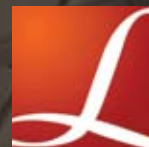


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LARSA, Inc.
105 Maxess Road
Melville | New York | 11747
1-212-736-4326
www.larsa4d.com

LARSA4D

AASHTO LRFD STEEL GIRDER BRIDGE
ANALYSIS & DESIGN

STEEL PLATE GIRDER BRIDGE MODULE

The **Steel Plate Girder Bridge Module** is a new tool for AASHTO LRFD analysis and design of steel girder bridges. The tool integrates model generation based on a series of component based questions, influence line and surface live load analysis on construction stages, and full code check reports.

MODEL GENERATION

The module creates curved, straight and skewed 3D finite element models from basic parameters, such as span lengths, number of girders, transverse stiffener locations, and deck dimensions with no limitation on the number of spans and girders. Four girder types are supported:

- Steel Plate I-Girder modeled as a single beam element. The beam element represents the web and flanges.
- Steel Plate I-Girder modeled as a composition of plate elements for the web and beam elements for the flanges.
- Steel Plate Box (Closed Top) Girder modeled as a single beam element.
- Steel Plate Tub (Open Top) Girder modeled as a single beam element.

The deck is modeled using plate elements.

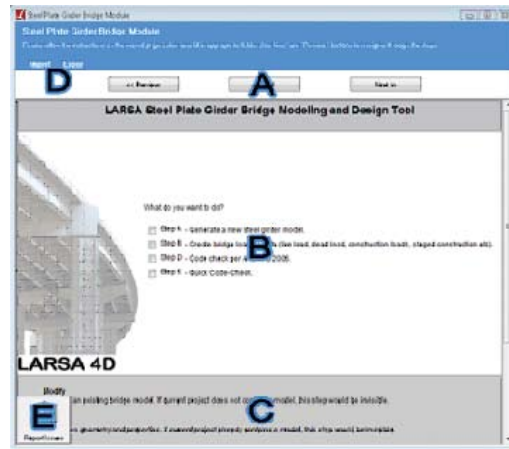
LARSA 4D's advanced **bridge path coordinate systems** simplify the geometry of curved bridge models. Horizontal and vertical alignments of curved bridges are used both for creating and editing the model. Geometry and results can be edited in "station-elevation-offset" coordinates that follow the curved path of the bridge, instead of straight "x-y-z".

BRIDGE CONSTRUCTION

The module generates roadway (lane) definitions, load cases for dead, live, and wind loading, staged construction analysis stages and steps, result combinations and envelopes according to AASHTO LRFD.

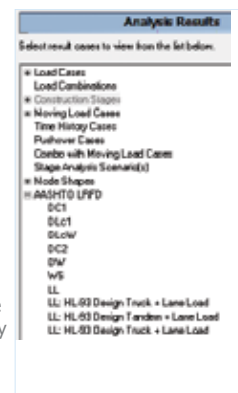
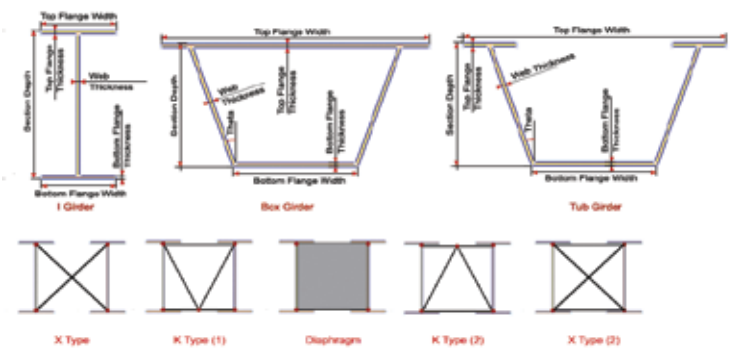
The staged construction analysis models the construction of the bridge in a sequence of steps:

- DC1: Construct girders/cross-frames, apply self-weight, then deck weight. Apply temporary construction loads.
- WS: Apply wind loads first in the positive direction, then in the negative direction.
- DC2: Construct the deck and apply additional load.
- DW: Apply additional loads.



Anatomy of the module:
 [A] Navigation buttons to advance or back track through the steps.
 [B] At each step the module will need you to input certain information.
 [C] Information specific to each step can be found at the bottom of the page.
 [D] All your input to the module can be exported to a file for external use
 [E] The "Report Issues" button can be used to seek help from our support team.

Information the module needs to create code based loading and staged construction data for the bridge.



Visual aids help you with the process. Diagram can be seen by clicking the "More Info" certain elements

The results of each loading condition and combination are reported so that they can be verified.

AASHTO LRFD code check can be used on models created with the module's model generator or on custom models created with **LARSA 4D**.

CODE CHECK

While the model generation component of the Steel Plate Girder Bridge Module can be used to rapidly create a *LARSA 4D* model, the module can also code check a model created independently. Elements such as girders and stiffeners are automatically located in the existing model.

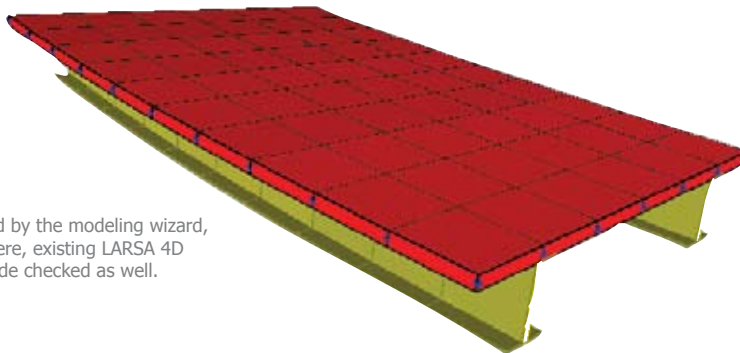
Code checking is based on **AASHTO LRFD 2006 (with 2007 additions)** with detailed reports covering the following components of the code:

- Cross-section proportion limits
- Constructability
- Service limit state
- Strength limit state
- Stiffeners

Members checked include tension, compression and flexural members with symmetrical or unsymmetrical section profiles made of plates as I-girders, box girders and rolled I shapes.

QUICK CODE CHECK

This option performs code check on a particular cross-section along a girder. During the step by step procedure, the user provides the sectional and material properties along with the forces and stresses acting on the section. This eliminates the need for a *LARSA* model to run the code check. This option is ideal for examining the code-check procedure of this module. This process yields a detailed (formula by formula) report on how the code-check is carried out on the cross-section.

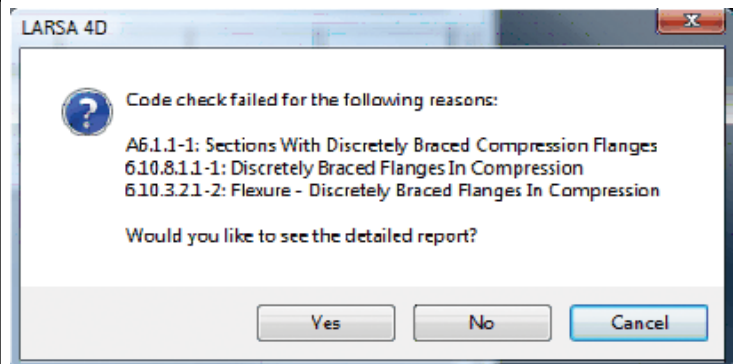
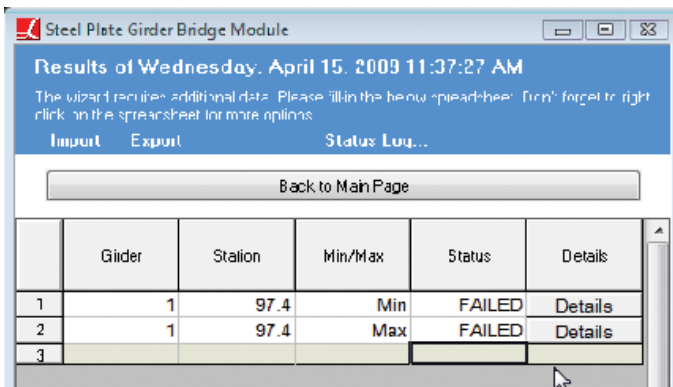


Besides models generated by the modeling wizard, such as the one shown here, existing *LARSA 4D* bridge projects can be code checked as well.

AASHTO LRFD CODE CHECK REPORTS

Reports include overall structure status and detailed member reports at stations along the bridge for factored combinations for static, live load, and staged construction analysis results.

All **equations and values** used in the code check are reported. When a member fails the code check, the exact **section of the code** in which the failure occurred is reported. The report simulates a full manual computation.



The code compliance check is based on LARSA's "4D" analysis engine, accurately considering the effects of curvature, transverse bracing, and time-effects on materials the code check and design process.

4 D ANALYSIS

All of this is integrated within the *LARSA 4D Bridge* application, taking advantage of its "4D" analysis engine, optimized sparse solver, and powerful user interface.

Bridge models are analyzed using the *LARSA 4D* analysis engine, meaning all 3D and torsional effects as well as the locked-in forces of the construction sequence are fully considered. The combination of model generation, code check, and 3D analysis with "4D" time effects in a single application is unique and is what makes the Steel Plate Girder Bridge Module the most appropriate tool for any advanced AASHTO LRFD project.

AN INTEGRATED TOOL

Through its integration with *LARSA 4D*, the user is free to inspect all input and result data and can modify the model prior to code check, **going beyond code-check** requirements as needed. Models created can include superstructure and substructure including foundation elements, such as modeled with *LARSA 4D*'s nonlinear grounded spring elements.

Models can take advantage of *LARSA 4D*'s full **analysis** capabilities, including response spectra, eigenvalue, and time history analysis, and *LARSA*'s other bridge design tools, such as **post-tensioning, ultimate strength check, and macros for program extensibility.**

LIVE LOAD WITH INFLUENCE SURFACES

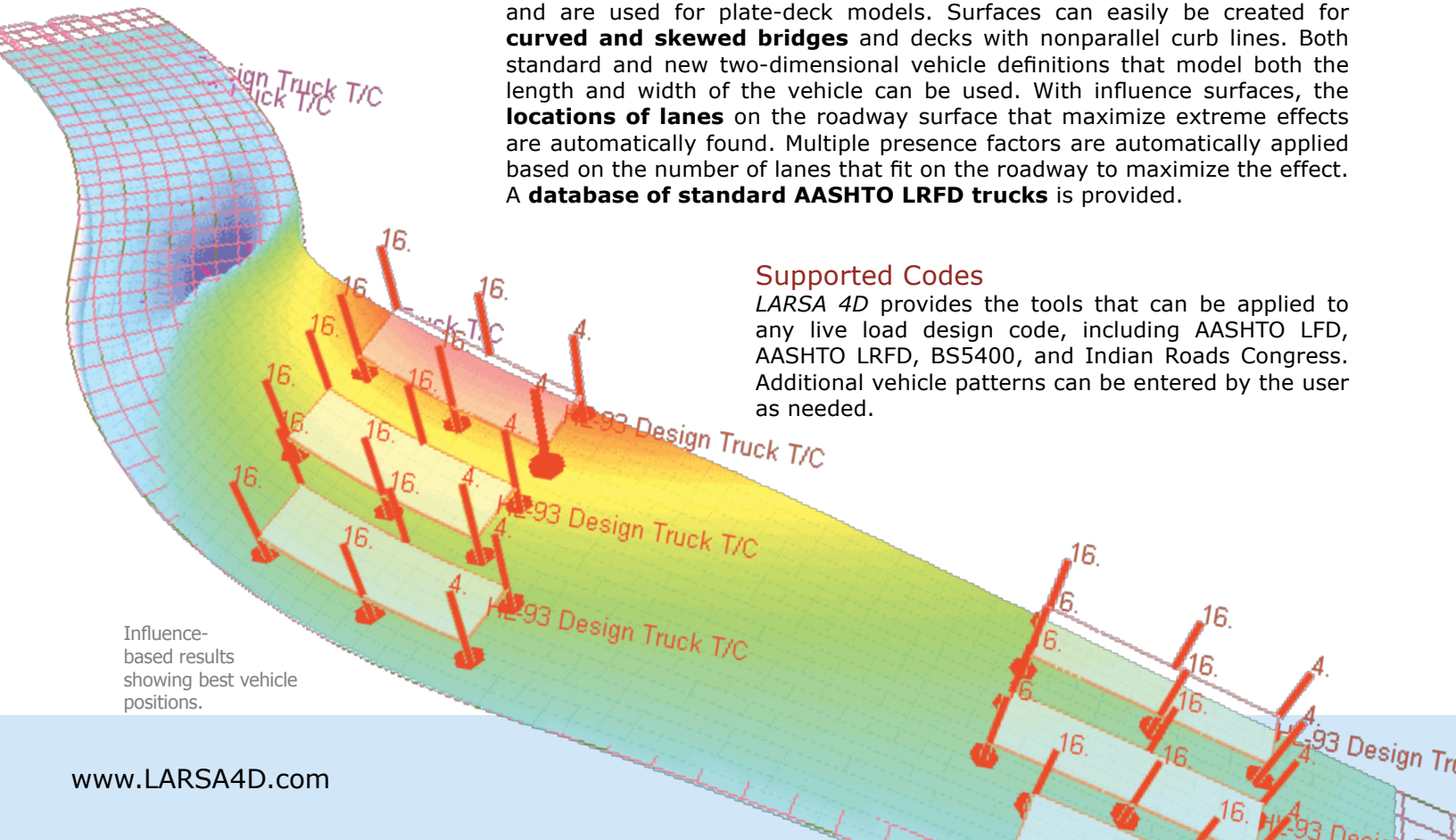
LARSA 4D's influence line & surface analysis finds the worst-case live load scenario by positioning vehicle and uniform lane loads to maximize the effect. In *LARSA 4D*, the engineer need not decide ahead of time which points on the structure he wants influence results for. Once the fast Influence Analysis is run, the most extreme conditions for any point on the structure are computed in real-time as they are needed.

Influence Surfaces

Influence surfaces extend the notion of an influence line onto a 2D surface and are used for plate-deck models. Surfaces can easily be created for **curved and skewed bridges** and decks with nonparallel curb lines. Both standard and new two-dimensional vehicle definitions that model both the length and width of the vehicle can be used. With influence surfaces, the **locations of lanes** on the roadway surface that maximize extreme effects are automatically found. Multiple presence factors are automatically applied based on the number of lanes that fit on the roadway to maximize the effect. A **database of standard AASHTO LRFD trucks** is provided.

Supported Codes

LARSA 4D provides the tools that can be applied to any live load design code, including AASHTO LFD, AASHTO LRFD, BS5400, and Indian Roads Congress. Additional vehicle patterns can be entered by the user as needed.



Influence-based results showing best vehicle positions.