(is) fespa indian standards

THE **RC EXPERT SOFTWARE** FOR THE ANALYSIS AND

DESIGN OF EARTHQUAKE RESISTANT STRUCTURES







1. About us

FESPA IS is specifically developed for the Indian market by LH Logismiki, with full implementation of Indian Standards IS1893, IS13920, IS456.

The company

LH Logismiki is a high performance software company that produces software suites for civil engineers and architects.

LH Logismiki's main products are Fespa: a 3d software for the analysis and design of earthquake resistant concrete structures and Tekton: a 3d architectural package.

The product

Fespa 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.

During the development of FESPA IS, the engineering staff of LH Logismiki was advised by Prof. Ioannis Psycharis, laboratory of earthquake engineering-National Technical University of Athens. Fespa covers all phases of a structural design project from the structural analysis to the production of fully integrated construction documentation and drawing sheets.

The support

Customer service is a key part of the LH Logismiki company philosophy. Its expert human resources are constantly occupied by customers' needs, queries and difficulties.

If you purchased your software through our international dealers, your dealer will provide you with techical support.

We also provide free online support through our support centre, in an easy - to - search website.

2. Data input



- 1 The basic toolbar contains tools useful for file management, printing & plotting and description/modification of the model.
- 2 The structural toolbar contains all the structural entities (column, beam, footing, etc) and the tools for editing the structural drawings.
- 3 The information bar helps the engineer to check the data of the structural member at a glance.
- The commands bar of the selected entity. It contains all the commands relevant to the selected entity.
- **5** In the prompt bar constant help guides you through the commands of Fespa.
- 6 The toolbar of auxiliary tools contains useful drafting tools (midpoint, layers, snap-points, etc).
- Explanatory images (Key) give the necessary information (shape, dimensions, symbols) for the description of the structural element in use.
- 3 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 may be defined.

The main screen of Fespa, with a typical properties window and commands bar activated.

The user interface

With Fespa the data entry is accomplished by inserting columns and walls at the snap points, defined by the guide lines. Slabs are described the same way. The insertion of beams completes the structural model.

In Fespa, the structural model is composed of various entities such as beams, columns, slabs, footings, etc. There is no limit on 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.

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

Each entity also has its own group of «Commands». They are used for inserting and editing entities. In the prompt bar, constant help guides you through the commands of Fespa. Fespa IS is specially developed for the analysis and design of earthquake resistant structures.

All the necessary data is inserted during the geometry description, in plan view. Fespa IS automatically builds the 3D model with all the information required (i.e. continuity of beams and columns) to perform the earthquake analysis by just clicking on the «Analysis and Design» command.

No additional data needs to be given at intermediate stages.



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

A few highlights:

- •Automatic calculation of beams' rigid offset length and geometry.
- Automatic calculation of capacity design of beams and columns in shear
- Automatic generation of seismic combinations according to the user's preferences.
- Soft storey checks according to Indian Standards.
- Automatic calculation of seismic storey drift and displacement.

Various loading conditions can be applied to the entities through the

relevant tab in the properties window and the special loading commands.

Guide 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.

The «multiple choices» command is available and gives the option to choose among nodes or members that have the same position on plan but different heights in 3D.

"Ready structural plans, column details, beam elevations from the very beginning! "



Insertion and modification of inclined beams with the «multiple choices» command.

Video - Fespa IS - Introductory video: http://youtu.be/Ca5T2BORMLo

Active grid tool/ automatic assignment of location to all members

Fespa IS is equipped with an intelligent, user friendly, active grid tool that assigns automatically to the structural elements (beams, columns and footings) their location name within the project at both plan and elevation view.

[•]Describe one floor and generate the rest. "

Generating tools

Generating tools facilitate the description of the structural model. Describe one floor and then automatically 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 any complex 3D structure possible. Use this tool and easily describe complex geometries such as domes, barrel vaults and irregularly shaped models.





Grid lines – Location applied to entities.



Beam 8(0) elevation - Automatic assignment of location names



Generation of structural models in both the horizontal and vertical plane, by using the "Move" command of the "Edit" tool.

3. Modelling and data verification

After the completion of the data input, Fespa IS automatically generates:

- The computational and the loading model.
- The earthquake loading according to the local design spectrum.
- Loading combinations which are presented in the data tables.

The accurate modelling is aided by the use of rigid offsets in 3D, rigid girders, elements on elastic foundation.

The 3DV tool helps with the data verification. It can display 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.

"Auto - detection of rigid offsets & shear walls simulation "





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.



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.

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Elastic length	1 of beam, $z < 1$
Usual value	$z_i, z_i = 0.50$

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$$J_i = f\left(\frac{L_i}{L_n}, J_n\right) = t \cdot J_n$$

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4. Analysis

Fespa IS offers linear structural and dynamic analysis. All the analysis procedures are performed through a very powerful, fast and accurate algorithm. The speed of calculation is phenomenal.

The 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.

Fespa IS is characterised by its user friendliness and efficiency.







3 dimensional wired frame view (3DV) of the structural model. Animation of the various mode shapes of the modal analysis.





Moment diagrams of beams and columns



Footings structural plan.



After the analysis procedure is completed, 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.

Soil - Structure interaction

Elements on elastic subsoil

Fespa IS performs the analysis and design of buildings taking into account the soil-structure interaction. The 3d model is equipped with a special element which represents the footings supported on elastic subsoil. This is of great importance for the correct distribution of seismic forces within the structure.

"Accurate geometry description of even the most complicated structural models is really simple with Fespa IS. "

5. Design

Fespa IS implements the Indian Standards:

IS1893
IS13920
IS 456

The design engineer has in his hands the best tool for designing earthquake resistant structures provided in areas of medium or high seismicity. All structural members are designed 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. Fespa IS 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 and footing) is highlighted on the screen.



Define material properties, define bar diameters to be used during the design.

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



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

Slabs

Analysis and design according to Pieper - Martens method and auto generation of reinforcment drawings.

The analysis and design of all slab types is done according to the Pieper-Martens method and all the loading is automatically transfered to the beams. The results report and structural drawings are automatically produced. No need for time consuming FE calculations.





"Fespa IS covers all phases of a structural design project from the structural analysis to the production of a fully integrated construction documentation and series of drawings. "



Interaction diagrams for the combination of static and seismic loads.

This method of slab calculation offers to the program all the necessary data for the automtic calculation of effective width of beams' flange bf according to IS456 considering explicitly the beam length and the dimensions of the adjacent slabs.

Beams

Different beam types are available for the best simulation of the structural model.

Each beam type has its own structural characteristics and is subjected to different checks, during the analysis and design, according to the applied Standards. The several available beam types help defining the structural model with accuracy.

Columns

Precise design of columns under biaxial bending and axial force.

- Dynamic analysis method addresses seismic actions on buildings realistically. However, special treatment for the derived results used for design has to be considered, as the three maximum component forces M1, M2, N are not applied simultaneously to columns.
- Fespa IS implements the Gupta method (i.e. the "probable simultaneous values" method of action effects) instead of the standard quadratic superposition, leading to economy in the calculated reinforcement.

Links

Video - Modeling and design of beams in Fespa: http://youtu.be/oMlIJJwga24

6. Output presentation - Drawings

Fespa IS covers all phases of a structural design project from the structural analysis to the production of a fully integrated construction documentation and series of drawings. After the completion of all calculations structural drawings for each floor are automatically created. Automatic and consistent column and beam details are also derived.

The program produces a very comprehensive report specially designed to facilitate cross-checking from the reviewers. It is well organized, conservative on paper consumption and can deliver detailed output for any beam, column, footing etc chosen.

Report

With the «Report» program, the design engineer can **edit the document according to his 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.
- 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.



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



The results in the Report can be edited by the design engineer.



Links Video - Navigating the user interface of Report software - Part 1/2: http://youtu.be/3Ea6PM1ngps

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218,14 95,97 940,60 208,/1 J	the set		richers Ka East
	25.45		10104
Quantities of steel reinforcement and concrete	25,45 01,36		
Surface of formwork [m/] 648,20 Weight of reinforcement	25,45 00,36		
nemovec (m ⁻² 0,00 Volume of concyde	25.45	[Kg]	77

Bill of quantities for the building.

MminY BrninZ MaY HaZ [kNm] [kNm] [kNm] [kNm]



Equilibrium of ultimate forces

 $N_{des} = \sum \alpha_{c} dA + \sum \alpha_{u} A = (-536, 15kN) + (87, 68kN) = -448, 47kN$

 $M_{datar} = \sum_{\sigma_i : z} dA + \sum_{\sigma_i : z_i : A_i} = (71,35kNm) + (75,43kNm) = 146,78kNm$

 $M_{dm2} = \sum \sigma_c \gamma dA + \sum \sigma_u \gamma A_i = (37,31kNm) + (35,32kNm) = 72,63kNm$ Capacity ratio

 $C.R. = \frac{\sqrt{N_{den}^2 + M_{den}^2 + M_{den}^2}}{\sqrt{N_e^2 + M_{den}^2 + M_{den}^2}} = \frac{\sqrt{(-448,47)^2 + (146,78)^2 + (72,63)^2}}{\sqrt{(r174,89)^2 + (58,14)^2 + (28,75)^2}} = \frac{477,44}{186,53} = 2,52$

Detailed output for column / Compression Zone / N vs M interaction diagram.



Reinforcement arrangements for columns per floor.

Detailed output for footings / punching section / ground pressure /eccentricities.

Earthquake analysis

No	Level	Storey mass	Seismic weight	Total W at and above the storey	
	(m)	[106]	W [kN]	Total W [kN]	
4	12.00	0.268E+03	0.2628=04	0.2628+04	
3	9.00	0.4338+03	0.4248=04	0.6878+04	
2	6.00	0.433E+03	0.4248+04	0.111E+05	
1 thinks	3.00	0.433E+03	0.424E+04	0.154E+05	

Acte: The se mic weight and mass of the building is derived according to 151893 §7.4

is is performed acc. to 251893 \$7.8.4

Analysis method

 $\begin{array}{l} Response \ spectrum \ diagram \ (I51893 \ \S6.4) - \ Fundamental \ natural \ period \ (\S7.6) \\ T_{ar} = \frac{0.09 \cdot h}{\sqrt{d}} = \frac{0.09 \cdot 12.00m}{\sqrt{2}23.75m} = 0.222s \ , \ T_{ar} = \frac{0.09 \cdot h}{\sqrt{d}} = \frac{0.09 \cdot 12.00m}{\sqrt{13.75m}} = 0.291s \end{array}$



Response spectrum diagram.





The column details, on the right hand side window, belong to the building appearing on the left hand side window.



Beam elevations for the beams of an entire floor.

Links

Video - Navigating the documented results of Fespa IS, in the Report - Part 2/2: http://youtu.be/u0PpbeNezIQ

Drawings

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

Dimensions may be added and calculated automatically. The Dimensions style (text and arrow heads) can be modified accordinf to the user's preferences.

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

Column Details

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

Beam Elevations

After the analysis, by selecting the desired beam, the add-on module «Beam elevations» automatically creates a file with the corresponding beam elevation. Beam elevations include longitudinal rebar size, stirrup size, section marks, walls, columns. The design engineer has the option to edit the details (change rebar diameters, the stirrup type, etc) then save and print them.

Sections & 3D solid view

Section drawings of the structure can be automatically created by Fespa IS. The section drawings may be further edited by the engineer using the relevant commands of the «Section» tool.



7. Interoperability with all CAD software

Fespa IS supports

DXF CAD format.

Plans can be easily imported/exported from and to other CAD systems.

CAD Organizer

CAD Organizer is the Fespa IS tool which offers interoperability with all CAD software, facilitating the exchange of information between specialists throughout the whole design process of a project. Interdisciplinary collaboration is achieved with smart, model-based workflows between the various disciplines, and therefore coordination errors can be reduced practically to a minimum during the succession of phases.

8. Support

Customer secvice is the cornerstone of the LH Logismiki company philosophy. We provide telephone, fax and e-mail support for all our customers.

If you purchased your software through our international dealers, please contact them with your technical questions.

We also provide free support through our support centre, available on the internet in an easy-to-search website.

- Learn from Fespa IS books, user's guides and examples.
- Watch videos.
- Search the tutorials to find usefull tips and answers to common questions.



The various entities are categorised in relevant layers so as to be easily recognised and edited in programs which use CAD 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. The more complicated entities (slabs, columns, rebars, etc) are exported as blocks or polylines.





"Benefit the most from our integrated knowledge base!,,



Links Video - CAD Organizer Interoperability with all CAD software: http://youtu.be/h4rfH4Yi6ZQ Book - Verification examples: http://www.lhlogismiki.gr/en/book/verification-examples/ Support - Visit our support centre: http://www.lhlogismiki.gr/en/support/support-centre/

9. Complement Fespa IS with Tekton Architectural software





One common workspace environment for both the architectural and structural design of buildings.



One common workspace environment for both the architectural and the structural design of buildings,

How Tekton complements Fespa IS?

You use one and only software for both the architectural and structural project. Having on your disposal all the appropriate tools, on one and only screen, you can start with the architectural design, continue with the structural model, the analysis and design of the structure and finish with the automatically produced, accurate architectural and structural drawings.

Tekton can work either as a stand alone program or together with Fespa IS in one common workspace environment.

Tekton is a 2D and 3D architectural drawing software, an indispensable tool, covering the needs of every architect and designer. It is equipped with easy to use real time 3D presentation and rendering tools that highlights your work from the initial phase of conseptualising to the last construction detail.

Links Video Tekton - 3D modeling of single storey house with mezzanine: http://youtu.be/HINRsHJqc3M See more about Tekton software: http://www.lhlogismiki.gr/en/products/architectural/tekton/



LOGISMIKI HIGH PERFORMANCE SOFTWARE

Developer: LH Logismiki

A: 23 Stournari street, Eksarhia, 10682, Athens, Greece.

E: lh@lhlogismiki.gr

W: www.lhlogismiki.gr



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Int. Dealer: Ram Caddsys Pvt Ltd

A: No:10 (Old No:8), 50th Street, 7th Avenue, Ashok Nagar, Chennai, India. Zip: 600 083.

E: info@ramcadds.in

T: +91 44 2474 3955 +91 44 2474 3966 +91 44 2371 7641

F: +91 44 2489 6097

W: www.ramcadds.in

