SCADA Pro™
Structural Analysis & Design

Example 6
Building Valuation and Redesign Study
3rd revision EIA 2022

ACE HELLAS
INTEGRATED SOLUTIONS

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

CONTENTS

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

FOREWORD

The analysis methodologies used to evaluate or redesign existing reinforced concrete structures for seismic loads are elastic analyses, static or dynamic, and inelastic analyses (i.e. non-linear due to material), also static or dynamic.
The elastic methods adopt the classical linear stress-strain relationship for the structural elements of the structure, where in approximate ways (e.g. using global or local indices of behaviour or ductility) they indirectly take into account the inelastic behaviour of the structure. These methodologies are simpler to apply, but may lead to less accurate results than their inelastic counterparts.
On the contrary, inelastic analysis methodologies help to better monitor and understand the actual response of the structures, demonstrating both the failure mechanisms and the potential for progressive collapse (it is therefore possible to control the deformations of the ends of the members, the overstrength reserves, as well as the way in which the plastic behaviour of the structure is triggered. In this way, inelastic analyses lead to a more rational and safer design. Inelastic dynamic analysis (i.e., time history analysis with direct numerical integration of nonlinear differential equations of motion) is the most complete and realistic methodology for the analysis of structures.
In the inelastic dynamic analysis the seismic action is introduced in the form of a history of base accelerations, either from actual recordings or from synthetic accelerograms. However, this analysis encounters problems in simulating the meteoric recurrent behaviour of the members of the structure, which is currently under scientific investigation and experimental verification. In addition, there is also the issue of appropriate selection of seismic accelerations, where the above analysis method is particularly sensitive.
Therefore, the design engineer conducting the assessment or redesign study of an existing structure using inelastic dynamic analysis should have considerable critical ability and experience. Thus, combined with its increased computational complexity, and the fact that the required analysis time even with modern computers is particularly high, especially in spatial analyses of high-rise buildings (note that because the analysis is non-linear, the principle of superposition does not apply), inelastic dynamic analysis is not considered practical for general use.
In contrast, the **static inelastic analysis** gives results that lie between the elastic methods and the inelastic dynamic method. It should be noted that, in the case where the externally applied load is horizontal seismic loads, the inelastic static analysis is also known as pushover analysis. Thus, although Pushover analysis does not have the accuracy of inelastic dynamics, since the seismic loads (which are dynamic) are taken into account approximately as static, it nevertheless leads to a significantly more accurate estimation of the response of the structure than elastic methods, and its application is much simpler than the corresponding inelastic dynamics.
It should be noted that inelastic static analysis is not a new methodology. However, in recent decades, extensive research has led to the development of simulations that allow the behaviour of reinforced concrete structural members after their theoretical failure to be estimated with reasonable accuracy, with the aid of appropriate

relationships (analytical or empirical) or tables. This is the reason why in recent years inelastic static analysis has been widely applied in the evaluation or redesign of existing buildings.

BASIC PRINCIPLES OF VALUATION AND REDESIGN IN ACCORDANCE WITH EIA (3h revision of the EIA 2022)

The Interventions Regulation KAN.EPE) aims to establish criteria for the assessment of the load-bearing capacity of existing structures and application rules for their seismic redesign, as well as for possible interventions, repairs or reinforcements.
Structures are mainly buildings with a load-bearing structure made of reinforced concrete (with or without damage).

It contains provisions of mandatory application, which specify:
α. The criteria for assessing the load-bearing capacity of an existing structure.
β. The minimum mandatory load-bearing capacity requirements for redesigned structures or their members.
c. Determining the ways in which intervention can be carried out.
δ. The correlation of this Regulation with other Regulations (materials, loadings, etc.).

VALUATION OF EXISTING STRUCTURES (§2.1 OF THE CODE OF PRACTICE)

The term '**assessment**' **of** an existing structure means the assessment of its available load-bearing capacity and the verification of compliance with the minimum mandatory requirements imposed by the regulations.
The assessment process leads to a decision on whether or not to intervene, and involves the following three stages:

- Data collection (research of the history of the structure)
- Analysis (of the structure as it is)
- Limit state control.

The valuation process varies depending on the existence or not of damage to the building to be valued.

REDESIGN (§2.4 OF THE ANNUITY SCHEME)

If a decision to intervene is taken, the "**redesign**" phase follows, consisting of the formulation and testing of one or more alternative intervention schemes that restore or enhance the load-bearing capacity of the structure.

As in valuation, there are three stages in the redesign process:

- Conception and preliminary design of the intervention scheme
- Analysis of the structure as it is intended to be developed
- Limit state control.

VALUATION AND REDESIGN OBJECTIVES (§2.2 OF THE REGULATION)

The whole philosophy of assessment and redesign is based on the so-called Performance Based Design, which is composed of a set of rules and criteria aimed at designing structures with predefined behaviour for a given level of seismic excitation.

By combining a Performance Level on the one hand and a Seismic Excitation Level on the other hand, a Design Objective (Assessment or Redesign) is obtained.

Performance levels §2.2.1

In order to serve wider socio-economic needs, various levels of performance (i.e. targeted behaviours) are established in the KANEPE, which relate exclusively to the supporting structure of the structure under consideration. In particular, the following three performance levels are defined according to the degree of damage:

α. "Limited damage" (A) : The building structure is only slightly damaged, with the structural elements not having suffered significant leakage and retaining their strength and stiffness. The permanent relative floor movements are negligible.
β. 'Significant damage' (B): the building structure has suffered significant and extensive but repairable damage, while the structural elements have residual strength and stiffness and are capable of supporting the intended vertical loads. Permanent relative floor displacements are moderate. The load-bearing structure can withstand moderate aftershocks.
c. 'Quasi-collapse' (C): the building's load-bearing structure has suffered extensive and serious or severe (mostly irreparable) damage. The permanent relative floor displacements are large. The load-bearing structure is still capable of supporting the intended vertical loads (during and for a period after the earthquake), but without any other substantial safety margin against total or partial collapse, even for moderate aftershocks.

Correlation between return period and probability of exceeding the seismic action §2.2.1 (3^{h} revision of the 2022 EIS)

The seismic excitation levels (i.e. the severity of the design earthquake) are defined based on the probability of exceeding a certain value of ground acceleration (depending on the seismic hazard of the area) in a certain period of time corresponding to the lifetime of the structure.

A nominal technical lifetime equal to the conventional lifetime of 50 years is generally accepted, irrespective of the presumed 'actual' remaining lifetime of the building.

In Table S 2.1, an indicative correlation of the return period and the corresponding probability of exceeding within the conventional 50-year lifetime of the seismic action with the corresponding reduced horizontal ground acceleration is presented.

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Πίνακας Σ 2.1. Ενδεικτική συσχέτιση περιόδου επαναφοράς και πιθανότητας υπέρβασης της σεισμικής δράσης με την αντίστοιχη ανηγμένη οριζόντια εδαφική επιτάχυνση.

Περίοδος Επαναφοράς (έτη)	Πιθανότητα υπέρβασης σεισμικής δράσης εντός του συμβατικού χρόνου ζωής των 50 ετών	$\alpha_g / \alpha_{g,ref}$
2475	2%	1.80
975	5%	1.30
475	**10%**	**1.00**
225	20%	0.75
135	**30%**	**0.60**
70	50%	0.45
40	70%	0.35
20	90%	0.25
<20	>90%	<0.25

Assessment and redesign objectives §2.2

The assessment or redesign objectives (Fig. 2.1) are combinations of a Performance Level on the one hand and a Seismic Action on the other hand, given a "tolerable probability of exceedance during the technical lifetime of the building" (design earthquake).

In the EIA CIP, reinspection targets are provided for, referring only to the load-bearing structure and wall fillings.

The choice of a specific valuation or redesign target implies the use of appropriately modified q or m indices, or tolerable deformations δd, the values of which are specified in Chap. 4 and 9.

It should be noted that the objectives of evaluation and redesign are not necessarily the same. Redesign targets may be higher than valuation targets.

Table 2.1 shows the correlation between the performance level of the load-bearing structure and the corresponding reduced horizontal ground acceleration.

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Πίνακας 2.1. Στόχοι αποτίμησης ή ανασχεδιασμού Φέροντος Οργανισμού.

$\alpha_g / \alpha_{g,ref}$	Στάθμη Επιτελεστικότητας Φέροντος Οργανισμού		
	Α «Περιορισμένες Βλάβες»	Β «Σημαντικές Βλάβες»	Γ «Οιονεί Κατάρρευση»
1.80	**A0**	**B0**	**Γ0**
1.30	**A1+**	**B1+**	**Γ1+**
1.00	**A1**	**B1**	**Γ1**
0.75	**A2+**	**B2+**	**Γ2+**
0.60	**A2**	**B2**	**Γ2**
0.45	**A3+**	**B3+**	**Γ3+**
0.35	**A3**	**B3**	**Γ3**
0.25	**A4+**	**B4+**	**Γ4+**
<0.25	**A4**	**B4**	**Γ4**

- αg,ref is the horizontal ground acceleration reference, defined with a 10% probability of exceeding the seismic action in the 50 years of the conventional life of the project.
- αg is the horizontal ground acceleration.

Indicatively, for new structures, a design objective B1 is provided according to Pin.
2.1.

Adopting a valuation or redesign target with a probability of exceeding the seismic action greater than 10% generally results in more frequent, more extensive and more severe damage compared to a corresponding target with a probability of exceeding the seismic action of 10%, while when the probability of exceeding the seismic action is less than 10%, generally less frequent and less damage is expected.
The probability of overrun:

- 30% in 50 years corresponds to an average recovery period of about 135 years,
- 10% in 50 years corresponds to an average recovery period of about 475 years.

The choice of a specific valuation or redesign target implies the use of appropriately modified q or m indices, or tolerable deformations δd, the values of which are specified in Chap. 4 and 9.

In the previous revision of the Regulations, Appendix 2.1 was added, which includes the minimum acceptable targets for the assessment or redesign of an existing building.
The Minimum Wind Assessment Targets provided in §2.2 in relation to the Performance Level of the load-bearing structure and the probability of exceeding the Seismic Action within the contractual life of 50 years, are defined according to the importance category of the building as follows:

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Πίνακας ΠΑ.2.1. *Ελάχιστοι ανεκτοί στόχοι αποτίμησης ή ανασχεδιασμού υφισταμένων κτιρίων.*

Κατηγορία Σπουδαιότητας	Ελάχιστοι Ανεκτοί Στόχοι
I	Γ2
II	Γ1
III	Β1
IV	Β1 και Α2 (Ικανοποίηση **και** των δύο στόχων)

Σε κάθε περίπτωση να θεωρηθεί ότι ισχύει Α1>Α2, Β1>Β2, Γ1>Γ2, Α1>Β1>Γ1 και Α2>Β2>Γ2

The four categories of importance are defined according to Annex 2.1 of the EIA and buildings are distinguished into
(I) buildings of minor importance in terms of public safety, (II) in ordinary buildings,
(III) buildings housing establishments of very high economic importance and public assembly buildings; and
(IV) in buildings whose function is vital during and after the earthquake.

Investigation, documentation of the load-bearing structure of an existing structure §3

Prior to the preparation of any valuation or redesign study, it is necessary to investigate and document the existing structure to a sufficient extent and depth in order to make the data on which the valuation or redesign study will be based as reliable as possible.

This requires

- the recording of the structure and its condition,
- the compilation of the history of the construction and its maintenance,
- the recording of any damage or deterioration, and
- the performance of on-site exploratory work and measurements.

§3.1 Damage and deterioration are recorded regardless of whether they are caused by earthquake or other actions (fire, environmental actions, etc.).
Depending on the intensity and extent of the damage or deterioration, and as far as the usability of the building is concerned, the following cases are mentioned:

i. No or minor damage : The building can be used without restrictions.

ii. Severe damage : The ability to use the building should be severely restricted until a more accurate and final assessment of the situation is made. The possibility of safety measures and shoring or bracing should also be considered.

iii. Severe damage, with or without collapse : Access to the building and access to the surrounding area should be prohibited. Parts likely to collapse suddenly should be demolished immediately and immediate intervention measures should be considered (see § 3.4.e).

Inspection procedures, checklists and other data collection procedures will follow professional or public agency specifications and should be compatible with the means available for inspection, investigation and repair/reinforcement measures.

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However, it may be difficult to always collect such detailed information. In such cases, uncertainties can be addressed by introducing the concept of

"**data reliability level**" (see § 3.7).

There are three **Categories of Data Reliability Level** S.A.D. §3.6.2:

- "High."
- "Satisfactory"
- "Windy"

The 3th revision of the EIA brings changes that also have to do with the Data Reliability Levels.
To be more precise, and until now there were individual SDSs. More specifically
there was:

- Material SDS that affected the Resistances (Strengths). It is distinguished into SADIS (Concrete) and SADYX (Steel). In the program there was in the definition of material strength in the dimensioning.
- Geometric data of the structure based on the following table. The table that existed until now and is related to geometry and reinforcements. The geometric data
  affect the actions. In the program, it is the option in the analysis scenario and affects the coefficient of permanent loads γg.

ΠΙΝΑΚΑΣ 3.2: ΣΤΑΘΜΗ ΑΞΙΟΠΙΣΤΙΑΣ ΓΕΩΜΕΤΡΙΚΩΝ ΔΕΔΟΜΕΝΩΝ

ΣΧΕΔΙΑ ΑΡΧΙΚΗΣ ΜΕΛΕΤΗΣ			ΠΡΟΕΛΕΥΣΗ ΔΕΔΟΜΕΝΟΥ	ΠΑΡΑΤΗΡΗΣΕΙΣ	ΔΕΔΟΜΕΝΑ								
					ΕΙΔΟΣ ΚΑΙ ΓΕΩΜΕΤΡΙΑ ΦΟΡΕΑ ΘΕΜΕΛΙΩΣΗΣ Ή ΑΝΩΔΟΜΗΣ			ΠΑΧΗ, ΒΑΡΗ κ.λπ. ΤΟΙΧΟΠΛΗΡΩΣΕΩΝ, ΕΠΙΣΤΡΩΣΕΩΝ, ΕΠΕΝΔΥΣΕΩΝ κ.λπ.			ΔΙΑΤΑΞΗ ΚΑΙ ΛΕΠΤΟΜΕΡΕΙΕΣ ΟΠΛΙΣΗΣ		
ΥΠΗΡΧΟΥΝ	ΔΕΝ ΥΠΗΡΧΟΥΝ				Ανεκτή	Ικανοποιητική	Υψηλή	Ανεκτή	Ικανοποιητική	Υψηλή	Ανεκτή	Ικανοποιητική	Υψηλή
√		1	Δεδομένα που προέρχεται από σχέδια της αρχικής μελέτης ή αυτά έχει αποδεδειγμένα εφαρμοστεί χωρίς τροποποιήσεις	(1)			√			√			√
√		2	Δεδομένα που προέρχεται από σχέδια της αρχικής μελέτης ή αυτά έχει εφαρμοστεί με λίγες τροποποιήσεις	(2)			√			√		√	
√		3	Δεδομένα που προέρχεται από αναφορά (π.χ. υπόμνημα σε σχέδια της αρχικής μελέτης)	(3)	√			√			√		
	√	4	Δεδομένα που έχει διαπιστωθεί ή/και μετρηθεί ή/και αποτυπωθεί αξιόπιστα	(4)		√			√			√	
	√	5	Δεδομένα που έχει προσδιοριστεί με έμμεσον αλλά εμπρός αξιόπιστον τρόπο	(5)	√	√		√	√		√	√	
	√	6	Δεδομένα που έχει εκ/γως θεωρηθεί κατά την κρουή Μηχανικού	(6)	√	√		√	√		√	√	

With the 3h revision of the EIA CIP
The corresponding table in Revision 3a concerning the geometry and layout and armament details

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Πίνακας 3.2 ΕΠΙΛΟΓΗ ΣΑΔr ΚΑΙ ΣΑΔΔ

ΣΧΕΔΙΑ ΑΡΧΙΚΗΣ ΜΕΛΕΤΗΣ		ΠΡΟΕΛΕΥΣΗ ΔΕΔΟΜΕΝΟΥ		ΠΑΡΑΤΗΡΗΣΕΙΣ	ΔΕΔΟΜΕΝΑ								
					ΣΑΔr (= η δυσμενέστερη μεταξύ των **ΣΑΔr1** & **ΣΑΔr2**)						**ΣΑΔΔ**		
					ΕΙΔΟΣ ΚΑΙ ΓΕΩΜΕΤΡΙΑ ΦΟΡΕΑ ΘΕΜΕΛΙΩΣΗΣ ή ΑΝΩΔΟΜΗΣ (**ΣΑΔr1**)			ΠΑΧΗ, ΒΑΡΗ κ.λπ. ΤΟΙΧΟΠΛΗΡΩΣΕΩΝ, ΕΠΙΣΤΡΩΣΕΩΝ, ΕΠΕΝΔΥΣΕΩΝ κ.λπ. (**ΣΑΔr2**)			ΔΙΑΤΑΞΗ ΚΑΙ ΛΕΠΤΟΜΕΡΕΙΕΣ ΟΠΛΙΣΗΣ		
ΥΠΑΡΧΟΥΝ	ΔΕΝ ΥΠΑΡΧΟΥΝ				Ανεκτή	Ικανοποιητική	Υψηλή	Ανεκτή	Ικανοποιητική	Υψηλή	Ανεκτή	Ικανοποιητική	Υψηλή
✓		1	Δεδομένο που προέρχεται από σχέδιο της αρχικής μελέτης η οποία έχει ολοκληρωθεί εφαρμοστεί χωρίς τροποποιήσεις	(1)			✓			✓			✓
✓		2	Δεδομένο που προέρχεται από σχέδιο της αρχικής μελέτης η οποία έχει εφαρμοστεί με λίγες τροποποιήσεις	(2)			✓			✓		✓	✓
✓		3	Δεδομένο που προέρχεται από αναφορά (π.χ. απάντημα σε σχέδιο της αρχικής μελέτης)	(3)	✓			✓			✓		
	✓	4	Δεδομένο που έχει διαπιστωθεί ή/και μετρηθεί ή/και αποτιμηθεί αξιόπιστα	(4)		✓	✓		✓	✓		✓	✓
	✓	5	Δεδομένο που έχει προσδιοριστεί με άμεσον αλλά επαρκώς αξιόπιστον τρόπο	(5)	✓	✓		✓	✓		✓	✓	
	✓	6	Δεδομένο που έχει εκτιμηθεί κατά την κρίση μηχανικού	(6)	✓	✓		✓	✓		✓	✓	

- The SDS relating to geometry was named SDG with two subcategories SDG1 and SDG2 and the SDS relating to the layout and reinforcement clamping details was named SDL.
- Until now, only the material's SWD was taken into account for the determination of strengths.
  In the new revision for the determination of the strength of steel in terms of forces
  very logically, the SADL is also taken into account.

Thus the coefficients affecting the strengths of the materials are as follows:

ΠΙΝΑΚΑΣ Π 4.1 : ΤΙΜΕΣ ΙΔΙΟΤΗΤΩΝ ΤΩΝ ΥΛΙΚΩΝ (που διαμορφώνουν τις αντιστάσεις) ΚΑΙ ΑΝΤΙΣΤΟΙΧΟΙ ΕΠΙΜΕΡΟΥΣ ΣΥΝΤΕΛΕΣΤΕΣ ΑΣΦΑΛΕΙΑΣ γ'_m

	ΜΕΘΟΔΟΣ ΕΛΕΓΧΟΥ [1]					
	ΣΕ ΟΡΟΥΣ ΔΥΝΑΜΕΩΝ [2]			ΣΕ ΟΡΟΥΣ ΠΑΡΑΜΟΡΦΩΣΕΩΝ [3]		
	ΥΦΙΣΤΑΜΕΝΑ ΥΛΙΚΑ [4]	ΠΡΟΣΤΙΘΕΜΕΝΑ ΚΑΝΟΝΙΣΜΟΙ		ΥΦΙΣΤΑΜΕΝΑ ΥΛΙΚΑ	ΠΡΟΣΤΙΘΕΜΕΝΑ ΚΑΝΟΝΙΣΜΟΙ	
		Ναι	Όχι		Ναι	Όχι
Αντιπροσωπευτικές τιμές [5]	X – s	X_k	X_k	X	X	X
Επιμέρους συντελεστές ασφαλείας γ'_m [6]	Για το σκυρόδεμα: Αναλόγως $\Sigma A\Delta_\gamma$ γ'_c = 1,30±0,15 Για τον χάλυβα οπλισμού: Για $\Sigma A\Delta_\Delta$ «Υψηλή» και αναλόγως $\Sigma A\Delta_\gamma$ γ'_s = 1,10±0,05 Για $\Sigma A\Delta_\Delta$ «Ικανοποιητική» και αναλόγως $\Sigma A\Delta_\gamma$ γ'_s = 1,15±0,05 Για $\Sigma A\Delta_\Delta$ «Ανεκτή» και αναλόγως $\Sigma A\Delta_\gamma$ γ'_s = 1,20±0,05	Αναλόγως διατομής ή / και προσπελασιμότητας		Αναλόγως $\Sigma A\Delta_\gamma$	Αναλόγως διατομής ή / και προσπελασιμότητας	
		γ'_m=(1,05 ή 1,20)	Αυξημένοι	γ'_m=1,10 ±0,10	γ'_m=1,15 ή 1,25	γ'_m=1,15 ή 1,25

- Υφιστάμενες τοιχοπληρώσεις: γ_m=1,5 ± 0,2.
- Προστιθέμενες τοιχοπληρώσεις: γ_m=1,70 ÷ 3,00, βλ. ΕΚ 6.

For your convenience they are detailed below:

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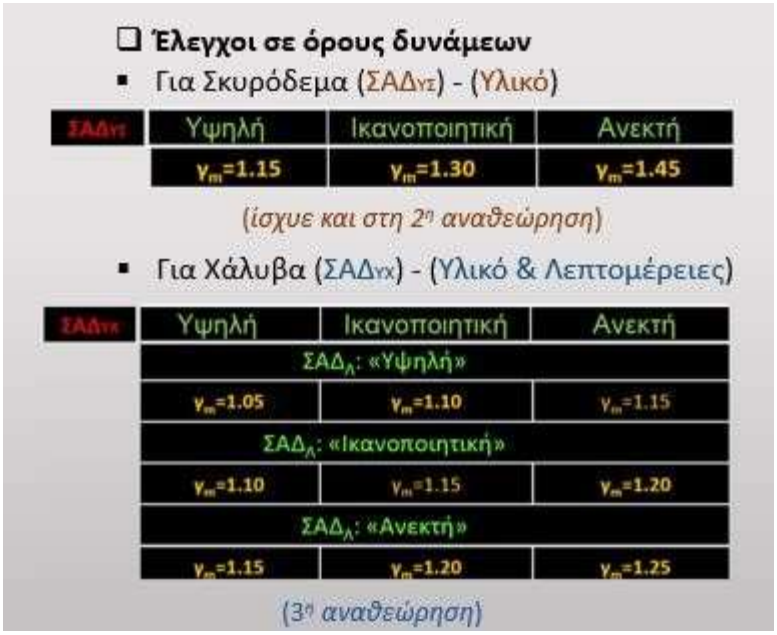

It is recalled that for the elastic analyses (checks in terms of forces - intensities) the representative (characteristic) strength value of the materials is the mean value minus one standard deviation, while for the inelastic analyses (checks in terms of deformations) and for the m method the representative (characteristic) strength value of the materials is the mean value. Method m is considered to belong, as far as the determination of strength is concerned, to the inelastic methods.

The EIS provides criteria for determining the S.A.D. §3.6.4 and Minimum investigation requirements for material characteristics, evaluation of results and definition of S.A.D. §3.7
In addition, in cases where it is objectively impossible to carry out the inspection and investigation programme (§§ 3.5 and 3.6) for the characteristics of the materials, and if no problems of defects, wear and tear, damage, etc. are found, reliable results of previous quality inspections may be used to document the strength of the materials.
Although these are not available, it is possible, exceptionally, to use 'in absentia' representative material strength values in accordance with Annex 3.1. In this case the Data Reliability Level (DRL) is considered 'tolerable' for concrete and masonry infills and 'satisfactory' for reinforcing steel.

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ANNEX 3.1
"EREMIN" REPRESENTATIVE PRICES OF MATERIAL RESISTANCE

α) Για το σκυρόδεμα

Πίνακας 1. «Ερήμην» Αντιπροσωπευτικές Τιμές Θλιπτικής Αντοχής Σκυροδέματος.

Εφαρμοσθέντες Κανονισμοί Μελέτης και Κατασκευής	«Ονομαστική» Μέση τιμή $f_{cm}\,(MPa)$	«Χαρακτηριστική» Μέση τιμή μείον μία τυπική απόκλιση $f_{ck}\,(MPa)$
…<1985	13	9
1985≤…	17	13

β) Για το χάλυβα οπλισμού

Πίνακας 2. «Ερήμην» Αντιπροσωπευτικές Τιμές Διαρροής Χάλυβα Οπλισμού.

Κατηγορία Χάλυβα Οπλισμού	«Ονομαστική» Μέση τιμή $f_{ym}\,(MPa)$	«Χαρακτηριστική» Μέση τιμή μείον μία τυπική απόκλιση $f_{yk}\,(MPa)$
S220 & Stahl I	280	240
S400 & Stahl III	450	410
S500 & Stahl IV	520	500

Security check

The safety check, carried out on an appropriate member or part or the whole structure, shall demonstrate that the imposed critical magnitude (stress and/or strain) is reliably less than the corresponding available capacity.
The safety factor applied in the assessment and redesign of existing structures is in the same general form as provided for in the Eurocodes:

Sd< Rd, with
Sd= γSd· S (Sk· γf) and
Rd= (1/γRd)· R (Rk/γm),

where:

- **Sd:** The design (and recheck) values of the stress or strain magnitudes caused by the actions.
- **Rd:** The design (and retest) values of the available corresponding resistances (transient or deformation magnitudes).
- **Sk:** The representative values of the baseline and random actions for which there is a certain probability of exceedance in 50 years.
- **Rk:** The representative values of the properties of the materials forming the resistances and having a certain probability of undercutting.
- **γf, γm:** the individual safety factors for the actions and properties of the materials, which take into account possible adverse deviations of the respective variables from the representative values.
- **γSd, γRd:** The individual safety factors that take into account the increased (compared to the design of new buildings) uncertainties of the simulations, through which the effects of the actions and the resistances of all kinds are estimated, respectively (see also Chapter 2, paragraphs 2.4.3 and 2.4.4.)

Finally, the safety inequality is checked by what is mentioned in more detail in Chap. 9, depending on the level of performance (see Chapter 2 of the CEFR).

Individual safety factors §4.5

Depending on the reliability of the data:

i. Appropriate safety factors γf are selected for certain actions with uncertain values, in combination with appropriate γSd (see § 4.4 and 4.5).

ii. Appropriate safety factors γm are selected for the existing material data, in combination with appropriate γRd (see § 4.4 and 4.5).

For the Simulators § 4.5.1

For the analysis simulations and for all tests, appropriate values of the individual safety factors γSd and γRd are used in order to take into account the increased uncertainties that accompany them.
The coefficients γRd are obtained in accordance with the provisions of Chapters 6 to 9 of the EIA.
The csd coefficients are obtained according to the severity and extent of the damage and deterioration suffered by the structure under study and are presented in Table C4.2 of CEE:

Πίνακας Σ 4.2: Τιμές του συντελεστή γ_{Sd}

Έντονες και εκτεταμένες βλάβες ή / και επεμβάσεις	Ελαφρές και τοπικές βλάβες ή / και επεμβάσεις	Χωρίς βλάβες και χωρίς επεμβάσεις
γ_{Sd} =1,20	γ_{Sd} =1,10	γ_{Sd} =1,00

Βλ. και Παράρτημα 7Δ και Παράρτημα ΣΤ περί βλαβών και φθορών.

Also, according to Chap. 5, and as far as elastic analysis, static or dynamic, is concerned, its application is permitted, for valuation purposes only, irrespective of the validity of the application conditions (see §§ 5.5.2.b and 5.6.1.b), if the γSd factors in this § 4.5.1 are increased by 0.15 (i.e. γSd,el. = γSd + 0.15).

Analysis

The determination of the building's stresses and strains requires the analysis of the building for the combinations of actions defined in § 4.4.2. Based on the stresses and strains resulting from the analysis by one of the recommended methods (§ 5.1.1), the corresponding checks for the satisfaction of the performance criteria, as described in §§5.1.3 and 5.1.4, as well as in Chap. 9.

The methods that can be used for the analysis are:

- Elastic (equivalent) static analysis (see §5.5), with global behaviour index (q) or local index (m)
- Elastic dynamic analysis (see §5.6) with global behaviour index (q) or local index (m)
- Elastic static analysis (see §5.7)
- Inelastic dynamic analysis (time history analysis) (see §5.8).

The selection of appropriate method is based on the importance and any damage or deterioration of the structure, as well as the available data on the cross-sections and strengths of the structural elements. In addition, the choice is also influenced by certain conditions that must be met for each method. These conditions are mainly related to the S.A.D. and the normality or otherwise of the structure under consideration.

Allows the distinction of elements into **primary** and **secondary*** (except for S.E. "A").
***Secondary** elements will be those elements that contribute to vertical loads but do not contribute significantly to earthquake resistance, or their contribution is rather unreliable due to low stiffness or strength or ductility. This category includes wall-coupling beams and, in general, relatively short beams contributing to walls, beams with indirect supports on beams, planted columns, etc. The distinction between primary and secondary elements is at the discretion of the engineer.*

4.6 SINGLE INTEREST INDICATOR q

The estimation of the available single index of behaviour of an existing structure depends on whether the building is damaged or not, as well as on the date of construction.
Depending on the performance level for the assessment or redesign of the building's load-bearing structure (see Chapter 2), the differentiated values of q* given in the following Table are taken into account, with the reference value q′ being the value applicable to
performance level B ("Significant damage"), which corresponds to the provisions and provisions of EC 8-1, as applicable to the design of new buildings.

Πίνακας 4.1 : Τιμές του λόγου q*/q΄ αναλόγως του στόχου επανελέγχου (για τον φέροντα οργανισμό)

Στάθμη επιτελεστικότητας		
«Περιορισμένες βλάβες» (Α)	«Σημαντικές βλάβες» (Β)	«Οιονεί κατάρρευση» (Γ)
0,6 πάντως δε 1,0<q*<1,5	1,0	1,4

According to Table S4.4 of CEE.EPE, the values of the behaviour index q are proposed for performance level B (significant damage), depending on the damage and the effect of the wall fillings on the whole structure:

Πίνακας Σ 4.4: Τιμές του δείκτη συμπεριφοράς q΄ για την στάθμη επιτελεστικότητας Β («Σημαντικές βλάβες»)

Εφαρμοσθέντες Κανονισμοί μελέτης (και κατασκευής)	Ευμενής παρουσία ή απουσία τοιχοπληρώσεων (1)		Δυσμενής (γενικώς) παρουσία τοιχοπληρώσεων (1)	
	Ουσιώδεις βλάβες σε πρωτεύοντα στοιχεία		Ουσιώδεις βλάβες σε πρωτεύοντα στοιχεία	
	Όχι	Ναι	Όχι	Ναι
1995≤…	3,0	2,3	2,3	1,7
1985≤…<1995(2)	2,3	1,7	1,7	1,3
…<1985	1,7	1,3	1,3	1,1

4.7 LOCAL INDICATORS m

The local indices m express the available local plasticity in the control areas of the linear elements. The local index m is defined as the ratio of the design value of the limiting strain depending on the level of performance to the corresponding value of the yielding strain of the linear member (CEE § 4.7) : / /□=□□□□=□□□□

The deformation magnitude taken into account in the calculation of the m indices is

- the chord angles of twist θ, for reinforced concrete members, and
- the angular deformations c, for wall fillings.

- At performance level A, the load-bearing structure (and the wall fillings) is expected to behave quasi-elastic, i.e. without the development of
  meteorological deformations. It is valid that θd≤ θy (i.e. m≈ 1.0), or respectively using the single behaviour index 1.0 ≤ q ≤ 1.5.
- At performance level B, the load-bearing structure develops significant post-tensioning deformations over a large area, but has sufficient and reliable
  margins against possible exhaustion of available failure strains. For the primary elements it holds that θd ≈ 0,5(θy + θu)/ γRd, while for the secondary elements θd ≈ θu/γRd.
- At performance level C, the load-bearing structure develops large metamorphic deformations, over a large area, reaching even the exhaustion of the available
  failure deformations, but without risk of collapse under gravity loads. It holds for primary elements that θd ≈ θu / γRd, while for secondary elements θd ≈ θu.

4.4.1.3 Response spectra

Generally, the response spectra in terms of acceleration, according to EC 8-1, are used as a function of the building's eigenperiod T and the critical viscous damping rate ξ or the behaviour index q.

If linear analysis methods are applied, with a global behaviour index q, the "design spectra", Sd(T), are used.

In case of application of non-linear methods of analysis, as well as linear methods using a local index m, the "elastic spectra", Se(T), are used.

In very specific cases, and only for the valuation of an existing structure, other approximate or empirical methods may be used.

4.4.1.4 Stiffness

Where more precise data are not available, stiffness values according to the Table below may be used.

4.4.2 Combinations of actions

Πίνακας Σ 4.1: Τιμές δυσκαμψίας

Α/Α	Δομικό στοιχείο	Δυσκαμψία
1.1	Υποστύλωμα εσωτερικό	$0,8*(E_cI_g)$
1.2	Υποστύλωμα περιμετρικό	$0,6*(E_cI_g)$
2.1	Τοίχωμα, μή - ρηγματωμένο	$0,7*(E_cI_g)$
2.2	Τοίχωμα, ρηγματωμένο (1)	$0,5*(E_cI_g)$
3	Δοκός (2)	$0,4*(E_cI_g)$

The combinations of actions, both for the failure limit states (basic and accidental combinations) and for the operational limit states, are made in accordance with the current Regulations in force and with the corresponding combination coefficients of the variable actions ψi.

4.4.3 Resistors

α) For the resistances of each structural element, the safety check (see § 4.1) is carried out with material properties generally dependent on the nature of the critical quantity to be checked (forces or deformations):

If the safety check is carried out **in terms of intensive quantities ("forces")**, the properties of the existing materials of a particular (individual) structural element are generally represented by **their average values reduced by one standard deviation** (or simply their average values, see Chapter 9), and the properties of the added materials are represented by their characteristic values as provided for in the relevant Regulations.

In this case, the material safety factors shall be taken as in §§ 4.5.3.1 and 4.5.3.2.

The calculation of the stiffnesses is done according to § 4.4.1.4.

If the safety check is carried out in **terms of deformation quantities (displacements, rotations, etc.)**, the properties of the materials are generally represented by their **average** values. *See also the following. See also § 4.1.4.*

In this case, the material safety factors are approximately equal to unity (§ 4.5.3.3).

The shape of the operation

When the assessment study of a structure concludes that intervention is required, the engineer, adopting one or more strategies, chooses the form of intervention based on general and technical criteria. Before any reference is made to the strategies, formulas and selection criteria, it is useful to clarify the terms

"intervention", "repair" and "reinforcement".

The term structural "**intervention**" means any work which results in the desired change in the existing mechanical characteristics of an element or structure and which has the effect of modifying its response. Any intervention is either repair or strengthening.

The term '**repair**' means the process of intervention on a structure damaged by any cause, which restores the pre-damage mechanical characteristics of the structural elements of the structure and returns it to its original load-bearing capacity.

The term '**strengthening**' means the process of intervention in a structure, with or without damage, which increases the load-bearing capacity or ductility of the element or structure to a level higher than that of the original design.

The choice of the intervention scheme is part of one or more strategies aimed at improving the seismic behaviour of the structure under consideration and consists of the modification or control of key parameters.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

The SCADA Pro

SCADA Pro has now fully integrated the CIP. With predefined parameters and automatic way all the necessary analyses are performed, all the checks of the performance criteria provided by the CIP are performed and the results are presented in a direct and supervisory way.

Anelastic static analysis also provides information and complete overview of the order of occurrence of plastic joints in the limbs. The designer now has a complete picture of the gradual deformation of the member at each step and can easily and quickly identify the "weak" points of the structure.

This method is mainly used in the assessment and control of the load-bearing capacity of existing buildings in relation to a defined level of performance, i.e. the desired and targeted behaviour of the building, based on the new regulation on interventions (KAN.EPE). It can also be used in redesign as well as in new buildings in order to determine from the resistance curve of the structure the ratio au/ai required, according to EC8, for the calculation of the seismic behaviour factor q of the structure.

REQUIREMENTS

A prerequisite for the execution of an inelastic analysis scenario is the existence of reinforcement in the cross-sections, which results from dimensioning ONLY with Eurocode 2 scenario with adaptation of the strengths of the Steel and Concrete materials to the strengths of the existing structure. The materials to be used shall NOT be B and STI grade (old material grades) but the adjustments of strengths and individual safety factors shall be based on the new materials.

INTRODUCTION

This manual was created to guide the researcher in his first steps in the field of inelastic analysis.

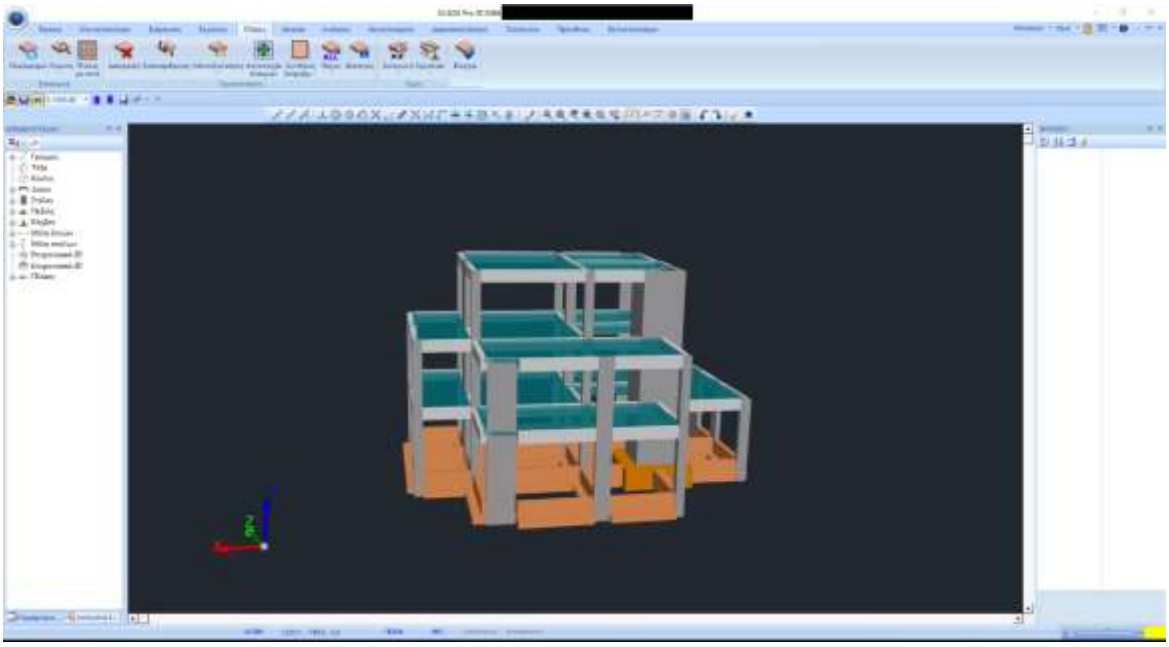
As an example, a three-storey reinforced concrete structure, considered as existing, was used in order to evaluate and check its load-bearing capacity in relation to a defined level of performance and is a guide for the new user in his effort to familiarize himself with the program.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

GENERAL DESCRIPTION

A. Geometry

The building under study consists of three floors in the superstructure, a foundation level and a roof slab. The foundation consists of footings and a footing under the elevator core.



B. Materials

For the construction of all members of the structure, concrete of C20/25 quality has been used, and for the reinforcement, steel of B500C quality.
In case that in the existing construction to be checked, quality B and STI materials (old material grades) were used, then they will NOT be imported as they are, but will be adapted to the strengths and individual safety factors of the new materials.

C. Regulations

Eurocode 8 for seismic loads. Eurocode 2 for dimensioning.
Intervention Regulation (CEN.EPE).

D. Loading - analysis assumptions

- **Dynamic Spectral Method with homonymous torsional pairs.**

The loadings according to the above analysis method in SCADA Pro are as follows:
(1) G (permanent)

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

(2) Q (mobile)

(3) EX (epicyclic loads forces of the earthquake at XI, from dynamic analysis).

(4) EZ (epicyclic loads forces of the earthquake at ZII, from dynamic analysis).

(5) Erx ± (epicentric torsional moment loads resulting from the epicentric forces of the earthquake XI displaced by the random eccentricity ±2eτzi).

(6) Erz±(epicyclic torsional moment loads resulting from the epicyclic forces of the earthquake ZLI displaced by the random eccentricity ±2eτxi.

(7) EY (vertical seismic component -earthquake by y- from dynamic analysis).

- Pushover Analysis. The simulation is subjected to horizontal loads distributed in a manner proportional to the inertial forces of the earthquake, which will increase monotonically, generally until a structural element is no longer able to carry its vertical loads.

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1ºSTEP 1: PRELIMINARY PROCEDURE

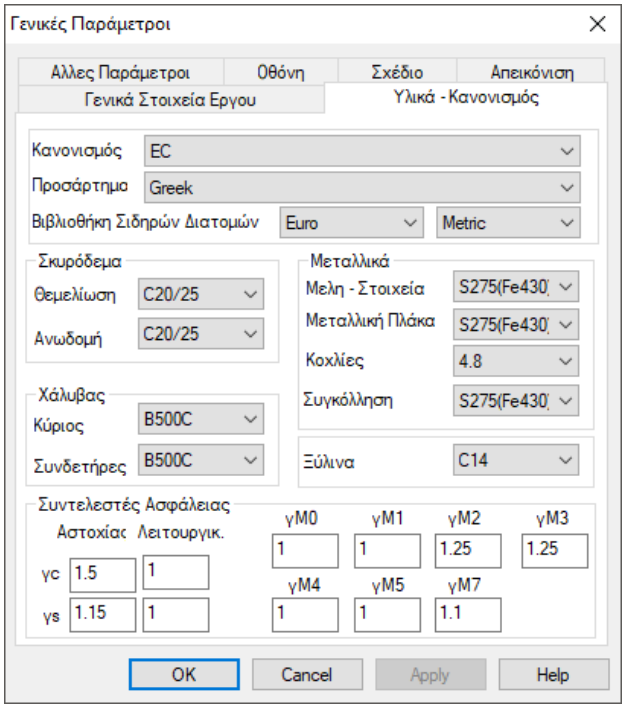
The data input of a structure in order to evaluate or redesign it is done by following exactly the same procedure as described for the design of a new project.

The detailed description for the creation, solution and dimensioning of a reinforced concrete structure can be found in the corresponding manual entitled "Example of a reinforced concrete structure".

In summary, here are the basic steps that must precede the Pushover analysis:

1.1. Create a New Project

In the initial parameters select **EC Greek** and the corresponding materials will automatically be selected.



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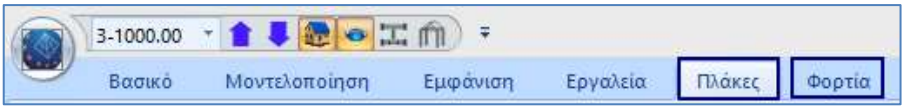
1.2. Modelling

Model, as usual, your vector using the relevant tools (dxf/dwg, standard constructions, draft, modelling), just as you would for a new construction.

1.3. Plates-Boards



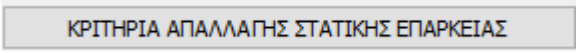
Insert plates and loads, using the relevant tools.

1.4. Analysis

Run a first analysis of the structure using a **Eurocode 8** scenario **(static or dynamic).**
Choose from the defaut scenarios and run the static or dynamic analysis, just like for a new construction, and create the combinations (predefined combinations).

E. Criteria for exemption from the structural adequacy inspection of existing buildings, according to Government Gazette 350/17-2-2016

The latest version of Scada Pro incorporates the criteria for exemption from the structural adequacy check of existing buildings, according to Government Gazette 350/17-2-2016.



The exemption applies to additions, changes of use-conversions and their simultaneous combination. A prerequisite for the exemption is that the building must not
"evidence of significant structural deficiency" which are:

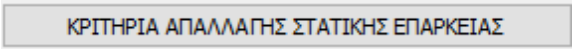
Obvious damage to the load-bearing structure or obvious serious design weaknesses such as:

1. Large cracks >0,4~0,5 mm
2. Significant reduction of reinforcement due to corrosion
3. Short columns without clamping in critical positions
4. Significant reduction of wall infill on adjacent floors (e.g. gantry) or very asymmetrical arrangement of wall infill in combination with lack of vertical elements with significant stiffness
(risk of formation of a loose floor).

In addition, in the case of an addition, a prerequisite is:
"The structural design of the existing building has been carried out with "full provision for the addition", i.e. all floors of the addition have been included in the structural simulation of the existing building"

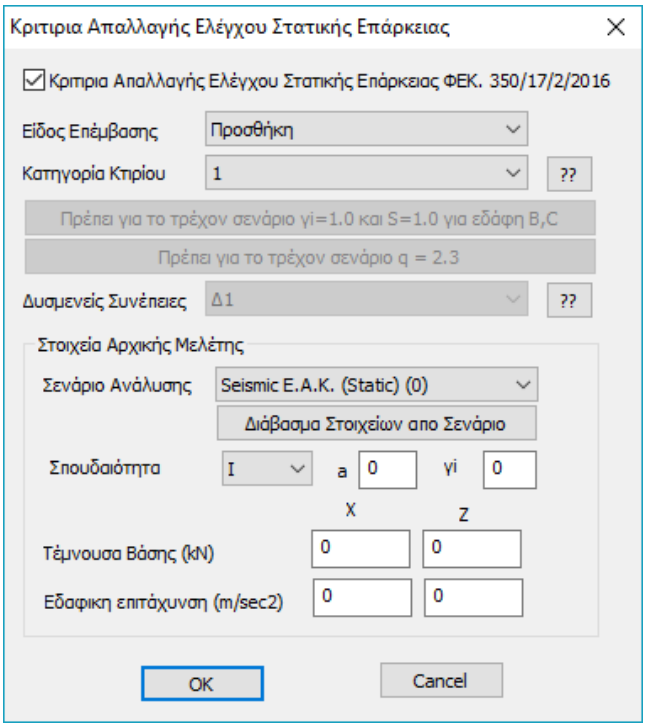
The course of action followed in the programme for the above cases is as follows:

The entity is entered as existing and an analysis scenario is selected for its analysis according to its original design.
The strong scenarios in the program in this case are **seismic** (**EAK** and **old**)
and **EC8 Greek** (**Static** or **Dynamic**).
Then, the addendum is inserted and a new analysis scenario is created (this study as opposed to the original one) which is necessarily an **EAK** (**Static** or **dynamic-et**) or **Eurocode 8** (**Static** or **Dynamic**).
The following option has been added to these scripts in their configuration dialog box:



Selecting it displays the following

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



The check means that the checks will be done and the results will be presented in the Seismic Action printout.

Then we choose the type of intervention

1. Add
2. Changes of Use - Conversions
3. At the same time both

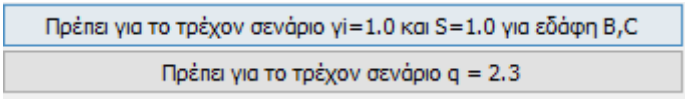
Next, the category of the existing building (original design) is selected according to the table

Κατηγορίες Κτιρίων

Κατηγορία 1	Κτίρια που έχουν μελετηθεί με βάση τους Κανονισμούς της Ομάδας Α, έτσι όπως ισχύουν σήμερα
Κατηγορία 2	Κτίρια που έχουν μελετηθεί με βάση ΝΕΑΚ/ΝΕΚΩΣ (1992), ΕΑΚ/ΕΚΩΣ (2000) EN1998-1, EN1992-1-1, EN1993-1-1, EN1994-1-1, EN1995, EN1996
Κατηγορία 3	Κτίρια που έχουν μελετηθεί με τις "Πρόσθετες Διατάξεις του 1984", από Οπλισμένο Σκυρόδεμα και κατηγορίας σπουδαιότητας Ι ή ΙΙ.
Κατηγορία 4	Οποιοδήποτε κτίριο

This table is also displayed with 

Under the building category, prompts are shown for parameter values of the current scenario (present study) according to the above GGC.



We then select the possible adverse effect in cases of change of use - conversion or a combination of both, according to the table below

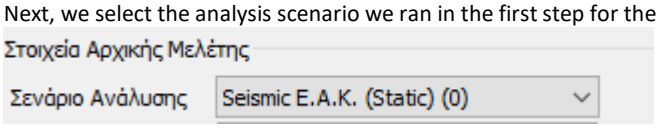
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

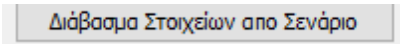
ΠΙΘΑΝΕΣ ΔΥΣΜΕΝΕΙΣ ΣΥΝΕΠΕΙΕΣ

Δυσμένεια Δ1	Αύξηση κατακόρυφων φορτίων
Δυσμένειες Δ2	Αύξηση μαζών και επομένως σεισμικών φορτίων
Δυσμένεια Δ3	Αλλαγή στατικού συστήματος που φέρει οριζόντια φορτία
Δυσμένεια Δ4	Δυσμενέστερη σεισμική απόκριση λόγω επιδείνωσης της μη-κανονικότητας λόγω αλλαγής τοιχοπληρώσεων
Δυσμένεια Δ5	Αύξηση του συντελεστή σπουδαιότητας

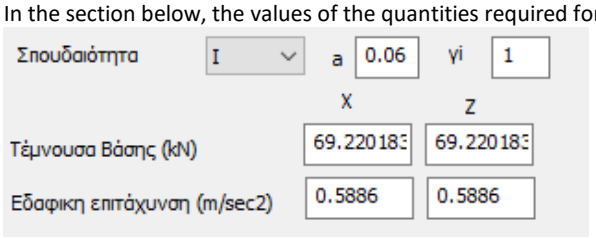
which is also displayed with 

Next, we select the analysis scenario we ran in the first step for the initial study



and press the 

In the section below, the values of the quantities required for the checks are shown.



Then, after setting the parameters as known, we run the scenario for this study.

The results of the criteria are displayed with the "Seismic Action" button

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

```
    ΚΡΙΤΗΡΙΑ ΑΠΑΛΛΑΓΗΣ ΕΛΕΓΧΟΥ ΣΤΑΤΙΚΗΣ ΕΠΑΡΚΕΙΑΣ ΥΠΑΡΧΟΝΤΟΣ ΚΤΙΡΙΟΥ
                        (ΦΕΚ 350/17-02-2016)
-------------------------------------------------------------------------
Είδος Επέμβασης              : Προσθήκη
Κατηγορία Κτιρίου            : 2
                               Κτίρια που έχουν μελετηθεί με βάση
                               ΝΕΑΚ/ΝΕΚΩΣ (1992), ΕΑΚ/ΕΚΩΣ (2000), EN1998-1,
                               EN1992-1-1, EN1993-1-1, EN1994-1-1, EN1995,
                               EN1996

            Στοιχεία Αρχικής Μελέτης : Seismic E.A.K. (Static) (0)
-------------------------------------------------------------------------
|Σπουδαιότητα| γi |  α  |αg,ex(m/sec2)|αg,ez(m/sec2)|Ve,ux (kN)|Ve,uz (kN)|
|------------+----+-----+-------------+-------------+----------+----------|
|     Σ3     |1.15|0.16 |    1.1267   |    1.0621   |   129.98 |   122.53 |
=========================================================================

            Στοιχεία Παρούσας Μελέτης : EC-8_Greek Statickyrio (7)
-------------------------------------------------------------------------
|Σπουδαιότητα| γi |  α  |αg,nx(m/sec2)|αg,nz(m/sec2)|Vn,ux (kN)|Vn,uz (kN)|
|------------+----+-----+-------------+-------------+----------+----------|
|     --     |1.00|0.36 |    2.0945   |    2.0945   |   205.39 |   205.39 |
-------------------------------------------------------------------------

Διεύθυνση X
            ρ  = αg,n/αg,ε = 1.86
            ρα = 1.00
            ρ/ρα =  1.86    Δεν απαλλάσσεται

            ρν  = Vn/Ve,u = 1.58
            ρα = 1.00
            ρν/ρα =  1.58    Δεν απαλλάσσεται

Διεύθυνση Z
            ρ  = αg,n/αg,ε = 1.97
            ρα = 1.00
            ρ/ρα =  1.97    Δεν απαλλάσσεται

            ρν  = Vn/Ve,u = 1.68
            ρα = 1.00
            ρν/ρα =  1.68    Δεν απαλλάσσεται
```

They appear in the order:

- The type of Intervention selected, the category of the building (if it is only Add, no adverse consequence option appears).
- The data of the analysis scenario of the original study are then displayed, such as its name and the corresponding values of the quantities required. This is followed by the corresponding data of the current study (without a value in the Importance field because the Importance of the original building is always taken).
- Finally, there follow the checks that relate to either intersection reasons, or to ground acceleration design reasons. Checks are made in each direction and it goes without saying that the criteria for exemption must be met in both horizontal directions. The final criterion is expressed on a case-by-case basis as a final ratio which, if greater than one, is not exempt and, if less than or equal to one, is exempt.

1.5. Sizing

Make a first dimensioning of the carrier using a **Eurocode 2** scenario
in order to calculate its reinforcement.

⚠ *As mentioned before, a prerequisite for the execution of an inelastic analysis scenario is the existence of reinforcement in the cross-sections, which results from dimensioning ONLY with Eurocode 2 scenario (not with the old regulation) with adaptation of the strengths of the Steel and Concrete materials to the strengths of the existing structure.*

⚠ *It is reminded that the materials to be used* ***must NOT be of B and STI quality*** *(old material grades) but the adjustments of strengths and individual safety factors must be made based on the new materials.*

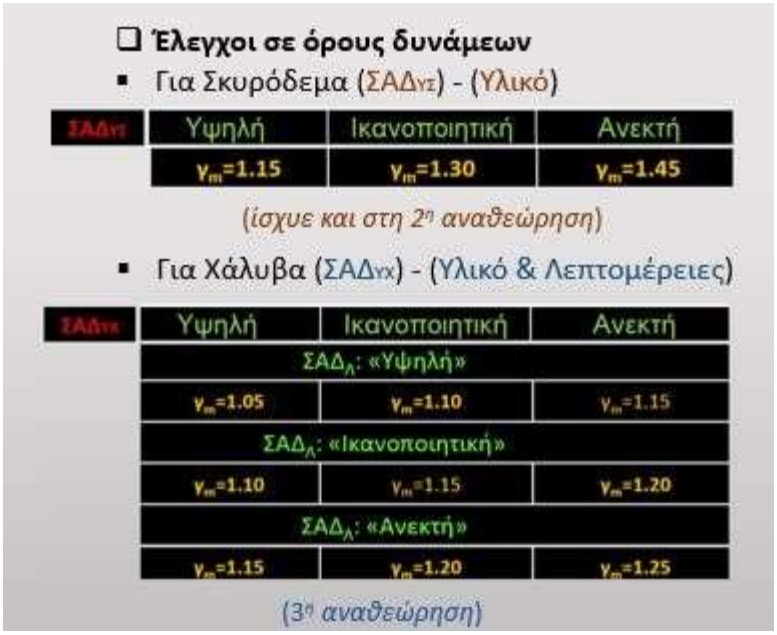
Within the Parameters of Sizing:
- select the combinations and
- adapt the strengths of the predefined materials to the qualities of your existing construction.

If the structure under inspection has **B** and **STI** quality materials, then in the definition of materials, in the sizing parameters, and before the initial sizing, you must define and modify the parameters of the materials per structural element by adapting them to the characteristics of the new materials and modifying the strengths accordingly, based on the of the CEE.

It is recalled that for the elastic analyses (checks in terms of forces - intensities) the representative (characteristic) strength value of the materials is the mean value minus one standard deviation, while for the inelastic analyses (checks in terms of deformations) and for the m method the representative (characteristic) strength value of the materials is the mean value. Method m is considered to belong, as far as the determination of strength is concerned, to the inelastic methods.

As mentioned above, the CEQS also provides for individual safety factors γm (γc and γs for concrete and steel respectively) which for existing materials are differentiated if the check is performed in terms of forces and if it is performed in terms of deformations and depend on the data reliability level (§ 4.5.3.)

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



❑ Έλεγχοι σε όρους δυνάμεων

- Για Σκυρόδεμα (ΣΑΔΥΣ) - (Υλικό)

ΣΑΔΥΣ	Υψηλή	Ικανοποιητική	Ανεκτή
	γ_m=1.15	γ_m=1.30	γ_m=1.45

(ίσχυε και στη 2η αναθεώρηση)

- Για Χάλυβα (ΣΑΔΥΧ) - (Υλικό & Λεπτομέρειες)

ΣΑΔΥΧ	Υψηλή	Ικανοποιητική	Ανεκτή
	$ΣΑΔ_Λ$: «Υψηλή»		
	γ_m=1.05	γ_m=1.10	γ_m=1.15
	$ΣΑΔ_Λ$: «Ικανοποιητική»		
	γ_m=1.10	γ_m=1.15	γ_m=1.20
	$ΣΑΔ_Λ$: «Ανεκτή»		
	γ_m=1.15	γ_m=1.20	γ_m=1.25

(3η αναθεώρηση)

❑ Έλεγχοι σε όρους παραμορφώσεων

συντελεστές σταθεροί ανεξάρτητα από υλικό

ΣΑΔΥ	Υψηλή	Ικανοποιητική	Ανεκτή
	γ_m=1.00	γ_m=1.10	γ_m=1.20

(ίσχυε και στη 2η αναθεώρηση)

ΠΙΝΑΚΑΣ Π 4.1 : ΤΙΜΕΣ ΙΔΙΟΤΗΤΩΝ ΤΩΝ ΥΛΙΚΩΝ (που διαμορφώνουν τις αντιστάσεις) ΚΑΙ ΑΝΤΙΣΤΟΙΧΟΙ ΕΠΙΜΕΡΟΥΣ ΣΥΝΤΕΛΕΣΤΕΣ ΑΣΦΑΛΕΙΑΣ γ'_m

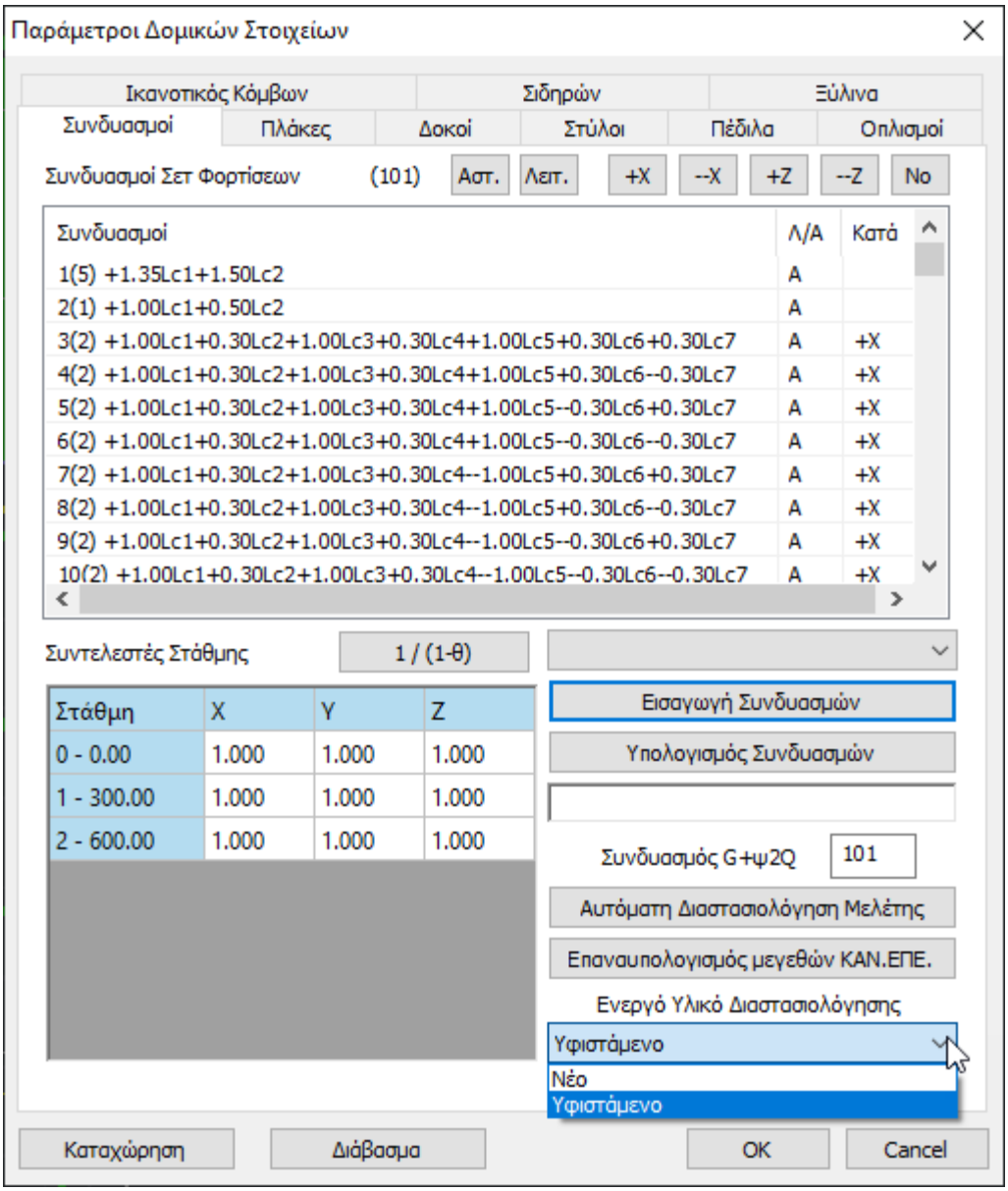
	ΜΕΘΟΔΟΣ ΕΛΕΓΧΟΥ [1]					
	ΣΕ ΟΡΟΥΣ ΔΥΝΑΜΕΩΝ [2]			ΣΕ ΟΡΟΥΣ ΠΑΡΑΜΟΡΦΩΣΕΩΝ [3]		
	ΥΦΙΣΤΑΜΕΝΑ ΥΛΙΚΑ[6]	ΠΡΟΣΤΙΘΕΜΕΝΑ ΚΑΝΟΝΙΣΜΟΙ		ΥΦΙΣΤΑΜΕΝΑ ΥΛΙΚΑ	ΠΡΟΣΤΙΘΕΜΕΝΑ ΚΑΝΟΝΙΣΜΟΙ	
		Ναι	Όχι		Ναι	Όχι
Αντιπροσωπευτικές τιμές[5]	$\bar{X} - s$	X_k	X_k	$\bar{X}$	$\bar{X}$	$\bar{X}$
Επιμέρους συντελεστές ασφαλείας γ'_m [4]	Για το σκυρόδεμα: Αναλόγως $ΣΑΔ_Υ$ γ'_c = 1,30±0,15 Για τον χάλυβα οπλισμού: Για $ΣΑΔ_Λ$ «Υψηλή» και αναλόγως $ΣΑΔ_Υ$ γ'_s = 1,10±0,05 Για $ΣΑΔ_Λ$ «Ικανοποιητική» και αναλόγως $ΣΑΔ_Υ$ γ'_s = 1,15±0,05 Για $ΣΑΔ_Λ$ «Ανεκτή» και αναλόγως $ΣΑΔ_Υ$ γ'_s = 1,20±0,05	Αναλόγως διατομής ή / και προσπελασιμότητας		Αναλόγως $ΣΑΔ_Υ$	Αναλόγως διατομής ή / και προσπελασιμότητας	
		γ_m•(1,05 ή 1,20)	Αυξημένοι	γ'_m=1,10 ±0,10	γ'_m=1,15 ή 1,25	γ'_m=1,15 ή 1,25

- Υφιστάμενες τοιχοπληρώσεις: γ_m=1,5 ± 0,2.
- Προστιθέμενες τοιχοπληρώσεις: γ_m=1,70 ÷ 3,00, βλ. ΕΚ 6.

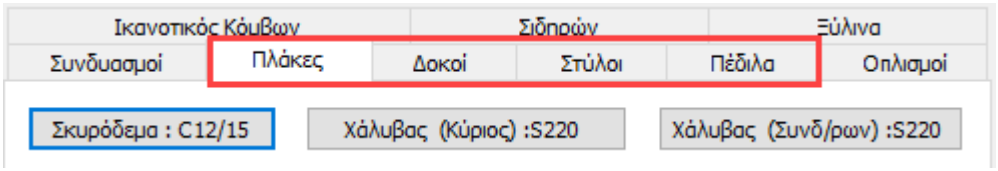
The definition of the above parameters taken into account for the calculation of the strengths of the existing materials is carried out within the Sizing Parameters.

- In the initial window in the Active Sizing Material field: select Existing

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



- In the fields Plates, Beams, Columns, Sheets, at the top, there is the choice of the corresponding materials:



Where,

choose the quality of the material to be used for both concrete and reinforcement (main, connectors).

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

By selecting a different quality for the concrete, the corresponding coefficients are automatically updated.

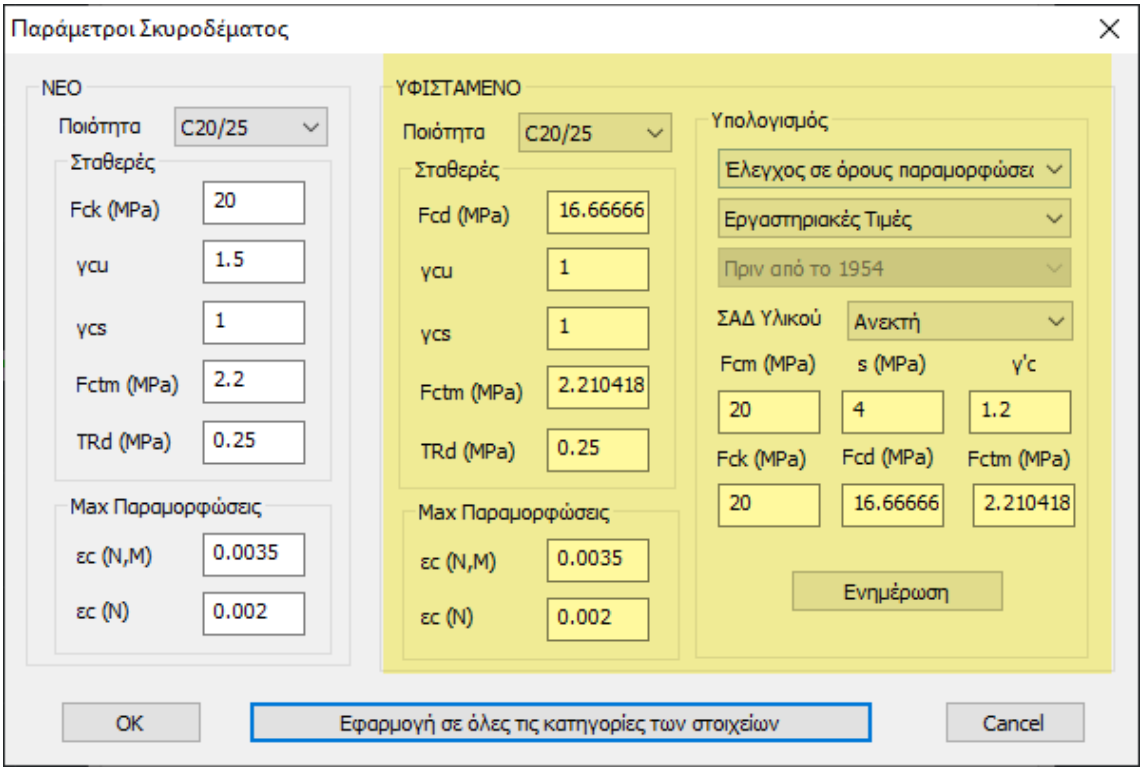
The new version of SCADA Pro 21 added the possibility of simultaneous definition of two material qualities for the structural elements: new and existing.

OBSERVATIONS:

- In the existing material, the calculation of the final compressive strength is now done automatically based on the corresponding provisions of the CEE.
- Then, the attribution of the quality of the material to the elements and consequently their classification (New or Existing) is done automatically with their dimensioning and this information is now stored in each member resulting in the complete separation of new and existing elements, which gives great flexibility to the designer for further processing.
- All three windows (Concrete - Steel main - Connectors) are divided into two sections:
  1. NEW (left) &
  2. BACK (right)

The procedure is the same for all 3 windows.

You select a quality from the list and then, based on provisions of the EIA, you select from the corresponding fields in the "Calculation" section



the corresponding parameters of your study based on the provisions of the relevant paragraph of the CEE. Once the selections are complete, you press the "**Update**" button and the corresponding final strengths are indicated in the fields below the material and are the ones that will be used by the program.

The coefficients γcu and γcs must remain unity.

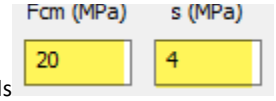
In detail:

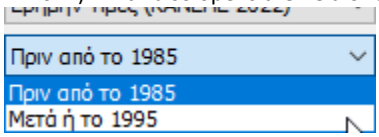
- **SKYRODEMA**

You choose whether a calculation will be made:

- in terms of Forces (Elastic analysis method q)
- in terms of Deformation (Elastic m & Inelastic method)

You choose whether to set:

- Laboratory Values - to be filled in the fields 

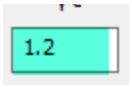
or
- In Absentia Prices (CANPE 2022) which also opens the field of choice of date logging 

and automatically completes the fixed.

(For compatibility reasons, and the Abandoned Prices of previous revision were retained.)

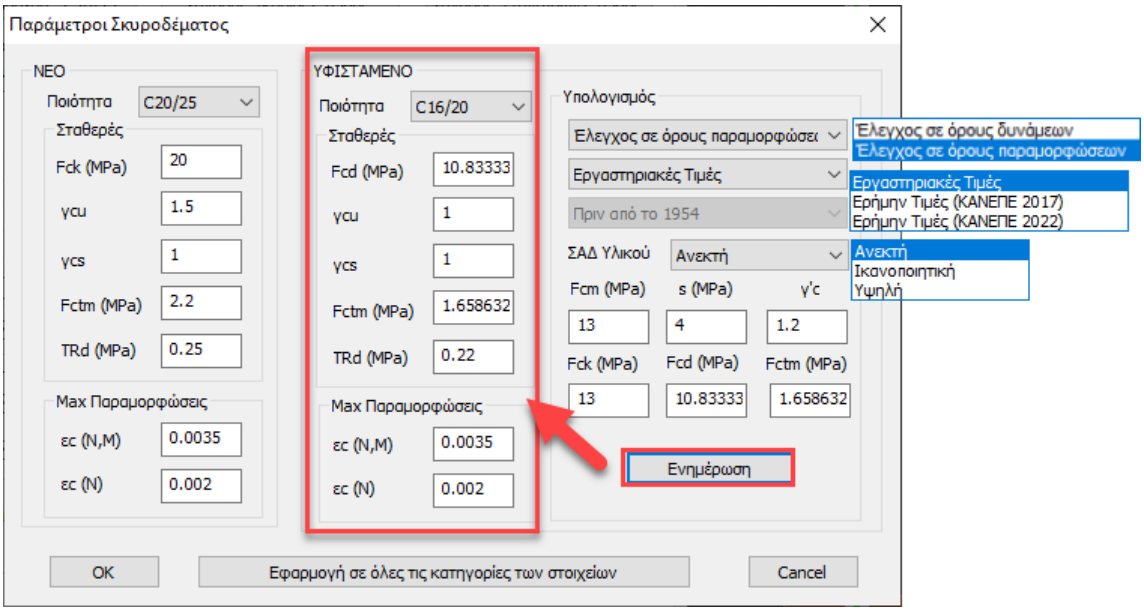
The last option is the Material SDS:

- Windy
- Iconopoeia
- High

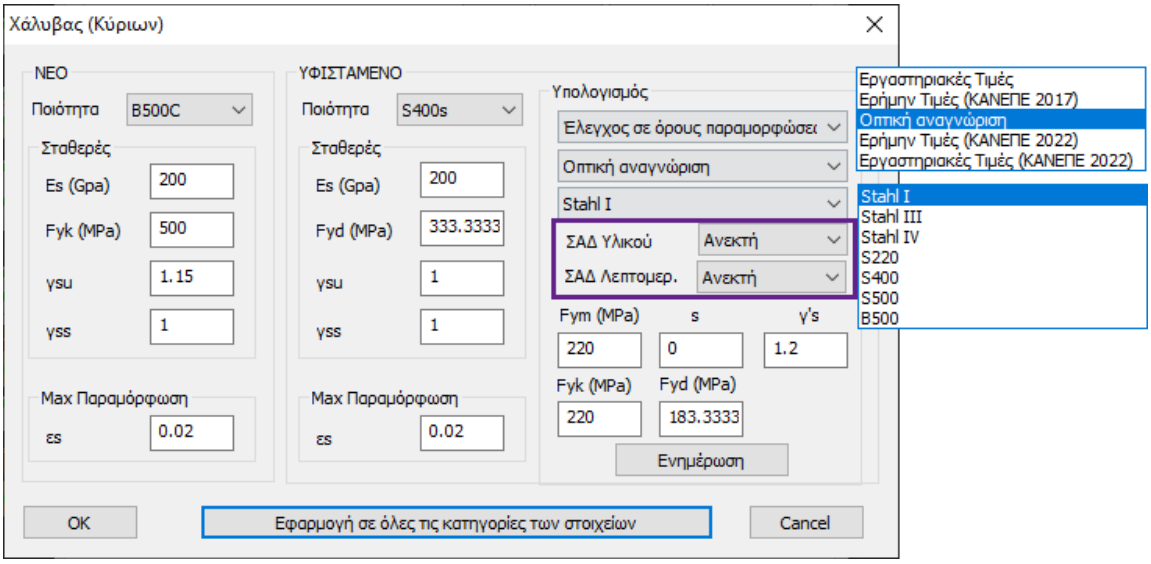
And it completes the 

All other values are automatically filled in and the **Update** calculates the Constants for the Existing Concrete.

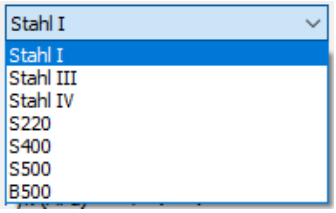
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

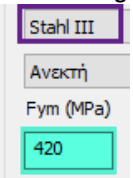


HALYVAS:



When determining the strengths of Steel (main & fasteners) there is the additional presence of **Optical Recognition**.

Selecting **Visual Recognition** opens the list of steel grades you select 

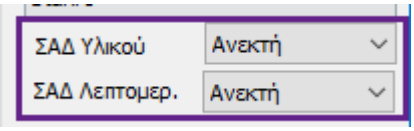
and automatically fills Fym . 

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

All other values are automatically filled in and with the **Update** the Constants for the Existing Steel (main & fasteners) are calculated.

3h revision of the EIA CIP

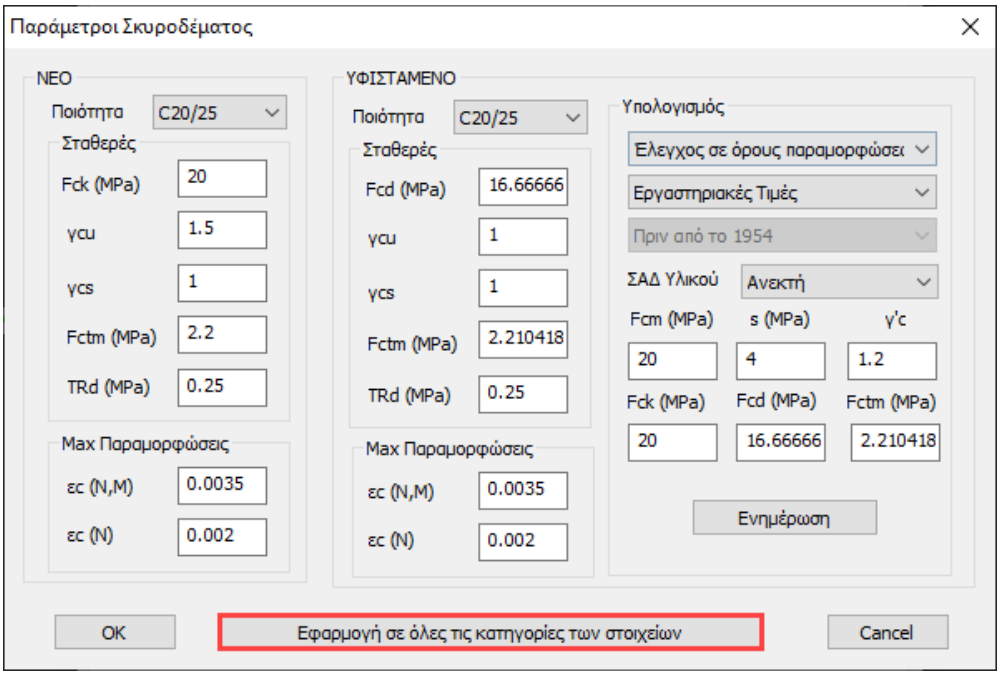
For steel, the material safety factor γs now depends not only on the material data reliability level but also on the detail data reliability level. These two new options have therefore been introduced:



The option Laboratory Values CANEPE 2022 was also introduced, where the cs is derived from a combination of the two SDSs and the option Absent Values CANEPE 2022 was also introduced where the requirement for steel is that the material SDS is satisfactory (rather than tolerable which was in the previous revision).

All other values are automatically filled in and with the **Update** the Constants for the Existing Steel (main & fasteners) are calculated.

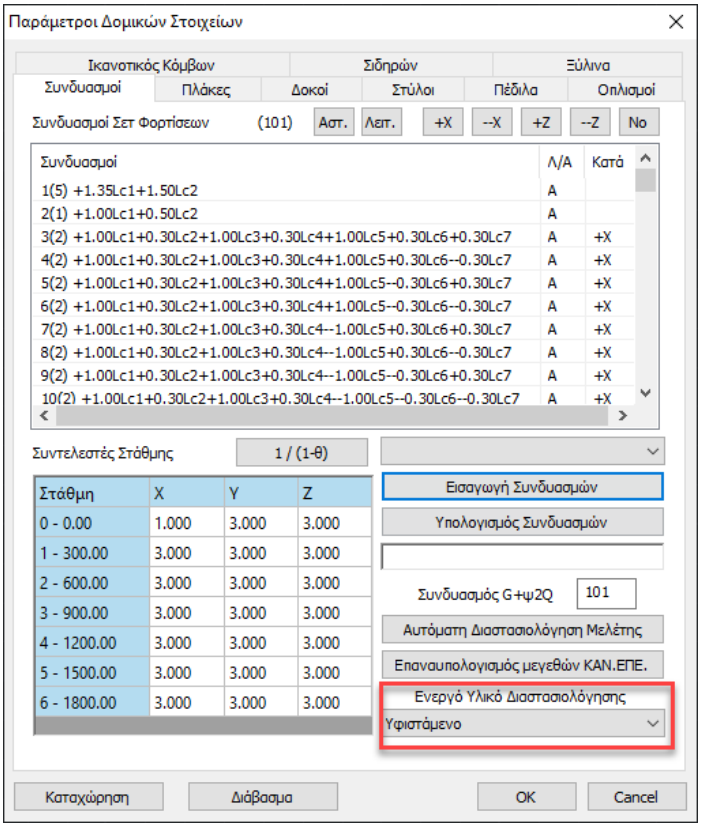
Finally, by selecting the "Apply to all categories of items" button,



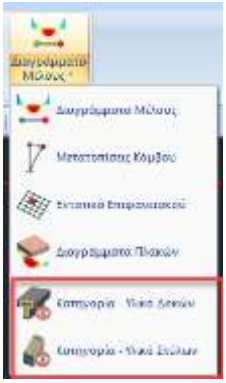
the materials you specify for one category of building elements (e.g. Pillars) are automatically copied to all other categories of building elements and so you do not need to specify them again, provided of course that the qualities are the same.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

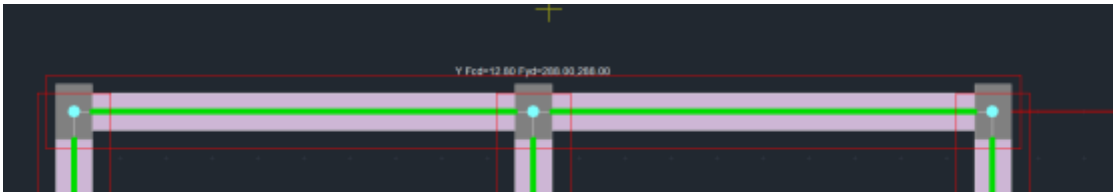
Then and before the initial sizing, as in the new building, the corresponding option in the parameters must be "Existing". Then and as usual you adjust the reinforcements of the structural elements.



With the command "Category - Beam Material" and "Category - Column Material" you can display the categorization of the elements and the strengths of the materials in your organisation.



For example, in the following beam spacing



there is the designation (Y), Existing material and the corresponding three characteristic strengths of concrete, main reinforcing steel and steel fasteners.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

F. New data on the structural adequacy of arbitrary buildings, in the context of the implementation of the urban planning law 4495/2017

In the context of the implementation of the Planning Law **4495/2017**, which provides for cases where the existing building, **partly or entirely arbitrary,** is exempted from the structural adequacy test under certain conditions and cases where the structural adequacy test is required. In cases where structural re-inspection is required, **the following procedure shall be followed:**

A) Determination of the SDS

B) Complete geometric survey of the construction on site

C) Inspection for damage to structural members. If there are substantial damages (e.g. corrosion of reinforcements, carbonation of concrete, etc.) these are recorded and then the corresponding structural degradation factors are calculated based on the CEQA.

D) The following assumptions are made for the mechanical characteristics of the materials according to the selected **SDS:**

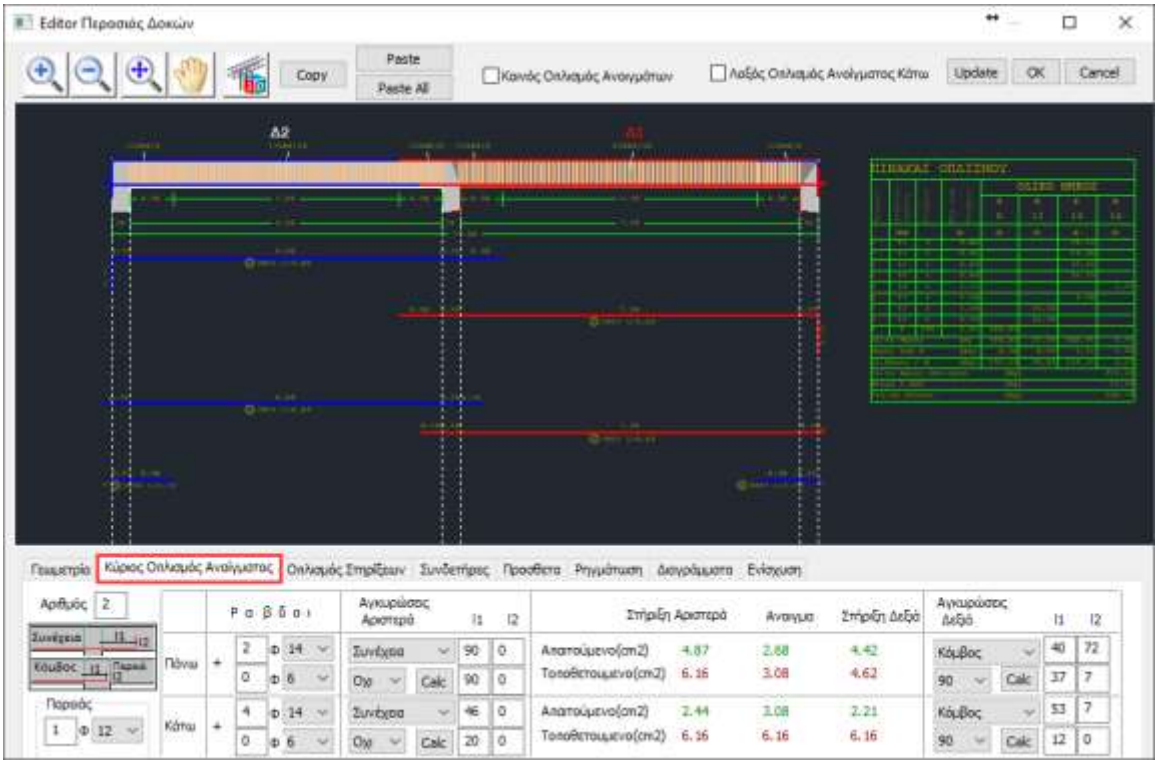
- **for a satisfactory RMS,** we define the values of the mechanical characteristics divided by **γf=1,1**
- **for a high SWD,** we define the values of the mechanical characteristics divided by **γf=1,0**
- **for a tolerable SWD,** we define the values of the mechanical characteristics (***Annex 3.1 of the CEE***) divided by **γf=1,2**

and we do the sizing.

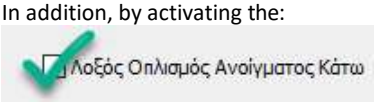
1.6. Modification and adaptation of the reinforcement

You will then need to modify and adjust this reinforcement according to the existing reinforcement of your structure, using the "Reinforcement Details" tools for beams and columns respectively.

In the Beam Reinforcement Details, the **Main Opening Reinforcement** section includes tools that allow you to modify the main reinforcement of the selected opening and the **Reinforcement of Supports** section includes tools to modify the reinforcement on the supports.

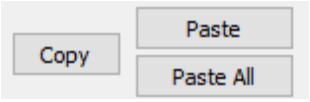


In addition, by activating the:



Half of the reinforcement of the lower openings shall be taken into account as oblique reinforcement, with the result that it is added to the supports and removed from the opening

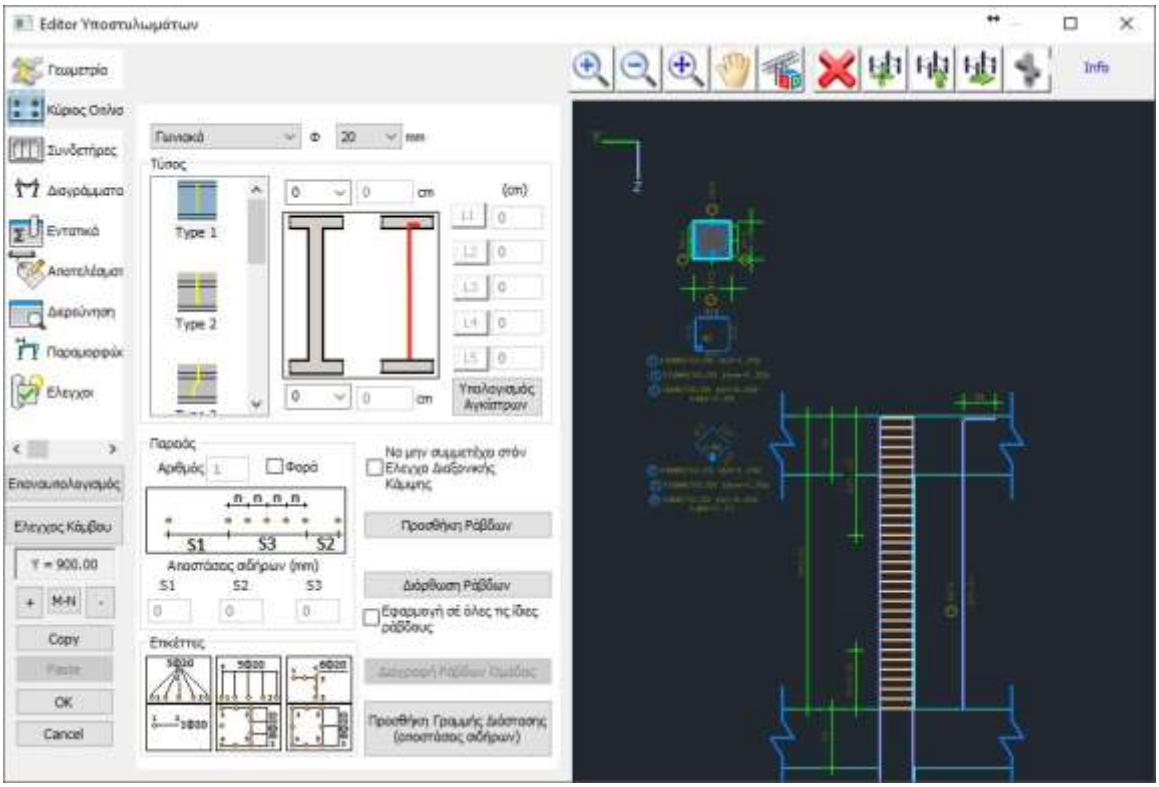
After you have adjusted all the reinforcements of a beam or a row, you can use the **Copy** and **Paste** or **Paste All** commands**,** which allow you to copy the reinforcement of an opening to another opening (Paste) or to all openings of the row (Paste all).



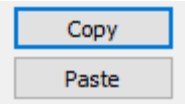
OBSERVATION:

⚠ A detailed description of the use and capabilities of the Beam Armour Detail tool can be found in the **User Manual Chapter A:** "Beam Armour Detail"

Similarly, in the Pillar Reinforcement Details, the **Main Reinforcement** section includes tools that allow you to modify the main reinforcement of the selected pillar or wall, and the **Connectors** section, tools to modify the connectors.



Then, after you have adjusted all the reinforcements of a column or wall, you can use the **Copy** and **Paste** commands**,** which allow you to copy the reinforcement of one column/wall to another (Paste), so that any modification you make to the cross-section of a column/wall can be copied to another column/wall, at the same or a different level, without having to repeat the process.

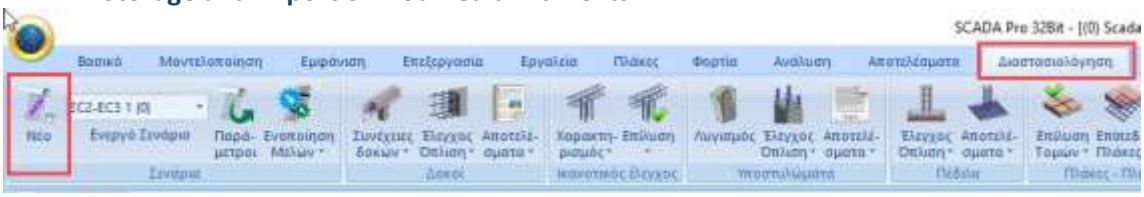


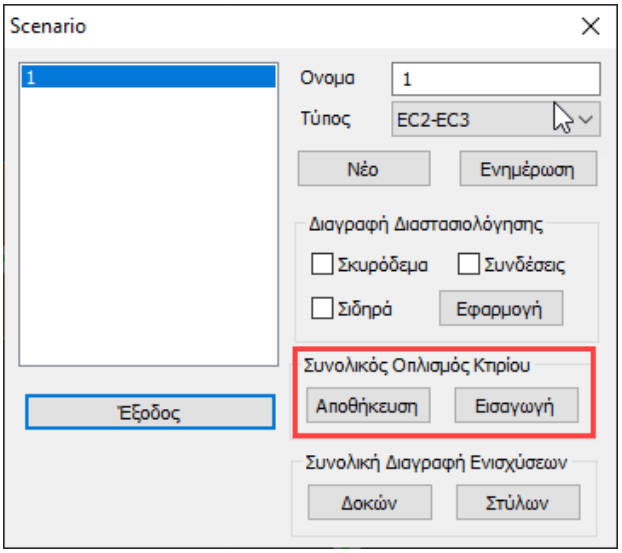
OBSERVATION:

⚠ A detailed description of the use and capabilities of the Beam Armour Detail tool can be found in the **User Manual Chapter B:** "Pillar Armour Detail"

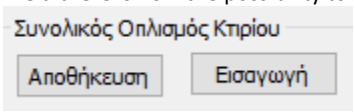
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

1.7. Storage and import of modified armaments

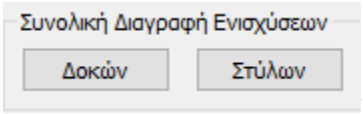




Within the NEO field there is now the possibility to store the total armament

of the building 

as well as to delete in total all the

reinforcement of beams and poles 

.

With the Total Building Reinforcement field, it is possible to store the reinforcement of the beams and columns with the manual modifications made by the user in order to adjust the reinforcement of an existing design for the purpose of evaluation and redesign, as well as the reinforcements given to these elements.
This command is very useful in cases where there is a need to remove, modify or add a new item.

PROCEDURE:
In these cases select **Save**, then return to modeling, make the modifications to the vector, run the original EC8_Greek analysis (Static or Dynamic) and come back to dimensioning. You load the combinations again and re-dimension the entire vector to pick up reinforcements and new or modified elements. By selecting the **Insert** command, all the rebars and any reinforcements that you manually inserted into the pre-existing elements are brought back in.
It now remains to insert the existing reinforcements into the new or modified elements.

1.8. Interaction Diagrams

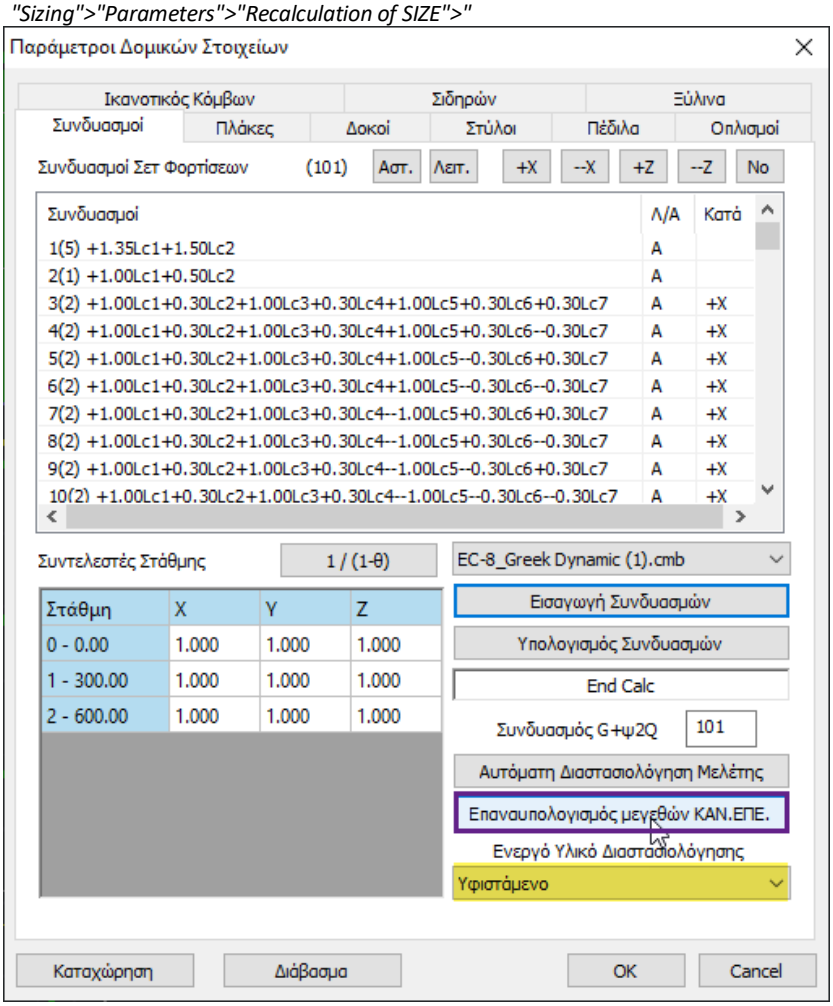
1.8.1. Strength calculation (Pushover)

After the preliminary procedure is completed and the existing reinforcement is inserted in all elements of the structure, and before the creation of the pushover analysis scenario, ***it is necessary to precede*** the "**Pushover Strength Calculation**" by selecting the corresponding command:

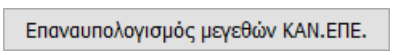
"Dimensioning">"Columns">"Results">"Pushover calculation"

Or alternatively for all elements of the study via the command:

"Sizing">"Parameters">"Recalculation of SIZE">"



Through this command, the program calculates the M-N interaction diagrams for all structural elements of the beam



and all levels.

Alternatively, the recalculation of the strengths after manual modification of the reinforcement for the beams and/or columns/wall and all levels, the corresponding options can be found in the Results of Beams and Columns:

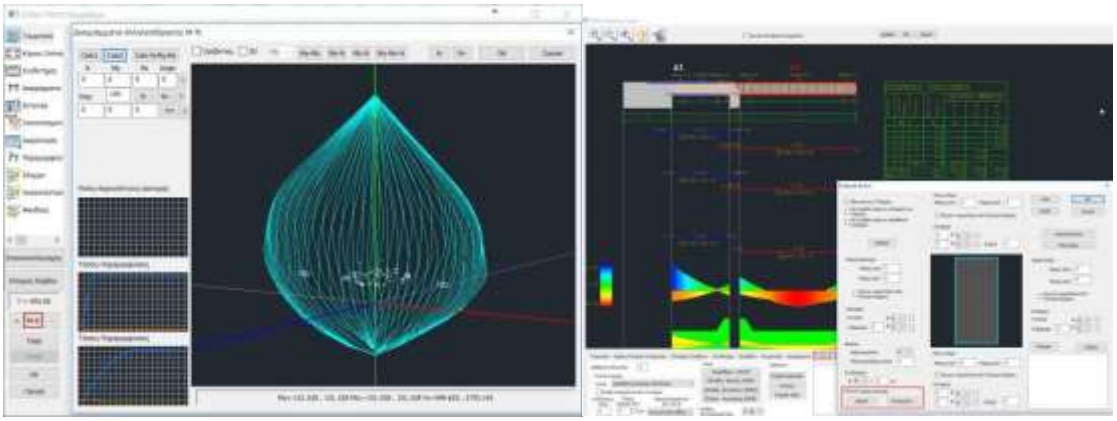
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

It involves the calculation and display of the moment-axial interaction diagrams, based on the geometry of the cross-section, the quality of the materials and the reinforcement. The three-dimensional diagram of the strength envelope (My, Mz, N) is produced. In addition, the Tension-Deformation diagrams for steel and concrete are displayed schematically, and the Stress-Curvature diagram is shown in detail.

⚠ **Observation:** *The points inside the diagram are the N-My-Mz points each combination.*

Select the calculation for the Pillars and/or Vault or Beams, per Floor or for the whole Building.
The program automatically calculates the interaction diagrams, while the diagrams are displayed on your screen.

In addition, for the individual element (beam or column/column), it is possible to calculate its new strengths through the Reinforcement Details.



1.8.2 Recalculation of the figures of CAN.Ltd.

In addition, the Επαναυπολογισμός μεγεθών ΚΑΝ.ΕΠΕ. , allows the recalculation of the strength moments in case of modification of the materials in the Beam-Pillar fields, and if the reinforcement has already been modified according to the existing situation.

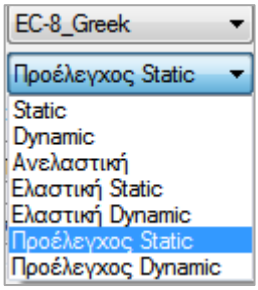
So if, for example, you have already defined the existing strengths of your materials, you have already dimensioned your design and modified the reinforcements of the structural elements and then you need to modify the strengths of your materials, you only need to make the change

and press the button Επαναυπολογισμός μεγεθών ΚΑΝ.ΕΠΕ. to recalculate all the sizes provided for by the EIA without having to repeat the procedure. The program will automatically calculate the new sizes for all members of the study.

2ºSTEP 2: PREVENTION

2. Foreword

In the option to create scenarios and select the type of analysis "EC8_Greek", there are the following types of analysis scenarios:



The types:

- Static
- Dynamic

They are used for the analysis of new buildings based on EC8 and the Greek national Appendices.

All the following types:

- Anelastic
- Elastic Static
- Elastic Dynamic
- Static pre-testing
- Dynamic pre-testing

They are used for the assessment and redesign of existing structures based on the provisions of the C.E.P.E.

2.1 Introduction

The two types of analysis scenarios "Static" and "Dynamic" are two preliminary elastic analyses in order to examine whether the criteria set by the CEE for the application of elastic (static or dynamic) analysis for the assessment and redesign of the structure are met. In particular, among other things, the inadequacy indices "λ" are calculated, which give a first picture of the earthquake resistance of the building (CEE §5.5.1.1). The morphological regularity of the building is also examined (CEE §5.5.1.2).

OBSERVATION:

⚠ *For **performance level A**, the following elastic analyses may be applied (static and dynamic) without conditions (§5.5 and §5.6)*

EPC 5.5.1.1.1 Structural element failure index

In order to determine the magnitude and distribution of the inelastic behaviour requirements in the primary load-bearing structures elements of the structure bearing the seismic actions, a preliminary elastic analysis of the building is required in order to calculate for each of its elements the ratios ('indices of inadequacy')

$\lambda = S / _{Rm}$ *(5.1)*

where S is the intensive magnitude (moment) due to the actions of the seismic combination (§4.4.2), where the seismic action is taken without reduction (the elastic spectrum of EC 8-1 is used), while $_{Rm}$ is the corresponding available resistance of the element, calculated the basis of the average values of the strengths of the materials (see §5.1.4).

The λ ratios will be calculated, both for valuation and for redesign, on each primary load-bearing element. The highest λ ratio for an individual element on a floor (the most overloaded) will be considered a critical λ ratio for the floor.

CAN.EPE 5.5.1.1.2 Morphological regularity

The scope of each method mentioned in §5.1.1 depends on the morphological characteristics of the building, which influence its behaviour under seismic actions. The building is considered to be morphologically normal when the conditions listed in EC 8-1 are met.

The CEE prescribes specific requirements for the application of Elastic Statics and Elastic Dynamics analysis:

⚠ *In addition, the EIA sets conditions for the application of the pushover analysis, which in order to be applied, the influence of the upper eigenmodes must not be significant (EIA §5.7.2 (b) INFLUENCE OF THE UPPER PROPERTIES) (see.*
***§Control of the influence of the higher idioms**)*

***EPC 5.5** For performance level A, the elastic static analysis may be applied without the conditions in § 5.5.2.*

***EPE** 5.5.2 Conditions of application (Elastic static analysis)*

For the elastic methods there is no question of conditions of application relating to the level of confidence in the data.	***α.** The application of the static elastic method is permitted (for performance levels B or C, see § 5.5) when all of the following conditions are met:*
	(i) For all the main elements λ≤2.5, or for one or more of them λ>2.5 and building is morphologically normal.
	(ii) The fundamental eigenperiod of the building $_{T0}$ is less than 4 $_{Tc}$ or 2s, (see EC 8-1).
As Criterion of this of condition, in the case that the aperture not is	*(iii) The ratio of the horizontal dimension in a floor to the corresponding dimension on a neighbouring floor floor not exceeds the 1.5*

deformable, the rule may be used that the relative floor arrow on either side of the building shall not exceed 150% of the through the relative arrow.	*(except o last floor and annexes).*
As a criterion for this condition, the rule may be used that the average relative arrow of a floor (excluding appendages) shall not exceed 150% of the relative arrow of the underlying or the floor above.	*(iv) The building does not exhibit a strongly asymmetrical distribution of stiffness in plan view on any floor.*

No required check of this treaty on sufficient mixed systems.	*(i) the building in sectional height does not exhibit an asymmetrical distribution of mass; or of stiffness.*
	(ii) The building has a system for absorbing seismic actions in approximately two vertical directions addresses between them.
The main objectives of this paragraph are, on the one hand, to prevent the exclusion of the method (which has the well-known advantages of simplicity and transparency), due to the fact that all the conditions application of the §5.5.2a , particularly in older buildings, and the possibility of using the same method of analysis both in assessment and in the redesign (in which case, because of the interventions, it is more likely the conditions for application will be met).	***β.*** *Notwithstanding the validity of conditions i, iii, iv and v of the previous paragraph, but that there is no substantial damage, the static elastic method may be used for the purpose of valuation (only). In this case the simulation safety factors γ_{Sd} provided for in § 4.5.1 shall be increased by 0,15.*

CAN.EPE 5.6.1 ***Conditions of application (Elastic Dynamic Analysis)***

For the elastic methods there is no question of conditions of application relating to the level of confidence in the data.	*α. The scope of the dynamic elastic method is defined by the condition that for all principal elements $\lambda \leq 2.5$. or for one or more of them $\lambda > 2.5$ and the building is morphologically normal.*

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

For the purposes of this provision b. Regardless of the validity of the conditions of the possibility see the comments of previous paragraph, but under the §5.5.2b.	*provided that there is no substantial damage, the dynamic elastic method may be used for the purposes of assessment (only). In this case the safety factors of the simulation $_{cSd}$ provided for in § 4.5.1 shall be increased by 0,15.*

In the following, the procedure, parameters and results of the controls of the "Pre-test" scenario in SCADA Pro are analyzed.
The CANEP requires that certain criteria be met in order for the flexible methods to be applied.

- For the **Elastic Static** Analysis it provides a set of criteria (including morphological regularity) of which have been implemented in the project and
  are presented in the form of controls, those of which contain quantitative quantities and could be implemented computationally.
- For the **Elastic Dynamic** Analysis the only criterion set by the CEFR is that the inadequacy index λ is less than or equal to 2.5 (λ≤ 2.5) or for one or more of these λ > 2.5 and the building is morphologically normal.

⚠ *However, for both methods, it gives the possibility to apply the elastic methods, for valuation only, as long as the coefficient of the permanent loads* ***γsd*** *is increased by* ***0.15.***

4.5.1d) *Also, according to Chap. 5, and as far as elastic analysis, static or dynamic, is concerned, its application is only permitted for valuation purposes, irrespective of the validity of the conditions of application (see §§ 5.5.2.b and 5.6.1.b), if the cSd coefficients in this*
§ 4.5.1 are increased by 0.15 (i.e. ***γSd,ελ.= γSd+ 0.15****).*

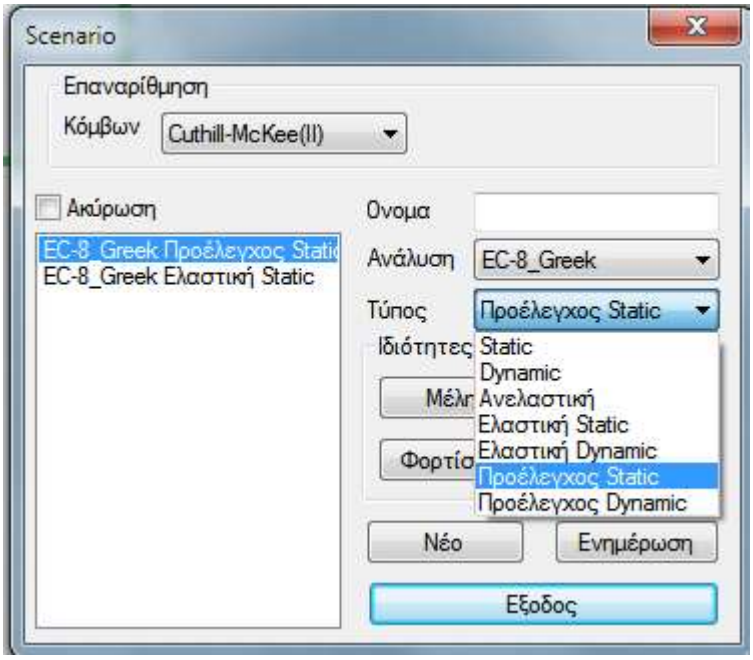
In the analysis section, you can now define a preliminary analysis scenario (pre-check), either static or dynamic, which will be run with an elastic spectrum and will perform all the checks for the analysis selection criteria, based on what was mentioned above.

⚠ **A prerequisite** for the execution of the preliminary analysis scenario is:

- √ the **existence of armaments**; and
- √ the **calculation of the corresponding strength moments**.

2.2 Pre-check

So in the analysis section and in the "New Scenario" option



create a new script "Static Pre-Control" or "Dynamic Pre-Control"

⚠ *Note that for this scenario, the stiffnesses of the elements are adjusted based on* ***Table C4.1 of CANEPE****.*

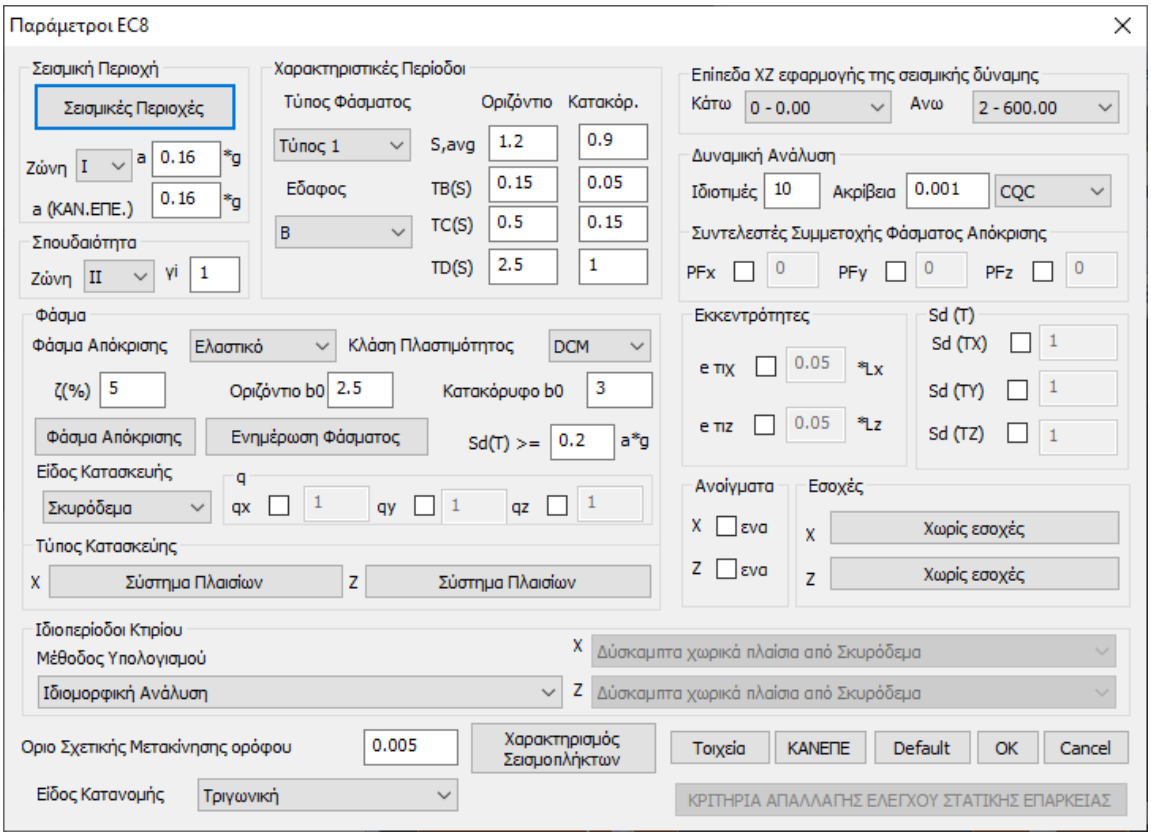
Πίνακας Σ 4.1: Τιμές δυσκαμψίας

Α/Α	Δομικό στοιχείο	Δυσκαμψία
1.1	Υποστύλωμα εσωτερικό	$0,8*(E_cI_g)$
1.2	Υποστύλωμα περιμετρικό	$0,6*(E_cI_g)$
2.1	Τοίχωμα, μή - ρηγματωμένο	$0,7*(E_cI_g)$
2.2	Τοίχωμα, ρηγματωμένο (1)	$0,5*(E_cI_g)$
3	Δοκός (2)	$0,4*(E_cI_g)$

You then follow the procedure for running the script.

In the "Parameters" dialog box you set the parameters as you would for an EC8 scenario:

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

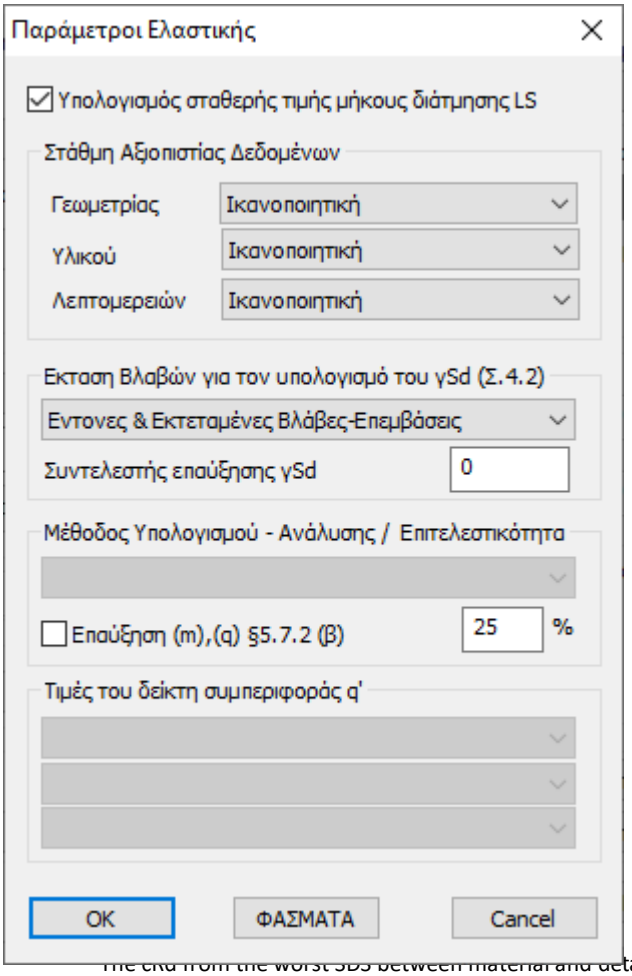


The response range for pre-testing shall be ***elastic****.*

In this box a new button 

has been added where in the dialog box that appears, you set (as in inelastic):

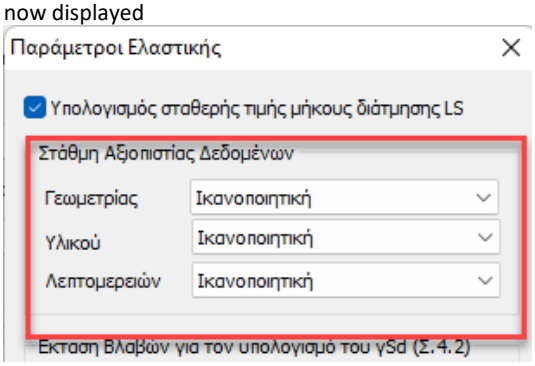
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



OBSERVATION:
Especially for the pretest scenario, the choice of how to calculate the shear length Ls does not affect the results.

The eka from the worst SDS between material and details.

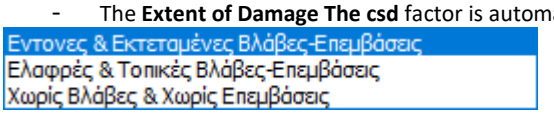
So in the four scenarios of the elastic analysis CANPE, in the dialogue box displayed by the CANPE button, all three SADs are now displayed



Select:

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

- For each ***Data Reliability Level***
- The **Extent of Damage The csd** factor is automatically calculated based on corresponding option,



The value 0 in the field

means that the coefficient will take the value based on **table .4.2.** of the EIA.

If you want your own value, enter a number and it will be added up to the value provided by the table. Calculations are made based on the resulting sum.

Where more precise data are not available, cSd values according to following Table may be used.

Table S 4.2: Values of the cSd coefficient

Intense and extensive damage and/or interventions	Light and localised damage and/or interventions	Without damage and without interventions
γ_{Sd} =1,20	γ_{Sd} =1,10	γ_{Sd} = 1,00

See. See also Annex 7D on damage and deterioration.

Then, select the command **FRAME**

The **EIR** provides a **minimum tolerable target based on the building's significance category** based on the table below:

Πίνακας ΠΑ.2.1. *Ελάχιστοι ανεκτοί στόχοι αποτίμησης ή ανασχεδιασμού υφισταμένων κτιρίων.*

Κατηγορία Σπουδαιότητας	**Ελάχιστοι Ανεκτοί Στόχοι**
I	Γ2
II	Γ1
III	Β1
IV	Β1 και Α2 (Ικανοποίηση **και** των δύο στόχων)

Σε κάθε περίπτωση να θεωρηθεί ότι ισχύει Α1>Α2, Β1>Β2, Γ1>Γ2, Α1>Β1>Γ1 και Α2>Β2>Γ2

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

3h revision of the 2022 EIA.

In the new EIA, more seismic hazard categories are introduced (9 in total from 2 before), the term *seismic class* is introduced, as well as a new method of assessment and redesign (which can be followed as an alternative to the one in force until now).

Seismic class is the maximum rating or redesign target for a given level of performance. It is derived from the combination of performance level and αg rate.

The seismic classes for performance level B are considered as basic seismic classes.

Πίνακας Σ 2.1. Ενδεικτική συσχέτιση περιόδου επαναφοράς και πιθανότητας υπέρβασης της σεισμικής δράσης με την αντίστοιχη ανηγμένη οριζόντια εδαφική επιτάχυνση.

Περίοδος Επαναφοράς (έτη)	Πιθανότητα υπέρβασης σεισμικής δράσης εντός του συμβατικού χρόνου ζωής των 50 ετών	$a_g / a_{g,ref}$
2475	2%	1.80
975	5%	1.30
475	**10%**	**1.00**
225	20%	0.75
135	**30%**	**0.60**
70	50%	0.45
40	70%	0.35
20	90%	0.25
<20	>90%	<0.25

Στον Πίνακα 2.1 παρουσιάζεται, η συσχέτιση της στάθμης επιτελεστικότητας του φέροντος οργανισμού με την αντίστοιχη ανηγμένη οριζόντια εδαφική επιτάχυνση. Στον Πίνακα Σ 2.1 παρουσιάζεται, μια **ενδεικτική συσχέτιση** της περιόδου επαναφοράς και της αντίστοιχης πιθανότητας υπέρβασης εντός του συμβατικού χρόνου ζωής των 50 ετών της σεισμικής δράσης με την αντίστοιχη ανηγμένη οριζόντια εδαφική επιτάχυνση.

Πίνακας 2.1. Στόχοι αποτίμησης ή ανασχεδιασμού Φέροντος Οργανισμού.

$a_g / a_{g,ref}$	Στάθμη Επιτελεστικότητας Φέροντος Οργανισμού		
	Α «Περιορισμένες Βλάβες»	Β «Σημαντικές Βλάβες»	Γ «Οιονεί Κατάρρευση»
1.80	**A0**	**B0**	**Γ0**
1.30	**A1***	**B1***	**Γ1***
1.00	**A1**	**B1**	**Γ1**
0.75	**A2***	**B2***	**Γ2***
0.60	**A2**	**B2**	**Γ2**
0.45	**A3***	**B3***	**Γ3***
0.35	**A3**	**B3**	**Γ3**
0.25	**A4***	**B4***	**Γ4***
<0.25	**A4**	**B4**	**Γ4**

- $a_{g,ref}$ είναι η οριζόντια εδαφική επιτάχυνση αναφοράς, που ορίζεται με πιθανότητα υπέρβασης της σεισμικής δράσης 10% στα 50 χρόνια συμβατικής ζωής του έργου.
- a_g είναι η οριζόντια εδαφική επιτάχυνση.

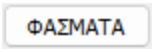
δ. Σεισμική κλάση κτιρίου ορίζεται ως ο μέγιστος στόχος αποτίμησης ή ανασχεδιασμού που μπορεί να εξασφαλίσει ένα κτίριο για μια επιλεγείσα στάθμη επιτελεστικότητας. Η σεισμική κλάση κτιρίου για στάθμη επιτελεστικότητας Β («Σημαντικές Βλάβες») θεωρείται **βασική σεισμική κλάση**.

Based on the above table we can summarize that my level of performance determines m, q (elastic) and θu (inelastic) and my return period and exceedance probability determines the seismic acceleration αg.

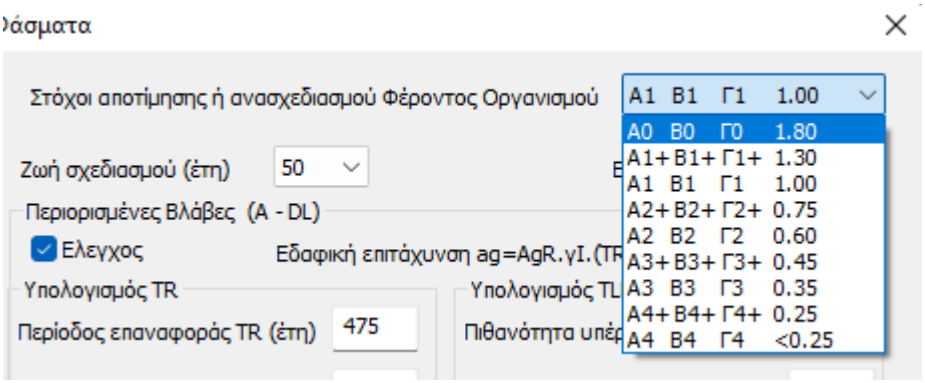
The three valuation targets (or the three seismic classes) for a 10% earthquake are still called A1, B1, C1 and have a factor of one but the targets for a 50% earthquake are now called A3+, B3+, C3+ and have a factor of 0.45 (from 0.53 previously). Still the two basic seismic hazard categories are no longer 10% and 50% but 10% with a factor of 1 and 30% with a factor of 0.60 (the two lines in bold in the table).

In the parameters of the 5 scenarios related to EIS there is now a new field for the ground acceleration that will be calculated and used based on the above table.

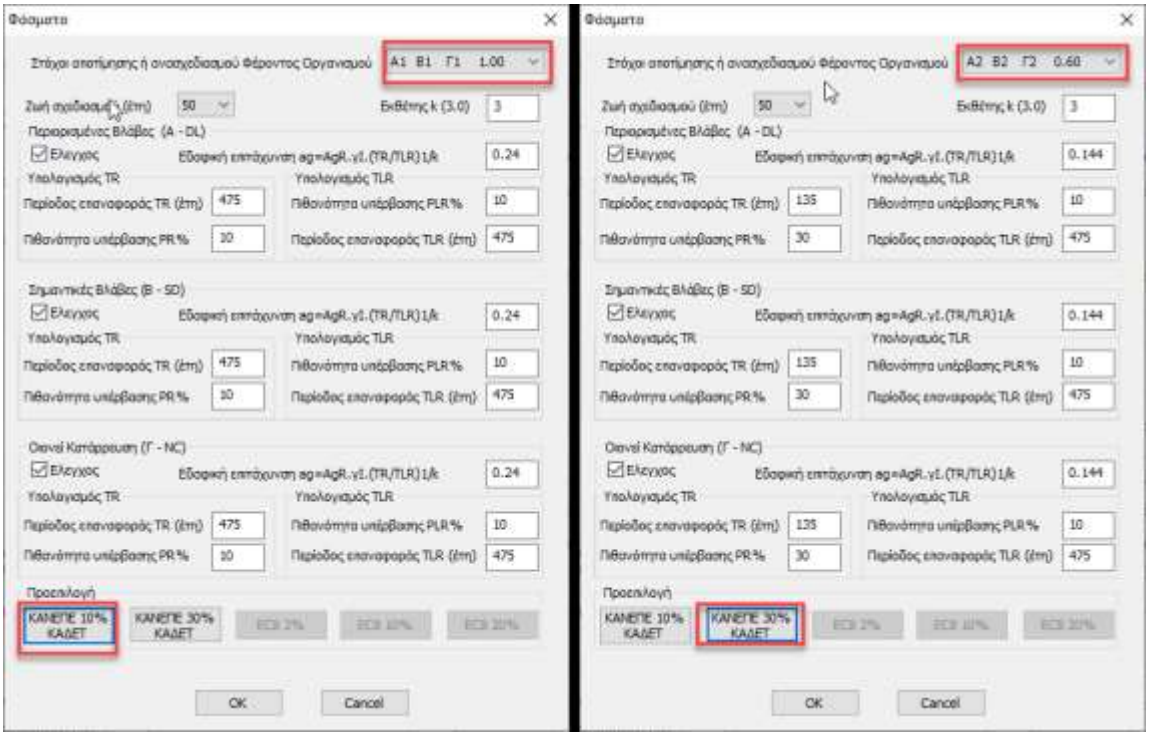
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

Going to the framework 

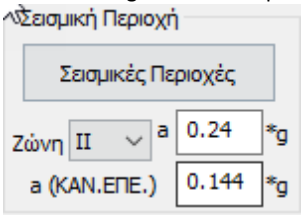
We select the seismic hazard category with the corresponding triad of seismic classes and the factor by which the initial reference ground acceleration will be multiplied in order to obtain the ground acceleration of the CANEPE



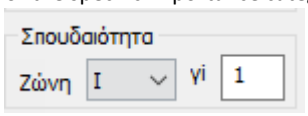
or the default 10% or 30% which automatically sets the Target:



and returning to the initial parameters of the scenario in the field of ground acceleration CAN.EPE.



we see the value of the ground acceleration as it was calculated previously and as it will be used in the execution of the scenario for the calculation of the seismic action.
It is also noted that the γi used for the calculation of the seismic action always becomes 1 (from 0.8 which was before for the specific importance category) based on the following paragraph of the CANEPE.



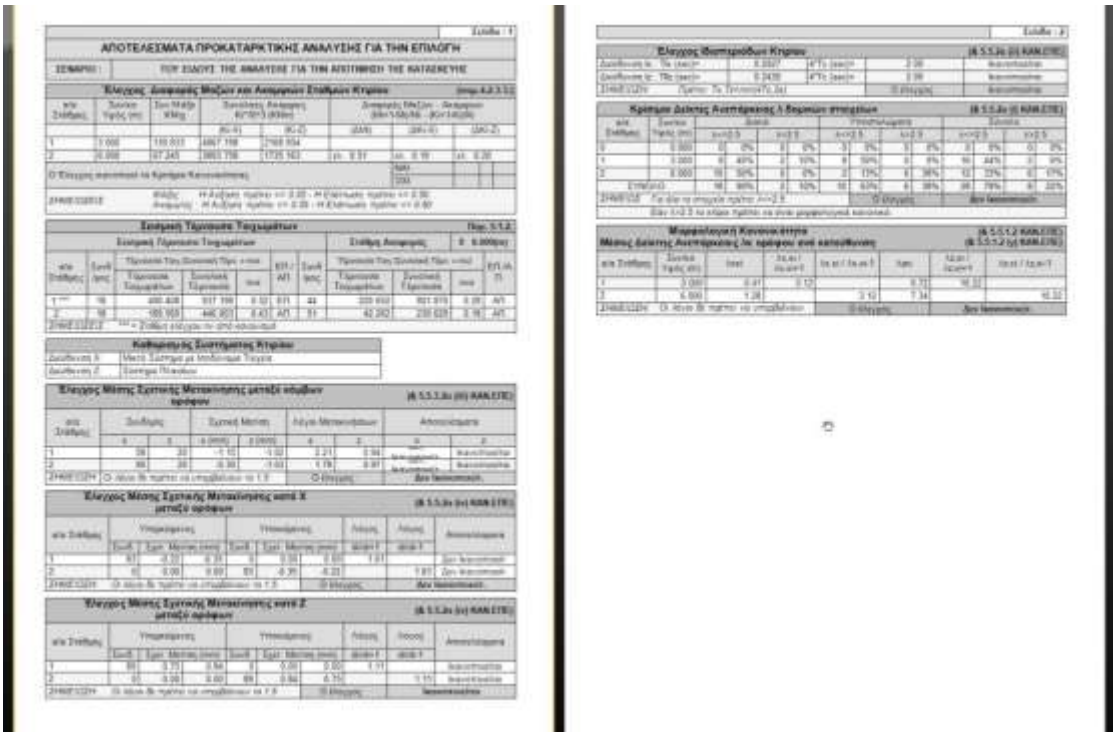
Για πιθανότητα υπερβάσεως 10% εντός του συμβατικού χρόνου των 50 ετών λαμβάνεται υπόψη η σεισμική δράση του ΕΚ 8-1, ενώ για διαφορετική πιθανότητα υπερβάσεως εντός του συμβατικού χρόνου των 50 ετών λαμβάνεται υπόψη το ποσοστό της παραπάνω σεισμικής δράσεως του ΕΚ 8-1, σύμφωνα με τα διαλαμβανόμενα στην § 2.2. θεωρώντας αντίστοιχα σε όλες τις περιπτώσεις τον συντελεστή σπουδαιότητας γ_I ίσο με τη μονάδα.

(3η Αναθεώρηση 2022)

The script is now ready to run without even needing a spectrum update.

You then run the script, save the file of combinations and in the "**Checks**" option, the results of the checks for the method selection criteria are displayed.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



The **<u>mass and stiffness difference test</u>** relates to criterion (v) of section (a) of *§ 5.5.2 of the CEQS.*

<u>The seismic wall shear test</u> relates to criterion (vi) of section (a) of
§ 5.5.2 of the EIA.

The **<u>relative movement controls between floors and nodes</u>** relate to criteria (iii) and (iv) of section (a) of *§ 5.5.2 of the EIS*. The first check concerns the relative movement between floors (above and below) and the node check concerns the movement of each node of the floor, relative to the average movement of the floor to which it belongs. Both of these checks are done per direction.

<u>The control of idiosyncrasies</u> relates to criterion (ii) of section (a) of § 5.5.2 of the CEQA.

<u>The tests of inadequacy indicators and morphological regularity</u> relate to criterion (i) of section (a) of § 5.5.2 of the CEQA. The check of the indicator λ is carried out per level separately for beams and columns and the number of beams above or below 2.5 and the percentage of the total number of beams or columns in the building is indicated, at each level respectively. The totals below are the sums per structural element and in total. Finally, the morphological regularity test includes the criterion of the average λki deficiency index of each floor (§ 5.5.1.2(c) CEQA).

OBSERVATIONS:

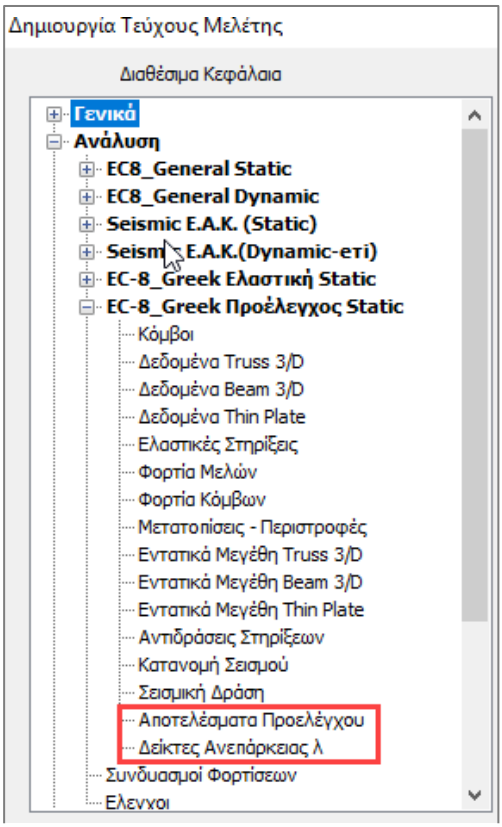
⚠ *The preliminary analysis scenario is used to calculate the criteria for selecting the type of analysis and gives an idea of the regularity of the building and the resistance of the building to earthquake.*

If, for example, there are λ>4 ratios for more than 30% of the building's elements, there is no point in further valuation of the building.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

⚠ *It is not used for the valuation and redesign of the building. Elastic or inelastic analysis is used for these procedures.*

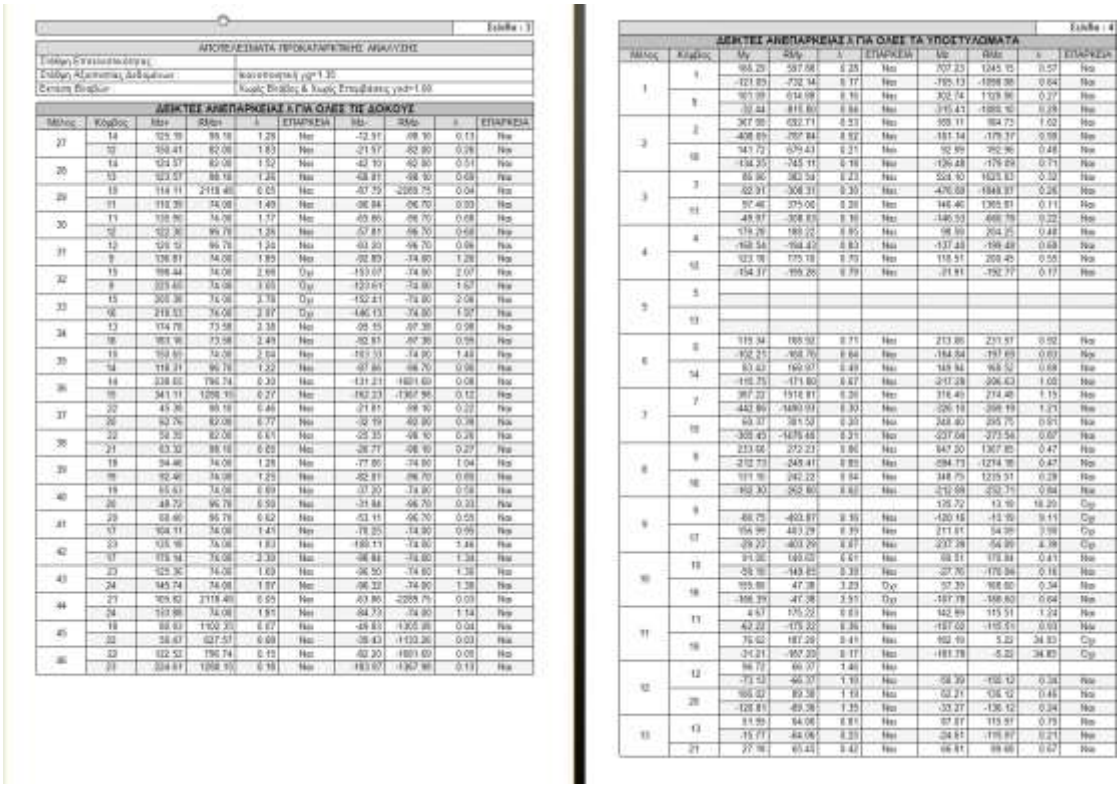
Based on the above criteria, therefore, inelastic (pushover) or elastic (static or dynamic) is applied.



In the field of Prints, for the preliminary analysis scenario, in addition to the known modules, it contains the options :

- **Pre-testing results** (the controls of the criteria analysed above)
- **Indicators of deficiency λ** : where presented in detail for each element the result of the pre-check for beams and columns.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



2.3 Influence of the upper peculiarities

A further check is contained in paragraph 5.7.2(b) of the EIA and relates to **the influence of higher eigenmodes**.

The CAN states that for pushover to apply, the influence of the higher eigenmodes must be insignificant.
The criterion for assessing how significant the influence is is as follows:

In order to check this condition, an initial **dynamic elastic analysis** is required where the seismic shear stress is calculated, for each floor and for each direction of the earthquake, once for those eigenmodes that activate at least 90% of the mass of the building and once for the fundamental (per direction) eigenmodes.

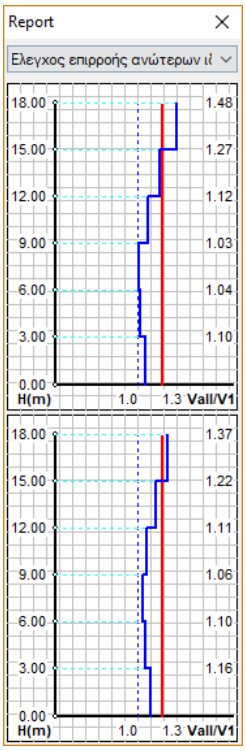
- The influence is considered **significant** when, even on one floor and in one direction, the ratio of the cutting force from the many eigenmodes (Vall) to the cutting force from one eigenmode (V1) is **greater than 1.3**.

➢ This criterion was only incorporated in the scenarios of the **EC8-Greek Dynamic Analysis**.

The results are displayed in three places:

1. In the graph within the analysis by selecting "Upper Eigenmode Influence Check"

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



2. As tabulated results by selecting "Seismic Action"

Έλεγχος Επιρροής Ανωτέρων Ιδιομορφών							(ΚΑΝ.ΕΠΕ. παρ.5.7.2)
α/α Στάθμ.	Συνολικό Ύψος (m)	Χ Διεύθυνση			Υ Διεύθυνση		
		Vall (Kn)	V1 (Kn)	Λόγος	Vall (Kn)	V1 (Kn)	Λόγος
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	3.00	675.33	593.93	1.14	954.65	811.29	1.18
3	6.00	225.85	212.44	1.06	205.84	147.52	1.40
ΣΗΜΕΙΩΣΗ:		*Οι λόγοι δεν πρέπει να υπερβαίνουν την τιμή 1.3*					

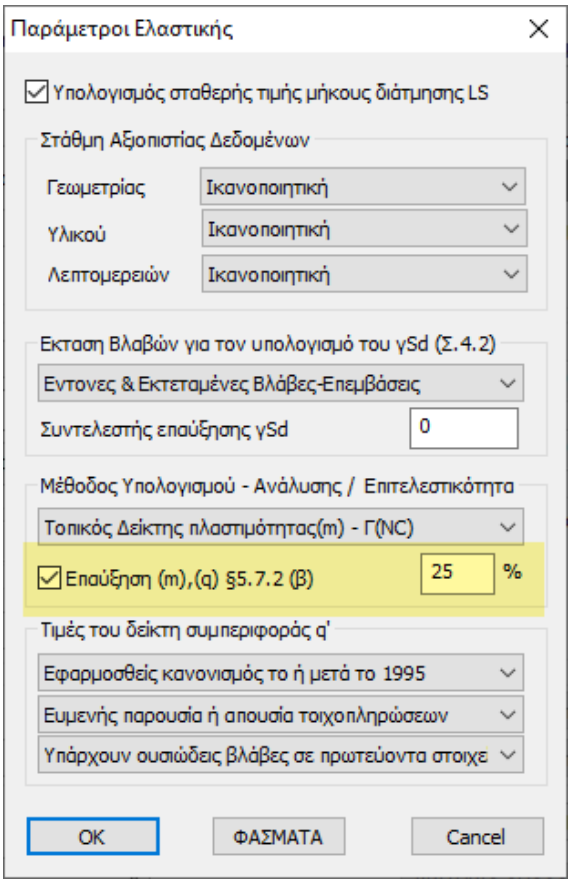
3. And finally in the print issue where an option has been added to the script to print the influence diagram of the upper eigenmodes.

So if this ratio is **greater than 1.3**, even at one level and in one direction, pushover can still be performed, but an elastic dynamic analysis (with seismic action calculated either from the EC8 design spectrum or from acceleration time histories) must be performed in parallel, using either method (m) or method (q).

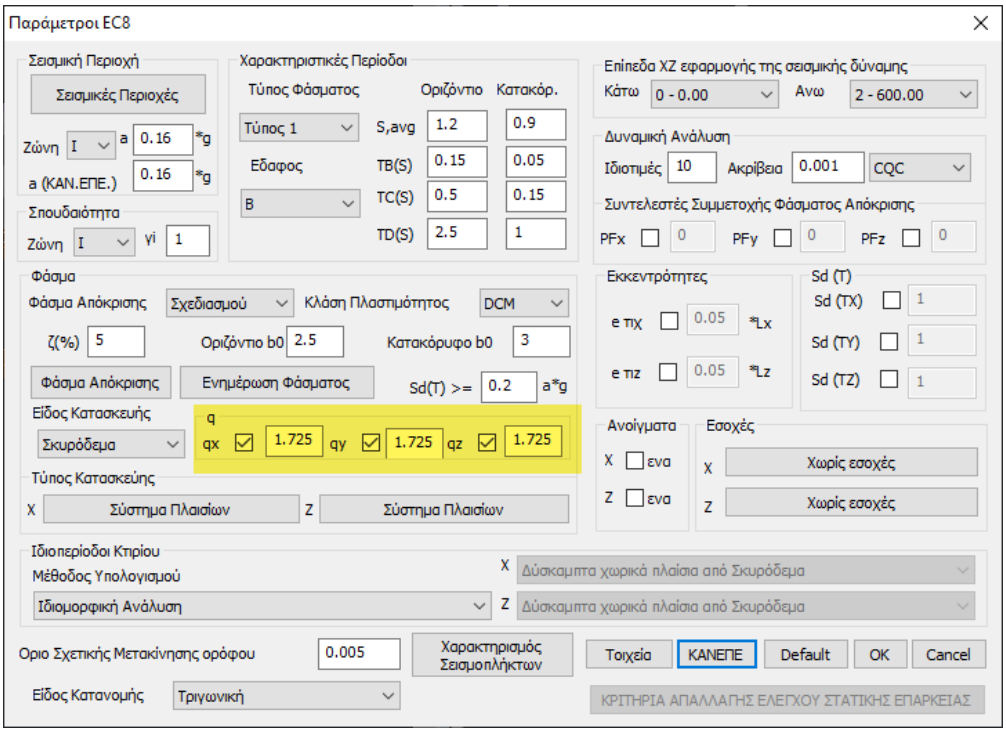
- In this scenario, an increase of these rates by 25% is allowed.
- So of the two scenarios that will be run (pushover and dynamic) the worst-case outcomes should be taken.

This increase of the coefficients is done by the user through the new parameter in the method selection dialog box

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



By checking the corresponding box. For method (q) the result is immediately shown in q appearing in the parameters



while for (m) the augmentation is internal.

- To summarize for the **influence** check of **the upper eigenmodes** the procedure is to check the influence criterion and when it is not met (ratio > 1.3) then in addition to the pushover an elastic dynamic should be performed by checking the 25% increment.

Based on the above criteria, therefore, inelastic (pushover) or elastic (static or dynamic) is applied.

3(a) STEP 3: ANALYTICAL ANALYSIS

3(a).1 General

The main objective of the static anelastic analysis is to estimate the magnitude of the inelastic deformations that will develop in the structural elements of the structure when it is subjected to the seismic action for which the assessment or redesign is performed. These magnitudes of inelastic deformations shall be compared with the allowable values determined on the basis of the target performance level and the capacities of the members.

In the static inelastic analysis, a simulation of the structure is used which takes into account inelastic load-deformation laws for the individual structural elements of the building. For concrete in particular, due to the coexistence of flexural and shear deformations, the inelastic law of bending moment - chord angle of twist (M-i) is used.

The simulation is then subjected to horizontal loads distributed in a manner proportional to the inertial forces of the earthquake. The loads increase monotonically, generally until a structural element is no longer able to carry its vertical loads. During the loading process, each time a cross-section leaks (i.e. a **plastic joint** is formed) the simulation is modified by introducing appropriate connections and the incremental process continues.

At each step of the analysis, the **base shear** (i.e. the *sum of the horizontal loads*) and the displacement of a characteristic point of the tested structure (*control node*), which is generally taken at its top, are recorded.
Thus, the base shear - peak displacement curve called the **resistance curve** is drawn, which is considered representative of the general seismic behaviour of a structure and is the basis for all the required checks for the satisfaction of the performance criteria.

The primary resistance curve is idealised into a bilinear curve which is assumed to correspond to the force-displacement diagram of an equivalent single-stage system, the response of which is correlated with the response of the structure.

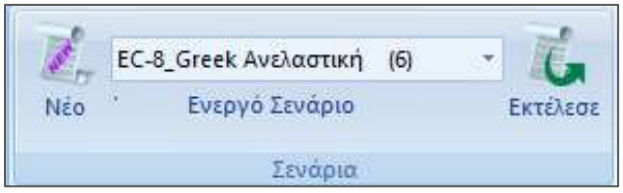
The design earthquake enters the process through its imposed movement of the control node, which is called **targeted movement**. The targeted displacement is calculated with the help of the elastic design spectrum of the excitation by applying the so-called displacement modification method. According to this, the target displacement is obtained from the elastic displacement of the equivalent single-stage system, which is multiplied by a number of correction factors to take into account certain factors such as the difference from the peak displacement of the beam, the difference in elastic/elastic displacement, the degradation of strengths and stiffnesses due to cyclic loading and the influence of P-D effects.

The last step of the Elastic Static Analysis is the check of the performance criteria, i.e. the comparison of the available strength values of the cross-sections of the structure with the required response values corresponding to a displacement of the control node equal to the target one.

For fishy failure modes and behaviour the check shall be in terms of transient quantities, while for plagiform failure modes and behaviour the check shall be in terms of displacements or

deformations. In the latter case, the acceptance criteria are expressed as percentages of exhaustion of the available plastic displacement or deformation, depending on the desired level of performance of the structure.

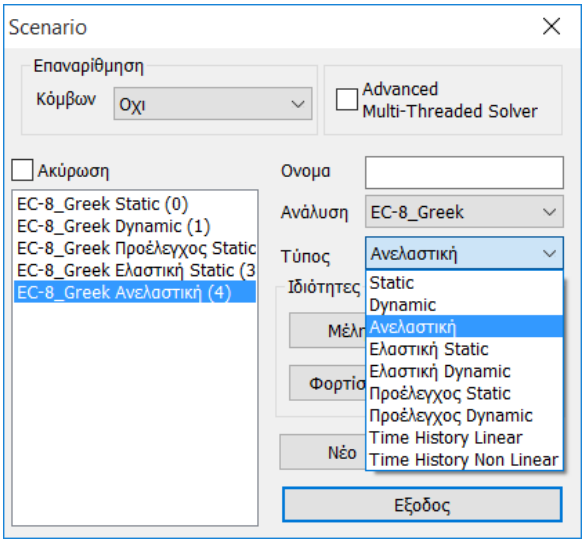
After calculating the M-N interaction diagrams the model is now ready for the pushover analysis.
First, returning to the Section: "**Analysis**", you create an inelastic analysis scenario.



- For Greece, you select EC-8 Greek/Anelastica and for Cyprus, Italy and Austria, for which the Eurocode appendices have been integrated.
  (For all other European countries, select EC-8 General and manually enter the parameters of the respective attachments)
- Especially for static inelastic analysis scenario, whether it is Eurocode 8 or CEE (EC-8_Greek / Inelastic), the multipliers of inertial quantities
  to be defined here will be taken into account in the first Pushover analysis concerning the permanent and mobile loads with default values those provided by EC8.
- *Then, in the parameters of the inelastic analysis, you can specify whether these values will be kept the same as in the first step in all*
  the steps of the process or whether they will be reduced at each step, starting of course from the whole initial values. Impairment may be applied either at the beginning of each step or after the plastic joint has been created.

3(a).2 Creating an Elastic Analysis Scenario

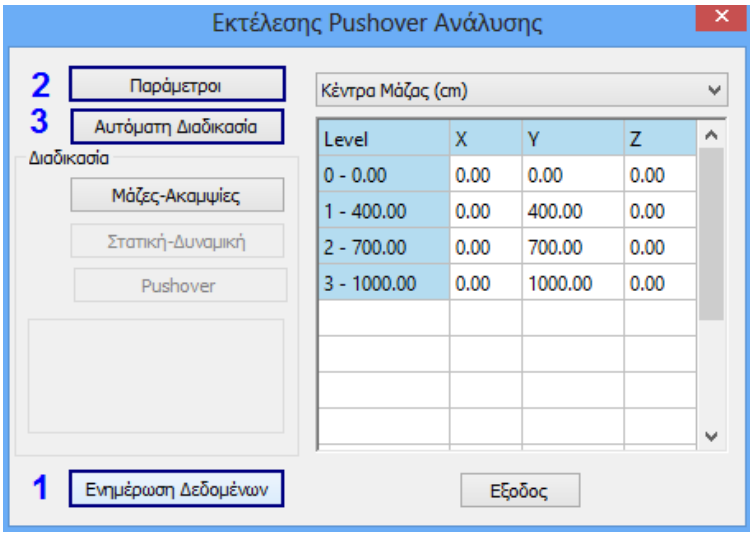
Within the list of scenarios, in addition to the two default scenarios, the inelastic scenario has now been created.



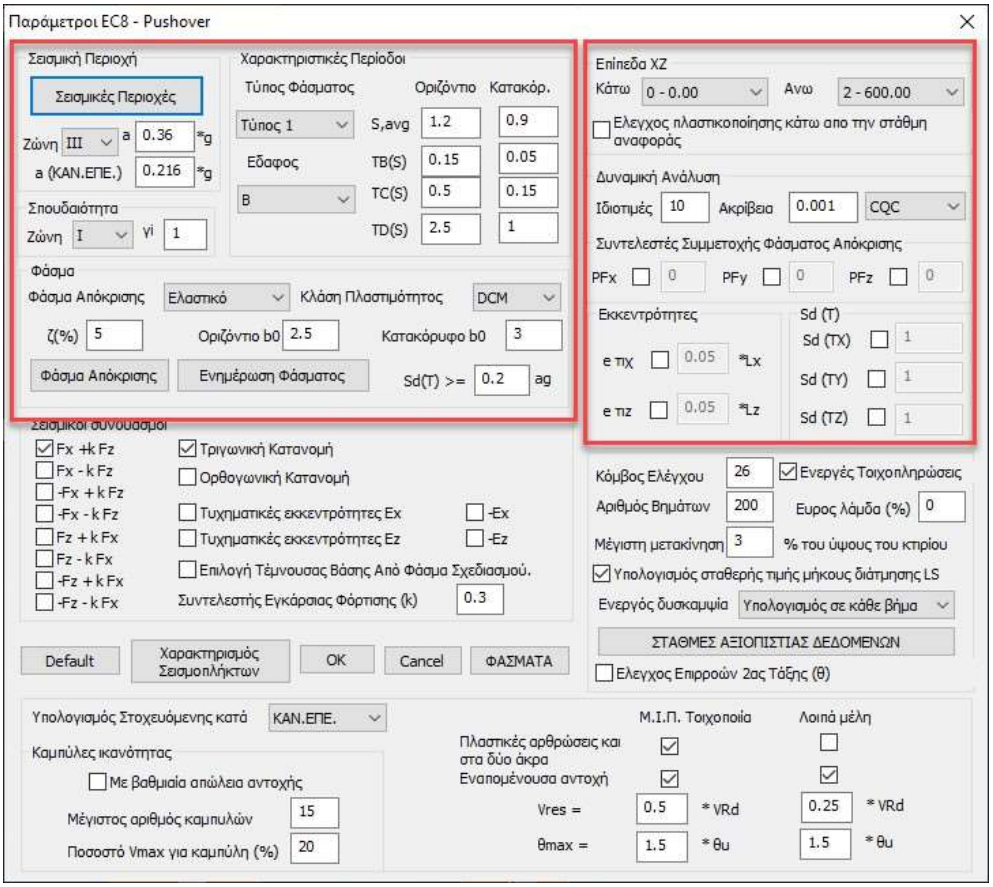
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

3(a).3 Scenario execution

3(a).3.1 Updating Data



3(a).3.2 Parameters

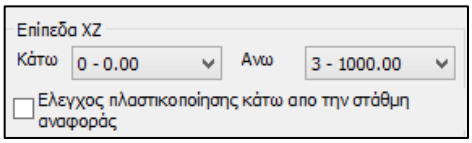


In the above dialogue box of the parameters of the inelastic analysis, the definition of the parameters in the two boxes enclosed by the two rectangles is the same as in the corresponding Eurocode scenario.

OBSERVATION:

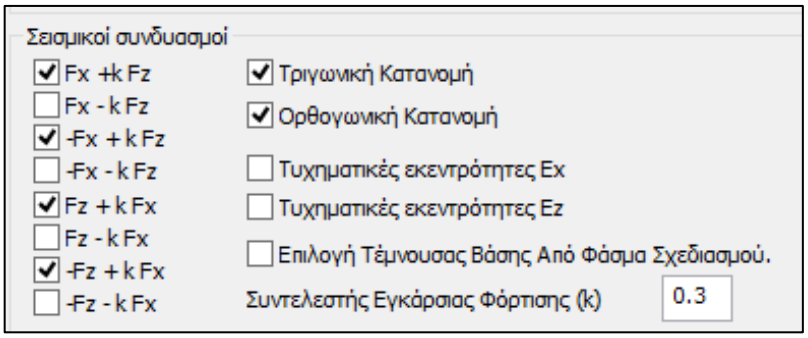
⚠ *It is important that according to CAN.EPE the response range should be* ***Elastic****.*

- In the "**XZ Levels**" section



You define from which level to which level the horizontal seismic load will be applied It is suggested that the upper level be defined as the last full level (not staircase ends). This level will include the control node, which will be either the bulkhead node or another node on the outer perimeter of the building.
The option "Check for plasticization below the reference level" when checked takes into account as possible locations of plastic joints also elements below the reference level.

In the section "**Seismic Combinations**"



- You define the combinations for which inelastic analyses will be performed. Each combination means that a seismic force will be applied in the specific direction (x or z) with a factor of 1 and a seismic force in the transverse direction with a factor which you specify in the 'Transverse loading factor' field.

  ⚠ *The default value is 0.3.*

- You also specify the type of distribution of the seismic force along the height of the building (triangular or rectangular).

  ⚠ *The EIA requires both seismic distributions.*

EPE 5.7.3.3.3 Distribution of seismic loads by height

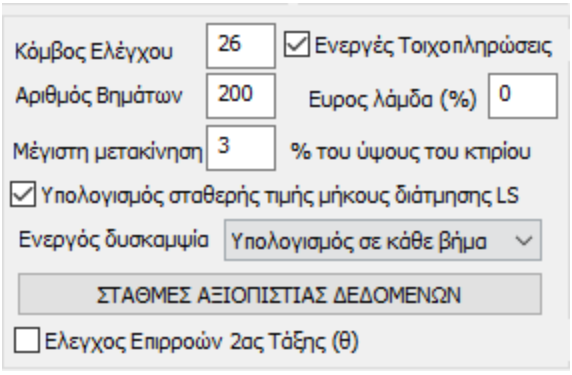
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

The horizontal static loads will be applied at the level of each diaphragm (floor slab), according to the distribution of the inertial loads of the earthquake. All analyses shall require the application of at least two different load distributions per height, in order to take into account (as far as possible) the variation of load distribution due to the meteorological behaviour of certain areas of the structure, but also due to the influence of the upper eigenmodes.

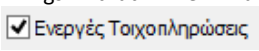
- Also, if you want to take into account, in addition to the seismic forces, moments resulting from the accidental eccentricities, activate the fields "Accidental eccentricities Eh and Ez".
- "Select Base Cutting Force from Design Spectrum" when checked, uses as base cutting force the one calculated by the dynamic analysis.

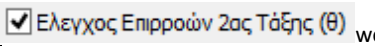
⚠ *Selecting all combinations with the random eccentricities produces a total of 64 combinations which means 64 inelastic analyses resulting in an increase in vector resolution time.*

- Here are the parameters listed in the following section



In the option "**Active Wall Fillings**" we select whether we want to take into account in the analysis the wall fillings that we have included in our construction .



In the option "**2nd Order (i) Influence Check**  we choose to perform the relevant check.

"**Control node**" you specify the number of the control node on the basis of which the targeted movement will be calculated.

CAN.EPE 5.7.3.2 Definition of the control node

The control node of the targeted movement will generally be taken at the centre of mass of the roof of the building. For buildings with attics or small dwellings in the attic, the control node shall be taken at the roof of the full underlying floor. The movement of the control node shall be calculated from the simulation analysis for horizontal static loads.

This node is usually the bulkhead node of the last full floor of the building. If there is no bulkhead, choose a perimeter node from the same level. In this example, the Control Node is 63.

"**Number of Steps**" sets the maximum number of steps (analyses) that each inelastic analysis will perform Pushover is an iterative process that is terminated, when no other limit is set, once the vector is converted to a mechanism. The number of steps is an upper maximum limit in order to avoid too many steps before the vector becomes a mechanism.

- The default value is 200.

The **"Maximum movement"** option as a percentage (%) of the total height of the building is second way to set an upper limit on the number of steps before the carrier becomes a mechanism. The process stops as soon as the maximum movement of the control node exceeds the specified percentage of the building height.

- The default value is 3% of the total height of the building.

The next parameter **"Lambda range (%)"** refers to the load factor λ. At each step the load factor λ is calculated for each element and the minimum value from all the structural elements determines that element at which the plastic joint will be created. With the default value of 0 in this parameter, the program selects a minimum value, i.e. only one element, even if there are values from other elements that are very close to this value.

- Setting a value different from 0 e.g. 10% means that those λ values that are less than or equal to the minimum value λ plus 10% will be taken into account in this step, resulting in a single step to create more than one plastic joint at a time and thus reducing the number of steps in the analysis.

EXAMPLE:
Suppose that in the first step of the pushover or minimum value λ is 1 and corresponds to a specific structural element on which the plastic joint will be created. By setting a value of 10% in this parameter, elements with λ values from 1 to 1.1 will also have plastic joints created in them, simultaneously with the first element.

In the **"Calculate constant LS shear length value"** option you specify:

- whether the shear length of the elements will be calculated with a fixed value based on their length in all steps as provided for in the CEQA (ticked)

EPE **The calculation of stiffness according to Eq. (2) through My, ϑy can be based on a fixed value of Ls, as follows:*
− In beams connected at both ends by vertical members, Ls may be taken to be equal to half the net span of the beam.
− In beams connected to a vertical member at one end only, Ls may be taken to be equal to the total net span of the beam.

− In columns, Ls may be taken as half of the net height between beams to which the column is monolithically connected within the considered plane of bending.
− In walls, Ls can be taken on each floor differently and equal to half the distance of the floor base cross-section from the top of the wall in the building.

- or whether it shall be calculated at each step of the inelastic analysis on the basis of the resulting intensities, where

  Shear length = M/V at the end section of the element, i.e. the distance of the end section from the zero point of the moments.

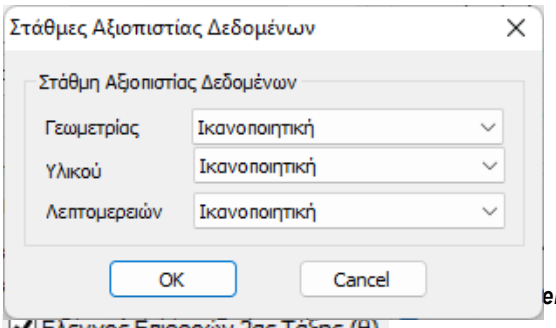
The parameter **"Active stiffness"** concerns the way of calculating the stiffnesses of the elements of the structure.

CAN.EPE *7.2.3. Active stiffness of OS data
The active stiffness of the element length Ls equal to: ***K=MyLs/3θy (2)***
where My and θy are the value of the moment and chord angle of twist, respectively, at the yielding of the end section of the element.
The active stiffness K of the total length of the element can be taken to be equal to average of the values calculated from Eq. (2) at the two end cross-sections of the element. If these cross-sections have a non-symmetrical shape or reinforcement (i.e. different for positive or negative bending moment), the average of the values of K from Eq. (2) for the two times of bending (positive or negative).

The first step of the inelastic analysis is to calculate intensive quantities from the permanent and mobile loads of the structure. The stiffnesses taken into account for these quantities are multiplied by the coefficients specified in the scenario parameters in the "Members" option. In the second step of the inelastic analysis where the seismic load is applied the program now gives three possibilities for this calculation.

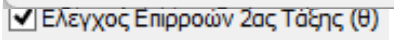
- **Home** : The rigidities of the elements will be maintained with coefficients of units in all the steps of the process.
- **Calculation at each step** : The CAN.EPE provides at each step of the pushover a reduction of stiffness. This option recalculates at each step, regardless of whether or not a plastic joint has been created, the stiffnesses based on the stiffnesses specified in the EPC. The value of the stiffnesses to which the impairment is applied is the original value, not the impaired value applied only in the first step.
- **After the plastic joint** : This option is the same as the previous one with the difference that the impairment takes place after the plastic joint is created. Until the step this element retains the rigidity of the first step.
- Finally, in the **"Data Reliability Level"** option, you select the corresponding SDSs.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



for the existing building according to the provisions of the CEE. This choice affects the coefficient of permanent loads **γg** on the basis of which the building will be solved.

ence Check (i)"



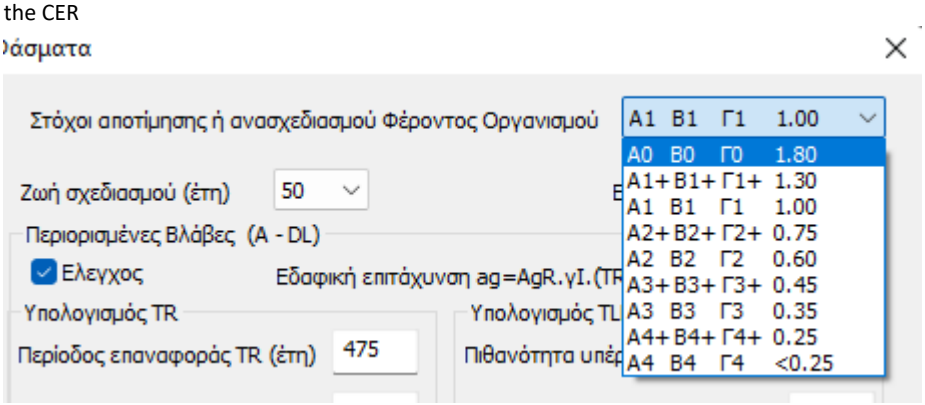
we choose to perform the relevant check.

In this example, the default values of the parameters were selected.

The "**PHASMS**" button refers to the Targeted Behavior in relation to the Damage Level. Selecting it displays the following

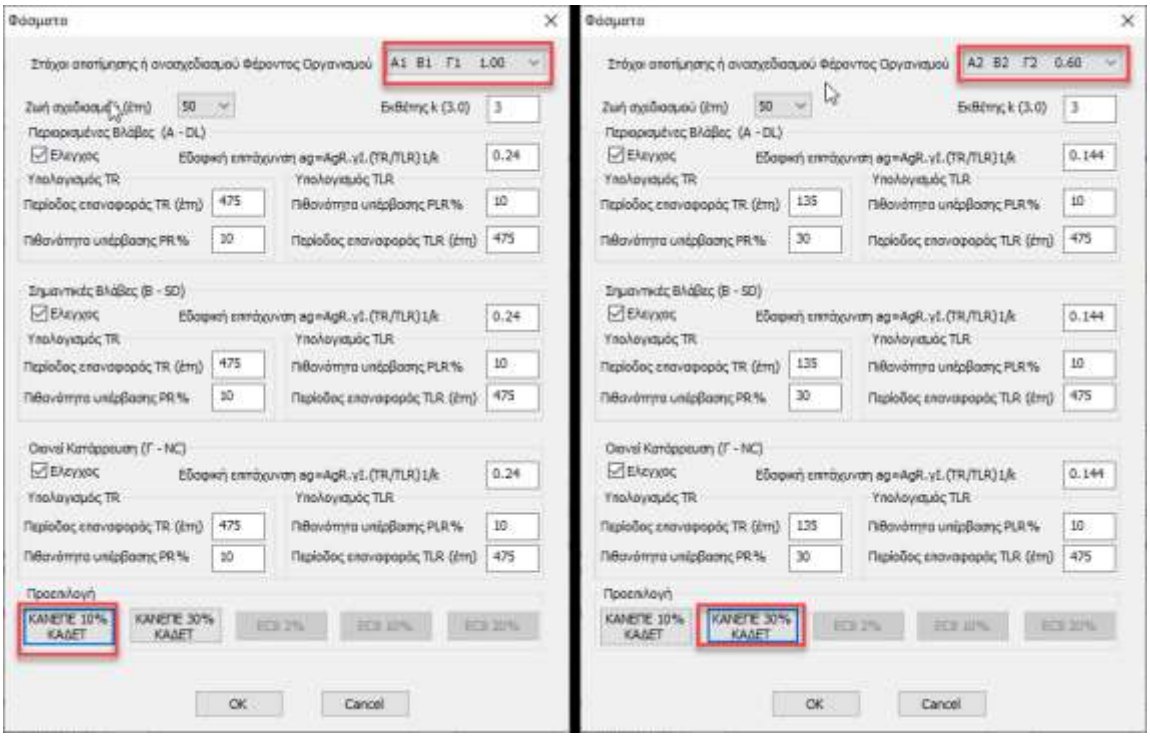
dialog box:

We select the seismic hazard category with the corresponding seismic triad
and the factor by which the initial reference ground acceleration is to be multiplied to obtain the ground acceleration of the CER

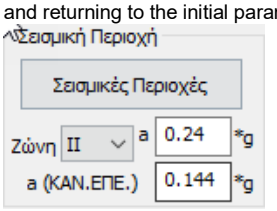


or the default 10% or 30% which automatically sets the Target:

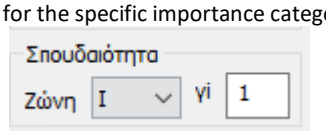
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



and returning to the initial parameters of the scenario in the field of ground acceleration CAN.EPE.



we see the value of the ground acceleration as it was calculated previously and as it will be used in the execution of the scenario for the calculation of the seismic action.
It is also noted that the γi used for the calculation of the seismic action always becomes 1 (from 0.8 which was before for the specific importance category) based on the following paragraph of the CANEPE.

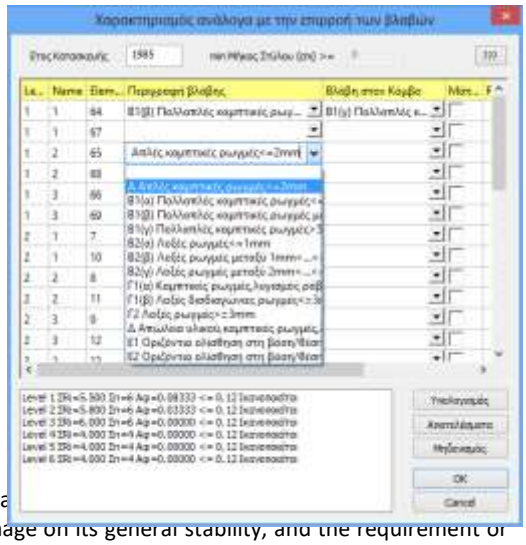


Για πιθανότητα υπερβάσεως 10% εντός του συμβατικού χρόνου των 50 ετών λαμβάνεται υπόψη η σεισμική δράση του ΕΚ 8-1, ενώ για διαφορετική πιθανότητα υπερβάσεως εντός του συμβατικού χρόνου των 50 ετών λαμβάνεται υπόψη το ποσοστό της παραπάνω σεισμικής δράσεως του ΕΚ 8-1, σύμφωνα με τα διαλαμβανόμενα στην § 2.2. θεωρώντας αντίστοιχα σε όλες τις περιπτώσεις τον συντελεστή σπουδαιότητας γ_I ίσο με τη μονάδα.

The script is now ready to run without even needing a spectrum update.

G. Earthquake victims - Official Gazette, No. No. 455, 25/02/20

Χαρακτηρισμός Σεισμοπλήκτων



CHARACTERISATION OF EARTHQUAKE VICTIMS
Definition minimum mandatory requirements for the preparation of studies for the restoration of reinforced concrete buildings damaged by earthquakes and the issue of the relevant repair permits.

Through the Χαρακτηρισμός Σεισμοπλήκτων command inside the analysis pa
classification of buildings according to the influence of the damage on its general stability, and the requirement or not for the preparation of rehabilitation studies for reinforced concrete buildings damaged by earthquake and the issuance of the relevant repair permits.
According to the F.E.K., depending on the loss of load-bearing capacity (Af) and the time studied, buildings are classified as follows:

ΚΤΙΡΙΑ ΜΕ ΒΛΑΒΕΣ ΠΕΡΙΟΡΙΣΜΕΝΗΣ ΣΠΟΥΔΑΙΟΤΗΤΑΣ (ΤΟΠΙΚΟΥ ΧΑΡΑΚΤΗΡΑ)	Αφ ≤ 0,12
ΚΤΙΡΙΑ ΜΕ ΒΛΑΒΕΣ ΠΟΥ ΕΠΗΡΕΑΖΟΥΝ ΕΝ ΓΕΝΕΙ ΤΗΝ ΑΣΦΑΛΕΙΑ ΤΟΥ ΚΤΙΡΙΟΥ (ΓΕΝΙΚΟΥ ΧΑΡΑΚΤΗΡΑ)	Αφ > 0,12

- Af≤0,12 No valuation study required
- Af>0,12 Valuation study required

Select the command and in the window "Characterization according to the influence of faults" define the fault in the members and/or nodes.
Enter the date of issue of the construction permit.

Members are displayed by level with their physical and mathematical number and aside, in case of failure, select one of the descriptions as detailed in

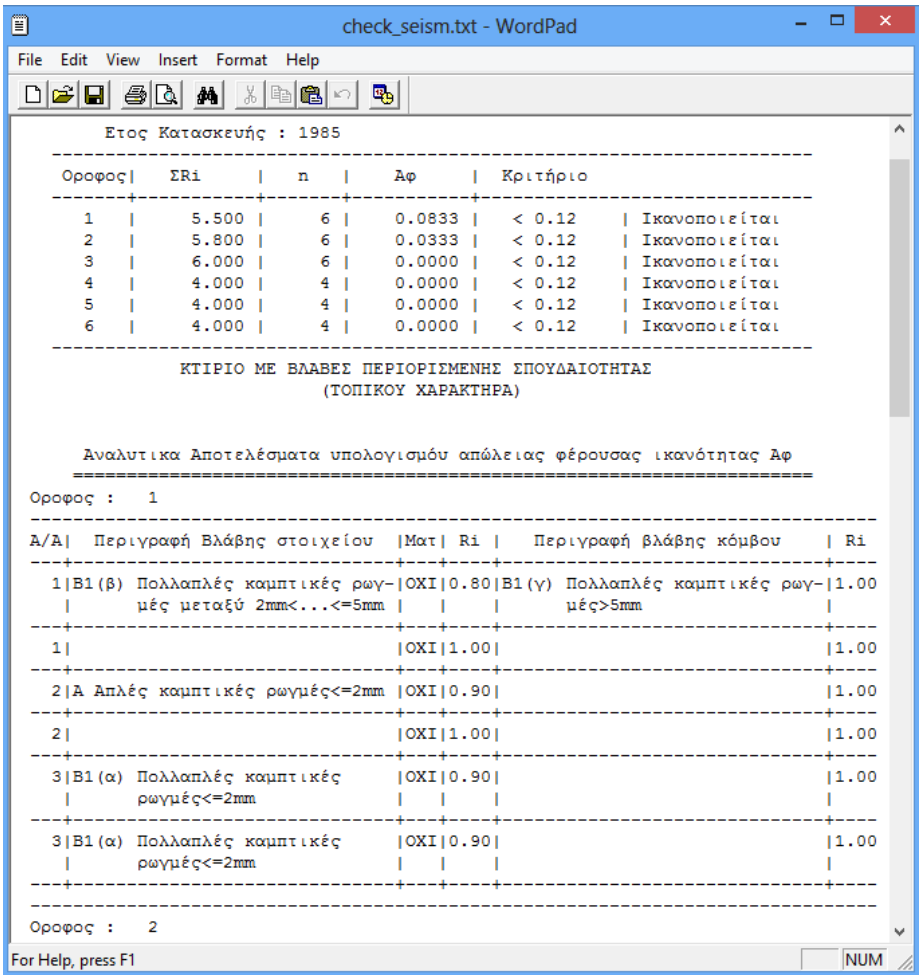
the corresponding F.E.K., which opens as a pdf file, by pressing the ???

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

After you have finished the description, press the button Υπολογισμός to see the summary results by level, at the bottom of the window

```
Level 1 ΣRi=5.500 Σn=6 Αφ=0.08333 <= 0.12 Ικανοποιείται
Level 2 ΣRi=5.800 Σn=6 Αφ=0.03333 <= 0.12 Ικανοποιείται
Level 3 ΣRi=6.000 Σn=6 Αφ=0.00000 <= 0.12 Ικανοποιείται
Level 4 ΣRi=4.000 Σn=4 Αφ=0.00000 <= 0.12 Ικανοποιείται
Level 5 ΣRi=4.000 Σn=4 Αφ=0.00000 <= 0.12 Ικανοποιείται
Level 6 ΣRi=4.000 Σn=4 Αφ=0.00000 <= 0.12 Ικανοποιείται
```

Selecting the command Αποτελέσματα opens the .txt file with detailed results of the tests per floor.



OBSERVATION:

In cases where there is a requirement for the preparation of rehabilitation studies for earthquake-affected buildings (Af>0.12), then the corresponding Acceleration Range for the Design of Repairs should be determined, in accordance with the relevant F.E.K.

H. Spectrum acceleration for on design repair design earthquake victims - Fire-ravaged buildings

You have the option to apply GGC455/25-2-14 and GGC2775/18-12-15 and automatically calculate the acceleration range for the design of earthquake and fire damaged building repairs.
The 2 GGCs are identical and the difference between them concerns the definition of the Characterisation of buildings depending on the influence of the damage.

- For the **Earthquake Affected** Buildings Government Gazette 455/25-2-14 the determination of the Characterization is made according to the

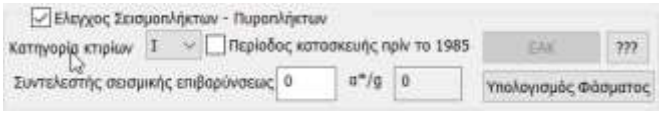
loss of load-bearing capacity (Af) and the time studied, the buildings are classified as follows:

ΚΤΙΡΙΑ ΜΕ ΒΛΑΒΕΣ ΠΕΡΙΟΡΙΣΜΕΝΗΣ ΣΠΟΥΔΑΙΟΤΗΤΑΣ (ΤΟΠΙΚΟΥ ΧΑΡΑΚΤΗΡΑ)	Αφ ≤ 0,12
ΚΤΙΡΙΑ ΜΕ ΒΛΑΒΕΣ ΠΟΥ ΕΠΗΡΕΑΖΟΥΝ ΕΝ ΓΕΝΕΙ ΤΗΝ ΑΣΦΑΛΕΙΑ ΤΟΥ ΚΤΙΡΙΟΥ (ΓΕΝΙΚΟΥ ΧΑΡΑΚΤΗΡΑ)	Αφ > 0,12

- While for the fire-affected buildings, the classification of the damage (i.e.

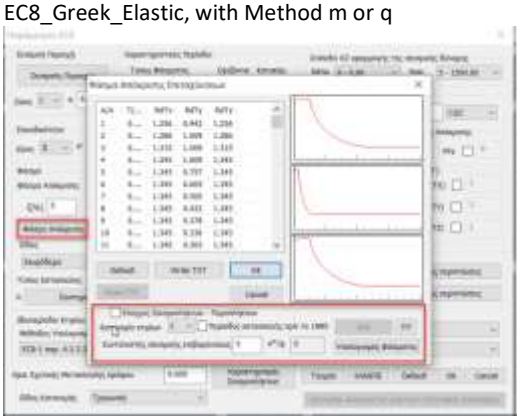
affect or not the general stability of the building) is determined on the basis of the above-mentioned description and number of damages estimated and proposed by the designer.

Depending on the choice of the analysis scenario, either *linear* or *non-linear* analysis, you can define the acceleration range for earthquake and fire affected buildings through the corresponding parameters.

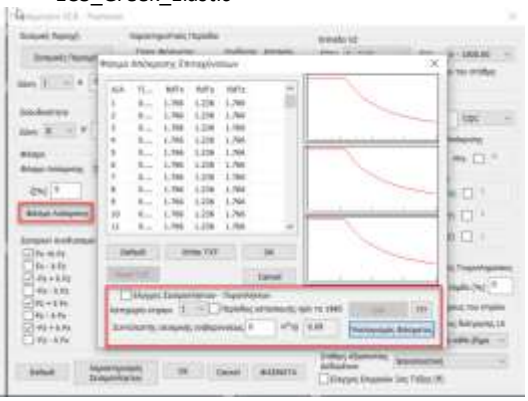


Select the analysis scenario and open the parameters

EC8_Greek_Elastic, with Method m or q



EC8_Greek_Elastic

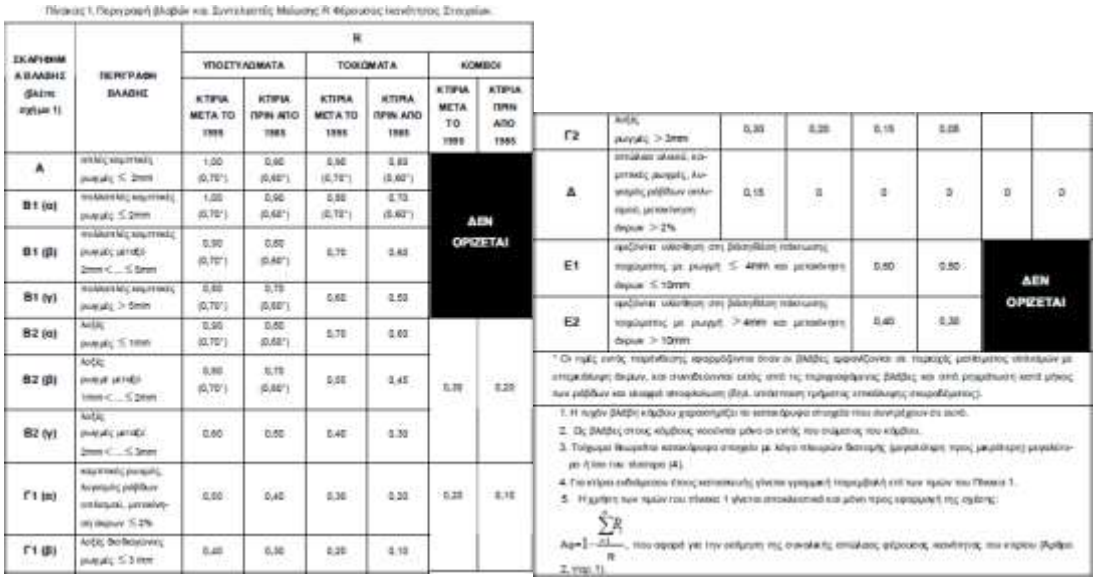


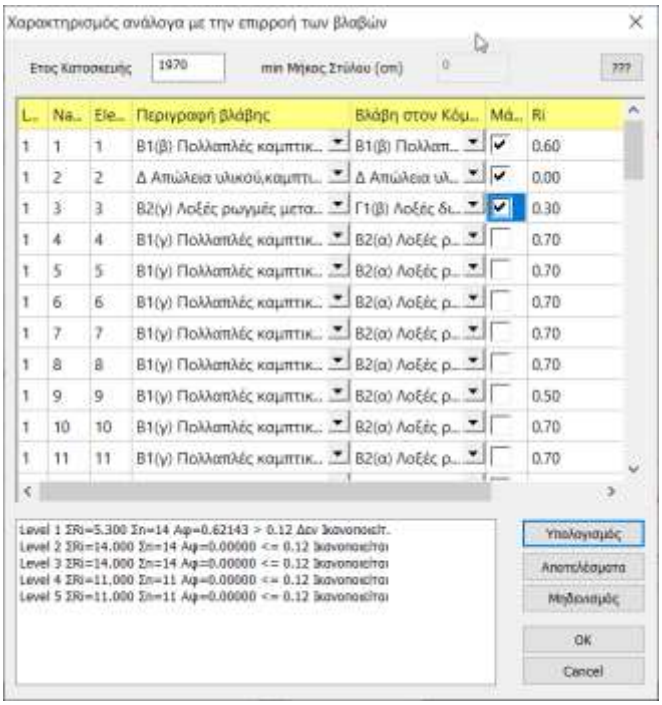
- For the **earthquake victims**:

Preceded by 

where Table 1 (Fault description and Reduction Factors R Reduction Factors R Element Capacity)

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.





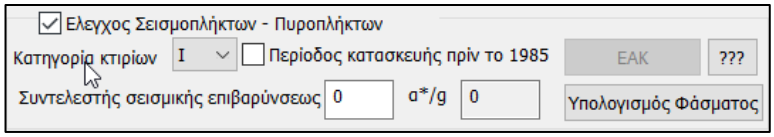
from which the requirement to prepare rehabilitation studies has been derived (i.e. where Af>0,12) and

- for the **fire victims**

with damage affecting the general safety of the building (of a general nature)

- select Φάσμα Απόκρισης to set the range.

The bottom part of the window that opens is about the earthquake-affected fire victims:



in case the designer wants to take into account in the pushover a spectrum other than that of EC8-1. Paragraph 5.7.4.2 of the EIA Code states that the spectrum used is that of EC8. The program by default uses this spectrum.

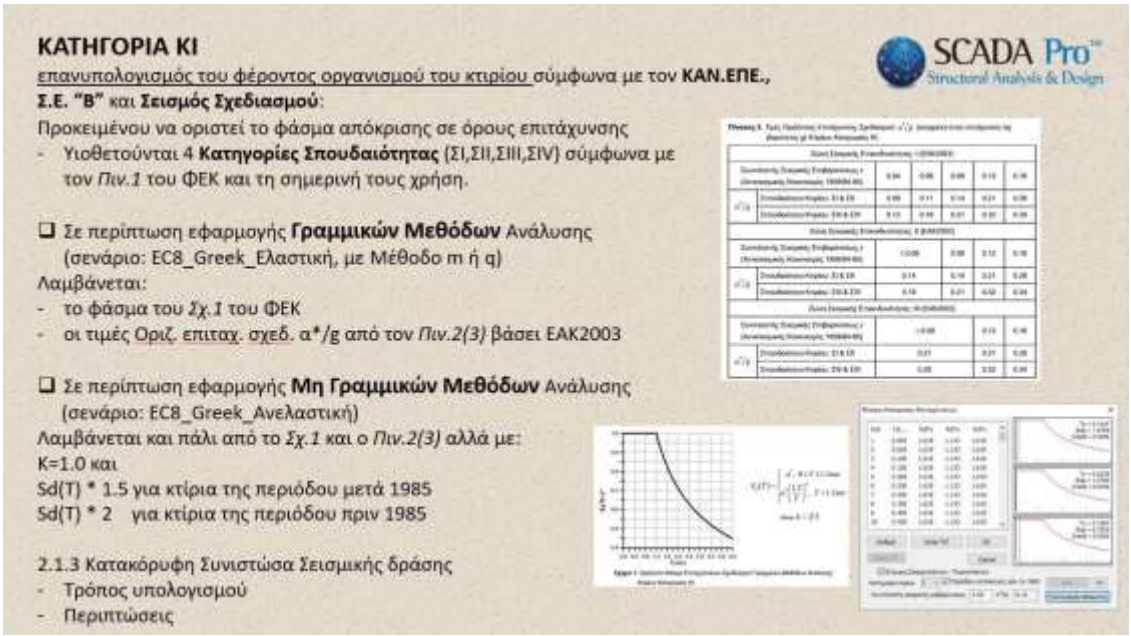
If the designer wants to take into account the spectrum of earthquake-fire victims, he/she checks the option "***Check Earthquake-Fire Victims***" and the program takes into account this spectrum or any other spectrum entered "manually" in the table of values. Also, when the earthquake-firefatality spectrum is selected, it prints only the one targeted for performance level B.

The Objective for the Assessment and Design of the load-bearing structure of reinforced concrete buildings is a combination of:

- of a **Performance Level**: the level is defined for all cases **"Significant Damage" (B)**,
- of a **Seismic Action** (design earthquake): according to **the CATEGORY (KI, KII)** of the building.

To check the earthquake-fire victims, first activate the corresponding checkbox
☑ Ελεγχος Σεισμοπλήκτων - Πυροπλήκτων .
Then you define the "Category of buildings" according to the Government Gazette 455/25-2-14 or Government Gazette 2775/18-12-15 where two categories of existing earthquake-affected-fire-affected buildings made of reinforced concrete (I,II) are distinguished, depending on the method of seismic calculation with which they were designed.

i. For buildings of category KI:



set the "***Seismic Load Factor e***" used for the design of the building, for the calculation of the *Horizontal Design Acceleration a*/g* according to Table 3 or 2 respectively (they are the same with differential numbering) and select the command Υπολογισμός Φάσματος

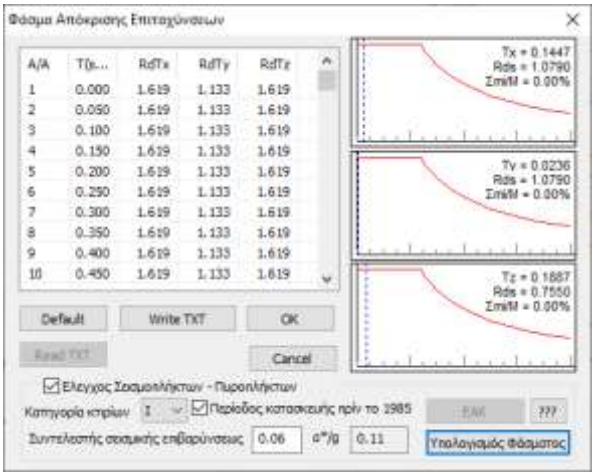
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

Πίνακας 2: Τιμές Οριζόντιας Επιτάχυνσης Σχεδιασμού a^*/g (αντιμετάθεση στην επιτάχυνση της βαρύτητας g) Κτιρίων Κατηγορίας Κ.

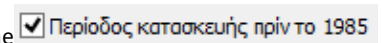
Ζώνη Σεισμικής Επικινδυνότητας: I (ΕΑΚ2003)						
Συντελεστής Σεισμικής Επιβαρύνσεως ε (Αντισεισμικός Κανονισμός 1959/84-85)		0.04	0.06	0.08	0.12	0.16
a^*/g	Σπουδαιότητα Κτιρίου: ΣΙ & ΣΙΙ	0.09	0.11	0.14	0.21	0.28
	Σπουδαιότητα Κτιρίου: ΣΙΙΙ & ΣΙV	0.12	0.16	0.21	0.32	0.34
Ζώνη Σεισμικής Επικινδυνότητας: II (ΕΑΚ2003)						
Συντελεστής Σεισμικής Επιβαρύνσεως ε (Αντισεισμικός Κανονισμός 1959/84-85)		≤ 0.06	0.08	0.12	0.16	
a^*/g	Σπουδαιότητα Κτιρίου: ΣΙ & ΣΙΙ	0.14	0.14	0.21	0.28	
	Σπουδαιότητα Κτιρίου: ΣΙΙΙ & ΣΙV	0.18	0.21	0.32	0.34	
Ζώνη Σεισμικής Επικινδυνότητας: III (ΕΑΚ2003)						
Συντελεστής Σεισμικής Επιβαρύνσεως ε (Αντισεισμικός Κανονισμός 1959/84-85)		≤ 0.08		0.12	0.16	
a^*/g	Σπουδαιότητα Κτιρίου: ΣΙ & ΣΙΙ	0.21		0.21	0.28	
	Σπουδαιότητα Κτιρίου: ΣΙΙΙ & ΣΙV	0.28		0.32	0.34	

Ζώνη Σεισμικής Επικινδυνότητας: I (ΕΑΚ2003)						
Συντελεστής Σεισμικής Επιβαρύνσεως ε (Αντισεισμικός Κανονισμός 1959/84-85)		0.04	0.06	0.08	0.12	0.16
a^*/g	Σπουδαιότητα Κτιρίου: ΣΙ & ΣΙΙ	0.09	0.11	0.14	0.21	0.28
	Σπουδαιότητα Κτιρίου: ΣΙΙΙ & ΣΙV	0.12	0.16	0.21	0.32	0.34
Ζώνη Σεισμικής Επικινδυνότητας: II (ΕΑΚ2003)						
Συντελεστής Σεισμικής Επιβαρύνσεως ε (Αντισεισμικός Κανονισμός 1959/84-85)		≤ 0.06	0.08	0.12	0.16	
a^*/g	Σπουδαιότητα Κτιρίου: ΣΙ & ΣΙΙ	0.14	0.14	0.21	0.28	
	Σπουδαιότητα Κτιρίου: ΣΙΙΙ & ΣΙV	0.18	0.21	0.32	0.34	
Ζώνη Σεισμικής Επικινδυνότητας: III (ΕΑΚ2003)						
Συντελεστής Σεισμικής Επιβαρύνσεως ε (Αντισεισμικός Κανονισμός 1959/84-85)		≤ 0.08		0.12	0.16	
a^*/g	Σπουδαιότητα Κτιρίου: ΣΙ & ΣΙΙ	0.21		0.21	0.28	
	Σπουδαιότητα Κτιρίου: ΣΙΙΙ & ΣΙV	0.28		0.32	0.34	

In buildings designed and/or constructed before 26/02/1959 as well as in buildings without a building permit, either partially or in their entirety, the seismic load factor e will be considered as the factor that should have been taken into account according to the Seismic Regulation of 1959, depending on the seismicity of the area (I, II, III) and the risk of the ground (a, b, c).



In case of application of non-linear methods of analysis, as provided for in the C.E.P.E., a horizontal elastic acceleration spectrum Se (T) shall be used, which shall be derived from the above-mentioned horizontal design spectrum Sd (T) (Figure 2 and Table 3) by setting k= to 1.0 and multiplying the values of the squares of the Sd (T) spectrum by a factor of 1.50 for buildings of the period ...< 1985 and by a factor of 2.00 for buildings of the period 1985 < ... < 1995, respectively.

For this reason, non-linear analysis methods are applied, check the 

checkbox on pre-1985 buildings.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

ii. For buildings of category KII:

ΚΑΤΗΓΟΡΙΑ ΚΙΙ

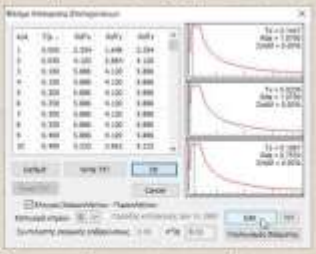
SCADA Pro Structural Analysis & Design

επανυπολογισμός του φέροντος οργανισμού του κτιρίου σύμφωνα με τον **ΚΑΝ.ΕΠΕ., Σ.Ε. "Β"** και **Σεισμός Σχεδιασμού**:

❑ Σε περίπτωση εφαρμογής **Γραμμικών Μεθόδων** Ανάλυσης (σενάριο: EC8_Greek_Ελαστική, με Μέθοδο m ή q)
❑ Σε περίπτωση εφαρμογής **Μη Γραμμικών Μεθόδων** Ανάλυσης (σενάριο: EC8_Greek_Ανελαστική)
Λαμβάνεται:

"Ως φάσμα σχεδιασμού και ελαστικό φάσμα, τόσο για τις οριζόντιες συνιστώσες όσο και για την κατακόρυφη συνιστώσα της σεισμικής δράσης, θα χρησιμοποιούνται τα φάσματα όπως αυτά παρουσιάζονται στους αντίστοιχους **Αντισεισμικούς Κανονισμούς ΝΕΑΚ & ΕΑΚ**, λαμβάνοντας υπόψη όλες τις παραδοχές που είχαν ληφθεί υπόψη κατά τη φάση μελέτης του πυρόπληκτου κτιρίου, αναφορικά με:

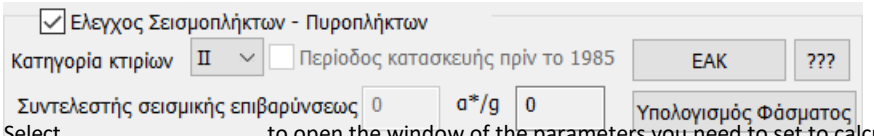
- Τη μέγιστη οριζόντια σεισμική επιτάχυνση εδάφους (A=α.g)
- Το συντελεστή σπουδαιότητας του δομήματος (γι)
- Το συντελεστή συμπεριφοράς του δομήματος (q)
- Το διορθωτικό συντελεστή απόσβεσης (εφόσον είχε ληφθεί υπόψη στη μελέτη) (η)
- Το συντελεστή επιρροής της θεμελίωσης (θ)
- Τις χαρακτηριστικές περιόδους του φάσματος (Τ1,Τ2)
- Το συντελεστή φασματικής ενίσχυσης (β0)
- Την κατηγορία εδάφους (Α,Β,Γ,Δ)



Διευκρινίζεται ότι, σε περίπτωση κτιρίων της κατηγορίας ΚΙΙ κατά τη φάση λειτουργίας τους εφαρμόστηκαν πρόσθετες μελέτες (π.χ. λόγω προσθήκης, αλλαγής χρήσης, κτλ.) θα λαμβάνονται υπόψη οι δυσμενέστερες παραδοχές που είχαν θεωρηθεί στις μελέτες αυτές."

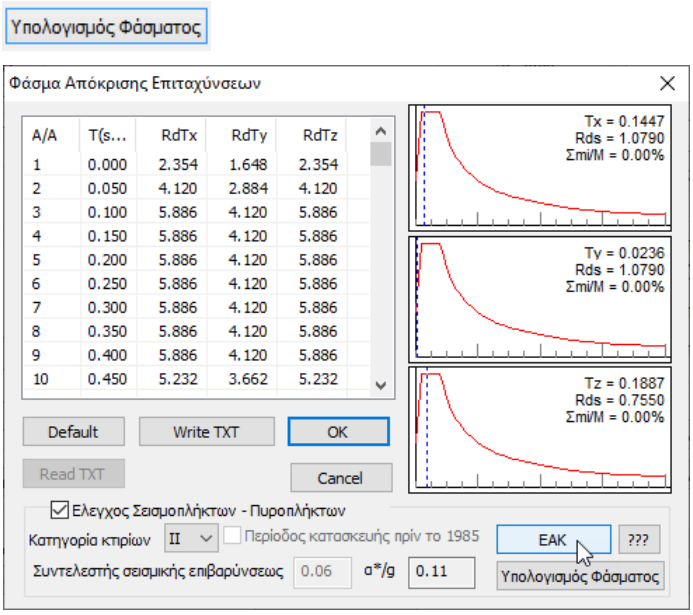
In the case of buildings of category KI as design spectrum and elastic spectrum, both for the horizontal components and for the vertical component of the action, the spectra as presented in the respective NEAK & EAK, taking into account all the assumptions that were taken into account during the design phase of the fire-affected - earthquake-affected building...

Choosing category II activates the button of the EAC, while the fields related to category I are deactivated accordingly



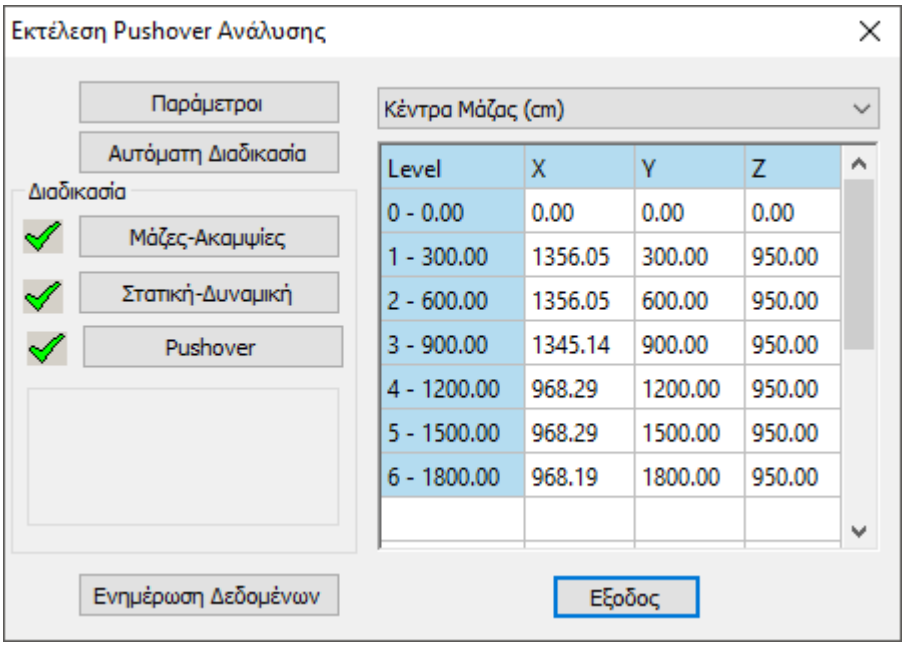
Select to open the window of the parameters you need to set to calculate the design spectrum.

After you have set the parameters, press OK. The configuration window closes and you select



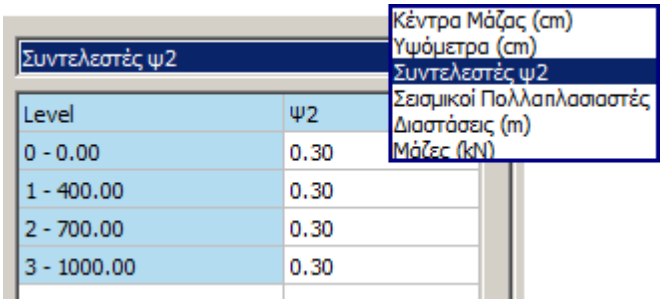
After calculating the spectrum, follow the procedure of analysis, elastic or non-elastic as explained in the previous chapters.

3(a).3.3 Automatic Procedure



Before performing the procedure, the value of the coefficient of the mobile loads ψ2 must be set.

- The default value is ψ2=0.30.

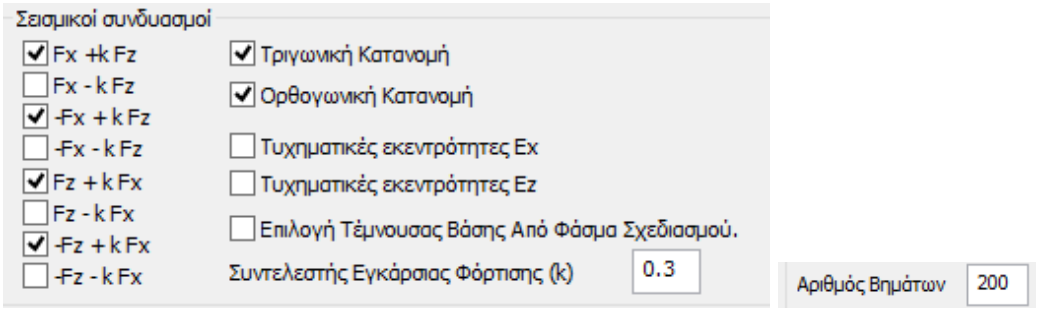


This process includes 3 steps which are executed sequentially, either automatically with the Automatic Process or selectively by choosing the keys one by one.

1. Calculation of masses and stiffnesses.
2. Perform a static analysis to calculate the intensities of permanent and mobile loads required to initiate the successive pushover analyses.
   Performing a corresponding dynamic with the EC8 elastic design spectrum to calculate the eigenmodes and target displacement.
3. Performing Pushover analyses.

In this example the automatic procedure was chosen, 4 seismic combinations with 2 distributions and 200 steps for each Pushover, a total of 1600 analyses approximately!

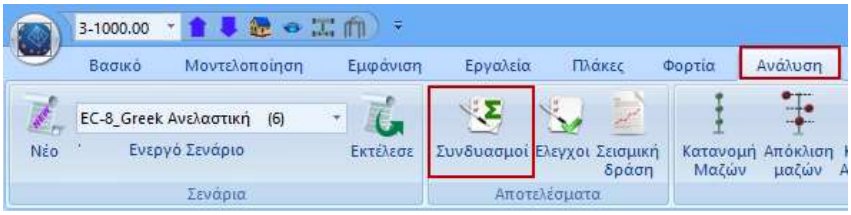
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



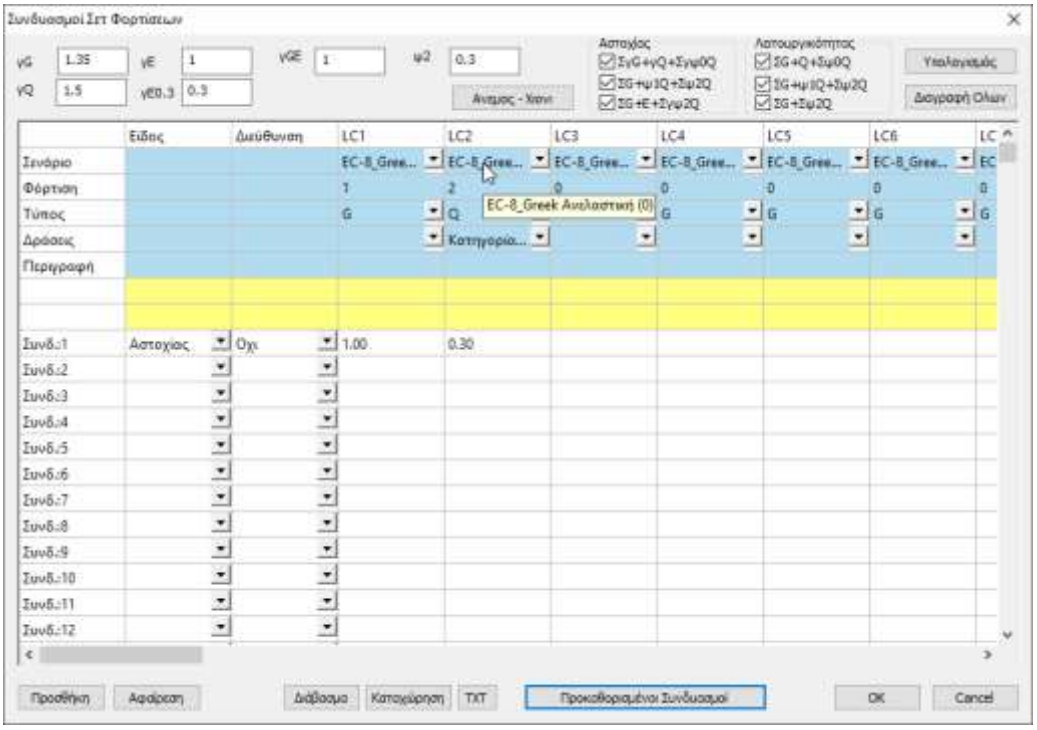
After the analysis process is completed, the following are:

1. The creation of the Pushover combinations (for sizing of reinforcements)
2. The appearance of the results (to investigate failures)

3(a).4 PUSHOVER Analysis Combinations



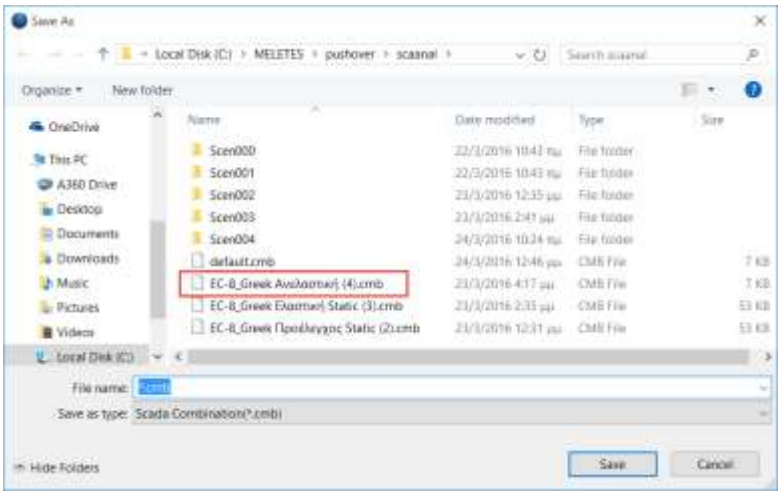
Press the ***Combinations*** command to open the combinations window, to create the combinations of loadings for fixed and mobile only (2 loadings)



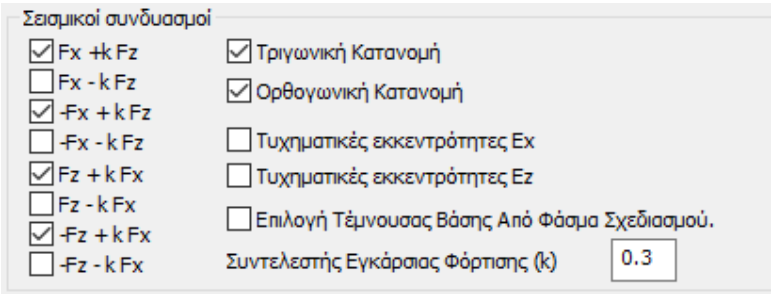
⚠ **Notes**: *The coefficients of G and Q are automatically filled in according to the* ***Data Reliability Level*** *selected in Parameters, as long as you select Predefined Combinations.*

The coefficients of the required failure combination are filled in and entered (with the corresponding name) automatically.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



Then through the parameters of the Anelastic scenario in the section "***Seismic Combinations***"

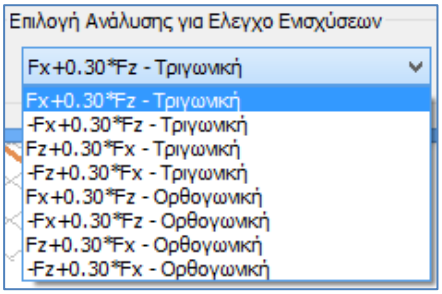


We define the combinations for which inelastic analyses will be performed. Each combination means that a seismic force will be applied in the specific direction (x or z) with a factor of 1 and a seismic force in the transverse direction with a factor that you specify in the "*Transverse load factor*" field.

⚠ The default value is 0.3.

We also determine the type of distribution of the seismic force along the height of the building (Triangular or Rectangular). The CANPE requires both seismic distributions.
Also, if we want to take into account, in addition to the seismic forces, moments resulting from the accidental eccentricities, then we activate the fields "*Accidental eccentricities Eh and Ez*".

Then, for the sizing of aid, you will also need to define the combination and distribution in the "***Select analysis for aid control***" field of the "**Controls**" command.

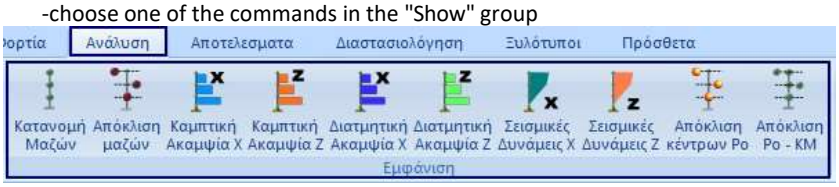


3(a).5 PUSHOVER Analysis Results

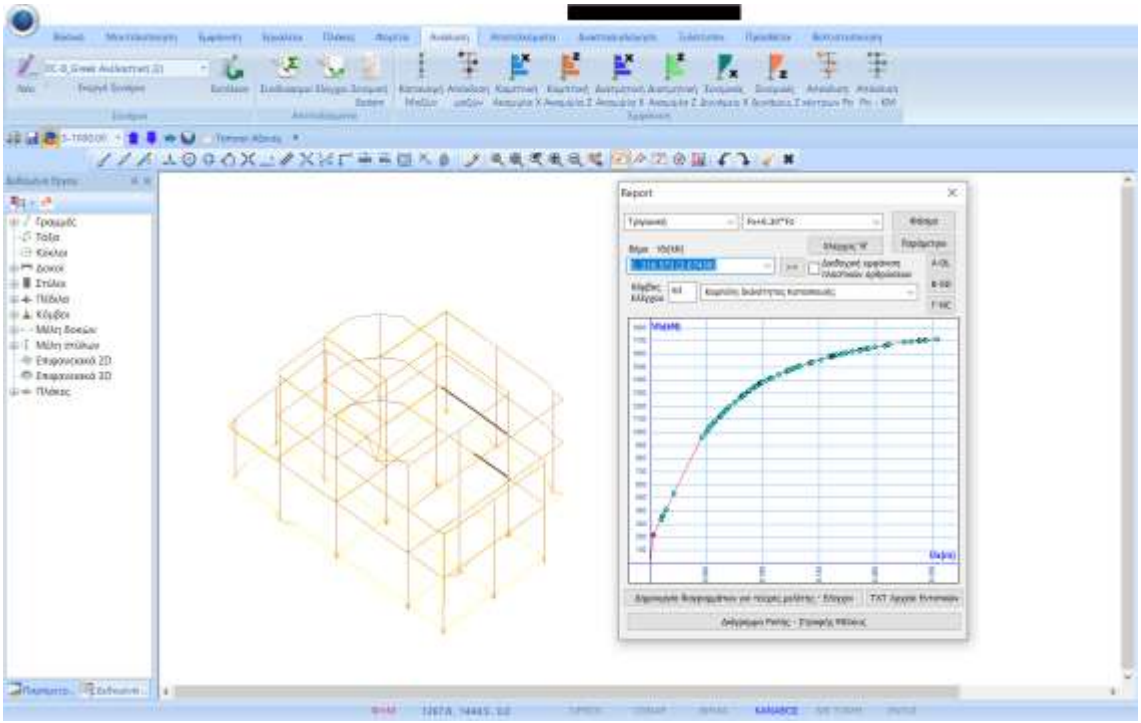
When applying the pushover analysis, the structure is gradually extruded with monotonically increasing lateral load (triangular or rectangular) until it reaches failure. Plastic joints are thus gradually formed at the ends of the component elements (beams, columns, walls) of the whole structure.
As these form, the strength of the nodes at the beginning and end of the element's length is gradually reduced. In the final steps of the analysis, a collapse mechanism will be created by the forming plastic joints in the structural elements of the structure, whose plastic deformations will be such that the elements not be able to receive further stress and the structure will be driven to failure.

The designer has the ability to view the results of all Pushover analyses in the form of diagrams and also display the visualization of the carrier as it responds to Pushover:

-choose the three-dimensional representation of the 
-choose one of the commands in the "Show" group



The 3D initial and deformed model of the vector is displayed on the desktop and the "Report" dialog box opens.



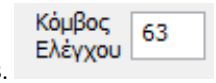
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

In the "Control Node" field you specify the number of the control node on the basis of which the resistance curve will be calculated.

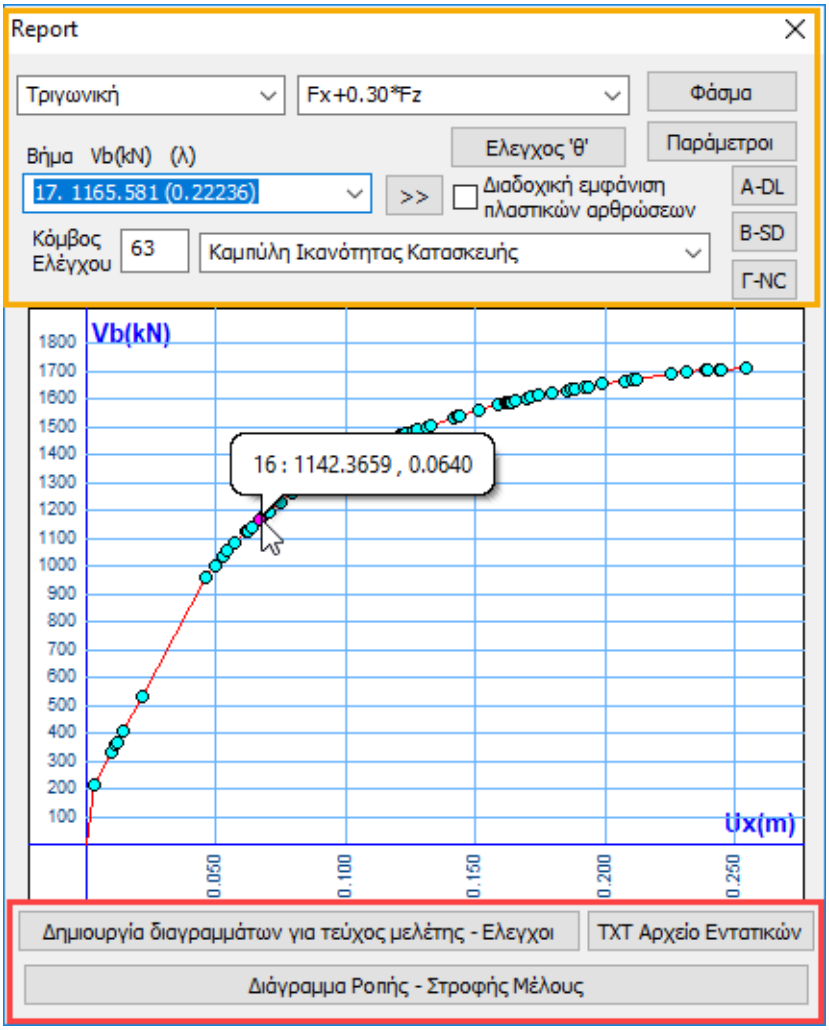
- This node is usually the bulkhead node of the last full floor of the building. If there is no bulkhead, choose a perimeter node

  from the same level.
- You can select another control node to view the results without having to run the analysis script again. The results

  are automatically updated.

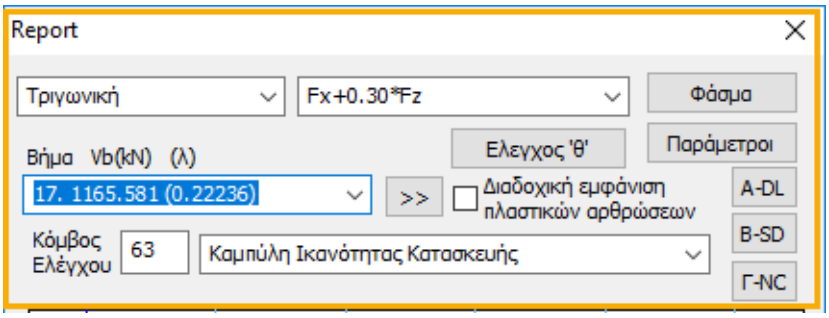


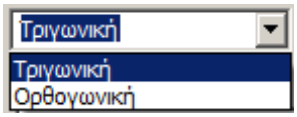
⚠ In this example, the Control Node is 63.

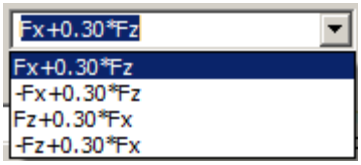


At the top of the window

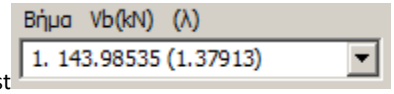
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



select one of the distributions, which you had previously set to be included in the window of the configuration, 

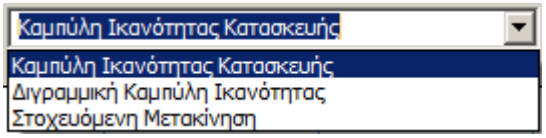
and respectively a of their and of default combinations 

and

in the list 

the steps of the specific anelastic analysis are displayed and for each step the cutting force Vb(kN) and the corresponding minimum load factor (λ) are shown, while at the same time they are formed:

- Capacity curve of the construction
- Bilinear Capability Curve
- Targeted Movement



3(a).5.1 Capability Curve

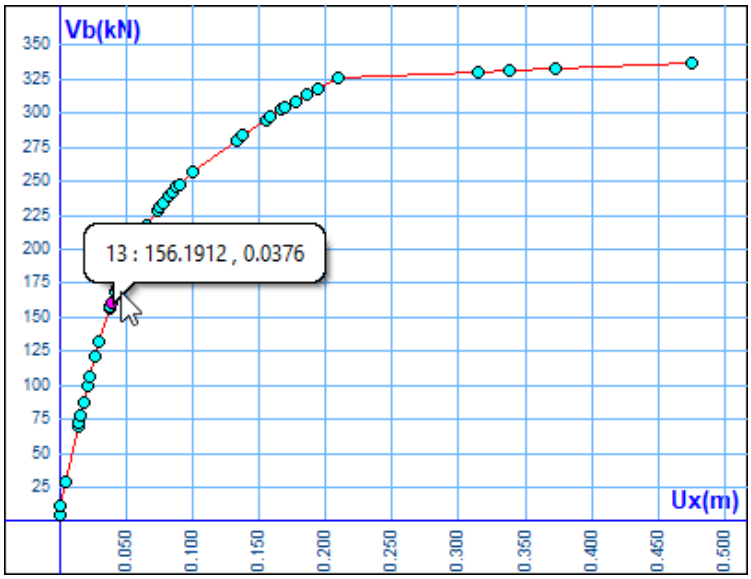
It expresses the non-linear relationship between the imposed horizontal load and the displacement of the Control Node.

EPE 7.1.2.2.1 Intensity-Deformation "F-d" curve

α) The mechanical behaviour of a structural element, a critical region of a structural element, or a connection of elements (node), is described by means of a diagram of stress 'F' versus strain or relative displacement 'd'. The type, direction, etc. of the magnitude F shall be chosen so as to characterise the main part of the stress caused by the seismic action on the element, critical region or connection. The deflection δ shall be chosen so that, in combination with the intensity magnitude F, expresses the deformation energy of the element, critical region or connection.

On the Resistance Curve, the "Steps" of the pushover analysis are formed in the form of points. The selected step is shown in pink and represents the creation of a plastic joint (i.e. when the shear stress at Control Node X has a value Vb then the first plastic joint is created).

- Moving the mouse to the step points displays the step number and the corresponding Vb and Ux values.

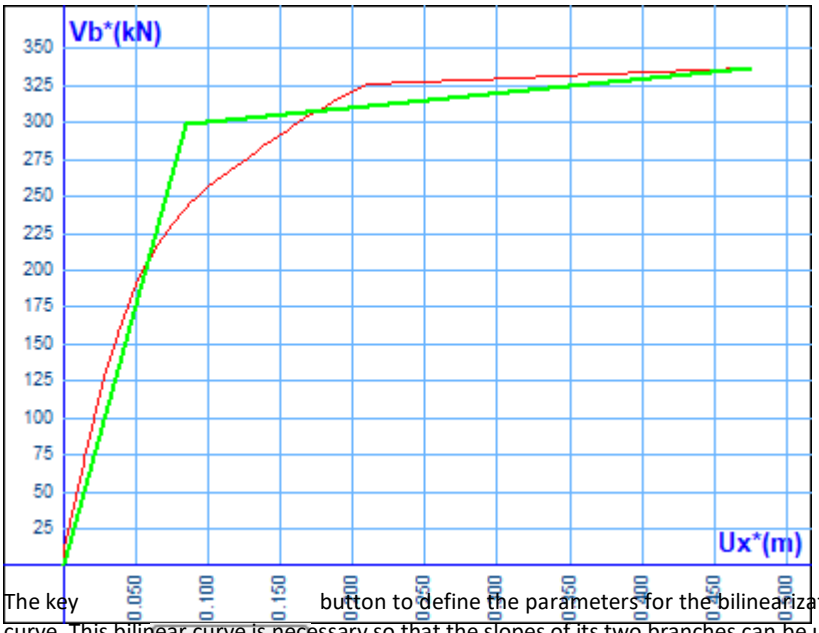


3(a).5.2 Bilinear Capability Curve

This is the corresponding bilinear curve calculated either in the simplified way provided for by the CEEAP, or by calculating equal areas. The key Παράμετροι concerns the definition of the parameters for the way of bilinearisation of the capacity curve of the structure.

CAN.EPE 5.7.3.4 Idealised force-mobility curve

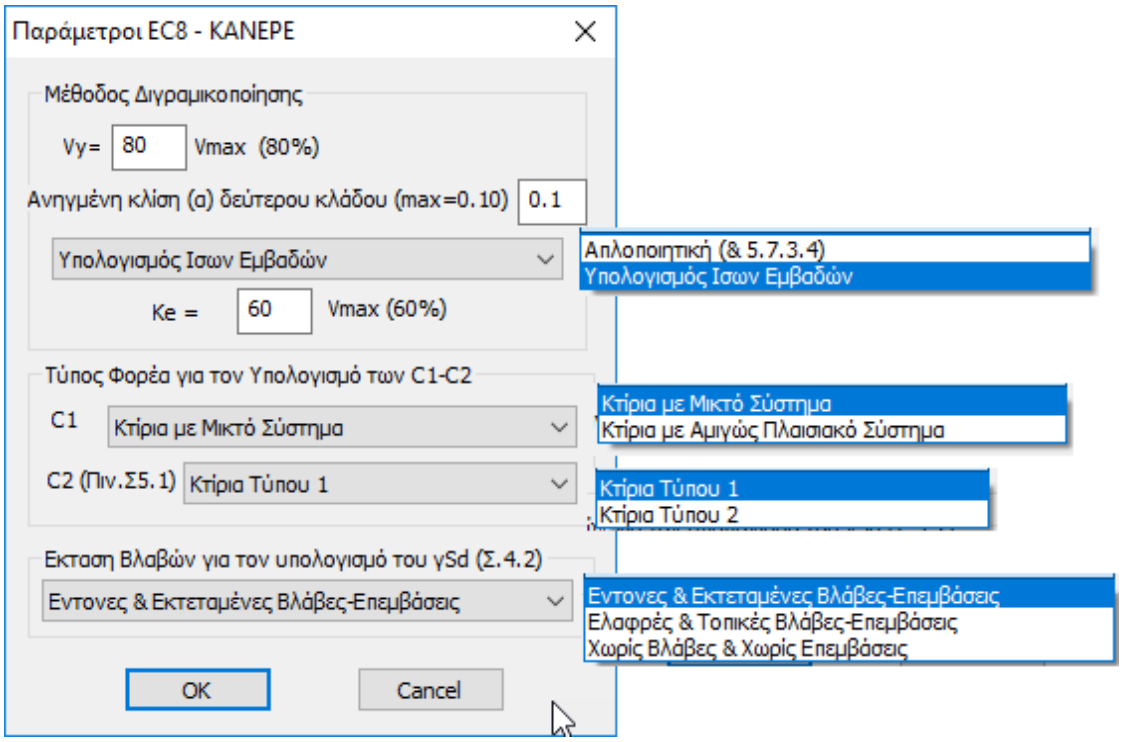
The non-linear force-displacement relationship linking the base shear and the displacement of the control node (§5.7.3.1a) shall be replaced by an idealised curve to calculate the equivalent lateral stiffness Ke and the corresponding yield strength Vy of the building.



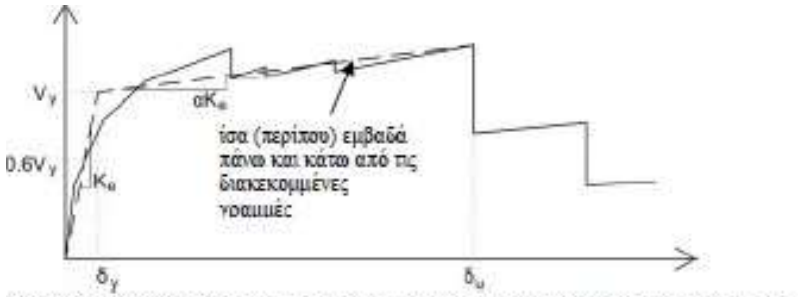
The key button to define the parameters for the bilinearization of the construction capacity curve. This bilinear curve is necessary so that the slopes of its two branches can be used to calculate the eigenperiod and the corresponding spectral acceleration.

Selecting it displays the following dialog box

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



(CAN.EPE)§5: *The idealized resistance curve (force-displacement relationship) is recommended to be bilinear (see also §7.1), with slope of the first branch Ke and slope of the second branch equal to αKe. The two lines constituting the bilinear curve may be determined graphically, on the basis of the approximate equality of the areas of the spaces above and below the intersections of the real and idealised curves (Fig. 5.2).*



Σχ. Σ5.2 Εξιδανίκευση μιας (σχηματικής) καμπύλης αντίστασης της κατασκευής με διγραμμική καμπύλη

There are two methods for calculating the bilinear curve:

1. The "simplifying" one, with values as provided by the EIA and entered in the parameters discussed below
2. The "method of equal areas", where these parameters are used as starting points for determining the bilinear.

(CAN.EPE)§5: *The equivalent lateral stiffness Ke is obtained as the occupant stiffness corresponding to a force equal to 60% of the yield strength Vy which is defined by the intersection of the lines mentioned above. The reduced slope (a) of the second branch is determined by a line passing through the point of the (real) non-linear resistance curve corresponding to the failure displacement (δu), beyond which a significant reduction in the strength of the beam is observed (Fig. In all cases the resulting value of α must be positive (or zero), but not exceed 0.10 (to be compatible with the other assumptions of the δt estimation method, such as the coefficient C1, see Fig. 5.2). § 5.5.5.2b and § 5.7.4.2a). The recommended value for the percentage reduction in strength is 15%, provided that no failure of a main vertical element has occurred at this level (in which case the bilinearisation shall be performed at the displacement corresponding to this failure). Simplistically, and since no estimation of the available ductility of the building is required, the slope Ke can be taken as the passenger value for a resistance level equal to 60% of the maximum resistance (Vmax), and the yield strength Vy, for the calculation of the R index relation (S5.7), as 80% of Vmax.*

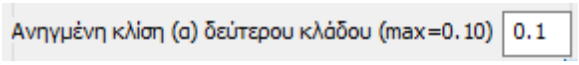
The first parameter concerns the slope of the second branch, which is:

- With the simplification method: constant
- By the method of equal areas: as a starting slope.

With a value of 0 the second branch will be drawn horizontally in both methods.

The Ke option refers to the starting slope of the first branch, which is:

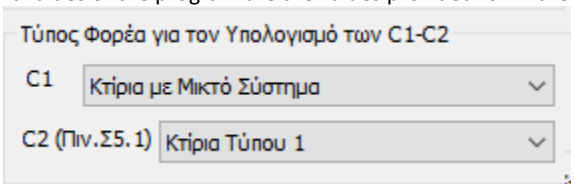
- With the simplification method: constant
- By the method of equal areas: as a starting slope.



The neglected slope (a) refers to the second branch:

- with a value of 0, is automatically calculated with a limit of 0.10 as provided for in the EIA, while
- with a user value, is plotted fixed at that slope.

The default values of the program are the values provided for in the CAN.EPE.



In the section "Type of building for the calculation of C1-C2" you select the type your building to calculate the above factors which are used for the calculation of the targeted movement.

(CAN.EPE)§5.7.4.2: *The target movement δt is allowed to be calculated based on the following relation (S5.6) and corrected as follows:*

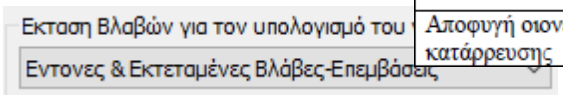
$$\delta t = C0\ C1\ C2\ C3\ (Te2/4\pi 2)\ Se(T) \qquad (\Sigma 5.6)$$

where Se(T) is the elastic spectral pseudo-spectral acceleration (from the spectrum of EC 8-1) corresponding to the equivalent eigenperiod of the structure Te (calculated from the inflexion point of the force-displacement diagram of the , as defined in § 5.7.3.4), and C0, C1, C2 and C3 are correction factors defined as follows:

- ***C0:*** *Coefficient relating the spectral displacement of the equivalent elastic carrier with stiffness Ke (Sd=[Te2/4π2]· Φe) to the actual displacement δt of the peak*
  of the elasto-plastically responsive carrier. (§5.7.3.4). Its values may be taken equal to 1.0, 1.2, 1.3, 1.4, 1.5, for numbers of floors 1, 2, 3, 5, and ≥10, respectively.
- *The ratio C1=δinel/δel of the maximum inelastic displacement of a building to the corresponding elastic displacement may be obtained from the relationships:*
  C1=1.0 for T≥ Tc , and
  C1=[1.0+(R-1)Tc/ T]/R for T < Tc , where Tc is the value at which the bad branch of the response spectrum begins (see EC 8-1) and R=Vel/Vy is the ratio of the elastic demand to the yield strength of the carrier. This ratio can be estimated from the relation R= ((Φe/g)/(Vv/W)).Cm ,(Σ5.7)
  in which the leakage resistance Vy is calculated by appropriate bilinearisation of the force (base shear) - displacement (top) diagram of the building, as defined in § 5.7.3.4.
  Simplifying (and on the safety side), the ratio Vy/W in relation (S5.7) can be taken as 0.15 for buildings with a mixed system, and 0.10 for buildings with a purely framed system.
- ***C2:*** *Coefficient taking into account the influence of the shape of the hysteresis loop at maximum movement. Its values can taken from Table C5.1. For T values between 0.1s and Tc, linear interpolation shall be used.*

Πίνακας Σ5.1: Τιμές του συντελεστή C_2

Στάθμη επιτελεστικότητας	T = 0.1s		T ≥ T_2	
	φορέας τύπου 1	φορέας τύπου 2	φορέας τύπου 1	φορέας τύπου 2
Άμεση χρήση μετά τον σεισμό	1.0	1.0	1.0	1.0
Προστασία ζωής	1.3	1.0	1.1	1.0
Αποφυγή οιονεί κατάρρευσης	1.5	1.0	1.2	1.0



Finally, in the section "Extent of damage for the calculation of γSd" you select the extent of damage in your building in order to take into account the appropriate safety factor of the **γSd** actions

Πίνακας Σ 4.2: Τιμές του συντελεστή γ_{Sd}

Έντονες και εκτεταμένες βλάβες ή / και επεμβάσεις	Ελαφρές και τοπικές βλάβες ή / και επεμβάσεις	Χωρίς βλάβες και χωρίς επεμβάσεις
γ_{Sd} =1,20	γ_{Sd} =1,10	γ_{Sd} =1,00

Βλ. και Παράρτημα 7Δ περί βλαβών και φθορών.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

NOTE: *It should be noted that any changes you make to the "Spectra" and "Parameters" options do not require you to run the analysis script again. The results are updated automatically.*

IN SUMMARY: From the analysis of the simulation, the resistance curve of the structure is constructed, which expresses the relationship between the base shear, the building and the peak displacement, d. Based on this curve, all the required checks are made to satisfy the performance criteria. For the determination of the target displacement, however, it is necessary to replace the resistance curve by an idealised bilinear curve from which the equivalent lateral stiffness, and the corresponding yield shear stress, is determined. The target displacement of the structure is calculated for a given earthquake return period according to CEE (see Section 4.1.1.1.1.1.1.1.2). Chapter 5 §5.7.4). After the expected displacement of the top of the structure has been calculated, the corresponding performance point is marked on the curve and compared with the desired level for the specific seismic excitation.

3(α). 5.3 Targeted Movement

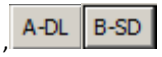
The three targeted movements, one for each level of performance.

EIA 5.7.4.2 Targeted movement

α. The target displacement δt (§5.7.1.2) shall be calculated by taking into account appropriately all factors affecting the displacement of an inelastic responding building. It is permissible to consider the displacement of an elastic single-stage system with an eigenplane equal to the fundamental eigenplane of the building (§5.7.3.5) subject to the seismic action for which the check is being made, with an appropriate correction to obtain the corresponding displacement of the elastically responding building...

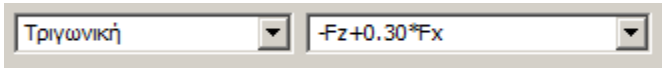
CAN.EPE 2.2.1 General

α. In order to serve wider socio-economic needs, various measures are introduced to "performance levels" (target behaviours) under given corresponding design earthquakes.
β. The assessment or redesign objectives are combinations of a performance level on the one hand and a seismic action on the other hand, with a given "tolerable probability of exceedance during the technical lifetime of the building" (design earthquake).

The options , 

, and 

give the deformed state of the vector for the three performance levels respectively, i.e. they show the deformed vector at the analysis step where the control node movement is equal to the corresponding target one. The blue dotted line corresponds to the target displacement for the first performance level and the yellow and red for the second and third respectively For this example, for a triangular distribution and for the combination -Fz+0.30*Fx



the steps of the analysis corresponding to the three levels are:

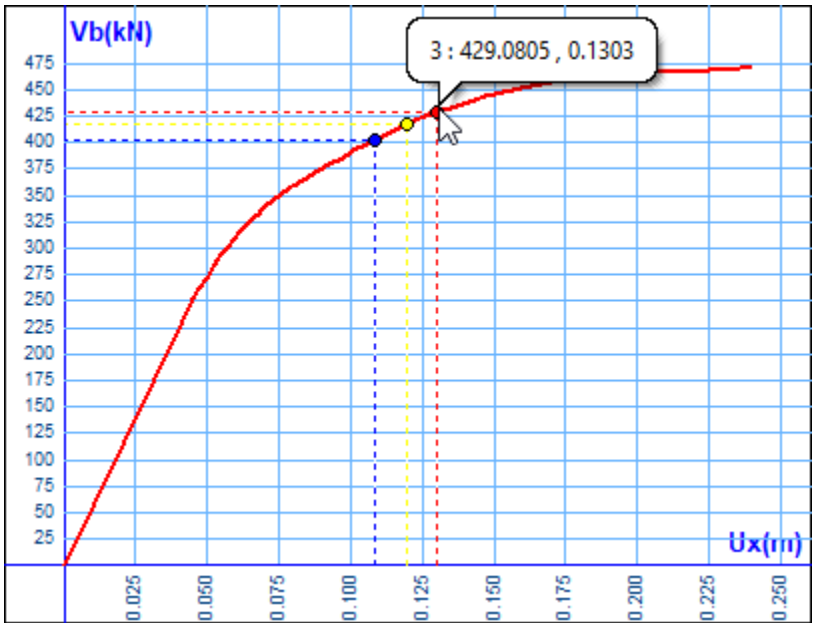
- Performance level 

: Step 85
- Performance level 

: Step 87
- Performance level 

: Step 89

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



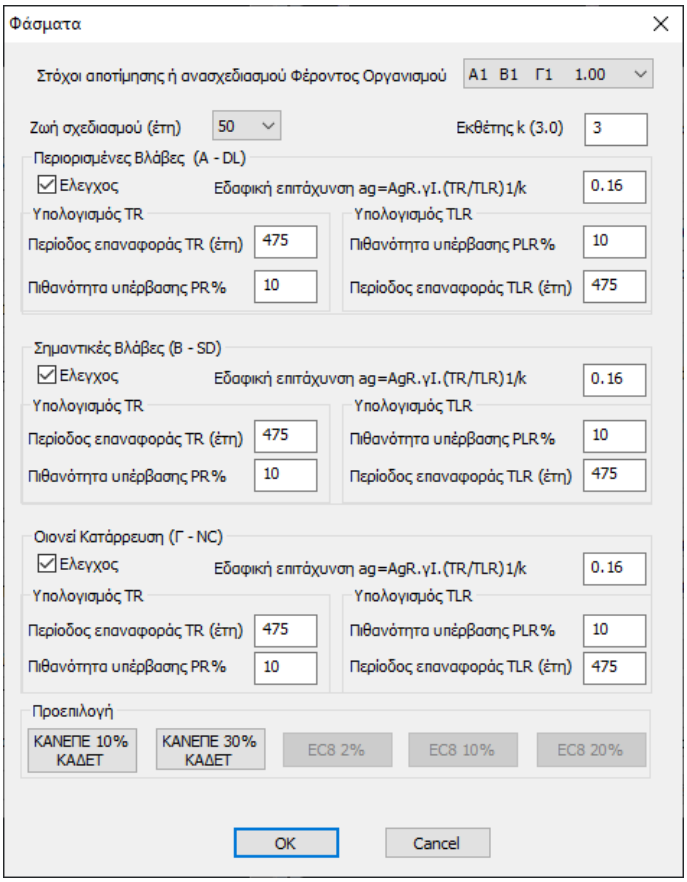
Moving the mouse to the points Displays the values for the three targeted movements, one for each performance level and the corresponding intersections at the Control Node.

Φάσμα button displays the same dialog box as the one in the original script parameters.

It should be noted that these parameters, because they relate to the calculation of the target displacement, can be set or modified after the inelastic analysis has been run, without the need to re-execute it. The same applies to the control node.

You can select another control node here without having to run the analysis again. The program automatically displays the results for this node.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



NOTE: *the printout of the cross-section adequacy checks in terms of deformation now shows in detail the quantities (Ci and the rest) used to calculate the target displacement.*

	Σελίδα : 1
ΑΠΟΤΕΛΕΣΜΑΤΑ ΕΛΕΓΧΩΝ	
ΣΕΝΑΡΙΟ :	**ΑΝΕΛΑΣΤΙΚΗ**

Είδος Ανάλυσης - Κατανομής :	*Fx+0.30*Fz - Τριγωνική (1)*
Κανονισμός για τον υπολογισμό της στοχεύομενης μετακίνησης :	**ΚΑΝ.ΕΠΕ.**

ΕΛΕΓΧΟΣ ΕΠΑΡΚΕΙΑΣ ΦΟΡΕΑ ΣΕ ΟΡΟΥΣ ΠΑΡΑΜΟΡΦΩΣΕΩΝ

	C0	C1	C2	C3	Se(T) (m/sec2)	Te (sec)
Περιορισμένες Βλάβες (A-DL)	1.20	1.17	1.00	1.00	7.06	0.33
Σημαντικές Βλάβες (B-SD)	1.20	1.17	1.24	1.00	7.06	0.33
Οιονεί Κατάρρευση (Γ-NC)	1.20	1.17	1.41	1.00	7.06	0.33

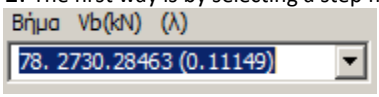
	Στοχευόμενη Μετακίνηση dt(cm)	Συνολική Μετακίνηση dm(cm)	λόγος λ=dt/dm	ΕΠΑΡΚΕΙΑ
Περιορισμένες Βλάβες (A-DL)	2.69	8.24	0.33	Ναι
Σημαντικές Βλάβες (B-SD)	3.33	8.24	0.40	Ναι
Οιονεί Κατάρρευση (Γ-NC)	3.78	8.24	0.46	Ναι

3(a).6 Illustration of the operator

The program also allows you to see in real time the deformation state of the beam and the edges of the cross-sections where plastic joints are created, for each step of the analysis.

There are two methods of imaging the vector.

1. The first way is by selecting a step from the list



(the selection becomes blue) and you will see for this step the state of the carrier and the points of plastic joints.
The original, undeformed state of the carrier is shown in grey. The deformed carrier is shown in red and the coloured dot shows the edge of the plastic joint.
This dot, depending on the size of the turning angle of the plastic joint, is coloured in three colours.

Blue when

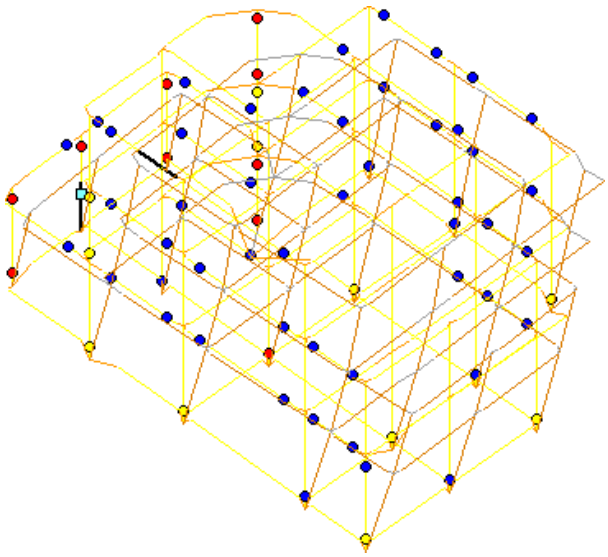
$$S_d \le \vartheta_d^{pl} = 0.5\,\vartheta^{pl} = 0.5\,\frac{\vartheta^{pl}}{\gamma_{Rd}} \qquad \frac{\vartheta^{cr}}{\gamma_{Rd}}$$

Yellow when

$$0.5\frac{\theta_{pl}}{\gamma_{Rd}} = 0.5\frac{\theta_{pl}^{cr}}{\gamma_{Rd}} \le S_d \le R_d = \theta_d^{pl} = \frac{\theta_{pl}}{\gamma_{Rd}} = \frac{\theta_{pl}^{cr}}{\gamma_{Rd}}$$

Red when

$$S_d \ge R_d = \theta_d^{pl} = \frac{\theta_{pl}}{\gamma_{Rd}} = \frac{\theta_{pl}^{cr}}{\gamma_{Rd}}$$



EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

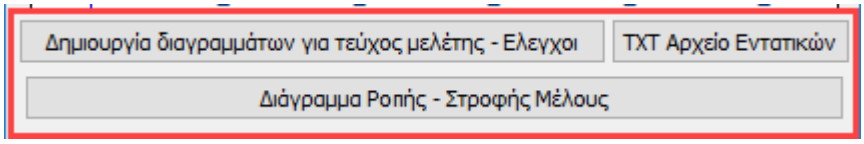
In addition, the sea blue squares that appear at the ends of the elements indicate shear failure.

⚠ At the end of the member that fails by shear, the box appears, while in the next step the program creates a plastic joint at this point with simultaneous reduction of θy as provided by the CEE for the elements that fail first by shear, and continues the process of completing the pushover analysis.

2. The second way of visualization is to select the first step and by pressing the button [>>] you can see the vector in motion with the creation of the plastic joints. You end the command by selecting the same key again. The same effect can be achieved by selecting a step and turning the mouse wheel.

The options , [A-DL] [B-SD] , and [Γ-NC] give the deformation state of the vector for the three performance levels respectively, i.e., they show the vector at the analysis step where the control node movement is equal to the corresponding target movement.

⚠ At the bottom of the window



- the selection of the key

Δημιουργία διαγραμμάτων για τεύχος μελέτης - Ελεγχοι

is **necessary** to create the necessary prints and controls and to update them after possible changes (e.g. bilinearization method, change of spectra, change of parameters, etc.).

- the selection of the key

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displays the file containing the lists with :

- Displacements and Junction Rotations for all junctions per direction
- Intensive Member sizes at the beginning and end of each member
- Active stiffnesses for each Pillar and each Beam

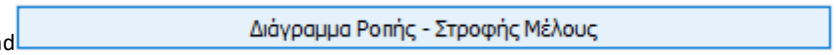
- the selection of the key

Διάγραμμα Ροπής - Στροφής Μέλους

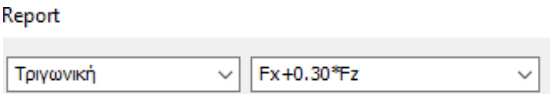
displays the torque-torque diagram of the member which is shown by member (start - end) and by direction.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

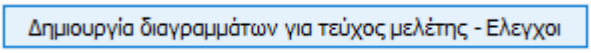
I. Member torque - turn diagram

By selecting the command 

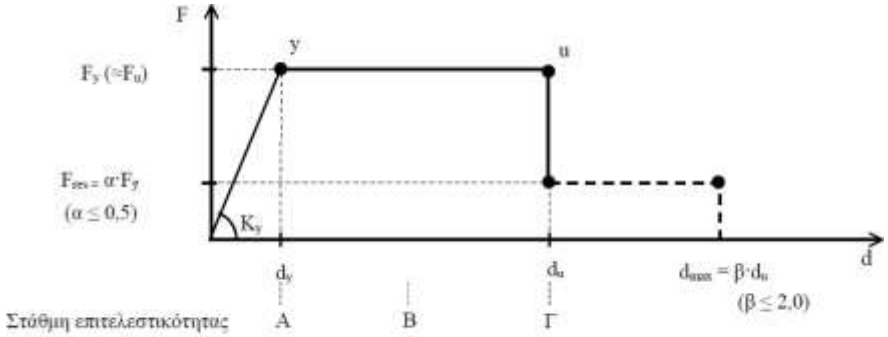
and then pointing with the left mouse button to a member of a column or beam, the torque - rotation diagram of the member is opened, which is displayed per member (start - end) and

per address for the selected distribution 

- A prerequisite for the display of the torque - rotation diagrams of a member is that the Checks have been previously performed, i.e. the command has been selected:



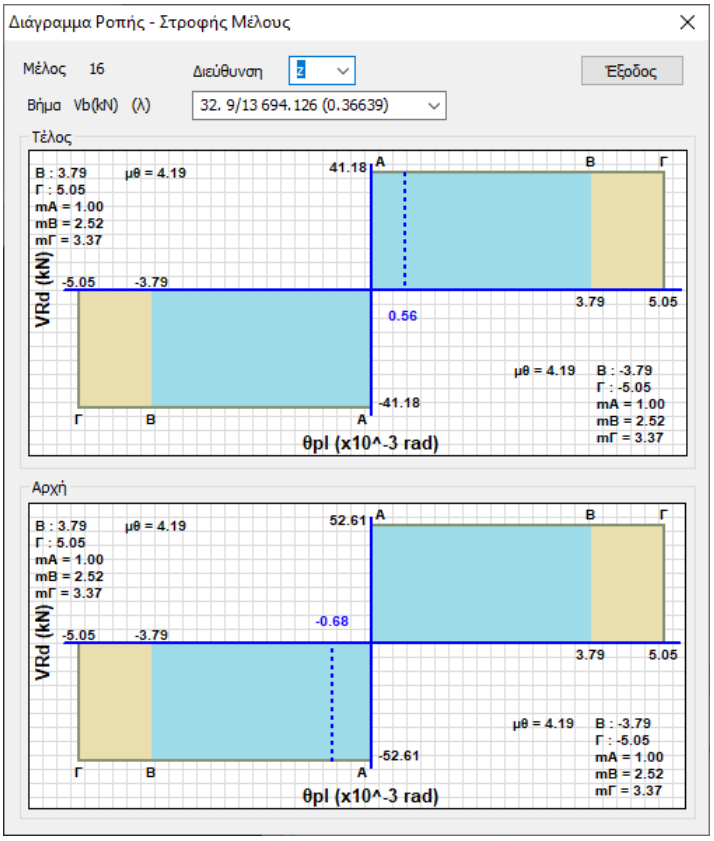
The skeletal diagram is a strength diagram of the end of the member. The critical quantities to be drawn are Fy, θy and θu.



Σκελετικό Διάγραμμα Συμπεριφοράς
(για τα επιμέρους δομικά στοιχεία, ή το δόμημα – ως σύνολο)

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

In SCADA θy or dy is 0. What is shown is :



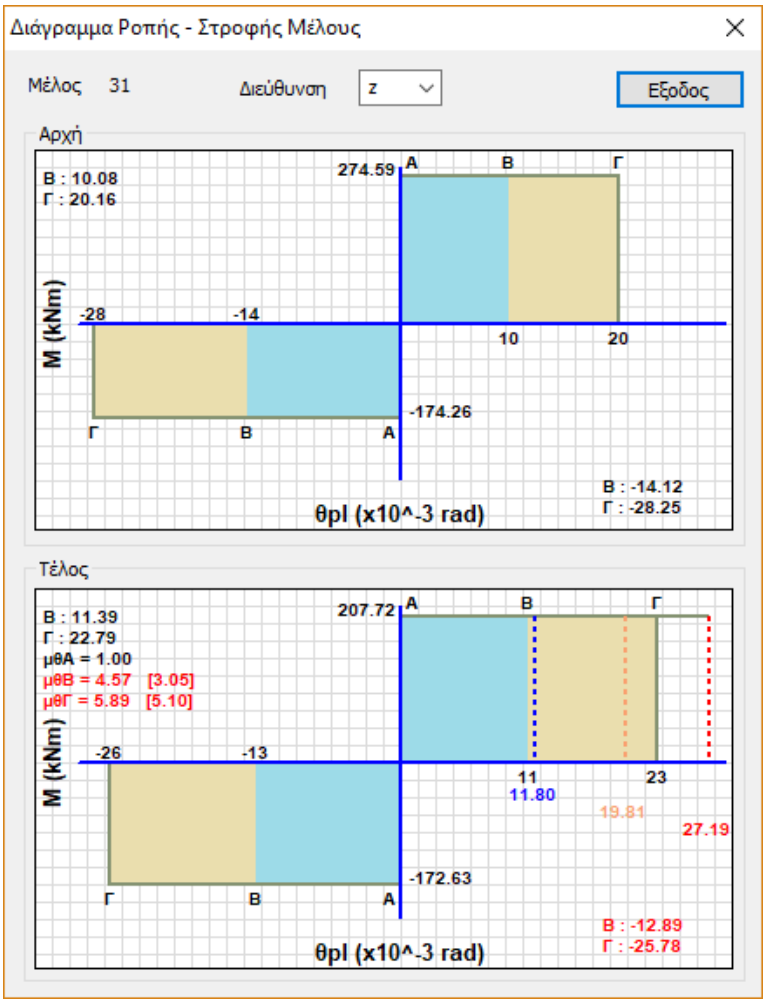
It has no sloping anionic elastic branch so θy=dy=0 but you do NOT show the value of θu or du on the diagram. It was preferred to show, for better overview, the boundaries of the B and C performance stations.

OBSERVATION:

⚠ Note that the printout now includes (for concrete & M.I.P.) ONLY those elements that have developed a plastic joint at one or both ends up to the step corresponding to performance level C.

That is, those which in all steps do NOT develop a plastic joint at any of their ends and those which do, but at a step larger than the step corresponding to the C level of performance are NOT printed.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



This diagram is based on the following assumptions:

- The calculation of the moment My is based on relation (A.6) of Annex 7A of CEE/CNR.
- The value of My is different for each step, due to the axonics involved in its calculation. In the skeletons of the masonry members and in the skeletons for concrete members the skeleton is calculated with the axial of each step.
  - Two values of My (positive and negative) are calculated and two values of My are plotted respectively. areas with thresholds (different) for the performance levels.

  For poles, due to the existence of symmetrical reinforcement, the two values will always be the same.
- As is known, the diagram does not have an elastic branch and shows only the corresponding plastic area.
- The values of **θ** have been divided by the corresponding safety factors. The θ_{pl} limits corresponding to the performance levels have been divided by the factor γ_{rd} and the turning angles θ_{sd} have been multiplied by the γ_{sd} factor.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

This was done to ensure compatibility with the corresponding print results.

Σελίδα : 1

ΑΠΟΤΕΛΕΣΜΑΤΑ ΕΛΕΓΧΩΝ

ΣΕΝΑΡΙΟ :	ΑΝΕΛΑΣΤΙΚΗ

Είδος Ανάλυσης - Κατανομής :	Fx+0.30*Fz - Τριγωνική (1)
Κανονισμός για τον υπολογισμό της στοχεύομενης μετακίνησης :	ΚΑΝ.ΕΠΕ.

ΕΛΕΓΧΟΣ ΕΠΑΡΚΕΙΑΣ ΦΟΡΕΑ ΣΕ ΟΡΟΥΣ ΠΑΡΑΜΟΡΦΩΣΕΩΝ

	C0	C1	C2	C3	Se(T) (m/sec2)	Te (sec)
Περιορισμένες Βλάβες (A-DL)	1.20	1.17	1.00	1.00	7.06	0.33
Σημαντικές Βλάβες (B-SD)	1.20	1.17	1.24	1.00	7.06	0.33
Οιονεί Κατάρρευση (Γ-NC)	1.20	1.17	1.41	1.00	7.06	0.33

	Στοχευόμενη Μετακίνηση dt(cm)	Συνολική Μετακίνηση dm(cm)	λόγος λ=dt/dm	ΕΠΑΡΚΕΙΑ
Περιορισμένες Βλάβες (A-DL)	2.69	8.24	0.33	Ναι
Σημαντικές Βλάβες (B-SD)	3.33	8.24	0.40	Ναι
Οιονεί Κατάρρευση (Γ-NC)	3.78	8.24	0.46	Ναι

ΕΛΕΓΧΟΣ ΕΠΑΡΚΕΙΑΣ ΔΙΑΤΟΜΩΝ ΣΕ ΟΡΟΥΣ ΠΑΡΑΜΟΡΦΩΣΕΩΝ (mrad)

ΔΟΚΟΙ — Fx+0.30*Fz - Τριγωνική (1)

		Περιορισμένες Βλάβες (A - DL)			Σημαντικές Βλάβες (B - SD)			Οιονεί Κατάρρευση (Γ - NC)		
Μέλος	Κόμβος	γsd*θsd	θpl/γrd	Επαρκεί	γsd*θsd	θpl/γrd	Επαρκεί	γsd*θsd	θpl/γrd	Επαρκεί
27	14	0.00	0.00	Ναι	0.00	10.58	Ναι	0.00	21.17	Ναι
					0.000			0.000		
	12	0.00	0.00	Όχι	0.00	10.58	Ναι	0.00	21.17	Ναι
					0.000			0.000		
30	11	1.81	0.00	Όχι	1.81	8.94	Ναι	1.81	17.88	Ναι
					0.202			0.101		
	12	0.00	0.00	Ναι	0.00	8.94	Ναι	0.00	17.88	Ναι
					0.001			0.000		
32	15	0.00	0.00	Ναι	0.00	10.03	Ναι	0.00	20.05	Ναι
					0.000			0.000		
	9	-0.00	0.00	Όχι	-0.00	10.03	Ναι	-0.00	20.05	Ναι
					0.000			0.000		
33	15	0.00	0.00	Όχι	0.00	9.70	Ναι	0.00	19.40	Ναι
					0.000			0.000		
	16	0.00	0.00	Ναι	0.00	9.70	Ναι	0.00	19.40	Ναι
					0.000			0.000		
35	10	1.50	0.00	Όχι	1.50	8.10	Ναι	1.50	16.21	Ναι
					0.185			0.093		
	14	0.00	0.00	Ναι	0.00	8.75	Ναι	0.00	17.50	Ναι
					0.000			0.000		

ΕΛΕΓΧΟΣ ΕΠΑΡΚΕΙΑΣ ΔΙΑΤΟΜΩΝ ΣΕ ΟΡΟΥΣ ΠΑΡΑΜΟΡΦΩΣΕΩΝ (mrad)

ΣΤΥΛΟΙ — Fx+0.30*Fz - Τριγωνική (1)

		Περιορισμένες Βλάβες (A - DL)			Σημαντικές Βλάβες (B - SD)			Οιονεί Κατάρρευση (Γ - NC)		
Μέλος	Κόμβος	γsd*θsd	θpl/γrd	Επαρκεί	γsd*θsd	θpl/γrd	Επαρκεί	γsd*θsd	θpl/γrd	Επαρκεί
1	1	-5.80	0.00	Όχι	-5.80	0.67	Όχι	-5.80	1.35	Όχι
					8.600			4.300		
	9	-6.06	0.00	Όχι	-6.06	0.67	Όχι	-6.06	1.35	Όχι
					8.984			4.492		

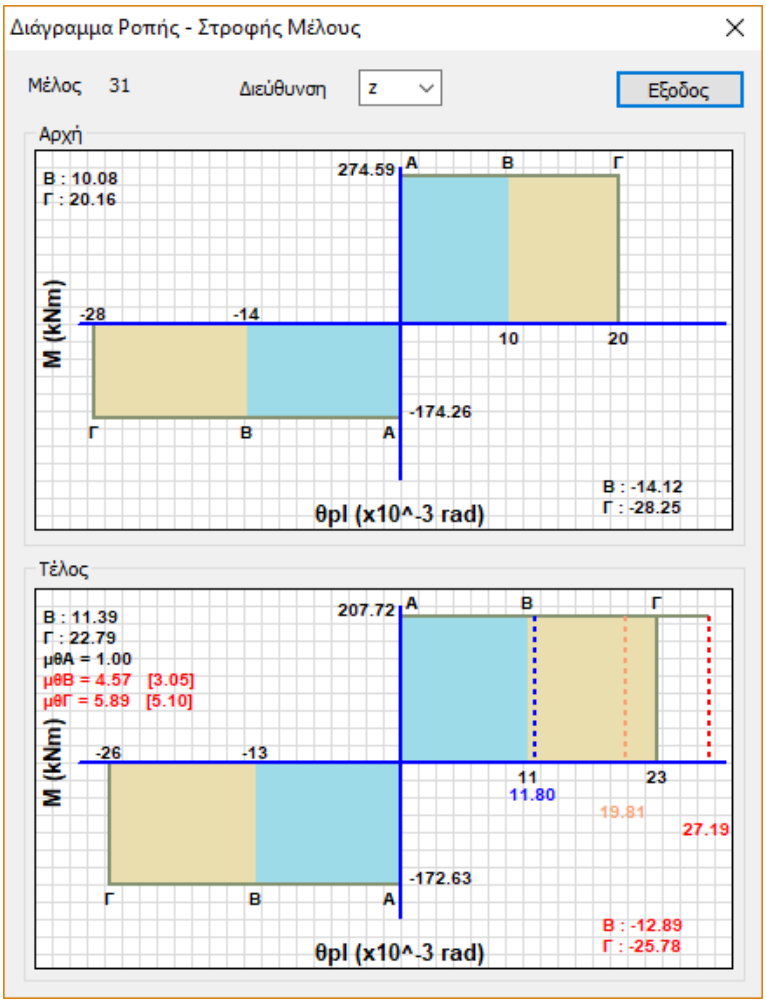
The diagram shows the angle of rotation of the plastic joint (requirement) for the three steps of the analysis corresponding to the three levels of performance:

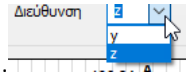
A:blue B:orange C:red

The values are displayed, depending on the sign of the angle, in the corresponding area.

In the dialog box that appears:
The corresponding diagram is shown for each end (Start-End).

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



The address is selected from the corresponding field . 

- For beams in particular, the default direction is the principal direction z, but with the assumption that the angle of rotation of the plastic joint is the worst case of both directions.

Two coloured areas appear, one positive and one for negative values of the axis, where **blue** represents the **B** level of performance and **brown** the **C** level respectively.

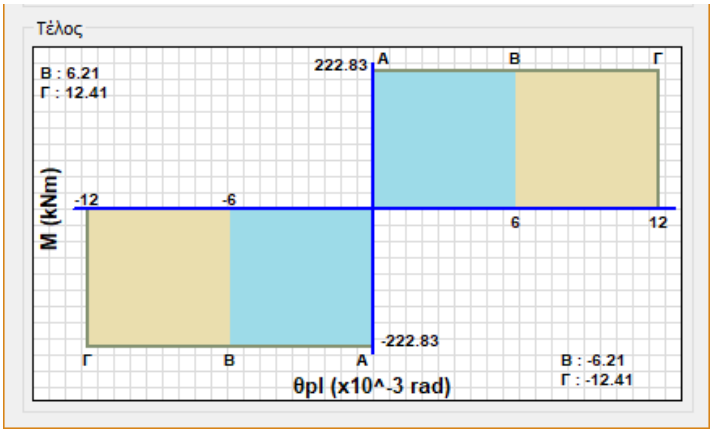
The values in **black** are the **limits** for each performance level.

- In the diagram they are shown as integers, but in the bottom right-hand part for negatives and in the top left-hand part for positives, they are written with their decimal places.

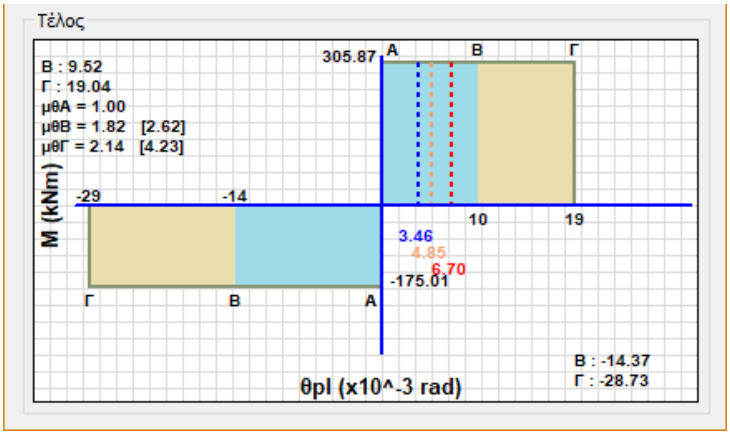
The colours that appear in the circles at the ends of each member in the 3D vector depend on where the corresponding angle of rotation of the plastic joint is located.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

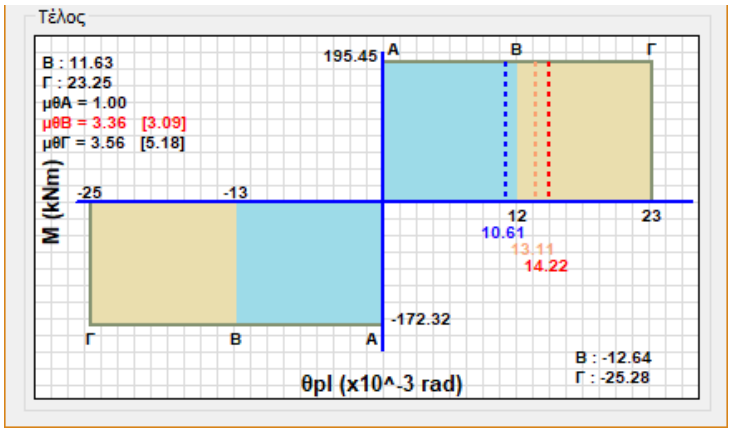
More specifically:
No value means that: the limb has not developed a plastic joint.



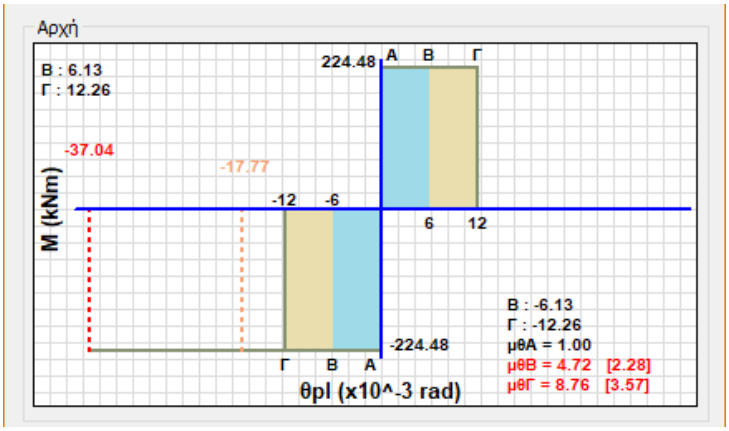
The **blue** colour means that: the corresponding blue line is within the blue area, i.e. the limit of A (which is 0) has been exceeded, but both it and the other two values have not exceeded the limit of B (blue area).



The yellow colour means that the corresponding value (orange line) has entered the brown area and the corresponding red one has not left the brown area.



Finally, the **red** colour means that the corresponding red value is outside the brown area.

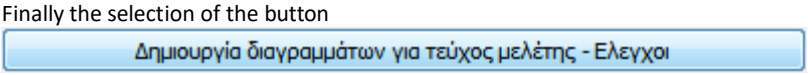


- All of the above is valid provided that the actor is at the step corresponding to the C level of performance, so that all of the above has been developed.

The ductility indices in terms of the angle of twist μθ for each level of performance are also given. The required one is given first, followed by the available one in brackets.
The sizes are displayed in red when the first value is greater than the second. For the first performance level is mthA=1.

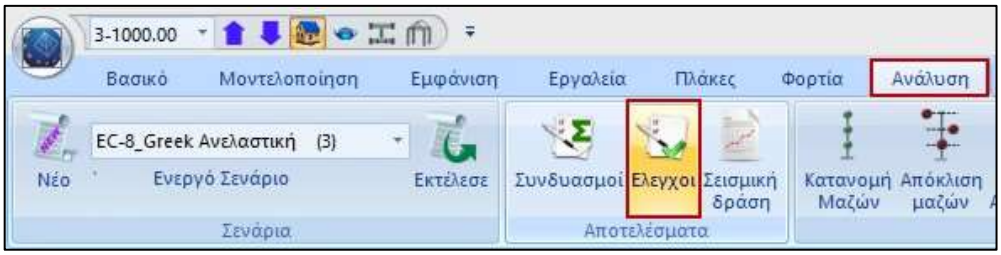
3(a).7 Creation of diagrams for study booklet-Checks

Finally the selection of the button

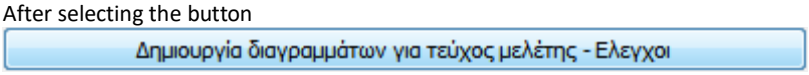


is **necessary** to create the necessary prints and controls and to update them after possible changes (e.g. bilinearization method, change of spectra, change of parameters, etc.)

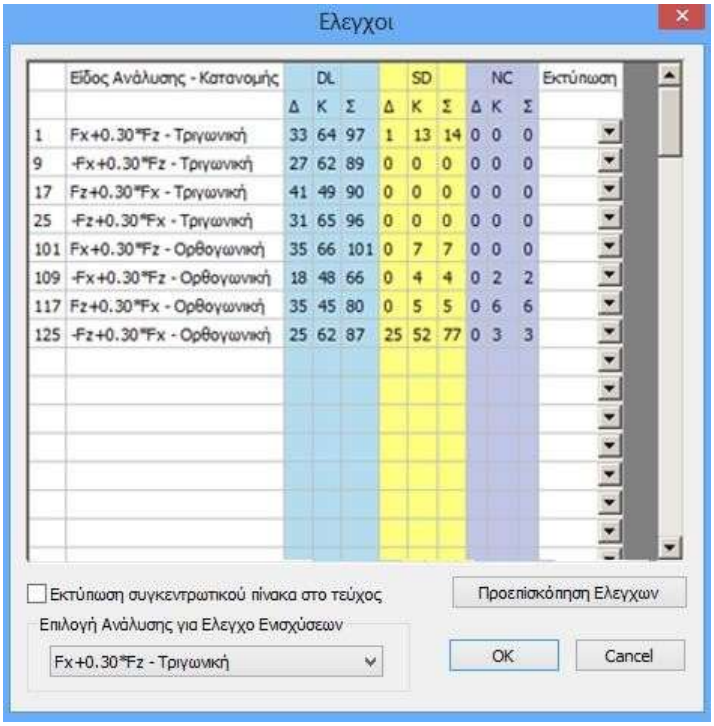
3(a).8 PUSHOVER Analysis Checks



After selecting the button



select the command "Checks" and the following dialog box appears:



	Είδος Ανάλυσης - Κατανομής	DL			SD			NC			Εκτύπωση
		Δ	K	Σ	Δ	K	Σ	Δ	K	Σ	
1	Fx+0.30*Fz - Τριγωνική	33	64	97	1	13	14	0	0	0	
9	-Fx+0.30*Fz - Τριγωνική	27	62	89	0	0	0	0	0	0	
17	Fz+0.30*Fx - Τριγωνική	41	49	90	0	0	0	0	0	0	
25	-Fz+0.30*Fx - Τριγωνική	31	65	96	0	0	0	0	0	0	
101	Fx+0.30*Fz - Ορθογωνική	35	66	101	0	7	7	0	0	0	
109	-Fx+0.30*Fz - Ορθογωνική	18	48	66	0	4	4	0	2	2	
117	Fz+0.30*Fx - Ορθογωνική	35	45	80	0	5	5	0	6	6	
125	-Fz+0.30*Fx - Ορθογωνική	25	62	87	25	52	77	0	3	3	

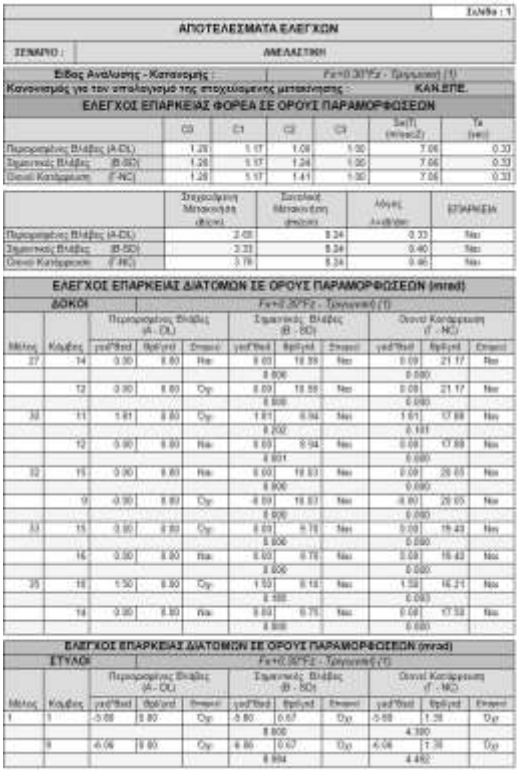
This table gives you, each inelastic analysis performed, the total number of insufficient beams and columns for each performance level.

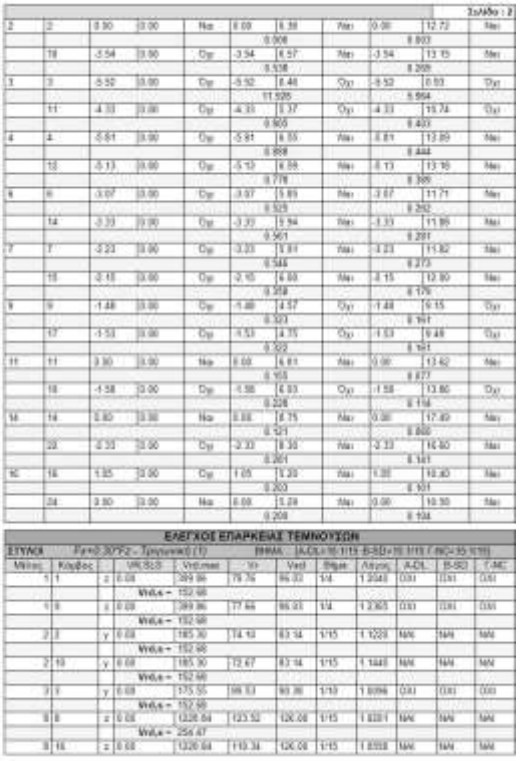
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

In the above example for all inelastic analyses, elements (D: Beams, K: Columns, S: Total) have failed in all distributions and combinations for the first performance level (DL), for some combinations in the second (SD) and even less in the third (NC).

In the "Print" column you select which inelastic analysis(s) to include in the study booklet.

By selecting a line with the mouse and pressing the "Preview Controls" button, the results for the specific analysis are displayed in detail:





OBSERVATION:

- The printout of the section adequacy checks in terms of deformation now shows in detail the quantities (Ci and the rest) used for the calculation of the targeted displacement and the check at the level of the girder:

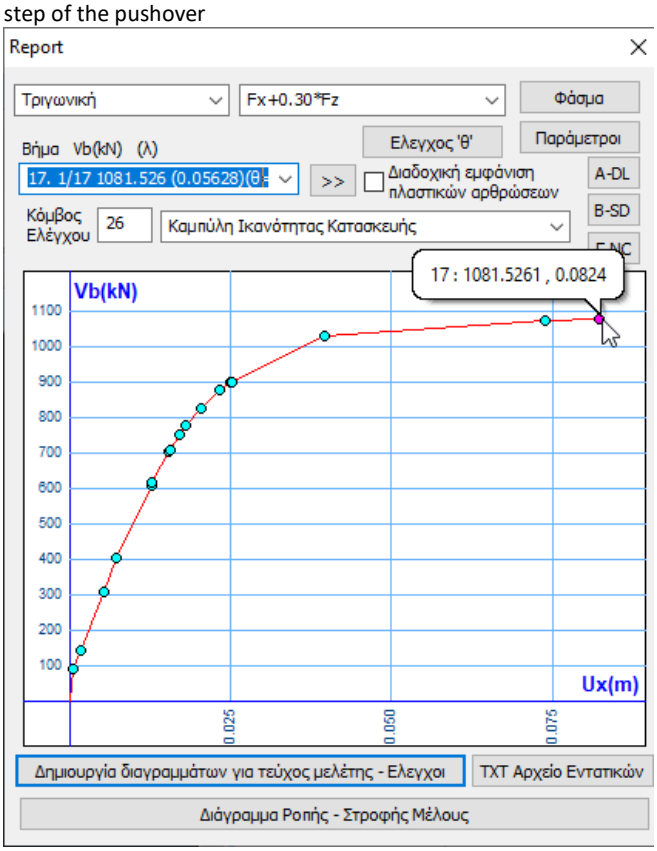
ΕΛΕΓΧΟΣ ΕΠΑΡΚΕΙΑΣ ΦΟΡΕΑ ΣΕ ΟΡΟΥΣ ΠΑΡΑΜΟΡΦΩΣΕΩΝ						
	C0	C1	C2	C3	Se(T) (m/sec2)	Te (sec)
Περιορισμένες Βλάβες (A-DL)	1.20	1.17	1.00	1.00	7.06	0.33
Σημαντικές Βλάβες (B-SD)	1.20	1.17	1.24	1.00	7.06	0.33
Οιονεί Κατάρρευση (Γ-NC)	1.20	1.17	1.41	1.00	7.06	0.33

	Στοχευόμενη Μετακινήση dt(cm)	Συνολική Μετακινήση dm(cm)	λόγος λ=dt/dm	ΕΠΑΡΚΕΙΑ
Περιορισμένες Βλάβες (A-DL)	2.69	8.24	0.33	Ναι
Σημαντικές Βλάβες (B-SD)	3.33	8.24	0.40	Ναι
Οιονεί Κατάρρευση (Γ-NC)	3.78	8.24	0.46	Ναι

- Control at operator level

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

This check is for the whole vector and compares the movement dm which is the movement corresponding to the last step of the pushover



With the targeted movements corresponding to the performance levels.

	Στοχευόμενη Μετακίνηση dt(cm)	Συνολική Μετακίνηση dm(cm)	λόγος λ=dt/dm	ΕΠΑΡΚΕΙΑ
Περιορισμένες Βλάβες (A-DL)	2.69	8.24	0.33	Ναι
Σημαντικές Βλάβες (B-SD)	3.33	8.24	0.40	Ναι
Οιονεί Κατάρρευση (Γ-NC)	3.78	8.24	0.46	Ναι

In this example the value is dm=8.24 cm. This is the maximum displacement the carrier can withstand before it collapses. This is compared to the target displacement of each performance level dt and must of course be larger, i.e. the demand (target) must be less than the "strength".

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

OBSERVATION:
At the bottom of the file, the Sectional Adequacy Check is also displayed only for shear-failing elements.

ΕΛΕΓΧΟΣ ΕΠΑΡΚΕΙΑΣ ΤΕΜΝΟΥΣΩΝ											
ΣΤΥΛΟΙ	*Fx+0.30*Fz - Τριγωνική (1)*					BHMA : [A-DL=15:1/15 B-SD=15:1/15 Γ-NC=15:1/15]					
Μέλος	Κόμβος		VR,SLS	Vrd,max	Vr	Ved	Βήμα	Λόγος	A-DL	B-SD	Γ-NC
1	1	z	0.00	399.86	79.76	96.03	1/4	1.2040	OXI	OXI	OXI
			Vrd,s =	152.68							
1	9	z	0.00	399.86	77.66	96.03	1/4	1.2365	OXI	OXI	OXI
			Vrd,s =	152.68							
2	2	y	0.00	185.30	74.10	83.14	1/15	1.1220	NAI	NAI	NAI
			Vrd,s =	152.68							
2	10	y	0.00	185.30	72.67	83.14	1/15	1.1440	NAI	NAI	NAI
			Vrd,s =	152.68							
3	3	y	0.00	175.55	89.53	90.38	1/10	1.0096	OXI	OXI	OXI
			Vrd,s =	152.68							
8	8	z	0.00	1228.84	123.52	126.00	1/15	1.0201	NAI	NAI	NAI
			Vrd,s =	254.47							
8	16	z	0.00	1228.84	119.34	126.00	1/15	1.0558	NAI	NAI	NAI

- addition, SCADA Pro incorporates the new check of the KANEPE, included in the latest revision of the KAN.EPE (2h Revision 2017) and concerns **the possibility of slippage due to shear at the base or other accidental cross-sections**
  wall.

The check is for pushover only and has been incorporated into the printout of the pushover checks in the corresponding section for intersections:

```
                    ΕΛΕΓΧΟΣ ΕΠΑΡΚΕΙΑΣ ΤΕΜΝΟΥΣΩΝ
-------------------------------------------------------------------------------
Δοκοί (Fx+0.30*Fz - Τριγωνική) (1)      BHMA : [A-DL=35 B-SD=36 Γ-NC=36]
-------------------------------------------------------------------------------
|Μέλος Κόμβ.|   Vrd,s |Vrd,max |  Vr   |  Ved  |Βήμα| Λόγος  |A-DL|B-SD|Γ-NC|
|-----------+---------+--------+-------+-------+----+--------+----+----+----|
|   37     2|y: 565.49|  328.34| 209.51| 226.79|   1|  1.0825|OXI |OXI |OXI |
|   37     5|y: 565.49|  328.34| 209.51| 232.08|   1|  1.1077|OXI |OXI |OXI |
|   44     8|y: 565.49|  328.34| 211.26| 226.02|   1|  1.0699|OXI |OXI |OXI |
|   44    11|y: 565.49|  328.34| 211.26| 232.85|   1|  1.1022|OXI |OXI |OXI |
|   51    14|y: 565.49|  328.34| 211.26| 226.56|   1|  1.0725|OXI |OXI |OXI |
|   51    17|y: 565.49|  328.34| 211.26| 232.31|   1|  1.0997|OXI |OXI |OXI |
-------------------------------------------------------------------------------
Στύλοι (Fx+0.30*Fz - Τριγωνική) (1)      BHMA : [A-DL=35 B-SD=36 Γ-NC=36]
-------------------------------------------------------------------------------
|Μέλος Κόμβ.|  VR,SLS |Vrd,max |  Vr   |  Ved  |Βήμα| Λόγος  |A-DL|B-SD|Γ-NC|
|-----------+---------+--------+-------+-------+----+--------+----+----+----|
|    4    31|y:   5.41|   10.41|  30.92|   6.29|   1|  1.1612|OXI |OXI |OXI |
|           |  Vrd,s =   97.36          |    |        |    |    |    |
|    4     4|y:   5.41|   10.41|  30.92|   6.29|   1|  1.1612|OXI |OXI |OXI |
|           |  Vrd,s =   97.36          |    |        |    |    |    |
-------------------------------------------------------------------------------
```

The value is **the slip resistance cutting torque VR,SLS** and the corresponding paragraph of the UNECE is Annex 7C. Two methods are provided for its calculation. The second one, the alternative (equation C.14), has been incorporated in the program.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

OBSERVATION:

Two points are highlighted:

- A prerequisite for calculation of this strength and for performance of the test respectively, is that a bending failure has occurred, i.e. a plastic joint has been created in the limb under test.
- The second condition for performing the check is that the shear failure of the flexure has not preceded the bending failure (i.e. the end must not have a "square" lit). If the shear failure has preceded the bending failure, the test is not performed at all.

  So when you do not see a value in the corresponding field, it means that the above conditions do not apply.

OBSERVATION:

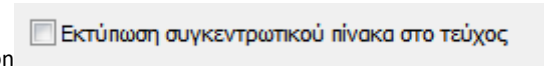
At the end of this file and if you have selected to include the wall infills in the scenario parameters, the results of the adequacy check in terms of deformations for each wall infill are displayed. No results are shown for the tension bars because they are not taken into account in the construction model.

ΕΛΕΓΧΟΣ ΕΠΑΡΚΕΙΑΣ ΤΟΙΧΟΠΛΗΡΩΣΕΩΝ ΣΕ ΟΡΟΥΣ ΠΑΡΑΜΟΡΦΩΣΕΩΝ										
		Περιορισμένες Βλάβες (A - DL)			Σημαντικές Βλάβες (B - SD)			Οιονεί Κατάρρευση (Γ - NC)		
Μέλος		γsd*εf	εy	Επαρκεί	γsd*εf	εu/γrd	Επαρκεί	γsd*εf	εu	Επαρκεί
47	Εφελκ									
48	Θλιβ.	0.00271	0.00150	Όχι	0.00271	0.00308	Ναι	0.00271	0.00400	Ναι
49	Θλιβ.	0.00374	0.00150	Όχι	0.00374	0.00308	Όχι	0.00374	0.00400	Ναι
50	Εφελκ									
51	Εφελκ									
52	Θλιβ.	0.00067	0.00150	Ναι	0.00067	0.00308	Ναι	0.00067	0.00400	Ναι
53	Θλιβ.	0.00332	0.00150	Όχι	0.00332	0.00308	Όχι	0.00332	0.00400	Ναι
54	Εφελκ									
55	Εφελκ									
56	Εφελκ									
57	Θλιβ.	0.00154	0.00150	Όχι	0.00154	0.00308	Ναι	0.00154	0.00400	Ναι
58	Εφελκ									
59	Εφελκ									
60	Θλιβ.	0.00090	0.00150	Ναι	0.00090	0.00308	Ναι	0.00090	0.00400	Ναι
63	Θλιβ.	0.00329	0.00150	Όχι	0.00329	0.00308	Όχι	0.00329	0.00400	Ναι
64	Εφελκ									

In addition to the above printout, a file named "TOIXPL_DAT.txt" is created in the analysis scenario folder, which contains the data of the types wall fillings used and then the data of the wall fillings per facet. The general folder for the analysis scripts is the subfolder named "scaanal" within your study folder and the script is identified by its serial number.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

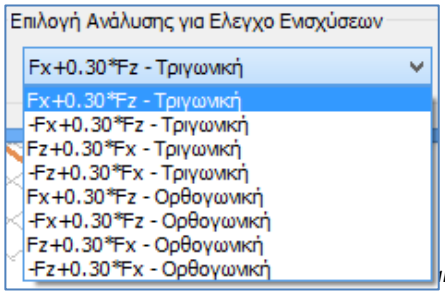
```
|                          ΤΥΠΟΙ ΤΟΙΧΟΠΛΗΡΩΣΕΩΝ
-------------------------------------------------------------------------------
Ονομα     : Μπατική οπτοπλινθοδομή
Είδος     : Υφιστάμενη      ΣΑΔ: Ικανοποιητική  ΣΠΕ: 1    γm=2.00
Κονίαμα   : Τσιμεντοκονίαμα-Μ5 (fm(MPa)=5.000)
            Πάχος(cm)=50.00 fk(Mpa)=3.44790 E(GPa)=3.45
Αρμοί     : Κατακόρυφοι πλήρεις: ΟΧΙ   Οριζόντιοι πάχους > 15mm: ΟΧΙ
-------------------------------------------------------------------------------


                        ΔΕΔΟΜΕΝΑ ΤΟΙΧΟΠΛΗΡΩΣΕΩΝ
-------------------------------------------------------------------------------
Μέλος          : 94 Κόμβος Αρχής:24 Κόμβος Τέλους:30   L(cm)=688.77
Τοιχοποιία     : Μπατική οπτοπλινθοδομή
Γεωμετρία(cm): Παχος t=50.00 Μήκος l=620.00 Ύψος h=300.00 Πλάτος h=0.00
Οπλισμένη      : Αοπλη   fwc,k(MPa)=3.45    E(GPa)=3.45
Ανοίγματα      : Χωρίς ή 1 μικρό περίπου στο κέντρο (n1=1.00)
Στάθμη Βλαβών: Χωρίς βλάβες (rR=1.00 rk=1.00)
Λυγηρότητα     : Περιμετρική Επαφή (n3=1.00[1.00,1.00])
Αρμοί          : Κατακόρυφοι Αρμοί πλήρεις       : ΝΑΙ (n4=0.75)
               : Οριζόντιος Αρμός πάχους > 15mm : ΟΧΙ (n5=1.00)
Παραμορφώσεις: εy=0.0006250   εu=0.0025000  ε΄u=0.0037500
Θλιπτική αντοχή fwc,s(MPa)=0.517     Μέτρο Ελαστικότητας : E'(GPa)=2.607

Μέλος          : 95 Κόμβος Αρχής:26 Κόμβος Τέλους:28   L(cm)=688.77
Τοιχοποιία     : Μπατική οπτοπλινθοδομή
Γεωμετρία(cm): Παχος t=50.00 Μήκος l=620.00 Ύψος h=300.00 Πλάτος h=0.00
Οπλισμένη      : Αοπλη   fwc,k(MPa)=3.45    E(GPa)=3.45
Ανοίγματα      : Χωρίς ή 1 μικρό περίπου στο κέντρο (n1=1.00)
Στάθμη Βλαβών: Χωρίς βλάβες (rR=1.00 rk=1.00)
Λυγηρότητα     : Περιμετρική Επαφή (n3=1.00[1.00,1.00])
Αρμοί          : Κατακόρυφοι Αρμοί πλήρεις       : ΝΑΙ (n4=0.75)
               : Οριζόντιος Αρμός πάχους > 15mm : ΟΧΙ (n5=1.00)
Παραμορφώσεις: εy=0.0006250   εu=0.0025000  ε΄u=0.0037500
Θλιπτική αντοχή fwc,s(MPa)=0.517     Μέτρο Ελαστικότητας : E'(GPa)=2.607

Μέλος          : 96 Κόμβος Αρχής:25 Κόμβος Τέλους:30   L(cm)=724.98
Τοιχοποιία     : Μπατική οπτοπλινθοδομή
Γεωμετρία(cm): Παχος t=50.00 Μήκος l=660.00 Ύψος h=300.00 Πλάτος h=0.00
Οπλισμένη      : Αοπλη   fwc,k(MPa)=3.45    E(GPa)=3.45
Ανοίγματα      : Χωρίς ή 1 μικρό περίπου στο κέντρο (n1=1.00)
Στάθμη Βλαβών: Χωρίς βλάβες (rR=1.00 rk=1.00)
Λυγηρότητα     : Περιμετρική Επαφή (n3=1.00[1.00,1.00])
```

Finally, the option 

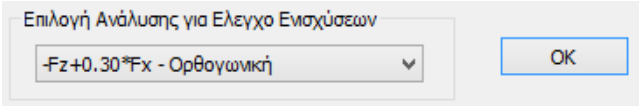
when checked includes in the study booklet the printing of this summary table.

OBSERVATION:

*It should be noted that the results of this table are **ONLY** an **INDICATION**. It is at the designer's discretion what the final choice will be, defined by selecting from the list the type of distribution which the control and sizing of the reinforcements will be carried out:*



"Select Analysis for Aid Control" and "ok" to enter.
For this example it was chosen:



nd at the reinforcement stage, no failing data for all the inelastic analyses for the chosen EIS.

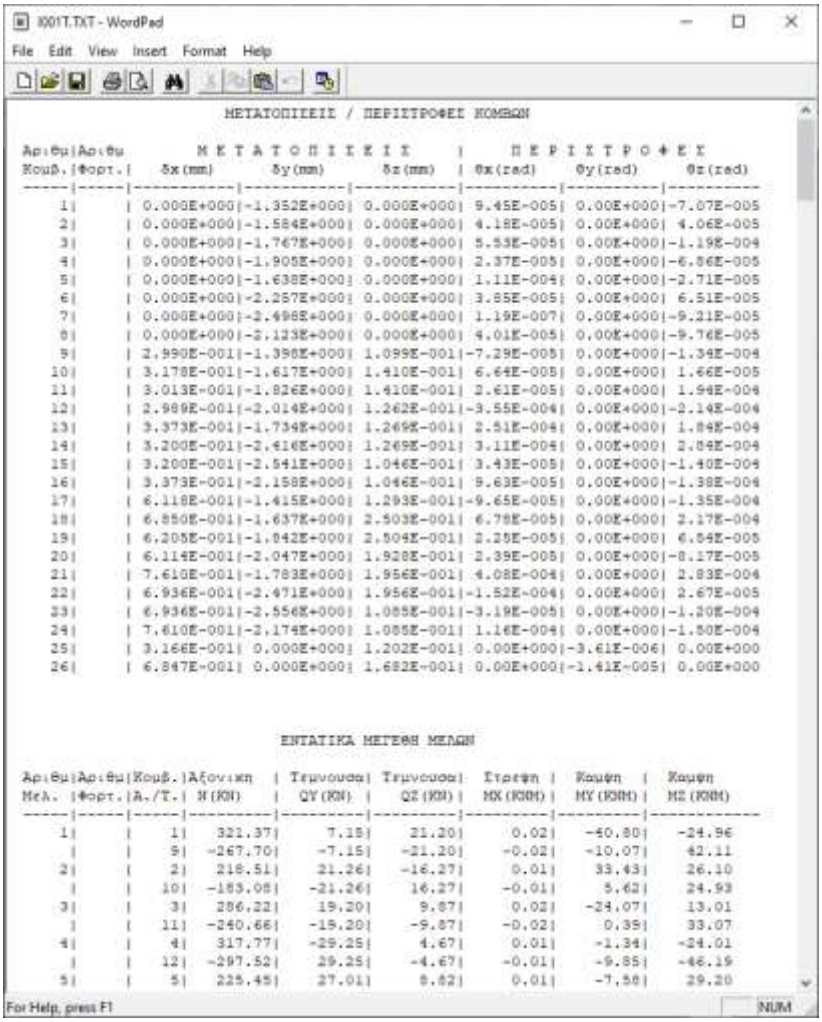
3(α).9 Results - Active stiffnesses

We select the command "TXT file Intensive", then the option of key

TXT Αρχείο Εντατικών

and the following file appears, containing the lists with :

- Displacements and Junction Rotations for all junctions per direction
- Intensive Member sizes at the beginning and end of each member
- Active stiffnesses for each Pillar and each Beam



001T.TXT - WordPad

File Edit View Insert Format Help

ΜΕΤΑΤΟΠΙΣΕΙΣ / ΠΕΡΙΣΤΡΟΦΕΣ ΚΟΜΒΩΝ

Αριθμ Κομβ.	Αριθμ Φορτ.	ΜΕΤΑΤΟΠΙΣΕΙΣ δx(mm)	δy(mm)	δz(mm)	ΠΕΡΙΣΤΡΟΦΕΣ θx(rad)	θy(rad)	θz(rad)
1		0.000E+000	-1.352E+000	0.000E+000	9.45E-005	0.00E+000	-7.07E-005
2		0.000E+000	-1.584E+000	0.000E+000	4.18E-005	0.00E+000	4.06E-005
3		0.000E+000	-1.767E+000	0.000E+000	5.53E-005	0.00E+000	-1.19E-004
4		0.000E+000	-1.905E+000	0.000E+000	2.37E-005	0.00E+000	-6.86E-005
5		0.000E+000	-1.638E+000	0.000E+000	1.11E-004	0.00E+000	-2.71E-005
6		0.000E+000	-2.257E+000	0.000E+000	3.85E-005	0.00E+000	6.51E-005
7		0.000E+000	-2.496E+000	0.000E+000	1.19E-007	0.00E+000	-9.21E-005
8		0.000E+000	-2.123E+000	0.000E+000	4.01E-005	0.00E+000	-9.76E-005
9		2.990E-001	-1.398E+000	1.099E-001	-7.29E-005	0.00E+000	-1.34E-004
10		3.178E-001	-1.617E+000	1.410E-001	6.64E-005	0.00E+000	1.66E-005
11		3.013E-001	-1.826E+000	1.410E-001	2.61E-005	0.00E+000	1.94E-004
12		2.989E-001	-2.014E+000	1.262E-001	-3.55E-004	0.00E+000	-2.14E-004
13		3.373E-001	-1.734E+000	1.269E-001	2.51E-004	0.00E+000	1.84E-004
14		3.200E-001	-2.416E+000	1.269E-001	3.11E-004	0.00E+000	2.84E-004
15		3.200E-001	-2.541E+000	1.046E-001	3.43E-005	0.00E+000	-1.40E-004
16		3.373E-001	-2.158E+000	1.046E-001	9.63E-005	0.00E+000	-1.38E-004
17		6.118E-001	-1.415E+000	1.293E-001	-9.65E-005	0.00E+000	-1.35E-004
18		6.850E-001	-1.637E+000	2.503E-001	6.78E-005	0.00E+000	2.17E-004
19		6.205E-001	-1.842E+000	2.504E-001	2.25E-005	0.00E+000	6.54E-005
20		6.114E-001	-2.047E+000	1.928E-001	2.39E-005	0.00E+000	-8.17E-005
21		7.610E-001	-1.783E+000	1.956E-001	4.08E-004	0.00E+000	2.83E-004
22		6.936E-001	-2.471E+000	1.956E-001	-1.52E-004	0.00E+000	2.67E-005
23		6.936E-001	-2.556E+000	1.085E-001	-3.19E-005	0.00E+000	-1.20E-004
24		7.610E-001	-2.174E+000	1.085E-001	1.16E-004	0.00E+000	-1.50E-004
25		3.166E-001	0.000E+000	1.202E-001	0.00E+000	-3.61E-006	0.00E+000
26		6.847E-001	0.000E+000	1.682E-001	0.00E+000	-1.41E-005	0.00E+000

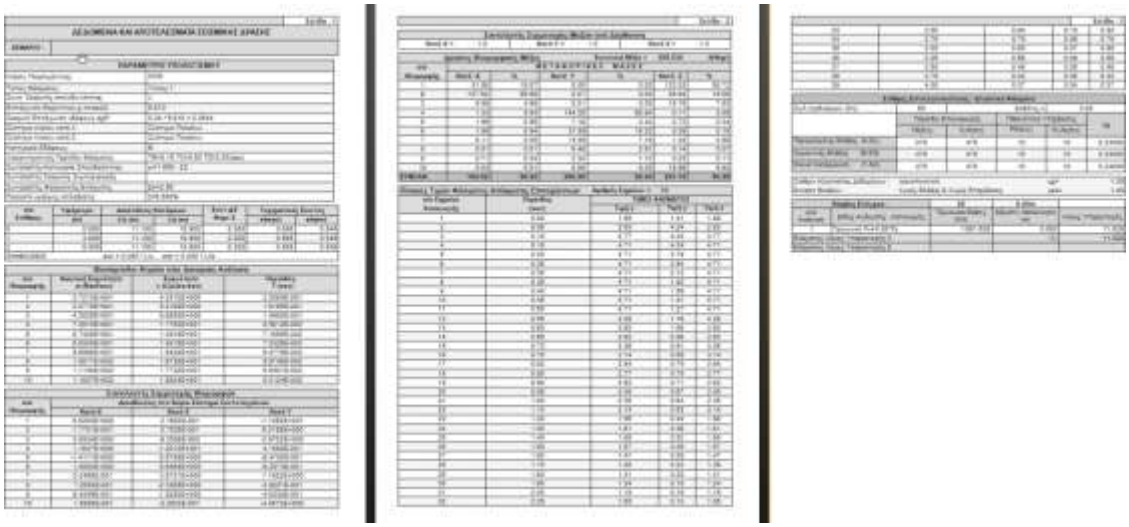
ΕΝΤΑΤΙΚΑ ΜΕΓΕΘΗ ΜΕΛΩΝ

Αριθμ Μελ.	Αριθμ Φορτ.	Κομβ. Α./Τ.	Αξονική N(KN)	Τεμνουσα QY(KN)	Τεμνουσα QZ(KN)	Στρεψη MX(KNM)	Καμψη MY(KNM)	Καμψη MZ(KNM)
1		1	321.37	7.15	21.20	0.02	-40.80	-24.96
		9	-267.70	-7.15	-21.20	-0.02	-10.07	42.11
2		2	218.51	21.26	-16.27	0.01	33.43	26.10
		10	-183.08	-21.26	16.27	-0.01	5.62	24.93
3		3	286.22	19.20	9.87	0.02	-24.07	13.01
		11	-240.66	-19.20	-9.87	-0.02	0.39	33.07
4		4	317.77	-29.25	4.67	0.01	-1.34	-24.01
		12	-297.52	29.25	-4.67	-0.01	-9.85	-46.19
5		5	225.45	27.01	8.82	0.01	-7.58	29.20

For Help, press F1 NUM

3(a).10 Seismic Action

Finally, with the inelastic scenario always active and by selecting the Seismic Action command, the data for the spectra, the level of performance and the extent of the damage are displayed and then, for each analysis, the maximum base shear, the corresponding maximum displacement and the overstrength ratio, the minimum overstrength ratios per direction:



Στάθμες Επιτελεστικότητας - Ελαστικά Φάσματα					
Ζωή σχεδιασμού (έτη)	50		Εκθέτης κ	3.00	
	Περίοδοι Επαναφοράς		Πιθανότητα Υπέρβασης		ag
	TR(έτη)	TLR(έτη)	PR(έτη)	PLR((έτη)	
Περιορισμένες Βλάβες (A-DL)	475	475	10	10	0.24000
Σημαντικές Βλάβες (B-SD)	475	475	10	10	0.24000
Οιονεί Κατάρρευση (Γ-NC)	475	475	10	10	0.24000

Στάθμη Αξιοπιστίας Δεδομένων :	Ικανοποιητική	γg=	1.35
Εκταση Βλαβών :	Χωρίς Βλάβες & Χωρίς Επεμβάσεις	γsd=	1.00

Κόμβος Ελέγχου :		26	6.00m	
Α/Α Ανάλυση	Είδος Ανάλυσης - Κατανομής	Τέμνουσα Βάσης (KN)	Μέγιστη Μετακίνηση (m)	Λόγος Υπεραντοχής
1	Τριγωνική Fx+0.30*Fz	1081.526	0.082	11.528
Ελάχιστος Λόγος Υπεραντοχής X			(1)	11.528
Ελάχιστος Λόγος Υπεραντοχής Z				

J. Showing Proficiency Ratios with Color Grading

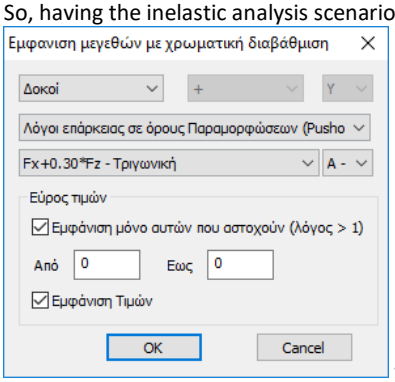
In the new version of SCADA Pro has been added to the Analysis the color gradation for the adequacy reasons concerning the valuation according to KAAN.EPE. Pressing right click on the desktop displays the following menu.

and selecting Show Color Gradients depending on the analysis scenario that is active For the pushover scenario both beams and columns, two values are calculated for the capacity ratios at the beginning and at the end of member:

- Sufficiency ratios in terms of Pushover (2 values, start - end)
- Reasons for adequacy in terms of Pushover
- Data behaviour

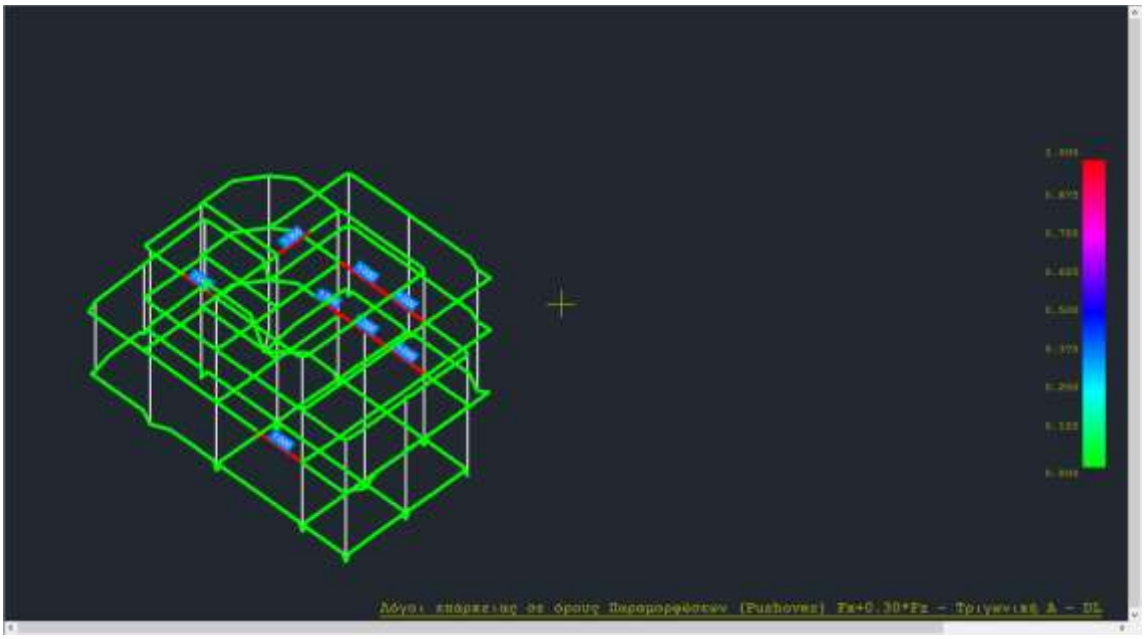
A prerequisite for the above reasons to appear is that you have gone through Controls Preview located by pressing

So, having the inelastic analysis scenario active, in the known dialogue box by selecting



you get the following vector image:

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



For more details about the colour gradations in the Anelastic analysis you can consult the User's Guide "8A.Analysis" (p.40).

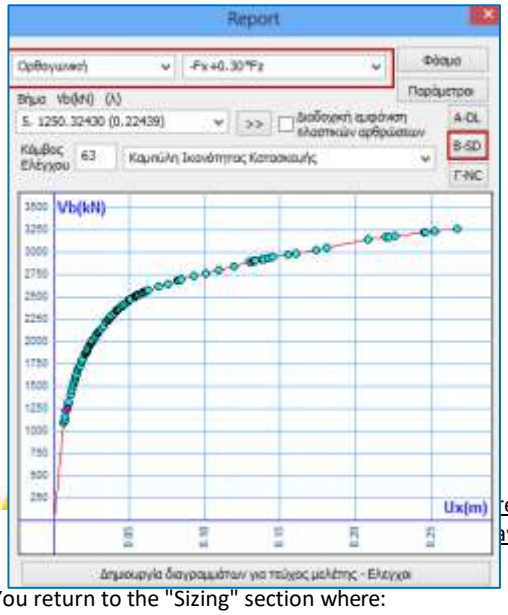
4(a) STEP 4: ENCOUNTERS

4 (a).1 General

A member is considered necessary to be strengthened when it cannot carry its vertical loads and the loads resulting from the design earthquake. The need to strengthen specific structural elements of the design is determined on the basis of options :

- The level of performance
- The type of distribution to be used for the control and sizing of aids

So, having selected performance level B and distribution type Orthogonal (for this example), you refer to "Report":



You select the type of distribution with which the control and sizing of the reinforcements and the level of performance will be carried out and by referring to the "Steps", you locate the post where the first plastic joint will be carried out.

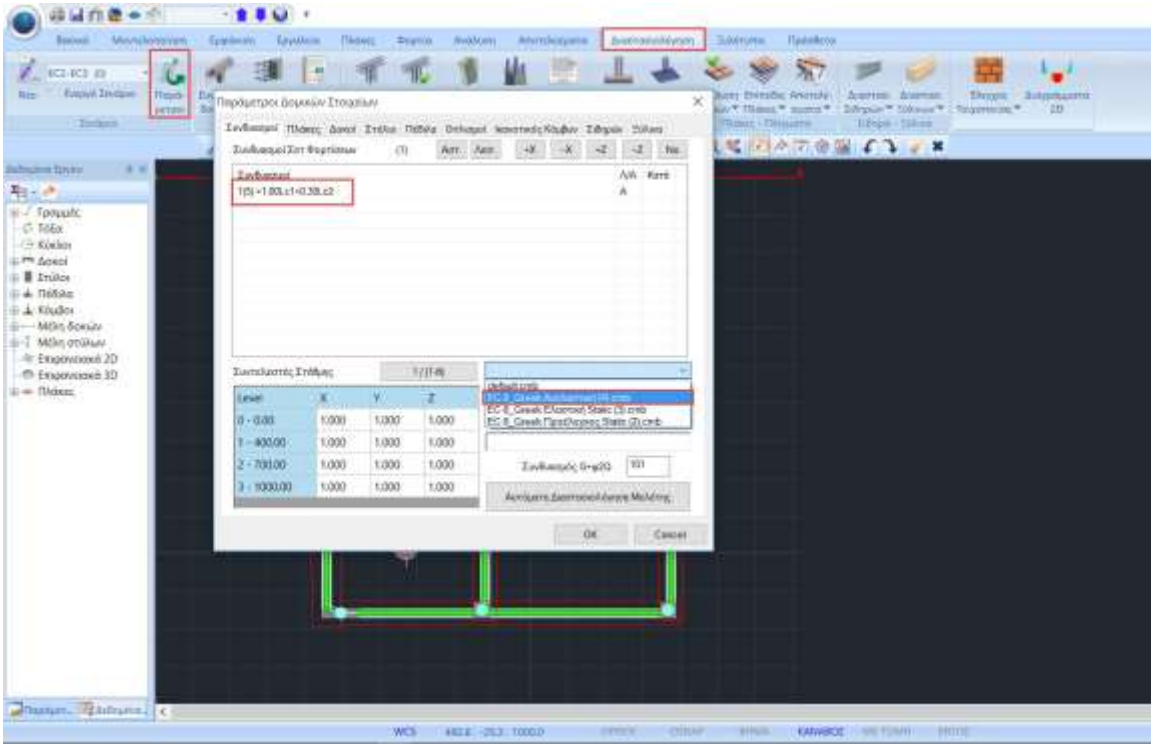
einforce and control, starting with this element, and progressing avior of your host.

You return to the "Sizing" section where:

by using the "Reinforcement Details" commands for columns and beams, you have the possibility to apply the materials and technologies of interventions and reinforcements according to the basic principles of these methods officially defined by the provisions of the Interventions Regulation.

NOTE: *The basic requirement for the sizing of the reinforcements is the selection and calculation of the combinations of the inelastic saved in a respective step of the procedure and the creation of a Eurocode (EC2) sizing scenario, as well as the selection of the desired Performance Level within the window of each reinforcement, between A, B and C.*

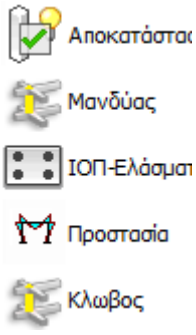
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



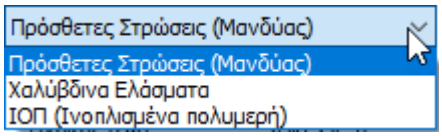
4 (a).2 Aid

ScadaPro has integrated the tools for the rehabilitation and strengthening needs of the columns and walls, as well as the beams, as required by the intervention regulation (KAN.EPE)

PENS and WALLS :



DOKOI :



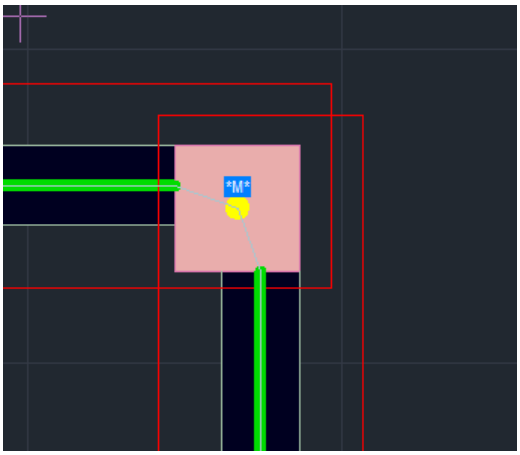
and all the controls and procedures required for them.

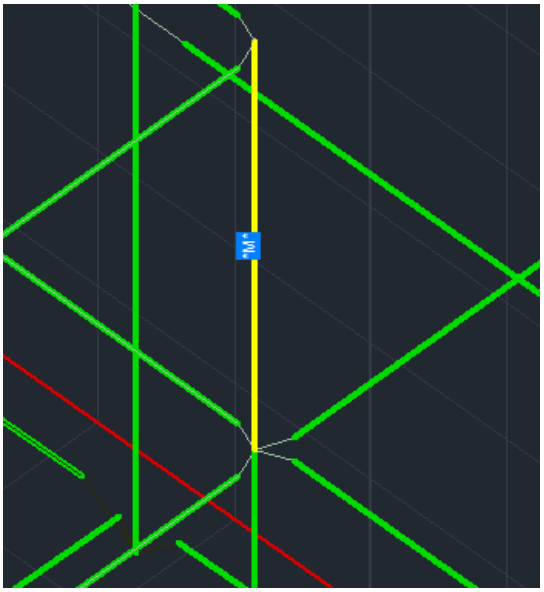
⚠ A detailed description of each aid is given in the corresponding chapter of the User Manual entitled CHAPTER A: 'DOKA INVESTMENTS' & CHAPTER B: 'DETAILS OF COLUMN REINFORCEMENTS

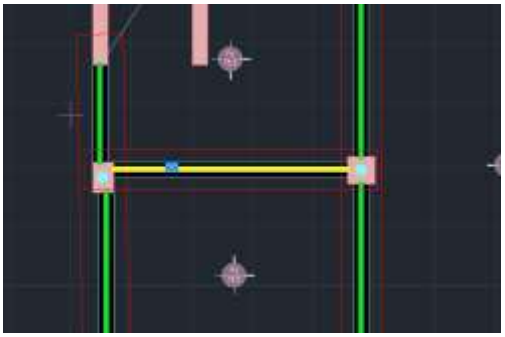
As for the reinforced columns, for the beams that have been reinforced, it is highlighted on the screen:

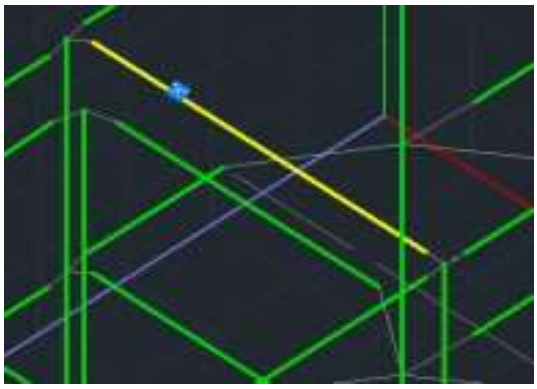
In addition, depending on the type of aid, the corresponding indicative letter appears:

- Cloak: "M"
- Lamma (Lama) : "L"
- IOP: "I"









A prerequisite for the display of the highlighting is that you have selected the Τεύχος button in the window of the respective aid

OBSERVATION:

It should be noted that after the introduction of reinforcements, new M-N interaction diagrams should always be calculated,

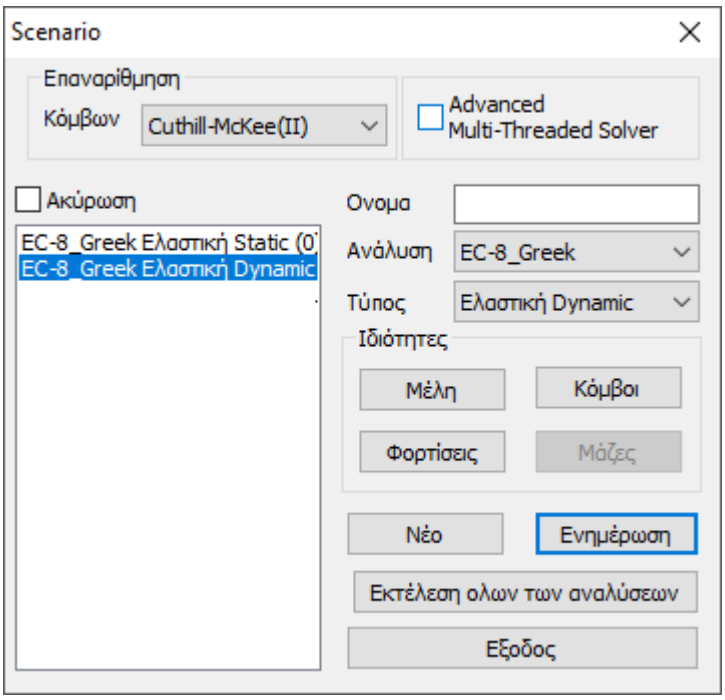
- or through the Armament Details for each cross-section separately,
- or via for all poles/row and all levels
- either with the via Επαναυπολογισμός μεγεθών ΚΑΝ.ΕΠΕ. for all structural elements of the vector and all levels.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

3(b) STEP 3: ELASTIC ANALYSIS

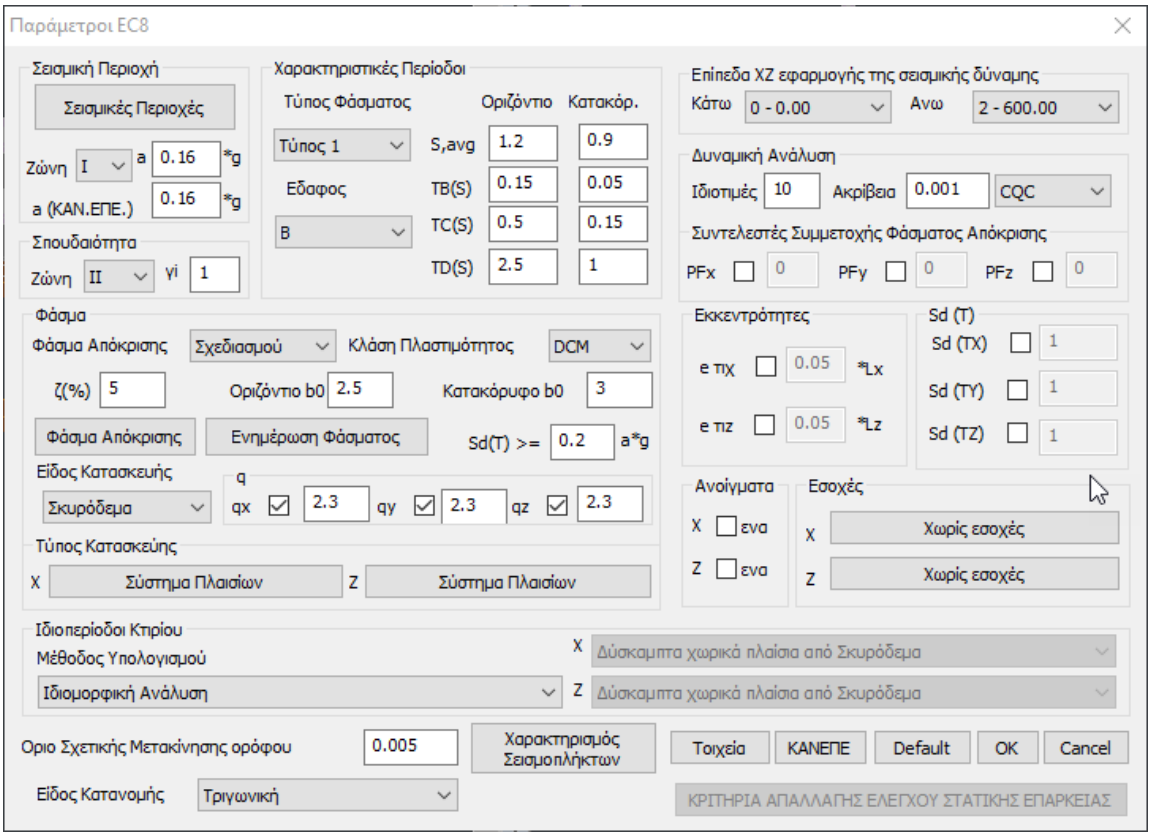
3(b).1 General

In the case of Elastic, you create a new elastic static or dynamic analysis scenario.



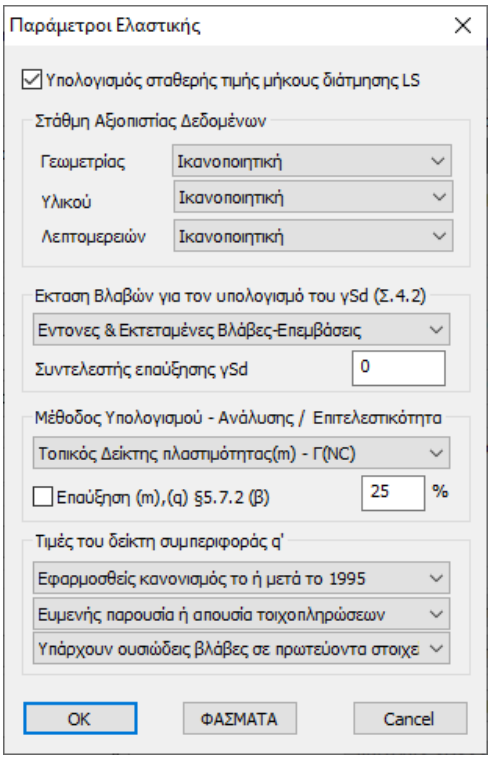
You then follow the procedure for running the script. In the "Parameters" dialog box:

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



set the parameters as you would for an EC8 scenario.

By pressing the "CANOPE" button the following dialog box appears



- In the "***Calculate constant LS shear length value***" option you specify:

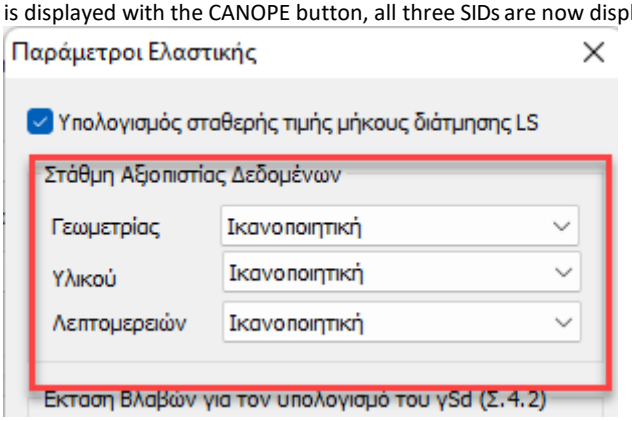
- if the shear length of the elements will be calculated with a fixed value based on the length as provided for by the CANEP* (ticked)
- or whether it will be calculated on the basis of the resulting intensive magnitudes, where Shear Length = M/V at the end section of the element, i.e. the distance of the end section from the zero point of the moments.

As far as shear length is concerned, the method of calculation is important, both for the classification of the elements into **plastic** and **sandy** and for the method of calculation of local plasticity indices where the calculation of θy and θu is required.

3h revision of the EIA:

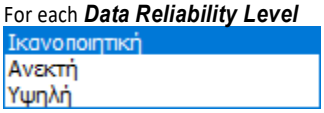
- The gg depends on the geometry and
- The cRd from the worst SDS between material and details.

So in the four scenarios of the CANPE of the elastic analysis, in the context of a dialogue that is displayed with the CANOPE button, all three SIDs are now displayed



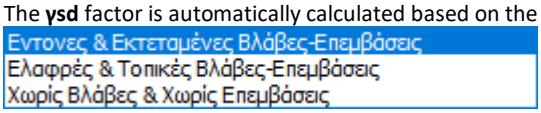
- ***Select:***

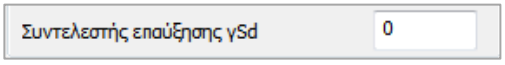
For each ***Data Reliability Level***



- ***Extent of Damage***

The **γsd** factor is automatically calculated based on the corresponding option,



- The value 0 in the field 

means that the coefficient will take the value based on ***table .4.2.*** *of the EIA*.
If you want your own value, enter a number and it will be added up to the value provided by the table. Calculations are made based on the resulting sum.
Where more precise data are not available, cSd values according to the following Table may be used.

Πίνακας Σ 4.2: Τιμές του συντελεστή γ_{Sd}

Έντονες και εκτεταμένες βλάβες ή / και επεμβάσεις	Ελαφρές και τοπικές βλάβες ή / και επεμβάσεις	Χωρίς βλάβες και χωρίς επεμβάσεις
γ_{Sd} =1,20	γ_{Sd} =1,10	γ_{Sd} =1,00

Βλ. και Παράρτημα 7Δ και Παράρτημα ΣΤ περί βλαβών και φθορών.

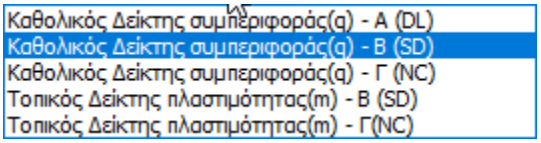
IMPORTANT OBSERVATION:

The csd coefficient is automatically calculated based on the corresponding option, but since the CANEPE allows the elastic analysis to be selected regardless of the criteria AND ONLY FOR ASSESSMENT, provided that the csd is increased by 0.15, there is a field "Increment coefficient", where you can enter the value you wish.

- ***Method of Calculation - Analysis / Performance***

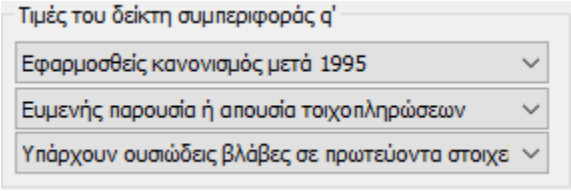
The next field concerns the choice of the type of elastic analysis (global index behaviour (**q**) or local ductility indices (**m**)) for each level of performance.

- For performance level A, the m method is not applicable.



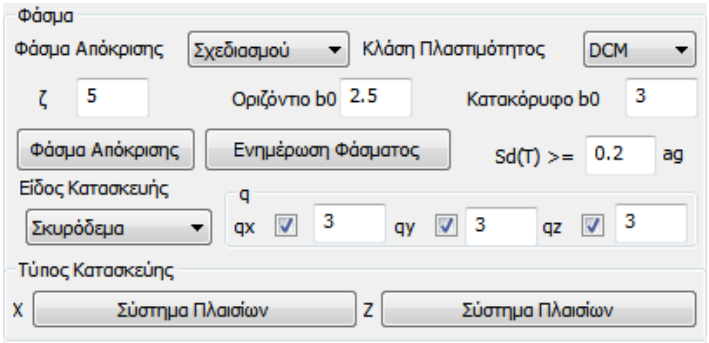
- The choice of method (m) assumes an elastic response spectrum, whereas the method (q) assumes a design spectrum with modified seismic coefficient behavior (q).

- The following fields relate to parameters for method q.



- The following figure of the parameters is shown when the method of the global index of behaviour (**q**) for performance level B is selected.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



Then, select the command **FRAME**

The **EIR** provides a **minimum tolerable target based on the building's significance category** based on the table below:

Πίνακας ΠΑ.2.1. *Ελάχιστοι ανεκτοί στόχοι αποτίμησης ή ανασχεδιασμού υφισταμένων κτιρίων.*

Κατηγορία Σπουδαιότητας	Ελάχιστοι Ανεκτοί Στόχοι
I	Γ2
II	Γ1
III	Β1
IV	Β1 και Α2 (Ικανοποίηση **και** των δύο στόχων)

Σε κάθε περίπτωση να θεωρηθεί ότι ισχύει Α1>Α2, Β1>Β2, Γ1>Γ2, Α1>Β1>Γ1 και Α2>Β2>Γ2

3h revision of the 2022 EIA.

In the new EIA, more seismic hazard categories are introduced (9 in total from 2 before), the term *seismic class* is introduced, as well as a new method of assessment and redesign (which can be followed as an alternative to the one in force until now).

Seismic class is the maximum rating or redesign target for a given level of performance. It is derived from the combination of performance level and αg rate.
The seismic classes for performance level B are considered as basic seismic classes.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

Πίνακας Σ 2.1. Ενδεικτική συσχέτιση περιόδου επαναφοράς και πιθανότητας υπέρβασης της σεισμικής δράσης με την αντίστοιχη ανηγμένη οριζόντια εδαφική επιτάχυνση.

Περίοδος Επαναφοράς (έτη)	Πιθανότητα υπέρβασης σεισμικής δράσης εντός του συμβατικού χρόνου ζωής των 50 ετών	$\alpha_g/\alpha_{g,ref}$
2475	2%	1.80
975	5%	1.30
475	**10%**	**1.00**
225	20%	0.75
135	**30%**	**0.60**
70	50%	0.45
40	70%	0.35
20	90%	0.25
<20	>90%	<0.25

Στον Πίνακα 2.1 παρουσιάζεται, η συσχέτιση της στάθμης επιτελεστικότητας του φέροντος οργανισμού με την αντίστοιχη ανηγμένη οριζόντια εδαφική επιτάχυνση. Στον Πίνακα Σ 2.1 παρουσιάζεται, μια **ενδεικτική συσχέτιση** της περιόδου επαναφοράς και της αντίστοιχης πιθανότητας υπέρβασης εντός του συμβατικού χρόνου ζωής των 50 ετών της σεισμικής δράσης με την αντίστοιχη ανηγμένη οριζόντια εδαφική επιτάχυνση.

Πίνακας 2.1. Στόχοι αποτίμησης ή ανασχεδιασμού Φέροντος Οργανισμού.

$\alpha_g/\alpha_{g,ref}$	Στάθμη Επιτελεστικότητας Φέροντος Οργανισμού		
	Α «Περιορισμένες Βλάβες»	Β «Σημαντικές Βλάβες»	Γ «Οριακή Κατάρρευση»
1.80	**A0**	**B0**	**Γ0**
1.30	**A1***	**B1***	**Γ1***
1.00	**A1**	**B1**	**Γ1**
0.75	**A2***	**B2***	**Γ2***
0.60	**A2**	**B2**	**Γ2**
0.45	**A3***	**B3***	**Γ3***
0.35	**A3**	**B3**	**Γ3**
0.25	**A4***	**B4***	**Γ4***
<0.25	**A4**	**B4**	**Γ4**

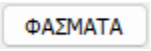
- $\alpha_{g,ref}$ είναι η οριζόντια εδαφική επιτάχυνση αναφοράς, που ορίζεται με πιθανότητα υπέρβασης της σεισμικής δράσης 10% στα 50 χρόνια συμβατικής ζωής του έργου.
- α_g είναι η οριζόντια εδαφική επιτάχυνση.

δ. Σεισμική κλάση κτιρίου ορίζεται ως ο μέγιστος στόχος αποτίμησης ή ανασχεδιασμού που μπορεί να εξασφαλίσει ένα κτίριο για μια επιλεγείσα στάθμη επιτελεστικότητας. Η σεισμική κλάση κτιρίου για στάθμη επιτελεστικότητας Β («Σημαντικές Βλάβες») θεωρείται **βασική σεισμική κλάση**.

Based on the above table we can summarize that my level of performance determines m, q (elastic) and θu (inelastic) and my return period and exceedance probability determines the seismic acceleration αg.

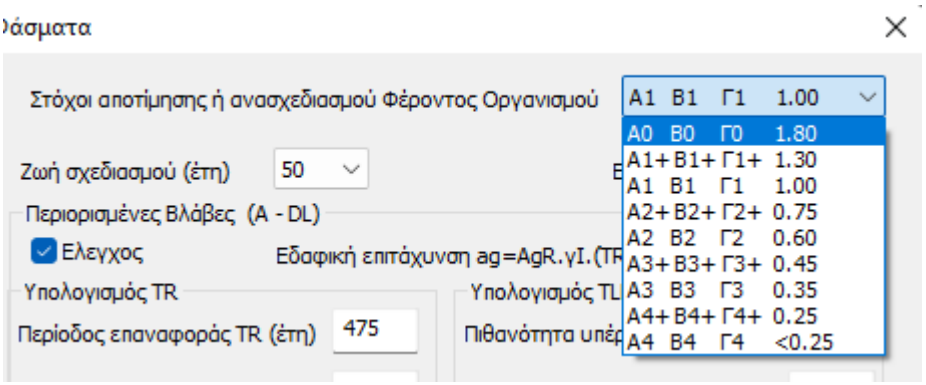
The three valuation targets (or the three seismic classes) for a 10% earthquake are still called A1, B1, C1 and have a factor of one but the targets for a 50% earthquake are now called A3+, B3+, C3+ and have a factor of 0.45 (from 0.53 previously). Still the two basic seismic hazard categories are no longer 10% and 50% but 10% with a factor of 1 and 30% with a factor of 0.60 (the two lines in bold in the table).

In the parameters of the 5 scenarios related to EIS there is now a new field for the ground acceleration that will be calculated and used based on the above table.

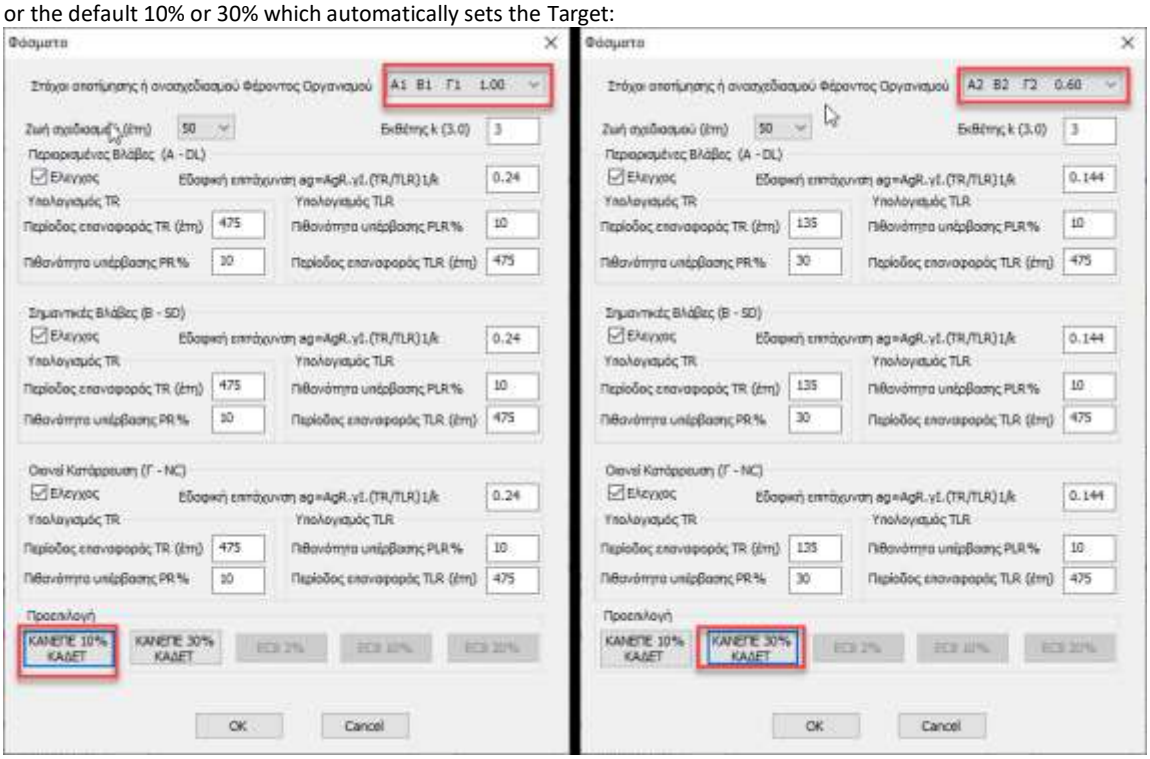
Going to the framework 

We select the seismic hazard category with the corresponding triad of seismic classes and the factor by which the initial reference ground acceleration will be multiplied in order to obtain the ground acceleration of the CANEPE

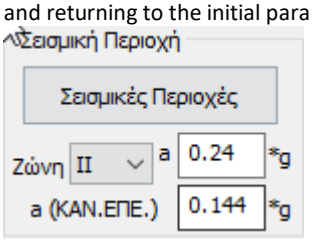
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



or the default 10% or 30% which automatically sets the Target:

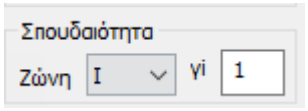


and returning to the initial parameters of the scenario in the field of ground acceleration CAN.EPE.



we see the value of the ground acceleration as it was calculated previously and as it will be used in the execution of the scenario for the calculation of the seismic action.
It is also noted that the γi used for the calculation of the seismic action always becomes 1 (from 0.8 which was before for the specific importance category) based on the following paragraph of the CANEPE.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



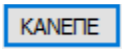
Για πιθανότητα υπερβάσεως 10% εντός του συμβατικού χρόνου των 50 ετών λαμβάνεται υπόψη η σεισμική δράση του ΕΚ 8-1, ενώ για διαφορετική πιθανότητα υπερβάσεως εντός του συμβατικού χρόνου των 50 ετών λαμβάνεται υπόψη το ποσοστό της παραπάνω σεισμικής δράσεως του ΕΚ 8-1, σύμφωνα με τα διαλαμβανόμενα στην § 2.2, θεωρώντας αντίστοιχα σε όλες τις περιπτώσεις τον συντελεστή σπουδαιότητας γ_I ίσο με τη μονάδα.

(3η Αναθεώρηση 2022)

The script is now ready to run without even needing a spectrum update.

K. Explanatory Example:

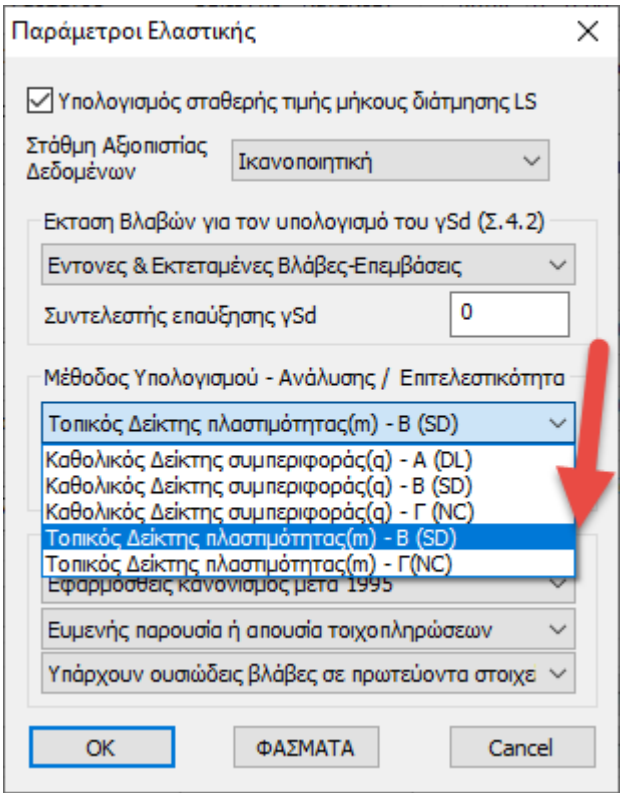
Suppose we are in zone II (α=0.24). We set the other parameters and select Update Spectrum to update the spectrum.

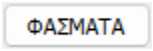
Then select the command . 

- ***Method m*** (only for performance levels B & C)

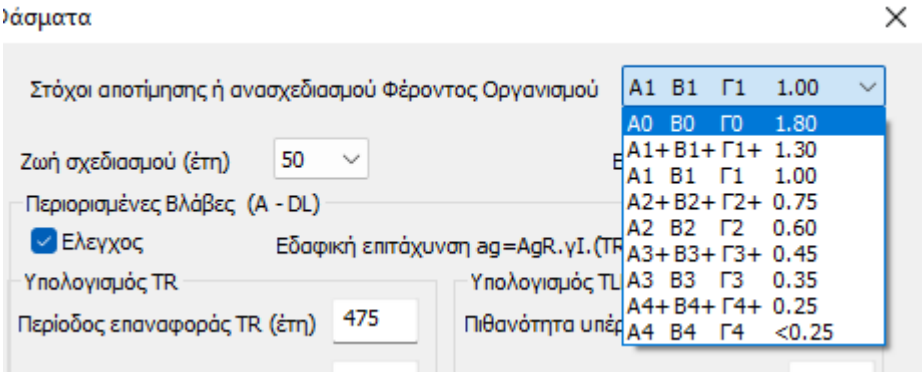
We select from the drop-down menu the m calculation method and the corresponding S.E.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

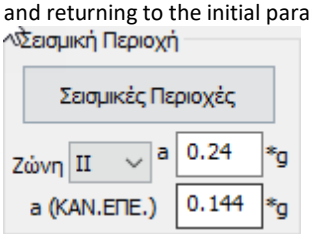


Going to the framework 

We select the seismic hazard category with the corresponding triad of seismic classes and the factor by which the initial reference ground acceleration will be multiplied in order to obtain the ground acceleration of the CANEPE



and returning to the initial parameters of the scenario in the field of ground acceleration CAN.EPE.



EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

- ***Method q*** (for performance levels A & B & C)

The final value to be used in the spectral acceleration is ag/q*. q* is the coefficient of Table 4.1 times q' .

Πίνακας 4.1 : Τιμές του λόγου q*/q΄ αναλόγως του στόχου επανελέγχου (για τον φέροντα οργανισμό)

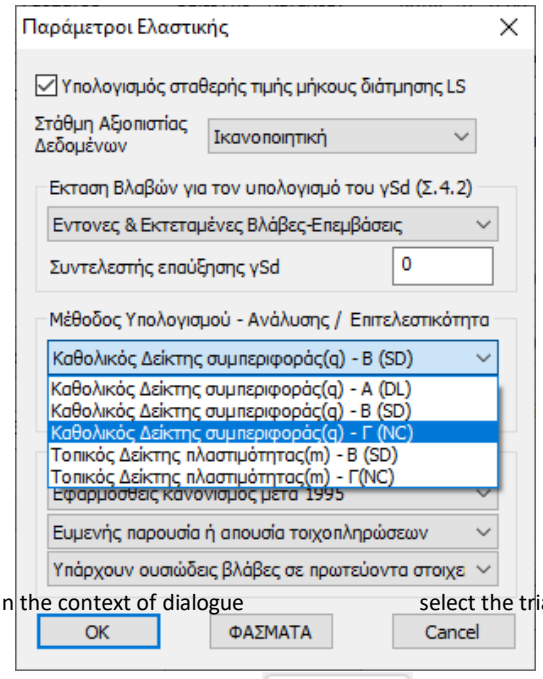
Στάθμη επιτελεστικότητας		
«Περιορισμένες βλάβες» (Α)	«Σημαντικές βλάβες» (Β)	«Οιονεί κατάρρευση» (Γ)
0,6 πάντως δε 1,0<q*<1,5	1,0	1,4

q' is obtained from Table 4.4 :

Πίνακας Σ 4.4: Τιμές του δείκτη συμπεριφοράς q΄ για την στάθμη επιτελεστικότητας Β («Σημαντικές βλάβες»)

Εφαρμοσθέντες Κανονισμοί μελέτης (και κατασκευής)	Ευμενής παρουσία ή απουσία τοιχοπληρώσεων (1)		Δυσμενής (γενικώς) παρουσία τοιχοπληρώσεων (1)	
	Ουσιώδεις βλάβες σε πρωτεύοντα στοιχεία		Ουσιώδεις βλάβες σε πρωτεύοντα στοιχεία	
	Όχι	Ναι	Όχι	Ναι
1995≤…	3,0	2,3	2,3	1,7
1985≤…<1995(2)	2,3	1,7	1,7	1,3
…<1985	1,7	1,3	1,3	1,1

This gives q*.
Note here that the user does not need to calculate anything.
The program does this on its own when we select CANPE, e.g.

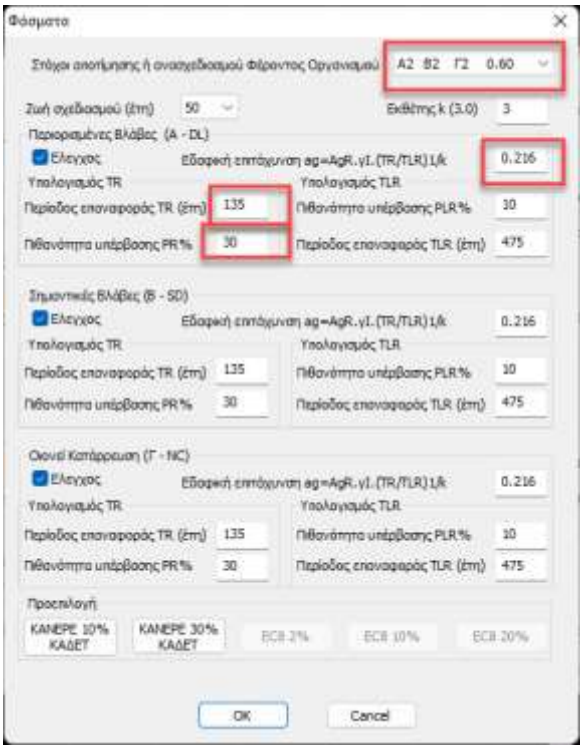


and then set the elastic parameters. Then the program returns the value of q*.
We conclude that the program automatically divides the spectral acceleration by q*.

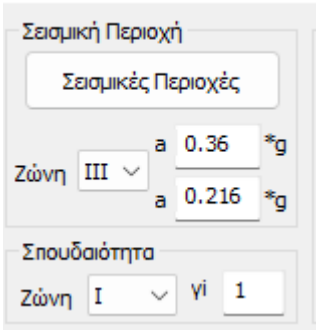
In the context of dialogue select the triad A2, B2, C2, C2

ΦΑΣΜΑΤΑ

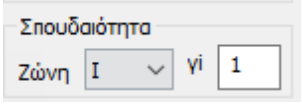
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



The program calculated the new acceleration 0.36*0.60= 0.216 and in the return period and in the probability of exceedance it wrote the data of the specific seismic hazard category. In this example it is 30% and 135 years.
And returning to the initial parameters of the scenario in the field of the ground acceleration CAN.EPE.



I see the value of the ground acceleration 0.216 as it was calculated previously and as it will be used in the scenario run to calculate the seismic action.
It is also noted that the γi used for the calculation of the seismic action always becomes 1 (from 0.8 which was before for this importance category).



So after the above parameters are selected, run the script. The "Default" combinations are automatically created and saved. You will use this file for sizing the reinforcements.

Selecting "**Checks**" again displays all the checks, including the analysis selection criteria, but what is of interest is only the following deficiency indicator check.

Κρίσιμοι Δείκτες Ανεπάρκειας λ δομικών στοιχείων **(& 5.5.2α (i) ΚΑΝ.ΕΠΕ)**

Σελίδα : 2

α/α Στάθμης	Συν/κο Υψός (m)	Δοκοί				Υποστυλώματα				Σύνολο			
		λ<=1.0		λ>1.0		λ<=1.0		λ>1.0		λ<=1.0		λ>1.0	
0	0.000	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
1	3.000	6	30%	4	20%	8	50%	0	0%	14	39%	4	11%
2	6.000	10	50%	0	0%	2	13%	6	38%	12	33%	6	17%
ΣΥΝΟΛΟ		16	80%	4	20%	10	63%	6	38%	26	72%	10	28%
ΣΗΜΕΙΩΣ Για όλα τα στοιχεία πρέπει λ<=1.0.							Ο έλεγχος :			**Δεν Ικανοποιείτ.**			

This table summarises the elements that fail and need to be strengthened.
The above check of the indicators of inadequacy is done in terms of intensive quantities (bending moments).
The program calculates the bending indices λ for all structural elements (flat and flattened). At the same time, however, the categorisation of the elements into flat and loose elements is done.
Based on the CEE, 3 criteria of fishiness are applied and if even one of the 3 is valid, the element is defined as fishy and the corresponding inadequacy index λ is calculated based on the shear forces.
This calculation is done regardless of whether the method of analysis is (m) or (q).

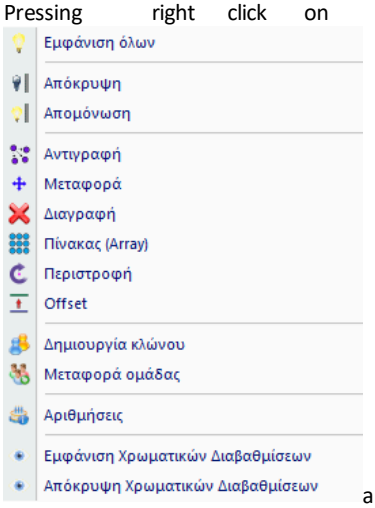
A detailed presentation of the elements that fail and the analytical results of the sandy elements and the flat elements are presented in the section of the prints.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

L. Show adequacy reasons with Color Grading

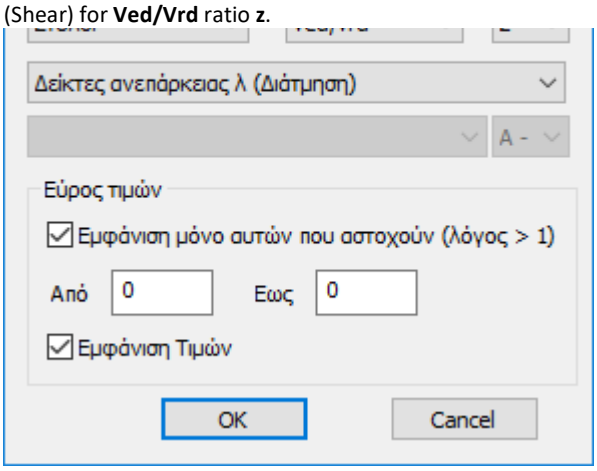
In the new version of SCADA Pro has been added to the Analysis the color gradation for the adequacy reasons concerning the valuation according to KAAN.EPE.

Pressing right click on surface desktop appears the the following menu.



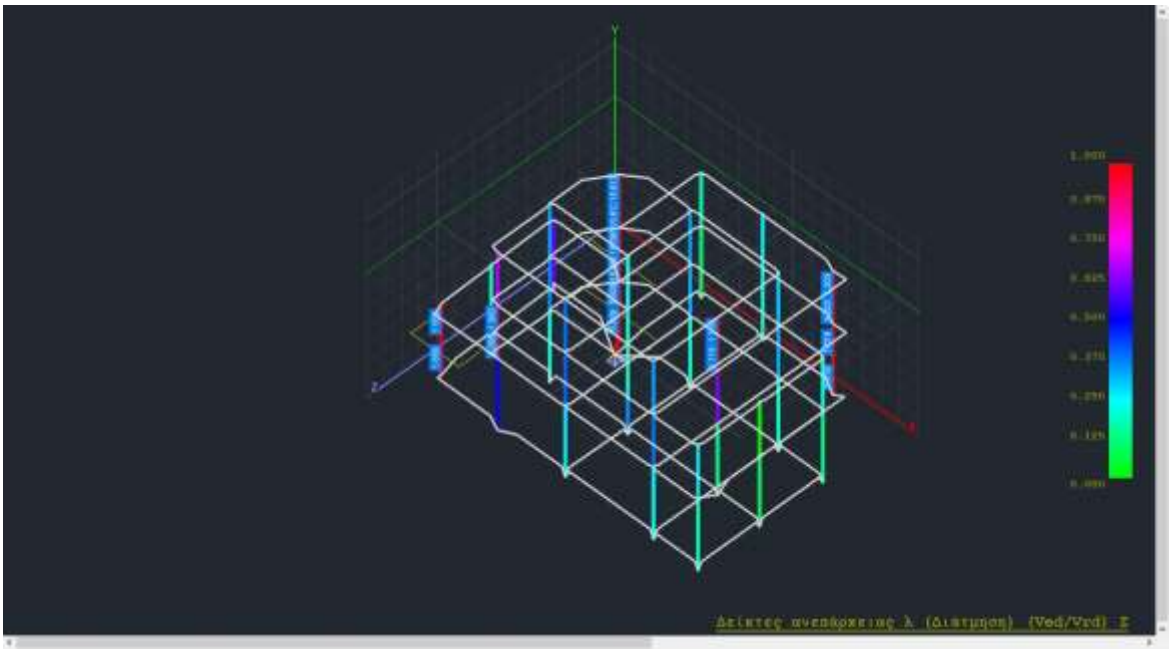
and by selecting Show Color Gradients depending on the analysis scenario that is active the corresponding sizes are displayed

With the Elastic Dynamic scenario active, let's say you want to display for the columns the inadequacy indices λ (Shear) for **Ved/Vrd** ratio **z**.



you have the following vector image :

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.



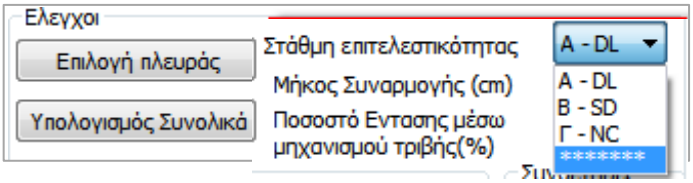
For more details about the colour gradations in Elastic analysis you can consult the "8A.Analysis" User Manual (p. 39).

4(b) STEP 4: ENCOUNTERS

With regard to the introduction and sizing of reinforcements, the same applies as in the section on inelastic analysis, with attention to the following points:

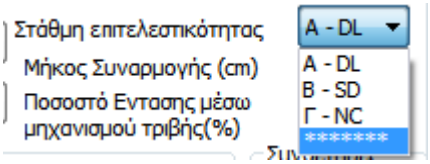
The basic requirement for sizing reinforcements by elastic analysis is the selection and calculation of the combinations stored in the previous step.

With regard to the sheathing of columns necessary condition for the execution of checks is in the field of stations performativity, is to click on the option with asterisks.

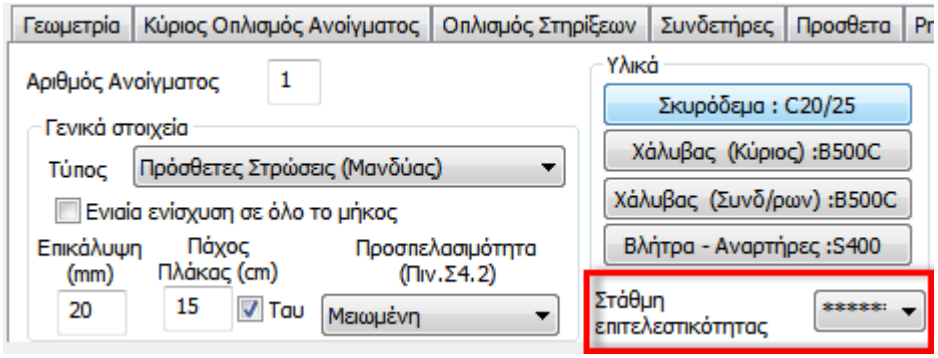


Regarding the choice of asterisks in the editors of dikes and poles regarding the intensive sizes for the reinforcement check: the option reads with first priority the intensities of the last scenario where the checks appeared in the analysis and with second priority the intensities of the combinations you loaded in the dimensioning.

A similar choice shall be made for the IOP-Fragments of the columns



And in the beams you make the same selection, in the beams editor

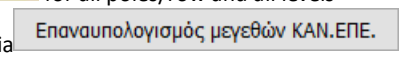


After inserting the reinforcements and calculating the new strength moments * you return to the Analysis section, run the elastic analysis scenario and see again the λ ratios of the elements.

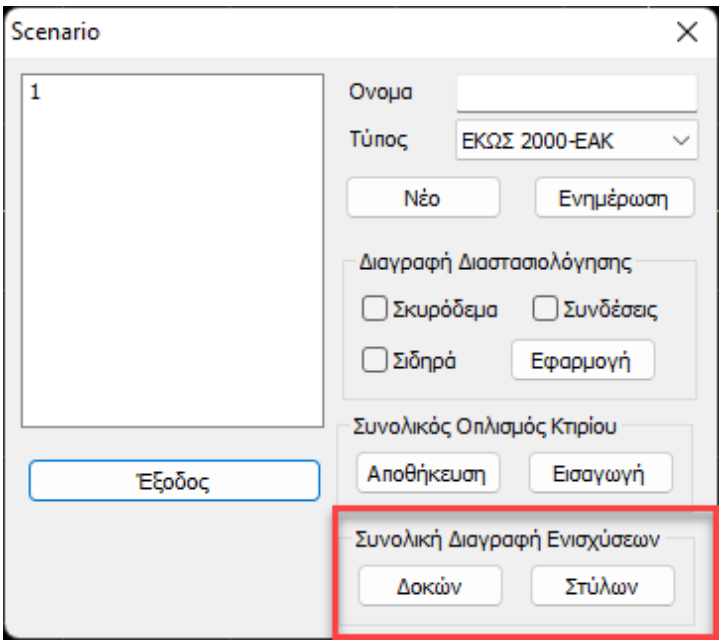
EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

OBSERVATION:

* It should be noted that after the introduction of reinforcements, new M-N interaction diagrams should always be calculated,

- or through the Armament Details for each cross-section separately,
- or via  for all poles/row and all levels
- either with the via  for all structural elements of the vector and all levels.

* In addition, there is also the possibility of total deletion of the reinforcements of beams and columns.



EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

5. NEW METHOD OF EVALUATION AND REDISTRIBUTION (CAN.EPE. 3. Review 2022)

The new method of valuation and redesign that can be followed as an alternative to the one analysed above and applicable until now. This method applies only to buildings of importance I and II and only for the basic seismic class B.

So for buildings of importance I and II it follows:

1. wastheuntil now with table PA2.1, that is, whatever class your building belongs to, you must meet the minimum requirements of the table.

Πίνακας ΠΑ.2.1. *Ελάχιστοι ανεκτοί στόχοι αποτίμησης ή ανασχεδιασμού υφισταμένων κτιρίων.*

Κατηγορία Σπουδαιότητας	Ελάχιστοι Ανεκτοί Στόχοι
I	Γ2
II	Γ1
III	Β1
IV	Β1 και Α2 (Ικανοποίηση **και** των δύο στόχων)

Σε κάθε περίπτωση να θεωρηθεί ότι ισχύει Α1>Α2, Β1>Β2, Γ1>Γ2, Α1>Β1>Γ1 και Α2>Β2>Γ2

2. The new possibility provided by the PA2.2 table where, after determining the basic seismic class to which your building belongs, it is enough to go up one basic seismic class.
seismic class, but this class shall be higher or at least equal to the minimum of table PA2.2.

Πίνακας ΠΑ.2.2. *Ελάχιστες βασικές σεισμικές κλάσεις υφισταμένων κτιρίων σπουδαιότητας Ι και ΙΙ.*

Εφαρμοσθέντες Κανονισμοί Μελέτης και Κατασκευής	Ελάχιστη Βασική Σεισμική Κλάση Κτιρίου
…<1985	Β3
1985≤…<1995	$B3^{+}$
1995≤…	$B2^{+}$

The above will be understood with an example

EXAMPLE
Building after 1995 Significance II

1. I do not specify its seismic class (I am not interested) and I am pursuing the minimum evaluation or redesign target C1 (as it was until now)
2. I identify the existing basic seismic class which is, for example, B2. I need to move up at least one class, i.e. to B2+ and I need to
this must be higher than the minimum of table PA2.2, which for our example is B2+ but improved by one class, i.e. B1. So the target is B1.

EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

Πίνακας 2.1. Στόχοι αποτίμησης ή ανασχεδιασμού Φέροντος Οργανισμού.

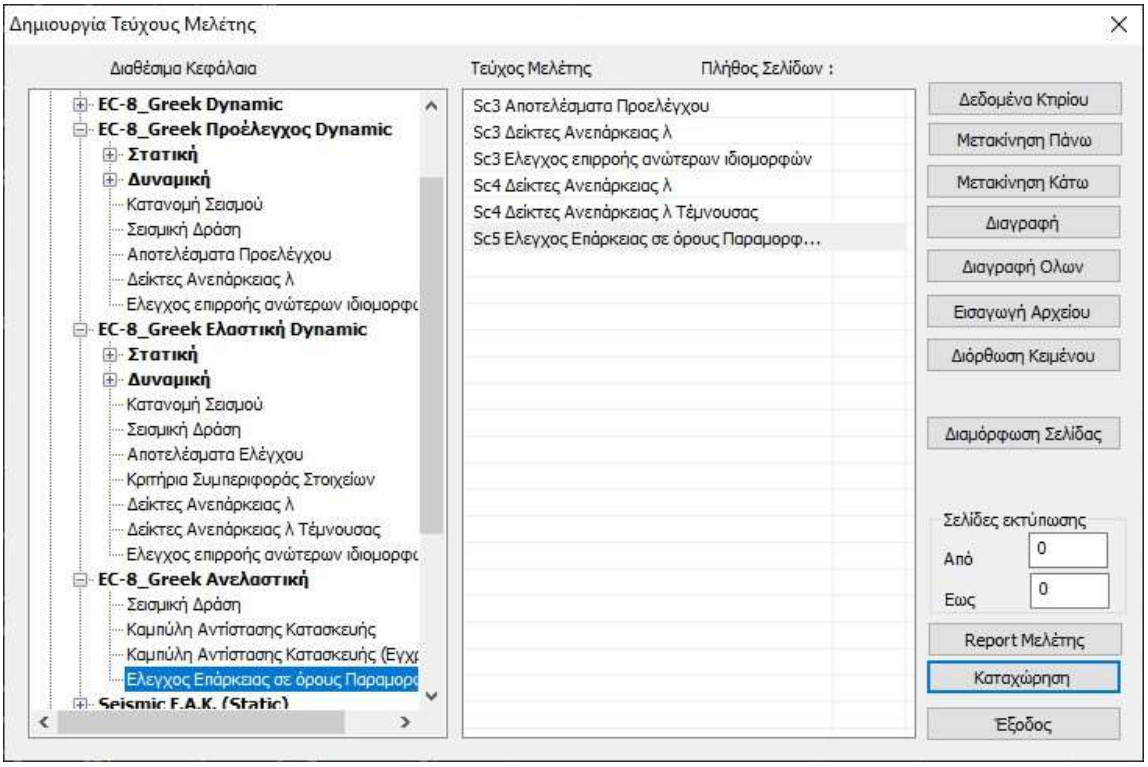
$\alpha_g / \alpha_{g,ref}$	Στάθμη Επιτελεστικότητας Φέροντος Οργανισμού		
	Α «Περιορισμένες Βλάβες»	Β «Σημαντικές Βλάβες»	Γ «Οιονεί Κατάρρευση»
1.80	**A0**	**B0**	**Γ0**
1.30	**A1+**	**B1+**	**Γ1+**
1.00	**A1**	**B1**	**Γ1**
0.75	**A2+**	**B2+**	**Γ2+**
0.60	**A2**	**B2**	**Γ2**
0.45	**A3+**	**B3+**	**Γ3+**
0.35	**A3**	**B3**	**Γ3**
0.25	**A4+**	**B4+**	**Γ4+**
<0.25	**A4**	**B4**	**Γ4**

Comparing the two cases and assuming approximately that B and C classes diagonally are approximately the same, C1 corresponds approximately to B2+. So the second method will give me less favourable results than the first.
In general, the second, new method favours older and weaker buildings while the existing method favours newer ones.
In the programme, at present, the determination of the seismic class can only be done by testing, i.e. by testing evaluation targets from the basic seismic class (B). That target where for elastic analyses λ is below unity and for pushover the tests for the B performance level are below unity is the existing basic seismic class of the building.
For this determination, however, we are preparing an automatic procedure where the program will automatically perform all the analyses and checks and will present the results in summary so that the designer can immediately find the seismic class of his building.

6. Printed from

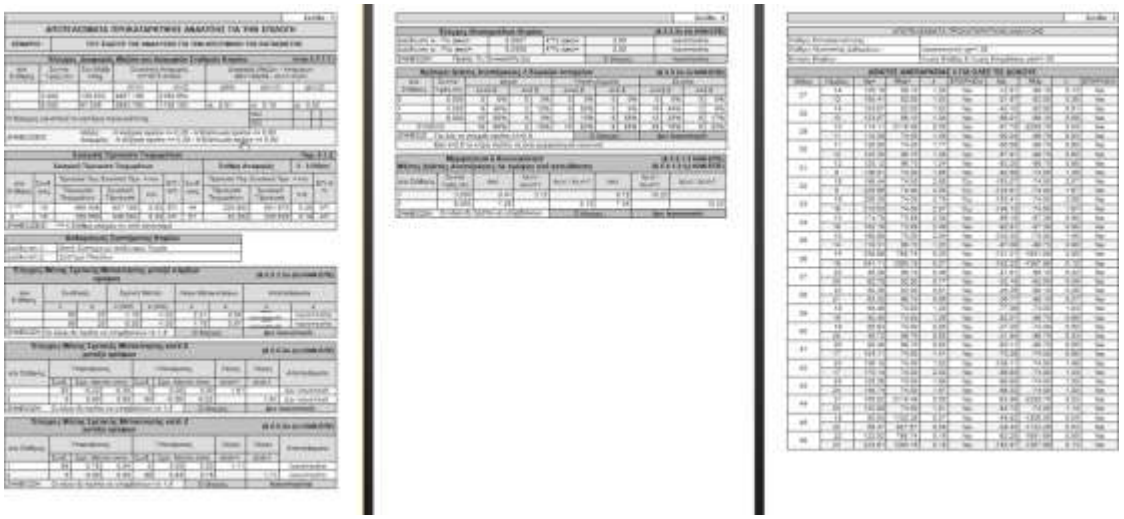
In the prints section and in the analysis scenarios field, the scenarios you have created are presented.

⚠ ***NOTE:*** *It is a prerequisite for the print files to be created that the controls are opened in the analysis. Any change, afterwards, in the parameters of the scenario requires the controls to be reopened in the analysis in order to update the prints each time.*

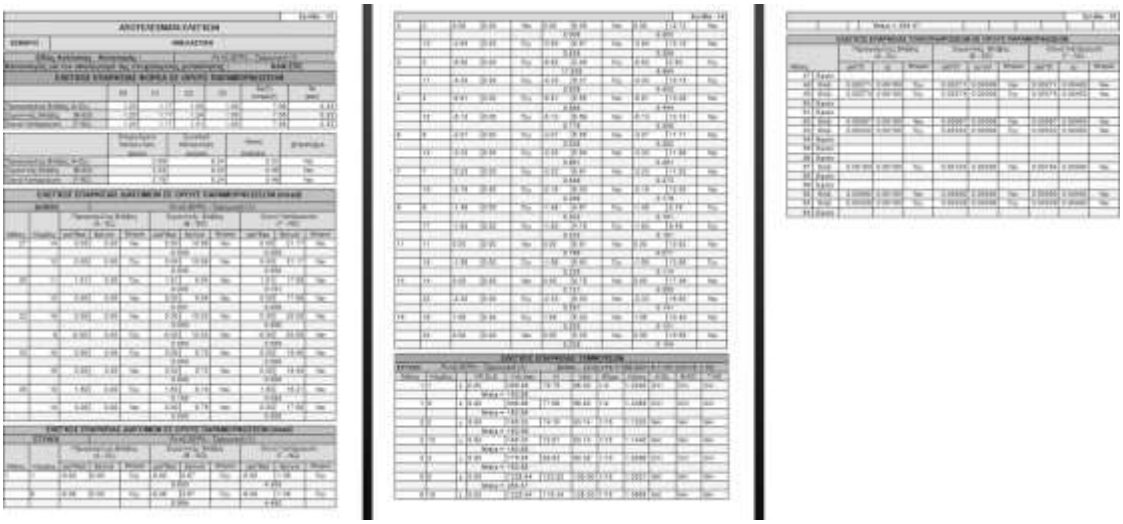


EXAMPLE 6: "STUDY FOR THE VALUATION AND REDESIGN OF A BUILDING ACCORDING TO THE CANC.

Pre-check:



Resilient:



Elastic: