

Development of the AISC "Days of Steel" Video Series to Engage Students Through Fun Online Videos (Case Study)

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Abstract

It is no secret that the current generation of students are plugged into their cellphones. As an instructor, it is frustrating that students can spend hours watching mindless videos online but cannot spare 30 minutes to read a foundational literature article related to their classwork and future careers. In order to engage these students, instructors must adapt to their lifestyles, including their online viewing habits.

The following paper presents a case study on the development of the AISC Days of Steel video series. These videos explore typical undergraduate steel design topics in a fun, amusing, yet educational manner, combining quirky humor with equations.

The intent of the video series is to provide content to students outside the classroom setting to increase engagement and interest in the technical topics. The videos will be made available online, and instructors have the option to utilize a series of handouts to supplement learning. The video content was primarily developed, filmed, and acted out by four, typical college-aged, engineering students to ensure the story plots were amusing and would interest their peers. Once created, the videos were reviewed by a number of other instructors and steel engineers to verify accuracy of the technical content.

The paper provides instructors with more background on the process of creating engaging engineering videos, highlighting some of the difficulties in filming as well as editing the content. The theoretical basis for some of the videos will be discussed. In particular, the paper will focus on techniques used to intentionally attract students' interest while promoting learning. Finally, very limited preliminary qualitative assessment of the videos will be shared.

Motivation

When teaching college-aged students, it has become increasingly apparent the students have developed a reliance on their cell phones. In fact, dating back to 2014, it was stated that "increasing reliance on cell-phones among young adults and college students may signal the evolution of cell-phone use from a habit to an addiction" [1]. Whether it is texting each other, checking on social profiles, or just playing games, the majority of students observed in the author's classes actively use a cell phone during class, often placing it on the desk. Sometimes it is functional- i.e. the student uses the cell phone as a calculator. But in most cases, it could be perceived as a possible distraction from course content and could inhibit learning for some individuals.

Regardless of whether instructors opt to or have the ability to restrict cell phone usage, the author believes it is critical that instructors adapt to new learning techniques and appeal to the interests of the students. With cell phone usage averaging 8-10 hours per day for college-aged men and women [1, 2], delivering content via digital media may provide another way to reinforce classroom learning goals. In particular, using online videos appeals to students because it allows adaptation to individual learning needs (exam preparation, missing lectures, homework help), manageability

(pausing material, skipping content already mastered, adding subtitles, replaying), and availability (asynchronous learning tool is accessible any time of day) [3].

To make the videos most accessible across all devices, YouTube is the obvious platform for providing these videos. YouTube is the second-most visited website and largest streaming video website in the world, with nearly 2 billion users worldwide that watch over 1 billion hours of video each day [4]. Other statistics note YouTube has been downloaded over 10 billion times from the Google Play Store as of 2022 and remains among the top downloaded apps for iOS [4]. School Learning Management Software platforms may be able to host videos, but it has been the author's experience that these apps are slow and 'clunky' to use and do not provide the functionality already built into the YouTube app, like automatic streaming in different qualities based on internet connection speed.

With these trends in mind, the author worked with undergraduate students to develop a series of online videos for an introductory steel design course. The series is titled "Days of Steel" and was made possible through funding from the AISC Teaching Aid Development Program.

The series focused on creating engaging, yet educational content for college-aged students. This means not only presenting technical content, but doing so in a way that promotes active learning and student interest. Some of the team's goals of using conversational language, speaking with enthusiasm, and keeping the videos brief align with ways to create engaging content, while pairing the videos with a handout or example problem promote active learning [5]. In addition, the use of storytelling and thematic elements have been observed to appeal to student interest [6, 7]. Lastly, it was important to the team that, when possible, the engineering student actors explain the steel design concepts to demonstrate to viewers that mastery of these concepts are attainable at their level.

Video Development and Timeline

The following is an overview of the process used to develop the final videos:

- 1. Develop ideas for videos
 - a. Identify basic topics in steel design, particularly difficult or confusing topics
 - b. Determine suitable visual aids that could be used within the video
 - c. Outline ideas for a handout or notes to accompany the video
 - i. Informative handouts for technical content
 - ii. Problem solving handouts if video shows sample calculations
- 2. Outline the scenes of the videos
 - a. Determine where each scene would take place and who would be in it
 - b. Determine material needs for props or visual aids
- 3. Write scripts for the videos
 - a. Include specific design language to be conveyed
 - b. Include details for acting cues
 - i. Voice tones
 - ii. Position of actors
 - iii. Sound effects

- c. Find ways to include engineering or steel design jokes
- 4. Reviews of video ideas and scripts
 - a. Met with AISC University Programs staff and faculty review panel
 - i. Refine video ideas
 - ii. Verify terminology for script
 - iii. Feedback on jokes
- 5. Film videos
 - a. Check sound and lighting before filming all scenes
 - b. Practice lines to ensure accuracy of terminology and delivery
 - c. Overcome scheduling and social distancing challenges due to COVID-19 pandemic
 - d. Perform many retakes because most engineering student and faculty actors are not theater majors
 - e. Develop system for labeling scenes and retakes to make editing easier
- 6. Edit videos
 - a. Select the best takes of the videos
 - b. Used iMovie to create content
 - c. Add clarifying text or graphics on-screen
 - d. Add sound effects and graphics for entertainment purposes
- 7. Create handouts to accompany videos
- 8. Review draft videos and handouts
 - a. AISC University Programs staff and faculty review panel provided feedback on videos
 - b. Organized a shared Google Sheet to capture all reviewer feedback for videos and handouts, including a minute-by-minute breakdown for specific video edits
- 9. Create final draft of videos and handouts
 - a. Address each reviewer feedback and provide comment in Google Sheet to describe changes
 - b. Finalize videos
 - c. Create closed captions
- 10. Done!

Throughout the video creation process, the students led the direction of the project. In addition to the completed videos, it was a major goal of the author to develop project management skills for the students as well as a passion and love for structural steel engineering. In terms of project management skills, it was observed that they all learned new ways to work with each other, particularly remotely as the pandemic interrupted film development. It has only been three years since their graduation, so it is yet to be seen how they pursue leadership roles at their respective companies, but two of the four have confirmed their acquisition of their PE license. In terms of loving structural engineering and steel design, two of the four students are currently working as structural engineers, with one of them having completed an MS degree in structural engineering. Fortunately, the team was able to use a majority of the funds provided by the AISC Teaching Aid Development Program to compensate the students for their tremendous effort.

As previously mentioned, the timeline of the project was interrupted due to the COVID-19 pandemic. While filming together was prohibited for a time, universities still found a way to move students towards graduation; thus, there was a secondary delay in editing when the students

originally on the project completed their degrees and moved away to start their careers. The distant location of students also delayed or prevented some scenes from being able to be re-filmed, so creative edits or on-screen text explanations and graphics were utilized to compensate for scenes requiring modification. Table 1 includes the planned timeline and actual timeline for the project along with brief notes.

Task	Planned	Actual	Notes
Start	01/2020	02/2020	
Develop ideas for videos	01/2020	02/2020	
Outline the scenes of the videos	01/2020-04/2020	02/2020-08/2020	
Write scripts for the videos	01/2020- 04/2020	03/2020-08/2020	
COVID-19 Pandemic	not planned	03/2020-09/2020	Pandemic prevented filming from March 2020-August 2020; then filming allowed but with social distancing protocols
Reviews of video ideas and scripts	03/2020	04/2020-08/2020	
Film videos	02/2020-06/2020	09/2020-01/2021	
Edit videos	03/2020-08/2020	10/2020-12/2021	Edits to videos were difficult following students' graduation in 12/2020; instructor was not prepared to be as involved in editing as was needed
Create handouts to accompany videos	03/2020-08/2020	10/2020-12/2020	
Review draft videos and handouts	04/2020-08/2020	12/2020-08/2021	
Address comments and provide second draft of videos	not planned	09/2021-12/2022	Based on feedback, scenes needed to be edited or graphics added to address comments. These strengthened the videos but with the lack of editing time, caused delay to the project.
Review second draft of videos and handouts	not planned	12/2022-06/2023	
Create final drafts of videos and handouts	08/2020	06/2023-02/2024	
Done	09/2020	03/2024	

Table 1: Project Timeline

As can be clearly seen in Table 1, the author was not ready to take on the editing work on the videos needed to complete the project in a timely manner, nor was the author prepared for the time required to produce highly edited content. Originally, it was planned for the students to do most of the editing. However, with the pandemic delaying filming but not student graduations, the students on the project graduated and began full-time jobs in January 2021. Fortunately, the one student Maria Ochoa, began her career local to the university and continued to work diligently with the instructor on the project through December 2022, and then was able to share the editing laptop with the author during Fall 2023 for him to complete the editing.

As alluded to in the previous paragraph, the software used to edit the videos also created some logistical problems. The project team utilized iMovie to edit the content, which is relatively easy to use and produces quality content. However, the way iMovie creates the project files, referencing individual video clips on the hard drive, made it impossible to share across laptops (at least the project team could not figure out a way to do it). This meant that the raw video files and original copies of the video projects remained on the student's laptop, which then required the author to schedule time outside of regular work hours to meet to complete the edits.

An effort was made to maximize funding for the students. All videos were created using a university borrowed video camera. The project borrowed two lapel microphones for the actors, as well as purchased a directional microphone that was externally connected to the recording device to provide enhanced audio. Otherwise, all costumes, props, and filming locations were found around the university, including the spare steel used in the welding videos. Originally, a total of \$6500 was planned for the project, with \$4500 allocated for student payment, \$1000 for a faculty stipend, and \$1000 for supplies. In the end, nearly \$5400 was made available to the students with the equipment savings, which aligned with the author's goal to have the project benefit the students, both academically and monetarily.

In terms of hours worked, the project proposal significantly underestimated the time needed. The proposal set aside about 450 hours total for student acting/working (3 students at 10 hours/week for a 15 week semester). However, the project ended up including a fourth student who volunteered his time, as well as a number of hours donated on behalf of the other three students. Total hours beyond the students' graduation were not recorded. The author is incredibly grateful for the commitment of these students to see the videos to completion, working on them without monetary compensation beyond the planned project conclusion and exhaustion of funding.

Topic Selection

In selecting the topics, it was important to the project team to identify the concepts from steel design that often create confusion or misconceptions for students. To this end, the students first relied upon their own experiences in Steel Design to decide which topics they would have benefited from having extra examples and technical material. As the steel design faculty member, the author was able to also provide insight to topics based on experience as well as end of semester surveys.

For instance, it was immediately evident the Direct Analysis Method created confusion among the students, and there was little to no outside resources for students to supplement the learning,

particularly resources aimed at an undergraduate level of understanding. Next, the students recalled difficulty in learning how to account for staggered bolts when computing net cross sectional area in fracture and block shear calculations, so this was selected as a topic. Other ideas included checking all tension member and bolt limit states in a complex analysis problem and a general overview of welding with visual aids.

A full list of topics covered in the series is provided in Table 2.

Table 2: Video Titles and	l Steel Desigr	Topics
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Video Title	Steel Design Topics	AISC Steel Construction Manual
1.1 Syllabus Walkthrough	Introduction to Video Series	
1.2 Beloved Steelio	Steel Material Properties	
1.3 Direct Analysis Method	Direct Analysis Method	Chapter C
1.4 Trash Bag and Pretzels- Part 1	Yielding, Rupture, Net Section for Straight and Staggered Bolts	Chapters B, D
1.5 Trash Bag and Pretzels- Part 2	Yielding, Rupture, Net Section for Straight and Staggered Bolts	Chapters B, D
1.6 Reunion with Trusses- Part 1	Load Path, Yielding, Rupture, Block Shear, Bearing Strength, Tearout Strength, Bolt Shear, Combining Bolt Limit States	Chapters D, J; Part 7
1.7 Reunion with Trusses- Part 2	Load Path, Yielding, Rupture, Block Shear, Bearing Strength, Tearout Strength, Bolt Shear, Combining Bolt Limit States	Chapters D, J; Part 7
1.8 Weight Room Dilemma- Part 1	Flexure, Axial Compression	Chapters E, F; Part 4
1.9 Weight Room Dilemma- Part 2	Welding	AISC Design Guide 21
1.10 AISC Manual Challenge	Axial Compression, Flexure, Width-to-Thickness Ratio	Chapters B, E, F; Parts 3, 4

Student Engagement

It was the belief of the project team for these videos to be popular among college-aged engineering students, that the videos needed to be informative and engaging. The students and the instructor brainstormed many ideas that would create fun scenarios for application of steel design topics. For instance, the students take a break during a social event to perform engineering calculations, much to the chagrin of their significant others. Inspired by the COVID-19 lockdown, another video has students designing their own gym equipment for working out, and then fabricating it.

In terms of project development, it was interesting to work with the student team as well as the professional staff from AISC and their faculty review panel. Some of the goofy jokes the students came up with were not always deemed to be as funny to the staff and faculty, while other times some slang/sayings used by the students had to be explained to the older generation. It was interesting to see both sides of the discussion as the engaging aspect of the videos is to appeal to college-aged kids, yet still produce a professional product. All in all, it is the team's belief the completed videos represent an excellent collaboration that will engage young and old engineers alike! See Figure 1 through Figure 4 for some snapshots from the videos!



Figure 1: Student Teaching Other Students about Welding



Figure 2: Instructor Checking Out Student Fabrication of Welded Pull Up Bar



Figure 3: Student Sharing Pretzels to Visualize Staggered Bolt Connections



Figure 4: Student Teaching Other Students about Direct Analysis Method

Handout Development

To increase the impact of the video series and to better assist other faculty with implementation into their introductory steel design courses, the project team decided to include handouts to accompany the videos. These handouts will be made available to faculty to use in their classes, and the included sample calculations could be covered as homework problems, with supplemental video instructions to help reinforce design concepts from the course. Some handouts are strictly informational, while others have example problems and accompanying solutions (see Figure 5 and Figure 6). Using the handouts with the videos will create a form of active learning for students.



Figure 5: Handout for Video 1.2 on Steel Material Properties



Figure 6: Handout for Videos 1.6 and 1.7 on Load Path, Yielding, Rupture, Block Shear, Bearing Strength, Tearout Strength, Bolt Shear, Combining Bolt Limit States for a Truss

Difficulties and Delays

COVID-19 Pandemic and Film Production

The original timeline for the project was to take place from January 2020-September 2020. The project team worked diligently during Fall 2019/January 2020 to determine most of the topics and develop the written scripts for the project. Filming began in January 2020, with some minor delays to enhance audio quality and lighting for the videos. Without an extensive background in filming, the first videos took many retakes, not only for actor errors, but also to fix audio problems, fix missing audio due to lack of experience with wireless microphones, and improve troublesome lighting. Just as the team became more confident in their setups, the world entered the COVID-19 lockdown (March 2020).

For the next six months, the project team was unable to record videos in-person on campus, which extended to university related projects. When filming was able to commence in September 2020, social distancing protocols had to be enforced along with masks, which required rewriting/reimagining scenes to allow actors to be individually in the video frame. In an effort to make the videos relevant after the pandemic, the team made attempts to limit the placement of masks in the video, which required creative editing to make a seamless storyline. On top of those difficulties, the team also had to deal with individuals getting sick or needing to quarantine.

Student Graduation

Even though the project experienced delays from the COVID-19 pandemic, the university managed to keep students on-track for graduation. Thus, 3 of the 4 students on the project team graduated in Fall 2020. Thankfully, the students were dedicated to completing the project and we were able to record the remaining videos at the conclusion of the Fall 2020 semester after the students on the team had officially graduated. However, once the students left the university, performing retakes of scenes was not possible and recording audio or voiceovers was much more difficult.

Next, the instructor worked with one of the students who was still local to complete the editing. The editing process took extra time as the student was now working full time for the local DOT and largely donating her time to complete the project. The draft videos were completed by about Fall 2021.

Review and Editing

Once the videos were completed, they needed to undergo review by AISC staff and their faculty review panel. This process required time for feedback. Once received edits needed to be made, which were often more difficult to do since the actors no longer lived in the area to come to campus to film. Edits were made and returned, and additional review led to some more changes. In short, the project team vastly underestimated the time to edit the videos to completion.

Despite these difficulties, the project team did find the use of the Google Sheet to organize content, video links, and feedback to be a crucial aspect of the project. The rather large video files made

sending/sharing the videos much more difficult- just like in the classroom. Therefore, the project team made use of posting them to YouTube as "Unlisted" videos, which also gave the review team the full student experience of using the YouTube platform to watch the content. See Figure 7 and Figure 8 for remote project organization using Google Sheets.

Ħ	1.0 AISC Days of Steel Videos, Handouts, and Notes ☆ ☎ ∞ File Edit View Insert Format Data Tools Extensions Help											
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1	A B	С	D	E	F	G	н	I	J	к	L	
2	Season.Episode	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	
3	Video Title	Syllabus Walkthrough	Beloved Steelio	Direct Analysis Method	Trash Bags and Pretzels, Pt.1	Trash Bags and Pretzels, Pt.2	Reunion with Trusses, Pt. 1	Reunion with Trusses, Pt. 2	Weight Room Dilemma, Pt. 1	Weight Room Dilemma, Pt. 2	AISC Manual Challenge	е
4	Торіс	 Introduces steel video series shows a list of the videos available 	•Steel stress vs strain curve •Uniaxial tension test	•Direct Analysis Method (Ch. C)	•Yielding and Fracture	•Yielding and Fracture Example Problem with Staggered Bolts	•Block Shear	 Bolt Limit States: Bearing, Tearout, and Bolt Shear 	•Beam and Column Strength using Parts 3 and 4	-Welding 101	•Using AISC Manual •Columns (Table 4-1a) •Beams (Table 3-10) •Local Buckling (Table 84. •Beam Deflection (Table 3-	.1a) -23)
37	0:00-0:20								0:00 This video is missing the "Days of Steel Video Series" intro slide 0:20 - The sad music and panning of the gym is fungal but it feels a little long. Is it posible to shorten that segment?	0:00 This video is missing the "Days of Steel Video Series" intro slide	0:00 This video is missing "Days of Steel Video Saries"	the * intro
38	0:20-0:40											
39	0:40-1:00	0:40-0:55 - The "If there aren't any actual questions" joke doesn't quite make sense. Is it possible to remove?	The term "fracture" versus "rupture" again.									
40	1:00-1:20			I'm wondering If we could cut 0:57-1:14? That would eliminate the hard to read thought bubbles, the "so the software" non-question, and the double up on the "actual questions" joke, but still makes the point of the prof. breezing past puzzled students.						"Groovy weld" joke at 1:00 - the laugh track happens during the joke. Can that be moved to take place after the joke?		
										Can you include a graphic that illustrates a PJP weld? Some		

Figure 7: Google Sheet Snapshot Highlighting Use with Project Team to Document Comments/Changes to Videos based on Timestamp

2	Season.Episode	1.1	1.2	1.3	
3	Video Title	Syllabus Walkthrough	Beloved Steelio	Direct Analysis Method	
4	Торіс	 Introduces steel video series shows a list of the videos available 	Steel stress vs strain curve Uniaxial tension test	•Direct Analysis Method (Ch. C)	
5	Handout	List of Videos	Steel Stress vs Strain Curve	"Big 5" Stability Requirements	
6	Notes	This video is the final version- January 10, 2024	This video is the final version- January 10, 2024	This video is the final version- January 10, 2024	
7	YouTube Links (Draft 1)	https://youtu.be/HuR	https://youtu.ba/y0Ke	https://youtu.be/mgx7N	
8	YouTube Links (Draft 2)	https://youtu.be/bv0	https://youtu.be/Pul.J	https://youtu.be/-YVfX6	
9	YouTube Links (Final Draft)	https://youtu.be/bv0	https://youtu.be/PuLJ	https://youtu.be/-YVIX6	
10	Captions	Yes	Yes	Yes	
11	Handout Link	https://drive.google.	https://drive.google.co	https://drive.google.co	
12	Handout #2 Link	https://doi.org/colif	https://doi.org/10.00	https://doi.org/activity	
13	Revised Handout #1 Link	nttps://anve.google.	nttps://arive.google.co	nttps://drive.google.co	

Figure 8: Google Sheet Snapshot Showing Organization of Links to Draft Videos and Handouts

Future Work

Given the many delays and difficulties, the project was finally released to the public in March 2024. Now they are officially available, the author is including them in the current semester steel design course and will obtain preliminary qualitative and quantitative survey information on the effectiveness of the videos and the impact on student engagement in Spring 2024. The instructor wishes to collaborate with other steel design faculty in the coming years to measure the impact and ease of implementing the videos at other institutions.

Preliminary Feedback

Preliminary qualitative feedback on videos from the students are positive. As the videos were not officially released, the instructor had only allowed students to preview the videos in-class. Observations indicate the students laugh at many of the jokes and say they can relate to the situations in the video. Students have stated the Direct Analysis Method video, when viewed one class after teaching, helped to reinforce the concepts and prepare them to apply the method to a real-world analysis problem. Another video involving a steel tension specimen named Steelio (who they meet in other courses taught by the instructor), also touches the students as he sacrifices himself to be tested to help them better understand steel material properties.

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Video and Handout Availability

As of March 2024, the AISC "Days of Steel" video series has been released for other steel instructors to use in their classes. Please visit AISC's University Programs website to find the links to the YouTube videos as well as the handouts: <u>https://www.aisc.org/education/university-programs/ta-days-of-steel/</u>. Additionally, solutions to the handouts are made available to steel design faculty through the AISC Educator Forum.

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