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**Connection Design**  
Tips, Tricks, and Lessons Learned





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### Session Description

#### 19.1 Delegated Connection Design: The Basics February 4, 2019

This session will focus on the responsibilities, relationships and communication among the various parties involved in the delegated design process. It will discuss how delegated connection design is addressed in the AISC Code of Standard Practice. Ways in which proper communication between the engineers can be maintained to ensure the safety of the structure while also addressing concerns about contract management will also be presented. Finally some general tips for those wishing to perform delegated connection design will be provided.



### Learning Objectives

- Name the three connection design options presented in AISC *Code of Standard Practice*.
- Explain the responsibilities for each party in the delegated connection design process, and how they contribute to the ultimate goal of safety on a project.
- Describe the preferred paths of communication related to connection design.
- List the characteristics of an effective connection designer.



## Night School 19 Connection Design: Tips, Tricks, and Lessons Learned

Session 1: Delegated Connection Design: The Basics  
February 4, 2019



Larry S. Muir, P.E.  
Consultant  
Atlanta, Georgia



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## Delegated Connection Design

### The Basics



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## The Scope

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## Scope

- Structural Steel
- Option 3 – Delegated Connection Design



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## Outside of Scope

- ~~Miscellaneous Steel, Stainless Steel, Etc.~~
- ~~Option 2 – Connection Selection/Completion~~
- ~~Rules and Laws~~



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## Scope & Future Sessions

- Session 2 - Delegating Connection Design Feb 11
- Session 3 - Shear Connections Feb 25
- Session 4 - Moment Connections Mar 4
- Session 5 - Vertical Bracing Connections Mar 11
- Session 6 - The Chevron Effect Mar 18
- Session 7 - Seismic Connections Mar 25
- Session 8 - Lessons Learned Apr 8



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## Code of Standard Practice for Steel Buildings and Bridges



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## Code of Standard Practice

### Code of Standard Practice for Steel Buildings and Bridges

- The AISC Code of Standard Practice (COSP) forms the basis of structural steel construction contracts.
- It sets forth criteria for the trade practices involved in steel buildings, bridges and other structures.



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## Three Options

Section 3.1.1 requires the owner's designated representative for design (EoR) to indicate one of three options for each connection:

- Option 1: Complete connection design shown in the structural design documents.
- Option 2: Connection selected or completed by an experienced steel detailer.
- Option 3: Connections designed by a licensed engineer working for the fabricator. (Delegated Design)



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## What is Delegated Connection Design?

Design of the connection details is delegated to a licensed engineer working for the fabricator.

Only the Engineer of Record has all the information necessary to evaluate the total impact of connection details on the overall structural design of the project. This authority traditionally has been exercised during the approval process. The Engineer of Record thus retains responsibility for the adequacy and safety of the entire structure.

~~~Paraphrased from the COSP



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## Who's the Boss?

- Safety first.
- The EoR is the final authority.
- Section 4.4 of the COSP states, "The owner's designated representative for design is the final authority in the event of a disagreement between parties regarding the design of connections to be incorporated into the overall structural steel frame."



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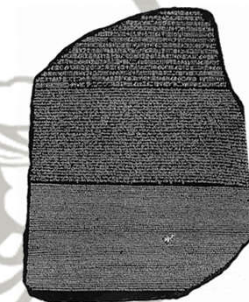
## With Great Power Comes Great Responsibility

- Section 4.4 of the COSP states, "The fabricator and licensed engineer in responsible charge of connection design are entitled to rely upon the connection design criteria provided in accordance with Section 3.1.1."
- More on this later...



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## The Code of Standard Practice: A Common Language

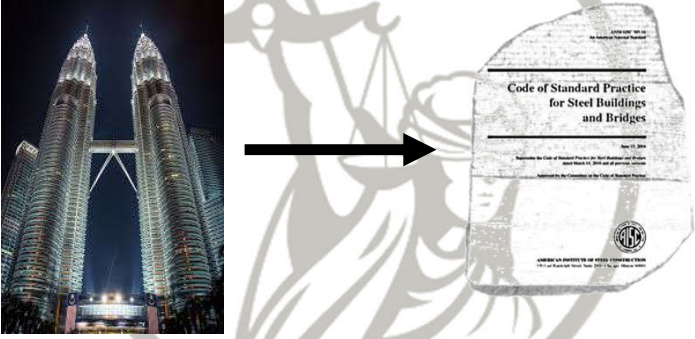


If you want to accomplish great things

You need to speak a common language



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### The Code of Standard Practice: A Common Language



If you want to accomplish great things

You need to speak a common language



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## Relationships And Responsibilities





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### The Construction Industry is Weird

In no other important industry is the responsibility for design so far removed from the responsibility for production.

~Sir Harold Emmerson  
Report to the Ministry of the Works (1962)



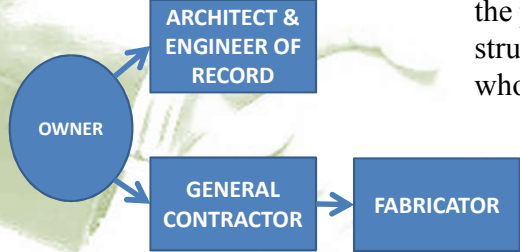
It has been estimated that 50% of the cost of erected steel is related to the connection design.



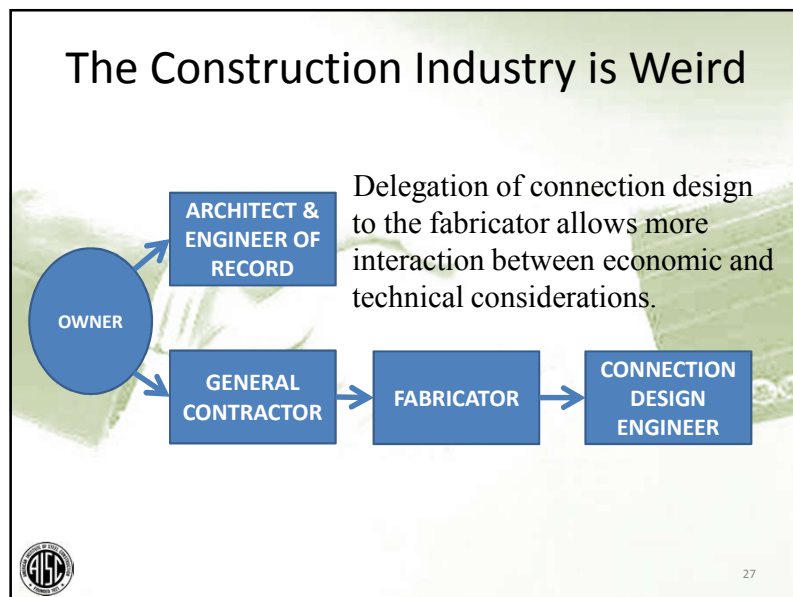
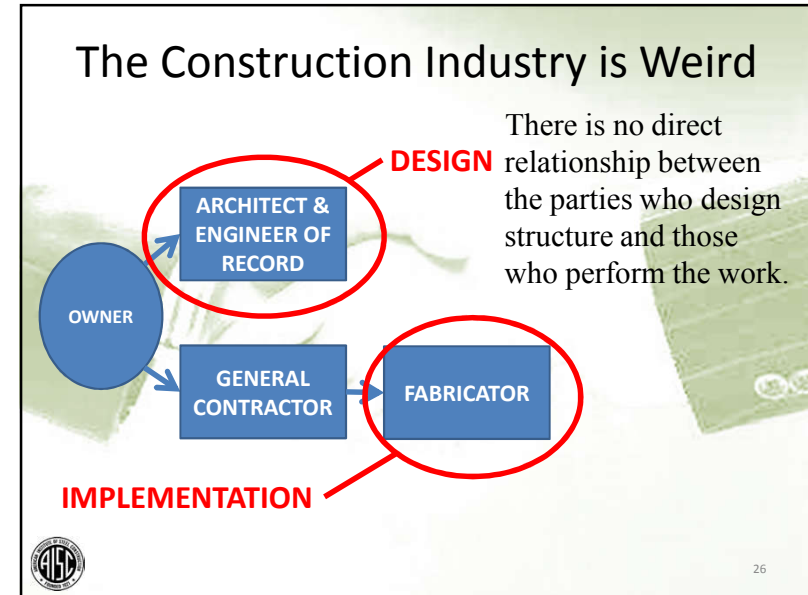
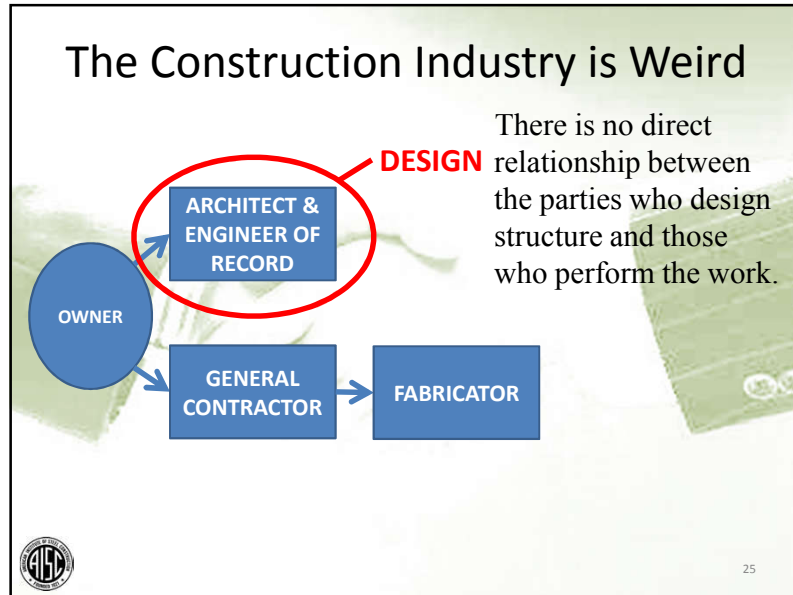
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### The Construction Industry is Weird

There is no direct relationship between the parties who design structure and those who perform the work.



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- ### Engineer of Record - Responsibilities
- Overall safety of the structure
  - Conveying design requirements to the connection design engineer
  - Approvals
- 
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## Connection Design Engineer- Responsibilities to Project

- Safety
- Competency
- Satisfying the Design Intent as Communicated by the Engineer of Record
- The Connection Design Engineer is **NOT** performing a peer review
- The Connection Design Engineer is **NOT** responsible for identifying discrepancies



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## The Connection Design Engineer & the Fabricator



The Connection Design Engineer and the Fabricator should work as a team.

Neither structural steel fabrication nor connection design should be treated as a commodity.



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## The Connection Design Engineer & the Fabricator



Decisions made regarding BOTH the connection design and the fabrication can add value to the project and provide benefits to both the connection design engineer and the fabricator.



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## Connection Design Engineer- Responsibilities to Fabricator

- Safety - Provide safe connections so the fabricator can sleep at night.
- Economy – Consider the cost of fabrication and impacts to schedule while completing connection design.



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## Connection Design Engineer- Responsibilities to Fabricator

- Revisions – Alert the fabricator of revisions to the contract that impact the design of the connections and potentially the cost of fabrication/erection.
- Defend Decisions – A Connection Design Engineer must be willing and able to defend their design decisions – especially when alternatives appear to be detrimental to the fabricator.



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## Fabricator - Responsibilities to Connection Design Engineer

- Shop Standards – Fabricator preferences should be communicated to the Connection Design Engineer.
- Line of Communication – Fabricator needs to provide and defend a line of communication between the Engineers .



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## Fabricator - Responsibilities to Connection Design Engineer

- Provide Back-up – The Fabricator should be prepared to back-up the Connection Design Engineer when disputes arise.



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## Relationships And Responsibilities Question

Have you participated in a project where connection design was delegated?

1. Yes. I have delegated connection design.
2. Yes. I have performed connection design.
3. Yes. I have both delegated and performed connection design.
4. No.



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## Required Information

Section 3.1.1 - The structural *design documents* and *specifications* must define the following criteria :

- Restrictions on the types of *connections* that are permitted.
- Loads sufficient to allow the design of the *connection details* while preparing the *approval documents*.
- Whether the loads are given at the service-load level or the factored-load level.
- Whether LRFD or ASD is to be used in the design of *connection details*.
- What *substantiating connection information*, if any, is to be provided.

Restricted

ASD

## Substantiating Connection Information

If you are performing connection design, you should always provide Substantiating Connection Information, even if it is not required by the contract.

If you are delegating connection design you should always require and review Substantiating Connection Information.



### Communication Is the Key

**ONLY** ↑

- Knowledge is Power.
- To be useful knowledge must be communicated and shared.
- There can sometimes be a perception that maintaining power requires maintaining control of communication.
- For contractual considerations contractors tend to insert themselves into the path of technical communication.

**NO ENTRY**

**NO TRESPASSING**

**KEEP OUT**

### Communication Is the Key

ENGINEER OF RECORD ↔ GENERAL CONTRACTOR ↔ FABRICATOR ↔ CONNECTION DESIGN ENGINEER

Non-ideal communication path

### Communication Is the Key

ENGINEER OF RECORD   GENERAL CONTRACTOR   FABRICATOR   CONNECTION DESIGN ENGINEER

Non-ideal communication path

Hmm. I don't see any transfer forces on the drawings.

### Communication Is the Key

ENGINEER OF RECORD   GENERAL CONTRACTOR   FABRICATOR   CONNECTION DESIGN ENGINEER

Non-ideal communication path

Section 3.1.1 of the COSP requires the Engineer to provide transfer forces. No transfer forces are shown. Please confirm that there are no transfer forces. For example, at column line A6 does the W16 transfer an axial load to the braced frame?

### Communication Is the Key

Does the W16 at column line A6 transfer force to the braced frame?

ENGINEER OF RECORD   GENERAL CONTRACTOR   FABRICATOR   CONNECTION DESIGN ENGINEER

Non-ideal communication path

www.aisc.org

### Communication Is the Key

Are forces transferred from the W16 and the braced frame at column line A6?

ENGINEER OF RECORD   GENERAL CONTRACTOR   FABRICATOR   CONNECTION DESIGN ENGINEER

Non-ideal communication path

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### Communication Is the Key

Of course there are forces in these members.

ENGINEER OF RECORD   GENERAL CONTRACTOR   FABRICATOR   CONNECTION DESIGN ENGINEER

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### Communication Is the Key

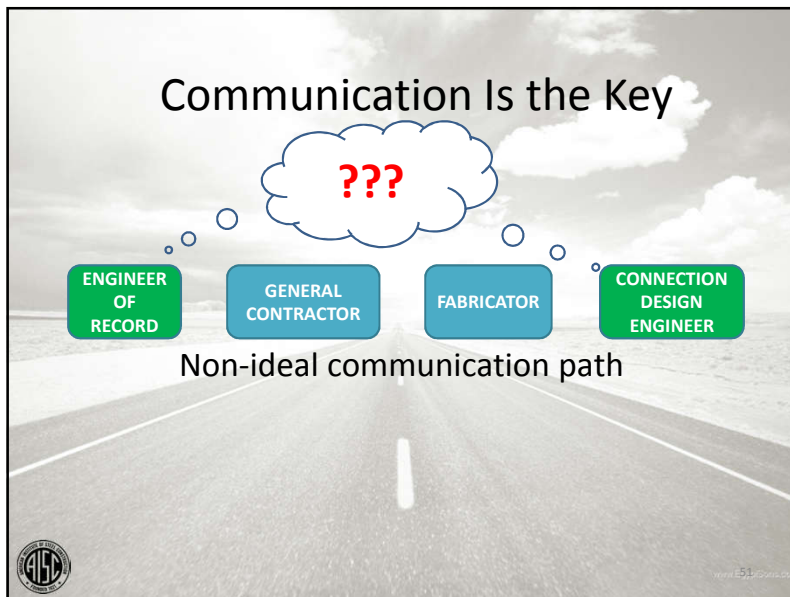
Yes. Use the forces shown on the plans and elevations associated with each member.

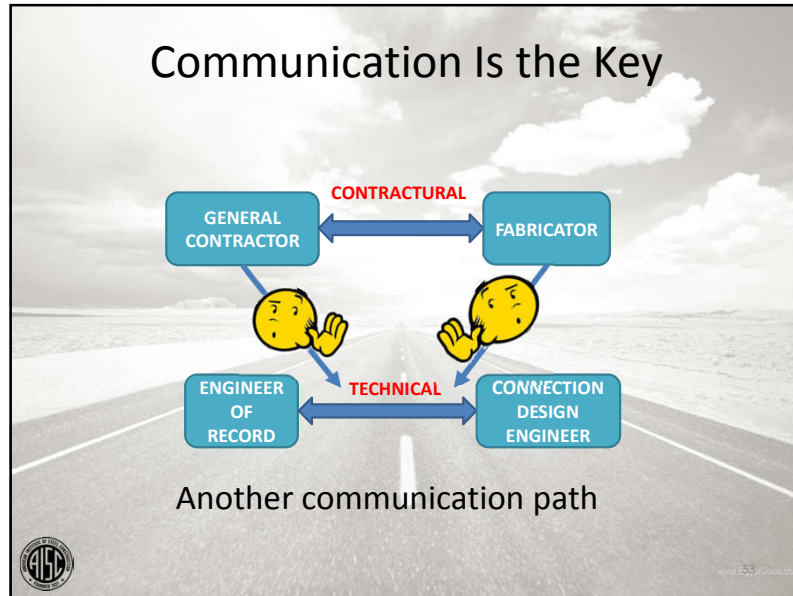
ENGINEER OF RECORD   GENERAL CONTRACTOR   FABRICATOR   CONNECTION DESIGN ENGINEER

Non-ideal communication path

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### When Problems Arise

**Discrepancy:** an unexpected difference, esp. in two amounts or two sets of facts or conditions, which suggests that something is wrong and has to be explained.

Most issues that arise during delegated connection design are in effect discrepancies.

Some information seems inconsistent within the context of the other information provided and this perceived inconsistency must be resolved.

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### Discrepancies

Discrepancies are addressed in the Code of Standard Practice.

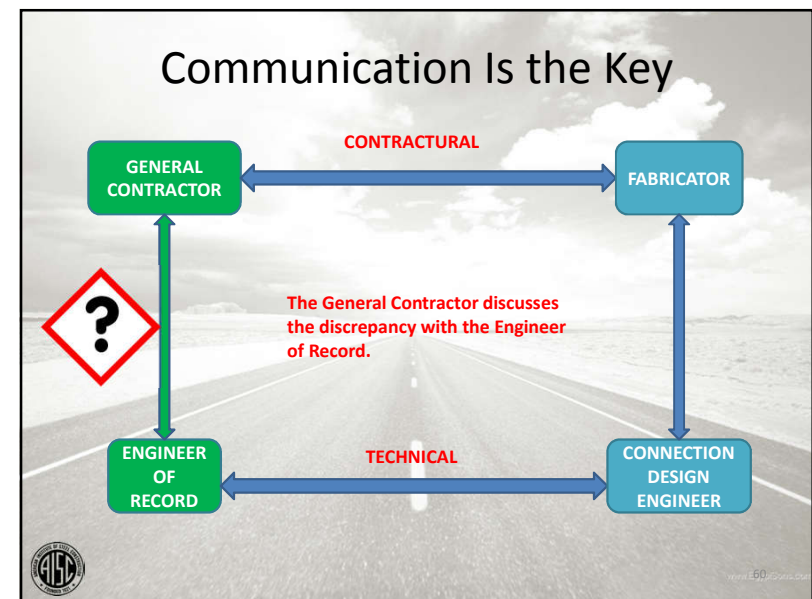
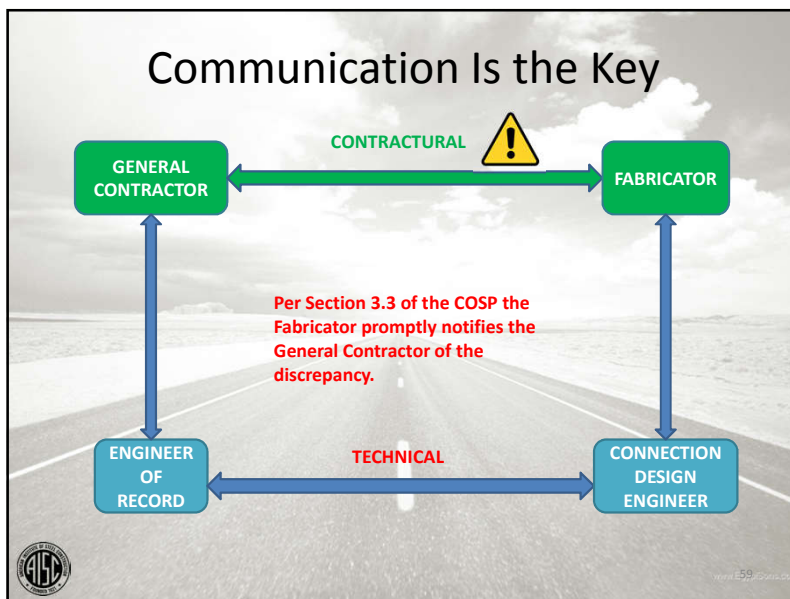
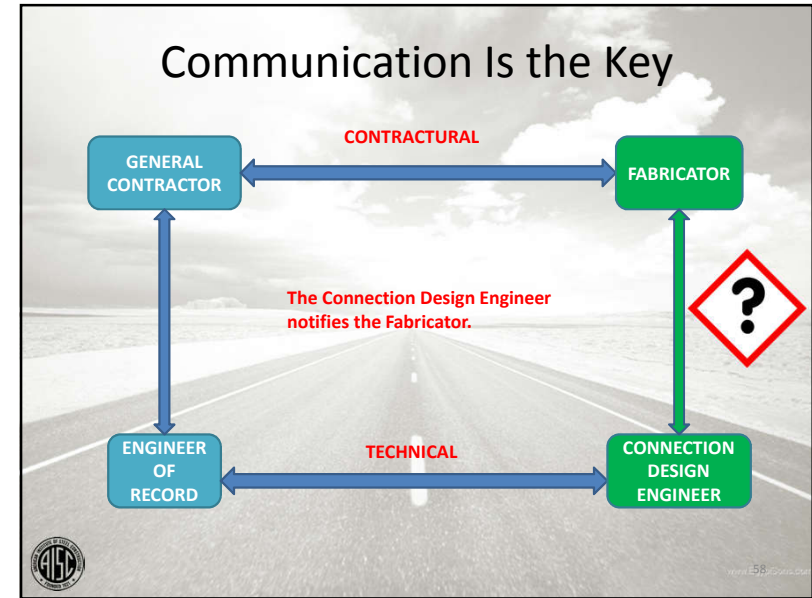
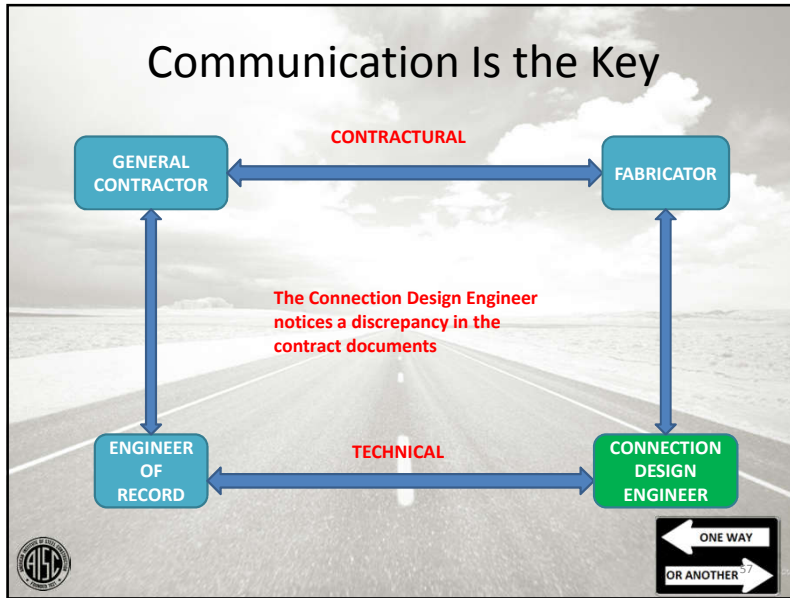
3.3. Discrepancies

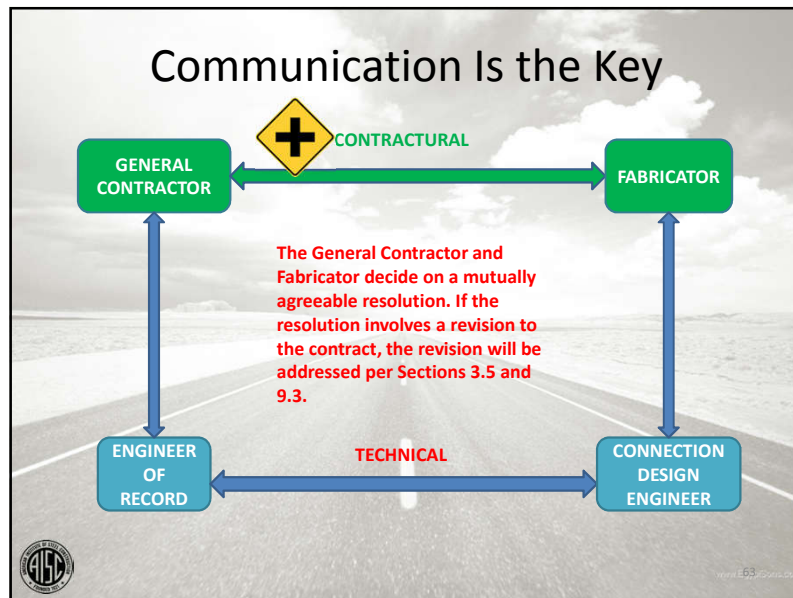
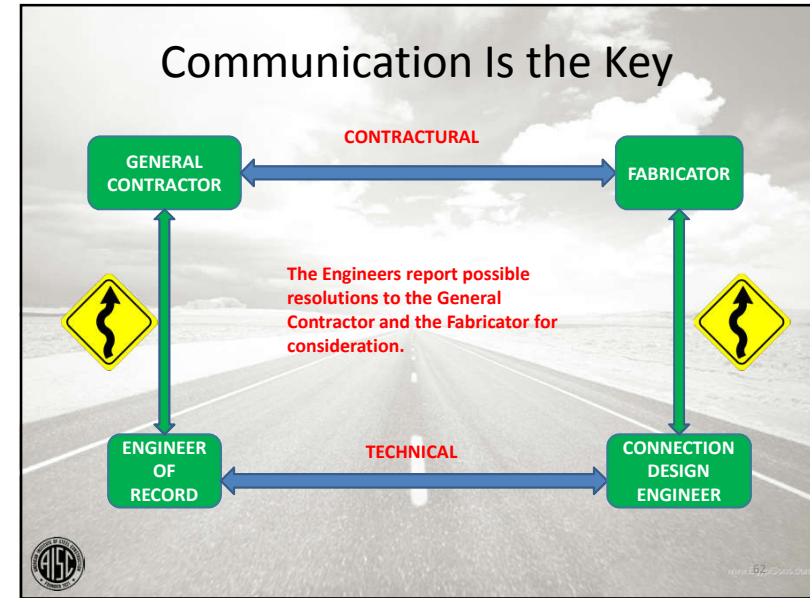
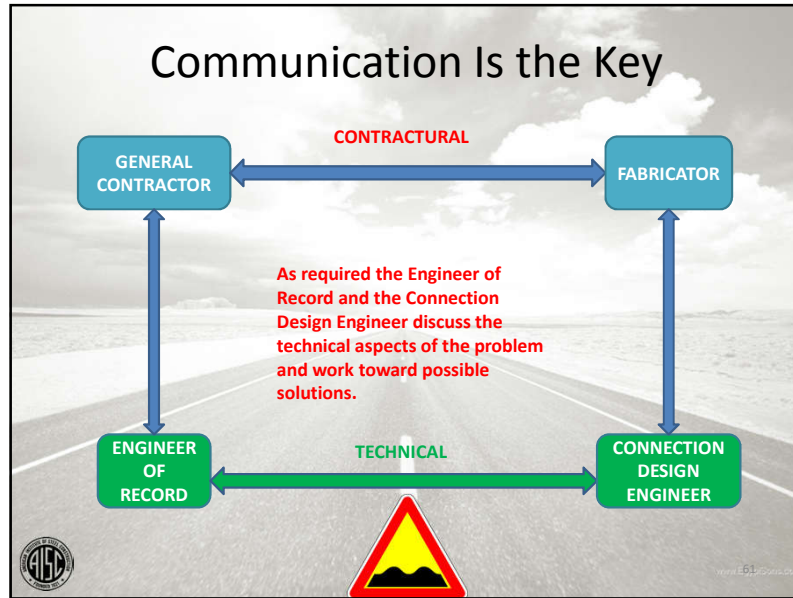
When discrepancies exist between the *design documents* and *specifications*, the *design documents* shall govern. When discrepancies exist between scale dimensions in the *design documents* and the figures written in them, the figures shall govern. When discrepancies exist between the structural *design documents* and the architectural, electrical or mechanical *design documents*, or the *design documents* for other trades, the structural *design documents* shall govern. When discrepancies exist between the *design drawings* and the *design model*, the governing document shall be as identified per Section 1.4.

When a discrepancy is discovered in the *contract documents* in the course of the *fabricator's work*, the *fabricator* shall promptly notify the *owner's designated representative for construction* so that the discrepancy can be resolved. Such resolution shall be timely so as not to delay the *fabricator's work*. See Sections 3.5 and 9.3.

It is not the *fabricator's* responsibility to discover discrepancies, including those that are associated with the coordination of the various design disciplines.

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### Communication Is the Key

#### Question

For those of you who have participated in projects where connection design was delegated – Was direct communication between the Engineer of Record and the Connection Design Engineer permitted?

1. All of the Time
2. Most of the Time
3. Some of the Time
4. None of the Time





**So You Wanna Be  
A Connection Designer?**

Then listen now to what I say




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**Tips for Success for  
the Connection Design  
Engineer**


Learn About Connection Design

- Work with someone who designs connections
- Read discussions and work examples
- Derive everything you can



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**Tips for Success  
Work for someone who  
knows**



Connection design has been called the Last Bastion of Rational Design.


There is a lot to know.

Most connection design is based on “first principles” so a deep understanding of basic engineering concepts is essential.




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**Tips for Success  
Work for someone who  
knows**



It is helpful to work with someone who has designed a lot of connections.

Fortunately, people who design connections tend to be a generous lot. There is a lot published on connection design.




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Tips for Success  
Read discussions and work examples



This is page 76 of Search Results for the term: **CONNECTION DESIGN** on aisc.org.

Tips for Success  
Read discussions and work examples

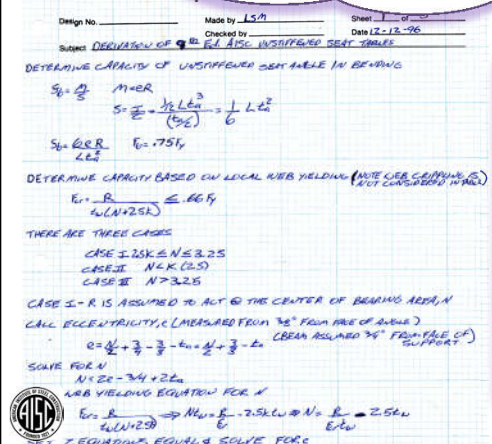


“demonstrate an approach”... “not intended to suggest that the approach presented is the only approach”... “designers have alternate approaches”... “Design approaches that differ from those presented in these examples are considered viable as long as...”

AISC has produced a lot of Design Guides.



Tips for Success  
Derive Everything



Many of the equations and methods in the Manual can be derived.

Even where you cannot derive the exact equation you should be able to get close.<sup>72</sup>



**Tips for Success**  
Figure out the “Why”

**Why doesn't pretensioning reduce the tensile capacity of a connection?**

**Why is this not preferable?**

Nonpreferred

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**Tips for Success for the Connection Design Engineer**

**Learn About the Construction Process**

- Read the Code of Standard Practice
- How would I build this?
- Listen to the People doing the Work
- Ask Questions

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**Tips for Success**  
Read the COSP

**All of your interactions are governed by the Code of Standard Practice.**

- Who is responsible?
- What are the loads?
- Which documents governs?
- What about discrepancies?
- How do I propose a change?


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**Tips for Success**  
Ask: “How would I build this?”

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**Tips for Success**  
Ask: "How would I build this?"


Face it we're engineers, so the answer is likely, "Badly," but ultimately all of your effort is wasted if your design can't be built efficiently. As you design connections you should always be thinking about how the structure will be fabricated and erected.



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**Tips for Success**  
Listen to the People doing the Work

**Rule #1**  
If someone tells you they can't do something, believe them.



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**Tips for Success**  
Listen to the People doing the Work

**Rule #1**  
If someone tells you they can't do something, believe them.

**Rule #2**  
If someone who has been "doing this for 30 years" says it looks wrong – it is worth a second look.




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**Tips for Success for the Connection Design Engineer**

**The Design Process**

- Start with a model
- Draw a Free-Body Diagram
- Follow all forces through the connection

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### CEU/PDH Certificates

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- Completely fill out online form. Don't forget to check the boxes next to each attendee's name!



## Individual Webinar Registrants

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### CEU/PDH Certificates

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- New reporting site (URL will be provided in the forthcoming email).
- Username: Same as AISC website username.
- Password: Same as AISC website password.



## 8-Session Registrants

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### CEU/PDH Certificates

One certificate will be issued at the conclusion of all 8 sessions.



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Access to the quiz: Information for accessing the quiz will be emailed to you by Wednesday. It will contain a link to access the quiz. EMAIL COMES FROM NIGHTSCHOOL@AISC.ORG

Quiz and Attendance records: Posted Tuesday mornings.  
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Reasons for quiz:

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- CEUs/PDHS – If you watch a recorded session you must take quiz for CEUs/PDHS.
- REINFORCEMENT – Reinforce what you learned tonight. Get more out of the course.

NOTE: If you attend the live presentation, you do not have to take the quizzes to receive CEUs/PDHS.



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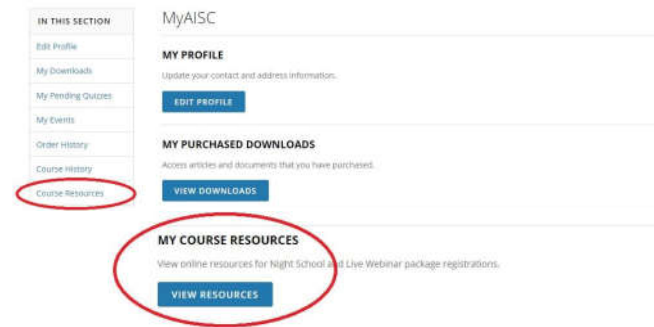
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Course Resources

| Event                                                                    | Start Date           |
|--------------------------------------------------------------------------|----------------------|
| NS 13 8-Session Package-Night School 13 - Design of Industrial Buildings | 1/30/2017 7:00:00 PM |
| NS 14 8-Session Package-Night School 14 - Fundamentals of Stability      | 6/5/2017 7:00:00 PM  |

## Night School Resources for 8-session package Registrants


Night School 13: Design of Industrial Buildings

**8-SESSION PACKAGE RESOURCES**

| Event                                                        | Date                 | Handouts                 | Video                                      | Quiz                         | Attendance |
|--------------------------------------------------------------|----------------------|--------------------------|--------------------------------------------|------------------------------|------------|
| NS13 - Design Criteria                                       | 1/30/2017 7:00:00 PM | <a href="#">Handouts</a> | <a href="#">Video</a><br>Passcode: NS13DDN | Pass Score: 80               | Pending    |
| NS13 - Economic Considerations                               | 2/6/2017 7:00:00 PM  | <a href="#">Handouts</a> | Available 02/08/2017 5pm EST               | Available 02/08/2017 5pm EST | Pending    |
| NS13 - Lateral Load Systems and Details                      | 2/13/2017 7:00:00 PM | <a href="#">Handouts</a> | Available 02/15/2017 5pm EST               | Available 02/15/2017 5pm EST | Pending    |
| NS13 - Preliminary Design Procedures                         | 2/27/2017 7:00:00 PM | <a href="#">Handouts</a> | Available 03/02/2017 5pm EST               | Available 03/02/2017 5pm EST | Pending    |
| NS13 - Crane Girder Design and Frame Analysis                | 3/6/2017 7:00:00 PM  | <a href="#">Handouts</a> | Available 03/08/2017 5pm EST               | Available 03/08/2017 5pm EST | Pending    |
| NS13 - Frame Member and Connection Design                    | 3/13/2017 7:00:00 PM | <a href="#">Handouts</a> | Available 03/15/2017 5pm EST               | Available 03/15/2017 5pm EST | Pending    |
| NS13 - Transfer Crane Girder & Longitudinal Brdg Bracing Dsn | 3/27/2017 7:00:00 PM | <a href="#">Handouts</a> | Available 03/29/2017 5pm EST               | Available 03/29/2017 5pm EST | Pending    |
| NS13 - Building Envelope and Bracing Design                  | 4/3/2017 7:00:00 PM  | <a href="#">Handouts</a> | Available 04/05/2017 5pm EST               | Available 04/05/2017 5pm EST | Pending    |
| NS13 - Final Exam                                            | 4/10/2017 7:00:00 PM |                          |                                            | Available 04/12/2017 5pm EST |            |

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- Weekly “quiz and recording” email.
- Weekly updates of the master Quiz and Attendance record found at [www.aisc.org/nightschool](http://www.aisc.org/nightschool). Scroll down to Quiz and Attendance records.
  - Updated on Tuesday mornings.



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  - Found in your registration confirmation/receipt.
  - Reminder email sent out Monday mornings.
- Link to handouts also found here.

