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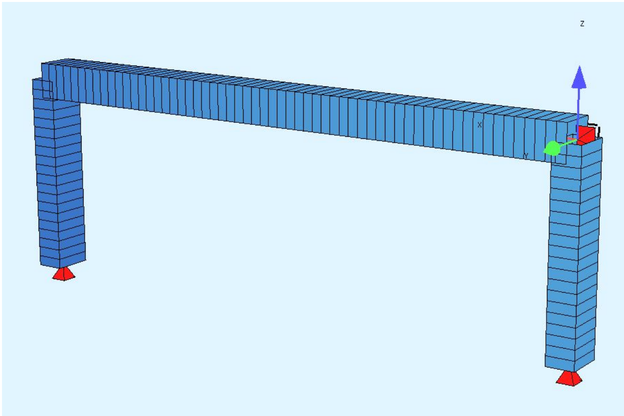

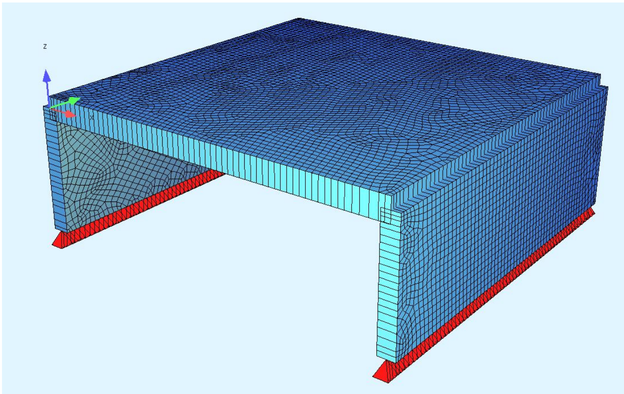

Structural assessment of existing portal frame bridges

Evaluating the difference in using 3D FEM approach and a 2D frame analysis

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Master's Thesis ACEX30
Gothenburg, Sweden 2024

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Cover: SOFiSTiK models of a portal frame bridge in one-way slab analysis and 3D finite element analysis

Department of Architecture and Civil Engineering
Gothenburg, Sweden 2024

Comparative study of evaluation methods for existing portal frame bridges
Evaluating the difference in using a 3D FEM-design approach and a one-way slab analysis when assessing existing bridge structures
Master's thesis in the Master's Programme Structural Engineering & Building Technology
CLARA IVARSSON
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Abstract

The bridge population in Sweden is ageing and the demands on our infrastructure are increasing. Therefore, there exists a demand for assessing the existing bridge population. The current practice for capacity assessments of old bridges in Sweden is based on two different modelling choices. Either the bridge is analysed in a two-dimensional (2D) frame analysis, as it was usually designed, or the bridge is modelled in a more modern 3D analysis. Both modelling choices have their advantages and disadvantages, and depending on what bridge is to be assessed the choice of modelling could influence the results of the capacity assessment as well as the overall workload associated with capacity assessments.

A study of the difference between the two modelling choices was performed on a portal frame bridge, to compare the results of different bridge geometries when using the 2D frame method and the three-dimensional finite element method. The study examined what parameters of the existing bridge design would have an influence on the difference in results. The study also varied different parameters on modelled bridges to examine the difference in results based on the two different analysis methods. Also included in the thesis was a study of existing bridges in Sweden that would relate the results of the study to common bridge geometries, to establish a connection between the study's findings and common assessment scenarios.

The study found that the width of the bridge becomes decisive for which analysis methods are best suited. In the case of wider bridges, the difference is not so great, and to some extent, the 3D models give a higher capacity classification than 2D models. For narrower bridges, the difference in results between 2D and 3D is much greater, where 2D in this case offers a higher capacity rating. However, an error regarding distribution widths was discovered, making the results of the study somewhat unreliable.

General guidelines are presented to simplify the choice of analysis method when a capacity assessment of an existing bridge is performed, in the capacity that is possible regarding the found error.

Keywords: Portal frame bridges, Capacity assessment, FEM, 3D modelling, One-way strip analysis.

Jämförande studie av utvärderingsmetoder för befintliga plattrambroar
Utvärdering av skillnaden i att använda en 3D FEM-designmetod och en strimlemetodsanalys vid bedömning av befintliga brokonstruktioner
Examensarbete inom Konstruktionsteknik och Byggnadsteknologi, masterprogram
CLARA IVARSSON
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Sammanfattning

Sveriges befintliga bropopulation åldras samtidigt som kraven på vår infrastruktur ökar. Därför finns det ett behov av att utvärdera befintliga broars bärförmåga runt om i Sverige idag. Nuvarande praxis för bärighetsbedömningar av gamla broar i Sverige bygger på två olika modelleringsval. Antingen analyseras en strimla av bron med en tvådimensionell (2D) ramanalys, vilket vanigtvis även användes då den konstruerades, eller så analyseras bron med en modernare 3D-analys. Båda analysmetoderna har sina för- och nackdelar, och beroende på vilken bro som ska bedömas kan valet av metod påverka resultatet av kapacitetsbedömningen som den totala arbetsbelastningen i samband med bärighetsbedömningen.

En studie av skillnaden mellan de två analysmetoderna för plattrambroar, med avsikt att jämföra inverkan av olika brogeometrier mellan en 2D ramanalys och en 3D finit element (FE)-analys. Studien undersökte vilka geometriska parametrar hos den befintliga brokonstruktionen som har inverkan på resultatet av en bärighetsberäkning. Studien varierade också olika parametrar på modellerade broar för att undersöka skillnaden i resultat mellan de två olika modellerna. I examensarbetet ingick också en studie av befintliga broar i Sverige för att relatera studiens resultat till vanliga brogeometrier, för att etablera ett samband mellan studiens resultat och vanliga scenarion vid bärighetsberäkningar.

Studien fann att bredden på bron blir avgörande för vilken av analysmetoderna som är bäst lämpad. Vid bredare broar så är skillnaden inte så stor, och ger till viss del en högre påvisad bärighet för broar analyserade med en 3D-modell jämfört med en 2D-modell. Vid smalare broar så är skillnaden på lasteffkter mellan 2D- och 3D-analys mycket större, där 2D ger en högre kapacitetsklassing. Dock upptäcktes ett fel i analysen beträffande utbredningsbredder av pålagda laster i 3D-analyserna, vilket gör resultaten av studien delvis opålitliga.

Allmänna riktlinjer presenteras för att förenkla valet av modell när en bärighetsberäkning av en befintlig bro ska genomföras, i den mån som är möjlig med avseende av felet med utbredningsbredder.

Nyckelord: Plattrambroar, Bärighetsberäkningar, FEM, 3D modellering, Strimlemetoden.

Contents

Preface

This Master's thesis about differences in modelling choices of existing portal frame bridges was performed as the final part of the Structural engineering and building technology MSc at Chalmers University of Technology. The project has been conducted on behalf of Rambolls Bridge Engineering division, west. The work was carried out from January to June 2024.

We express our gratitude to our supervisors Victor Andersson and Elly Yman at Ramboll. Thank you for taking time out of your day to help us and for your positive support throughout the work. We were very fortunate and thankful to have you.

We would also like to thank our assistant supervisor Mario Plos from Trafikverket for his very valuable feedback as well as his assistance in interpreting the results. Finally, we wish to extend our heartfelt appreciation to our supervisor at Chalmers, Carlos Gil Berrocal, for his contributions and guidance throughout the entirety of the project.

I, Clara, would also like to thank my friends in the class. Thank you to the girls and Tim for making this experience so fun and filled with good memories for me.

Clara Ivarsson, Gothenburg, May 2024
Simon Magnusson, Gothenburg, May 2024

Glossary

bogie load	The total load emanating from a tandem wheel axle, which is when two axles in a vehicle lay within 2 meters of each-other.
single axle load	The total load emanating from a single wheel axle.
superstructure	The parts of a bridge that are located over the bearings or similar. Alternatively for a flat slab bridge the part that are located over the casting joint between the frame legs and the slab.

Acronyms

A-value	Maximum value of single axle load.
AASTHO	American association of State Highway and Transportation Officials.
B-value	Maximum value of tandem axle load.
SLS	Serviceability limit state.
SS-EN 1992 1-1	Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings.
SS-EN 1992 2	Eurocode 2: Design of concrete structures - Part 2: Concrete bridges - Design and detailing rules.
TSFS	Regulations from the Swedish Transport Agencys constitution collection.
ULS	Ultimate limit state.

Nomenclature

γ_d	Partial safety factor considering safety class
μ	Scale factor depending on practical considerations, usually assigned to 1
$\psi\gamma_{G.j.inf}$	Load coefficient for favourable permanent loads
$\psi\gamma_{G.j.sup}$	Load coefficient for unfavourable permanent loads
$\psi\gamma_{Q.1}$	Load coefficient for variable main load
$\psi\gamma_{Q.i}$	Load coefficient for variable secondary loads
$G_{k.j.inf}$	Characteristic permanent loads, favourable
$G_{k.j.sup}$	Characteristic permanent loads, unfavourable
$M_{rx.bottom}$	Design value for reinforcement moment resistance in bottom of slab
M_{xy}	Torsional moment
M_x	Bending moment in main load carrying direction of reinforcement
$Q_{k.1}$	Characteristic variable main load
$Q_{k.i}$	Characteristic variable secondary loads load
V_0	Design value for shear resistance in reinforcement
V_x	Shear in longitudinal direction
V_y	Shear in transversal direction
$M_{Ed.ex.v}$	Moment load effect from all loads other than vehicle loads
$M_{max.v.(A/B)}$	Maximum moment load effect from vehicle axle load
M_{Rd}	Moment capacity
$V_{Ed.ex.v}$	Shear load effect from all loads other than vehicle loads
$V_{max.v.(A/B)}$	Maximum shear load effect from vehicle axle load
V_{Rd}	Shear capacity

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1 Introduction

The first chapter of this thesis aims to provide an understanding for the background to the problem, as well as the aims and process to achieve them.

1.1 Background

The majority of existing bridges in Sweden were designed and constructed during the period of 1965-1980 (Sveriges Kommuner och Landsting, 2016). Today the demands on modern infrastructure are increasing and there is a need for assessing these existing bridges to verify if they can withstand higher loads than originally designed for. By reassessing existing bridges their service life can potentially be prolonged, avoiding the need for strengthening or replacement, which in turn leads to a lower climate impact and lower cost for society.

The most common bridge types in Sweden's public road network today are portal frame bridges (Asp et al., 2020). Portal frame bridges are a common solution for short spans and are recommended for span lengths up to 25 meters if ordinary reinforced concrete is used (Trafikverket, 2008). These older slab frame bridges were often designed assuming a one-way load distribution, which often led to an overly conservative design where the real load carrying capacity was underestimated (Davids et al., 2013).

When assessing slab frame bridges it is common to use either a 2D or a 3D finite element model. A higher estimation of the bridge capacity could potentially be obtained by using a 3D model, due to a more realistic modelling of the geometry. On the other hand, the modelling and processing of results gets more time-consuming and expensive for the client, whereas a 2D model usually is less strenuous to perform. Furthermore, if the bridge was originally designed using a one-way strip approach, a linear elastic analysis will almost always underestimate the real capacity (Middleton, 2008).

1.2 Aim

This master's thesis aims to investigate how modelling a portal frame with different modelling methods affects the capacity assessments of the bridge. Subsequently, the thesis will also study if any parameters are central to the potential difference between the models. An ambition for this thesis is to create general guidelines for when it is beneficiary to use the different analysis methods in a capacity assessment of a bridge.

1.3 Objectives

The main objectives of the study will be:

1. Perform a parametric study to compare assessment with 3D FEM analysis to 2D frame analysis of a longitudinal section through the bridge.
2. Evaluate the difference in capacity assessment between the modelling methods
3. Identify which parameters of a slab frame bridge that will determine if the difference between a 3D analysis and a 2D analysis will be considerable, and quantify their influence
4. Compose general guidelines for when a certain analysis should be used for structural assessment of older slab frame bridges

1.4 Social, ethical and ecological aspects

Under Sweden's climate goals and climate policy framework, the Swedish transport administration has decided to aim for a climate-neutral infrastructure by 2040 (Trafikverket, 2023b). It is therefore important that only necessary strengthening and replacements of the existing bridge stock occur, to not unnecessarily use up resources that would be more beneficial elsewhere.

Both maintenance as well as investments in new construction are major economic commitments for a lot of governments, and in turn for taxpayers (Mattsson & Sundquist, 2007). This signifies an even greater responsibility to use resources sustainably and smartly.

1.5 Scope & Limitations

To limit the scope of the project, the thesis will only focus on the shear- and moment capacity in Ultimate limit state (ULS). The study will consequently not investigate the load-carrying capacity concerning reinforcement anchorage or response in Serviceability limit state (SLS). The study only includes single-span bridges with a skewness of less than 10%.

Only slab frame bridges designed for road traffic are investigated, to minimise the number of parameters that differ between the analysed bridges. Thus no bridges designed for train loads or pedestrian bridges are included. The difference between these kinds of bridges would have been the placement of loads, size of loads as well and whether the fatigue has to be analysed or not. However, the general conclusions could still apply to these kinds of bridges.

Loads that have little to no impact on the load effects in ULS will be excluded from the analysis. To simplify the resting earth pressure acting on the bridge a standard soil type will be used.

The project is limited to numerical data, and no experimental data of actual capacity is analysed. Instead, the capacity analysis is based on the theory of plasticity to ensure the required safety of the design. Another limitation will be the, to a certain degree, limited number of 3D analyses we will be able to perform due to computation time.

1.6 Approach

A representative bridge will be modelled in both a 3D analysis and a 2D analysis. The design of the representative bridge will be based on a portal frame bridge designed according to 1960 or previous years' design standards. A number of existing bridges will be studied to determine common relationships between parameters and to be able to relate results to real-world occurrences.

For the analyses the finite element software SOFiSTiK FEA 2024 will be utilised using an interface in the programming language CADINP. In the 2D frame analysis, the model will be programmed as a one metre wide one-way strip in the longitudinal direction of the slab using beam elements, whereas shell elements and a more detailed bridge geometry will be included in the 3D model.

All of the calculations and assumptions will be performed in accordance with the Swedish Transport Administrations requirements for structural assessment of old bridges, TRVINFRA-00331 Version 2.0 (Trafikverket, 2023a). A sensitivity analysis is performed to determine what parameters of a bridge geometry will influence the difference in assessed capacity between a 2D and 3D analysis.

Several iterations of bridge geometries will be analysed in both a 3D FEM analysis as well as a 2D one-way slab analysis. The findings of the analysis will be presented with respect to the different parameters that are investigated.

Some general guidelines for when to use which analysis will be proposed. The results will be compared with the findings from the literature study.

2 Structural Analysis of Bridges

In this chapter the definitions and facts around the specific bridge type are presented, along with information about common practice in capacity assessments of old bridges.

2.1 Portal frame bridges

A portal frame bridge consists of a bridge deck, frame legs or walls and a foundation, a conceptual image of these can be seen in figure 2.1. Portal frame bridges are similar to slab frame bridges, where the defining difference between the two bridge types is that the portal frame bridge deck has a width of at least five times the slab thickness (Trafikverket, 2008). Reinforced concrete portal frame bridges are commonly used for span lengths up to 25 meters (Trafikverket, 2008).

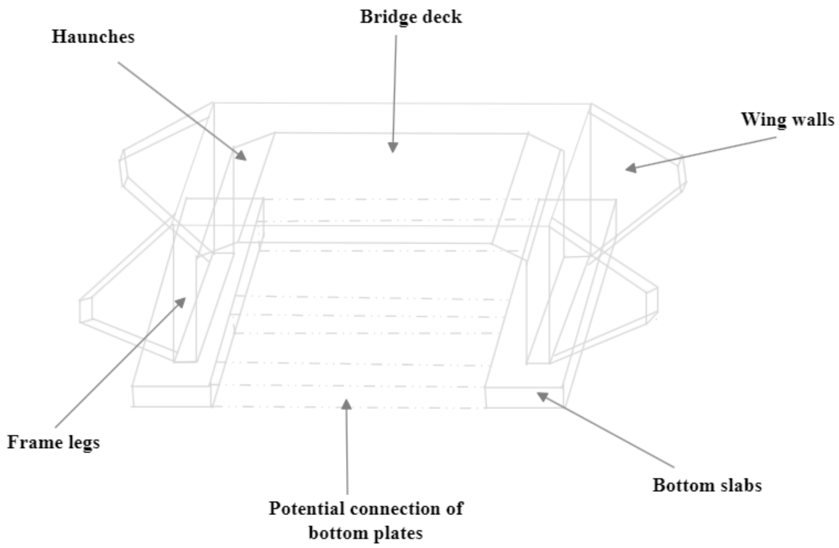


Figure 2.1: *A conceptual illustration depicting a standard portal frame bridge, wherein the image describes the names of various structural components of the bridge.*

For the design standards that were applicable from 1960 onward and for a long period thereafter, the design of portal frame bridges was done according to the strip method. Hence, most bridges from this period have a majority of the reinforcement in the longitudinal direction and only a minimum amount in the transversal direction compared to modern bridges.

2.1.1 Bridge deck

The bridge deck on a portal frame bridge is commonly designed as a homogeneous slab (Brosamverkan, 2020). The slab should be able to transfer the acting forces to the frame legs.

When the span length exceeds 10-12 meters a common solution to increase the shear capacity is to use 1:5-haunches in the frame corners (Brosamverkan, 2020). Portal frame bridges with shorter spans usually still have a haunch, albeit smaller. The impact of step-wise changes on the thickness of the slab, i.e. the size of haunches, that can be utilised when calculating the capacity of construction parts is a maximum of 1:3 (Boverket, 2004).

2.1.2 Frame legs

Frame legs on a portal frame bridge will transfer the loads from the bridge deck down to the foundation, as well as withstand the loads from the lateral earth pressure. The longitudinal reinforcement is continuous in the upper part of the connection between the frame legs and the bridge deck to ensure the moment-transferring ability of the connection.

2.1.3 Foundation

Portal frame bridges can be built either with separate or joined bottom plates. The choice of either solution is usually dependent on the ground conditions, span length and whether it should be launched or not (Brosamverkan, 2020).

If the bottom plates were placed onto a foundation consisting of anything other than rock the frame legs were recommended, in the design standards from 1960, to be designed as connected monotonically to the bottom plates. In the connection to the bottom plates, the moments were therefore assigned to be able to transfer from the frame legs to the bottom plate (Ahlström et al., 1966). If the foundation instead consists solely of rock, the frame legs were recommended to be connected as a joint with the bottom plates, with little moment transferring abilities.

2.1.4 Additional parts

Wing walls are commonly connected to the frame legs to intercept the height difference at the end of support to the bridge. However, since they do not affect the load effects for shear- and moment capacity they are commonly not included in the structural analysis of the superstructure.

The edge beams connected to the superstructure are assumed to not contribute to the capacity of the bridge, and only carry their own gravity load. In reality, the edge beams and other nonstructural components will provide some stiffness to the structure that will change the load distribution on the bridge (Ravazdezh et al., 2021). However, these effects should not be included in the capacity assessments of old bridges (Trafikverket, 2023a).

2.2 Capacity assessments of existing bridges

The capacity assessments of existing bridges in Sweden is regulated by the Swedish Transport Administration and the governing document TRVINFRA-00331 (Trafikverket, 2023a). According to this document, when calculating the capacity of concrete structures, the Eurocodes SS-EN 1992 1-1 and SS-EN 1992 2 should be applied together with TSFS 2018:57 from the Swedish Transport Agency (CEN, 2004, 2005; Transportstyrelsen, 2018).

Classifications of capacity on old road traffic bridges aim to evaluate the maximum permitted size of single axle load (A-value) and bogie load (B-value) from different vehicles that the bridge can safely withstand.

The calculation for A-value / B-value is done by scaling up vehicle load effects on the bridge so that they, together with the combined load effects from the other loads, reach the maximum capacity of the section, like in equation 2.1 and equation 2.2.

$$M_{Rd} = M_{Ed.ex.vehicle} + M_{max.vehicle.(A/B)} \tag{2.1}$$

$$V_{Rd} = V_{Ed.ex.v} + V_{max.v.(A/B)} \tag{2.2}$$

where:
M_{Rd} = Moment capacity
$M_{Ed.ex.v}$ = Moment load effect from all loads other than vehicle loads
$M_{max.v.(A/B)}$ = Maximum moment load effect from vehicle axle load
V_{Rd} = Shear capacity
$V_{Ed.ex.v}$ = Shear load effect from all loads other than vehicle loads
$V_{max.v.(A/B)}$ = Maximum shear load effect from vehicle axle load

The section of the bridge with the lowest A-value and B-value determine the final classification values on the bridge.

Depending on what design standards the bridge is designed according to, some assumptions and constraints are changed in the load capacity assessments in accordance with TRVINFRA-00331 (Trafikverket, 2023a).

2.2.1 Loads

The loads that should be included in a load rating analysis are permanent loads, variable loads as well as accidental loads as in Trafikverket (2023a, ch.8.2-8.4). Some examples of loads considered in each category are presented in table 2.1.

Permanent loads	**Variable loads**	**Accidental loads**
- Self weight - Paving and overfill - Earth pressure - Shrinkage - Suspended load from piles	- Traffic loads - Brake loads - Increased soil pressure *(from displacements)* - Temperature loads - Wind loads	- Collision force *(vehicle)* - Collision force *(ship)* - Collision forces on curbs

Table 2.1: Examples of loads included in each load category, according to TRVINFRA-00331 (Trafikverket, 2023a, ch.8.2-8.4)

For capacity assessment of old bridges, a safety-class 3 should be used for verification in ULS (Trafikverket, 2023a). However, for bridges with a span longer than 15 meters, safety class 2 ought to be utilised. The safety class will determine a safety factor used in the load combinations.

2.2.2 Traffic load models

When performing a capacity calculation of a bridge, the maximum permitted axle loads are calculated for the most unfavourable load models and traffic lane placements. For road traffic bridges there are 15 different load models (a - o) for traffic vehicles that should be used (Trafikverket, 2023a, p. 167-168). Type vehicle a is used for single axle load calculations and type vehicles b - o are used for the bogie load calculations. These should be assumed to be loading the bridge parallel to the longitudinal direction of the traffic lane.

Every load lane is assumed to be 3m wide and the vehicle loads should be centrally placed within these. The number of load lanes should be equal to the number that fits within the width of the roadway, however no more than four. An example of this can be seen in figure 2.2.

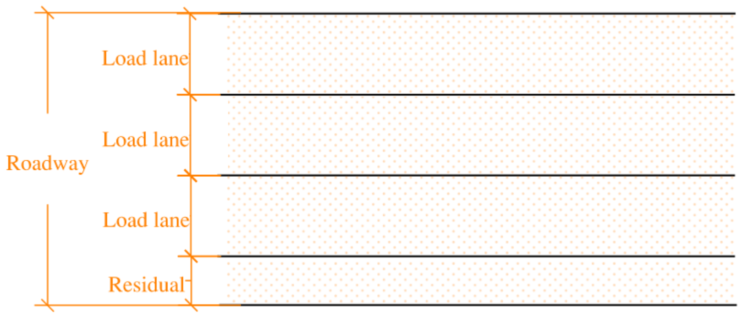


Figure 2.2: *Example of division of roadway into load lanes*

In capacity assessments, load lanes with type vehicles should be limited to a maximum of two (Trafikverket, 2023a). One type vehicle should be multiplied by the factor 1.0 and the other type vehicle in a different load field should be reduced by the factor 0.8. An unfavourable distributed load is placed on the load lanes that are not loaded with type vehicles.

When using the strip method one meter wide strips are analysed of the bridge. For road traffic bridges, 1/3 of the total traffic load from one load field is applied on the strip (Trafikverket, 2023a, Chapter 10.1.2.5.1). No consideration is taken for loads in adjacent traffic lanes. For the load case with single traffic in the middle of the bridge, 1/4 of the total traffic load can be assumed instead, while still analysing a one metre strip (Statens offentliga utredningar 1961:2, 1961).

2.2.3 Load combinations

The applied loads should be combined in the most unfavourable combination for each part of the structure (Trafikverket, 2023a). The loads are combined in accordance with equation 2.3. To account for the safety class of the structure, all unfavourable permanent loads and variable loads are multiplied with a safety factor γ_d. This safety factor is equal to 1 for bridges in safety class 3, and 0.91 for bridges in safety class 2 (Trafikverket, 2023a, Chapter 6.3).

$$(\sum_{j\geq 1} \gamma_d \psi \gamma_{G.j.sup} G_{k.j.sup} + \gamma_{G.j.inf} G_{k.j.inf}) + \gamma_d \psi \gamma_{Q.1} Q_{k.1} + (\sum_{i\geq 1} \gamma_d \psi \gamma_{Q.i} Q_{k.i}) \tag{2.3}$$

where:
- γ_d = Partial safety factor considering safety class
- $\psi\gamma_{G.j.sup}$ = Load coefficient for unfavourable permanent loads
- $G_{k.j.sup}$ = Characteristic permanent loads, unfavourable
- $\psi\gamma_{G.j.inf}$ = Load coefficient for favourable permanent loads
- $G_{k.j.inf}$ = Characteristic permanent loads, favourable
- $\psi\gamma_{Q.1}$ = Load coefficient for variable main load
- $Q_{k.1}$ = Characteristic variable main load
- $\psi\gamma_{Q.i}$ = Load coefficient for variable secondary loads
- $Q_{k.i}$ = Characteristic variable secondary loads load

Load combination the load combination in equation 2.3 is used for Ultimate limit state, the corresponding load coefficients for each load is taken from table 8-12 in TRVINFRA-00331 (Trafikverket, 2023a, p.92-93). No accidental loads are considered as the load combination factor is set to 0 for this load combination.

In the load combination the variable loads should be limited to the four with the most unfavourable impact. If the flat slab bridge has joined bottom plates, with vehicle load in an additional level, the number of variable loads should be increased to a minimum of five. The variable load with the most unfavourable impact is assigned as the main variable load, with the corresponding higher load coefficient.

2.3 Linear Elastic analysis

To simplify a structural analysis it is common to assume the material to be linear elastic. In reality, reinforced concrete is a composite material whose behaviour is highly nonlinear, due to the cracking of the concrete as well as the reinforcement yielding. These phenomena will in reality lead to a reduction of stiffness and redistribution of forces, that the linear elastic analysis will not take into consideration (Schlune et al., 2009).

A linear elastic model is based on the lower-bound theory of plasticity, which assumes the material to reach a state of equilibrium that balances the applied loads with plastic redistribution (Chen & El-Metwally, 2017). Thus the model can be applied when the real behaviour reflects a linear elastic response, as well as in the ultimate limit state because of this plastic redistribution (Schlune et al., 2009).

In a linear elastic material model, the relation between stress and strain in the material is assumed to follow a linear relation. The strains are assumed to be small in relation to other relevant properties of the studied body. A linear elastic material model makes Hook law valid and allows for the superposition of load cases.

2.3.1 One-way strip analysis

A one-way strip analysis assumes a bridge slab is divided into several strips that each will behave according to beam theory. The beam theory Bernoulli-Euler is based on the linear elastic behaviour of the materials, as well as additional assumptions such as plane stress and plane strain.

Beam elements are used in this model. One beam element that represents the slab is connected to two separate beam elements that represent the frame legs. The frame legs are connected to the slab element and on the other side have boundary conditions that represent the connection to the bottom slab.

Figure 2.3: *A conceptual image of the modelling principle of a one-way slab analysis of a portal frame bridge. The black lines represent beam elements.*

2.3.2 Three-Dimensional finite element analysis

A three-dimensional finite element analysis, contrary to the one-way strip analysis, models the full bridge geometry divided into a finite number of elements.

Shell elements are commonly used to model a three-dimensional bridge structure. By using shell elements a more complex geometry can be modelled, as each part of the bridge is represented by a lot of small elements, as opposed to the 2D model which is composed of only a few beam elements.

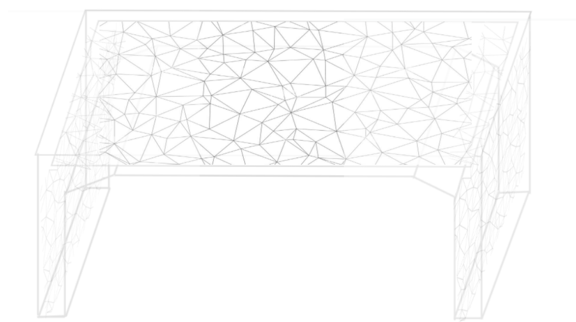


Figure 2.4: *A conceptual image of the modelling principle of a three-dimensional finite element model*

2.3.2.1 Reinforcement moments- and shear force

When analysing a slab in a three-dimensional analysis the resulting moment will consist of bending as well as torsional moments. In ULS the reinforcement capacity will account for the effect of both. The load effects that the bottom reinforcement should be dimensioned for will be computed as in equation 2.4, as described in Pacoste et al. (2012). Here x is the main load-carrying direction of the reinforcement and y is the transversal direction.

$$M_{rx.bottom} = M_x \pm \mu \mid M_{xy} \mid \tag{2.4}$$

where: M_x = Bending moment in main load carrying direction of reinforcement
M_{xy} = Torsional moment
μ = Scale factor depending on practical considerations, usually assigned equal to 1

The resulting shear force from the three-dimensional analysis will consist of shear in two directions, x and y. The shear reinforcement capacity should therefore be calculated for the shear force according to equation 2.5, also proposed in Pacoste et al. (2012).

$$V_0 = \sqrt{V_x^2 + V_y^2} \tag{2.5}$$

where: V_0 = Design value for shear resistance in reinforcement
V_x = Shear in longitudinal direction
V_y = Shear in transversal direction

2.3.2.2 Stress concentrations

Due to the simplifications made in the linear FE analysis, unrealistic stress concentrations will appear in regions near introduced point loads or supports modelled in single nodes (Pacoste et al., 2012). In a real concrete structure, the concrete will crack when the maximum tensile stress is reached and the reinforcement will yield when it reaches the yield stress, which will lead to redistribution of the stresses in those areas. The linear FE models do not account for the cracking of concrete or yielding of the reinforcement and in theory, the stresses can tend to infinity in these areas if the mesh is fine enough.

To compensate for the linear elastic FE-model not taking this redistribution into account, an average procedure described by Pacoste et al. (2012) can be used. In this procedure, the maximum reinforcement moment obtained from the FE-analysis is smeared out over a certain distribution width derived from SS-EN1992-1-1. In a similar procedure, the shear forces are also smeared over a different distribution width.

2.4 Findings from previous study

A study performed by Davids et al. (2013) investigated fourteen in-service flat slab bridges and calculated load rating factors for the bridges, both by using the American association of State Highway and Transportation Officials (AASTHO) finite strip width method and by using a 3D finite element model.

The AASTHO finite strip width method sub-divides the bride deck into strips of equivalent widths of traffic lanes (AASHTO, 2015). This is different from the one-metre strips used in TRVINFRA00331. The AASTHO also uses different vehicle loads from the Swedish TSFS regulations. The result of the study showed an average increase of 26% in rating factor using a finite element model.

Furthermore Davids et al. (2013) made a live load test to verify a FE-model. Trucks were placed at different positions on one of the studied bridges and strains in the bridge deck were measured. The test showed a good consistency and the FE-model was conservative compared to the measured results.

3 Methods

In this chapter the methods for the analysis are presented along with made assumptions and simplifications. The analysis consists of a three-dimensional finite element and a one-way slab analysis of a portal frame bridge with varying parameters.

3.1 Investigated bridge

The investigated bridge is, as previously stated, a road traffic bridge designed according to the Swedish 1960 road traffic load regulations. The bridge is also assumed to have two separate bottom plates without any connections.

Since the bridge is modelled according to 1960 design standards, it is assumed to have minimum reinforcement in the transversal direction, with the main load carrying reinforcement in the longitudinal direction. The amount of reinforcement assumed in transversal direction is therefore set to a standard of ϕ 10 mm bars with a centre-to-centre distance of 300 mm.

3.1.1 Varying geometrical parameters

A one-way strip analysis and three-dimensional finite element analysis were performed with several iterations of the representative bridge. The varying parameters were chosen to represent the largest and smallest dimensions of portal frame bridges in Sweden, and the definition of each parameter can be seen in figure 3.1. The edge beams are assumed as a separate part of the bridge and not accounted for in the width definition.

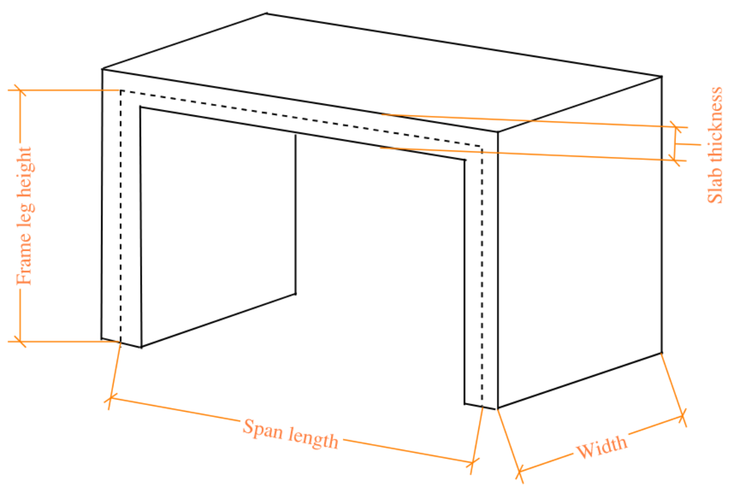


Figure 3.1: *Definitions of different parameters on bridge*

The maximum span length to be analysed is assumed in accordance to the recommended span length recommended in guidelines and standards valid during 1960s (Ahlström et al., 1966). The minimum span length is the minimum length declared necessary to define a construction as a bridge according to the Swedish road traffic administration (Trafikverket, 2023a). The width is assumed to vary between a bridge for one traffic lane up to a maximum width requirement for a four lane road. The rest of the parameters are set to represent the existing portal frame bridge population, in accordance with our supervisors. The final maximum and minimum values for each parameter are presented in table 3.1

Parameter	Min	Max
Length	2 m	17m
Width	3.5 m	17m
Frame leg height	2 m	10 m
Slab thickness	0.3 m	1.5 m
Frame leg thickness	0.3 m	1 m

Table 3.1: Assumed minimum and maximum values of the varying parameters of a typical flat slab bridge

3.1.2 Material parameters

The bridge is assumed to consist of reinforced concrete with a self-weight in accordance with a bridge designed before 2002 in Trafikverket (2023a, ch.8). A concrete of class K40 is assumed with the corresponding density and strength classifications. Since this analysis is based on linear elastic theory, the only strength parameter used will be the modulus of elasticity.

The final parameters of the material were defined in accordance with the relevant building codes from when the bridge was assumed to be built (Andersson et al., 1969). The material parameters used in the analysis are presented in table 3.2.

Material parameter	Used value
Density ρ	24 kN/m^3
Elasticity module, E_{sk}	200 GPa
Poisson's ratio, μ	0.2 [-]

Table 3.2: Material parameters used in the analysis

To account for the fact that the bridge is assumed to have a minimum amount of reinforcement in the transversal direction, the three-dimensional model is assigned a lesser stiffness in the transversal direction. This will represent the real three-dimensional behaviour of the slab in a better manner, since the more prominent longitudinal reinforcement will attract more forces than the transversal. The stiffness in the transversal direction is reduced to a percentage of the longitudinal stiffness.

3.2 Modelling approaches

The bridge is modelled in two different ways using SOFiSTiK 2024, one 2D model and one 3D model, and the geometrical parameters are varied in both models. The modelling choices for each model are presented in this section.

The models does not account for any haunches in the frame leg corners, but instead the bridge is modelled as having constant thickness over the whole slab. In reality most often these haunches will be prevalent and will change placement of the maximum load effects. However since this analysis focuses on comparing the maximum load effects between models, rather than their size and placement, the haunches are relevant to the results of the analysis.

3.2.1 Boundary conditions

The bottom of the frame legs are assigned as simply supported without any spring underneath to model the soil behaviour. Since the analysis only focuses on behaviour in the Ultimate limit state, this is an adequate assumption (Pacoste et al., 2012).

In accordance to advice from TRVINFRA-00331, all bridges dimensioned for 1988 road traffic load regulations or previous can be modelled as a hinge on the bottom of the slab. The set boundary conditions are thus modelled as in the system drawing presented in figure 3.2.

Figure 3.2: *System drawing of the modelled boundary conditions of the bridge*

3.2.2 One-way strip model

The one-way strip model is modelled as a frame consisting of beam elements. The width of the model is set to 1 metre. The global coordinate system is here set as positive Z in the upward direction, X in plane and Y out of plane.

The bottom of the frame legs are locked in the Z- and X- direction to model the boundary conditions of a hinge. To prevent the model from experiencing 3D effects, an additional boundary condition is assigned to the frame corner that restricts movement in the transversal direction.

A conceptual image of a modelled bridge in 2D, along with assigned boundary conditions, is presented in figure 3.4.

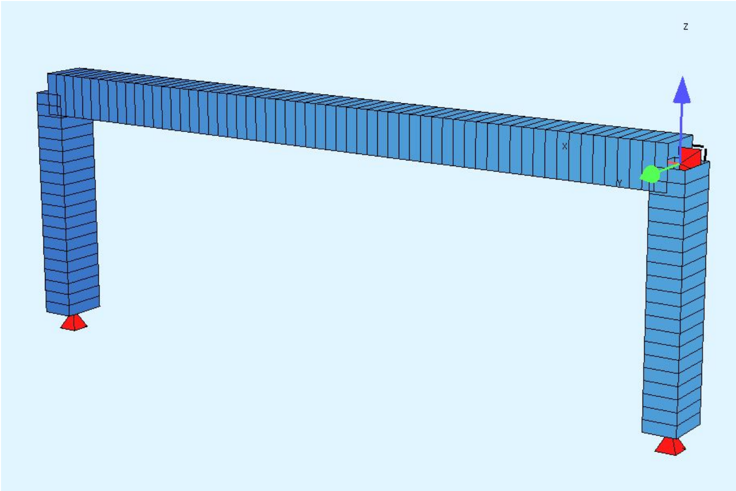


Figure 3.3: *2D frame modelled in SOFiSTiK 2024 with beam elements*

3.2.3 Three-dimensional finite element model

The three-dimensional model is modelled using shell elements. The global coordinate system of the model is assigned as Z positive in the upward direction. X is assigned along the length of the bridge and Y is out across the width.

The boundary conditions of the three-dimensional model are applied to the line connecting the frame legs to the bottom plates. In this line, the model is locked in the Z and X directions, again to model a hinge behaviour.

A conceptual image of a modelled bridge in 3D, along with assigned boundary conditions, is presented in figure 3.4.

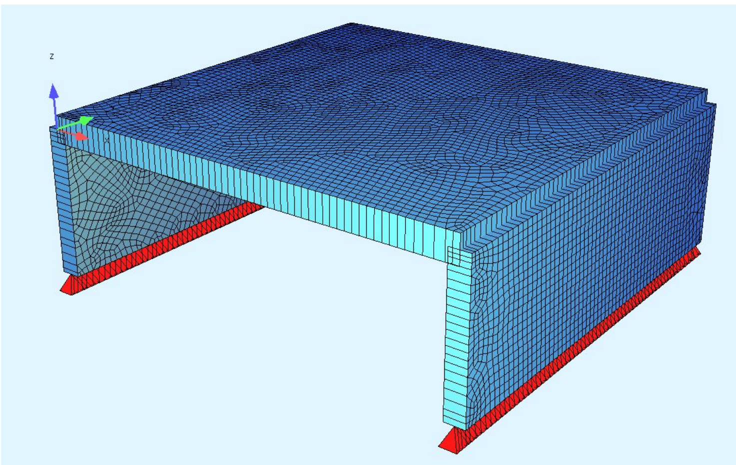


Figure 3.4: *3D frame modelled in SOFiSTiK 2024 with shell elements*

3.3 Assigned loads

The loads that are included in this analysis are constrained as the following:

- Self weight of structure
- Self-weight of Paving
- Earth Pressure from backfill
- Vertical traffic loads

Other loads are excluded from this analysis since they are assumed to have an insignificant effect on the difference between models in ultimate limit state. Loads such as brake loads, temperature loads as well as shrinkage are therefore excluded from this analysis.

The size and placement of the included loads are calculated in appendix A.

3.3.1 Self-weight and paving

The loads from self-weight and paving on the bridge are assigned as a vertical uniformly distributed load acting on top of the bridge. The self-weight is assigned as a density in the material so the size varies depending on the volume of concrete in the model.

The paving is assumed to have a constant thickness for all models and is assigned as an area-load in the model.

3.3.2 Vertical traffic loads

All vertical loads from the traffic is defined in accordance to Trafikverket (2023a). To place the type vehicles according to the different traffic placements, the loads in the 3D model are run through traffic lines assigned in SOFiSTiK. To alleviate the model, only the critical placements of the two traffic lanes with type vehicles are run in the analysis. One with the main vehicle in the middle, with the second type vehicle in an adjacent lane. The other critical placement is with the main type vehicle at the edge of the slab, with the second type vehicle in the adjacent lane. The placement of these are shown in figure 3.5.

In the 2D model the main vehicle is assigned a traffic line centrically, and the load is divided by three as described in chapter 2.2.2.

Dynamic longitudinal contribution from the traffic load is considered by a dynamic amplification factor assigned to each point load. This dynamic amplification factor is calculated by a determining length for the portal frame bridge, calculations which are also presented in appendix A.

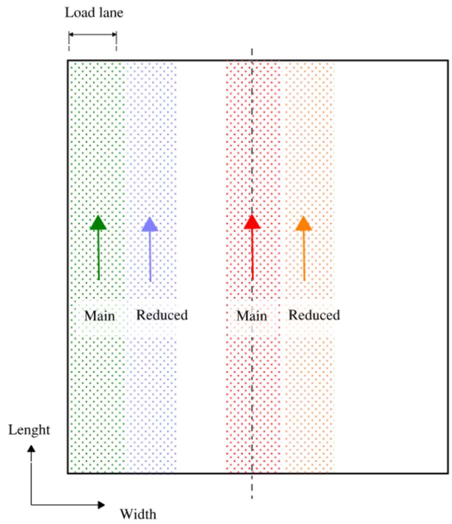


Figure 3.5: *Assigned traffic lane placement for maximum load effects in 3D model*

3.3.3 Earth pressure

For the backfill, material properties for sand are used according to TRVINFRA-00331 (Trafikverket, 2023a, Table 8.2). Resting earth pressure against the frame leg is considered.

3.4 Verification of models

To validate our results and verify the results from the analyses, the model was compared to hand calculations. The hand calculation equations are based on the rigid frame analyses presented in the book by Kleinlogel (1980). The results of the verification are presented in table 3.3, and the full calculations can be seen in appendix B.

Load effect	Results Hand Calculations	Results 2D model	Error
Bending moment in frame corners from uniform load	$35.71kN/m$	$34.7kN/m$	2.84%
Bending moment in middle of span from uniform load	$39.29kN/m$	$40.3kN/m$	2.58%
Horizontal force from uniform load	$11.91kN$	$11.6kN$	2.56%
Bending moment in frame corners from point load	$13.94kN/m$	$13.01kN/m$	2.86%
Bending moment in middle of span from point load	$24.11kN/m$	$24.49kN/m$	1.59%
Horizontal force from point load	$4.46kN$	$4.3kN$	3.68%

Table 3.3: Results of verification between model and hand calculations. The error was deemed to be sufficiently small.

The differences between the obtained value from the two-dimensional beam model are assumed to be sufficiently small and the model is therefore deemed verified.

To verify the three-dimensional model, the results from the load case self-weight were compared between the 2D model and the 3D model. The bridge geometry described in appendix B was used. The width of the 3D model was 5 meters and the result was extracted from a longitudinal cut in the centre of the bridge. The results can be seen in figure 3.6. The difference between results is also here deemed sufficiently small, as the error in mid-span is 1.35 %.

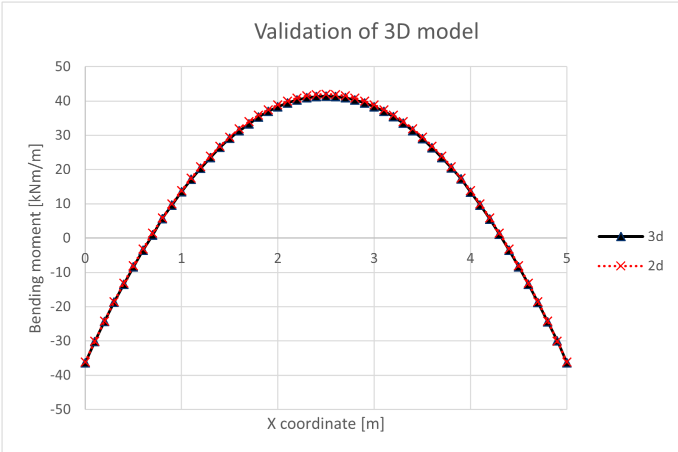


Figure 3.6: *Validation of 3D model by comparison of validated 2D model*

3.5 Study of existing bridges

A study of 7 portal frame bridges, detailed in appendix C, designed for the same design standards as the investigated bridge was analysed to determine some standard ratios. The goal was to determine commonly occurring ratios of different variables to validate what dimensions are prevalent in these types of bridges. The results of this analysis are used to refer the findings of the other studies to more common real-world examples, to minimise the risk of focusing on unrealistic designs. The results were also used to make realistic assumptions for some calculations, such as the smear length of concentrated loads.

Each bridge included in this study was analysed from the existing drawings to obtain different geometric parameters. Every bridge in the analysis is a portal frame bridge constructed in the time around 1960s. The parameters examined include: span length, bridge width, frame leg height, slab thickness as well as frame leg thickness. Also for each bridge, the depth of the neutral axis as well as the effective depth of the section was calculated.

3.6 Sensitivity analysis

In order to potentially minimise the variability of parameters in the parameter study, a sensitivity analysis was conducted. This analysis involved examining the impact of varying factors on the load effects experienced by a standard bridge, with the aim of interpreting their respective contributions to the outcomes. If both the one-way slab and three-dimensional model exhibit similar differences in results regardless of the altered variable, the variable will be omitted from the primary analysis. To thoroughly eliminate any potential discrepancies between the two analyses, the sensitivity analysis was conducted across three distinct bridge sizes: one of small dimensions, one considered standard, and one of large dimensions.

3.6.1 Procedure for sensitivity analysis

The sensitivity analysis, detailed in Appendix D, involved applying a point load to the midpoint of the span. Load effects were then computed and extracted from three specific bridge sections: the frame corner, the mid-span, and a segment subjected to maximum shear force. To mitigate stress concentrations resulting from the point loads, the procedure from Pacoste et al. (2012), described in Section 2.3.2.2, was implemented.

The point load assigned to the one-way strip model was set as four times smaller than the point load in the three-dimensional finite element model to obtain an approximately consistent answer between the models. This would be equivalent to a single type vehicle travelling alone in the middle of the bridge, as described in section 2.2.2.

3.6.2 Varied parameters

The frame leg height affects the stiffness of the frame legs, and could thus have an effect on the load effect results. In the sensitivity study, the height of frame legs was varied between the minimum and maximum lengths presented in table 3.1. The stiffness ratio between slab thickness versus frame leg thickness will also affect the stiffness of the structure.

The influence of applied bending stiffness in transversal direction was also analysed, as this could have a large influence on the final results of the parameter study.

All varied parameters as well as step size, minimum- and maximum values of parameters can be seen in table 3.4.

Varied parameter	**Minimum value**	**Maximum value**	**Increments**
Frame leg height	3 m	8 m	1 m
Ratio of thickness slab- vs. frame legs	0 [−]	1.3 [−]	0.1 [−]
Stiffness ratio	0.1 [−]	1 [−]	0.15 [−]

Table 3.4: Varied parameters in sensitivity study

3.7 Analysis of the difference in the moment- and shear load effects in 2D and 3D

In the main analysis of this study, the moment- and shear capacity of several iterations of a bridge is analysed. The three-dimensional model detailed in section 3.2.3 and the two-dimensional model from section 3.2.2 are used, as well as the assigned loads and boundary conditions in section 3.3.

Maximum load effects from the combined loads are analysed between the two models. The maximum load effects for the moment in the frame will occur either in the frame corner or in the middle of the span, so both of these positions are analysed. The maximum shear effect can be assumed to occur at a distance of 0.9 times the plate thickness from the frame leg when no haunches are included (Al-Emrani et al., 2019).

3.7.1 Mesh convergence study

A convergence study was performed to decide on the size of mesh required for each iteration of bridge in the 3D analysis. The convergence study compared the maximum deflection of all nodes to the total number of nodes in the model.

To avoid using the same size mesh for the small bridge models as well as the large bridge models, several different convergence studies were executed for different minimum lengths occurring on the analysed bridge. The model was tested for the lowest length occurring on the bridge, so the smallest parameter of length, width or frame leg height. The implication being that the model is thus tested for the biggest mesh for the smallest length of bridge. So, all bridges with a larger length that is analysed for the same mesh can also be assumed to have converged.

The results of the mesh convergence study can be seen in appendix E. The selected mesh sized for each bridge-length is presented in table 3.5.

Smallest length occurring	**Mesh size**
$l < 3m$	$0.10\ m$
$3m \leq l \leq 4m$	$0.125\ m$
$4m \leq l < 5m$	$0.15\ m$
$5m \leq l < 6m$	$0.175\ m$
$6m \leq l < 8m$	$0.20\ m$
$l \geq 8m$	$0.25\ m$

Table 3.5: Mesh size where convergence was obtained for different lengths occurring on bridge

4 Results

In this chapter, the results from the study of existing bridges, the sensitivity analysis as well as the parametric study are presented.

4.1 Results of study of existing bridges

The study of existing bridges performed on the different similar bridges is presented in appendix C. The results of this can be seen in the sections below, and are mostly presented as scatter plots with an upper and lower limit inserted.

4.1.1 Span length and width

For the old bridges, the span length and width are plotted in figure 4.1. In this figure, the studied bridges are represented by the blue dots. Upper and lower limits of the common relationship between upper and lower bound are drawn in as dotted red lines.

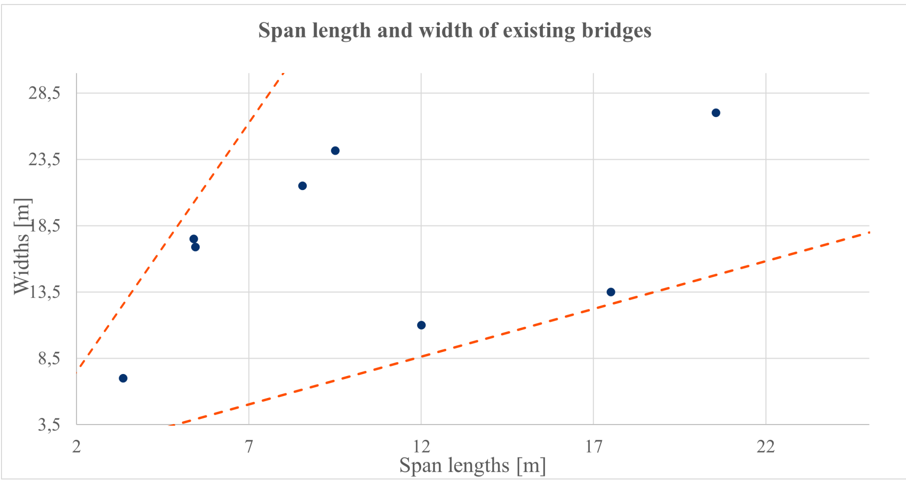


Figure 4.1: *Scatter plot of span length versus width of bridge. The blue dots represent the existing bridges studied and the red dotted lines represent the upper and lower bound of the relation between the parameters*

The equations for the limits are presented in equation 4.1 for the lower limit and 4.2 for the upper limit. Thus the assumption is that most bridges that exist in Sweden at this moment have a ratio of span between these two limits.

$$Width = 0.72 \times Span\ length \tag{4.1}$$

$$Width = 3.75 \times Span\ length \tag{4.2}$$

4.1.2 Frame leg thickness versus Slab thickness

The relationship between frame leg thickness and slab thickness is presented in figure 4.2.

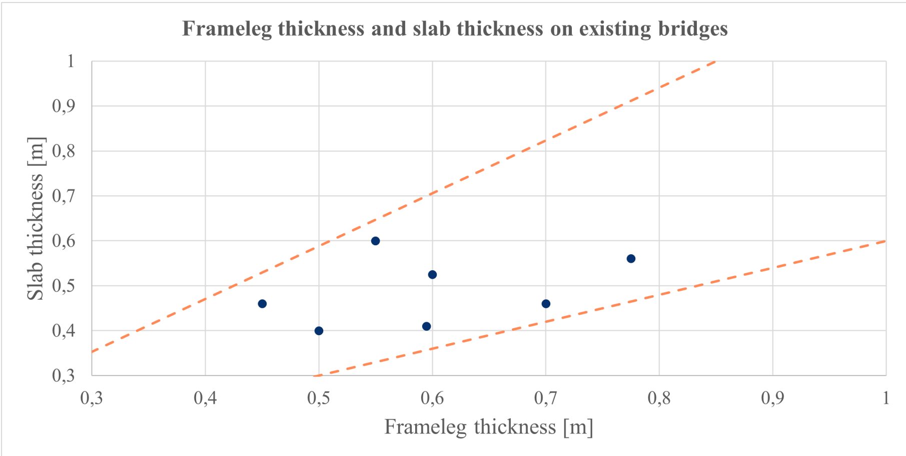


Figure 4.2: *Scatter plot of slab frame leg thickness and slab thickness of existing bridges. The blue dots represent the existing bridges studied and the red dotted lines are representing the upper and lower bound of the relation between the parameters*

The equations for the limits are presented in equation 4.3 for the lower limit and 4.4 for the upper limit. Thus the assumption is that most bridges that exist in Sweden at this moment has a ratio of span between these two limits.

$$Slab\,thickness = 0.6 \times Frameleg\,thickness \tag{4.3}$$

$$Slab\,thickness = 1.2 \times Frameleg\,thickness \tag{4.4}$$

4.1.3 Span length and frame leg height

The relationship between span length and frame leg height is presented in figure 4.2.

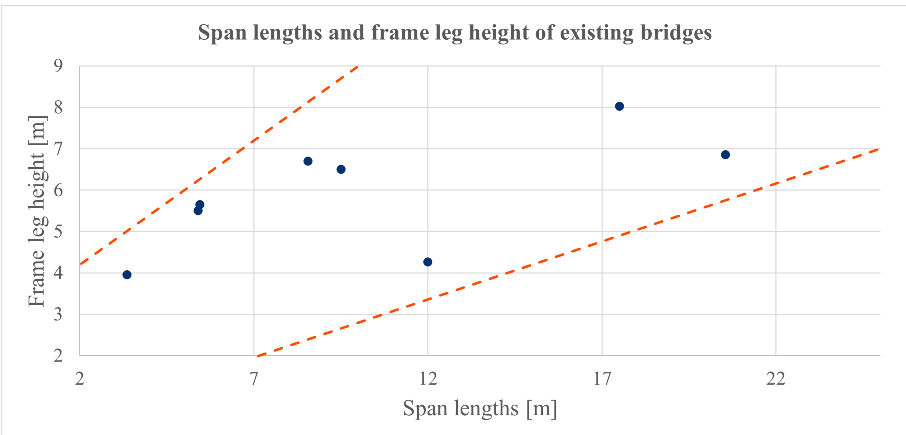


Figure 4.3: *Scatter plot of span lengths and frame leg height of existing bridges. The blue dots represent the existing bridges studied and the red dotted lines represent the upper and lower bound of the relation between the parameters*

The equations for the limits are presented in equation 4.5 for the lower limit and 4.6 for the upper limit. Thus the assumption is that most bridges that exist in Sweden at this moment have a ratio of span between these two limits.

$$Frameleg\ height = 0.28 \times Span\ length \tag{4.5}$$

$$Frameleg\ height = 0.9 \times Span\ length\ + 3m \tag{4.6}$$

4.1.4 Bending stiffness in the transversal direction over the bending stiffness in the longitudinal direction

An assumption of difference in bending stiffness is made by analysing the difference in reinforcement area in the longitudinal and transverse directions. The result for bending stiffness in the different directions for each analysed bridge is presented in figure 4.4.

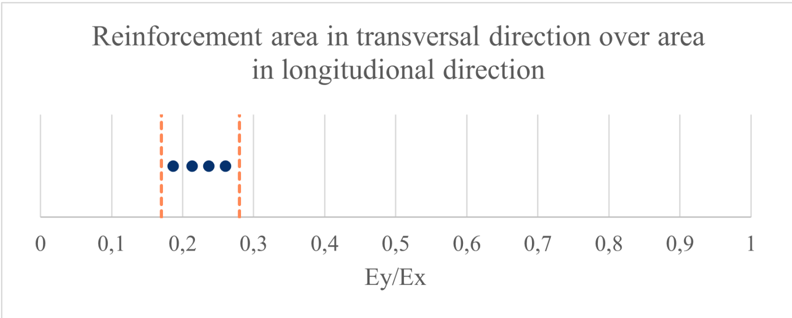


Figure 4.4: *Scatter plot of bending stiffness in transversal direction over bending stiffness in the longitudinal direction for each bridge included in the study. The blue dots represent each analysed bridge. The red dotted lines are upper and lower limit of the values found in existing bridges*

As seen in figure 4.5 most of the studied bridges have a relationship between bending stiffness at around 0.2. The lower limit of reinforcement area in the transversal direction over the area in the longitudinal direction is 19%, while the upper limit lies at 28% in this study.

4.1.5 Depth of neutral axis over the section effective depth

The result for the depth of the neutral axis over the effective depth of the section for each analysed bridge is presented in figure 4.5. These results are used to better approximate what assumptions are realistic to make when smearing out stress concentrations in the finite element model results.

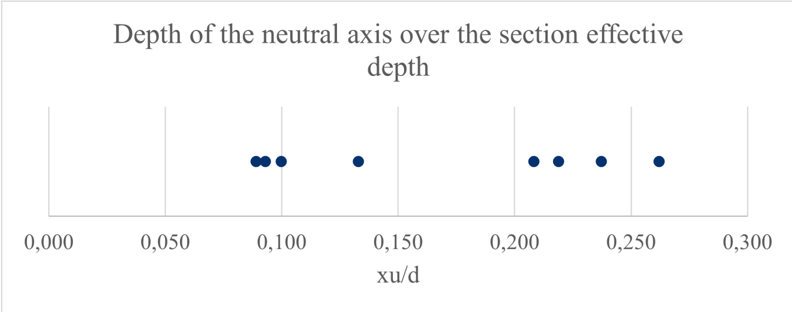


Figure 4.5: *Scatter plot of the neutral axis depth over effective depth for each bridge included in the study. The blue dots represent each analysed bridge. Most bridges have a relationship between the neutral axis and effective depth at around 0,1 or 0,2-0,25*

As seen in figure 4.5 most of the studied bridges have a relationship between neutral axis and effective depth at around 0.1 or between 0.2-0.25.

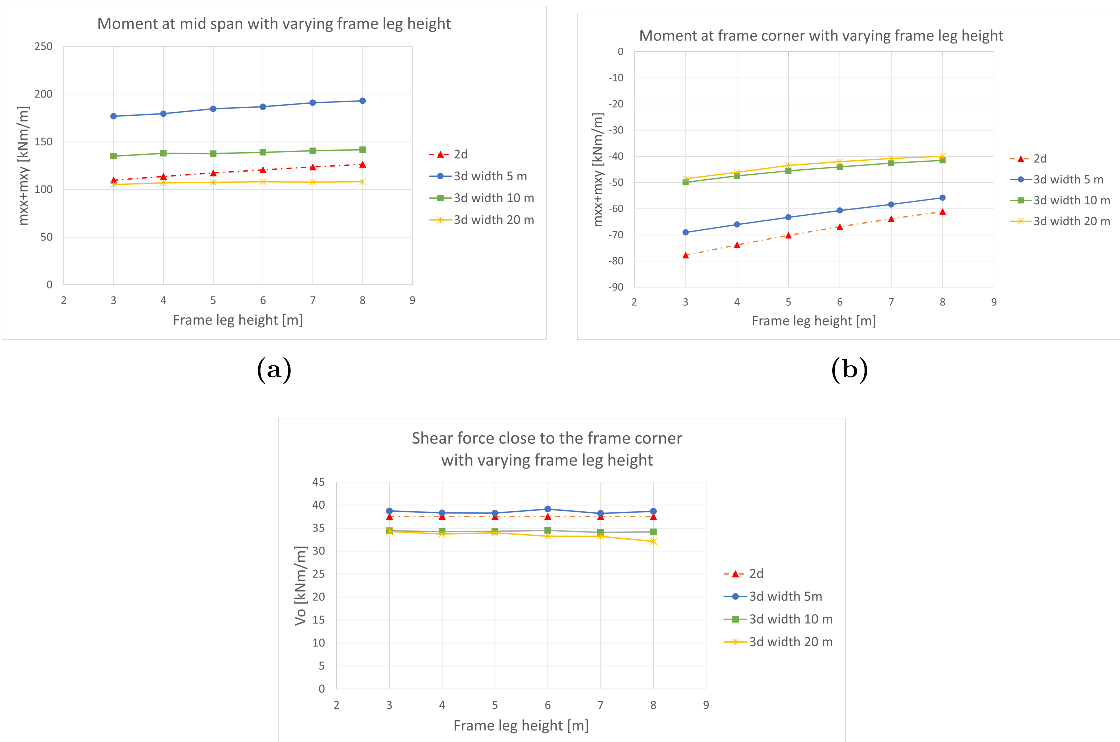
4.2 Results of sensitivity analysis

In this sensitivity study the height of the frame legs, the ratio between the slab thickness and frame leg thickness and the stiffness ratio (EI_y/EI_x) was varied between the minimum and maximum values presented in table 3.1. The analysis of the different bridges while varying separate parameters can be seen in appendix D, and the results are presented below.

4.2.1 Frame leg height

The frame leg height is varied between the models to determine any eventual difference between the results of the 2D and 3D models. To determine if the parameter frame leg height can be excluded from the main analysis, the deciding factor will thus be the difference in inclination of the change in load effects for the 2D model compared with the 3D models.

In figure 4.6 the results of the sensitivity analysis when frame leg height is changed are presented. The striped line represents the 2D model and the solid lines are the different 3D models of bridges with different widths.



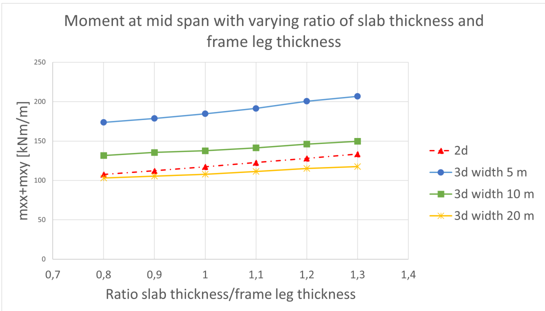
(a) (b) (c)

Figure 4.6: *Results of sensitivity analysis when changing frame leg height, for the moment in mid-span (a), frame leg corner (b) as well as maximum shear position (c). The 2D model is modelled using a striped line, while the three different 3D models are represented by solid lines. Only small differences between the inclination of the 2D model and 3D models can be seen.*

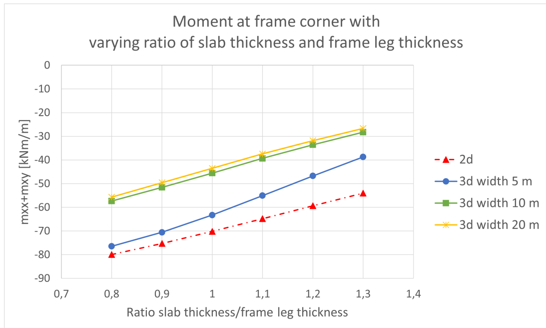
The sensitivity analysis indicate that the frame leg height will influence the results in a different way depending on the ratio between the length and the width. Although some differences in inclination of lines between the 2D and 3D models were observed, the differences were assessed to be sufficiently small to exclude the parameter varying frame leg height from the main analysis.

4.2.2 Ratio slab thickness and frame leg thickness

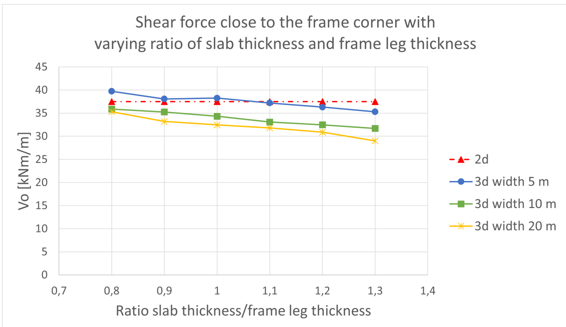
The ratio between slab thickness and frame leg thickness was varied in this section of the sensitivity analysis. The results of this can be seen in figure 4.7.



(a)



(b)



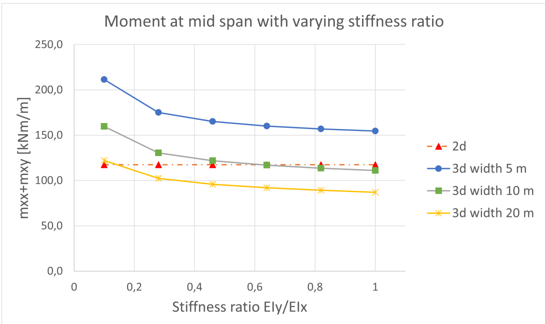
(c)

Figure 4.7: *Results of sensitivity analysis when changing ratio frame leg thickness and slab thickness, for the moment in mid-span (a), frame leg corner (b) as well as maximum shear position (c). The 2D model is modelled using a striped line, while the three different 3D models are represented by solid lines. The inclination between lines of the 2D model and the 3D models correspond mostly, however, some differences can be observed for the moment load effects for the bridges with a width of 5m.*

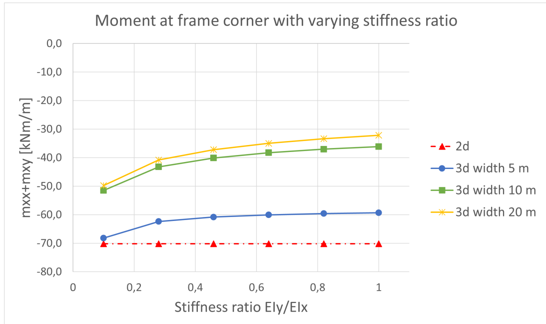
The sensitivity analysis indicates that the ratio of slab thickness and frame leg thickness have a similar changing rate in load effects between the 2D model and the 3D models. However, for the moment load effects the 3D bridge with a width of 5m behaves differently from the 2D model and the other bridges with different widths. In the frame corner, the moment load effects increase exponentially from the 2D model, which will lead to the 3D model showing higher moment effects compared to the 2D model if the ratio between slab thickness and frame leg thickness is higher than one on the analysed bridge.

4.2.3 Stiffness distribution in transversal direction

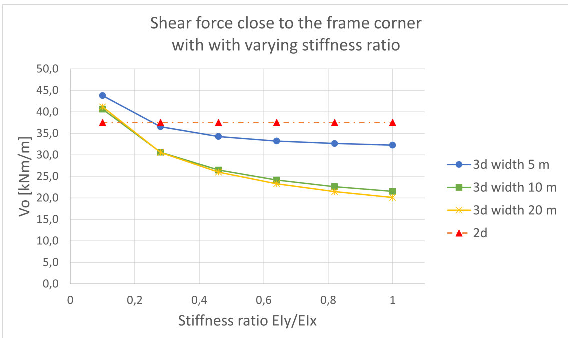
In the sensitivity analysis the load distribution in the slab when changing the ratio between the slab thickness and the frame leg thickness is also analysed, the results of this can be seen in figure 4.8. The striped line represents the 2D model and the solid lines are the different 3D models of bridges with different widths.



(a)



(b)



(c)

Figure 4.8: *Results of sensitivity analysis when changing stiffness distribution in transversal direction, for moment in mid-span (a), frame leg corner (b) as well as maximum shear position (c). The 2D model results are presented using a striped line, while the three different 3D models are represented by solid lines. The difference between the 2D model and the 3D models can be relevant to the result if there are almost no transversal stiffness*

The sensitivity analysis of changing stiffness distribution shows a minor difference in inclination of the plots between the 2D model and 3D models, except for when the stiffness ratio is below approximately 20% were a more distinct difference can be observed. From the results of the study of existing bridges we know that most portal frame bridges have values around 20% or over, however, if a bridge that is studied is assumed to have a lower stiffness distribution, there could be some additional differences between the 2D and 3D models.

4.3 Results of analysis of the difference in the moment- and shear load effects in 2D and 3D

In this section, the results of the main analysis are presented, where the moment- and shear load effects are analysed for different bridge geometries.

From the results of the sensitivity analysis, a decision was made to only vary the length and width of the bridge in the analysis, since the other parameters only occasionally had a discrepancy between 2D and 3D. The frame leg height is therefore set as 5 meters throughout this analysis. The slab thickness and frame leg thickness is set to 0.5 meters and the stiffness ratio (EI_y/EI_x) is set to 20%. The width and length of the bridge will in this analysis vary between the values presented in table 3.1. The depth of the neutral axis over the effective depth of the section is in all studied bridges set to 0.3. This choice was made as a conservative assumption based on the values of the existing bridges presented in figure 4.5.

An example of results from SOFiSTiK on an arbitrary bridge geometry in the 2D analysis can be seen in appendix F. The same results from a SOFiSTiK report for the 3D analysis is presented in appendix G.

The findings from the main analysis are in this chapter illustrated as contour plots, data points are denoted as red crosses. Values between the data points are extrapolated values. In appendix H the values derived from the analysis are presented. In the original analysis, ten different widths evenly distributed between 3.5 and 17 meters were evaluated. In order to enhance the resolution where the shift between decreasing ratio and increasing ratio appears two additional widths were added to the analysis. One at 5.9 meters and another at 6 meters, the reason for choosing these widths was that for widths over 6 meters an additional traffic lane, which is assumed to have a substantial impact on the results is added in the 3D analysis.

4.3.1 Difference in moment- and shear effects, A-values

In figure 4.9 the difference in maximum load effects for the moment in the middle of the span between the 2D model and 3D model is presented for type vehicle A.

Figure 4.9 illustrates that for narrow bridges the ratio of 3D over 2D starts at around 1-3-1.5 for bridges with a width of 3 meters. The ratio is then gradually decreasing towards 1.0-1.2 for bridges with a width approaching 6 meters. At a width of 6 meters, when one more traffic lane is added in the 3D analysis a distinct boundary for the load effect ratios can be seen and the ratio is rapidly increasing to 1.3-1.7. For bridges with widths larger than 6 meters, the ratio decreases when the widths of the bridges increase, a gradual decrease of the ratio can be seen until the ratio is stabilised around 0.9-1.1 for bridges wider than 9.5 meters. It can be observed that the load effect ratio for bridges generally decreases with increasing length except for bridges with a span length below 5 meters where the trend is the opposite.

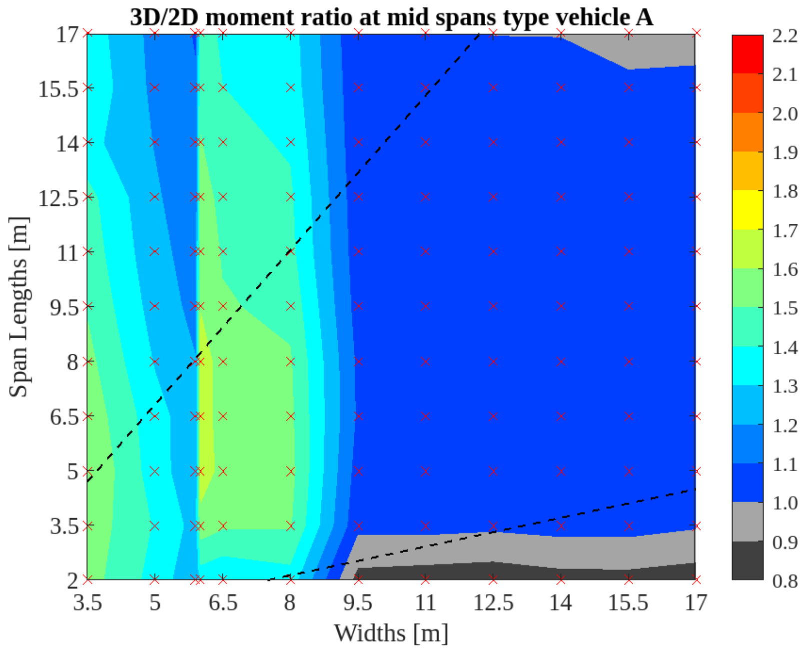


Figure 4.9: *Difference in moment load effect between the 2D and 3D analysis in the middle of the bridge span for type A vehicles. The colour represents the relative difference between the 3D model compared to the 2D model, and the striped lines represent the upper and lower limit of common ratios from chapter 4.1.1.*

The difference in maximum load effects for the moment in the frame corner between the 2D model and 3D model is presented in figure 4.10.

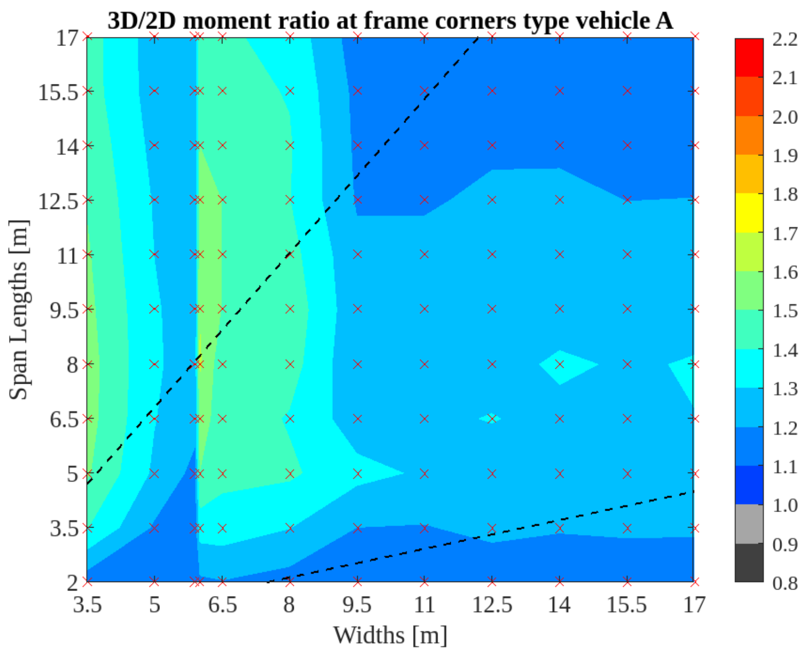


Figure 4.10: *Difference in moment load effect between the 2D and 3D analysis in the frame corner for type A vehicles. The colour represents the relative difference between the 3D model compared to the 2D model, and the striped lines represent the upper and lower limit of common ratios from chapter 4.1.1.*

In figure 4.10 it is observable that the 3D over 2D moment ratio for the frame corners displays a similar pattern as the ratio for the mid-span presented in figure 4.9. For bridges with a width of 3.5 meters, the ratio initiates at 1.0-1.6 varying depending on the bridge length, and then gradually decreases towards 1.0-1.2 as the width approaches 6 meters. For bridges wider than 6 meters, the ratio begins at 1.1-1.6 and gradually decreases as the width increases and stabilises around 1.0-1.2 for bridges wider than 9.5 meters.

In figure 4.11 the difference in maximum load effects for shear in a critical section between the 2D model and 3D model is presented.

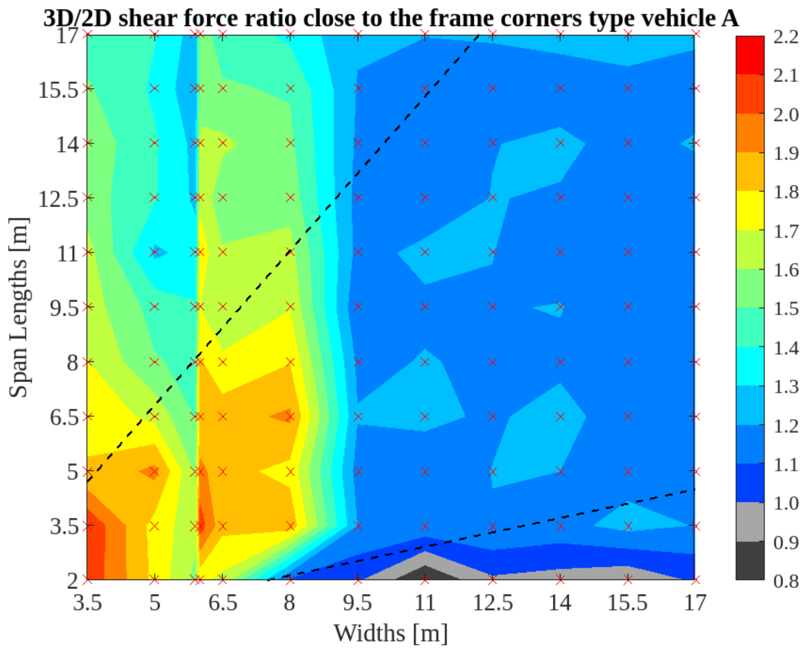


Figure 4.11: *Difference in shear load effect between the 2D and 3D analysis in a critical section for type A vehicles. The colour represents the relative difference between the 3D model in comparison to the 2D model, and the striped lines represent the upper and lower limit of common ratios from chapter 4.1.1.*

Figure 4.11 shows that for bridges with a width of 3.5 meters, the ratio 3D over 2D initially varies between 1.4-2.2 depending on the span length of the bridges. When the width increases the ratio gradually decreases until the width are approaching 6 meters where the ratio is in the range of 1.1-1.7. For bridges with a width of 6 meters, the ratio begins at 1.5-2.2 and as the bridge widths increases the ratio decreases. For bridges wider than 9.5 meters, the ratio stabilises around 1.0-1.3. In general, the ratio decreases with increasing length, except for bridges wider than 5.9 meters and a span length below 5 meters where the relation is the opposite.

4.3.2 Difference in moment- and shear effects, B-values

In figure 4.12 the difference in maximum load effects for the moment in the middle of the span between the 2D model and 3D model is presented.

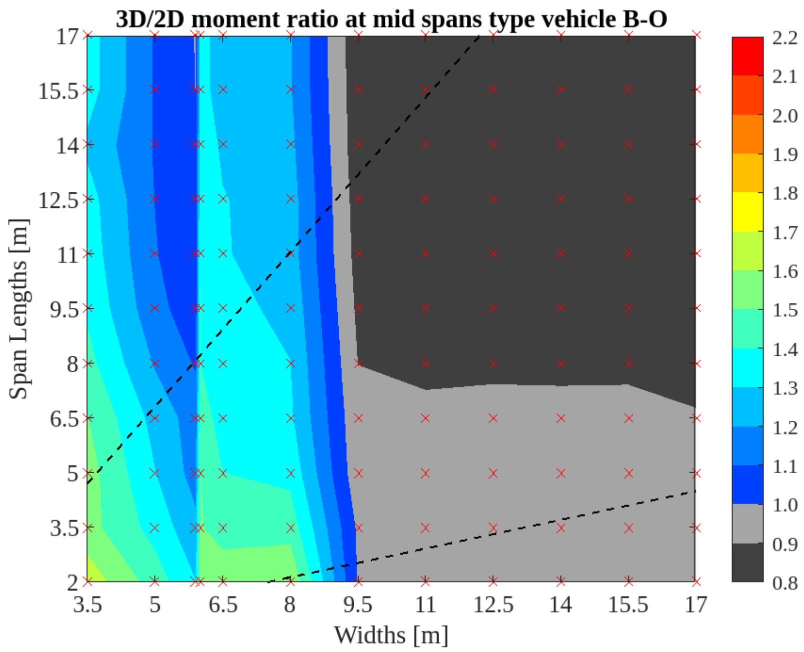


Figure 4.12: *Difference in moment load effect between the 2D and 3D analysis in the middle of the bridge span for type B-O vehicles. The colour represents the relative difference between the 3D model in comparison to the 2D model, and the striped lines represent the upper and lower limit of common ratios from chapter 4.1.1.*

Figure 4.12 shows that the ratio begins around 1.3-1.7 for bridges with a width of 3.5 meters. As the width increases the ratio decreases until the width approaches 6 meters where the ratio is in the range between 1.0-1.2. When the width is 6 meters a distinct boundary can be seen and the 3D over 2D ratio varies between 1.3-1.6. As the bridge gets wider than 6.0 meters the ratio gradually decreases and for bridges with widths around 9.5 meters, the ratio stabilises around 0.8-1.0. The ratio is decreasing when the length is increasing.

In figure 4.13 the difference in maximum load effects for the moment in the frame corner between the 2D model and 3D model is presented.

As seen in figure 4.13 the ratio initially ranges from 1.1-1.6 for bridges with a width of 3.5 meters and then gradually decreases towards ratios of 1.1-1.3 as the width approaches 6 meters. When the width is 6 meters a distinct increase of the ratio occurs. For bridges with a width of 6 meters or wider the ratio decreases when the width increases and stabilises around 0.9-1.0 for bridges wider than 9.5 meters.

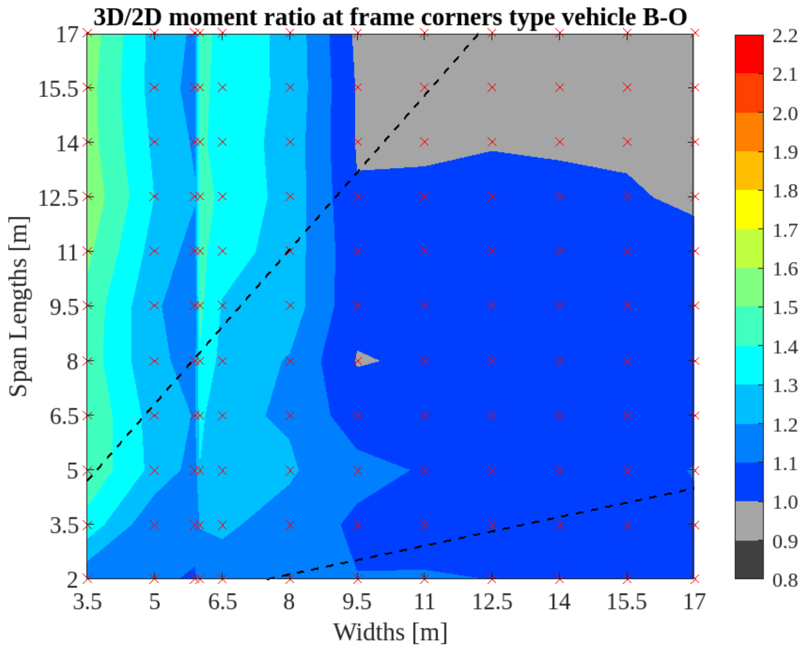


Figure 4.13: *Difference in moment load effect between the 2D and 3D analysis in the frame corner for type B-O vehicles. The colour represents the relative difference between the 3D model compared to the 2D model, and the striped lines represent the upper and lower limit of common ratios from chapter 4.1.1.*

The difference in maximum load effects for shear in a critical section between the 2D model and 3D model is presented in figure 4.14.

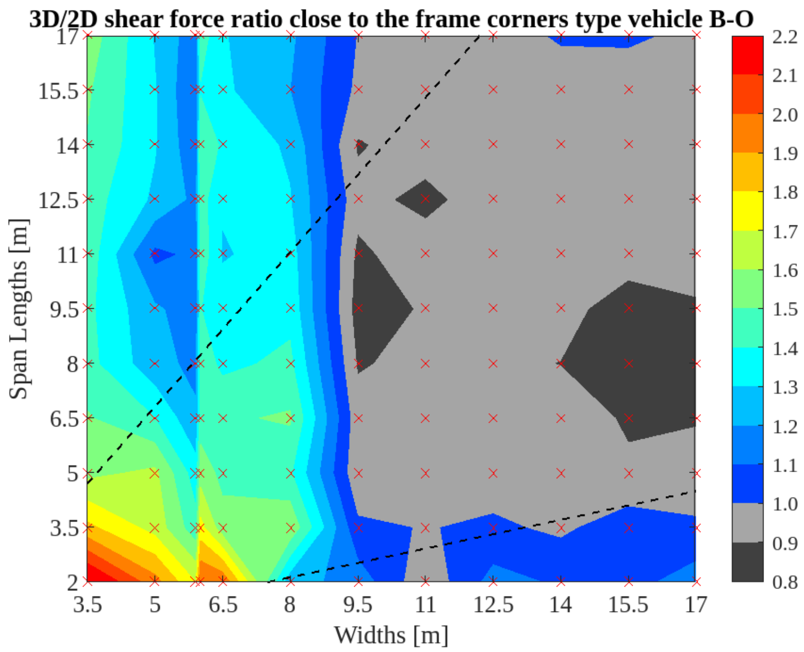


Figure 4.14: *Difference in shear load effect between the 2D and 3D analysis in a critical section for type B-O vehicles. The colour represents the relative difference between the 3D model compared to 2D model, and the striped lines represent the upper and lower limit of common ratios from chapter 4.1.1.*

As presented in figure 4.14 the ratio initially ranges from 1.4-2.2 for bridges with a width of 3.5 meters. As the width of the bridges increases, a gradual decrease in the ratio can be observed and when the width is approaching 6 meters the ratio varies between 1.1-1.7. At 6 meters the ratio increases to the range from 1.6-2.0. For widths of 6 meters and wider, the ratio decreases as the widths increase. The ratio stabilises around 0.8-1.0 for bridges wider than 9.5 meters and span lengths exceeding 3.5 meters.

5 Discussion

This chapter discusses the results of each study conducted in this thesis to evaluate and analyse conclusions and assumptions.

5.1 Geometric parameters of existing bridges

The study of existing bridges was included in this thesis to relate results from the analysis to real-world occurrences, to not focus the findings on bridge geometries that will not realistically often occur. The study was performed only on a small number of bridges, so the findings should be seen as indicative rather than definitive.

Most of the existing bridges analysed have span lengths in the lower half of the range we examined. This could skew the results for other analysed ratios, as the distribution might differ for bridges with longer spans for example. However, since the later analysis concentrated on length and width parameters, this skew is unlikely to significantly impact the results.

5.2 Sensitivity study

The sensitivity study performed, presented in section 4.2, shows that the varied parameters have mostly a minor impact. Nevertheless, some results varied, which are further discussed in the following sections.

5.2.1 Influence of the frame leg height

In chapter 4.2.1 the influence of a varied frame leg height was investigated in terms of differences in load effects for the 3D and 2D models, respectively. Even though the influence of a varied frame leg height was considered to be sufficiently small to exclude it from the main analysis it could impact the results of differences between 2D and 3D load effects. An increase in the frame leg height reduces the stiffness at the frame corners, which leads to a decrease in the moment at the frame corners and an increase in the moment in the mid-span. This is valid for both the 2D and the 3D model as can be seen in figure 4.6. However, there are some differences depending on the width of the bridge between the 3D and the 2D analysis in the magnitude of this phenomenon.

The 3D model will, as seen in the sensitivity analysis, show a slightly lower load effect in mid-span for wide bridges with higher frame legs and a higher load effect in frame corners, and vice versa with lower frame legs. However, these differences are considered relatively small.

5.2.2 Influence of the ratio between slab thickness and frame leg thickness

The impact of a changed ratio for the slab thickness over the frame leg thickness on the load distribution in the slab is presented in chapter 4.2.2. If the ratio increases, which implies a relatively thick slab compared to the frame leg thickness, the moment in the mid-span will increase while the moment at the frame leg will decrease. In figure 4.6 it is evident that this is valid for both the 3D and the 2D model.

For narrow bridges, the 3D model will show a lower moment load effect in the frame corner compared to the 2D analysis as seen in the sensitivity analysis. So if the analysed bridge can be considered narrow and has a frame leg thickness that is lower than the slab thickness, the 3D analysis will show a lower moment load effect in the frame corner. The other load effects can be determined to not have an impact on the difference between load effects in the different models.

5.2.3 Transversal bending stiffness

A source of uncertainty could be the assumption made of transversal bending stiffness versus the longitudinal bending stiffness made in the study. The choice was based on reinforcement areas in the two different directions in existing bridges, which will indicate the structural behaviour in ULS. This assumption presupposes that the bridge deck will crack in both the longitudinal and the transversal direction in ULS. To obtain a more accurate estimation of the stiffness as the bridge approaches ULS, a non-linear analysis would be necessary, which is out of the scope of this study. If the same stiffness had been used in both the transversal and longitudinal direction, as presented in figure 4.8, it would have resulted in a more even load distribution of point loads along the bridge deck due to better redistribution abilities of the slab. However, this would come with the cost of an increase of the moment in the transversal direction of the slab, which in many cases could cause the bridge to fail in the transversal direction when doing a load assessment of an existing slab frame bridge.

5.3 Differences between modelling methods

By examining the results, the overarching results show that for the narrowest bridges, those less than 9 meters wide, there is a significant difference in load effects between the 2D and 3D models. The 2D model consistently has a lower load effect for these narrow bridges in comparison to the 3D model. Consequently, the 2D model allows for a greater scaling of the A- and B-values, resulting in a higher capacity rating for the bridge. For wider bridges, the difference in load effects between the two models is less pronounced, and in some instances in common bridge ratios, the 3D model shows a lower load effect for the B-value.

When performing a capacity assessment the load effects arising from the traffic loads are scaled up to the total capacity of the bridge. In this analysis, the loads from both the permanent and traffic loads are analysed together. The difference in results will consequently indicate the extent of scaling feasibility. Nevertheless, should there be a discrepancy in the proportions between traffic loads and permanent loads from the one used in this analysis, it will impact the scaling potential accordingly.

5.3.1 Previous studies

The results of the study differ from the findings of the previous study mentioned in chapter 2.4. In the previous studies, when comparing a two-dimensional analysis to a three-dimensional analysis, the results showed an increase in load rating when using a three-dimensional model. However, for our study, the load effects on most analysed bridges were larger for the three-dimensional analyses rather than the one-way slab, which consequently would lead to a lower load rating. A reason for this discrepancy could be the differences in traffic load application between Sweden and the countries in which the studies were performed.

The relevant codes in Sweden, used in this analysis, apply more load on the three-dimensional models by for example applying two type vehicles for bridges over a certain width, while the other study compared the same type vehicles in load application in both models. Thus the 2D model in this study is subjected to different loads than the 3D model for widths over six meters, which is not the case in the previous study referenced. This difference in load applications could explain some of the discrepancies in results.

As the study by Davids et al. (2013) also showed that the 3D finite element model of a bridge showed good consistency to strains measured in the concrete when driving vehicles over an analysed bridge, the 3D model is thus considered to be more consistent with real load effects than the 2D model.

5.3.2 Distribution of traffic loads

The traffic load models described in chapter 2.2.2 permit to distribute the traffic load evenly across the entire three-meter lane width when performing a 2D analysis. If the width of a bridge is three meters this implies that when performing a 2D analysis, a perfectly even load distribution over the entire width of the bridge is assumed. In a real case, the applied point loads will result in larger internal forces close to the applied point loads. A 3D model provides a load distribution that more accurately reflects the real behaviour and consequently gives higher internal forces closer to the applied point loads. An example of this can be seen in figure 5.1. For narrow bridges this makes the 2D analysis more favourable compared to the 3D model in terms of giving lower load effects from the traffic loads, leading to a higher load rating. This implies that either the 2D model risks not being on the safe side, or the procedure for choosing a distribution width described in Pacoste et al. (2012) is overly conservative.

In figure 5.1 the bending moment in the bridge deck for one example bridge with a length of 5 meters and a width of 3 meters is presented. The fluctuation of the bending moment in the transversal direction, which is one of the reasons for the differences in results between the 2D and a 3D model is clearly illustrated.

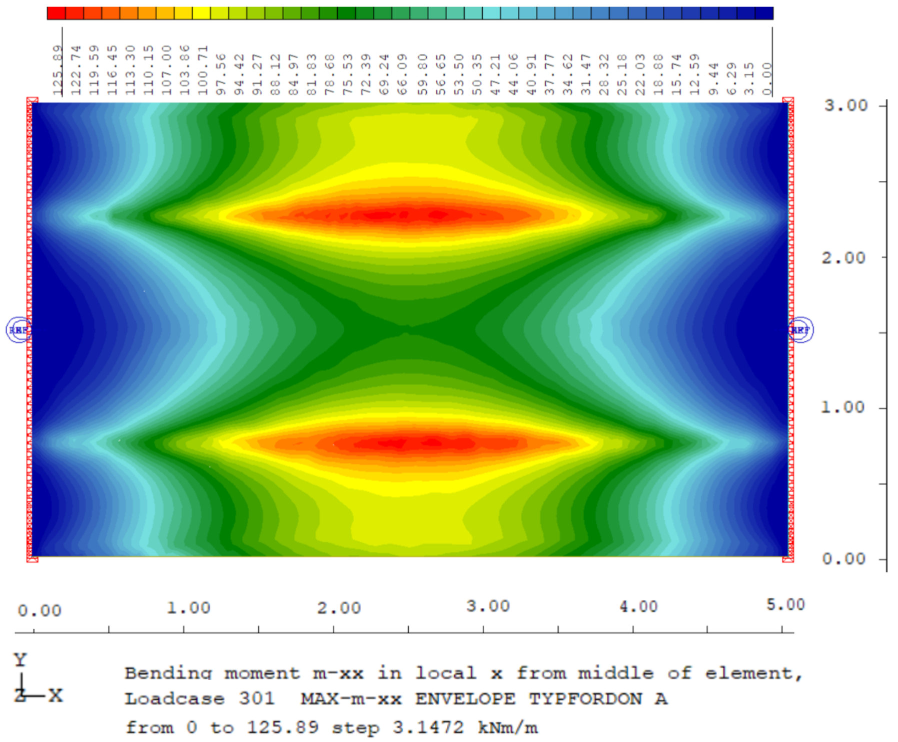


Figure 5.1: *Bending moment M_{xx}, in the bridge deck with load load from type vehicle A, positioned at mid span.*

5.3.3 Stress concentrations

To smear out unrealistic stress concentrations in regions near introduced point loads, a procedure described in chapter 2.3.2.2 was used to determine the distribution widths. The method requires a known ratio between the depth of the neutral axis and the effective depth of the section. The depth of the neutral axis is dependent on the reinforcement layout, which in the analysed bridges is unknown therefore a conservative assumption was made. Based on the results of the study of existing bridges presented in chapter 4.1.1 the ratio between the depth of the neutral axis and the effective depth of the section was in all studied bridges assumed to be 0.30. If the ratio of the depth of the neutral axis over the effective depth of the section is lower a larger distribution width would be allowed. Which will result in lower load effects in the 3D analysis.

5.4 Error regarding distribution widths

After the result chapter was finished, a mistake regarding the distribution widths for smearing out stress concentrations was detected. A procedure described by Pacoste et al. (2012) was used, but by mistake the width of the bridge was used instead of the span length when determining the distribution widths. To comprehend to what extent this mistake affects the results, a comparison was made for five bridges. The magnitude of the error in the distribution widths increases as the difference between the span length and the width of the bridge increases. To compare the difference in load effect between the original and corrected distribution widths, where the error is expected to be the largest, four of the chosen bridges have a significant difference between the length and the width. The result of the comparison between the original and updated values can be seen in table 5.1

	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B
Length [m]	14		17		11		2		5	
Width [m]	3,5		5,9		6,5		14		17	
Distribution width moment original [m]	1		1,18		1,3		2,5		2,5	
Distribution width moment corrected [m]	2,5		2,5		2,2		1		1	
Distribution width shear original [m]	1		1,18		1,3		1,75		2,5	
Distribution width shear corrected [m]	2,5		2,5		2,2		1		1	
Shear load effect original [kN/m]	266,24	442,01	287,53	439,8	252,1	358,52	56,14	62,04	110,14	121,43
Shear load effect corrected [kN/m]	251,43	419,15	271,38	425,39	236,68	342,29	60,33	66,07	127,39	132,22
Moment load effect original [kNm/m]	462,06	684,41	524,09	743,86	352,92	470,78	27,86	30,97	95,33	103,31
Moment load effect corrected [kNm/m]	430,39	644,83	514,91	733,33	346,07	462,51	33,18	37,83	102,17	108,64
Difference shear load effect	-5,72%	-5,31%	-5,78%	-3,33%	-6,31%	-4,63%	7,19%	6,29%	14,52%	8,51%
Difference moment load effect	-7,10%	-5,96%	-1,77%	-1,43%	-1,96%	-1,77%	17,43%	19,94%	6,93%	5,03%

Table 5.1: *Moment load effect at mid span and shear load effect at a criticial section for original and corrected distribution widths*

In most cases the error is between 3-8% but the bridge with a length of 2 meters shows a difference in moment load effect of 20%. That the wrong distribution widths was used in the study adds an uncertainty of up to around 20% for some of the studied bridges, while other bridges depending on their geometry are unaffected. To get a better overview over the expected error for the studied bridges, the length over width ratio were plotted against the error between the original and corrected load effects, as shown in figure 5.2.

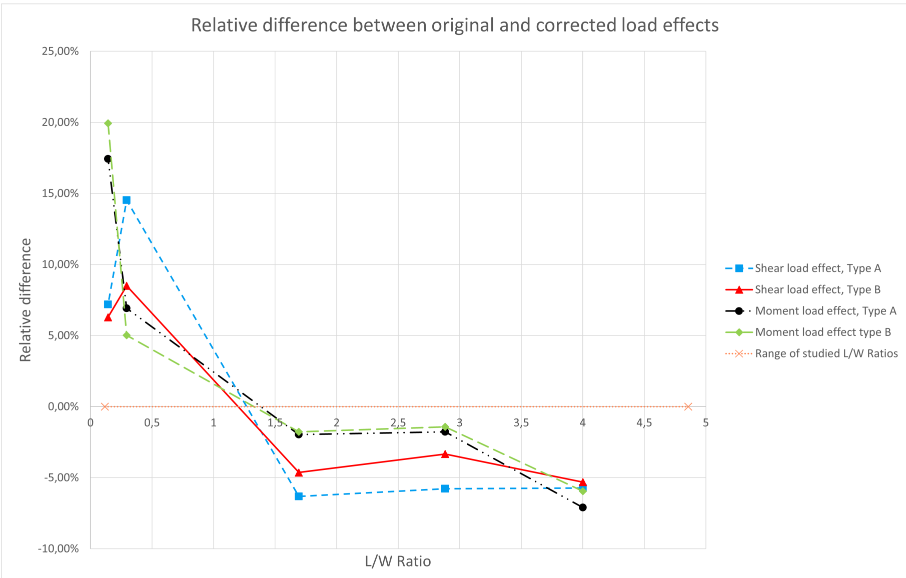


Figure 5.2: *Relative difference in moment load effect at mid span and shear load effect at a critical section between original and corrected distribution widths*

6 Conclusion

In this chapter the conclusions of the study are presented together with general guidelines for when to use either analysis method.

6.1 Difference in modelling choices

This study concludes that there are differences in capacity assessments when using 2D and 3D models. When starting the thesis, the hypothesis was that the 3D model would generally provide a higher load capacity assessment than the 2D model for most bridges, except for long and narrow bridges that resembled the response of a beam.

The study instead showed that the difference in capacity assessments depended primarily on the width of the bridge, rather than the width-length ratio. Drawing from the findings, this discrepancy partially depends on the load applications prescribed in Swedish standards, where more traffic load is applied to the 3D model than the 2D model. However, the results of this study are highly dependent on the chosen distribution width. Because of the error regarding this, the results are not conclusive, especially for shorter bridges with large widths.

In a 2D analysis, according to Swedish regulations, the distribution width is always assumed to be 3m. When comparing this value to the correct distribution widths in the 3D analysis from (Pacoste et al., 2012), as seen in table 5.1, the distribution width for a load is lower than 3m for all tested bridge types in that analysis. Based on this, a credible conclusion is that the 3D analysis will show more conservative results than the 2D analysis in many cases, and that the 2D analysis risks to not be on the safe side.

6.2 General guidelines

As discussed in chapter 5 the distribution widths for the point loads in the 3D model as well as the transversal stiffness could have a substantial impact on the result and have thus influenced the choice of model differently. It is therefore difficult to give recommendations based on the findings of this study. However, from the results of this study a 3D model is recommended to give a more realistic load distribution, and to avoid the risk of overestimating the load-bearing capacity of the bridge.

Note that when analysing a bridge that is as wide or wider than the span length, the frame leg height will have a small influence on the moment distribution over the frame corner as well as the mid-span. The 2D model will show a slightly higher load effect in the mid-span and a lower load effect in the frame corners compared to the 3D model, the discrepancy increases with increasing frame leg height as per the sensitivity analysis.

It should also be considered that if the slab thickness is higher than the frame leg thickness when analysing a narrow bridge, the moment load effects in the frame corners will show a higher discrepancy than in the figures from section 4.3, in accordance to the sensitivity analysis. The 2D model will show a higher load effect than the 3D.

6.3 Further studies

The study raised some questions for further studies on the subject. Some examples of extensions and further investigations of the study would be:

- Analysing the bending stiffness assumption in the transversal direction versus the longitudinal direction gives the most accurate representation of a bridge behaviour.
- Comparing the results of the linear elastic one-way slab analysis and three-dimensional analysis to the results of a plastic analysis, to compare the results of upper-limit and lower-limit capacities.
- Performing a non-linear analysis of concrete slabs loaded with point loads, where plastic rearrangements of moments and transverse forces are studied, as well as analysing the plastic rotations arising from this.

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A Applied loads and boundary conditions

Loads and Boundary Conditions

A.1 Self weight and permanent loads

Concrete and reinforcement in frame:

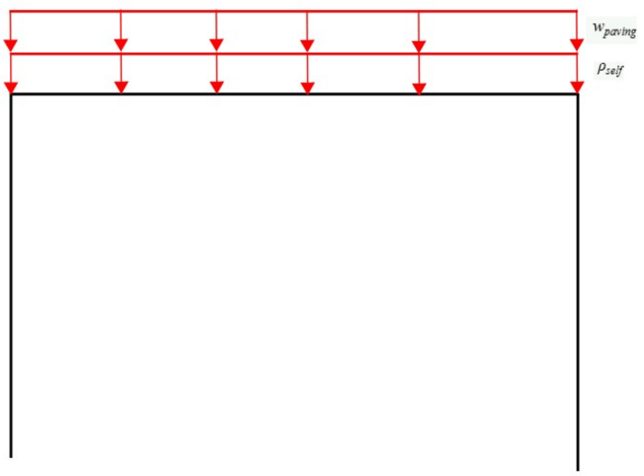
$\rho_{self} := 24 \ \frac{kN}{m^3}$ *TRVINFRA-00331 Table 8-1*

Paving:

$\rho_{paving} := 22 \ \frac{kN}{m^3}$ *TRVINFRA-00331 Chapter 8.2.2*
Assuming asphalt paving

$t_{paving} := 0.15 \ m$ Assuming a thickness of 150mm

$w_{paving} := \rho_{paving} \cdot t_{paving} = 3.3 \ \frac{kN}{m^2}$ Applied load to structure from weight of paving



B1.1 Applied loads from self weight and paving

A.2 Earth pressure:
Assuming sand above GWS

$\gamma_{sand.mf} := 18 \frac{kN}{m^3}$ *TRVINFRA-00331 Table 8-2*

$K_0 := 0.43$ Resting earth pressure coefficient

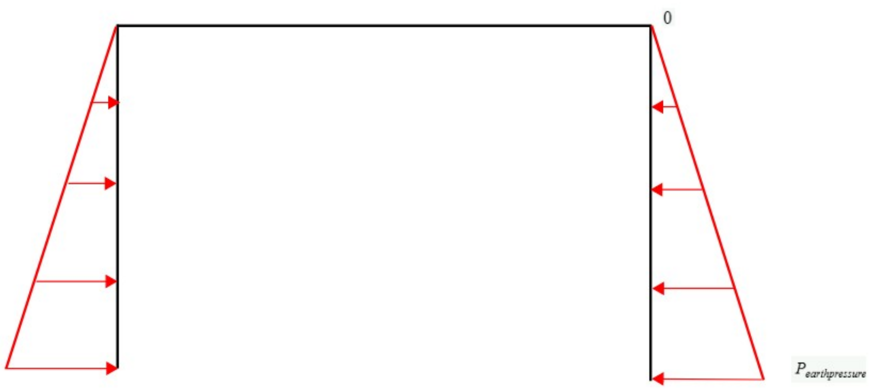
Disregarding effects of increased earth pressure caused by the movement of structural parts towards the soil, since the framelegs are assumed to be of equal height.

The the increased earth pressure from temperature and brake load because of structural part movement is not taken into account while performing a capacity assessment
TRVINFRA-00331 8.3.5

Assuming soil only on outside of framelegs

$x := 0 .. H_{frameleg}$

$P_{earthpressure} := \gamma_{sand.mf} \cdot K_0 \cdot H_{frameleg}$



B2.1 Applied loads from earth pressure

A.3 Vertical traffic load:

Type vehicles a) - o) *TRVINFRA-00331 Appendix 1*

As the span length of the bridge is shorter than 25m no consideration is made to the distance between type vehicles j, k and l as described in TRVINFRA-00331 K224831

The type vehicles are placed in traffic lanes with a width of 3m. The axles of the vehicles are always placed centrally within these. The number and placement of traffic lanes are for each iteration placed for the most unfavourable load effects acting on the analysed part of the structure. The maximum number of traffic lanes containing type vehicles is set to a maximum of two. One type vehicle is multiplied by a factor of 1 and the other type vehicle is reduced by a factor of 0.8.

The other load fields are loaded with the uniformly distributed load q

$q_{traffic} := 5 \frac{kN}{m}$

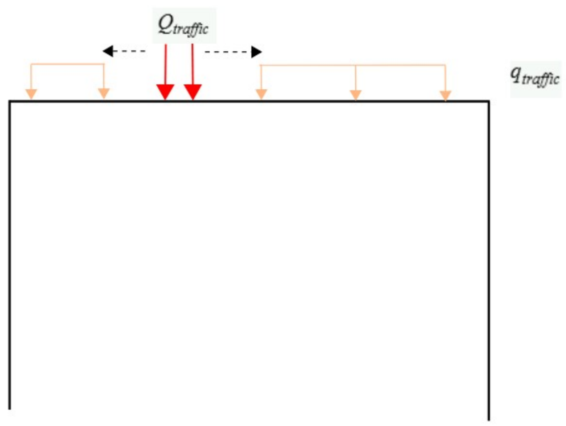
This load can be assigned either 0 or 5 kN/m and should be evenly distributed over the traffic lane

TRVINFRA-00331 8.3.2.2.1

The maximum number of load fields should be equal to the number that can be accommodated within the road, however no more than four.

When using the strip method one or several meter strips are analysed of the bridge. For road traffic bridges, 1/3 of the total traffic load from one load-field is applied on the strip. No consideration is taken for loads in adjacent traffic lanes.

TRVINFRA-00331 ch. 10.1.2.5.1



B3.1 Applied loads from traffic

A.3.1 Dynamic factor:

A dynamic contribution factor should be applied to all point loads from vehicle traffic.
TRVINFRA ch. 8.3.2.2.2

Determining length for dynamic amplification factor:
TRVINFRA-00331 appendix 2

For a portal frame bridge in one span: Should be considered as a continious bridge with three spans, where the frame legs are considered as one span each. The average value of the span lengths is multiplied with 1.3.

$$L_m := \frac{H_{frameleg} + L_{span} + H_{frameleg}}{3}$$

$$L_{det} := \max\left(1.3 \cdot L_m, H_{frameleg}, L_{span}\right)$$

Dynamic amplification factor:

$v := 80$ *Must be set to 80 km/h according to TRVINFRA-00331*

$$D_{dyn} := \frac{180 + 8 \cdot (v - 10)}{20 + L_{det}} \quad [\%]$$

The maximum dynamic factor should however not exceed 35%, so:
Where: $D_{dyn} \leq 35\%$

B.4 Load combination factors

For load combination A the corresponding used load coefficients for each load are presented here. The values for load coefficients are as in table 8-12 in TRVINFRA - 00331

Permanent loads:

$\psi\gamma_{self} := 1.2$

$\psi\gamma_{paving} := 1.2$

$\psi\gamma_{earthpressure} := 1.2$

Variable loads:

$\psi\gamma_{traffic} := 1.5$ / 0.7

The most unfavourable variable action load is assigned the higher value of the load coefficient, while the rest of the variable loads are assigned the lower value

TSFS:

Safety class 2: $\gamma_{d.2} := 0.91$ For bridges with span 15m

Safety class 3: $\gamma_{d.3} := 1$ For bridges with span over 15m

B Verification of model

Verification of model

To validify and verificate the results from our analysis the SOFiSTiK two-dimensional beam model was compared against hand calculations for a simple 2D rigid frame. The self weight of the structure was considered as well as a point load placed in the middle of the span.

The hand calculation equations used are the common rigid frame formulas for a symmetrical rectangular two-hinged frame (Kleinogel, A. 1980, s. 158).

Geometry:

$h := 3\ \mathbf{m}$	*Height of frame legs*
$L := 5\ \mathbf{m}$	*Span length*
$b := 1\ \mathbf{m}$	*Width of element, in our case assumed one metre strip*
$t_{slab} := 1\ \mathbf{m}$	*Thickness of slab*
$t_{frameleg} := 1\ \mathbf{m}$	*Thickness of frame leg*

Material parameters:

$\rho_{concrete} := 24\ \dfrac{\mathbf{kN}}{\mathbf{m}^3}$	*Self weight of reinforced concrete for bridges designed before 2002, From table 8-1 in 00331*

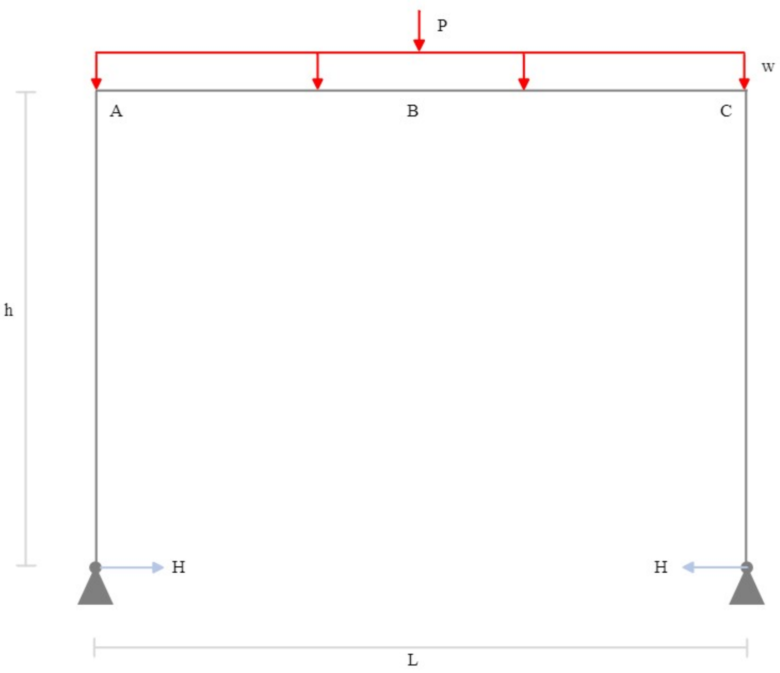
Applied forces:

$P := 30\ \mathbf{kN}$	*Point load*
$w := \rho_{concrete} \cdot (t_{slab} \cdot b) = 24\ \dfrac{\mathbf{kN}}{\mathbf{m}}$	*Distributed load from self-weight*
$I_{horisontal} := \dfrac{t_{slab} \cdot b^3}{12} = 0.083\ \mathbf{m}^4$	*Second moment of inertia of the slab*
$I_{vertical} := \dfrac{t_{frameleg} \cdot b^3}{12} = 0.083\ \mathbf{m}^4$	*Second moment of inertia of the framelegs*

Factors:

$$\alpha := \frac{h}{L} \qquad \beta := \frac{I_{horisontal}}{I_{vertical}}$$

Load model:



Load effects from uniform load, equations from Kleiogel, A. "Rigid frame formulas" (1980) page 158:

$$H_u := \frac{w \cdot L}{4 \cdot \alpha \cdot (2 \cdot \beta \cdot \alpha + 3)} = 11.905\ kN$$ *Horisontal force from uniform load*

$$M_{A.u} := \frac{w \cdot L^2}{4 \cdot (2 \cdot \beta \cdot \alpha + 3)} = 35.714\ kN \cdot m$$ *Bending moment in frame corners from uniform load*

$$M_{B.u} := \frac{w \cdot L^2}{8} \cdot \frac{(2 \cdot \beta \cdot \alpha + 1)}{(2 \cdot \beta \cdot \alpha + 3)} = 39.286\ kN \cdot m$$ *Bending moment in middle of span from uniform load*

Load effects from centric point load, equations as from Kleiogel, A. "Rigid frame formulas" (1980) page 158 :

$$H_P := \frac{3 \cdot P \cdot L}{8 \cdot h \cdot (2 \cdot \beta \cdot \alpha + 3)} = 4.464\ kN$$ *Horisontal force from point load*

$$M_{A.P} := \frac{3 \cdot P \cdot L}{8 \cdot (2 \cdot \beta \cdot \alpha + 3)} = 13.393\ kN \cdot m$$ *Bending moment in frame corners from point load*

$$M_{B.P} := \frac{P \cdot L}{8} \cdot \left(\frac{4 \cdot \beta \cdot \alpha + 3}{2 \cdot \beta \cdot \alpha + 3}\right) = 24.107\ kN \cdot m$$ *Bending moment in middle of span from point load*

Results from SOFiSTiK model:

Loads effects from uniform load:

$M_{A.U.FEM} := 34.7\ kN \cdot m$ — *Bending moment in frame corners from uniform load*

$M_{B.U.FEM} := 40.3\ kN \cdot m$ — *Bending moment in middle of span from uniform load*

$H_{U.FEM} := 11.6\ kN$ — *Horisontal force from uniform load*

Load effects from point load:

$M_{A.P.FEM} := 13.01\ kN \cdot m$ — *Bending moment in frame corners from point load*

$M_{B.P.FEM} := 24.49\ kN \cdot m$ — *Bending moment in middle of span from point load*

$H_{P.FEM} := 4.3\ kN$ — *Horisontal force from point load*

Difference between models:

$$Error_{MAU} := \text{abs}\left(\frac{M_{A.U.FEM} - M_{A.u}}{M_{A.u}}\right) = 2.84\%$$

$$Error_{MBU} := \text{abs}\left(\frac{M_{B.U.FEM} - M_{B.u}}{M_{B.u}}\right) = 2.582\%$$

$$Error_{HU} := \text{abs}\left(\frac{H_{U.FEM} - H_{u}}{H_{u}}\right) = 2.56\%$$

Since the differences between the model are small the model is considered validified

$$Error_{MAP} := \text{abs}\left(\frac{M_{A.P.FEM} - M_{A.P}}{M_{A.P}}\right) = 2.859\%$$

$$Error_{MBP} := \text{abs}\left(\frac{M_{B.P.FEM} - M_{B.P}}{M_{B.P}}\right) = 1.588\%$$

$$Error_{HP} := \text{abs}\left(\frac{H_{P.FEM} - H_{P}}{H_{P}}\right) = 3.68\%$$

C Study of existing portal frame bridges

A study of bridges designed from the same design standards is performed in this appendix. Drawings from the bridges were analysed and the results are presented below.

The results of the study will be used to make realistic assumptions for calculations as well as to relate the results to realistic dimensions and relationships. The relationships analysed in this study are:

- Span length versus width of the bridge
- Slab thickness versus frame leg thickness
- Span length versus frame leg height
- Difference in reinforcement area in longitudinal and transversal direction
- Depth of neutral axis over the section effective depth

The values for each of these parameters are read from existing drawings of these bridges, as well as some previous capacity calculations of these existing bridges.

The depth of the neutral axis is calculated for the ultimate limit state following the method presented in Al-Emrani et al. (2019) for cross-sectional response in pure bending. The calculation model assumes a linear variation of strains across the cross-section as well as that the embedded reinforcement is assumed to cooperate completely with the concrete. As the calculations are made in ULS non-linear material response is used for the steel and concrete. The influence of the strained concrete under the neutral layer is neglected.

C.1 Analysed bridges

Every bridge analysed in this study is presented in table form in this section. In order not to give out classified information in any way the real bridge numbers are replaced with a numbering unique for this study.

Bridge A:

Built:	1967
Width	17,5 m
Span length	5,4 m
Frame leg height	5,5 m
Thickness of slab	0,4 m
Frame leg thickness	0,5 m
Depth of neutral axis	0,033 m
Effective depth, d	0,355 m
xu/d	0,093

Bridge B:

Built:	1966
Width	16,9 m
Span length	5,45 m
Frame leg height	5,65 m
Thickness of slab	0,46 m
Frame leg thickness	0,45 m
Depth of neutral axis	0,0381 m
Effective depth, d	0,428 m
xu/d	0,089

Bridge C:

Built:	[-]
Width	21,5 m
Span length	8,55 m
Frame leg height	6,7 m
Thickness of slab	0,6 m
Frame leg thickness	0,55 m
Depth of neutral axis	0,062 m
Effective depth, d	0,622 m
xu/d	0,100

Bridge D:

Built:	[-]
Width	24,15 m
Span length	9,5 m
Frame leg height	6,5 m
Thickness of slab	0,525 m
Frame leg thickness	0,6 m
Depth of neutral axis	0,092 m
Effective depth, d	0,442 m
xu/d	0,208

Bridge E:

Built:	1973
Width	27 m
Span length	20,55 m
Frame leg height	6,854 m
Thickness of slab	0,56 m
Frame leg thickness	0,775 m
Depth of neutral axis	0,076 m
Effective depth, d	0,572 m
xu/d	0,133

Bridge F:

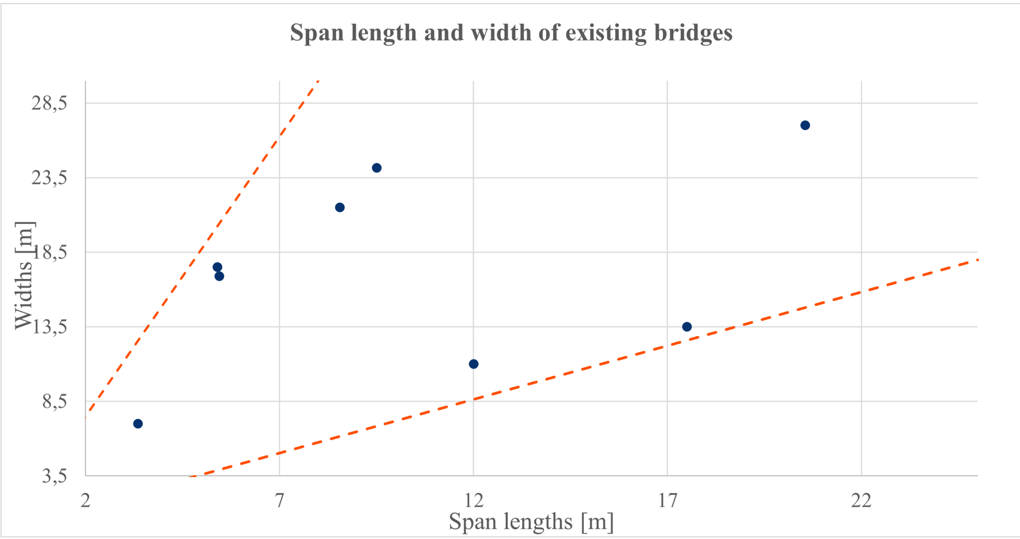
Built:	1932
Width	7 m
Span length	3,35 m
Frame leg height	3,95 m
Thickness of slab	0,2 m
Frame leg thickness	0,35 m
Depth of neutral axis	0,044 m
Effective depth, d	0,168 m
xu/d	0,262

Bridge G:

Built:	[-]
Width	13,5 m
Span length	17,5 m
Frame leg height	8,027 m
Thickness of slab	0,46 m
Frame leg thickness	0,7 m
Depth of neutral axis	0,102 m
Effective depth, d	0,43 m
xu/d	0,237

C.2 Span length and width

All bridges' span lengths versus their widths are plotted together here in the figure below. In this figure, the studied bridges are represented by the blue dots. The upper and lower limits of the common relationship between the upper and lower bound are drawn in as dotted red lines in the same figure.



The equations for the limits are presented in the equations below.

Lower limit:

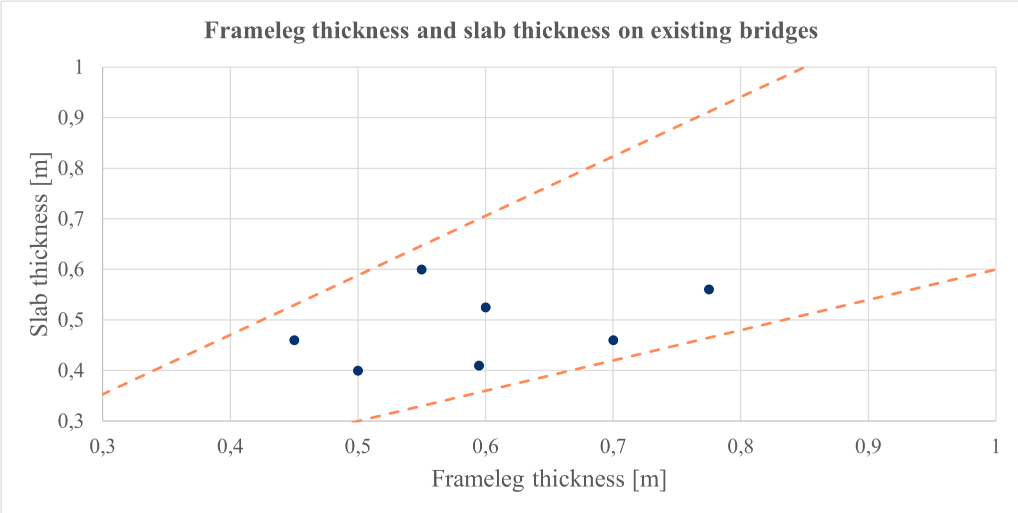
$$Width = 0.72 \times Span\ length \tag{C.1}$$

Upper limit:

$$Width = 3.75 \times Span\ length \tag{C.2}$$

C.3 Slab thickness versus Frame leg thickness

The relationship between slab thickness and frame leg thickness is presented in figure 4.2.



The equations for the drawn-in limits are presented in the equations below.

Lower limit:

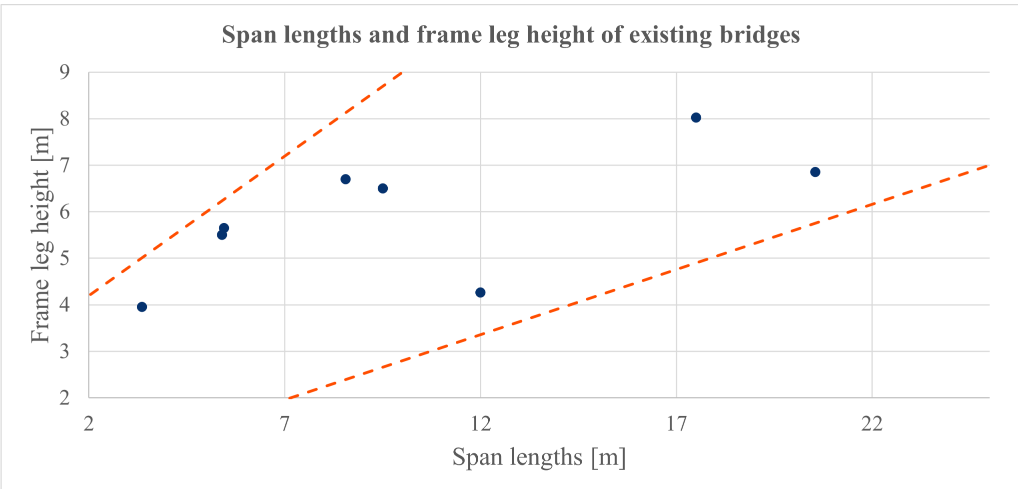
$$Slab\,thickness = 0.6 \times Frameleg\,thickness \tag{C.3}$$

Upper limit:

$$Slab\,thickness = 1.2 \times Frameleg\,thickness \tag{C.4}$$

C.4 Span length and frame leg height

The relationship between span length and frame leg height is presented in figure 4.2.



The equations for the limits are presented in equation 4.5 for the lower limit and 4.6 for the upper limit. Thus, the assumption is that most bridges in Sweden currently have a ratio of the span between these two limits.

Lower limit:

$$Frameleg\,height = 0.28 \times Span\,length \tag{C.5}$$

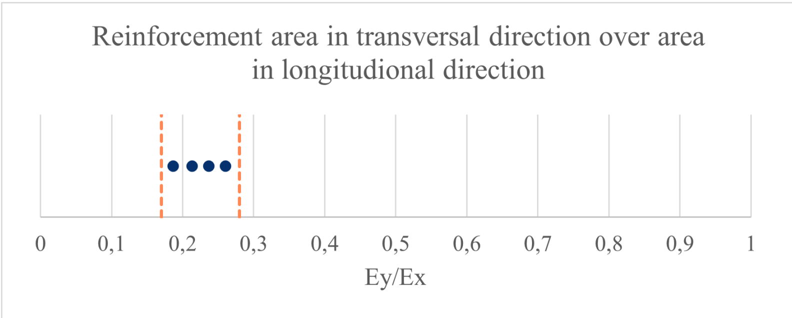
Upper limit:

$$Frameleg\ height = 0.9 \times Span\ length + 3m \tag{C.6}$$

C.5 Difference in reinforcement area

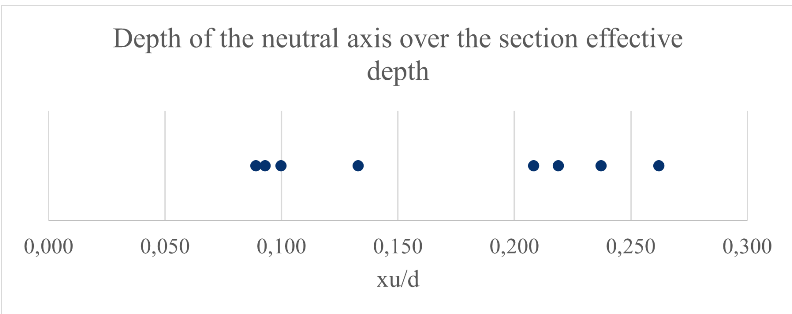
In a 3D finite element model, an assigned point load will be distributed evenly in longitudinal and transversal directions. In reality, the bridge will be stiffer in the longitudinal direction since most forces will be carried by the reinforcement, which is different in the two directions. Thus the ratio between the amount of reinforcement in longitudinal and transversal is of interest, to better model the real behaviour of the bridge.

In the figure below, every bridge included in the study where the information about transversal reinforcement could be found is plotted on a scale for their ratio between transversal and longitudinal reinforcement amount.



C.6 Depth of neutral axis over the section effective depth

The result for the depth of the neutral axis over the effective depth of the section for each analysed bridge is presented in the figure below.



D Sensitivity analysis

To investigate the possibility to exclude parameters from the parameter study, as well as studying the effects of each parameter a sensitivity analysis was conducted. The studied parameters in the sensitivity analysis were:

- Ratio between the plate thickness and the frame leg thickness
- Height of frame legs
- Applied stiffness in longitudinal versus transversal direction.

The sensitivity analysis aims to investigate how moment- and shear load effects are affected by the analysed parameters. If the increase or decrease of load effects are similar from both the 2D and 3D model, then the parameter can be excluded from the main parameter study. Thus, only the gradient of load effects of the two models are of interest in this study, the size of them is insignificant to the results.

Two effects are studied, the moment load effects that the reinforcement is designed for as well as the shear force load effects, since that is what will be relevant to the results of this master's thesis.

1.1 Bridge geometries

To thoroughly eliminate any potential discrepancies between the two analyses, the sensitivity analysis was conducted across three distinct bridge sizes in 3D: one with a width half of the span length, one with the same width as the span length and one with a width double the span length. The 2D model will thus remain constant while the different 3D models will be able to describe the behaviour of different types of bridge geometries.

The assigned original bridge geometries are described in table 1. For each analysis that variable will vary from the value assigned here, however the other parameters will remain constant.

Length [m]	10
Width [m]	3D: 5 / 10 / 20 2D: 1
Slab Thickness [m]	0.46
Frame leg thickness [m]	0.46
Fram leg height [m]	5
Stiffness ratio [-] (EIy/EIx)	0,2

Table 1- Assigned bridge geometries

1.2 Load case

A point load was placed in the middle of the span of each bridge. The point load assigned to the one-way strip model was set as four times smaller as the point load in the three-dimensional finite element model to obtain an approximately consistent answer between the models. This is done in accordance with an assumption described in section 2.2.2 in the main report. A detailed description of the assigned load as well as placement is described in table 2.

Type	Magnitude 3D	Position 3D (X, Y, Z)	Magnitude 3D	Position 2D (X, Z)
Point load	300 kN	$\left(\frac{L}{2},\frac{B}{2},0\right)$	75kN	$\left(\frac{L}{2},0\right)$

Table 2- Description of load case

1.3 Studied sections

The results from the sensitivity analysis were extracted and compared from three different sections. The sections were chosen to represent the section with maximum moment in the bridge deck [1], the section with maximum shear force in the bridge deck [2] and the section with the moment in the frame leg corner [3], see table 3.

Position	3D (X, Y, Z)	2D (X, Z)
Frame corner [1]	$\left(0,\frac{B}{2},0\right)$	$(0,0)$
Cut for maximum shear [2]	$\left(0.9 \cdot d + \frac{t_{frameleg}}{2},\frac{B}{2},0\right)$	$\left(0.9 \cdot d + \frac{t_{frameleg}}{2},0\right)$
Mid span [3]	$\left(\frac{L}{2},\frac{B}{2},0\right)$	$\left(\frac{L}{2},0\right)$

Table 3 – Studied sections

1.4 Convergence study

A convergence studies was conducted. To cover all the investigated bridges, the convergence study was performed on the smallest of the studied bridges. The same mesh size was then used for all the different bridge geometries in the sensitivity analysis. The bridge geometry is presented in table 4.

Length [m]	10
Width [m]	5
Frame leg height [m]	25
Slab Thickness [m]	0.46
Frame leg thickness [m]	0.46
Mesh size [m]	0.05–2

Table 4 Studied bridge geometry in convergence study

The load case considered in the convergence study was self-weight and the parameter studied was relative error for the minimum displacement compared with a converged solution with a mesh size of 0,05 m, see table 5 for the results from the convergence study.

Mesh size [m]	**Number of Nodes**	**Min displacement [mm]**	**Relative difference displacement %**
2	58	-30,4286	1,636996
1.5	81	-35,7974	1,962307
1.25	119	-49,5675	0,618843
1	133	-65,857	1,49534
0.8	206	-80,5529	0,861022
0.6	303	-140,556	0,417797
0.4	603	-304,91	0,252249
0.35	797	-388,816	0,237611
0.3	1048	-528,258	0,251984
0.25	1498	-733,41	0,135034
0.2	2239	-1127,7	0,063849
0.1	8369	-4230,22	0,014869

Table 5 – Relative error of maximum dispacement for different mesh sizes. The chosen mesh size is marked as red text.

The relative error of the minimum displacement compared with a converged solution with a mesh size of 0,05 m can be seen in figure A.

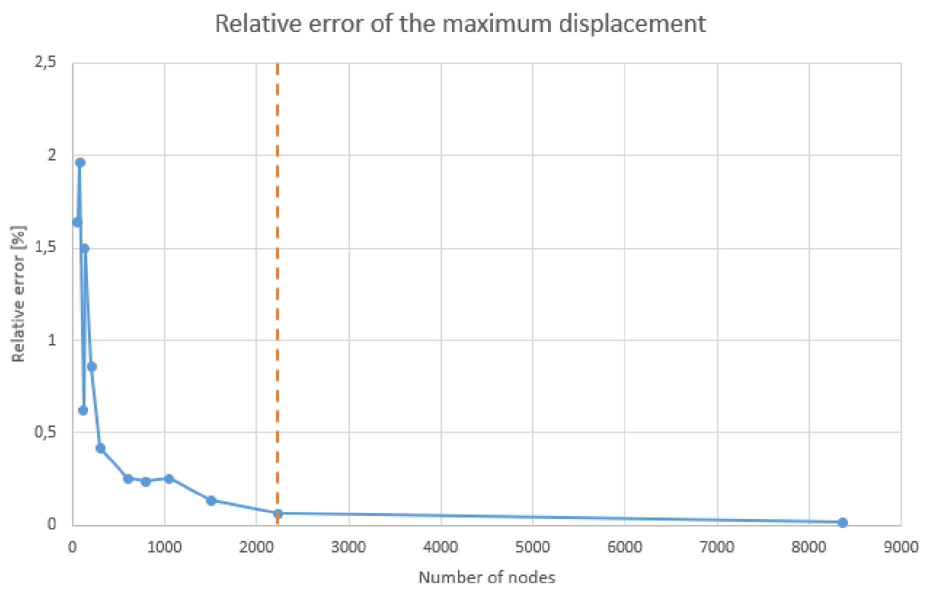


Figure A - *Convergence study. Number of nodes for chosen mesh size is marked as a red dotted line*.

A mesh size of 0.2 m was chosen from this convergence study, as marked by the red dotted line in figure A.

1.5 Boundary conditions

In the sensitivity analysis a simply supported frame were used both in the 2d and 3d case where all translational degrees of freedom at the supports were set to zero.

1.6 Frame leg height

The three different bridges were analysed for 6 different frame leg heights in both a 2D and 3D analysis. The frame leg heights were varied between three meters to eight meters with 1m increments. The results from the sensitivity analysis with different frame leg heights for both 2d and 3d in the section for maximum span moment are presented in figure B. The analysis of moment at frame corner is presented in figure C and the analysis of shear force in figure D.

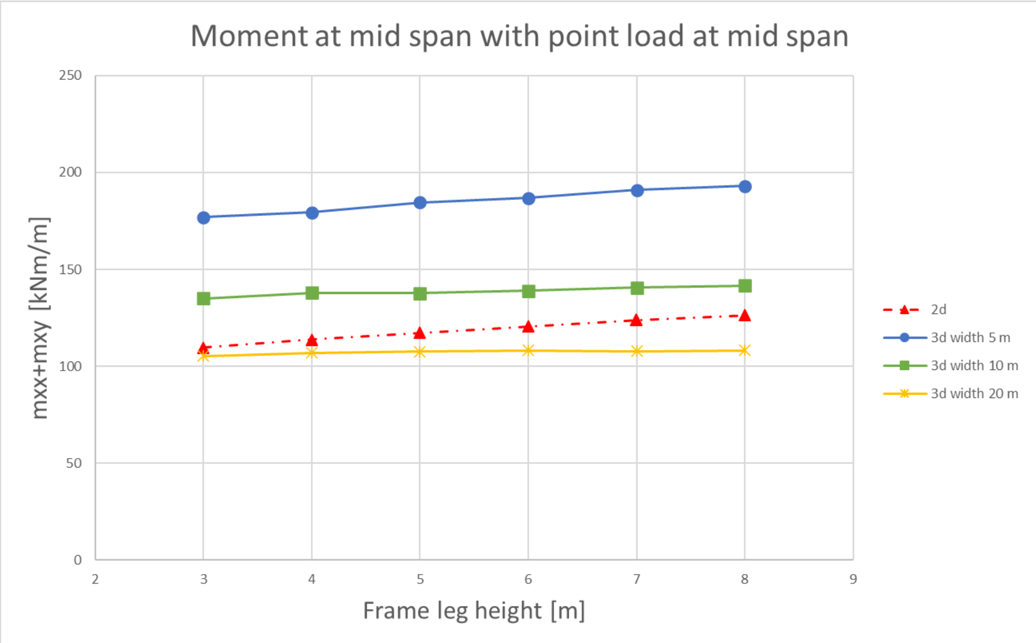


Figure B – Longitudinal moment load effect in middle of span. The figure shows a relatively small difference in inclination between 2D and 3D analysis.

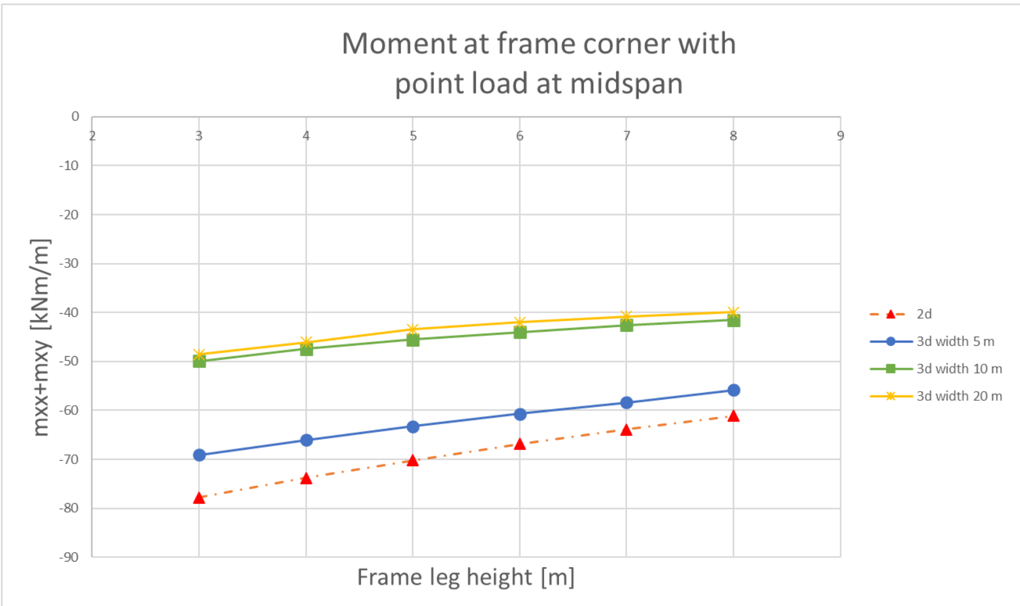


Figure C – Longitudional moment load effect in frame corner. The figure shows almost no difference in inclination between 2D and 3D analysis.

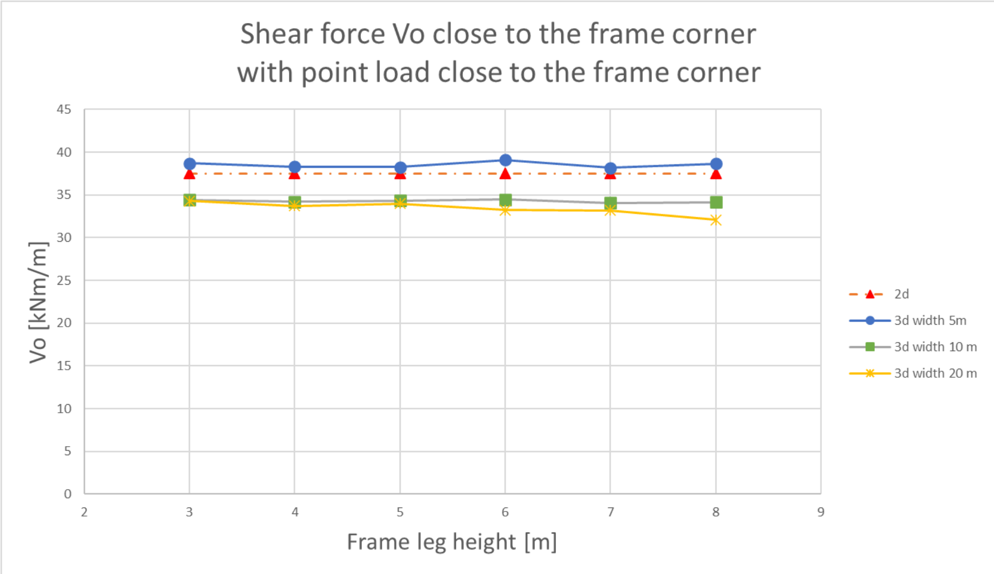


Figure D– Shear force load effect at worst position for shear for different frame leg heights. The figure shows no relative difference in inclination between 2D and 3D analysis.

The results in numbers are presented in tables 6, 7 and 8. These are the same values used in figure A, B and C.

Moment in middle of span [kNm/m]	Stiffness ratio EIy/EIx	0,1	0,28	0,46	0,64	0,82	1
Width = 5m	3D	176,8	179,5	184,6	186,8	191,0	193,0
	2D	109,7	113,7	117,3	120,6	123,7	126,4
Width = 10m	3D	135,1	137,9	137,7	139,0	140,6	141,7
	2D	109,7	113,7	117,3	120,6	123,7	126,4
Width = 20m	3D	105,3	107,0	107,5	108,2	107,8	108,2
	2D	109,7	113,7	117,3	120,6	123,7	126,4

Table 6 - Result sensitivity analysis in middle of span when frame leg height is changed

Moment in frame corner [kNm/m]	Stiffness ratio EIy/EIx	0,1	0,28	0,46	0,64	0,82	1
Width = 5m	3D	-69,0	-66,0	-63,3	-60,7	-58,4	-55,8
	2D	-77,8	-73,8	-70,2	-66,9	-63,8	-61,1
Width = 10m	3D	-49,9	-47,4	-45,5	-44,0	-42,5	-41,5
	2D	-77,8	-73,8	-70,2	-66,9	-63,8	-61,1
Width = 20m	3D	-48,5	-46,1	-43,4	-42,0	-40,8	-39,9
	2D	-77,8	-73,8	-70,2	-66,9	-63,8	-61,1

Table 7 - Result sensitivity analysis in frame corner when frame leg height is changed

Shear force close to frame corner [kN/m]	Stiffness ratio EIy/EIx	0,1	0,28	0,46	0,64	0,82	1
Width = 5m	3D	38,7	38,3	38,3	39,1	38,2	38,7
	2D	37,5	37,5	37,5	37,5	37,5	37,5
Width = 10m	3D	34,4	34,2	34,3	34,5	34,1	34,2
	2D	37,5	37,5	37,5	37,5	37,5	37,5
Width = 20m	3D	34,3	33,7	34,0	33,2	33,2	32,1
	2D	37,5	37,5	37,5	37,5	37,5	37,5

Table 8 - Result sensitivity analysis for shear close to frame corner when frame leg height is changed

1.7 Ratio between slab thickness and frame leg thickness

The three different bridges were analysed for 6 different ratios between frame leg thickness and slab thickness in both a 2D and 3D analysis. The ratios were varied between 0.8 to 1.3, with 0.1 increments. The results from the sensitivity analysis with different frame leg heights for both 2d and 3d in the section for maximum span moment are presented in figure E. The analysis of moment at frame corner is presented in figure F and the analysis of shear force in figure G. The results in numbers are presented in tables 9, 10 and 11.

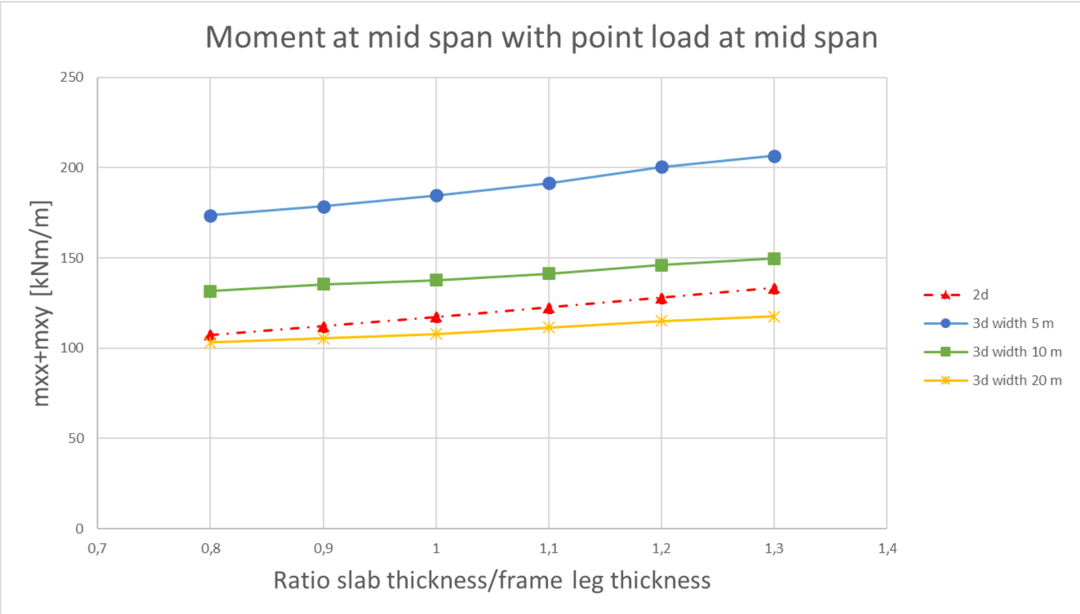


Figure E – Longitudinal moment load effect in middle of span. The figure shows almost no difference in inclination between 2D and 3D analysis.

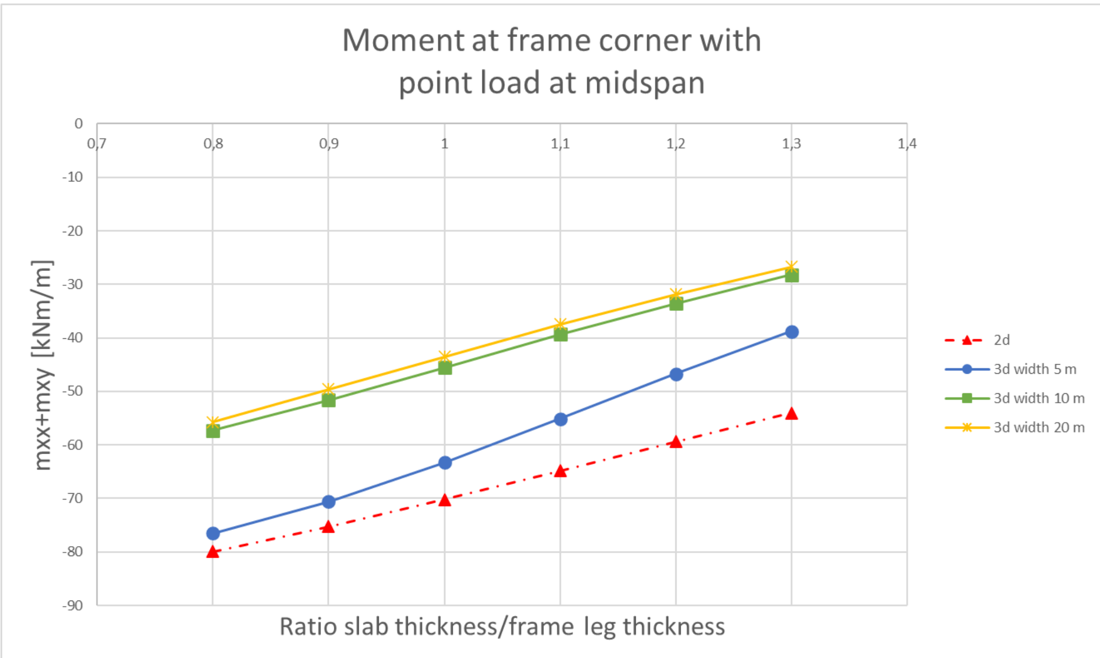


Figure F – Longitudinal moment load effect in frame corner. The figure shows a relatively small difference in inclination between 2D and 3D analysis for the narrowest bridge.

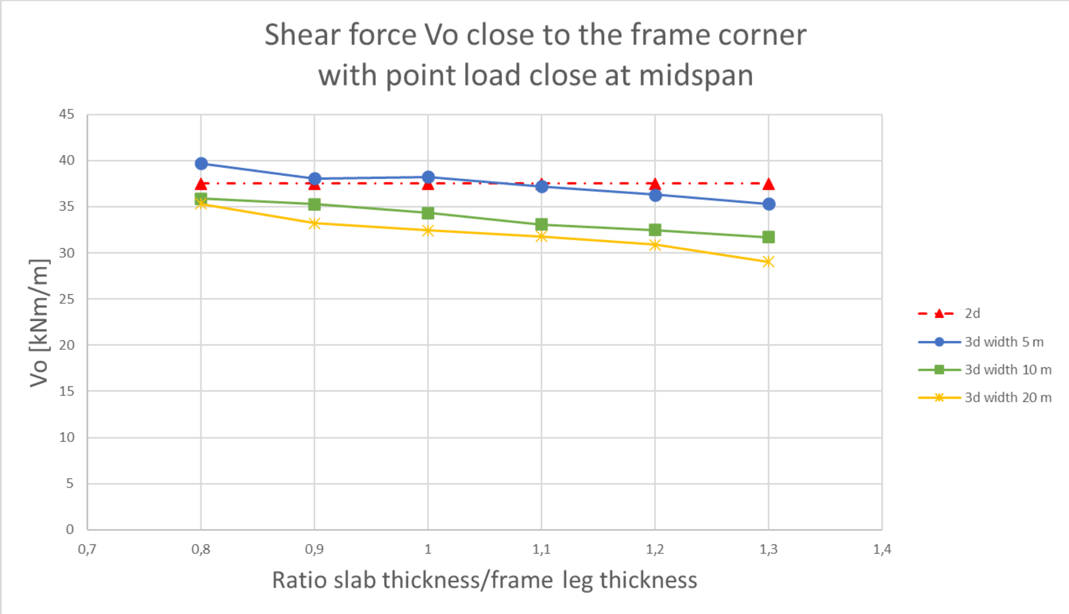


Figure G– Shear force load effect at worst position for shear for different frame leg heights. The figure shows a small difference in inclination between the 2D and 3D analysis.

Moment in middle of span [kNm/m]	Stiffness ratio EIy/EIx	0,1	0,28	0,46	0,64	0,82	1
Width = 5m	3D	173,7	178,6	184,6	191,4	200,6	206,6
	2D	107,6	112,2	117,3	122,7	128,1	133,5
Width = 10m	3D	131,6	135,5	137,7	141,4	146,1	149,8
	2D	107,6	112,2	117,3	122,7	128,1	133,5
Width = 20m	3D	103,2	105,5	107,9	111,4	115,2	117,7
	2D	107,6	112,2	117,3	122,7	128,1	133,5

Table 9 - Result sensitivity analysis in middle of span when stiffness ratio is changed

Moment in frame corner [kNm/m]	Stiffness ratio EIy/EIx	0,1	0,28	0,46	0,64	0,82	1
Width = 5m	3D	-76,5	-70,6	-63,3	-55,1	-46,7	-38,8
	2D	-79,9	-75,3	-70,2	-64,8	-59,4	-54,0
Width = 10m	3D	-57,3	-51,6	-45,5	-39,3	-33,6	-28,2
	2D	-79,9	-75,3	-70,2	-64,8	-59,4	-54,0
Width = 20m	3D	-55,7	-49,6	-43,5	-37,4	-31,8	-26,7
	2D	-79,9	-75,3	-70,2	-64,8	-59,4	-54,0

Table 10 - Result sensitivity analysis in frame corner when stiffness ratio is changed

Shear force close to frame corner [kN/m]	Stiffness ratio EIy/EIx	0,1	0,28	0,46	0,64	0,82	1
Width = 5m	3D	39,7	38,1	38,3	37,2	36,3	35,3
	2D	37,5	37,5	37,5	37,5	37,5	37,5
Width = 10m	3D	35,9	35,2	34,3	33,1	32,5	31,7
	2D	37,5	37,5	37,5	37,5	37,5	37,5
Width = 20m	3D	35,3	33,2	32,5	31,8	30,9	29,0
	2D	37,5	37,5	37,5	37,5	37,5	37,5

Table 11 - Result sensitivity analysis for shear close to frame corner when stiffness ratio is changed

1.7 Stiffness ratio

The three different bridges were analysed for 6 different ratios of bending stiffness ratio EI, since an old bridge will behave stiffer in the longitudinal direction than the transversal. The point of this analysis is to determine how big of an influence this assumption will have on the results. Analysed ratios were varied between 0.1 to 1, with 6 even increments between. The results from the sensitivity analysis with different stiffness ratios for both 2D and 3D in the section for maximum span moment are presented in figure H. The analysis of moment at frame corner is presented in figure I and the analysis of shear force in figure J. All values from the analysis are presented in table 12, 13 and 14.

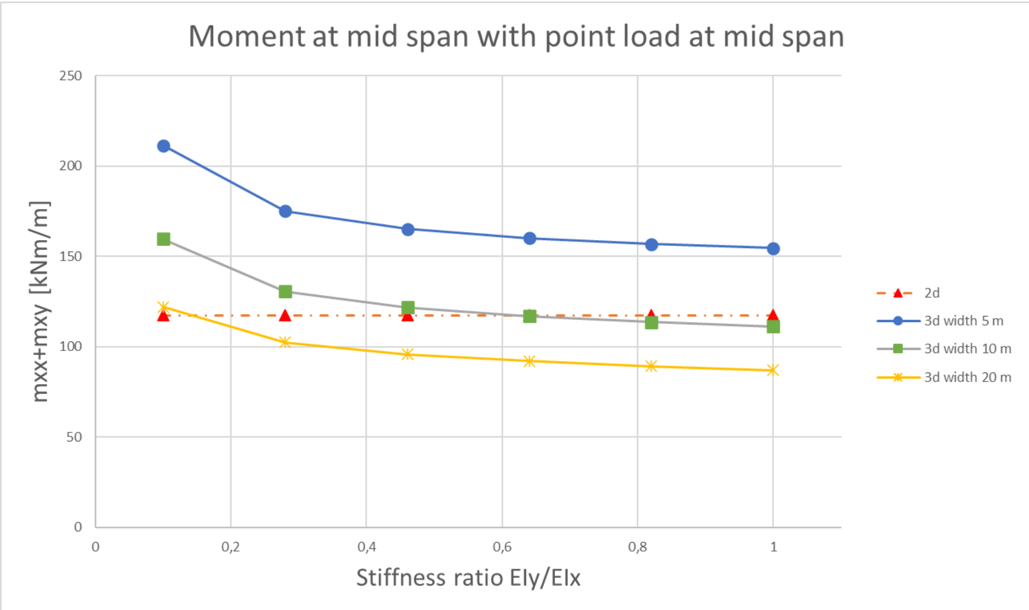


Figure E – Longitudinal moment load effect in middle of span. The figure shows almost no difference in inclination between 2D and 3D analysis.

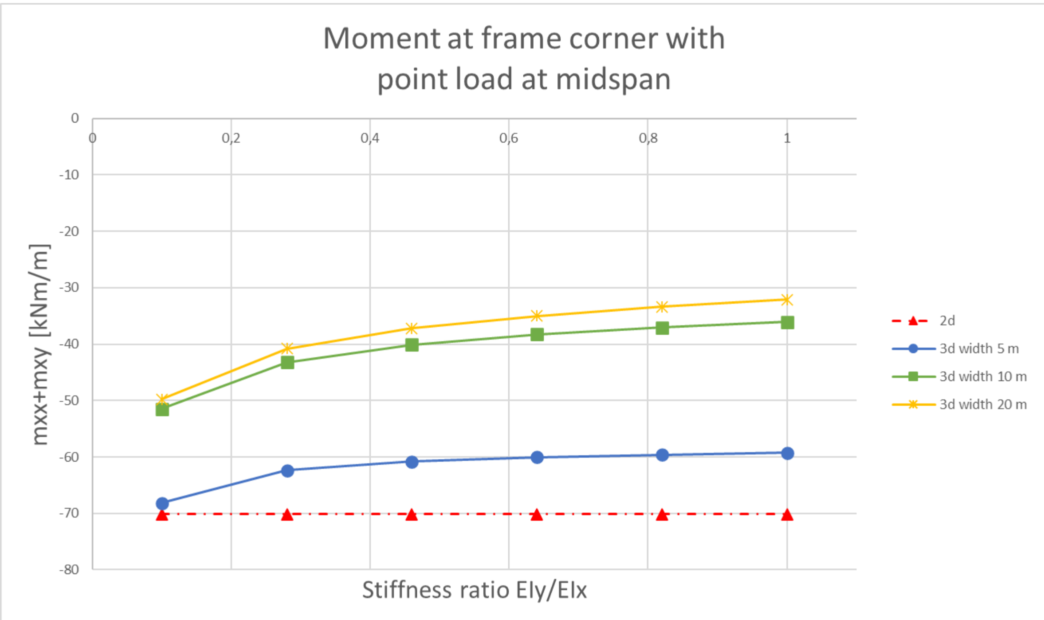


Figure F – Longitudinal moment load effect in frame corner. The figure shows a relatively small difference in inclination between 2D and 3D analysis for the narrowest bridge.

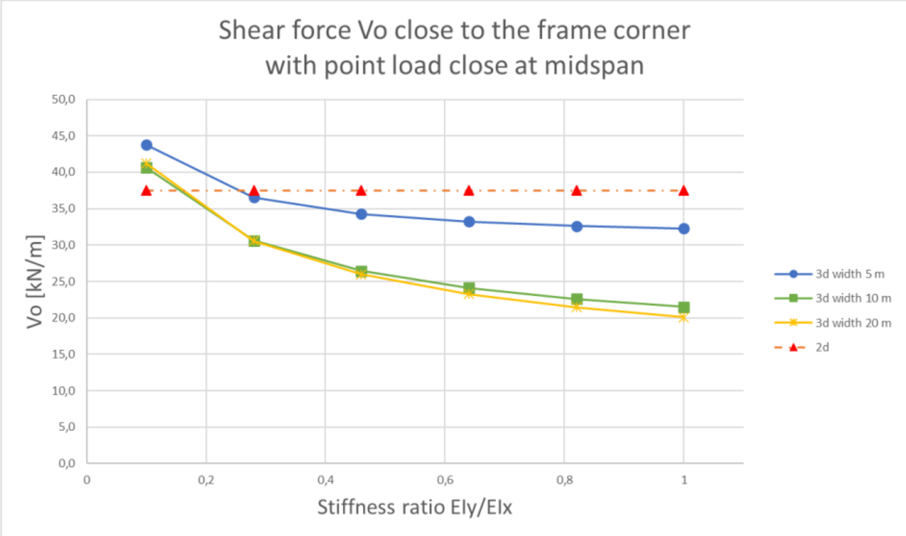


Figure G– Shear force load effect at worst position for shear for different frame leg heights. The figure shows a small difference in inclination between the 2D and 3D analysis.

Moment in middle of span [kNm/m]	Stiffness ratio EIy/EIx	0,1	0,28	0,46	0,64	0,82	1
Width = 5m	3D	211,4	175,0	165,1	160,0	156,8	154,6
	2D	117,3	117,3	117,3	117,3	117,3	117,3
Width = 10m	3D	159,7	130,6	121,7	116,9	113,6	111,2
	2D	117,3	117,3	117,3	117,3	117,3	117,3
Width = 20m	3D	122,0	102,4	95,9	92,0	89,2	87,1
	2D	117,3	117,3	117,3	117,3	117,3	117,3

Table 16 - Result sensitivity analysis in middle of span when stiffness ratio is changed

Moment in frame corner [kNm/m]	Stiffness ratio EIy/EIx	0,1	0,28	0,46	0,64	0,82	1
Width = 5m	3D	-68,2	-62,4	-60,8	-60,1	-59,6	-59,3
	2D	-70,2	-70,2	-70,2	-70,2	-70,2	-70,2
Width = 10m	3D	-51,5	-43,2	-40,1	-38,3	-37,0	-36,1
	2D	-70,2	-70,2	-70,2	-70,2	-70,2	-70,2
Width = 20m	3D	-49,8	-40,8	-37,2	-35,0	-33,4	-32,1
	2D	-70,2	-70,2	-70,2	-70,2	-70,2	-70,2

Table 17 - Result sensitivity analysis in frame corner when stiffness ratio is changed

Shear force close to frame corner [kN/m]	Stiffness ratio EIy/EIx	0,1	0,28	0,46	0,64	0,82	1
Width = 5m	3D	43,8	36,5	34,3	33,2	32,6	32,3
	2D	37,5	37,5	37,5	37,5	37,5	37,5
Width = 10m	3D	40,6	30,6	26,5	24,1	22,6	21,5
	2D	37,5	37,5	37,5	37,5	37,5	37,5
Width = 20m	3D	41,2	30,6	26,0	23,3	21,4	20,1
	2D	37,5	37,5	37,5	37,5	37,5	37,5

Table 18 - Result sensitivity analysis for shear close to frame corner when stiffness ratio is changed

E Mesh convergence study

A mesh convergence study is performed to confirm the accuracy of the solutions for every iteration of bridge. Since the analysis in the report analyses several different geometries of bridges, a convergence study is performed for different smallest lengths occurring on a bridge, so the smallest parameter of length, width or frame leg height. The implication being that the model is thus tested for the biggest mesh for the smallest length of bridge. So, all bridges with a larger length that is analysed for the same mesh can also be assumed to have converged.

The convergence study is performed by decreasing the element size used in the model and analysing the maximum displacement in the model. An analysis is run where the mesh size is set as very small, and then the relative error of the maximum displacement between each mesh size compared to the very small mesh size is analysed. When the relative error between the models can be considered small enough, the model is considered converged, and that mesh is chosen.

A new mesh is used for every length presented below in table 1.

Smallest length occurring:
l < 3m
3m ≤ l < 4m
4m ≤ l < 5m
5m ≤ l < 6m
6m ≤ l < 8m
l ≥ 8m

Table 1 -Different smallest lengths that will have different size meshes.

E.1 Convergence for bridges with length smaller than 3 meters

The used mesh size, number of nodes, maximum displacement and relative error for a minimum length of under 3 meters is presented in table 2. The same results are shown in figure 1. The chosen converged mesh size is highlighted in red in table 2 and with a red dotted line in figure 1.

Mesh size [m]	**Number of nodes**	**Maximum displacement [mm]**	**Relative error [%]**
1	124	-0,01833	3,442222
0,75	149	-0,01839	3,144918
0,625	236	-0,01851	2,512572
0,5	261	-0,01843	2,908508
0,4	359	-0,0185	2,546221
0,3	535	-0,0187	1,518272
0,2	1533	-0,01879	1,03362
0,175	1872	-0,01887	0,607497
0,15	2542	-0,01893	0,297686
0,125	3316	-0,01895	0,176802
0,1	5132	-0,01897	0,07139

0,05	20450	-0,01898	0,013215
0,025	84545	-0,01899	

Table 2 - Relative error of maximum displacement for different mesh sizes. The chosen mesh size is marked as red text.

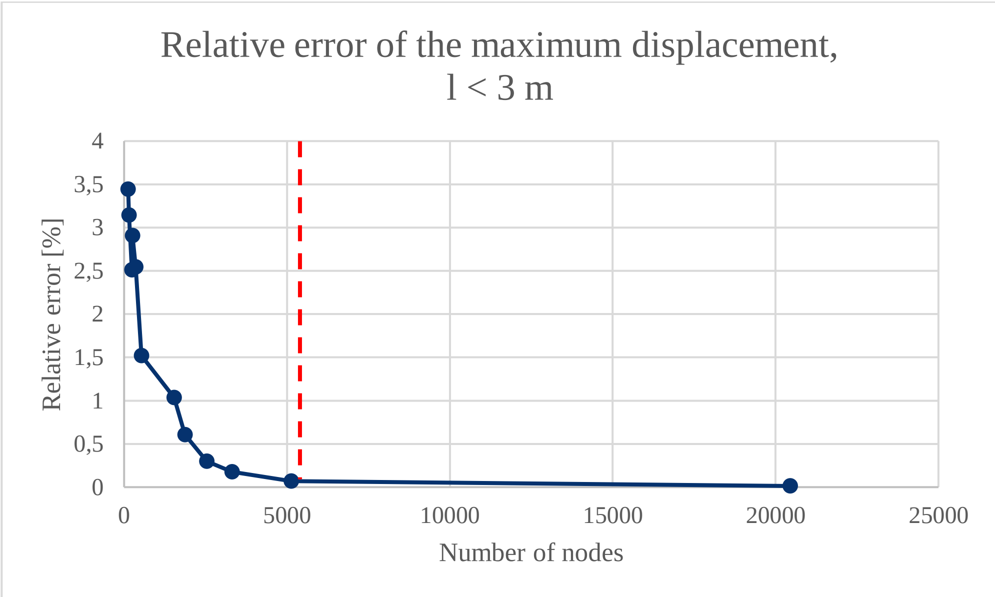


Figure 1 - Convergence study with smallest length being less than 3 meters. Number of nodes for chosen mesh size is marked as a red dotted line.

E.2 Convergence for bridges with length equal to 3m up to 4m

The used mesh size, number of nodes, maximum displacement and relative error for a minimum length equal to 3 meters up to 4 meters is presented in table 3. The same results are shown in figure 2. The chosen converged mesh size is highlighted in red in table 3 and with a red dotted line in figure 2.

Mesh size [m]	**Number of nodes**	**Maximum displacement [mm]**	**Relative error [%]**
1	117	-0,04173	3,96564
0,75	197	-0,04164	4,170689
0,625	219	-0,0414	4,726927
0,5	345	-0,04233	2,574287
0,4	469	-0,04277	1,567972
0,3	811	-0,04294	1,175526
0,2	1921	-0,04325	0,450026
0,175	2491	-0,04336	0,21142
0,15	3286	-0,04336	0,200788
0,125	4748	-0,04339	0,138148
0,1	7123	-0,04341	0,082634

0,05	29284	-0,04345	0,006868
0,025	118520	-0,04345	

Table 3 - Relative error of maximum displacement for different mesh sizes, where the smallest length occurring is equal to 3m up to 4m. The chosen mesh size is marked as red text.

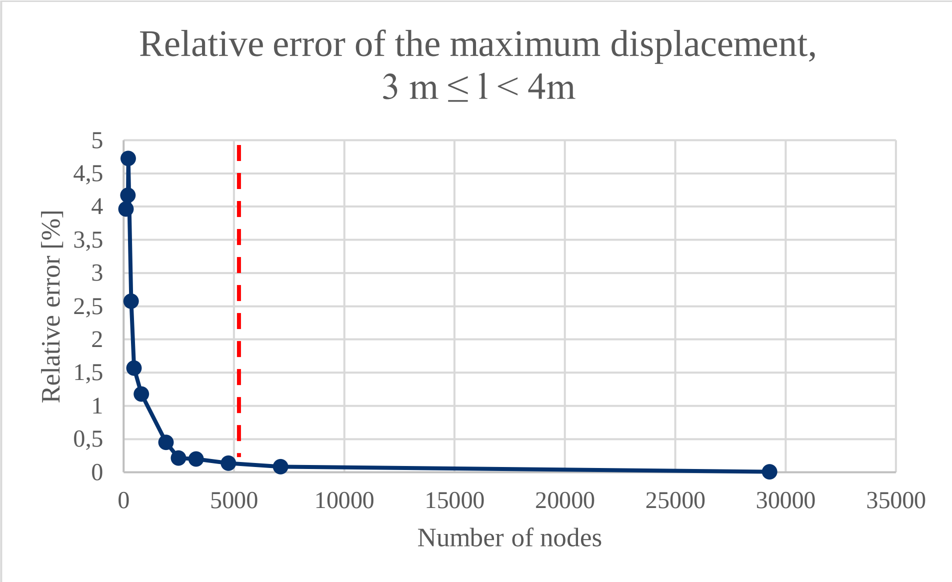


Figure 2 - Convergence study for bridge with the smallest length less than 4m. Number of nodes for chosen mesh size is marked as a red dotted line.

E.3 Convergence for bridges with length equal to 4m up to 5m

The used mesh size, number of nodes, maximum displacement and relative error for a minimum length 4 meters up to 5 meters is presented in table 4. The same results are shown in figure 3. The chosen converged mesh size is highlighted in red in table 4 and with a red dotted line in figure 3.

Mesh size [m]	Number of nodes	Maximum displacement [mm]	Relative error [%]
2	64	-0,09054	7,340986
1,5	95	-0,093	4,824265
1	165	-0,09283	4,998611
0,8	193	-0,093	4,827452
0,6	291	-0,09489	2,88459
0,4	686	-0,09669	1,04157
0,35	866	-0,09715	0,578891
0,3	1048	-0,09644	1,29745
0,25	1491	-0,09722	0,505295

0,2	2285	-0,09746	0,255972
0,15	3744	-0,09772	0,007625
0,1	8696	-0,09766	0,055182
0,025	144782	-0,09771	

Table 4 - Relative error of maximum displacement for different mesh sizes, where the smallest length occurring is 4 meters up to 5 meters. The chosen mesh size is marked as red text.

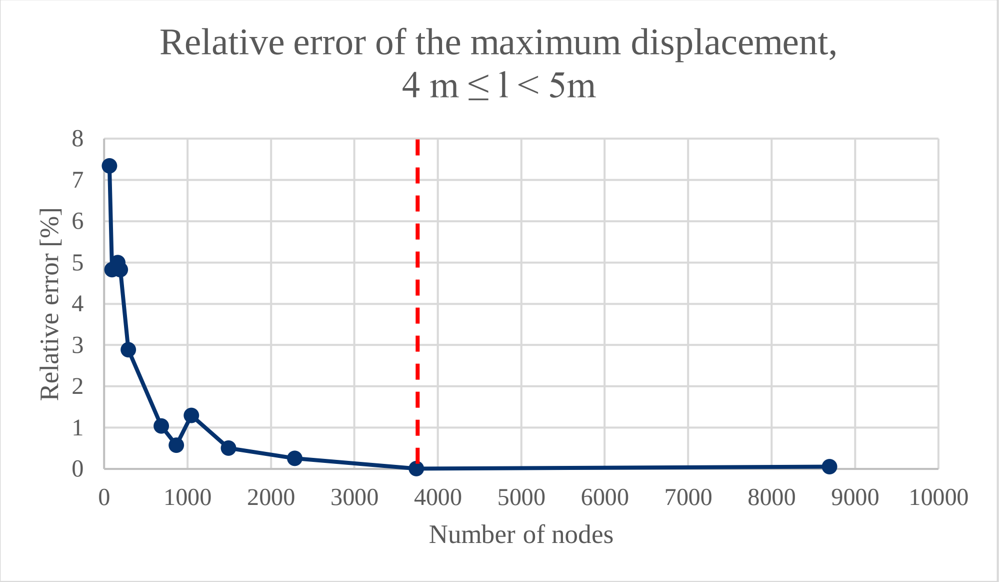


Figure 2 - Convergence study for bridge with the smallest length is 4 meters up to 5 meters. Number of nodes for chosen mesh size is marked as a red dotted line.

E.4 Convergence for bridges with length equal to 5m up to 6m

The used mesh size, number of nodes, maximum displacement and relative error for a minimum length of 5 meters up to 5 meters is presented in table 5. The same results are shown in figure 4. The chosen converged mesh size is highlighted in red in table 5 and with a red dotted line in figure 4.

Mesh size [m]	**Number of nodes**	**Maximum displacement [mm]**	**Relative error [%]**
2	64	-0,18439	6,769122
1,5	93	-0,18817	4,858595
1	163	-0,18753	5,179745
0,7	265	-0,19304	2,396979
0,4	755	-0,19599	0,905262
0,35	883	-0,19585	0,975218
0,3	1319	-0,19668	0,553915
0,25	1825	-0,19716	0,310376
0,2	2767	-0,19726	0,259255

0,175	3668	-0,19742	0,178322
0,15	4933	-0,19768	0,048099
0,1	10923	-0,19772	0,027116
0,025	179405	-0,19778	

Table 5 - Relative error of maximum displacement for different mesh sizes, where the smallest length occurring is 5 meters up to 6 meters. The chosen mesh size is marked as red text.

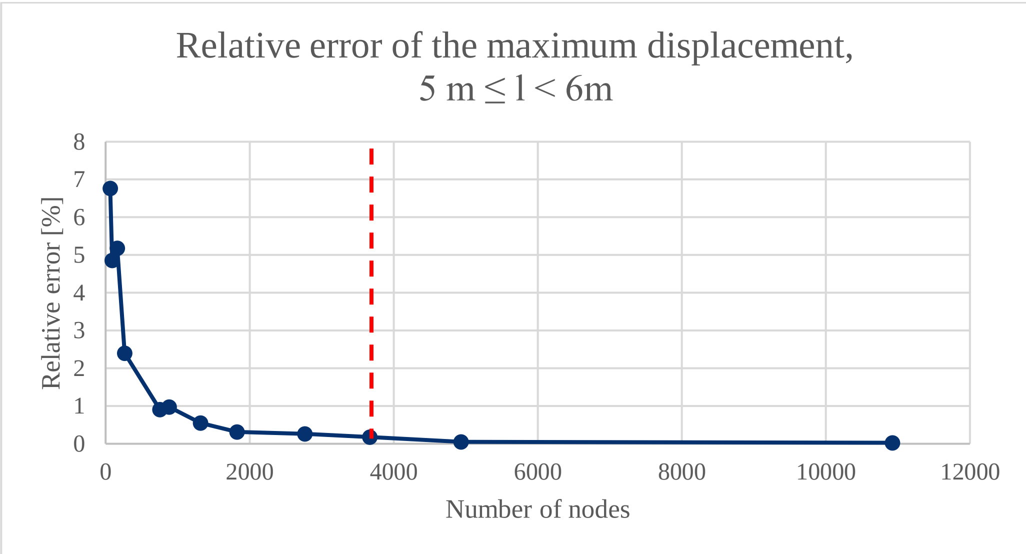


Figure 3 - Convergence study for bridge with the smallest length is 5 meters up to 6 meters. Number of nodes for chosen mesh size is marked as a red dotted line.

E.5 Convergence for bridges with length equal to 6m up to 8m

The used mesh size, number of nodes, maximum displacement and relative error for a minimum length of 6 meters up to 8 meters is presented in table 6. The same results are shown in figure 5. The chosen converged mesh size is highlighted in red in table 6 and with a red dotted line in figure 5.

Mesh size [m]	**Number of nodes**	**Maximum displacement [mm]**	**Relative error [%]**
2	88	-0,34635	4,367658
1,5	97	-0,33945	6,273798
1	221	-0,35396	2,268421
0,7	335	-0,35382	2,307154
0,4	802	-0,36009	0,576056
0,35	1138	-0,35942	0,759788
0,3	1538	-0,35958	0,714686
0,25	2226	-0,36152	0,179774
0,2	3406	-0,36154	0,174862

0,175	4232	-0,36184	0,090253
0,15	5762	-0,36209	0,023468
0,1	13371	-0,36209	0,022983
0,025	215968	-0,36217	

Table 6 - Relative error of maximum displacement for different mesh sizes, where the smallest length occurring is 6 meters up to 8 meters. The chosen mesh size is marked as red text.

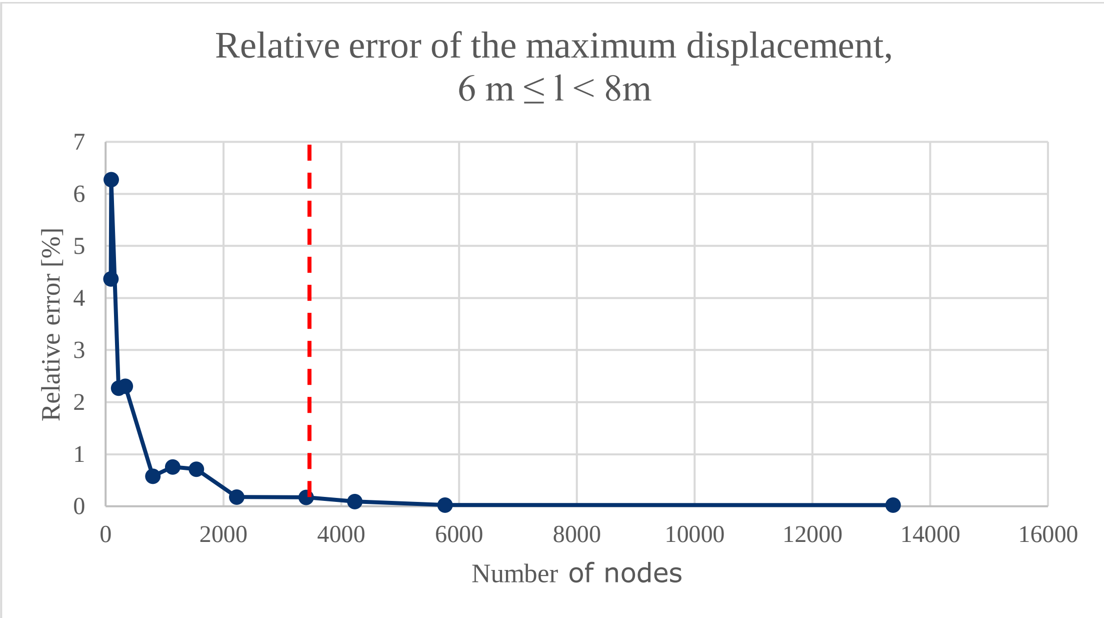


Figure 4 - Convergence study for bridge with the smallest length 6 meters up to 8 meters. Number of nodes for chosen mesh size is marked as a red dotted line.

E.6 Convergence for bridges with length equal to and over 8 meters

The used mesh size, number of nodes, maximum displacement and relative error for a minimum length of over 8 meters is presented in table 7. The same results are shown in figure 6. The chosen converged mesh size is highlighted in red in table 7 and with a red dotted line in figure 6.

Mesh size [m]	**Number of nodes**	**Maximum displacement [mm]**	**Relative error [%]**
2	100	-0,91426	5,771076
1,5	123	-0,92078	5,099572
1	267	-0,95097	1,988003
0,8	351	-0,96631	0,40685
0,6	547	-0,96246	0,803643
0,5	811	-0,96472	0,57078
0,4	1269	-0,96656	0,381386
0,35	1631	-0,96787	0,245776

0,3	2139	-0,96824	0,207854
0,25	2948	-0,96843	0,188491
0,2	4634	-0,96972	0,055534
0,15	8153	-0,96987	0,04049
0,05	74897	-0,97026	

Table 7 - Relative error of maximum displacement for different mesh sizes, where the smallest length occurring is equal to or over 8m. The chosen mesh size is marked as red text.

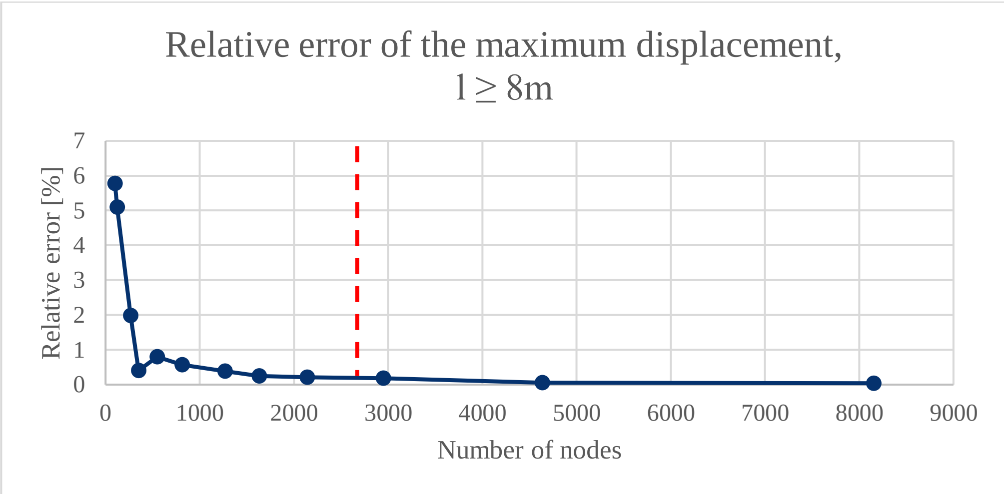


Figure 5 - Convergence study for bridge with the smallest length equal to or over 8 meters. Number of nodes for chosen mesh size is marked as a red dotted line.

E.7 Summary

In table 8 below is a summary of what mesh sizes are used in the analysis for different smallest lengths occurring.

Smallest length occurring	**Mesh size [m]**
l < 3m	0,1
3m ≤ l < 4m	0,125
4m ≤ l < 5m	0,15
5m ≤ l < 6m	0,175
6m ≤ l < 8m	0,2
l ≥ 8m	0,25

Table 3 – Summary of mesh sizes and their corresponding smallest length occurring.

F Sample report from SOFiSTiK, 2D analysis

Geometry & cross sections
Material

Design Code

EuroNorm Bridges: SS EN 1992-2:2005 (TSFS 2018:57) Design of concrete structures (Sverige) V 2024
Konstruktion og säkerhetsklass: B3 (Vägbroar klass 3)
Snow load zone : 1

National Defined Parameters

Reference of parameter in design code	Value
long term reduction concrete compressive strength α-cc EN 1992-1-1 3.1.6 (1)	1.000¹
long term reduction concrete tensile strength α-ct EN 1992-1-1 3.1.6 (2)	1.000¹
safety coefficient γ-c for concrete EN 1992-1-1 2.4.2.4	1.500¹
safety coefficient γ-CE for concrete elasticity EN 1992-1-1 5.8.6 (3)	1.200¹

¹ national defined parameter taken from the INI-files

Materials

Mat	Classification
1	C 35/45 (EN 1992) Concrete in su

Mat 1 C 35/45 (EN 1992) Concrete in sup

Young's modulus	E	34000	[N/mm2]	Safetyfactor		1.50	[-]
Poisson's ratio	μ	0.20	[-]	Strength¹	fc	35.00	[MPa]
Shear modulus	G	14167	[N/mm2]	Nominal strength	fck	35.00	[MPa]
Compression modulus	K	18889	[N/mm2]	Tensile strength	fctm	3.21	[MPa]
Nominal Weight	γ	25.0	[kN/m3]	Tensile strength	fctk,05	2.25	[MPa]
Mean density	ρ	2400.0	[kg/m3]	Tensile strength	fctk,95	4.17	[MPa]
Elongation coefficient	α	1.00E-05	[1/K]	Bond strength	fbd	3.37	[MPa]
				Service strength	fcm	43.00	[MPa]
				Fatigue strength	fcd,fat	17.06	[MPa]
				Tensile strength	fctd	1.50	[MPa]
				Tensile failure energy	Gf	0.14	[N/mm]

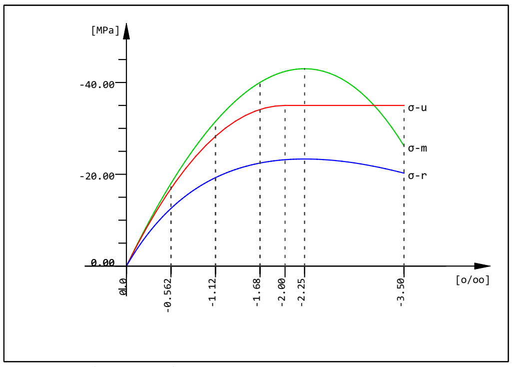
¹ fc = fck * α-cc

Stress-Strain for serviceability	ε[o/oo]	σ-m[MPa]	E-t[N/mm2]
Is only valid within the defined	0.000	0.00	35781
stress range	-0.562	-17.99	28179
	-1.123	-31.50	19765
	-1.685	-40.02	10420
	-2.246	-43.00	0
	-3.500	-26.18	-28065
	Safetyfactor		1.50

Stress-Strain for ultimate load	ε[o/oo]	σ-u[MPa]	E-t[N/mm2]
Is only valid within the defined	0.000	0.00	35000
stress range	-2.000	-35.00	0
	-3.500	-35.00	0
	Safetyfactor		1.50

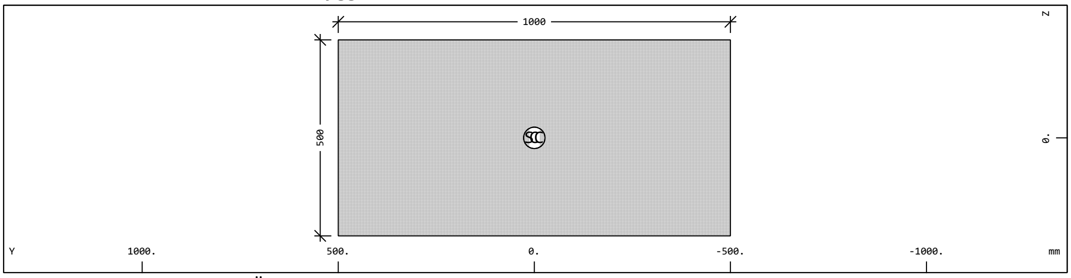
Stress-Strain of calc. mean values	ε[o/oo]	σ-r[MPa]	E-t[N/mm2]
Is only valid within the defined	0.000	0.00	29818
stress range	-0.562	-12.55	16227
	-1.123	-19.27	8335
	-1.685	-22.45	3349
	-2.246	-23.33	0
	-3.500	-20.25	-4413
	Safetyfactor		(1.50)

Geometry & cross sections
Material



C 35/45 (EN 1992) Concrete in sup

Cross section No. 1 - Överbyggnad



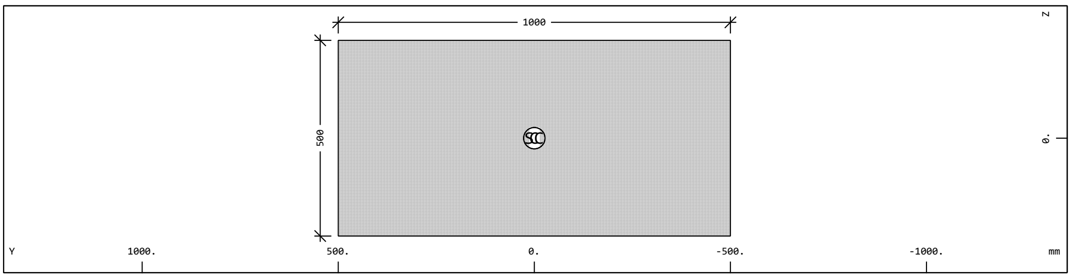
Cross section No. 1 - Överbyggnad

Static properties of cross section

SNo	Mat	A[m2]	Ay[m2]	Iy[m4]	yc[mm]	ysc[mm]	E[N/mm2]	g[kg/m]	I-1[m4]
	MRf	It[m4]	Az[m2]	Iz[m4]	zc[mm]	zsc[mm]	G[N/mm2]		I-2[m4]
			Ayz[m2]	Iyz[m4]					α[°]
1	1	5.0000E-01	4.189E-01	1.042E-02	0.0	0.0	34000	1250.0	4.167E-02
		2.888E-02	4.310E-01	4.167E-02	0.0	0.0	14167	(BEAM)	1.042E-02
	= Överbyggnad								

SNo	section number	yc[mm],zc[mm]	ordinate of elastic centroid
Mat	material number	ysc[mm],zsc[mm]	ordinate of shear centre
A[m2]	sectional area	E[N/mm2]	Young's modulus
Ay[m2],Az[m2],Ayz[m2]	transverse shear deformation area	g[kg/m]	mass per length
Iy[m4],Iz[m4],Iyz[m4]	bending moment of inertia		
I-1[m4],I-2[m4],α[°]	principal moments of inertia and angle of the principal axes		
MRf	reinforcement material number		
It[m4]	torsional moment of inertia		
G[N/mm2]	Shear modulus		

Cross section No. 2 - RAMBEN



Cross section No. 2 - RAMBEN

Geometry & cross sections
Material

Static properties of cross section

SNo	Mat	A[m2]	Ay[m2]	Iy[m4]	yc[mm]	ysc[mm]	E[N/mm2]	g[kg/m]	I-1[m4]
	MRf	It[m4]	Az[m2]	Iz[m4]	zc[mm]	zsc[mm]	G[N/mm2]		I-2[m4]
			Ayz[m2]	Iyz[m4]					α[°]
2	1	5.0000E-01	4.189E-01	1.042E-02	0.0	0.0	34000	1250.0	4.167E-02
		2.888E-02	4.310E-01	4.167E-02	0.0	0.0	14167	(BEAM)	1.042E-02
= RAMBEN									

SNo	section number	yc[mm],zc[mm]	ordinate of elastic centroid
Mat	material number	ysc[mm],zsc[mm]	ordinate of shear centre
A[m2]	sectional area	E[N/mm2]	Young's modulus
Ay[m2],Az[m2],Ayz[m2]	transverse shear deformation area	g[kg/m]	mass per length
Iy[m4],Iz[m4],Iyz[m4]	bending moment of inertia		
I-1[m4],I-2[m4],α[°]	principal moments of inertia and angle of the principal axes		
MRf	reinforcement material number		
It[m4]	torsional moment of inertia		
G[N/mm2]	Shear modulus		

Geometry & cross sections

Geometric axis KF

Segments

from station[-]	to station[-]	Total Length[m]
0.000	17.000	17.000

Structural Elements

Structural Points

Number	X[m]	Y[m]	Z[m]	Support Conditions	Designation
1	0.000	0.000	0.000	PY	
2	17.000	0.000	0.000	PY	
3	0.000	0.000	-5.000	PP	
4	17.000	0.000	-5.000	PP	

Structural Lines

Number	SPt-a	SPt-e	Ref	Type	SNo	Grp	Hinges-a	Hinges-e	Designation
1	1	5		BEAM	1	1			
2	3	1		BEAM	2	2			
3	4	2		BEAM	2	2			
4	5	2		BEAM	1	1			

SPt-a,SPt-e structural point start / end; SNo section number
Ref reference line, reference axis; Grp primary group number
Type element type

Groups

Grp	Number	Type	min-no	max-no	Designation
1	24	BEAM	10001	10024	ÖVERBYGGNAD
2	14	BEAM	20001	20014	RAMBEN

Grp primary group number; Type element type
Number number of elements within group; min-no,max-no minimum/maximum element number

Summary of beam elements

Groups

Grp	TotLength [m]	Max.Length [m]	TotVolume [m3]	TotMass [t]	Surface [m2]	Designation
1	17.000	0.709	8.500	21.250	51.000	ÖVERBYGGNAD
2	10.000	0.714	5.000	12.500	30.000	RAMBEN
Sum	27.000		13.500	33.750	81.000	

Grp primary group number; TotVolume Total volume
TotLength Total length; TotMass Total mass
Max.Length Maximum length in an element; Surface Total surface

Geometry & cross sections
Definition of load groups

Actions

type	part	sup	Designation	γ-u	γ-f	γ-a	ψ_0	ψ_1	ψ_2	$\psi_1$inf
G_1	G	perm	Self weight	1.00	1.00	1.00	1.00	1.00	1.00	1.00
G_2	G	perm	Earth pressure	1.00	1.00	1.00	1.00	1.00	1.00	1.00
G_3	G	perm	Paving	1.00	0.00	1.00	1.00	1.00	1.00	1.00
L	Q	excl	live loading	1.00	1.00	1.00	1.00	1.00	1.00	1.00
L_A	Q_1	excl	Typ A	1.00	0.00	1.00	1.00	1.00	1.00	1.00
L_B	Q_1	excl	Typ B	1.00	0.00	1.00	1.00	1.00	1.00	1.00
			Reliability factor Kfi	1.000						
			Reduction factor xsi	0.890						

type action; γ-u,γ-f,γ-a partial safety factors for unfavourable/favourable/accidental
part partition of the action; ψ_0,ψ_1,ψ_2,$\psi_1$inf combination coefficients
sup superposition type

Geometry & cross sections
EARTH PRESSURE

Actions

type	part	sup	Designation	γ-u	γ-f	γ-a	ψ_0	ψ_1	ψ_2	$\psi_1$inf
G_1	G	perm	Self weight	1.00	1.00	1.00	1.00	1.00	1.00	1.00
G_2	G	perm	Earth pressure	1.00	1.00	1.00	1.00	1.00	1.00	1.00
G_3	G	perm	Paving	1.00	0.00	1.00	1.00	1.00	1.00	1.00
L	Q	excl	live loading	1.00	1.00	1.00	1.00	1.00	1.00	1.00
L_A	Q_1	excl	Typ A	1.00	0.00	1.00	1.00	1.00	1.00	1.00
L_B	Q_1	excl	Typ B	1.00	0.00	1.00	1.00	1.00	1.00	1.00
			Reliability factor Kfi	1.000						
			Reduction factor xsi	0.890						

type action γ-u,γ-f,γ-a partial safety factors for unfavourable/favourable/accidental
part partition of the action ψ_0,ψ_1,ψ_2,$\psi_1$inf combination coefficients
sup superposition type

Load Case 2 (G_2) EARTH PRESSURE

Factor forces and moments 1.000
unfavourable partial safety factor 1.000
favourable partial safety factor 1.000
Combination coefficient ψ_0 1.000 (rare)
Combination coefficient $\psi_1$inf 1.000 (infrequent)
Combination coefficient ψ_1 1.000 (frequent)
Combination coefficient ψ_2 1.000 (permanent)

Loads

Kind	Reference to	Projection Designation	W[m]	Coordinates X[m]	Y[m]	Z[m]	Type	Load value
Line	sln 2			0.000	0.000	-5.000	PXX	38.70 [kN/m]
				0.000	0.000	0.000		0.00 [kN/m]
						activated		100.00 percent
Line	sln 3			17.000	0.000	-5.000	PXX	-38.70 [kN/m]
				17.000	0.000	0.000		0.00 [kN/m]
						activated		100.00 percent

Load Case 3 (G_3) Paving

Factor forces and moments 1.000
unfavourable partial safety factor 1.000
favourable partial safety factor 0.000
Combination coefficient ψ_0 1.000 (rare)
Combination coefficient $\psi_1$inf 1.000 (infrequent)
Combination coefficient ψ_1 1.000 (frequent)
Combination coefficient ψ_2 1.000 (permanent)

Loads

Kind	Reference to	Projection Designation	W[m]	Coordinates X[m]	Y[m]	Z[m]	Type	Load value
Line	sln -mult-			0.000	0.000	0.000	PZZ	-3.30 [kN/m]
				17.000	0.000	0.000		-3.30 [kN/m]
						activated		100.00 percent

Geometry & cross sections
Analyze all static loads

Load Case 1 (G_1) Self weight

```
Factor forces and moments                  1.000
Factor dead weight             DL-ZZ      -1.000
unfavourable partial safety factor         1.000
favourable partial safety factor           1.000
Combination coefficient        ψ0          1.000 (rare)
Combination coefficient        ψ1inf       1.000 (infrequent)
Combination coefficient        ψ1          1.000 (frequent)
Combination coefficient        ψ2          1.000 (permanent)
```

Load Case 2 (G_2) Earth pressure

```
Factor forces and moments                  1.000
unfavourable partial safety factor         1.000
favourable partial safety factor           1.000
Combination coefficient        ψ0          1.000 (rare)
Combination coefficient        ψ1inf       1.000 (infrequent)
Combination coefficient        ψ1          1.000 (frequent)
Combination coefficient        ψ2          1.000 (permanent)
```

Load Case 3 (G_3) Paving

```
Factor forces and moments                  1.000
unfavourable partial safety factor         1.000
favourable partial safety factor           0.000
Combination coefficient        ψ0          1.000 (rare)
Combination coefficient        ψ1inf       1.000 (infrequent)
Combination coefficient        ψ1          1.000 (frequent)
Combination coefficient        ψ2          1.000 (permanent)
```


Sum of Loadings

Loadcase	Σ(Loads)			Designation
	X[kN]	Y[kN]	Z[kN]	
1	0.0	0.0	-337.5	Self weight
2	0.0	0.0	0.0	Earth pressure
3	0.0	0.0	-56.1	Paving

Beam Forces and Moments Loadcase 1 Self weight

Grp	Number	x [m]	N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
1	10001	0.000	-50.2	0.00	106.25	0.00	-251.23	0.00
		0.700	-50.2	0.00	97.50	0.00	-179.92	0.00
1	10002	0.000	-50.2	0.00	97.50	0.00	-179.92	0.00
		0.709	-50.2	0.00	88.64	0.00	-113.96	0.00
1	10003	0.000	-50.2	0.00	88.64	0.00	-113.96	0.00
		0.709	-50.2	0.00	79.78	0.00	-54.28	0.00
1	10004	0.000	-50.2	0.00	79.78	0.00	-54.28	0.00
		0.709	-50.2	0.00	70.92	0.00	-0.87	0.00
1	10005	0.000	-50.2	0.00	70.92	0.00	-0.87	0.00
		0.709	-50.2	0.00	62.07	0.00	46.25	0.00
1	10006	0.000	-50.2	0.00	62.07	0.00	46.25	0.00
		0.709	-50.2	0.00	53.21	0.00	87.10	0.00
1	10007	0.000	-50.2	0.00	53.21	0.00	87.10	0.00
		0.709	-50.2	0.00	44.35	0.00	121.66	0.00
1	10008	0.000	-50.2	0.00	44.35	0.00	121.66	0.00
		0.709	-50.2	0.00	35.49	0.00	149.95	0.00
1	10009	0.000	-50.2	0.00	35.49	0.00	149.95	0.00
		0.709	-50.2	0.00	26.63	0.00	171.97	0.00
1	10010	0.000	-50.2	0.00	26.63	0.00	171.97	0.00
		0.709	-50.2	0.00	17.77	0.00	187.70	0.00
1	10011	0.000	-50.2	0.00	17.77	0.00	187.70	0.00
		0.709	-50.2	0.00	8.91	0.00	197.16	0.00

Geometry & cross sections
Analyze all static loads

Beam Forces and Moments Loadcase 1 Self weight

Grp	Number	x [m]	N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
1	10012	0.000	-50.2	0.00	8.91	0.00	197.16	0.00
		0.709	-50.2	0.00	0.05	0.00	200.33	0.00
1	10013	0.000	-50.2	0.00	0.05	0.00	200.33	0.00
		0.709	-50.2	0.00	-8.80	0.00	197.23	0.00
1	10014	0.000	-50.2	0.00	-8.80	0.00	197.23	0.00
		0.709	-50.2	0.00	-17.66	0.00	187.85	0.00
1	10015	0.000	-50.2	0.00	-17.66	0.00	187.85	0.00
		0.709	-50.2	0.00	-26.52	0.00	172.20	0.00
1	10016	0.000	-50.2	0.00	-26.52	0.00	172.20	0.00
		0.709	-50.2	0.00	-35.38	0.00	150.26	0.00
1	10017	0.000	-50.2	0.00	-35.38	0.00	150.26	0.00
		0.709	-50.2	0.00	-44.24	0.00	122.05	0.00
1	10018	0.000	-50.2	0.00	-44.24	0.00	122.05	0.00
		0.709	-50.2	0.00	-53.10	0.00	87.56	0.00
1	10019	0.000	-50.2	0.00	-53.10	0.00	87.56	0.00
		0.709	-50.2	0.00	-61.96	0.00	46.79	0.00
1	10020	0.000	-50.2	0.00	-61.96	0.00	46.79	0.00
		0.709	-50.2	0.00	-70.82	0.00	-0.26	0.00
1	10021	0.000	-50.2	0.00	-70.82	0.00	-0.26	0.00
		0.709	-50.2	0.00	-79.67	0.00	-53.58	0.00
1	10022	0.000	-50.2	0.00	-79.67	0.00	-53.58	0.00
		0.709	-50.2	0.00	-88.53	0.00	-113.19	0.00
1	10023	0.000	-50.2	0.00	-88.53	0.00	-113.19	0.00
		0.709	-50.2	0.00	-97.39	0.00	-179.07	0.00
1	10024	0.000	-50.2	0.00	-97.39	0.00	-179.07	0.00
		0.709	-50.2	0.00	-106.25	0.00	-251.23	0.00
2	20001	0.000	-168.8	0.00	-50.25	0.00	0.00	0.00
		0.714	-159.8	0.00	-50.25	0.00	-35.89	0.00
2	20002	0.000	-159.8	0.00	-50.25	0.00	-35.89	0.00
		0.714	-150.9	0.00	-50.25	0.00	-71.78	0.00
2	20003	0.000	-150.9	0.00	-50.25	0.00	-71.78	0.00
		0.714	-142.0	0.00	-50.25	0.00	-107.67	0.00
2	20004	0.000	-142.0	0.00	-50.25	0.00	-107.67	0.00
		0.714	-133.0	0.00	-50.25	0.00	-143.56	0.00
2	20005	0.000	-133.0	0.00	-50.25	0.00	-143.56	0.00
		0.714	-124.1	0.00	-50.25	0.00	-179.45	0.00
2	20006	0.000	-124.1	0.00	-50.25	0.00	-179.45	0.00
		0.714	-115.2	0.00	-50.25	0.00	-215.34	0.00
2	20007	0.000	-115.2	0.00	-50.25	0.00	-215.34	0.00
		0.714	-106.2	0.00	-50.25	0.00	-251.23	0.00
2	20008	0.000	-168.8	0.00	50.25	0.00	0.00	0.00
		0.714	-159.8	0.00	50.25	0.00	35.89	0.00
2	20009	0.000	-159.8	0.00	50.25	0.00	35.89	0.00
		0.714	-150.9	0.00	50.25	0.00	71.78	0.00
2	20010	0.000	-150.9	0.00	50.25	0.00	71.78	0.00
		0.714	-142.0	0.00	50.25	0.00	107.67	0.00
2	20011	0.000	-142.0	0.00	50.25	0.00	107.67	0.00
		0.714	-133.0	0.00	50.25	0.00	143.56	0.00
2	20012	0.000	-133.0	0.00	50.25	0.00	143.56	0.00
		0.714	-124.1	0.00	50.25	0.00	179.45	0.00
2	20013	0.000	-124.1	0.00	50.25	0.00	179.45	0.00
		0.714	-115.2	0.00	50.25	0.00	215.34	0.00
2	20014	0.000	-115.2	0.00	50.25	0.00	215.34	0.00
		0.714	-106.2	0.00	50.25	0.00	251.23	0.00

Grp primary group number
Number element number

Geometry & cross sections
Analyze all static loads

Nodal Displacements Loadcase 1 Self weight

Node No	u-X [mm]	u-Y [mm]	u-Z [mm]	phi-X [mrad]	phi-Y [mrad]	phi-Z [mrad]
1	0.025	0.000	-0.040	0.000	1.196	0.000
2	-0.025	0.000	-0.040	0.000	-1.196	0.000
3	0.000	0.000	0.000	0.000	-0.578	0.000
4	0.000	0.000	0.000	0.000	0.578	0.000
5	0.023	0.000	-1.046	0.000	1.621	0.000
1000	-0.410	0.000	-0.007	0.000	-0.542	0.000
1001	-0.768	0.000	-0.013	0.000	-0.433	0.000
1002	-1.023	0.000	-0.020	0.000	-0.252	0.000
1003	-1.123	0.000	-0.025	0.000	0.001	0.000
1004	-1.016	0.000	-0.031	0.000	0.327	0.000
1005	-0.651	0.000	-0.036	0.000	0.725	0.000
1006	0.410	0.000	-0.007	0.000	0.542	0.000
1007	0.768	0.000	-0.013	0.000	0.433	0.000
1008	1.023	0.000	-0.020	0.000	0.252	0.000
1009	1.123	0.000	-0.025	0.000	-0.001	0.000
1010	1.016	0.000	-0.031	0.000	-0.327	0.000
1011	0.651	0.000	-0.036	0.000	-0.725	0.000
1012	0.021	0.000	-2.317	0.000	1.914	0.000
1013	0.019	0.000	-3.749	0.000	2.081	0.000
1014	0.017	0.000	-5.258	0.000	2.135	0.000
1015	0.015	0.000	-6.768	0.000	2.089	0.000
1016	0.013	0.000	-8.212	0.000	1.954	0.000
1017	0.010	0.000	-9.532	0.000	1.744	0.000
1018	0.008	0.000	-10.679	0.000	1.471	0.000
1019	0.006	0.000	-11.614	0.000	1.148	0.000
1020	0.004	0.000	-12.304	0.000	0.787	0.000
1021	0.002	0.000	-12.728	0.000	0.401	0.000
1022	0.000	0.000	-12.872	0.000	0.002	0.000
1023	-0.002	0.000	-12.731	0.000	-0.396	0.000
1024	-0.004	0.000	-12.311	0.000	-0.783	0.000
1025	-0.006	0.000	-11.624	0.000	-1.144	0.000
1026	-0.008	0.000	-10.692	0.000	-1.468	0.000
1027	-0.010	0.000	-9.547	0.000	-1.741	0.000
1028	-0.013	0.000	-8.229	0.000	-1.952	0.000
1029	-0.015	0.000	-6.786	0.000	-2.087	0.000
1030	-0.017	0.000	-5.277	0.000	-2.135	0.000
1031	-0.019	0.000	-3.767	0.000	-2.082	0.000
1032	-0.021	0.000	-2.334	0.000	-1.916	0.000
1033	-0.023	0.000	-1.060	0.000	-1.625	0.000

Nodal Reactions Loadcase 1 Self weight

Node No	P-X [kN]	P-Y [kN]	P-Z [kN]	M-X [kNm]	M-Y [kNm]	M-Z [kNm]
3	50.2		168.8			
4	-50.2		168.8			

Beam Forces and Moments Loadcase 2 Earth pressure

Grp	Number	x [m]	N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
1	10001	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.700	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10002	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10003	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10004	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00

Geometry & cross sections
Analyze all static loads

Beam Forces and Moments Loadcase 2 Earth pressure

Grp	Number	x [m]	N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
1	10005	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10006	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10007	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10008	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10009	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10010	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10011	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10012	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10013	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10014	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10015	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10016	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10017	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10018	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10019	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10020	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10021	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10022	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10023	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
1	10024	0.000	-34.1	0.00	0.00	0.00	-9.12	0.00
		0.709	-34.1	0.00	0.00	0.00	-9.12	0.00
2	20001	0.000	0.0	0.00	62.68	0.00	0.00	0.00
		0.714	0.0	0.00	37.01	0.00	35.37	0.00
2	20002	0.000	0.0	0.00	37.01	0.00	35.37	0.00
		0.714	0.0	0.00	15.29	0.00	53.81	0.00
2	20003	0.000	0.0	0.00	15.29	0.00	53.81	0.00
		0.714	0.0	0.00	-2.48	0.00	58.15	0.00
2	20004	0.000	0.0	0.00	-2.48	0.00	58.15	0.00
		0.714	0.0	0.00	-16.30	0.00	51.20	0.00
2	20005	0.000	0.0	0.00	-16.30	0.00	51.20	0.00
		0.714	0.0	0.00	-26.18	0.00	35.79	0.00
2	20006	0.000	0.0	0.00	-26.18	0.00	35.79	0.00
		0.714	0.0	0.00	-32.10	0.00	14.75	0.00
2	20007	0.000	0.0	0.00	-32.10	0.00	14.75	0.00
		0.714	0.0	0.00	-34.07	0.00	-9.12	0.00
2	20008	0.000	0.0	0.00	-62.68	0.00	0.00	0.00
		0.714	0.0	0.00	-37.01	0.00	-35.37	0.00
2	20009	0.000	0.0	0.00	-37.01	0.00	-35.37	0.00

Geometry & cross sections
Analyze all static loads

Beam Forces and Moments Loadcase 2 Earth pressure

Grp	Number	x [m]	N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
2	20009	0.714	0.0	0.00	-15.29	0.00	-53.81	0.00
2	20010	0.000	0.0	0.00	-15.29	0.00	-53.81	0.00
		0.714	0.0	0.00	2.48	0.00	-58.15	0.00
2	20011	0.000	0.0	0.00	2.48	0.00	-58.15	0.00
		0.714	0.0	0.00	16.30	0.00	-51.20	0.00
2	20012	0.000	0.0	0.00	16.30	0.00	-51.20	0.00
		0.714	0.0	0.00	26.18	0.00	-35.79	0.00
2	20013	0.000	0.0	0.00	26.18	0.00	-35.79	0.00
		0.714	0.0	0.00	32.10	0.00	-14.75	0.00
2	20014	0.000	0.0	0.00	32.10	0.00	-14.75	0.00
		0.714	0.0	0.00	34.07	0.00	9.12	0.00

Grp primary group number
Number element number

Nodal Displacements Loadcase 2 Earth pressure

Node No	u-X [mm]	u-Y [mm]	u-Z [mm]	phi-X [mrad]	phi-Y [mrad]	phi-Z [mrad]
1	0.017	0.000	0.000	0.000	-0.219	0.000
2	-0.017	0.000	0.000	0.000	0.219	0.000
3	0.000	0.000	0.000	0.000	0.286	0.000
4	0.000	0.000	0.000	0.000	-0.286	0.000
5	0.016	0.000	0.147	0.000	-0.201	0.000
1000	0.200	0.000	0.000	0.000	0.247	0.000
1001	0.349	0.000	0.000	0.000	0.155	0.000
1002	0.419	0.000	0.000	0.000	0.039	0.000
1003	0.406	0.000	0.000	0.000	-0.072	0.000
1004	0.318	0.000	0.000	0.000	-0.161	0.000
1005	0.178	0.000	0.000	0.000	-0.213	0.000
1006	-0.200	0.000	0.000	0.000	-0.247	0.000
1007	-0.349	0.000	0.000	0.000	-0.155	0.000
1008	-0.419	0.000	0.000	0.000	-0.039	0.000
1009	-0.406	0.000	0.000	0.000	0.072	0.000
1010	-0.318	0.000	0.000	0.000	0.161	0.000
1011	-0.178	0.000	0.000	0.000	0.213	0.000
1012	0.014	0.000	0.283	0.000	-0.183	0.000
1013	0.013	0.000	0.406	0.000	-0.164	0.000
1014	0.011	0.000	0.516	0.000	-0.146	0.000
1015	0.010	0.000	0.613	0.000	-0.128	0.000
1016	0.009	0.000	0.697	0.000	-0.110	0.000
1017	0.007	0.000	0.768	0.000	-0.091	0.000
1018	0.006	0.000	0.827	0.000	-0.073	0.000
1019	0.004	0.000	0.872	0.000	-0.055	0.000
1020	0.003	0.000	0.904	0.000	-0.037	0.000
1021	0.001	0.000	0.924	0.000	-0.018	0.000
1022	0.000	0.000	0.930	0.000	-0.000	0.000
1023	-0.001	0.000	0.924	0.000	0.018	0.000
1024	-0.003	0.000	0.905	0.000	0.036	0.000
1025	-0.004	0.000	0.873	0.000	0.055	0.000
1026	-0.006	0.000	0.827	0.000	0.073	0.000
1027	-0.007	0.000	0.769	0.000	0.091	0.000
1028	-0.009	0.000	0.698	0.000	0.109	0.000
1029	-0.010	0.000	0.614	0.000	0.128	0.000
1030	-0.011	0.000	0.517	0.000	0.146	0.000
1031	-0.013	0.000	0.407	0.000	0.164	0.000
1032	-0.014	0.000	0.284	0.000	0.182	0.000
1033	-0.016	0.000	0.149	0.000	0.201	0.000

Geometry & cross sections
Analyze all static loads

Nodal Reactions Loadcase 2 Earth pressure

Node No	P-X [kN]	P-Y [kN]	P-Z [kN]	M-X [kNm]	M-Y [kNm]	M-Z [kNm]
3	-62.7					
4	62.7					

Beam Forces and Moments Loadcase 3 Paving

Grp	Number	x [m]	N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
1	10001	0.000	-13.3	0.00	28.05	0.00	-66.32	0.00
		0.700	-13.3	0.00	25.74	0.00	-47.50	0.00
1	10002	0.000	-13.3	0.00	25.74	0.00	-47.50	0.00
		0.709	-13.3	0.00	23.40	0.00	-30.08	0.00
1	10003	0.000	-13.3	0.00	23.40	0.00	-30.08	0.00
		0.709	-13.3	0.00	21.06	0.00	-14.33	0.00
1	10004	0.000	-13.3	0.00	21.06	0.00	-14.33	0.00
		0.709	-13.3	0.00	18.72	0.00	-0.23	0.00
1	10005	0.000	-13.3	0.00	18.72	0.00	-0.23	0.00
		0.709	-13.3	0.00	16.38	0.00	12.21	0.00
1	10006	0.000	-13.3	0.00	16.38	0.00	12.21	0.00
		0.709	-13.3	0.00	14.05	0.00	22.99	0.00
1	10007	0.000	-13.3	0.00	14.05	0.00	22.99	0.00
		0.709	-13.3	0.00	11.71	0.00	32.12	0.00
1	10008	0.000	-13.3	0.00	11.71	0.00	32.12	0.00
		0.709	-13.3	0.00	9.37	0.00	39.59	0.00
1	10009	0.000	-13.3	0.00	9.37	0.00	39.59	0.00
		0.709	-13.3	0.00	7.03	0.00	45.40	0.00
1	10010	0.000	-13.3	0.00	7.03	0.00	45.40	0.00
		0.709	-13.3	0.00	4.69	0.00	49.55	0.00
1	10011	0.000	-13.3	0.00	4.69	0.00	49.55	0.00
		0.709	-13.3	0.00	2.35	0.00	52.05	0.00
1	10012	0.000	-13.3	0.00	2.35	0.00	52.05	0.00
		0.709	-13.3	0.00	0.01	0.00	52.89	0.00
1	10013	0.000	-13.3	0.00	0.01	0.00	52.89	0.00
		0.709	-13.3	0.00	-2.32	0.00	52.07	0.00
1	10014	0.000	-13.3	0.00	-2.32	0.00	52.07	0.00
		0.709	-13.3	0.00	-4.66	0.00	49.59	0.00
1	10015	0.000	-13.3	0.00	-4.66	0.00	49.59	0.00
		0.709	-13.3	0.00	-7.00	0.00	45.46	0.00
1	10016	0.000	-13.3	0.00	-7.00	0.00	45.46	0.00
		0.709	-13.3	0.00	-9.34	0.00	39.67	0.00
1	10017	0.000	-13.3	0.00	-9.34	0.00	39.67	0.00
		0.709	-13.3	0.00	-11.68	0.00	32.22	0.00
1	10018	0.000	-13.3	0.00	-11.68	0.00	32.22	0.00
		0.709	-13.3	0.00	-14.02	0.00	23.11	0.00
1	10019	0.000	-13.3	0.00	-14.02	0.00	23.11	0.00
		0.709	-13.3	0.00	-16.36	0.00	12.35	0.00
1	10020	0.000	-13.3	0.00	-16.36	0.00	12.35	0.00
		0.709	-13.3	0.00	-18.69	0.00	-0.07	0.00
1	10021	0.000	-13.3	0.00	-18.69	0.00	-0.07	0.00
		0.709	-13.3	0.00	-21.03	0.00	-14.15	0.00
1	10022	0.000	-13.3	0.00	-21.03	0.00	-14.15	0.00
		0.709	-13.3	0.00	-23.37	0.00	-29.88	0.00
1	10023	0.000	-13.3	0.00	-23.37	0.00	-29.88	0.00
		0.709	-13.3	0.00	-25.71	0.00	-47.27	0.00
1	10024	0.000	-13.3	0.00	-25.71	0.00	-47.27	0.00
		0.709	-13.3	0.00	-28.05	0.00	-66.32	0.00
2	20001	0.000	-28.0	0.00	-13.26	0.00	0.00	0.00
		0.714	-28.0	0.00	-13.26	0.00	-9.47	0.00
2	20002	0.000	-28.0	0.00	-13.26	0.00	-9.47	0.00

Geometry & cross sections
Analyze all static loads

Beam Forces and Moments Loadcase 3 Paving

Grp	Number	x [m]	N [kN]	Vy [kN]	Vz [kN]	Mt [kNm]	My [kNm]	Mz [kNm]
2	20002	0.714	-28.0	0.00	-13.26	0.00	-18.95	0.00
2	20003	0.000	-28.0	0.00	-13.26	0.00	-18.95	0.00
		0.714	-28.0	0.00	-13.26	0.00	-28.42	0.00
2	20004	0.000	-28.0	0.00	-13.26	0.00	-28.42	0.00
		0.714	-28.0	0.00	-13.26	0.00	-37.90	0.00
2	20005	0.000	-28.0	0.00	-13.26	0.00	-37.90	0.00
		0.714	-28.0	0.00	-13.26	0.00	-47.37	0.00
2	20006	0.000	-28.0	0.00	-13.26	0.00	-47.37	0.00
		0.714	-28.0	0.00	-13.26	0.00	-56.85	0.00
2	20007	0.000	-28.0	0.00	-13.26	0.00	-56.85	0.00
		0.714	-28.0	0.00	-13.26	0.00	-66.32	0.00
2	20008	0.000	-28.0	0.00	13.26	0.00	0.00	0.00
		0.714	-28.0	0.00	13.26	0.00	9.47	0.00
2	20009	0.000	-28.0	0.00	13.26	0.00	9.47	0.00
		0.714	-28.0	0.00	13.26	0.00	18.95	0.00
2	20010	0.000	-28.0	0.00	13.26	0.00	18.95	0.00
		0.714	-28.0	0.00	13.26	0.00	28.42	0.00
2	20011	0.000	-28.0	0.00	13.26	0.00	28.42	0.00
		0.714	-28.0	0.00	13.26	0.00	37.90	0.00
2	20012	0.000	-28.0	0.00	13.26	0.00	37.90	0.00
		0.714	-28.0	0.00	13.26	0.00	47.37	0.00
2	20013	0.000	-28.0	0.00	13.26	0.00	47.37	0.00
		0.714	-28.0	0.00	13.26	0.00	56.85	0.00
2	20014	0.000	-28.0	0.00	13.26	0.00	56.85	0.00
		0.714	-28.0	0.00	13.26	0.00	66.32	0.00

Grp primary group number
Number element number

Nodal Displacements Loadcase 3 Paving

Node No	u-X [mm]	u-Y [mm]	u-Z [mm]	phi-X [mrad]	phi-Y [mrad]	phi-Z [mrad]
1	0.007	0.000	-0.008	0.000	0.316	0.000
2	-0.007	0.000	-0.008	0.000	-0.316	0.000
3	0.000	0.000	0.000	0.000	-0.153	0.000
4	0.000	0.000	0.000	0.000	0.153	0.000
5	0.006	0.000	-0.274	0.000	0.428	0.000
1000	-0.108	0.000	-0.001	0.000	-0.143	0.000
1001	-0.203	0.000	-0.002	0.000	-0.114	0.000
1002	-0.270	0.000	-0.004	0.000	-0.067	0.000
1003	-0.296	0.000	-0.005	0.000	0.000	0.000
1004	-0.268	0.000	-0.006	0.000	0.086	0.000
1005	-0.172	0.000	-0.007	0.000	0.191	0.000
1006	0.108	0.000	-0.001	0.000	0.143	0.000
1007	0.203	0.000	-0.002	0.000	0.114	0.000
1008	0.270	0.000	-0.004	0.000	0.067	0.000
1009	0.296	0.000	-0.005	0.000	-0.000	0.000
1010	0.268	0.000	-0.006	0.000	-0.086	0.000
1011	0.172	0.000	-0.007	0.000	-0.191	0.000
1012	0.006	0.000	-0.609	0.000	0.505	0.000
1013	0.005	0.000	-0.987	0.000	0.549	0.000
1014	0.004	0.000	-1.386	0.000	0.564	0.000
1015	0.004	0.000	-1.784	0.000	0.551	0.000
1016	0.003	0.000	-2.165	0.000	0.516	0.000
1017	0.003	0.000	-2.514	0.000	0.460	0.000
1018	0.002	0.000	-2.817	0.000	0.388	0.000
1019	0.002	0.000	-3.064	0.000	0.303	0.000
1020	0.001	0.000	-3.246	0.000	0.208	0.000
1021	0.001	0.000	-3.358	0.000	0.106	0.000

Geometry & cross sections
Analyze all static loads

Nodal Displacements Loadcase 3 Paving

Node No	u-X [mm]	u-Y [mm]	u-Z [mm]	phi-X [mrad]	phi-Y [mrad]	phi-Z [mrad]
1022	0.000	0.000	-3.396	0.000	0.001	0.000
1023	-0.001	0.000	-3.359	0.000	-0.105	0.000
1024	-0.001	0.000	-3.248	0.000	-0.207	0.000
1025	-0.002	0.000	-3.066	0.000	-0.302	0.000
1026	-0.002	0.000	-2.820	0.000	-0.387	0.000
1027	-0.003	0.000	-2.518	0.000	-0.460	0.000
1028	-0.003	0.000	-2.170	0.000	-0.515	0.000
1029	-0.004	0.000	-1.789	0.000	-0.551	0.000
1030	-0.004	0.000	-1.391	0.000	-0.564	0.000
1031	-0.005	0.000	-0.992	0.000	-0.550	0.000
1032	-0.006	0.000	-0.614	0.000	-0.506	0.000
1033	-0.006	0.000	-0.277	0.000	-0.429	0.000

Nodal Reactions Loadcase 3 Paving

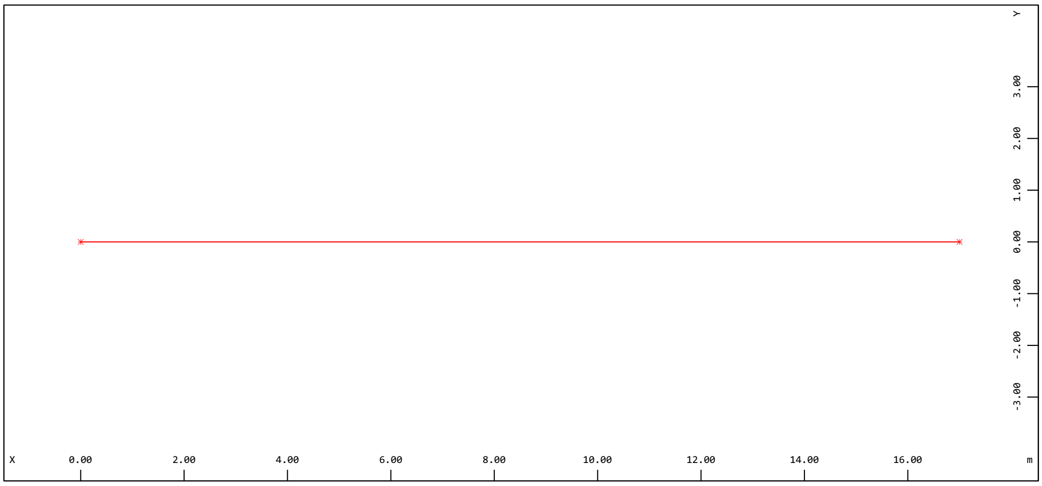
Node No	P-X [kN]	P-Y [kN]	P-Z [kN]	M-X [kNm]	M-Y [kNm]	M-Z [kNm]
3	13.3		28.0			
4	-13.3		28.0			

Sum of Reactions and Loadings

Loadcase	Σ(Reactions) X[kN]	Y[kN]	Z[kN]	Designation
	Σ(Loads)			
1	0.0	0.0	337.5	Self weight
	0.0	0.0	-337.5	
2	0.0	0.0	0.0	Earth pressure
	0.0	0.0	0.0	
3	0.0	0.0	56.1	Paving
	0.0	0.0	-56.1	

Geometry & cross sections
SVENSKA TYPFORDON

Geometric axis KF



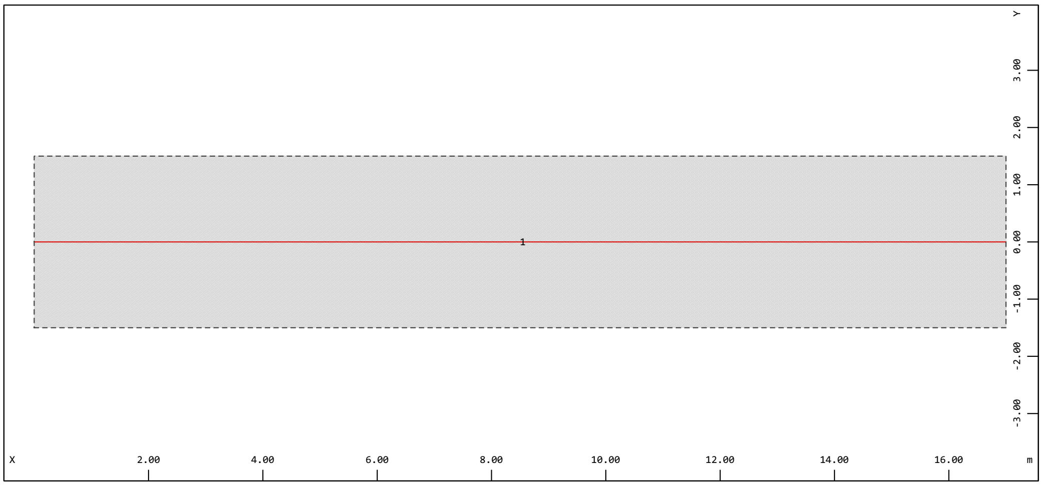
Segments
z x

Segments

S[-]	L[m]	R[m]	X[m]	Y[m]	Z[m]	DX[-]	DY[-]	DZ[-]
0.000	17.000		0.000	0.000	0.000	1.000	0.000	0.000
17.000			17.000	0.000	0.000	1.000	0.000	0.000

S[-] station value at start point X[m],Y[m],Z[m] coordinates of start point
L[m] length of the segment DX[-],DY[-],DZ[-] component of the direction
R[m] radius of curvature

Dimensions for Live Loads



Lane 0 - 9
z x

Lane 0 - 99

S [-]	n	yc [m]	yr [m]	yl [m]	l-phi [m]	hs [m]	incl [-]	h-eff [m]	b-eff [m]	d-eff [m]	a-sl [m]
0.000	1	0.000	1.500	-1.500	17.000	0.000	0.000	0.000	0.000	0.000	0.000
17.000		0.000	1.500	-1.500		0.000	0.000	inc-d=	0.250		

S station value

Geometry & cross sections
SVENSKA TYPFORDON

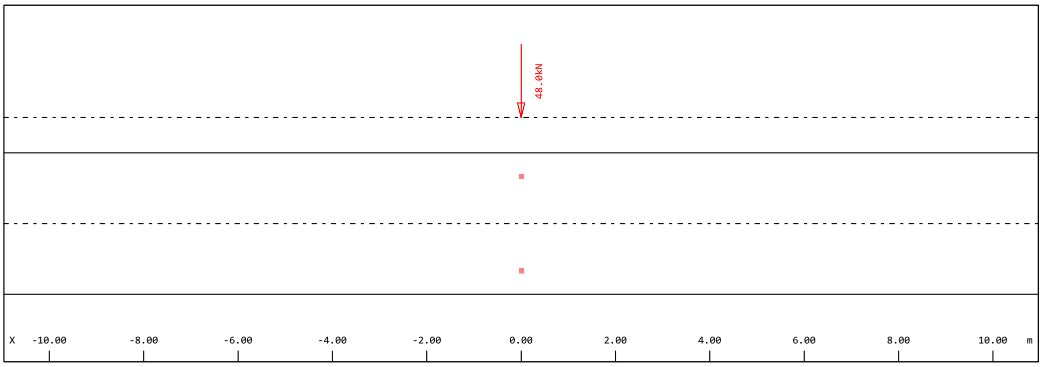
Actions

type	part	sup	Designation	γ-u	γ-f	γ-a	ψ_0	ψ_1	ψ_2	$\psi_1$inf
G_1	G	perm	Self weight	1.00	1.00	1.00	1.00	1.00	1.00	1.00
G_2	G	perm	Earth pressure	1.00	1.00	1.00	1.00	1.00	1.00	1.00
G_3	G	perm	Paving	1.00	0.00	1.00	1.00	1.00	1.00	1.00
L	Q	excl	live loading	1.00	1.00	1.00	1.00	1.00	1.00	1.00
L_A	Q_1	excl	Typ A	1.00	0.00	1.00	1.00	1.00	1.00	1.00
L_B	Q_1	excl	Typ B	1.00	0.00	1.00	1.00	1.00	1.00	1.00
			Reliability factor Kfi	1.000						
			Reduction factor xsi	0.890						

type action — γ-u,γ-f,γ-a partial safety factors for unfavourable/favourable/accidental
part partition of the action — $\psi_0,\psi_1,\psi_2,\psi_1$inf combination coefficients
sup superposition type

Load Train 50 Typfordon a)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

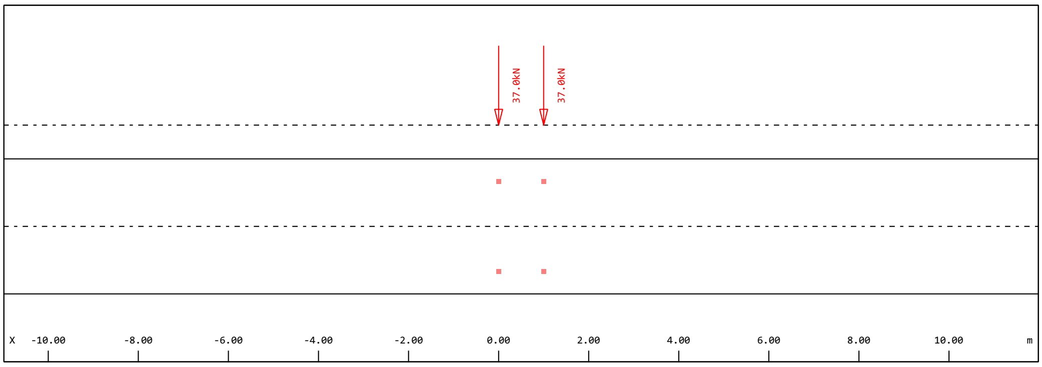
P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	48.0	0.0	0.0	48.0	0.0	0.000		0.000	0.000	0.000	2.000	

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 51 Typfordon b)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

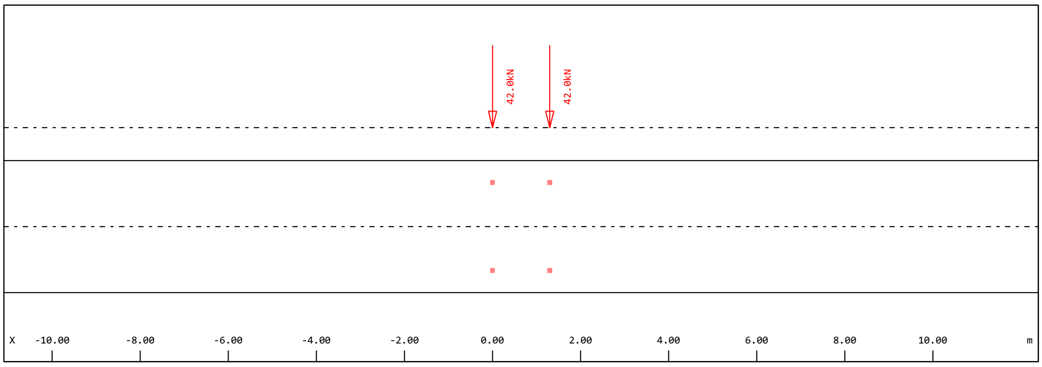
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	37.0	0.0	0.0	37.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	1.000	(min)	0.000	0.000	0.000	2.000	

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 52 Typfordon c)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	42.0	0.0	0.0	42.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	42.0	0.0	0.0	42.0	0.0	1.300	(min)	0.000	0.000	0.000	2.000	

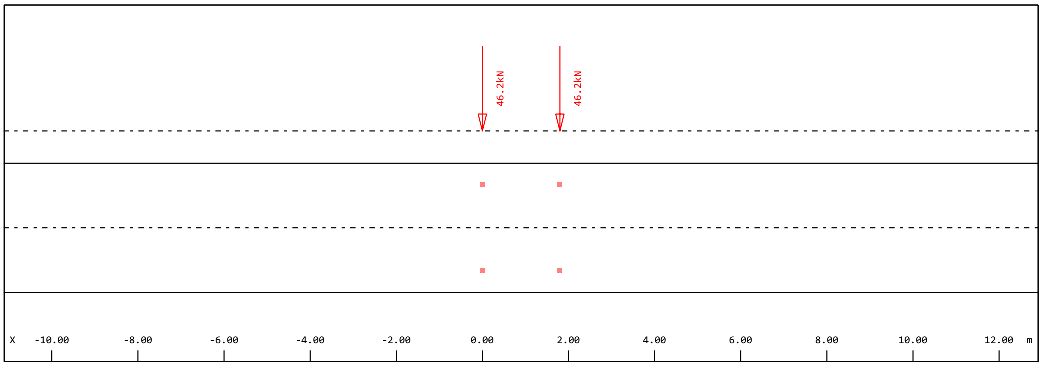
Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels

Geometry & cross sections
SVENSKA TYPFORDON

Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 53 Typfordon d)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	46.2	0.0	0.0	46.2	0.0	0.000		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	1.800	(min)	0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 54 Typfordon e)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
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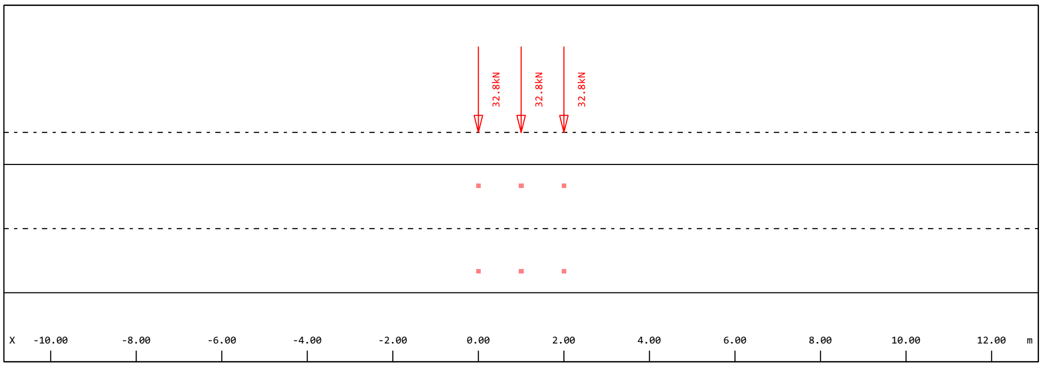


User defined

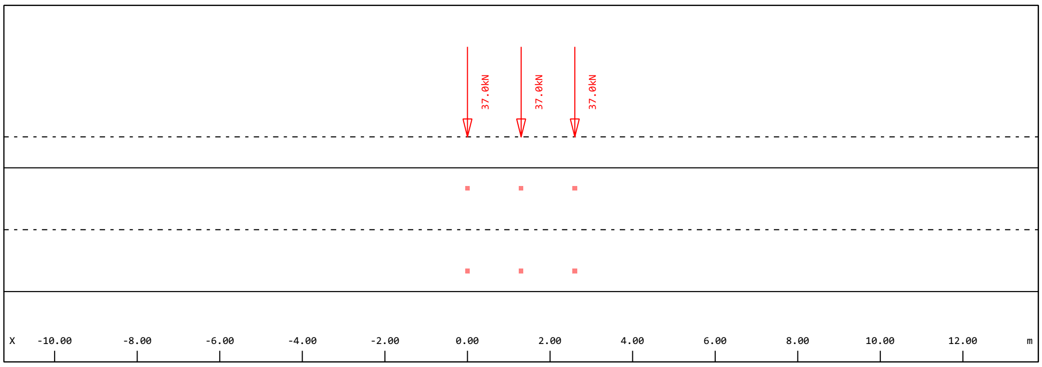
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	32.8	0.0	0.0	32.8	0.0	0.000		0.000	0.000	0.000	2.000	
2P	32.8	0.0	0.0	32.8	0.0	1.000		0.000	0.000	0.000	2.000	
2P	32.8	0.0	0.0	32.8	0.0	2.000	(min)	0.000	0.000	0.000	2.000	

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 55 Typfordon f)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	37.0	0.0	0.0	37.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	1.300		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	2.600	(min)	0.000	0.000	0.000	2.000	

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Geometry & cross sections
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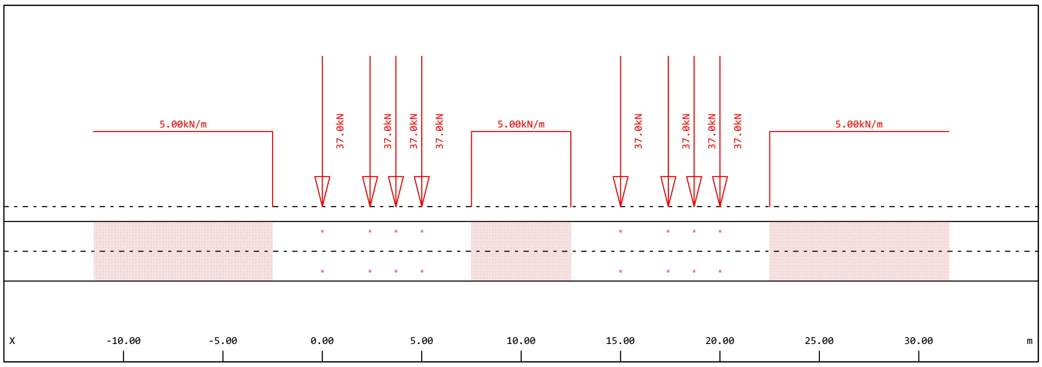
Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 56 Typfordon g)
USER User defined

Load elements of Load Train	**Load value**	**Remark**
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	37.0	0.0	0.0	37.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	2.400		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	3.700		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	5.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	10.000	0.000	0.000	0.000		
2P	37.0	0.0	0.0	37.0	0.0	15.000	(min)	0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	17.400		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	18.700		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	20.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	12.500	10.000	0.000	0.000	0.000		

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P,B	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 57 Typfordon h)
USER User defined

Load elements of Load Train	**Load value**	**Remark**
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		

Geometry & cross sections
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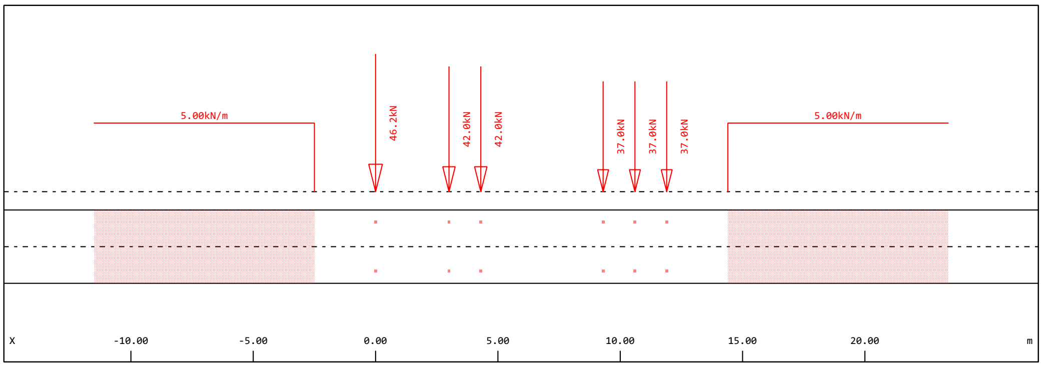
USER User defined

Load elements of Load Train	Load value	Remark
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

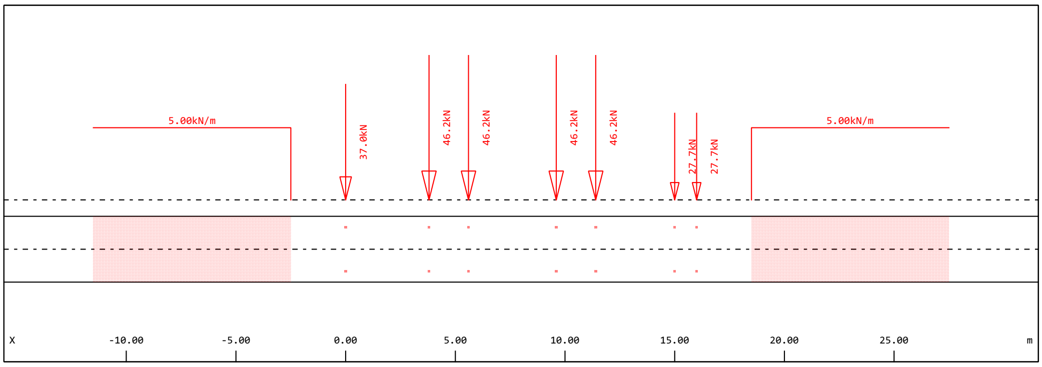
 P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000 =	1.67	[kN/m2]
2P	46.2	0.0	0.0	46.2	0.0	0.000		0.000	0.000	0.000	2.000	
2P	42.0	0.0	0.0	42.0	0.0	3.000		0.000	0.000	0.000	2.000	
2P	42.0	0.0	0.0	42.0	0.0	4.300		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	9.300		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	10.600		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	11.900		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	16.900	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 58 Typfordon i)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

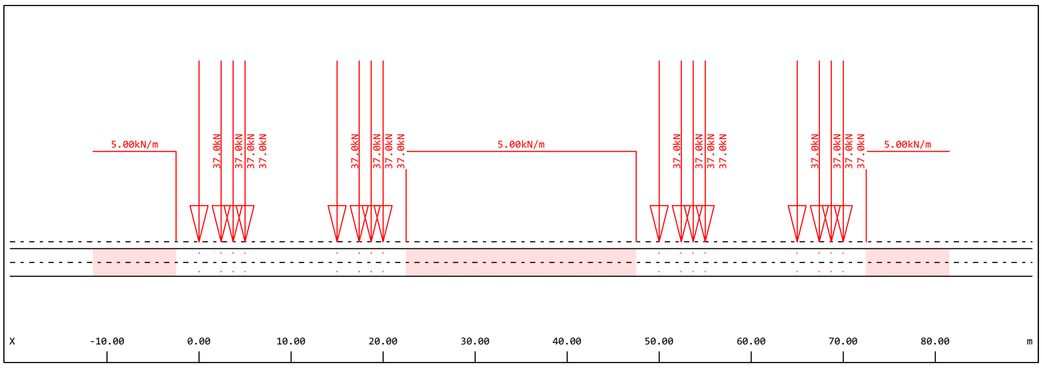
Load elements of Load Train

	Pv	Pl	Pw	Pf	ffav	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m]	cont@
P	[kN]	[kN]	[kN]	[kN]	[-]						bw[m]	lw[m]
B	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]						bw[m]	
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	37.0	0.0	0.0	37.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	3.800		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	5.600		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	9.600		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	11.400		0.000	0.000	0.000	2.000	
2P	27.7	0.0	0.0	27.7	0.0	15.000		0.000	0.000	0.000	2.000	
2P	27.7	0.0	0.0	27.7	0.0	16.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	21.000	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 59 Typfordon j)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Geometry & cross sections
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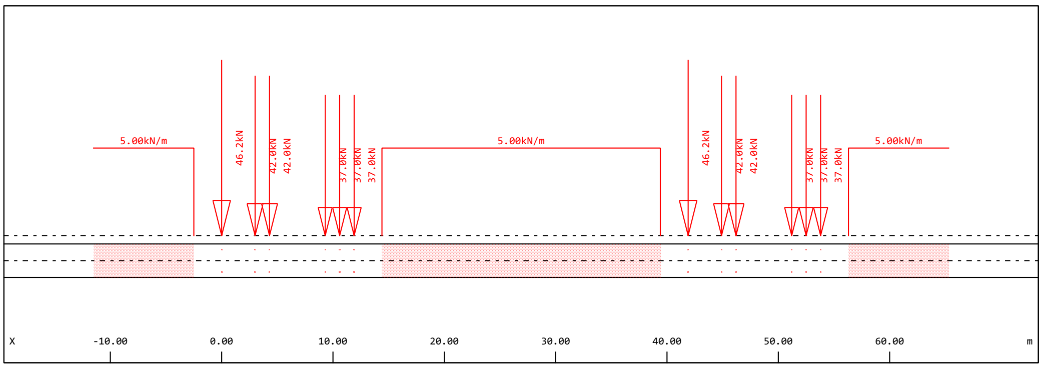
Load elements of Load Train

	Pv	Pl	Pw	Pf	ffav	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m]	cont@
P	[kN]	[kN]	[kN]	[kN]	[-]						bw[m]	lw[m]
B	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]						bw[m]	
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	37.0	0.0	0.0	37.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	2.400		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	3.700		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	5.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	15.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	17.400		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	18.700		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	20.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	25.000	0.000	0.000	0.000		
2P	37.0	0.0	0.0	37.0	0.0	50.000	(min)	0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	52.400		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	53.700		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	55.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	65.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	67.400		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	68.700		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	70.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	47.500	25.000	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 60 Typfordon k)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Geometry & cross sections
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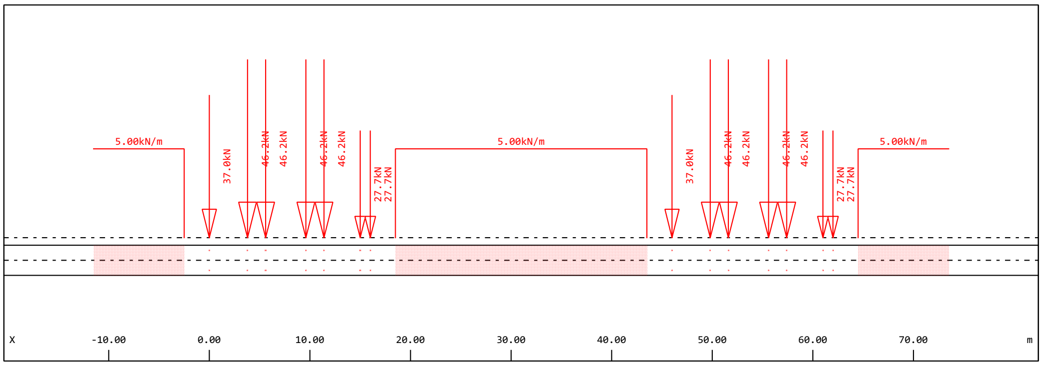
Load elements of Load Train

	Pv	Pl	Pw	Pf	ffav	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m]	cont@
P	[kN]	[kN]	[kN]	[kN]	[-]						bw[m]	lw[m]
B	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]						bw[m]	
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	46.2	0.0	0.0	46.2	0.0	0.000		0.000	0.000	0.000	2.000	
2P	42.0	0.0	0.0	42.0	0.0	3.000		0.000	0.000	0.000	2.000	
2P	42.0	0.0	0.0	42.0	0.0	4.300		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	9.300		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	10.600		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	11.900		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	16.900	0.000	0.000	0.000		
2P	46.2	0.0	0.0	46.2	0.0	41.900	(min)	0.000	0.000	0.000	2.000	
2P	42.0	0.0	0.0	42.0	0.0	44.900		0.000	0.000	0.000	2.000	
2P	42.0	0.0	0.0	42.0	0.0	46.200		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	51.200		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	52.500		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	53.800		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	39.400	16.900	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 61 Typfordon 1)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

	Pv	Pl	Pw	Pf	ffav	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m]	cont@
P	[kN]	[kN]	[kN]	[kN]	[-]						bw[m]	lw[m]
B	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]						bw[m]	
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	37.0	0.0	0.0	37.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	3.800		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	5.600		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	9.600		0.000	0.000	0.000	2.000	

Geometry & cross sections
SVENSKA TYPFORDON

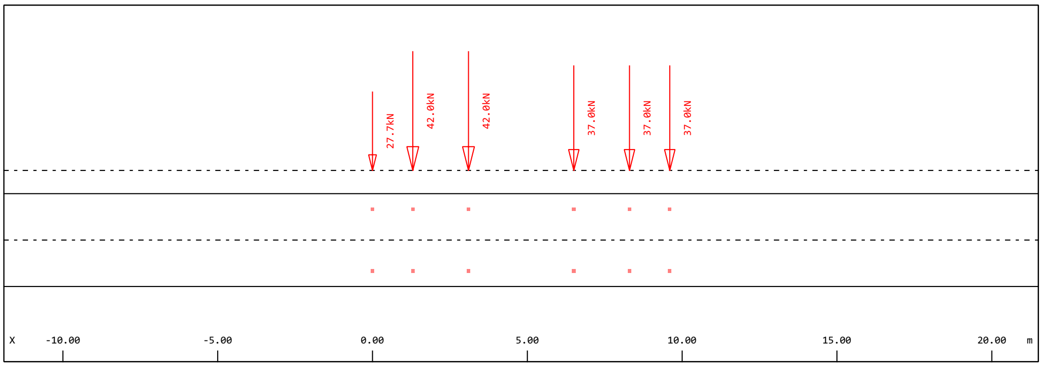
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
2P	46.2	0.0	0.0	46.2	0.0	11.400		0.000	0.000	0.000	2.000	
2P	27.7	0.0	0.0	27.7	0.0	15.000		0.000	0.000	0.000	2.000	
2P	27.7	0.0	0.0	27.7	0.0	16.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	21.000	0.000	0.000	0.000		
2P	37.0	0.0	0.0	37.0	0.0	46.000		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	49.800		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	51.600		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	55.600		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	57.400		0.000	0.000	0.000	2.000	
2P	27.7	0.0	0.0	27.7	0.0	61.000		0.000	0.000	0.000	2.000	
2P	27.7	0.0	0.0	27.7	0.0	62.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	43.500	21.000	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 62 Typfordon m)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	27.7	0.0	0.0	27.7	0.0	0.000		0.000	0.000	0.000	2.000	
2P	42.0	0.0	0.0	42.0	0.0	1.300		0.000	0.000	0.000	2.000	
2P	42.0	0.0	0.0	42.0	0.0	3.100		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	6.500		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	8.300		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	9.600		0.000	0.000	0.000	2.000	

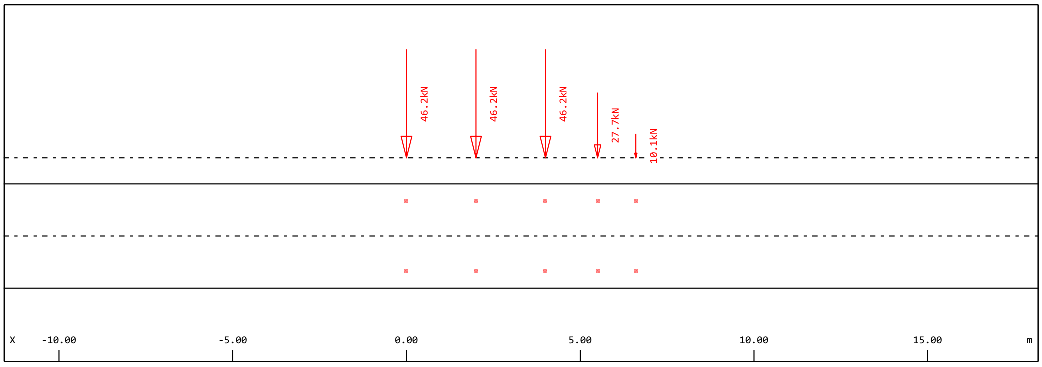
Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model

Geometry & cross sections
SVENSKA TYPFORDON

ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 63 Typfordon n)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

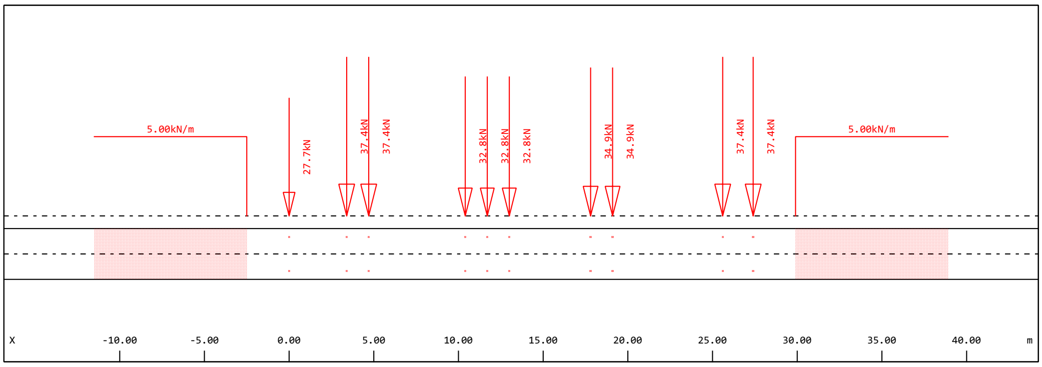
P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	46.2	0.0	0.0	46.2	0.0	0.000		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	2.000		0.000	0.000	0.000	2.000	
2P	46.2	0.0	0.0	46.2	0.0	4.000		0.000	0.000	0.000	2.000	
2P	27.7	0.0	0.0	27.7	0.0	5.500		0.000	0.000	0.000	2.000	
2P	10.1	0.0	0.0	10.1	0.0	6.600		0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 64 Typfordon o)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

Load elements of Load Train

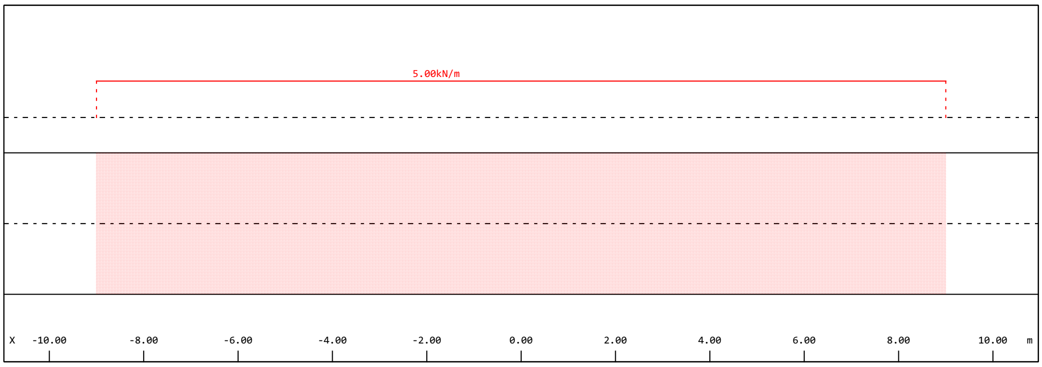
P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	27.7	0.0	0.0	27.7	0.0	0.000		0.000	0.000	0.000	2.000	
2P	37.4	0.0	0.0	37.4	0.0	3.400		0.000	0.000	0.000	2.000	
2P	37.4	0.0	0.0	37.4	0.0	4.700		0.000	0.000	0.000	2.000	
2P	32.8	0.0	0.0	32.8	0.0	10.400		0.000	0.000	0.000	2.000	
2P	32.8	0.0	0.0	32.8	0.0	11.700		0.000	0.000	0.000	2.000	
2P	32.8	0.0	0.0	32.8	0.0	13.000		0.000	0.000	0.000	2.000	
2P	34.9	0.0	0.0	34.9	0.0	17.800		0.000	0.000	0.000	2.000	
2P	34.9	0.0	0.0	34.9	0.0	19.100		0.000	0.000	0.000	2.000	
2P	37.4	0.0	0.0	37.4	0.0	25.600		0.000	0.000	0.000	2.000	
2P	37.4	0.0	0.0	37.4	0.0	27.400		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	32.400	0.000	0.000	0.000		

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P,B	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 65 FILLAST
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

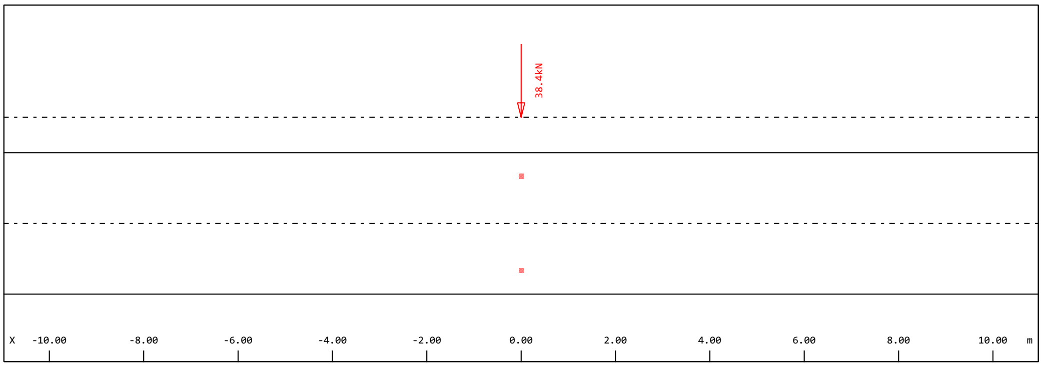
Load elements of Load Train

B	Pv [kN/m]	Pl [kN/m]	Pw [kN/m]	Pf [kN/m]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area

Load Train 150 Typfordon a)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	38.4	0.0	0.0	38.4	0.0	0.000		0.000	0.000	0.000	2.000	

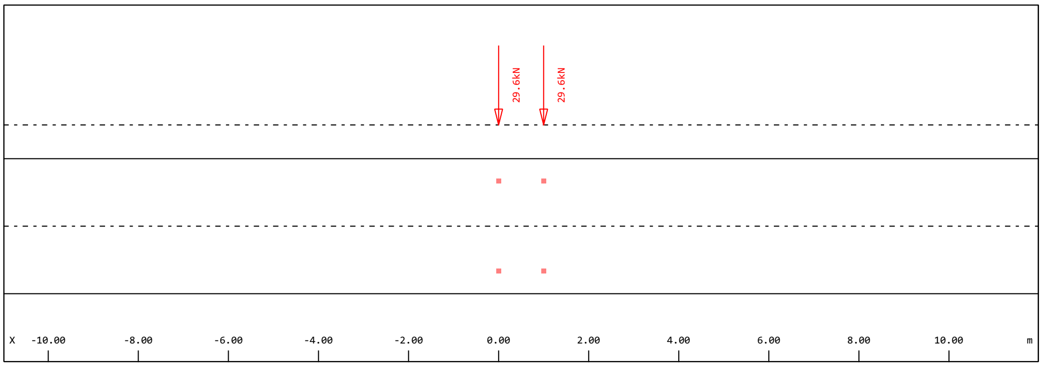
Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area

Geometry & cross sections
SVENSKA TYPFORDON

L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 151 Typfordon b)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	29.6	0.0	0.0	29.6	0.0	0.000		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	1.000	(min)	0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 152 Typfordon c)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

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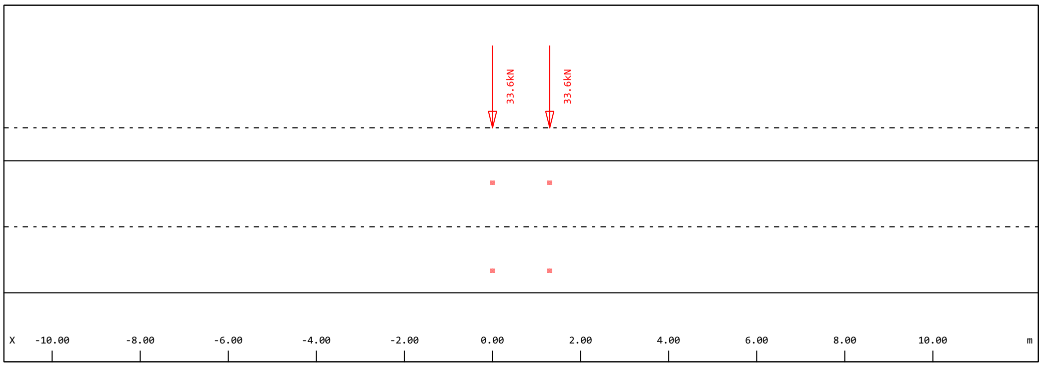
Geometry & cross sections
SVENSKA TYPFORDON



User defined

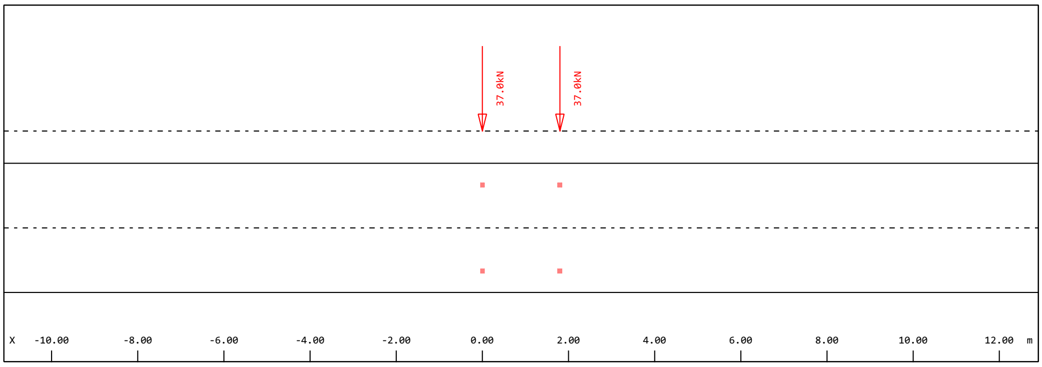
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	33.6	0.0	0.0	33.6	0.0	0.000		0.000	0.000	0.000	2.000	
2P	33.6	0.0	0.0	33.6	0.0	1.300	(min)	0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 153 Typfordon d)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	37.0	0.0	0.0	37.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	1.800	(min)	0.000	0.000	0.000	2.000	

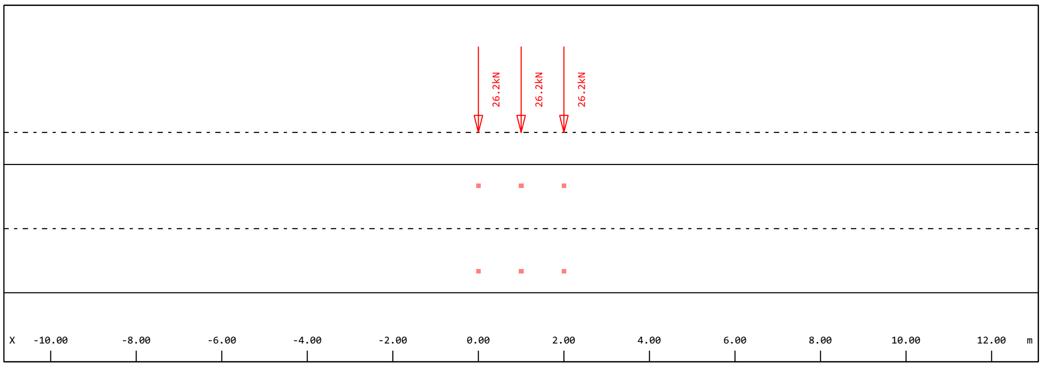
Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels

Geometry & cross sections
SVENSKA TYPFORDON

Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 154 Typfordon e)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	26.2	0.0	0.0	26.2	0.0	0.000		0.000	0.000	0.000	2.000	
2P	26.2	0.0	0.0	26.2	0.0	1.000		0.000	0.000	0.000	2.000	
2P	26.2	0.0	0.0	26.2	0.0	2.000	(min)	0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 155 Typfordon f)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

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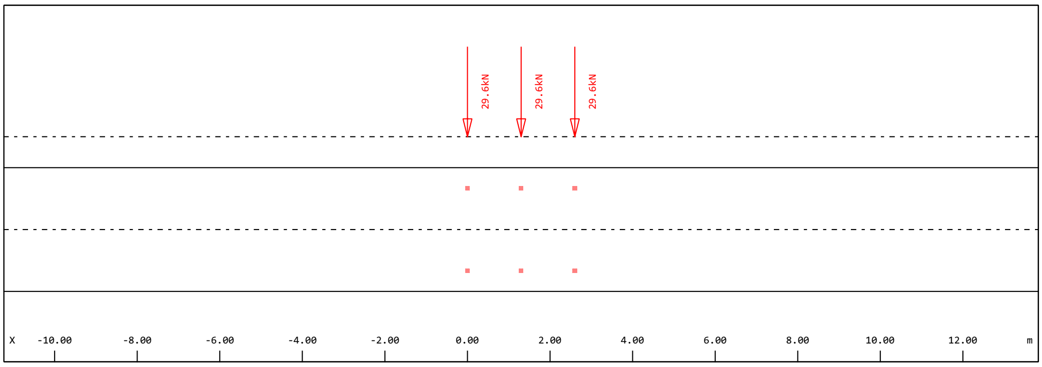
Geometry & cross sections
SVENSKA TYPFORDON



User defined

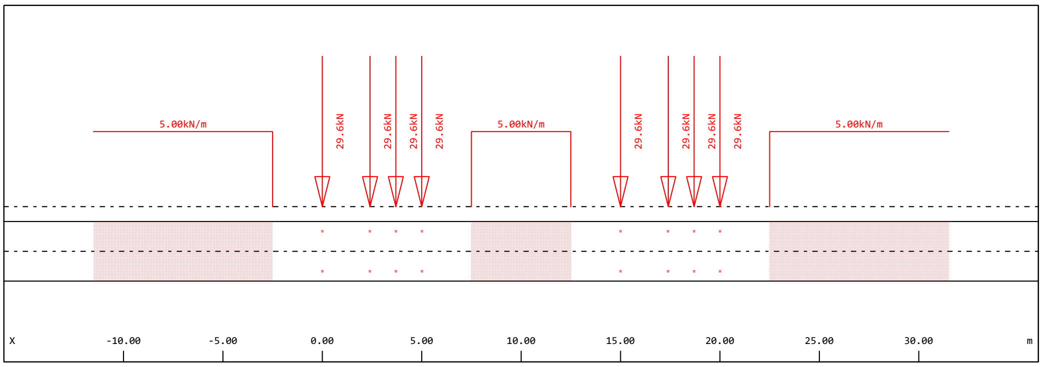
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	29.6	0.0	0.0	29.6	0.0	0.000		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	1.300		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	2.600	(min)	0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 156 Typfordon g)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000 =	1.67	[kN/m2]
2P	29.6	0.0	0.0	29.6	0.0	0.000		0.000	0.000	0.000	2.000	

Geometry & cross sections
SVENSKA TYPFORDON

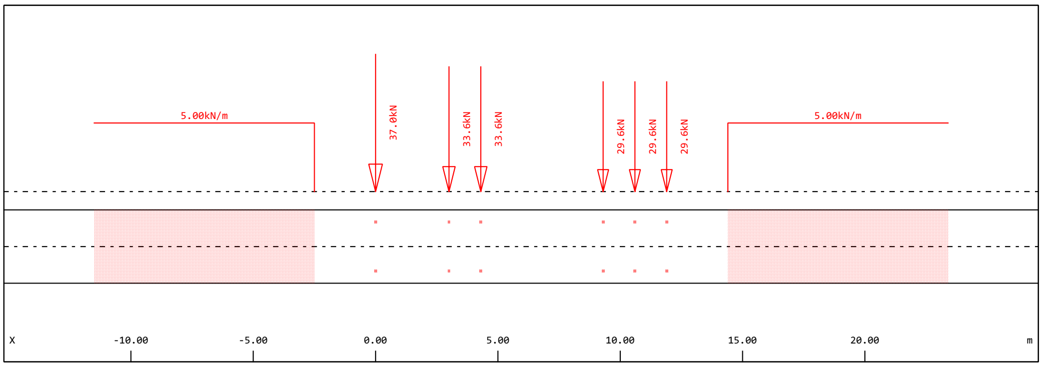
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
2P	29.6	0.0	0.0	29.6	0.0	2.400		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	3.700		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	5.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	10.000	0.000	0.000	0.000		
2P	29.6	0.0	0.0	29.6	0.0	15.000	(min)	0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	17.400		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	18.700		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	20.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	12.500	10.000	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 157 Typfordon h)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	37.0	0.0	0.0	37.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	33.6	0.0	0.0	33.6	0.0	3.000		0.000	0.000	0.000	2.000	
2P	33.6	0.0	0.0	33.6	0.0	4.300		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	9.300		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	10.600		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	11.900		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	16.900	0.000	0.000	0.000		

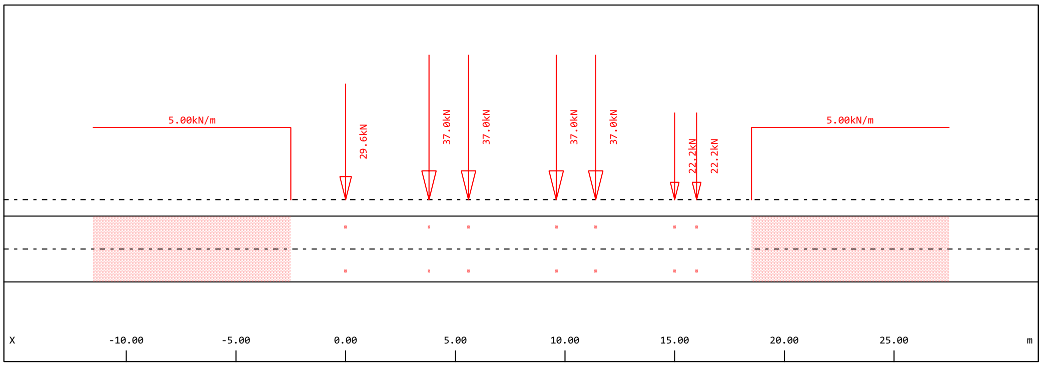
Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model

Geometry & cross sections
SVENSKA TYPFORDON

ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 158 Typfordon i)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

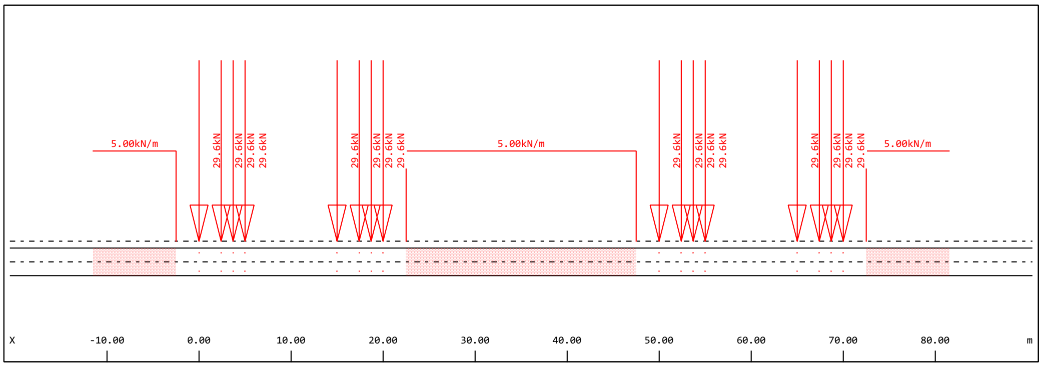
P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	29.6	0.0	0.0	29.6	0.0	0.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	3.800		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	5.600		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	9.600		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	11.400		0.000	0.000	0.000	2.000	
2P	22.2	0.0	0.0	22.2	0.0	15.000		0.000	0.000	0.000	2.000	
2P	22.2	0.0	0.0	22.2	0.0	16.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	21.000	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 159 Typfordon j)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

Load elements of Load Train

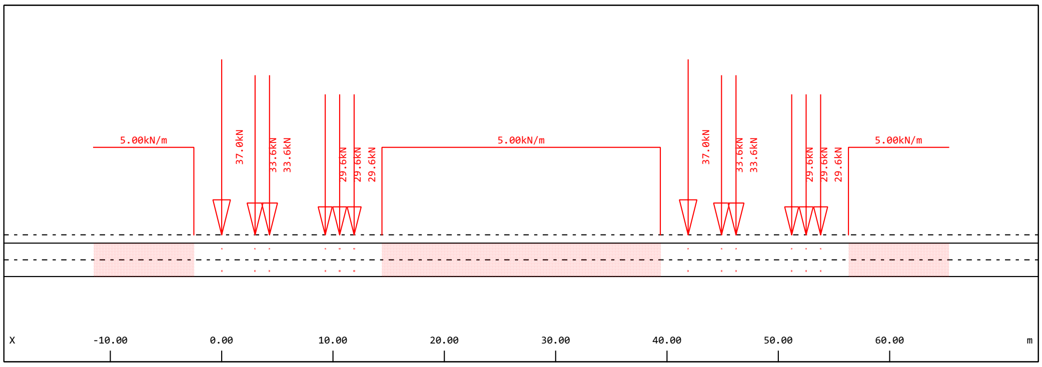
P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	29.6	0.0	0.0	29.6	0.0	0.000		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	2.400		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	3.700		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	5.000		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	15.000		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	17.400		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	18.700		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	20.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	25.000	0.000	0.000	0.000		
2P	29.6	0.0	0.0	29.6	0.0	50.000	(min)	0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	52.400		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	53.700		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	55.000		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	65.000		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	67.400		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	68.700		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	70.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	47.500	25.000	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 160 Typfordon k)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

Load elements of Load Train

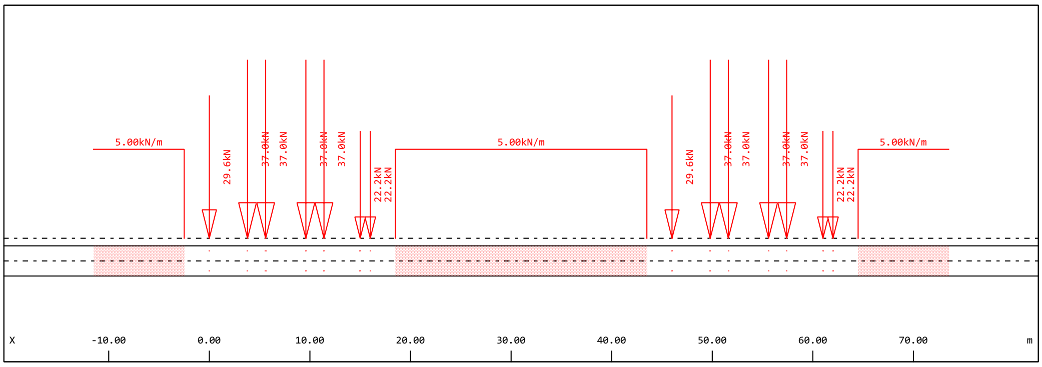
P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	37.0	0.0	0.0	37.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	33.6	0.0	0.0	33.6	0.0	3.000		0.000	0.000	0.000	2.000	
2P	33.6	0.0	0.0	33.6	0.0	4.300		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	9.300		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	10.600		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	11.900		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	16.900	0.000	0.000	0.000		
2P	37.0	0.0	0.0	37.0	0.0	41.900	(min)	0.000	0.000	0.000	2.000	
2P	33.6	0.0	0.0	33.6	0.0	44.900		0.000	0.000	0.000	2.000	
2P	33.6	0.0	0.0	33.6	0.0	46.200		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	51.200		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	52.500		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	53.800		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	39.400	16.900	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 161 Typfordon 1)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

Load elements of Load Train

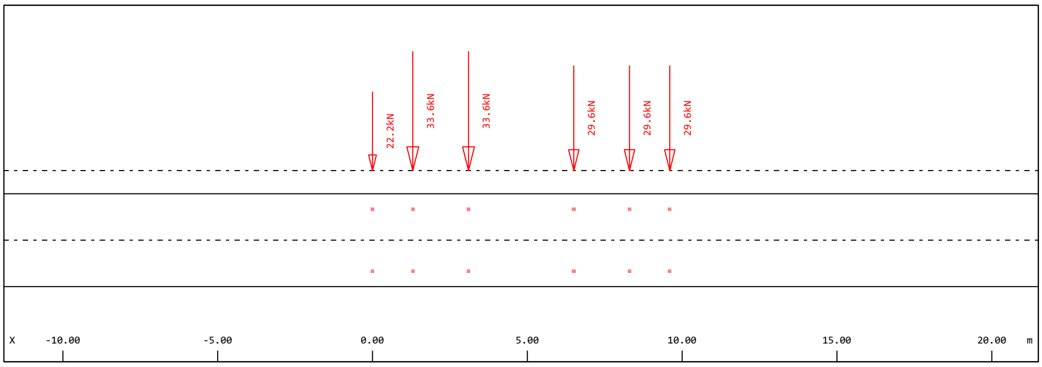
P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000 =	1.67	[kN/m2]
2P	29.6	0.0	0.0	29.6	0.0	0.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	3.800		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	5.600		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	9.600		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	11.400		0.000	0.000	0.000	2.000	
2P	22.2	0.0	0.0	22.2	0.0	15.000		0.000	0.000	0.000	2.000	
2P	22.2	0.0	0.0	22.2	0.0	16.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	21.000	0.000	0.000	0.000		
2P	29.6	0.0	0.0	29.6	0.0	46.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	49.800		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	51.600		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	55.600		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	57.400		0.000	0.000	0.000	2.000	
2P	22.2	0.0	0.0	22.2	0.0	61.000		0.000	0.000	0.000	2.000	
2P	22.2	0.0	0.0	22.2	0.0	62.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	43.500	21.000	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 162 Typfordon m)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

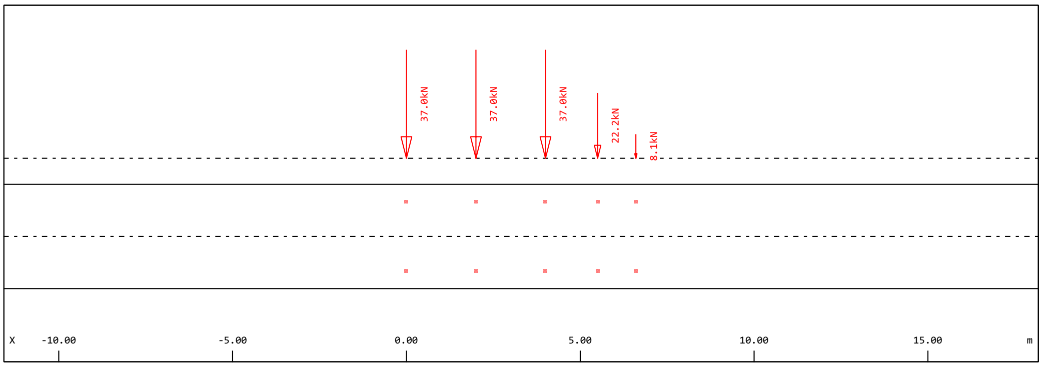
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	22.2	0.0	0.0	22.2	0.0	0.000		0.000	0.000	0.000	2.000	
2P	33.6	0.0	0.0	33.6	0.0	1.300		0.000	0.000	0.000	2.000	
2P	33.6	0.0	0.0	33.6	0.0	3.100		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	6.500		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	8.300		0.000	0.000	0.000	2.000	
2P	29.6	0.0	0.0	29.6	0.0	9.600		0.000	0.000	0.000	2.000	

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 163 Typfordon n)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

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Geometry & cross sections
SVENSKA TYPFORDON

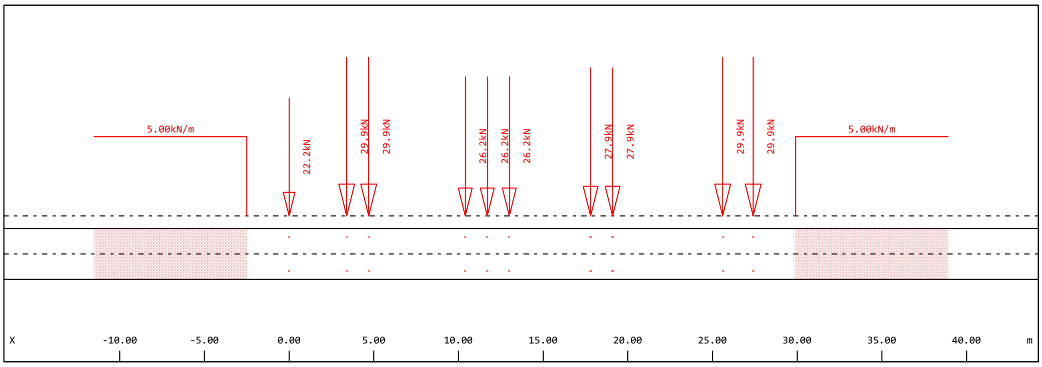
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	37.0	0.0	0.0	37.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	2.000		0.000	0.000	0.000	2.000	
2P	37.0	0.0	0.0	37.0	0.0	4.000		0.000	0.000	0.000	2.000	
2P	22.2	0.0	0.0	22.2	0.0	5.500		0.000	0.000	0.000	2.000	
2P	8.1	0.0	0.0	8.1	0.0	6.600		0.000	0.000	0.000	2.000	

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 164 Typfordon o)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	22.2	0.0	0.0	22.2	0.0	0.000		0.000	0.000	0.000	2.000	
2P	29.9	0.0	0.0	29.9	0.0	3.400		0.000	0.000	0.000	2.000	
2P	29.9	0.0	0.0	29.9	0.0	4.700		0.000	0.000	0.000	2.000	
2P	26.2	0.0	0.0	26.2	0.0	10.400		0.000	0.000	0.000	2.000	
2P	26.2	0.0	0.0	26.2	0.0	11.700		0.000	0.000	0.000	2.000	
2P	26.2	0.0	0.0	26.2	0.0	13.000		0.000	0.000	0.000	2.000	
2P	27.9	0.0	0.0	27.9	0.0	17.800		0.000	0.000	0.000	2.000	
2P	27.9	0.0	0.0	27.9	0.0	19.100		0.000	0.000	0.000	2.000	
2P	29.9	0.0	0.0	29.9	0.0	25.600		0.000	0.000	0.000	2.000	
2P	29.9	0.0	0.0	29.9	0.0	27.400		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	32.400	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area

Geometry & cross sections
SVENSKA TYPFORDON

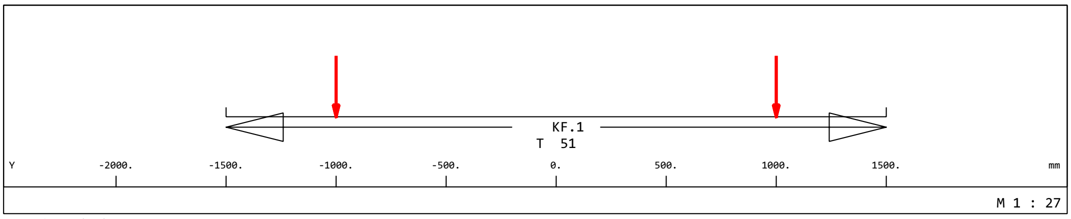
L[m] length of loading	lw[m] length of wheel contact area
y[m] excentricity of loading	

Geometry & cross sections
Influenslinjer ULS/SLS LM1

Evaluation : Case 1 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	51	Typfordon b)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading

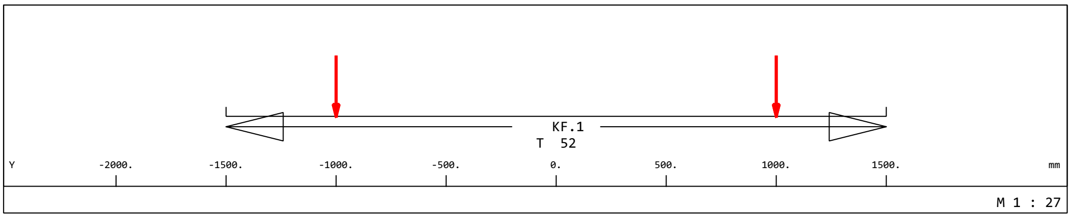


Loadposition case 1

Evaluation : Case 2 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	52	Typfordon c)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading

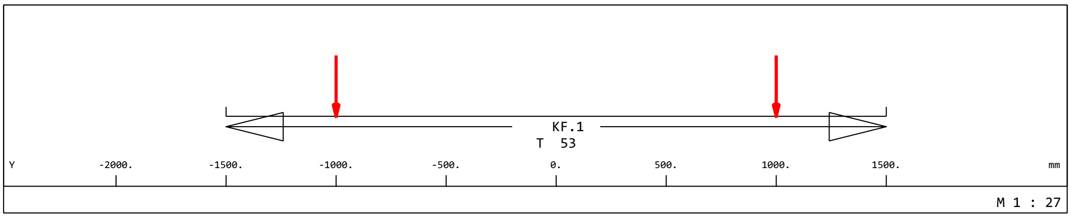


Loadposition case 2

Evaluation : Case 3 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	53	Typfordon d)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading



Loadposition case 3

Evaluation : Case 4 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	54	Typfordon e)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading

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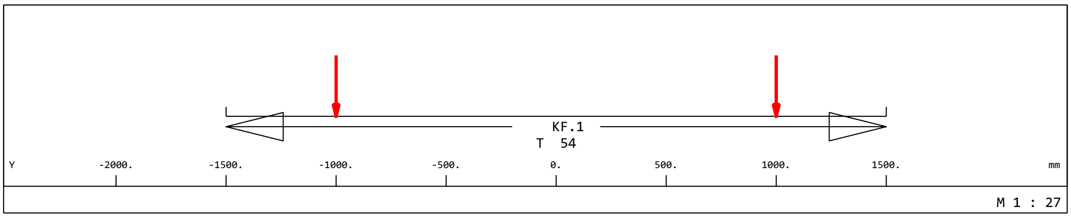
Geometry & cross sections
Influenslinjer ULS/SLS LM1

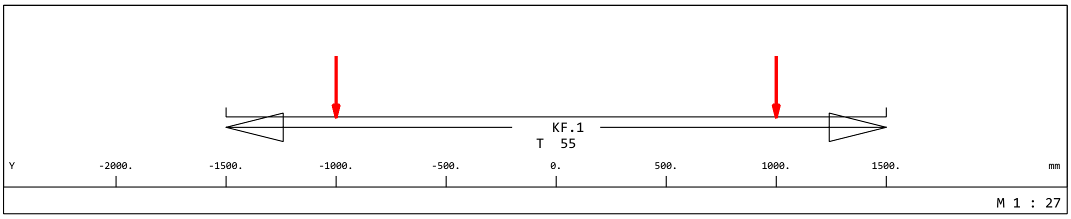


Loadposition case 4

Evaluation : Case 5 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	55	Typfordon f)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading

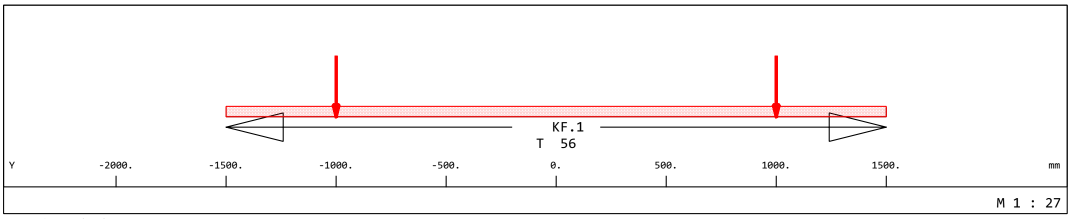


Loadposition case 5

Evaluation : Case 6 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	56	Typfordon g)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading



Loadposition case 6

Evaluation : Case 7 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	57	Typfordon h)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading

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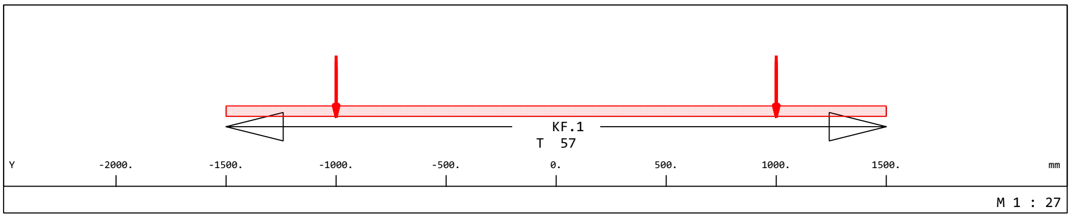
Geometry & cross sections
Influenslinjer ULS/SLS LM1

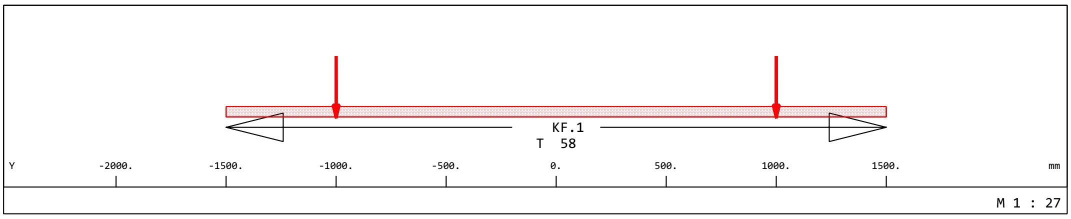


Loadposition case 7

Evaluation : Case 8 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	58	Typfordon i)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading

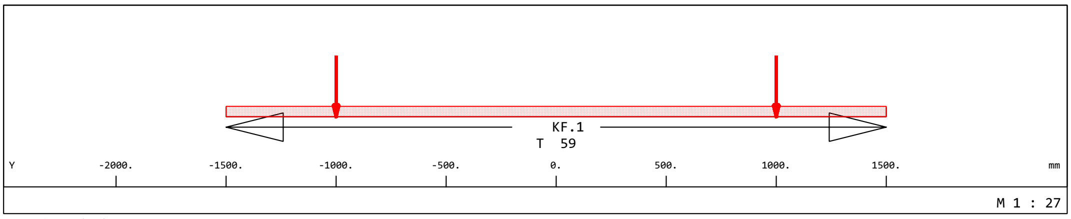


Loadposition case 8

Evaluation : Case 9 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	59	Typfordon j)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading



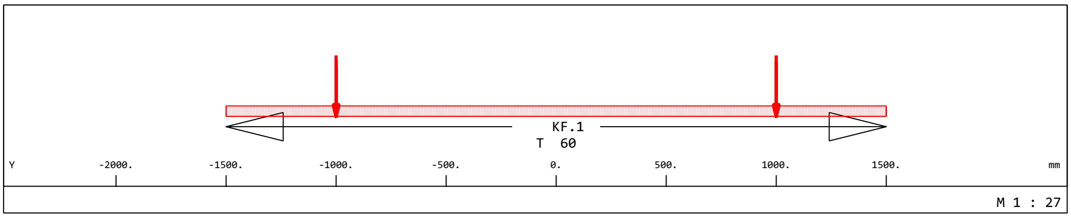
Loadposition case 9

Evaluation : Case 10 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	60	Typfordon k)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading

Geometry & cross sections
Influenslinjer ULS/SLS LM1

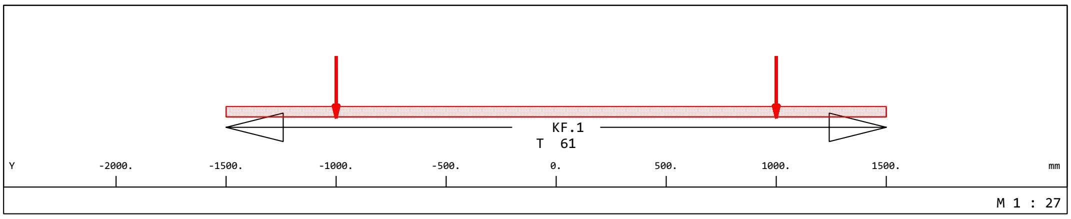


Loadposition case 10

Evaluation : Case 11 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	61	Typfordon l)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading

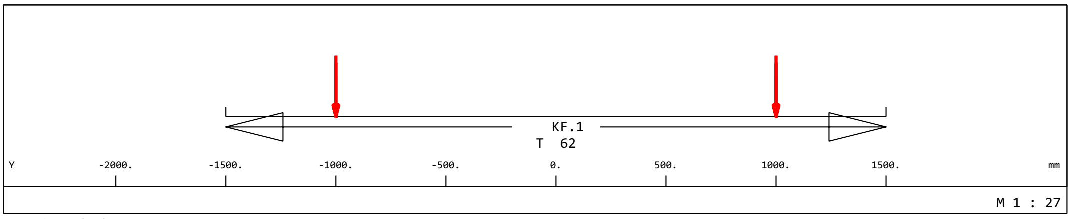


Loadposition case 11

Evaluation : Case 12 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	62	Typfordon m)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading



Loadposition case 12

Evaluation : Case 13 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	63	Typfordon n)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading — RDL* factor on residual loads
v[km/h] velocity of the load train — BRK* factor on longitudinal loads
yex[m] eccentricity of load train — TRA* factor on transverse loads
PL* factor on single loads — FUG* factor on centrifugal loads
UDL* factor on uniform loads — WIND factor on wind loading

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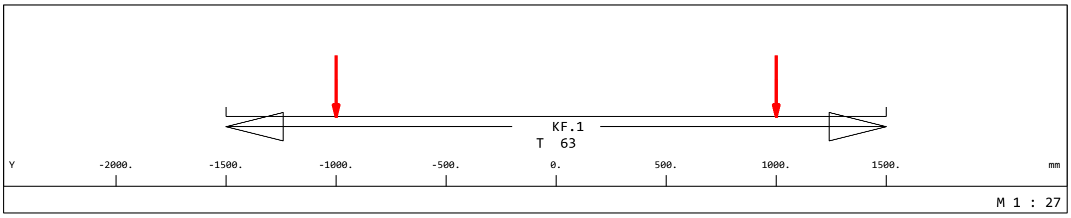
Geometry & cross sections
Influenslinjer ULS/SLS LM1

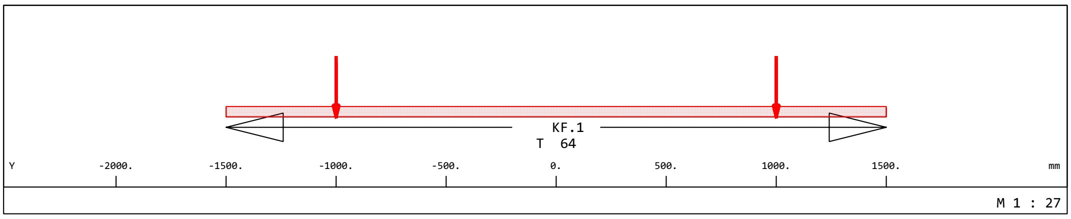


Loadposition case 13

Evaluation : Case 14 ENVELOPE TYPFORDON B

Lane	LC		p[kN/m2]	v[km/h]	yex[m]	PL*	UDL*	RDL*	BRK*	TRA*	FUG*	WIND
KF.1	64	Typfordon o)	0.00	0.0	0.000	1.00	1.00	1.00	0.00	0.00	0.00	0.00

p[kN/m2] residual loading
v[km/h] velocity of the load train
yex[m] eccentricity of load train
PL* factor on single loads
UDL* factor on uniform loads
RDL* factor on residual loads
BRK* factor on longitudinal loads
TRA* factor on transverse loads
FUG* factor on centrifugal loads
WIND factor on wind loading



Loadposition case 14

Evaluation : Beam 10001 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-55.0	0.00	161.55	0.00	-274.76	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-65.8	0.00	111.30	0.00	-328.87	0.00

Evaluation : Beam 10001 x 0.700

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-58.6	0.00	151.26	0.00	-187.22	0.00
402 MIN-Vz	-2.6	0.00	-1.90	0.00	18.07	0.00
403 MAX-My	-2.6	0.00	44.30	0.00	18.07	0.00
404 MIN-My	-65.0	0.00	100.32	0.00	-254.80	0.00

Evaluation : Beam 10002 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-58.6	0.00	151.26	0.00	-187.22	0.00
402 MIN-Vz	-2.6	0.00	-1.90	0.00	18.07	0.00
403 MAX-My	-2.6	0.00	44.30	0.00	18.07	0.00
404 MIN-My	-65.0	0.00	100.32	0.00	-254.80	0.00

Evaluation : Beam 10002 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-61.3	0.00	140.99	0.00	-108.03	0.00
402 MIN-Vz	-5.2	0.00	-3.95	0.00	35.53	0.00
403 MAX-My	-10.3	0.00	57.38	0.00	42.84	0.00
404 MIN-My	-62.7	0.00	89.20	0.00	-187.65	0.00

Evaluation : Beam 10003 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-61.3	0.00	140.99	0.00	-108.03	0.00
402 MIN-Vz	-5.2	0.00	-3.95	0.00	35.53	0.00

Geometry & cross sections
Influenslinjer ULS/SLS LM1

Evaluation : Beam 10003 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
403 MAX-My	-10.3	0.00	57.38	0.00	42.84	0.00
404 MIN-My	-62.7	0.00	89.20	0.00	-187.65	0.00

Evaluation : Beam 10003 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-63.3	0.00	130.96	0.00	-39.27	0.00
402 MIN-Vz	-9.2	0.00	-7.25	0.00	61.79	0.00
403 MAX-My	-14.9	0.00	53.28	0.00	75.01	0.00
404 MIN-My	-53.0	0.00	61.87	0.00	-134.16	0.00

Evaluation : Beam 10004 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-63.3	0.00	130.96	0.00	-39.27	0.00
402 MIN-Vz	-9.2	0.00	-7.25	0.00	61.79	0.00
403 MAX-My	-14.9	0.00	53.28	0.00	75.01	0.00
404 MIN-My	-53.0	0.00	61.87	0.00	-134.16	0.00

Evaluation : Beam 10004 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-65.1	0.00	121.68	0.00	18.43	0.00
402 MIN-Vz	-13.1	0.00	-10.75	0.00	86.77	0.00
403 MAX-My	-34.6	0.00	86.76	0.00	110.23	0.00
404 MIN-My	-48.7	0.00	53.06	0.00	-93.44	0.00

Evaluation : Beam 10005 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-65.1	0.00	121.68	0.00	18.43	0.00
402 MIN-Vz	-13.1	0.00	-10.75	0.00	86.77	0.00
403 MAX-My	-34.6	0.00	86.76	0.00	110.23	0.00
404 MIN-My	-48.7	0.00	53.06	0.00	-93.44	0.00

Evaluation : Beam 10005 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-65.8	0.00	112.40	0.00	68.46	0.00
402 MIN-Vz	-17.4	0.00	-14.65	0.00	110.48	0.00
403 MAX-My	-43.7	0.00	85.09	0.00	153.28	0.00
404 MIN-My	-43.1	0.00	44.25	0.00	-58.95	0.00

Evaluation : Beam 10006 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-65.8	0.00	112.40	0.00	68.46	0.00
402 MIN-Vz	-17.4	0.00	-14.65	0.00	110.48	0.00
403 MAX-My	-43.7	0.00	85.09	0.00	153.28	0.00
404 MIN-My	-43.1	0.00	44.25	0.00	-58.95	0.00

Evaluation : Beam 10006 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-56.8	0.00	103.18	0.00	153.82	0.00
402 MIN-Vz	-21.9	0.00	-19.20	0.00	135.37	0.00
403 MAX-My	-48.3	0.00	77.73	0.00	191.81	0.00
404 MIN-My	-29.8	0.00	27.84	0.00	-30.61	0.00

Evaluation : Beam 10007 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-56.8	0.00	103.18	0.00	153.82	0.00
402 MIN-Vz	-21.9	0.00	-19.20	0.00	135.37	0.00
403 MAX-My	-48.3	0.00	77.73	0.00	191.81	0.00
404 MIN-My	-29.8	0.00	27.84	0.00	-30.61	0.00

Geometry & cross sections
Influenslinjer ULS/SLS LM1

Evaluation : Beam 10007 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-58.1	0.00	95.83	0.00	183.84	0.00
402 MIN-Vz	-26.4	0.00	-24.07	0.00	157.97	0.00
403 MAX-My	-52.1	0.00	70.38	0.00	224.26	0.00
404 MIN-My	-19.5	0.00	16.74	0.00	-14.85	0.00

Evaluation : Beam 10008 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-58.1	0.00	95.83	0.00	183.84	0.00
402 MIN-Vz	-26.4	0.00	-24.07	0.00	157.97	0.00
403 MAX-My	-52.1	0.00	70.38	0.00	224.26	0.00
404 MIN-My	-19.5	0.00	16.74	0.00	-14.85	0.00

Evaluation : Beam 10008 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-58.6	0.00	88.47	0.00	207.79	0.00
402 MIN-Vz	-31.3	0.00	-29.88	0.00	182.08	0.00
403 MAX-My	-55.1	0.00	63.03	0.00	250.65	0.00
404 MIN-My	-12.3	0.00	9.92	0.00	-5.50	0.00

Evaluation : Beam 10009 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-58.6	0.00	88.47	0.00	207.79	0.00
402 MIN-Vz	-31.3	0.00	-29.88	0.00	182.08	0.00
403 MAX-My	-55.1	0.00	63.03	0.00	250.65	0.00
404 MIN-My	-12.3	0.00	9.92	0.00	-5.50	0.00

Evaluation : Beam 10009 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-58.2	0.00	81.12	0.00	225.67	0.00
402 MIN-Vz	-36.2	0.00	-36.04	0.00	202.19	0.00
403 MAX-My	-57.1	0.00	55.67	0.00	270.95	0.00
404 MIN-My	-3.2	0.00	2.36	0.00	-0.85	0.00

Evaluation : Beam 10010 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-58.2	0.00	81.12	0.00	225.67	0.00
402 MIN-Vz	-36.2	0.00	-36.04	0.00	202.19	0.00
403 MAX-My	-57.1	0.00	55.67	0.00	270.95	0.00
404 MIN-My	-3.2	0.00	2.36	0.00	-0.85	0.00

Evaluation : Beam 10010 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-56.9	0.00	73.77	0.00	237.46	0.00
402 MIN-Vz	-40.3	0.00	-42.21	0.00	217.22	0.00
403 MAX-My	-58.3	0.00	48.32	0.00	285.19	0.00
404 MIN-My	-0.1	0.00	0.05	0.00	0.00	0.00

Evaluation : Beam 10011 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-56.9	0.00	73.77	0.00	237.46	0.00
402 MIN-Vz	-40.3	0.00	-42.21	0.00	217.22	0.00
403 MAX-My	-58.3	0.00	48.32	0.00	285.19	0.00
404 MIN-My	-0.1	0.00	0.05	0.00	0.00	0.00

Evaluation : Beam 10011 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-54.8	0.00	66.41	0.00	243.19	0.00
402 MIN-Vz	-43.7	0.00	-48.38	0.00	227.18	0.00

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Evaluation : Beam 10011 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
403 MAX-My	-58.6	0.00	40.96	0.00	293.34	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 10012 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-54.8	0.00	66.41	0.00	243.19	0.00
402 MIN-Vz	-43.7	0.00	-48.38	0.00	227.18	0.00
403 MAX-My	-58.6	0.00	40.96	0.00	293.34	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 10012 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-51.8	0.00	59.06	0.00	242.84	0.00
402 MIN-Vz	-46.6	0.00	-54.68	0.00	232.25	0.00
403 MAX-My	-58.0	0.00	33.61	0.00	295.43	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 10013 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-51.8	0.00	59.06	0.00	242.84	0.00
402 MIN-Vz	-46.6	0.00	-54.68	0.00	232.25	0.00
403 MAX-My	-58.0	0.00	33.61	0.00	295.43	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 10013 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-47.9	0.00	51.70	0.00	236.42	0.00
402 MIN-Vz	-51.8	0.00	-61.52	0.00	220.60	0.00
403 MAX-My	-56.6	0.00	26.26	0.00	291.44	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 10014 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-47.9	0.00	51.70	0.00	236.42	0.00
402 MIN-Vz	-51.8	0.00	-61.52	0.00	220.60	0.00
403 MAX-My	-56.6	0.00	26.26	0.00	291.44	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 10014 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-43.1	0.00	44.35	0.00	223.92	0.00
402 MIN-Vz	-53.9	0.00	-68.45	0.00	215.40	0.00
403 MAX-My	-54.3	0.00	18.90	0.00	281.38	0.00
404 MIN-My	-0.0	0.00	-0.02	0.00	0.00	0.00

Evaluation : Beam 10015 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-43.1	0.00	44.35	0.00	223.92	0.00
402 MIN-Vz	-53.9	0.00	-68.45	0.00	215.40	0.00
403 MAX-My	-54.3	0.00	18.90	0.00	281.38	0.00
404 MIN-My	-0.0	0.00	-0.02	0.00	0.00	0.00

Evaluation : Beam 10015 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-37.7	0.00	37.13	0.00	205.80	0.00
402 MIN-Vz	-58.4	0.00	-77.30	0.00	201.00	0.00
403 MAX-My	-57.9	0.00	-13.90	0.00	267.37	0.00
404 MIN-My	-3.1	0.00	-2.33	0.00	-0.83	0.00

Geometry & cross sections
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Evaluation : Beam 10016 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-37.7	0.00	37.13	0.00	205.80	0.00
402 MIN-Vz	-58.4	0.00	-77.30	0.00	201.00	0.00
403 MAX-My	-57.9	0.00	-13.90	0.00	267.37	0.00
404 MIN-My	-3.1	0.00	-2.33	0.00	-0.83	0.00

Evaluation : Beam 10016 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-31.9	0.00	30.19	0.00	182.83	0.00
402 MIN-Vz	-61.9	0.00	-86.58	0.00	181.46	0.00
403 MAX-My	-56.3	0.00	-21.25	0.00	247.59	0.00
404 MIN-My	-12.3	0.00	-9.86	0.00	-5.42	0.00

Evaluation : Beam 10017 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-31.9	0.00	30.19	0.00	182.83	0.00
402 MIN-Vz	-61.9	0.00	-86.58	0.00	181.46	0.00
403 MAX-My	-56.3	0.00	-21.25	0.00	247.59	0.00
404 MIN-My	-12.3	0.00	-9.86	0.00	-5.42	0.00

Evaluation : Beam 10017 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-26.5	0.00	24.14	0.00	158.28	0.00
402 MIN-Vz	-64.3	0.00	-95.86	0.00	154.26	0.00
403 MAX-My	-53.8	0.00	-28.61	0.00	221.74	0.00
404 MIN-My	-19.5	0.00	-16.67	0.00	-14.71	0.00

Evaluation : Beam 10018 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-26.5	0.00	24.14	0.00	158.28	0.00
402 MIN-Vz	-64.3	0.00	-95.86	0.00	154.26	0.00
403 MAX-My	-53.8	0.00	-28.61	0.00	221.74	0.00
404 MIN-My	-19.5	0.00	-16.67	0.00	-14.71	0.00

Evaluation : Beam 10018 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-22.0	0.00	19.26	0.00	135.66	0.00
402 MIN-Vz	-65.5	0.00	-105.14	0.00	119.40	0.00
403 MAX-My	-50.5	0.00	-35.96	0.00	189.82	0.00
404 MIN-My	-34.6	0.00	-33.31	0.00	-31.31	0.00

Evaluation : Beam 10019 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-22.0	0.00	19.26	0.00	135.66	0.00
402 MIN-Vz	-65.5	0.00	-105.14	0.00	119.40	0.00
403 MAX-My	-50.5	0.00	-35.96	0.00	189.82	0.00
404 MIN-My	-34.6	0.00	-33.31	0.00	-31.31	0.00

Evaluation : Beam 10019 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-17.4	0.00	14.70	0.00	110.78	0.00
402 MIN-Vz	-65.7	0.00	-114.42	0.00	76.87	0.00
403 MAX-My	-46.3	0.00	-43.31	0.00	151.82	0.00
404 MIN-My	-43.0	0.00	-44.14	0.00	-58.57	0.00

Evaluation : Beam 10020 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-17.4	0.00	14.70	0.00	110.78	0.00
402 MIN-Vz	-65.7	0.00	-114.42	0.00	76.87	0.00

Geometry & cross sections
Influenslinjer ULS/SLS LM1

Evaluation : Beam 10020 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
403 MAX-My	-46.3	0.00	-43.31	0.00	151.82	0.00
404 MIN-My	-43.0	0.00	-44.14	0.00	-58.57	0.00

Evaluation : Beam 10020 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-13.2	0.00	10.80	0.00	87.05	0.00
402 MIN-Vz	-64.8	0.00	-123.70	0.00	26.68	0.00
403 MAX-My	-33.7	0.00	-41.22	0.00	110.10	0.00
404 MIN-My	-48.6	0.00	-52.95	0.00	-92.97	0.00

Evaluation : Beam 10021 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-13.2	0.00	10.80	0.00	87.05	0.00
402 MIN-Vz	-64.8	0.00	-123.70	0.00	26.68	0.00
403 MAX-My	-33.7	0.00	-41.22	0.00	110.10	0.00
404 MIN-My	-48.6	0.00	-52.95	0.00	-92.97	0.00

Evaluation : Beam 10021 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-9.3	0.00	7.29	0.00	62.11	0.00
402 MIN-Vz	-62.8	0.00	-132.98	0.00	-31.18	0.00
403 MAX-My	-14.9	0.00	-20.47	0.00	75.38	0.00
404 MIN-My	-53.0	0.00	-61.76	0.00	-133.62	0.00

Evaluation : Beam 10022 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-9.3	0.00	7.29	0.00	62.11	0.00
402 MIN-Vz	-62.8	0.00	-132.98	0.00	-31.18	0.00
403 MAX-My	-14.9	0.00	-20.47	0.00	75.38	0.00
404 MIN-My	-53.0	0.00	-61.76	0.00	-133.62	0.00

Evaluation : Beam 10022 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-5.0	0.00	3.85	0.00	34.98	0.00
402 MIN-Vz	-59.7	0.00	-142.26	0.00	-96.70	0.00
403 MAX-My	-10.3	0.00	-24.57	0.00	43.26	0.00
404 MIN-My	-62.6	0.00	-89.06	0.00	-186.88	0.00

Evaluation : Beam 10023 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-5.0	0.00	3.85	0.00	34.98	0.00
402 MIN-Vz	-59.7	0.00	-142.26	0.00	-96.70	0.00
403 MAX-My	-10.3	0.00	-24.57	0.00	43.26	0.00
404 MIN-My	-62.6	0.00	-89.06	0.00	-186.88	0.00

Evaluation : Beam 10023 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-2.6	0.00	1.93	0.00	18.28	0.00
402 MIN-Vz	-55.5	0.00	-151.54	0.00	-169.89	0.00
403 MAX-My	-2.6	0.00	1.93	0.00	18.28	0.00
404 MIN-My	-65.0	0.00	-100.18	0.00	-253.93	0.00

Evaluation : Beam 10024 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-2.6	0.00	1.93	0.00	18.28	0.00
402 MIN-Vz	-55.5	0.00	-151.54	0.00	-169.89	0.00
403 MAX-My	-2.6	0.00	1.93	0.00	18.28	0.00
404 MIN-My	-65.0	0.00	-100.18	0.00	-253.93	0.00

Geometry & cross sections
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Evaluation : Beam 10024 x 0.709

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-50.1	0.00	-160.82	0.00	-250.74	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-65.8	0.00	-111.30	0.00	-328.87	0.00

Evaluation : Beam 20001 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	0.00	0.00
403 MAX-My	-133.0	0.00	-34.63	0.00	0.00	0.00
404 MIN-My	-49.9	0.00	-46.84	0.00	0.00	0.00

Evaluation : Beam 20001 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-46.98	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-46.98	0.00

Evaluation : Beam 20002 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-46.98	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-46.98	0.00

Evaluation : Beam 20002 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-93.96	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-93.96	0.00

Evaluation : Beam 20003 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-93.96	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-93.96	0.00

Evaluation : Beam 20003 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-140.94	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-140.94	0.00

Evaluation : Beam 20004 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-140.94	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-140.94	0.00

Evaluation : Beam 20004 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-187.93	0.00

Geometry & cross sections
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Evaluation : Beam 20004 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-187.93	0.00

Evaluation : Beam 20005 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-187.93	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-187.93	0.00

Evaluation : Beam 20005 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-234.91	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-234.91	0.00

Evaluation : Beam 20006 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-234.91	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-234.91	0.00

Evaluation : Beam 20006 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-281.89	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-281.89	0.00

Evaluation : Beam 20007 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-281.89	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-281.89	0.00

Evaluation : Beam 20007 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	0.0	0.00	0.00	0.00	0.00	0.00
402 MIN-Vz	-111.3	0.00	-65.77	0.00	-328.87	0.00
403 MAX-My	0.0	0.00	0.00	0.00	0.00	0.00
404 MIN-My	-111.3	0.00	-65.77	0.00	-328.87	0.00

Evaluation : Beam 20008 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	0.00	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-51.2	0.00	47.57	0.00	0.00	0.00
404 MIN-My	-112.5	0.00	28.26	0.00	0.00	0.00

Evaluation : Beam 20008 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	46.98	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	46.98	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Geometry & cross sections
Influenslinjer ULS/SLS LM1

Evaluation : Beam 20009 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	46.98	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	46.98	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20009 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	93.96	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	93.96	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20010 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	93.96	0.00
402 MIN-Vz	-37.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	93.96	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20010 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	140.94	0.00
402 MIN-Vz	-37.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	140.94	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20011 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	140.94	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	140.94	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20011 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	187.93	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	187.93	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20012 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	187.93	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	187.93	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20012 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	234.91	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	234.91	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20013 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	234.91	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00

Geometry & cross sections
Influenslinjer ULS/SLS LM1

Evaluation : Beam 20013 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
403 MAX-My	-111.3	0.00	65.77	0.00	234.91	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20013 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	281.89	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	281.89	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20014 x 0.000

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	281.89	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	281.89	0.00
404 MIN-My	-37.0	0.00	0.00	0.00	0.00	0.00

Evaluation : Beam 20014 x 0.714

Loadcase	N[kN]	Vy[kN]	Vz[kN]	Mt[kNm]	My[kNm]	Mz[kNm]
401 MAX-Vz	-111.3	0.00	65.77	0.00	328.87	0.00
402 MIN-Vz	0.0	0.00	0.00	0.00	0.00	0.00
403 MAX-My	-111.3	0.00	65.77	0.00	328.87	0.00
404 MIN-My	0.0	0.00	0.00	0.00	0.00	0.00

Geometry & cross sections
LOAD COMBINATION FOR TYPFORDON

Design Code

EuroNorm Bridges: SS EN 1990:2002 (TSFS 2018:57) Basis of structural design (Sverige) V 2024

Combination rule Number 1

6.10a gr1
Superposition according to explicitly defined formula
(1.20/1.00)*G_1+(1.20/0.00)*G_2+(1.20/1.00)*G_3+(1.50/0.00)*{Q1}(L_A)+(0.70/0.00)*{QI}(L_A)
Resulting Load Cases type ULS fundamental combination

Load Case selection and Actions

Act	Part / LC	fac-u	fac-f	facu1	facf1	facu2	facf2	facu3	facf3	Fact	Type	Designation
G_1	G	1.20	1.00									Self weight
	1									1.00	PERM	Self weight
G_2	G	1.20	0.00									Earth pressure
	2									1.00	PERM	Earth pressure
G_3	G	1.20	1.00									Paving
	3									1.00	PERM	Paving
L_A	Q_1	0.70	0.00	1.50	0.00							Typ A
	301									1.00	A61	MAX-Vz ENVELOPE TYPFORDON A
	302									1.00	A61	MIN-Vz ENVELOPE TYPFORDON A
	303									1.00	A61	MAX-My ENVELOPE TYPFORDON A
	304									1.00	A61	MIN-My ENVELOPE TYPFORDON A

Act — action
Part — partition of the action
fac-u,fac-f — factor unfavourable/favourable
facu1,facf1,facu2,facf2,facu3,facf3 — factors unfavourable/favourable 1st,2nd,3rd dominant action
LC — number of the load case
Fact — factor for load case
Type — type of the load case
PERM — permanent load grouped in actions
A — exclusive load

Combination rule Number 3

6.10a gr1
Superposition according to explicitly defined formula
(1.20/1.00)*G_1+(1.20/0.00)*G_2+(1.20/1.00)*G_3+(1.50/0.00)*{Q1}(L_B)+(0.70/0.00)*{QI}(L_B)
Resulting Load Cases type ULS fundamental combination

Load Case selection and Actions

Act	Part / LC	fac-u	fac-f	facu1	facf1	facu2	facf2	facu3	facf3	Fact	Type	Designation
G_1	G	1.20	1.00									Self weight
	1									1.00	PERM	Self weight
G_2	G	1.20	0.00									Earth pressure
	2									1.00	PERM	Earth pressure
G_3	G	1.20	1.00									Paving
	3									1.00	PERM	Paving
L_B	Q_1	0.70	0.00	1.50	0.00							Typ B
	401									1.00	A62	MAX-Vz ENVELOPE TYPFORDON B
	402									1.00	A62	MIN-Vz ENVELOPE TYPFORDON B
	403									1.00	A62	MAX-My ENVELOPE TYPFORDON B
	404									1.00	A62	MIN-My ENVELOPE TYPFORDON B

Act — action
Part — partition of the action
fac-u,fac-f — factor unfavourable/favourable
facu1,facf1,facu2,facf2,facu3,facf3 — factors unfavourable/favourable 1st,2nd,3rd dominant action
LC — number of the load case
Fact — factor for load case
Type — type of the load case
PERM — permanent load grouped in actions
A — exclusive load

Generated Load Cases

Number	Combination	Designation
500	1	MAX-MY BEAM ULS 6.10a fordon A
501	1	MIN-MY BEAM ULS 6.10a fordon A
502	1	MAX-VZ BEAM ULS 6.10a fordon A
503	1	MIN-VZ BEAM ULS 6.10a fordon A

Geometry & cross sections
LOAD COMBINATION FOR TYPFORDON

Generated Load Cases

Number	Combination	Designation
508	3	MAX-MY BEAM ULS 6.10a fordon B
509	3	MIN-MY BEAM ULS 6.10a fordon B
510	3	MAX-VZ BEAM ULS 6.10a fordon B
511	3	MIN-VZ BEAM ULS 6.10a fordon B

G Sample report from SOFiSTiK, 3D analysis

Geometry & cross sections
Material

Design Code

EuroNorm Bridges: SS EN 1992-2/TSFS 2018:57, SS EN 1993-2/TSFS 2018:57, SS EN 1994-2/TSFS 2018:57
(Sverige) V 2024
Konstruktion og säkerhetsklass: B3 (Vägbroar klass 3)
Snow load zone : 1

Materials

Mat	Classification
1	Elastic Material

Geometry & cross sections
Permanent loads

Load Case 1 (G_1) Self weight

Factor forces and moments		1.000
Factor dead weight	DL-ZZ	-1.000
unfavourable partial safety factor		1.000
favourable partial safety factor		1.000
Combination coefficient	ψ_0	1.000 (rare)
Combination coefficient	$\psi_1$inf	1.000 (infrequent)
Combination coefficient	ψ_1	1.000 (frequent)
Combination coefficient	ψ_2	1.000 (permanent)

Load Case 2 (G_2) Soil pressure

Factor forces and moments		1.000
unfavourable partial safety factor		1.000
favourable partial safety factor		1.000
Combination coefficient	ψ_0	1.000 (rare)
Combination coefficient	$\psi_1$inf	1.000 (infrequent)
Combination coefficient	ψ_1	1.000 (frequent)
Combination coefficient	ψ_2	1.000 (permanent)

Loads acting on QUAD elements

Element				Type	Remark	Load value	Unit	Variation		
from	to		inc		Prim-LC/CC			dP/dX	dP/dY	dP/dZ
20001	29999	grp	2	Pz		0.00	[kN/m2]			-7.74
30001	max	grp	3	Pz		0.00	[kN/m2]			-7.74

Load Case 3 (G_3) Paving

Factor forces and moments		1.000
unfavourable partial safety factor		1.000
favourable partial safety factor		0.000
Combination coefficient	ψ_0	1.000 (rare)
Combination coefficient	$\psi_1$inf	1.000 (infrequent)
Combination coefficient	ψ_1	1.000 (frequent)
Combination coefficient	ψ_2	1.000 (permanent)

Loads

Kind	Reference to	Projection		Coordinates			Type	Load value
		Designation	W[m]	X[m]	Y[m]	Z[m]		
Area	SAR 1						PG	3.30 [kN/m2]
						activated		100.00 percent

Geometry & cross sections
Analyze all static loads

Sum of Loadings

Loadcase	Σ(Loads)			Designation
	X[kN]	Y[kN]	Z[kN]	
1	0.0	0.0	-1062.5	Self weight
2	0.0	0.0	0.0	Soil pressure
3	0.0	0.0	-115.5	Paving

Nodal Reactions Loadcase 1 Self weight

Node No	P-X [kN]	P-Y [kN]	P-Z [kN]	M-X [kNm]	M-Y [kNm]	M-Z [kNm]
5	1.9	2.5	8.0			
6	2.3	-2.6	10.2			
7	-1.9	2.6	8.2			
8	-1.8	-2.2	8.1			
1237	1.9	2.0	9.4			
1238	1.4	2.0	8.5			
1239	1.2	1.9	8.5			
1240	0.9	2.0	9.0			
1241	0.7	2.1	9.6			
1242	0.4	2.0	9.4			
1243	0.4	2.2	11.2			
1244	0.3	2.4	13.1			
1245	0.3	2.2	13.3			
1246	0.4	2.0	13.2			
1247	0.4	1.8	13.1			
1248	0.5	1.6	13.1			
1249	0.5	1.4	13.1			
1250	0.6	1.2	13.1			
1251	0.7	1.1	13.1			
1252	0.7	0.9	13.1			
1253	0.7	0.7	13.1			
1254	0.8	0.6	13.2			
1255	0.8	0.5	13.2			
1256	0.8	0.3	13.2			
1257	0.8	0.2	13.2			
1258	0.8	0.0	13.2			
1259	0.8	-0.1	13.2			
1260	0.8	-0.3	13.2			
1261	0.8	-0.4	13.2			
1262	0.8	-0.6	13.2			
1263	0.7	-0.7	13.2			
1264	0.7	-0.9	13.1			
1265	0.7	-1.0	13.1			
1266	0.6	-1.2	13.1			
1267	0.5	-1.4	13.1			
1268	0.5	-1.5	13.1			
1269	0.4	-1.7	13.1			
1270	0.4	-2.0	13.1			
1271	0.3	-2.2	13.3			
1272	0.3	-2.5	13.8			
1273	0.5	-2.9	14.5			
1274	0.7	-2.9	13.5			
1275	1.2	-2.9	12.9			
1276	1.6	-2.7	12.2			
1277	2.6	-3.0	12.4			
1360	-1.9	2.0	9.3			
1361	-1.5	2.1	9.1			
1362	-1.2	1.9	8.5			
1363	-0.7	1.8	8.3			
1364	-0.6	2.1	9.6			

Geometry & cross sections
Analyze all static loads

Nodal Reactions Loadcase 1 Self weight

Node No	P-X [kN]	P-Y [kN]	P-Z [kN]	M-X [kNm]	M-Y [kNm]	M-Z [kNm]
1365	-0.4	2.1	10.4			
1366	-0.4	2.2	11.2			
1367	-0.3	2.2	12.2			
1368	-0.3	2.2	13.3			
1369	-0.3	2.0	13.2			
1370	-0.4	1.8	13.1			
1371	-0.5	1.6	13.1			
1372	-0.5	1.4	13.1			
1373	-0.6	1.2	13.1			
1374	-0.7	1.1	13.1			
1375	-0.7	0.9	13.1			
1376	-0.7	0.8	13.1			
1377	-0.8	0.6	13.2			
1378	-0.8	0.5	13.2			
1379	-0.8	0.3	13.2			
1380	-0.8	0.2	13.2			
1381	-0.8	0.0	13.2			
1382	-0.8	-0.1	13.2			
1383	-0.8	-0.3	13.2			
1384	-0.8	-0.4	13.2			
1385	-0.8	-0.6	13.2			
1386	-0.7	-0.7	13.1			
1387	-0.7	-0.9	13.1			
1388	-0.7	-1.0	13.1			
1389	-0.6	-1.2	13.1			
1390	-0.6	-1.4	13.1			
1391	-0.5	-1.6	13.1			
1392	-0.4	-1.7	13.1			
1393	-0.4	-1.9	13.1			
1394	-0.3	-2.2	13.3			
1395	-0.3	-2.5	13.8			
1396	-0.5	-2.8	14.5			
1397	-0.6	-2.9	13.6			
1398	-1.2	-2.9	12.9			
1399	-1.9	-3.0	13.6			
1400	-2.9	-3.2	13.0			

Nodal Reactions Loadcase 2 Soil pressure

Node No	P-X [kN]	P-Y [kN]	P-Z [kN]	M-X [kNm]	M-Y [kNm]	M-Z [kNm]
5	-8.5	0.1	0.2			
6	-10.0	-0.1	0.2			
7	8.3	0.1	0.2			
8	7.7	-0.0	0.2			
1237	-9.0	0.0	0.2			
1238	-7.0	0.0	0.2			
1239	-6.2	0.0	0.2			
1240	-5.2	0.0	0.2			
1241	-4.7	0.0	0.2			
1242	-3.8	0.0	0.2			
1243	-4.8	0.0	0.2			
1244	-5.0	-0.0	0.2			
1245	-5.8	-0.0	0.1			
1246	-6.4	-0.0	0.1			
1247	-6.5	-0.0	0.0			
1248	-6.7	-0.0	-0.0			
1249	-7.0	-0.0	-0.1			

Geometry & cross sections
Analyze all static loads

Nodal Reactions Loadcase 2 Soil pressure

Node No	P-X [kN]	P-Y [kN]	P-Z [kN]	M-X [kNm]	M-Y [kNm]	M-Z [kNm]
1250	-7.3	-0.0	-0.1			
1251	-7.4	-0.0	-0.1			
1252	-7.7	-0.0	-0.2			
1253	-7.6	-0.0	-0.2			
1254	-7.6	0.0	-0.2			
1255	-7.8	0.0	-0.3			
1256	-8.0	0.0	-0.3			
1257	-7.8	0.0	-0.3			
1258	-7.9	0.0	-0.3			
1259	-7.8	0.0	-0.3			
1260	-7.7	0.0	-0.3			
1261	-7.8	0.0	-0.3			
1262	-7.8	0.0	-0.2			
1263	-7.6	0.0	-0.2			
1264	-7.8	0.0	-0.2			
1265	-7.4	0.0	-0.2			
1266	-7.2	0.0	-0.1			
1267	-7.0	0.0	-0.1			
1268	-6.9	0.0	-0.0			
1269	-6.6	0.0	0.0			
1270	-6.2	0.0	0.1			
1271	-5.8	0.0	0.1			
1272	-5.6	0.0	0.2			
1273	-5.8	0.0	0.2			
1274	-5.8	-0.0	0.3			
1275	-7.4	-0.0	0.3			
1276	-8.5	-0.0	0.3			
1277	-12.3	-0.1	0.3			
1360	9.0	0.0	0.2			
1361	7.6	0.0	0.2			
1362	6.6	0.0	0.2			
1363	4.5	0.0	0.2			
1364	4.4	0.0	0.2			
1365	4.3	0.0	0.2			
1366	4.6	0.0	0.2			
1367	5.0	-0.0	0.2			
1368	5.9	-0.0	0.1			
1369	6.0	-0.0	0.1			
1370	6.4	-0.0	0.0			
1371	6.8	-0.0	-0.0			
1372	7.0	-0.0	-0.1			
1373	7.3	-0.0	-0.1			
1374	7.4	-0.0	-0.1			
1375	7.6	-0.0	-0.2			
1376	7.7	-0.0	-0.2			
1377	7.7	0.0	-0.2			
1378	7.8	0.0	-0.3			
1379	7.8	0.0	-0.3			
1380	7.9	0.0	-0.3			
1381	7.9	0.0	-0.3			
1382	7.9	0.0	-0.3			
1383	7.8	0.0	-0.3			
1384	7.8	0.0	-0.3			
1385	7.8	0.0	-0.2			
1386	7.7	0.0	-0.2			
1387	7.6	0.0	-0.2			
1388	7.5	0.0	-0.2			

Geometry & cross sections
Analyze all static loads

Nodal Reactions Loadcase 2 Soil pressure

Node No	P-X [kN]	P-Y [kN]	P-Z [kN]	M-X [kNm]	M-Y [kNm]	M-Z [kNm]
1389	7.3	0.0	-0.1			
1390	7.1	0.0	-0.1			
1391	6.8	0.0	-0.0			
1392	6.5	0.0	0.0			
1393	6.2	0.0	0.1			
1394	5.8	0.0	0.1			
1395	5.7	0.0	0.2			
1396	5.8	0.0	0.2			
1397	5.7	-0.0	0.3			
1398	7.2	-0.0	0.3			
1399	9.7	-0.0	0.3			
1400	13.6	-0.1	0.3			

Nodal Reactions Loadcase 3 Paving

Node No	P-X [kN]	P-Y [kN]	P-Z [kN]	M-X [kNm]	M-Y [kNm]	M-Z [kNm]
5	0.5	0.3	1.0			
6	0.6	-0.3	1.2			
7	-0.5	0.3	1.0			
8	-0.5	-0.3	1.0			
1237	0.5	0.2	1.1			
1238	0.4	0.2	1.0			
1239	0.3	0.2	1.0			
1240	0.2	0.2	1.0			
1241	0.2	0.2	1.1			
1242	0.1	0.2	1.1			
1243	0.1	0.3	1.3			
1244	0.1	0.3	1.4			
1245	0.1	0.3	1.4			
1246	0.1	0.2	1.4			
1247	0.1	0.2	1.4			
1248	0.1	0.2	1.4			
1249	0.1	0.2	1.4			
1250	0.2	0.2	1.4			
1251	0.2	0.1	1.4			
1252	0.2	0.1	1.4			
1253	0.2	0.1	1.4			
1254	0.2	0.1	1.4			
1255	0.2	0.1	1.4			
1256	0.2	0.0	1.4			
1257	0.2	0.0	1.4			
1258	0.2	0.0	1.4			
1259	0.2	-0.0	1.4			
1260	0.2	-0.0	1.4			
1261	0.2	-0.1	1.4			
1262	0.2	-0.1	1.4			
1263	0.2	-0.1	1.4			
1264	0.2	-0.1	1.4			
1265	0.2	-0.1	1.4			
1266	0.2	-0.2	1.4			
1267	0.1	-0.2	1.4			
1268	0.1	-0.2	1.4			
1269	0.1	-0.2	1.4			
1270	0.1	-0.2	1.4			
1271	0.1	-0.3	1.4			
1272	0.1	-0.3	1.5			
1273	0.1	-0.3	1.6			

Geometry & cross sections
Analyze all static loads

Nodal Reactions Loadcase 3 Paving

Node No	P-X [kN]	P-Y [kN]	P-Z [kN]	M-X [kNm]	M-Y [kNm]	M-Z [kNm]
1274	0.2	-0.3	1.5			
1275	0.3	-0.3	1.5			
1276	0.4	-0.3	1.4			
1277	0.7	-0.4	1.5			
1360	-0.5	0.2	1.1			
1361	-0.4	0.2	1.1			
1362	-0.3	0.2	1.0			
1363	-0.2	0.2	1.0			
1364	-0.2	0.2	1.1			
1365	-0.1	0.3	1.2			
1366	-0.1	0.3	1.3			
1367	-0.1	0.3	1.3			
1368	-0.1	0.3	1.4			
1369	-0.1	0.2	1.4			
1370	-0.1	0.2	1.4			
1371	-0.1	0.2	1.4			
1372	-0.1	0.2	1.4			
1373	-0.2	0.2	1.4			
1374	-0.2	0.1	1.4			
1375	-0.2	0.1	1.4			
1376	-0.2	0.1	1.4			
1377	-0.2	0.1	1.4			
1378	-0.2	0.1	1.4			
1379	-0.2	0.0	1.4			
1380	-0.2	0.0	1.4			
1381	-0.2	0.0	1.4			
1382	-0.2	-0.0	1.4			
1383	-0.2	-0.0	1.4			
1384	-0.2	-0.1	1.4			
1385	-0.2	-0.1	1.4			
1386	-0.2	-0.1	1.4			
1387	-0.2	-0.1	1.4			
1388	-0.2	-0.1	1.4			
1389	-0.2	-0.2	1.4			
1390	-0.1	-0.2	1.4			
1391	-0.1	-0.2	1.4			
1392	-0.1	-0.2	1.4			
1393	-0.1	-0.2	1.4			
1394	-0.1	-0.3	1.4			
1395	-0.1	-0.3	1.5			
1396	-0.1	-0.3	1.6			
1397	-0.2	-0.3	1.5			
1398	-0.3	-0.3	1.5			
1399	-0.5	-0.4	1.6			
1400	-0.8	-0.4	1.6			

Sum of Reactions and Loadings

Loadcase	Σ(Reactions)			Designation
	X[kN]	Y[kN]	Z[kN]	
	Σ(Loads)			
1	0.0	0.0	1062.5	Self weight
	0.0	0.0	-1062.5	
2	0.0	0.0	0.0	Soil pressure
	0.0	0.0	0.0	
3	0.0	0.0	115.5	Paving
	0.0	0.0	-115.5	

Geometry & cross sections
SVENSKA TYPFORDON

Antal spann vänster om körfält (Last i mitten): 0
Bredd på defälten: 0
Antal spann höger om körfält (Last i mitten): 0
Bredd på de fälten: 0
Antal spann höger om körfält (Last på vänster kant): 0.00
Bredd på de fälten:0.00

Geometric axis KF
Segments

from station[-]	to station[-]	Total Length[m]
0.000	7.000	7.000

Geometric axis LF
Segments

from station[-]	to station[-]	Total Length[m]
0.000	7.000	7.000

Geometric axis RF
Segments

from station[-]	to station[-]	Total Length[m]
0.000	7.000	7.000

Geometric axis RRF
Segments

from station[-]	to station[-]	Total Length[m]
0.000	7.000	7.000

Actions

type	part	sup	Designation	γ-u	γ-f	γ-a	ψ_0	ψ_1	ψ_2	$\psi_1$inf
G_1	G	perm	Self weight	1.00	1.00	1.00	1.00	1.00	1.00	1.00
G_2	G	perm	Earth pressure	1.00	1.00	1.00	1.00	1.00	1.00	1.00
G_3	G	perm	Paving	1.00	0.00	1.00	1.00	1.00	1.00	1.00
L	Q	excl	live loading	1.00	0.00	1.00	1.00	1.00	1.00	1.00
L_A	Q_1	excl	Typ A	1.00	0.00	1.00	1.00	1.00	1.00	1.00
L_B	Q_1	excl	Typ B	1.00	0.00	1.00	1.00	1.00	1.00	1.00
			Reliability factor Kfi 1.000							
			Reduction factor xsi 0.890							

type action — γ-u,γ-f,γ-a partial safety factors for unfavourable/favourable/accidental
part partition of the action — $\psi_0,\psi_1,\psi_2,\psi_1$inf combination coefficients
sup superposition type

Load Train 50 Typfordon a)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

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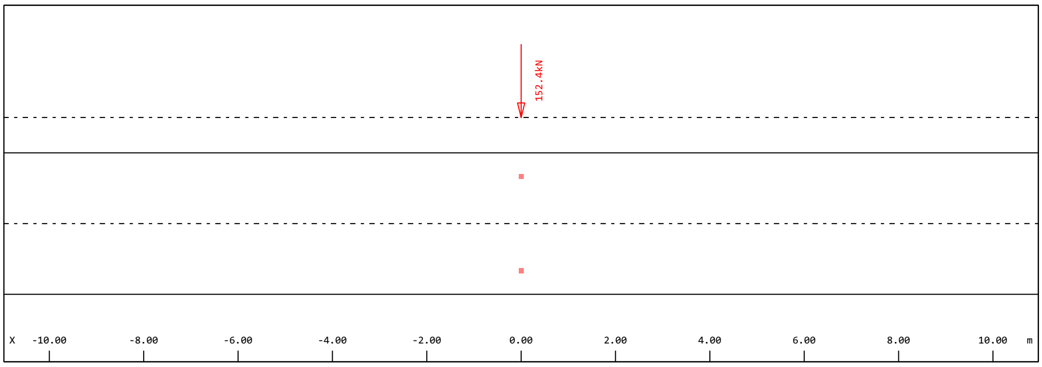
Geometry & cross sections
SVENSKA TYPFORDON



User defined

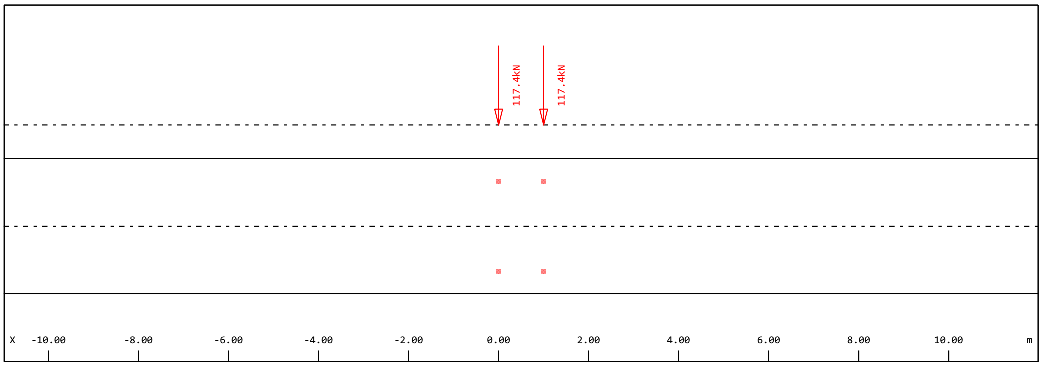
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	152.4	0.0	0.0	152.4	0.0	0.000		0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 51 Typfordon b)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	117.4	0.0	0.0	117.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	1.000	(min)	0.000	0.000	0.000	2.000	

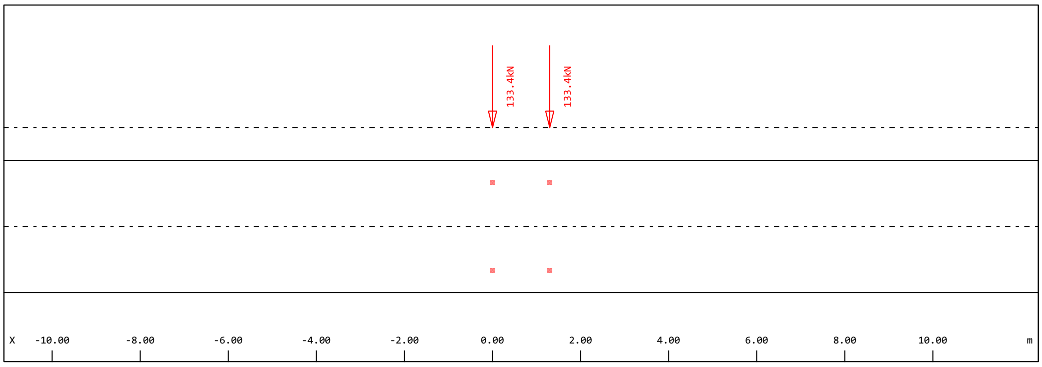
Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model

Geometry & cross sections
SVENSKA TYPFORDON

ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 52 Typfordon c)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

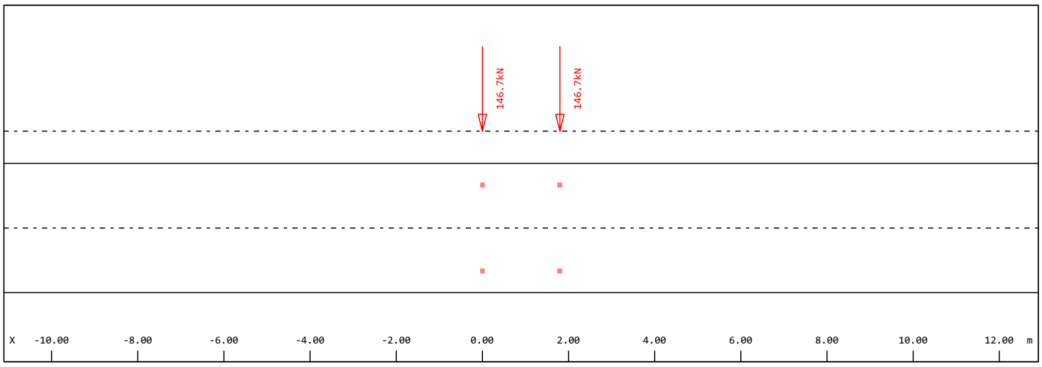
P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	133.4	0.0	0.0	133.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	133.4	0.0	0.0	133.4	0.0	1.300	(min)	0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 53 Typfordon d)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

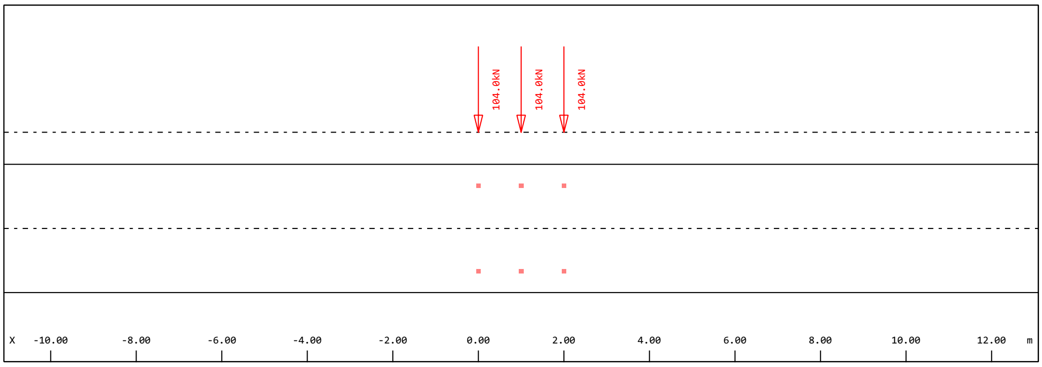
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	146.7	0.0	0.0	146.7	0.0	0.000		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	1.800	(min)	0.000	0.000	0.000	2.000	

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 54 Typfordon e)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	104.0	0.0	0.0	104.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	104.0	0.0	0.0	104.0	0.0	1.000		0.000	0.000	0.000	2.000	
2P	104.0	0.0	0.0	104.0	0.0	2.000	(min)	0.000	0.000	0.000	2.000	

Pv vertical load value
hw[m] height of lateral acting force

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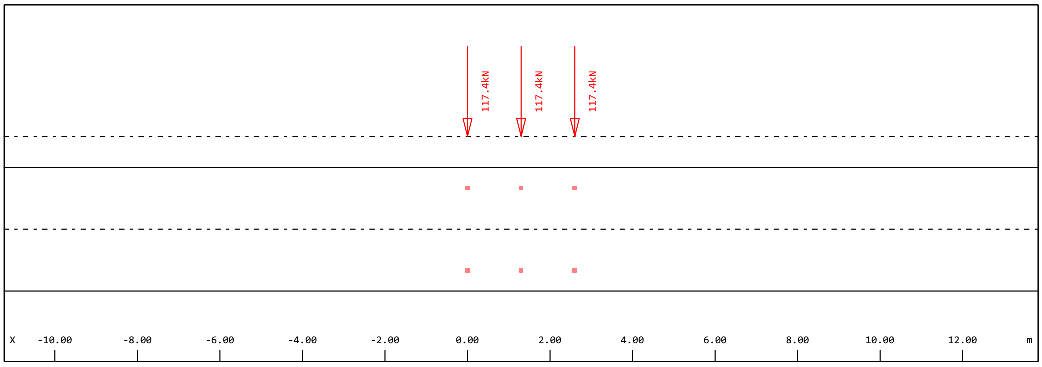
Geometry & cross sections
SVENSKA TYPFORDON

Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 55 Typfordon f)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

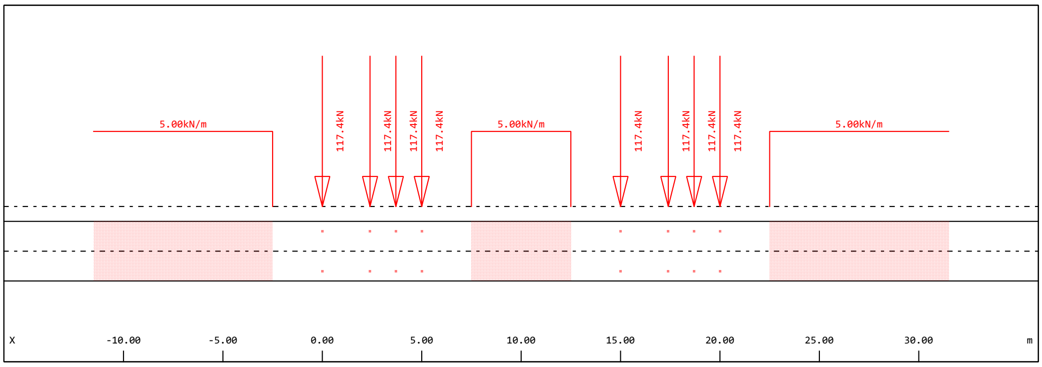
P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	117.4	0.0	0.0	117.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	1.300		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	2.600	(min)	0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 56 Typfordon g)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

Load elements of Load Train

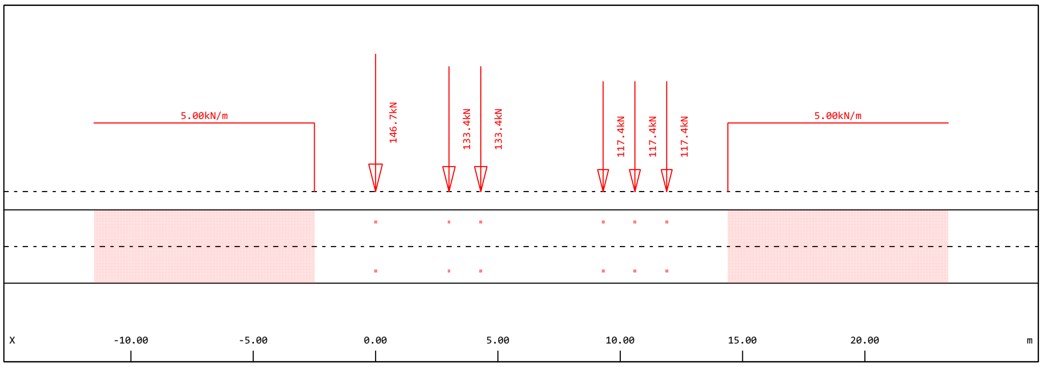
	Pv	Pl	Pw	Pf	ffav	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m]	cont@
P	[kN]	[kN]	[kN]	[kN]	[-]						bw[m]	lw[m]
B	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]						bw[m]	
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	117.4	0.0	0.0	117.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	2.400		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	3.700		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	5.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	10.000	0.000	0.000	0.000		
2P	117.4	0.0	0.0	117.4	0.0	15.000	(min)	0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	17.400		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	18.700		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	20.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	12.500	10.000	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 57 Typfordon h)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

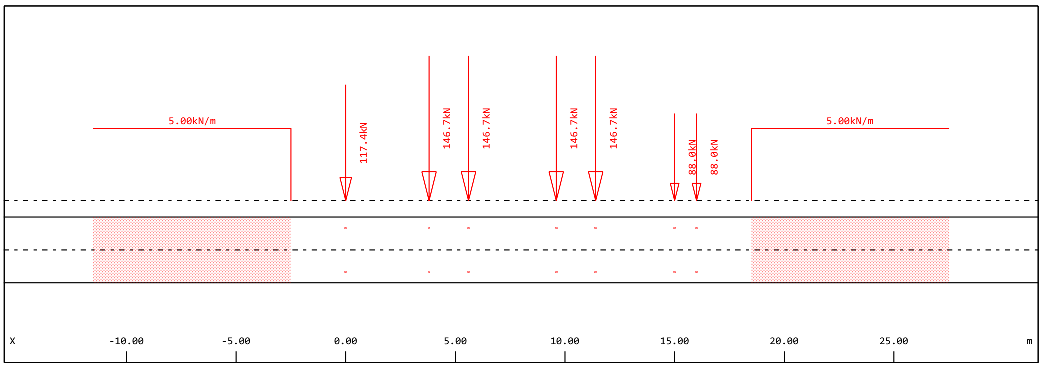
Load elements of Load Train

	Pv	Pl	Pw	Pf	ffav	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m]	cont@
P	[kN]	[kN]	[kN]	[kN]	[-]						bw[m]	lw[m]
B	[kN/m]	[kN/m]	[kN/m]	[kN/m]	[-]						bw[m]	
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	146.7	0.0	0.0	146.7	0.0	0.000		0.000	0.000	0.000	2.000	
2P	133.4	0.0	0.0	133.4	0.0	3.000		0.000	0.000	0.000	2.000	
2P	133.4	0.0	0.0	133.4	0.0	4.300		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	9.300		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	10.600		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	11.900		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	16.900	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 58 Typfordon i)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Geometry & cross sections
SVENSKA TYPFORDON

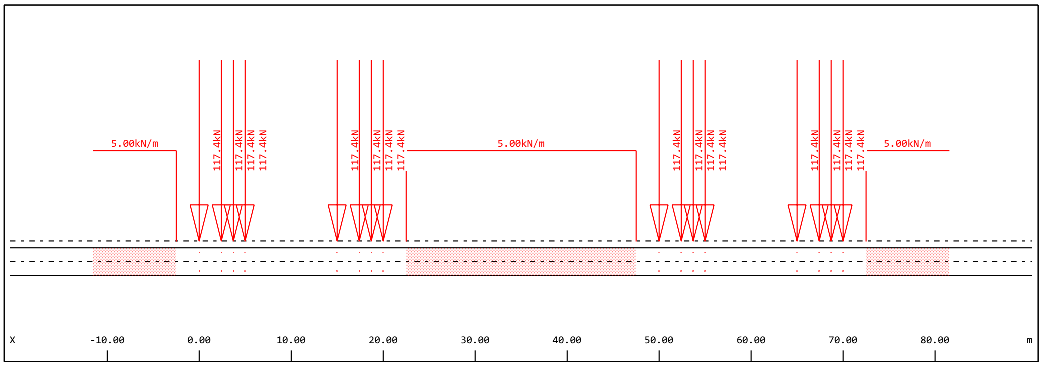
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000 =	1.67	[kN/m2]
2P	117.4	0.0	0.0	117.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	3.800		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	5.600		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	9.600		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	11.400		0.000	0.000	0.000	2.000	
2P	88.0	0.0	0.0	88.0	0.0	15.000		0.000	0.000	0.000	2.000	
2P	88.0	0.0	0.0	88.0	0.0	16.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	21.000	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 59 Typfordon j)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000 =	1.67	[kN/m2]
2P	117.4	0.0	0.0	117.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	2.400		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	3.700		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	5.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	15.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	17.400		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	18.700		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	20.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	25.000	0.000	0.000	0.000		
2P	117.4	0.0	0.0	117.4	0.0	50.000	(min)	0.000	0.000	0.000	2.000	

Geometry & cross sections
SVENSKA TYPFORDON

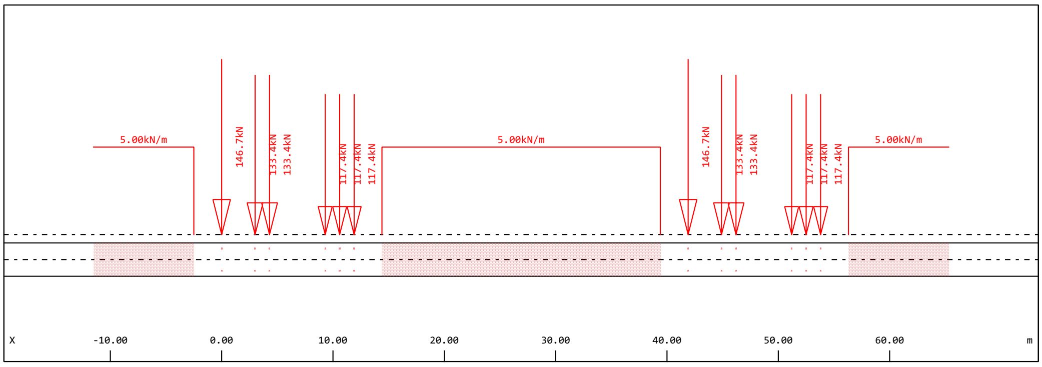
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
2P	117.4	0.0	0.0	117.4	0.0	52.400		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	53.700		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	55.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	65.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	67.400		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	68.700		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	70.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	47.500	25.000	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 60 Typfordon k)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	146.7	0.0	0.0	146.7	0.0	0.000		0.000	0.000	0.000	2.000	
2P	133.4	0.0	0.0	133.4	0.0	3.000		0.000	0.000	0.000	2.000	
2P	133.4	0.0	0.0	133.4	0.0	4.300		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	9.300		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	10.600		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	11.900		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	16.900	0.000	0.000	0.000		
2P	146.7	0.0	0.0	146.7	0.0	41.900	(min)	0.000	0.000	0.000	2.000	
2P	133.4	0.0	0.0	133.4	0.0	44.900		0.000	0.000	0.000	2.000	
2P	133.4	0.0	0.0	133.4	0.0	46.200		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	51.200		0.000	0.000	0.000	2.000	

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Geometry & cross sections
SVENSKA TYPFORDON

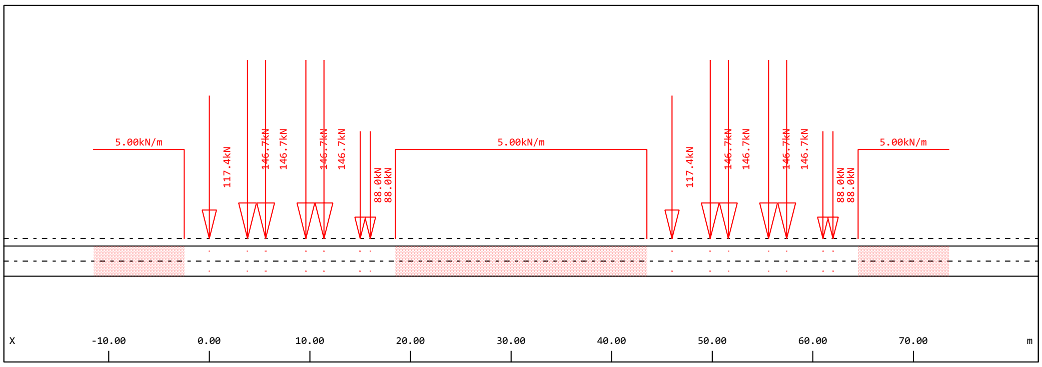
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
2P	117.4	0.0	0.0	117.4	0.0	52.500		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	53.800		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	39.400	16.900	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 61 Typfordon 1)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

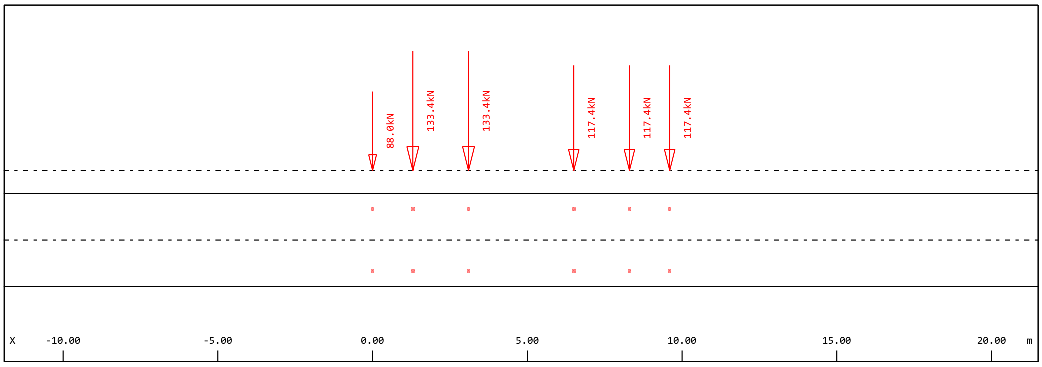
P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	117.4	0.0	0.0	117.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	3.800		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	5.600		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	9.600		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	11.400		0.000	0.000	0.000	2.000	
2P	88.0	0.0	0.0	88.0	0.0	15.000		0.000	0.000	0.000	2.000	
2P	88.0	0.0	0.0	88.0	0.0	16.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	21.000	0.000	0.000	0.000		
2P	117.4	0.0	0.0	117.4	0.0	46.000		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	49.800		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	51.600		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	55.600		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	57.400		0.000	0.000	0.000	2.000	
2P	88.0	0.0	0.0	88.0	0.0	61.000		0.000	0.000	0.000	2.000	
2P	88.0	0.0	0.0	88.0	0.0	62.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	43.500	21.000	0.000	0.000	0.000		

Geometry & cross sections
SVENSKA TYPFORDON

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P,B	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 62 Typfordon m)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	88.0	0.0	0.0	88.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	133.4	0.0	0.0	133.4	0.0	1.300		0.000	0.000	0.000	2.000	
2P	133.4	0.0	0.0	133.4	0.0	3.100		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	6.500		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	8.300		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	9.600		0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 63 Typfordon n)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

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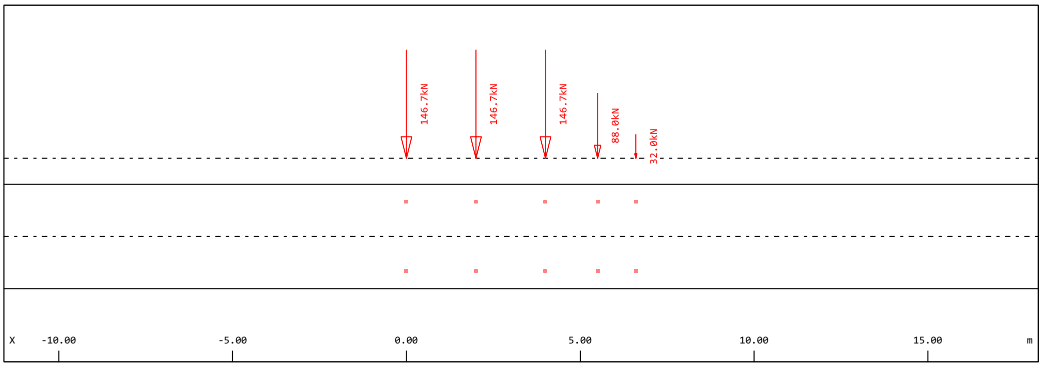
Geometry & cross sections
SVENSKA TYPFORDON



User defined

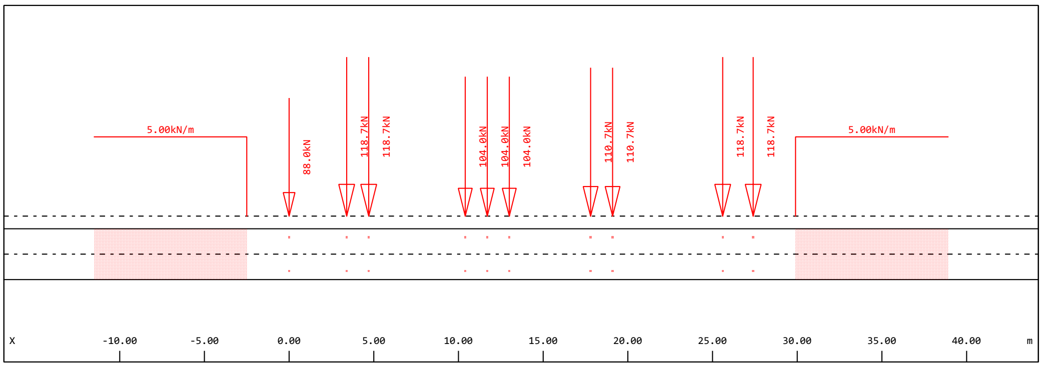
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	146.7	0.0	0.0	146.7	0.0	0.000		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	2.000		0.000	0.000	0.000	2.000	
2P	146.7	0.0	0.0	146.7	0.0	4.000		0.000	0.000	0.000	2.000	
2P	88.0	0.0	0.0	88.0	0.0	5.500		0.000	0.000	0.000	2.000	
2P	32.0	0.0	0.0	32.0	0.0	6.600		0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 64 Typfordon o)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

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Geometry & cross sections
SVENSKA TYPFORDON

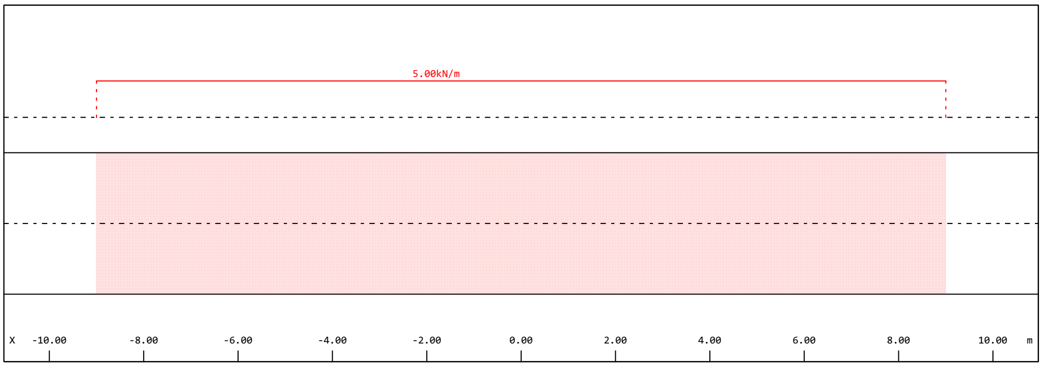
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	88.0	0.0	0.0	88.0	0.0	0.000		0.000	0.000	0.000	2.000	
2P	118.7	0.0	0.0	118.7	0.0	3.400		0.000	0.000	0.000	2.000	
2P	118.7	0.0	0.0	118.7	0.0	4.700		0.000	0.000	0.000	2.000	
2P	104.0	0.0	0.0	104.0	0.0	10.400		0.000	0.000	0.000	2.000	
2P	104.0	0.0	0.0	104.0	0.0	11.700		0.000	0.000	0.000	2.000	
2P	104.0	0.0	0.0	104.0	0.0	13.000		0.000	0.000	0.000	2.000	
2P	110.7	0.0	0.0	110.7	0.0	17.800		0.000	0.000	0.000	2.000	
2P	110.7	0.0	0.0	110.7	0.0	19.100		0.000	0.000	0.000	2.000	
2P	118.7	0.0	0.0	118.7	0.0	25.600		0.000	0.000	0.000	2.000	
2P	118.7	0.0	0.0	118.7	0.0	27.400		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	32.400	0.000	0.000	0.000		

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P,B	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 65 FILLAST
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

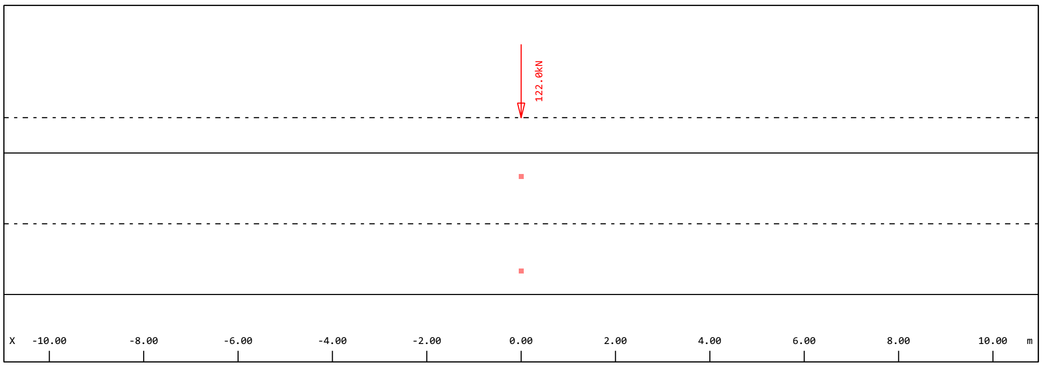
B	Pv [kN/m]	Pl [kN/m]	Pw [kN/m]	Pf [kN/m]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]

Pv	vertical load value	y[m]	excentricity of loading
Pl	longitudinal load value (breaking)	hw[m]	height of lateral acting force
Pw	transverse load value	hs[m]	height of centrifugal mass center
Pf	effective load for centrifugal loading	b[m]	spacing of wheels
ffav	factor for favourable load positions	cont@	connected to node number of vehicle model
X[m]	location along load train	B	load Type (P) = axle/pointload, (B) = distributed load
L[m]	length of loading	bw[m]	width of wheel contact area

Geometry & cross sections
SVENSKA TYPFORDON

Load Train 150 Typfordon a)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

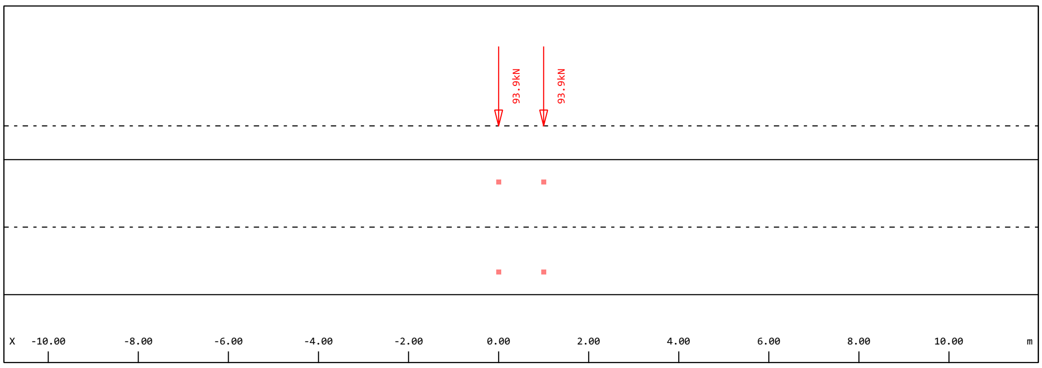
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	122.0	0.0	0.0	122.0	0.0	0.000		0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 151 Typfordon b)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

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Geometry & cross sections
SVENSKA TYPFORDON

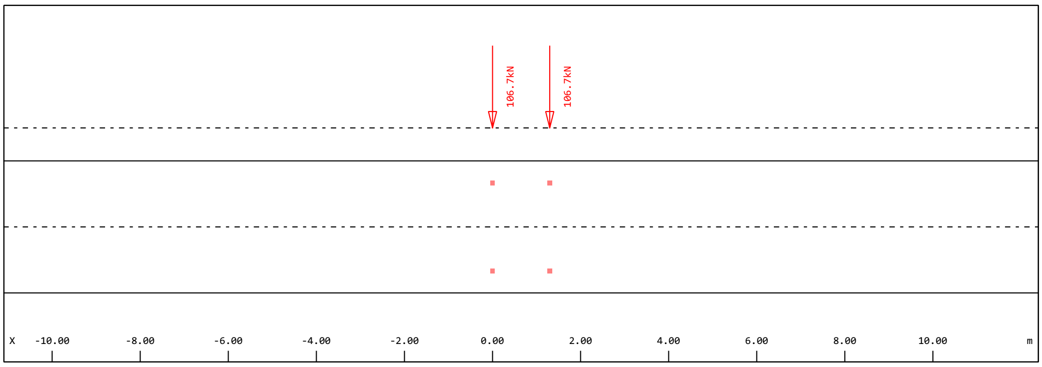
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	93.9	0.0	0.0	93.9	0.0	0.000		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	1.000	(min)	0.000	0.000	0.000	2.000	

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 152 Typfordon c)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

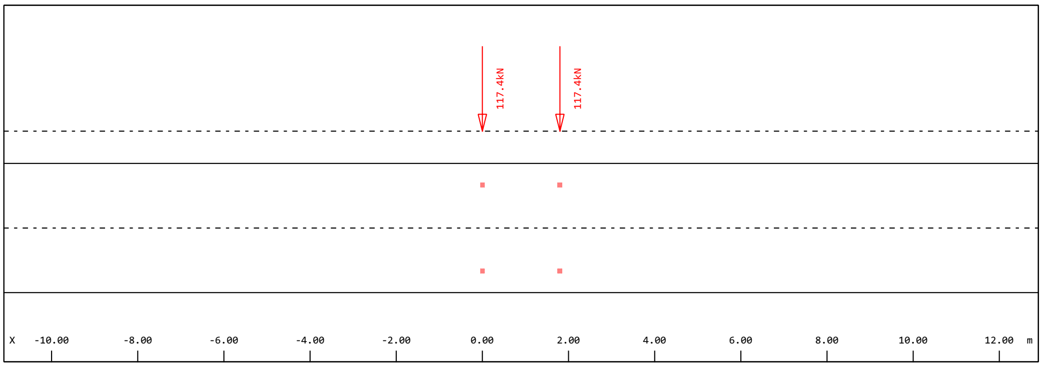
P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	106.7	0.0	0.0	106.7	0.0	0.000		0.000	0.000	0.000	2.000	
2P	106.7	0.0	0.0	106.7	0.0	1.300	(min)	0.000	0.000	0.000	2.000	

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 153 Typfordon d)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

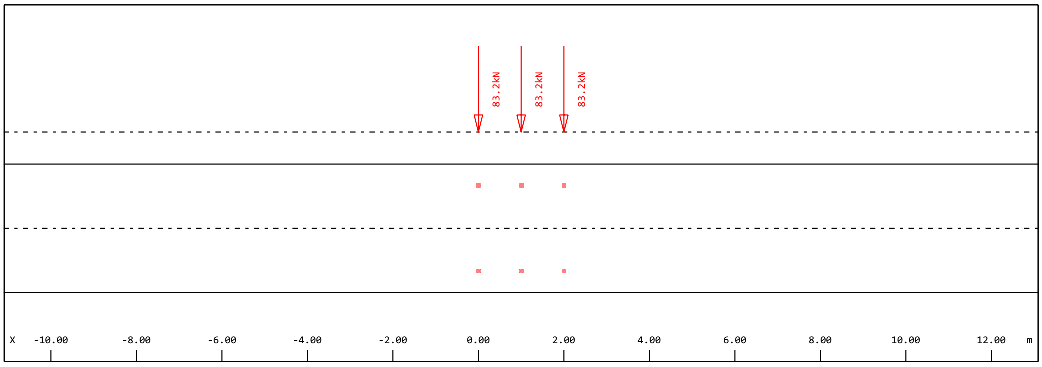
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	117.4	0.0	0.0	117.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	1.800	(min)	0.000	0.000	0.000	2.000	

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 154 Typfordon e)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	83.2	0.0	0.0	83.2	0.0	0.000		0.000	0.000	0.000	2.000	
2P	83.2	0.0	0.0	83.2	0.0	1.000		0.000	0.000	0.000	2.000	
2P	83.2	0.0	0.0	83.2	0.0	2.000	(min)	0.000	0.000	0.000	2.000	

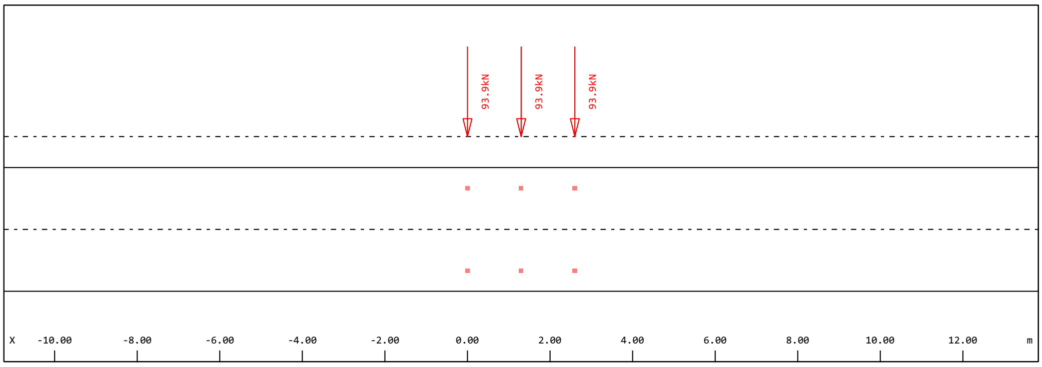
Pv vertical load value
hw[m] height of lateral acting force

Geometry & cross sections
SVENSKA TYPFORDON

Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 155 Typfordon f)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	93.9	0.0	0.0	93.9	0.0	0.000		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	1.300		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	2.600	(min)	0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 156 Typfordon g)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

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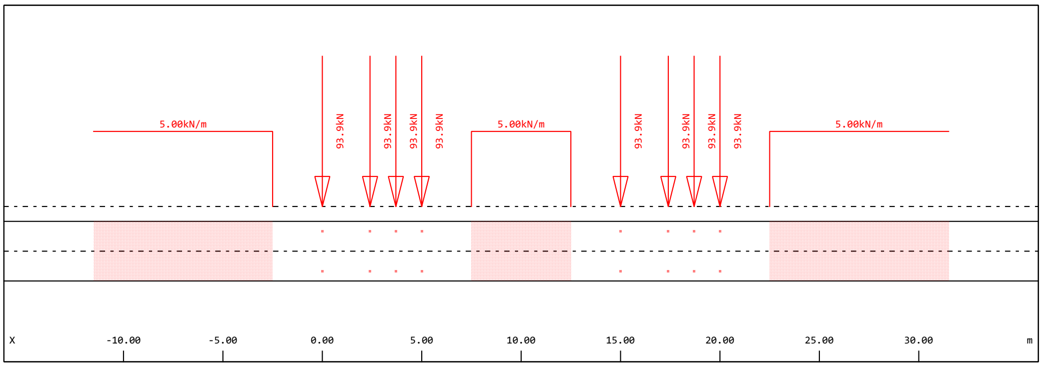
Geometry & cross sections
SVENSKA TYPFORDON



User defined

Load elements of Load Train

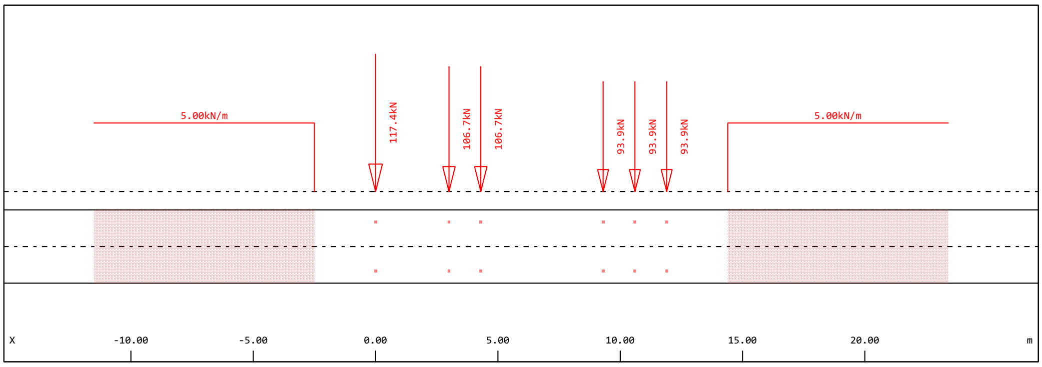
 P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	93.9	0.0	0.0	93.9	0.0	0.000		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	2.400		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	3.700		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	5.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	10.000	0.000	0.000	0.000		
2P	93.9	0.0	0.0	93.9	0.0	15.000	(min)	0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	17.400		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	18.700		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	20.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	12.500	10.000	0.000	0.000	0.000		

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P,B	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 157 Typfordon h)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

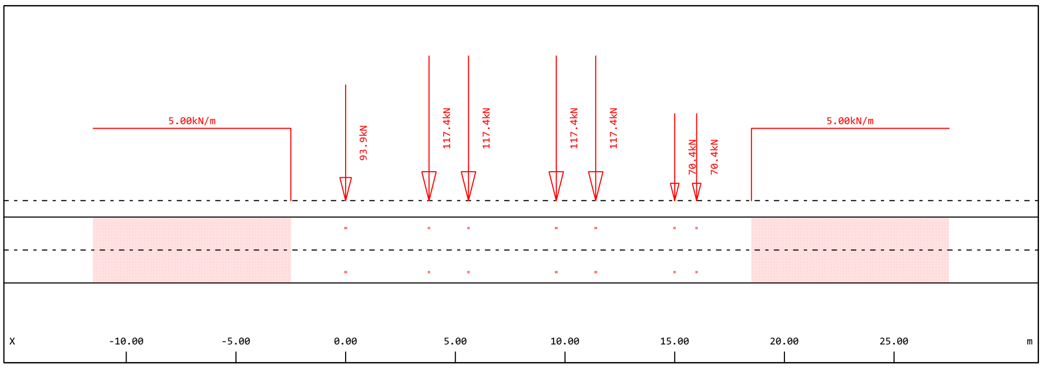
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	117.4	0.0	0.0	117.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	106.7	0.0	0.0	106.7	0.0	3.000		0.000	0.000	0.000	2.000	
2P	106.7	0.0	0.0	106.7	0.0	4.300		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	9.300		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	10.600		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	11.900		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	16.900	0.000	0.000	0.000		

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P,B	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 158 Typfordon i)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Geometry & cross sections
SVENSKA TYPFORDON

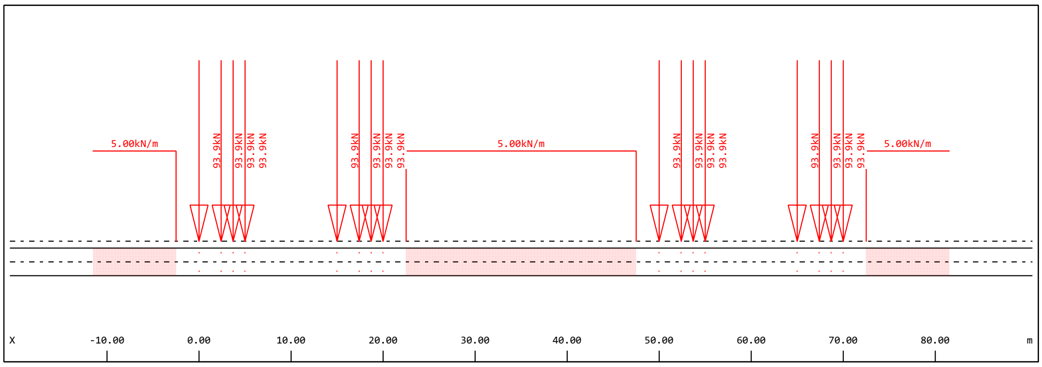
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	93.9	0.0	0.0	93.9	0.0	0.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	3.800		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	5.600		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	9.600		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	11.400		0.000	0.000	0.000	2.000	
2P	70.4	0.0	0.0	70.4	0.0	15.000		0.000	0.000	0.000	2.000	
2P	70.4	0.0	0.0	70.4	0.0	16.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	21.000	0.000	0.000	0.000		

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P,B	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 159 Typfordon j)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	93.9	0.0	0.0	93.9	0.0	0.000		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	2.400		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	3.700		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	5.000		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	15.000		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	17.400		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	18.700		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	20.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	25.000	0.000	0.000	0.000		
2P	93.9	0.0	0.0	93.9	0.0	50.000	(min)	0.000	0.000	0.000	2.000	

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Geometry & cross sections
SVENSKA TYPFORDON

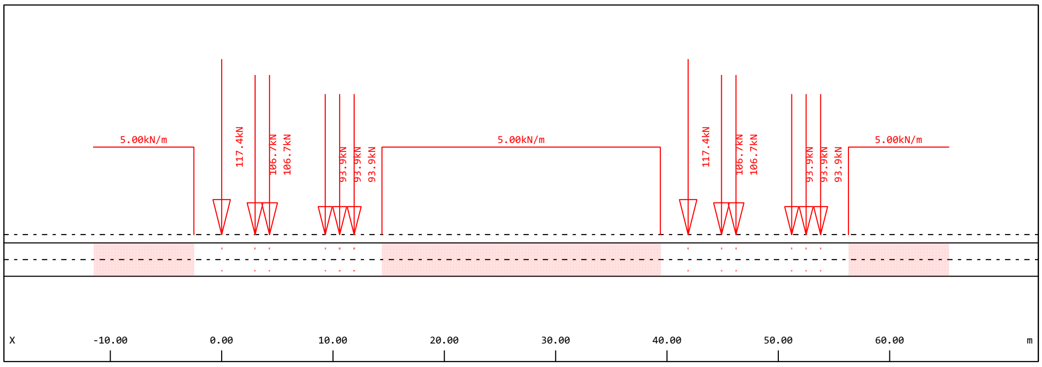
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
2P	93.9	0.0	0.0	93.9	0.0	52.400		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	53.700		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	55.000		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	65.000		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	67.400		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	68.700		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	70.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	47.500	25.000	0.000	0.000	0.000		

- Pv vertical load value
- Pl longitudinal load value (breaking)
- Pw transverse load value
- Pf effective load for centrifugal loading
- ffav factor for favourable load positions
- X[m] location along load train
- L[m] length of loading
- y[m] excentricity of loading
- hw[m] height of lateral acting force
- hs[m] height of centrifugal mass center
- b[m] spacing of wheels
- cont@ connected to node number of vehicle model
- P,B load Type (P) = axle/pointload, (B) = distributed load
- bw[m] width of wheel contact area
- lw[m] length of wheel contact area

Load Train 160 Typfordon k)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	117.4	0.0	0.0	117.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	106.7	0.0	0.0	106.7	0.0	3.000		0.000	0.000	0.000	2.000	
2P	106.7	0.0	0.0	106.7	0.0	4.300		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	9.300		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	10.600		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	11.900		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	16.900	0.000	0.000	0.000		
2P	117.4	0.0	0.0	117.4	0.0	41.900	(min)	0.000	0.000	0.000	2.000	
2P	106.7	0.0	0.0	106.7	0.0	44.900		0.000	0.000	0.000	2.000	
2P	106.7	0.0	0.0	106.7	0.0	46.200		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	51.200		0.000	0.000	0.000	2.000	

Geometry & cross sections
SVENSKA TYPFORDON

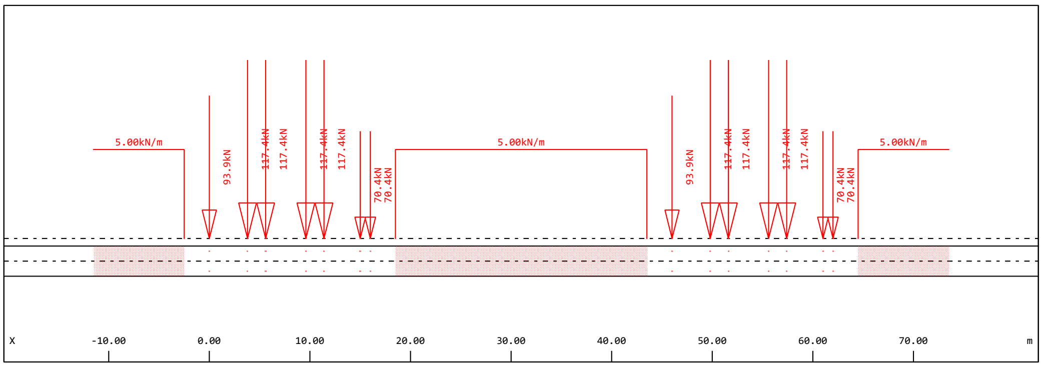
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
2P	93.9	0.0	0.0	93.9	0.0	52.500		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	53.800		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	39.400	16.900	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 161 Typfordon 1)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

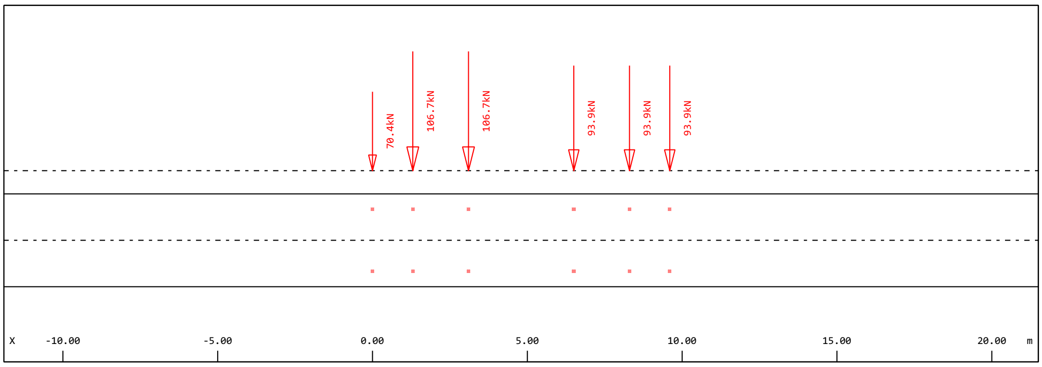
P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	93.9	0.0	0.0	93.9	0.0	0.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	3.800		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	5.600		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	9.600		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	11.400		0.000	0.000	0.000	2.000	
2P	70.4	0.0	0.0	70.4	0.0	15.000		0.000	0.000	0.000	2.000	
2P	70.4	0.0	0.0	70.4	0.0	16.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	21.000	0.000	0.000	0.000		
2P	93.9	0.0	0.0	93.9	0.0	46.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	49.800		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	51.600		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	55.600		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	57.400		0.000	0.000	0.000	2.000	
2P	70.4	0.0	0.0	70.4	0.0	61.000		0.000	0.000	0.000	2.000	
2P	70.4	0.0	0.0	70.4	0.0	62.000		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	43.500	21.000	0.000	0.000	0.000		

Geometry & cross sections
SVENSKA TYPFORDON

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P,B	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 162 Typfordon m)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

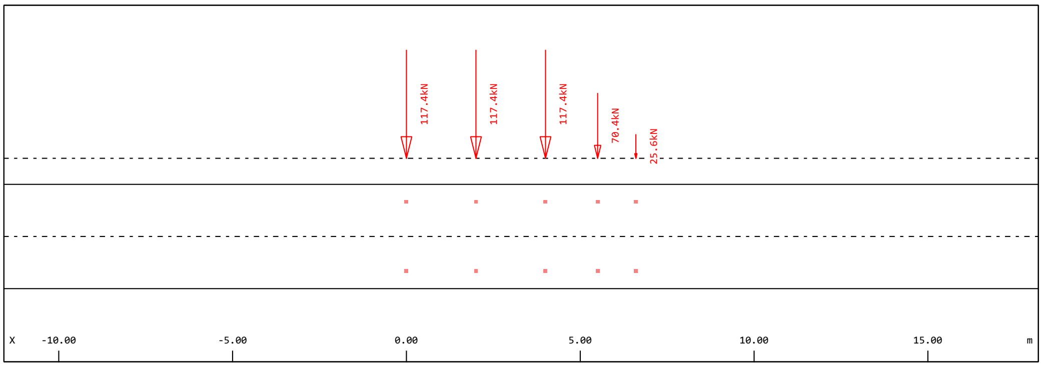
P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	70.4	0.0	0.0	70.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	106.7	0.0	0.0	106.7	0.0	1.300		0.000	0.000	0.000	2.000	
2P	106.7	0.0	0.0	106.7	0.0	3.100		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	6.500		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	8.300		0.000	0.000	0.000	2.000	
2P	93.9	0.0	0.0	93.9	0.0	9.600		0.000	0.000	0.000	2.000	

Pv	vertical load value	hw[m]	height of lateral acting force
Pl	longitudinal load value (breaking)	hs[m]	height of centrifugal mass center
Pw	transverse load value	b[m]	spacing of wheels
Pf	effective load for centrifugal loading	cont@	connected to node number of vehicle model
ffav	factor for favourable load positions	P	load Type (P) = axle/pointload, (B) = distributed load
X[m]	location along load train	bw[m]	width of wheel contact area
L[m]	length of loading	lw[m]	length of wheel contact area
y[m]	excentricity of loading		

Load Train 163 Typfordon n)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		

Geometry & cross sections
SVENSKA TYPFORDON



User defined

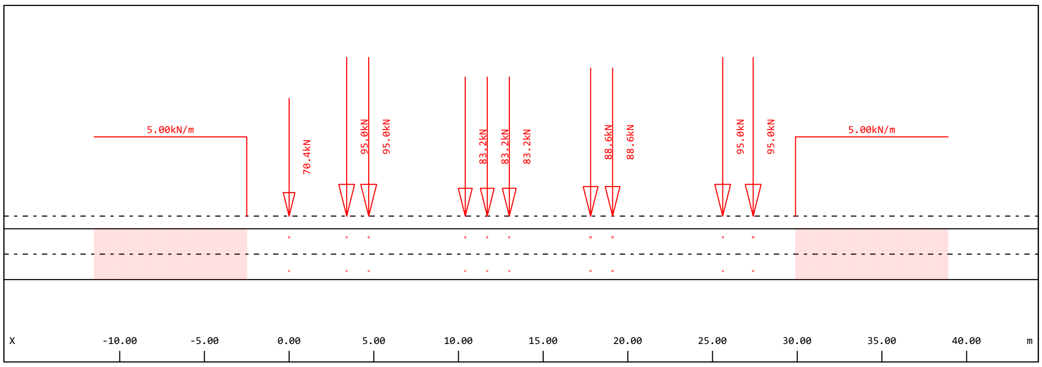
Load elements of Load Train

P	Pv [kN]	Pl [kN]	Pw [kN]	Pf [kN]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@ lw[m]
2P	117.4	0.0	0.0	117.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	2.000		0.000	0.000	0.000	2.000	
2P	117.4	0.0	0.0	117.4	0.0	4.000		0.000	0.000	0.000	2.000	
2P	70.4	0.0	0.0	70.4	0.0	5.500		0.000	0.000	0.000	2.000	
2P	25.6	0.0	0.0	25.6	0.0	6.600		0.000	0.000	0.000	2.000	

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 164 Typfordon o)
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Width of loading	3.000 [m]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Geometry & cross sections
SVENSKA TYPFORDON

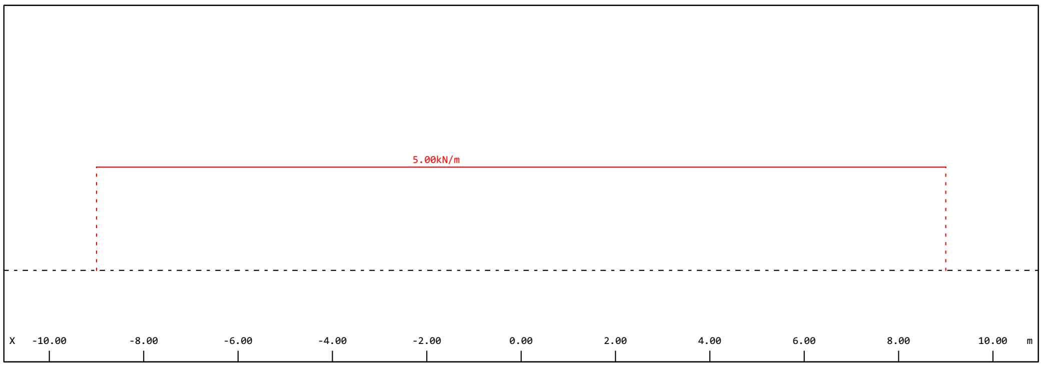
Load elements of Load Train

P B	Pv [kN] [kN/m]	Pl [kN] [kN/m]	Pw [kN] [kN/m]	Pf [kN] [kN/m]	ffav [-] [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m] bw[m]	cont@ lw[m]
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000	= 1.67	[kN/m2]
2P	70.4	0.0	0.0	70.4	0.0	0.000		0.000	0.000	0.000	2.000	
2P	95.0	0.0	0.0	95.0	0.0	3.400		0.000	0.000	0.000	2.000	
2P	95.0	0.0	0.0	95.0	0.0	4.700		0.000	0.000	0.000	2.000	
2P	83.2	0.0	0.0	83.2	0.0	10.400		0.000	0.000	0.000	2.000	
2P	83.2	0.0	0.0	83.2	0.0	11.700		0.000	0.000	0.000	2.000	
2P	83.2	0.0	0.0	83.2	0.0	13.000		0.000	0.000	0.000	2.000	
2P	88.6	0.0	0.0	88.6	0.0	17.800		0.000	0.000	0.000	2.000	
2P	88.6	0.0	0.0	88.6	0.0	19.100		0.000	0.000	0.000	2.000	
2P	95.0	0.0	0.0	95.0	0.0	25.600		0.000	0.000	0.000	2.000	
2P	95.0	0.0	0.0	95.0	0.0	27.400		0.000	0.000	0.000	2.000	
B	-5.00	basis deduction		-5.00	0.0	-2.500	32.400	0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
P,B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area
lw[m] length of wheel contact area

Load Train 265 FILLAST 11
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Load elements of Load Train

B	Pv [kN/m]	Pl [kN/m]	Pw [kN/m]	Pf [kN/m]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000		

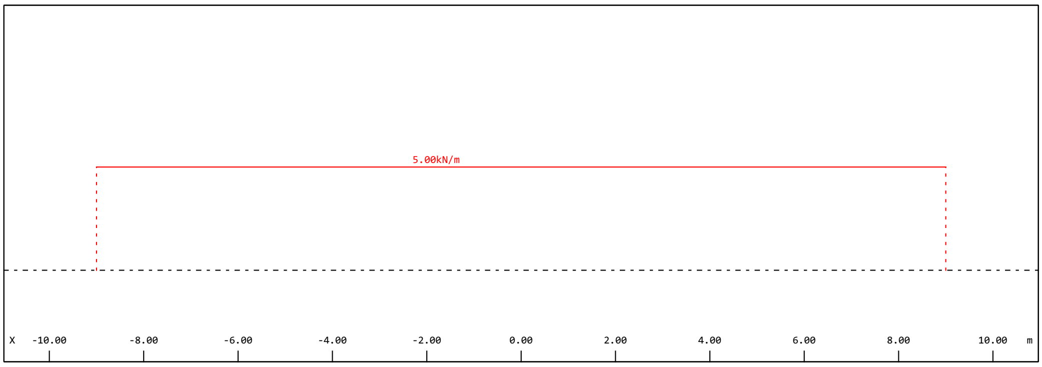
Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area

Load Train 266 FILLAST 22

Geometry & cross sections
SVENSKA TYPFORDON

USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

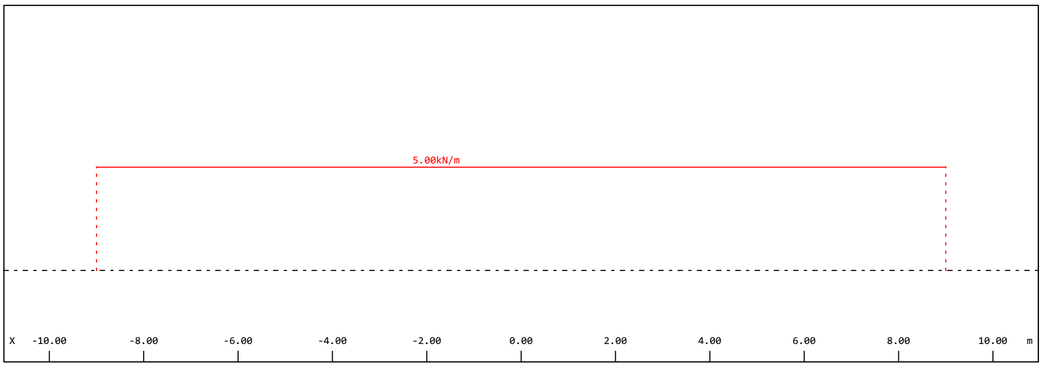
Load elements of Load Train

B	Pv [kN/m]	Pl [kN/m]	Pw [kN/m]	Pf [kN/m]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000		

Pv vertical load value
Pl longitudinal load value (breaking)
Pw transverse load value
Pf effective load for centrifugal loading
ffav factor for favourable load positions
X[m] location along load train
L[m] length of loading
y[m] excentricity of loading
hw[m] height of lateral acting force
hs[m] height of centrifugal mass center
b[m] spacing of wheels
cont@ connected to node number of vehicle model
B load Type (P) = axle/pointload, (B) = distributed load
bw[m] width of wheel contact area

Load Train 267 FILLAST 33
USER User defined

Load elements of Load Train	Load value	Remark
Total factor	1.000 [-]	
Fact.centrifugal	1.000 [-]	
Loading travels in both directions		
Transverse loading in unfavourable direction		



User defined

Geometry & cross sections
SVENSKA TYPFORDON

Load elements of Load Train

B	Pv [kN/m]	Pl [kN/m]	Pw [kN/m]	Pf [kN/m]	ffav [-]	X[m]	L[m]	y[m]	hw[m]	hs[m]	b[m] bw[m]	cont@
B	5.00	0.00	0.00	5.00	0.0			0.000	0.000	0.000		

Pv	vertical load value	y[m]	excentricity of loading
Pl	longitudinal load value (breaking)	hw[m]	height of lateral acting force
Pw	transverse load value	hs[m]	height of centrifugal mass center
Pf	effective load for centrifugal loading	b[m]	spacing of wheels
ffav	factor for favourable load positions	cont@	connected to node number of vehicle model
X[m]	location along load train	B	load Type (P) = axle/pointload, (B) = distributed load
L[m]	length of loading	bw[m]	width of wheel contact area

Geometry & cross sections
LOAD COMBINATION FOR TYPFORDON

Design Code

EuroNorm Bridges: SS EN 1990:2002 (TSFS 2018:57) Basis of structural design (Sverige) V 2024

Combination rule Number 1

6.10a gr1
Superposition according to explicitly defined formula
(1.09/1.00)*G_1+(1.09/0.00)*G_2+(1.09/1.00)*G_3+(1.37/0.00)*{Q1}(L_A)+(0.64/0.00)*{QI}(L_A)
Resulting Load Cases type ULS fundamental combination

Load Case selection and Actions

		Superposition Factors										
Act	**Part**	**fac-u**	**fac-f**	**facu1**	**facf1**	**facu2**	**facf2**	**facu3**	**facf3**			**Designation**
	LC									**Fact**	**Type**	
G_1	G	1.09	1.00									Self weight
	1									1.00	PERM	Self weight
G_2	G	1.09	0.00									Earth pressure
	2									1.00	PERM	Soil pressure
G_3	G	1.09	1.00									Paving
	3									1.00	PERM	Paving
L_A	Q_1	0.64	0.00	1.37	0.00							Typ A
	301									1.00	A61	MAX-m-xx ENVELOPE TYPFORDON A
	302									1.00	A61	MIN-m-xx ENVELOPE TYPFORDON A
	303									1.00	A61	MAX-m-yy ENVELOPE TYPFORDON A
	304									1.00	A61	MIN-m-yy ENVELOPE TYPFORDON A
	305									1.00	A61	MAX-m-xy ENVELOPE TYPFORDON A
	306									1.00	A61	MIN-m-xy ENVELOPE TYPFORDON A
	307									1.00	A61	MAX-v-x ENVELOPE TYPFORDON A
	308									1.00	A61	MIN-v-x ENVELOPE TYPFORDON A
	309									1.00	A61	MAX-v-y ENVELOPE TYPFORDON A
	310									1.00	A61	MIN-v-y ENVELOPE TYPFORDON A

Act action
Part partition of the action
fac-u,fac-f factor unfavourable/favourable
facu1,facf1,facu2,facf2,facu3,facf3 factors unfavourable/favourable 1st,2nd,3rd dominant action
LC number of the load case
Fact factor for load case
Type type of the load case
PERM permanent load grouped in actions
A exclusive load

Combination rule Number 3

6.10a gr1
Superposition according to explicitly defined formula
(1.09/1.00)*G_1+(1.09/0.00)*G_2+(1.09/1.00)*G_3+(1.37/0.00)*{Q1}(L_B)+(0.64/0.00)*{QI}(L_B)
Resulting Load Cases type ULS fundamental combination

Load Case selection and Actions

		Superposition Factors										
Act	**Part**	**fac-u**	**fac-f**	**facu1**	**facf1**	**facu2**	**facf2**	**facu3**	**facf3**			**Designation**
	LC									**Fact**	**Type**	
G_1	G	1.09	1.00									Self weight
	1									1.00	PERM	Self weight
G_2	G	1.09	0.00									Earth pressure
	2									1.00	PERM	Soil pressure
G_3	G	1.09	1.00									Paving
	3									1.00	PERM	Paving
L_B	Q_1	0.64	0.00	1.37	0.00							Typ B
	401									1.00	A62	MAX-m-xx ENVELOPE TYPFORDON B
	402									1.00	A62	MIN-m-xx ENVELOPE TYPFORDON B
	403									1.00	A62	MAX-m-yy ENVELOPE TYPFORDON B
	404									1.00	A62	MIN-m-yy ENVELOPE TYPFORDON B
	405									1.00	A62	MAX-m-xy ENVELOPE TYPFORDON B
	406									1.00	A62	MIN-m-xy ENVELOPE TYPFORDON B
	407									1.00	A62	MAX-v-x ENVELOPE TYPFORDON B
	408									1.00	A62	MIN-v-x ENVELOPE TYPFORDON B
	409									1.00	A62	MAX-v-y ENVELOPE TYPFORDON B

Geometry & cross sections
LOAD COMBINATION FOR TYPFORDON

Load Case selection and Actions

Act	Part	fac-u	fac-f	facu1	facf1	facu2	facf2	facu3	facf3			Designation
	LC									Fact	Type	
	410									1.00	A62	MIN-v-y ENVELOPE TYPFORDON B

(Superposition Factors: fac-u to facf3)

Act	action		Fact	factor for load case
Part	partition of the action		Type	type of the load case
fac-u,fac-f	factor unfavourable/favourable		PERM	permanent load grouped in actions
facu1,facf1,facu2,facf2,facu3,facf3	factors unfavourable/favourable 1st,2nd,3rd dominant action		A	exclusive load
LC	number of the load case			

Generated Load Cases

Number	Combination	Designation
2000	1	MAX-MXX QUAD ULS 6.10a Typ A
2001	1	MIN-MXX QUAD ULS 6.10a Typ A
2002	1	MAX-VX QUAD ULS 6.10a Typ A
2003	1	MIN-VX QUAD ULS 6.10a Typ A
2004	1	MAX-VY QUAD ULS 6.10a Typ A
2005	1	MIN-VY QUAD ULS 6.10a Typ A
2006	1	MAX-MXX QUAD ULS 6.10a Typ A
2007	1	MIN-MXX QUAD ULS 6.10a Typ A
2008	1	MAX-MYY QUAD ULS 6.10a Typ A
2009	1	MIN-MYY QUAD ULS 6.10a Typ A
2010	1	MAX-MXY QUAD ULS 6.10a Typ A
2011	1	MIN-MXY QUAD ULS 6.10a Typ A
2012	3	MAX-MXX QUAD ULS 6.10a Typ B
2013	3	MIN-MXX QUAD ULS 6.10a Typ B
2014	3	MAX-VX QUAD ULS 6.10a Typ B
2015	3	MIN-VX QUAD ULS 6.10a Typ B
2016	3	MAX-VY QUAD ULS 6.10a Typ B
2017	3	MIN-VY QUAD ULS 6.10a Typ B
2018	3	MAX-MXX QUAD ULS 6.10a Typ B
2019	3	MIN-MXX QUAD ULS 6.10a Typ B
2020	3	MAX-MYY QUAD ULS 6.10a Typ B
2021	3	MIN-MYY QUAD ULS 6.10a Typ B
2022	3	MAX-MXY QUAD ULS 6.10a Typ B
2023	3	MIN-MXY QUAD ULS 6.10a Typ B

H Results

In this appendix, the results from the main analysis are presented. The results presented includes the moment- and shear load effects for all studied bridges for the 3D model and the 2D model respectively. The moment load effects presented was evaluated in the mid-span and at the frame corner, while the shear force was evaluated at a critical section close to the frame corner. The values presented in this appendix forms the basis for the contour plots presented in chapter 4.

H.1 Moment- and shear load effects, type vehicle A

In table H.1 and table H.2 the moment load effects for the studied bridges with different lengths and widths are presented, a complete description of the geometries of the bridges is presented in chapter 4.3. The assigned traffic load is type vehicle A together with the loads described in chapter 3.3.

Length \ Width	3,5	5	5,9	6	6,5	8	9,5	11	12,5	14	15,5	17
2	49,78	43,92	39,19	43,26	42,20	43,72	27,84	27,37	27,01	27,86	27,95	27,29
3,5	93,64	83,33	75,72	93,40	90,79	90,54	61,51	61,84	61,17	62,08	62,10	60,61
5	143,37	120,85	109,39	149,19	140,05	137,43	94,67	94,86	95,58	95,29	96,01	95,33
6,5	189,67	162,19	149,29	202,45	186,63	184,42	131,37	130,92	129,66	129,86	129,52	128,10
8	237,01	200,00	186,39	256,55	240,56	233,94	167,36	164,29	165,50	165,29	165,96	165,72
9,5	287,61	242,46	225,94	308,02	291,28	284,05	204,38	202,84	200,46	202,62	202,49	203,10
11	337,88	285,36	268,09	364,86	352,92	331,56	242,90	242,45	241,67	239,45	239,37	240,35
12,5	393,30	332,82	311,21	422,89	403,95	388,67	284,69	282,52	281,80	282,91	279,24	280,70
14	462,06	385,69	363,67	486,71	462,68	448,01	332,96	330,80	328,20	327,76	326,80	327,03
15,5	566,73	483,02	456,49	606,02	576,57	557,76	422,64	418,17	413,97	415,70	412,65	412,86
17	640,28	549,69	524,09	681,35	652,44	633,18	479,45	476,45	471,12	470,90	468,35	468,83

Table H.1: *Moment load effects [kNm/m] for the 3D analysis at the mid-span, type vehicle A.*

Length \ Width	3,5	5	5,9	6	6,5	8	9,5	11	12,5	14	15,5	17
2	-54,02	-53,68	-52,4	-55,75	-56,44	-54,75	-53,32	-53,4	-53,1	-53,13	-53,11	-53,08
3,5	-77,08	-65,14	-64,03	-73,92	-74,25	-71,54	-65,85	-65,55	-67,45	-66,34	-66,86	-66,71
5	-109,6	-92,84	-84,89	-108,65	-103,42	-102,62	-96,34	-93,25	-88,72	-91,81	-91,53	-94,17
6,5	-151,07	-128,04	-120,85	-150,36	-144,02	-136,57	-122,48	-124,94	-128,35	-123,3	-125,81	-127,34
8	-202,67	-172,37	-165,17	-212,7	-188,04	-189,86	-159,8	-161,59	-162,41	-174,37	-168,24	-172,38
9,5	-261,89	-225,18	-212,76	-274,04	-256,73	-251,83	-210,87	-210,11	-209,79	-209,58	-220,76	-212,8
11	-330,56	-283,96	-267,43	-344,05	-327,37	-314,26	-267,4	-267,69	-265,48	-267,15	-264,47	-270,23
12,5	-406,6	-351,45	-332,41	-421,18	-408,36	-382,16	-324,43	-324,36	-331,14	-329,87	-326,75	-327,19
14	-489,83	-423,06	-403,6	-499,19	-490,72	-469,15	-392,88	-395,39	-395,16	-396,64	-392,99	-391,56
15,5	-635,34	-551	-526,73	-650,03	-632,62	-611,68	-515,25	-511,78	-510,6	-512,48	-516,35	-518,04
17	-751,65	-650,3	-625	-769,96	-736,13	-711,1	-597,16	-609,7	-608,05	-593,5	-600,01	-606,45

Table H.2: *Moment load effects [kNm/m] for the 3D analysis at the frame corner, type vehicle A.*

In table H.3 the shear load effects for the studied bridges with different lengths and widths are presented, a complete description of the geometries of the bridges is presented in chapter 4.3. The assigned traffic load is type vehicle A together with the loads described in chapter 3.3.

Length \ Width	3,5	5	5,9	6	6,5	8	9,5	11	12,5	14	15,5	17
2	109,08	93,32	82,57	90,85	88,14	56,83	53,26	41,92	51,62	56,14	48,21	53,25
3,5	157,79	132,94	123,62	155,21	138,18	141,32	90,67	88,87	90,39	88,23	93,23	90,44
5	166,06	177,44	145,70	177,46	168,70	162,61	106,57	106,13	110,45	110,31	106,53	110,14
6,5	189,39	177,26	159,13	193,27	197,82	204,01	128,29	129,39	126,40	131,05	122,23	124,71
8	204,34	180,89	176,80	217,52	205,56	215,34	141,43	144,54	142,02	141,56	142,33	135,40
9,5	219,73	194,64	187,58	226,48	219,07	225,63	148,90	157,59	158,94	160,39	150,71	153,90
11	239,51	186,88	195,99	256,91	252,10	239,17	170,73	178,72	175,62	168,26	175,40	164,93
12,5	246,01	224,23	203,85	266,66	258,92	248,26	185,49	181,10	191,38	189,25	185,10	180,67
14	266,24	242,76	218,43	277,72	278,89	261,72	203,03	201,45	205,63	210,23	199,74	208,09
15,5	307,09	280,60	246,81	318,03	306,37	302,69	242,36	237,89	236,71	233,12	238,40	233,97
17	314,90	304,97	287,53	333,48	317,47	298,75	262,51	260,65	261,62	266,36	267,86	264,05

Table H.3: *Shear load effects in a critical section [kN/m] for the 3D analysis at the frame corner, type vehicle A.*

In table H.4 the moment- and shear load effects for the studied bridges with different lengths are presented, a complete description of the geometries of the bridges is presented in chapter 4.3. The assigned traffic load is type vehicle A together with the loads described in chapter 3.3.

Length [m]	Moment at framecorner [kNm/m]	Shear force at a critical section [kN/m]	Moment at mid-span [kNm/m]
2	-47,24	52,60	32,23
3,5	-54,89	75,55	59,92
5	-72,43	91,91	89,51
6,5	-98,18	106,32	121,03
8	-131,36	119,93	154,75
9,5	-171,58	133,14	192,80
11	-218,61	146,15	231,77
12,5	-272,33	159,04	274,13
14	-332,65	171,86	322,76
15,5	-439,04	202,90	411,32
17	-519,69	216,92	471,23

Table H.4: *Load effects for the 2D analysis, type vehicle A.*

H.2 Moment- and shear load effects, type vehicle B-O

In table H.5 and table H.6 the moment load effects for the studied bridges with different lengths and widths are presented, a complete description of the geometries of the bridges is presented in chapter 4.3. The assigned traffic load is type vehicle B-O together with the loads described in chapter 3.3.

Length \ Width	3,5	5	5,9	6	6,5	8	9,5	11	12,5	14	15,5	17
2	51,91	45,36	40,69	48,59	48,58	49,74	31,07	30,50	29,85	30,97	30,95	30,35
3,5	100,08	88,75	79,82	98,12	95,19	94,98	64,00	64,08	63,60	64,24	64,44	63,21
5	170,84	144,23	128,27	166,28	155,05	151,86	103,23	103,02	104,15	104,05	103,93	103,31
6,5	238,80	201,06	182,76	232,79	214,26	209,45	146,72	146,45	144,99	145,04	144,94	143,45
8	311,90	259,00	237,25	305,04	292,72	283,24	195,68	191,38	194,13	193,86	194,11	192,99
9,5	392,84	321,65	295,55	399,28	377,89	362,31	249,82	247,27	244,73	246,22	247,87	246,68
11	478,63	390,61	358,54	492,79	470,79	439,70	304,63	303,25	302,41	299,97	297,46	300,62
12,5	570,51	466,65	426,29	587,33	555,21	529,67	362,30	359,07	359,64	357,76	357,08	355,84
14	684,41	549,94	505,18	686,58	646,78	618,25	423,62	421,19	418,89	419,51	417,88	416,77
15,5	864,60	702,02	642,88	852,90	815,31	778,05	539,01	531,25	528,05	526,61	522,72	523,71
17	993,04	801,61	743,86	979,69	929,41	889,32	610,19	603,65	594,36	594,53	591,91	591,42

Table H.5: *Moment load effects [kNm/m] for the 3D analysis at the mid-span, type vehicle B-O.*

Length \ Width	3,5	5	5,9	6	6,5	8	9,5	11	12,5	14	15,5	17
2	-54,18	-54,33	-52,31	-55,75	-56,44	-54,75	-53,32	-53,4	-53,1	-53,13	-53,11	-53,08
3,5	-87,91	-72,06	-74,52	-77,67	-78,18	-75,58	-69,52	-69,21	-70,83	-70,08	-70,41	-70,2
5	-142,27	-121,77	-111,63	-124,6	-119,05	-116,23	-109,16	-104,74	-99,57	-103,59	-103,22	-105,98
6,5	-211,59	-178,41	-169,85	-188,9	-172,82	-169,51	-148,03	-150	-154,86	-145,72	-149,82	-151,8
8	-306,13	-256,13	-246,85	-293,12	-266,4	-250,64	-209,28	-212,41	-212,96	-231,25	-222,72	-228,24
9,5	-421,24	-348,82	-325,11	-408,74	-371,23	-360,21	-293,28	-291,31	-290,61	-290,02	-306,76	-295,82
11	-562,91	-464,18	-430,31	-528,24	-497,05	-463,66	-379,57	-378,59	-378,88	-377,51	-373,69	-381,78
12,5	-718,89	-593,91	-552	-662,78	-629,8	-578,08	-461,01	-460,05	-468,23	-465,35	-462,61	-449,73
14	-875,08	-724,73	-673,4	-804,82	-770,56	-715,72	-562,3	-564,44	-564,47	-562,17	-558,81	-554,3
15,5	-1158	-943,46	-877,29	-1078,92	-1019	-959,75	-745,56	-737,95	-737,15	-734,48	-738,89	-740,62
17	-1382,26	-1116,33	-1047,91	-1288,04	-1203,13	-1128,4	-865,71	-878,48	-852,8	-848,77	-859,66	-866,99

Table H.6: *Moment load effects [kNm/m] for the 3D analysis at the frame corner, type vehicle B-O.*

In table H.7 the shear load effects for the studied bridges with different lengths and widths are presented, a complete description of the geometries of the bridges is presented in chapter 4.3. The assigned traffic load is type vehicle B-O together with the loads described in chapter 3.3.

Length \ Width	3,5	5	5,9	6	6,5	8	9,5	11	12,5	14	15,5	17
2	114,34	98,70	86,62	102,08	100,90	62,92	58,99	46,99	57,92	62,04	54,01	58,73
3,5	174,17	158,52	137,18	165,90	147,07	150,75	97,36	94,80	97,09	93,43	100,65	96,56
5	203,28	209,73	174,27	201,79	189,89	182,83	119,24	118,18	122,20	122,16	117,88	121,43
6,5	247,48	229,58	199,41	237,73	243,25	247,92	153,85	151,43	150,16	154,79	145,73	145,93
8	286,11	245,86	234,24	291,35	274,28	283,70	177,48	185,33	182,64	178,98	179,13	172,73
9,5	324,89	277,39	261,91	320,23	308,59	312,58	195,08	207,43	211,37	212,53	194,95	202,51
11	369,17	270,86	282,99	371,17	358,52	339,88	221,41	242,08	233,75	226,94	237,21	237,72
12,5	395,39	349,82	320,84	394,70	365,13	356,44	255,82	236,92	262,99	255,86	253,46	248,39
14	442,01	384,83	330,13	440,32	406,40	377,43	261,66	280,15	285,88	288,82	282,84	283,46
15,5	528,01	456,57	383,04	486,80	460,94	418,96	341,37	336,01	331,74	340,70	335,68	337,63
17	584,42	484,48	439,80	548,62	490,10	456,75	373,42	370,77	367,44	376,75	378,81	369,23

Table H.7: *Shear load effects in a critical section [kN/m] for the 3D analysis at the frame corner, type vehicle B-O.*

In table H.8 the moment- and shear load effects for the studied bridges with different lengths are presented, a complete description of the geometries of the bridges is presented in chapter 4.3. The assigned traffic load is type vehicle A together with the loads described in chapter 3.3.

Length [m]	Moment at framecorner [kNm/m]	Shear force at a critical section [kN/m]	Moment at mid-span [kNm/m]
2	-48,29	50,83	31,21
3,5	-64,53	95,29	65,12
5	-96,06	129,13	110,67
6,5	-142,23	163,77	158,86
8	-210,36	199,23	217,56
9,5	-287,22	228,06	283,96
11	-369,57	251,99	352,81
12,5	-457,58	272,87	425,18
14	-566,76	294,09	503,84
15,5	-751,35	348,84	643,26
17	-885,31	374,78	736,06

Table H.8: *Load effects for the 2D analysis, type vehicle B-O.*