



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



**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



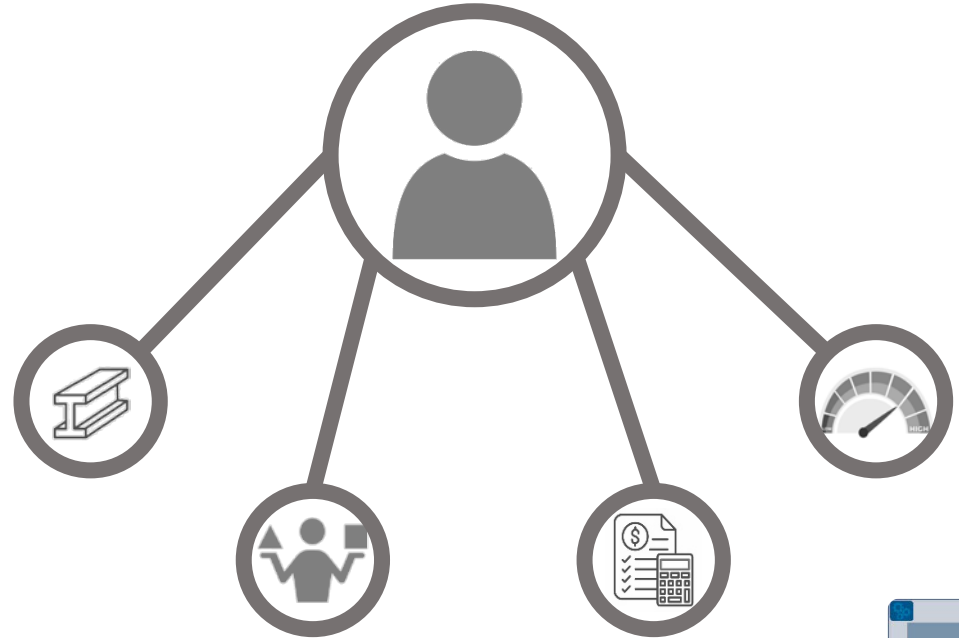
Know where to seek additional information



LRFD Simon Fundamentals

Typical Use Cases

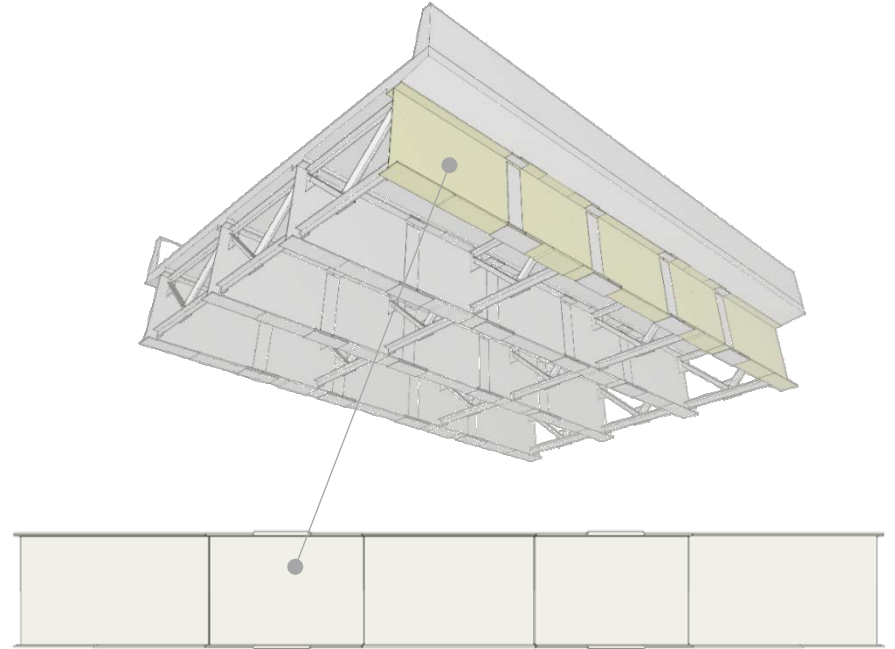
- Early girder sizing
- Comparing alternatives
- Cost and weight estimation
- Sensitivity checks



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What LRFD Simon Is...

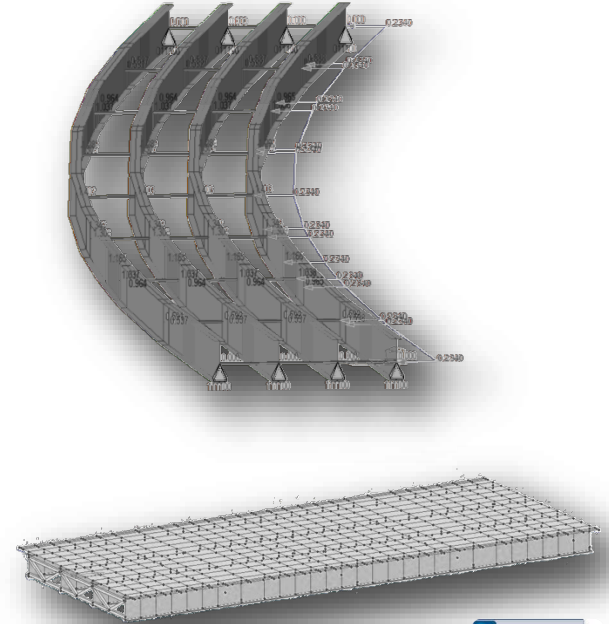
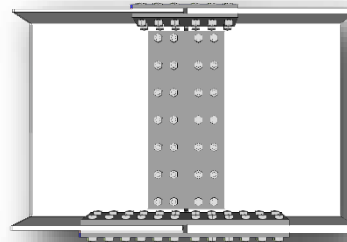
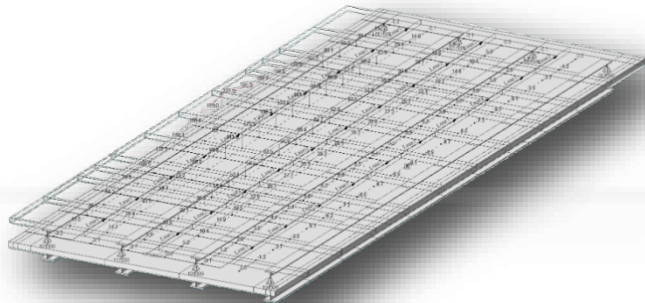
- Line-girder analysis and design tool
- Intended for preliminary bridge design
- Specification-driven and deterministic
- Transparent and engineer-controlled
- Fast and iteration-friendly



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



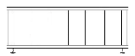
Simple span or up to 12 continuous spans



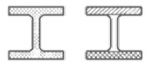
Partial or full-length dead loads



AASHTO or user-defined live loads



Stiffened or unstiffened webs



Homogenous or hybrid cross-sections



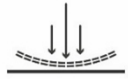
Parabolic or linear web haunches

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Outputs You Can Expect



Moments/shears at tenth points



Live load envelopes



Deflections



Performance ratios for all limit states



Stiffener & shear connector design



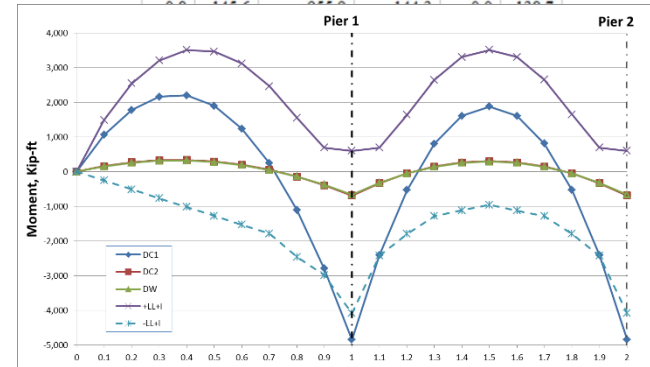
Bill of materials with estimated costs



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



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Conceptual Workflow

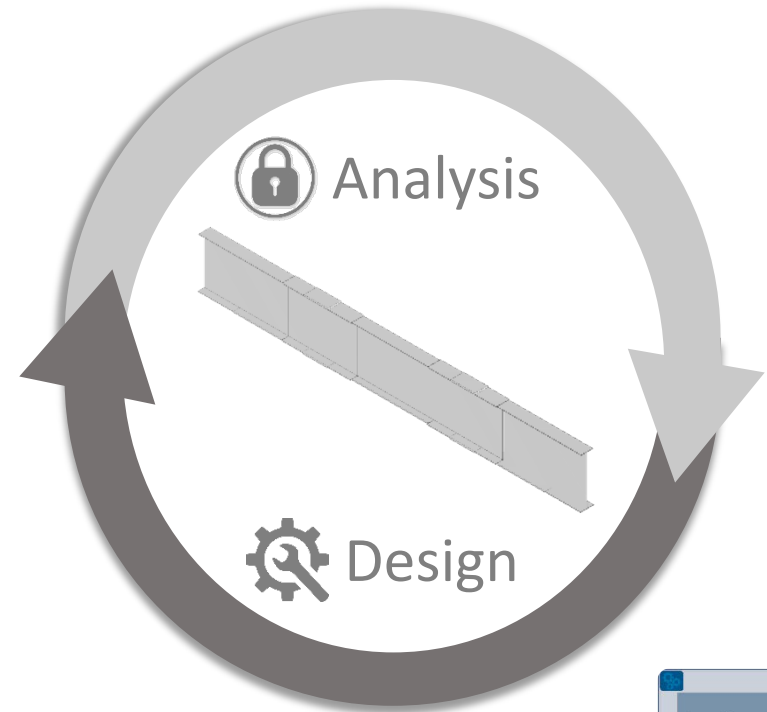
1. Establish global model context
2. Define load distribution assumptions
3. Apply loads and span-specific information
4. Define girder geometry and detailing
5. Validate the model
6. Run analysis or design
7. Review results and iterate



LRFD Simon Fundamentals

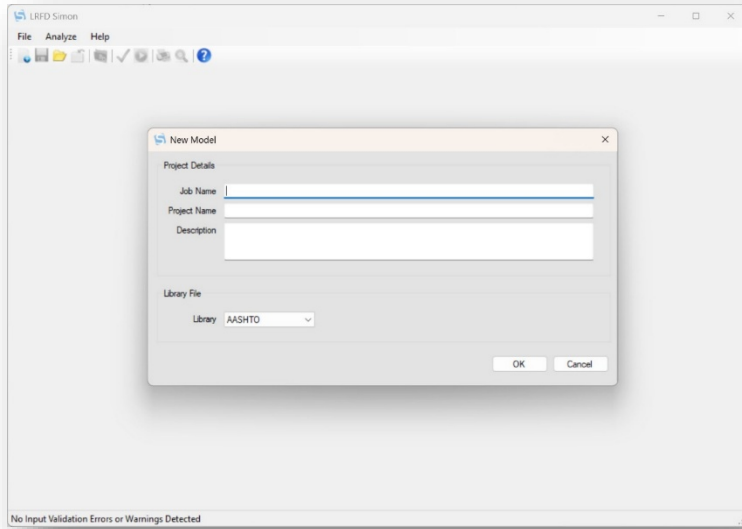
Analysis vs Design

- **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

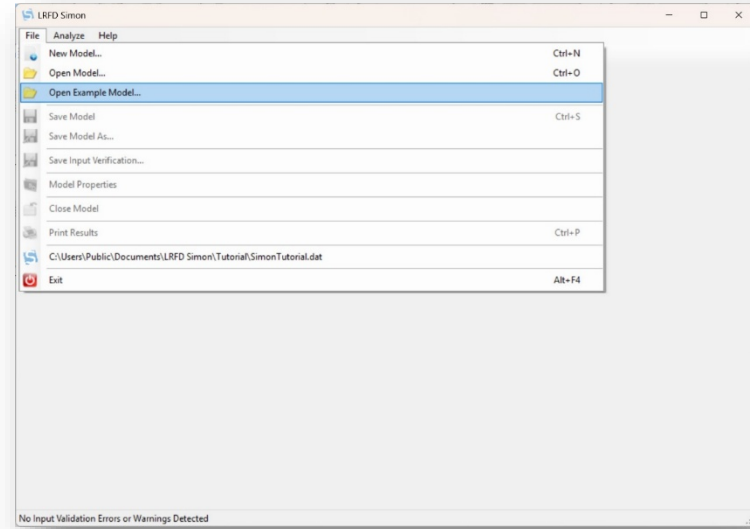


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Two Paths to a Simon Model



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



Standard Plans for Steel Bridges
Single Span Bridges and
Multi-span Bridges
with Link Slabs



Standard Plans for Steel Bridges

Two-span
Continuous
Span Bridges



Standard Plans for Steel Bridges

Three-span
Continuous
Span Bridges



Standard Plans for Steel Bridges

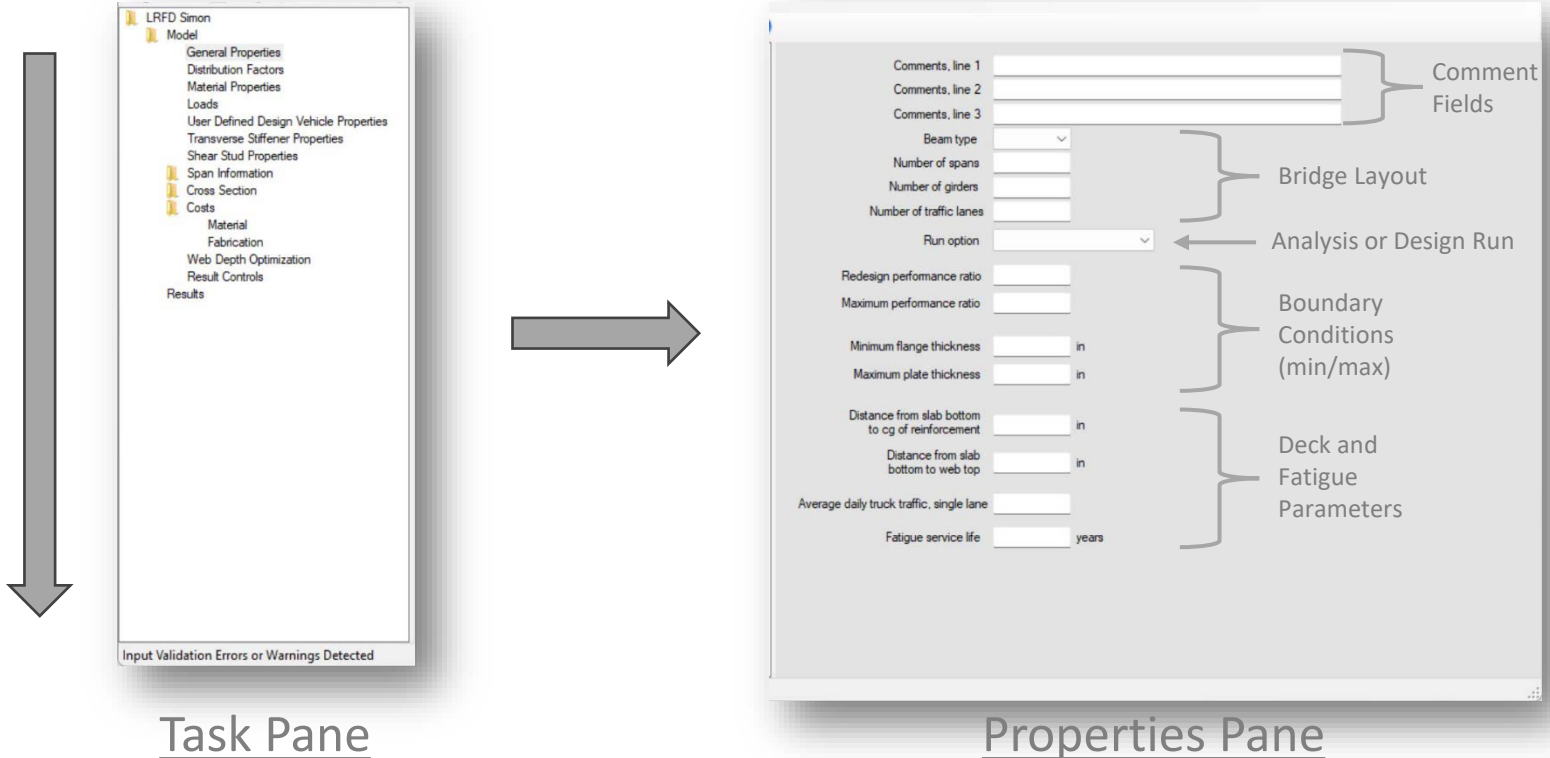
Four-span
Continuous
Span Bridges



aisc.org/standard-bridge-plans

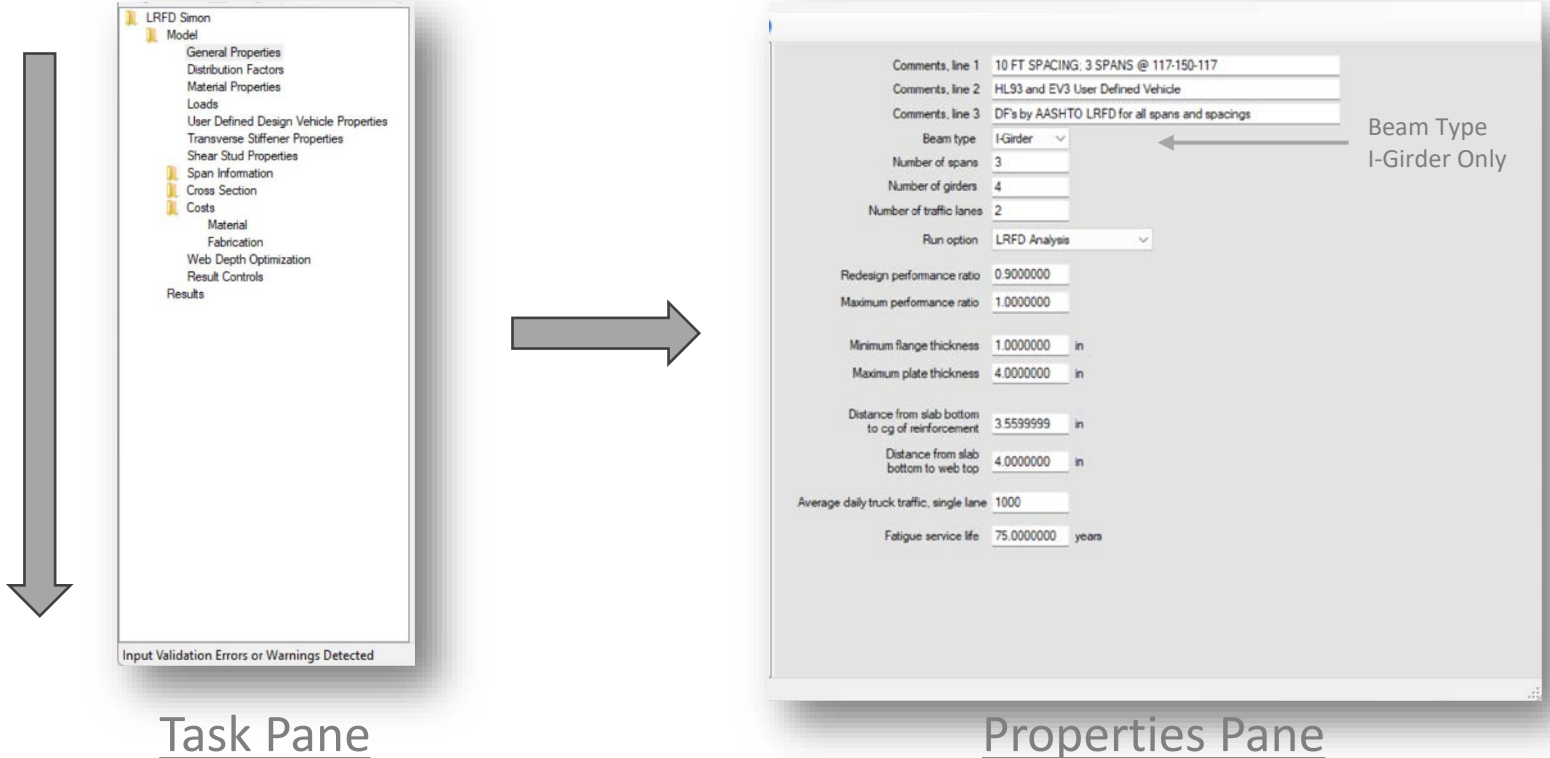
LRFD Simon Fundamentals

Program Interface Navigation – General Properties



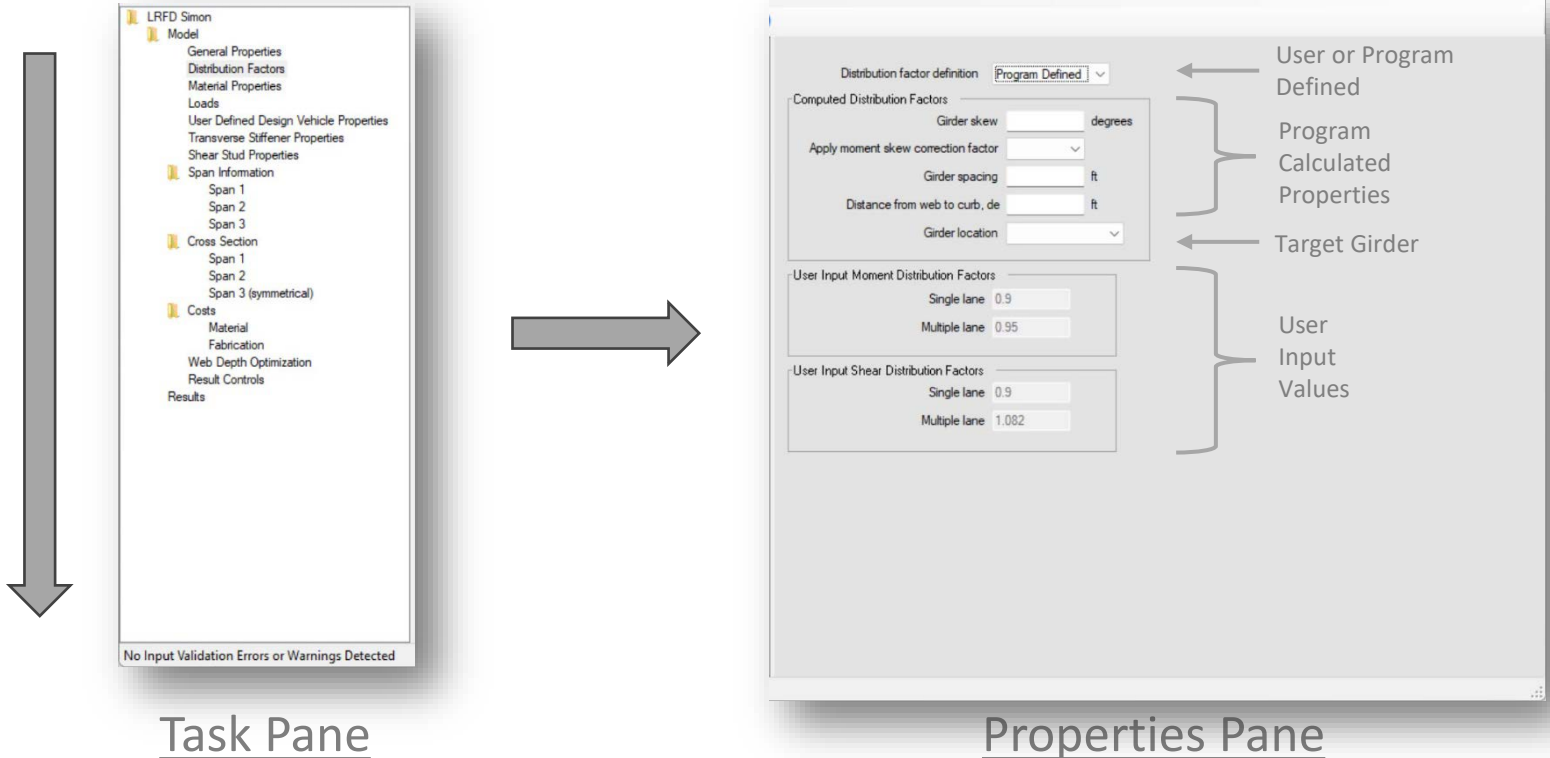
LRFD Simon Fundamentals

Program Interface Navigation – General Properties (New)



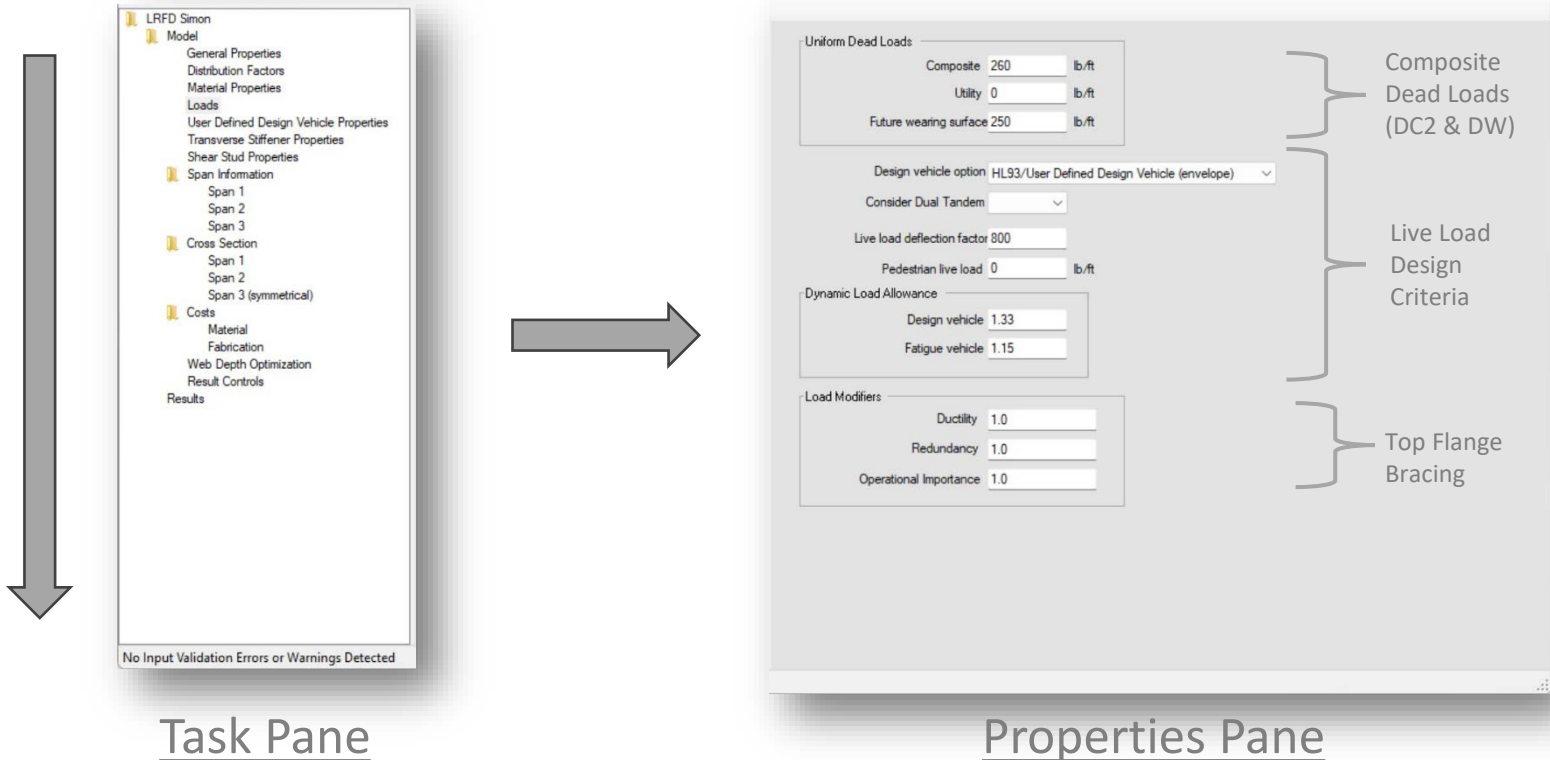
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Program Interface Navigation – Distribution Factors



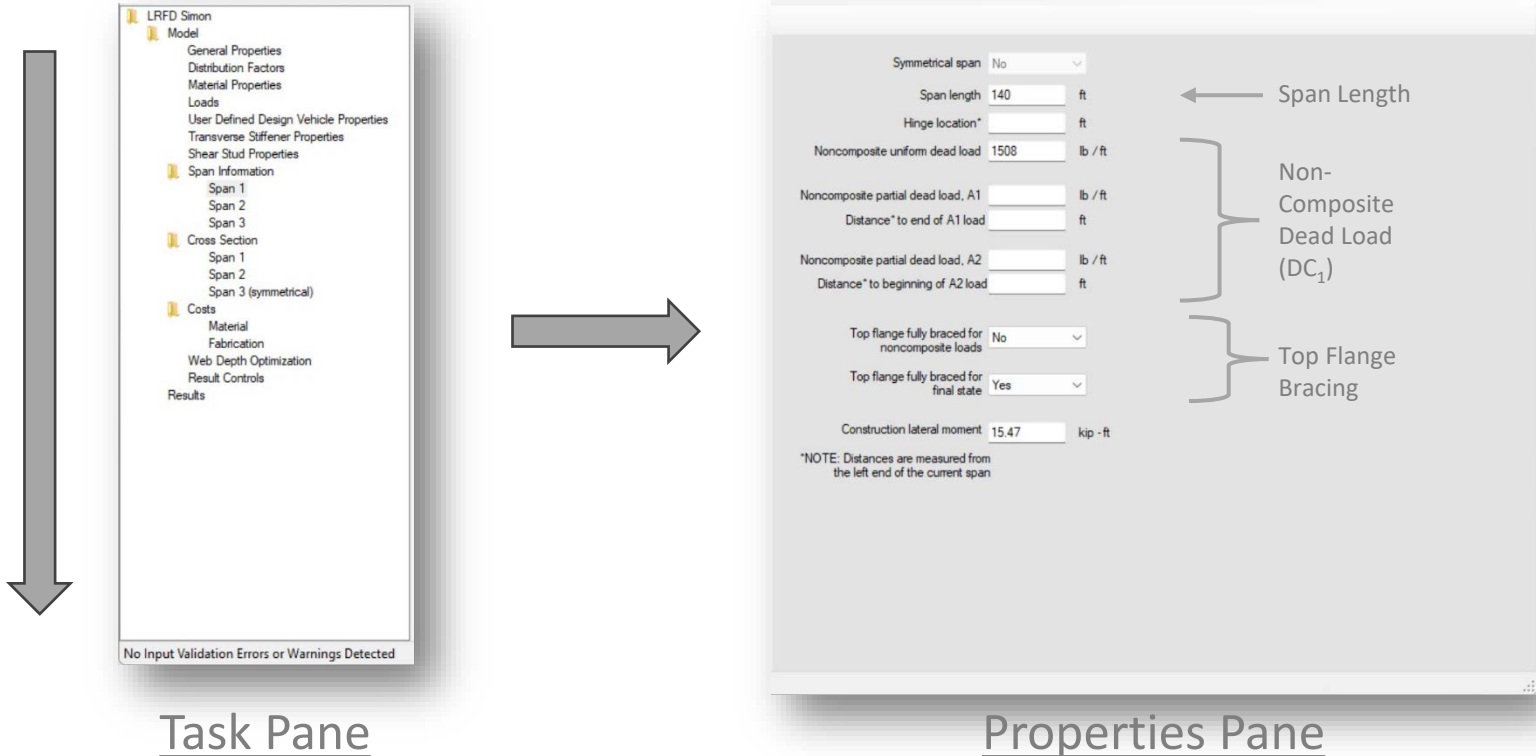
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Program Interface Navigation – Loads



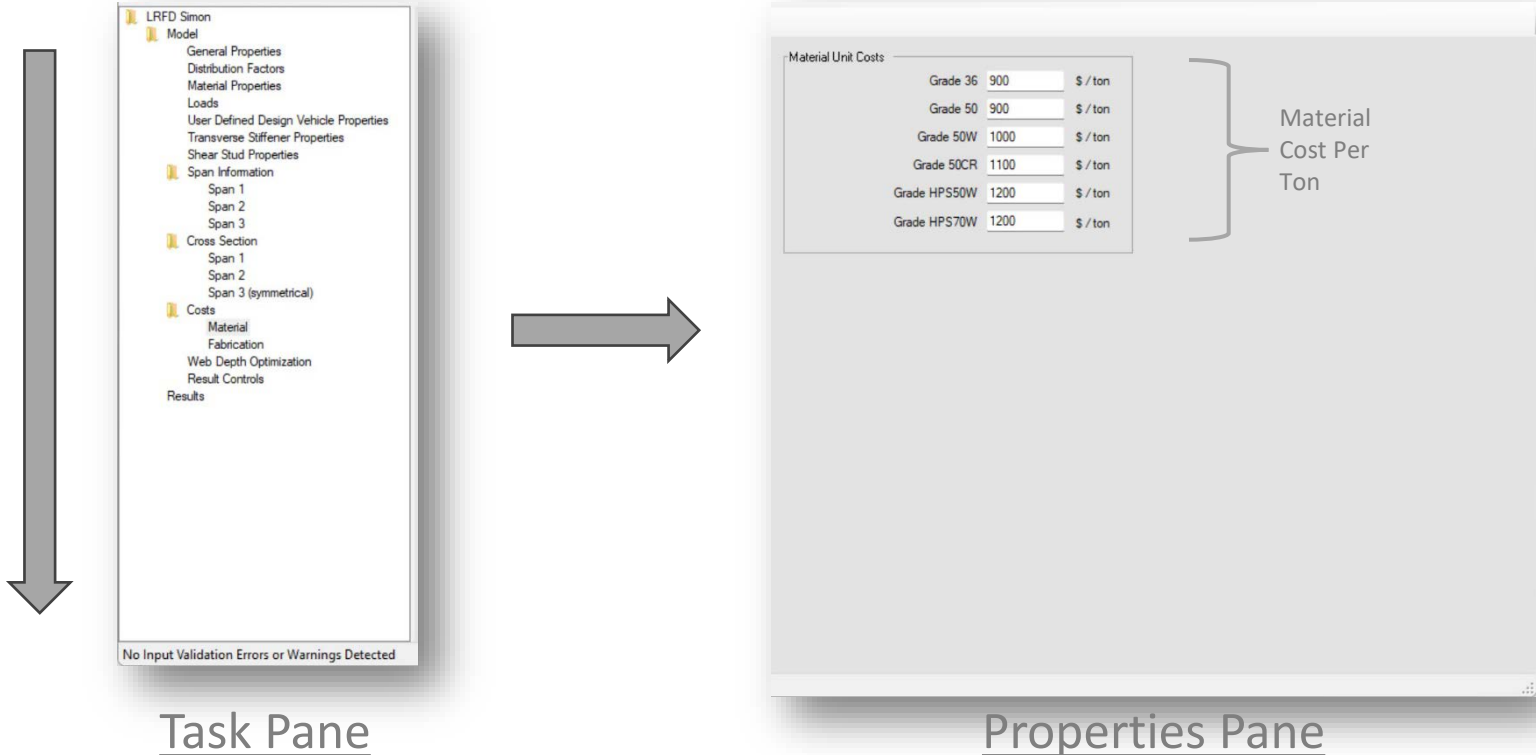
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Program Interface Navigation – Span Information



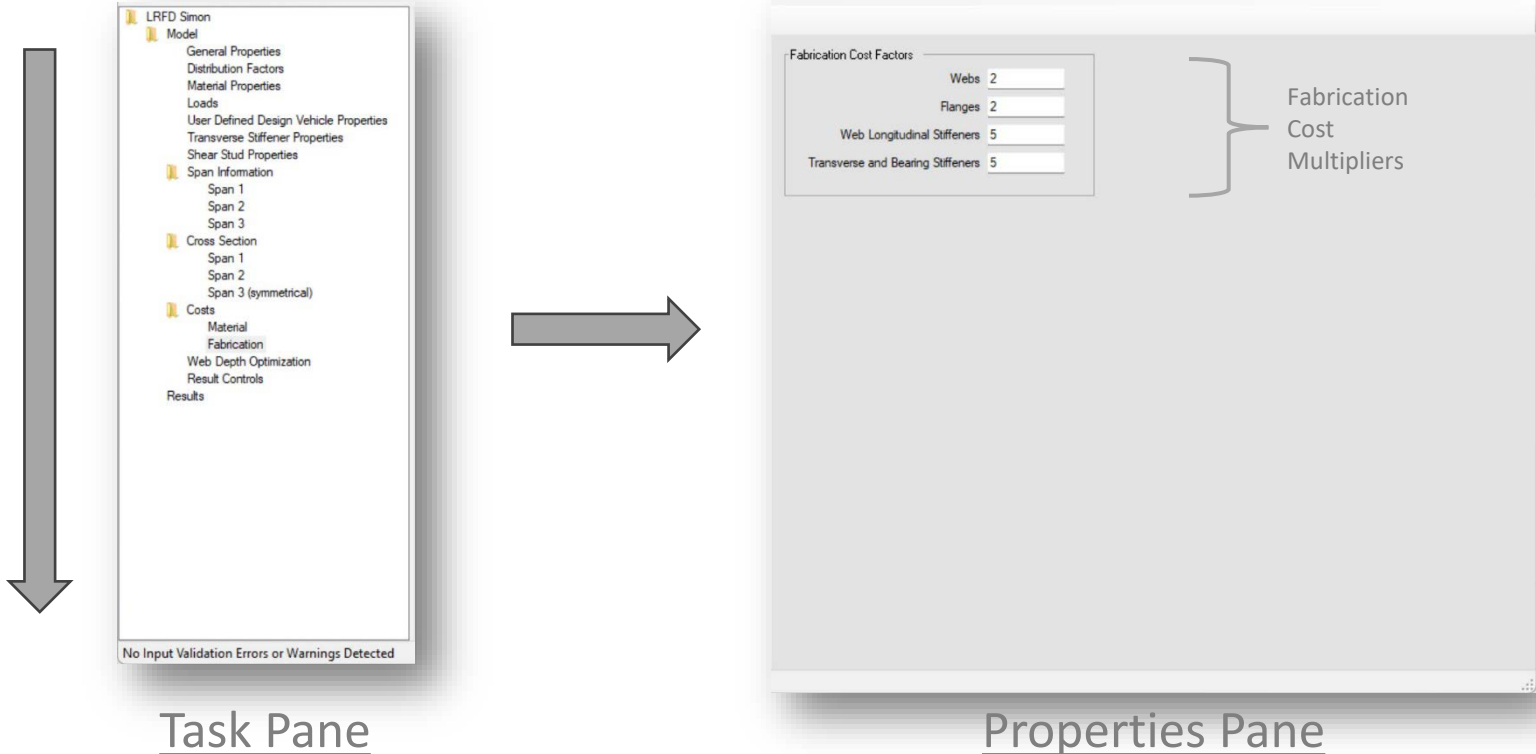
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Program Interface Navigation – Unit Costs



LRFD Simon Fundamentals

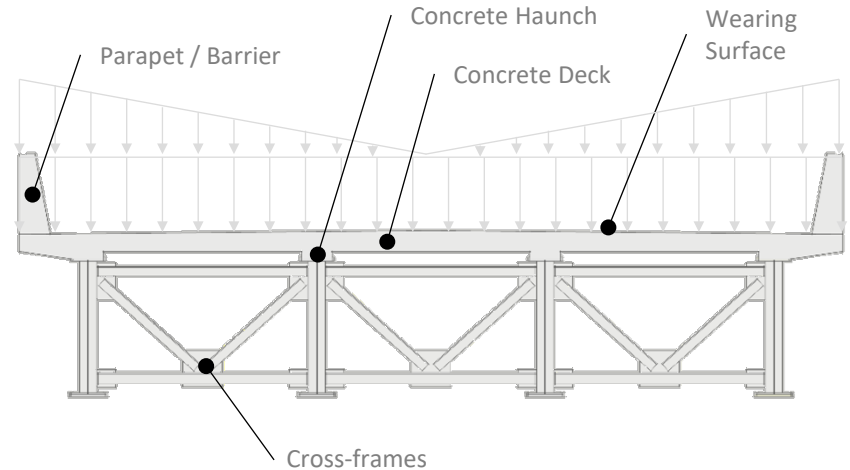
Program Interface Navigation – Unit Costs



LRFD Simon Fundamentals

Deck, Haunch & Dead Loads

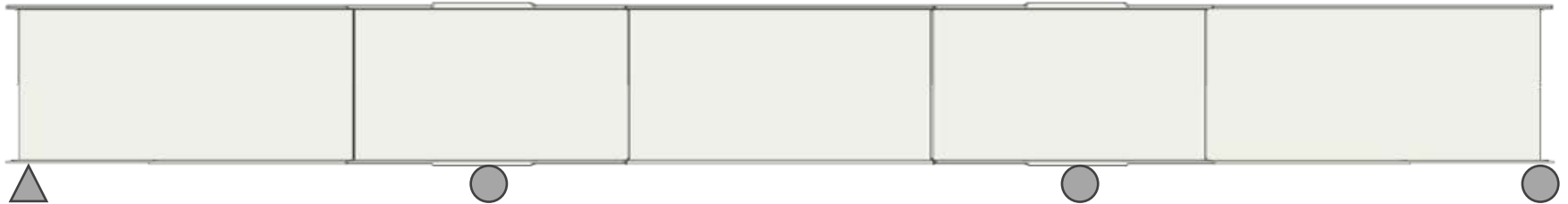
- Dead load is entered in two parts: DC_1 and DC_2
 - Distribute DC_1 loads equally to each girder (vs. tributary area)
 - Assign a reasonable percentage of the DC_2 loads to the exterior girders & the adjacent interior girders
 - Distribute wearing surface DW load equally to all the girders
 - Cross-frame 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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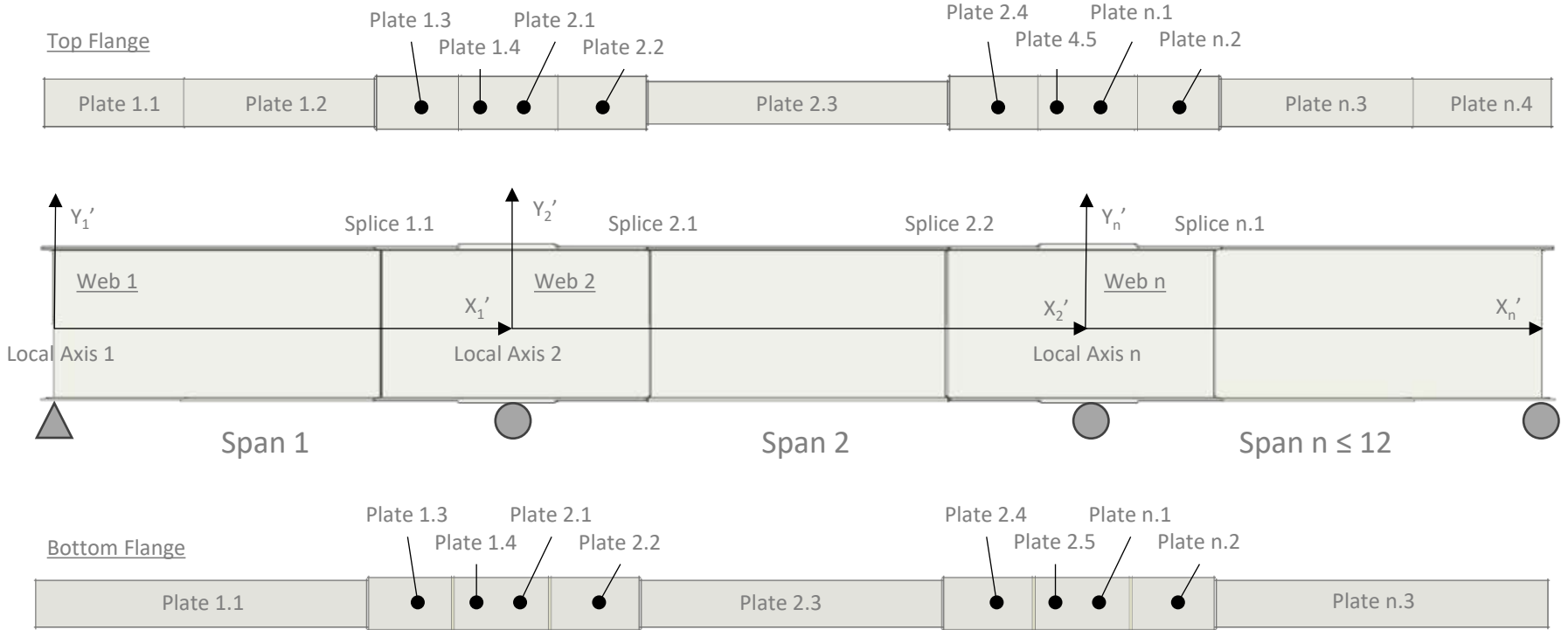
Geometry Drives Everything

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



LRFD Simon Fundamentals

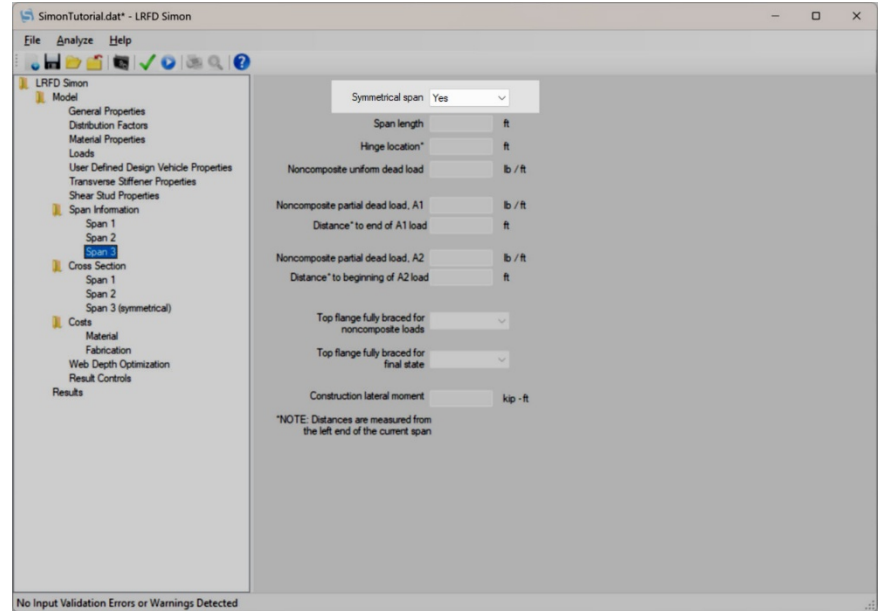
Geometry Drives Everything



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



steelwise

Steel Plate Availability for Highway Bridges

BY CHRISTOPHER GABELL, PE, AND TRAVIS HOPPER, PE

An overview of plate sizes commonly produced by domestic mills.

A QUESTION MANY ENGINEERS overlook when designing highway bridges is the availability of various plate lengths, widths, and thicknesses. The practice of specifying one size, thickness, and length is typically not the best solution for the overall bridge and superstructure. However, understanding the availability of plate material while performing design iterations will ensure that the material specified can be readily sourced from domestic steel mills, which usually yields improved fabrication speed and better economy for the overall bridge superstructure.

The information listed in this article is not intended to be an all-encompassing set intended to be able to produce it. It is intended to provide an overview of where the thickness, width, and lengths produced by each mill will be available from one or more of these mills. One should consult the AISC Construction Manual for more information on this topic. The information is provided for informational purposes only. It is not intended to be used as a substitute for professional engineering advice. For more information, contact the AISC Regional Office nearest you or the AISC National Office at 1110 W. Congress, Suite 1000, Austin, TX 78701. For more information, visit www.aisc.org.

Domestic Mills

Currently, there are three domestic plate producers in the United States: Cleveland-City, Nucor, and SSAB. While these mills are located within the same steel plant, they are located within the same mill. The availability of a mill to a physical project bridge will not necessarily influence availability or procurement.

Variable Area

The plate from which each component of a steel plate girder is cut and fabricated is sometimes referred to as a "variable" plate. Steel plates may be received by the fabricator with a "variable" area. This means that the length and width of the plate may vary from one end to the other. This is typically the case for a steel plate girder. The length and width of the plate may vary from one end to the other. This is typically the case for a steel plate girder. The length and width of the plate may vary from one end to the other. This is typically the case for a steel plate girder.

Figure 1: Normalization of plate thickness, width, and length availability.

Figure 2: Domestic plate mill locations.

steelwise

Figure 3: Example variable plate area for straight flanges.

Figure 4: Example field cutting process.

Figure 5: Example variable plate area for curved flanges.

Figure 6: Variable plate area for a haunched deck.

ASTM A570 Grade 50C

Several of these grades are low carbon steels, some with only one dimension that increases from 1/8" to 1/2". The remaining dimensions are constant. The thickness of the plate is constant, but the length and width of the plate may vary from one end to the other. This is typically the case for a steel plate girder.

Table 2: Plate Widths Available by Steel Grade

Width	A570 Grade 50C	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
48				
54				
60				
66				
72				
78				
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Figure 7: Plate Widths Available by Steel Grade

ASTM A570 Grade 50W

Table 3: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 4: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 5: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 6: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 7: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 8: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 9: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 10: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 11: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 12: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 13: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 14: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 15: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 16: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 17: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 18: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 19: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 20: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 21: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 22: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 23: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 24: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 25: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 26: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 27: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

Table 28: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				
114				
120				
126				
132				
138				

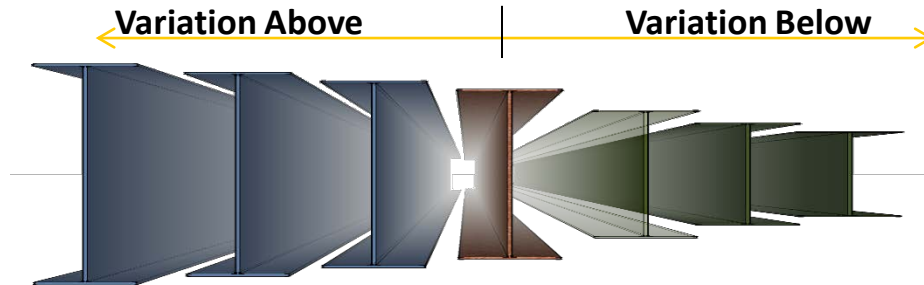
Table 29: Plate Widths Available by Steel Grade

Width	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W	A570 Grade 50W
84				
90				
96				
102				
108				

LRFD Simon Fundamentals

Web Depth Optimization: When & Why

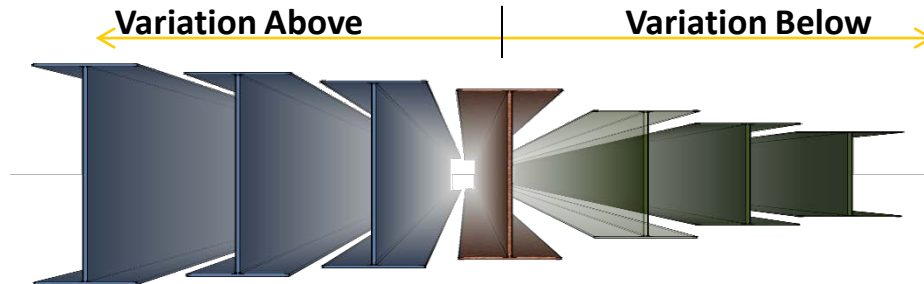
- Automatically generate and run series of trial design input files from a starting design input - that vary only in the web depth.
- Automatic Depth Variation
 - Percentage Based
 - Fixed Value Based
- Summary table created of depth, weight, and cost for each depth



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



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

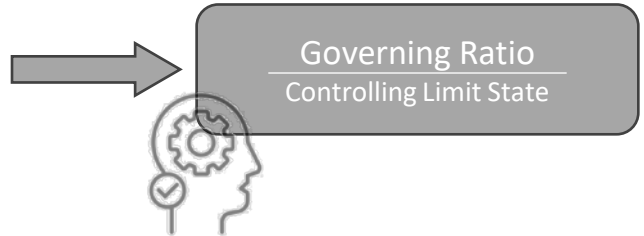


LRFD Simon Fundamentals

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

0.82
0.94
0.76
0.88
0.63
0.71
0.97



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



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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

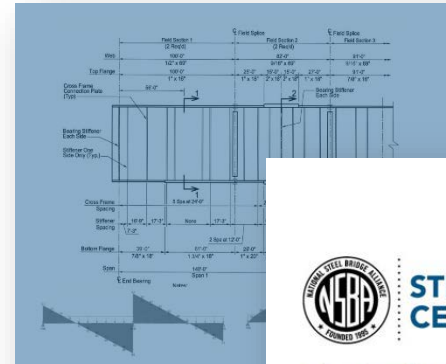
- Validate immediately
- Rebuild cross-frame layout
- Run Analysis before Design
- Expect different results



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
VERSION: 10.5
Software User's
Guide
Compatible with the
AASHTO LRFD Bridge Design Specifications, 10th Edition



**STEEL SOLUTIONS
CENTER**

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

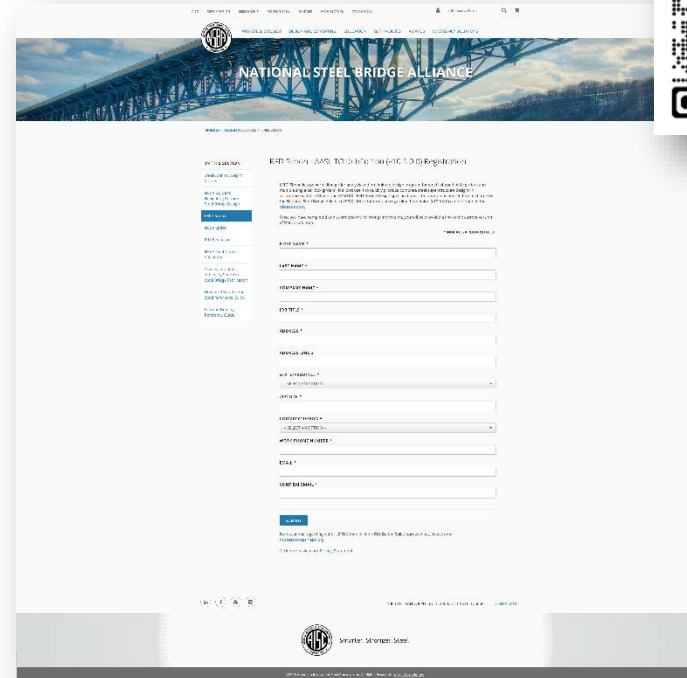
aisc.org/askaisc
solutions@aisc.org
866.ASK.AISC



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!

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**Smarter.
Stronger.
Steel.**