

Example 7 Masonry building – Assessment (ec8-3)







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• OVERVIEW

SCADA Pro new version is a result of more than 40 years of research and development while containing all the innovative capabilities and top-notch tools for the construction business.

SCADA Pro utilizes a compact and fully adequate platform for constructing new buildings (analysis and design) or existing ones (check, assessment, and retrofitting).

The software employs the Finite Element Method, combining line and plane finite elements in a smooth way. For design purposes, the user is offered all the Eurocodes as well as all the relevant Greek regulations (N.E.A.K, N.K.O.S., E.K.O.S. 2000, E.A.K. 2000, E.A.K. 2003, Old Antiseismic, Method of permissible stresses, KAN.EPE).

There are numerous possibilities offered for the modeling of various kind of structures. Structures made of reinforced concrete, steel, timber, masonry, or composite structures are now fully feasible.

Several smart operations add on to the practicality and usability of the software. The user can produce the model of a structure no matter how complicated it is, work at ease with the 3D model, process through the steps of analysis and design in a convenient way, up to the conclusion of what initially may seem the most demanding project.

SCADA Pro is presented to you as a powerful tool to meet the highest needs of modern civil engineering!

• INTRODUCTION

The current manual comes as an aid for a new user of SCADA Pro, making the interface of the software as familiar as possible. It consists of several chapters, where one after the other, describes the consecutive steps of a simple example of a loadbearing masonry project. The most useful information is presented, in regards to the best possible understanding of the software commands and logic, as well as the process that has to be followed.

• THE NEW INTERFACE

The new interface of the SCADA Pro software is based on the RIBBON structure, thus, the several commands and tools are reached neatly. The main idea of the RIBBON structure is the grouping of commands that have small differences and work in the same context, in a prominent position different to each group. This converts the use of a command, from a tedious searching procedure through menus and toolbars, into an easy to remember the chain of two or three clicks of the mouse button.

The user can collect his/her most popular commands into a new group, for an even faster access. This group remains as it is for future analyses after the program ends. Different commands can be added to it or removed from it, and its placing in the workspace may be altered through the "Customize Quick Access Toolbar" utility.

Cus	ustomize Quick Access Toolbar					
V	Quick Print					
	More Commands					
	Show Below the Ribbon					
	Minimize the Ribbon					





Apart from the RIBBON structure, all the entities that a structure consists of are presented in a tree structure, at the left side of the SCADA Pro main window, either for the whole structure or at each level of the structure. This categorization enhances the use of each entity. When the tree structure is choosing an entity, it is highlighted at the graphical interface and the level of the structure that contains this entity is isolated. At the same time, at the right side of the window, the entity's properties appear. The user can check or modify any of these properties at once. Conversely, the entity can also be chosen at the graphical interface, and automatically it is presented, at the left side in the tree

structure and at the right side with its properties. The right-click mouse button can be very helpful here, since several commands and features, distinct for each entity, can be activated with it.



The "Properties" list that shows up at the right side of the window, not only shows all the properties of the entity shown but can be used for any quick and easy changes, the user wants to make, too.



GENERAL DESCRIPTION

Geometry

The considered single floor masonry structure consists of 10 external views with openings and six internal walls.



Materials

All walls are of single-leaf type with dimensional natural stone units 20x20x25 and M5 mortar named, "Wall M5 0.50". For the raft, concrete C20/25 and Reinforcing Steel B500C was used. The building will be considered as anchored to the base.

Regulations

Eurocode 8 (EC8, EN1998) for seismic loads. Eurocode 2 (EC2, EN1992) for the design of the concrete elements.

Load and Analysis assumptions

Dynamic Spectrum Analysis with pairs of torsional moment along the same direction. The loads by the method above are:

(1) G (dead)

(2) Q (live)

(3) EX (node loads, seismic forces along XI axes, derived from dynamic analysis).

(4) EZ (node loads, seismic forces along ZII axes, derived from dynamic analysis).

(5) Erx \pm (node torsional moments, derived from node seismic forces along XI axes, offset by the accidental eccentricity $\pm 2ezi$).



(6)Erz±(node torsional moments, derived from node seismic forces along ZII XI axes, offset by the accidental eccentricity ±2etxi.

(7)EY (seismic vertical component –seismic force along y direction- derived from dynamic analysis).

Notes

All the commands that were used in this example, as well as the rest of the commands, are explained in detail in the manual that accompanies the program.



1. STEP: DATA INPUT – MODELING

SCADA Pro is enriched with a masonry library while the user can automatically create the masonry model using only the centered outline of the structure and modify each side through the Templates editor.

1. The **Templates** command can be used in two ways so that it fulfills every modeling demands.



Use the **button** located at the initialization window, or select "New" **w** sweather from the menu, to create a new file. In the dialog box that appears define the data of the new project.

New Projec	t.	
Project Name Details	MASONRY Masonry Structure Analysis and Design	^
Folders:	c:\	V Network
C:\ 201 ACI ACI ACI ACI ACI	15 E ERP E HELLAS FILES odesk	ОК
can cus cus	ntasia_projects mel bs Y	Cancel

▲ The name of the file can contain up to 8 characters of the Latin alphabet without any symbols (/, -, _) nor spaces. You can add a description or add some information related to the structure, in the "Info" field.



Masonry

1.1 Masonry library – wall definition:

command, opens the respective library: Masonry Arbitrary Concrete Section Libraries Properties of masonry Х Existing Type Masonry Brick blocks wall - M2 25 cm \sim Concrete jacket Name Masonry Brick blocks wall - M2 25 cm 0 Thickness Single Sided Load-bearing Single-leaf wall ~ ? Cocrete Type Steel C20/25 S500 Masonry uni Common brick 6x9x19 \sim Φ 8 / 10 cm fRdo,c(MPa)= Thickness 25 fb=1.6733 fbc=2.0000 ε=15.00 Anchorage Without any additional care \checkmark Mortar Cement-M2 \sim Mortar General purpose designed masonry mortar fm=2.0000 ? L1 (cm) 0 t1 (cm) 0 Wall t2 (cm) 0 Shell Bedded Wall 0 ? Total width of the two mortar strips g (cm) ? Filled vertical joints (3.6.2) Bed join of thickness >15 mm lt1 Masonry uni t2 Thickness (Equivalent) 25 0 Thickness 15 Specific weight (KN/m3) Mortar Compressive strength fk 0.794381 Masonry units -Mortars library Modulus of elasticity 1000 0.794381 Wall ? L1 (cm) 0 t1 (cm) 0 t2 (cm) 0 (GPa) Characteristic strength fvk0 0.1 (N/mm2) Concrete infill Maximum shear strength fck (N/mm2) Thickness 0.108766 New fvkmax (N/mm2) 20 0 Flexural strength fxk1 Save 0.1 (N/mm2) Data reliability level Execution control KL1:Limited ~ 1 ~ Exit Flexural strength fxk2 class 0.2 (N/mm2) Mean Compressive strength Tensile strength fwt (N/mm2) 0 Equal biaxial compr. strength (N/mm2) 0 0 fm (N/mm2)

Inside the "Modeling" unit, in "Libraries" group, the "Masonry"

Choose a predefined wall, or create a new one. Type a name for the wall, select the "Type" from the drop-down list and define the related properties for the "Masonry Unit", "Mortar", "Piers", "Concrete Infill" and "Concrete Jacket".

- Depending on the selected TYPE of masonry, in the dialog box, some fields are enabled or disabled.
- ▲ The definition for each type is displayed by clicking the _____ button on the right.





In this example all walls are of single-leaf type with dimensional natural stone units 20x20x25 and M5 mortar named, "Wall M5 0.50".

In the command "*Masonry Units – Mortars Library*" you will find standard typologies of clay bricks, mortar and masonry. You can enter other bricks and mortar, by simply typing the name and specifying the class and group, for the compressive strength (which is updated automatically). Then select the button "New".

You can also change the class and group of an existing masonry or mortar and update it by clicking "Submit".

In the field "Masonry Units", select from the drop-down lists the type of bricks and mortar, and create a new type of masonry by clicking "New". The weight and strength are calculated automatically.

Masonry unit	ts - Mortars		×
-Masonry unit	S	Mortars	
Stones 20x2	20x50 ~	Mortar Cement-M1	\sim
Name	Stones 20x20x50	Name Mortar Cement-M1	
Туре	Dimensioned natural stone units $\qquad \lor$	Type General purpose designed masonry mortar	?
Class	II ~ ? Group 1 ~ ?	Resistar M1 - Compressive strength fm 1	
Resistance of dy dy dy dy dy dy dy dy	calculation from dimensions $dx (mm) dy (mm) dz (mm) \delta$ 200 200 500 1.15 ? dz Mean compressive strength fbc 8 reight ϵ (KN/m3) 26 New sive strength fb 9.2 Save	New Save	
	Save	Exit	

For this example we chose:

1.2 Masonry units

Masonry u Stones 2	nits 0x20x50
Name	Stones 20x20x25
Туре	Dimensioned natural stone units
Class	II ~ ? Group 1 ~ ?
dy	dx (mm) dy (mm) dz (mm) δ 200 200 250 1.15 ? Mean compressive strength fbc 8



Name: Dimensional natural stone units 20x20x25 (type in) Type: Dimensional natural stone units (select from list) Category: II, Group: 1 (select from list)

For the Strength Calculation from Dimensions, type the dimensions of the masonry unit and the

reduction factor δ , is automatically filled by the respective table $\red{eq:table}$

Resistance calculation from dimensions



Type the "Compressive Strength" fbc, which is the average value of experiments regarding the compressive strength of the masonry units and the "Specific Weight ϵ ".

The "Compressive Strength" fb is automatically calculated by the program.

Specific weight ϵ (KN/r	m3) 26
Compressive strength	fb 9.20
New New	

Select

to store in the masonry library this masonry unit.

Levery time that you save a masonry unit this is stored permanently and is available for the current and any future project as well.



Mortar C	Cement-M5 ~	
Name	Mortar Cement-M5	
Туре	General purpose designed masonry mortar V ?	General purpose designed masonry mortar
Resistar	M5 V Compressive strength fm 5	General purpose prescribed masonry mortar Thin layer masonry mortar Lightweight mortar of density <=800 Kg/m3 Lightweight mortar of density <=1300 Kg/m3
Jame: N	Aortar-M5(select from list)	
strength	n: M5 (select from list)	
Strength The com	n: M5 (select from list)	by the program.
Strength The com	pressive strength Fm is automatically filled in	by the program.
Strength The com	is M5 (select from list) pressive strength Fm is automatically filled in Save and Exit to return to the	by the program. nasonry library, where you can select th
Strength The com Select	sonry unit, which is now located in the list.	by the program. nasonry library, where you can select th
Strength The com Select	all	by the program. nasonry library, where you can select th
Strength The com Select new mas	ni Stones 20x20x25	by the program. nasonry library, where you can select th
Fine com Select Select Select Masonry ur	All Stones 20x20x25 Stones 20x20x25 Stones 20x20x50 Brick blocks Perforated 6x9x19 Brick blocks Perforated 12x14x25 YTONG 20x25x50	by the program. masonry library, where you can select th
Strength The com Select new mas 1.4 Wa Masonry ur Mortar Wall	All Stones 20x20x25 Stones 20x20x25 Stones 20x20x25 Stones 20x20x50 Brick blocks Perforated 6x9x19 Brick blocks Perforated 6x9x19 Brick blocks Perforated 9x9x19 Brick blocks Perforated 12x14x25 YTONG 20x25x60 Stones - stones drilled 20x20x25 Concrete blocks Common brick 6x9x19	by the program. nasonry library, where you can select th



Masonry	Brick blocks wall - M5 50 cm $\qquad \checkmark$		Type Exis	ting
lame	Masonry Brick blocks wall - M5 50 cm		Concrete jacket	Single Sided
ype	Load-bearing V Double-leaf wall V ?		Cocrete S	Steel
Masonry Mortar Wall	y uni Stones 20x20x25 Thickness 25 fb=9.2000 fbc=8.0000 ε=26.00 Mortar Cement-M5 General purpose designed masonry mortar fm=5.0000 ? L1 (cm) 0 t1 (cm) 0 t2 (cm) 0		C20/25 ✓ Φ 8 / 10 cm fRdo Anchorage Without any a	S500 × ,c(MPa)= 0.00 additional car∈ ×
Shell Be Total wi	edded Wall 0 ? idth of the two mortar strips g (cm) 0 ? 5.00 k=0.45 fk=3.4479 2 2		Filled vertical joints (3.6	i.2)
Masonry	y uni Stones 20x20x25 Thickness 25 fb=9,2000 fbc=8,0000 ε=26,00	t1 ↔t2	Bed join of thickness >1 Thickness (Equivalent) Specific weight (KN/m3)	L5 mm 50 26
Mortar Wall	Mortar Cement-M5 V General purpose designed masonry mortar fm=5.0000 2 (cm) 0 ? L1 (cm) 0 t1 (cm) 0	Masonry units - Mortars library	Compressive strength fk Modulus of elasticity (GPa)	3.44790 1000 3.44790
tef=25	5.00 k=0.45 fk=3.4479		Characteristic strength fr (N/mm2)	vk0 0.1
	te infill fck (N/mm2) Thickness	New	Maximum shear strength fvkmax (N/mm2)	0.414
ata relia	bility level Ki tri inited Execution control	Save	Flexural strength fxk1 (N/mm2)	0.1
Те	ensile strength fivt (N/mm2) 0 Equal biaxial compr. strength	Exit	Hexural strength fxk2 (N/mm2) Mean Compressive streng fm (N/mm2)	0.4 gth 0

Thickness: 25 cm

The total masonry results are calculated by the program based on the input data and they are

transferred to the summary table on the right. fb=9.2000 fbc=8.0000 ϵ =26.00

Mortars: Mortar cement-M5

Prescribed Masonry Unit fm is automatically updated.

General purpose designed masonry mortar fm=5.0000

Double-leaf:

Thickness (Equivalent): 50 cm

Save For this example, all the masonry data are defined. Click to update the library and add the defined masonry to the list.



1.5 Modeling:

1.5.1 Insert a dwg file and line recognition

SCADA Pro gives you the possibility to create a masonry structure on any external boundary, by using the tool "Templates", quickly and easily.

The procedure is as follows:





Import File Layers			×
Number o-prov-5 s-scala s-scala-kagelo s-scala-lept s-walls s-wc s-ypost-hatch	Visible C C C C C C C C C C C C C C C C C C C		Select All Cancel Option Visible Non Visible Convert Lines - Arcs
TOKOS top-oria olk.		~	OK Cancel

▲ Using this command, all lines belonging to the dwg layer "TOIXOS", converted into drawing lines of SCADA and so is recognizable by the command "Front View Identification", explained in detail in the next chapter.



IMPORTANT NOTES

In case that you do not have a .dxf or .dwg file, you can design the plan level directly to the XZ level of the SCADA environment.



SCADA Pro

Structural Analysis & Design

1 The dwg file auxiliary file, inserted in the SCADA environment in the active XZ level

identifying the origin to the upper left point of the design

▲ Lines and polylines defining the static walls, to be recognized as SCADA's lines, should belong to a separate layer, and using the command "Convert Lines, Arcs" to obtain the identification.

1.5.2 Front view identification

In "Modeling" select the command "3D">>"Front View Identification", and use the window to select the entire floor plan.







Right click and opens the Templates window:



The program automatically recognizes the geometry of the floor plan. Proposes by default the height and creates the views as to the Universal axes.





After completing the process for each view and each opening, click the OK button.

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A You can save the formed model as an .stp file, by clicking the Save button, creating in this way your very own template library. Click Open to call a saved file and load the model at any point.

A WARNING: Make sure that the Equivalent Thickness of the wall defined to the library has the same value as the Thickness defined in the Templates.

Pr	operty	Value		Properties of masonry			
	Geometry		~	Masonry stone wall - MS 50 cm V Name Masonry stone wall - MS 50 cm Type Existing Concrete judget Type Signate Concrete Signat			
	Number of front	16		Type Load-bearing v Single-leaf wall v ? Coorete Steel C20/25 v S500 v			
	Along y	1	Masonry	Masonry uni Stones 20x20x25 ✓ Thidness 50 tb=9.2000 tbc=8.0000 c=25.00			
	Distance y	300.00		Mortar Mortar Cement MS Ceneral purpose designed masonry mortar fm=5.0000			
	Width (cm)	50.00		Wal 2 L1 (cm) 0 t2 (cm) 0 Shell Bedded Wal			
	Thickness (cm)	20.00		Total width of the two mortar strips g (on) 0 ?			
	Position Angle	0.0					
	Distance along y			Thickness (Equivalent) 50			
	Ly1 (cm)	300.00		Model Method Method Gene Method Gene Method Gene			
	Front Views		Concr		Characteristic strength fixid (Jimm2) 0.1		
	Divide			Concrete infil fox (94mm2) Thickness New filmm2) Thickness New Filmma (94mm2)			
	Front View 1			Data reliability (vel Sutficient Execution control data Execution control to the security of the sec			

▲ WARNING: In the templates field you can define a single value of thickness for all walls. To edit the thickness of some walls, you open the "Plate Elements Creation" form and you modify the values respectively.

As soon as you have completed the process for each side and each opening, insert the project on the desktop by selecting the button "OK".



Inside SCADA environment, you can see the outlines for each view and its openings in 3D presentation.



DXF	
Layers	Copy Paste
-	Level Level
	Move 🗱
	Delete
DXF	Lay Belete Import File Delete Import File
DXF	Freeze Layers
DXF	Rotate

▲ Use Delete command to cancel the auxiliary file.

1.5.3 Mesh Group Definition:

As soon as the model is imported in SCADA environment, select the 3D "Mesh" command inside "Surface Elements" group.



In the dialog window that opens, the Mesh Groups list, contains the 1 PLATE mesh, with its corresponding surfaces (one for each view). By selecting the 1 PLATE the fields regarding the Density, Width, Thickness etc (previously defined at Templates) values, are automatically filled in.

Plate Elements (Creation					×
Description Pl	LATE		Material Mason	ry ~	Туре	Masonry stone \smallsetminus
Element		Ks (Mpa/cm)	Isotropic	Orthot	opic	Angle 0
Plate	\sim	300				
Density	Width (cm)	Thickness	Exx (GPa)	3.447902642	Gxy (GPa)	1.379161056
0.20 ~	30	50	Eyy (GPa)	3.447902642	ε (kN/m3)	26
Description	s 🗌 Mes	sh	Ezz (GPa)	3.447902642	atx*10-5	1
Mesh Groups	Flai	t Surface	vxy(0.1-0.3)	0	aty*10-5	1
	2P S 3P S	1/2/3(2) 1/3/2(2)	vxz(0.1-0.3)	0	atxy*10-5	1
	4P S 5P S	1/4/2 1/5/2	vyz(0.1-0.3)	0	Exx * v	<pre>xz = Eyy * vxy</pre>
	6P S	1/6/2(2)	Redefinition	n Steel Re	inforcement	
			Del From Lis	st	amorcement	OK
			New	S220	~	Exit



In the type, select from the list the previously defined wall from the library, and the respective fields Exx, Gxy and special weight ε are automatically updated.



The derived from templates mesh model comes along with the Mesh group (1 PLATE) and a surface for each view.

In the Surface name 1P S1/1/3(2) :

- The first number is the number of the view,
- The P letter stands for flatness
- The number inside the parenthesis, defines the number of holes in the respective view.

Activate the Mesh and select a surface. The fields are updated accordingly by the defined values of the selected surface,

Plate Elements C	Creation					×
Description S	1/1/3		Material Mason	ry V	Туре	Masonry stone \smallsetminus
Element		Ks (Mpa/cm)	Isotropic	Orthotr	ropic	Angle 0
Plate	\sim	300				
Density	Width (cm)	Thickness	Exx (GPa)	3.447902642	Gxy (GPa)	1.379161056
0.20 ~	30	50	Eyy (GPa)	3.447902642	ε (kN/m3)	26
Description	s 🗹 Me	sh	Ezz (GPa)	0	atx*10-5	1
Mesh Groups	Flai	t Surface	vxy(0.1-0.3)	0	aty*10-5	1
I PLATE	2P S 3P S	1/1/3(2) 1/2/3(2) 1/3/2(2)	vxz(0.1-0.3)	0	atxy*10-5	1
	4P S 5P S	1/4/2 1/5/2	vyz(0.1-0.3)	0	Exx * v	xz = Eyy * vxy
	6P S	1/6/2(2)	Redefinition	1 Steel Pe	inforcement	
			Del From Lis	st	amorcement	OK
			New	S220	~	Exit



Enabling in this way the modification of any parameter (name, density, width, thickness type etc.) regarding the selected surface. Finally, click Redefinition to apply the modifications.

1.5.4 New Mesh sub-Group Definition for the slabs modeling

For the slabs modelling, turn to the two-dimensional display and with the help of/, display the floor plan level 1-300.00 .



Then select "3D">> "External Boundary" and left click to select the lines of the first boundary and right click to complete. Repeat this process for all four slabs:





Insert Surface Element X	Insert Surface Element X
Description S17	Description S18
Element Ks (MPa/cm)	Element Ks (MPa/cm)
Plate ~ 300	Plate ~ 300
Width (cm) Thickness	Width (cm) Thickness
30 20 ✓ Flat Surface	30 20 Flat Surface
OK Cancel	OK
Insert Surface Element	Insert Surface Element X
Insert Surface Element X Description S19	Insert Surface Element X Description S20
Insert Surface Element X Description S19 Element Ks (MPa/cm)	Insert Surface Element × Description S20 Element Ks (MPa/cm)
Insert Surface Element × Description S19 Element Ks (MPa/cm) Plate v 300	Insert Surface Element X Description S20 Element Ks (MPa/cm) Plate V 300
Insert Surface Element × Description S19 Element Ks (MPa/cm) Plate 300 Width (cm) Thickness	Insert Surface Element × Description S20 Element Ks (MPa/cm) Plate Vidth (cm) Thickness
Insert Surface Element X Description S19 Element Ks (MPa/cm) Plate 300 Width (cm) Thickness 30 20 V Flat Surface	Insert Surface Element × Description S20 Element Ks (MPa/cm) Plate 300 Width (cm) Thickness 30 20 ✓ Flat Surface

The characteristics of the first mesh subgroup are displayed in the dialog box. The active "Flat Surface" command means that the surface belongs to the level.

Set the grid parameters of each slab:

-Set, width and thickness (30, 20)

Press the OK button.

		6333
Return	to	*4444

Mesh command to see the new sub-groups "S17-20" containing in the PLATE group.

Description S1 Element	.7	Ks (Mpa/cm)	Material Concre Isotr Steel S	ete ~ ete Standard Welded	Туре оріс	C20/25 ∨ Angle 0
Density 0.05 V	Width (cm)	Thickness	Exx (GI Timbe Mason Eyy (GPa)	r Profiles r Users-Profile: ry 29	Gxy (GPa) ε (kN/m3)	12.0833 25
Descriptions	s 🗹 Me	sh	Ezz (GPa)	29	atx*10-5	1
Mesh Groups	Fla	t Surface	vxy(0.1-0.3)	0.2	aty*10-5	1
	11P 12P	S1/11/3 S1/12/2	vxz(0.1-0.3)	0.2	atxy*10-5	1
	13P 14P	S1/13/2 S1/14/2(1)	vyz(0.1-0.3)	0.2	Exx * vx	z = Eyy * vxy
	15P 16P	S1/15/2 S1/16/2	Redefinitio	n ai la	. .	
	17P 18P	S17 S18	Del From Li	st Steel R	einforcement	ОК
	19P 20P	S19 S20 ∽	New	S220	~	Exit



1.5.5 Surface Calculation



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1.5.6 Mathematical Model calculation: Tools Slabs Loads Analysis Post-Processor Member 1,11 -Definition Beam-Column Beam Beam Column Calculation am Beam Connection * Break Merging Adjustment UCS - WCS ural Elements

To create the mathematical model of the structure, from "Tools" unit select "Calculation" and click OK on the dialog window that opens:

Mat	thematical Model	\times
5	Select Regulation (inertial)	
	EC2	\sim
	Change Regulation	
	Calculation Inertia Redefinition	
	Calculation of Inertia – ☑ Surfaces with the Boundary Element Method	
	OK Cancel	



View

Inside the



As soon as the mathematical model is created, the local axes and their direction (in respect with the global axes) must be redefined.



command, activate the 🔽 Local Axes option.

 Return to the "3D Mesh >> Calculation" command, and in the dialog form, select all the surfaces through the Select All command and click Auto to adjust local axes of

all the surface finite elements of the plate to have the same direction.



- Finally, for views of which the local axis is parallel to the global axes X or Z, select them and click or respectively, to define the main direction of the steel reinforcement (direction X or Z). For surfaces that run along X direction (vertical to Z axis) click X, while for surfaces that run along Z direction (vertical to X axis) click Z.
 - for views where the x local axis is parallel to global X, leave X
 - for views where the z local axis is parallel to global Z, press Z
 - for views that are not parallel or perpendicular to the global axes, leave X, because the main reinforcement direction is <u>automatically</u> defined.

In this example:



Multise



Finally, for this example, we want to consider it **Fixed** at its base. So, using the command and the window selection, select all nodes of the foundation level and **Fixed** them.

	Properties	×
	Momber Properties Element Poloscos Element Digit Officeta	Draw History
	Material Cross-Section Cross-Section Details Nodes	Member Type
	Node Spring	
	✓ Dx Fixed ∨ 0 0	kN/m
	Dy Fixed V 0 0	kN/m
	Dz Fixed V 0 0	kN/m
		kNm/rad
		La
	✓ Ry Fixed ✓ 0 0	kīNm/rad
	Rz Fixed V 0 0	kNm/rad
	New Master Slave Node To 0	
·····	Coordinate Recalculation	
		_
	Free Fixed	
		Apply
		14994
		_
	Exit	Help



Loads

2. STEP: LOADS DEFINITION

2.1 Manually imported:



"Member Loads" commands' group contains the commands for insert, edit, view and copy the loads of members, nodes and surfaces finite elements.

For this example, to apply the loads regarding the slab that shelters the structure, to the top nodes of the perimeter, follow the procedure described next:



Use 🖾 and select all the nodes of the upper level

щ

	1 de	X
insert		~
	Load Case Ueaa Load Case Group Group 1 ad Property ad Type Load Kind j, (+) (+) _j	
	ate V Pressure V	ĸ
	scription	
	lue (kN/m2)	
	sti (cm) 0 Distj (cm) 0 i/	
	ply To Local Z V Local L	
	LG Description	st
	Clear by Select	ct
	ок	
	Cancel	
<		

 Right click and in the dialog form: Select: Dead - Plate, Pressure, Type: 1.5 KN/M2 Press: Insert then Select: Live - Plate, Pressure, Type: 2 KN/M2 Press: Insert Click: OK to apply the defined loads





2.2 Load Destribution on the Surface



The new version of SCADA Pro comes with a new tool for the automatic distribution and application of loads on mesh areas.



Analytical description on how to use this command can be found in chapter 6 "LOADS".



Analysis

3. STEP: ANALYSIS

3.1 Masonry structure analysis by Eurocode

As soon as you complete the modeling and load definition processes, move on to analysis. For masonry structures analysis, create a Eurocode analysis scenario, so that SCADA Pro will perform the analysis by the provisions of the Eurocodes.

New	EC8_General Dynamic (2) ' Active Scenario	•	Run
	Scenarios		

Move to "Analysis" unit and from the "Scenarios" command group, click "New" to create an Eurocode scenario for masonry structures analysis.

Click "New" and in the dialog window that opens:

-select Nodes Renumbering according to Cuthill-McKee(II) method

-create a new scenario by selecting the type and the respective annex -> EC-8_ Dynamic

Scenario			×
Renumbering Nodes Cuthill-McKee(II)		Advanced Multi-Thre	aded Solver
Disable	Name		
Seismic E.A.K.(Static) (0) Seismic E.A.K. (Dynamic-eti) (Analysis	EC8_Gen	eral 🗸 🗸
EC8_General Dynamic (2)	Туре	Dynamic	\sim
	Propertie	5	
	Eleme	nts	Nodes
	Load Ca	ises	Masses
	New		Update
		Exit	



-select from the list the Eurocode scenario and click

In the dialog box that opens, accept the warning regarding the diaphragm absence and click:

Attention!		\times
	The Current Analysis Method is Incompatible due to (Rigid Link Constraint Absence). Proceed?	
	Yes No	



2 Paramet	ters	Mass Centers	; (cm)			\sim
Automatic Pr	ocedure	nuss centers	(cin)			
ocedure	occuare	Level	Х	Υ	Z	Â
Mass - Stit	ffness	0 - 0.00	0.00	0.00	0.00	
11000 00		1 - 300.00	0.00	300.00	0.00	_
Regular	ity					_
Regular In Pla	n					
In Ele	vation					
Equival	ent					
Analys	sis					~
		,	·	·		
Initialize	data		1	Exit		
Initialize da	ta to	update the p	aramete	ers of the o	current s	cenario
		• •				
Parameter	rs to	define the a	nalysis p	arameters	5	
Parameters ismic Area	rs to	o define the a	nalysis p	arameters Apply seism	ic actions on l	.evels XZ
Parameters ismic Area Seismic Areas	Characteristic Spectrum Typ	Periods	nalysis p	Apply seism Down 0 - (ic actions on I	Levels XZ
Parameters ismic Area Seismic Areas ne I ~ a 0.16 *g	Characteristic Spectrum Tyr Type 1	Periods S,avg 1.2	Nalysis p	Apply seism Down 0 - (Dynamic An	ic actions on I 0.00 ~	evels XZ Up 1 - 300.00
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-Define "Zone", "Importance" and "Soil". -select "Design" spectrum and



-at the type of structure field select "Confined Masonry" -Click OK to update the parameters and close the window.

Three Automatic Procedure to run the analysis.

Let the program to complete the process and click Exit.

Parameters	Mass Center	s (cm)			~
Automatic Procedure	Level	Х	γ	Z	^
Procedure	0 - 0.00	0.00	0.00	0.00	
Mass - Stiffness	1 - 300.00	848.50	300.00	448.92	
Regularity					
Regular In Plan In Elevation					
Equivalent					
Analysis					~





3.2 Combinations

EC8_	General Dynamic (2)
1.0	Active Scenario

With the

scenario activated, select "Combinations" and in the

, to fill in automatically the

dialog form that opens click Default Combinations coefficients of the dynamic analysis according to Eurocode.

Click "Save", to store the combinations file inside the folder of your project to use it later on during the "Post-Processor" and "Member Design" process.

c 135		1	VGE	1	ω2	0.3	Ultim	ate	Serviceability		Calaulatia	
Q 1.5	VE0.3	0.3		•				ς σ+γQ+2γφ0Q G+ψ1Q+Σψ2Q	ΣG+ψ1Q	ψυQ +Σψ2Q	Dalata A	
	12010					Wind - Snow	Σ	G+E+Σγψ2Q	✓ ΣG+Σψ20	2	Delete Al	All
	Туре		Direction	LC1		LC2	LC3	LC4	LC5	LC6	l	L
Scenario				EC-8_G	ree 💻	EC-8_Gree 본	EC-8_Gree	EC-8_Gree.	EC-8_Gree	e 본 EC-8_(Gree 🔟 B	E
Load Case				1		2	3	4	5	6		5
Load Type				G		Q •	ExD	EzD	Erx	Erz	<u> </u>	E
Actions					-	Category A 💌		<u> </u>	<u> </u>	<u> </u>	<u> </u>	
Description												
Comb.:1	Ultimate	• _	No	1.35		1.50						
Comb.:2	Ultimate	• _	No	1.00		0.50						
Comb.:3	Ultimate	• -	Dir. +X	1.00		0.30	1.00	0.30	1.00	0.30		0
Comb.:4	Ultimate	• -	Dir. +X	1.00		0.30	1.00	0.30	1.00	0.30		-
Comb.:5	Ultimate	• -	Dir. +X	1.00		0.30	1.00	0.30	1.00	-0.30		0
Comb.:6	Ultimate	· _	Dir. +X	1.00		0.30	1.00	0.30	1.00	-0.30		-
Comb.:7	Ultimate	• <u> </u>	Dir. +X	1.00		0.30	1.00	0.30	-1.00	0.30	(0
Comb.:8	Ultimate	• -	Dir. +X	1.00		0.30	1.00	0.30	-1.00	0.30		-
Comb.:9	Ultimate	• <u> </u>	Dir. +X	1.00		0.30	1.00	0.30	-1.00	-0.30	(0
Comb.:10	Ultimate	• <u> </u>	Dir. +X	1.00		0.30	1.00	0.30	-1.00	-0.30		-
Comb.:11	Ultimate	• <u> </u>	Dir. +X	1.00		0.30	1.00	-0.30	1.00	-0.30	(0
Comb.:12	Ultimate	· _	Dir. +X	1.00		0.30	1.00	-0.30	1.00	-0.30		-
¢												
Add	Remove		Re	ad	Save	TXT	Default	Combinations		ОК	Cano	c
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🕹 Downl	oads		EC-8_Greek Dy	namic (2).c	mb	2/23/2	0104:06 PM	CIMB File				
👌 Music												
Picture	es											
Videos												

Hide Folders	2	Save	Cancel	
Save as type:	s Scada Combination(*.cmb)			~
File name:	EC-8_Greek Dynamic (2).cmb			~
Network	v <			2
🏪 Local Disk (C:	C:)			
📑 Videos				
Pictures				
Music				



Post-Processor 4.

4. STEP: RESULTS

- 0

4.1 Deformed shape of Model:

Move to "Results" unit and check the deformation of the model.

				Load Combinations	×
	Combinations				
Select		and calculate (click Calcu	ulation) the	Load	
combir	nations that yo	ou previously saved (Select t	he File).	Load	
					~
				default.cmb	
				EC-8_Greek Dynamic (2).cmb	
				Calculation	
				ОК	Cancel
		Diagrams-Stress Contours			
		Model			
		Diagrams-Stress Contours			
Select	from the list		and in the		
dialog	window, seled	ct to view "Plate Elements"	-> "DY Deform	nations" caused by "Loa	ad Case 1"
for all r	model (Select	All):			
Select Ma	gnitude				×
Plate Elem	nent V Deformations	✓ DY ✓ Load Case ✓ 1	✓ 3D Member ∨ 1:	10 Pick Select All C	Clear All ??
At tho	hottom har ar	stivate			
			BAR V	ALLIES	
LIMITS	000		DAK V	REGES	
Or, sel	ect to see the	e Deformed Model by Elgen	alues, choosi	ng the Dynamic scenar	to and the
Color g	radient:				
Deformed M	lodel	×			
Eigenvalue	s				
Load Case I	No:1 As:3 Lc=1				
				The second second	
Load Case	No:2 As:3Lc=2				
Load Case Load Case	No:4 As:3 Lc=4 No:5 As:3 Lc=5		1		
Load Caee	No.6.4e-3.Le=6				
EC8_Gen	eral Dynamic V Dynamic	Vinanie			
	Eigenvalues 1	·			
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Direction	Animation Step (%)		1994 Augusta		
+	10	Cancel			
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e					



Members Design 5. STEP: MEMBERS DESIGN

5.1 Design Scenario Creation in accordance to Eurocode provisions:

For masonry structures, SCADA Pro embeds the checks of the Eurocode 6. Thus it is necessary to create a Eurocode design scenario to perform the respective checks with the "Masonry Design" command.

Scenario	Exit		Name Type Design Cor Ste	eurocode EC2-EC3 w Update Delete horrete Connecti el Apply	× M cre Ent	ove to "De eate the de ter a name a	esign" u sired sc and click	nit and enario t "New".	click by seled	New Cting E	to :C2.
Select the file combinati	the Insert and ions a	consi t Combin press ind by	dered nations	scenario tha Combination g OK the wind	EC2-EC3 e • Active t opens th ns Calculatio ow closes	eurocode 🔻 Scenario ne folder wit	and h the reg The p	and gistered program	click .cmb fil calcu	Para mete	lect
Structural Compo Steel Reinfor Combinations of Combinations 1(5) +1.35Lc1+ 2(1) +1.00Lc1+ 3(2) +1.00Lc1+ 5(2) +1.00Lc1+ 5(2) +1.00Lc1+ 9(2) +1.00Lc1+	+1.50Lc2 +0.50Lc2 +0.30Lc2+ +0.30Lc2	Capac Slabs 1.00Lc3+0.30 1.000	City Design Bean Ult. S (1-0) S 1.000 1.000	Steel Tir is Columns ierv. +X -X +Z ULS/ ULS ULS/ ULS ULS/ ULS 540.30LcF0.30Lc7 ULS 5-0.30Lc6-0.30Lc7 ULS 6-0.30Lc7 ULS 6-0.30Lc7 ULS 6-0.30Lc7 ULS 6-0.30Lc7 ULS 6-0.30Lc7 ULS 6-0.30Lc7 ULS 6-0.30Lc6-0.30Lc7 ULS 6-0.30Lc6-0.30Lc7 <td>And the structures Footings -Z No SLS Dir. +X +X +X +X +X +X +X +X +X +X</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	And the structures Footings -Z No SLS Dir. +X +X +X +X +X +X +X +X +X +X						





The checks are made for each section of pier/spandrel, where the predominant intensive size is either:

- Axial force and bending, either
- Shear force

Resulting the critical failure of the wall element, is calculating respectively the bearing capacity for all three Performance Objective A, B and C.



Select the command

In the dialog box that opens, the user must identify the parts of the walls such as described in "New masonry building".

Assessment	of masonry bu	uilding (EC	(8-3)				\times
				~	Report	Performar Objectiv	nce e
Description						A - DL	\sim
l(cm) 0	Pick			 			
h(cm) 0	Pick						
Support: 4 S	ides 🖂 🖂						
New	Update						
Delete	Reinforcement						
Check	Total Check		Results	Total Res	sults	Exit	

▲ In order to pick the points easily, take advantage of the object snap utility in a most efficient way by deactivating any layers that "confuse" the picking procedure (e.g. when a whole wall is to be picked, keep active only the layers of "Lines circles" to pick the corner points of the wall).





Define the walls typing one description (at least four characters and numbers) and press "New".

l(cm)	0	Pick
h(cm)	0	Pick

Use these fields to define the geometry of the considered wall: Click the first "Pick" to define the length of the wall by left clicking at the end points.



Press the button "**Pick**" (the first one) to define the x starting and ending points of the part (i.e. length definition). After the starting point is clicked, an elastic chord emerges from it, waiting to link it with the ending point (second click).

In the same manner, press the second button "Pick" (under the first one), to define the y starting and ending points of the part (i.e. height definition).



l(cm)	1000	Pick
h(cm)	300	Pick

The values are automatically assigned to the fields "I" and "h".

Note that:

The identification of pier/spandrel comes automatically by the program. Means that the user defines the whole wall including the openings and the program checks automatically separating the piers and the spandrels (means the wall portions above and below the openings)

Complete the definition of all the building's walls. Then select Performance Level/.

Press Check to check each section of pier/spandrel of the selected wall.

Total Check command makes checks for each section of pier/spandrel of all the defined walls.

A Pier and Spandrel strength checks are made regarding forces and deformations, for each section, depending on the Performance Level.



After completing their strength checks regarding forces and deformations depending on the Performance Level, display the "Results" for each wall or through the "Total Results", all of the walls.



	Assessme	nt of m	asonry b	uilding (E	C8-3)					×	
	1111						~	Report	Pe	rformance Objective	
	Description	n 1111	1						1	A - DL 🗸	
	I(cm) 7	769.99	Pick	Check	Ratio	D	Vf1	Vf2	Ved	δu 🔨	
	h(cm) 3	300	Pick	Pier 1	0.569	1.51	0.21	22.52	-0.12	0.0	
	Support: 4	4 Sides	\sim	Pier 2 Pier 3	0.231	2.00	0.14	29.97	-1.01	0.0	
E E E E E E E E E E E E E E E E E E E	New	U	Jpdate	Lintel 1	1.057	0.80	0.03	11.85	-0.09	0.0	
	Delete	Reinf	forcement	<						>	
	Check	т	otal Check	(Results		Total R	esults		Exit	
	1										
<											>

In "Ratio" show the adequacy ratios, where rises the possible need to reinforce.

6. STEP: STRENGTHENING

SCADA Pro offers the possibility of strengthening the masonry with:



- simple or double of reinforced concrete jacket to increase the compressive and the inplane shear and flexural strength of the element
- Textile Reinforced Mortar for in-plane shear strength

After completing the checks through the "Masonry Assessment" printing files, you can read the characterization of the failure and strengthen accordingly.

culation's Printout													×	
Availiable Chapters	Printout			Nu	mber	of Pa	iges		_					
⊕ General ⊕ Analvsis	Assessment	of \	Wall:	1111						B	uilding	Data		
Design Reinforcement	Assessme	Assessme Wall : 1111											Assess	age mer
Steel Timber Masonry	Assessme Assessme Assessme	西部町	A REAL PROPERTY AND	ANA ANA A	石田道	Din Nar Typ Thio	nensions ne xe ckness (e	Masor : Single	n (l) =7.70 nry stone -Leaf Wal t) tef	(m) Heig wall - M2 I = 50.0	oht (h) =3.00 50 cm 0	i(m)		
- Masonry Assessment - 1111 - 2222 - 3333		22 N	Aasonry	properti	es :	Par Lim Kno Cha	tial facto it State : owledge l aract. cor	r for ma: Level : mpressiv	KL1:Li e strength	= 2.20 A - DL imited a fk (N/mr	m2)	(&2.4.3) Ci	EC8 (&9.6.(3 Fm = 1.35 2.62	3))
- 4444 6666 8888						Me Chi Me Ma	an comp aract. initi an initial kimum sł	ressive s ial shear shear str hear strer	trength fr strength f ength fvm ngth fvkm	n (N/mm2 fvk0 (N/m 10 (N/mm) 1ax (N/mm	?) (m2) 2) n2)	-	3.12 0.10 0.15 0.20	
Bill of Materials			Height	Thick	(C	Shear apacity o	Pier pro force ca controlled	perties a apacity d by flexi	and chara	cterisatic Shea (Capa	ir force cap city control	acity led by	Capacity	
		α/α 1	(cm) 300.0	(cm)	Ho (cm) 183.9	D (cm) 150.6	N (kN) -0.5	vd (x10-3) 0.7	Vf (kN) 0.2	D' (cm) 150.6	fvd (MPa) 74.8	Vf (kN) 22.5	Flexure	-
		2	300.0	20.0	600.0 155.6	200.0	-0.8	0.9	0.1	200.0	74.9 74.6	30.0 26.7	Flexure	
														+
		Limit state				Pier	strength	checks	(in terms Limit s (in t	of drift o tates of S terms of	or force) SD or NC Drift)			5
		a/a	Ved (kN)	Vf (kN)	Ved / V	/f (mr	n) (i	ui mm)	фј (rad)	çi (rad)	δed (rad)	δu (rad	i j) δed / δι	-

6.1 Strengthening with concrete jacket



To strengthen a wall with single or double jacket, in "Masonry" Library define the characteristics for the concrete jacket. Automatically change all the characteristics of the initial wall also.

Properties of masonry		Х
Masonry stone wall - M5 50 cm $\qquad \lor$		Type Existing \vee
Name Masonry stone wall - M5 50 cm		Concrete jacket Thickness 10 Double-Leaf V
Type Load-bearing \checkmark Double-leaf wall \checkmark ?		Cocrete Steel
Masonry uni Stones - stones drilled 20x20x25 V		C20/25 × S500 ×
Thickness 25 fb=8.0000 fbc=8.0000 ε=20.00		Φ 10 / 10 cm fRd,c (MPa) = 0.30
Mortar Cement-M5 ~		
General purpose designed masonry mortar fm=5.0000		
Wall ? L1 0 t1 (cm) 0 t2 (cm) 0		
Total width of the two mortar strips g (cm)		
tef=25.00 k=0.45 fk=3.1266		✓ Filled vertical joints (3.6.2)
Masonry uni Stones - stones drilled 20x20x25 V	t ¹	Thiskness (Equinalent)
Thickness 25 fb=8.0000 fbc=8.0000 ε=20.00		Consideration 21.42857
Mortar Mortar Cement-M5 ~		Compressive strength fk 11 74376
General purpose designed masonry mortar fm=5.0000	Masonry units - Mortars library	Modulus of elasticity 1000 10.80468
		(GPa)
tet=25.00 k=0.45 tk=3.1266		(N/mm2)
Concrete infill fck (N/mm2) Thickness	New	fvkmax (N/mm2)
C20/25 V 20 0	Save	Flexural strength fxk1 0.1 (N/mm2)
Data reliability level KL1:Limited \checkmark Execution control class 1 \checkmark	Exit	Flexural strength fxk2 0.4 (N/mm2)

Set a new name for the strengthened element and save it for using it later, defining the reinforced wall.



		·	-		
lasonry s	stone wall - M5 50 cm 🗸 🗸		Туре	Existing	
ame	REINF/Masonry stone wall - M5 50 cm		Concrete jacket	Devil	I. I
L			I nickness 10	Doub	le-Lear
уре	Load-bearing \vee Double-leaf wall \vee ?		Cocrete	Steel	
			C20/25 ~	S500	
Masonry	uni Stones - stones drilled 20x20x25	_	Φ 10 / 10 cm	fRd,c (MPa	a)= 0.30
	Thickness 25 fb=8.0000 fbc=8.0000 ε=20.00		Anchorage Without	any additi	é anglegre
4ortar	Mortar Cement-M5 ~	and the second	Without a	any addition	
	General purpose designed masonry mortar fm=5.0000			hh.	
Vall	? 11 0 t1 (cm) 0 t2 (cm) 0				
- Call					
Shell Bed	ided Wall				
Total wi	dth of the two mortar strips g (cm) 0 ?				
Total wi tef=25.	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266			(2.6.2)	
Total wi tef=25.	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266		Filled vertical joints	s (3.6.2)	
Total wi tef=25.	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266 ?		Filled vertical joints Bed join of thickness	s (3.6.2) ss >15 mr	m
Total wi tef=25. Nasonry	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266		Filled vertical joints	s (3.6.2) ss >15 mr t)	m 70
Total wi tef=25. Iasonry	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266		Filled vertical joints	s (3.6.2) ss >15 mr t)	m 70 21.429
Total wi tef=25. Iasonry	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266		Filled vertical joints Bed join of thicknes Thickness (Equivalen Specific weight	s (3.6.2) ss >15 mr t)	m 70 21.428
Total wi tef=25. Iasonry Iortar	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266		Filled vertical joints Bed join of thicknes Thickness (Equivalen Specific weight Compressive strengt	s (3.6.2) ss >15 mr t) h fk	m 70 21.428 11.7437
Total wi tef=25. Nasonry Nortar	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266	Masonry units -	Filled vertical joints Bed join of thicknes Thickness (Equivalen Specific weight Compressive strength Modulus of elasticity	s (3.6.2) ss >15 mr t) h fk	m 70 21.428 11.7437
Total wi tef=25. Masonry Mortar Vall	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266	Masonry units - Mortars library	Filled vertical joints Bed join of thicknes Thickness (Equivalen Specific weight Compressive strength Modulus of elasticity (GPa)	s (3.6.2) ss >15 mr t) h fk	m 70 21.428 11.7437 10.8044
Total wi tef=25. lasonry lortar /all tef=25.	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266	Masonry units - Mortars library	Filled vertical joints Bed join of thickness Thickness (Equivalen Specific weight Compressive strength Modulus of elasticity (GPa) Characteristic streng (N/mm2)	s (3.6.2) ss >15 mr t) h fk 1000 th fvk0	m 70 21.428 11.7437 10.804 0.1
Total wi tef=25. lasonry lortar /all tef=25. Concrete	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266	Masonry units - Mortars library	✓ Filled vertical joints Bed join of thickness Thickness (Equivalen Specific weight Compressive strengtl Modulus of elasticity (GPa) Characteristic streng (N/mm2) Maximum shear strengtl Maximum shear strengtl	s (3.6.2) ss >15 mr t) h fk 1000 th fvk0 ngth	m 70 21.428 11.7437 10.8044 0.1 0.36
Total wi tef=25. lasonry lortar /all tef=25. concrete :20/25	dth of the two mortar strips g (cm) 0 ? 00 k=0.45 fk=3.1266 0 ? uni Stones - stones drilled 20x20x25 ~ Thickness 25 fb=8.0000 fbc=8.0000 ɛ=20.00 Mortar Cement-M5 ~ General purpose designed masonry mortar fm=5.0000 ? L1 0 t1 (cm) 0 t2 (cm) 0 00 k=0.45 fk=3.1266	Masonry units - Mortars library	✓ Filled vertical joints Bed join of thickness Thickness (Equivalen Specific weight Compressive strengtl Modulus of elasticity (GPa) Characteristic streng (N/mn2) Maximum shear stre fvkmax (N/mm2) Flexural strength fxd (N/mm2)	s (3.6.2) ss >15 mr t) h fk 1000 ngth k1	70 21.428: 11.7437 10.8044 0.1 0.36 0.1

Open Mess 3D command and Calculation to identify the sub-groups that need reinforcement:





Then inside the window of the mesh group identify the sub-groups and modify their **quality** and **thickness**:

A Remember to press **Redefinition** every time you modify something

Plate Elements Creation X										
Description	Description PLATE			Material Masonry 🛛 Yype						
Element		Ks (Mpa/cm)	Isotropic	Orthotr	opic	Angle 0				
Plate	\sim	300								
Density	Width (cm)	Thickness	Exx (GPa)	10.80468436	Gxy (GPa)	4.321873747				
0.05 ~	30	70	Eyy (GPa)	10.80468436	ε (kN/m3)	21.42857142				
Descripti	ons Me	esh	Ezz (GPa)	10.80468436	atx*10-5	1				
Mesh Groups		at Surface	vxy(0.1-0.3)	0	aty*10-5	1				
	2S 3P	PLATE(1) 51/3/3	vxz(0.1-0.3)	0	atxy*10-5	1				
		S1/4/2(2) S1/5/2	vyz(0.1-0.3)		Exx * vxz = Eyy * vxy					
6P S1/6/2			Dedefinition							
	8P 9	51/7/2 51/8/2	Steel Reinf		inforcement	ОК				
	9P 9	51/9/2	Del From Li	st	L					
10P S1/10/3 11P S1/11/3			New	S220		Exit				

Then, repeat the analysis process, updating with new data, and check again the reinforced wall to receive new adequacy ratios, until you manage to get ratios smaller than one. The process is iterative and could be done repeatedly.



<section-header>

Use Textile Reinforced Mortar for in-plane shear strengthening, defined by the corresponding window for the selected wall from the list.

Select the "Design Method".

To SCADA Pro contains two methods and you can select between

ACI 549.4R-13 ~ ACI 549.4R-13 Triantafillou & Antonopoulos (2000)

Specify the characteristics of the material, based on catalogs and commercial materials.

1 In SCADA Pro commercial materials have been introduced

EM4C Sika

By selecting the company and the corresponding material the mesh properties are automatically filled in by the program.





Then press again the "Checks" button and check the results obtained after the introduction of the TRM. The software check under shear only the walls and the spandrels that initially failed under shear. Additionally, the capacity under flexure is rechecked to ensure the sufficiency of the elements now strengthened for shear.

You can repeat the process until sufficiency is reached.



				(0.2)					+
1111 Description	on [11]	11	inding (c	.00-3/		~	Report	Pe	rformance Objective
l(cm) [h(cm) [769.99 300	Pick Pick	Check Pier 1 Pier 2	Ratio 0.569	D 1.51 2.00	Vf1 0.21 0.14	Vf2 22.52 29.97	Ved -0.12 -1.01	δu ^ 0.(
Support: New Delete	4 Sides	Update nforcement	Pier 3 Lintel 1 K	0.231 1.057	1.79	0.25	26.75 11.85	-0.06	0.0 0.0 ×
Check		Total Check		Results		Total R	esults		Exit