

Software for the Earthquake analysis and design of concrete and steel structures according to Eurocode 8



Fespa 10 Earthquake analysis and design of concrete and steel structures

Fespa 10 is a 3D software for the analysis and design of structures, comprised of linear and surface elements, of different materials and arbitrary cross-sections, subjected to various loading conditions.

As now LH Logismiki continues into its fourth decade of activity, it tackles all new code regulations with the responsibility that its experience guarantees. Firmly oriented towards developing pioneer software products to be used both in Greece and abroad, Fespa 10 ranks among the best software products, offering integrated analysis solutions to be engaged in all kinds of technical projects. Especially with regard to the earthquake analysis and design, Fespa 10 covers an extensive range of benefits contributing to the establishment of a new era in the field of computational analysis under the challenge of continuously evolving design standards. In few words Fespa 10 is a modern-day product linked to the pursuit of quality production, meeting in full the customers' requirements and expectations.

Fespa is being developed through the continuous collaboration of a highly skilled personnel and academic consulting team. Before the release of a new version of **Fespa**, a wide range of test methods are thoroughly carried out by professionals.

Customer service is a key part of the LH Logismiki organisational structure. Its expert human resources are constantly occupied by customers' needs, queries and difficulties. A free fax and e-mail hotline is available to all customers. The e-Support tool of Fespa 10 facilitates the procedure of submitting a query as the current user's file is automatically sent to the support department of LH Logismiki. Thereafter a qualified team of engineers provides a comprehensive and accurate answer the soonest possible.

Fespa 10 will cover all your future needs.

In **Fespa 10**, the structural model is composed of various **entities** such as beams, columns, slabs, footings, etc. There is no limit of size and shape.

Each entity has its own group of **"Properties"**, which are categorized in appropriate tabs according to their use. For example there are properties for geometrical representation in 2D and 3D, those for structural analysis and design, type and diameter of reinforcement, material selection, earthquake resistance, etc. All these properties can be interchanged between the elements of the same entity, thus facilitating the modifications procedure.

Each entity also has its own group of "**Commands**". They are used for inserting and editing entities. In the status bar, **constant help** guides you through the commands of **Fespa 10**.

Various **loading conditions** can be applied to the entities through the relevant tab in the properties window and the special loading commands.

Grid lines and snap points make the accurate geometry description of even the most complicated structural models really simple.

All the given data is automatically transferred in **data tables** for further assessment and/or quick group changes.

Data input

Entities: their commands and properties. You learn one, you know them all.



By just clicking on the "?" next to each property or by using the F1 key for the commands, the e-manual automatically opens to the respective explanation.

MASTER 10 - (sikop5 Eng. Version.tek - Plan - Floor 0)

File CAD Toolbars Edit Grid Architectural 2D Draw Structural View Win



Cross-section library for columns. The multiple windows offer simultaneous views of the structural plan and the data tables in one or more screens.

The basic and structural toolbar of Fespa.



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The properties window, of the selected entity, consists of several tabs, which contain relevant properties. For example in the «Reinforcement» tab of the «Beam» entity the material properties of the reinforcement, the bar diameters, etc may be defined.

Explanatory images (Key) give the necessary information (shape, dimensions, symbols) for the description of the structural element in use.



The user indicates the start and end node of the continuous beam. Fespa 10 automatically creates all spans after tracing the columns and free nodes between the start and end node.



Insertion and modification of inclined beams, X-bracings, etc. The "multiple choices" command is available and gives the option to choose among nodes or members that have the same position on plan but with different heights.

Generating tools facilitate the description of the structural model. Describe one floor and then generate the rest. Generate footings. Generate combinations of actions.

Not only the floor based input is supported but also a free form description is available through the "Edit" tool. Powerful commands make the construction of the complex 3D structure possible. Using this tool domes, barrel vaults, and irregularly shaped models can be described.



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Bie Iools Window Help

All members of the structure with common type are highlighted. The local coordinate system of members can be shown or hidden. Member and node info are displayed by just clicking on the member or node.

After the completion of the data input, **Fespa 10** automatically generates the **computational** and the **loading model**. Earthquake loading is automatically generated according to the local design spectrum. Loading combinations are automatically generated and presented in the data tables. The accurate modeling is aided by the use of rigid offsets in 3D, fictitious girders, elements on elastic foundation.

The **3DV tool** helps with the data verification. Displays loading diagrams, local coordinates names and lengths of members. It also highlights members with the same structural or design properties e.g. hinged members, X bracings. The proper connection of structural members may be checked.



Multiple windows and simultaneous modification of the structural model on one screen. Data tables for quick group changes in the values of the various properties. 3D wired frame view of the structural model.

Such is the structure of **Fespa 10** that after the input of the data, the only thing the engineer has to do is to proceed with the "Analysis and design" of the building. This is possible because everything needed for analysis, design and drawings is there from the beginning. **There is no need of intermediate steps, interchange of data and results between the various analysis and design modules.** The whole procedure is therefore automatic and secure.



Fespa 10 offers **linear structural** and **dynamic** analysis as well as non linear **pushover** analysis. All the analysis procedures are performed through a very powerful, fast and accurate solving algorithm. The speed of calculation is phenomenal even for the non linear analysis. The completion time of the non linear analysis for a five storey building, 350 m² lies within the limits of some seconds.

The solution algorithm is equipped with the current trends of mathematics and engineering. For example complete CQC of modal responses, mass matrix formation with distribution of the mass at the nodes, six degrees of freedom per node, care for rigid diaphragms, automatic calculation of the number of mode shapes for 90% mass sum, automatic check for structural irregularities, works due to axial and shear forces – bending and torsional moments.





After the analysis procedure is finished, the engineer can use the three dimensional wire frame view tool (3DV) to:

- Display the deformed geometry of the model based on any load, or combinations of loads.
- View the animated deflections of the model.
- View the animated various mode shapes of the modal analysis.
- Display the shear, moment and axial force diagrams.









After the pushover analysis the Force-Displacement diagram as well as the value of au/al (for all combinations of loading distribution and direction of loading) is displayed in 3DV.





Axial force diagrams and loading diagrams for selected members

4 Strengthening and repair of buildings according to EN 1998-3-Pushover analysis



The successive formation of plastic hinges at beam and column ends is displayed for uniform, triangular and modal load pattern as well as for every loading direction. The Acceleration Displacement Response Spectrum (ADRS) is simultaneously updated for every step. **Fespa 10** is equipped with the add on module (**Fespa 10R**) which performs **repair and strengthening** of existing reinforced concrete buildings and **evaluation** of the seismic performance of a new building.

The engineer describes the **reinforcement arrangement** at beam and column ends of the **existing building**, using the relative properties and commands. Furthermore, using the appropriate set of commands and properties the user can describe **column cross-sections of arbitrary shape** and their reinforcement model. The **momentchord rotation diagrams** of beams and columns are developed, for the assigned reinforcement arrangements (**moment – chord rotation diagrams** can also be developed for **steel members**). After the pushover analysis the **Acceleration Displacement Response Spectrum** (ADRS) is generated and displayed in 3DV. The **target displacement** is calculated for up to three discreet accelerations and limit states. The **capacity ratios**, for all members, are derived for every limit state.

Static pushover analysis – ADRS

- Uniform, triangular or modal lateral load patterns.
- \bullet P- Δ effects are taken into account considering geometric nonlinearity.
- Accidental eccentricity is considered.
- The resistance curvature of the structure is developed either by applying a force method of analysis, or a displacement method of analysis.
- Acceleration Displacement Response Spectrum generated both in three dimensional wire frame view and in the Report.



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• Derivation of the chord rotation angle both at yield and ultimate limit state. Moment – chord rotation diagrams for columns and beams are included in the Report.



Moment - chord rotation diagrams for columns and beams are included in the generated Report.

Assigning reinforcement model at beam ends

- The bending and shear reinforcements at beam end can be specified by using the relevant properties.
- The engineer has the option of characterizing the members either as new members or as existing members and either as primary or secondary seismic members so as their resistances to be calculated according to EN 1998-3.
- Slip of anchorage of bars.
- Strengthening by applying concrete jackets or by FRP plating and wrapping.

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7	Cross- section reinforcement	?	According to di	mensioning	•]
•	Longitudinal reinforcement					
7	Top reinforcement n*D (mm)	?	2D10			
₽	Cross-sectional area of top reinforcement As_t [cm²]	?	1.57			
5	Cross-sectional area of top reinforcement outside stirrups, As_sl [cm²/m]	?	0.00			
V	Bottom reinforcement n*D [mm]	?	4D10			4hf or 2hf
7	Cross-sectional area of bottom reinforcement As_b [cm²]	?	3.14			Rehars outside
•	Shear reinforcement					stirrup
₽	Shear reinforcement (stirrups) n*D/s [mm/cm]	?	2D10/25			Top longitudinal and
7	Cross-sectional area of stirrups Asw/s [cm²/m]	?	6.28			nclined reinforcement reinforcement
₽	Diagonal shear reinforcement n°D [mm]	?	2D10			(andar)
7	Cross-sectional area of diagonal reinforcement As_d [cm²]	?	1.57			
┍	Pushover - Appearance					Stirrups
9	Possible slip of the top reinforcement anchorage	?	No			Reinforcement details of beam end
₽	Possible slip of the bottom reinforcement anchorage	?	No			
₽	Show reinforcement	?	Yes			
7	Description of reinforcement	?	Number of bars	& diameters, n*D	•	Ī
	Key << 🔽 Current Tab 🔽 All/None					

The quantities of longitudinal and shear reinforcement are assigned to the beam end through the relevant properties.





Column cross-sections of arbitrary geometry are calculated by Fespa 10. The cross-section's geometry is described using the linear tools of Fespa 10. The required bending and shear reinforcements are calculated. The rebar's arrangement can be further edited through the relevant tools of Fespa 10.

Assigning reinforcement model at columns

- Special commands allow for the description of column cross-sections even of arbitrary shape.
- The reinforcement model of the column cross-section is created by using the appropriate commands and properties.
- Taking into account the action effects derived from the analysis, the cross-section geometry, the material properties and the reinforcement model:
 - The safety factor against bending is calculated.
 - The moment chord rotation diagrams which will be used for the assessment of existing structures using pushover analysis, are calculated.







The design engineer has the ultimate control of the analysis and design procedure.

Fespa 10 is implementing Eurocodes:

- Eurocode 0
- Eurocode 2 for the design of concrete structures,
- Eurocode 3 for the design of steel structures and
- Eurocode 7 for geothechnical design
- **Eurocode 8** for the earthquake resistance of structures.

By choosing the appropriate National Annex the design engineer has in their hands the best tool for designing structures with adequate resistance to earthquakes, provided in areas of medium or high seismicity (Turkey, Portugal, Spain, countries of Northern Africa, etc).

The following step is the design of all structural members according to the selected standards, the material in use and the results of the analysis.



The design procedure starts automatically after the analysis. After all entities (slabs, columns, footings, beams, etc) have been checked an error record is created and is displayed on screen. **Fespa 10** helps the design engineer to locate the members that failed during the analysis and suggests ways of resolving the error that led to the specific failure. An error or warning message appears in the results window and by double clicking on that error or warning, the relevant member (slab, column, beam, footing) is highlighted on the screen.



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Design

Each member has its own properties. They are modified through the various tabs in the properties windows.



Error messages with explanations based on the relevant paragraph of the Standards and recommended ways of resolving the specific error.

Concrete

All necessary checks are performed according to Eurocode 2 and Eurocode 8 for every ductility class. Some very important calculations are described hereafter:

Redistribution of moments

Fespa 10 is equipped with the moment redistribution method through which the hogging moments at beam supports are lowered leading to more uniform and economical beam reinforcement and subsequently column reinforcement.

The reduction of the additional reinforcement placed at the supports contributes in a positive way:

- In satisfying the local ductility requirement
- In applying the capacity design rule of columns in bending
- In applying the shear check of joint (DCH)



Redistribution of moments diagram as it is printed in the Report.

Ductile walls

Bending moment and shear force checks are performed at every level of a wall with the values that are obtained from the design envelopes which are produced in accordance with EC8-1.





Design envelope for shear forces in shear walls as it is printed in the Report.

Detailing for local ductility

Adequate ductility of beams is ensured by fulfilling the conditions of EN 1998-1 relevant with the maximum permissible reinforcement ratio of the tension zone and the required compression reinforcement.

Serviceability limit state controls

• Deflection control. For the deflection control of slabs there is the option of following the simplified method or of analytically calculating the deflection.

• Crack control. For the crack control there is the option of following the simplified method or of analytically calculating the crack width.

• Stress limitation. Limitation of the compressive and tensile stresses in the concrete and steel respectively is achieved, by using the appropriate arrangement of reinforcements.

Prevention of bond failure – Anchorage of reinforcement

The minimum permissible column size, to prevent bond failure, depends on the diameter of beam longitudinal rebars passing through the beam-column joint. Fespa 10 suggests minimum dimensions of column cross-sections with regard to the ductility class of the structure, the strength class of concrete, and the beam longitudinal bars passing through the beam - column joint.

Secondary seismic members

The design engineer has the option of characterising beams and columns as secondary seismic members. This option gives a way out from satisfying certain requirements of EN 1998-1.



Characterisation of a beam as a secondary seismic member by setting the value of the property "Increased ductility demands" to "Secondary seismic member".

Masonry

The add-on module of Masonry is used for the design of Masonry structures according to EN 1996-1-1. Fespa 10 supports composite structures consisting of masonry, reinforced concrete and steel members. The check of masonry columns subjected to bending is performed according to EN 1996-1-1



Display of the structure with its materials.

Structural steel



Fespa 10 provides beam types with special structural characteristics (truss members, seismic links with or without eccentricity, purlins, etc) that need to satisfy specific requirements. The properties that control the structural characteristics (hinges, buckling length, length for the calculation of deflections, etc) of those beams as well as the properties that control certain check requirements (lateral torsional buckling) are automatically updated with regard to the selected beam type.



Beam type selection - truss member, tension member, purlin, diagonal bracings, etc.

Properties for the elastic hinges at beam ends for both main directions of the cross section



Fespa 10 provides a table with multiple cross-section types (IPE, HEB, HEA, etc) and facilitates the specification of any standard cross-section by providing a list of available dimensions (180, 200, 240, etc.). The engineer also has the option to describe a **welded** cross-section

Output presentation – Drawings

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During the design procedure reinforcements are displayed on the structural plan. After the end of all calculations structural drawings for each floor are automatically created. At the same time all data is documented in a report which can be opened edited and printed by the "Report" program, provided with **Fespa 10**.

Report

With the "Report" program, the design engineer can edit the document according to their preferences:

- The extent of the report can be adjusted, as a variety of filters are offered. Furthermore, the engineer can create their own templates of filter groups.
- Simultaneous presentation of graphics and text data.
- Design envelope for shear forces and bending moments in shear walls.
- Error / Warning messages with explanation based on relevant paragraphs of the Standards and recommended ways of resolving the specific error.
- Export of tables in tek / csv/ html files so that they can also be used, for example, in the structural drawings.

Fespa lists the results of the required reinforcement in clearly arranged tables together with detailed design information. It is possible to edit the reinforcement proposal and to adjust for example the number of rebars, the anchorage and the length of rebar.



A variety of filters is offered in order to help the engineer to compose the report according to their own preferences.









Action effects of steel beam cross-section as they are printed in the report.

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Bill of quantities for the building

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Reinforcement arrangements for beams and columns per floor.

Create structural plan drawings from the very beginning. With Fespa 10 you can fully edit your drawings. There is no need to use other CAD programs.

Drawings

For the editing of drawings, multiple colours, line types, line densities and hatches are provided to describe the various members (slabs, beams, columns, footings).

Dimensions may be added and calculated automatically and there are various font texts that can be used for the dimension texts.

Captions, symbols, tags and heights can be easily inserted and modified.

Drawing of structural plan



Drawings of a concrete structure



Column details

After the analysis, **Fespa 10** creates a separate file (for each floor) which includes the cross-sections of all columns with their rebars and stirrups.

The design engineer has the option to edit the details (change rebar diameters, the stirrup type, etc) then save and print them.

The editing of rebars and stirrups of column cross-sections is performed by using the "Cross-section rebar" and "Cross-section stirrup" tools of **Fespa 10**.



On the right side window the column details of the building of the left hand side window. The column details may be edited by the commands of the "Cross-section" tool, the "Cross-section rebar" tool, etc.

3D solid view



3D solid view of a steel building.

Beam elevations

After the analysis, by selecting the desired beam, the addon module "Beam elevations" automatically creates a file with the corresponding beam elevation. Beam elevations include longitudinal rebar size, stirrup size, section marks, walls, columns.

Edit of beam elevation's rebars with the "Rebar in beam elevations" tool.



Sections

Section drawings of the structure can be automatically created by **Fespa 10**. The section drawings may be further edited by the engineer using the relevant commands of the "Section" tool.



Automatically created sections using the "Section" tool.

Connections of steel members

Di J · M B G

Design of joints

The module of Steel Connections is fully compatible with **Fespa 10**. All necessary data (member dimensions, action effects, etc) for the analysis of joints may be imported from **Fespa 10**. The results are exported in a Report accompanied by the details of every joint.

The software of steel connections may also be used independently for the calculation of the connection's resistance. The calculation is performed based on the geometric characteristics defined by the user.

The joint is assumed to be an assembly of basic components in accordance with EC3-1-8. The calculation of the connection's total resistance is based on plastic analysis of all the basic components that assemble the joint.

For every possible joint (beam-to beam, beam-to-column, etc) the optimum number of bolts, the best position of bolts, the appropriate thickness of the endplate, etc, are suggested.

Automatic functions for the dimensioning and strengthening of joints

The design engineer can modify every property that takes part in the analysis

Details of connection at any scale







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Beam-to-beam moment connection with end-plate.



Bolted or welded vertical bracing connection.





Shear connection. Beam-to-beam. Beam-to-column flange/web.

Report-Results



The results of the analysis are given in the Report, for editing or printing.



The values of the design moment resistance (MjRd), for each combination of diameter and bolt grade, are displayed in the table.

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10 - 721 - 181 (100 0.0 + 773 (100 - 208 - 398.1 - 1493.8 0.05 (0.0 + 61 - 44 (0.2 - 0.02 + 0.27 - 0.0 + 0.1 + 45 + 0.25 - 0.05 - 0.1 + 45 + 0.25 - 0.05 - 0.1 + 149.3 + 0.15 (0.0 + 137 - 0.0 + 0.1 + 0.1 + 149.3 + 0.15 (0.0 + 137 - 0.0 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.0 + 0.1 + 0.1 + 0.0 + 0.1 + 0.1 + 0.0 + 0.1 + 0.1 + 0.0 + 0.0 + 0.1 + 0.1 + 0.0 + 0.	9 -92	3 -32.8	1,00	0,0	-50.6	1,00	-14,2	-383,1	1493,9	0.13	0.01	18,9	3,0	0.07	0,01	9,46
11 Hest Sol. 100 0.00 44.8 100 100 -98.1 149.3 105 0.00 0.01 2.2 0.07 0.01 0.0	10 -72	1 -18,1	1.00	0.0	-17,3	1.00	-20,8	-383,1	1493,9	0.05	0.01	6.1	44	0.02	0.02	9,46
Izz Idda <thi< td=""><td>11 -96.</td><td>3 -35,3</td><td>1.00</td><td>0.0</td><td>-56.8</td><td>1.00</td><td>-13.0</td><td>-383,1</td><td>1493,9</td><td>0.15</td><td>0.01</td><td>21,3</td><td>2.7</td><td>0.07</td><td>0.01</td><td>9,46</td></thi<>	11 -96.	3 -35,3	1.00	0.0	-56.8	1.00	-13.0	-383,1	1493,9	0.15	0.01	21,3	2.7	0.07	0.01	9,46
SISTANCE/STIFFIESS FOR EACH_LC: RESISTANCE JULY ISS FOR ORTICAL LC: 7 INVESTIGATION FOR CRITCAL LC: 7 ROTATIONAL STFFIES ORTICAL LC: 7 c. 16. (010) 100. (010) 0 9 100. (010) 100. (010) 0 <t< th=""><th>LCULATIO</th><th>N OF CON</th><th>VECTION</th><th>è C/\Use</th><th>s\christo</th><th>sm\Des</th><th>ktop\Eng</th><th>lish Version</th><th>Prospectus</th><th>Αρχεία 1</th><th>ek\Meta</th><th>Uwó\Co</th><th>nection</th><th>F0_C1_8</th><th>12.0</th><th></th></t<>	LCULATIO	N OF CON	VECTION	è C/\Use	s\christo	sm\Des	ktop\Eng	lish Version	Prospectus	Αρχεία 1	ek\Meta	Uwó\Co	nection	F0_C1_8	12.0	
K. Mc Mc Max	ESISTANC	E/STIFFN ACH L.C.	ESS FO	R	RESIST	ANCE CRITIC/	ANALYS ALLC:	IIS FOR 7	INVEST	IGATION	FOR C	RITICAL	RC	CR	ial stif	FNESS .C:7
Levy <thlevy< th=""> Levy Levy <thl< th=""><th>.c. No</th><th>Mc</th><th>k,wc</th><th>Mb2</th><th>Mb1 (ktim)</th><th>β</th><th>Vb1</th><th>Mj,Rd (klim)</th><th>Vj,Rd</th><th>mj</th><th>vj</th><th>OW (NDa)</th><th>TW</th><th>gw/</th><th>TW/</th><th>Sj,ini</th></thl<></thlevy<>	.c. No	Mc	k,wc	Mb2	Mb1 (ktim)	β	Vb1	Mj,Rd (klim)	Vj,Rd	mj	vj	OW (NDa)	TW	gw/	TW/	Sj,ini
4 755 493 100 00 422 100 497 -303 1453 006 00 422 0 407 -303 1453 005 00 422 00 407 -303 1453 010 422 407 401 423 401 401 403 401 403 401 403 401 403 401 403 401 403 401	3 .114	2 .37.7	1.00	0.0	-50.3	1.00	22.8	-383.1	1493.9	013	0.02	185	48	0.06	0.02	9.46
5 43.5 -33.6 1,00 0.0 -61.4 1,00 -14.0 -340.1 1433.9 0.13 0.01 10.3 2.8 0.07 0.01 -0.1 6 -77.7 177.5 10.0 0.7 -68.8 10.0 -303.1 1433.9 0.0 0.0 5.3 4.4 0.02 0.0 -0.0 5.9 4.4 0.02 0.0 0.0 0.0 5.4 0.02 0.0	4 -75	5 -19.8	1.00	0.0	-22.7	1.00	-19.7	-383.1	1493.9	0.06	0.01	82	41	0.03	0.02	9.46
5 -7.7 1.00 0.0 -16.8 100 -20.5 -30.3 145.3 0.04 0.01 5.9 4.4 0.02 0.27 7 7.53 5.55 1.00 0.01 42.5 -303.1 1453.3 0.04 0.01 5.7 4.0 0.02 0.27 7 7.50 7.55 1.00 0.0 47.4 1.00 42.5 -303.1 1453.3 0.01 0.1 2.7 0.07 0.01 5.7 7 7.50 7.50 1.00 0.0 47.5 1.00 41.53 1.00 1.05 0.01 6.0 8.5 4.1 0.01 0.01 5.00 0.01 5.00 1.01 0.01 1.03 0.02 0.01 <td< td=""><td>5 -93</td><td>5 -33.6</td><td>1.00</td><td>0.0</td><td>-51.4</td><td>1.00</td><td>-14.0</td><td>-383.1</td><td>1493.9</td><td>0.13</td><td>0.01</td><td>19.3</td><td>2.9</td><td>0.07</td><td>0.01</td><td>9.46</td></td<>	5 -93	5 -33.6	1.00	0.0	-51.4	1.00	-14.0	-383.1	1493.9	0.13	0.01	19.3	2.9	0.07	0.01	9.46
7 97.3 95.8 100 0.0 97.4 100 12.9 930.1 1433.9 0,15 0.01 21.6 27 0,07 0.01 9.0 8 76.0 90.5 100 90.2 300.1 1403.9 100.5 00.0 8.7 10.0 9.0	6 -71,	7 -17,6	1,00	0,0	-16,8	1,00	-20,9	-383,1	1493,9	0,04	0,01	5,9	44	0.02	0.02	9,46
8 76.0 70.5 1.00 0.0 72.5 1.00 0.0 73.5 738.1 1493.9 0.60 0.01 8.5 41 0.03 0.2 9. 9 -72.5 1.00 0.0 -56.6 1.00 1.42 -380.1 1493.9 0.01 0.01 8.0 0.07 0.01 9. 9 -72.1 1.48 1.00 0.0 -56.8 1.00 1.42 -380.1 1493.9 0.05 0.01 1.05 3.0 0.07 0.01 9. 9 -72.1 1.48 1.00 0.0 -50.6 1.08 -148.3 0.05 0.05 6.1 4.0 0.02 0.22 9.	7 -97,	3 -35.8	1.00	0,0	-57,4	1,00	-12,9	-383,1	1493,9	0,15	0,01	21,6	2,7	0,07	0,01	9,46
9 -52.9 -32.8 1.00 0.0 -50.6 1.00 -142 -383.1 1493.9 0.13 0.01 18.9 3.0 0.07 0.01 9./ 10 -72.1 -18.1 1.00 0.0 -17.3 1.00 -20.8 -383.1 1493.9 0.05 0.01 6.1 4.4 0.02 0.02 9./	8 -76.	J -20.5	1,00	0,0	-23.5	1,00	-19,6	-383,1	1493,9	0.06	0.01	8.5	41	0.03	0.02	9,46
10 -72.1 -18.1 1.00 0.0 -17.3 1.00 -20.8 -383,1 1493,9 0.05 0.01 6.1 4.4 0.02 0.02 9.4	9 -92	3 -32.8	1,00	0.0	-50.6	1,00	-14.2	-383,1	1493,9	0.13	0.01	18,9	3.0	0.07	0.01	9,46
	10 •72.	1 -18.1	1.00	0.0	-17,3	1.00	-20,8	-383,1	1493,9	0.05	0.01	6.1	44	0.02	0.02	9,46
11 -96.9 -35.3 1.00 0.0 -56.8 1.00 -13.0 -303.1 1493.9 0.15 0.01 21.3 2.7 0.07 0.01 9.4	11 -96.	3 -35.3	1.00	0,0	-56.8	1.00	-13.0	-383,1	1493,9	0.15	0.01	21,3	27	0.07	0.01	9,46
11 -96.9 -35.3 1.00 0.0 -56.8 1.00 -13.0 -383.1 1493.9 0.15 0.01 21.3 2.7 0.07 0.01	7 -97, 8 -76, 9 -92, 10 -72, 11 -96,	3 -35,8 3 -20,5 3 -32,8 1 -18,1 9 -35,3	1,00 1,00 1,00 1,00 1,00	0,0 0,0 0,0 0,0 0,0	-57.4 -23.5 -50.6 -17.3 -56.8	1,00 1,00 1,00 1,00 1,00	-12.9 -19.6 -14.2 -20.8 -13.0	-383,1 -383,1 -383,1 -383,1 -383,1 -383,1	1493,9 1493,9 1493,9 1493,9 1493,9 1493,9	0,15 0.06 0.13 0.05 0.15	0.01 0.01 0.01 0.01 0.01	21,6 8.5 18.9 6.1 21,3	2.7 4.1 3.0 4.4 2.7	0,07 0.03 0.07 0.02 0.07	0.01 0.02 0.01 0.02 0.02 0.01	



Resistance of the joint for each load case

Actions, resistances of the joint and ratios of bond strength are displayed for each load case. The load case with the critical (highest) value of bond strength ratio is marked with bold font.

Resistance analysis (for critical load case)

The program automatically calculates and displays not only the total resistance of a joint but also the individual resistances of its basic components.

Resistance investigation

All the possible values for the total resistance of bolting, for each combination of diameter and bolt grade, are displayed in a table. The user has the option to choose the method of bolting reinforcement (supplementary plate on web, backing plate at lower flange, transverse stiffeners, etc.) and its efficiency.

Rotational stiffness (for critical load case)

The rotational stiffness of a joint is determined from the flexibilities of its basic components, each represented by an elastic stiffness coefficient ki.



You write your question and it is automatically sent, with the file, at the support department.

" You name: Date Black sive and accurate answers to your questions quickly.

With the e-support tool in the menu bar of Fespa 10, you can immediately send your question and .tek file to the support department of LH Logismiki. We offer the support you need to complete your daily work.

Customer service is the cornerstone of the LH Lo-

gismiki company philosophy. Our interest in cus-

tomers does not end at the point of sales. A

gualified team of engineers will give comprehen-

e-support

9

Cad Organizer

Well organised and structured transfer of entities (e.g. columns, reinforcements). The various entities are categorised in relevant layers so as to be easily recognised and edited in programs which use AutoCAD platforms.

The entities which are common in both environments (dimensions, lines, arcs, texts of one or multiple lines) are transferred from one environment to the other intact and unaltered. Those entities are categorised in corresponding layers and can be edited by using the corresponding commands.

The more complicated entities (objects, openings, layers, slabs, columns, rebars, reinforcement details) are recognised as blocks or polylines.

What are the benefits of using CAD-Organizer?

Editing of the structural plan by using software other than Fespa 10.

After having finished the analysis process using **Fespa 10**, you can send the structural plans of the building to your co-workers who use for example AutoCAD. They can open and edit the files with AutoCAD.

Co-operation of all engineers (Architects, Civil engineers) even if they use different software.

- Phenomenal ease of use.
- Accurate implementation of Eurocodes.
- ► No additional CAD program needed.
- Precise structural plan drawings are produced.
- ► Free technical support.





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