Steel Reel

Supplemental information for instructors

This teaching aid seeks to give students an opportunity to hear voices from the structural engineering profession. These short interviews with professionals give insights to experiences, career paths, and interests pertaining to the design and construction of steel structures. Instructors may choose to use them within lecture, as remote learning resources, or as part of an assignment. The notes below serve a resource for instructors wishing to incorporate these videos within their class. In addition, a few sample questions are supplied. The videos are loosely listed in order of complexity, from simplest to most complex in concepts.

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[1] Collaboration, Sustainability, and Concept Design

Jon Magnusson, SE, PE, NAE

The focus of this video is Concept Design. However, Jon makes some great points regarding collaboration and sustainability. Jon discusses the trade-offs involved regarding client priorities. In addition, he advocates for the use of steel, since it has a "cradle-to-cradle" lifecycle aspect, which is something that can be part of discussion with students. As a leader and founder of the firm Magnusson Klemencic Associates, Jon represents someone who has had a successful career as a structural consultant to design architects.

Example follow-up questions to students:

1. What is meant by "steel is cradle to cradle"?

2. What are the two primary strategies for minimizing embodied carbon in a steel structure?

3. What type of companies have recently moved to make sustainability their top goal?

4. Who ultimately makes the call on whether sustainability strategies are implemented?

5. When Magnusson talks about "early involvement" as having a positive impact on the design process, who is he referring to being involved?

[2] Rehabilitation & Renovation Engineering

Andrea Shear, PE

As a forensic engineer, Andrea Shear discusses her job as an engineer involved in renovations and rehabilitation projects. She talks in historical terms about steel construction and working on existing structures. She talks of building reuse as "the first line of sustainability" and mentions that over-design for loading can actually be an investment in the life of a building. She also gives an example project of a parking garage that she worked on that had corrosion at the columns. Andrea also lists some tools of the trade that students interested in this career path like to know.

Example follow-up questions to students:

1. What material did steel replace in the early 1900's?

2. Name of the tools mentioned in the process of renovation and rehab

[3] Steel Design Resources

Christina Harber, SE, PE

Christina Harber, AISC's Senior Director of Education, talks about the resources available to engineers, many of which are included in the free student membership offered by AISC. Christina begins by talking about how she got into engineering, then continues with recounting an instance in her experience in practice with vibration design and her use of AISC *Design Guide 11*. Christina also lists other available resources, such as live webinars, education archives, AISC Design Examples, and the AISC and AISC Education YouTube channels.

Example follow-up questions to students:

1. What are the two specific examples of areas that need to consider the effects of vibration?

2. What is the portion of the *Steel Construction Manual* called that describes how steel must be designed (other than the portion containing tables and member properties)?

3. What is the *Code of Standard Practice*?

[4] Connection Design

Logan Bertling

Logan Bertling describes a career path in structural engineering that some students may not be aware of: the role of a steel connection designer. Steel connection designers are employed by fabricators, and they design the steel connections, such as sizing plates, bolts, and welds. Logan gives some project examples and also talks about fabricator preferences, such as a desire to avoid field welding. Logan's commentary on being a new engineer is very relatable, and he talks about the process of gaining confidence as he grows into his role.

Example follow-up questions to students:

1. Is it acceptable or typical for the fabrication and erection to begin before all the connections are designed for the entire building?

2. List a reason why bolted connections may be preferred instead of field welding?

[5] Column Base Plates

Adam Friedman, SE, PE

In this short video, Adam Friedman prompts students to consider the in-construction conditions of columns and the forces that are incurred on baseplates. Since the beams and girders are not tied into the column until later, the baseplate handles a small moment while the column is a "flagpole."

Example follow-up questions to students:

1. What is Friedman's reasoning for not using baseplates thinner than ¾" and anchor bolts smaller than 1" in diameter?

2. What type of load do columns typically carry?
    a. Tensile Loads
    b. Moments
    c. Lateral Loads
    d. Gravity Loads

[6] Framing Strategies

Larry McDowell, SE, PE

Larry talks about decisions structural engineers make to increase efficiency in a structure. He mentions minimizing the number of pieces in order to speed erection and also talks about how fire rating effects framing decisions. Many items Larry mentions bridge the gap between decisions made with the architects and the priorities of fabricators and erectors, such as exposed connections. Larry also talks about aiming for a balanced structural depth by framing girders in the short direction and filler beams in the long direction of a bay.

Example follow-up questions to students:

1. In order to create a balanced structural depth, should the girders span the long or short dimension of a rectangular bay?

2. Aside from steel weight, what is another metric fabricators may use to estimate the bid in a steel building?

3. When the speaker mentions choosing a beam that is shallower than the beam it is framing into, what is he trying to avoid?

[7] Lateral Torsional Buckling

Craig Quadrato, PE, PhD

Craig starts the video with recalling his experience walking across a wide flange that was on the verge of experiencing lateral torsional buckling. He then talks about his research on the behavior of beams in lateral torsional buckling and a pipe stiffener solution that was tested. This includes a brief video of a beam going into LTB.

Example follow-up questions to students:

1. What did the gravity load simulators Craig mentioned allow, in contrast to the method of a device anchored to the floor that directly pulls on the beam from below?

2. What solution did Craig's research employ in order to mitigate lateral torsional buckling?

[8] Construction Engineering

Adam Friedman, SE, PE

Adam offers a perspective of what possible structural engineering career path: looking into the stability of a structure during erection. He talks about the engineer putting themselves in the shoes of the iron workers installing steel, and what steps can be taken to make connections more accessible. For example, he talks about the location of a column splice as determined by an engineer can affect the ease of installation for the iron worker. In addition, Adam makes the point that an engineer's time to find an accessible solution is relatively inexpensive compared to any time lost in the field to make adjustments or wait for an accessible solution. Instructor note: if students are unfamiliar with "CJP" and "PJP" terminology, it is advisable to explain prior to viewing the video.

Example follow-up questions to students:

1. What example did Adam give of a missing load path?

2. What location did the speaker recommend for the placement of a column splice in order to facilitate easy access for the iron worker?

3. What alternative to CJP welds does the speaker urge engineers to consider?

[9] Load Paths During Construction

Adam Friedman, SE, PE

It is advisable that students watch Adam Friedmans' Construction Engineering video prior to this video so that they understand that Adam is speaking from a perspective of engineering during structure erection. Adam mentions load paths that exist in the completed structure, but are not yet installed during erection, and how to consider the stability of the not-yet-complete structure.

Adam's first example is a truss. While trusses may not have the full design load during construction, they also do not have any compression chord bracing along their length. So, the engineer must ensure they are adequate for the construction loads or install temporary bracing. The second example Adam mentions is missing component in the lateral system. The solution is temporary bracing. Adam also talks about wind and hurricane scenarios and planning for those weather events in a partially-completed structures.

Note: Students may benefit by explaining the acronym "SER" refers to the "Structural Engineer of Record." In addition, students should understand that the mechanics of trusses and understand the controlling limit state of compression for the top chord.

Example follow-up questions for students:

1. What is the concern Adam mentioned with long-span trusses in a partially completed structures?

2. If a lateral system in not complete, what must be installed for the structure to be stable?

3. What considerations are taken for projects under construction in a hurricane-prone region?

[10] Learning from the Field

Adam Friedman, SE, PE

This video starts with a specific example of coordination between the fabricator, erector, and construction engineer. The example is a project that has steel framing into concrete by use of embeds. The solution included a communication with the welders to make custom drawings. Adam also speaks of the importance of talking to people in the field to understand how a building is assembled. Aside from understanding how steel embeds into concrete work, most of the content of the video is general advice for all levels of students.

Example follow-up questions for students:

1. In the example project, what assisted the field welders in making the connection to the embeds?

2. What are some of the examples that the speaker gives of things you can learn by talking to people in the field?

[11] Optimization at All Scales

Steve Hofmeister, SE, PE

In comparison to the other Steel Reel topics, Steve's talk may be more advanced. Steve starts by talking about how he got into engineering, and then he gives two examples of engineering decisions that optimized the steel design in a way that took creativity on behalf of the design team.

The first example discusses some heavily loaded trusses on a long-span arena project. Steve's team opted to connect both chords of the truss to create a fixed condition at the columns, utilizing both negative and positive moments. However, the fully factored design load considering both dead and live would have made the connections at the columns (where negative moment would occur) very large. Steve's team instead did not connect the bottom chord until after the slab was poured. This made the trusses pinned-end for dead load moment, relieving some of the forces at the truss-to-column connections. This outside-the-box thinking is one way to reduce labor costs on a project.

The second example is Yankee Stadium. The design team recognized a problematic joint, or node, on the project that had a lot of force due to a cantilever condition. The design team solution included a shop-fabricated node that pulled bolting away from the joint and avoided costly field-welding. An understanding of how moment works in a continuous beam system works will be essential to understanding the first example.

Example follow-up questions for students:

1. What moment diagram was altered due to the design team's decision to leave the bottom truss chords unconnected until after the slab was poured?

2. What are a few of the unique circumstances about the condition at Yankee Stadium that prompted the design team to look into connection options?

[12] Connection Design Pass-Through Forces

Christina McCoy, SE, RA

This video focuses on a niche topic of connection design: pass-through forces. These pass-through forces sometimes occur due to the load path established by the engineer. A common occurrence is in drag beams for lateral load. This topic may be hard to envision for students who do not have experience learning about load paths. Christina gives the example based on her project experience on Tulane Football Stadium.

Example follow-up questions for students:

1. With pass-through forces, does the connection absorb any force?

2. Why was a pass-through force and connection needed on the Tulane football stadium?