THE INTERNATIONAL BRIDGE CONFERENCE

Photo: 2020 Prize Bridge National Winner – Manning Crevice (Idaho) – Photo Credit: Ken Saindon

LRFD Simon Fundamentals – 10th Edition

Brandon Chavel, PhD, PE - National Steel Bridge Alliance

International Bridge Conference 2026 – Workshop W03

NATIONAL STEEL BRIDGE ALLIANCE NSBA FOUNDED 1995

Smarter.
Stronger.
Steel.

LRFD Simon Fundamentals

Notice on Software Version and Content

- Content reflects the recently released 10th Edition AASHTO LRFD version of LRFD Simon
- Some features discussed may differ from currently released versions
- New or updated capabilities will be clearly identified

LRFD Simon Fundamentals

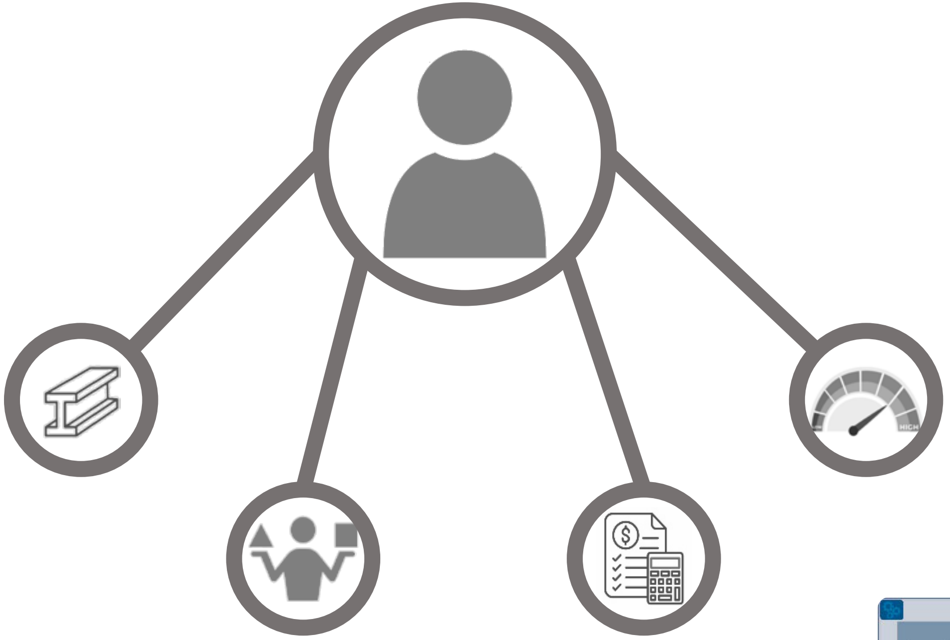
Learning Objectives

- Understand what LRFD Simon is designed to do
- Set up a basic straight girder model
- Run analysis and design with confidence
- Interpret key results
- Understand how to migrate legacy Simon files
- Know where to seek additional information

LRFD Simon Fundamentals

Typical Use Cases

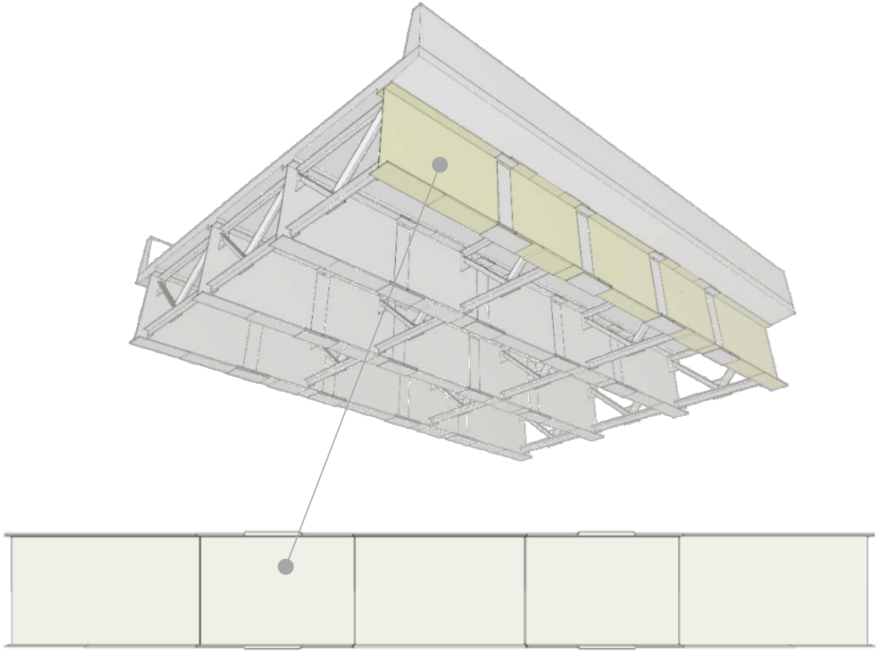
- Early girder sizing
- Comparing alternatives
- Cost and weight estimation
- Sensitivity checks



LRFD Simon Fundamentals

What LRFD Simon Is…

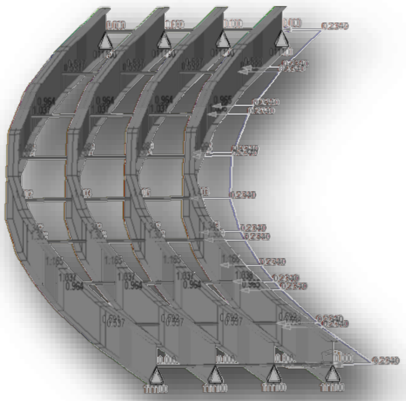
- Line-girder analysis and design tool
- Intended for preliminary bridge design
- Specification-driven and deterministic
- Transparent and engineer-controlled
- Fast and iteration-friendly

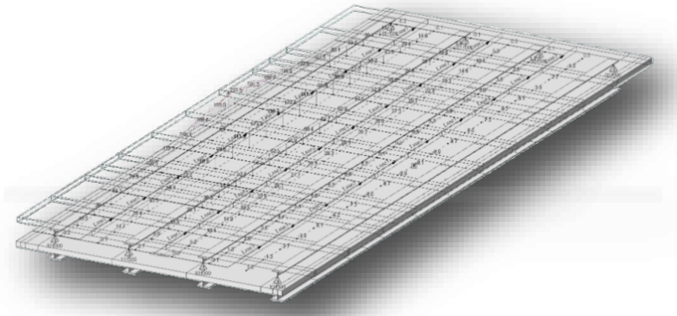


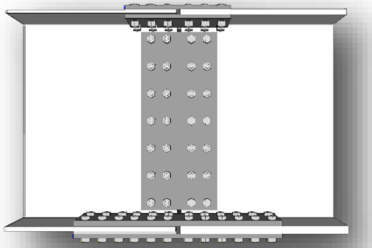
LRFD Simon Fundamentals

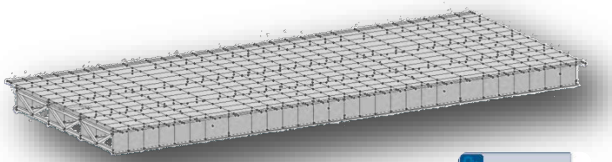
What LRFD Simon Is Not…

- Not a 3D bridge model
- Not for curved bridges
- Not for large skews
- Not for detailing or connections









LRFD Simon Fundamentals

What LRFD Simon Is Not…

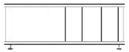
LRFD Simon Fundamentals

Inputs You Can Explore

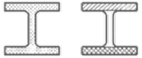
- Simple span or up to 12 continuous spans

- Partial or full-length dead loads

- AASHTO or user-defined live loads



- Stiffened or unstiffened webs



- Homogenous or hybrid cross-sections

- Parabolic or linear web haunches

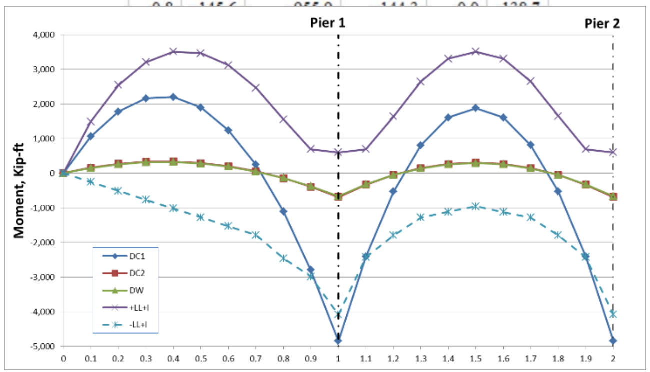
LRFD Simon Fundamentals

Outputs You Can Expect

- Moments/shears at tenth points
- Live load envelopes
- Deflections
- Performance ratios for all limit states
- Stiffener & shear connector design
- Bill of materials with estimated costs
- Automatically generated “best design” input file

Span: 1

Point	Girder	Other DC1	Comp DL	Utility	FWS
0.0	0.0	0.0	0.0	0.0	0.0
0.1	146.0	915.0	160.3	0.0	154.2
0.2	247.8	1534.4	269.7	0.0	259.3
0.3	305.4	1858.3	328.1	0.0	315.5
0.4	315.8	1886.6	335.5	0.0	322.6
0.5	276.0	1619.3	292.0	0.0	280.8
0.6	186.1	1056.5	197.5	0.0	189.9
0.7	45.9	198.1	52.1	0.0	50.1



LRFD Simon Fundamentals

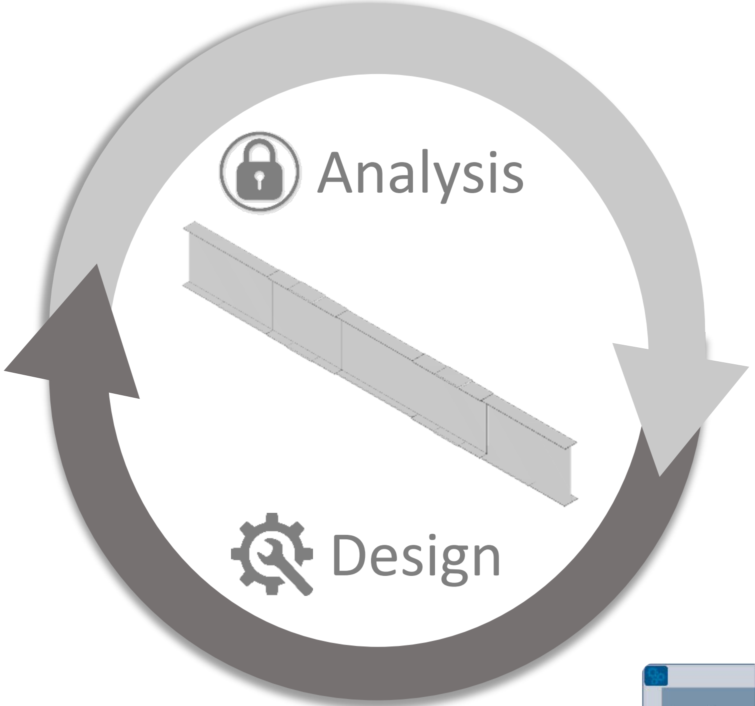
Conceptual Workflow

1. Establish global model context
2. Define load distribution assumptions
3. Apply loads and span-specific information
4. Define girder geometry and detailing
5. Validate the model
6. Run analysis or design
7. Review results and iterate

LRFD Simon Fundamentals

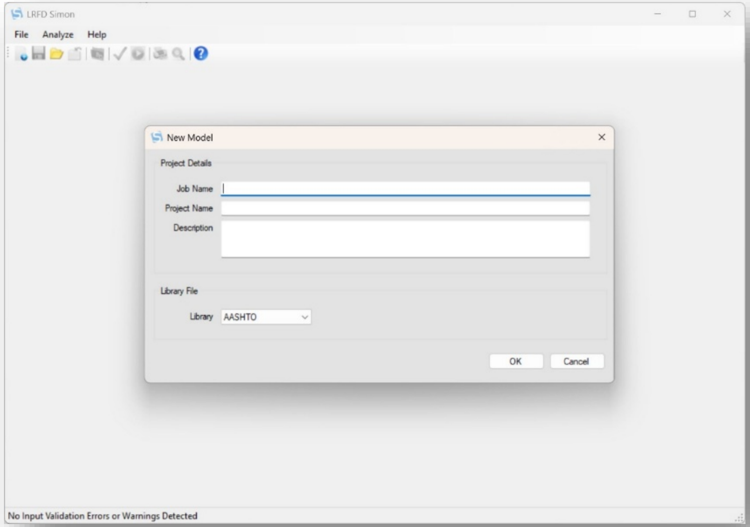
Analysis vs Design

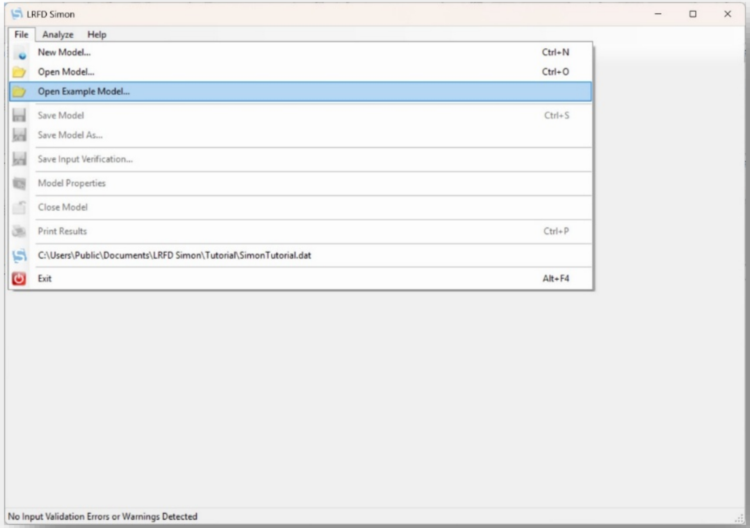
- **Analysis:** evaluates the behavior of a fully defined trial girder
- **Design:** adjusts girder components to satisfy LRFD requirements within user-defined limits
- **Both:** rely on reasonable assumptions and well-defined inputs



LRFD Simon Fundamentals

Two Paths to a Simon Model





New Model

Example Model

LRFD Simon Fundamentals

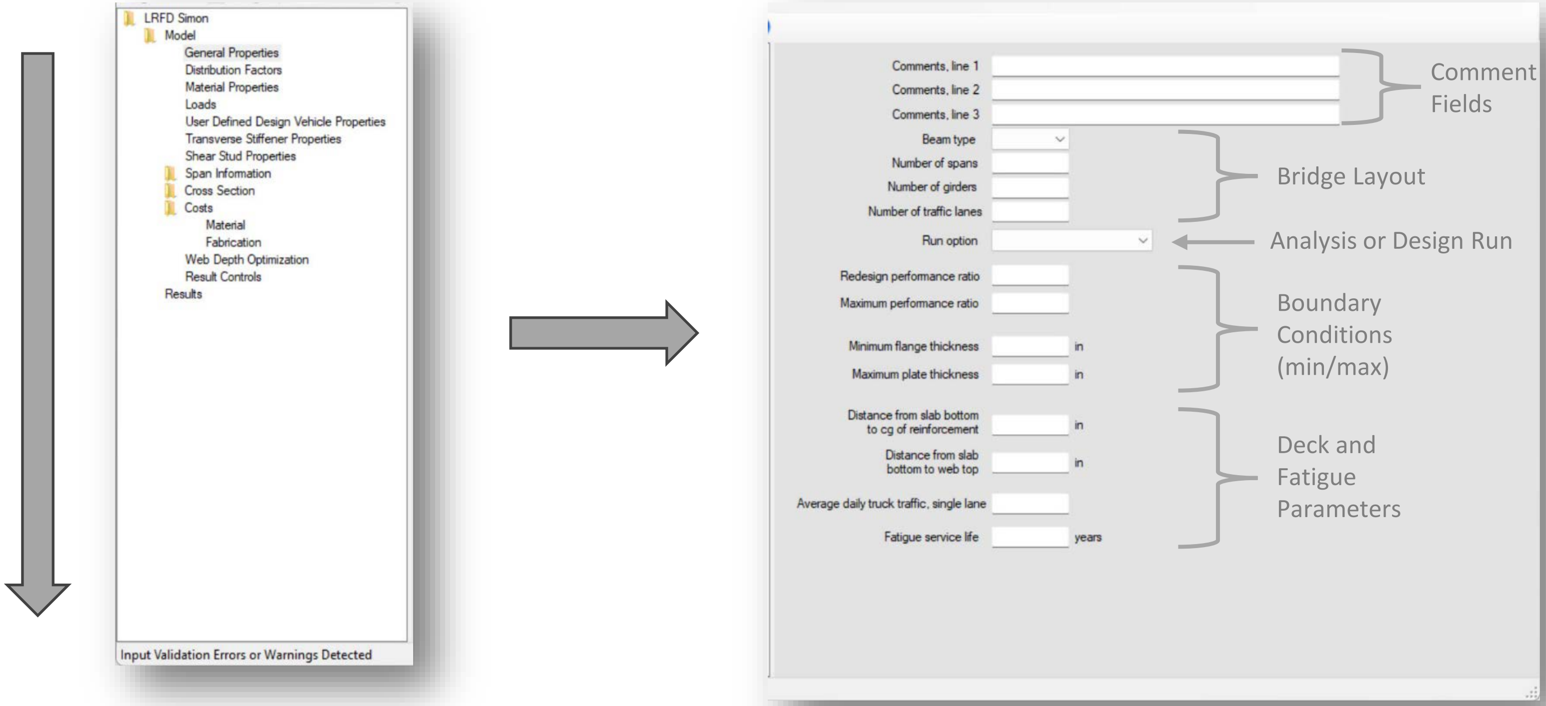
Two Paths to a Simon Model

- 224 example input files included with Simon
- Each corresponds to an NSBA Standard Plan design
- Covers common span, spacing, and length ranges
- Often closely matches real projects

aisc.org/standard-bridge-plans

LRFD Simon Fundamentals

Program Interface Navigation – General Properties

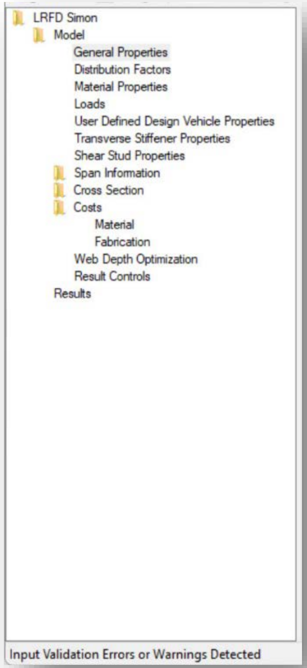


Task Pane

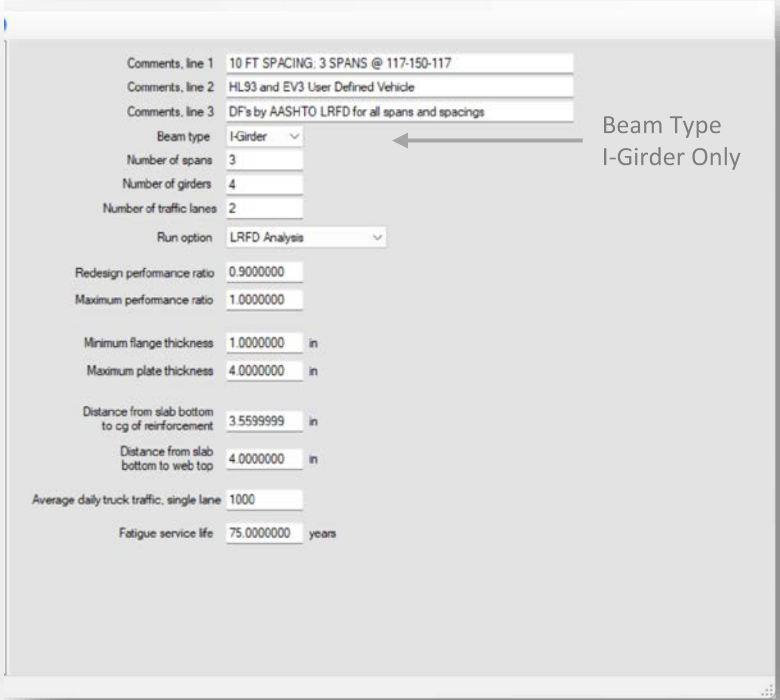
Properties Pane

LRFD Simon Fundamentals

Program Interface Navigation – General Properties (New)



Task Pane

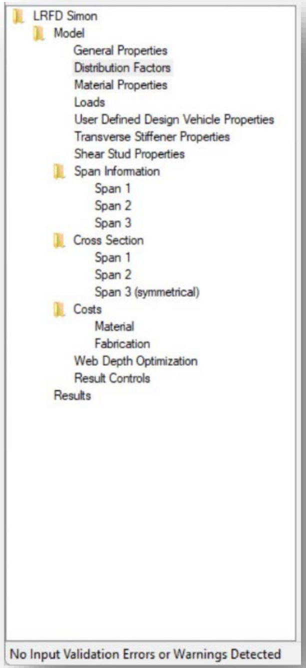


Beam Type
I-Girder Only

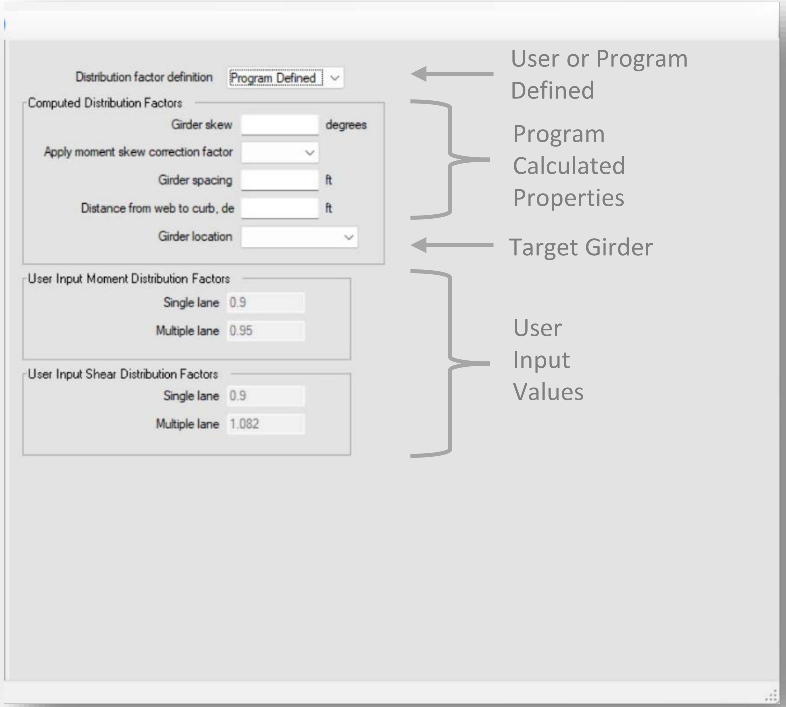
Properties Pane

LRFD Simon Fundamentals

Program Interface Navigation – Distribution Factors



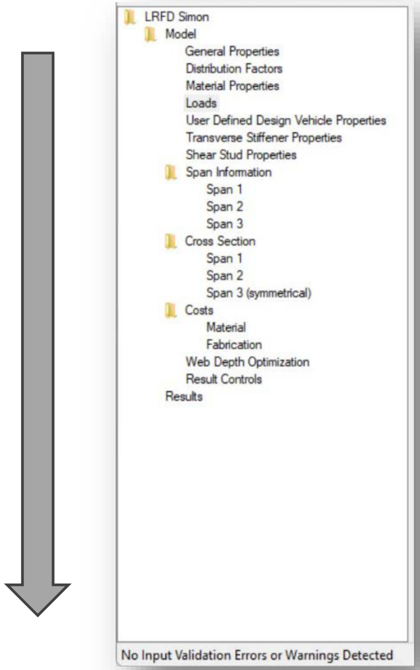
Task Pane



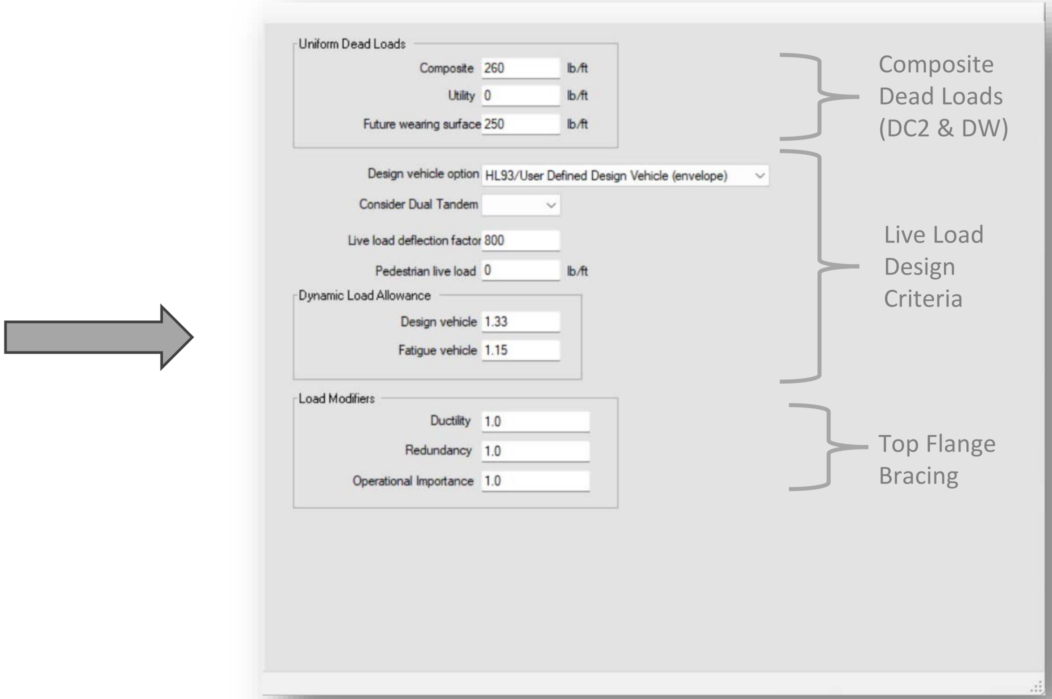
Properties Pane

LRFD Simon Fundamentals

Program Interface Navigation – Loads



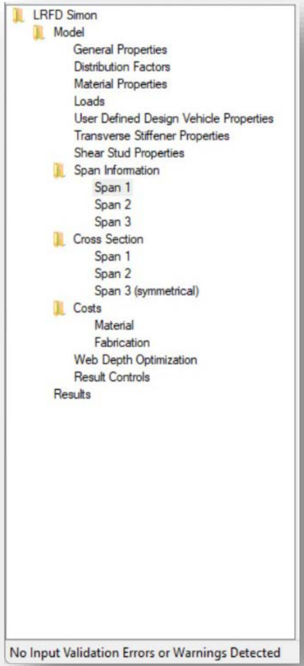
Task Pane



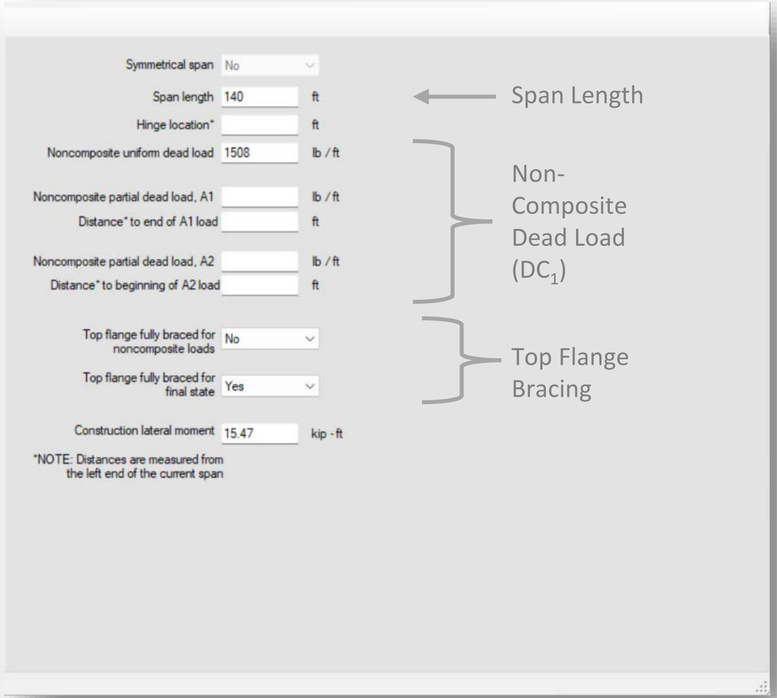
Properties Pane

LRFD Simon Fundamentals

Program Interface Navigation – Span Information



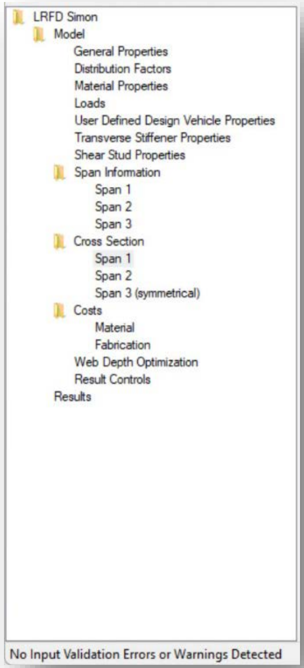
Task Pane



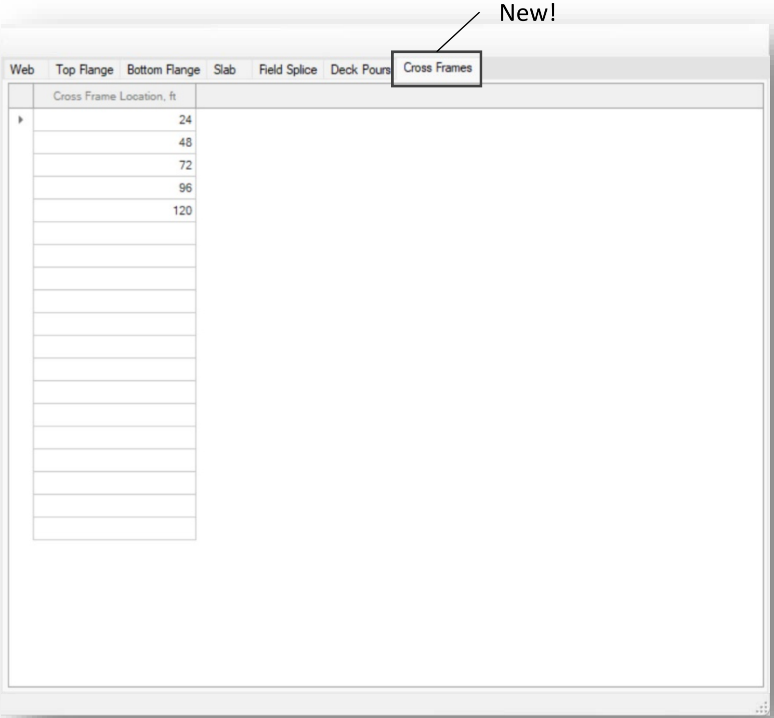
Properties Pane

LRFD Simon Fundamentals

Program Interface Navigation – Cross Section



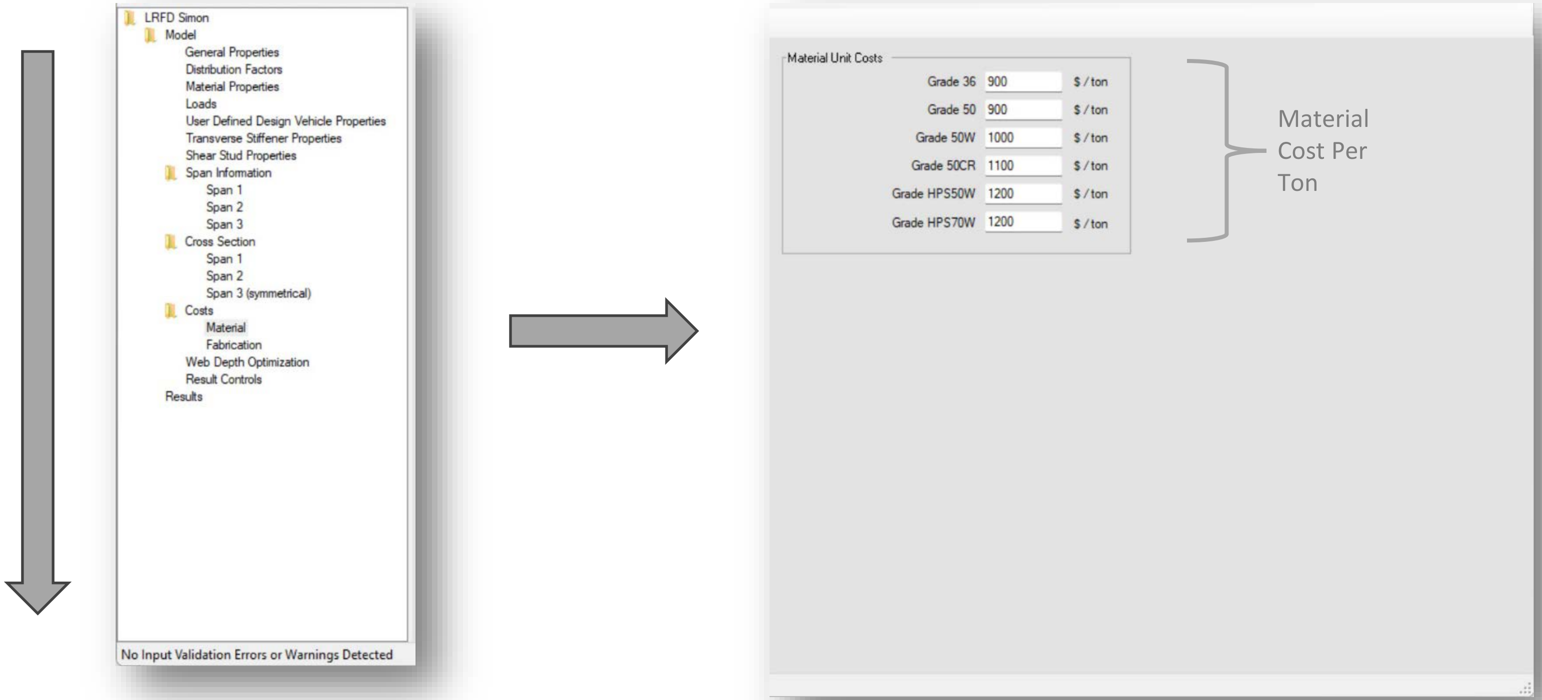
Task Pane



Properties Pane

LRFD Simon Fundamentals

Program Interface Navigation – Unit Costs

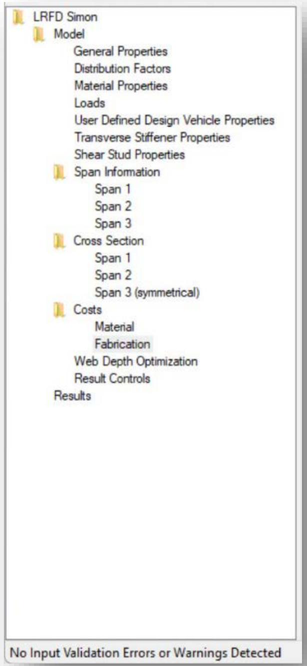


Task Pane

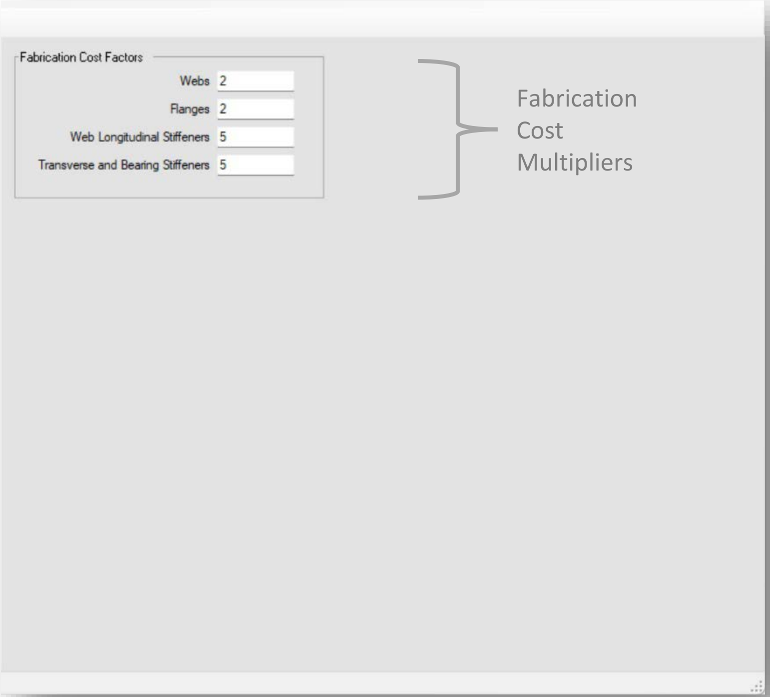
Properties Pane

LRFD Simon Fundamentals

Program Interface Navigation – Unit Costs



Task Pane



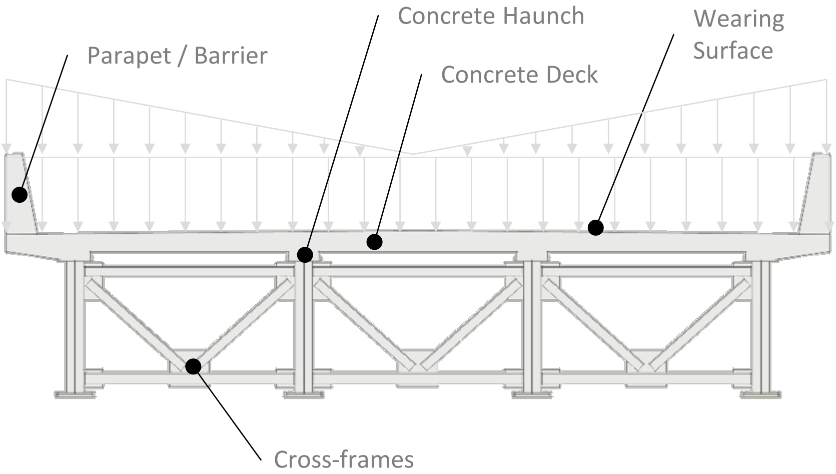
Fabrication Cost Multipliers

Properties Pane

LRFD Simon Fundamentals

Deck, Haunch & Dead Loads

- Dead load is entered in two parts: DC_1 and DC_2
  - Distribute DC_1 loads equally to each girder (vs. tributary area)
  - Assign a reasonable percentage of the DC_2 loads to the exterior girders & the adjacent interior girders
  - Distribute wearing surface DW load equally to all the girders
  - Cross-frame weight must be accounted for.
- Loads are applied along the girder length
- Simon combines loads per AASHTO internally
- Load assumptions directly affect all results



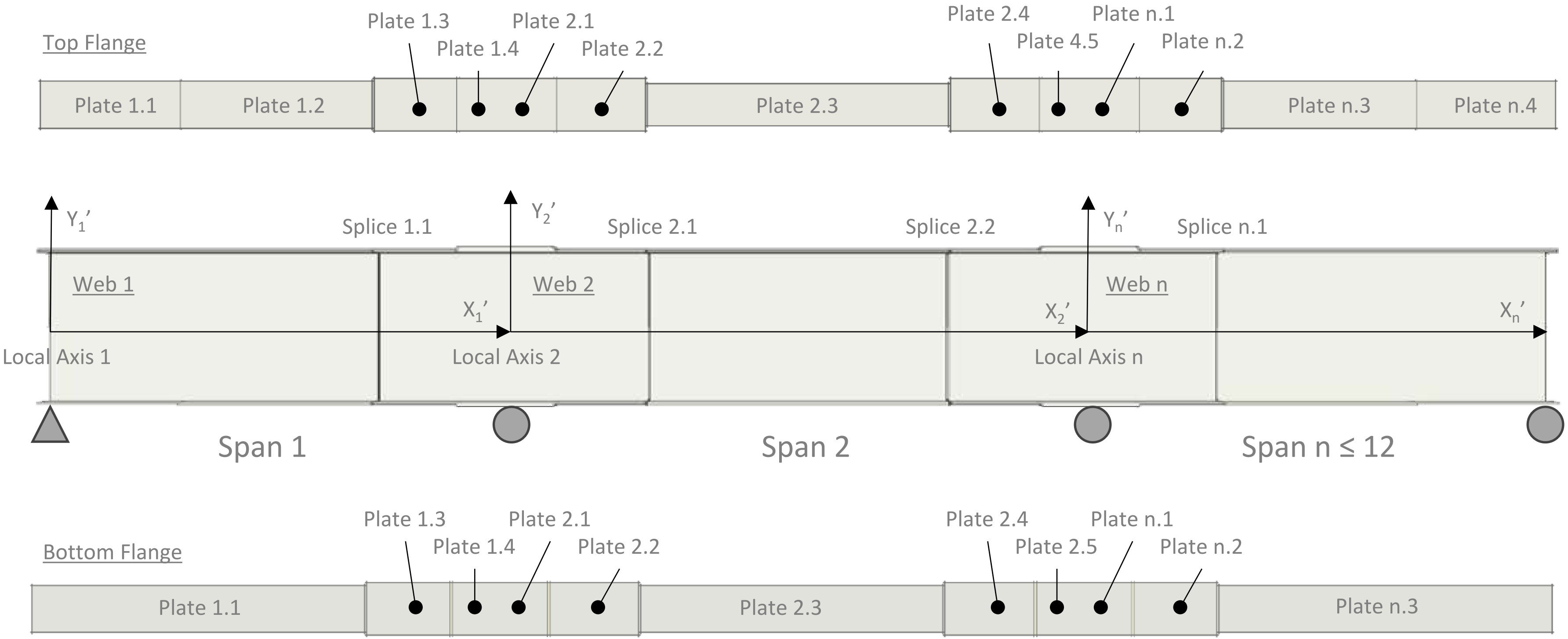
LRFD Simon Fundamentals

Geometry Drives Everything

- Span lengths and continuity
- Girder depth and haunch geometry
- Plate dimensions and cutoff locations
- System continuity assumptions

LRFD Simon Fundamentals

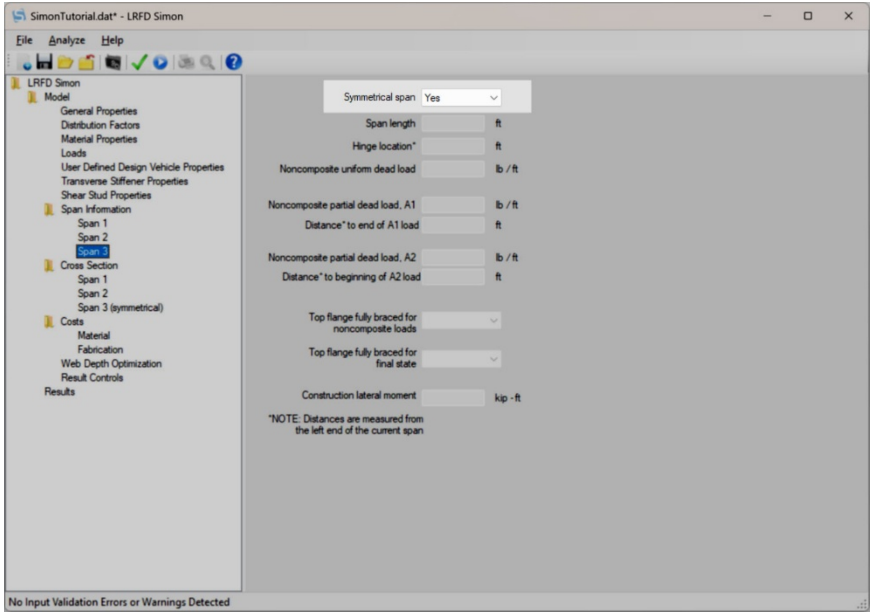
Geometry Drives Everything



LRFD Simon Fundamentals

Symmetrical Spans (Simon's "Easy Button")

- Applicable only for girders symmetrical about the bridge centerline
- Symmetrical Span designation is made on the Span Information Form
- A symmetrical span:
  - Is on the right side of the bridge centerline
  - Mirrors a corresponding span on the left side
- Spans up to and including the center span cannot be designated as symmetrical
- When a span is declared symmetrical:
  - No additional span input is required
  - Simon reduces the amount of output generated
- All non-symmetrical spans require explicit span length input



LRFD Simon Fundamentals

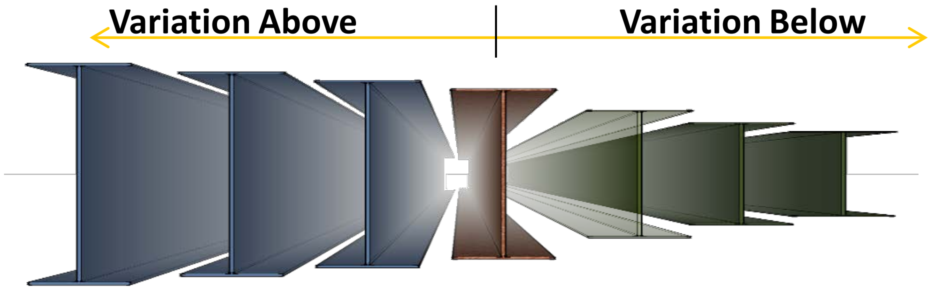
Material Procurement - Plate

aisc.org/plate-availability

LRFD Simon Fundamentals

Web Depth Optimization: When & Why

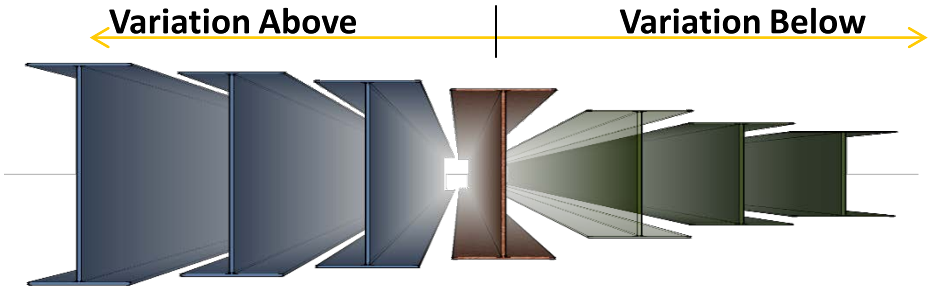
- Automatically generate and run series of trial design input files from a starting design input - that vary only in the web depth.
- Automatic Depth Variation
  - Percentage Based
  - Fixed Value Based
- Summary table created of depth, weight, and cost for each depth



LRFD Simon Fundamentals

Web Depth Optimization: What It Does Not Do

- Does not finalize overall girder design
- Does not replace engineering judgment
- Does not account for fabrication or detailing preferences
- Intended for preliminary exploration, not final selection



SIMON

LRFD Simon Fundamentals

Validation = Run Readiness

- Confirms file completeness and syntax
- Helps prevent execution failures
- Run after major input changes

LRFD Simon Fundamentals

You Are Now Ready to Run

- ✓ General properties and run intent established
- ✓ Loads and distribution assumptions defined
- ✓ Geometry and plate definition completed
- ✓ Design boundaries and options understood
- ✓ Model validated for run readiness

LRFD Simon Fundamentals

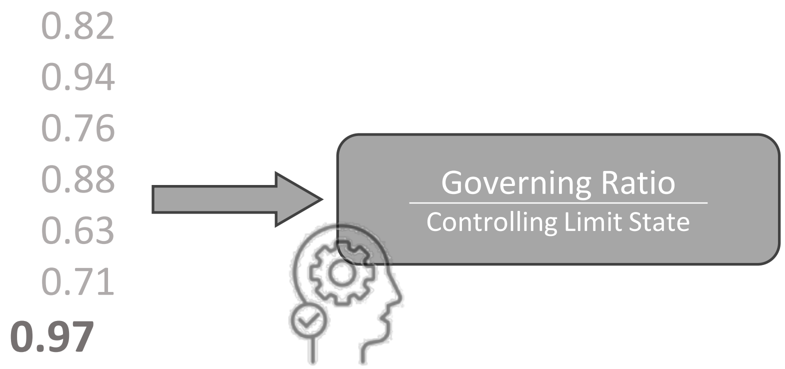
Results to Review First

- Performance ratios
- Final Girder Geometry & Plate Sizes
- Material Quantities
- Cost Summary

LRFD Simon Fundamentals

Performance Ratios

- Performance ratios are reported for many limit states and locations
- A ratio < 1.0 indicates LRFD requirements are satisfied
- The governing ratio identifies the controlling limit state
- Simon reports results — engineers interpret why they control



LRFD Simon Fundamentals

Final Girder Geometry & Plate Sizes

- Final plate dimensions by span and location
- Reflects governing limit states and design bounds
- Represents Simon’s best design for the given inputs
- Starting point for detailing and refinement

LRFD Simon Fundamentals

Material Quantities

- Quantities derived directly from final plate geometry
- Reported by component and span
- Used for comparison, not final estimating
- Feeds Simon’s cost and optimization features

LRFD Simon Fundamentals

Estimated Costs & Unit Cost Influence

- Costs derived from quantities and user-defined unit costs
- Includes material and fabrication cost factors
- Intended for comparison, not bidding
- Helps identify cost-effective alternatives early

LRFD Simon Fundamentals

Migration awareness: Using Legacy Simon Files

- Older files may not meet current LRFD
- New versions require new inputs
- Assumptions change between versions

LRFD Simon Fundamentals

Migration awareness: Minimum Safe Steps for Old Files

- Validate immediately
- Rebuild cross-frame layout
- Run Analysis before Design
- Expect different results

LRFD Simon Fundamentals

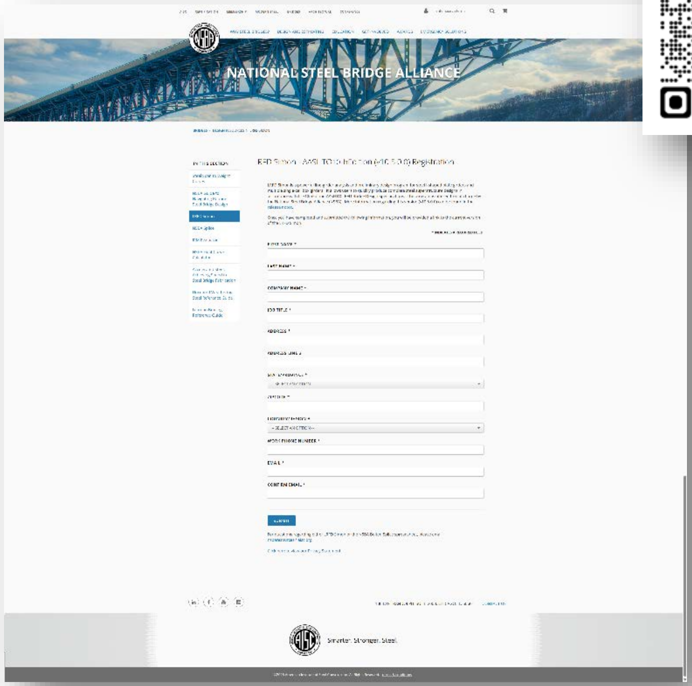
More Information

- LRFD Simon User’s Guide
  - Assumptions
  - Limitations
  - Workflows
  - Tips and Tricks
- AISC Solution Center
  - Questions outside Simon’s scope
  - General design
- NSBA Website

LRFD Simon Fundamentals

More Information

- 10th Edition AASHTO Bridge Design Specification – available now



aisc.org/simon

Assessment Question

Q. Which statement best describes the intended use of LRFD Simon?

A - Final, fabrication-ready girder designs without the need for engineering judgment.

B - Detailed finite element modeling of complex bridge systems.

C - Preliminary analysis and design of steel I-girder bridges and comparison of alternatives.

D - Replace the need for other NSBA design guides and tools.

Assessment Question

Q. What is the primary purpose of the Validation step in LRFD Simon?

A - To confirm the girder meets all LRFD strength and service limit states.

B - To check that the input file is complete and can run without execution errors.

C - To optimize girder geometry for minimum cost.

D - To automatically correct inconsistent inputs.

Assessment Question

Q. Which statement best describes how loads are handled in LRFD Simon?

A - All dead and live loads are applied using tributary areas for each girder.

B - Loads are entered by span and automatically converted into final design forces.

C - Loads are applied along the girder length and combined internally per AASHTO.

D - Simon requires users to manually apply LRFD load combinations.

Photo: 2024 Prize Bridge Merit Award, Medium Span - Rt. 34B over Salmon Creek Bridge – Photo Credit: NYSDOT

Thank you!

Brandon Chavel, PhD, PE
312.805.2137
chavel@aisc.org
www.aisc.org/nsba/

Smarter.
Stronger.
Steel.