ALLPLAN
A NEMETSCHEK COMPANY

ALLPLAN BRIDGE
NEW FEATURES IN VERSION 2021

HIGHLIGHTS

Modeling:
An important new functionality is the possibility to interactively moving a station or a section. Furthermore, it is possible to interactively displaying the cross-section at any point along the structure.

Earthquake Load:
Allplan Bridge uses the multi-mode Response Spectrum Method for evaluating the effects of seismic loading. The solution consists of 2 separate tasks in the calculation procedur.

Combinations:
The table definition and visualization of the combination scheme allows for highest usability and perfect overview.

Code-Based Design:
Once the global effects are calculated and the relevant envelopes have been created the user can perform code dependent design tasks to determine the required reinforcement content.

Allplan Bridge is the professional BIM solution for modeling, analysis, design, and detailing. Engineers work with a single solution from parametric model creation with high level of detail including pre-stressing to integration of the construction process, structural analysis, and reinforcement design and detailing.

CALCULATION OF EIGEN MODES

The natural modes of the structure are calculated on the undamped system by determining the roots of the homogeneous equation system $[K]*u - \omega^{2}*[M]*u = 0$.

A subspace iteration scheme according to Bathe is used to find the eigenvalues of this equation system and thus the natural frequencies ω and relevant displacement directions for computing the mode shapes.

The eigen modes are normalized to a maximum displacement value of 1. They are saved to the database in order to allow for visualization and further evaluation tasks.

In addition to the stiffness matrix also the mass matrix is required as governing parameter of the Eigen value calculation.

It represents the oscillating masses of the structure. In Allplan Bridge 2021, the self-weights and superimposed dead loads as defined for the static load-case are automatically considered for calculating a consistent mass matrix.

This ensures accurate results even with coarse element subdivisions.

Any additional relevant masses can be easily defined by the user with their position and possible moment of inertia.

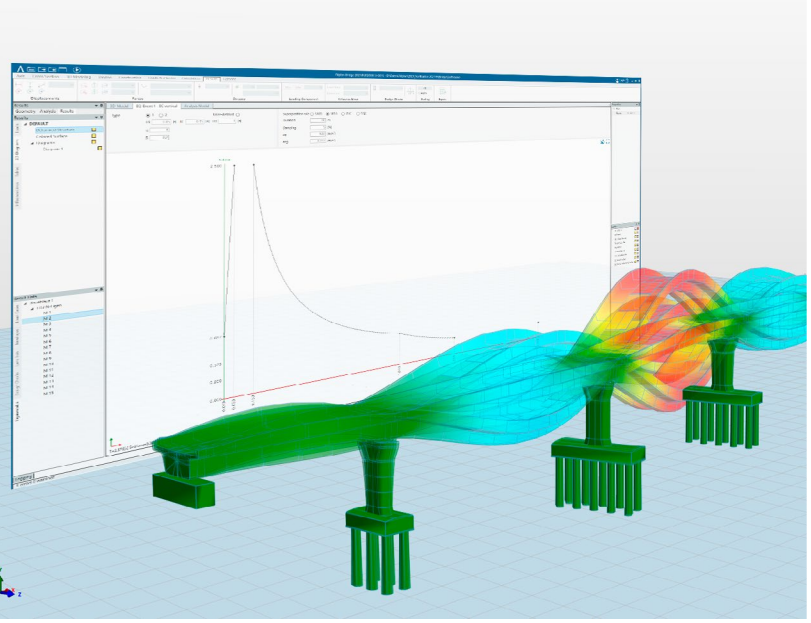
RESPONSE SPECTRUM ANALYSIS

In case of an earthquake, the actual extent of excitation of the different natural modes is dependent on the direction of the seismic waves (ground accelerations), the corresponding mass participation and on the damping behavior of the structure.

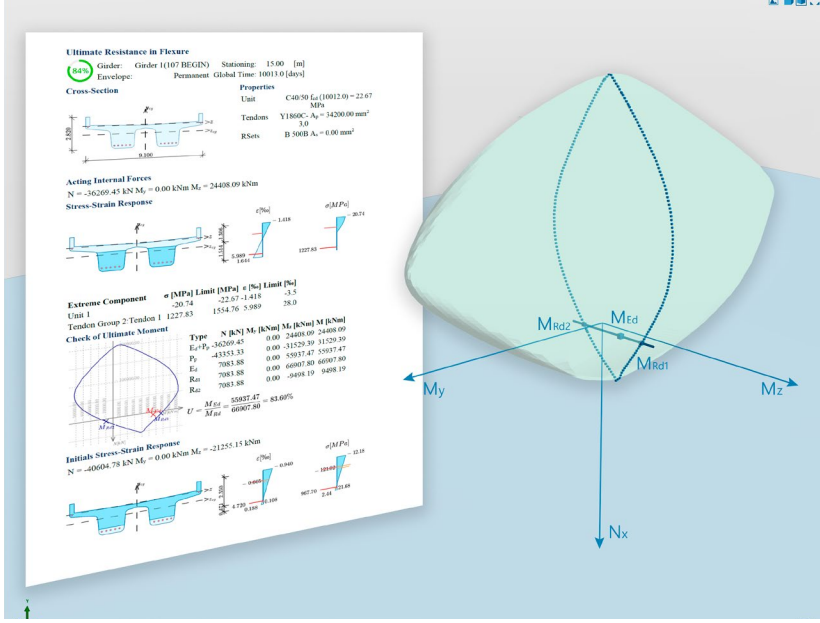
The analytic solutions for typical structures and unit impacts are provided in the design codes as relevant response spectra, specifying the relevant proportionality factors for the individual eigenmodes dependent on the natural frequency.

The calculated amplitudes related to the individual natural modes are superimposed using different methods described in literature. Allplan Bridge 2021 offers the ABS-method, the SRSS method, and the CQC method.

Three separate calculations are provided to consider different possible earthquake directions, transverse, longitudinal and vertical directions. These different cases are combined to get finally the envelope of extreme values.



Earthquake Load



Code-Based Design

COMBINATIONS

The table definition and visualization of the combination scheme allows for highest usability and perfect overview. The table form gives the user an overview not only of the defined load factors but also of different types of combinations. The combination type becomes an important attribute when the code-based design is performed. It allows specific design procedures for automatically using the corresponding combinations.

CREEP, SHRINKAGE AND RELAXATION ACCORDING TO JTG AND KOREAN STANDARD

Particularly important for the construction stage analysis of prestressed and reinforced concrete structures is the correct consideration of the time-dependent effects. In Allplan Bridge the calculation of creep and shrinkage of concrete and relaxation of prestressing steel is code-compliant and now also available for Chinese and Korean Standard.

CODE-BASED DESIGN

Once the global effects are calculated and the relevant envelopes have been created the user can perform code dependent design tasks to determine the required reinforcement content. After the reinforcement area has been calculated or manually specified, ULS and SLS checks can be performed according to EN code, and ULS flexural capacity checks also according to AASHTO LRFD.

For ULS checks of flexural capacity a 3D interaction surface of the section resistance is calculated. Intersecting this surface with the relevant internal moment vector M_{Res} gives the user the detailed information on the level of capacity utilization. EN design for shear is based on the variable-angle truss model. The torsional resistance of a section is calculated based on an equivalent thin-walled closed section. The cross-section parts effective for the resistance in shear and torsion are automatically defined based on linear elastic shear stress distribution due to unit loads Q_z, Q_y and T_x. The effects of all components of internal forces may be superimposed and the interaction of N, M_y, M_z, V_y, V_z, and T can be checked.

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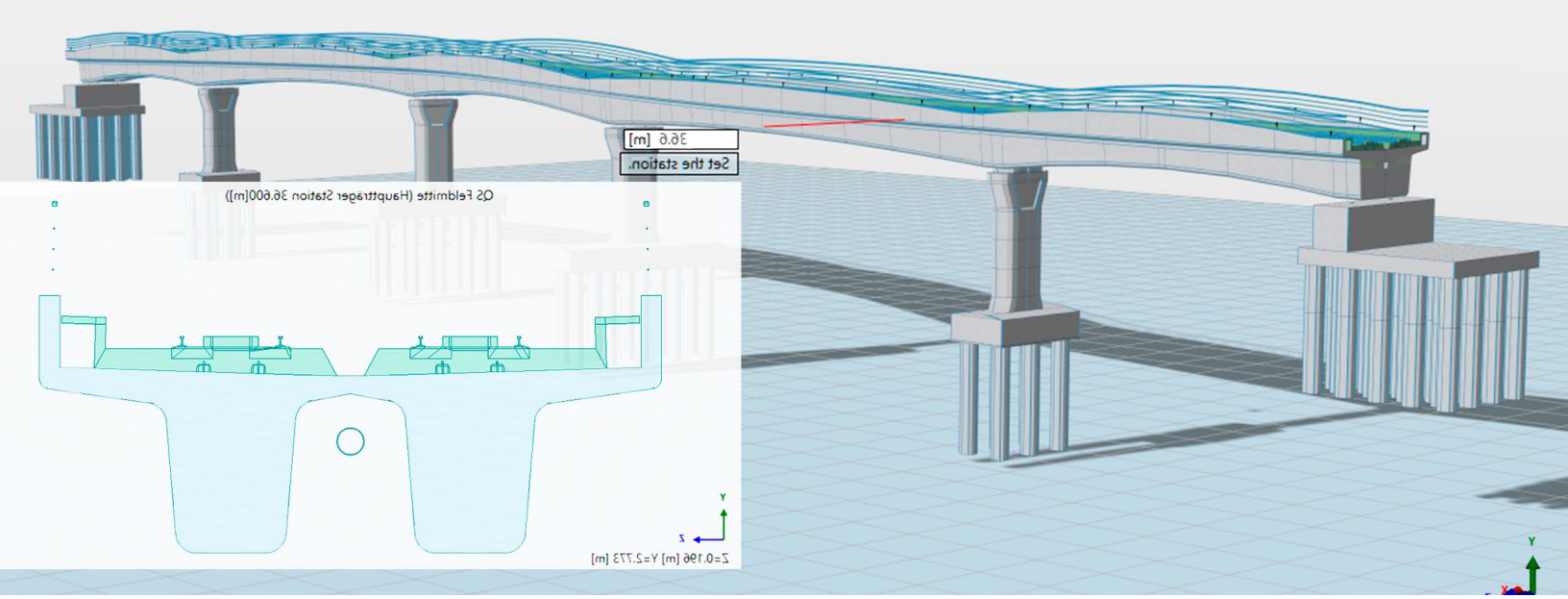

In Allplan Bridge 2021 it is possible to interactively displaying the cross-section at any point along the structure

As concerning the EN code assessments, also the serviceability conditions are often governing the cross-section design. Normal stresses and crack width due to service effects are calculated assuming the concrete ineffective in tension. The EN crack width approach is extended into an innovative general method suitable for real-life bridge cross-sections. Arbitrarily shaped reinforced cross–sections are converted into local cracking zones, where the area of effective embedment is determined. At the same time bar strain calculation takes account of full section geometry.

FURTHER NEW FEATURES

There are many further features and improvements included in this version. An important new functionality is the possibility to interactively moving a station or a section. Furthermore, it is possible to interactively displaying the cross-section at any point along the structure. This gives the user a better control of the parametrically defined geometry.

Some new features are available also for tendon modeling. For example, it is possible to use a longitudinal eccentricity for the tendon point definition. This minimizes the necessary definition of stations. A further new functionality is a sophisticated tendon report, which generates an Excel sheet containing not only geometrical data but also certain analytical data, e.g. the initial forces in the tendon. What is more, the construction sequence calculation is extended with a detailed computation of camber values, which are exported to an Excel sheet.

Current system requirements can be found at allplan.com/info/sysinfo

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