Improving the Efficacy of Learning Bridge Inspection & Maintenance

TAC Educational Achievement Award Submission

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Background

Ontario Good Roads Association (OGRA) has been offering courses on the construction and maintenance of Ontario highways, roads, bridges, and related infrastructure for 119 years. Technology has changed dramatically since the first course was delivered in Gananoque in 1901, where some of the challenges included a scarcity of workers and water, and the horses being frightened by noisy machinery (Ontario Good Roads Association, 1994, p.14).

OGRA's Bridge and Culvert Management course was first offered in 1980 as part of the C.S. Anderson Road School, delivered annually at the University of Guelph campus. Over the past 20 years the course has trained approximately 860 students. Based on an analysis of students who attended the course in 2018 and 2019, 41.5% of the class are public works supervisors (this includes lead hands and fore persons) and 38.5% are operators including drivers, workers, labourers. Instructors use the Bridge Inspection & Maintenance instructional video during this course, but after 25 years the video is now dated.

1994 Video host

The revised video has seven modules:

1. Introduction & Bridge Composition
2. Bridge Components
3. Material Defects*
4. Safety
5. Routine Inspections
6. Routine Maintenance
7. Consequences of Neglect

* This was not a stand-alone module in the original video and will be discussed on p. 3 of this submission.

This project was made possible thanks to contributions made by 407 ETR and GHD Limited.

Innovation in Program Approach and Execution

While the video is currently being used as part of the content for a road school course, one of our goals is to add content to the Bridge Inspection course. Bridge Inspection is part of the Municipal Infrastructure Training Program geared towards technicians, technologists, and engineers. The two courses where the videos will be used are currently offered exclusively in-person. There has been an increase in the popularity of these courses and demand for additional offerings which is sometimes difficult to accommodate as the courses are taught by volunteers whose availability has limits.

OGRA is in the midst of exploring options for blended and/or online learning for some of its programs. To this end, we have invested in closed captioning for the video to assist those who may have a hearing impairment.

Technology Used

- Sony Fs5 video camera: shoots 4K, the highest resolution you can shoot at
- Top of the line lenses
- Audio - Wireless Sennheiser Lavalier Microphones
- Sennheiser Shock Microphone
- Kino Flo Lightening
- DJI Ronin - M Smooth Steady Cam to ensure continuous moving footage and high production value
- Drone – Mavic Pro Zoom
- The aspect ratio has been updated from the original 4:3 aspect ratio of the 1990's, which increases the size of the video on the screen it's played on. This revised aspect ratio properly fits all modern screens, e.g. television, monitor, projector; and allows a wider field of view.

2019 Filming at night

Education / Training Impacts on Program Participants

The original script was rewritten to reflect modern practices and allow for a more modular approach. The original script made reference to what students viewed and would view and included information about defects throughout each module making it confusing for the viewer. Eliminating references to other parts of the video streamlined the content, therefore decreasing students' cognitive load. Each module is self-contained due to this revised approach and doesn't require viewing the other modules. This provides an à la carte option to enhance content throughout the course, and the ability to add or omit a module depending on the needs of students. Information about defects has been moved into one comprehensive module making it easier for the students to grasp the content.

If all modules are shown throughout the duration of a course, the sequencing is important to build knowledge and understanding. The Bridge Composition module reviews bridge materials commonly used in Canada, and touches on different types of structures e.g. temporary modular bridges, culverts. Bridge Components builds on composition and increases technical knowledge of the parts of structures. The information from the Composition and Components modules gives students prerequisite knowledge to explore and understand material defects. The Safety module is placed prior to Inspections and Maintenance to explain key concepts and then allow students to see it subsequently role modeled. Consequences of Neglect was placed at the end as it reinforces everything learned in the previous modules and highlights their role in the big picture of their employer's operations.

2019 Video screen shot

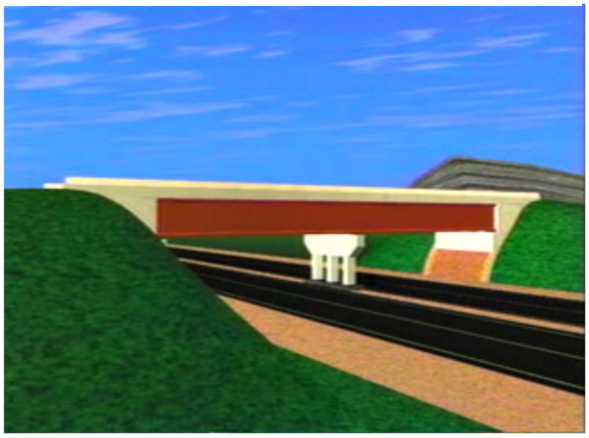
Appealing to Different Learner Styles

It's well known that using a variety of instructional methods increases students' enjoyment of a course by appealing to their preferred learning method (Morrison, Ross, Kalman, & Kemp, 2013, p. 54). Videos are a good way to appeal to visual and auditory learners, with the added appeal that the content is always consistently delivered as intended. By keeping each video succinct and concise, the length of each video fits well with current digital learning trends.

2019 Drone footage

To enhance the experience for visual learners, we used a high-resolution camera. To get unique aerial shots at interesting angles, a drone was used.

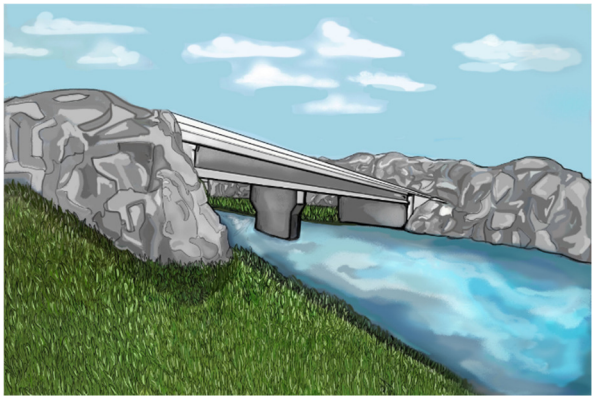
The bridge animations have been updated to make them contemporary, realistic, and more accurately demonstrate key concepts.



1994 Animation screen shot

To the right is a sample of the graphics previously used for the animation. By current standards, the resolution was poor, and the variety of vibrant colours pulls the eye across the screen in a distracting way. Overall, the look is dated and feels computer generated.

The updated graphic is timeless and shows the bridge at an angle to improve the aesthetic. The image is softer with the dark lines of the bridge bringing more focus on the subject matter. The road below the bridge was changed to water to remove distractions and inconsistencies in the previous bridge illustration.



2019 Animation screen shot

For auditory learners, we used technology that provides crisp sound without distracting background noise. Background sound effects were specifically incorporated in certain segments, such as welding and demonstrating delamination surveys of concrete, to help students immerse themselves in the content.

Focus on Safety

The Safety module script was updated to include content beyond a checklist of tasks to be completed. Key modifications included:

- Changed the language from putting an onus for safety on supervisors to highlight the need of everyone to create a safe workplace
- Added information about Ontario's *Occupational Health & Safety Act* and workers' right to know, participate, and refuse unsafe work
- Updated the content to include safety considerations before arriving at the site
- Expanded safety training to be consistent with current requirements
- Removed content with any safety practices that are no longer used.

2019 Video – work zone control

2019 Video – safety harness check

The focus on changing to a safety mindset extended to the visuals:

- Throughout the video, maintenance and inspection personnel are wearing the required high visibility personal protective clothing in compliance with the CSA Z96.15 standard.
- Included footage of a worker ensuring she is wearing all of her personal protective equipment before leaving her vehicle and entering the work site
- The first aid kit is now shown as being easily accessible and complete to current requirements
- Added images of modern safety equipment e.g. harnesses
- Throughout the video, removed any clips demonstrating unsafe behaviour e.g. children climbing on rails

1994 Video with unsafe behaviours at the side of the bridge

Payoff or Benefits Achieved

As the production of the video will be finalized in January 2020, its payoff or benefits haven't yet been realized.

It is the desire of OGRA that this video will improve the quality of training. This increased quality of training will hopefully translate into students more easily grasping the information presented in the course, increased enjoyment of the learning process, and an overall positive experience.

Contribution to Improved Practices, Skill Sets, and the Overall Transportation Community

Domains of Learning

The purpose of this video is to support cognitive domain learning. Following Bloom's taxonomy of cognitive objectives (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956), it is our desire that the video will take students beyond knowledge and offer increased comprehension. The video, used in conjunction with field trips and class discussion, provides the opportunity to increase cognitive objectives related to application, analysis, and evaluation.

In the psychomotor domain (Heinich, Molenda, & Russell, 1993), on field trips students should be able to demonstrate wearing appropriate personal protective equipment and engage in safe behaviour.

An objective that goes beyond performance in the classroom and is difficult to evaluate, is if the video can assist with learning in the affective domain i.e. changing attitudes or feelings (Krathwohl, Bloom, & Masia, 1964). The team of industry experts updating the script were conscientious about emphasizing safety and making students understand the vital role they play in maintaining the lifespan of infrastructure. At a minimum, students will leave the course with an increased awareness of the need for everyone to contribute towards a safe workplace and the importance of bridge inspection and maintenance.

Subject Matter Experts

To create a top quality, technically accurate product, OGRA recruited assistance from industry subject matter experts who teach OGRA courses and are leaders in their organizations – 407 ETR, GHD Limited, and the Town of Innisfil. Between them, these industry experts brought over a century of experience.

Thanks to these experts, the content was reviewed to ensure technical accuracy and consistency with the Ontario Structure Inspection Manual. The script and video content were reviewed and debated at length to ensure the information is practical and reflects modern standards and practices that can realistically be used post course. More importantly, thanks to their expertise the footage was updated to demonstrate the best safety practices to reinforce the important role safety plays in all bridge inspection and maintenance activities.

Technology

Throughout the video, the use of modern technology and devices were shown, such as iPads. Thanks to our subject matter experts and their generous employers, we were able to include video footage of specialized equipment in use such as a Bridgemaster truck.

2019 Video – incorporating modern practices

Diversity

In reviewing the old video, it was quickly noted that people shown do not reflect today's diverse workforce. To rectify this, we selected both a female and male host to present the information. We also ensured a variety of different ethnic backgrounds were represented in the video, using people who are all currently employed in the infrastructure industry.

2019 Video – incorporating modern machinery

Accessible Learning

The majority of OGRA's courses either take place in Guelph (Road School) or Mississauga. As an association striving to provide training and professional development opportunities to Ontario municipal staff, geography can be an issue due to factors such as the travel time and travel expenses. We are exploring options to make our courses easier to attend e.g. Contact North, blended learning, e-learning. As we proceed, we need to balance access with a positive learning experience, effective transfer of knowledge and skills, and the value of networking and learning from peers. The technical specifications of this video e.g. resolution, aspect ratio, closed captioning; provide OGRA with a high-quality tool to enhance learning regardless of the delivery method(s) we use in the future.

2019 Video Host – Meredith Goodwin

2019 Video Host – David Gagné

Lessons Learned

Staff changes at OGRA over the past few years has resulted in a loss of corporate memory when it comes to video production. The remaking of the Bridge Inspection & Maintenance video provided an excellent opportunity to rebuild this knowledge through the project's successes and challenges.

What worked well:

- Using Bare Bones Marketing to manage the project. This project seemingly had a million moving parts and felt like an overwhelmingly gargantuan task. Suzanne Lynch, Owner, was fun to work with and was dedicated to ensuring a high-quality product that meets our needs. This included a leading role working with the subject matter experts to update the script, and her willingness to change the scope of the project a couple of times to allow for considerable script changes, reorganizing the content, and adding closed captioning near the end of the project. Suzanne has a network of production experts who are true artists. As an added bonus, Suzanne was already familiar with OGRA staff and operations thanks to her tenure covering a maternity leave.
- Having a small committee of subject matter experts. Four subject matter experts provided us with different perspectives, while still being a manageable group that allowed for interaction and exchange of information.
- Our specific group of subject matter experts. Not only were Tony Angelo, Dennis Baxter, David Gagné, and Meredith Goodwin knowledgeable, but also keen to do everything in their power to make the project succeed. The project was able to stay on schedule thanks to their willingness to make time for emails, meetings, and film shoots. The volunteer committee was a delight to work with.

Changes for next time:

- More accurate budgeting. I had no idea where to start or who to approach about production when I budgeted for this project. As a result, my project budget fell significantly short of our needs and the project was only able to proceed thanks to contributions made by 407 ETR and GHD Limited.
- More time to determine what we want. At the project onset we thought the script and video only required minor updates. We intended to make a few edits to the original script and replicate the original shots in the same order. For our next project I will do more work with the subject matter experts reviewing the script at the start of the project, before bringing in Bare Bone Marketing with the goal of reducing or eliminating major changes to the story board.

Sample Video

A sample of the video is available for the committee to view:

https://vimeo.com/user13559001/review/387562047/9fd2d6064f

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