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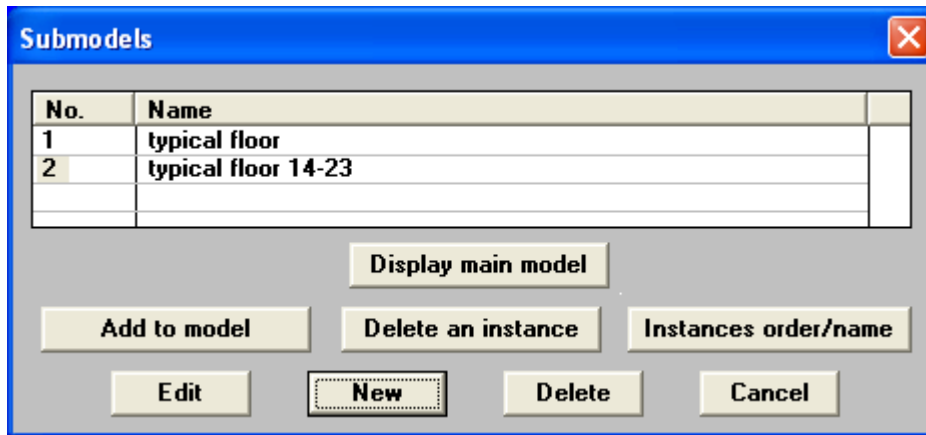
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# 1 Submodel



A submodel is a part of the final model defined in a separate working area.

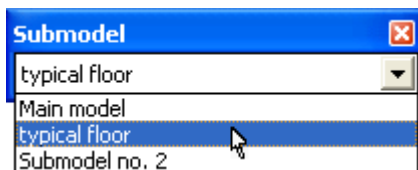
- all the geometry options are available when defining a submodel.
- a submodel may be added to the current model any number of times (referred to as '*instances*') at any location and at any angle. Two options are available:
  - the submodel is added as a **submodel**, i.e. the complete model at all stages - geometry, loads, results, etc. - consists of the 'Main model' and one or more 'submodels'. Note that **each** submodel may be defined with the maximum number of nodes and/or elements (32,000), i.e. the total size of the model (main model + submodels) is unlimited. (see note).
  - as **individual elements**, i.e. the submodel is merged into the main model when it is added.

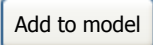
Refer to submodels - general.



There are three steps when using submodels:

- create the submodel - select 
- edit a submodel - click and highlight a submodel in the list and click . Alternatively, select the submodel in the small list box:



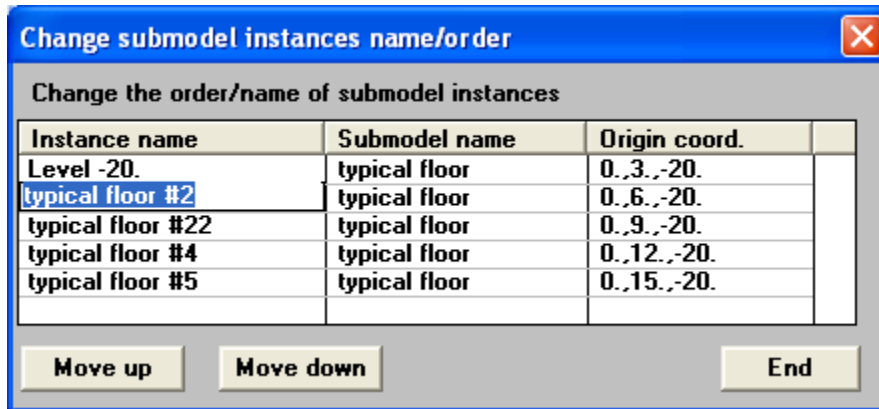
- add the submodel to the main model - click and highlight a submodel in the list and select 

## Display main model

Return the main model to the display. Alternatively, select 'main model' in the small listbox



## Instances order/name



To change an instance name:

- click on the appropriate name in the left-hand column (as shown above)
- type in a new name

To rearrange the list:

- click and highlight the appropriate line
- click  or

## Delete an instance

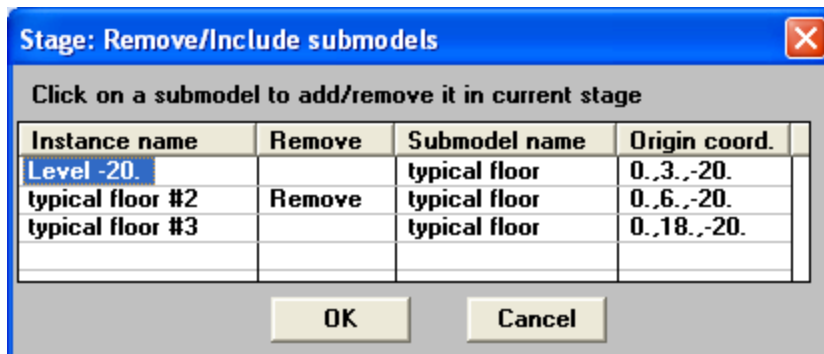
Delete selected instances of a submodel from the main model; the submodel itself is not deleted.

- click and highlight one or more lines in the listbox
- click

## Delete

Delete a submodel and all of its instances.

If the option is selected when a Stage other than "Whole model" is current, an **entire** submodel instance may be deleted from the Stage; individual beams, elements, etc. may not be removed from the stage.



Click on a line to toggle the status in the **Remove** column.

## 1.1 General

### **What are submodels:**

A submodel is a part of the final model defined in a separate working area.

A submodel may be added to the current model any number of times (referred to as '*instances*') at any location and at any angle. Two options are available:

- the submodel is added as a **submodel**, i.e. the complete model at all stages - geometry, loads, results, etc. - consists of the 'Main model' and one or more 'submodels'. The submodel is retained by the program and may be revised at a later time.
- as **individual elements**, i.e. the submodel is merged into the main model when it is added. The submodel is not retained by the program.

### **When to use submodels:**

Submodels are recommended when a repetitive element is present in the structure, e.g. a typical floor in a high-rise building.

- each typical floor type is defined as a submodel
- every occurrence of a typical floor type is added to the model as an instance

### **Advantages:**


If the submodels are added as **submodels**:

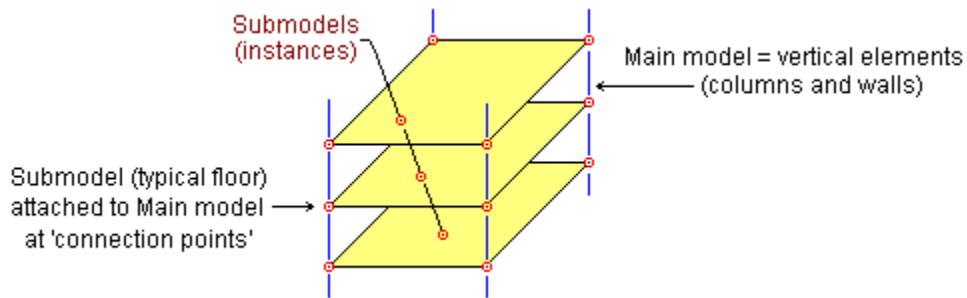
- **each submodel** may be defined with the maximum number of nodes and/or elements (32,000) and multiple instance may be added, i.e. the total size of the model (main model + submodel instances) is **unlimited**. (see note)
- the **solution time** for a model defined with submodels is **significantly reduced**, i.e. slabs may be defined with more refined meshes without a significant increase in the solution time.
- revising the geometry of a submodel (e.g. a typical floor) automatically revises the geometry in all of the instances.
- Loads may be defined either on the submodel (applied to all instances) or on a selected instance of the submodel. If applied to the submodel, any change to the loads is applied to all of the instances.
- the node and element numbering is independent in each submodel, i.e. all numbering starts from **1** in each submodel; large node/element numbers are avoided.
- Each submodel has its own property group list (which may be identical to the Main model property list). Refer to Submodel - new.
- Each submodel (or instance) can be displayed separately without defining a View.

Note that the submodel is connected to the main model at connection points only. These points are defined in the submodel similar to restraints, i.e. any degree-of-freedom may be restrained or free.

### **How to use submodels:**

The recommended procedure for a high-rise building is as follows:

- Define all columns and walls in the main model.
- Define the typical floor at one level in the main model (this ensures correct dimension in the submodel)
- Create the submodel: select the  **Use part of a model** option and select all nodes in the typical floor. The program automatically identifies the common submodel/main model nodes and automatically creates the connection points in the submodel.
- Modify the connection point type, if necessary (the are completely fixed by default)
- Add the typical floor submodel to the main model at each level; each level is represented by an **Instance** of the same submodel.



- repeat for other typical floor types.

#### **Restrictions:**

- all the geometry options are available when defining the submodel, except the following:
  - supports and springs; all supports and springs must be defined in the main model
  - compression-only beams
  - individual submodel beams/elements cannot be removed in a Stage; however entire instances may be removed from or added to a stage.
- the concrete design module cannot identify columns and walls in submodels (they must be defined in the Main model)
- The following modules cannot handle models with submodels in the current version: *BRIDGE*, *CONNECT*, *POSTTEN*, Dynamic time-history analysis.

#### **Display:**

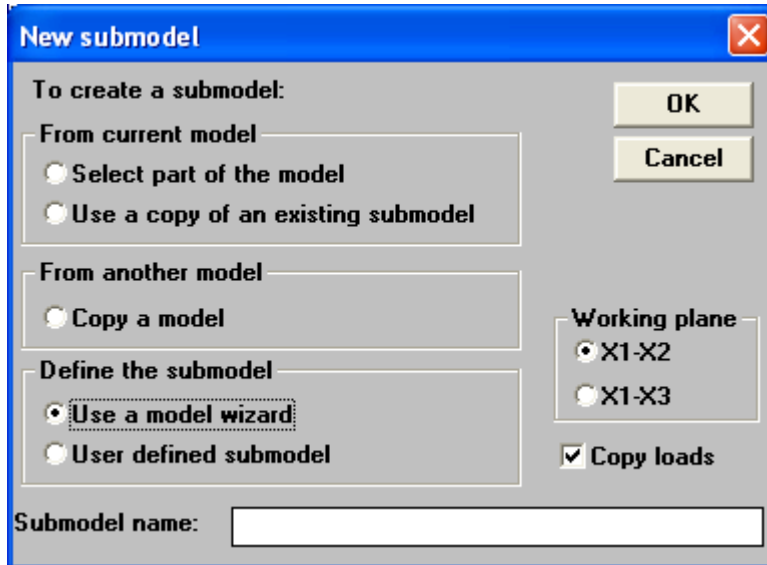
- either the Main model or any of the submodels may be displayed on the screen:
  - revisions to submodel geometry or loads applied to submodels may be made only when the submodel is displayed
  - submodel results may also be viewed when the main model is displayed
- geometry tables list only submodel data if a submodel is currently displayed.
- 'right-click' **Model properties** option:
  - Main model is displayed: total weight and center-of gravity are shown for the entire model (including all submodels)
  - Submodel is displayed: total weight and center-of gravity are shown only for the current submodel.
- Node/beam/element number display: refer to Display node/beam/element numbers.

#### **Capacity:**

- the 'unlimited' capacity is available only in the 32,000/element node version of *STRAP*.
- in smaller capacity versions (e.g 1000 nodes), submodels may be defined but the total number of nodes or elements in the entire model (main model + submodels) may not exceed the purchased program capacity.

## 1.2 New

There are several methods for creating the submodel:



For all options:

- Enter the **Submodel name**
- select the  option to create the submodel and click
- the program displays the submodel on the screen; edit using the standard geometry options.
- Attach the submodel to the Main model with the  option.


Note:

- each submodel has its own property list; note the way it is created according to the option selected.
- the  **Copy loads** option works differently for each option.

### **From the current model**

- **Select part of the model**  
Select part of the model using the standard Node Selection option;
  - only elements with **all of their end nodes** selected are included in the submodel.
  - nodes that have an **unselected** beam/element/wall attached to them are automatically designated as connection points.
  - the program automatically **turns the selected part of the model into a submodel** instance (even though it was defined as part of the main model).
  - the entire Main model property list is copied to the property list for the new submodel.
  - the  **Copy loads** option is not available
- **Use a copy of an existing submodel**  
Select a submodel from the list.
  - the property list from the existing submodel is copied to the property list for the new submodel.
  - Set  **Copy loads** to copy the loads defined in the other submodel.

### From another model


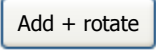
- Browse to the correct folder; click and highlight the model name in the list and click .
- if the model also contains submodels, you must select either the main model or one of the submodels.
  - the property list from the selected main model/submodel is copied to the property list for the new submodel
  - Set  **Copy loads** to copy the loads defined in the other model.

### Define the submodel

#### Use a model wizard

Create the submodel from one of the models in the Wizard library.

- the property list defined in the wizard is copied to the property list for the new submodel.
- Set  **Define loads** to define loads in the wizard.

- select the definition plane for the wizard model -  **X1-X2** or  **X1-X3**. The  option adds submodels to the Main model **on the same plane** by default (The  option does not rotate loads).


#### User-defined model

The program displays a empty working area; define the submodel using all of the standard geometry options.

- the entire Main model property list is copied to the property list for the new submodel.

Note:

- submodels should be defined in the same planes that they will appear in the Main model (to avoid rotating them when adding them to the model).
- the submodels are attached to the model at connection points. These points are the nodes in the submodel that are attached to corresponding nodes in the Main model. The connection may be

defined as active or released in any degree-of-freedom (similar to Restraints). Click  in the side menu when editing the submodel.

## 1.3 Connection points

The submodel is connected to the main model at common nodes called **Connection points**. Use this option to define the location and types of connection.


The option is similar to the Restraints option:

- specify the connection type (all directions / pinned / other)
- select the nodes using the standard Node selection option.

Rigid links may also be defined in this option:

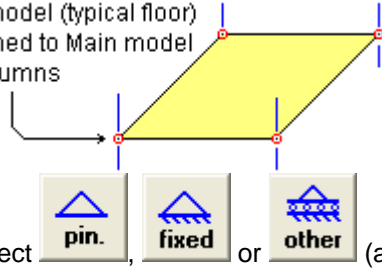
- the rigid links are defined between nodes in the submodel
- if two connection points are connected by a rigid link, the program automatically creates the identical rigid link between the corresponding nodes in the Main model when submodel is attached.

Note:

- If the submodel is defined using the  **Select part of the model** option, nodes that have an **unselected** beam/element/wall attached to them are automatically designated as connection points.
- using submodels with a **pinned** connection point is a simple way to connect elements to columns without transferring moments (see note below).

**Example:**

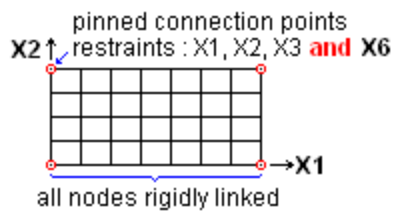
Submodel (typical floor)  
attached to Main model  
at columns



- select **pin.**, **fixed** or **other** (and select the restrained degrees-of-freedom)
- select the nodes at the locations corresponding to the columns in the Main model using the standard Node selection option.

Note:

- if the typical floor submodel is rigidly linked **and** the connection points are pinned, the connection points must be restrained for rotation about the axis perpendicular to the floor:



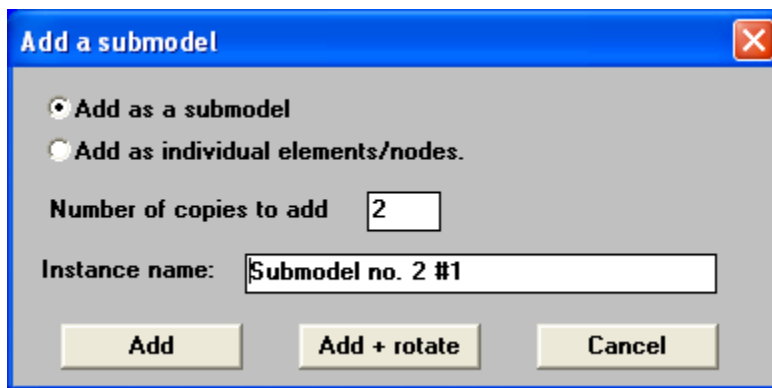
## 1.4 Add to main model

The submodel is added to the main model using a method similar to the geometry "**Copy**" option:

- one or three reference nodes are defined in the submodel and the corresponding nodes are selected in the main model. The program then attaches the submodel to the main model at the first reference node; the model may be rotated if three reference nodes are defined.
- the submodel may either be added as a **submodel** (i.e. the complete model at all stages - geometry, loads, results, etc. - consists of the 'Main model' and one or more 'submodels') or as **individual elements** (i.e. the submodel is merged into the main model when it is added). Refer to Submodels - general for more information.

Note:

- this option copies the **entire** submodel, including supports, offsets, rigid links, springs, etc.
- load cases may be copied if the submodel was created from an "existing model" and is added as "individual elements"



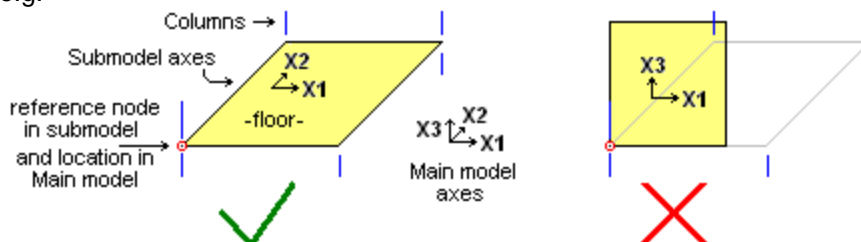
Any number of instances may be added at the same time, each at a different location:

- specify **Number of copies to add**
- if you select  **Add as a submodel**, define the **Instance name**

### Add as a submodel

- - Select a single reference node in the submodel and the reference node location in the main model; the submodel is added to the main model at the location of the reference node.

- the submodel is neither stretched nor squeezed
- the submodel is added in the same plane in the main model as it was defined in the submodel, e.g.

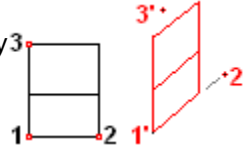


- the program prompts for the reference node location in the main model for **each** of the **Number of copies to add**

## Add + rotate

Select three reference nodes in the submodel and the corresponding locations of the reference nodes location in the main model; the submodel is added to the main model at the location of the reference node.

- the submodel is neither stretched nor squeezed
- Node 1 in the submodel is placed at node 1' in the main model. Nodes 2' and 3' are used only for determining direction; 1-2 is aligned with 1'-2' and the entire submodel is placed in the plane formed by 1'-2'-3'.



- the program prompts for the reference node location in the main model for **each** of the **Number of copies to add**

Note:

- each connection point in the submodel must be aligned with an existing node in the main model. The program checks that this is true for each instance. In cases where a connection point is not aligned with a node the program creates a rigid link between the connection point and the nearest node in the main model and displays a list. For example:

Connection nodes						
Some connection nodes in the submodel do not have a corresponding node with the same coordinate at the main model The program will connect them to the closest node in the model as specified in the list below.						
Submodel node	Main node	Dist	DX1	DX2	DX3	Instance
5981	207	3.131	1.6799	1.7267	2.	Submodel no. 3 #1
5997	207	5.2995	1.3201	4.7267	2.	Submodel no. 3 #1
6013	206	2.7283	0.6799	1.7266	2.	Submodel no. 3 #1
6029	207	2.7137	1.3202	1.2733	2.	Submodel no. 3 #1

Press "Cancel" to change the model or submodel before creating the submodel instance.

OK Cancel

### Add as individual elements/nodes

## Add

Similar to "Add as a submodel above"

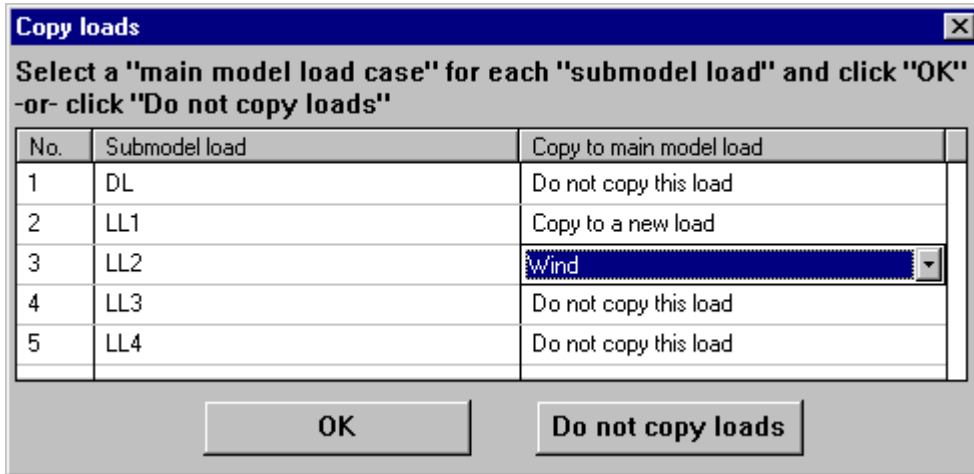
## Add + rotate

- The copy is generated by defining **three** reference nodes:
  - as the three nodes can be located anywhere in space, this option allows the copied block to be rotated with respect to the original.
  - if the distances from the first reference node to the second or from the second reference node to the third are not the same in the copied block as in the original block, the program will 'stretch' or 'squeeze' all of the elements in the block accordingly; **the program will not distort the block**, i.e. all parallel beams will be stretched or squeezed **by the same factor**.

Note:

- the program will not create a new node at the location of an existing node; the restraints at the existing node will be the sum of the previous restraints in the existing node and the restraints in the submodel node.
- the program will not create a new beam/element at the identical location of an existing beam/element.
- restraints or springs defined parallel to global axes in the submodel will be oriented in the closest possible global direction in the main model. Restraints defined according to a local system will be rotated to the same orientation relative to the submodel.

For a submodel created from an "existing model":

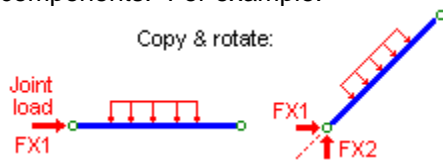


For each load case in the submodel, click on the right column, open up the list box, and select:

- the name of an existing load case in the main model - the loads will be added to the load case.
- "Copy to a new load" - to create a new load case in the main model.

Note:

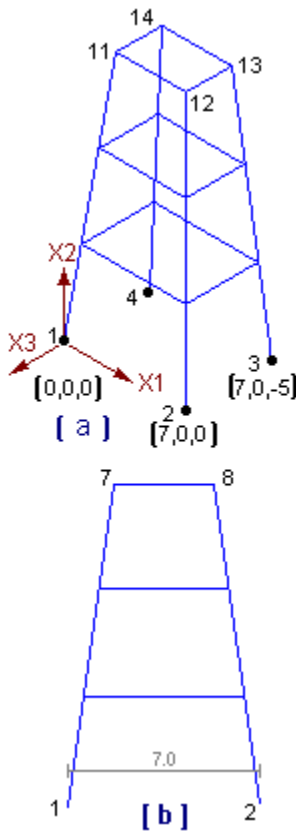
- Joint loads, beam loads, element loads and global loads only may be copied.
- Support displacements are not copied.
- Loads that were added to the load case using the "**Combine**" command cannot be copied.
- Element loads generated using the "Linear" element load option are not copied.
- Joint loads rotated to a direction not parallel to a global axis are separated to the equivalent global components. For example:



- Global loads defined in a global direction are applied in the closest global direction after rotation. Global loads applied perpendicular to the plane will remain perpendicular to the plane.
- 

The option is best illustrated by an example:

Create the model displayed in Figure (a) from the submodel displayed in Figure (b).



**Create plane 1-2-11-12 from the submodel:**

- define the three reference nodes in the submodel:  
 first reference node: 1  
 second reference node: 2  
 third reference node: 8
- define their new locations in the main model:  
 first reference node: 1  
 second reference node: 2  
 third reference node: 12

**Create planes 2-3-13-12 from the submodel:**

- define the three reference nodes in the submodel as above:
- define their new locations in the main model:  
 first reference node: 2  
 second reference node: 3  
 third reference node: 13

**Note:**

- the distance from the first to the second reference node is changed from 7.0 in the original block to 5.0 in the copied block; all of the dimensions in this direction are revised proportionally.
- As the perpendicular distance from the third reference node to the line joining the first two nodes remains unchanged in the copied block, all vertical dimensions will remain constant.
- The program should create a node at the new location of node 2. However it also checks if two nodes will be at the same location. Upon discovering that the new node is at the same location as node 2, it connects all elements to the existing node. Similarly new beams are not created on the line 2-12.