Connection Design

Tips, Tricks, and Lessons Learned

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AISC Night School

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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.

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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

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Consultant
Atlanta, Georgia

Smarter. Stronger. Steel.

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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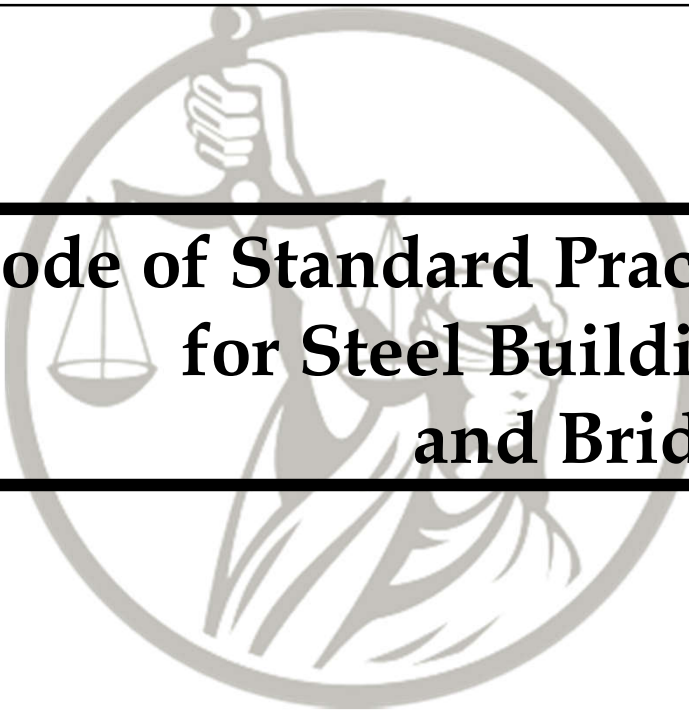

Code of Standard Practice for Steel Buildings and Bridges

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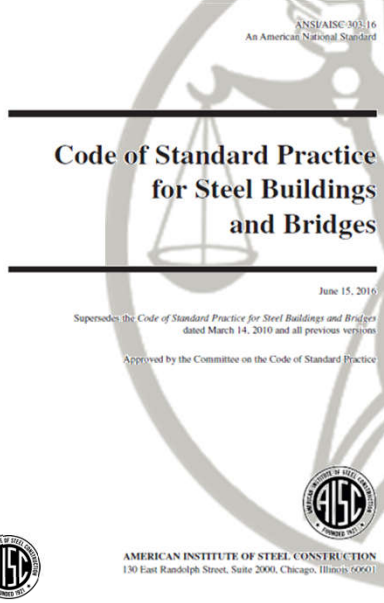
Code of Standard Practice



- 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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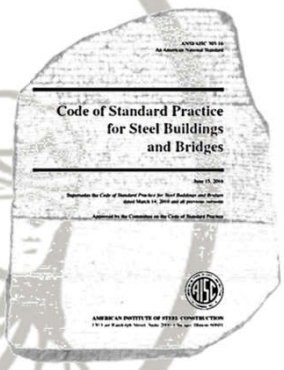
The Code of Standard Practice: A Common Language



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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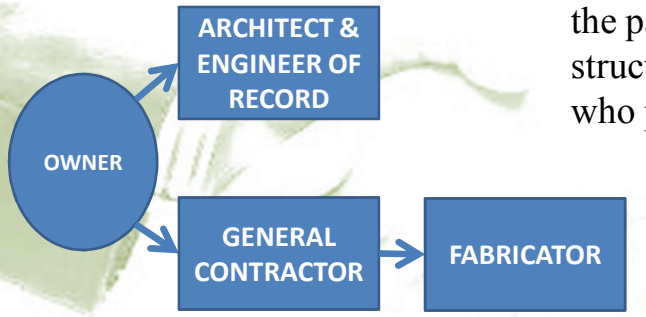
The Construction Industry is Weird

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



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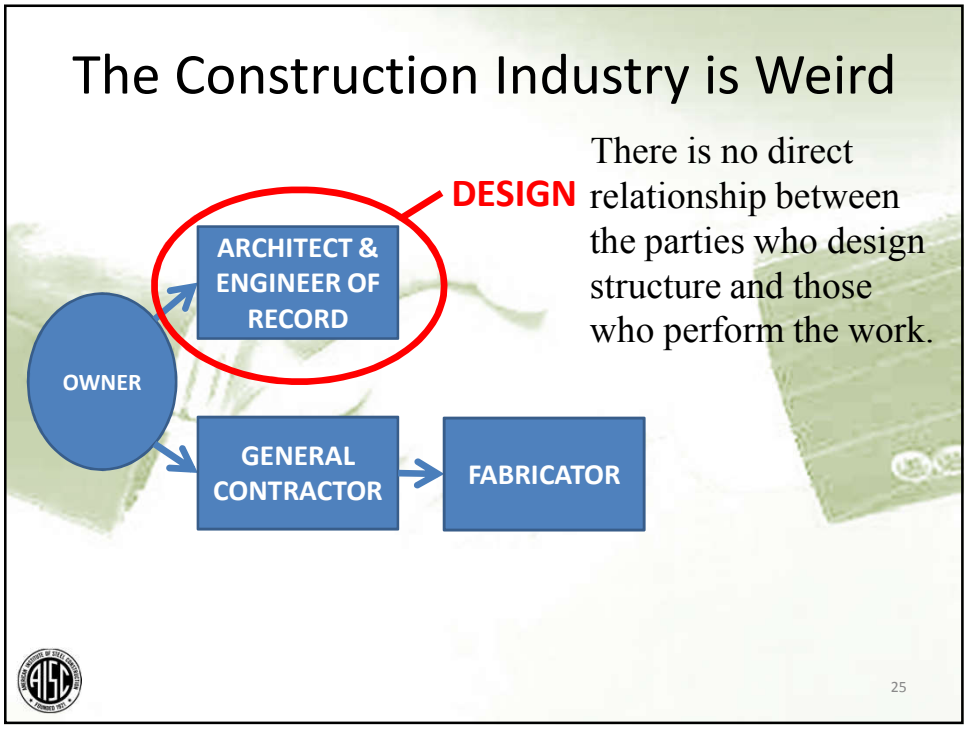
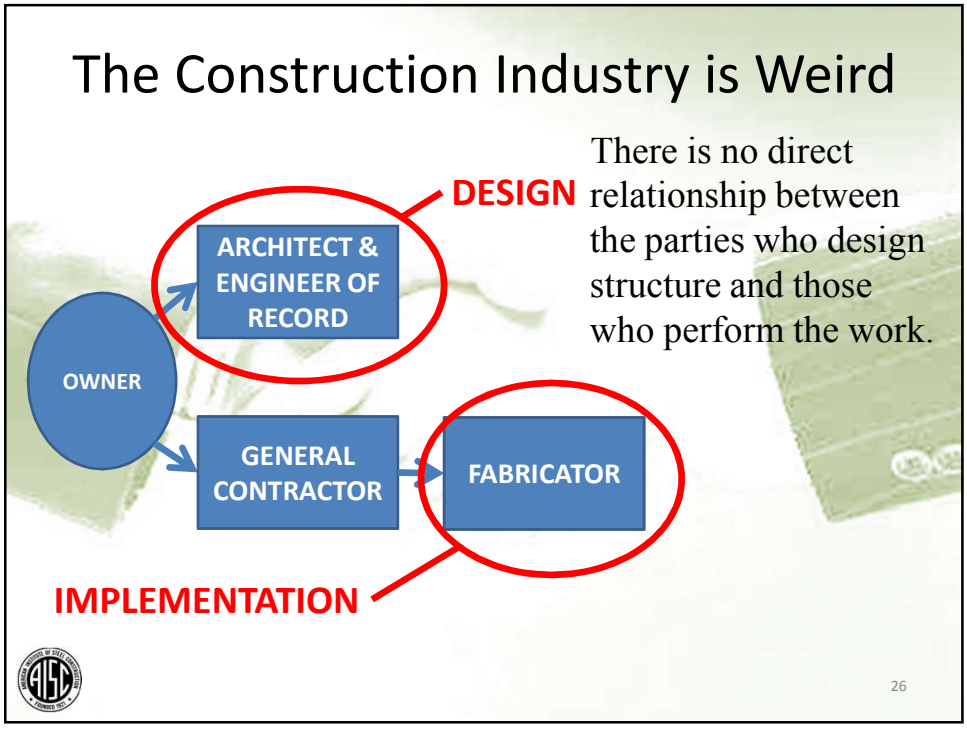
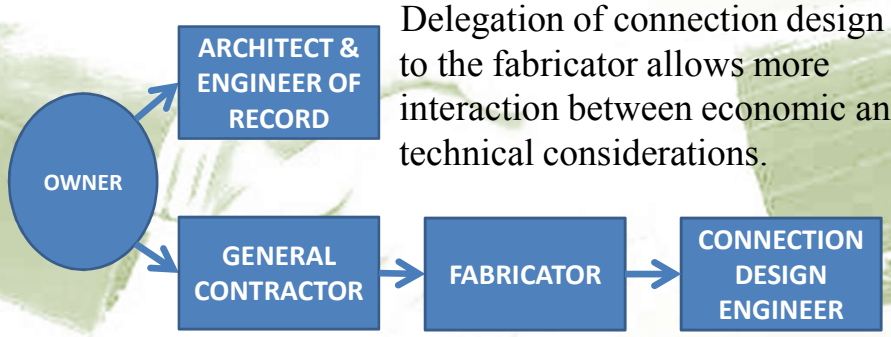




The Construction Industry is Weird



Delegation of connection design to the fabricator allows more interaction between economic and technical considerations.

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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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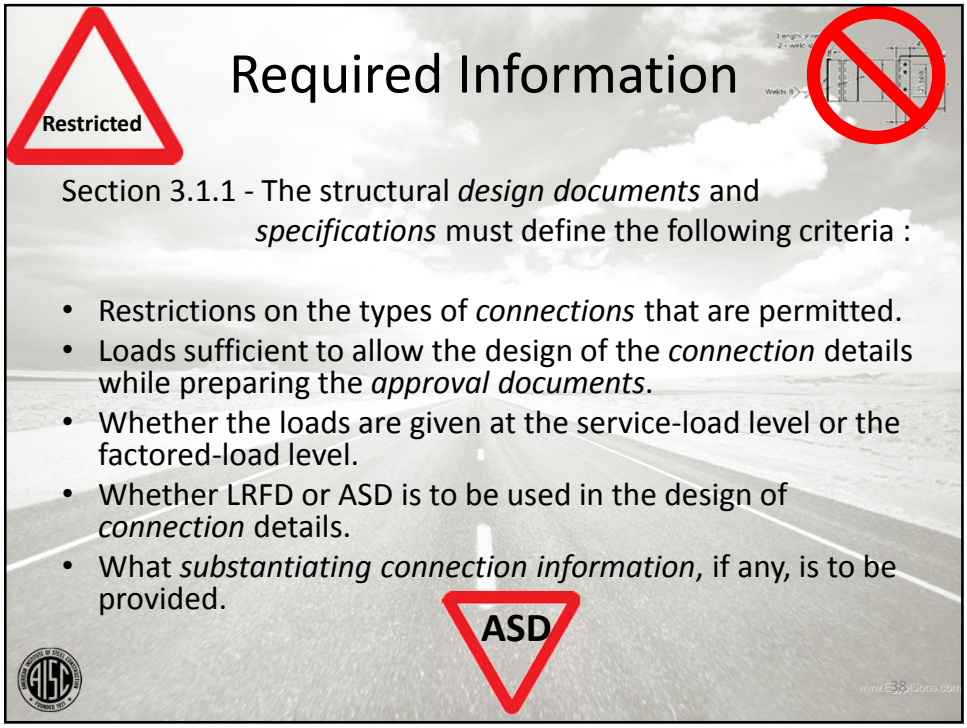


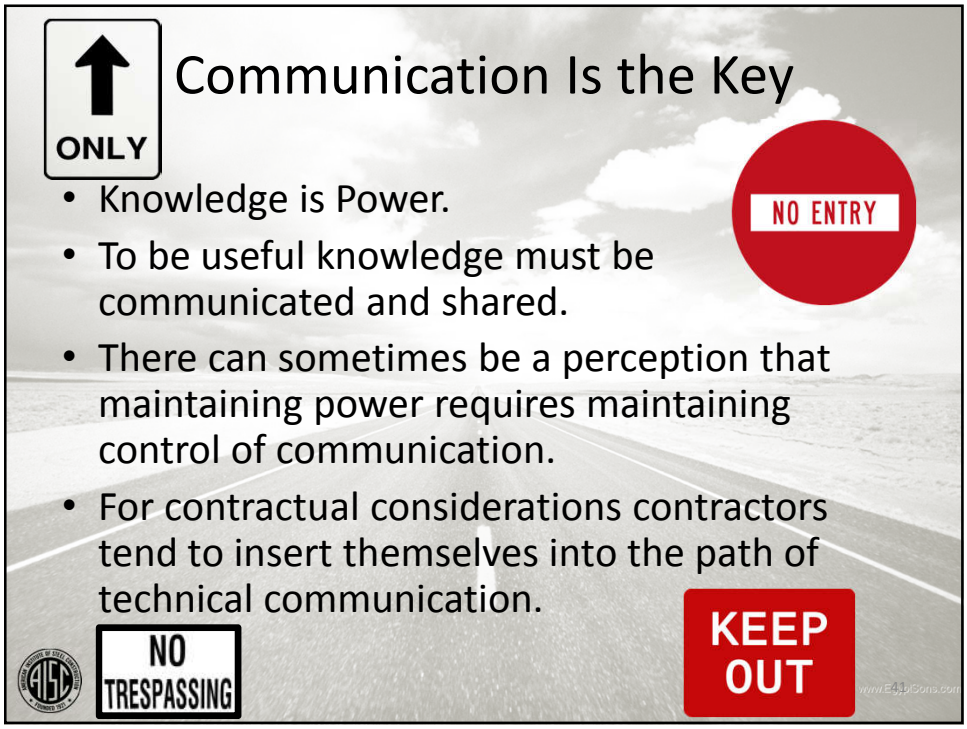
Substantiating Connection Information

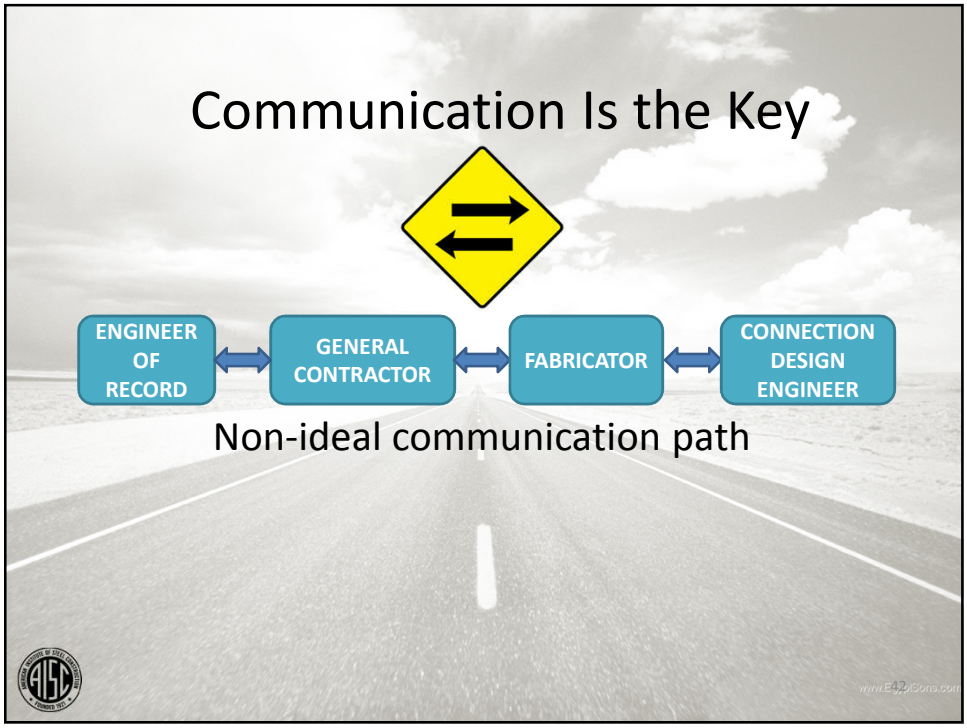
If you are performing connection design, you should <u>always</u> provide Substantiating Connection Information, even if it is not required by the contract.

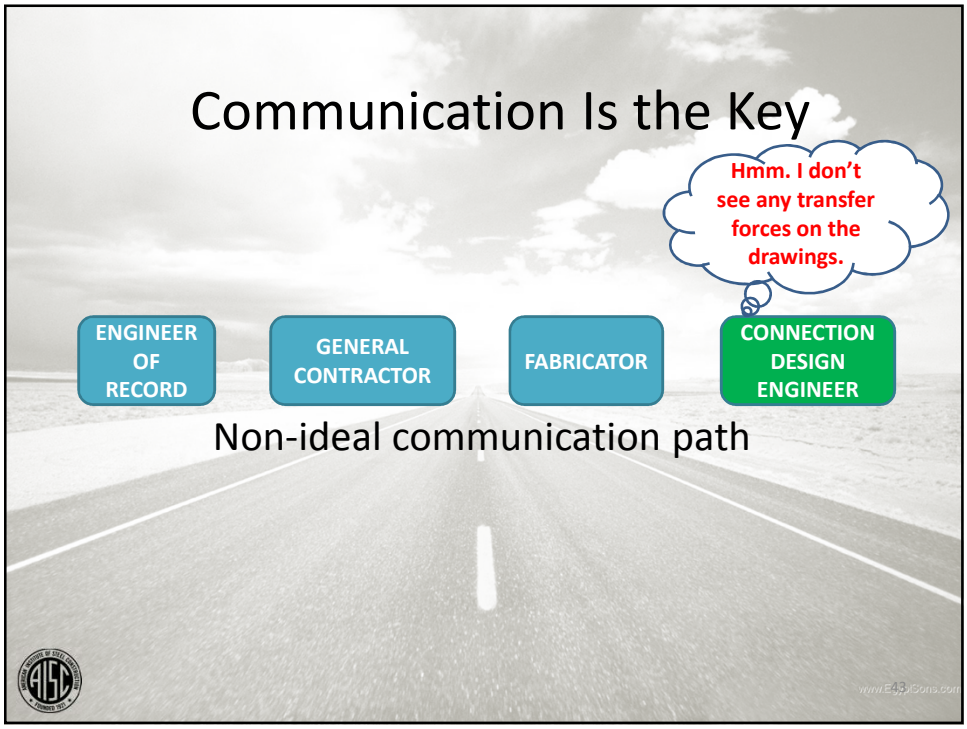
If you are delegating connection design you should <u>always</u> require and review Substantiating Connection Information.

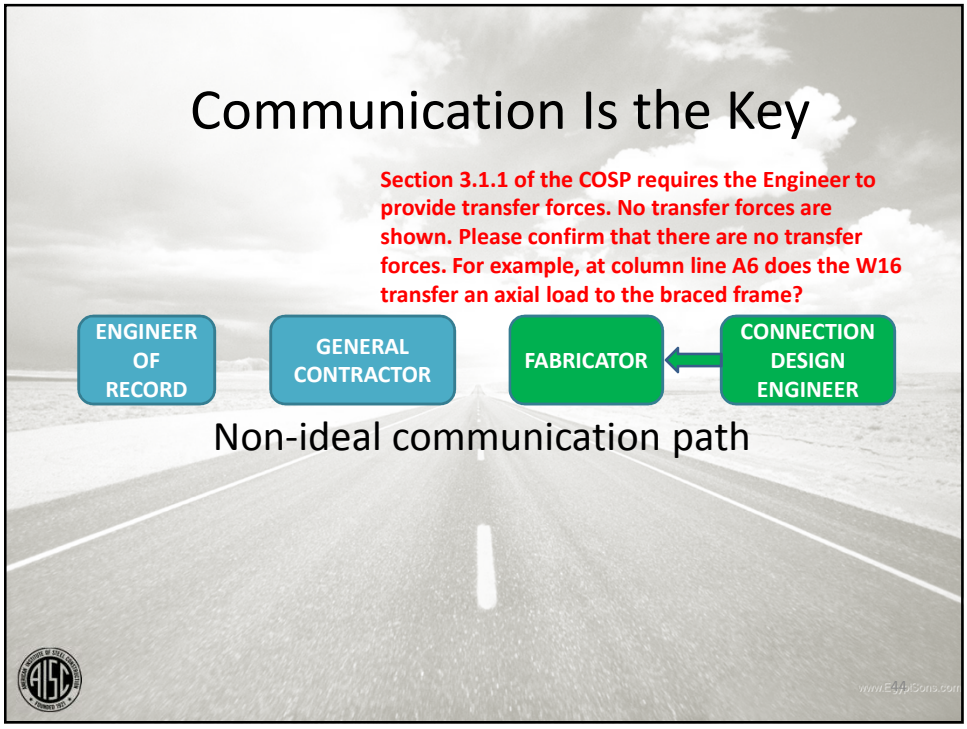
Communication Is the Key to Avoiding Problems

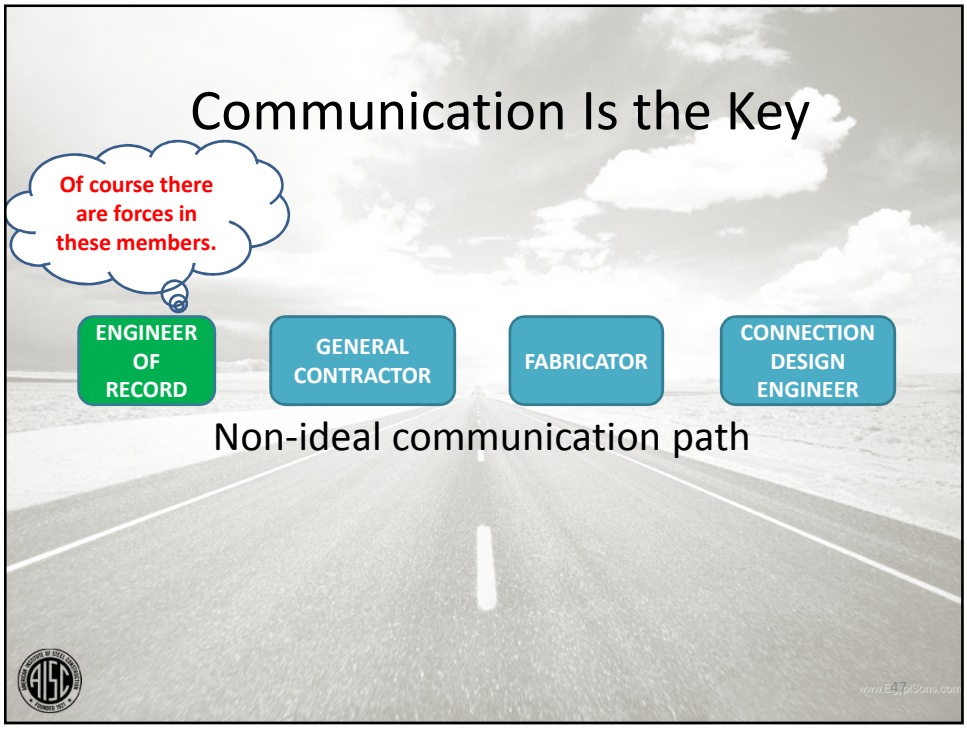
The approval process described in the Code of Standard Practice is intended to ensure that the necessary communication occurs and that the design intent is satisfied.

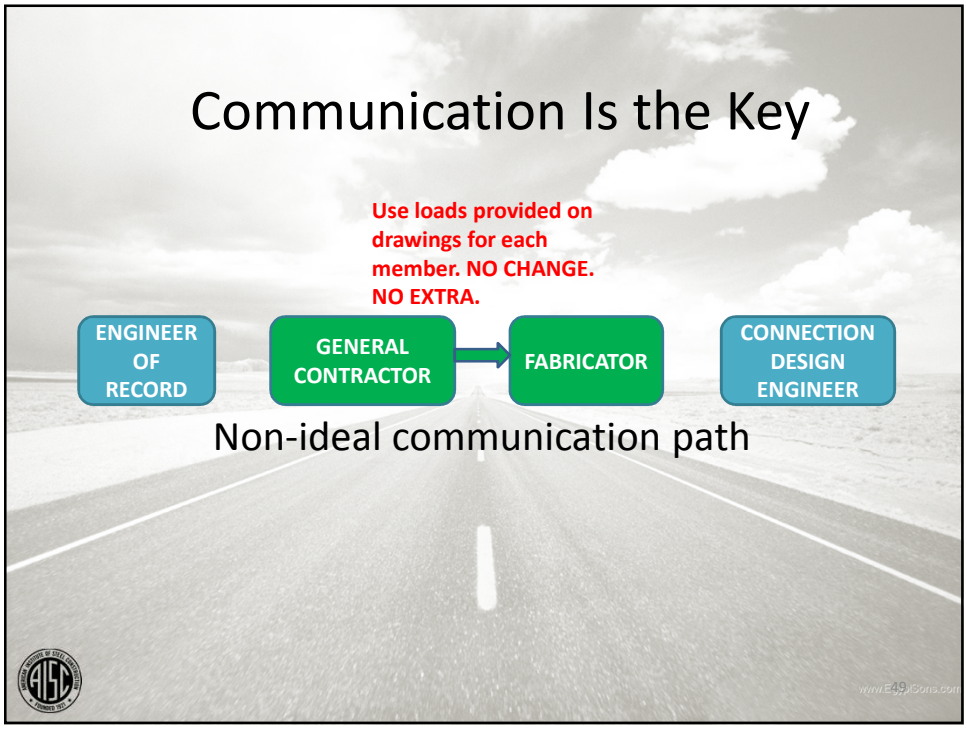


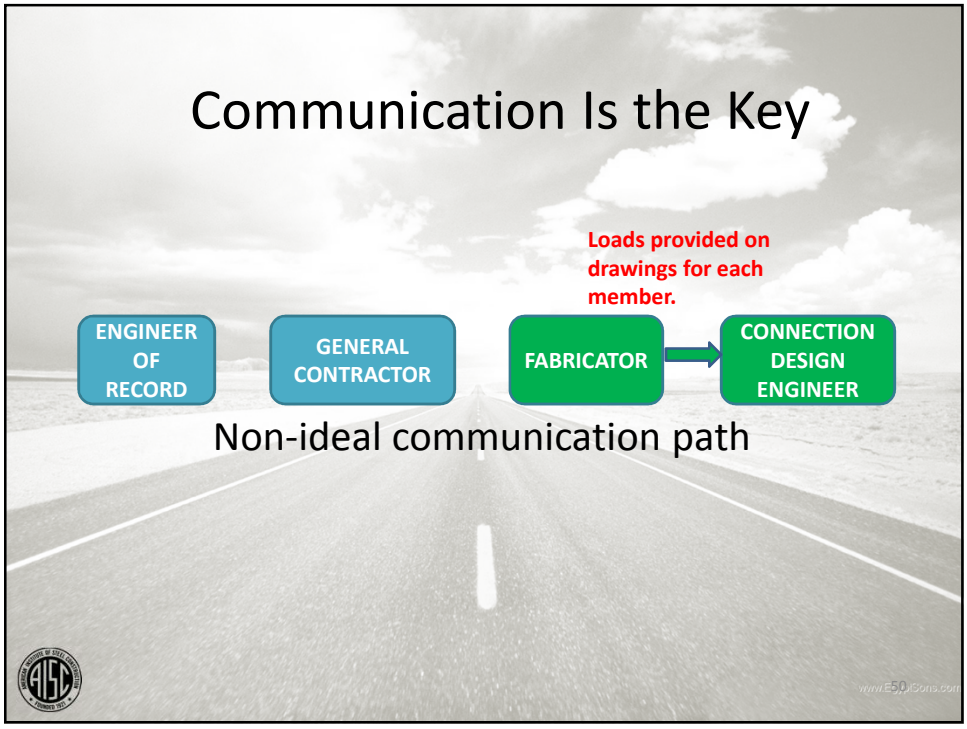


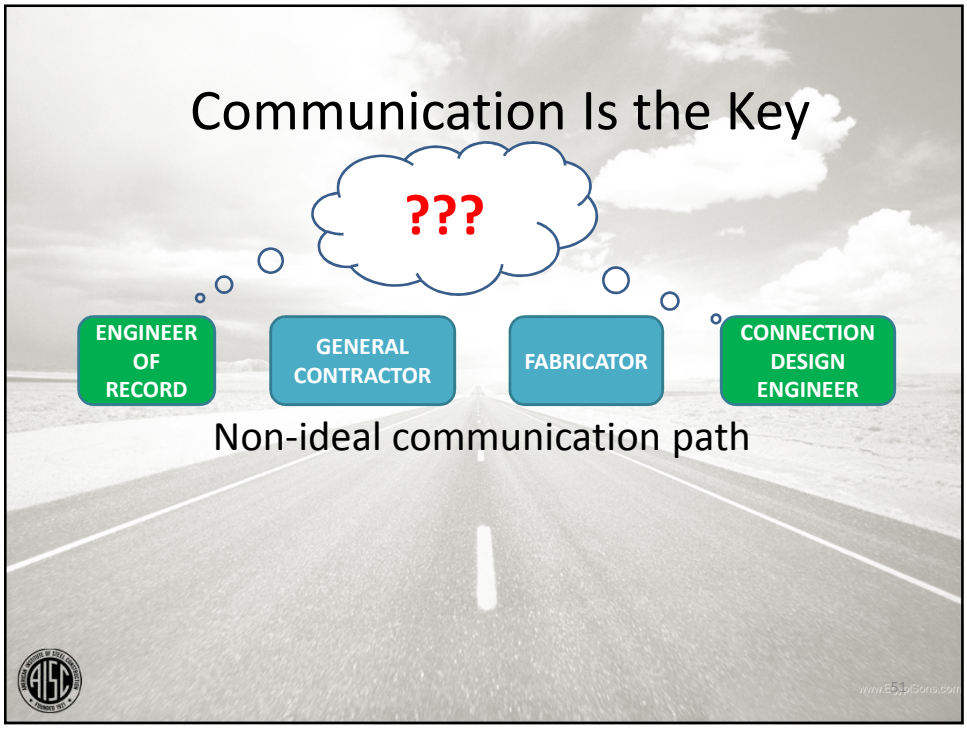


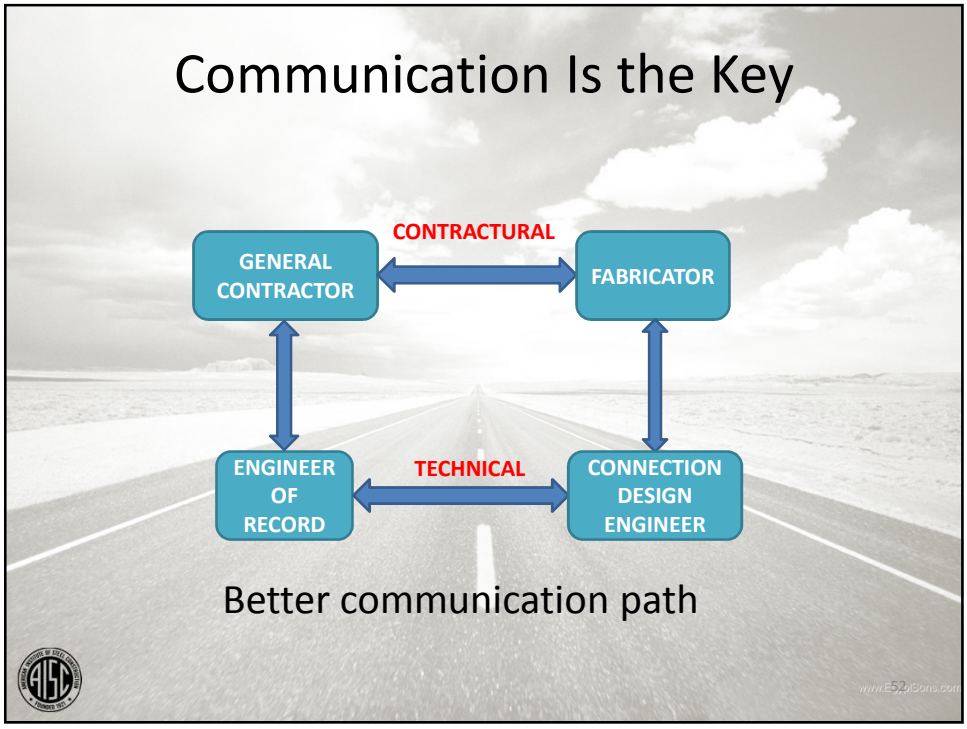


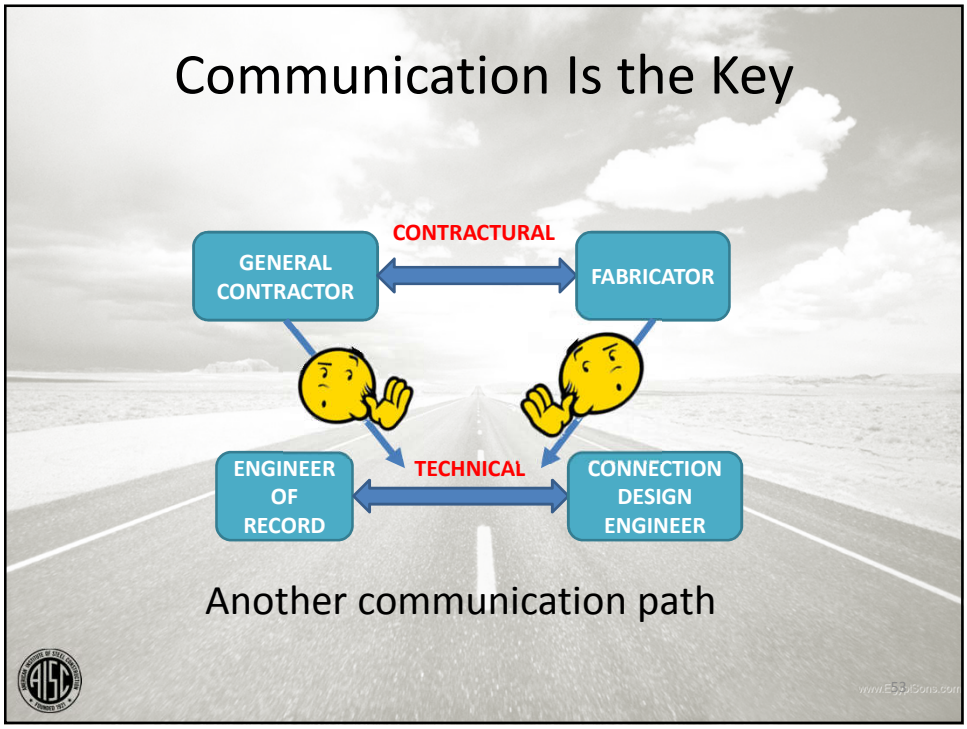












When Problems Arise

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.

Discrepancies

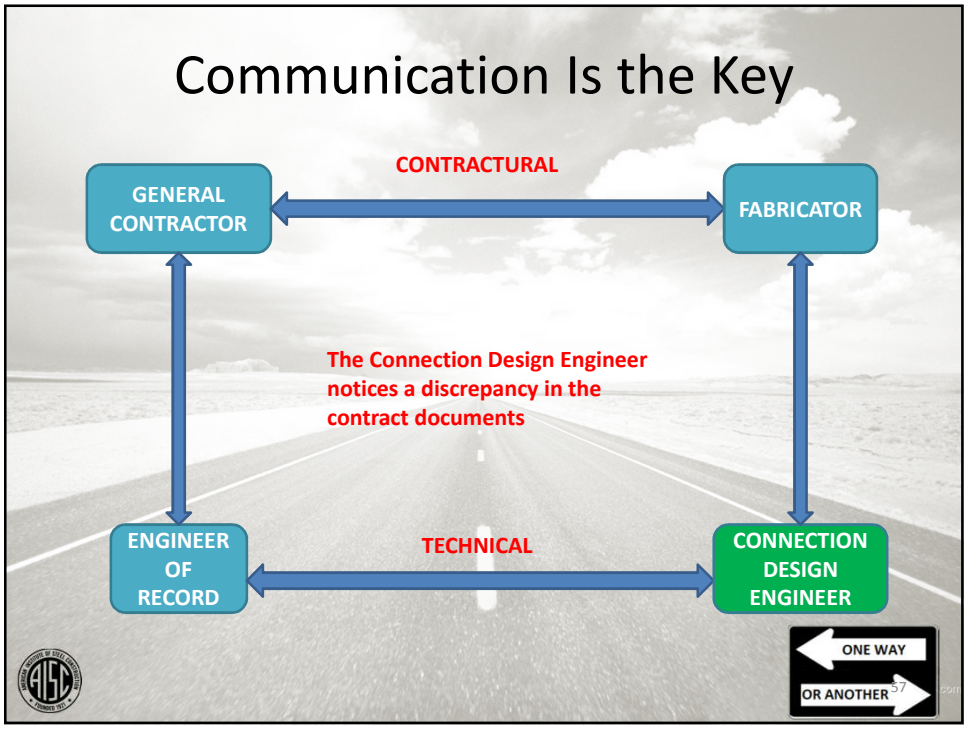
Discrepancies are addressed in the Code of Standard Practice.

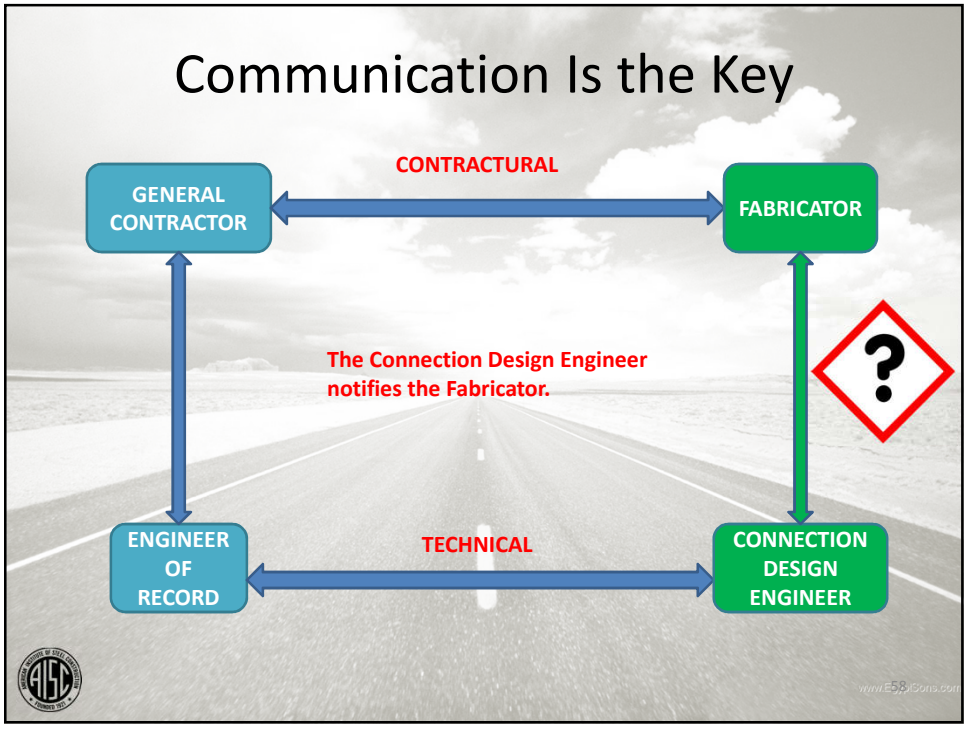
3.3. Discrepancies

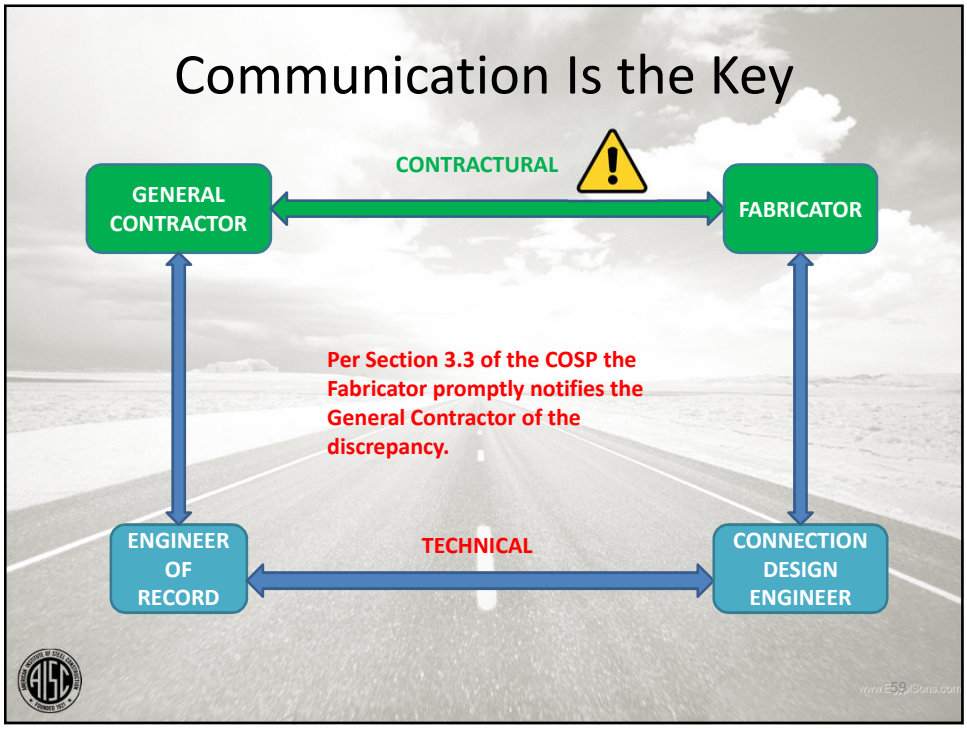
When discrepancies exist between the *design documents* and *specifications*, the *design documents* shall govern. When discrepancies exist between scale dimensions in the *design documents* and the figures written in them, the figures shall govern. When discrepancies exist between the structural *design 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.

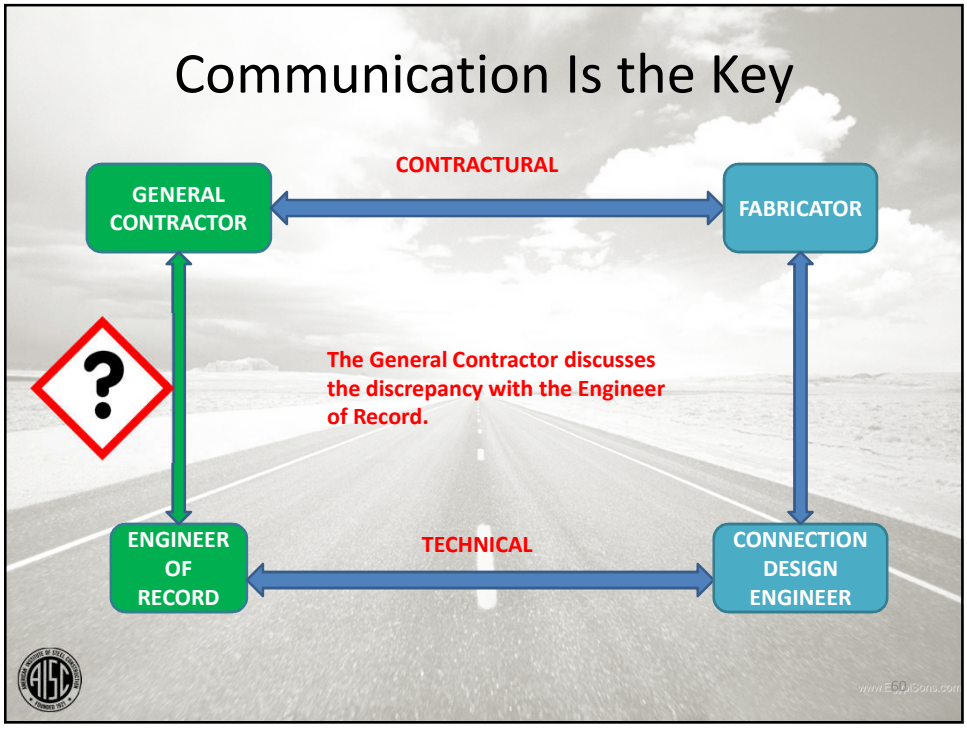
When a discrepancy is discovered in the *contract documents* in the course of the *fabricator's* work, the *fabricator* shall promptly notify the *owner's designated representative for construction* so that the discrepancy can be resolved. Such resolution shall be timely so as not to delay the *fabricator's*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

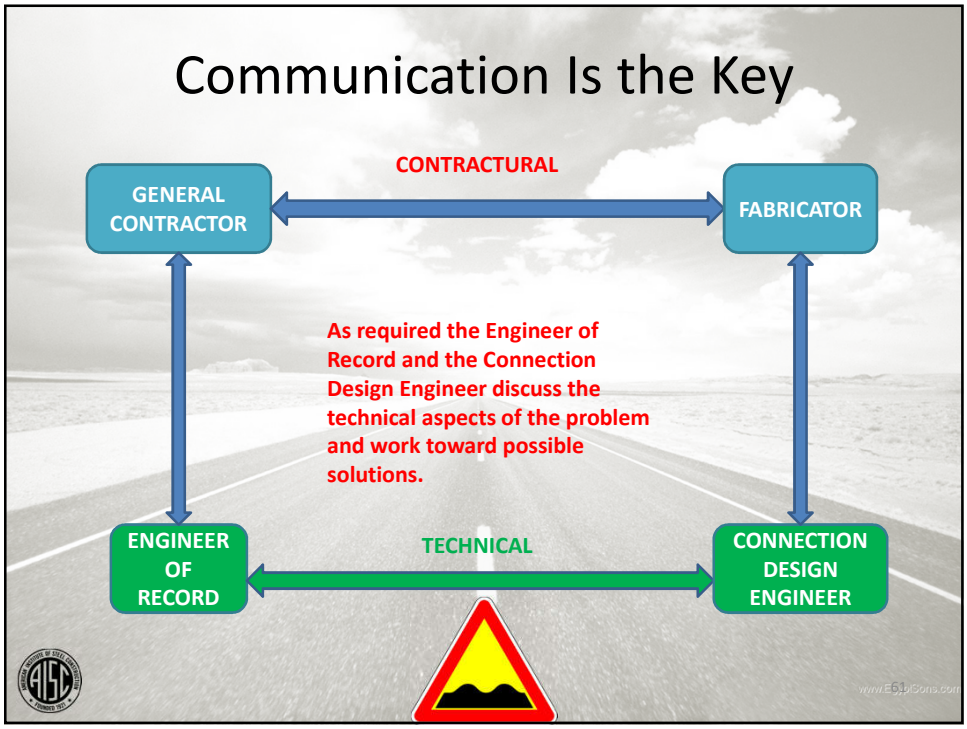
It is not the *fabricator's* responsibility to discover discrepancies, including those that are associated with the coordination of the various design disciplines.

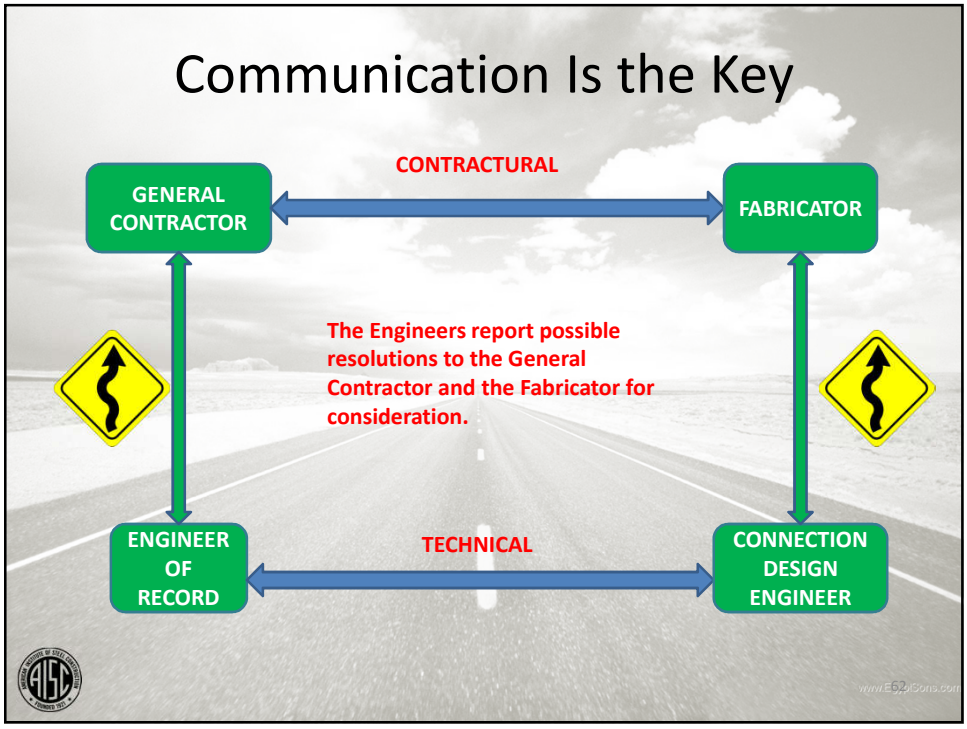


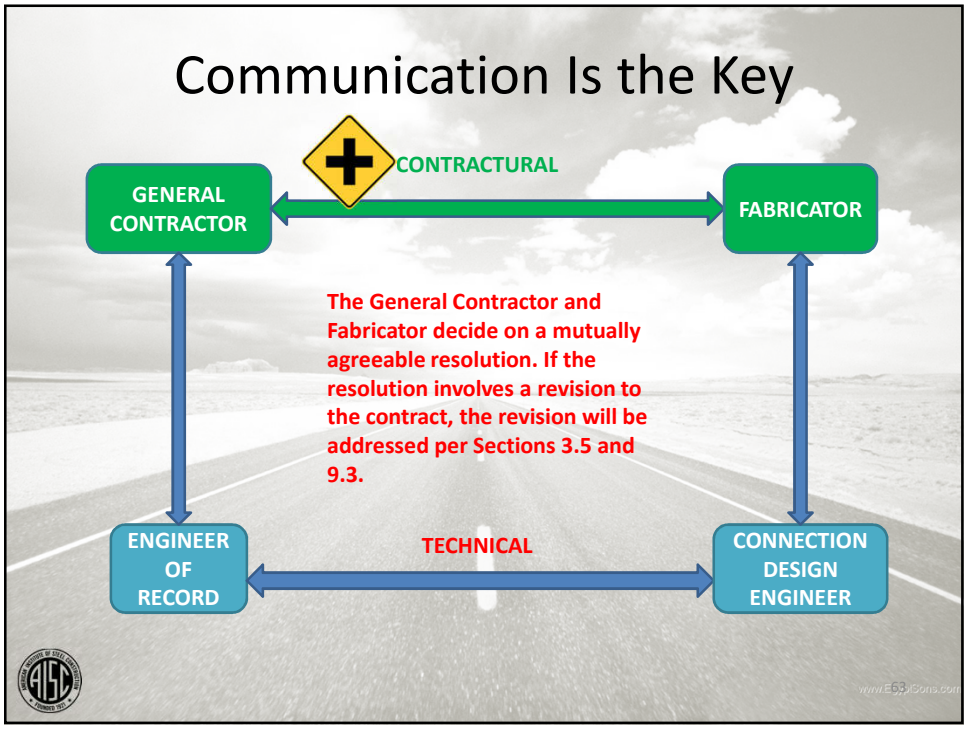


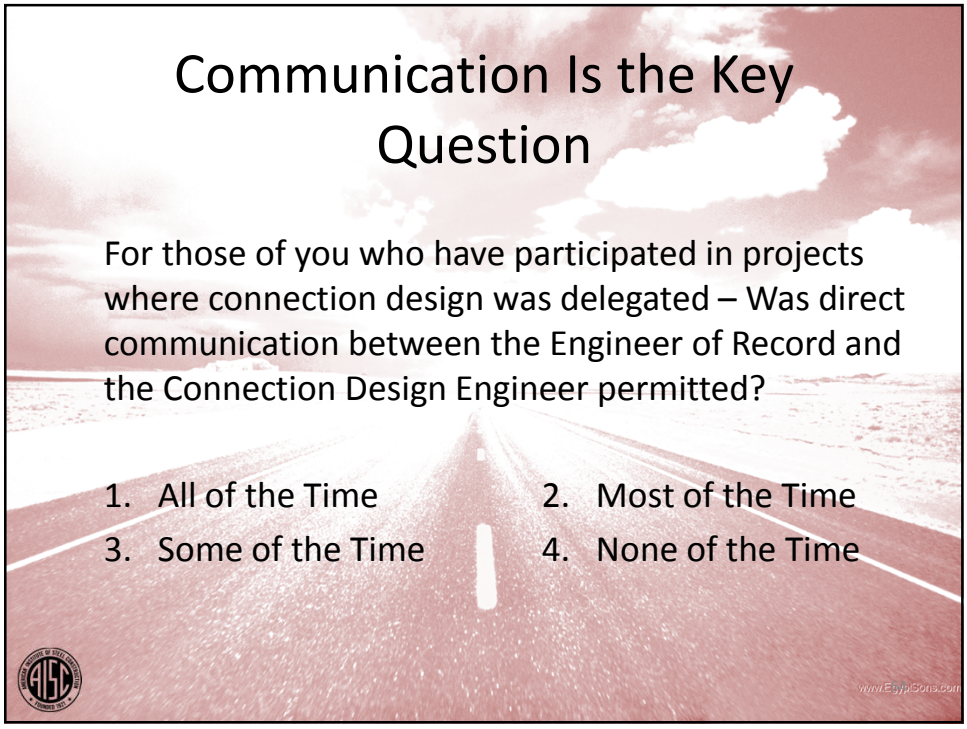












So You Wanna Be A Connection Designer?

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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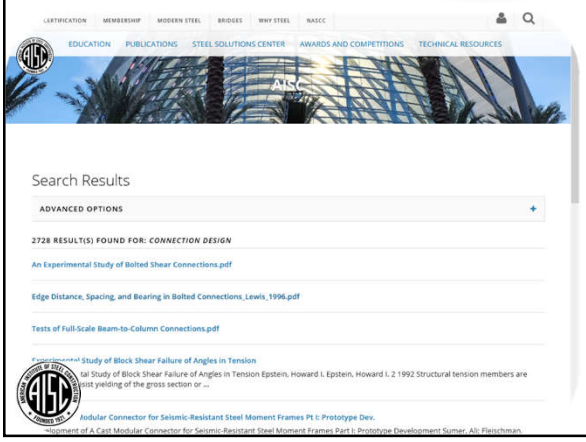
Tips for Success
Read discussions and work examples



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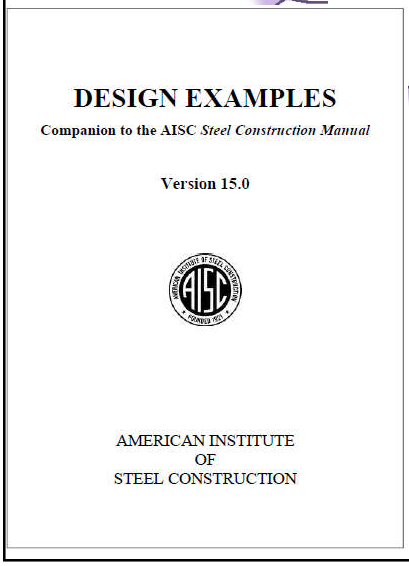
Tips for Success
Read discussions and work examples



"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…"

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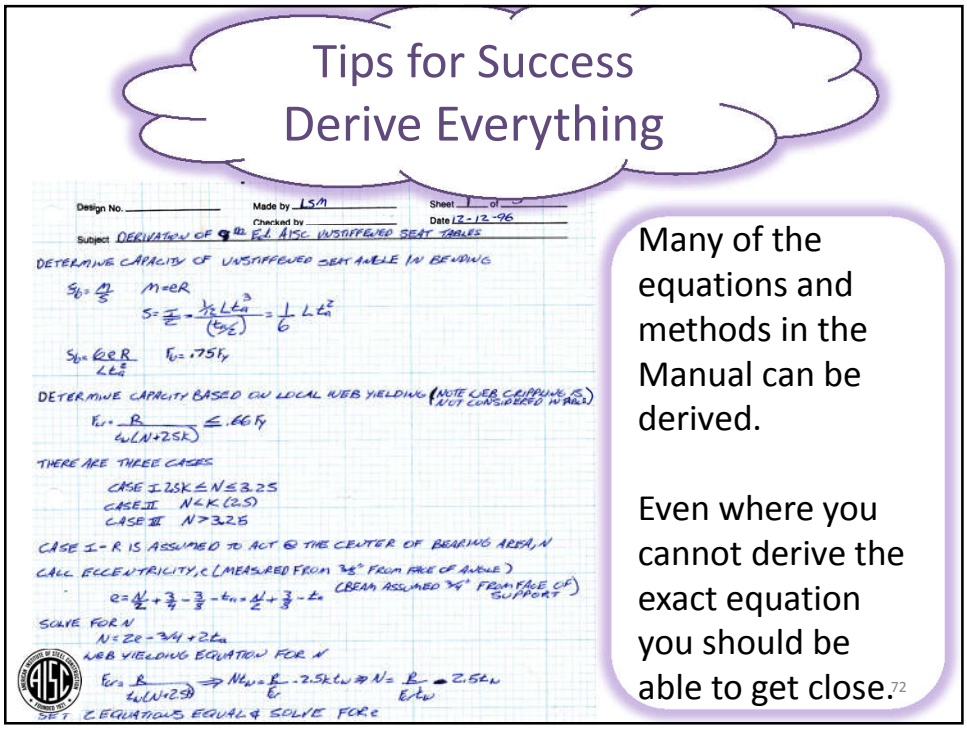
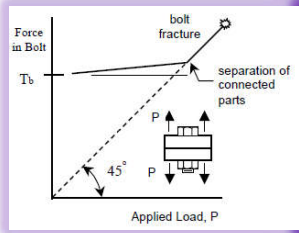
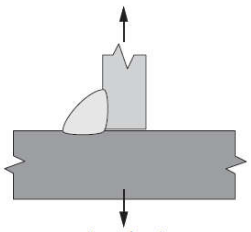


Tips for Success
Figure out the "Why"



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

Why is this not preferable?



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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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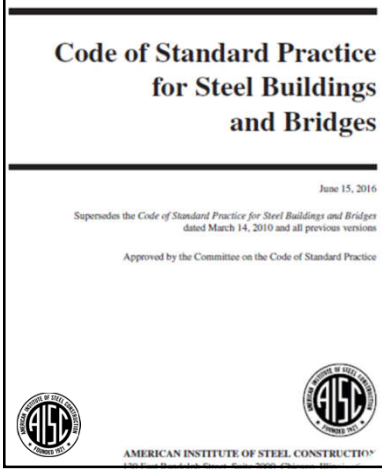
Tips for Success
Read the COSP



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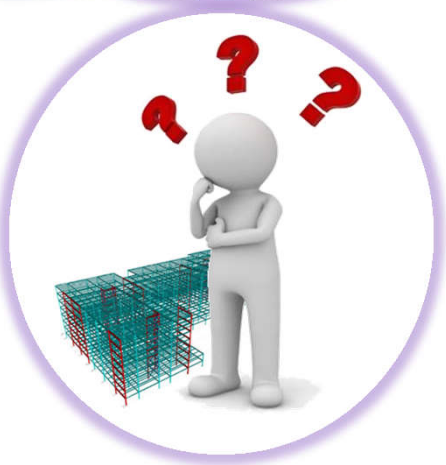
Tips for Success
Ask: "How would I build this?"



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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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Tips for Success for the Connection Design Engineer

It's the Statics Stupid

The Design Process

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

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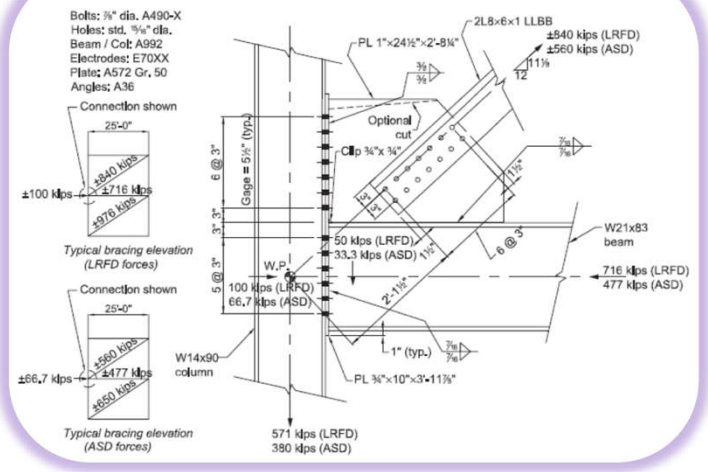
Tips for Success
Everything Starts with a Model



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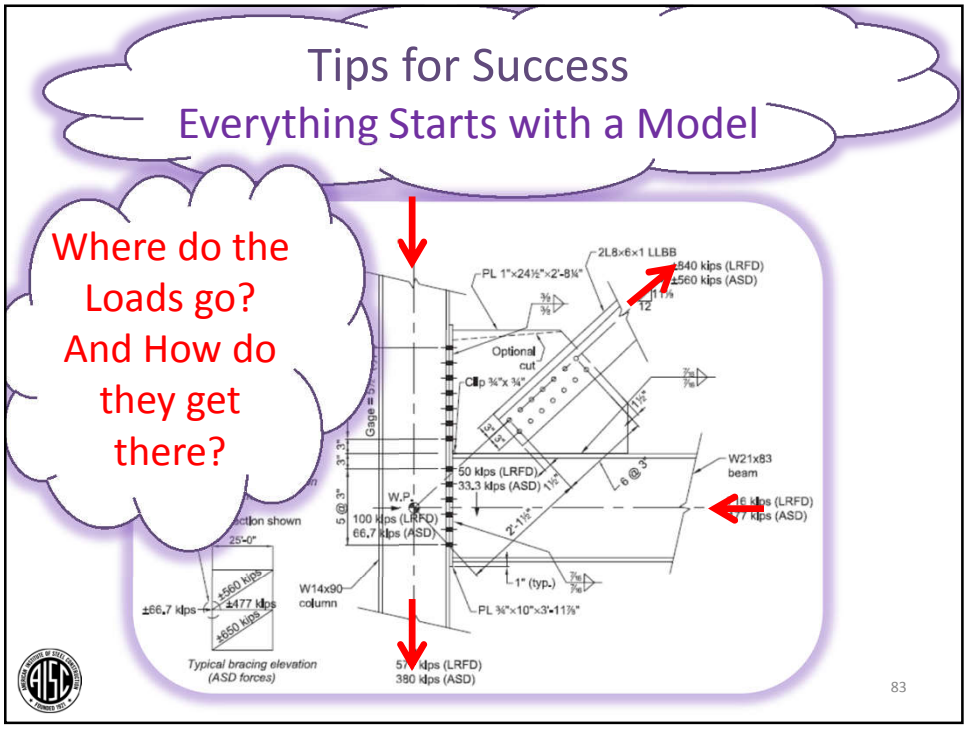
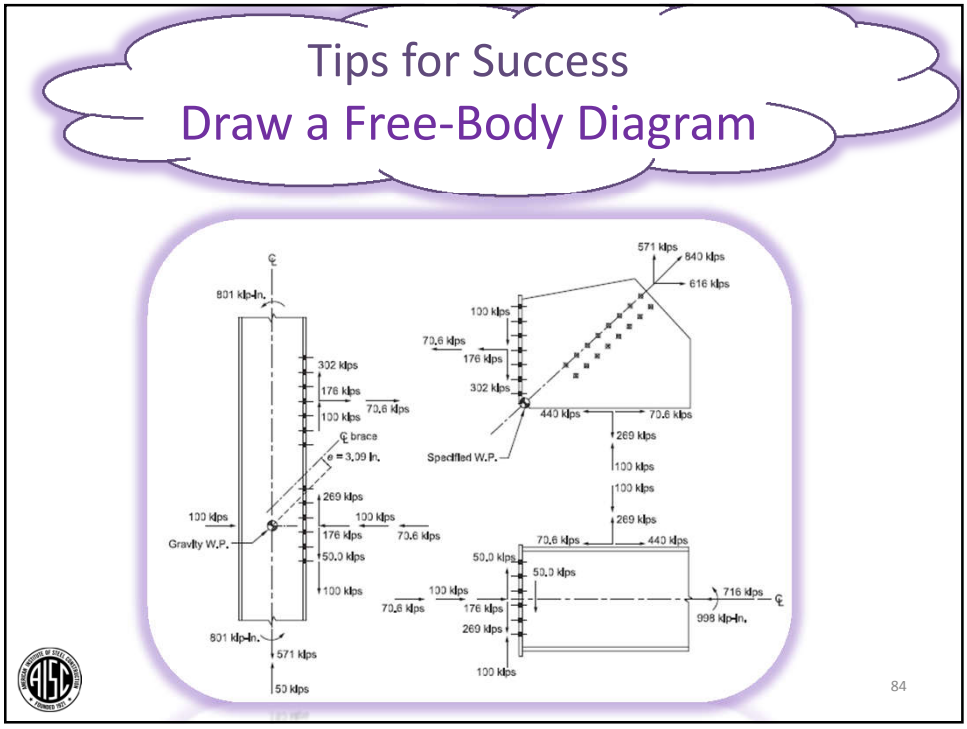
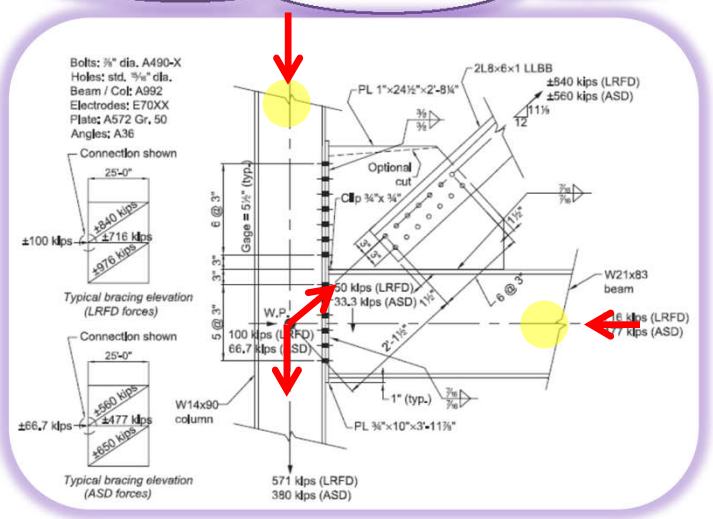




Tips for Success
Follow Forces thru Connection



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Future Sessions

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Delegated Connection Design

Questions?

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AISC | Questions?

Smarter. Stronger. Steel.

Individual Webinar Registrants

CEU/PDH Certificates

Within 2 business days…

- You will receive an email on how to report attendance from: registration@aisc.org.
- Be on the lookout: Check your spam filter! Check your junk folder!
- Completely fill out online form. Don't forget to check the boxes next to each attendee's name!

Individual Webinar Registrants

CEU/PDH Certificates

Within 2 business days…

- 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

CEU/PDH Certificates

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

8-Session Registrants

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.
www.aisc.org/nightschool - click on Current Course Details.

Reasons for quiz:

- EEU – must take all quizzes and final to receive EEU
- 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.

8-Session Registrants

Access to the recording: Information for accessing the recording will be emailed to you by this Wednesday. The recording will be available for three weeks. For 8-session registrants only. EMAIL COMES FROM NIGHTSCHOOL@AISC.ORG.

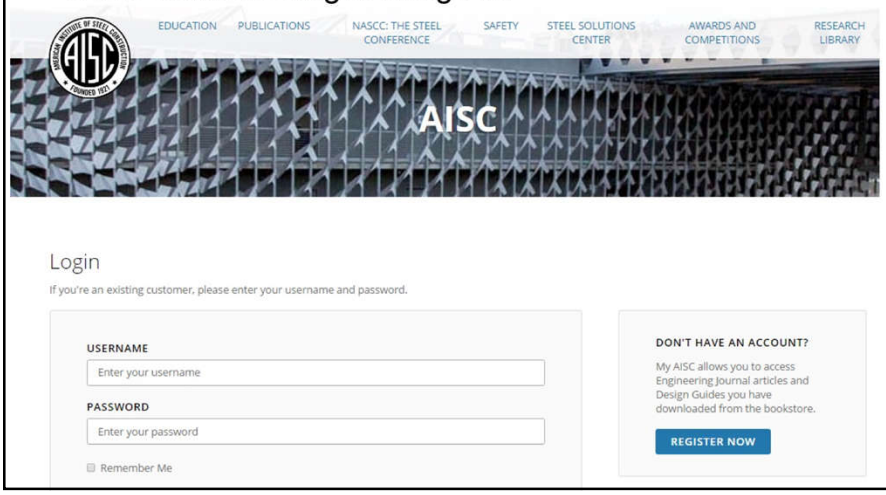
CEUs/PDHS – If you watch a recorded session you must take AND PASS the quiz for CEUs/PDHs.

Night School Resources for 8-session package Registrants

Find all your handouts, quizzes and quiz scores, recording access, and attendance information all in one place!

Night School Resources for 8-session package Registrants

Go to www.aisc.org and sign in.



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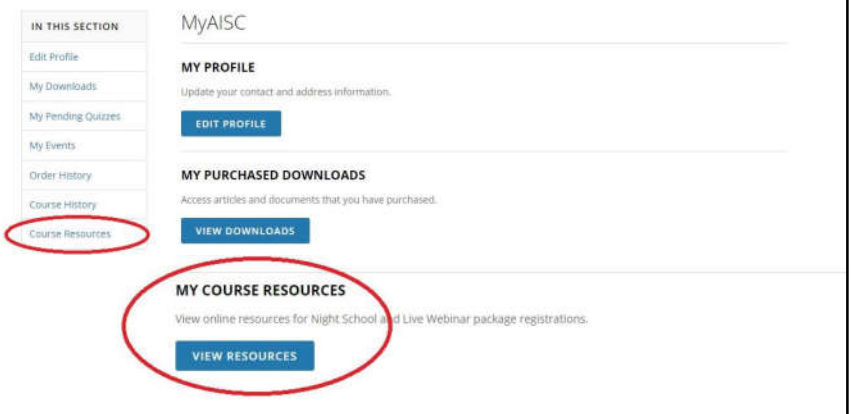
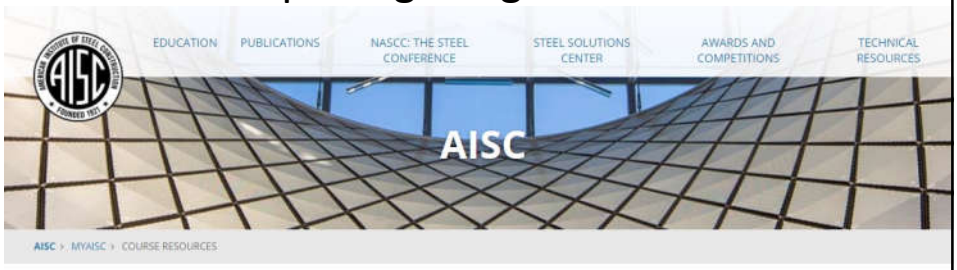


Night School Resources for 8-session package Registrants



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	Handouts	View Passcode: NS13DSN	Pass Score: 80	Pending
NS13 - Economic Considerations	2/6/2017 7:00:00 PM	Handouts	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	Handouts	Available 02/15/2017 5pm EST	Available 02/15/2017 5pm EST	Pending
NS13 - Preliminary Design Procedures	2/27/2017 7:00:00 PM	Handouts	Available 03/01/2017 5pm EST	Available 03/01/2017 5pm EST	Pending
NS13 - Crane Girder Design and Frame Analysis	3/6/2017 7:00:00 PM	Handouts	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	Handouts	Available 03/15/2017 5pm EST	Available 03/15/2017 5pm EST	Pending
NS13 - Transfer Crane Girder & Longitudinal Bldg Bracing Dsn	3/27/2017 7:00:00 PM	Handouts	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	Handouts	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	

Night School Resources for 8-session package Registrants

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

Night School Resources for 8-session package Registrants

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

AISC | Thank you

Smarter.
Stronger.
Steel.