*Dispute Resolution*

One of the forces driving the move to design-build is the all-too-often adversarial relationship between the designer and builder. The traditional design-bid-build method does little to discourage this type of relationship. Litigation has proven so costly and time consuming, that all participants in construction are looking for a better way. Partnering, teaming, and design-build are all attempts at finding a better way of working with one another.

Design-build is relatively new for many participants, and they are exploring how to make it successful. One of the best ways to improve the odds of success is to explicitly state in the contract documents how disputes are to be resolved. Each document family approaches this differently, but all agree on one thing-avoid litigation if at all possible.

The AIA documents have no provision addressing the timeliness of claims. The dispute resolution article calls for mediation first and then arbitration according to the rules of the American Arbitration Association (AAA).

AGC 410 states that any claim for additional time or money must be submitted in writing within 21 days after the event or 21 days after first recognizing the event. If the claim cannot be quickly resolved, then the parties must use further direct discussions, and then mediation according to the rules of the AAA. Losers are required to pay attorney's fees. This is an attempt to encourage resolution through direct negotiation.

The EJCDC documents require the design-builder to first submit a written notice of intent to make a claim within 30 days of event and then submit documentation within 30 days of notice of intent. Otherwise, the parties are allowed to use whatever method works best for them. (Both the

EJCDC and the DBIA contracts are brief compared to the AIA and AGC documents because they rely more on exhibits, and because they rely on a separate document calledgeneral conditions.) The EJCDC documents call for an exhibit titled "Dispute Resolution Agreement." This exhibit calls for all claims to be settled through mediation and then arbitration. Without an exhibit, the parties must resort to litigation.

The DBIA addresses dispute resolution in the general conditions instead of the agreement. Like the AGC documents, the aggrieved party must first submit written notice within 21 days after the event or 21 days after time for reasonably noticing the event. Paragraph 10.2.1 states that parties are fully committed to working with each other. This is consistent with the design-build philosophy of minimizing disputes. The parties should first try to resolve any differences at the field level, then between senior representatives of both parties within 30 days after a request for a meeting. The next step is non-binding mediation, then arbitration. Arbitration is final and binding. The loser pays attorney's fees.

*Ownership of Design and Documents*

As previously stated, the standard form contracts reflect the biases of the organizations that created them. This is especially true for the question, "Who owns the design and documents?" The AIA has a long history of claiming ownership of the design, design documents, and any copyrights associated with the design documents. The AIA design-build contracts continue this claim. Architects maintain they sell services, not products, and the design documents are extensions of that service. A191 states, "The Design/Builder's Architect and other providers of professional services shall retain all common law, statutory and other reserved rights, including copyright in those instruments of service furnished by them." There are many reasons why architects and engineers claim ownership of thedesign and documents. Perhaps the most compelling reason is that unauthorized use of design documents increases the designer's liability. Buildings are typically designed for a particular location. Building the design at another location increases the chance of systems failure or code violation. The EJCDC documents take a similar approach except the design-builder retains ownership instead of the engineer. The instructions about reusing the documents are located in the general conditions instead of the agreement.

The AGC documents take a different approach. Upon making the agreed upon payment, the owner becomes the legitimate owner of the documents. However, the owner is not allowed to make "derivative works" from the documents for other projects without written authorization from the design-builder. Unlike the AIA documents, the AGC documents do not provide any incentive for the owner to retain the design-build team after preliminary design. Also, the documents are not clear as to who owns the copyrights, an important issue for architects and engineers.

The DBIA maintains that the design documents belong to the design-builder, and the owner cannot reuse the documents without the design-builder's written permission and appropriate consideration.

## *Liquidated Damages*

The difference between liquidated damages and a penalty is that a penalty is considered to be arbitrary, whereas liquidated damages should be based solely on realistic estimated losses anticipated by the owner if the project is not completed on time. Liquidated damages have become a standard feature in many construction agreements. The purpose is twofold. The first is to provide incentive to the constructor to finish on time; the second is to provide a method for the owner to recover economic loss. There are times when liquidated damages are entirely justified; however, owners should remember that contractors already have a powerful incentive to finish on time, because a delay in the project reduces profits. It can be detrimental to the project if the parties allocate time and resources preparing for litigation instead of completing the job.

The AIA and AGC documents do not address liquidated damages at all. The owner must include this item as a supplemental condition. EJCDC 1910-40-A and 1910-40-B have lengthy paragraphs for liquidated damages with blanks for delays in substantial completion and failure to achieve final completion. There is no mention of an early completion bonus. The DBIA, on the other hand, believes that a penalty for late completion should be accompanied by a bonus for early completion (DBIA, 1999) and includes both in the standard contracts.

## *Warranties*

A warranty is a promise that a statement about some fact is true and will continue to be true (Twomey, 1989). There are two kinds of warranties-express warranties and implied warranties. Express warranties are explicit-usually written; implied warranties are tacit or inferred. Professional liability insurance typically excludes any type of express warranty, so design professionals typically do not include any express warranty in their contracts. However, this does not mean that designers are not held accountable. Design professionals are held accountable by what is known as a standard of care. A standard of care is that level of performance that a client could expect from a typical designer in a similar situation. Failure to meet this standard of care is called negligence. Negligence is a breach of duty imposed by common law and is actionable (Twomey, 1989). Negligence is what is covered by professional liability insurance.

In traditional design-bid-build, the owner impliedly warrants the contractor that the plans and specifications are free from defects. Courts have ruled that the contractor will not be held accountable for any defects in the plans and specifications by the Spearin doctrine (Vornehm, Pitts, & Leone, 2000). The owner assumes the risk for design. Design-build is dramatically different. Responsibility for design is now transferred to the design-builder who impliedly warrants the design to the owner. Moreover, courts have been willing to rule that the warranty now may apply to the performance of the project (Cushman & Taub, 1997). This raises the bar considerably from a traditional standard of care. This is more likely to be the case when the owner relies more on performance specifications than prescriptive design. The design-builder's liability increases even more if a court rules that the project is a product instead of a design. In this case, the court may apply the Uniform Commercial Code (UCC) to expand the design-builder's warranty (Cushman & Taub, 1997). (Modular housing is a good example.) Since it is not very clear how courts may rule on this, the contract language on warranties should be very specific.

All of the standard form contracts contain "boiler plate" language that warrants the owner that the design-builder will install new materials and equipment unless otherwise directed, that construction will be free of defects, and that construction will conform to the contract documents. However, the documents differ in regard to fitness for a particular purpose and merchantability. Fitness for a particular purpose is a higher standard than a standard of care. Contractors may be more accustomed to this higher standard than designers. As previously stated, courts have been willing to rule that a design-build warranty may apply to the performance of a project. This is the view adopted by the DBIA (DBIA, 1999). It is fair and reasonable that an owner can expect the facility to operate as intended. However, AGC 410 and 415 state in bold, capital letters, "All other warranties expressed or implied including the warranty of merchantability and the warranty of fitness for a particular purpose are expressly disclaimed" (AGC, 1999). None of the other documents disclaim fitness for a particular purpose or merchantability.

Is the design-builder providing a service or a product? It is probably wise that the design-builder not claim to provide a product that can be warranted under the UCC. Construction projects tend to be unique, not products of mass production. A disclaimer to this effect can be added as a supplemental condition. A warranty for fitness for intended purpose is another matter. The owner and design-builder should carefully negotiate this issue. Cushman and Taub recommend that design-build contracts state exactly the performance the owner requires, provide enforceable guarantees of that performance, and exclude all other performance guarantees that might be inferred (Cushman & Taub, 1997).

*Changes in the Work*

As anyone in the construction industry knows, changes in the work are the most common source of disputes. The most common instrument for executing changes is the change order. DBIA 535 (General Conditions) defines a change order as follows: "A Change Order is a written instrument issued after execution of the Agreement signed by Owner and Design-Builder, stating their agreement upon all of the following: (1) The scope of the change in the Work; (2) The amount of the adjustment to the Contract Price; and (3) The extent of the adjustment to the Contract Time(s) (DBIA, 1999). A minor change in the work does not affect contract price or time, and all of the standard contracts allow the design-builder to make minor changes if they do not affect the ability of the project to function as intended.

With the exception of the DBIA, all of the organizations discussed in this paper have developed a philosophy and set of procedures over a considerable period of time for dealing with changes. The approaches for making changes established in the design-bid-build documents are carried over to the design-build documents. For instance, the AIA documents allow for construction change directives, and the EJCDC documents allow for work change directives. These instruments allow the owner to direct the design-builder to make a change before it has been established if the owner will pay for the change. Architects and engineers obviously find a need for such an instrument; contractors do not. AGC 410 states that the design-builder does not have to perform changes before a properly executed change order, or a written order to proceed with the owner agreeing to pay the extra cost. The position of the AGC is that a construction change directive represents a threat to fair and equitable compensation.

The DBIA tries to strike a reasonable compromise. It allows the owner to issue a work change directive, but the design-builder is entitled to 50 percent of its estimated cost for the change upon receiving a written notice to proceed. Any further disagreement can be pursued according to the dispute resolution procedures.

*Differing Site Conditions*

Allocation of risk is a very important issue in all construction projects. A risk that poses substantial consequences for any project is what lies beneath the surface of the ground. Unanticipated subsurface conditions can literally make or break some projects. Who should bear this risk? The standard form contracts agree that the owner is the appropriate party to bear this risk. Some owners may try to shift this risk to the contractor or design-builder, but this is usually a shortsighted strategy. If the contractor cannot make reasonable assumptions based on the available data, then the contractor must include a substantial contingency in the proposal to cover unanticipated subsurface conditions. If these conditions are not encountered, then the contractor reaps a windfall. If the contingency is not enough, then the contractor experiences loss. It is far better for the owner of the property to pay for whatever subsurface exploration provides an acceptable comfort level, and hold harmless the contractor for unanticipated conditions.

The standard contracts are in agreement on this issue, and the wording is very similar. They identify two types of differing conditions: (1) Conditions differing from those stated in the contract documents, and (2) Conditions which differ considerably from those ordinarily encountered. The EJCDC contemplates that the owner will develop a set of concept documents prior to soliciting proposals, and that subsurface data will be part of that proposal. This approach has much to recommend it.

*Termination for Convenience*

Even though the right to terminate a contract is rarely used in the area of private construction contracts, (Vornehm et al., 2000) it is an important issue and should be addressed in the agreements. The owner should have the right to terminate the agreement if the project becomes impractical, but the design-builder should be fairly compensated for all of its contributions. A design-builder may work for a very low margin in the design phase anticipating higher profits during construction. Moreover, the design-builder may provide a key idea that is essential to the success of the project. What, then, is fair compensation? The standard form contracts approach this issue differently.

The AIA documents limit the ability of the owner to terminate. Part 1 of AIA A191 allows the owner to terminate the contract for convenience (without cause); however, Part 2 allows the owner to terminate only if the project is abandoned. If this occurs, the owner must pay the design-builder all earned fees, proven loss, and “applicable damages.” The term, applicable damages, is open-ended and invites controversy. The termination for convenience clause should be closely coordinated with the ownership and use of documents clause as discussed earlier.

The EJCDC documents are the most advantageous to the owner. These documents require the owner to pay only reasonable overhead and profit for completed work-not for any uncompleted work, and no damages. The owner may then proceed with the project.

The AGC recognizes the value of the design-builder in the preliminary phase (naturally) and provides for the design-builder to receive some or all of the anticipated construction fees. AGC 410 (cost plus) allows the design-builder to be reimbursed for the following: (1) proven costs and demobilization, (2) all of the design phase compensation, and (3) a percentage of the construction fee-25 percent before the onset of construction and 100 percent after the onset of construction. AGC 415 (lump sum) allows the design-builder to receive design costs according to the schedule of values and a percentage of the contract price (to be specified in the agreement). This specificity can discourage dispute and litigation.

The DBIA documents follow the lead of the AGC by allowing the design-builder to be reimbursed for a percentage of the remaining balance of the contract price.These documents provide blanks to be filled in by the contract parties instead of set amountsone amount to be paid before the onset of construction, and another amount to be paid after the onset of construction. In addition to these sums, the design-builder is entitled to be paid for all work provided, proven cost and expenses and demobilization. All of the standard contracts call for written notice to be submitted by the terminating party so many days before proceeding. It is essential that the schedule be strictly followed for the termination to be valid.

## Learning Module Application

Design-build contracts may be relevant to many areas of the construction curriculum. Presenting information on design-build contracts as a learning module allows faculty touse the module where and how they think appropriate. The module might be used in a capstone course, for continuing education credits, or in courses in construction law, construction documents, delivery systems, or design-build.

## Outcomes Assessment

There is a trend in higher education towards a more learner-centered environment (Huba & Freed, 2000). An important component of a learner-centered curriculum is assessment. Assessment provides accountability and a method for improvement. Two important steps in any assessment plan are the creation of objectives and intended student outcomes (or performance criteria) (Rogers & Sando, 1996). The objectives for this learning module are listed after the introduction. The learning module outcomes are listed as follows:

1 Identify four domestic, professional organizations that publish design-build standard form contracts.
2 Draw a bubble diagram charting the contractual relationships between all parties for each "family" of published standard form contracts.

3 Identify two ways design-builders can limit their liability.
4 Identify two areas of indemnity addressed by standard form contracts for design-build.
5 Explain why professional licensure by architects and engineers is important in design-build.
6 List five common legal instruments for managing risk in design-build projects.
7 Identify two methods of resolving disputes in design-build contracts that do not involve going to court.
8 Explain why ownership of the design documents is important to designers.
9 Identify which professional organizations do not include provisions for liquidated damages in their design-build standard form contracts.
10 Define "standard of care" for design professionals.
11 Define "negligence."
12 Explain why it is important that design-build contracts should make clear that the project is a design and not a product.
13 Identify which "family" of design-build contracts allow the owner to make a change before it has been established if the owner will pay for the change.
14 Identify which party the standard form design-build contracts state should assume the risk of unanticipated subsurface conditions.
15 Identify which design-build contracts are most advantageous to the owner if the owner wants to terminate the contract for convenience.
16 Identify which family of design-build contracts allow the design-builder to be reimbursed for a percentage of the construction costs if the owner terminates the contract.

## Conclusion

Contract negotiations are an important skill in the construction industry. While it is true that many graduates from undergraduate and even graduate construction programs may never be involved with directly negotiating a contract for their company, construction programs have an obligation to provide a curriculum which will prepare students to assume positions of leadership in the industry. This paper has presented the value of standard form contracts and recurring issues of importance addressed by these contracts. Armed with this knowledge, our graduates will be better prepared to take their place as leaders in the construction industry.

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# Use of Reciprocal Peer Tutoring Technique in an Environmental Control Systems Course at an Undergraduate Level

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The purpose of this study was to examine the effects of reciprocal peer tutoring (RPT) on student performance in one of the Environmental Control Systems courses offered by the Department of Construction Science, Texas A&M University. Reciprocal peer tutoring has been used extensively at school level for developing academic skills of the students. It has also been used at college level for different disciplines. In this technique, students occasionally function equally as both tutor and tutee in a classroom situation. It enables the students to gain both from the preparation and instruction in which the tutors engage, and from the instructions that the tutees receive. The study population consisted of the students who attended the course in Summer terms of 1998 and 2000, and Spring semester of 2000. Sample size of the study was 156 students. Relevant data was collected from the Student Information Management System database of the university. Chi-square tests were performed to ascertain the relationship between student performance and RPT. The findings generated from the analysis of the data indicated that RPT has a statistically significant effect on student performance in this particular Environmental Control Systems course.

**Key words**: Environmental Control Systems, Reciprocal Peer Tutoring, Undergraduate Education.

## Statement of the Problem

Peer tutoring is a cooperative learning strategy that capitalizes on the benefits students receive from preparing to tutor one another. It has been found to be an effective technique for increasing students' academic achievement (Jenkins & Jenkins, 1985; Magolda & Rogers, 1987; Slavin, 1991). Literature indicates that both the tutors and tutees attain a better understanding of the materials by participating in the process (Annis, 1983; Sherman, 1991).

Advancing this strategy a step further, a few other researchers have developed a procedure that enables all the members in a group to participate in the role of the tutor. This is known as reciprocal peer tutoring (RPT). In this technique, students function equally as both tutor and tutee. It enables the students to gain both from the preparation and instruction in which the tutors engage, and from the instructions that the tutees receive (Griffin & Griffin, 1997).

Reciprocal peer tutoring has been used extensively at junior and high school levels for developing academic skills of the students. It has also been used at college level for different disciplines. Some studies indicate that this teaching procedure helps the students improve their academic skills (Gartner & Riessman, 1994; Kohler & Greenwood, 1990). There are yet other findings that do not provide a strong support for the effectiveness of the procedure (Griffin & Griffin, 1998).

The Department of Construction Science within the College of Architecture at Texas A&M University offers Environmental Control Systems courses at an undergraduate level. Apart from Construction Science students, Environmental Design students of the College of Architecture also take these courses. The author introduced reciprocal peer tutoring (RPT) to teach an Environmental Control Systems course in the summer of 2000. It appeared that the student performance in that class was significantly higher than the previous classes in which RPT was not adopted. The purpose of this study is to test the hypothesis that reciprocal peer tutoring has a positive effect on student performance in Environmental Control Systems courses.

## Methodology

### *Study Population*

The study population consists of the students who registered for and actually attended Environmental Control Systems I course offered by the Department of Construction Science, Texas A& M University, in the following semesters:

1. Summer I, 1998
2. Spring, 2000
3. Summer I, 2000.

Reciprocal peer tutoring technique was not introduced in Summer I, 1998 and Spring, 2000; the students from these semesters form the non-RPT classes in the study. The technique was adopted in Summer I, 2000; students in this semester form the RPT class in the study. Number of students in the non-RPT classes was 116 (25 females and 91 males) and that in the RPT class was 40 (11 females and 29 males). The total population size was 156. The entities under study are the students who attended these classes. The unit of analysis is the student.

### *Data Collection*

The RPT class was divided into small groups ranging from three to five students. The groups met every alternate day during the class period, discussed the materials that were presented by the tutor on the previous day, developed a series of questions on the materials, and used the questions to quiz each other. The questions with correct answers were handed to the tutor at the end of the class. Students in this class formed the treatment group.

Students from the non-RPT classes formed the control group. This group did not have any exposure to the reciprocal peer tutoring technique. None of the activities mentioned above adopted under this technique were performed by the students in this group. The final letter grades of both the groups of students in the course were recorded as student performance.

### *Grading Criteria*

Students for both RPT and non-RPT classes were taught the course using the same syllabus. Both the groups did four assignments and took three tests during the semester. The final grade was a weighted average of the assignments and tests. The assignments were worth 40 percent and the tests were worth 60 percent of the total.

The researcher of the study being also the instructor and class evaluator gives rise to the problem of researcher bias. The problem was recognized and attempts were made to minimize it as follows:

1. Multiple-choice questions of similar nature were used for the tests for both the groups of classes. The students recorded the answers on SCANTRON ® computers forms that were fed into optical scanners for grading electronically.
2. The assignments were checked against standard checklists for both the groups.

### *Variables and their Operationalization*

*Student Performance (GRADE)*

Student performance is the actual academic performance of the student in the class. Itwas measured by the letter grade (*A, B, C, D,* or *F*) obtained by the student in the course. For the purpose of providing a minimum number of observations in every cell in the statistical analysis, the observations for letter grades *D* and *F* were collapsed to form a category called *Other*. The relationship between a letter grade and numerical grade was as follows:

*A* = 90 per cent or above;
*B* = 80 percent and above, but lower than 90 per cent;
*C* = 70 percent and above, but lower than 80 percent;
*Other* = lower than 70 percent.

*Reciprocal Peer Tutoring (RPT)*

This variable was included to measure the effect of the particular teaching method on student performance. For the purpose of statistical analysis, a "yes" was assigned to the students who used reciprocal peer tutoring technique and a "no" was assigned to those did not use it. The total counts of "yes's" and "no's" were used for the statistical analysis.

## **Analysis and Interpretation**

### *Results*

A chi-square test was performed to determine the relationship between student performance and reciprocal peer tutoring. It is a non-parametric test of statistical significance for bivariate tabular analysis. A hypothesis tested with chi-square is whether or not two different samples are different enough in some characteristic or aspect of their behavior that we can generalize from our samples that the populations from which our samples are drawn are also different in the behavior or characteristic (Ott, 1988). If the chi-square value is found to be larger than the critical value at a chosen probability of error threshold, then the data present a statistically significant relationship between variables used in the test.

The formula for calculating chi-square is:

$$?^2 = ? \{(o-e)^2/e\} \quad (1)$$

Where, *o* = observed data and *e* = expected data.
The results of the test are shown in Table 1.

Table 1

*Chi-square Analysis of RPT*

| ***GRADE*** | ***RPT*** Yes | ***RPT*** No | ***Chi-square*** | **Degrees of Freedom** | ***p*-value** | **Critical Value of *Chi-square*** |
|---|---|---|---|---|---|---|
| *A* | 16 (0.40)[1] | 17 (0.1466)[1] | 16.238 | 3 | 0.001 | 7.815 |
| *B* | 20 (0.50)[1] | 57 (0.4914)[1] | | | | |
| *C* | 4 (0.10)[1] | 36 (0.3103)[1] | | | | |
| *Other* | 0 (0)[1] | 6 (0.0517)[1] | | | | |
| Total | 40 (0.2564)[2] | 116 (0.7436)[2] | | | | |

(1) Figures within parenthesis represent the proportion of students receiving grades in different categories.
(2) Figures within parenthesis represent the proportion of students in RPT and non-RPT classes.

*Interpretations*

The chi-square value was found be quite high at a level of significance of 0.001. The results showed that the proportions of students in the RPT class (RPT "yes") receiving grades of *A*, *B*, *C*, and *Other* were 0.40, 0.50, 0.10, and 0 respectively; and those of the in the non-RPT classes (RPT "no") receiving grades of *A*, *B*, *C*, and *Other* were 0.1466, 0.4914, 0.3103, and 0.0517 respectively. The difference in proportions (except that for grade category *B*) was found to be significant. In other words, the results indicated that overall student performance in the class in which reciprocal peer tutoring technique was adopted differed significantly from that in the classes where the technique was not adopted. Students in the class that used RPT performed better than those in the classes that did not use the technique. A graphical representation student performance is given Figure 1.

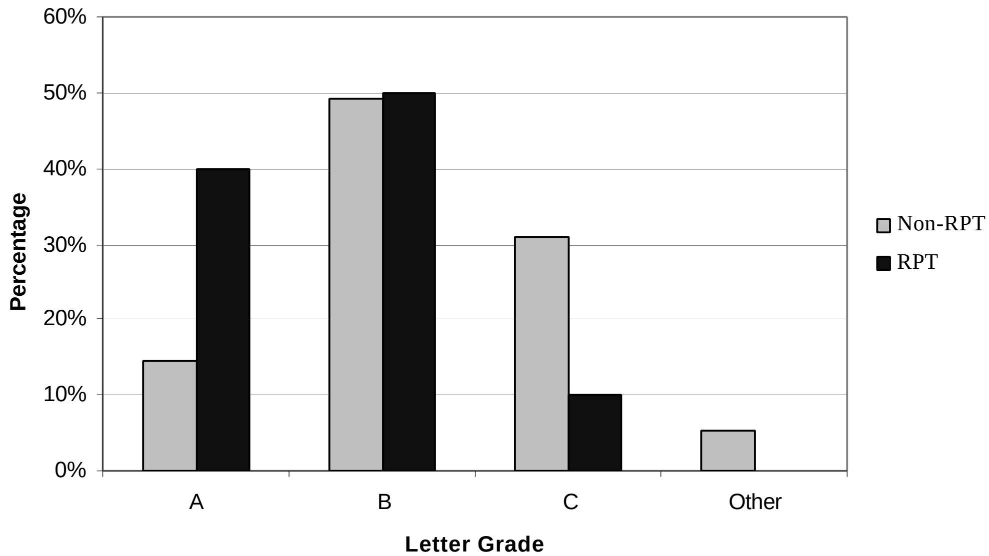


*Figure 1*. Student Performance

## Conclusions

Reciprocal peer tutoring (*RPT*) was found to have a significant positive effect on student performance in environmental control systems courses at the 0.001 level. This is probably because of the reason that cooperative learning results in higher level of reasoning and more frequent generation of ideas and solutions than individualistic learning. Literature indicates that students tend to form multidimensional and realistic impressions of one another's competencies and give accurate feedback in a reciprocal peer tutoring process (Johnson & Johnson, 1994).

An informal discussion with the students using RPT revealed that their perceptions about the technique were positive. Nearly all of them agreed that the technique was useful because it forced them to apply the course content and provided additional review and practice. It made them better prepared for the tests and to complete the major class assignments. However, the results should be viewed with caution because the technique had been adopted for only one class in a summer semester. For future studies, it will be worthwhile to use data from regular semesters with RPT effect.

A chi-square test allows a researcher to make decisions about whether a relationship between two or more variables exists; it does not provide the strength of that relationship. It will be interesting to perform statistical analyses that allow one to determine whether RPT continues to remain statistically significant in the presence of other probable correlates of student performance such as overall academic ability, class size, and gender difference (Choudhury, 1999).

The study was conducted to observe the effect of RPT only on Environmental Control Systems courses. It may be useful to replicate the study to find whether RPT has similar positive effects on student performance in other courses in Construction Science.

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# Predicting the Annual Salaries of Construction Educators using Multiple Regression

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The development of a mathematical model to predict the annual salaries of construction educators is presented. A review of the literature identified a number of factors that are hypothesized to affect the annual salary of construction educators; academic qualifications, longevity, academic rank, parent college of the department, region in which the institution is located and gender. The responses from the annual ASC Faculty Salary Survey were used to develop a multiple regression model that predicts the annual 9-month salary of a construction educator. The stepwise selection method was used to select seven independent qualitative or dummy variables to include in the model. The model developed does not have a very high predictive efficacy as only 51 percent of the variation in the dependent variable (annual 9-month salary) is explained by the variation in the selected independent variables. The variables selected for the model includes levels of academic rank, academic qualifications, region in which the institution is located and parent college of the department. Independent variables representing longevity and gender were not included in the model.

**Key Words:** Construction Educators, Salaries, Regression, Predictive Models

## Introduction

How much should I be earning? It is a question that most of us ask, but very few of us receive a satisfactory answer, particularly those of us who teach in institutions of higher learning. Studies on salary compensation are of interest to both academicians and administrators. There exists a wide body of literature on faculty salary levels in institutions of higher learning. One of the basic tenets of market economy is that income should be distributed according to contribution, and none takes greater pride in rewarding people for merit alone than academicians. Some studies seek to explain the difference in salary levels in terms of performance and contributions. The purpose of this study is to identify whether there are other factors that affect faculty compensation, particularly those engaged in teaching in the member schools of the Associated Schools of Construction.

Literature indicates that apart from scholarly productivity, longevity makes a substantial contribution to faculty salaries (Ferber, 1974; Monks & Robinson, 2001). Studies suggest that when adequate measures of past mobility are controlled for, the evidence of a positive correlation between income and seniority of academic faculty is overwhelming.

There is a large dissatisfaction with the salary equity of women faculty in some universities. Findings by Bellas et al. (2001) show that a sizable gap between men's and women's salaries exists after controlling for academic qualifications. The study indicates that women's scarcity in higher-level faculty positions contributes to their slower promotion rates, which in turn depresses their salary growth rates.

Faculty salaries also differ across the disciplines. A study by Cox (2001) shows that average earnings by law professors, at both public and private universities, are the highest among all disciplines. Similar findings are reported by an earlier study by Schneider (1999). Construction science is taught in schools ranging from architecture to business to technology in different universities. It is likely that the school in which they are employed may affect the salaries of the faculty in the department of construction.

Most of the studies on faculty salary include academic rank as an endogenous factor for prediction of salaries. Webster (1995) reports that while salary of a full professor differs from that of faculty in other ranks, the associate and assistant professor ranks have no statistically significant relationship with salary. He suggests that the outcome may be due to the effect of salary compression.

In view of the evidence provided by the results of the studies conducted in other disciplines, it is hypothesized that faculty salary in schools of construction that are members of the Associated Schools of Construction are affected by the following factors:

- Academic qualifications
- Longevity
- Academic rank
- Parent college of the department
- Region in which the institution is located
- Gender

## Method

### *Study Population*

The study population consists of all faculty that teach at institutions that are members of the Associated Schools of Construction (ASC). The ASC web site identifies that there are 585 ASC Faculty.

### *Data Collection*

During the fall of 2001 ASC faculty were sent email messages inviting them to take part in the survey. The initial invitation was sent out on the 11 October and follow up messages were sent on 18 & 28 October. The messages invited faculty members to visit the ASC web site and complete an on-line survey. A screen capture from the web site showing the on-line survey form is shown in figure 1. By November 16, 2001, 200 of the 585 ASC Faculty had responded, a response rate of 34.2 percent. From the 200 respondents, 21 selected not to participate leaving 181 Faculty completing the survey. Of the 181 Faculty completing the survey, 5 Faculty did not supply a full-time annual salary figure and were therefore not used in constructing the statistical model. Permission was sought and obtained from the ASC to use the database for the purposes of this study. The ASC board had previously voted to allow any program or faculty to have access to Data within the ASC Database. The data provided has been cleaned so that it is not proprietary and does not identify any particular individual.

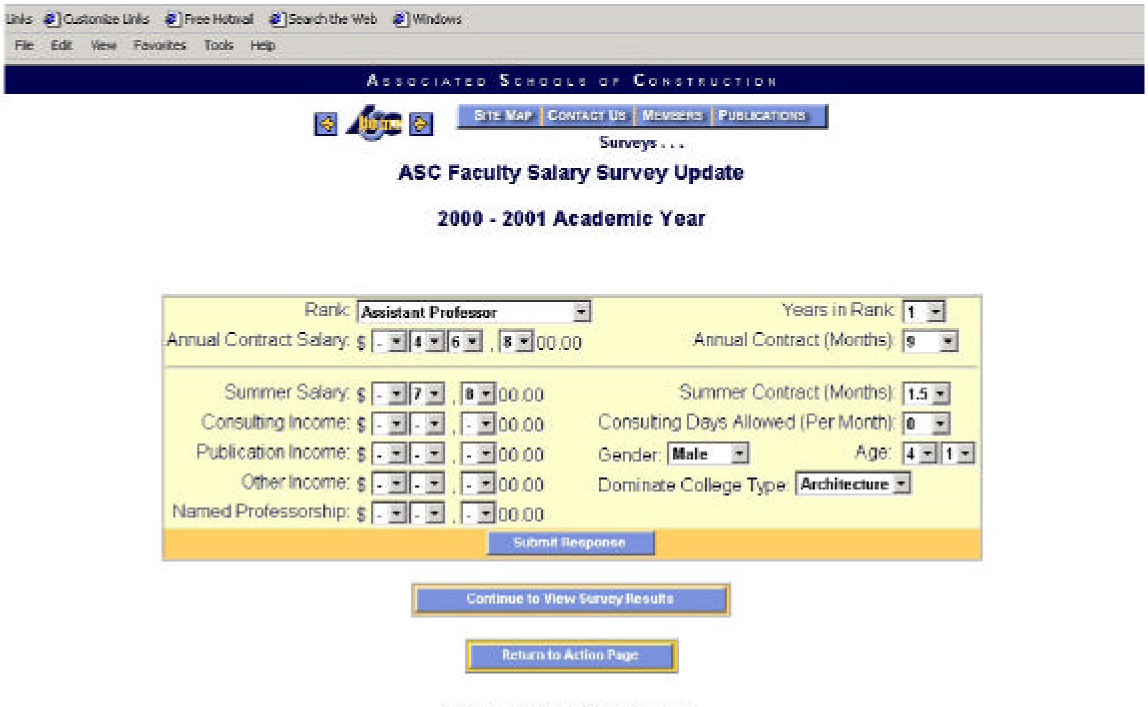


*Figure 1:* ASC Faculty Salary Survey Update form.

*Variables of Interest*

The dependent variable of interest is the annual contract salary of ASC faculty for a period of 9 months (ASC_9MO). Respondents submitted their annual contract salary and the annual contract period in months. Multiplying the annual contract salary by 9 and dividing it by the number of months of the annual contract calculated the dependent variable. The predictor or independent variables are of two types: quantitative and qualitative. The quantitative predictor variables are:

- Age of the faculty (AGE)
- Years in current rank (YRS_RANK).

The qualitative or dummy variables are used to represent further information about the faculty. The dummy variables cover the qualifications, rank, geographical region, college and gender of the faculty. A value of 1 is assigned if a faculty is a member of a particular qualification, rank, geographical region, college or gender group and a 0 if they are not. The qualitative or dummy variables are:

- Baccalaureate Degree (BS)
- Master of Science Degree (MS)
- Master of Arts Degree (MA)

- Law Doctorate (JD)
- Doctor of Education (DED)
- Doctor of Philosophy (PHD)
- Assistant Professor (ASST_PRO)
- Associate Professor (ASSO_PRO)
- Full Professor (FULL_PRO)
- Department Head or Chair (DEPT_HD)
- Senior Lecturer (SNR_LECT)
- Lecturer (LECTURER)
- Visiting/Adjunct Instructor (INSTRUCT)
- Graduate Teaching Assistant (GTA)
- Far West Region (FAR_WEST)
- Great Lakes Region (GT_LAKES)
- North Central (N_CENTRAL)
- North East Region (N_EAST)
- Rocky Mountain Region (ROCKY_MT)
- South Central Region (S_CENTRAL)
- South East Region (S_EAST)
- Architecture (ARCH)
- Business (BUSI)
- Engineering (ENGR)
- Technology (TECH)
- Other College (OTHER)
- Male (MALE)
- Female (FEMALE)

The names in brackets are the names assigned to the variables for use in the statistical software used for the analysis, SAS® for Windows® version 8.

*Hypothesis*

The hypothesis is that the 9-month annual salary of ASC Faculty can be predicted using the following multiple regression model:

$$ASC\_9MO = ß_0 + ß_1 AGE + ß_2 YRS\_RANK + ß_3 BS + ß_4 MS + ß_5 MA + ß_6 JD + ß_7 DED + ß_8 PHD + ß_9 ASST\_PRO + ß_{10} ASSO\_PRO + ß_{11} FULL\_PRO + ß_{12} DEPT\_HD + ß_{13} SNR\_LECT + ß_{14} LECTURER + ß_{15} INSTRUCT + ß_{16} GTA + ß_{17} FAR\_WEST + ß_{18} GT\_LAKES + ß_{19} N\_CENTRAL + ß_{20} N\_EAST + ß_{21} ROCKY\_MT + ß_{22} S\_CENTRAL + ß_{23} S\_EAST + ß_{24} ARCH + ß_{25} BUSI + ß_{26} ENGR + ß_{27} TECH + ß_{28} OTHER + ß_{29} MALE + ß_{30} FEMALE + e.$$

## Analysis & Interpretation

### *Development of the Statistical Model*

A multiple regression model was developed to express the relationship between the dependent variable and the independent variables. The regression model was developed using the three-step approach set down by Ott (1993) namely; selecting the independent variables, forming a suitable model and checking the model assumptions. The selection process identified those independent variables that caused the greatest variation in the dependent variable. The stepwise selection method was used to select the variables in the model. The significance level (P-value) for an independent variable to enter and remain in the model was set at 0.10.

### *Results of the Stepwise Selection Method*

The results of the multiple regression analysis are set out in table 1. The F value is used to test whether there is a significant regression relation between the dependent variable and the independent variables. The high F value and low P value (<0.0001) show that there is a significant regression relation. This result in itself however does not mean that the model is suitable for predicting annual salaries. The R-Square value is the coefficient of determination and measures how well the regression fits. The R-Square value of 0.5140 shows that approximately 51 percent of the variation in the 9-month annual salary is explained by the variation in the selected independent variables.

Table 1

*Results of the multiple regression procedure*

| Source | DF | Analysis of Variance<br>Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 7 | 16914761271 | 2416394467 | 25.53 | < 0.0001 |
| Error | 169 | 15994330969 | 94641012 | | |
| Corrected Total | 176 | | | | |
| | Root MSE | 9728 | R-Square | 0.5140 | |
| | Dependent Mean | 60792 | Adj R-Sq | 0.4939 | |
| | Coeff Var | 16.003 | | | |

The independent variables selected by the multiple regression process and their parameter estimates are set out in table 2. All variables selected for the model have a significance level of P < 0.10. All the variables selected were qualitative or dummy variables, therefore the parameter estimate is the amount in dollars that is added or subtracted to the intercept value.

Table 2

*Parameter estimates for multiple regression model including 95 percent upper and lower confidence intervals*

**Parameter Estimates**

| Variable | DF | Parameter | Standard Error | t Value | Pr > t ? | Standardized Estimate |
|---|---|---|---|---|---|---|

| | | Estimate | | | | |
|---|---|---|---|---|---|---|
| Intercept | 1 | 52605 | 1568 | 33.53 | <0.0001 | 0 |
| PHD | 1 | 4927 | 1488 | 3.31 | 0.0011 | 0.18061 |
| N_CENTRAL | 1 | -4765 | 2070 | -2.30 | 0.0226 | -0.12754 |
| S_CENTRAL | 1 | -5927 | 2141 | -2.78 | 0.0061 | -0.15188 |
| ASSO_PRO | 1 | 7191 | 1834 | 3.92 | 0.0001 | 0.24156 |
| FULL_PRO | 1 | 20092 | 1844 | 10.89 | <0.0001 | 0.65509 |
| DEPT_HD | 1 | 22322 | 3868 | 5.77 | <0.0001 | 0.31905 |
| TECH | 1 | -4561 | 1672 | -2.73 | 0.0071 | -0.14870 |

Figure 2 shows a chart showing predicted 9-month salary values with 95 percent confidence and prediction intervals and actual 9-month salary values for all 176 observations.

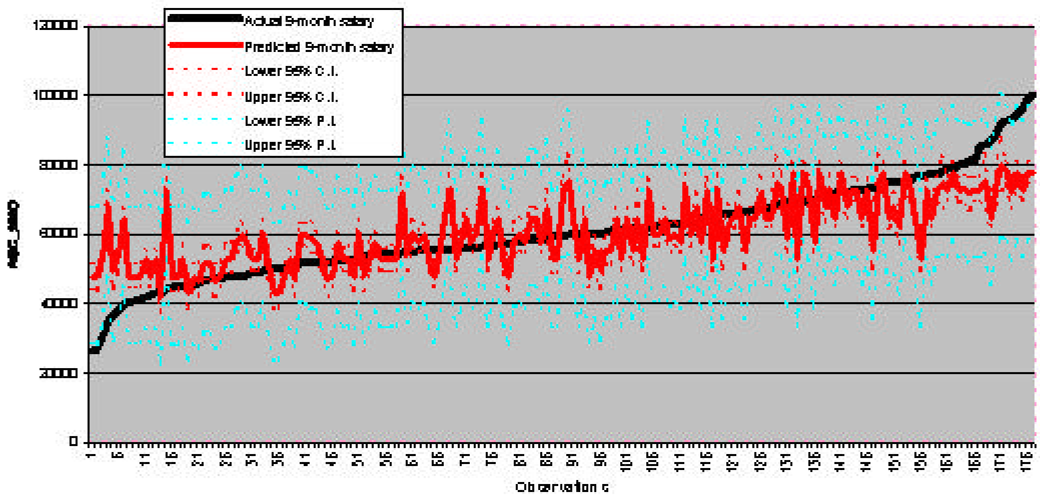


*Figure 2:* Chart showing predicted 9-month salary values and actual 9-month salary values

In light of the independent variables selected using stepwise procedure, the salary prediction model can be rewritten as follows:

$$ASC\_9MO = \beta_0 + \beta_8 PHD + \beta_{10} ASSO\_PRO + \beta_{11} FULL\_PRO + \beta_{12} DEPT\_HD + \beta_{19} N\_CENTRAL + \beta_{22} S\_CENTRAL + \beta_{27} TECH + e.$$

## Discussion

The results show that faculty salary is correlated with one academic qualification variable, three of the faculty rank variables, two geographical region variables, and one college type variable. The regression model explains approximately 51 percent of the variation in the 9-month salary. This means that the predictive efficacy of the model is not very high. That is, nearly 50 percent of the variation in salary is unexplained by the model. This can be seen in figure 2. The mode appears to predict 9-month salaries between the values of $45,000 and $80,000 quite well, as most of the actual 9-month salary values lie within the 95 percent confidence intervals. At the extreme ends of the salary scale the model is not so good at predicting salaries, although the actual 9-month salary values lie within the 95 percent prediction intervals. There is some concern that some of the lower salary values may not be for full-time faculty members. If this were the case then it would be prudent to change the ASC Faculty Salary Survey Update form to allow a faculty member to enter the percentage of a full-time salary they receive. In fact, the literature indicates that studies on faculty salary are usually conducted using full-time effort criterion (Monk & Robinson, 2001;Webster; 1995). The Information Management and Testing Services (1996) at Baylor University defines a full-time faculty as a member of the instructional staff who is employed full-time and whose regular assignment is instruction, including those with released time for research.

The model only selected PHD from the qualification dummy variables and suggests that the possession of a PHD adds approximately $ 4927 to a faculty member's 9-month salary. Evidence in the literature provides support for this finding (Lamb & Moates, 1999; Webster, 1995).

Three faculty rank dummy variables were selected. This was expected as most promotions in academia result in salary increases. The model indicates the rank of Associate Professor would increase the 9-month salary by $ 7191, the rank of Full Professor by $ 20092, and the rank of Department Head by $ 22322. I t will be interesting to see in future studies whether these differences remain significant if a productivity measure is introduced in the model.

Only two of the seven geographical region dummy variables were selected. The model indicates that Faculty in the North Central and South Central regions would have their 9-month salaries reduced by $ 4765 and $ 5927, respectively. It will, however, be interesting to see whether these differences remain significant after adjusting for variations in taxes and cost of living across geographical locations.

The only college dummy variable selected was Technology. The model indicates that being a faculty member in a College of Technology would decrease their 9-month salary by $ 4561. There is some evidence in the literature in support of this finding. Schneider (1999) did a study on differences in salaries of university professors by disciplines in four-year institutions. The findings suggest that the average faculty salary in colleges of technology is significantly lower than that in colleges of architecture, business, and engineering.

The variables that were not selected are also of interest. Neither of the two quantitative independent variables, age and years in rank, was found to be statistically significant. Even though the general body of literature suggests that a correlation exists between salary compensation and these two variables, a study by Moore et al. (1998) provides evidence contrary to this belief. The researchers did not find any positive relationship between either longevity or seniority with faculty salary when the model took into account only these two independent variables. The variables, however, became significant when a quality-adjusted measure of research publications was introduced in the model. It will be worthwhile to introduce such a variable for future studies on ASC faculty salary.

The study did not provide any evidence of gender differences in salary, even though the literature indicates that women faculty earn less on average than their male counterparts (Bellas, et. al. 2001; Hamton, et. al. 2000). Bellas, et al. (2001), however, indicated in their study that this gap maybe partially attributed to the concentration of women faculty in relatively low-paying disciplines. It might be a reason for gender not being a predictor of salaries for the faculty in construction schools.

## Conclusions

The results indicate that the model as a whole accounts quite well for the behavior of the dependent variable, faculty salary in schools of construction that are members of ASC. This is evident from the high F-value of the model that is statistically significant at the 0.0001 level. The predictive efficacy of the model is not very high with an $R^2$ value of 0.51; but such values are not unusual in empirical studies related to social sciences. Faculty salary is found to be correlated with academic qualification variable Ph. D., faculty rank variables Associate Professor, Professor, and Department Head, geographical region variables North Central and South Central, and college type variable Technology. All these variables are statistically significant at the 0.05 level or less. The results did not provide evidence that salary level is affected by age or length of service in a rank of a faculty. It is also not affected by gender difference. However, in the light of preceding discussions, it recommended to include a quality-adjusted measure of publications and research by the faculty in pursuing future research on faculty salary.

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