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PERFORMANCE HIGHLIGHTS
ALLPLAN BRIDGE LINEAR ANALYSIS

Allplan Bridge Linear Analysis is the ideal complement to the Allplan Bridge Modeler. The parametric 4D model serves as the basis for the static calculation. The analytical model is automatically derived from the geometrical model. The automation accelerates the workflows enormously. Nevertheless, the engineer retains always full control. Furthermore, also loads are automatically assembled from the 4D model.

MATERIAL CATALOGUE (EURO NORM) IN ALLPLAN BIMPLUS

Allplan Bimplus is the open BIM platform for all disciplines to collaborate efficiently. In order to improve the collaboration a material catalogue is available. There are several different types of material at hand such as concrete, reinforcement steel, prestressing steel, etc. Each material contains the parameters required for structural analysis and several additional parameters. This allows the user to easily load the materials into the project, assign it to corresponding bridge part and perform the analysis.

SEMI-AUTOMATICAL GENERATION OF ANALYSIS MODEL

Allplan Bridge automatically generates the analysis model from the geometrical model. This greatly reduces the amount of work and the susceptibility to errors. Hereby the engineer retains full control by specifying structural parts and those ones which contribute as load only. One of additional analysis-relevant definitions is the choice of generating a beam or a grillage model.

ASSEMBLING CONSTRUCTION SEQUENCE CALCULATION

Allplan Bridge analyses the defined construction schedule and sets up all necessary calculation definitions in an automated process, like load cases, element activations and calculation actions. This includes input data for calculating non-linear time effects, like creep, shrinkage and relaxation. Complete transparency is granted, the user keeps full control of the generated items and an overview of the results at any time of construction.

AUTOMATED TENDON LOAD APPLICATION

The Analysis model for placing the tendons in the beam elements is generated from their defined position in space. The product analyses the exact position of the tendon in relation to the girder and assigns it automatically the corresponding beam elements with the relevant eccentricity values. Once the user specifies the point in time when the tendon is stressed the product generates automatically the corresponding load cases and calculation action and applies the load on the structure.

NONLINEAR TIME DEPENDENT MATERIAL EFFECTS

Based on the assembled input parameters describing the creep and shrinkage behavior of the concrete and relaxation of the pre-stressing throughout the construction phases, respective creep load cases are calculated for every time interval between relevant changes of the active structural system and/or loading state. The calculation is based on the formulas specified in the selected standard. A final creep load case covers the long-term effects arising during life time.

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SUPERIMPOSED DEAD LOADS DERIVATED FROM GEOMETRICAL MODEL

The weight and the position of superimposed dead loads (like sidewalk, road pavement, etc.) are automatically retrieved from the geometrical model. The user needs to specify the point in time of the equipment installation, and consequently the load is applied. Additional loads, such as temperature change or wind loads, can be defined and applied easily as well.

TRAFFIC LOAD DEFINITION

Traffic loads can be defined and applied in a very comfortable way. On one side, the traffic load is automatically applied in accordance with the selected standard. On the other side, the generic approach of live load definition implemented in Allplan Bridge allows the user to consider any type of moving load.

CALCULATION AND EVALUATION OF INFLUENCE LINES

With Allplan Bridge, the most unfavorable effects due to traffic loads can be determined quickly and easily. In the first step, the influence lines are calculated for each element and for all degrees of freedom. In the second step, the influence lines are evaluated with the corresponding load train (vehicle) and the results are stored as an envelope.

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.

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.

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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.

NEXT GENERATION SUPERPOSITION

The superposition in Allplan Bridge works very user-friendly . The schematic definition of the superposition combines maximum flexibility with optimal overview. It is possible to select several stress components in user-defined stress points and perform a stress leading superposition. Furthermore, the superposition allows for storing corresponding results for selected elements.

STRUCTURAL ANALYSIS

A global static analysis based on the Bernoulli beam theory is performed for all automatically and manually generated calculation actions defined previously in the construction sequence definition. The analysis is enhanced to accurately consider the cross-section variation. Furthermore, the non-linear calculation of time-dependent effects is performed, considering design code formulas.

ELEMENT & LOAD REMOVAL

Part of every construction process are temporary structures. In Allplan Bridge, the time as 4th dimension is considered when specifying the construction phases. New in this release is the possibility to consider these structures within the construction plan not only geometrically but also analytically. The product analyzes the defined construction schedule and assembles all necessary calculation tasks in an automated process, like load case definition, element deactivation, calculation actions and updating the summation load-cases.

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

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