Problem Statement and Goals
MTOBridge

Team 15, Alpha Software Solutions
Badawy, Adham
Yazdinia, Pedram
Jandric, David
Vakili, Farzad
Vezina, Victor
Chiu, Darren

Table 1: Revision History

Date	Developer(s)	Change
9/22/2022	Pedram Yazdinida	First Draft
9/24/2022	Pedram Yazdinida	First Revision
9/25/2022	Pedram Yazdinida	Second Revision
9/25/2022	Adham Badawy	Final Revision

1 Problem Statement

1.1 Background

For years, Bridge engineers in Ontario have based their bridge analysis on the Canadian Highway Bridge Design Code (CHBDC) (CSA S6-19) which typically features conservatism and adds excessive costs. With the development of refined methods of analysis, engineers can precisely determine the properties and constraints of the proposed design. Nevertheless, the new methods of analysis have yet to be offered within a one-stop program with an intuitive and simple UX. Using refined methods of analysis to precisely determine the load-carrying capacity of bridge members would allow bridge engineers to make well-informed decisions on bridge repair and load posting as well.

1.2 Problem

As part of a direct collaboration with The Ontario Ministry of Transport, the proposed solution will take advantage of the refined methods of analysis developed by the Department of Civil Engineering to create a full-fledged application that can easily elevate the computations done by Bridge Engineers. MTOBridge will package the existing engine written in MATLAB with modern interactive User Interface (UI), well-defined Input/Output (I/O), and standard bridge section Database. The program will allow engineers to intuitively input their specifications on load, material, geometry, and prestress where the engine is then used to solve for variables on ultimate flexure, shear and torsion. The user will have the ability to switch between the refined and traditional methods of analysis, visualizing the cost savings and improvements across the board. Finally, the output will also include interactive graphs and charts where the user can find further specific information based on a given point.

1.3 Inputs and Outputs

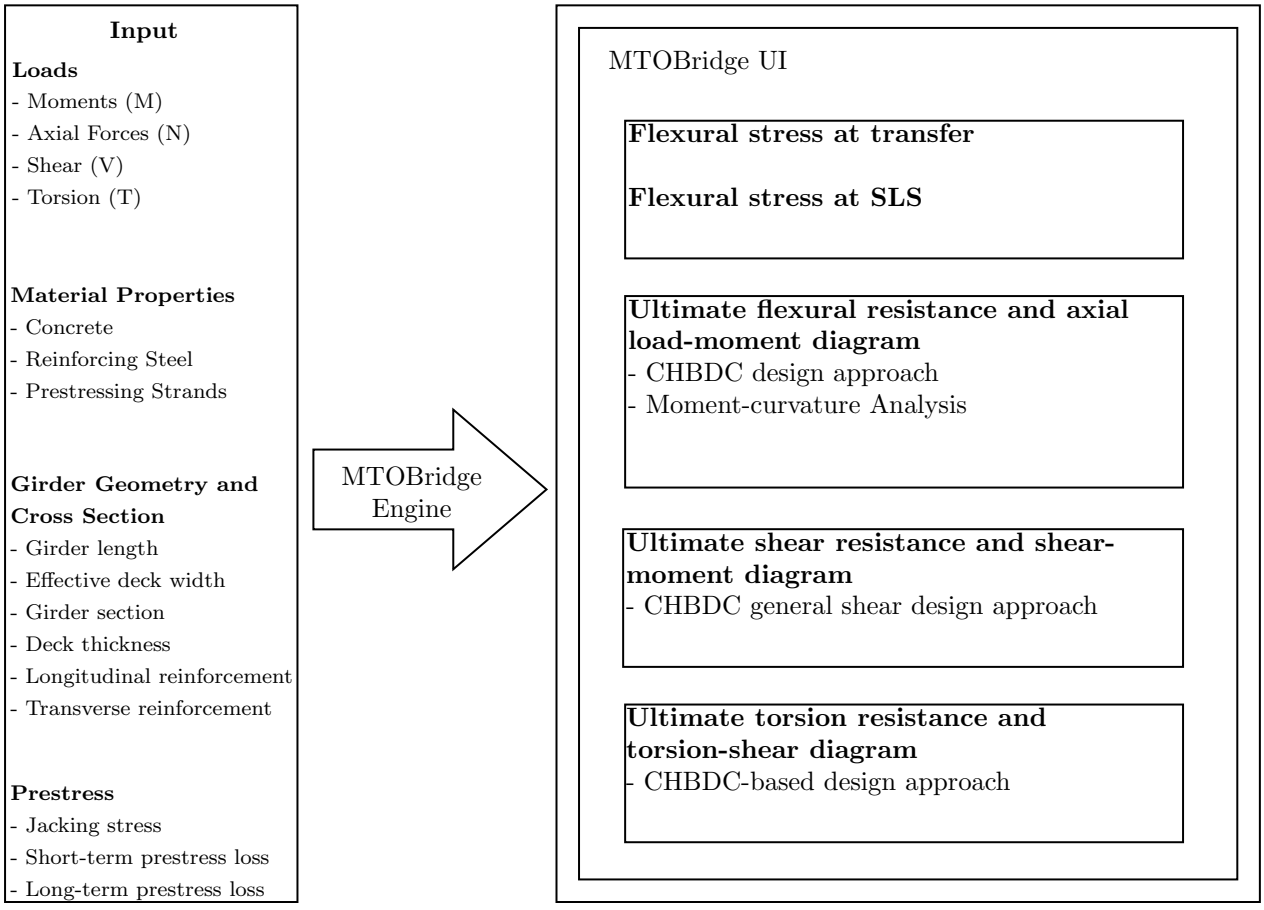

Figure 1: **MTOBridge Data Flow**

1.4 Stakeholders

- Ontario Ministry of Transport
  - The proposed program will be primarily used by Engineers within The Ontario Minstry of Transport.
- Department of Civil Engineering, McMaster
  - The proposed program will be directly developed in collaboration with The Department of Civil Eningeering.
- Department of Computing and Software, McMaster
  - The proposed program will be directly developed by Engineers from The Department of Computing and Software.

1.5 Environment

- Compatible with the latest Windows 10 versions (20H1+)
- Fully operational offline
- Requires C++ GNU compiler

2 Goals

2.1 Interactive UI

The User Interface for MTOBridge will be designed from the scratch using the latest design principles to deliver an intuitive and simple experience. The UI will have a special focus on the extensive data entry, employing various design tools for a quick and effortless data entry.

2.2 Ease of Use

Developing a Windows application allows for high portability and accessibility. When developed MTOBridge will offer a one-stop solution for Engineers to enter, compute and visualize their data without the need for switching between different applications.

2.3 Graphic Output

In addition to a streamlined input entry, MTOBridge will rely upon various visualization tools to draw the results of the calculations. This will include various interconnected graphs and charts which will provide detailed information on specific input points.

2.4 Cost Savings

At the heart of MTOBridge lies the computational models that refine the current methods of bridge analysis. Bundled with the interactive UI, streamlined I/O and efficient database, our frontend will enhance these cost savings through efficiency, portability and convenience.

2.5 Visualizing the Improvements

As one of the unique features of our program, MTOBridge will have the ability to rely upon both traditional as well as refined methods of analysis to calculate the output. It will then allow the user to view and observe both results in a visual context where they can make a better decision.

3 Stretch Goals

3.1 in-App Sketch Function

The bridge cross section is a crucial input for any analysis method. In its initial phase, the user will have the ability to select one of preloaded cross-sections that have been verified by the domain experts. In the next phases, we will develop an in-app sketch functionality that will allow the user to draw out their desired cross-section under certain guidelines.

3.2 Customizable UI

While the current computational models are much better than the traditional ones, we believe that this a continuous process and there will be more, and better models developed in the near future. To address this issue, we aim to develop a customizable UI that can accommodate similar models with little effort in a plug-and-play manner.