

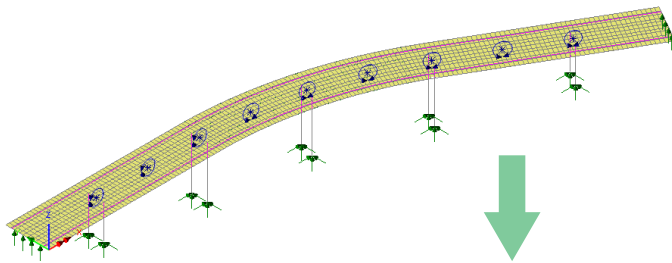
## Vehicle Load Optimisation

The LUSAS Vehicle Load Optimisation (VLO) software option extends the static and moving vehicle loading capabilities of LUSAS *Bridge*. It identifies critical highway vehicle and train (rail) loading patterns on bridges and applies these loading patterns to LUSAS models. It greatly simplifies the evaluation of worst load position, reduces the amount of time spent generating models, and leads to more efficient and economic design, assessment or load rating of bridge structures.

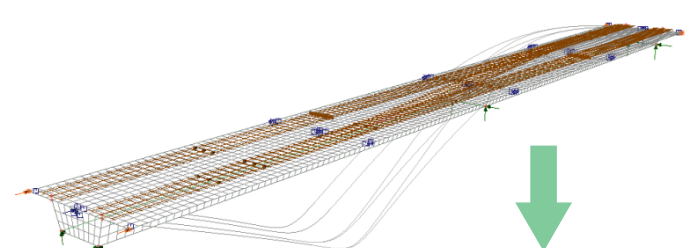
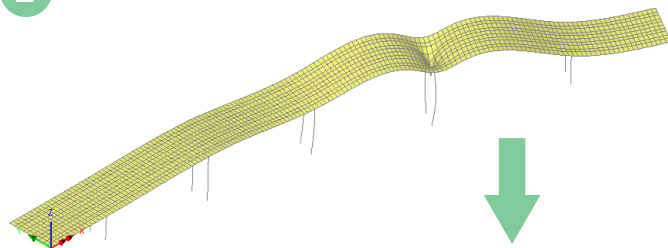
### For highway vehicle load optimisation...

### For train (rail) load optimisation...

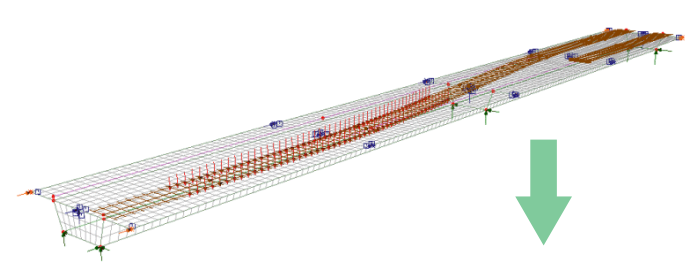
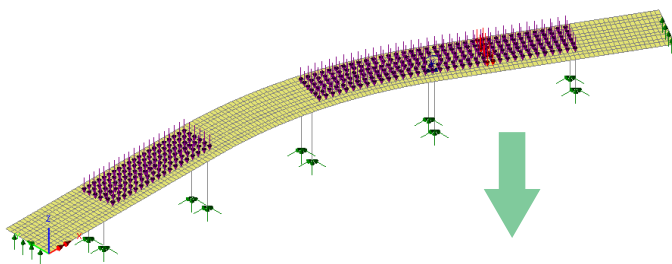
- 1** One or more positions to be used for loading evaluation are selected and assigned influence attributes. For highway vehicles, kerb lines defining the carriageway extent are needed. For rail load optimisation, track layouts must be defined.



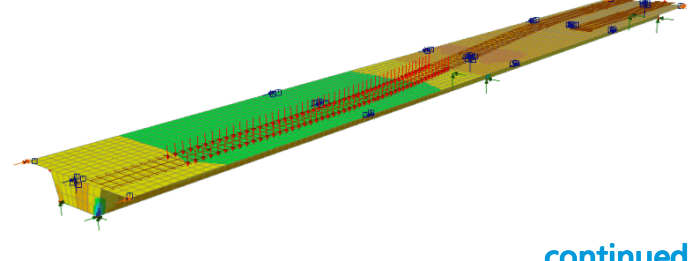
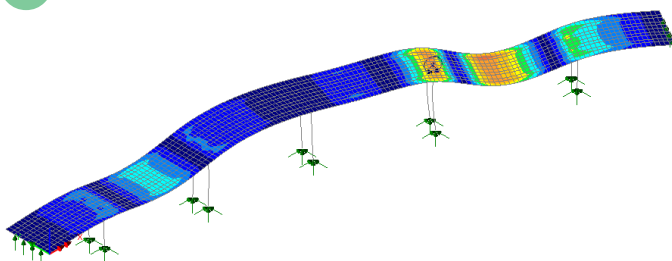
- 2** An influence surface for each position is automatically calculated and can be optionally displayed.



- 3** The vehicle load optimisation facility interrogates each influence surface or set of influence lines, and calculates the critical loading pattern for each. Critical loading patterns can be optionally displayed prior to calculating loading effects.



- 4** Critical loading patterns are then used to calculate the loading effects for each location of interest on the model.



# Traffic Load Optimisation

## SUMMARY OF USE AND BENEFITS

### Onerous results

An onerous effects table can also be optionally displayed to show sorted results for all chosen influences at nodes that are visible, with the most onerous results listed first in the table. For Direct Method Influences these values are due to traffic loading for the specified load effect of interest at specified locations on the model. That is, a single value direct from the LUSAS Vehicle Load Optimisation facility, without the need for a further static solution. Additional traffic load patterns can be created on a case-by-case basis, if not already chosen as part of the initial solution.

|    | Influence Assignment                   | Node | Mx      | Caused by | Create loading  |
|----|--|------|---------|-----------|-----------------|
| 1  | Point 8 - (Surface 1)                  | 127  | 224.859 | HL93      | Loading created |
| 2  | Point 8 - (Surface 2)                  | 127  | 224.775 | HL93      | Create loading  |
| 3  | Point 11 - (Surface 3)                 | 113  | 224.15  | HL93      | Create loading  |
| 4  | Point 11 - (Surface 2)                 | 113  | 224.112 | HL93      | Create loading  |
| 5  | Point 12 - (Surface 3)                 | 10   | 206.304 | HL93      | Create loading  |
| 6  | Point 12 - (Surface 2)                 | 10   | 206.037 | HL93      | Create loading  |
| 7  | Point 7 - (Surface 1)                  | 23   | 205.848 | HL93      | Create loading  |
| 8  | Point 7 - (Surface 2)                  | 23   | 205.667 | HL93      | Create loading  |
| 9  | (10.5074, 79.8113, 0.0) - (Element 57) | 82   | 189.14  | HL93      | Create loading  |
| 10 | (10.5074, 79.8113, 0.0) - (Element 77) | 82   | 189.139 | HL93      | Create loading  |
| 11 | (10.5074, 79.8113, 0.0) - (Element 75) | 82   | 188.912 | HL93      | Create loading  |
| 12 | (10.5074, 79.8113, 0.0) - (Element 60) | 82   | 188.8   | HL93      | Create loading  |

### In Summary:

- Automatic generation of influence lines / surfaces in LUSAS Bridge
- Solves several points on a structure in one analysis session
- For use with LUSAS beams, plates, shells and grillages
- Precise identification of critical loading patterns to the appropriate international code of practice
- Graphical visualisation of vehicle loading patterns
- Generates loadings for straight or curved carriageways/tracks
- Facility to accommodate changes in design codes
- Pre-defined standard vehicles
- User customisation of vehicle loads
- Option to use non-default values
- Option to create user-defined rules
- Fast solution times with loading files being produced far quicker than can be done manually
- Facility with some supported codes for sensitivity testing - for example determining the maximum number of HB units which a structure may support, with or without HA loading
- Onerous results table facility with display and optional sorting of results for all visible nodes.

**"Using the LUSAS Vehicle Load Optimization facility expedited the live load analyses for a highly repetitive task that would have otherwise been extremely time consuming."**

*Dr Ihab Darwish, Alfred Benesch and Company.*

### Highway design codes supported

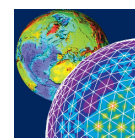
- Australia: AS5100-2: 2004, AS5100-7: 2004 (Austroads)
- Canada CAN/CSA-S6-06 (Design)
- China: JTG D62-2015
- Denmark: DS/EN 1991-2 DK NA:2015
- Europe: EN1991-2 Recommended values
- Finland: LO 24/2014
- India: IRC:6-2017
- Ireland: EN1991-2
- Italy: EN1991-2
- New Zealand (Transit NZ Bridge Manual)
- Norway: NS EN1991-2.2004 NA 2010 + NA-rundsskiv 07-2015
- Poland: EN1991-2
- Saudi Arabia: MOMRA Bridges Design Specifications
- Sweden: EN1991-2 (2009), EN1991-2 (2011), TDOK 2013:0267 Version 3.0
- South Africa: TMH7
- United Kingdom: EN1991-2, BA34/90, BD21/01 including Annexes D and E, BD37/01 (Road+Rail), BD86/11, BS5400 Rail Railtrack document RT/CE/025, CS 454 rev0
- United States of America: AASHTO LRFD (7th and 6th Edition) and AASHTO Standard Specifications (17th Edition)

### Train (rail) design codes supported

- Eurocode EN1991-2 (Recommended values) (p491ae) and National Annexes for Denmark, Finland, Ireland, Italy, Norway, Poland and the United Kingdom
- International UIC Leaflet 776-1 (5th Edition)
- United Kingdom NR-GN-CIV-025

### Availability

The Vehicle Load Optimisation software option is included in all LUSAS Bridge software products for new sales from LUSAS Version 19 onwards.



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