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

LRFD Simon Fundamentals – 10th Edition

Christopher Garrell, PE

National Steel Bridge Alliance



Smarter.
Stronger.
Steel.

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LRFD Simon Fundamentals

Notice on Software Version and Content

- Content reflects the upcoming 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
- Release of the updated version is anticipated soon



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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

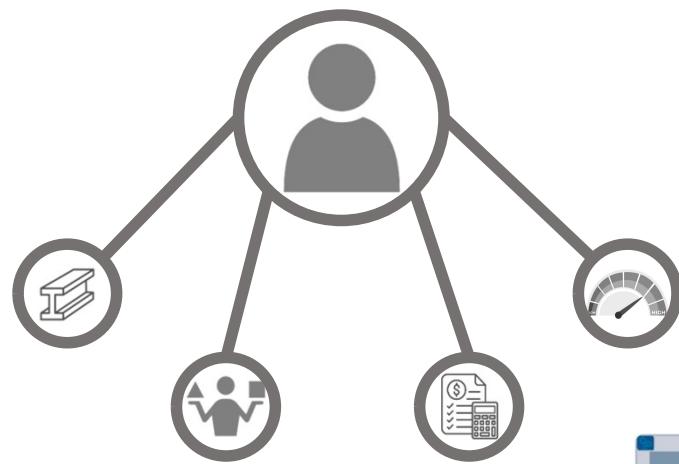


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LRFD Simon Fundamentals

Typical Use Cases

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

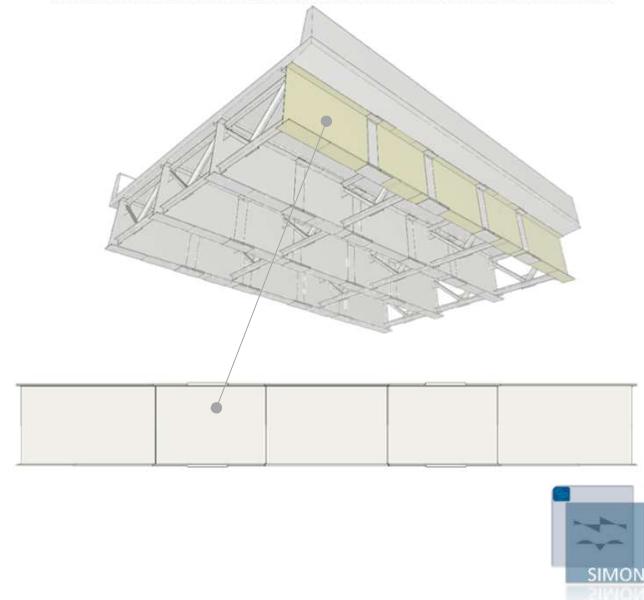


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LRFD Simon Fundamentals

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

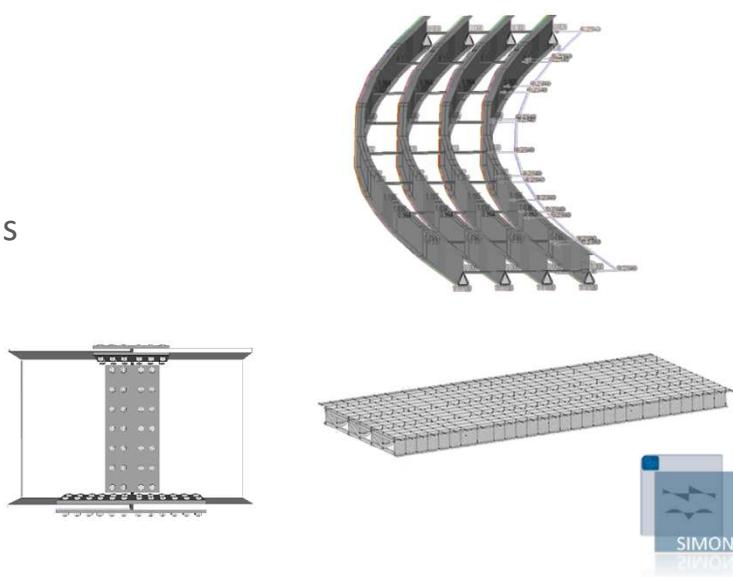


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LRFD Simon Fundamentals

What LRFD Simon Is Not...

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



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LRFD Simon Fundamentals

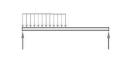
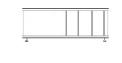
What LRFD Simon Is Not...



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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



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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



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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

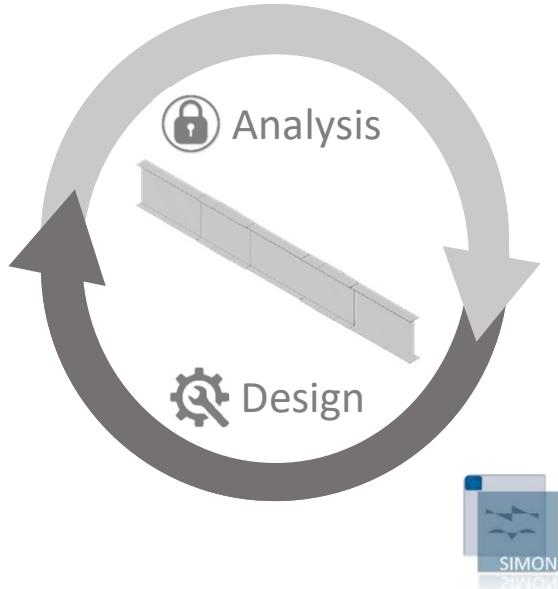


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LRFD Simon Fundamentals

Analysis vs Design

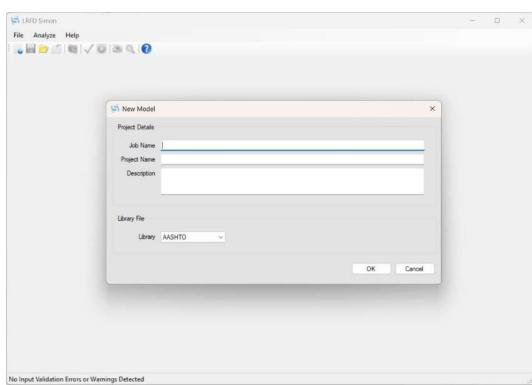
- **Analysis:** evaluates the behavior of a fully defined trial girder
- **Design:** adjusts girder components to satisfy LRFD requirements within user-defined limits
- **Both:** rely on reasonable assumptions and well-defined inputs



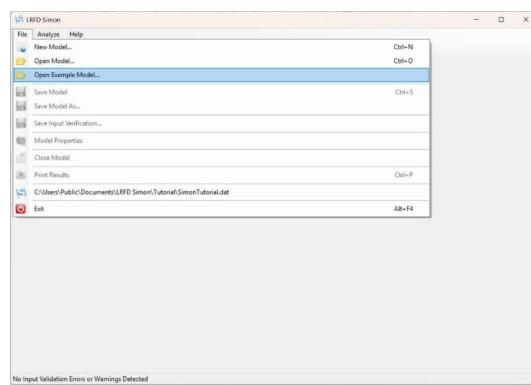
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LRFD Simon Fundamentals

Two Paths to a Simon Model



New Model



Example Model

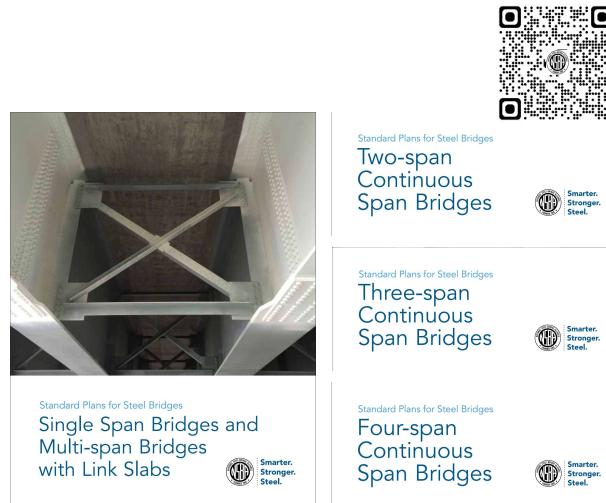


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LRFD Simon Fundamentals

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

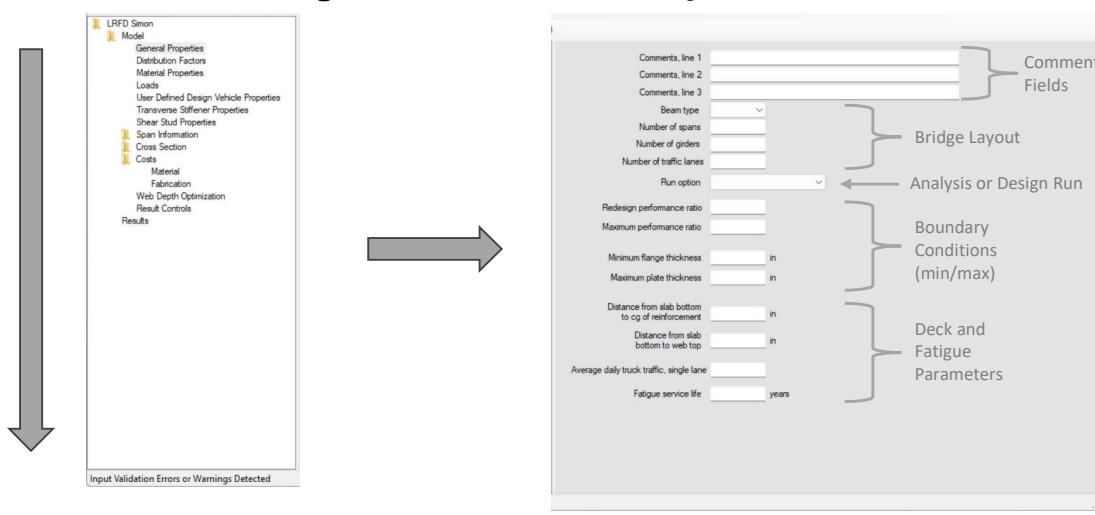


aisc.org/standard-bridge-plans

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LRFD Simon Fundamentals

Program Interface Navigation – General Properties



Task Pane

Properties Pane

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LRFD Simon Fundamentals

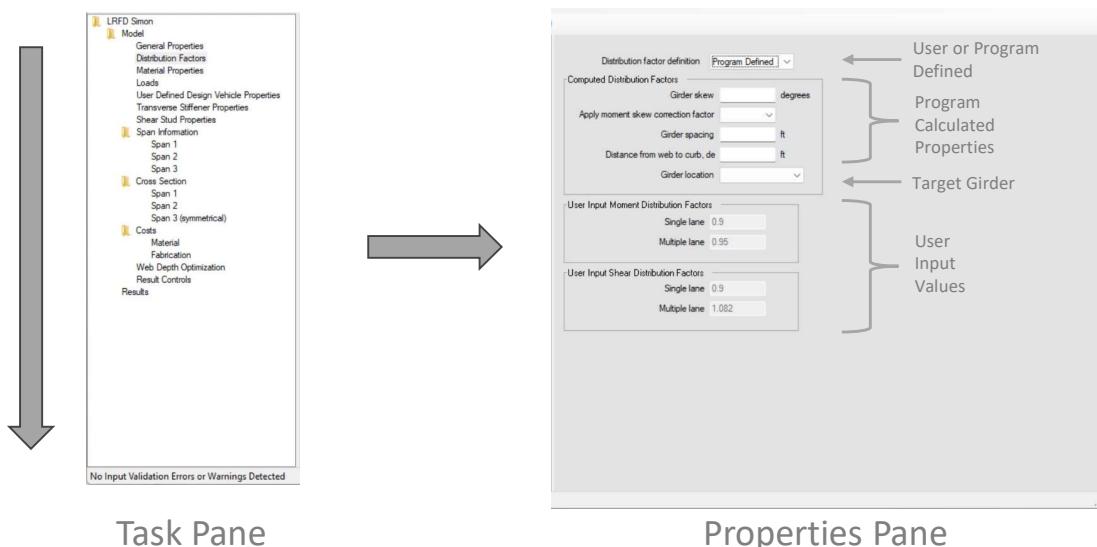
Program Interface Navigation – General Properties (New)



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LRFD Simon Fundamentals

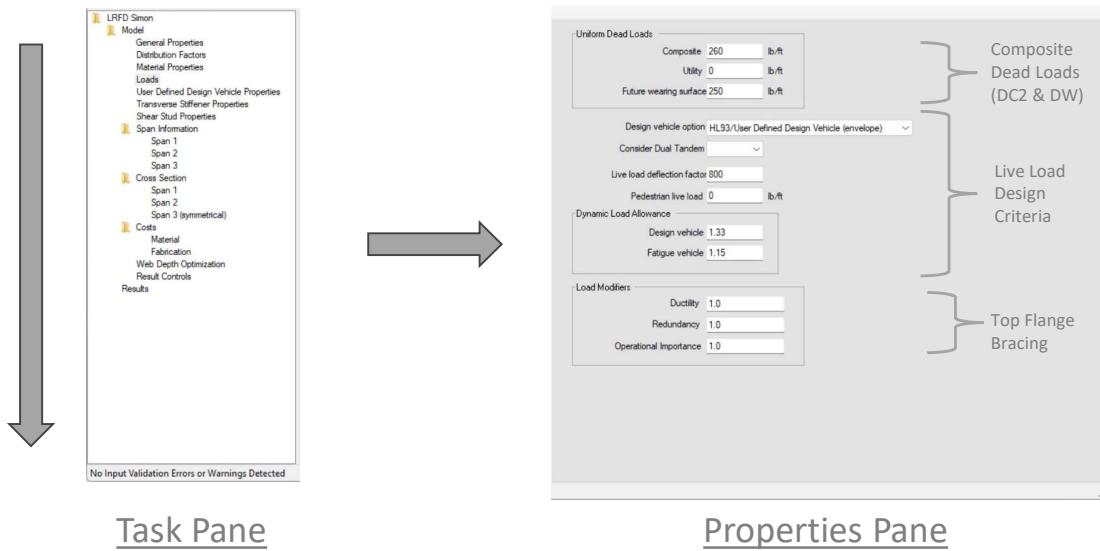
Program Interface Navigation – Distribution Factors



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Program Interface Navigation – Loads



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LRFD Simon Fundamentals

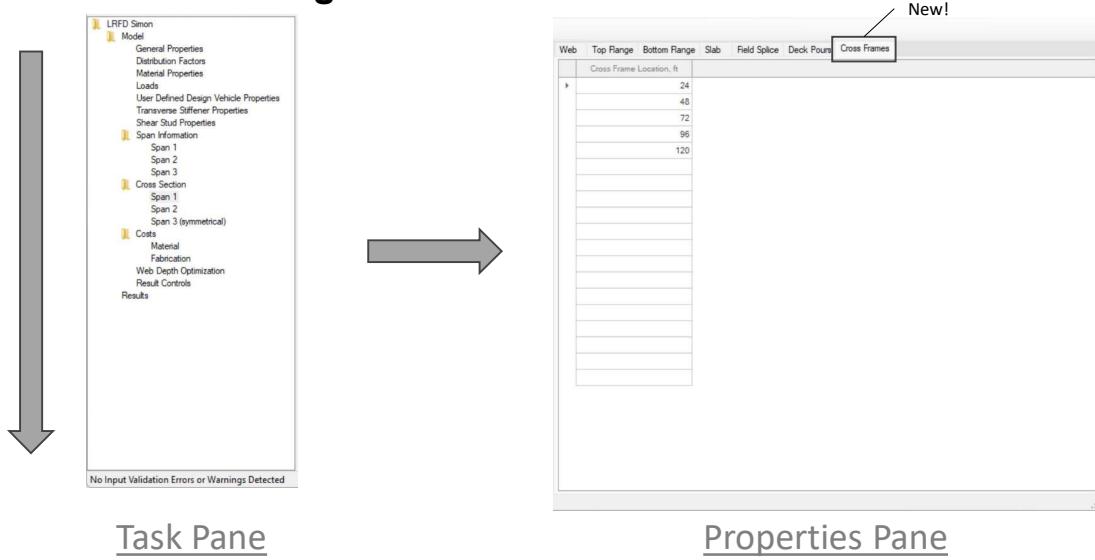
Program Interface Navigation – Span Information



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LRFD Simon Fundamentals

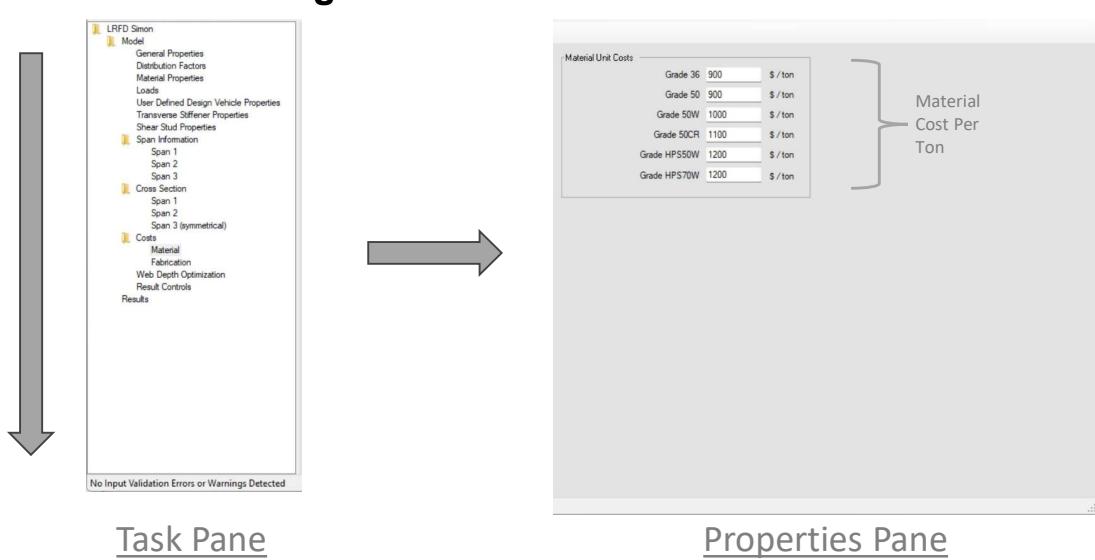
Program Interface Navigation – Cross Section



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LRFD Simon Fundamentals

Program Interface Navigation – Unit Costs



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LRFD Simon Fundamentals

Program Interface Navigation – Unit Costs

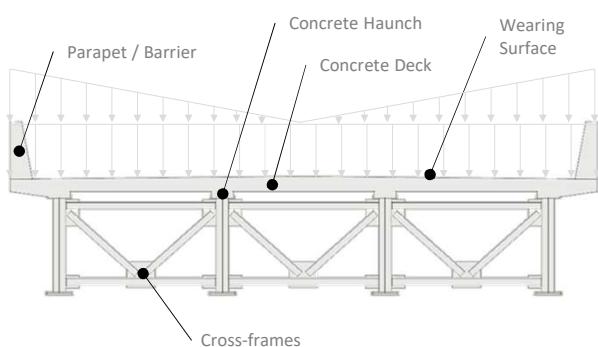


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LRFD Simon Fundamentals

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



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LRFD Simon Fundamentals

Geometry Drives Everything

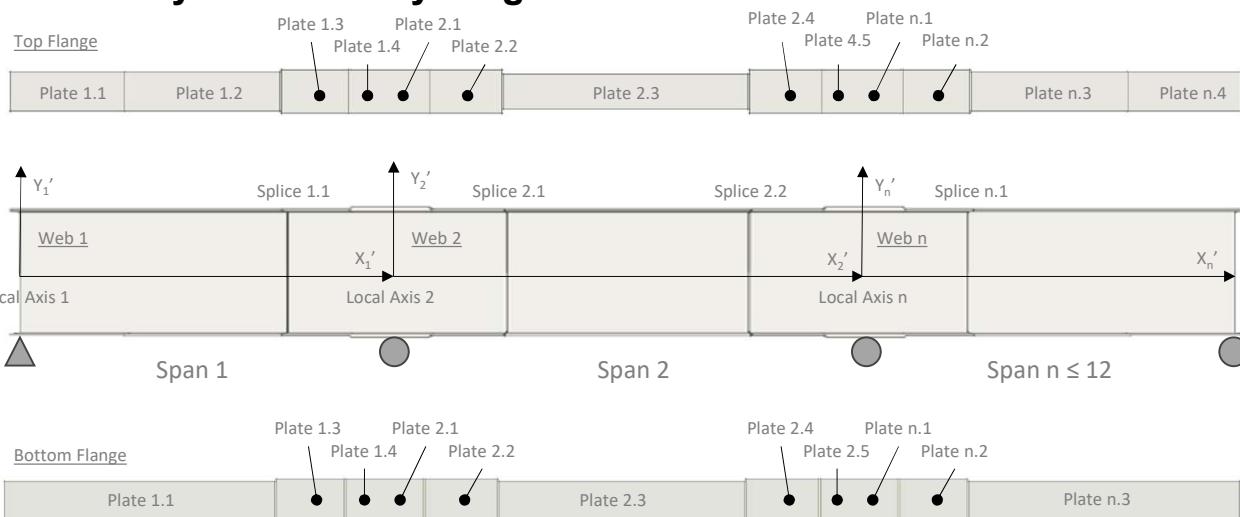
- Span lengths and continuity
- Girder depth and haunch geometry
- Plate dimensions and cutoff locations
- System continuity assumptions



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LRFD Simon Fundamentals

Geometry Drives Everything

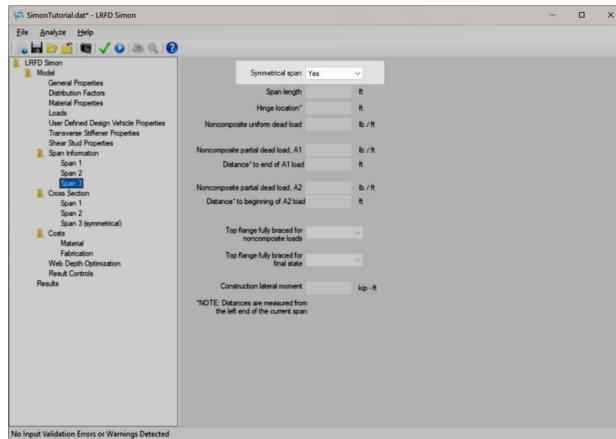


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LRFD Simon Fundamentals

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



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LRFD Simon Fundamentals

Material Procurement - Plate

aisc.org/plate-availability

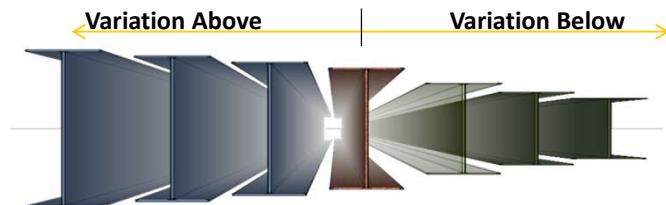
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LRFD Simon Fundamentals

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

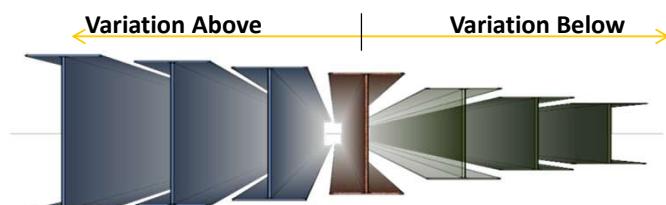


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LRFD Simon Fundamentals

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



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LRFD Simon Fundamentals

Validation = Run Readiness

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



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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

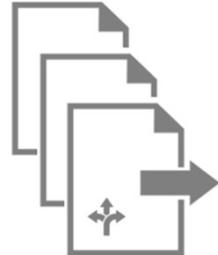


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LRFD Simon Fundamentals

Results to Review First

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

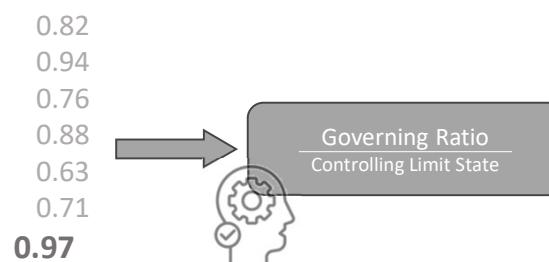


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LRFD Simon Fundamentals

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



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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



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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



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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



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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



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LRFD Simon Fundamentals

Migration awareness: Minimum Safe Steps for Old Files

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

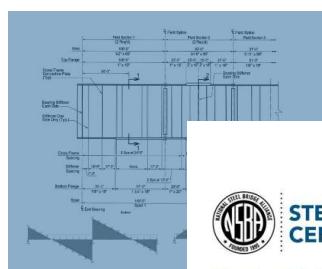


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LRFD Simon Fundamentals

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
VERSION: 10.5
Software User's
Guide
Compatible with the
ASD-3600/LRFD-3600 Design Specifications, 10th Edition



The Steel Solutions Center is your gateway to nearly 100 years of steel knowledge, and it's just a phone call or email away.

aisc.org/askaisc
solutions@aisc.org
866.ASK.AISC



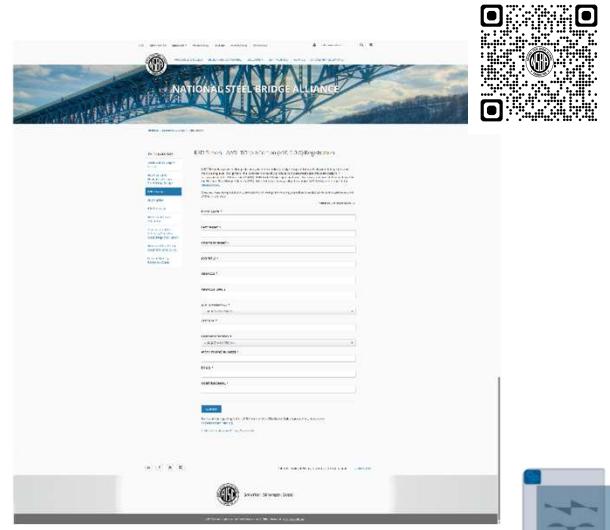
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LRFD Simon Fundamentals

More Information

- 9th Edition AASHTO Bridge Design Specification – available now
- New 10th Edition AASHTO Bridge Design Specification – expected Q1 2026



The screenshot shows a web page for 'LRFD Simon Fundamentals'. At the top, there is a banner featuring a bridge and the text 'NATIONAL STEEL BRIDGE ALLIANCE'. Below the banner is a search form with fields for 'Search', 'Category', and 'Submit'. To the right of the search form is a QR code. At the bottom of the page, there is a logo for 'SIMON' with a stylized bridge icon.

aisc.org/simon

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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.

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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.

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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.

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