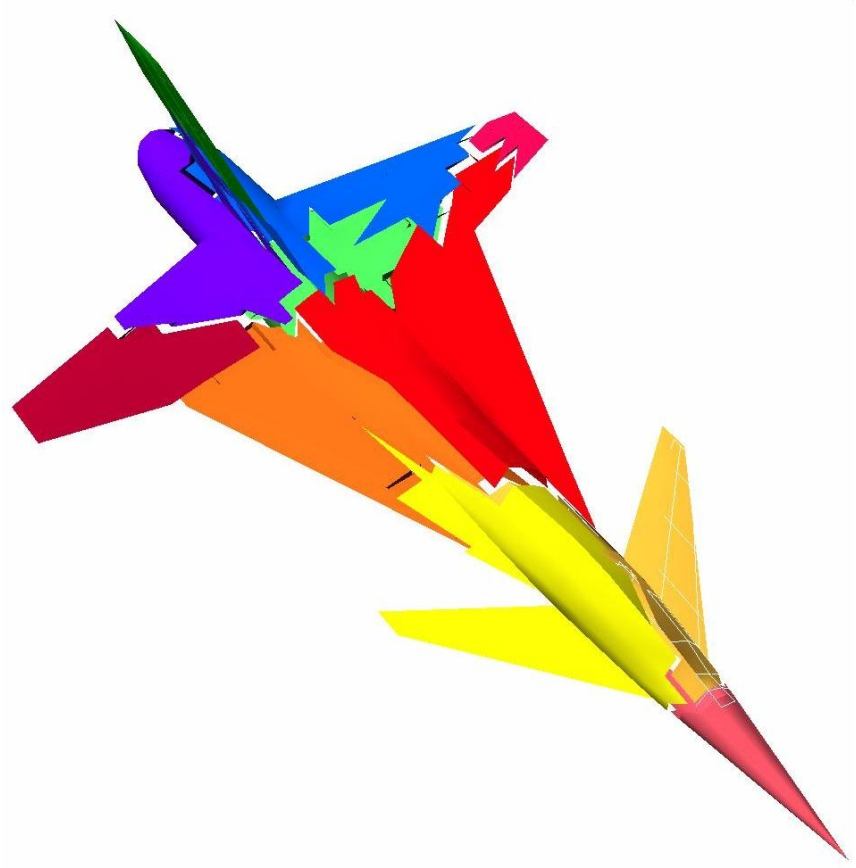
TOP/DOMDEC

A Totally Object Oriented Program for Visualization, Domain Decomposition And Parallel Processing



User's Manual
Version 2.4

Last Update: February 26, 2011
By: Charbel Farhat

Preface

The purpose of this manual is to document the usage of TOP/DOMDEC, a Totally Object oriented Package for visualization, DOMain DEComposition, and parallel processing. This software is written in C++. It uses the Open GL graphics system. Its interface windows are built with MOTIF TOOLS (Streamlined GUI Design and Programming with Xmt Library).

Table Of Contents

Chapter 1: Introduction

1.1 Introduction

TOP/DOMDEC is an interactive software package for scientific visualization, mesh partitioning, and parallel processing.

TOP is a general purpose object oriented three-dimensional postprocessor for irregular (unstructured) meshes. It can also be used for regular (structured) grids. TOP offers most standard capabilities for scientific visualization, including wireframe and solid rendering, isovalue extraction, contour and curve plotting, shading, etc. It also features multiple window operations, high-speed animation, and a user-friendly "point-and-click" environment.

DOMDEC offers a state-of-the-art environment for mesh decomposition that is optimized for FETI methods. Generated mesh partitions can be smoothed and optimized for minimum interface, perfect subdomain aspect ratio, and maximum load balance.

TOP/DOMDEC also provides a real-time means for assessing, a priori, the quality of a ***Mesh Partition*** and discriminating between different mesh partitioning algorithms. It includes an inter-processor communication simulator for today's massively parallel systems.

1.2 Conventions Used in This Manual

New vocabulary appears as *italics* before or on the occasion of the term's definition. Reserved words appear as **bold face** within the text. Text for input and output files appears as if it is `typewritten`. Concepts appear as ***bold italics***. All instances of graphic and database objects are Capitalized.

This manual uses four kinds of information boxes each identified with an icon.

The most common box is the "information" box that displays information about a corresponding figure.

The next kind of box is the warning/attention box. This usually contains crucial information regarding the behavior of TOP/DOMDEC and highlights areas where the user must be careful.

The question box is used to provide additional information about some concept being explained. Usually the message in this box will refer to another section of the manual.

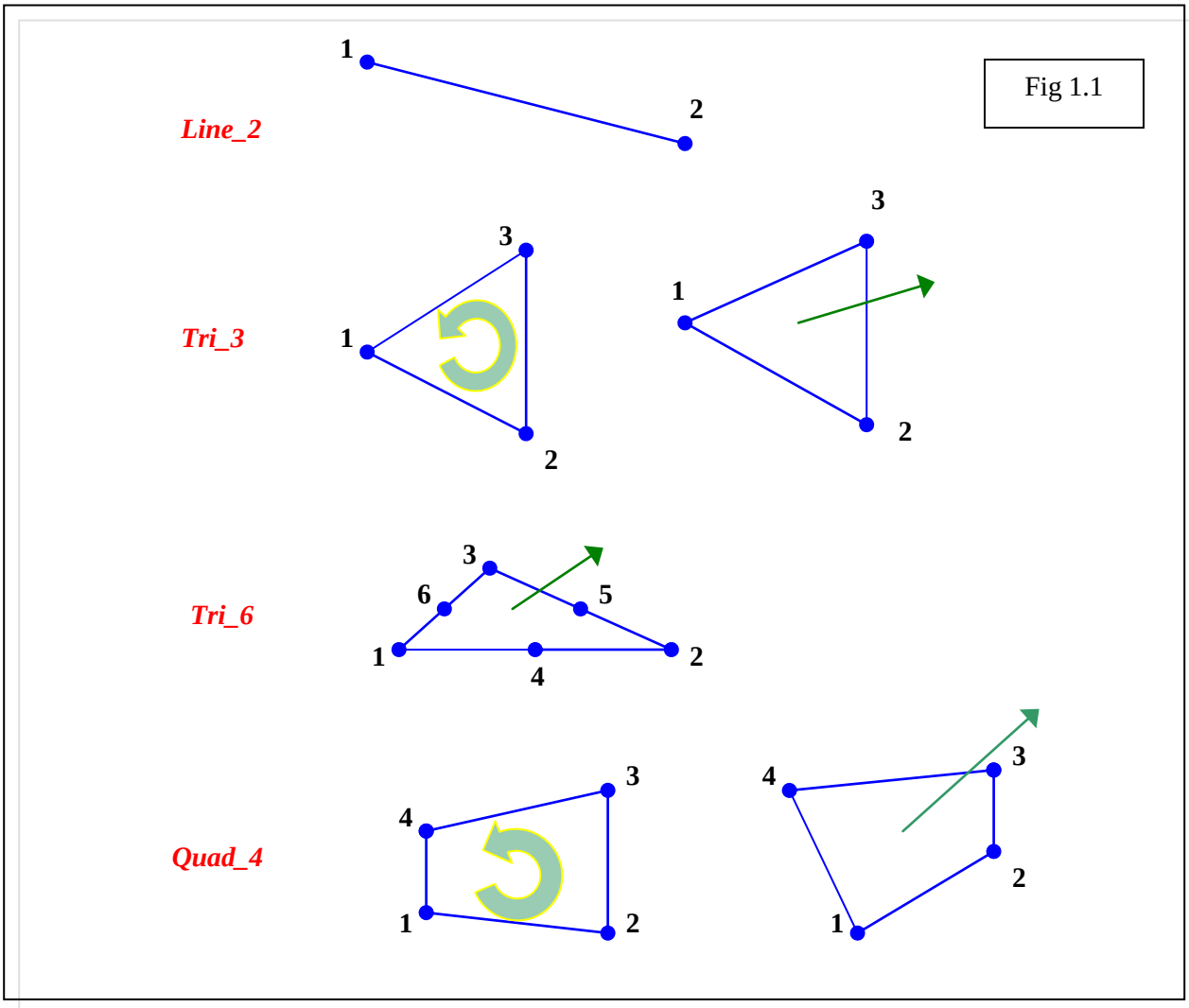
The tip box provides additional information which might be helpful to the user.

Note that all the figures in this manual showing the operation of TOP/DOMDEC have been taken from actual screen-shots.

1.3 Objects in TOP/DOMDEC

The objects in TOP/DOMDEC include ***Element Sets, Node Sets, Load Cases, Vector Results, Scalar Results, ElemScalar Results, Patterns, Structural Displacement Boundary Conditions, Structural Force Boundary Conditions, Fluid Boundary Conditions, Fluid/Structure Boundary Conditions***, ***Temperature Boundary Conditions***, and ***Mesh Partitions***. Commonly, an ***Element Set*** and a ***Node Set*** define a mesh. While viewing, statistics can be obtained about a chosen ***Element Set***.
Load Cases, Vector Results, Scalar and ElemScalar Results define static or dynamic results. Note that dynamic results have multiple time steps. All objects are stored by name in the TOP/DOMDEC database.
A ***Mesh Partition*** is used to define the decomposition of a mesh into subdomains. This partition can be viewed as if it were a regular ***Element Set*** in one of the four Display Windows. In the database, a ***Mesh Partition*** appear as an ***Element Set***.

TOP/DOMDEC recognizes seventeen basic geometric types of ***Element*** as well as a long list (see section 2.4) of finite element types of ***Element***. The basic geometric types are: ***Line_2, Tri_3, Tri_6, Quad_4, Quad_8, Quad_9, Quad_16, Quad_V, Tetra_4, Tetra_10, Tetra_V, Brick_8, Cube_20, Cube_32, Cube_V, Penta_6,*** and ***Penta_26.*** They are shown in Figure 1.1, together with the ***Constraint*** element. Note that the wide arrow shows the order of node definition while the thin arrow indicates the direction of the outward normal. The finite element types are specified in section 2.4. These types distinguish themselves from the geometric ones in that they imply mathematical information that is exploited when using TOP/DOMDEC to partition a mesh.



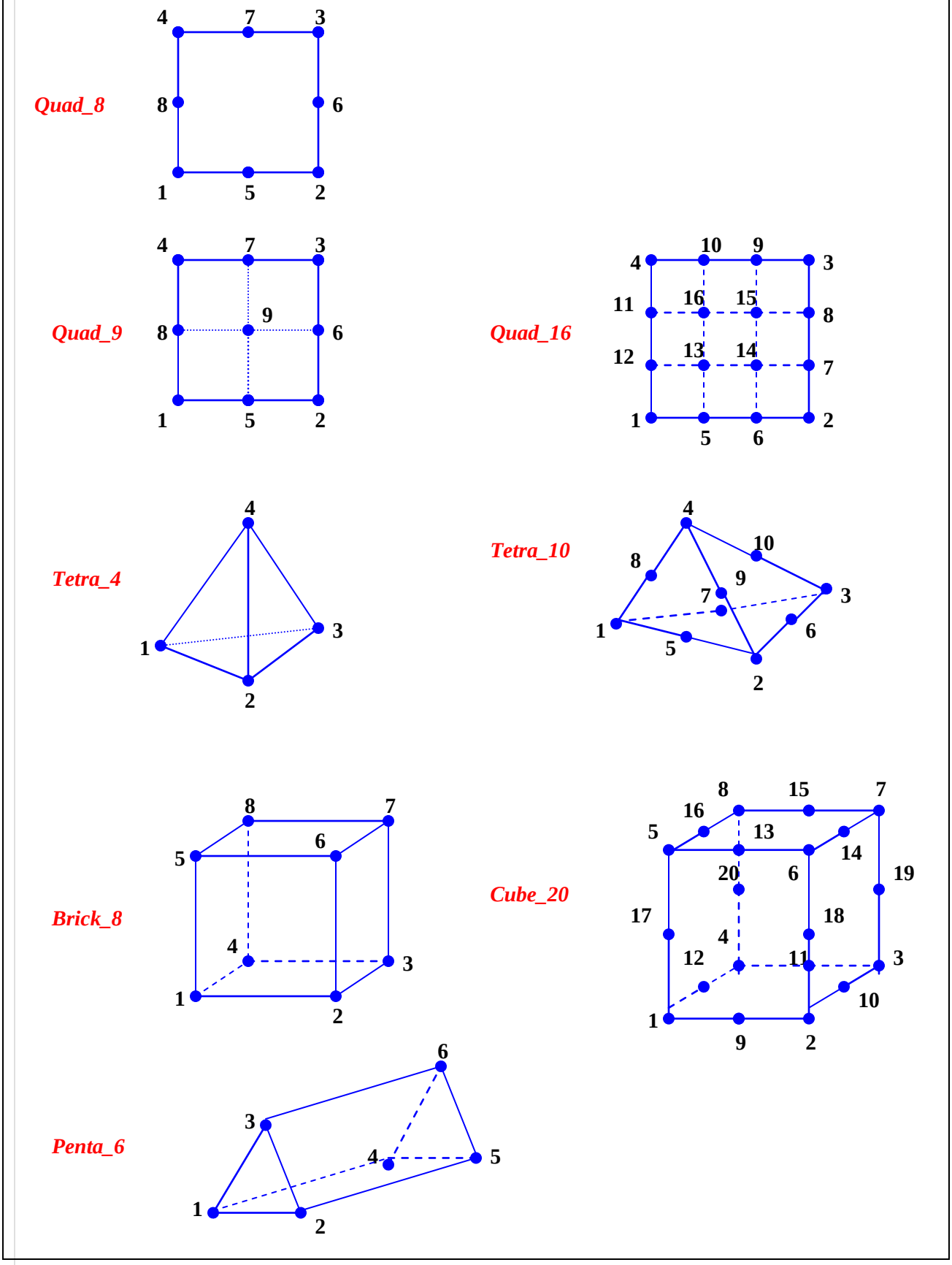
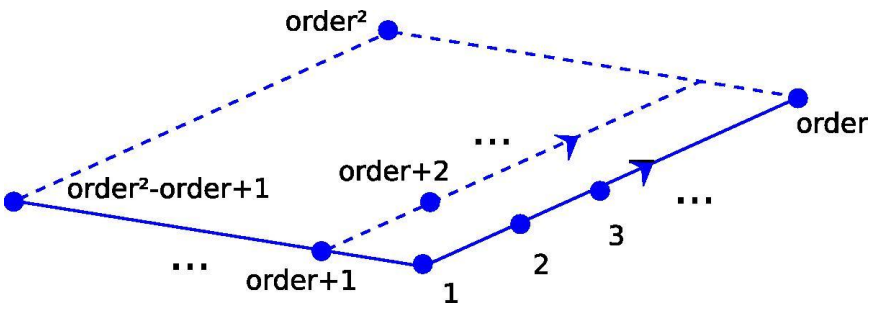
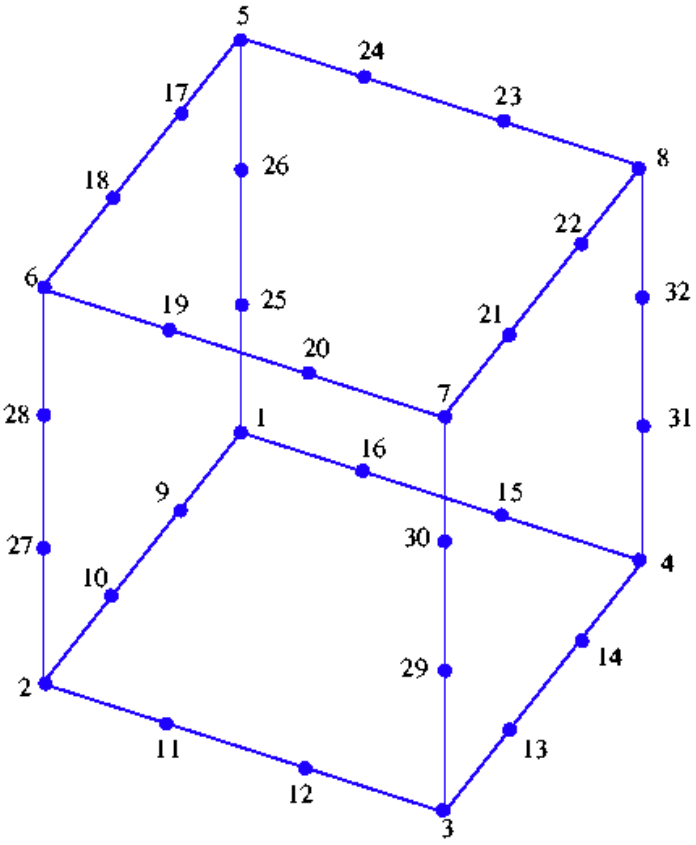

Quad_8
4 7 3
8 6
1 5 2
Quad_9
4 7 3
9
8 6
1 5 2
Quad_16
10 9
4 3
11 16 15 8
12 13 14 7
1 5 6 2
Tetra_4
4
1 3
2
Tetra_10
4
10
8
9
7
3
1
6
5
2
Brick_8
8 7
6
5
4
3
1
2
Cube_20
8 15 7
16
5 13
14
20 6 19
17 18
4
12 11 3
10
1 9 2
Penta_6
6
3
4 5
1 2

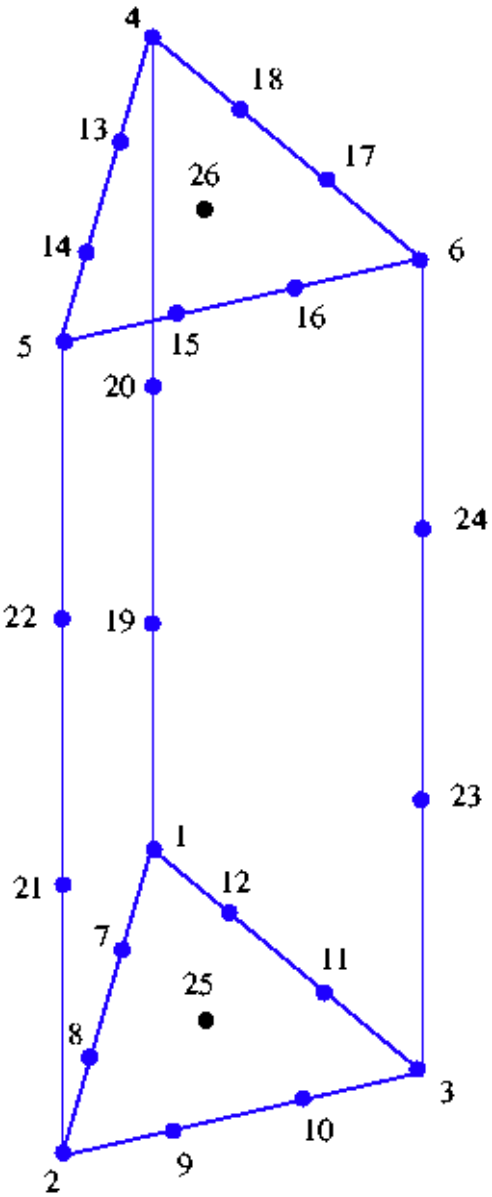
Fig. 1.2



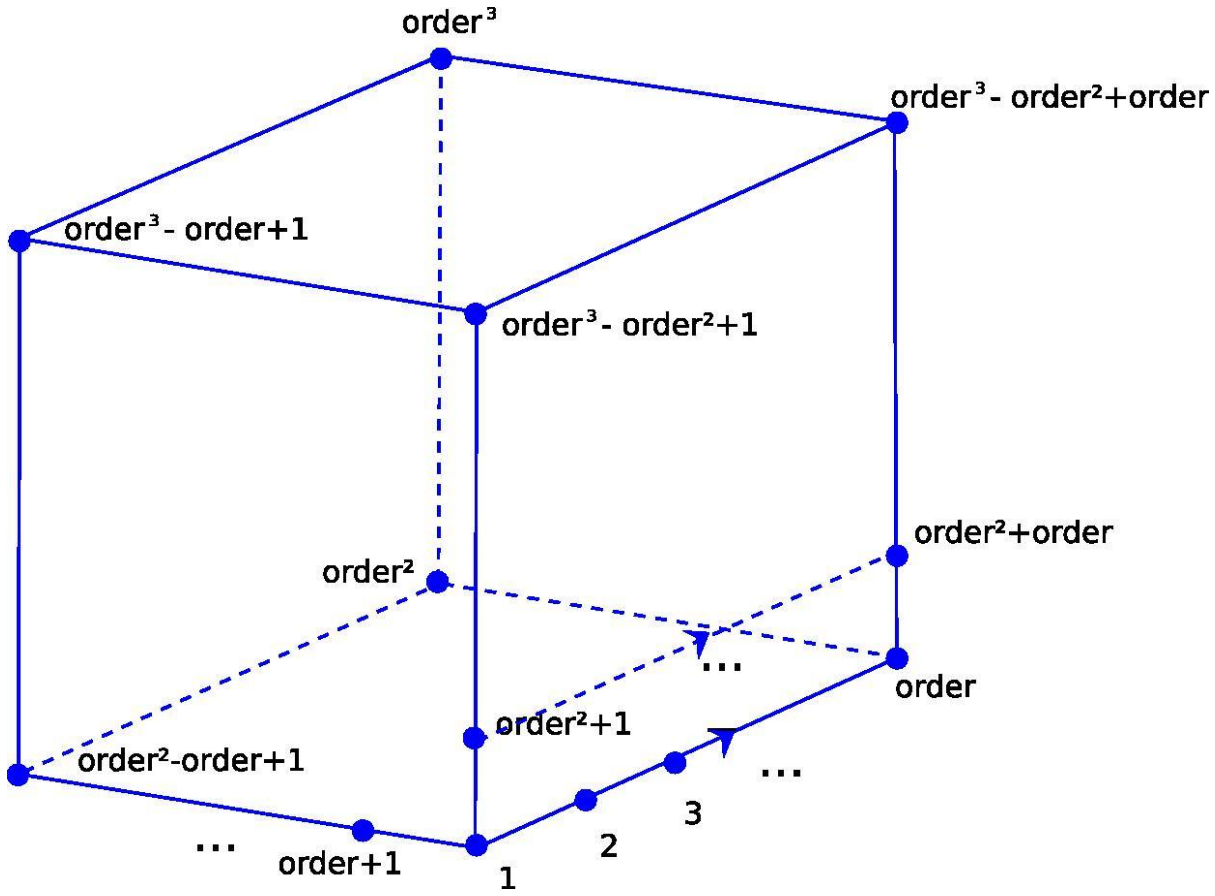
Quad_V (order measure in L2 norm)



Cube_32



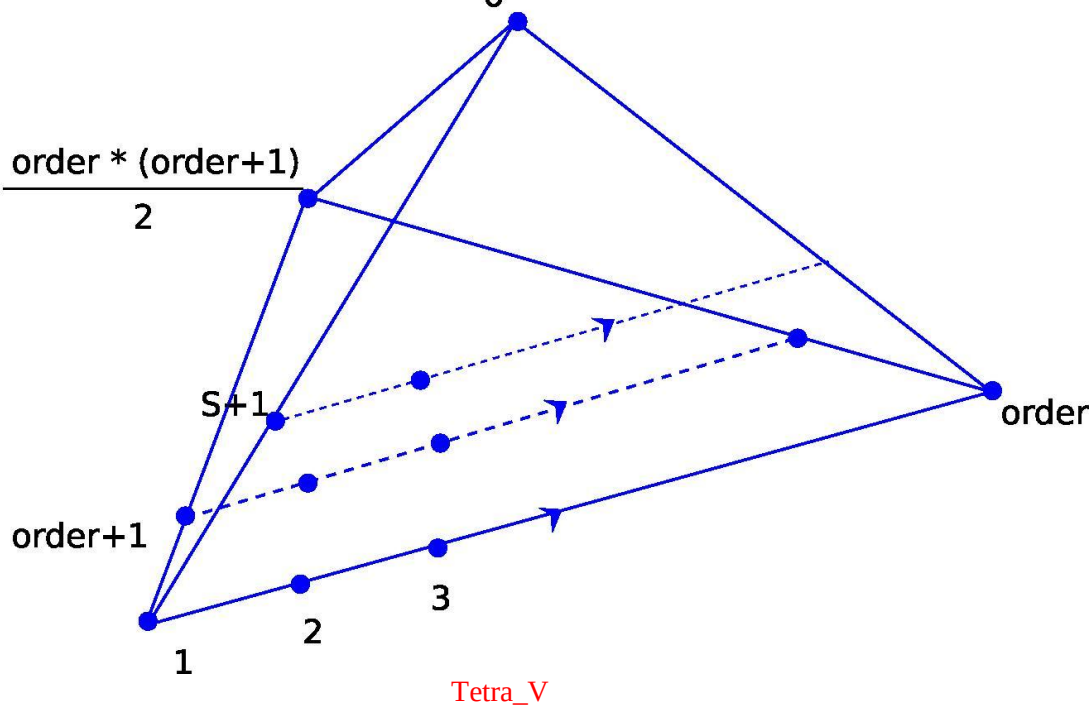
Penta_26



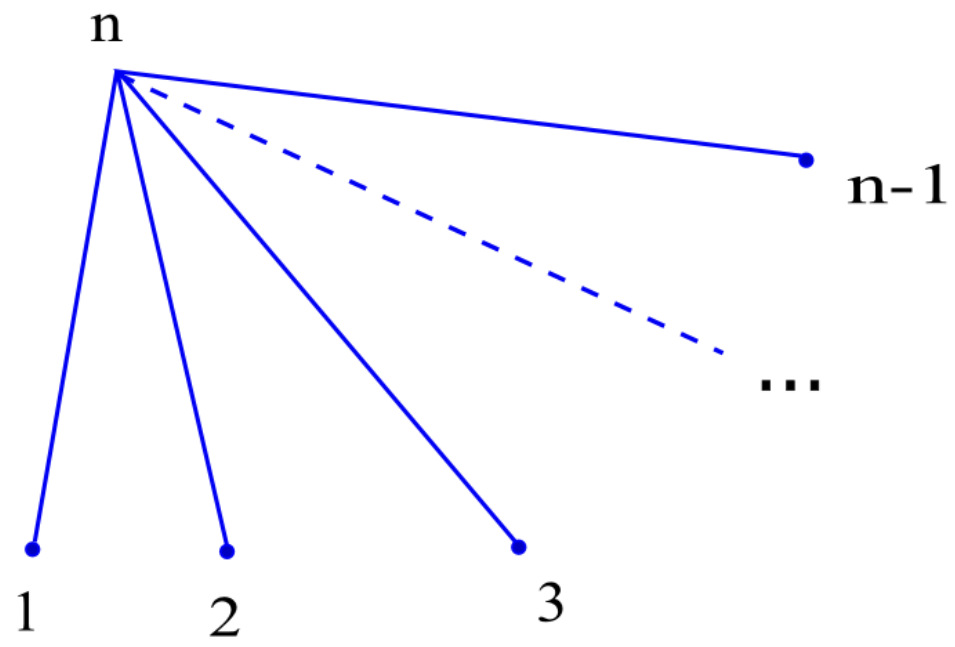
Cube_V (order measured in L2 norm)

$$S = \frac{order * (order+1)}{2}$$

$$\frac{order * (order + 1) * (order + 2)}{6}$$



Tetra_V



Constraint

1.4 The Graphic User Interface

Upon startup, two main windows appear: The **Main Display Window** and the **Main Controller**.

Fig. 1.3

These windows are discussed in more detail later in this section

1.4.1 The Main Display Window

All visualization takes place in the Main Display Window. This window can be split into two or four individual display windows for the simultaneous visualization of multiple ***Element Sets*** and/or multiple results. (For more information about how to set this window, see section 3.6 (Window Status)).

The Main Controller window is used to select objects and results for display, and control how they are rendered. The controller shows which objects are displayed, their color, whether they are displayed as Wireframe or Solid Body, and which ***Load Cases*** and ***Results*** are displayed.

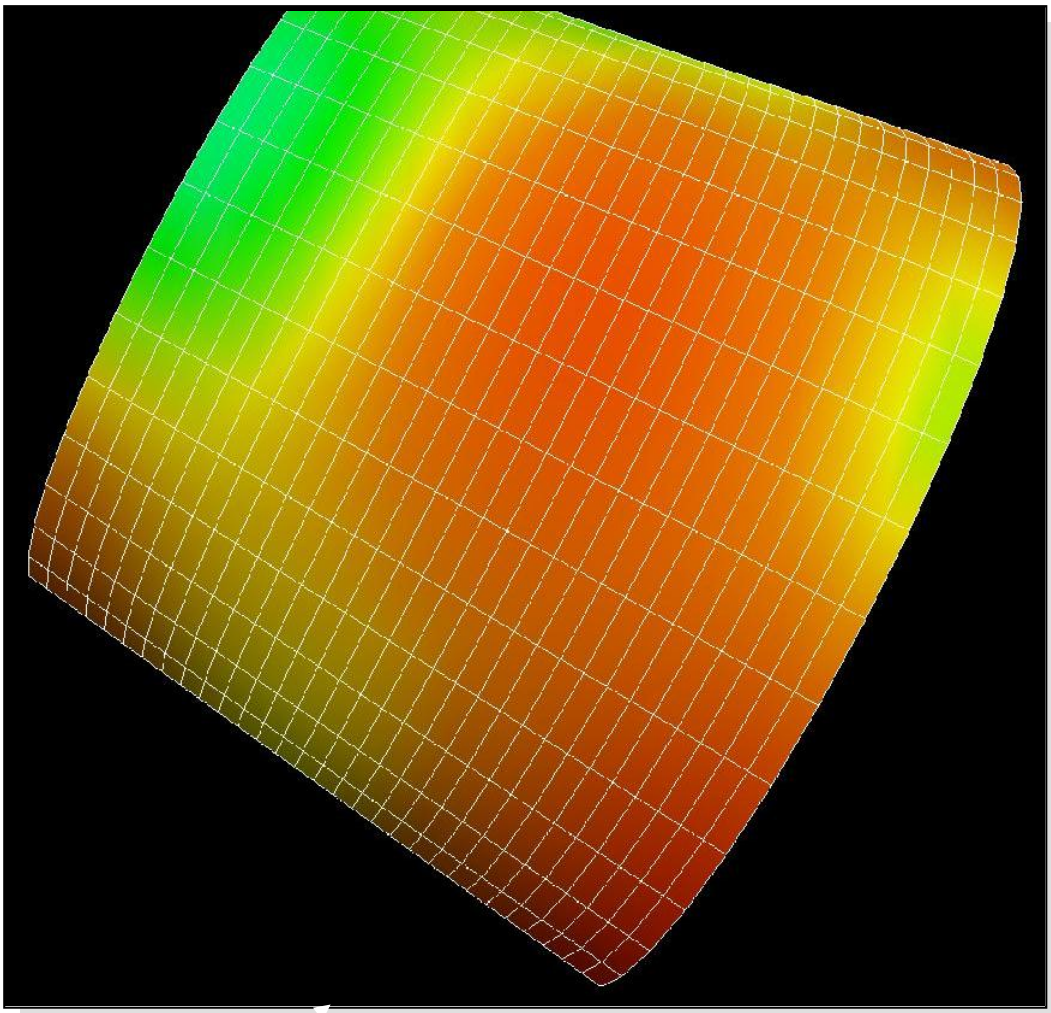


Fig.1.4

In this figure, the Main Display Window has been set to one active window. It is displaying a cone figure with a wireframe and dynamic results.

A useful hidden feature is the "F11" function. This key anti-aliases the Display Window containing the mouse arrow to give better definition to objects in the display. If the main Display Window is split in multiple windows, the F11 key anti-aliases the window containing the mouse arrow. On some computer systems this function may be activated instead with the "Print Screen" key.

1.4.2 The Mouse

Like most Graphic User Interfaces, TOP/DOMDEC requires a three-button mouse. A two-button mouse may be used, but some functionalities will not be available. The mouse appears in the display as a small red arrow pointing to the top-left corner of the Display Window.

General functions: The left mouse button serves as the means for interacting with the various tools described in the following sections. A user may "click" on buttons and various other program controls.

Graphic functions: The three mouse buttons serve different purposes while the mouse is utilized within Display Window during a graphic rendering. The left mouse button performs horizontal and vertical translations of objects in the Display Window. This is done by clicking and holding on the left mouse button (the mouse arrow does not need to be specifically on the object), and dragging the object to its new location.

The middle mouse button rotates objects in the Display Window. This is done by clicking and holding on the middle mouse button and moving the mouse in the direction of rotation. This is a low precision visual adjustment to the object. For more details regarding rotation, refer to the Rotation Window discussion in section 3.2.3.6.1.

The right mouse button performs a "zoom" effect. To use this feature, click and hold the right mouse button and then move the mouse downward to enlarge the object or upwards to shrink the object.

Zooming may also be performed in another fashion. The user may zoom to a specific area of the object by creating a zooming box. The zooming box is created by clicking on the left mouse button and dragging to cover the desired zooming area while holding the "Ctrl" key. While dragging, TOP/DOMDEC indicates the zooming area with a red rectangle. TOP/DOMDEC will zoom to the selected area when the user releases the mouse button or the "Ctrl" key.

1.4.3 The Windows

All windows in TOP/DOMDEC are organized in the same fashion. The large number of options provided by TOP/DOMDEC are represented by different windows. The options are grouped so the user can easily find any specific option. Each window is discussed individually in the following sections.

The following are a general guidelines for each window.

- A window has a title that is displayed at the top of the frame as shown in figure 1.5. This label refers to the general purpose of the window.
- Beneath the title, some windows display a "Window Selection" label with a chooser on its right. This chooser selects the Display Window in which the chosen options will apply. In the main area of the window, one can find various objects for option selection, including choosers, buttons, and sliders.
- Often, inside a single window there are several yellow labels. Each of these labels indicates a sub-division of choices that are available to the user. These choices are presented inside a rectangle beneath the yellow label. Each choice has a black or gray label. A black label means that the corresponding option is "On" (or is available to the user) otherwise the option is "Off" (or is unavailable to the user).
- At the very bottom of the window there are two or three main buttons: "Apply", "Close", and "Help". The "Apply" button appears in certain windows that require the user to click to confirm their choices. TOP/DOMDEC then saves and processes the chosen options. Whenever an "Apply" button is not present, it is an indication that the user might need to push on the "Redraw" button of the Main Controller to apply the chosen options. (See section 3.3.1 (Redraw Button)).

Figure 1.5 shows a typical option window.

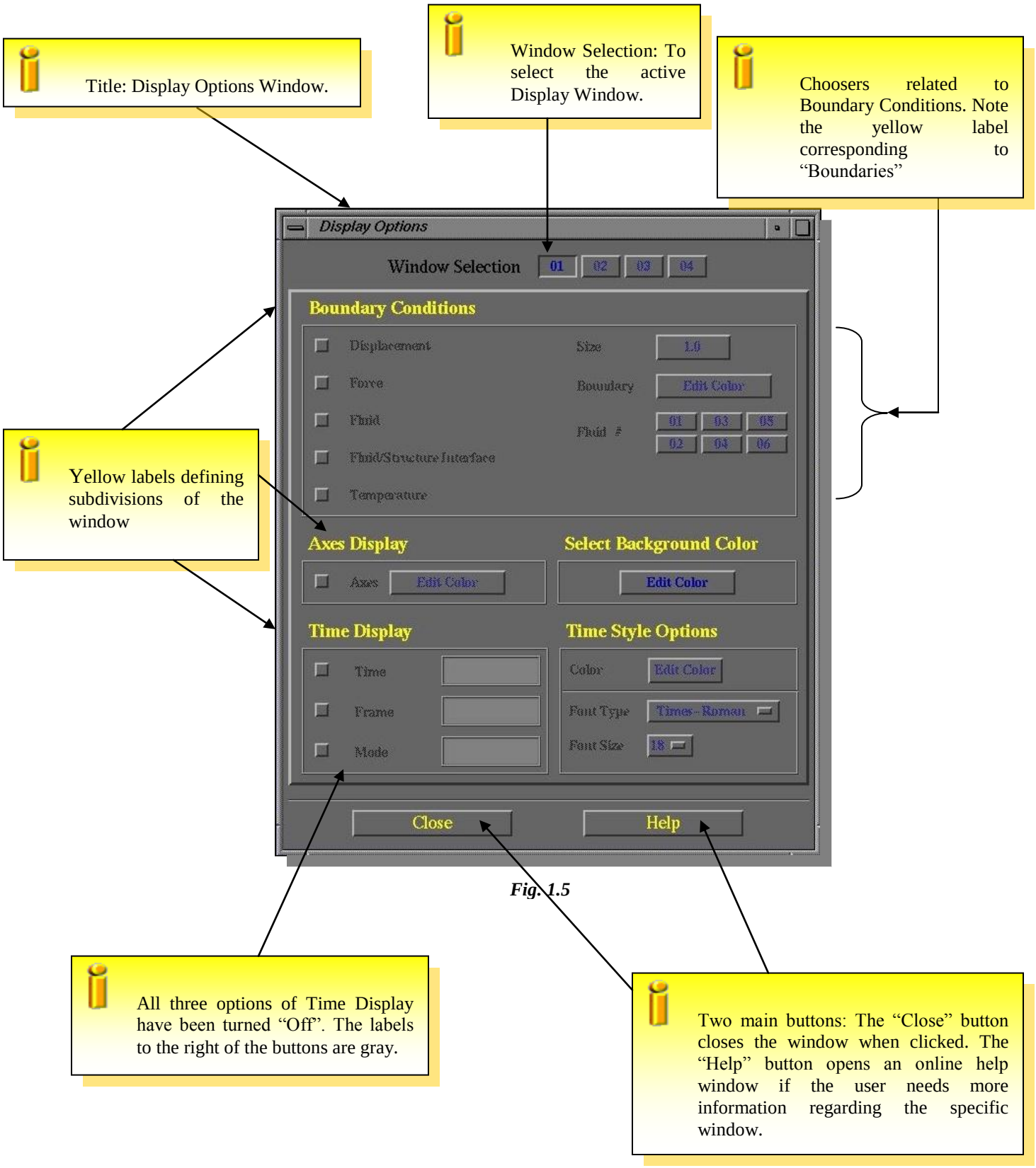

Title: Display Options Window.
Window Selection: To select the active Display Window.
Choosers related to Boundary Conditions. Note the yellow label corresponding to "Boundaries"
Yellow labels defining subdivisions of the window
All three options of Time Display have been turned "Off". The labels to the right of the buttons are gray.
Two main buttons: The "Close" button closes the window when clicked. The "Help" button opens an online help window if the user needs more information regarding the specific window.
Display Options
Window Selection
01
02
03
04
Boundary Conditions
Displacement
Force
Fluid
Fluid/Structure Interface
Temperature
Size
1.0
Boundary
Edit Color
Fluid #
01
03
05
02
04
06
Axes Display
Axes
Edit Color
Select Background Color
Edit Color
Time Display
Time
Frame
Mode
Time Style Options
Color
Edit Color
Font Type
Times - Roman
Font Size
18
Close
Help

Fig. 1.5

1.4.4 Buttons and Choosers

Buttons

Buttons are used to open new windows containing more options. The label on each button refers to the window that will be opened. If the corresponding window is already open, then the button closes the indicated window.

Fig. 1.6

In this figure, the two buttons, "Node" and "Element" each open a new window that allow the user to label respectively the nodes and the elements of the object that is displayed in a given Display Window.

Choosers

In this version of TOP/DOMDEC there are three different types of choosers: "Checkbox", "Options", and "Buttons".

a) Checkbox Choosers

The "Checkbox" chooser is a small empty square button with a label to its right. The label details the meaning of the option. Clicking on an available chooser changes its label to black indicating the selected option has been turned "On".

This figure shows that TOP/DOMDEC supports five kinds of Boundary Conditions and that each has been turned off.

These are checkbox type choosers. They represent, as their labels indicate, respectively Displacement, Force, Fluid, Fluid/Structure Interface, and Temperature Boundary Conditions.

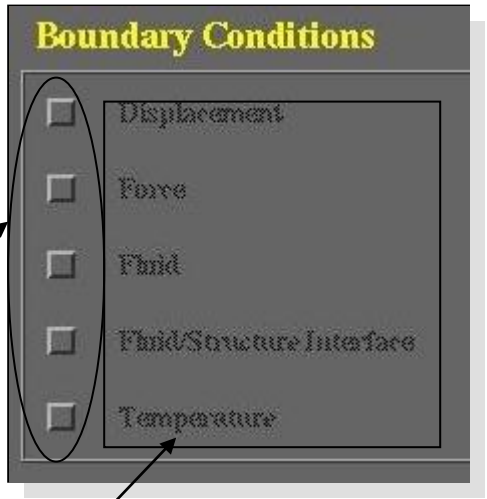


Fig. 1.7

Five labels that change color after the user has chosen to turn "On" the corresponding option.

b) Options Choosers

The "Options" type of chooser is contained by a rectangle and has multiple items. Each chooser has a label on its left indicating the meaning of the option. Only one item listed in the chooser can be selected at a time. The first item listed is the default choice. To select an option, click and hold on the chooser. TOP/DOMDEC then displays the possible choices starting with the default value. Drag up or down to the desired choice.

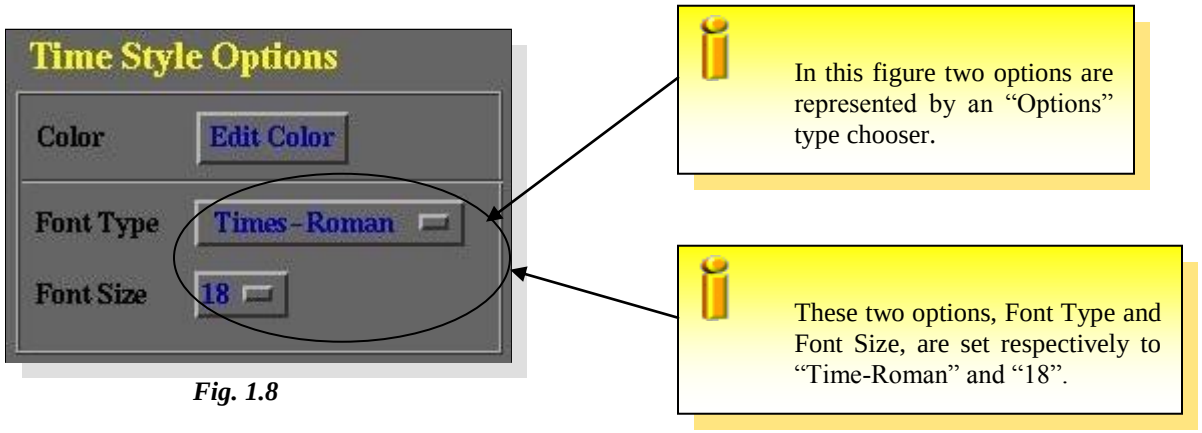


Fig. 1.8

c) Button Choosers

The "Button" type of chooser is a square button with a picture indicating the meaning of the option. In the Element Controller this type of chooser opens an Option Window (see section 3.3 (Object Display)). Elsewhere, several "Button" choosers are grouped together and only one may be selected at a time.

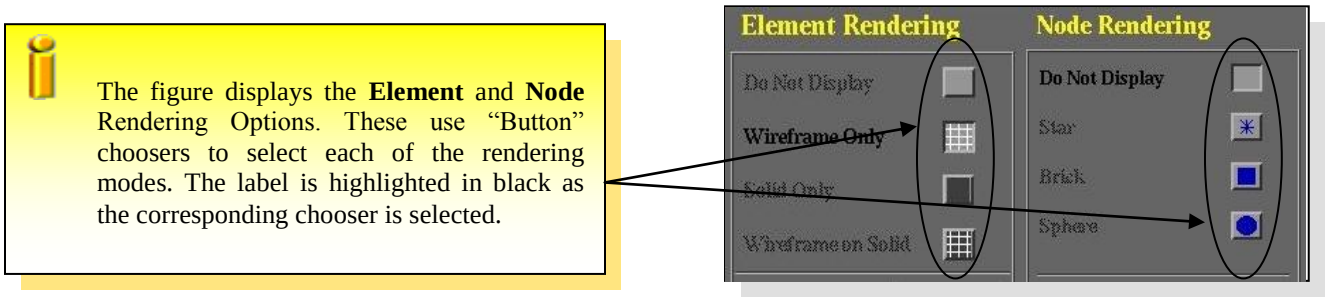


Fig. 1.9

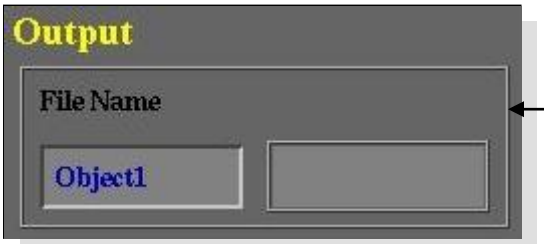
To select an item from a group of "Button" choosers, click with the mouse on the desired button. The corresponding label, on the left, will change to black to indicate the selection.

1.4.5 Prompt Boxes

A prompt box is used for inputting text from the keyboard. Usually, a prompt box has a label above it indicating the type of data expected and a label on its right indicating what has been entered. To enter data, click on the prompt box, (a blinking cursor then appears inside the prompt box), type the data, and press the "Enter" key. The label to the right is updated to indicate the new data. Entering numeric data in a prompt box is discussed in section 1.4.6 (Input Window).

This sequence of figures shows how input data is entered in a prompt box.

This figure shows a prompt box ready to accept a File Name.
Note that the yellow label indicates the use of the file name. In this example, the file name entered will be used as the output file name for the previously selected decomposition. (See section 3.2.2.4 (Output)).



Once the user has clicked on the prompt box on the left, they can enter a name for the output file. In this example, "Object1" has been entered.

Fig. 1.10(b)

To complete the entry the user must push the "Enter" key. The label is then moved to the right indicating that the output file name will be "Object1".

Fig. 1.10(c)

1.4.6 Input Windows

An Input Window appears each time the user needs to enter a numeric value. The window has a yellow label describing the usage of the expected number and a gray label indicating either the Display Window number or the name of the object to which the number will be applied.
The user enters the number in the prompt box. The previous value of the number is listed next to the box.
Once the user has entered the desired value and pushed "Enter", the Input Window will be closed. If the number is accepted, then the button that created the Input Window is updated with the new value, otherwise an error message is displayed.

The next page illustrates this process.

This sequence of figures shows how an Input Window accepts a value.

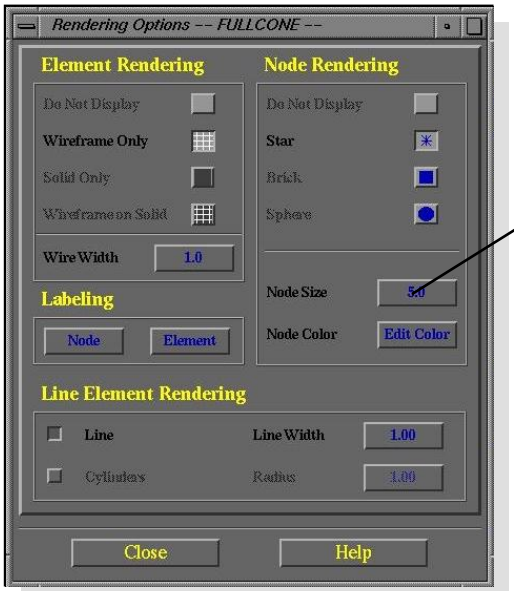


Fig. 1.11 (a)

If the user clicks on the "Node Size" button an Input Window appears with the gray label indicating the object to which the size will be applied. The yellow label tells the user that TOP/DOMDEC is expecting a Node Size value.

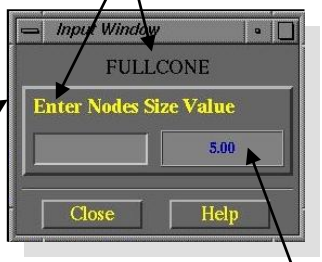


Fig. 1.11 (b)

Note that upon opening of the window the right label displays the last value of the node size.

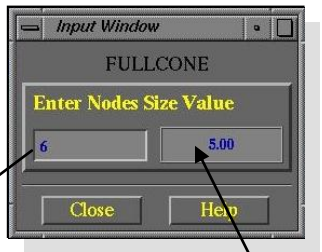


Fig. 1.11 (c)

The user enters the desired value and hits the "Enter" key. TOP/DOMDEC then closes the Input Window and updates the button label with the new value.

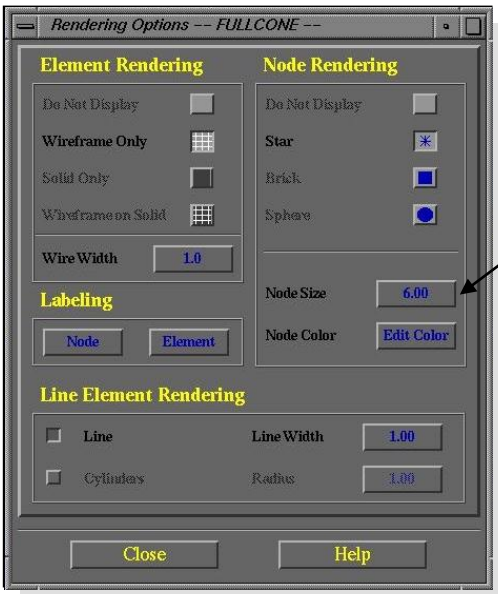


Fig. 1.11 (d)

If the user simply clicks on the "Close" button of an Input Window, TOP/DOMDEC ignores the entered value. The only way for TOP/DOMDEC to recognize a new value is to push the "Enter" key.

1.4.7 Single and Multiple Selection Browsers

A browser appears whenever TOP/DOMDEC must display an arbitrary amount of text data. In TOP/DOMDEC, there are two kinds of browsers, Single and Multiple selection browsers. They are both explained in detail in the next sections. These browsers may allow a "Double-Click" feature. This feature is available in only some browsers. When using the double-click feature, TOP/DOMDEC acts as if the user has clicked on the "Apply" button of the corresponding window. Refer to each window section of this manual to know if a specific browser allows the "double-click" feature and/or permits the multiple selections.

Single Selection Browsers

The "File Load Window" is an example of a window that uses single selection browsers. These browsers display directories and files in the file system.
Each browser contains a text display with a vertical slider and two buttons on the right. The slider indicates how much of the data appears in the display, and can be moved to view different parts of the data. The buttons, which appear on top and bottom of the slider, move the displayed text up and down one line at a time. An item is selected from the browser by clicking the left mouse button. The data is highlighted to show that it has been selected.

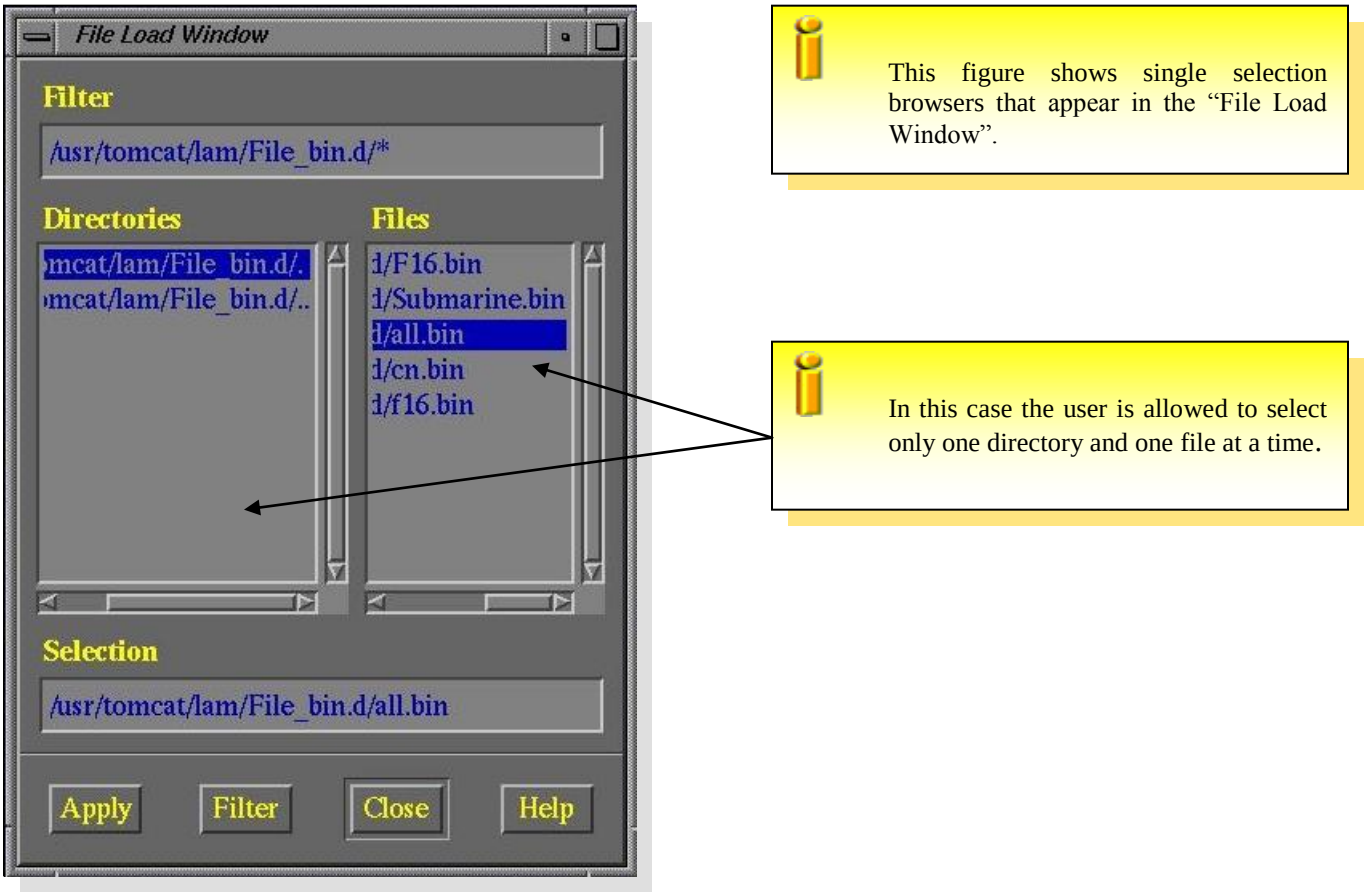


Fig. 1.12

Multiple Selections Browsers

Some browsers allow the simultaneous selection of more than one item. The user can select the first item as described above and by holding the left mouse button drag down the list until the last desired item has been selected (highlighted). The user may also hold down the "Ctrl" key and then select each of the desired items. Each selected item is highlighted.

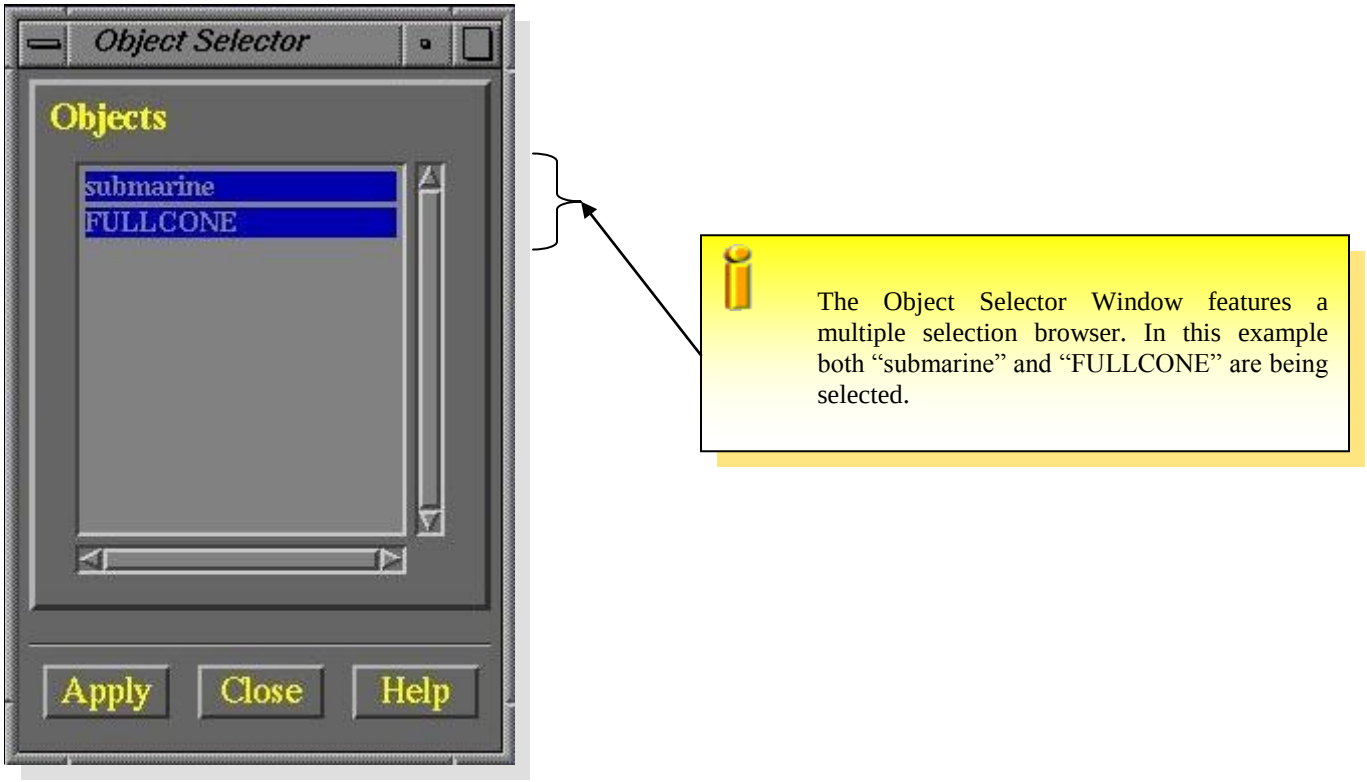


Fig. 1.13

For both types of browsers the same procedures holds when unselecting an item (or a list of items). The following lists the three different methods to unselect an item.

An item is unselected in three different ways

- When the "Apply" button has been clicked and TOP/DOMDEC has completed the desired action.
- Hold the "Ctrl" key and re-select the unwanted item.
- Re-select a new item.

1.4.8 Sliders

A slider can appear vertically or horizontally. It is used to indicate a value between 0 and 100 (except for the Color Window which is described in section 1.4.9).

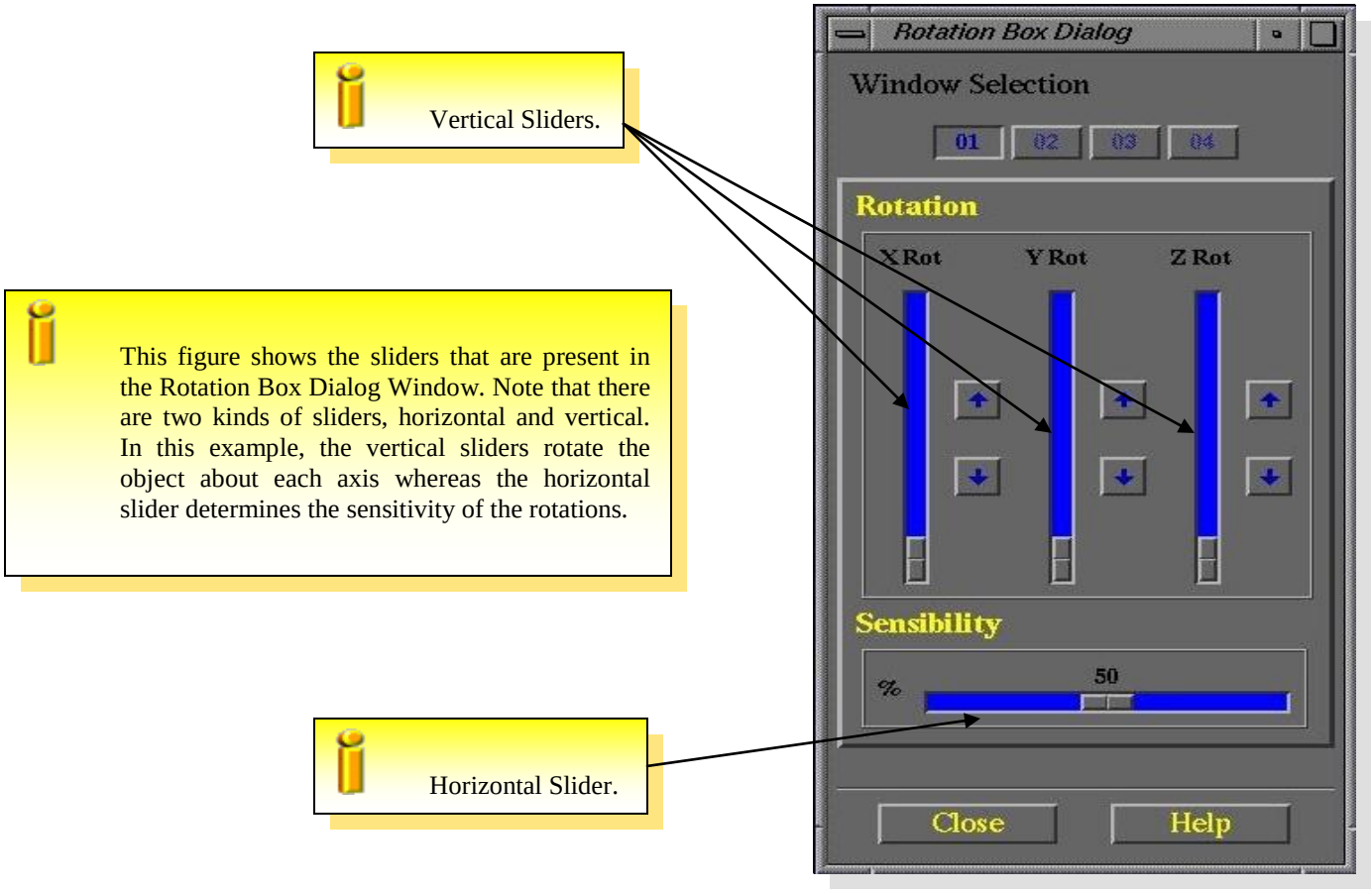


Fig. 1.14

To use the slider move the mouse cursor on top of the slider. Hold the left mouse button and drag the slider to the desired value. The arrow buttons next to a slider may also be used to adjust the slider in small increments.

1.4.9 Color Selection

The Color Window appears when the user wants to specify a new color for an object. This window is shown in figure 1.15(b).

This window contains three main sliders on the left and a colored rectangle on the right. From left to right, the sliders represent the colors red, green and blue. On top of each of these sliders a number is displayed which corresponds to the intensity of each color. This intensity can vary from 0 to 255. Via the combination of these three colors TOP/DOMDEC is able to represent all possible colors from black to white. The higher the intensity, the more the corresponding color appears in the final color. The rectangle on the right of the window displays the color resulting from the chosen combination of the three primary colors. The rectangle changes color as the user moves the sliders up and down, so the user can see easily the variation of color.

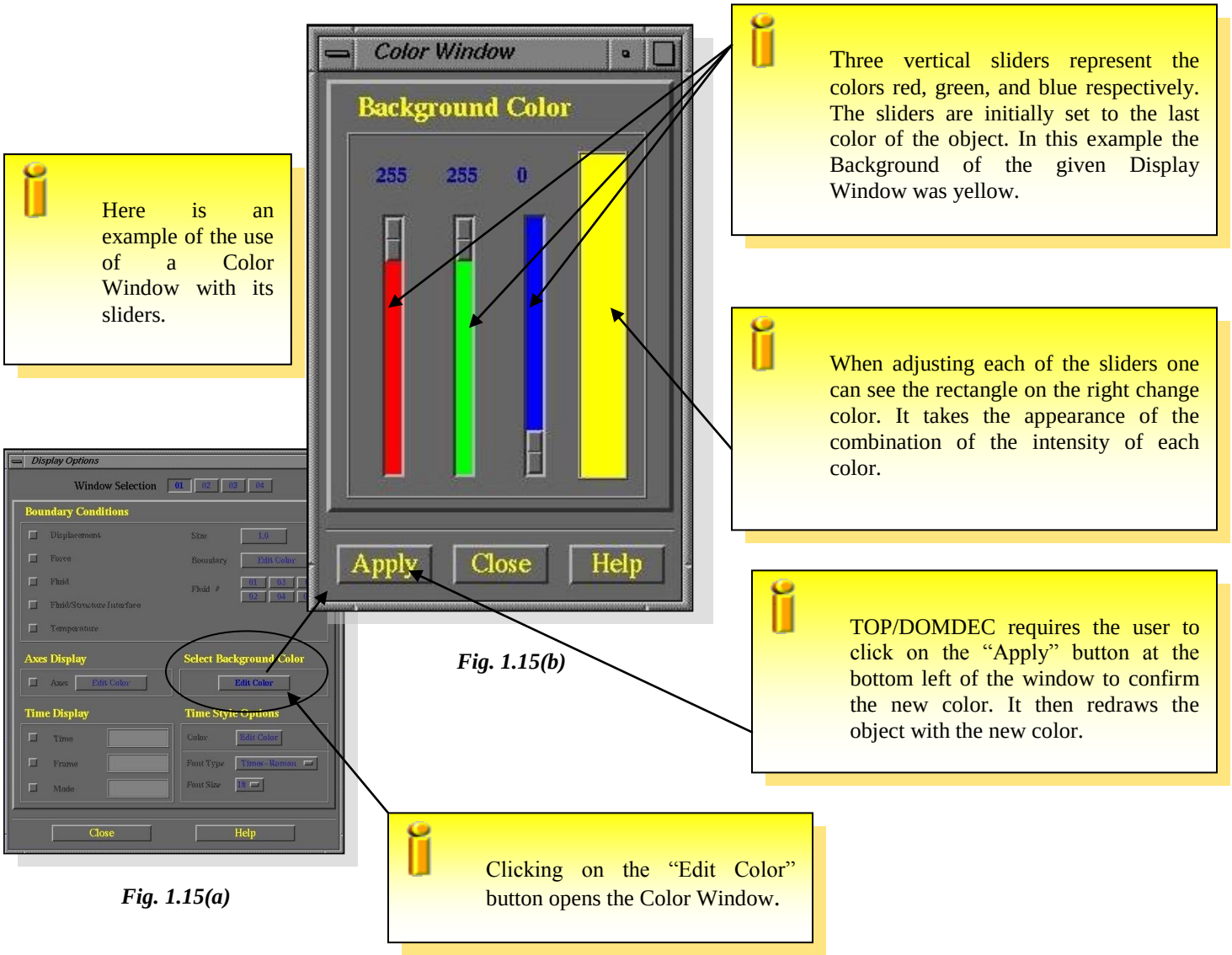


Fig. 1.15(b)

Fig. 1.15(a)

Chapter 2: Input Data Layout

2.1 Introduction

This section compiles basic information on how to prepare input data for TOP/DOMDEC. The input data can consist of ***Element Sets***, ***Node Sets***, ***Vector, Scalar and ElemScalar Results***, ***Pattern*** for an ***ElemScalar Results*** and ***Matching*** data between a ***Pattern*** and an ***Element Set***, ***Boundary Conditions***, ***Mesh Partitions, Curve Data, Graph Data,*** and ***Weight factors*** for domain decomposition.

Multiple Objects may be included in a single file. Each object is read and stored independently in the database.

The following general rules apply to input files:

- The user is allowed to have as many comment lines as they wish (See section 2.2).
- For the best results, name objects uniquely so that TOP/DOMDEC does not become confused. While reading an object, if TOP/DOMDEC finds any pre-existing object with the same name it will ask the user if they wish to overwrite the existing object. TOP/DOMDEC is unable to store two objects of different types with one common name.

Input data files are case sensitive. The following is a list of reserved words: ***Nodes***, ***Elements***, ***Scalar***, ***ElemScalar***, ***Vector***, ***Pattern, Match, DBoundary***, ***SFBoundary***, ***Fboundary***, ***FSBoundary***, ***Decomposition***, ***TimeData***, ***Graph***, **using**, **under**, **for**, **Step**, **MultiBody**, **typedef**, ***Line_2***, ***Quad_4***, ***Quad_8***, ***Quad_9***, ***Quad_16***, ***Cube_8***, ***Cube_20***, ***Tetra_4***, ***Tetra_10***, ***Tri_3***, ***Tri_6***, ***Penta_6 as well as all the type names in the array of section 2.4***.

The following sections discuss in detail the syntax of input data.

2.2 Comments

Data files in TOP/DOMDEC accept C++ style comments. A "//" in a line tells the parser to ignore the rest of the line, while a "/*" will tell the parser to ignore everything until a "*/" is encountered. In our examples, all comments will be `typewritten`.

```
// This is a one line comment
/* This is a
     multi-line comment */
```

2.3 Node Set

The following is an example of a ***Node Set*** definition:

```
Nodes AllNodes

1    0.0 0.0
2    16.0 0.0
3    32.0 0.0
4    0.0 16.0
5    16.0 16.0
6    32.0 16.0
7    0.0 32.0
8    16.0 32.0
9    32.0 32.0
```

A ***Node Set*** cannot be displayed by itself. It must be used to describe the nodes of **Elements** in an ***Element Set.***

The reserved word ***Nodes*** is used to indicate a ***Node Set***. In this example, `AllNodes` is a user-defined name for this ***Node Set***. The following lines each define a ***Node***. A line consists of the ***Node*** number followed by the X, Y, and Z coordinates, respectively. Note that the Z coordinate has been left off in this example. If no Y and Z coordinates are given, their values are set to zero. The **Node** numbers may be any integer value and need not to be in order nor contiguous.

2.4 Element Set

The following is an example of an ***Element Set*** definition:

```
Element AllElements using AllNodes

1  2  1  2  5  4
2  2  8  7  4  5
3  2  2  3  6  5
4  4  5  6  9
5  4  9  8  5
```

Figure 2.1 shows a 5 element object that is described on the left. To help the reader, the node numbers are displayed in red.

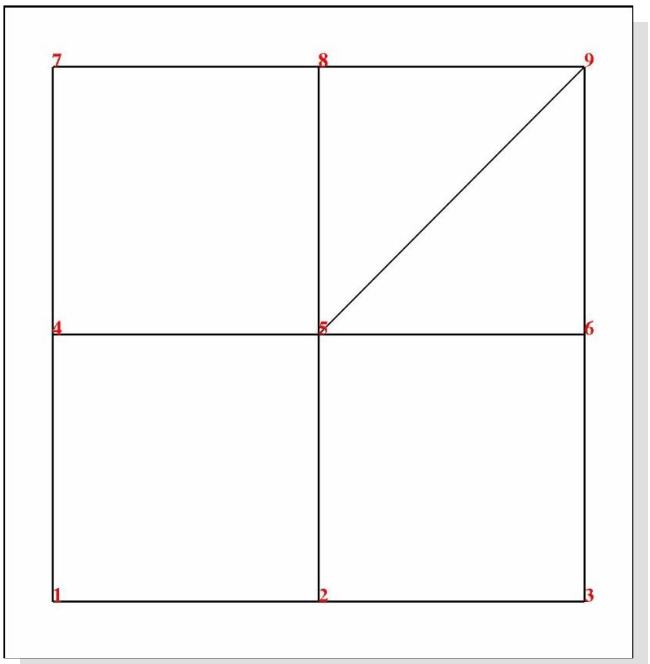


Fig. 2.1

The reserved word ***Elements*** is used to indicate an ***Element Set***. In this example, `AllElements` is a user-defined name for this ***Element Set***. After the ***Element Set*** name comes the reserved word **using**, and then the name of the ***Node Set*** used by the ***Element Set***. The lines following the ***Element Set*** declaration represent the ***Elements*** in the ***Element Set***. Each line has an ***Element*** number followed by the ***Element*** type and the ***Nodes*** that make up the ***Element***. One ***Element*** is defined per line.

TOP/DOMDEC allows having more ***Nodes*** than necessary for an element. In this case TOP/DOMDEC simply takes as many nodes as it needs to build the element and ignores the extra node(s). On the other hand, if there are fewer ***Nodes*** than necessary, TOP/DOMDEC generates a missing node error message.
The ***Element*** numbers may be any integer value and need not to be in order nor contiguous. However, the list of nodes defining the element must be given in the order described in section 1.3 (Objects in TOP/DOMDEC).

The following table shows the type names of the basic geometric ***Elements***, their type number, and the relevant number of nodes:

Type Names	Type number	Number of Nodes	Type Names	Type number	Number of Nodes
Line_2	1	2	***Tetra_10***	11	10
Quad_4	2	4	***Quad_8***	12	8
Brick_8	3	8	***Cube_32***	13	32
Tri_3	4	3	***Penta_26***	14	26
Tetra_4	5	4	***Cube_V***	15	*Variable*
Quad_16	6	16	***Tetra_V***	16	*Variable*
Quad_9	7	9	***Quad_V***	17	*Variable*
Tri_6	8	6			
Cube_20	9	20			
Penta_6	10	6			

The following table shows the type names of the "Mechanical'' (as per the terminology of the FEM code) ***Elements***, their type number, and the relevant number of nodes:

Type Names	Type number	Number of Nodes	Type Names	Type number	Number of Nodes
MTwoNodeTruss	101	2	***MRotnSprLink***	122	2
MFourNodeQuad	102	4	***MFourNodeTet***	123	4
MThreeNodeTri	104	3	***MSixNodePent***	124	6
MTwoNodeEulerBeam	106	2	***MtenNodeTet3Dof***	125	10
MTwoNodeTimoshenkoBeam	107	2	***MTwentyNodeBrick***	172	20
MThreeNodeShell	108	3	***MFourNodeShell***	188	4
MTorSpring	111	1	***MThirtyTwoNodeBrick***	191	32
MEightNodeBrick	117	8	***MTwentySixNodePent***	192	26
MThreeNodeMembrane	119	4	***MNLEightNodeBrick***	301	8
MFourNodeTet6Dof	118	4	***MGNLEightNodeBrick***	302	8

MThreeNodeCompoShell	120	3	***MFourNodeCompShell***	2120	4
MTransSprLink	121	2			

The following table shows the type names of the "Thermal'' (or "Heat", as per the terminology of the FEM code) ***Elements***, their type number, and the relevant number of nodes

Type Names	Type number	Number of Nodes	Type Names	Type number	Number of Nodes
HFourNode3DQuad	103	4	***HFourNodeTet***	150	4
HTwoNodeBar	109	2	***HEightNodeBrick***	151	8
HFourNodeQuad	110	4	***HThreeNodeTri***	153	3
HEightNodeBrickGLS	144	8	***HFourNodeShell***	4746	4
HThreeNodeShell	146	3	***HFourNodeQuad ContactResistance***	148	4
HTwoNodeBarConvec	147	2	***HEightNodeBrick ContactResistance***	151	8
HTwoNodeBarRad	147	2	***HSixNodePenta ContactResistance***	124	6
HFourNodeQuadConvec	148	4	***HThreeNodeTriBulk***	149	3
HFourNodeQuadRad	148	4	***HFourNodeTetraBulk***	150	4
HThreeNodeTriConvec	149	3			
HThreeNodeTriRad	149	3			

The following table shows the type names of the "Acoustic'' (as per the terminology of the FEM code) ***Elements***, their type number, and the relevant number of nodes

Type Names	Type number	Number of Nodes	Type Names	Type number	Number of Nodes
AFourNodeQuad	130	4	***AFourNodeAxiQuad***	160	4
AFourNodeQuadGLS	131	4	***AThreeNodeAxiTri***	161	3
AEightNodeQuad	132	8	***AEightNodeAxiQuad***	162	8
AThreeNodeTri	135	3	***AVarNodeQuad***	163	-
AThreeNodeTriGLS	136	3	***ASixNodePent***	190	6
ASixNodeTri	138	6	***ATwentyTwoNodeBrick***	193	32
AFourNodeTet	140	4	***ATwentySixNodePent***	194	26
AFourNodeTetGLS	141	4	***AVarNodeHexa***	195	-
ATenNodeTet	142	10	***AVarNodeTetra***	196	-
AEightNodeBrick	145	8			

The following table shows the type names of the "Constraint", "Fluid-Structure Interaction", and "Discrete Mass" ***Elements***, their type identification numbers, and their number of nodes

Type Names	Type number	Number of Nodes	Type Names	Type number	Number of Nodes
CmpcElement (*)	501	-	***DiscMass(*)***	506	2
CfsiElement (*)	502	-			

Elements with a (*) are currently not supported by the decomposer integrated in TOP/DOMDEC.

The reserved word ***typedef*** allows the user to define type numbers. An example of this is:

typedef 107 ***AThreeNodeAxiTri***

Whenever the parser sees a 107 in the type field, the ***Element*** will be recognized as type ***AThreeNodeAxiTri*** instead of type ***MTwoNodeTimoshenkoBeam.***

(note : the overridden number does not have to be an existing element !)

Want to know how to visualize a mesh? See sections 3.2.2.1 (Select) and 3.3.1.1 (Element Rendering)

For example, if an input file has elements of type **Quad_9,** and the user wants TOP/DOMDEC to consider these elements as **Quad_4,** then the only thing to do is to add at the top of the input file:

typedef 7 ***Quad_4***

TOP/DOMDEC then reads the first four nodes of each element to build the ***Quad_4*** instead of building **Quad_9** elements.

2.5 Load Cases & Results

Load Cases are a collection of ***Vector, Scalar*** and ***ElemScalar Results***. ***Load Cases*** are defined implicitly through the definition of ***Vector, Scalar,*** or ***ElemScalar Results***.
Vector and ***Scalar Results*** are defined at the nodes of a mesh whereas ***ElemScalar Results*** are defined for the elements of a mesh.

The ***Vector***, ***Scalar and ElemScalar Results*** are described in the following sections. Remember that they do not need to be in the same file or be read in a specific order.

2.5.1 Vector Results

The following is an example of a ***Vector Results*** definition:

Vector `slant` **under** `Load` **for** `AllNodes`

```
9
0.001
0.00    0.00    0.00
0.23    0.06    0.00
0.68    -0.45   0.00
0.00    0.00    0.00
0.30    0.00    0.00
0.26    0.00    0.00
0.00    0.00    0.00
0.23    -0.06   0.00
0.68    0.45    0.00
0.002
0.00    0.00    0.00
0.24    0.16    0.00
0.69    -0.35   0.00
0.02    0.01    0.00
0.37    -0.01   0.00
0.21    0.00    0.00
0.01    0.00    0.00
0.26    -0.03   0.00
0.69    0.47    0.00
```

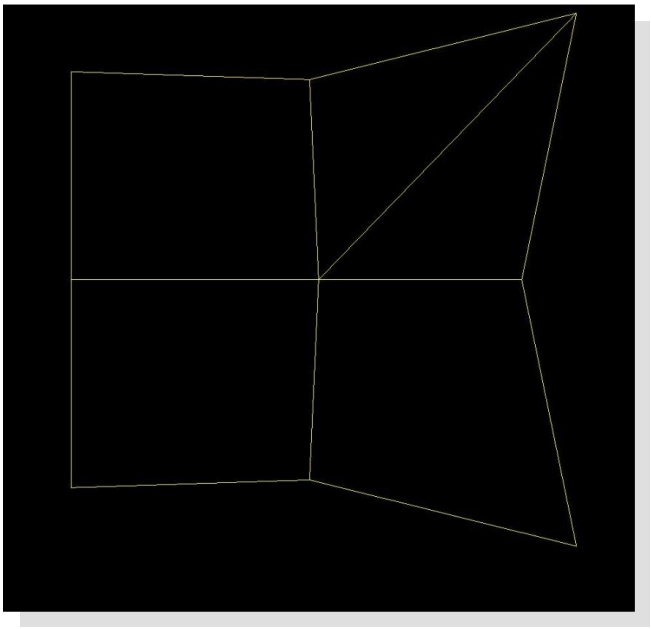
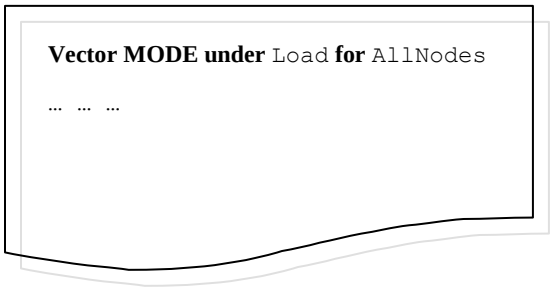


Fig. 2.2

Figure 2.2 shows our 5 element object with the ***Vector Results*** on the left.

The reserved word **Vector** is used to indicate a ***Vector Results***. After the name of the ***Vector Results,*** the parser expects the reserved word **under** and the name of the ***Load Case***, followed by the reserved word **for** and the name of the ***Node Set*** for the ***Vector Results***. The second line gives the number of ***Nodes*** in the ***Node Set***. The remaining lines must be a multiple of the number of ***Nodes*** n, plus one. Each set of n+1 lines represents a time-step in the ***Vector Results***. The first line is a number representing the time value, while the remaining n lines give the result for each node at that time-step. These lines contain three numbers that correspond to the X, Y, and Z-components of a ***Displacement***. The ***Displacement*** is always defined with respect to the initial position of the object. As with the definition of a ***Node***, the Y and Z-coordinates can be omitted if they are zero.

In the particular case where the ***Vector Results*** contains mode shapes, (eigenvectors), the definition of the ***Vector Results*** becomes:



The reserved word **MODE** is used to indicate a ***Shape Result***, while all other words have the same meaning as previously discussed. In this case, the time-step value should be replaced by the frequency associated with the mode shape, and each set of n+1 lines represents a frequency and mode shape pair.

The following sections describe the ***Scalar Results*** and the ***ElemScalar Results***.

2.5.2 Scalar Results

The following is an example of a ***Scalar Results*** definition:

Scalar `Degree` **under** `Manual` **for** `AllNodes`

9
0.001
4.0
5.0
6.0
5.0
6.0
7.0
6.0
7.0
8.0
0.002
8.0
10.0
12.0
10.0
12.0
14.0
12.0
14.0
16.0

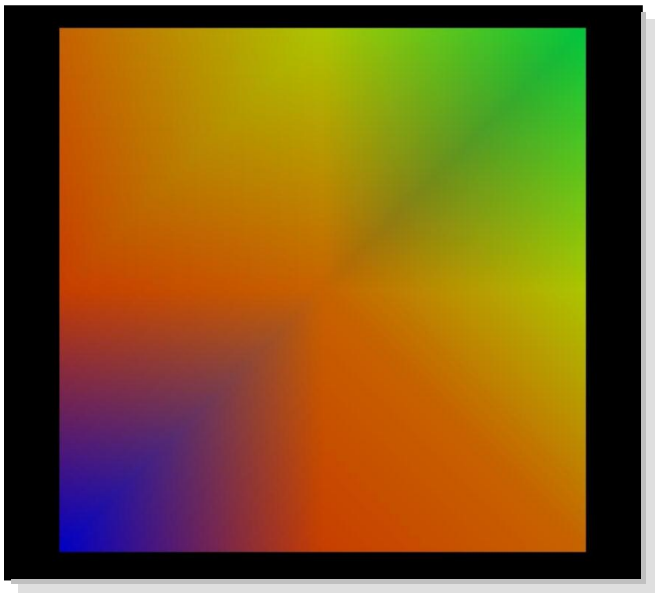


Fig. 2.3

Figure 2.3 shows the effect of the ***Scalar Results***, which is described on the left of the figure, on our 5 element object.

The reserved word **Scalar** is used to indicate a ***Scalar Results***. After the name of the ***Scalar Results,*** the parser expects the reserved word **under** and the user-defined name of the ***Load Case***, followed by the reserved word **for** and the name of the ***Node Set*** for the ***Scalar Results***. The second line gives the number of ***Nodes*** in the ***Node Set***. The number of remaining lines must be a multiple of the number of ***Nodes*** n, plus one. Each block of n+1 lines represents a single time-step in the ***Scalar Results***. The first line is a real number representing the time value, while the remaining n lines contain the result for each node at that time-step. Typical ***Scalar Results*** include stress, temperature, and pressure fields.

2.5.3 ElemScalar Results

The rendering of ***ElemScalar Results***, which is element-based, requires first the understanding of two related TOP/DOMDEC concepts: ***Pattern*** and ***Match***.

The following sections describe the concept and syntax for a ***Pattern***, an ***ElemScalar Results*** and a ***Match*** command.

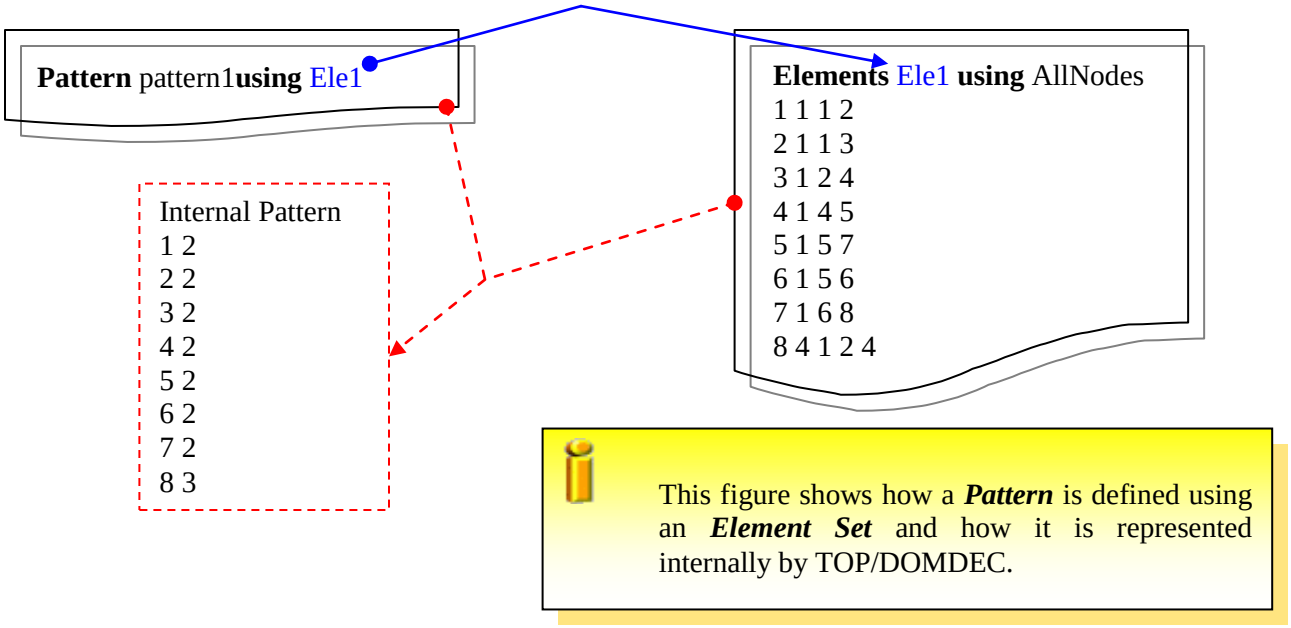
2.5.3.1 Pattern Layout

In TOP/DOMDEC, a pattern is an internal table of integers which specifies how the ***ElemScalar Results*** will be read. This table can be based on an existing ***Element Set*** (already loaded in TOP/DOMDEC), or it can also be read from an input file.

There are two ways to specify a ***Pattern***:

- using an ***Element Set*** already loaded in the TOP/DOMDEC database
- entering the ***Pattern*** manually in an input file

The simplest way to define a ***Pattern*** is using an ***Element Set*** already loaded in the TOP/DOMDEC database. In this case the user needs to enter a single line such as:

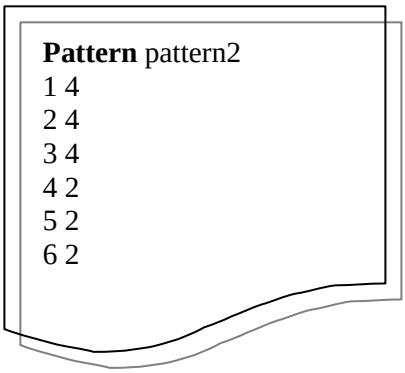


The reserved word **Pattern** is used to indicate a ***Pattern***. After the name of the ***Pattern,*** in this case, pattern1, the parser expects the reserved word **using** and the user-defined name, in this case, Ele1, of the ***Element Set*** used to define this ***Pattern***.

When TOP/DOMDEC recognizes this input pattern it generates automatically the desired pattern. Internally a ***Pattern*** is an array of integers of the size of the ***Element Set*** that defines it. The first column of the array stores the element id number, and the second column stores the number of nodes belonging to this element.

In order to be ale to use this definition of a ***Pattern*** the ***Element Set*** that defines the new ***Pattern*** must be read before (or must be already present in the TOP/DOMDEC database). Otherwise, TOP/DOMDEC displays an error message and stops the reading process.

The user may also enter the definition of the ***Pattern*** without the use of a specific ***Element Set***. In this case this ***Pattern*** is not attached to any of ***Element Set***. The following section describes what TOP/DOMDEC expects as input for this alternative.

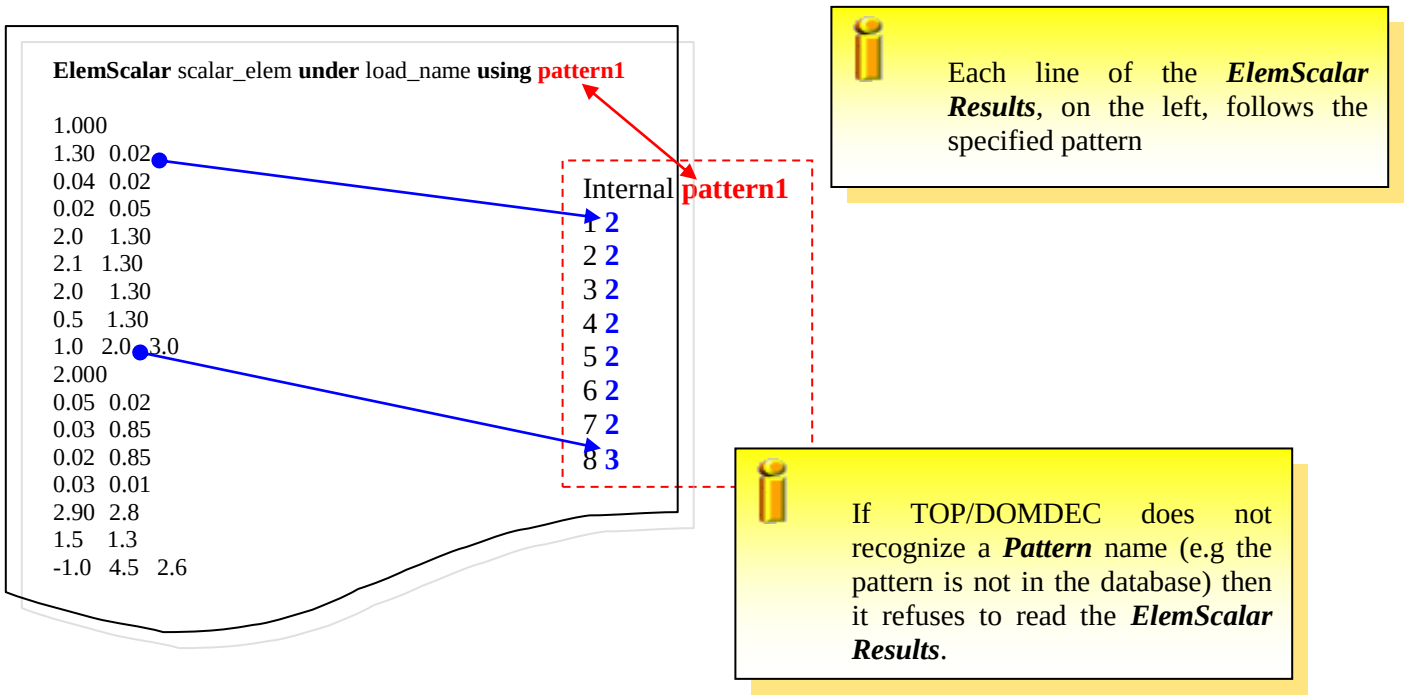


The reserved word ***Pattern*** is used to indicate a ***Pattern***.
The following lines define the ***Pattern***. Each line represents a single element number ID which, is followed by the number of nodes that this element has.

After the ***Pattern*** has been read successfully, the user may load the ***ElemScalar Results*** that will use this pattern. The next section describes the correct input layout of an ***ElemScalar Results***.

2.5.3.2 ElemScalar Layout

The following is an example of an ***ElemScalar Results*** layout:

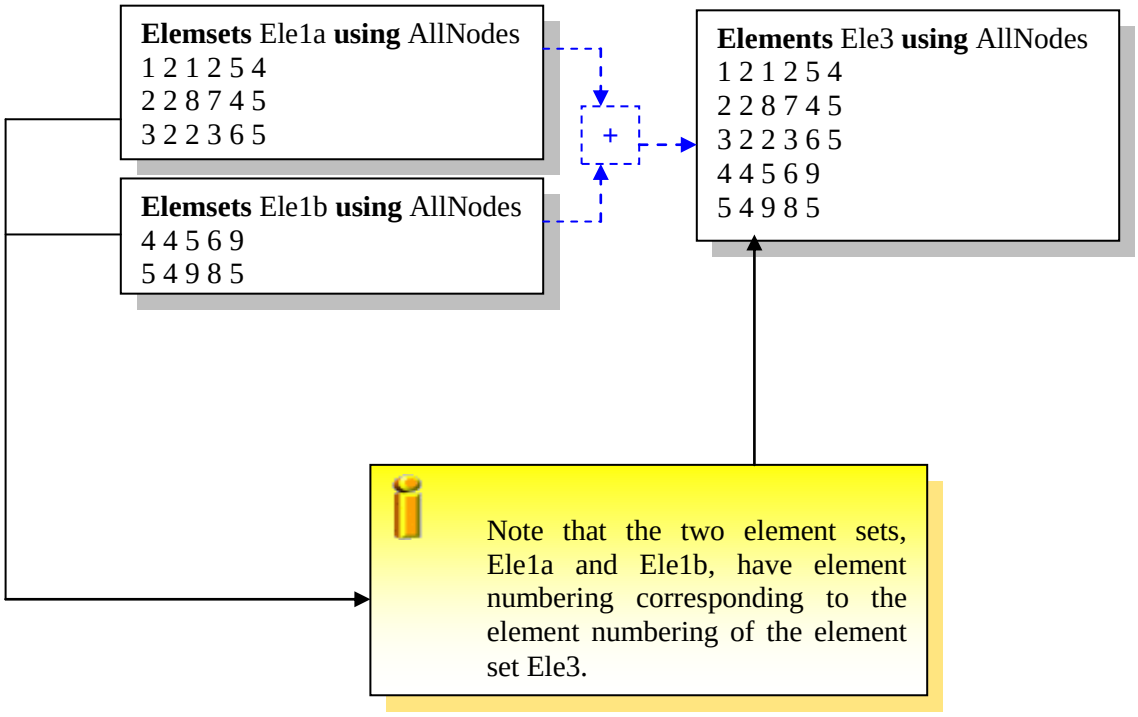


The reserved word **ElemScalar** is used to specifies an ***ElemScalar Results***. After the name of the ***ElemScalar Results,*** the parser expects the reserved word **under** and the user-defined name of the ***Load Case***, followed by the reserved word **using** and the name of the ***Pattern*** for the ***ElemScalar Results***. The following lines must be divisible by the size of the pattern n, plus one (in this case n equals 8). Each block of n+1 lines represents a single time-step in the ***ElemScalar Results***. The first line is a real number representing the time value, while the remaining n lines contain the results for each node of each element at that time-step.

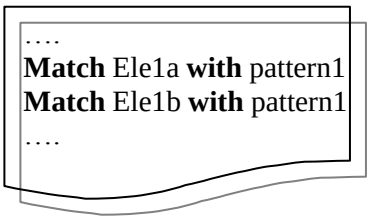
A ***Pattern*** can be re-used by several ***Element Sets***. The following section describes how to do so with the ***Match*** command.

2.5.3.3 Match Layout

The ***Match*** command allows the user to match several ***Element Sets*** with a single ***Pattern***.



In this case if a single ***Pattern***, pattern1, was defined using the ***Element Set*** Ele3 described above, then the two ***Element Sets***, Ele1a and Ele1b, can also use the same pattern if the following lines are added in an input file:

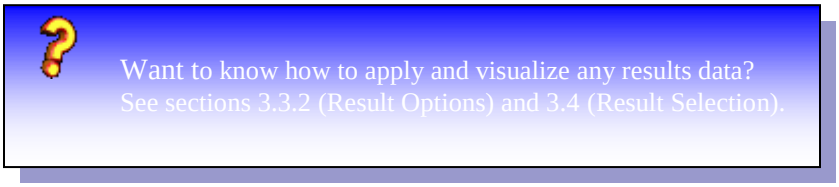


Once again, to be able to assign a specific ***Pattern*** to an ***Element Set***, the ***Pattern*** must be defined first. Otherwise TOP/DOMDEC displays an error message and stop the reading process.

With the above two lines added in the input file, the user can visualize the ***ElemScalar Results*** associated with either or both ***Element Sets*** if desired, rather than visualizing the ***ElemScalar Results*** for the entire ***Element Set*** Ele3. In other words, the ***Match*** command allows visualizing ***ElemScalar Results*** with a subset of a given ***Element Set***.

All elements described in section 2.5 can be placed in a single input file.

The following pages feature a visual example of the usage of each of the elements described in section 2.5 (Load Cases and Results).



Note that ***Scalar, ElemScalar*** and ***Vector Results*** can be combined in a single visualization as shown in figures 2.4.

Figure 2.4a shows our example with both ***Scalar*** and ***Vector Results*** selected.

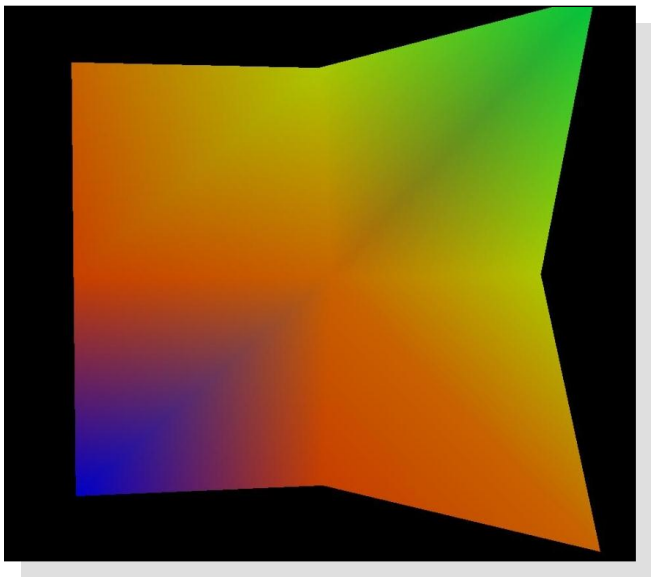


Fig. 2.4a

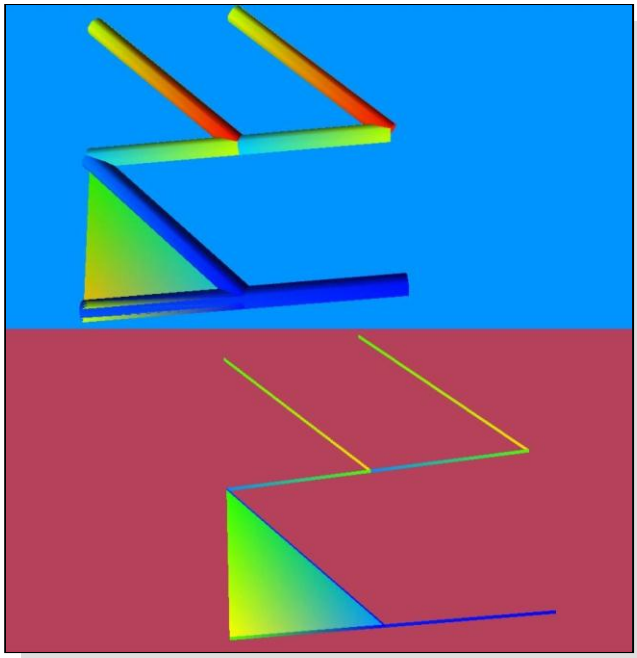
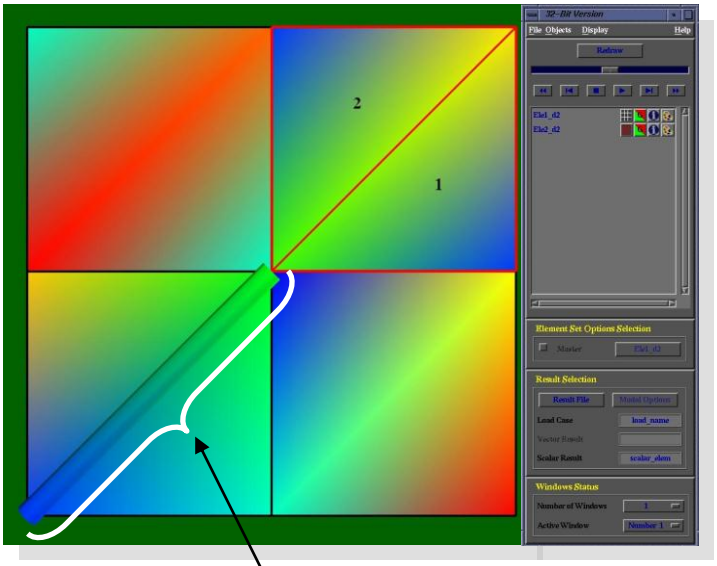


Fig. 2.4b

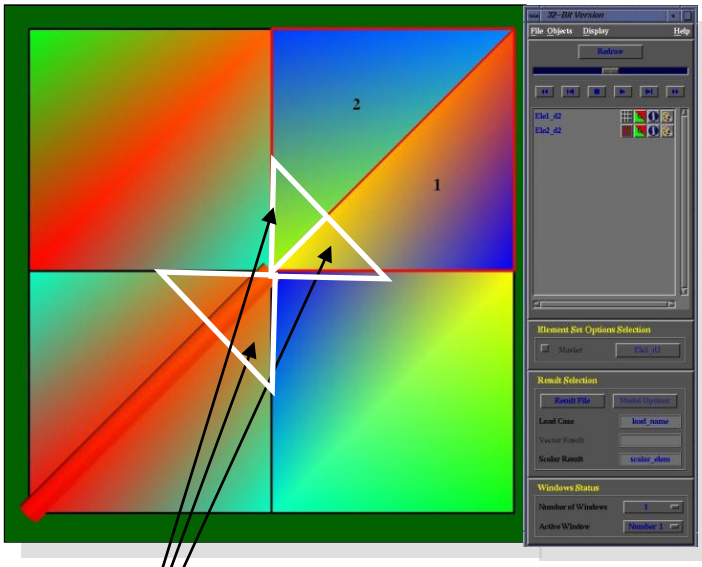
Figure 2.4b shows an example of ***Element Set*** with some ***ElemScalar*** selected.
Note that the ***Element Set*** contains Bar type elements which are displayed in Cylinder mode in the first Display Window (top) and Line mode in the second Display Window (bottom).

One can notice the variation of colors in a bar type element as the rendering goes from one side to the other. This is due to the fact that both extremes of the bar have different values. If they both have the same value then the color remains the same all along the bar.

The following pictures display an element set with bar, triangle and quad elements and an ***ElemScalar Results*** corresponding to a stress field at 4 different time stations.



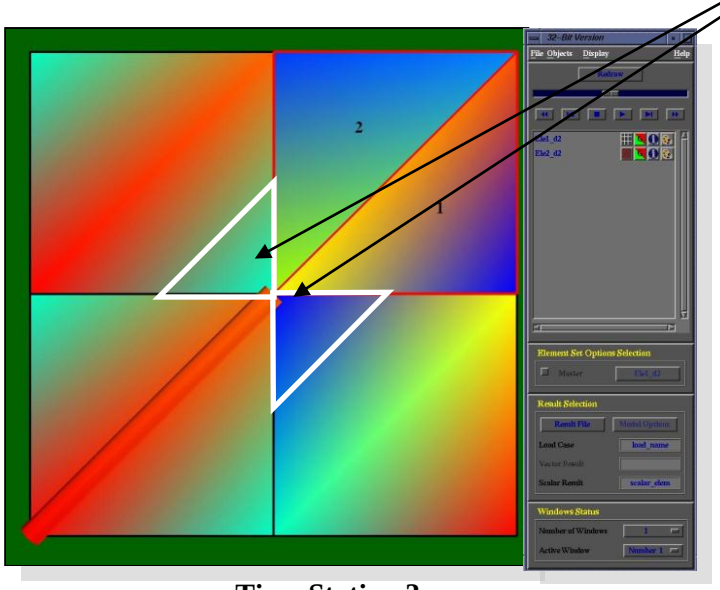
Time Station 1



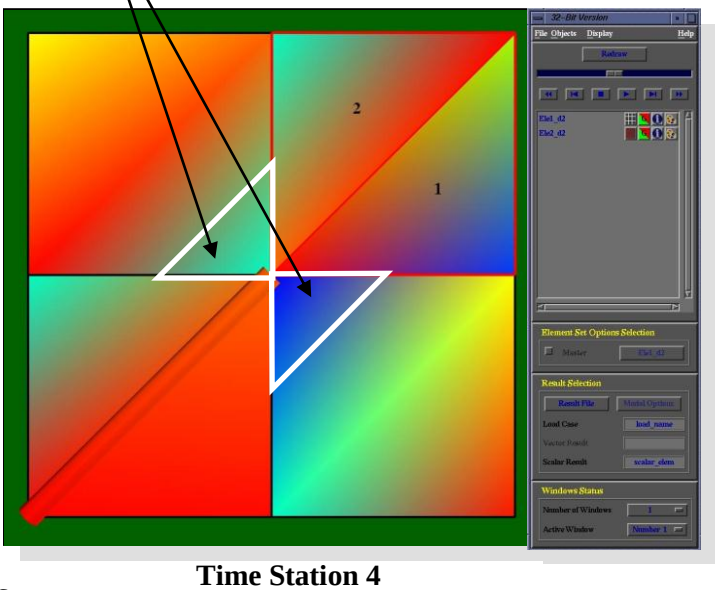
Time Station 2

The rendering color of the cylinder varies from one end to the other as the values of each extreme are different.

Notice that the middle node has a different value depending on which element the node is attached to.



Time Station 3



Time Station 4

Fig 2.4c

2.6 Boundary Conditions

TOP/DOMDEC accepts two types of ***Structural Boundary Conditions***, (**Displacement** and **Force**), six types of ***Fluid Boundary Conditions***, ***Fluid/Structure Interaction Boundary Conditions***, and ***Temperature Boundary Conditions***.

All ***Boundary Conditions*** are explained separately in the following sections but remember that they need not be read in any order and can appear in multiple files.

2.6.1 Structural Displacement Boundary Conditions – SDBoundary –

The following is an example of a ***SDBoundary Value*** definition:

SDBoundary `sdbound` **using** `AllNodes`

1	4	0.000000
1	5	0.000000
1	6	0.000000
2	4	0.000000
2	5	0.000000
2	6	0.000000
3	4	0.000000
3	5	0.000000
3	6	0.000000
4	4	0.000000
4	5	0.000000
4	6	0.000000
6	1	0.000000
6	2	0.000000
6	3	0.000000
7	1	0.000000
7	2	0.000000
7	3	0.000000
8	1	0.000000
8	2	0.000000
8	3	0.000000
9	1	0.000000
9	2	0.000000
9	3	0.000000

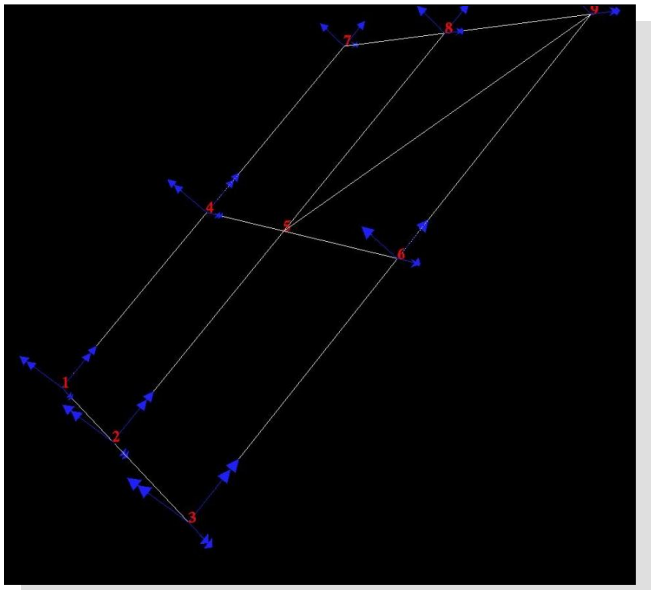
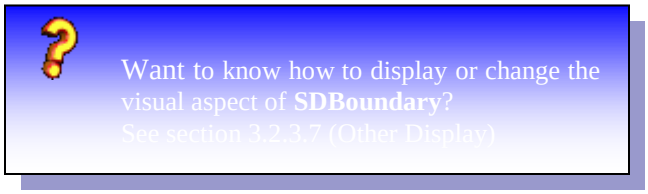


Fig. 2.5

Figure 2.5 shows ***Displacement Boundary Conditions*** drawn for our 5 element object. The boundaries are drawn at the boundary **Node** (x, y, z). Note that the x, y, z-displacement boundary conditions are shown as single arrows, while the x, y, z-rotation boundary conditions are shown as double arrows. For clarity, the picture shows also the **Node** numbers.

The reserved word **SDBoundary** is used to indicate an ***SDBoundary Value***. In this example, `sdbound` is a user-defined name for the ***SDBoundary Value***. After the ***SDBoundary Value*** name comes the reserved word **using**, then the name of the ***Node Set*** for the ***SDBoundary Value***. The following lines represent **Nodes** in the ***SDBoundary Value***. Each line has a **Node** number followed by a local degree of freedom number, and the boundary displacement value. There are six degree of freedom numbers (1-6), each representing a local degree of freedom. One through three (1-3) are the translational degrees of freedom, (x, y, z-displacement), while four through six (4-6) are the rotational (x, y, z-rotation).



2.6.2 *Structural Force Boundary Conditions – SFBoundary –*

The following is an example of a ***SFBoundary Value*** definition:

SFBoundary `sfbound` **using** `AllNodes`

1	2	1.000000
2	2	1.000000
3	2	1.000000
4	2	1.000000
6	3	2.000000
7	3	2.000000
8	1	3.000000

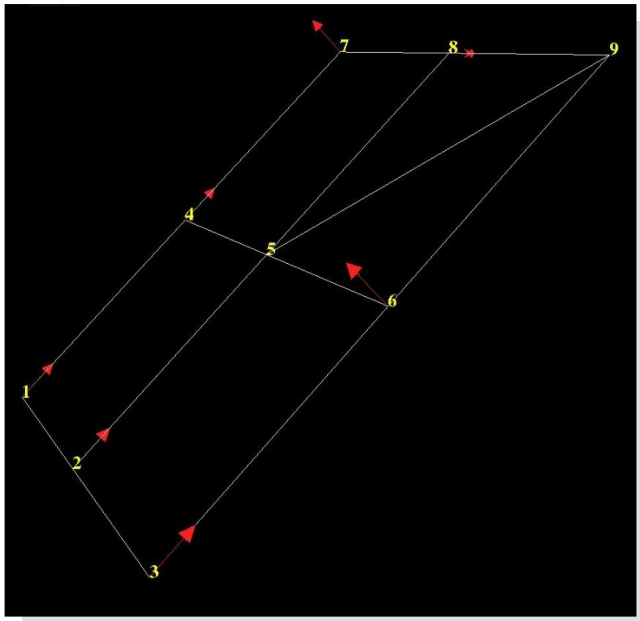


Fig. 2.6

Figure 2.6 shows the ***Force Boundary Conditions*** for this ***Element Set***. As for the **SDBoundary** a force is shown by a three-dimensional arrow at the **Node** while a double arrow shows a moment. In this picture the **Node** numbers are also shown.

The reserved word ***SFBoundary*** is used to indicate an ***SFBoundary Value***. In this example, `sfbound` is a user-defined name for this ***SFBoundary Value***. After the ***SFBoundary Value*** name comes the reserved word **using**, and the name of the ***Node Set*** for the ***SFBoundary Value***. The following lines represent the **Nodes** in the ***SFBoundary Value***. Each line has a **Node** number followed by a local degree of freedom number and a boundary force value. In TOP/DOMDEC, **Structural Force Boundary Conditions** are programmed the same way as **Displacement Boundary Conditions**, but are differentiated so that the user can plot either set separately. The difference is a matter of physical interpretation. Six numbers expressing the local degree of freedom are again used, however the translational numbers (1-3) now pertain to x, y, z-forces, while the rotational numbers (4-6) now pertain to x, y, and z-moments.

Want to know how to display or change the visual aspect of **SFBoundary?**
See section 3.2.3.7 (Other Display Options).

2.6.3 Fluid Boundary Conditions – FBoundary -

The following is an example of a ***FBoundary Value*** definition:

```
FBoundary fbound using AllNodes

1       1
2       2
3       4
4       5
5       6
6       3
```

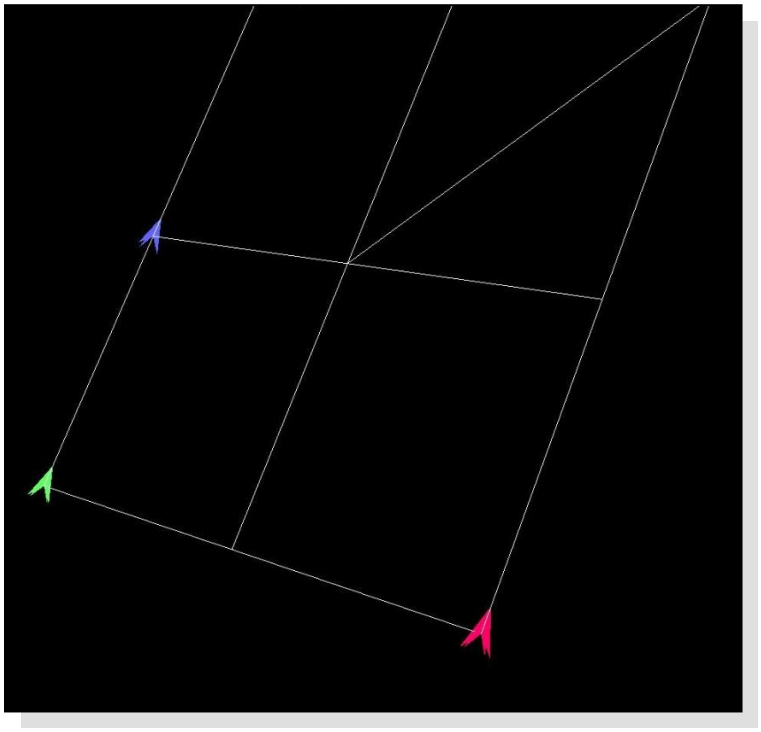


Fig.2.7

Figure 2.7 shows **Fluid Boundary Conditions** displayed by TOP/DOMDEC for the data in the example file on the left. In this figure all **Fluid Boundary Conditions** have not been turned on. Note that **Fluid Boundary Conditions** are displayed in different colors according to their numbers.

The reserved word **FBoundary** is used to indicate an ***FBoundary Value***. In the example, `fbound` is a user-defined name for this ***FBoundary Value***. After the ***Fboundary Value*** name comes the reserved word **using**, and the name of the ***Node Set*** for the ***FBoundary Value***. The following lines represent the **Nodes** in the ***FBoundary Value***. Each line has a **Node** number followed by a boundary code number. This code number varies between 1 and 6. The physical meaning of these numbers is arbitrary; rather they are defined by the user to group different types of boundaries.

Want to know how to display or change the visual aspect of **FBoundary**?
See section 3.2.3.7 (Other Display Options)

2.6.4 Fluid/Structure Interaction Boundary Conditions – FSBoundary -

The following is an example of a ***FSBoundary Value*** definition:

FSBoundary `fsbound` **using** `AllNodes`

1
2
3
4
5
6
7
8
9

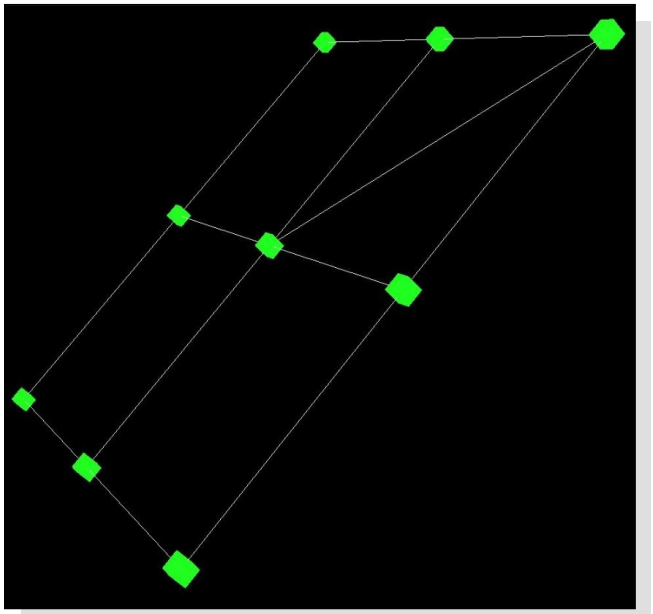


Fig. 2.8

Figure 2.8 shows the ***Fluid/Structure Boundary Conditions*** for our example. They are represented by green cubes.

The reserved word **FSBoundary** is used to indicate a ***FSBoundary Value***. In this example, `fsbound` is a user-defined name for this ***FSBoundary Value***. After the ***FSBoundary Value*** name comes the reserved word **using**, and the name of the ***Node Set*** for the ***FSBoundary Value***. The following lines represent the **Nodes** in the ***FSBoundary Value***. Each line has only a **Node** number.

Want to know how to display or to change the visual aspect of **FSBoundary**?
See section 3.2.3.7 (Other Display Options)

2.6.5 Temperature Boundary Conditions - TBoundary –

The following is an example of a ***TBoundary Value*** definition:

```
TBoundary tbound using AllNodes
1       0.0
2       0.1
3       0.4
4       0.6
5       1.5
6       2.0
7       3.0
8       6.0
```

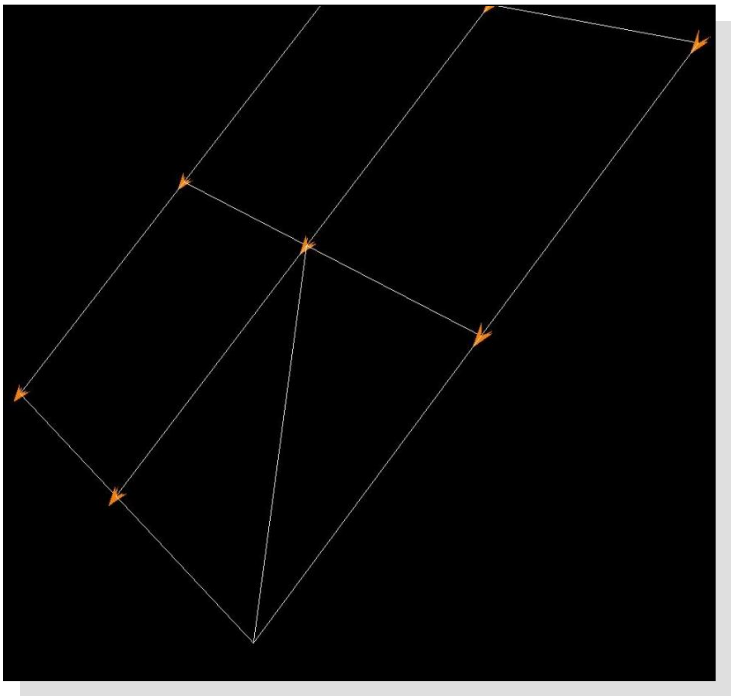


Figure 2.9 shows the ***Temperature Boundary Conditions*** drawn in our example. They are represented by three-dimensional triangles.

Fig. 2.9

The reserved word **TBoundary** is used to indicate a ***TBoundary Value***. In the example, `tbound` is a user-defined name for this ***TBoundary Value***. After the ***TBoundary Value*** name comes the reserved word **using**, and the ***Node Set*** for the ***TBoundary Value***. The following lines represent the ***Nodes*** in the ***TBoundary Value***. Each line has a **Node** number followed by a ***Temperature Boundary Conditions*** value.

Want to know how to display or to change the visual aspect of **TBoundary**?
See section 3.2.3.7 (Other Display Options)

2.7 Mesh Partition

The following describes the correct format of an input file containing a ***Mesh Partition***.

```
Decomposition FULLCONE.L.10 for FULLCONE
 11
 55
1
2
3
4
5
....
 55
274
275
289
291
....
 17
470
471
487
488
...
 27
....
```

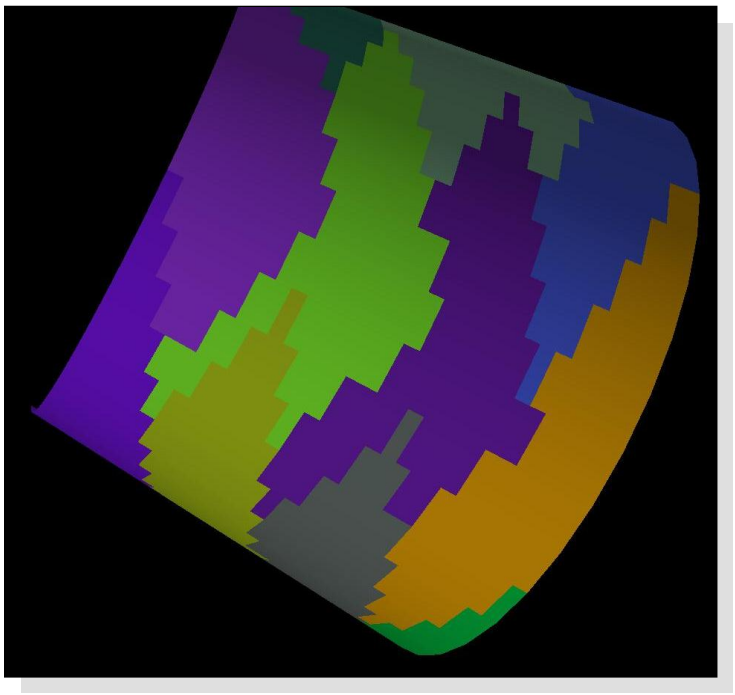


Fig. 2.10

Figure 2.10 shows the mesh of FULLCONE partitioned into 11 subdomains. Part of the input file of the partitioned mesh is shown on the left. Note that each of the subdomains has its own default color.

The reserved word **Decomposition** is used to indicate a ***Mesh Partition***. In this example, `FULLCONE.L.10` is a user-defined name for this ***Mesh Partition***. After the ***Mesh Partition*** name comes the reserved word **for** and the ***Element Set*** for the partitioned mesh. The next line has a single number, which represents the number of subdomains in the partition. Then comes the description of the subdomains of the partitioned mesh. The first line of each subdomain description is a single number, n, that indicates the number of elements in this subdomain. Then, the n following lines are the list of element numbers that compose this subdomain.

Want to know how to display or to change the visual aspect of a ***Partition Mesh***?
See section 3.2.3.7 (Other Display Options)

2.8 Curve and Graph Data

This is a new feature in this TOP/DOMDEC version. This feature allows the user to plot any kind of graph along with any animation. (For more information about plots see section 3.2.3.9 (Plots)). The following is an example of a ***Curve*** and ***Graph Data*** definition:

```
TimeData ExponentCurve 5
1.0     1
2.0     0.985104
3.0     0.96066
4.0     0.927102
5.0     0.8834782
6.0     0.834782
7.0     0.777272
8.0     0.713141
9.0     0.643141
10.0    0.568109
11.0    0.488886
12.0    0.406347
13.0    0.321382
…
TimeData CosinusCurve 1
1.0     1
2.0     0.995004
3.0     0.980067
4.0     0.955336
5.0     0.921061
…

Graph ExampleGraph 3
ExponentCurve CosinusCurve
SineCurve
Graph Second_Graph 1
ExponentCurve
```

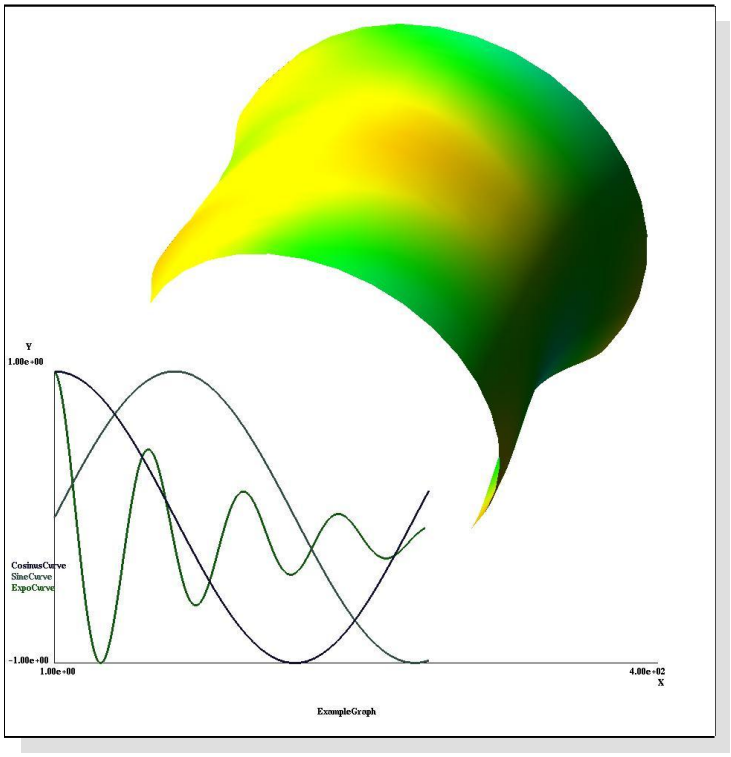


Fig. 2.11

Figure 2.11 shows an example of a graph plot along with the FULLCONE object. The graph is drawn as the animation progresses. In this figure there are three different curves on the same scale. (For more information on how to plot a graph see section 3.2.3.9 (XY Plot)).

The reserved word **TimeData** is used to indicate a ***Curve Data*** to be plotted. In this example, `ExponentCurve` and `CosinusCurve`, are user-defined names for two different curves. After the name of the data, TOP/DOMDEC expects an integer that represents the frequency of the data to consider. (In this example, for the `ExponentCurve` data set, only one out of five of the following lines will be taken as data to be plotted, whereas for the `CosinusCurve` since the frequency number is "1" TOP/DOMDEC will take all the following lines as data to be plotted.) The next lines represent the set of data to plot for this particular curve. The user may provide as many data lines as they wish.

In this example, one can see that after the ***Curve Data*** definitions there appear two ***Graph Data*** definitions. The reserved word **Graph** is used to indicate a ***Graph Data***. In this example, `ExampleGraph` and `Second_Graph`, are two different ***Graph Data*** definitions. Following the name, TOP/DOMDEC expects an integer, which indicates the number of curve(s) in the graph. Then, on the next lines, TOP/DOMDEC expects the relevant curve's names.

Both the Graph Data and the Curve Data types read by TOP/DOMDEC are stored in the database but will not appear in the Delete Window as with other data types. They will appear in the Data Plot Window. For more information see section 3.2.3.9 (XY Plot).

2.9 Weight Factors

Weight factors are used for the decomposition options of TOP/DOMDEC (see section 3.2.2.3 (Decompose)). A user-defined set of weight factors may be loaded from an input file.

The input file consists of a sequence of integers followed by float numbers (on a single line) representing the weight for each element type recognized by TOP/DOMDEC (see section 1.3 (Objects in TOP/DOMDEC)).

The integer to use for a particular element will be its unique TOP/DOMDEC number which is 100 + its FEM number. (The same number that represents the element in the TOP/DOMDEC file).
For each of the eighteen geometric elements of TOP/DOMDEC, use its number instead without adding 100.
If you're not familiar with these numbers, we do recommend that you create your weight file using the weight dialog boxes described in section 3.2.2.3.

All elements not mentioned in the input file will have their default weight value.

```
119 1.0
188 3.0
4 4.5
```

This input file loads the weight factors for the three node membrane element (100 + 19), the mechanical four node shell (100+88) and the Tri_3 (4) element. The remaining types will take their default weight values.

Chapter 3: The Main Controller

3.1 Introduction

The main controller contains five main parts. From top to bottom they are the Main Menu Options, the Animation Controller, the Object Controller, the Result Controller, and the Window Manager.

Figure 3.1 describes the Main Controller and its five main parts.

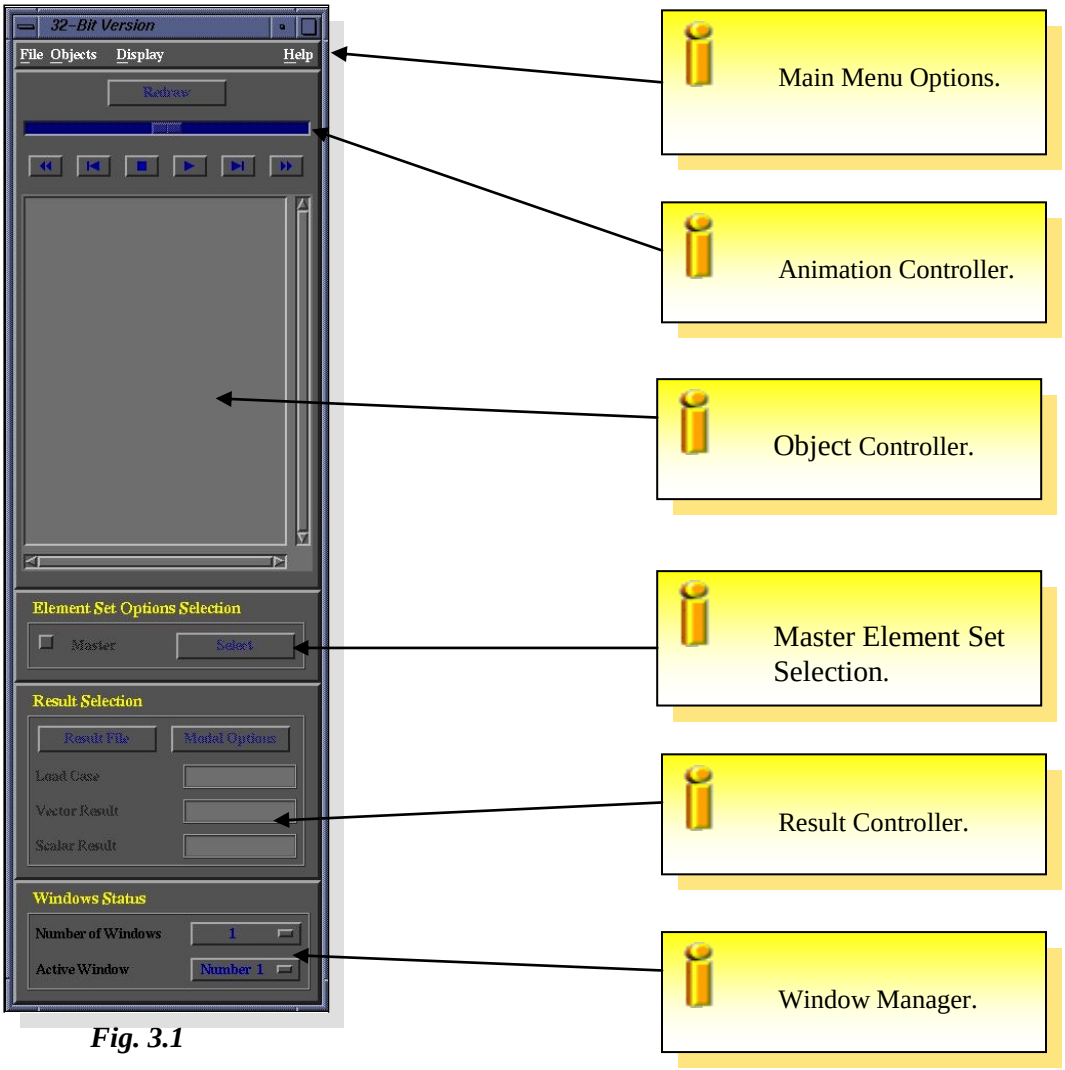


Fig. 3.1

The following sections will describe each part in detail.

3.2 The Main Menu Options

This is a new feature in TOP/DOMDEC that helps save space for the **Main Display Window** used for visualizations. The Main Menu Options is a single line with four entities. It is on the top of the Main Controller Window as shown in figure 3.1.

The four options are: File, Options, Display, and Help as shown in figure 3.2(a). Each contains a list of possible option items. When selected these options open a window containing various choices. The following sections describe in detail the possibilities in each of the four options.

Each of the four options can be used as a "Tear-off" by clicking on them and scrolling down to the first dashed-line. This creates a window containing the sub-menu as shown in figure 3.2(b) that can be moved as desired.

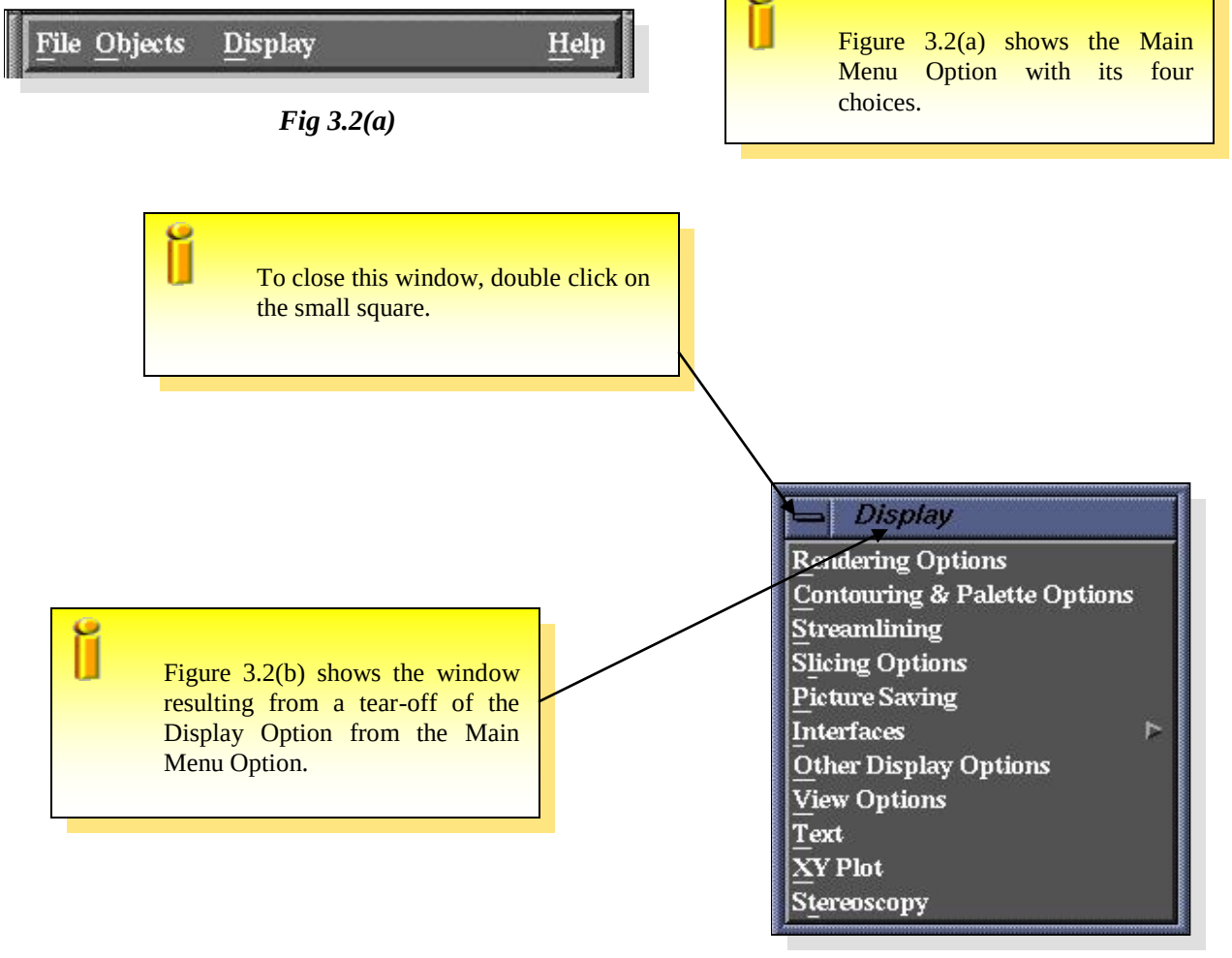


Fig 3.2(a)

Fig. 3.2(b)

3.2.1 File

Under File Option the user has four possible actions: Load, Save, Delete, Preferences and Exit. In general these options are used to manage the database in TOP/DOMDEC.

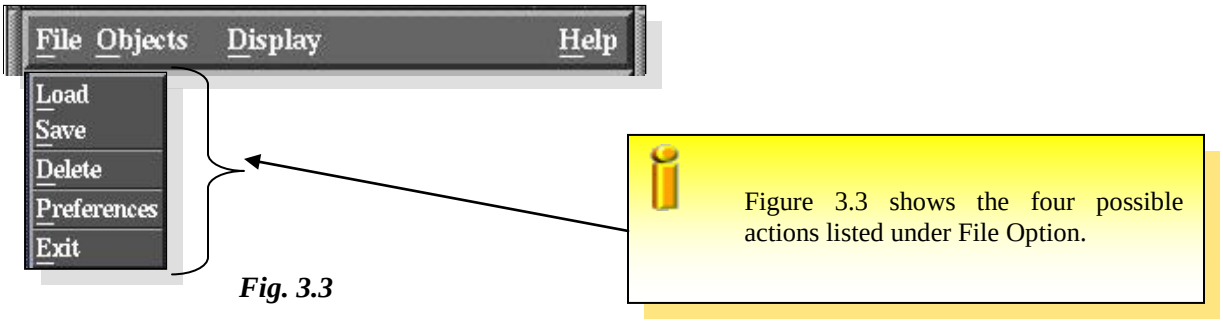


Fig. 3.3

3.2.1.1 Load

Clicking on the "Load" option opens the File Load Window. This window is designed to help the user to load and store data in the TOP/DOMDEC database. The next figure describes this window and its functionalities.

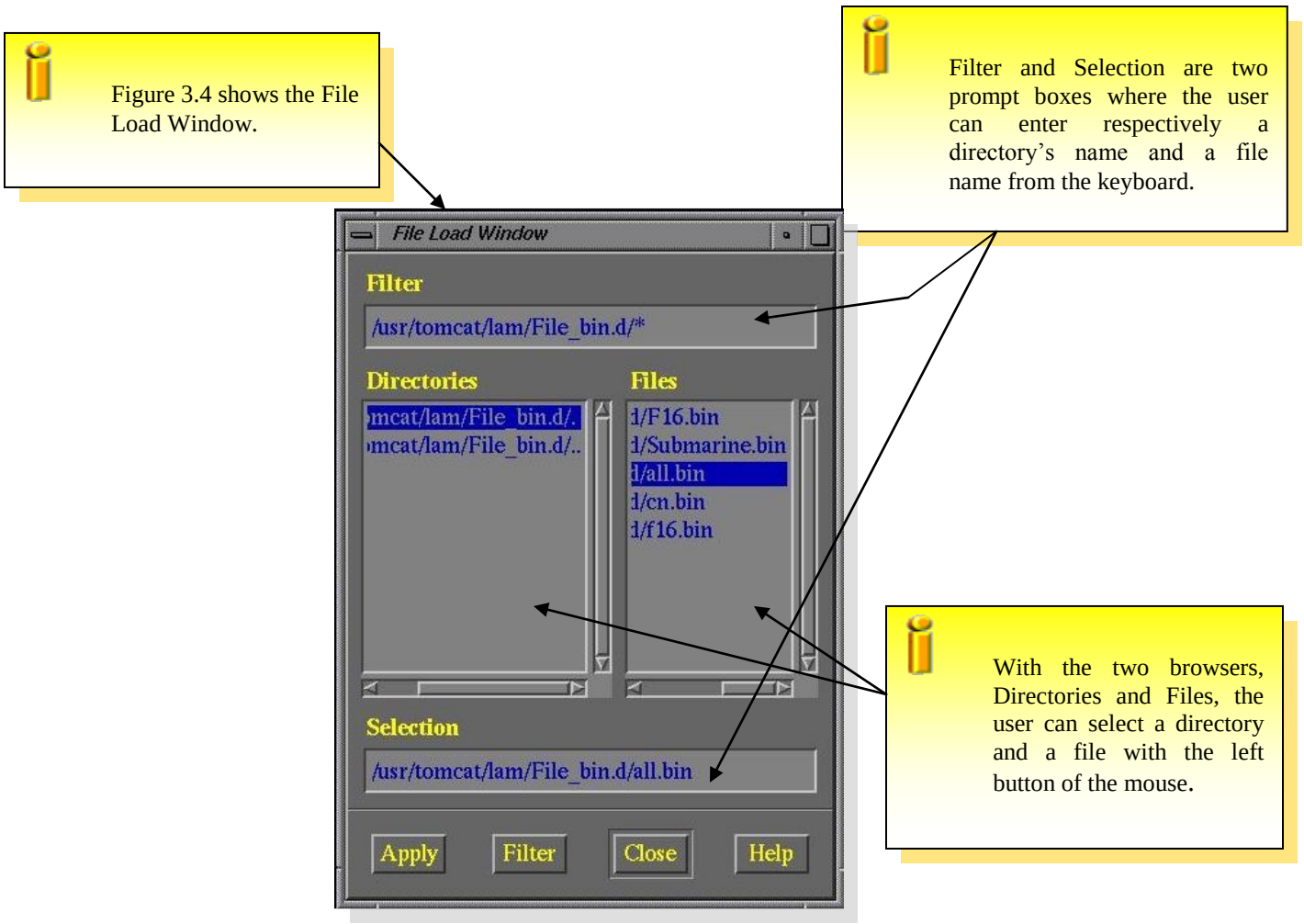


Fig. 3.4

How to use the window

As already discussed in section 1.4.7 (Single and Multiple Selection Browsers) some of the browsers in TOP/DOMDEC support the double-click feature. This function can be very useful in the File Load Window. The first set of rules explains how to use this window without the double-click feature. The usage of this double-click feature is explained in the second set of rules.

Using this window without the double-click feature

- With the keyboard enter the directory path (including "**/*" at the end of any directory path) in the "Filter" prompt box at the top to the window as shown in figure 3.4. The user can then either push on the "Enter" key of the keyboard or click with the mouse on "Filter" at the bottom of the window next to the "Apply" button as shown in figure 3.4.

- TOP/DOMDEC then displays, in the "Directories" browser, the list of sub-directories contained within the chosen directory and, in the "Files" browser, the list of files contained within this same directory. The user can to go to another directory by using the same sequence of actions.

- The user can select the file to be read by clicking on the desired file name listed in the "Files" browser and either pushing at the "Enter" key of the keyboard or clicking on the "Apply" button at the bottom left hand side of the window. This will activate the reading process of TOP/DOMDEC.

Using this window with the double-click feature

- The double-click feature works only with browsers.

- Upon the opening of the window, TOP/DOMDEC displays, in the "Directories" browser, the list of the directories that are under the current directory (the one from which TOP/DOMDEC has been launched) and in the "Files" browser, the files contained within this directory.

- The user can now go to a different directory by double-clicking on it in the "Directories" browser. At the top of the list there are two special kind directories, "***directory_path/.***" and "***directory_path/..***". The first one is not used by the user. Double-clicking the second one causes TOP/DOMDEC to go up a directory.

- By double-clicking on a desired file listed in the "Files" browser the user activates the reading process as if they had clicked on the "Apply" button.

As the reading process advances, TOP/DOMDEC updates the database with new objects. At the end of the reading process all of the new objects are available to the user. The list of available objects can be displayed in the "Delete" window as discussed in section 3.2.3 (Delete Window).

While reading a file TOP/DOMDEC displays a Timer Window indicating the approximate amount of time remaining to complete the reading process. The Timer Window will disappear after TOP/DOMDEC has completed reading the file. While reading, TOP/DOMDEC does not allow the user to perform any other actions. A "Stop" button is available in the Timer Window, which interrupts the reading process when clicked.

By interrupting the reading process the user is advised that TOP/DOMDEC has not yet completed the reading. Thus, some information in the file may not have been saved in the database.

File types

TOP/DOMDEC is able to read text, binary and compressed files. Text files need not have any extension. TOP/DOMDEC recognizes a binary file by the extension "**.bin**", while it recognizes a compressed file by the extension "**.Z**".

Warnings and Error Messages

A message window is displayed when TOP/DOMDEC encounters a possible error while reading a file. A TOP/DOMDEC warning may not be an error. TOP/DOMDEC will confirm with the user this is exactly what they intended. An error is a situation where TOP/DOMDEC does not know how to proceed. TOP/DOMDEC reports the error to the user and stops the reading process.

Same file warning

This message is displayed whenever TOP/DOMDEC has recognized that the selected file has the same file name as one previously loaded. This could be intentional by the user but it could also be an error. TOP/DOMDEC asks the user to confirm reading of the file. If "Yes" is answered then the reading proceeds, while if "No" is answered the reading process is cancelled.

Same object name warning

This message is displayed whenever TOP/DOMDEC encounters the same type of object with the same name as one already in the database. This could be an error or be intentional by the user. TOP/DOMDEC asks the user to confirm the reading of this object and therefore the deletion of the previous same object. If "No" is answered, then TOP/DOMDEC stops the reading process.

Format not recognized error

This message is displayed whenever TOP/DOMDEC does not recognize one of the three allowed file formats.

Parsing error

This message is displayed whenever TOP/DOMDEC has encountered a parsing error during the reading process. This is usually a syntax error in the input file. For instance, this occurs when TOP/DOMDEC does not find an object name during an object declaration. For more details on the correct syntax of an input file see Chapter 2 (INPUT DATA LAYOUT).

Whenever a warning or error window is opened, TOP/DOMDEC waits for the user to either confirm the error or answer the question. No other action can be taken while a warning or error window is displayed.

While reading a file, TOP/DOMDEC displays also a dialog window in which it indicates the name of the object that is being read.

Attention: The Linux version of TOP/DOMDEC does not read the binary file format.

3.2.1.2 Save

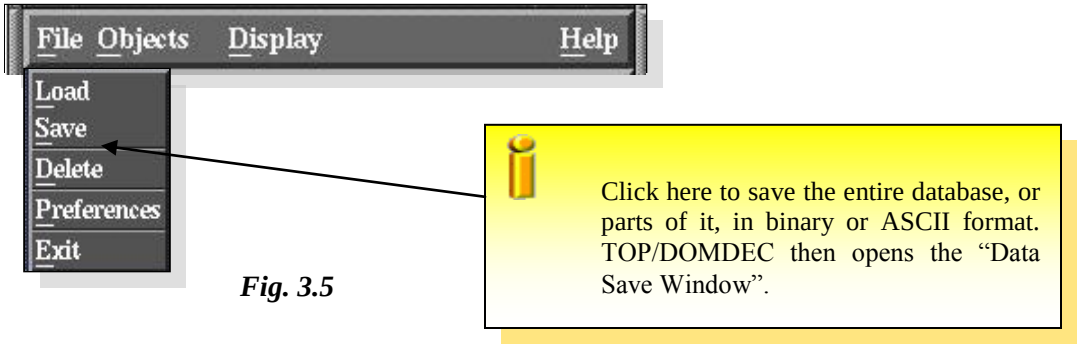


Fig. 3.5

Clicking on the "Save" option opens a new window called the Data Save Window. This window shown in figure 3.6a is designed for the user to select the file name in which to save the current database, or the list of selected objects to be saved in binary or in plain text ASCII format.
The objects that TOP/DOMDEC is able to save are: the ***Node Sets***, the ***Element Sets***, the ***Vector*** and ***Scalar*** and ***ElemScalar Results***, ***Patterns***, and the five kinds of ***Boundary Conditions.***

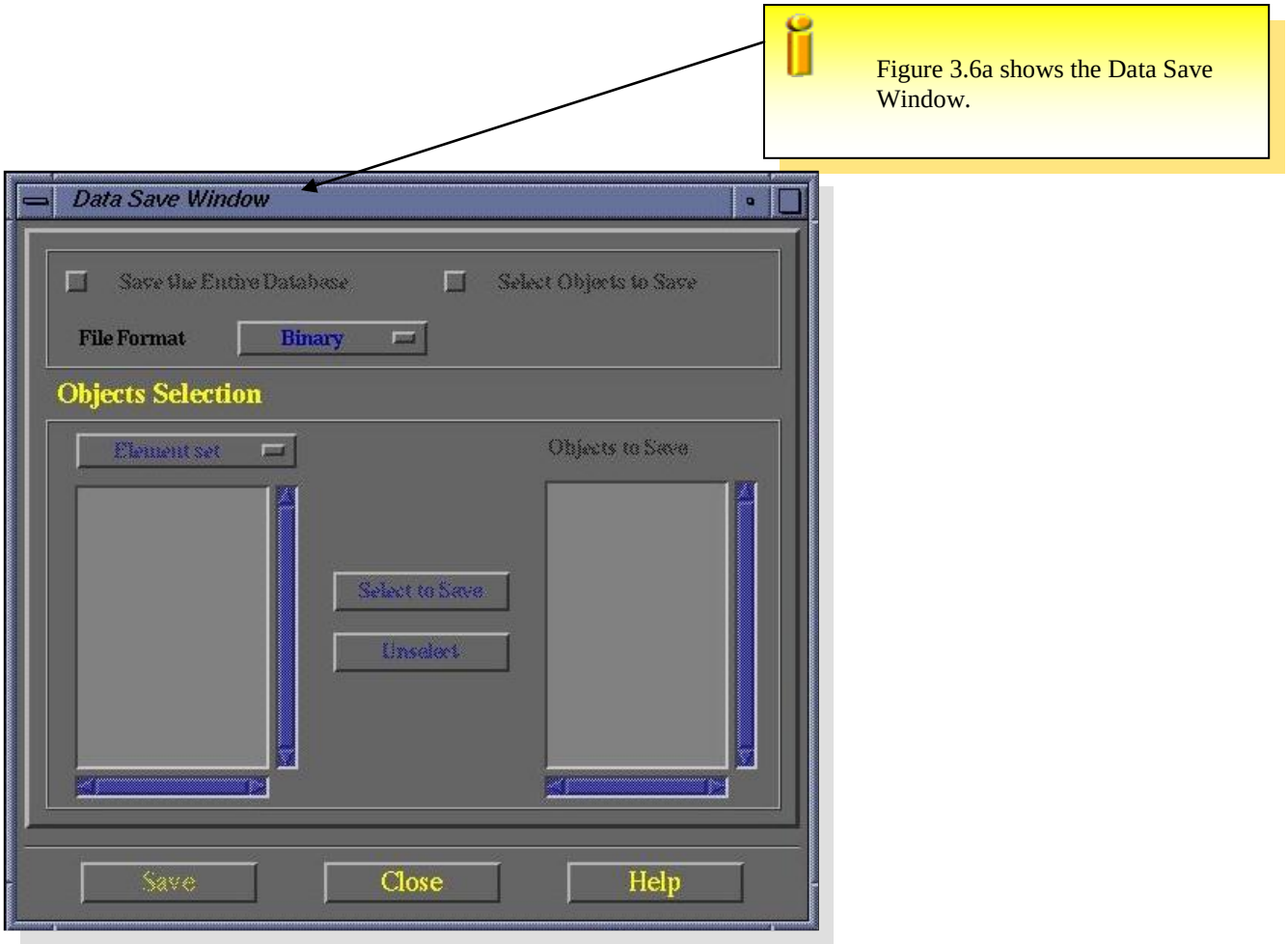


Fig 3.6a

How to use the window

Save the Entire Database: Click on this choice to save the entire database that is currently loaded in TOP/DOMDEC.

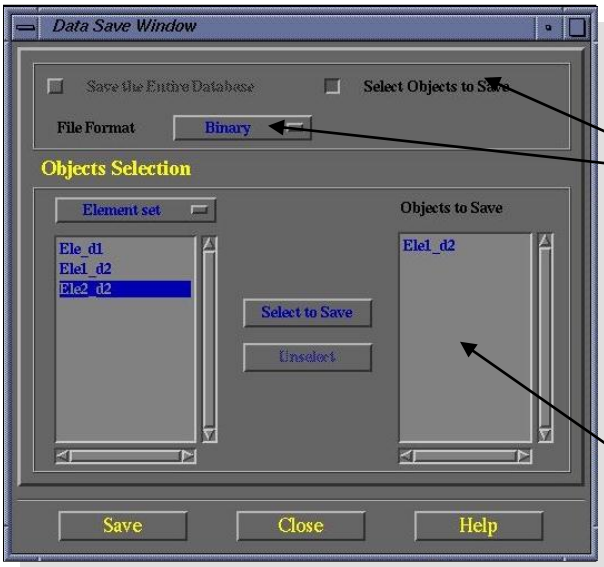
Select Objects to Save: Click on this option if only part of the current database is to be saved. Selecting this choice enables the bottom part of the window, Object Selection, for the user to select the list of objects to be saved.

Format: With this option the user is allowed to save in binary or plain text ASCII mode.

Object Selection
This part of the window is available to the user only if part of the database is to be saved.
It shows two browsers, objects and list of objects to save. When available the user can see all types of objects currently in the database by clicking on the chooser right above the left browser.

Object Chooser: The object chooser is the chooser that is located above the first browser. Selecting any of the items listed in this option updates the browser that is located right below it with the names of the corresponding objects currently in the TOP/DOMDEC database. The items of this chooser are: Element Set, Node Set, Vector Set, Scalar Set, Pattern, etc …

Select to Save: When an item of the left browser has been selected the user must click on the "Select to Save" button to put the selected object on the "List to Save". Later, when TOP/DOMDEC will start to save, it will save the list that has been selected and presents in this browser.



3.6b

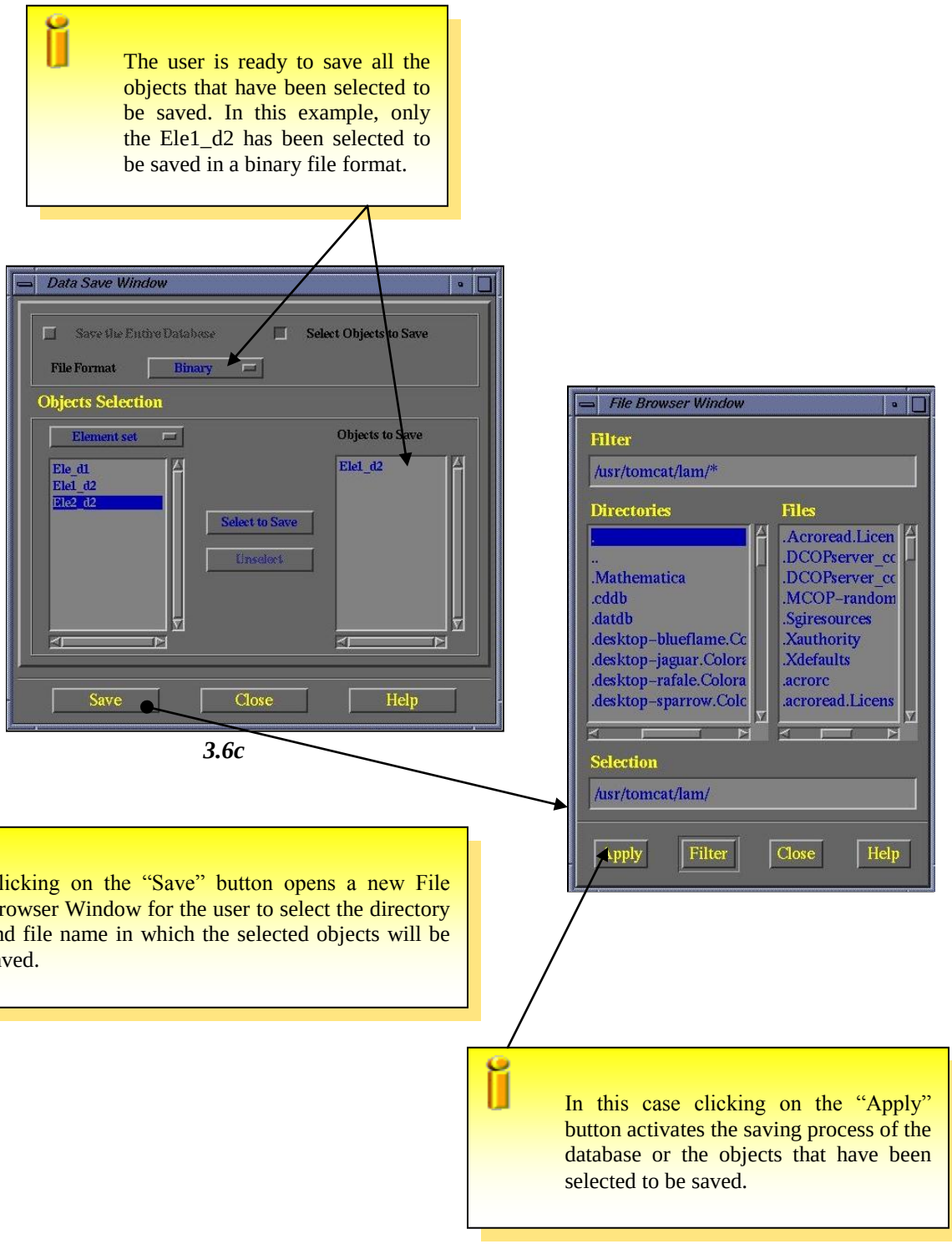
Figure 3.6b shows that the user has selected to save only parts of the current database and they are selecting the objects to be saved.
Note that the chosen file format is binary.

This list represents the list of objects that will be saved by TOP/DOMDEC when the user clicks on the "Save" button.

Unselect: If the user changes their mind and wishes to not save an item that has been previously selected to be saved, then they can select the item from the "Objects to Save" and click on "Unselect" to remove the items from the list of items to be saved.

When the selection of all items to be saved is done, TOP/DOMDEC becomes ready to start the saving process. To invoke the save action click on the "Save" button of the window.

Save
Clicking on this button instructs TOP/DOMDEC to open a new file system window for the user to select the directory and file name in which to save the selection of this window. The next figure illustrates how the user can save objects with this "Save" button.



3.2.1.4 Delete

The Delete Window appears when the user selects the "Delete" option. The Delete Window is shown in figure 3.8.

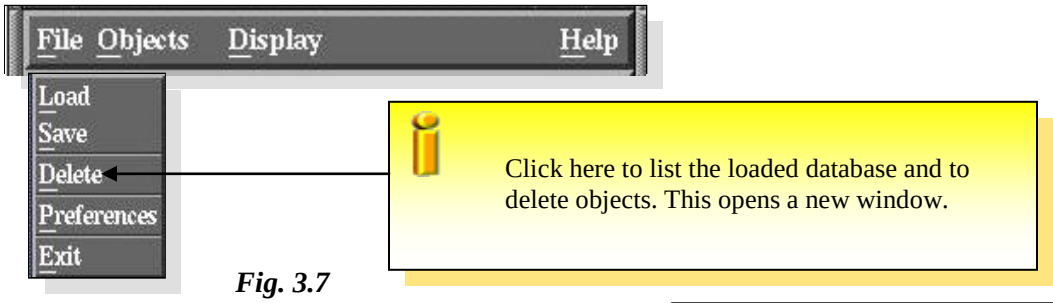


Fig. 3.7

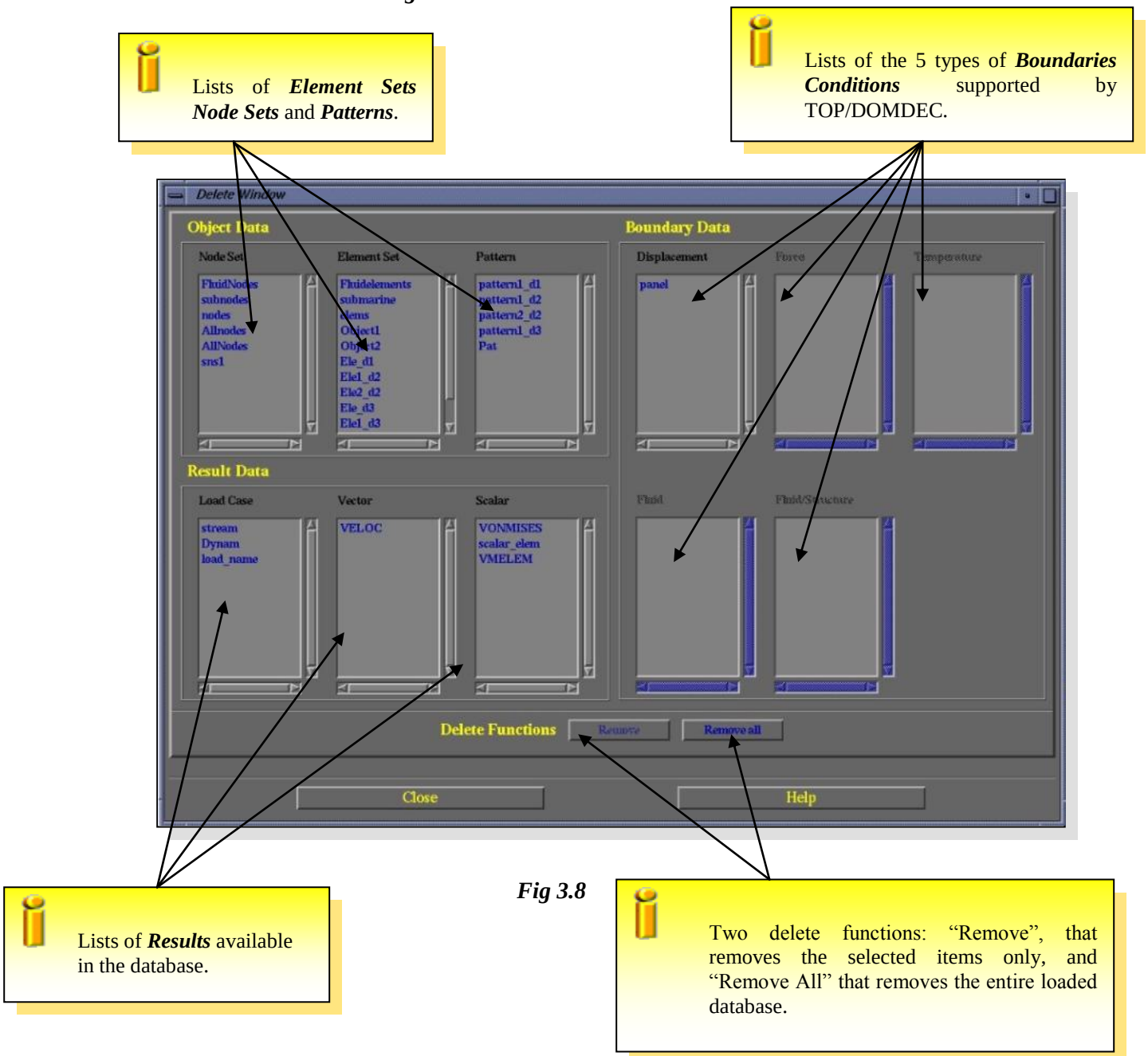


Fig 3.8

The Delete Window is designed to help the user to manage the database. The next sections explain how to delete one (or more) object(s) and how such a process affects the TOP/DOMDEC session. All browsers present in this window are multiple selection browsers. (See section 1.4.7, (Single and Multiple Selection Browsers) for more information about multiple selection browsers). These browsers do not support the double-click feature.

Before and after the deletion

Before removing any object in the database, TOP/DOMDEC stops all current animation. TOP/DOMDEC asks the user to confirm each object (if any) that will be deleted in addition to the selected items.

After the deletion of any object(s), TOPDOMDEC updates all windows using these object(s).

There is no recovery in TOP/DOMDEC when an object has been deleted from the database. If the user wants to reuse the object it must be re-read from the appropriate input file(s).

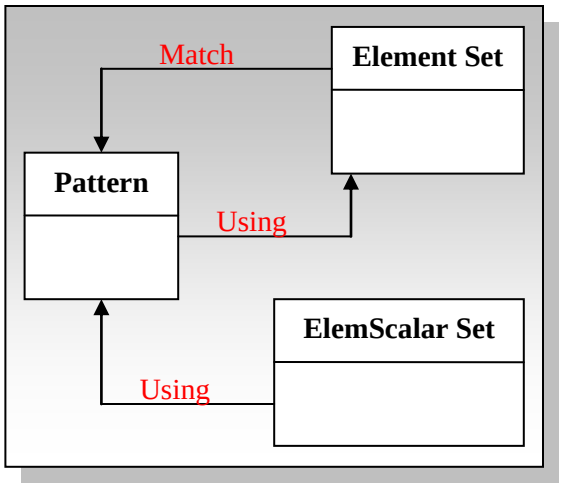
Object Data

Rules to keep in mind when deleting a Node Set or an Element Set

An ***Element Set*** can be deleted individually. If the Element Set has been used to define a Pattern in the database then TOP/DOMDEC will ask the user to confirm the deletion of this attached Pattern as well (see figure below). If the deleted ***Element Set*** had been selected in any **Display Window**, TOP/DOMDEC removes the whole list of ***Element Set(s)*** in that particular **Display Window**. Thus, that particular **Display Window** becomes empty.

Be careful, because of the relationship between an ***Element Set*** and its corresponding ***Node Set,*** the deletion of any of the ***Node Set(s)*** automatically deletes all ***Element Sets*** that use the selected ***Node Set(s)***.

For the deletion of a Pattern see explanation and figure below.



Looking at this picture one can understand that the deletion of a Pattern from the database will unable the user to use the ElemScalar Set since this latest is using it, therefore TOP/DOMDEC will ask to confirm the deletion of this ElemScalar Set as well.

If a Pattern is deleted from the database TOP/DOMDEC will also look at any macthing command that may have match an Element Set with this Pattern. In this case, TOP/DOMDEC will reset the Elemset Set so that it does not match anymore this deleted Pattern.

Result Data

Rules to keep in mind when deleting a Result.

A ***Vector Results***, a ***Scalar Results,*** and an ***ElemScalar Results*** can be deleted individually. However, there is a "one to one" relation between a ***Load Case*** and its ***Vector Results*** and ***Scalar Results*** or ***(ElemScalar Results).*** If all the ***Vector*** and ***Scalar Results*** (or ***ElemScalar Results***) associated with the same ***Load Case*** are deleted, then that ***Load Case*** is deleted as well.

When a ***Vector Results*** is deleted any **Display Window** using that ***Vector Results*** will have it removed. The ***Element Set(s)*** displayed in this **Display Window** is displayed without the ***Vector Results***. The same warning is true for a ***Scalar Results*** and an ***ElemScalar Results***.

If a ***Load Case*** is deleted then its corresponding ***Vector Results*** (if any) and ***Scalar Results*** (if any) and ***ElemScalar Results*** (if any) will also be deleted.

Boundary Data

There is no particular rule when deleting ***Boundary Conditions***. The user just selects and deletes the desired ***Boundary Conditions***. If the selected ***Boundary Conditions*** is being used in any **Display Window** then that window is updated and the selected ***Boundary Conditions*** is removed from it.

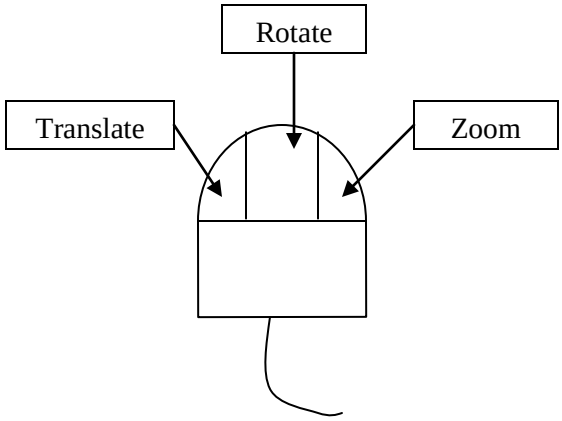
Remove Buttons

There are two buttons available to the user for deletion, “Remove” and “Remove All”. They are located on the bottom of the window just underneath the lists. Clicking on the “Remove” button deletes only the selected object(s) and its related object(s) as discussed above. Clicking on the “Remove All” button deletes the entire database. TOP/DOMDEC then appears as if nothing has yet been loaded in to the database.

3.2.1.4 Preferences

Fig. 3.9a

The user can set their preferences while working with the mouse on the **Main Display Window**. The default actions of the three buttons of the mouse are the following:



After clicking on the Preferences option as shown on Figure 3.9a, TOP/DOMDEC opens the Preferences Setting window as shown in Figure 3.9b for the user to change this option for the session.

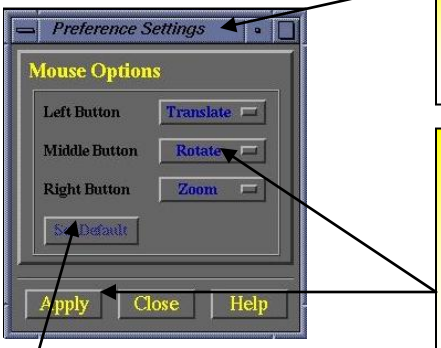


Fig 3.9b

Figure 3.9b shows the Preference Settings window with its options.

The user can now change each action carried by each button of the mouse as their preferences.
Note that they must click on the "Apply" button for TOP/DOMDEC to save their choices for the session.

When the changes are made the user can always go back to the default settings by clicking on the "Set Default" button.

Attention: Any changes made are saved for one session of TOP/DOMDEC only. For the next session if desired the user has to reset these options again.

3.2.1.5 Exit

Fig. 3.10

Clicking on the "Exit" option displays a warning window asking the user to confirm the termination of the TOP/DOMDEC session. Clicking on "Yes" exits from TOP/DOMDEC and kills all processes under the TOP/DOMDEC activities.

3.2.2 Objects

Under the Objects button, the user has four possible actions: Select, Assemble, Decompose, and Output. These options allow the user to manipulate objects in TOP/DOMDEC.

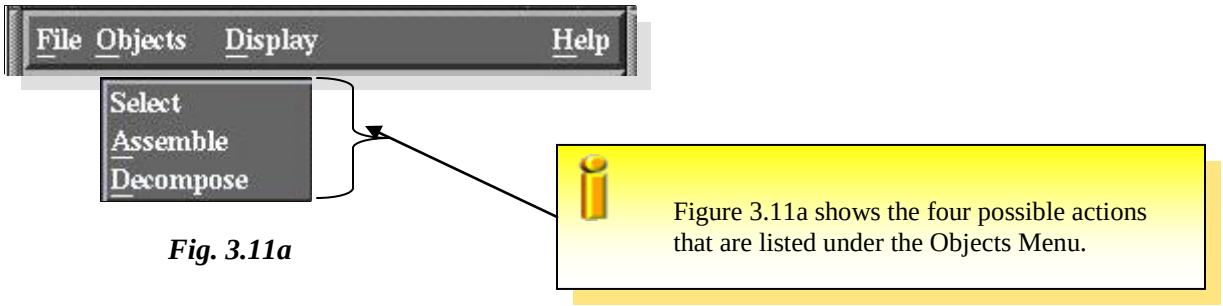


Fig. 3.11a

3.2.2.1 Select

Clicking on the "Select" option displays the Object Selector Window. This window is used to select the set of objects to display in the current **Display Window**. This window contains a multiple selection browser and supports the double-click feature. (See section 1.4.7, (Single and Multiple Selection Browsers) for more information about multiple selection browsers).

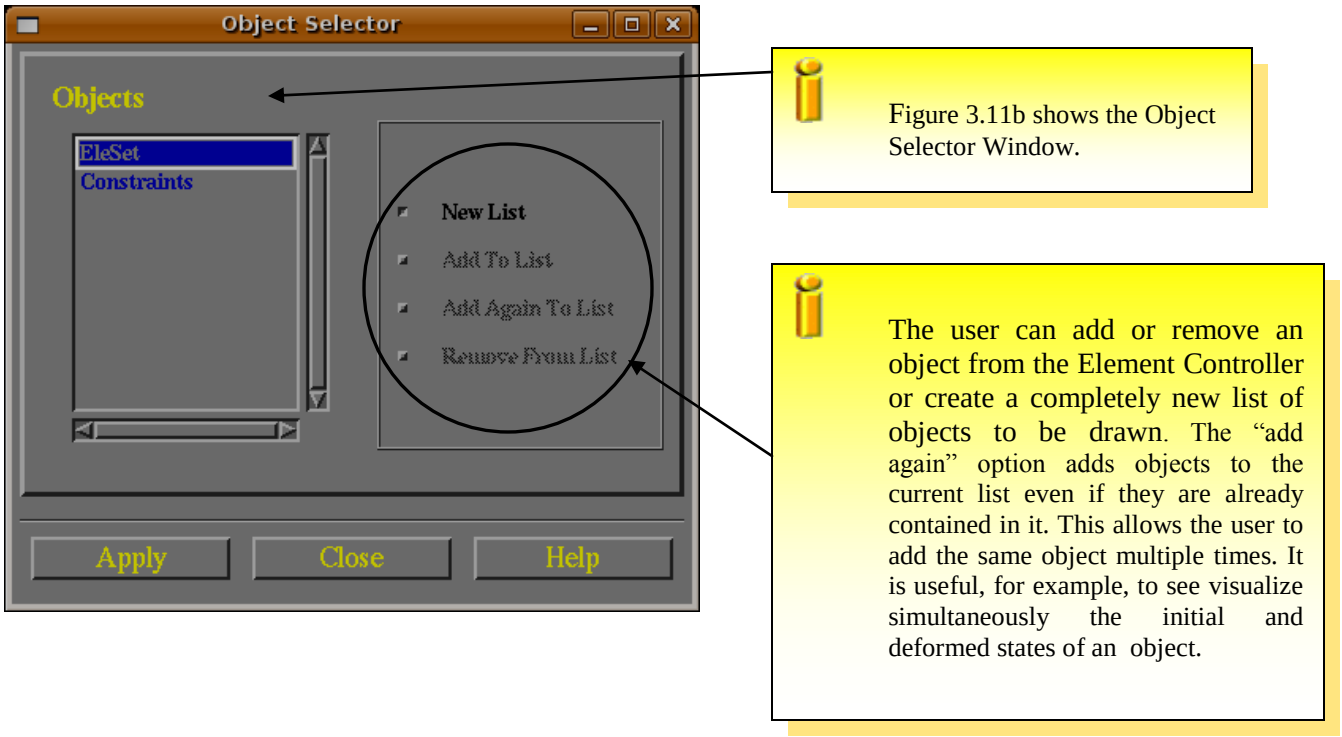


Fig. 3.11b

How to use the window

- The window displays one browser that lists the available ***Element Set(s)*** in the database. This browser is automatically updated whenever TOP/DOMDEC adds or deletes ***Element Set(s)*** in the database.

- To select an object, click on the desired object and then depending on the state of the session TOP/DOMDEC enables the options on the right for the user to add the selection to the current list of objects in the Element Controller or to remove the selection from the current list or simply create a new list of objects to be drawn.

- The user must click on a choice and click the "Apply" button. If the user does not choose any option then TOP/DOMDEC applies its default action, which is to create a new list of ***Element Set(s)*** to be drawn.

- The selected set of objects applies to the **Display Window** currently selected in the "Window Manager" of the Main Controller as shown in figure 3.1.

The following are some concepts to keep in mind whenever a selection is made

- The selected set of objects appears in the Main Element Controller. **Remember the Main Element Controller displays the list of *Element Sets* that are in the current Display Window**. (For more information on the Main Element Controller and the current **Display Window** see respectively sections 3.4 (Object Display) and 3.5 (Window Status)).

- Upon selection of a set of objects, TOP/DOMDEC updates all option windows related to the selected set of objects. When a new set of objects has been selected, most "Display" options revert to their default initial state.

- Selecting a new set of objects for a **Display Window** causes any Results for that window to be unselected.

3.2.2.2 Assemble

The Assemble Window is used to assemble objects. Figure 3.12 shows the Assemble Window. The window contains a multiple selection browser and does not support the double-click feature. (See section 1.4.7, (Single and Multiple Selection browsers) for more information about multiple selection browsers).

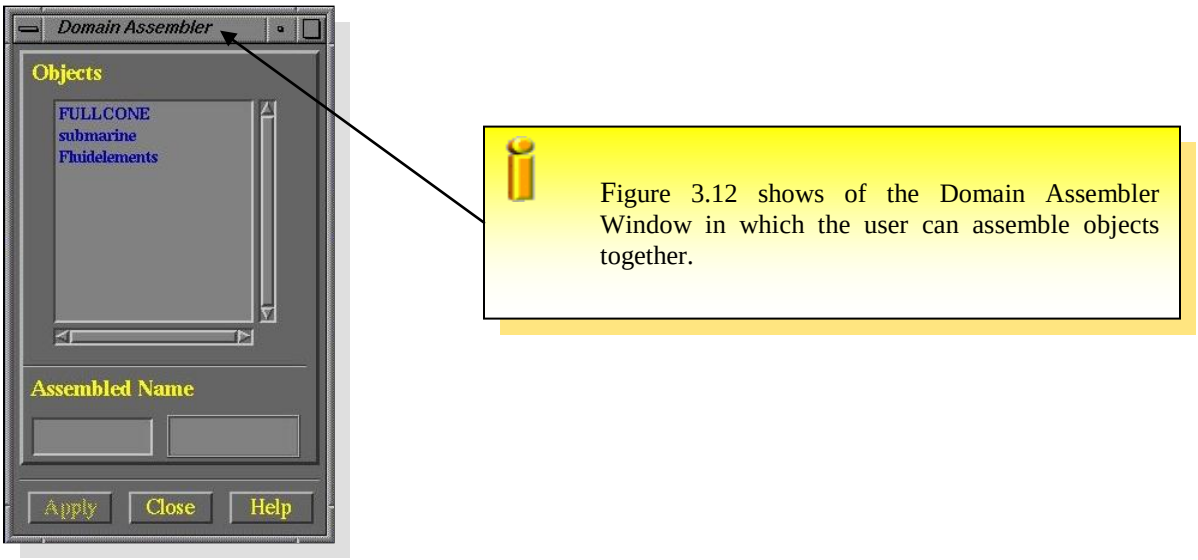


Fig. 3.12

How to use the window

- The window displays the list of ***Element Set(s)*** that are currently loaded in the TOP/DOMDEC database. It is updated automatically whenever ***Element Set(s)*** are added or deleted in the database.
- Note that there is a prompt box below the "Object" list. It is used to enter the assembled object's name by the user. (See section 1.4.5, (Prompt Boxes) for more information about the usage of a prompt box in TOP/DOMDEC)

The following are some concepts to keep in mind when assembling objects.

- TOP/DOMDEC allows only the assembly of ***Element Sets*** that share the same ***Node Set***. Assembling objects with different ***Node Sets*** causes an error. TOP/DOMDEC will display an error message and stop the assembly process.
- After assembly, TOP/DOMDEC displays the new object as an ordinary ***Element Set***. The object is manipulated as if it were an ordinary ***Element Set***.

3.2.2.3 Decompose

The Decomposer Window is opened by clicking on the "Decompose" option of the Objects Menu Option as shown in figure 3.13.

Clicking in this option opens the Decomposer Window Option to partition a mesh.

Fig. 3.13

The following section discusses the features that are in the Decomposer Window. The window is shown on figure 3.14

Objects browser lists the current ***Element Sets*** in the database.

Optimization Options allow the user to improve the initial ***Mesh Partition***.

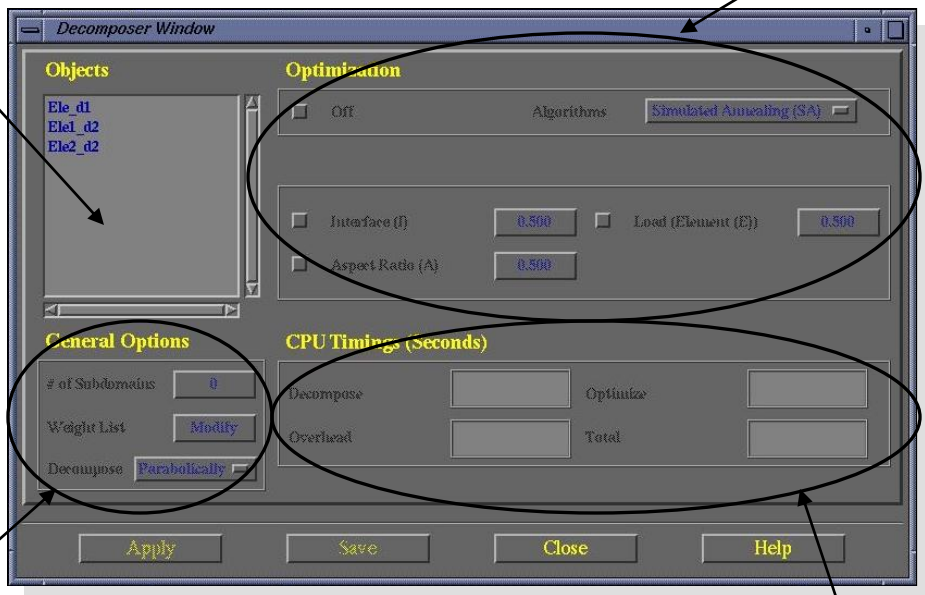


Fig 3.14

General Options allow the user to set the options for the ***Mesh Partition***.

TOP/DOMDEC displays the statistical time data after the partition has been completed.

Objects Browser

This browser is a single selection browser and does not allow the double-click feature (see section 1.4.7 (Single and Multiple Browsers) for more information about browsers in TOP/DOMDEC). The user may select any of the ***Element Sets*** in this browser to be partitioned. The list is automatically updated as an ***Element Set*** is added (or deleted) to (or from) the database. The user must select one item from the list for the options of the window to be available.

Optimization

After the user has made a selection in the browser, the "On/Off" button chooser is available. Turning "On" this button tells TOP/DOMDEC to optimize the decomposition of the selected mesh.
When this option is "On", the user may select the optimization algorithm and set non-deterministic criteria such as interface size, element-wise load balance, and subdomain aspect ratio.

TOP/DOMDEC contains two optimization algorithms: Simulated Annealing (SA) and Deterministic (DE). The default optimization algorithm is Simulated Annealing.

The user may also set any of the non-deterministic parameters as follows:

Click on the button chooser on the left side of the label. The label then becomes black and the button to the right of the label becomes available. Clicking on this button opens an Input Window (see section 1.4.6 (Input Window) for more information about inputting numbers in TOP/DOMDEC) for inputting the corresponding factor number.
When these choices are "Off" TOP/DOMDEC takes the default value of 0.5 when running the optimization algorithm.

CPU Timings

After the completion of the decomposition, TOP/DOMDEC displays timing data for the decomposition.
From left to right the values displayed are:

- The time to decompose the mesh
- The time for optimization if optimization is selected
- The time of the overhead
- The total time of the process

All times are displayed in seconds.

Naming the decomposition

TOP/DOMDEC names the decomposition as follows:

- Name of the selected ***Element Set***.
- Add the extension "**.P**" or "**.L**" respectively for a Parabolic or Linear decomposition.
- Add the extension "**.n**" where n is the number of subdomains requested by the user. Note that this number might be different from the actual number of subdomains of the decomposition.

If an optimization algorithm had been used to decompose the ***Element Set*** TOP/DOMDEC adds the following extensions to the name of the ***Partitioned Mesh***.

- "**.SA**" or "**.DE**" respectively for Simulated Annealing or Deterministic optimization.
- "**.I**", "**.E**", and/or "**.A**" if Interface, Low Element, or Aspect Ratio criterion have been selected.

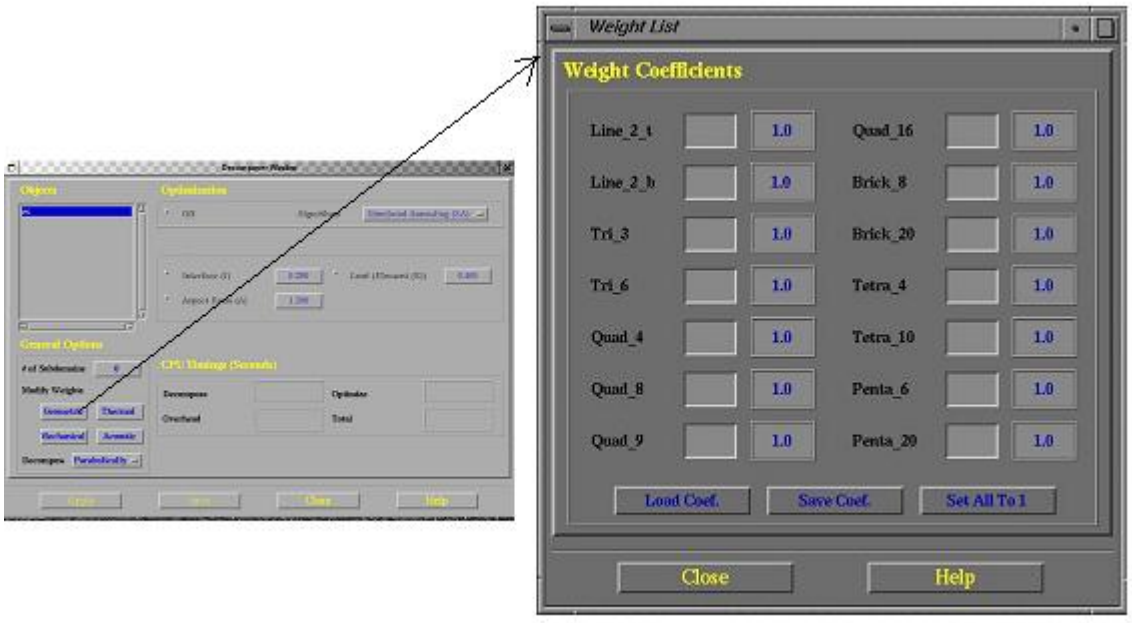
After the decomposition TOP/DOMDEC lists the new ***Partitioned Mesh*** as a regular ***Element Set*** in all browsers listing ***Element Sets***.

General Options

This part of the window is available when the user has selected at least one object from the browser. Here the user may enter the number of subdomains in the decomposition of the selected ***Element Set***.

The user may select either the Parabolic or Linear mode of decomposition. When decomposing parabolically, TOP/DOMDEC considers that elements may contain middle nodes (see section 1.3 Objects in TOP/DOMDEC). When decomposing Linearly, TOP/DOMDEC ignores all middle nodes.

The user may set a weight factor for each element type in TOP/DOMDEC. Clicking on "Geometric", "Mechanical", "Thernal" or "Acoustic" will open a window in which the user may set a new weight factor for any element type. As you can see the elements are grouped in the traditional FEM classes: M, H and A and one geometric section (window shown below in fig 3.15) for compatibility with previous versions of TOP/DOMDEC. The default weight for each element type is 1.0.



The next section explains the usage of the Weight List Windows.

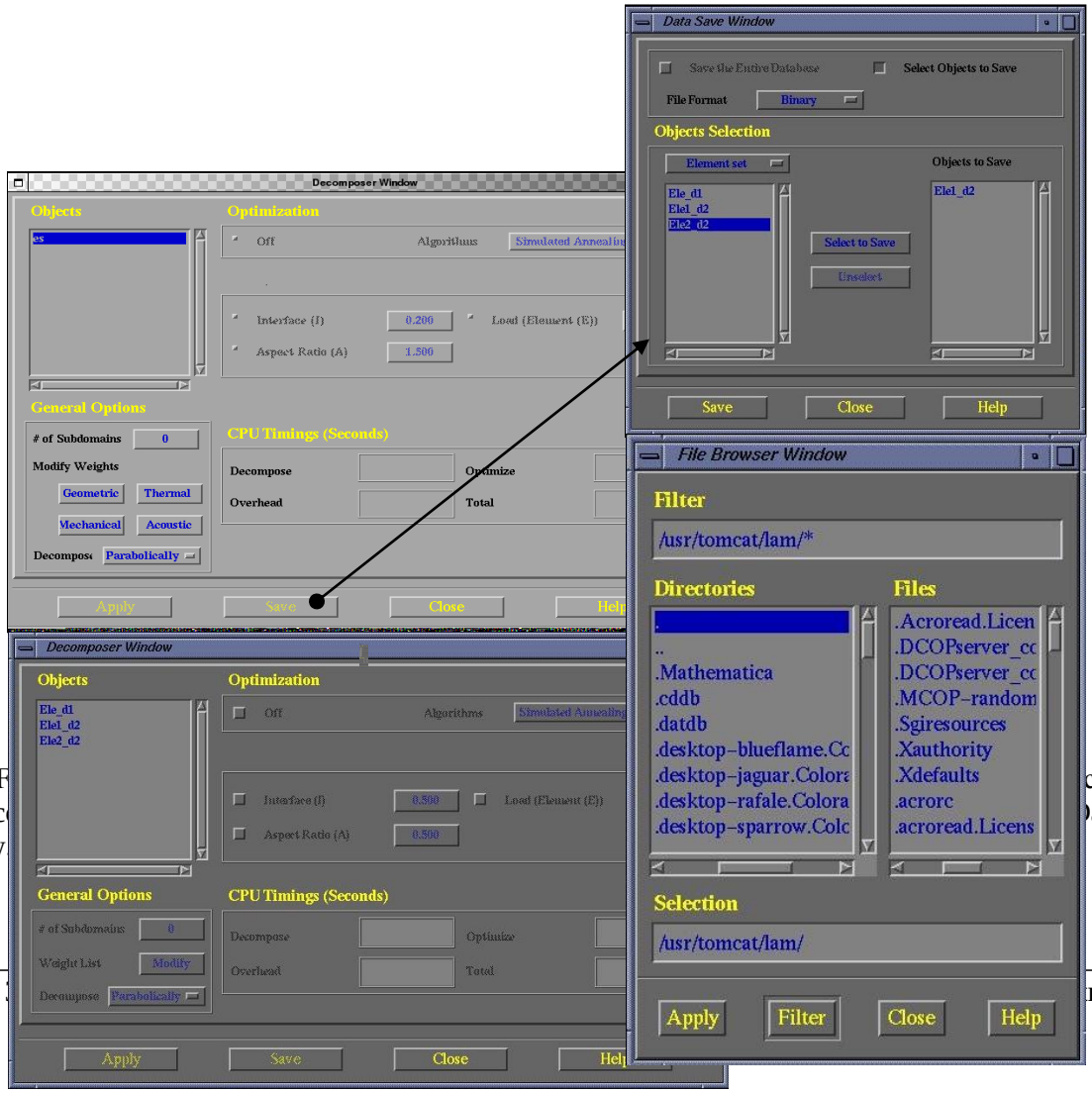
The Weight Window displays the list of element types with their respective weight factors.

Weights may be changed by two methods.

- Click on the prompt box for the desired element type and enter the new weight factor. After entering the number, the user must push the "Enter" key.
- TOP/DOMDEC can also load the entire set of weight factors from an input file (see section 2.9 (Weight Factors)). Clicking on the "Load Weight" button tells TOP/DOMDEC to load the set of weight factors from an input file. The name of the input file must be "***WeightFile***." This file can be located in any directory. However, the user must have in their home directory a file named "***.Xdefaults***" containing a line reading "***WeightFile: <path_name>***".
  If this file is not in the home directory TOP/DOMDEC will refuse to load the set of weights and display an error message.

The user may save the set of weight factors by clicking on the "Save Weight" button. TOP/DOMDEC will then save the set of weight values in the "***WeightFile***" file. If TOP/DOMDEC does not find the path of this file in "***.Xdefaults***" the weight factors will not be saved and an error message will be displayed.

After the decomposition has been completed, the user can save it by clicking the "Save" button located next to the "Apply" button. After clicking on this button, TOP/DOMDEC opens a file system window as shown in the next figure for the user to select the path and file name for the new decomposition. Be aware that the decompositions are saved only in ASCII format. No binary save mode is available for decomposition.



As shown in F can select the dec Data Save Window

3.2.3 Display

Under Display Option there are several possible options. Each option opens a new option window.

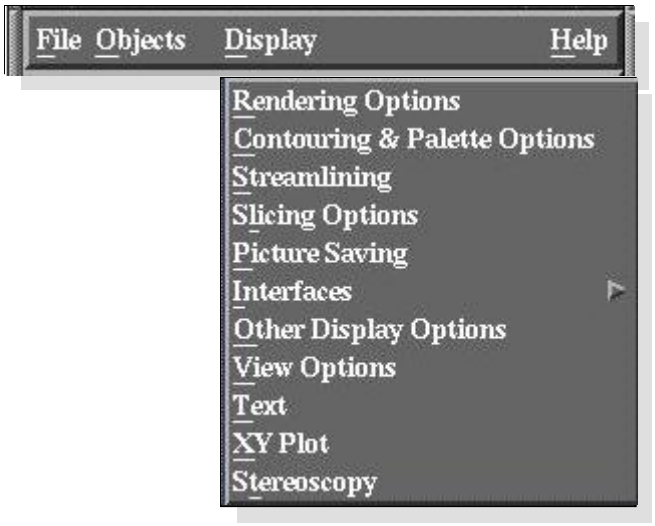
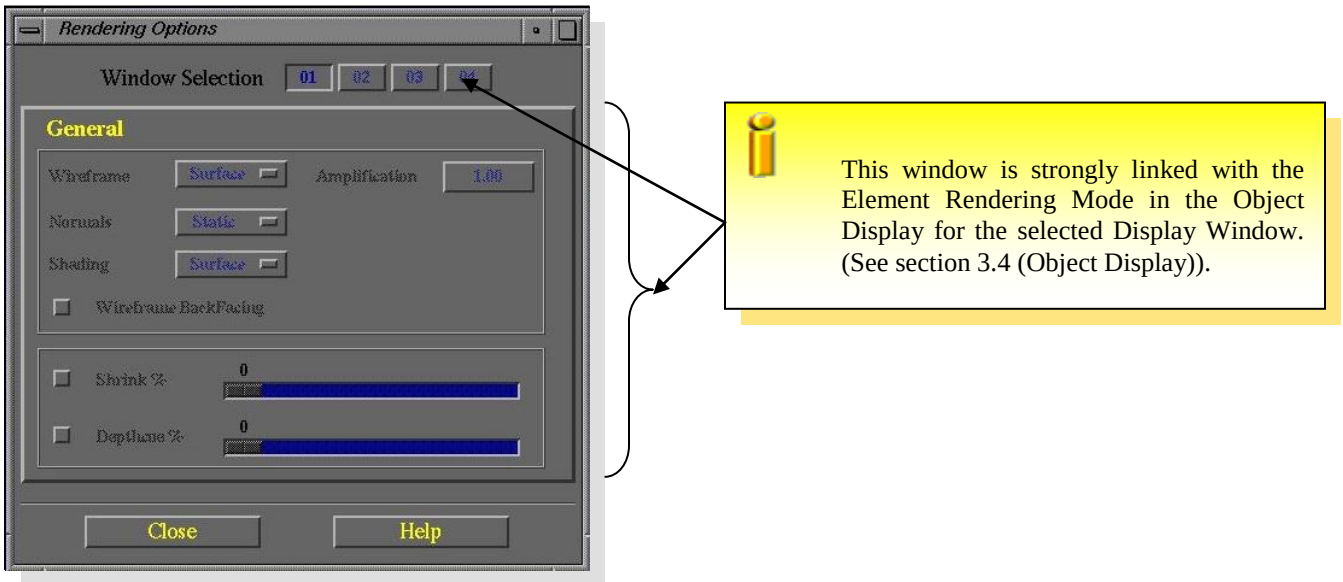


Figure 3.17 shows the Display Option of the Main Menu.

Fig. 3.17

3.2.3.1 Rendering Options

The first "Display" option is the Rendering Options Window, which adjusts how ***Element Sets*** are displayed in each **Display Window**. The **Display Window** is selected using the buttons at the top of the Rendering Option Window as shown in figure 3.18.



This window is strongly linked with the Element Rendering Mode in the Object Display for the selected Display Window. (See section 3.4 (Object Display)).

Fig. 3.18

Each option appearing in this window is explained in the following sections.

Wireframe

While rendering a three-dimensional wireframe, the user has the option of viewing all surfaces of the wireframe ("Full"), or only the outside surfaces ("Surface"). The default mode is "Surface" which saves computing time and memory. The difference between "Surface" and "Full" rendering is only noticeable for volumetric objects.

Normals

Normals are used for shading when any rendering (Solid, Surface, two-dimensional, three-dimensional) is combined with a ***Vector Results***. This option specifies the method by which the normals of the mesh surface are computed. Two choices are available, "Static" (default) and "Dynamic". When "Static" is chosen, the shading is computed on the un-deformed mesh, while "Dynamic" computes normals with respect to the (time-dependent) deformed shape. Thus, the "Dynamic" option requires more memory and CPU time.

Shading

This option selects between "Full" and "Surface" (default) shading of objects. When "Full" is selected, internal and external facets of the mesh are shaded. When "Surface" is chosen, only the external facets of the mesh are shaded. The "Surface" mode has faster response and uses less memory. However, "Full" mode should be selected for inspecting the inside of an object.

Wireframe Backfacing

This is a checkbox type chooser, so it is either "On" or "Off". The concept of shading makes sense only when thinking of objects with surfaces. If the objects are rendered only as Wireframe, the user may still wish to see differences between the internal and external skins. This option allows the user to shade the wire itself.

Amplification

This option is available when a ***Vector Results*** has been selected for the ***Element Set (s)*** in a given **Display Window**. For better visualization of the deformed shape, the user can enter an amplification factor for the displacement results. The greater the factor the more deformed the object.

Shrink

This option shrinks decomposed objects in a given **Display Window** to a specified percentage of their original size. This can give better insight into the true shapes of, and relations between, multiple three-dimensional objects.
To shrink subdomains, click on the checkbox to the left of the label "% Shrink". The label will turn black and the slider to the right becomes available. Adjust the slider to alter the amount of shrinking. Moving the slider right corresponds to a greater percentage of shrinking.

Depthcue

This option controls the amount of light the rendering receives. It can enhance the three-dimensional perception of an object. To "dim" the lighting, click on the checkbox to the left of the label "% Depthcue". The label will turn black and the slider to the right becomes available. Moving the slider right corresponds to dimming the light received by the rendering.

Note that options in this window are not available at all times. The following describes when options are available.

Option availability

- The "Wireframe Backfacing" option is available only if the element rendering display mode is either "Wireframe" or "Solid/Wireframe".
- The "Normals" and "Shading" options are available only if the element rendering display mode is either "Solid" or "Solid/Wireframe".
- The "Amplification" option is available only if a ***Vector Results*** has been selected for the ***Element Set(s)*** of the given **Display Window**.
- The "Shrink" option is available only if the ***Element Set(s)*** displayed in a given **Display Window** is a Decomposed Object.

When a chooser is available, the label to its left is displayed in black, otherwise the label is gray.

For more information on making choices with the Options type choosers of this window, see sections 1.4.4 (Buttons And Choosers).
*For more information on setting the rendering mode of an **Element Set** see section 3.3.1.1 (Element Rendering).*
*For more information on selecting a **Vector Results** see sections 3.4 (Result Selector) and 3.3.2 (Results Options).*

The next pages show in detail most features of this window.

This sequence of figures demonstrates the "Amplification" option of the Rendering Options Window.

Fig 3.19 (b)

The FULLCONE of the second active window is using wireframe rendering and has the selected ***Vector Results*** applied.

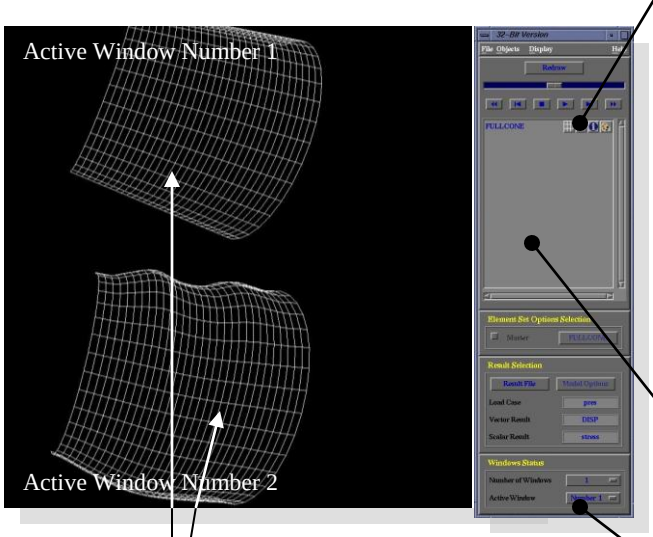


Fig 3.19 (a)

The Windows Status part of the Main Controller shows that the Element Controller for the bottom **Display Window** is currently active.

Window one (top) has an amplification factor of 1.0. Window two (bottom) has an amplification factor of 50.0.

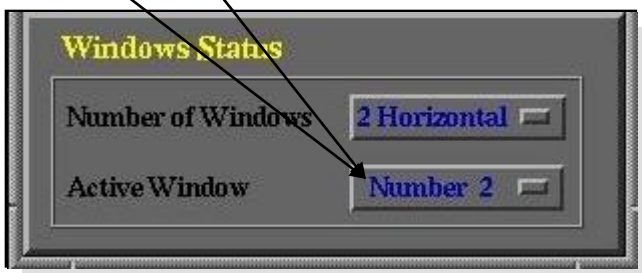
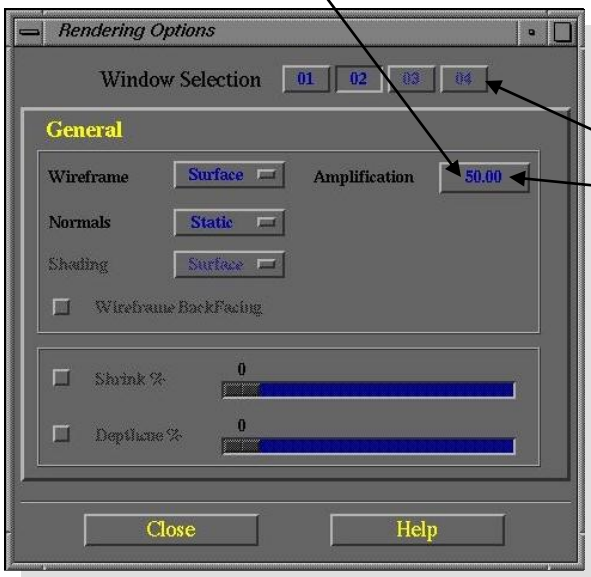


Fig 3.19 (c)



Since a ***Vector Results*** has been applied, the "Amplification" option of the Rendering Options Window is available.

Fig 3.19 (d)

This figure demonstrates the "Shrink" option of the Rendering Options Window.

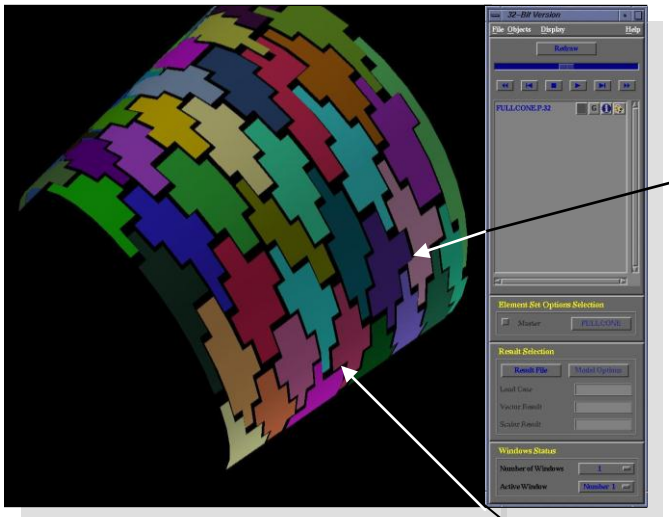


Fig. 20(a)

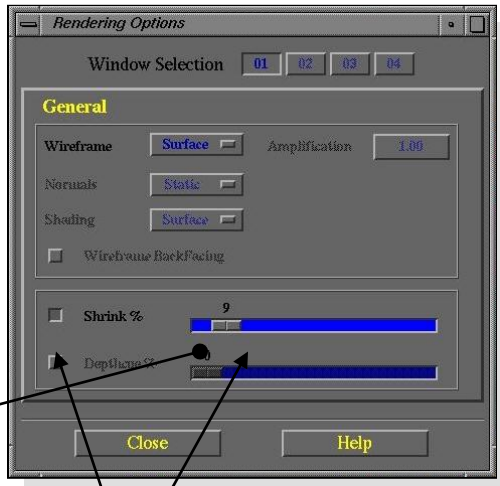


Fig. 20(b)

The "Shrink" option has been turned "On" and the percentage of shrink has been set to 9 percent of the original size of the decomposed object.

In this example, the ***Element Set*** "FULLCONE" has been decomposed in 50 subdomains. (For more information on the visualization of decomposed objects see section 3.3.3 (Data Information)).

This figure shows the usage of the "Wireframe" option. One can see the difference between "Surface" (**Display Window** 1) and "Full" (**Display Window** 2)

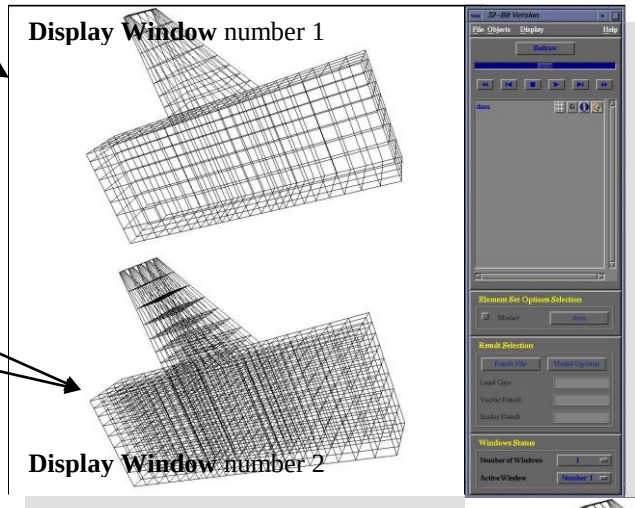


Fig. 21(b)

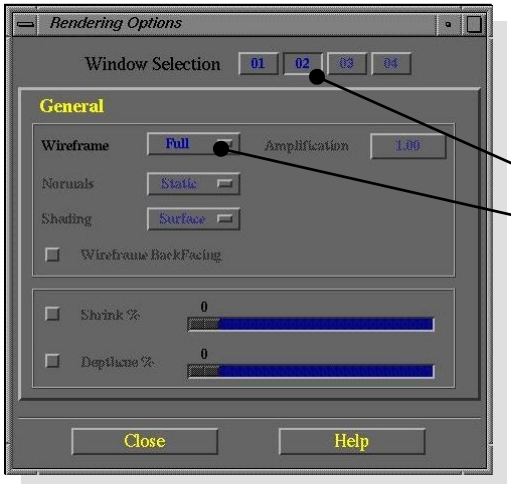


Fig. 21(a)

3.2.3.2 Contouring & Palette Options

The Contouring and Palette Options Window is opened by choosing “Contouring & Palette Options”as shown in figure 3.22

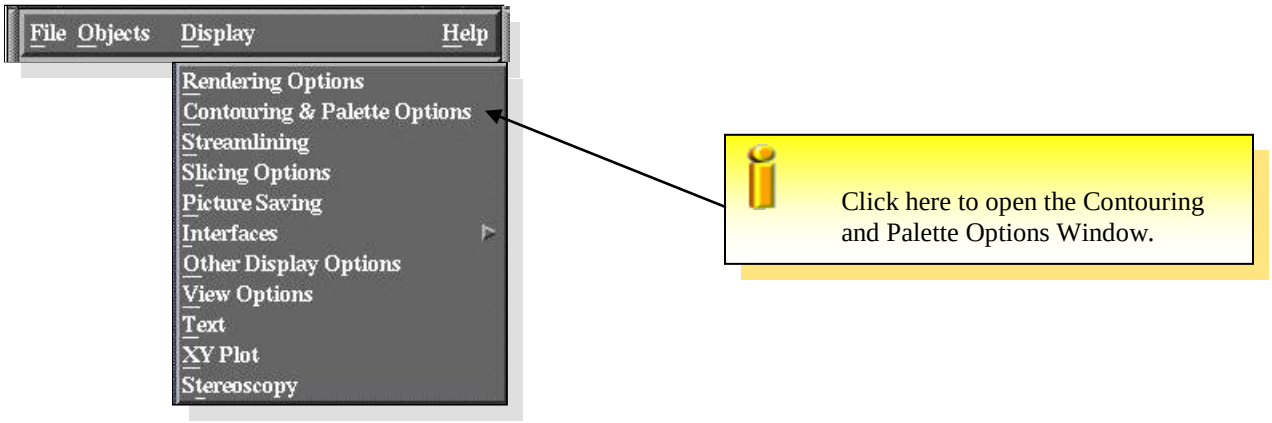


Fig. 3.22

This window is designed to select the desired contouring options, such as the three (or two)-dimensional isovalues, and the palette of colors to apply to a given **Display Window**. The Contouring And Palette Options Window is shown in figure 3.23. Each option in this window is explained in the next sections.

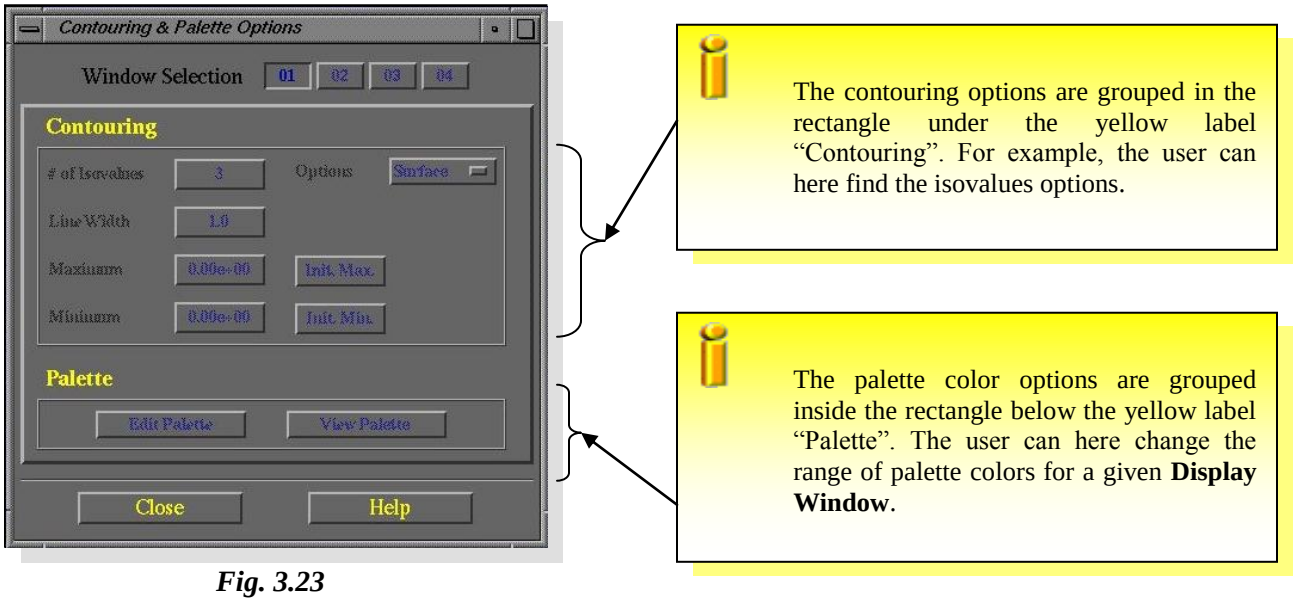


Fig. 3.23

Contouring Options

TOP/DOMDEC provides three "Contouring" options, which affect the rendering of ***Scalar Results***. The following sections explain each of these options. These options are only available if a ***Scalar Results*** has been selected for a given **Display Window**.

Options

This is an "Options" type chooser. (See section 1.4.4 (Buttons and Choosers)) It gives the user three possibilities: "Full", "Surface", and "Isovalues". The user can visualize the internal contour plot by selecting the "Full" mode. The "Surface" mode allows the user to visualize only the contour plot on the surface of the object. The "Isovalues" option extracts and draws as many isovalues as the user specifies, between the minimum and the maximum values.

# of Isovalues, Line Width

These options control the number of isovalues to be drawn and their width. The buttons are used to input the desired values. (For more information about inputting a number see section 1.4.6 (Input Window)). These two options are available only when the chooser "Options" described above is set to "Isovalues".

Maximum and Minimum values

These values are computed by TOP/DOMDEC when an object is drawn with ***Scalar Results***. These values are the extreme values found in the selected ***Scalar Results*** for this object. The user may adjust the computed values.
TOP/DOMDEC saves the original values so the user may recover the "initial" minimum and maximum values by clicking on the "Init. Min" and "Init. Max" buttons respectively.

When using "Isovalues" with a ***Partitioned Mesh*** TOP/DOMDEC does not shrink the isovalues with the mesh.

Palette Options

TOP/DOMDEC has a pre-defined color palette ranging from blue to red. The palette may be changed by using the "Edit Palette" window by clicking on "Edit Palette". The current palette can be viewed in the Color View window by clicking on "View Palette". The following section explains these windows.

3.2.3.2.1 Color View Window

The Color View Window appears by clicking on "View Palette" in the Contouring Window as shown in figures 3.24(a) and 3.24(b).

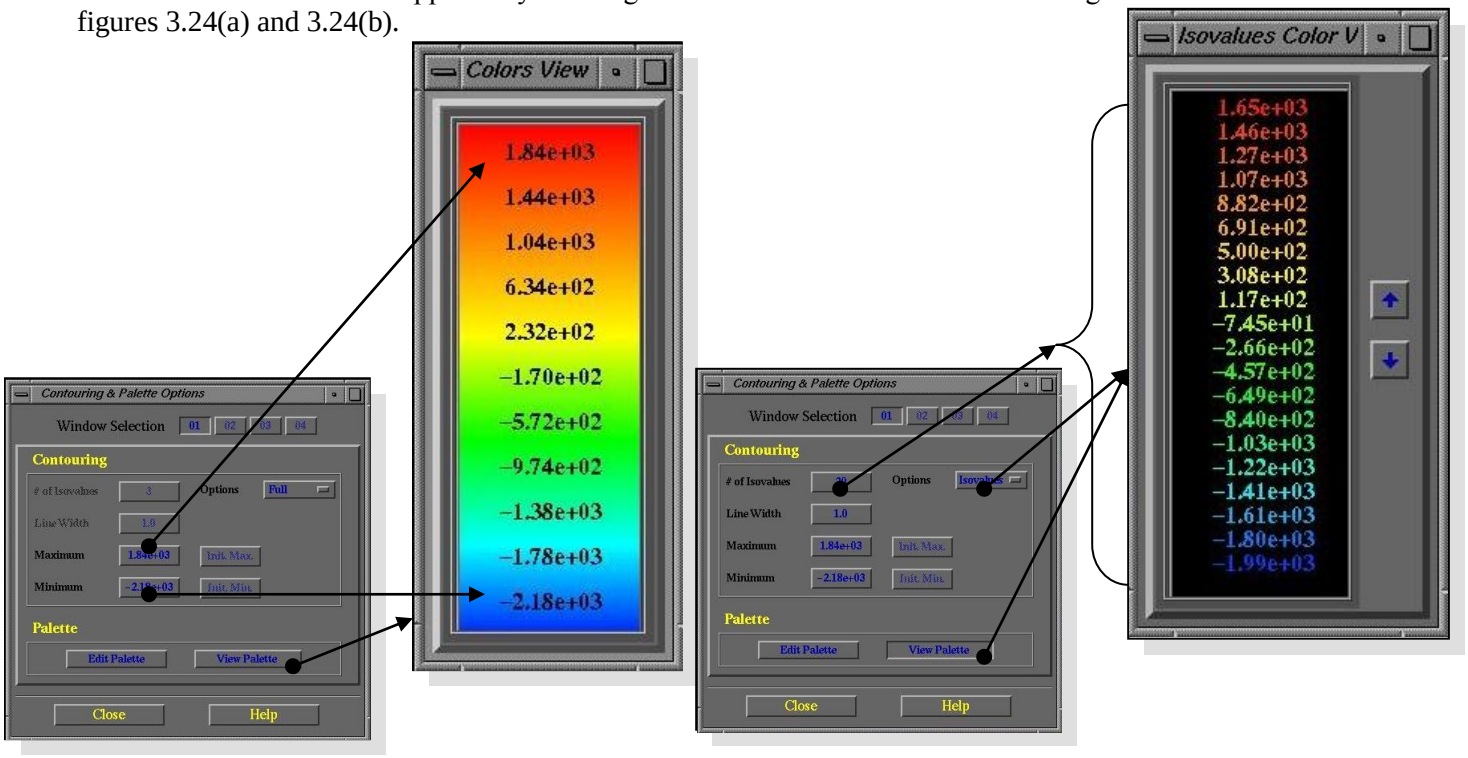


Fig. 3.24(a) ***Fig. 3.24 (b)***

How to read this window?

- Clicking on the "View Palette" button while the "Options" chooser is set to either "Full" or "Surface" opens the Color View Window as in figure 3.24(a). If the "Options" chooser is set to "Isovalues", this opens the Color View Window as in figure 3.24(b).
- The Color View Window is a single rectangle with range of colors and values. This range corresponds to the palette colors used by TOP/DOMDEC. This range can be changed with the Edit Palette Window as described in the next section. In the above example, the range of colors is the default.
- In figure 3.24(a) the range corresponds to a distribution between extreme values found by TOP/DOMDEC for the selected ***Scalar Results*** for the given **Display Window**. This range is automatically updated if the user changes the minimum and maximum values.
- In figure 3.24(b) the range contains values of the isovalues drawn by TOP/DOMDEC. There are as many values as the number of isovalues. TOP/DOMDEC displays up to twenty isovalue values at a time. If there are more than twenty, the next (or previous) twenty values can be displayed by clicking on the two buttons on the right. Each value is displayed with the color used to draw the corresponding isovalue. TOP/DOMDEC updates these values as the minimum and/or the maximum values change.

3.2.3.2.2 Edit Palette

The Edit Palette Window sets the color palette used to display objects in the given **Display Window**. TOP/DOMDEC maps ***Scalar Results*** with this color palette.

This window is shown in figure 3.25. The following sections explain the functionalities of this window and its options.

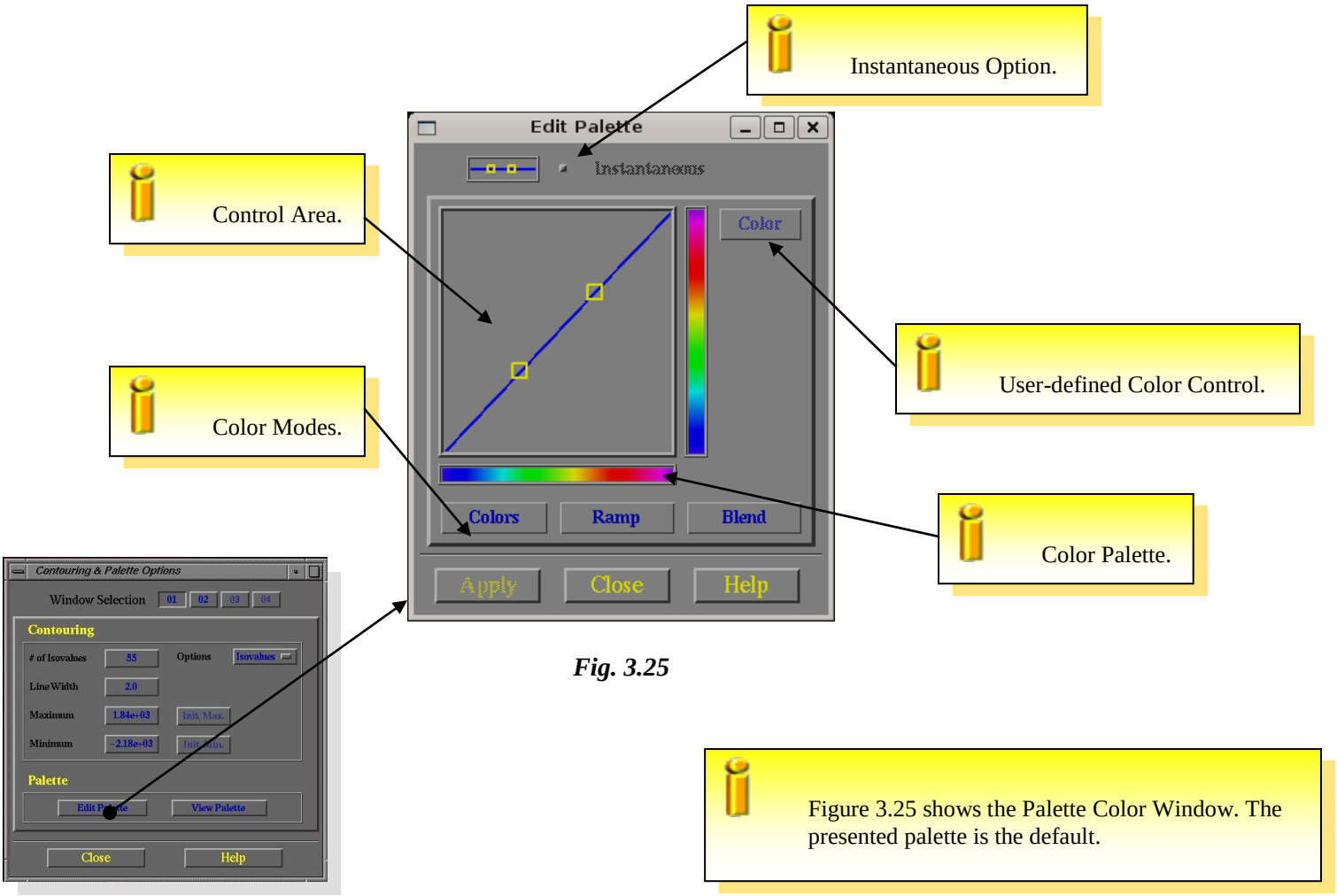


Fig. 3.25

Control Area

The Control Area, shown in figure 3.25, is a square area with a blue diagonal line, and has two yellow "cursors". This area is used to create a color palette and map the values of the selected ***Scalar Results*** onto these colors. Clicking inside the area will move the closest square to the point clicked. By holding the left button of the mouse and moving the mouse inside the area the user changes the color palette.

Color Modes

TOP/DOMDEC has three different modes of color display: “Colors”, “Ramp”, and “Blend”. The “Colors” mode allows discrete color mapping of the rendering. The “Ramp” mode is useful for computers with gray scale displays, and is convenient for observing differentiation within a field of a single color. Finally, the “Blend” mode allows blended color mapping to achieve a broader spectrum of differentiation.

Color Palette

This color palette is used to map the ***Scalar Results***. It is automatically updated as the user makes color changes.

Instantaneous Option

This option causes the instantaneous mapping of the ***Scalar Results*** without requiring the user to confirm color changes with the “Apply” button. This option can be very expensive and any animation might slow down while TOP/DOMDEC makes the changes.

User-Defined Color Control

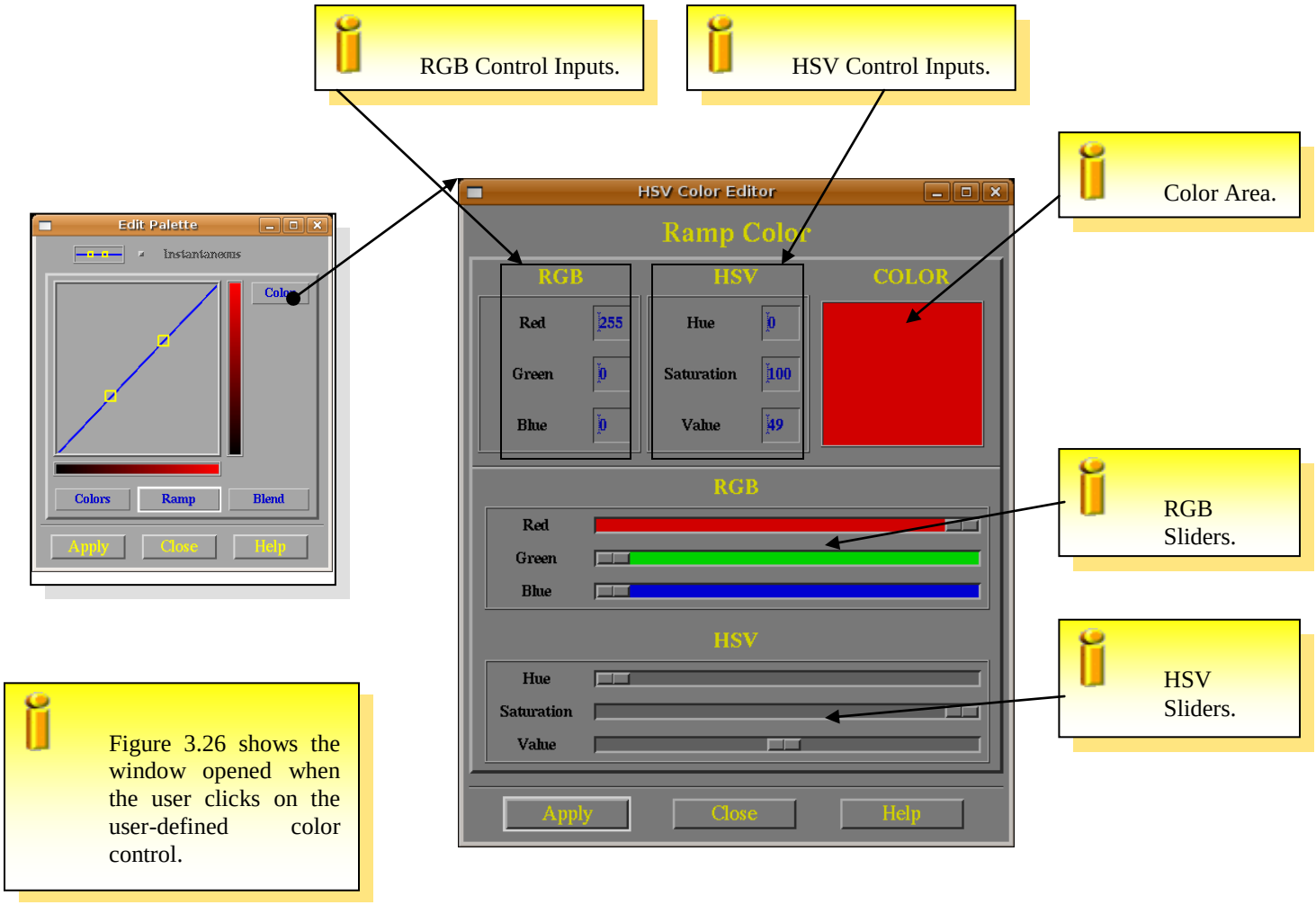
This control allows the user to change the color used in “Ramp” mode (see Color Modes). Clicking tit opens a new window (shown in figure 3.26) in which the user can change the selected color. When the color is changed, TOP/DOMDEC automatically updates the color area on the right and the color palette.

Apply Button

This button is available when changes have been made to the color palette. Clicking the “Apply” button “re-maps” the ***Scalar Results*** with these colors. TOP/DOMDEC does not change the mapping until the user has pushed on the “Apply” button unless the “Instantaneous” option is “On”.

The next section explains how to change the user-defined “Ramp” color .

3.2.3.2.2.1 HSV Edit Color



The following sections explain the functionality of this window and its options.

RGB Control Inputs and RGB Sliders

These controls allow the user to set the amount of red, green, and blue in the selected color. The user can move each of the sliders (see section 1.4.8 (Sliders)) or enter a number in a prompt box (see section 1.4.5 (Prompt Boxes)) to modify the amount of the corresponding color to be used in the final color.

HSV Control Inputs and HSV Sliders

These function similarly to the RGB Control Input and Sliders, but may allow the user to adjust the desired color easier. The meaning of the "HSV" is as followed:

- The letter "H" stands for Hue. Hue represents the basic family of the color. For example, there are many different shades of red, but they all have the same basic hue.

.

- The letter "S" stands for Saturation. The saturation of a color measures the purity of the color. A fully saturated red, for instance, is pure red. A less saturated red has an amount of green and blue mixed in.

- Finally, the letter "V" stands for Value of light (or Brightness). It describes how much white or black is mixed with a color.

Color Area

The Color Area displays the color as the user makes changes. TOP/DOMDEC automatically updates this area.

Apply Button

TOP/DOMDEC updates the color palette with the new color only when the user clicks on the "Apply" button. This confirms the final color replace of the previous color.

The following pages show some examples of usage of the Contouring and Palette Options Window.

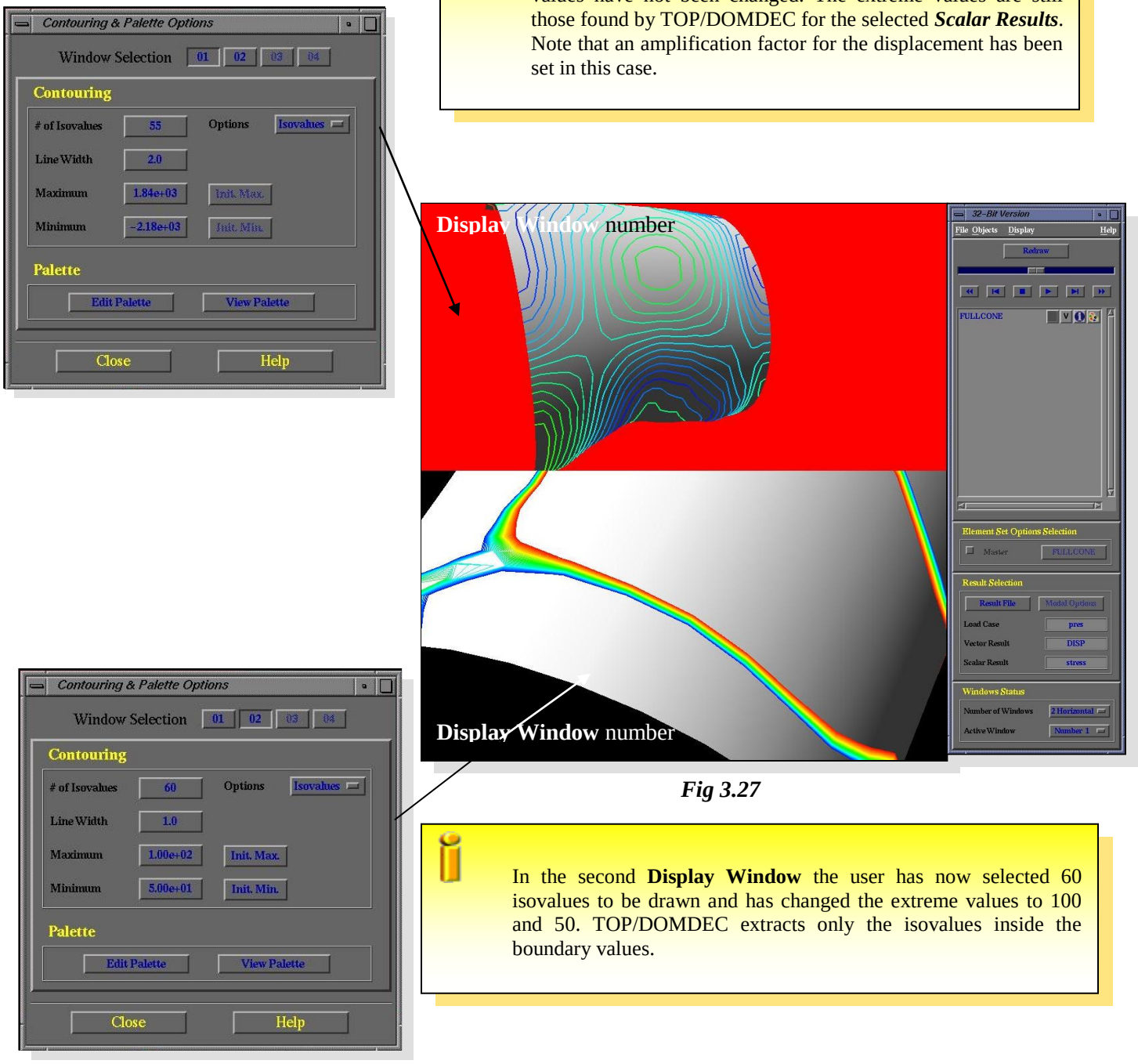


Fig 3.27

For **Display Window** number 1 the user has asked for 55 isovalues to be drawn. The palette of colors and the extreme values have not been changed. The extreme values are still those found by TOP/DOMDEC for the selected ***Scalar Results***. Note that an amplification factor for the displacement has been set in this case.

In the second **Display Window** the user has now selected 60 isovalues to be drawn and has changed the extreme values to 100 and 50. TOP/DOMDEC extracts only the isovalues inside the boundary values.

The next picture shows an example of three-dimensional isovalues.

In this figure, both **Display Window**s show the same object and same ***Scalar Results***. In the first **Display Window** 12 three-dimensional isovalues have been drawn.

Note that the three-dimensional isovalues are set by selecting the "Full" option of the "Options" chooser of the Contouring & Palette Options window.

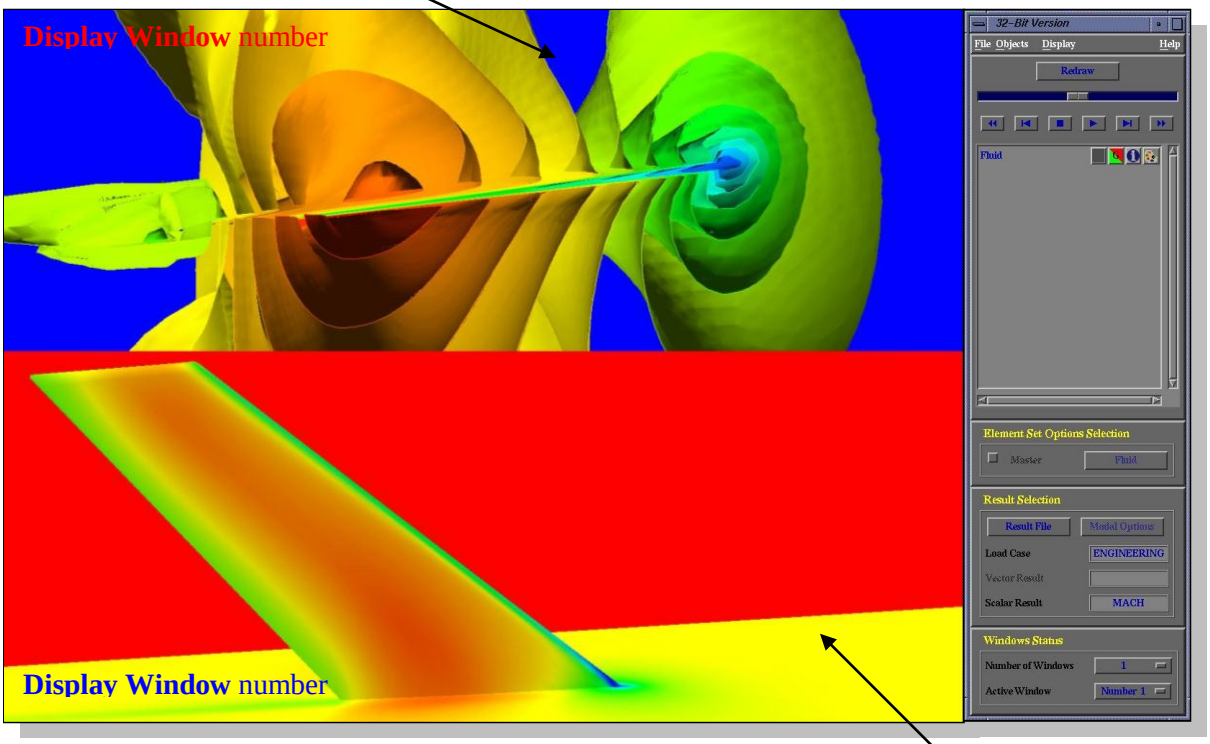


Fig. 3.28

In the second **Display Window** the ***Scalar Results*** have been drawn with "Surface" contours. Note that both windows use the same color palette. Thus, the color of the isovalues in the first **Display Window** corresponds to the color of the contour plot in the second **Display Window**.

Note that the object in the second **Display Window** has been rotated from the orientation of the object in the first **Display Window**.

3.2.3.3 Streamlining

Clicking on the "Streamlining" option of the Display Menu Option, as shown in figure 3.29 opens the Streamlining Window. The next sections discuss this window and its options.

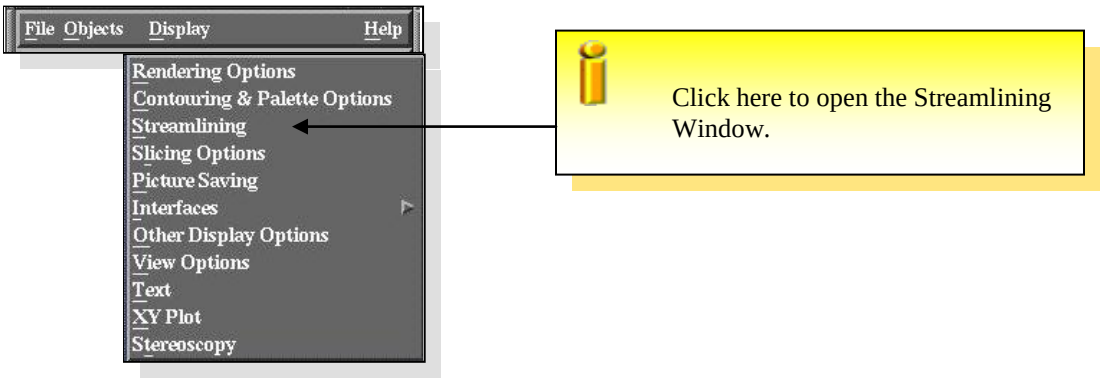


Fig. 3.29

The Streamlining Window is designed to easily select where particles start in a fluid mesh for a given **Display Window**. This window is shown in figure 3.30.

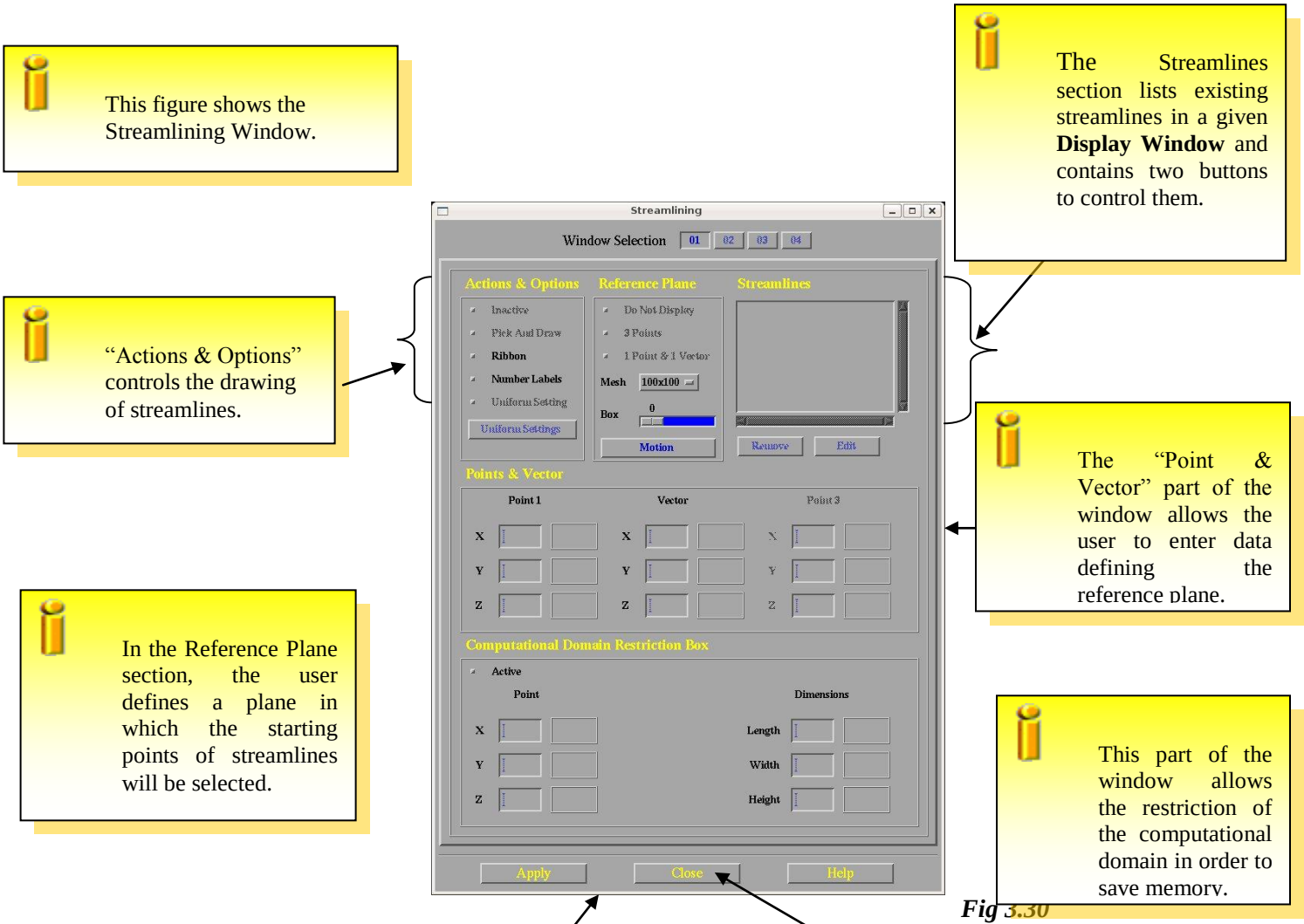


Fig 3.30

TOP/DOMDEC can only draw streamlines for a fluid mesh with a set of ***Vector Results*** whose name is "VELOC". Otherwise, this window is not available.
The following sections explain each part of the Streamlining Window.

Actions & Options

Here, the user can find options for drawing streamlines. These options are explained below.

Active/Inactive

This chooser must be turned "On" to draw streamlines. It is available if, for a given **Display Window**, the ***Element Set*** has ***Vector Results*** with the name "VELOC". When turned "On" the label shows "Active" and all the other options of the window become available. If this option is "Off", the label on its right shows "Inactive" and TOP/DOMDEC will not draw any streamlines in the given **Display Window**.

Pick And Draw

This option allows the user to click on the user-defined plane that has been drawn by TOP/DOMDEC (for more information on how to set a plane see below) to specify where to start the streamline. TOP/DOMDEC then starts the drawing process of the streamline at the specified point.

TOP/DOMDEC starts drawing the streamlines by finding the first element containing the selected point in the mesh. If TOP/DOMDEC cannot find any starting element, it stops drawing and gives control back to the user (for a more precise pick). Otherwise, TOP/DOMDEC searches for the next element containing the particle and continues this process until the end of the mesh. It may take several seconds to draw the streamline (usually the first one takes the longest to draw). Thus, while drawing any streamline TOP/DOMDEC is in a busy state showing a black and white watch icon. The user is not allowed to perform any action during the inspection/drawing. When TOP/DOMDEC has completed the drawing, the streamline is listed on the right side of the window and control is given back to the user.

While the "Pick And Draw" option is "On", TOP/DOMDEC is waiting for the user to click in the **Display Window** to select a starting point. The user may not perform any other action (such as moving the object). To turn off this "clicking" state of the **Display Window**, click on the "Done" button at the bottom left of the window.

Ribbon

This option allows the user to visualize the streamlines in ribbon mode. This may help to have better insight of how the particle is moving, since ribbons can show twisting while normal lines cannot. Turning "On/Off" this option automatically redraws the streamlines with the desired mode.

Number ID Labels

When drawing the streamlines TOP/DOMDEC labels them with sequential numbers. These labels appear at the beginning of each streamline. By default TOP/DOMDEC shows the streamline numbers. Turning this option "Off" removes the labels.

Uniform Setting

This option allows to group-assign all of the streamlines a given color and/or width, using the Uniform Settings button described below. Selecting and deselecting this option allows to move back and forth between the original colors and sizes and the assigned uniform color and size.

Uniform Settings

This button chooser opens a window as shown in figure 3.31 where the user can either choose a new color or a width (or both) to apply to all streamlines.

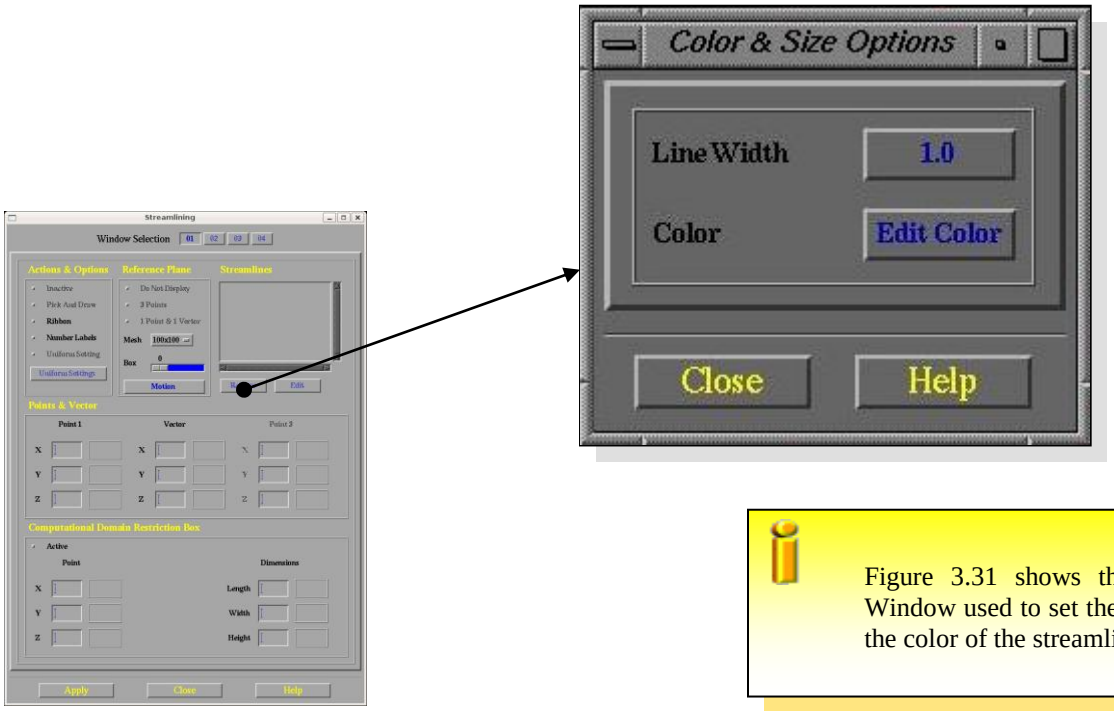


Figure 3.31 shows the Color and Size Window used to set the uniform width and the color of the streamlines.

Fig. 3.31

Reference Plane

In this group of options the user can define and manipulate the plane from which the streamlines start. The following sections explain each of these options.

Display/Do Not Display

When this option is "On" the label reads "Display", otherwise the label reads "Do Not Display". This option toggles the drawing of the reference plane in which the streamlines start. To define the plane, the user must click this option "On"; otherwise TOP/DOMDEC refuses to proceed to the plane definition.

3 Points

This option allows the reference plane to be defined with 3 points specified by the user. TOP/DOMDEC will accept three points with x, y, and z coordinates. To enter the coordinates of the points, see below in section "Points & Vector." If this option is "On" then the option "1 Point & 1 Vector" is turned "Off."

1 Point & 1 Vector

This option allows the reference plane to be defined with 1 point and 1 vector specified by the user. TOP/DOMDEC will accept the point's coordinates and the vector's components. To enter the coordinates of the point see the section "Points & Vector." If this option is "On", then the option "3 Points" is turned "Off."

Mesh

The reference plane is drawn by TOP/DOMDEC as a red square plane with a hundred small squares. The plane is centered on the object. For some objects, the default number of squares will be sufficient to pick starting points. However, some objects may require the user to increase the precision (to add more squares) using this option. TOP/DOMDEC provides up to 500x500 squares in the plane and automatically redraws it as the number of squares is adjusted.

Box

The size of the plane drawn by TOP/DOMDEC is based on the maximum size of the fluid mesh. For some cases this size might be too big and the user might not be able to click with precision on the point where they want the streamline to start. With this slider the user is now able to reduce the size of the plane to focus on a particular area more precisely. By default TOP/DOMDEC always draws the plane at its maximum size.

Motion

This option allows the user to move the reference plane. This button opens a new window as shown in figure 3.32.

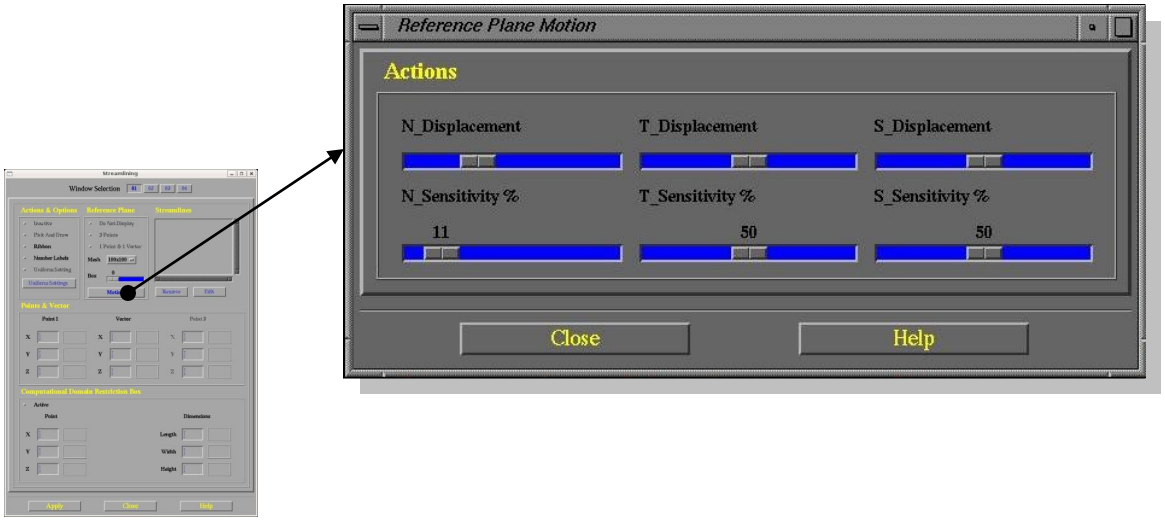


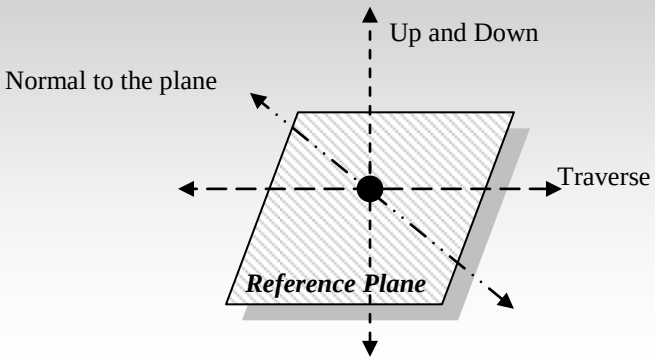
Fig. 3.32

Figure 3.32 shows the Reference Plane Motion Window opened by clicking on the "Motion" button as shown.

The next section explains how to use the Reference Plane Motion Window.

How to use the Reference Plane Motion Window

The window has six sliders, organized in three groups, each with two sliders. In order, from left to right they move the plane in a direction normal to the plane (N_Displacement and N_Sensitivity), traverse in the plane (T_Displacement and T_Sensitivity) and up and down (S_Displacement and S_Sensitivity.)



Streamlines

In this set of options the user can set the color and width for a streamline individually (rather than all streamlines uniformly, as discussed above) or remove a streamline. The next sections explain these options.

List

This browser is a multiple selection browser (see section 1.4.7 (Single and Multiple Selection Browsers) for more information about browsers) and does not support the double-click feature.
This browser lists the currently drawn streamlines. It is not available in the "Pick and Draw" mode. When using "Pick And Draw" clicking on the "Done" button indicates that no more streamlines are being entered for the moment. TOP/DOMDEC then sets this browser so that the user can select the streamline that they wish to modify or remove.

Remove

The "Remove" button is available when at least one listed streamline is selected. Clicking this button removes the selected streamline(s) from the given **Display Window** and updates the list.

Edit

This button is available if the user has selected only one streamline from the list. Clicking on it opens a new window to adjust the width and the color of this selected streamline. This window is shown in figure 3.33.

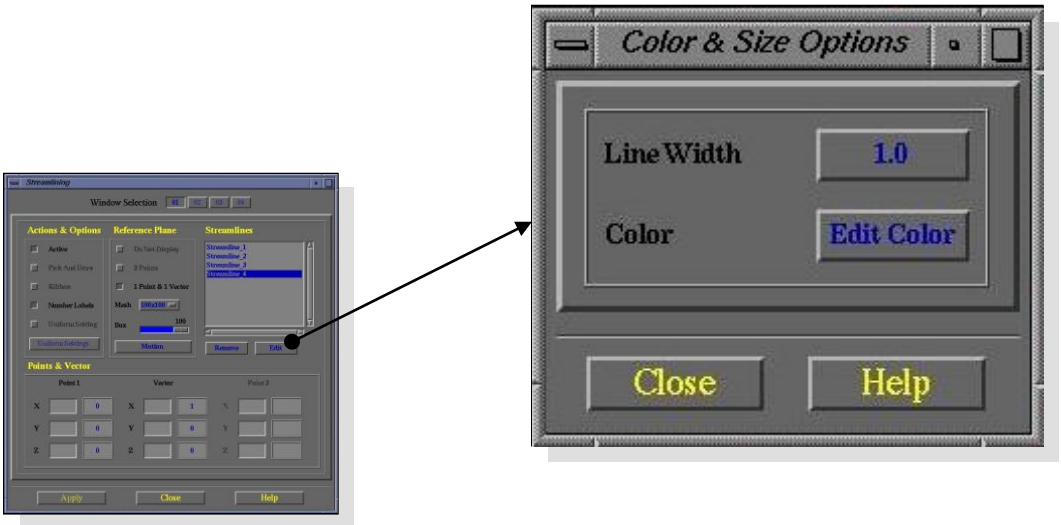


Fig. 3.33

Figure 3.33 shows the window opened by clicking on the "Edit" button. It is used to set the width and color of the selected streamline.

Points & Vector

This part of the window is used to enter the coordinates of the points and the components of the vector that define the reference plane.
If the desired plane is defined by three points, then TOP/DOMDEC expects the user to enter all the coordinates of the three points. When defining the plane by one point and one vector, then the "Point 2" label becomes "Vector" and the prompt boxes beneath the "Vector" label are used to enter the three components of the vector. The "Point 3" boxes are not used in this case.
After entering the point coordinates and/or vector components, click on the "Apply" button at the bottom left of the window. Any field left empty is considered as a zero value.

The following illustrates of the usage of this streamlining window.

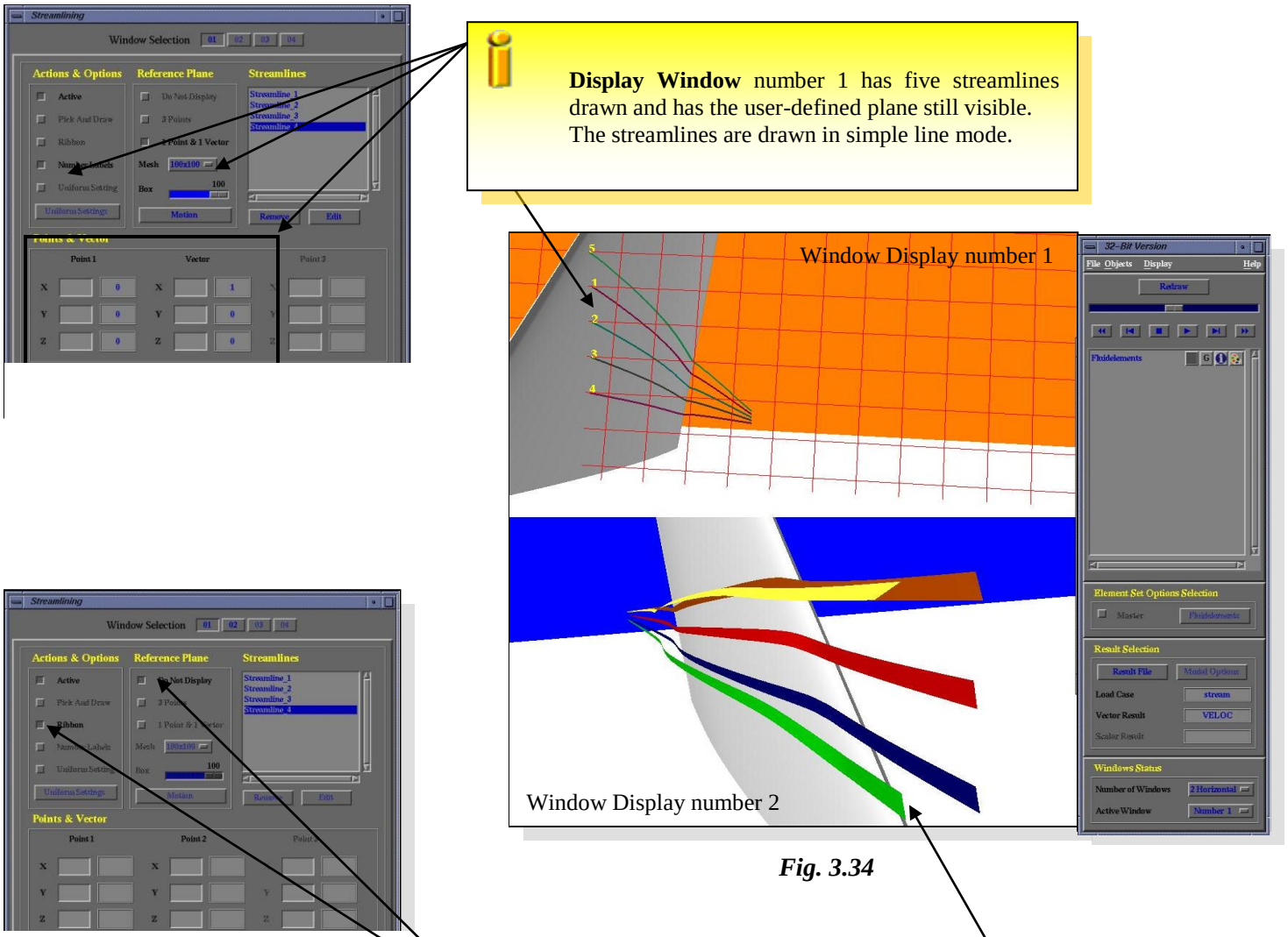


Fig. 3.34

Computational Domain Restriction Box

Most of the time, the fluid mesh used to compute the streamlines is very large and therefore covers a huge domain. However, the part of a streamline of interest is often located in a small volume that is a very small subset of the computational domain. This optional feature allows the user to restrict the computation and visualization of the streamlines to the region delimited by a specified box, in order to reduce TOP/DOMDEC's memory consumption and CPU time.

The box is simply specified by a point representing one of the corner points on one of the faces of the box, and the length, width and height of the box (see figure 3.30). The Active/Inactive switch should be used to activate or turn off the restriction at any time. Note that the reference plane must intersect the chosen box. Otherwise, any chosen starting point for a streamline will fall outside the box, be discarded, and therefore will not initiate the drawing of any streamline.

"Step by Step Instructions

The following section gives "step by step" instructions for the activation of the streamline feature.

- The selected ***Element Set*** should correspond to a fluid mesh.
- ***Vector Results*** named "VELOC" must be selected for the given **Display Window**.
- Once the ***Vector Results*** is selected, the "Active/Inactive" option should become available. Click on this chooser.
- The "Reference Plane" mode should be "Do Not Display". Click, now on either "3 Points" or "1 Point & 1 Vector" and enter the coordinates of the point(s) (and/or the components of the vector).
- Once the coordinates are entered click on the "Apply" button. If an object has been already drawn, then the plane should appear immediately, otherwise the plane will appear with the next object drawn in the **Display Window**.
- Once the plane and object are drawn, move the plane (with the Motion Window) to the desired location to start the streamlines.
- Click on "Pick And Draw" to begin drawing the streamlines. When done, don't forget to turn "Off" this option by clicking on the "Done" button. Otherwise, TOP/DOMDEC will continue to draw streamlines as you click on the **Display Window**.
- The Streamlines Options can then be used to edit or remove individual streamlines.

3.2.3.4 Slicing Options

This is a new feature in TOP/DOMDEC. It is especially useful when one wants to visualize results on the inside of a mesh. Clicking on the "Slicing Options" as shown in figure 3.35, opens the "Slicing Options Window" as shown in figure 3.36.

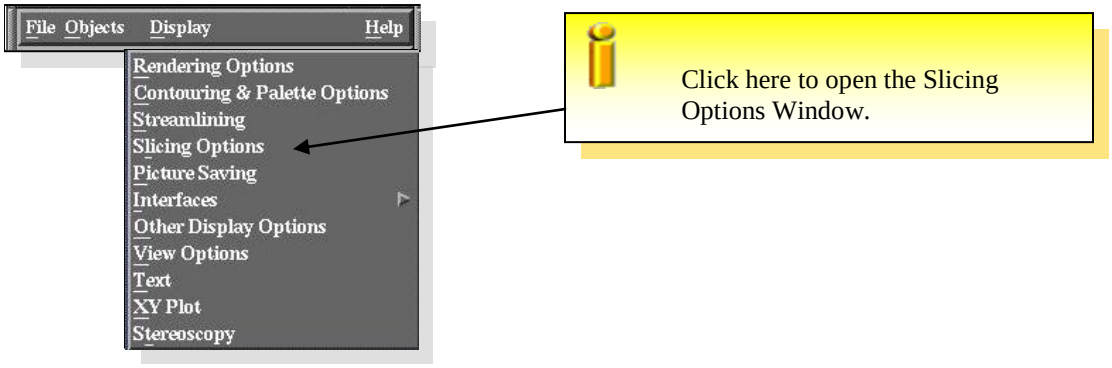


Fig. 3.35

The following figure shows the "Slicing Options Window" and its options.

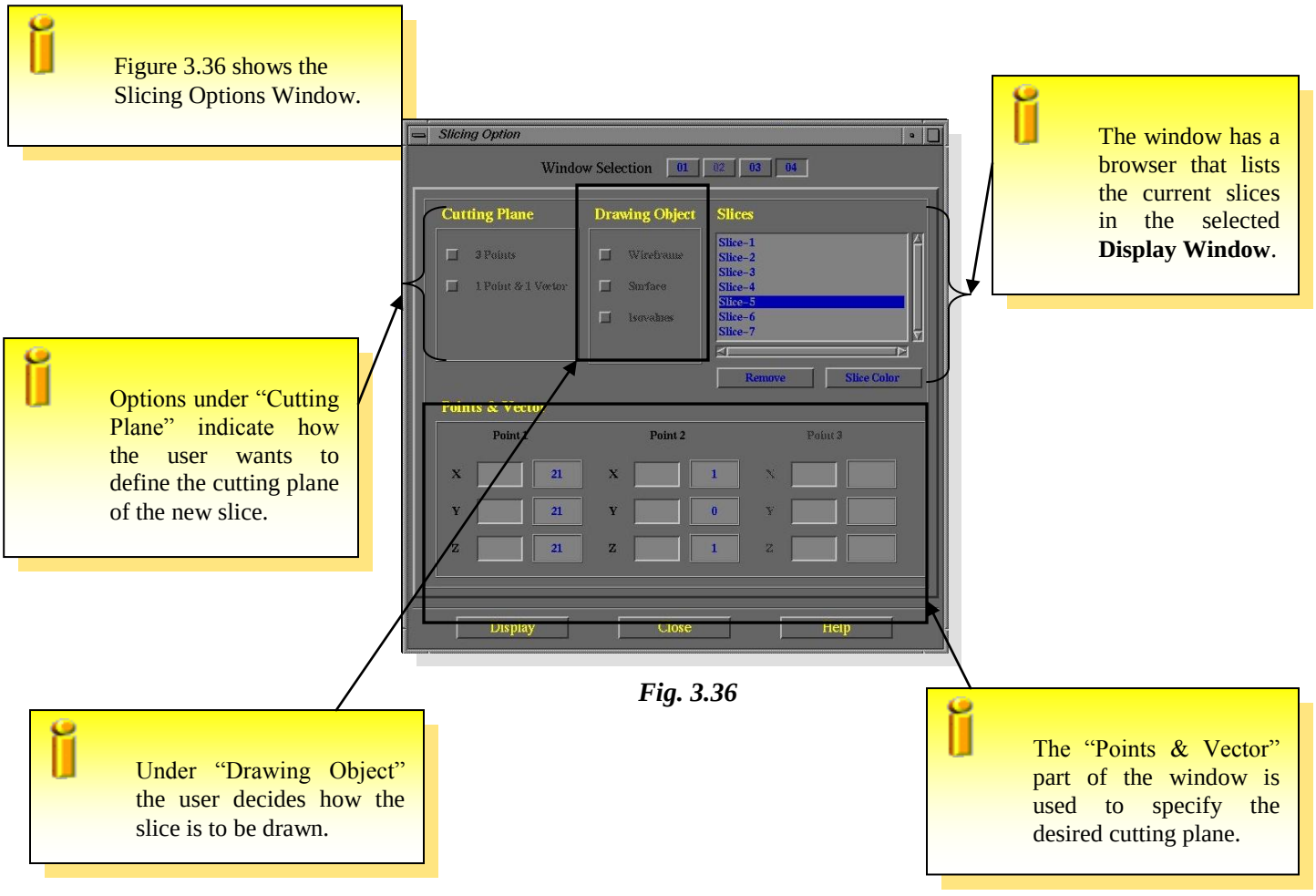


Fig. 3.36

The following explains in detail the options of the Slicing Options Window.

Cutting Plane

The "Cutting Plane" chooser determines how the cutting plane will be defined. As for the streamlines discussed above, the user defines the cutting plane with either three given points or one point and a vector. Since TOP/DOMDEC creates the slice according to the ***Element Set (s)*** present in the given **Display Window**, these two options are available when there is at least one selected ***Element Set***.

Drawing Object

In this part of the window, the user decides how the slice is to be drawn. Three options are listed, but there are restrictions regarding when these options are available. *These options can only be used after an existing slice is selected from the browser on the right.*

Wireframe

This option allows the user to visualize the slice in wireframe mode. This option is available when there is at least one ***Element Set*** in the **Display Window**.

Surface

This option is available when ***Scalar Results*** have been selected for the given **Display Window**. It allows the user to visualize the slice with the selected ***Scalar Results***.

Isovalues

This option allows the user to visualize isovalues on the surface of the slice. To activate this option the user must set the Isovalues Options of the Contouring Window as described in section 3.2.3.2 (Contouring & Palette Options). It is important that the user set the contour rendering option to "Surface" in order to use the "Isovalues" option of the Slicing Window. The Contouring Window controls the isovalue properties including the number displayed, their size, and color.

The above three options will apply to the slice(s) that is (are) selected from the browser.

Slices

This browser is a multiple selection browser (see section 1.4.7, (Single and Multiple Selection Browsers) for more information about multiple selection browsers) and does not support the double-click feature. This browser lists all slices for the selected **Display Window** in the order created.

Under the list, two buttons are used to control the slices, "Remove" and "Slice Color".

Remove

This button is available when at least one slice has been selected. Clicking on it removes the slice(s) from memory and from the **Display Window**.

Slice Color

This button is available only when a slice is selected. It sets the color of the wireframe of the selected slice. When first drawn, the slice has a random color. The user may select any other color for each slice.

Points & Vector

This part of the window is similar to the Streamlining Window. It allows the user to enter the coordinates of the points and/or the components of the vector that are used by TOP/DOMDEC to cut the slice.

After entering the desired points (and/or vector), click on the "Apply" button. TOP/DOMDEC then lists the slice in the browser without drawing the slice. The user may enter as many slices as they desire. Only when the user clicks on the "Redraw" button of the Main Controller does TOP/DOMDEC cut the defined slices. After drawing, the user will only see one slice (the last entered). However, all listed slices have been cut and saved by TOP/DOMDEC.

To visualize a particular set of slices, the user needs to select the desired slices to display in the browser. TOP/DOMDEC then changes the "Apply" button to a "Display" button. Clicking the "Display" button will display the chosen slices.

The following page illustrates the usage of this window.

In this first **Display Window**, TOP/DOMDEC has displayed a slice using the "Wireframe" option. The user has turned off the ***Element Set*** from which the slice has been cut.

This second **Display Window** shows the same slice as the first **Display Window**, except using the "Surface" option. The "Surface" option is available because ***Scalar Results*** have been selected for this particular **Display Window**.

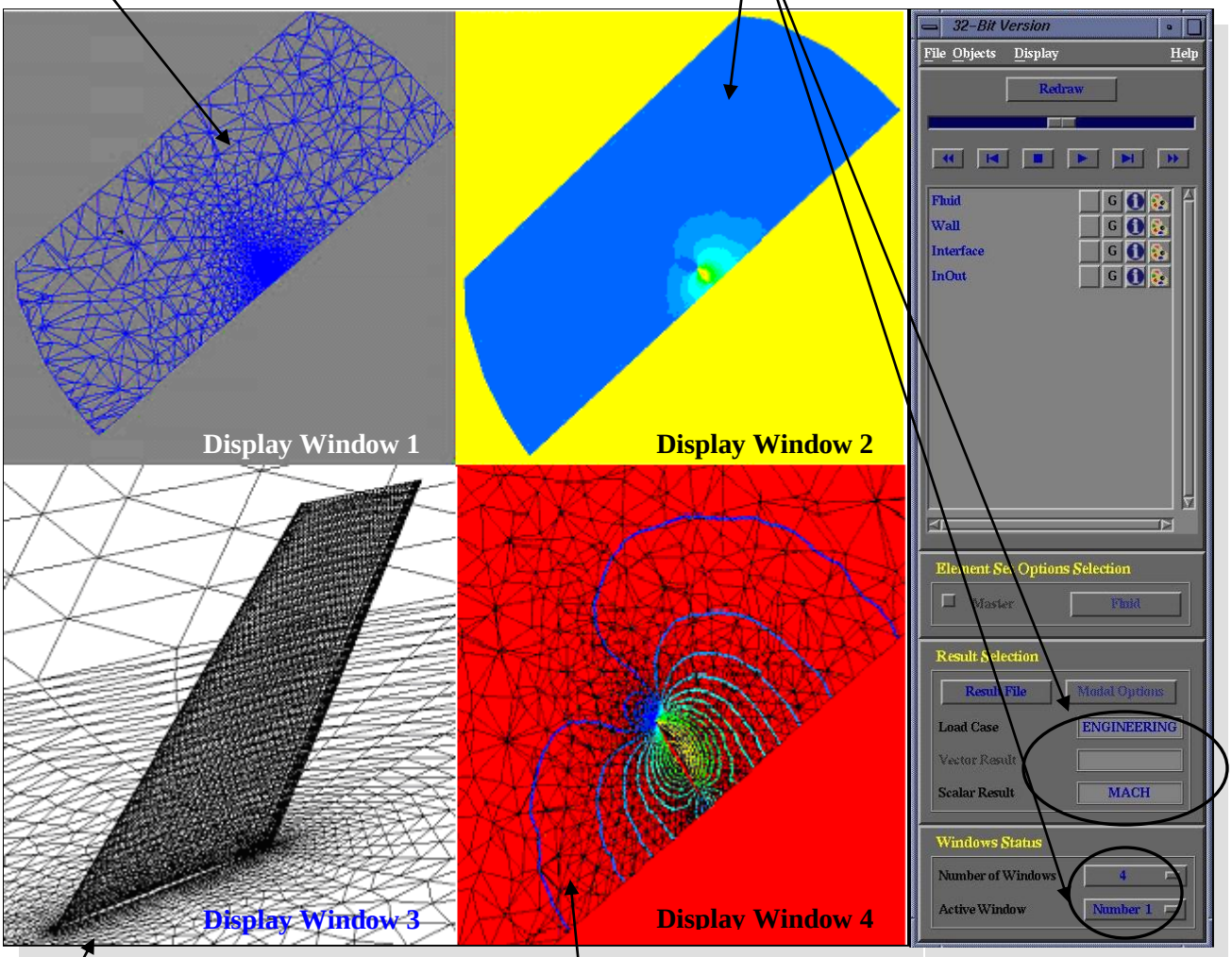


Fig. 3.37

This third **Display Window** shows the **Element Set**s from which the slices of the other **Display Window**s have been cut.

In this last **Display Window**, the user has decided to draw Isovalues on the surface of the selected slice, which is rendered in wireframe mode. To do so, the user sets the isovalues in the Contouring Window as discussed, and turns "On" the "Isovalues" option of this window.

3.2.3.5 Picture Saving

IMPORTANT

Attention! To use this feature the user needs to have a file named "***.Xdefault***" in their home directory. This file tells TOP/DOMDEC where to get the path (and the name) of the saving program.

This feature allows the user to save the **Main Display Window** into a file. It is also useful for creating short movies. Clicking on "Picture Saving", as shown in figure 3.38, opens a Picture Saving Window. Here, the user sets the options to be used for saving a set of pictures.

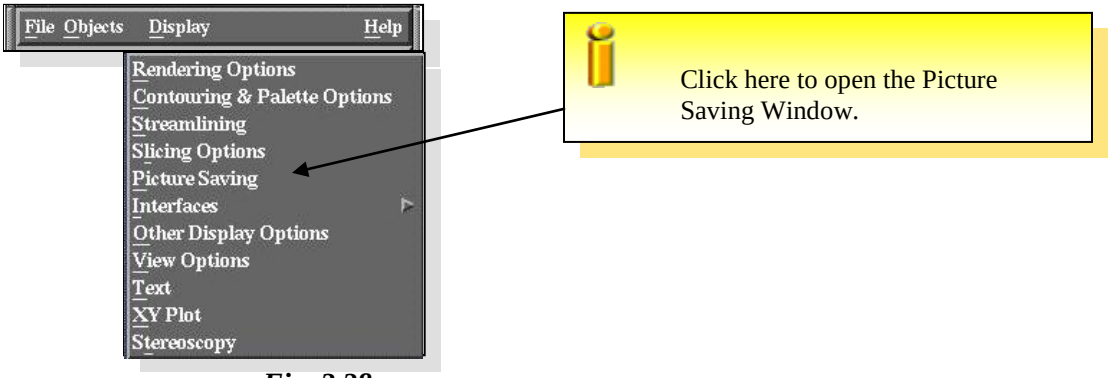


Fig. 3.38

The next figure shows the Picture Saving Window and explains its options.

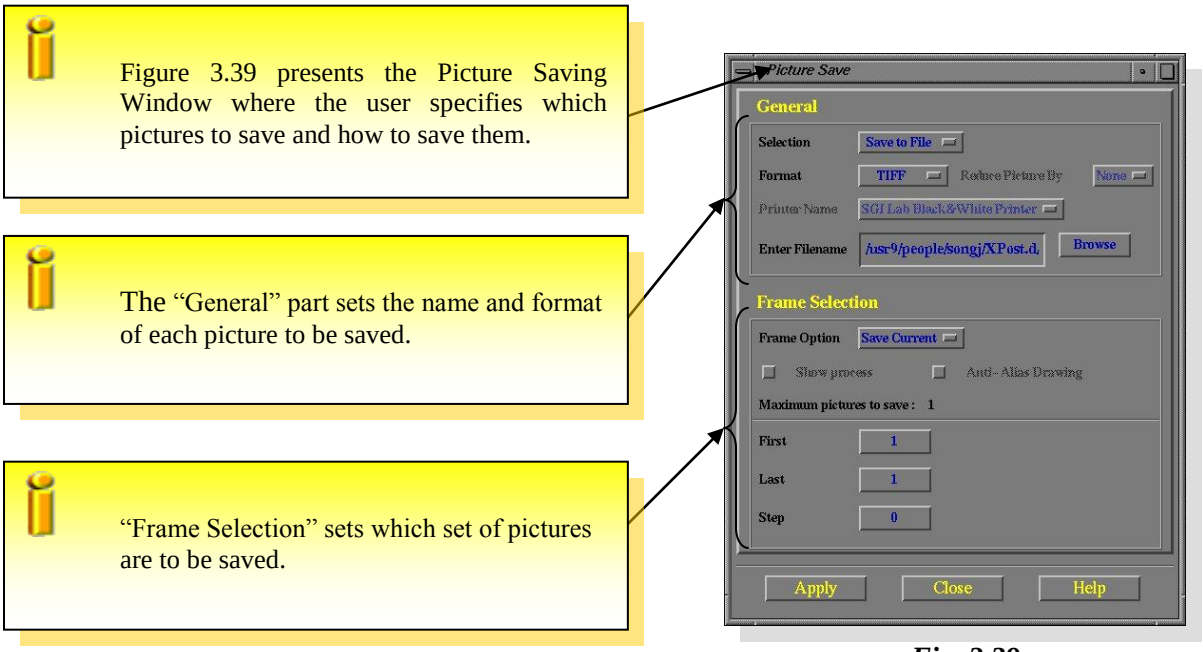


Fig. 3.39

General

Selection

TOP/DOMDEC saves the picture into a file or prints a screen dump of the **Main Display Window**. This option is an "Options" chooser (see section 1.4.4. (Buttons and Choosers) for more information about this type of chooser) with three choices: "Save To File", "Print Only", and "Save & Print". The default choice is "Save To File" which is the only option currently active. The other options have not yet been implemented.

Format & Reduce Picture By

Here, the user decides in which format the file is to be written. TOP/DOMDEC can save in TIFF, JPG and PS (Postscript) formats. The default format is TIFF.

The "Reduce Picture By" option is available only for the JPG format. TOP/DOMDEC saves in JPG format by first saving in RGB format then transforming into a JPG format. During the conversion, TOP/DOMDEC can reduce the storage size of the picture. Reducing the picture saves space, but does not preserve the quality of the picture.

Printer Name

When "Print" or "Save & Print" is selected, the user may select the device used for printing the pictures.

Enter File Name

This is a regular prompt box (see section 1.4.5 for more information about prompt boxes in TOP/DOMDEC) where the user enters the name of the file in which to save the pictures. The user does not need to enter any extension to the file name. TOP/DOMDEC adds the correct extension ("***.tiff***", "***.jpg***", "***.ps***") according to the selected format.
The user can also browse from the file system to locate and find a particular file name. After clicking on the "Browse" button, TOP/DOMDEC opens a window for the user to navigate into the file system to select the directory and the file name of the picture to be saved.

Anti-Alias Drawing

If this option is selected, TOP/DOMDEC draws the picture with the anti-alias option, to make the picture smoother, higher quality, and then saves the picture.

Frame Selection

Frame Option

This is an option chooser (see section 1.4.4 (Buttons and Choosers) for more information about choosers in TOP/DOMDEC) that lets the user select a suitable way to save the picture. The three options are: "Save Current", "Save Selected", and "Save all". The default choice is "Save Current".

Save Current

This option is intended particularly for the case where the user pauses an animation of the ***Vector Results*** and/or ***Scalar Results***, and wishes to save the content of the **Display Window**. The user does not need to specify the intended frame of the animation, because in this case TOP/DOMDEC saves a picture without redrawing it.

Save Selected

This option allows the user to save a series of selected frames of the ***Vector Results*** and/or ***Scalar Results*** by identifying them using the buttons **First**, **Last,** and **Step**. While saving the pictures, TOP/DOMDEC redraws in this case the content of the **Display Window** according to the frame parameters.

Save All

This option allows the user to save all available frames. In this case, for each frame, TOP/DOMDEC redraws the active **Display Window**(s) and saves the corresponding picture a file that shares the same prefix as the others.

Show Process

This option allows the user to see which frame is being saved. If selected, during the saving process, TOP/DOMDEC displays a small window at the right bottom of the screen with the number of the picture being saved.

Anti-Alias Drawing

If this option is selected, TOP/DOMDEC draws the frame with the anti-alias option, to make the picture smoother, higher quality, and then saves the picture.

Maximum Pictures to Save

This label is automatically updated when TOP/DOMDEC draws the object with ***Vector Results*** or/and ***Scalar Results***. This is the maximum number of pictures and corresponds to the maximum time step of all of the activated **Display Window**s.

First, Last & Step

When the "Save Selected" option is chosen, the user needs to select which frames are to be saved using the three buttons, "First", "Last", and "Step". The user enters the number of the first and last frames to be saved. Between these two numbers, the user may wish to save only a few of them at a certain frequency. For example, setting the "Step" number to three causes TOP/DOMDEC to save one out of three frames between the first and the last frame numbers. To save a single frame, set the first and last numbers equal to the desired frame number.

The following is a set of rules to keep in mind when saving frames

.

Before saving the pictures, TOP/DOMDEC warns the user to clear the area used by the **Main Display Window**. If any other window is present and placed in this area, TOP/DOMDEC saves that window as well. Therefore, the other window will appear in the picture saved by TOP/DOMDEC.

When saving pictures, TOP/DOMDEC adds a number to the file name entered by the user. The final filename is created as follows:

- The user enters a desired file name (without extension): *filename*
- TOP/DOMDEC adds the correct extension after the file name: *filename.rgb*
- While saving, TOP/DOMDEC adds a number between the filename and the extension to create the final file name. The number corresponds to the time step of the picture. *filename13.rgb*

TOP/DOMDEC does not check if the final picture name is already in the current directory. It is up to the user to confirm that TOP/DOMDEC does not overwrite an existing file.

3.2.3.6 Interfaces

The “Interfaces” option of the Main Display Menu offers three different interfaces, “Rotations”, “Clippings”, and “Lightings”.

3.2.3.6.1 Rotations

Clicking on the “Rotation” option opens the Rotation Box Dialog Window. Figure 3.40 shows and describes this window.

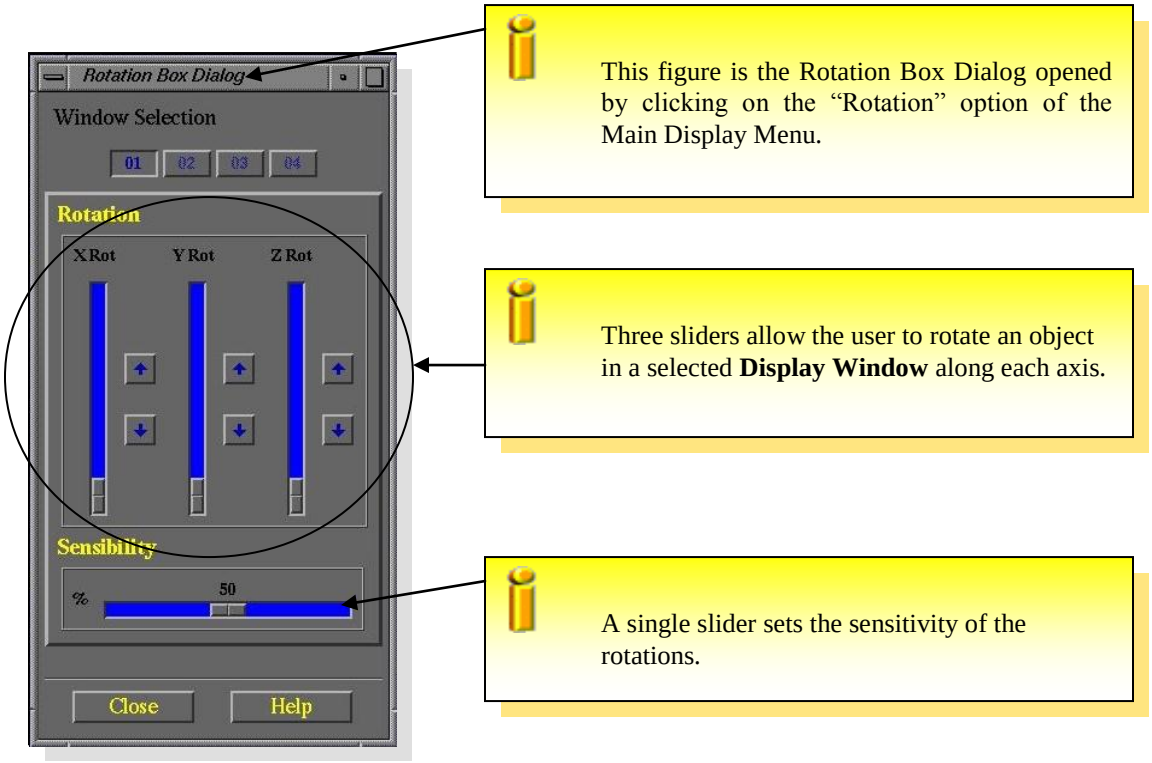


Fig. 3.40

This window displays four sliders (see section 1.4.8 for more information about Sliders in TOP/DOMDEC). The three vertical sliders are labeled “XRot”, “YRot”, and “ZRot”. Each rotates the object in the selected **Display Window** along the corresponding axis more precisely than by using the middle button of the mouse (as discussed in section 1.4.2 (The Mouse)). For incremental changes, the user may use the buttons that appear on the right side of each slider. An upward motion of the slider corresponds to a rotation counter-clockwise about the respective axis, while a downward motion causes a clockwise rotation. TOP/DOMDEC automatically rotates the object as the user slides any of the sliders.

The last slider, “Sensitivity”, controls the sensitivity of the rotation sliders and buttons.

3.2.3.6.2 Clippings

Clicking on the "Clippings" option of the Main Display Menu opens the Clipping Window. Figure 3.41 shows the Clipping Window and its options.

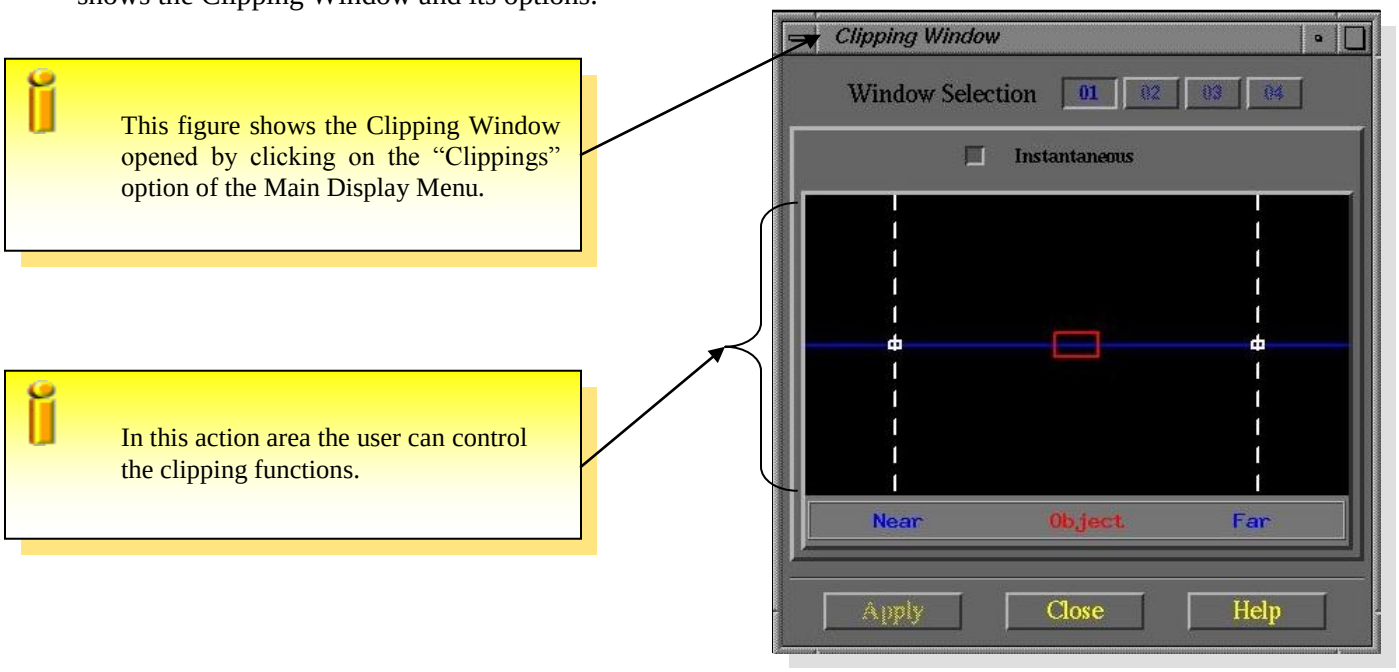


Fig. 3.41

This window presents a black rectangle area, which represents the **Display Window** selected at the top of the window. The black rectangle contains a red rectangle that represents the object in the selected **Display Window**. When the object is zoomed, this red rectangle gets larger. The user may not see the red rectangle if the object is highly zoomed. In the black area there are two vertical white dashed lines. These lines indicate, from left to right, respectively the near and far planes. By clicking and dragging these lines, the user moves the near and the far planes of the viewing volume. The corresponding blue label follows the movement of each line. Only the portion of the object inside the area defined by the two planes (near and far) is displayed in the **Display Window**.

What are the near and the far planes?

- The near plane is a virtual plane between the eyes of the user and the object drawn in the **Display Window**.
- The far plane is a virtual plane that is behind the object drawn in the **Display Window**.

On top of the black area, TOP/DOMDEC provides an option for instantaneous action. When this option is "On", TOP/DOMDEC redraws the selected **Display Window** as the user moves either line. When this option is "Off", the user first places the lines and then clicks on the "Apply" button at the bottom left of the window to redraw the **Display Window**.

3.2.3.6.3 Lightings

Light sources have a number of properties, such as color, position and direction. TOP/DOMDEC provides a way to change these properties to allow better visualization of the object displayed in a **Display Window**. The following sections explain how to control these properties and the appearance of the resulting light.

Clicking on "Lightings" in the Main Display Menu opens the Lighting Window. Figure 3.42 shows the Lighting Window and its options.

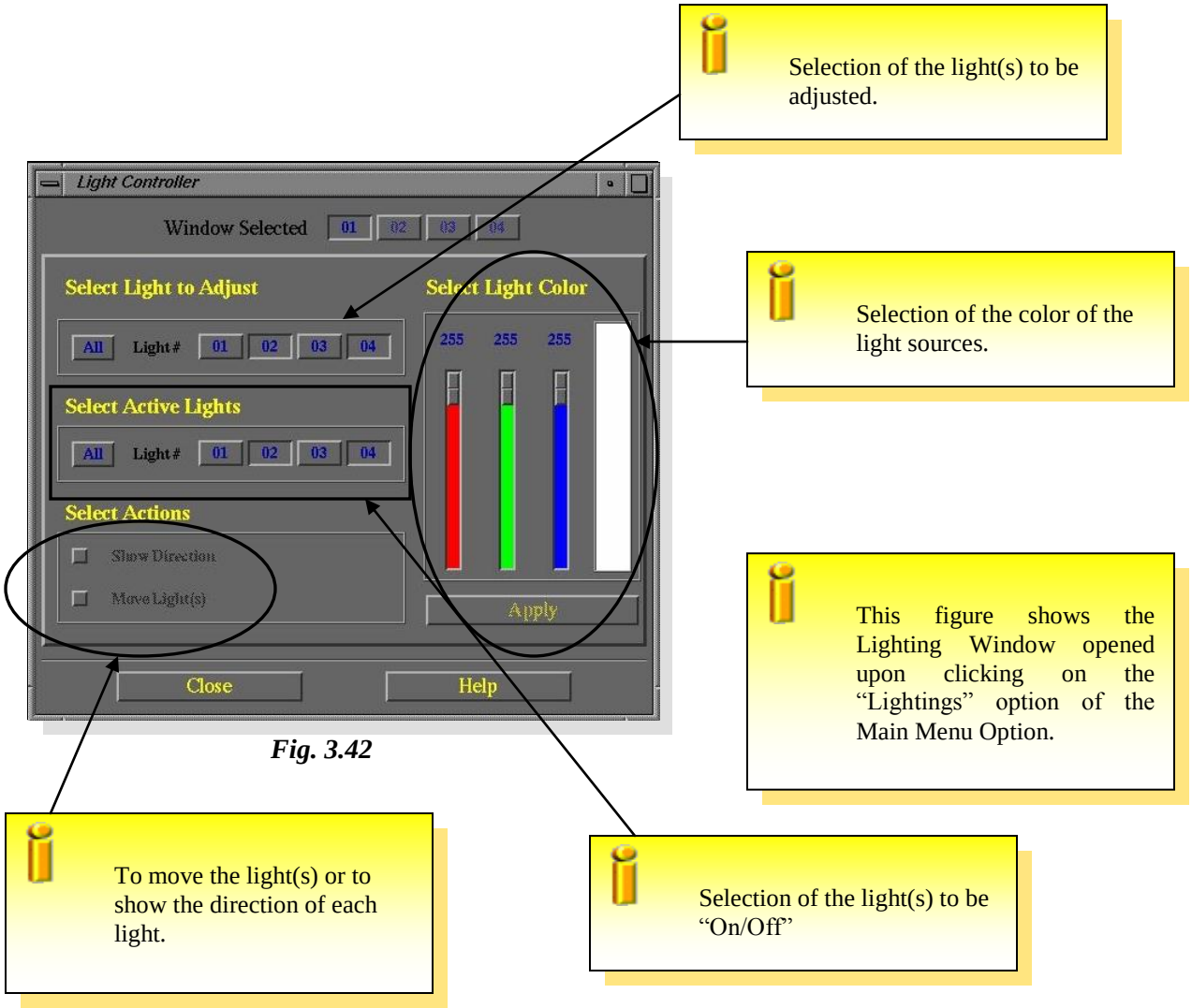


Fig. 3.42

TOP/DOMDEC has four different light sources. By default only two of them are active. When the Lighting Window is opened, the two default light sources (n° 2 and n° 4) are displayed in the **Display Window**. Each of the light sources is labeled with its number. By default, the light sources use the color white.

The following sections explain the four parts of this window.

Select Light To Adjust

Here, select the light(s) to be adjusted. Any modification affects all lights selected with this chooser.

Select Active Light

By default, only the lights n^{o} 2 and n^{o} 4 are active. The user may choose to activate (or de-activate), other light sources. Turning "On" or "Off" light sources will increase or reduce the amount of light projected onto the object.

Select Action

To have better insight regarding the light sources, TOP/DOMDEC provides two options: ***Show Direction*** and ***Move Light***. Turning "On" the "Show Direction" option shows the direction of the light sources that are selected for adjustment. It allows the user to see where the selected light sources are projected. Selecting the "Move Light" option allows the user to move the light sources.
Move lights using the same commands as when rotating on object with the mouse.

- Place the red mouse arrow in the **Display Window**.
- Click the middle button of the mouse.
- While holding the middle button, move the mouse. The light sources will follow the red mouse arrow.

It is recommended to position each light source individually.
To rotate an object, the user must turn this option "Off" or close the window.

Select Light Color

Here, select the color of the light sources. To confirm each color click on the "Apply" button. This option changes the color of the light sources that have been selected for adjustment, even if a light source is not displayed.

The next page illustrates the usage of this feature.

Lights 1 and 3 are set to the color white.

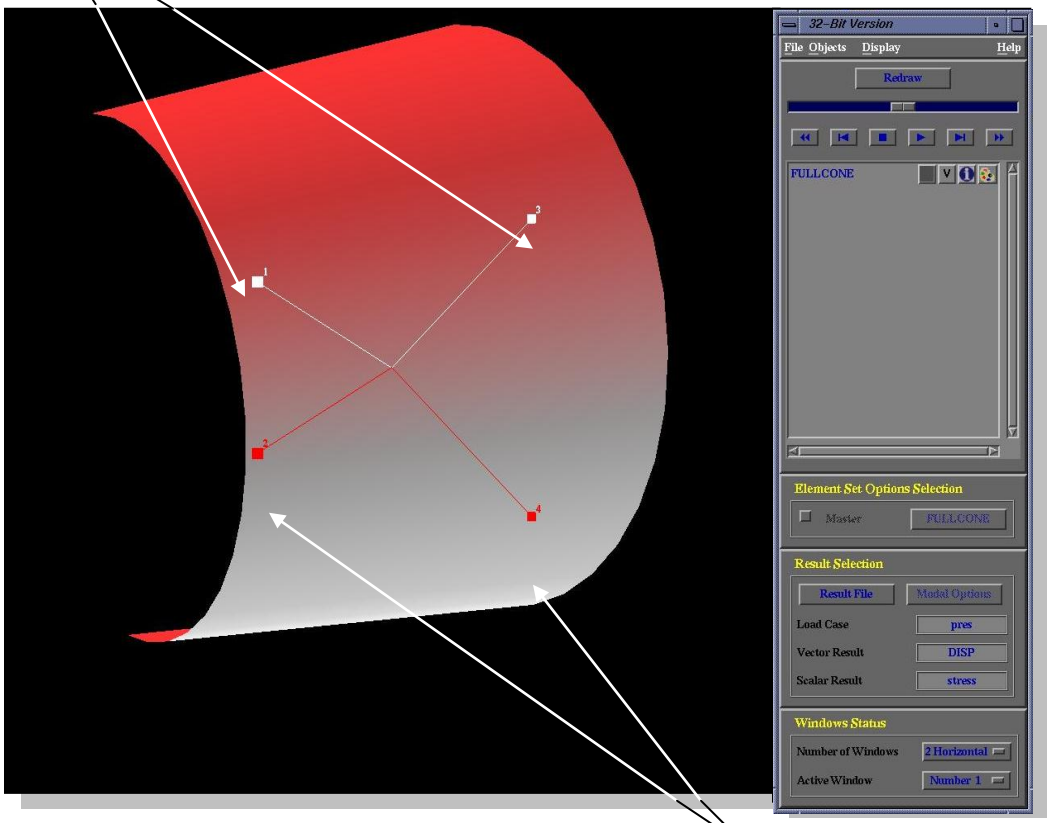


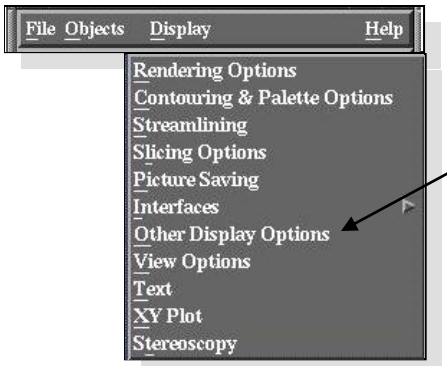
Fig 3.43

Lights 2 and 4 are set to the color red.

3.2.3.7 Other Display Options

Various display options are available in this window. Clicking on “Other Display Options” opens the Display Options Window shown in figure 3.45. The following sections describe the different parts of the Display Options Window.

F



Click here to open the Display Options Window.

Fig. 3.44

Boundary Conditions Display Options.

Axis Display Options.

Background Color Option.

Time and Frame Display Options.

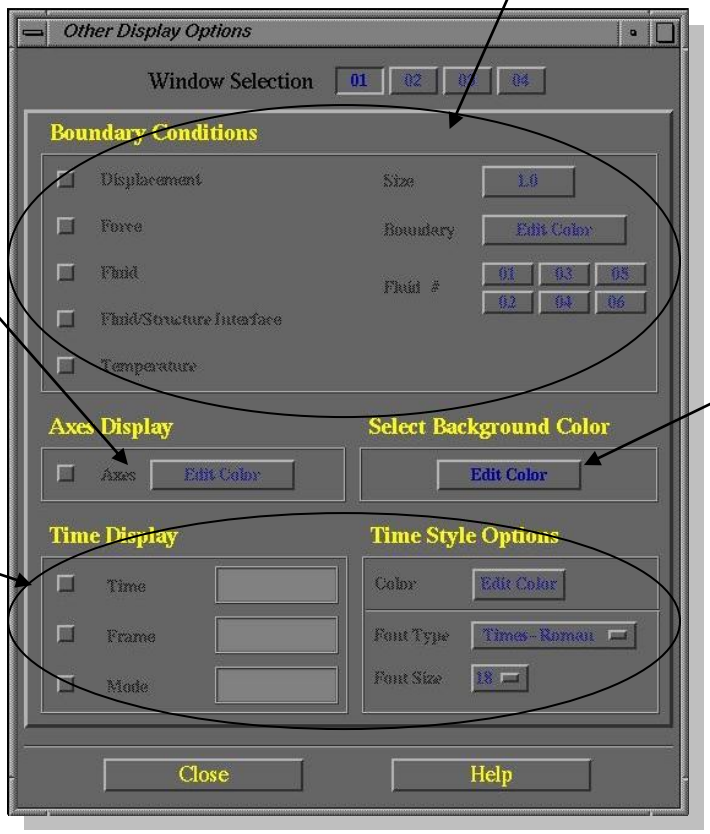


Fig 3.45

Boundary Conditions

The five possible types of boundary conditions are listed here. When available, the user can visualize the boundary conditions of a specific object. Each option is available only if the relevant boundary conditions are in the database and applied to the ***Element Sets*** of the **Display Window**.
If a type of boundary is available then selecting it causes it to be displayed. Note that TOP/DOMDEC displays automatically each boundary condition if the element set is already visible in the Display Window, otherwise the user will have to click on the "Redraw" button to visualize the selected Boundary Conditions.

Here, the user can also set the size of the symbol used to represent the Boundary Conditions.
Selecting the "Fluid" option makes the chooser on the right available. This chooser displays six fluid numbers (as discussed in section 2.6.3 (Fluid Boundary Conditions)). The user may select any of the six Fluid Boundary Conditions to be drawn.

Selecting a type of boundary condition allows the user to change its color and/or the size. To change the color of boundary conditions click on the "Edit Color" button as shown in figure 3.46. TOP/DOMDEC opens the Boundary Condition Color Selector Window, as explained in the following section.

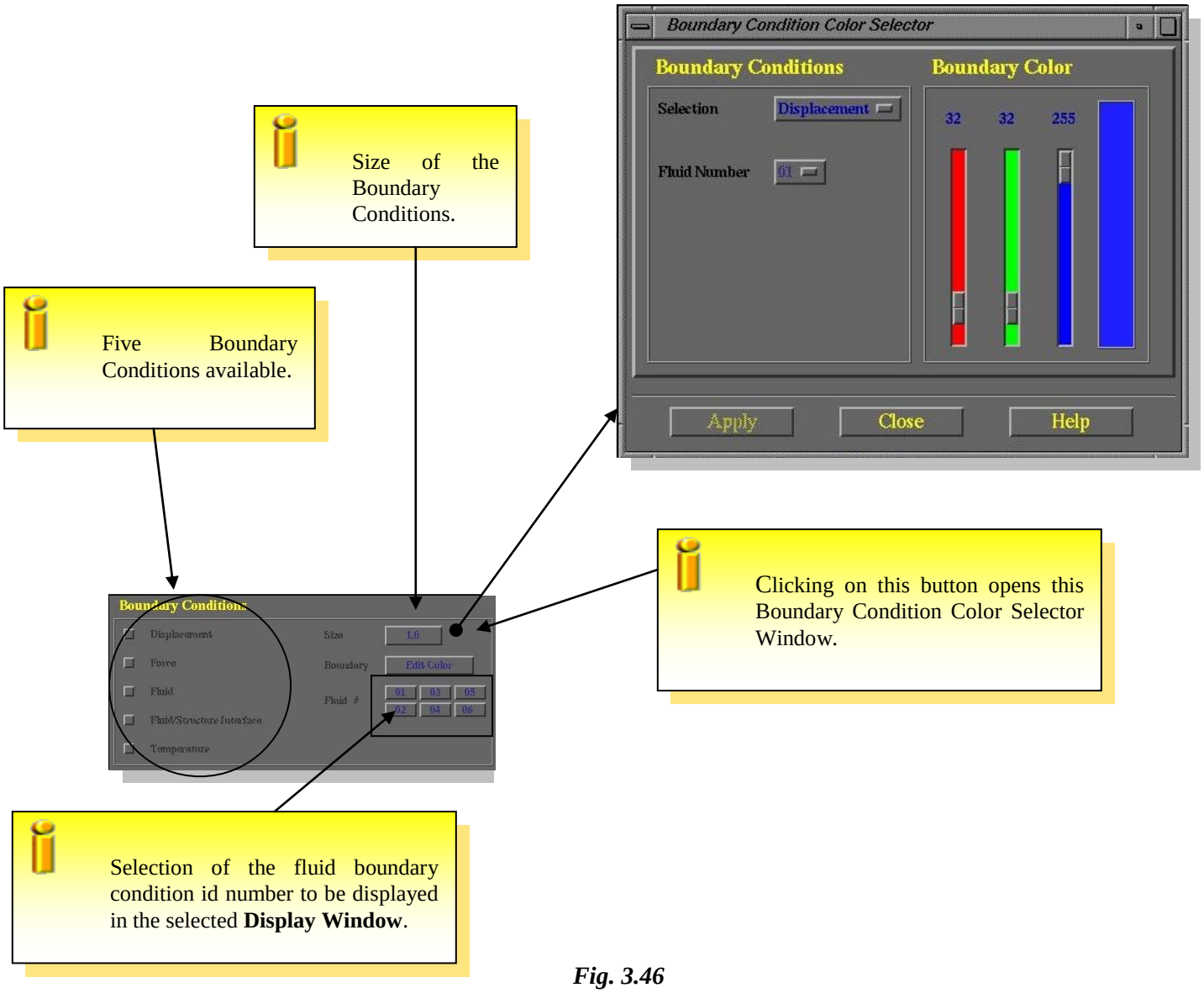


Fig. 3.46

Boundary Color Selector Window

Selection

The selection chooser determines the type of boundary conditions for which the color is to be changed. The chooser lists the five Boundary Conditions, which are available if they have been selected in the parent window. As the user selects boundary conditions TOP/DOMDEC automatically updates the color area on the right of the window.

Fluid Number

The fluid boundary condition id number chooser is available when the user selects the "Fluid" option in the Selection chooser. Each fluid boundary condition id number is available only if it has been selected in the parent window. As the user selects the number of the fluid boundary condition TOP/DOMDEC automatically updates the color area on the right of the window.

Boundary Color

Here, the user selects the color to apply to the selected Boundary Conditions. TOP/DOMDEC automatically updates the color of the selected Boundary Conditions.

Axes Display Options & Select Background Color

The chooser on the left of the label "Axes" is used to draw the X,Y,Z-axes in the upper right corner of the **Display Window**. By default, the color of the axes is yellow. The user may change the color of the axes by clicking on the "Edit Color" button. This opens a color window to select the new axes' color.

Clicking the "Edit Color" button is under the yellow "Background Color" label opens a color window with the current background color of the **Display Window**. The user can then select a new color to apply to the **Display Window**. The default background color is black.

Time Display Option & Time Style Options

Time and Frame options are related to the selected results of the **Display Window**. If no results have been selected in a **Display Window** these options are not available.
The following figure explains the Time Display & Style Options.

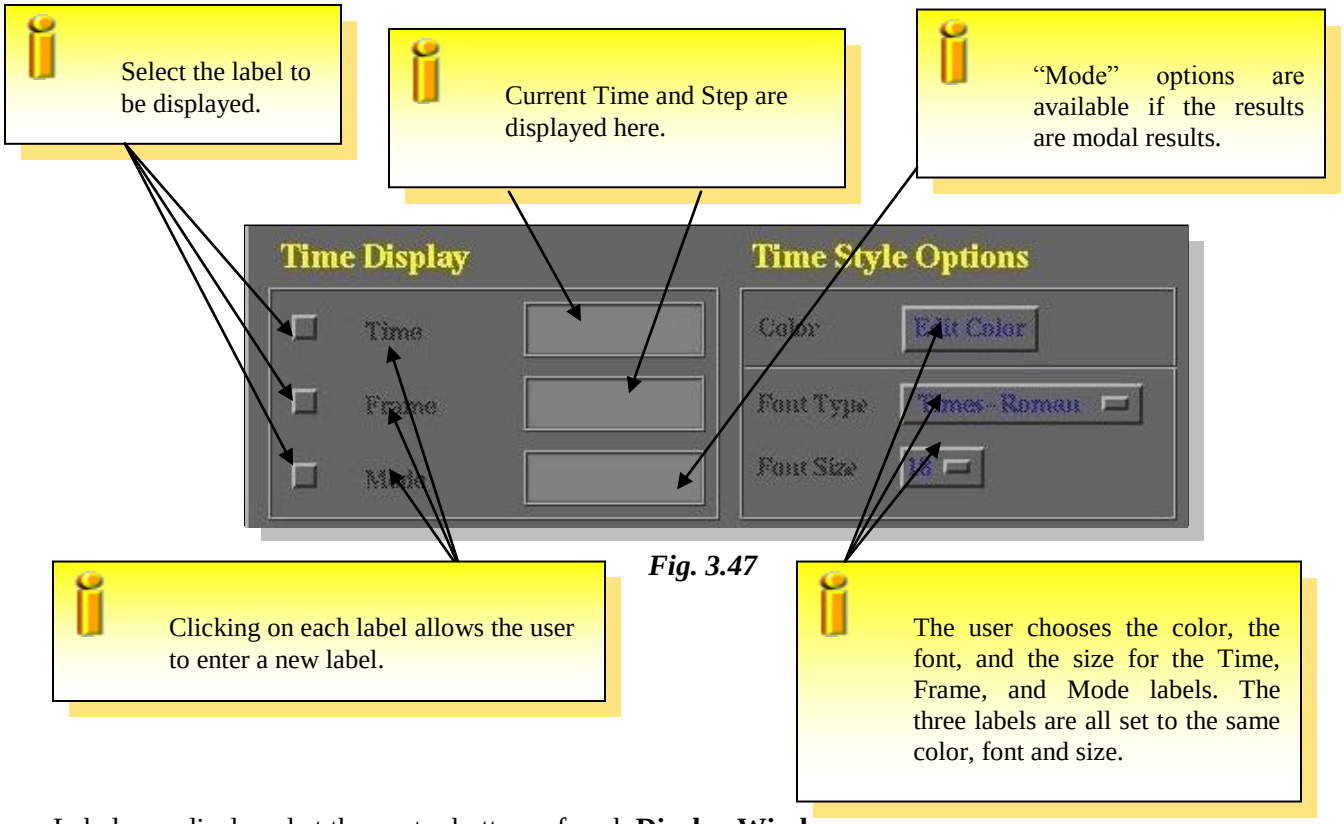
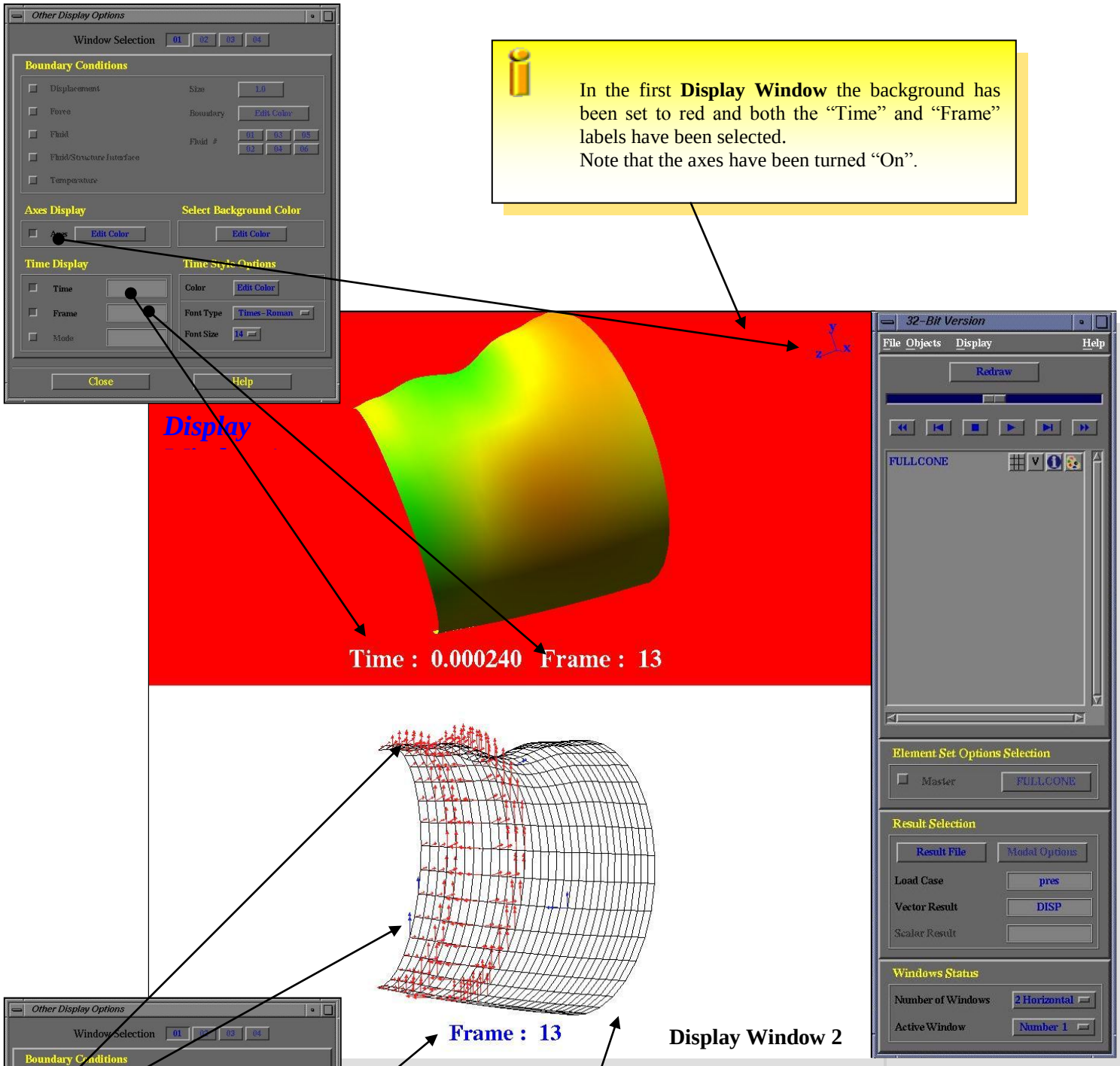


Fig. 3.47

Labels are displayed at the center bottom of each **Display Window**.
The following describes the avaibility and the default values for each option.

- The default color, font type, and size are respectively white, Time-Roman, and 18. The user may change these as shown in the figure.
- The default labels are, "Time", "Frame", and "Mode". Each label can be changed by clicking on the desired label and entering a new label. TOP/DOMDEC automatically updates the label in the **Display Window**.
- The "Mode" options are available if the results are modal results. In this case the default label for "Time" is "Frequency". TOP/DOMDEC displays the frequency value corresponding to the mode id number selected by the user. (For more information about Modal Results see section 3.2 (Results Selection)).

The next page shows a figure which illustrates some of the features of the Display Options Window which includes Boundary Conditions, Axes Options, Background Color, and Time Display Options.



In the first **Display Window** the background has been set to red and both the "Time" and "Frame" labels have been selected.
Note that the axes have been turned "On".

Fig 3.48

In the second **Display Window** Displacement and Force Boundary Conditions have been turned "On" and the user has set the background color to white.
Note that the "Frame" label has been selected for display.

3.2.3.8 View Options

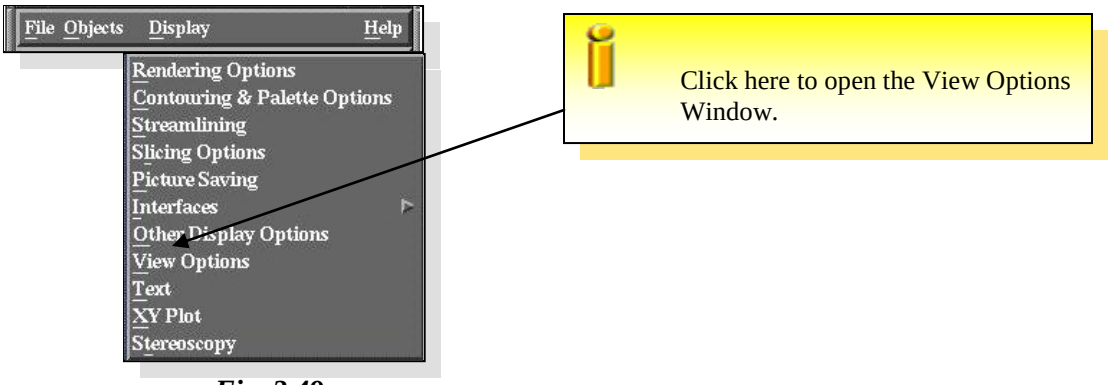


Fig. 3.49

The View Options Window is presented in figure 3.50. It is used to set the view of an object in each of the **Display Windows**. The following sections explain each of the choices given to the user in this window.

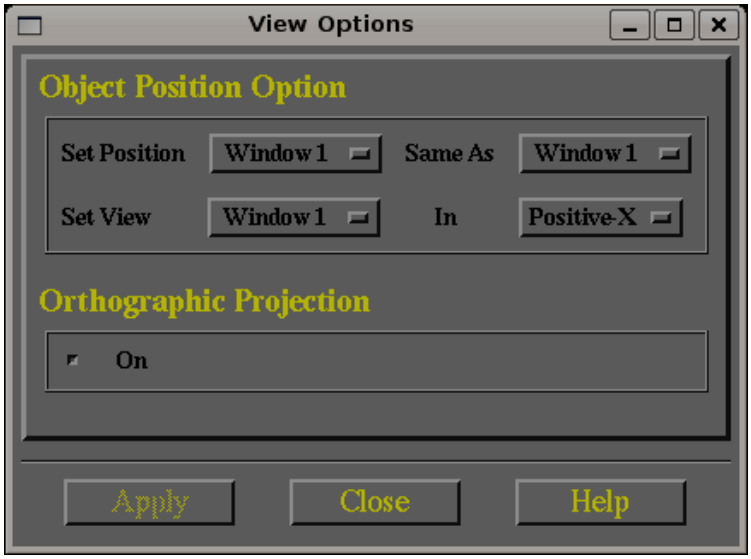
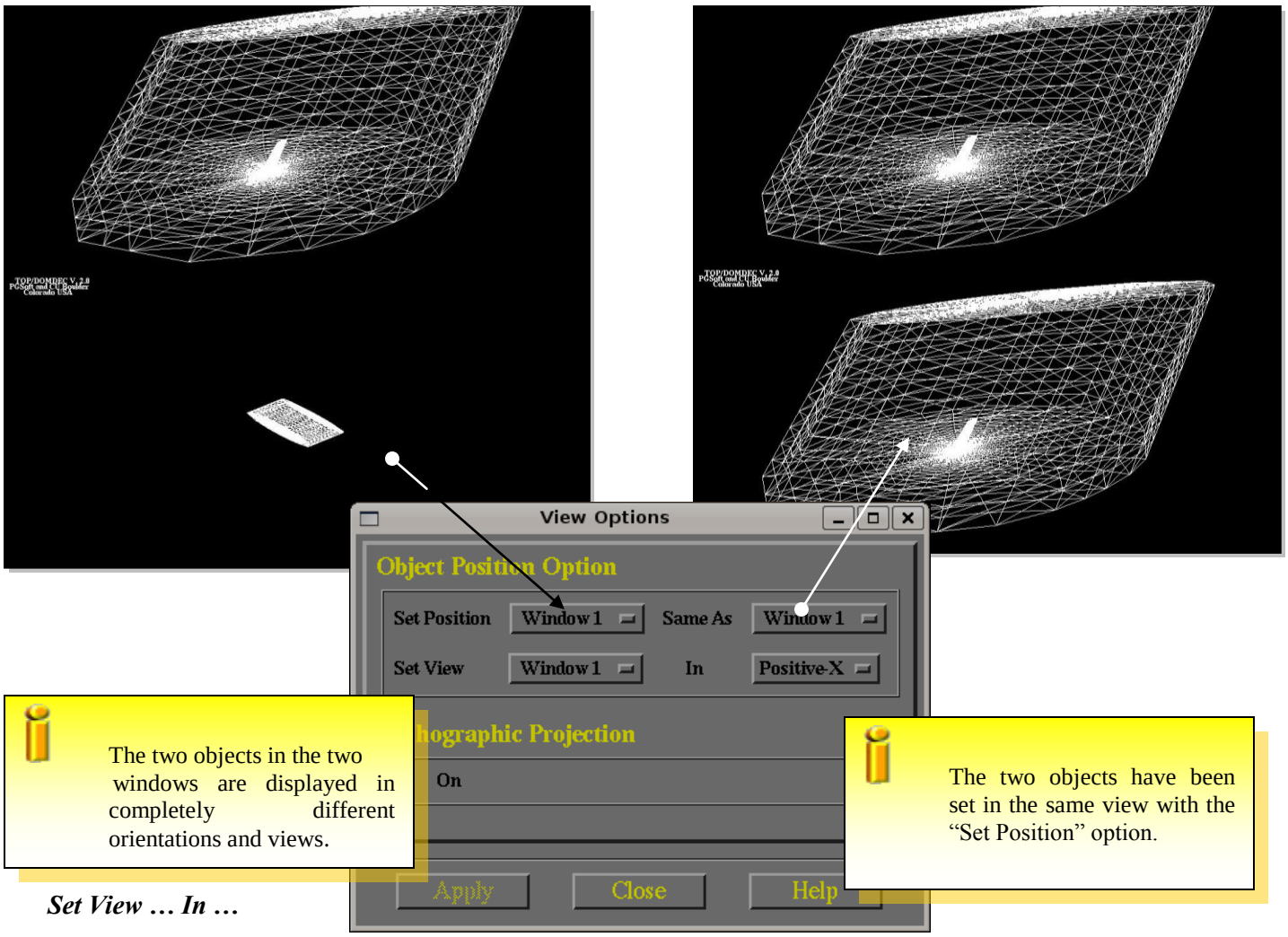


Fig. 3.50

Set Position … Same As …

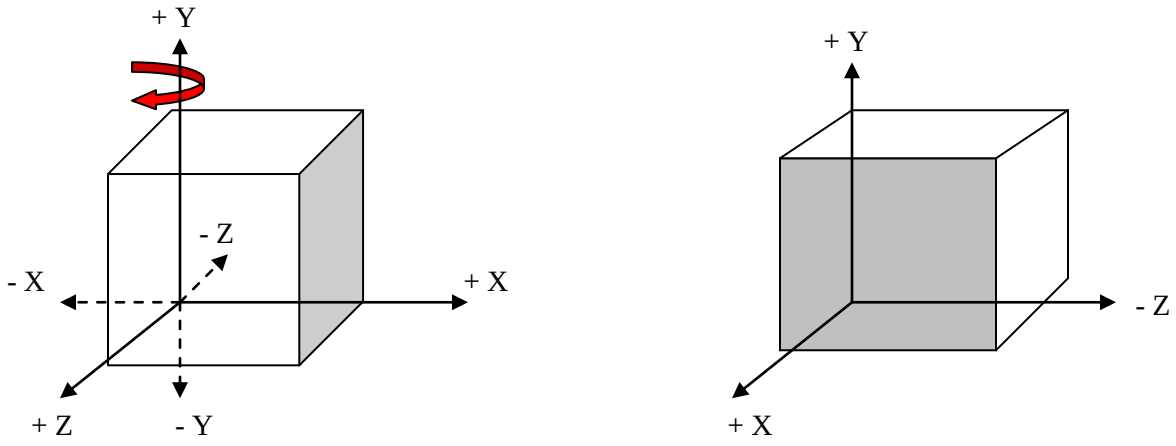
The first line of options allow the user to set the position of the object(s) of one of the active **Display Windows** as the same as another active **Display Window**. This is only possible if there are more than one active **Display Windows**.

The next figure shows the effect of such option.



Set View … In …

TOP/DOMDEC allows the user to view a particular face of the object. Each face is determined by its axes. Here is an illustration of the defined faces.



Rotating the object in the direction of the red arrow will result in a display of the object as shown in the right picture, with the darken side facing the user's view.

To visualize a particular side of an object, select the **Display Window** in which the object appears, with the first chooser as shown in figure 3.52, and then select the desired face with the second chooser. The selected **Display Window** will be updated automatically without the user having to click on the "Apply" button or "Redraw" button of the Main Controller. The user will see the selected face of the object at the right angle with their view. If the referring axes are displayed, the user can check that when a particular view is selected, the particular axes are pointing outward from the screen.

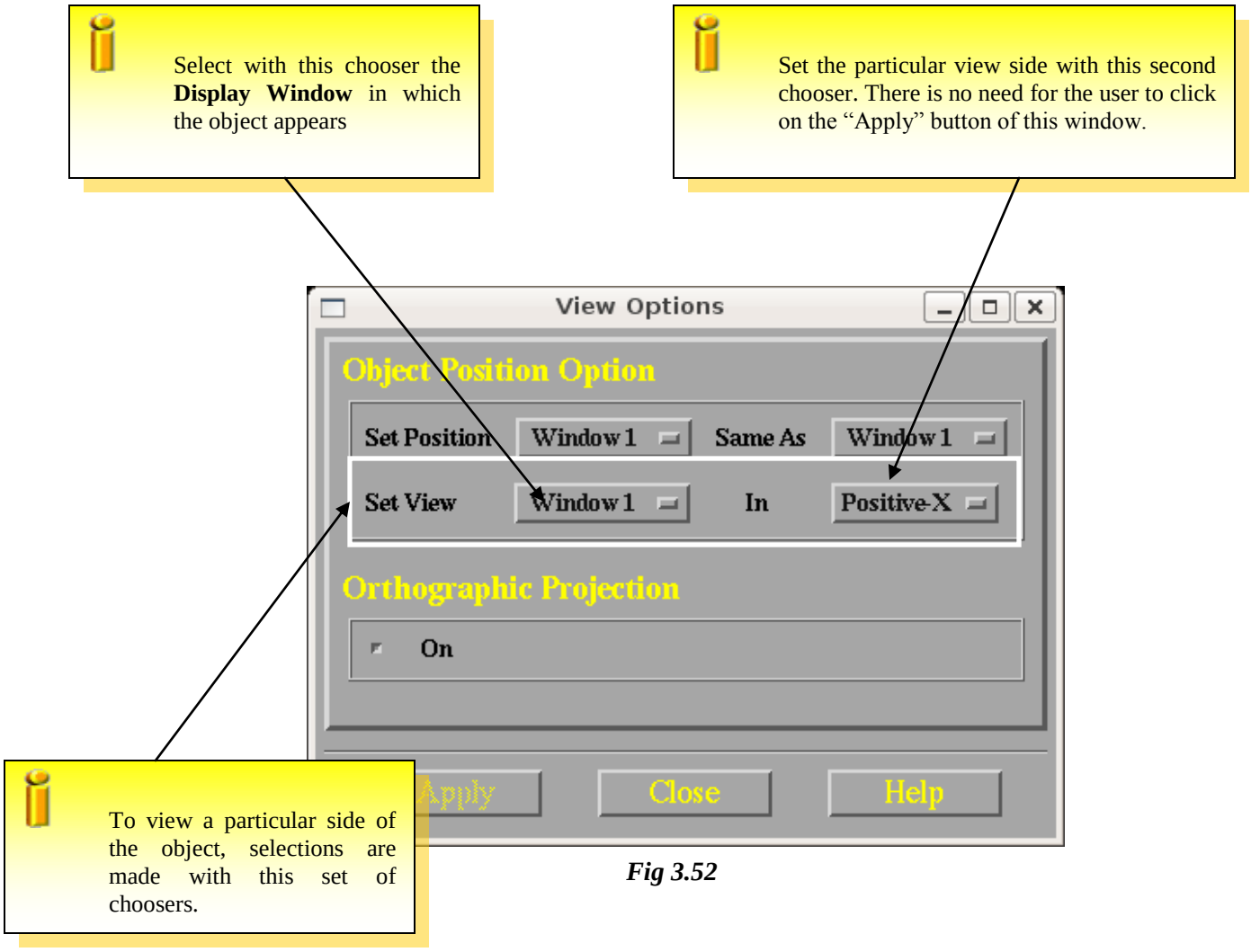


Fig 3.52

Orthographic Projection

This control allows you to switch from a perspective projection (the default) to an orthographic projection for all the 3D rendering in the main display window.

3.2.3.9 Text

This is a new option in this version of TOP/DOMDEC. It allows the user to display text in a **Display Window**.
Clicking on the "Text" option opens the Input Text Window as shown in figure 3.50. The following sections explain the options in this window.

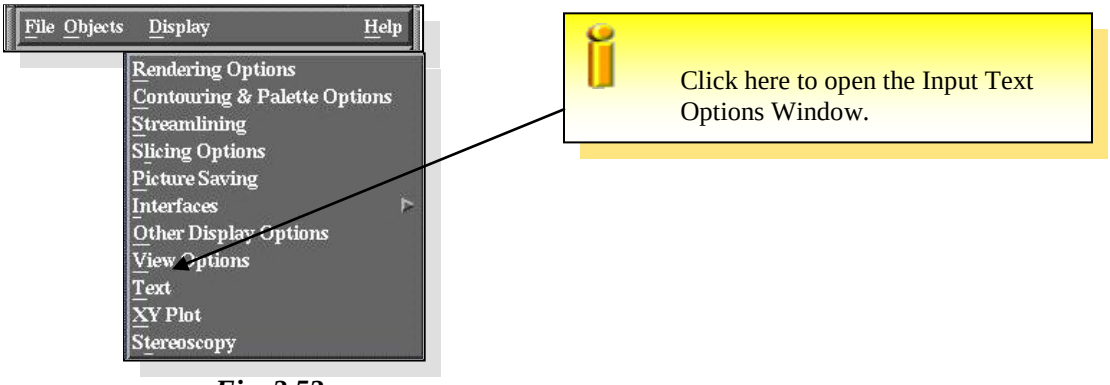


Fig. 3.53

The following figure shows the Input Text Window.

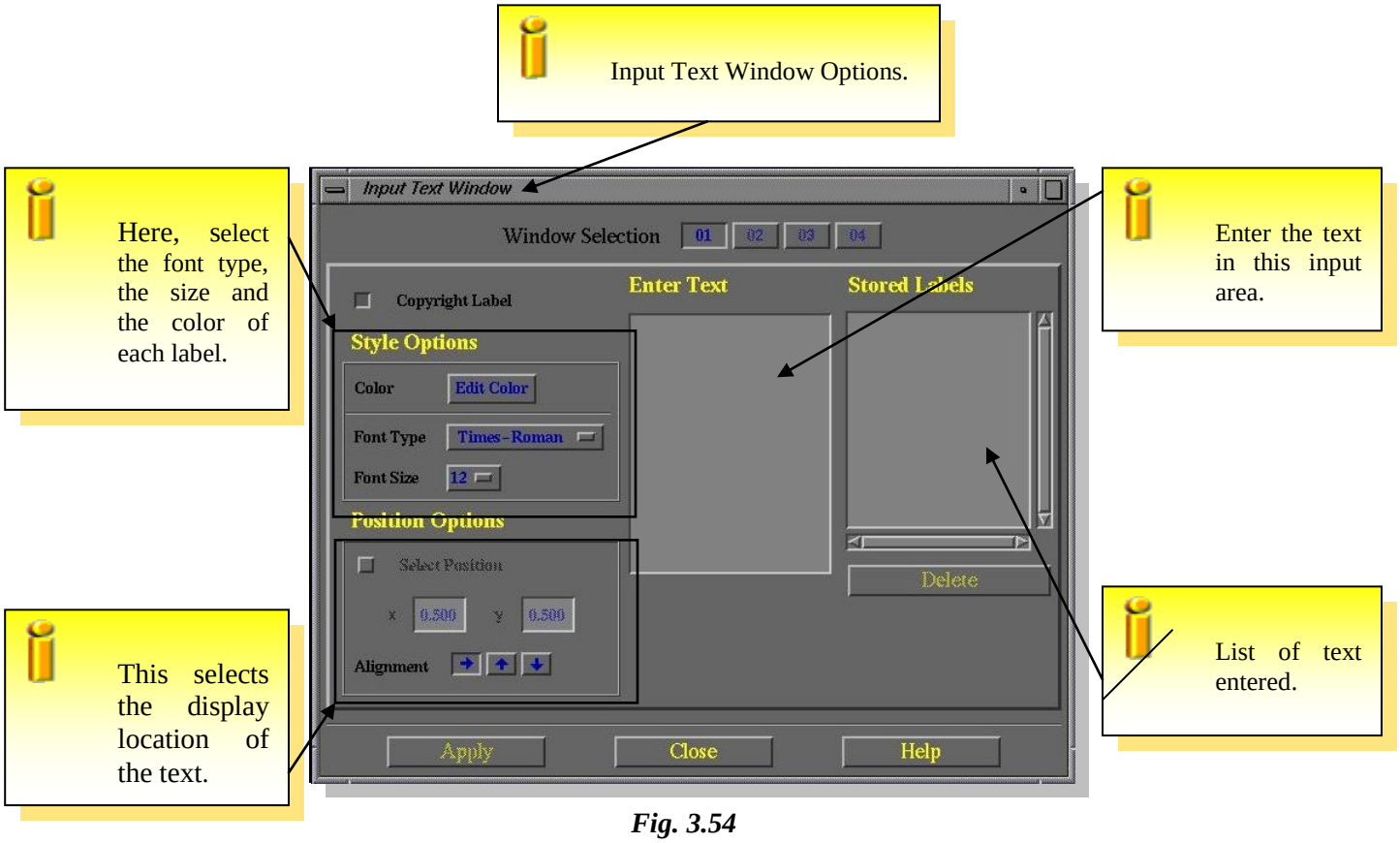


Fig. 3.54

Copyright Label

This button on the top-left toggles display of the copyright label. When displayed, the label appears in the top-left corner of each **Display Window**.

ATTENTION!

This option affects only a single **Display Window**. If the user wishes to un-display the copyright label in all **Display Window**s they must do it individually for each window.

The size, font and color of this label cannot be changed.

Style Options

This area controls the style of the text. The user may set the style before or after entering the text. Once stored, the user must select the text from the list (on the right of the window) to change the style. By default, the text is displayed in white, with a "Time-Roman" font type and a size of 12.

Position Options

"Select Position" is used to select where the text should appear in the **Display Window**. Clicking it turns the label black and TOP/DOMDEC enters the "Click/Draw" mode. TOP/DOMDEC will now wait for the user to click inside the **Display Window**. TOP/DOMDEC displays the coordinates (x and y) of the point clicked, in the two prompt boxes beneath the "Select Position" chooser. If a text is currently in the "Enter Text" prompt box, TOP/DOMDEC then displays this text, from left to right, starting from the clicked point. TOP/DOMDEC will keep moving the text to the point the user clicks and will keep updating the coordinates of the point.

TOP/DOMDEC stays in "Click/Draw" mode until the "Done" button is clicked. This updates the list of stored text on the right side of the window and TOP/DOMDEC returns to its "normal" state.

There are two prompt boxes beneath the "Select Position" chooser. They display the x and y coordinates where TOP/DOMDEC will display the text. The user may enter the coordinates directly in these prompt boxes (rather than clicking inside the **Display Window** as described above). The user must hit the "Enter" key to confirm each coordinate. TOP/DOMDEC then moves the text to the new starting point. The point (0,0) is in the bottom left corner of the **Display Window**, while (1,1) is the upper-right.

The "Alignment" option selects how the text is to be displayed. TOP/DOMDEC allows three ways to display the text. From left to right, the alignment choices are: left-to-right, bottom-to-top, and top-to-bottom. The default is to display from left-to-right.

Enter Text

This is a prompt box to enter the desired text.

Stored Label

This browser is a single selection browser and does not support the double-click feature. (For more information about browsers, refer to the section 1.4.7 (Single and Multiple Selection Browsers)).

The browser lists the stored text that has been entered. When selected, the text will appear in the "Enter Text" prompt box. The user may edit the text or adjust its color, size and font.
To delete a text click on "Delete." The selected text will be removed from both the browser and the **Display Window**.

The following figure shows an example of the usage of the Text options.

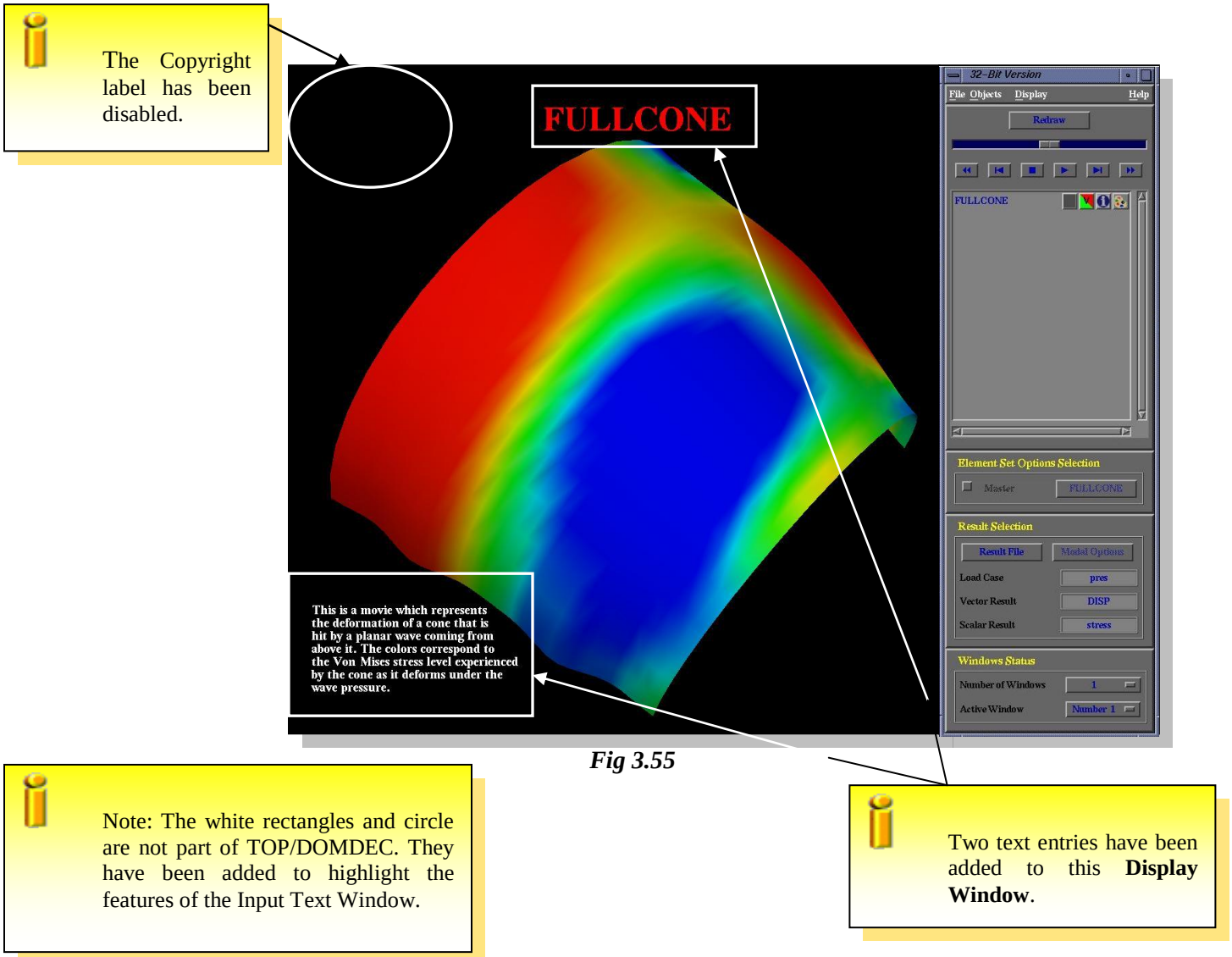


Fig 3.55

3.2.3.10 XY Plot

This is a new feature in this version of TOP/DOMDEC. It displays plots as the object is animated in the **Display Window**. The following sections discuss this feature.

Open the window to plot graphs by clicking on "XY Plot" as shown in figure 3.52.

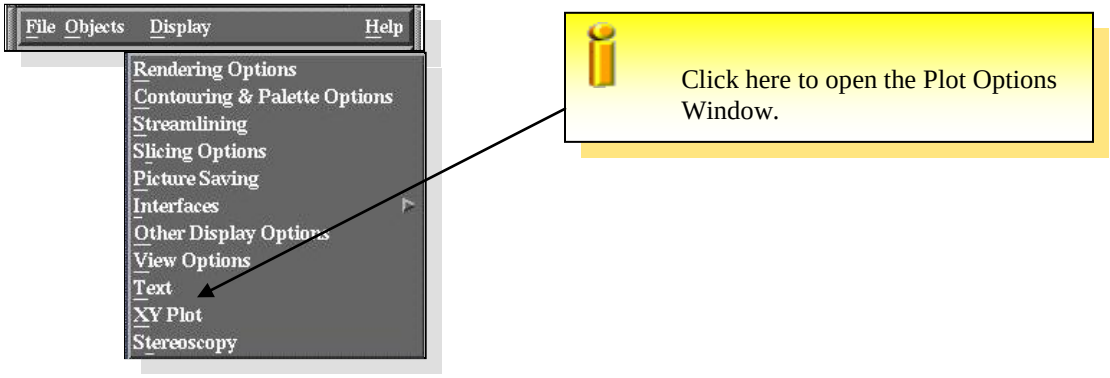


Fig. 3.56

Clicking on "XY Plot" opens a window to control the visualization of plots along with the animation of objects in a **Display Window**. This window is shown in figure 3.53.

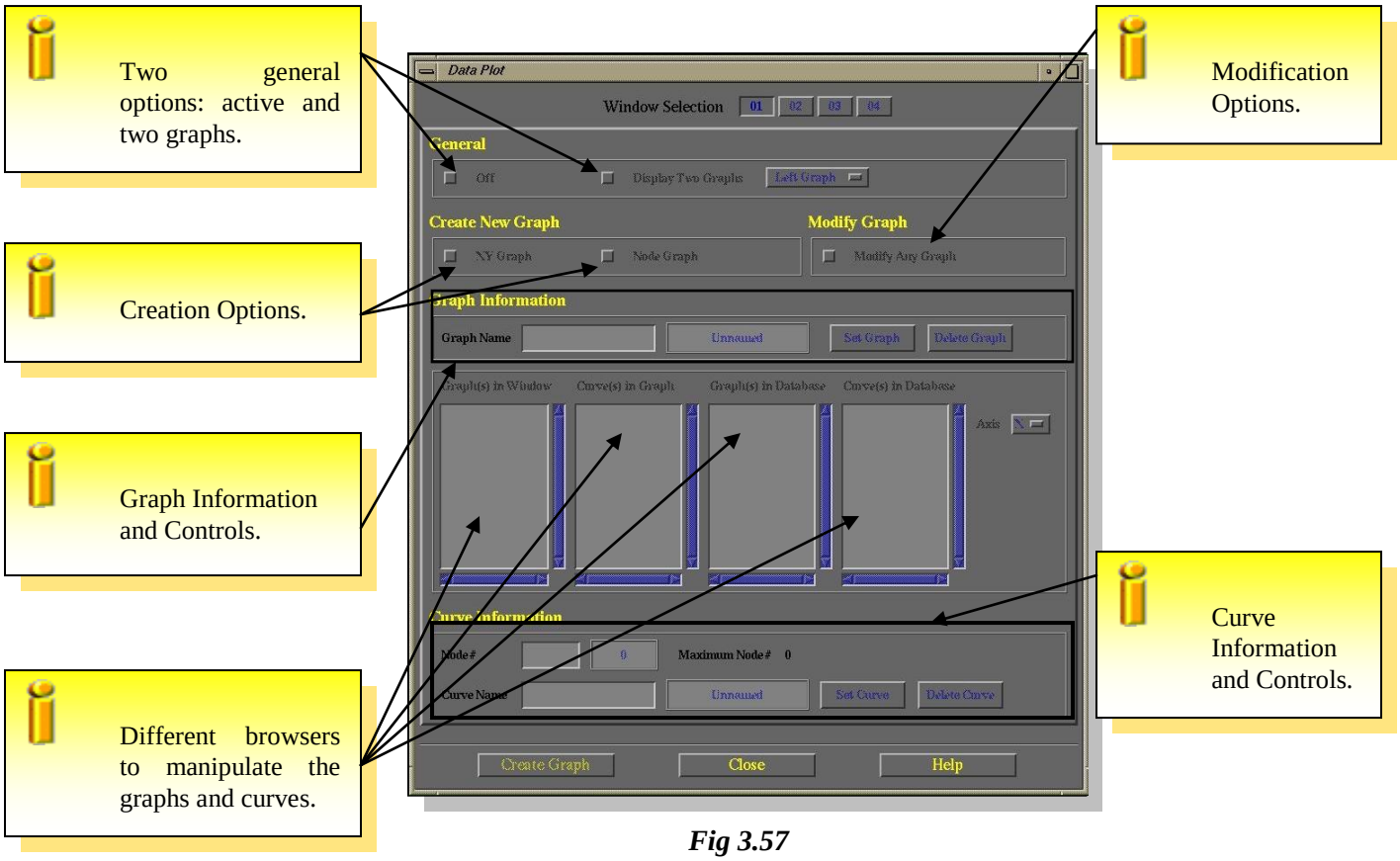


Fig 3.57

General

Under the yellow label "General", the user finds two main chooser buttons, "On/Off" and "Display Two Graphs".

- **"On/Off"** tells TOP/DOMDEC to display graphs along with the animation. When this option is "Off", TOP/DOMDEC does not display any graph in the **Display Window** and disables all the options of this window. To manipulate these window options, the user must turn this option "On".

- **"Display Two Graphs"** toggles the display of two plots in the same **Display Window**. TOP/DOMDEC allows a maximum of two plots in the same **Display Window**. If selected, TOP/DOMDEC displays two plots, one next to the other. Internally, TOP/DOMDEC recognizes these plots as "Left Graph" and "Right Graph". By default, TOP/DOMDEC always displays the "Left Graph".

Create New Graph

TOP/DOMDEC can display two kinds of plots, "XY Graph" and "Node Graph".

- "XY Graph" is a plot that is constructed based on data that does not have any internal relation with the object being animated. The curves that compose the graph must be loaded in the database as discussed in section 2.8 (Curve and Graph data).
- "Node Graph" is a plot related to a node that is present in the object animated in the **Display Window**. TOP/DOMDEC can display the behavior of a node of a mesh when applying results. For instance, TOP/DOMDEC can display the displacement in the X-axis of a node when ***Vector Results*** are being applied. It can also display the variation of the value at a node when ***Scalar Results*** are being applied.

Thus, TOP/DOMDEC provides two ways to create a graph: XY Graph and Node Graph.

- When creating an XY Graph TOPDOMDEC

  - enables "Graph Information" to enter the desired name of the graph.
  - labels the title of the first browser "Curve(s) In Database".
  - displays in the first browser the list of all curves that are currently in the database.

- When creating a Node Graph TOP/DOMDEC

  - enables "Graph Information" to enter the desired name of the graph.
  - labels the title of the first browser "Nodesets".
  - displays in the first browser the list of all nodesets currently present in the database.

Modify Graph

To change an aspect of any graph and/or curve in the database and/or in a **Display Window** click on the "Modify Graph" chooser. The user should be aware of which **Display Window** they are currently working in and which graph they are modifying (Left or Right graph).

Clicking on this option

- disables the "Graph Information" and the "Curve Information" options.
- changes the title of each browser.
  In this case, in order from left to right, the browser titles are: "Graph In Window", "Curve In Graph", "Graph In Database", and "Curve In Database"
- displays in each browser the corresponding list of graphs/curves.

By default, TOP/DOMDEC displays the list of "Left Graph" in the "Graph In Window" browser.

Graph Information

This set of options controls graph properties.
It is available when:

- creating a new graph.
- selecting a graph from "Graph In Window" or from "Graph In Database".

Graph Name

The graph is labeled "Unnamed" when first created. When creating a graph TOP/DOMDEC does not allow the user to click on the "Apply" button if the graph name label is "Unnamed". The user must enter a new graph name.
When modifying a graph, TOP/DOMDEC displays the name of the selected graph.
The name of a graph can be changed here. The user enters the desired graph name and TOP/DOMDEC automatically updates the name of the graph in the database and in the browsers.

IMPORTANT

Changing the name of a graph in a window will also change the name in the database.

When naming a graph, if the name is already in use by another graph TOP/DOMDEC refuses to change the name.

Set Graph

This button opens a Graph Options Window. The user can set the appearances of the selected graph. The name of the selected graph appears at the top of this window. This window is shown in figure 3.54.

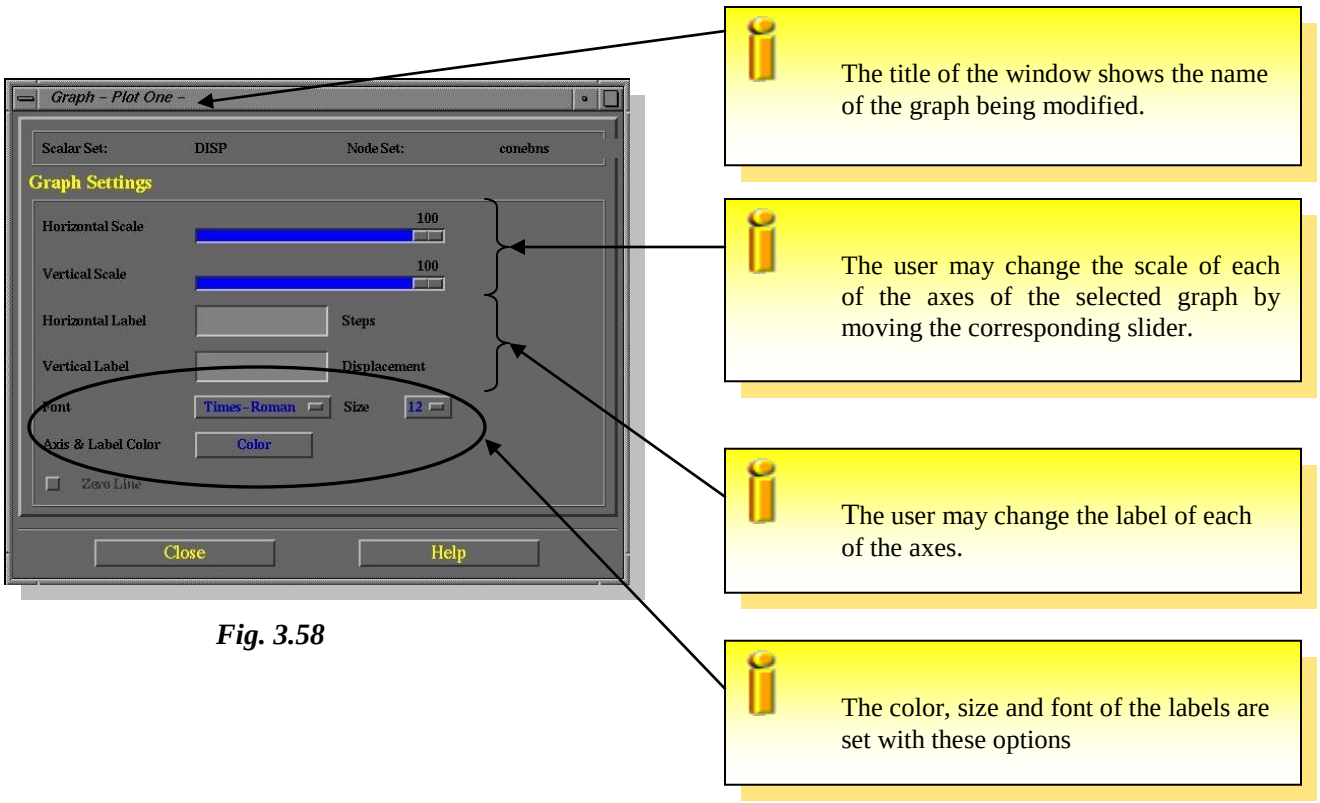


Fig. 3.58

On top of the window TOP/DOMDEC provides information about the nature of the selected graph. If applicable, TOP/DOMDEC displays the type and name of results and the name of the Nodeset on the top of the window.

The "Zero Line" option allows the user to visualize the zero value line of the y-axis. Selecting this option draws a horizontal line in the graph at y equal to zero.

Delete Graph

The user may remove a graph selected from the "Graph In Window" or the "Graph In Database" browsers.
If the graph has been selected from the "Graph In Window" browser, Delete Graph will remove it from the selected side of the **Display Window**.
If the graph has been selected from the "Graph In Database" browser, Delete Graph will remove it from the database and all **Display Window**s.

Browsers

There are four browsers in this window. They are single selection browsers and do not support the double-click feature (see section 1.4.7 (Single and Multiple Selection Browsers) for more information about browsers).
The browsers behave differently according to the options selected above the browsers. The following table describes the different titles and contents of each browser according to the action chosen by the user.

Title & Contents of Browsers	XY-Graph Creation	Node-Graph Creation	Modifying a Graph
List 1	Curves In Database	Nodesets	Graphs In Window
List 2	N/A	Load Case	Curves In Graph
List 3	N/A	Scalar Set	Graphs In Database
List 4	N/A	Vector Set	Curves In Database

Note that "Curves In Database" only lists the XY-Curves that are read from an input file. Curves created for a node and result do not appear in the list, because they are created "on the fly" (along with the animation). They are never stored in the database.

The next table describes the different actions that occur when the user selects an item from any of the lists.

Selection from	*XY-Graph Creation*	*Node-Graph Creation*	*Modifying a Graph*
List 1	✓ Check all conditions to create an XY Graph and enable the "Create Graph" button.	✓ Update List 2 to display possible ***Load Cases*** for the selected nodeset. ✓ Enable the "Curve Information" to enter a node number and updates the maximum possible node number.	✓ Update List 2 to display the curves currently in the selected graph. ✓ Enable "Graph Information" to set options of the selected graph.
List 2	**N/A**	✓ Update List 3 to display the ***Scalar Results*** corresponding to the selected ***Load Case***. ✓ Update List 4 to display the ***Vector Results*** corresponding to the selected ***Load Case***.	✓ Enable "Curve Information" to set options of the selected curve in the selected graph.
List 3	**N/A**	✓ Disable the axis chooser since the ***Scalar Results*** of node do not depend on the axis. ✓ Unselect entries in List 4. ✓ Check if all conditions to create a new Node Graph are fulfilled and enable the "Create Graph" button to display the graph.	✓ The bottom left button of the window becomes "Add Graph" to allow the addition of the selected graph into the selected side of the **Display Window**. ✓ Enable "Graph Information" so the user can remove the graph from the database or change its name. ✓ Unselect entries in List 1, List 2, and List 4.
List 4	**N/A**	✓ Enable the axis chooser to select which axis of the ***Vector Results*** to visualize. ✓ Unselect entries in List 3. ✓ Check if all conditions to create a new Node Graph are fulfilled and enable the "Create Graph" button to display the graph.	✓ The bottom left button of the window becomes "Add Curve" to allow the addition of the selected curve into the selected graph. ✓ Enable "Curve Information" so the user can modify the name of the curve or remove the curve from the database. ✓ Unselect entries in List 2 and List 3.

Curve Information

This set of options controls curve properties.

It is available only when the user selects:

- a nodeset, from the list 1, to enter a node number.
- a curve from the "Curve In Graph" browser.
- a curve from the "Curve In Database" browser.

Node #

Node # is available during the creation of a node curve. The user enters the desired node number of the new curve.

Curve Name

This prompt is available if the selected curve is an XY-Curve type. The user may change the name of the selected XY-Curve. The name of a Node-Curve is composed of the node number and the chosen axis of the Vector Results if applicable. This name cannot be changed.

Set Curve

This button opens a window used to adjust the width and color of a selected curve. A random color is given to all curves. The default width of a curve is 1.0.

Remove Curve

This button removes the selected curve from the database or selected graph.

IMPORTANT

Changing the name of a curve in a window also changes the name in the database.

The following is a list of important rules for this window.

- TOP/DOMDEC does not allow having twice the same graph on both the left and the right sides of a **Display Window**.
- TOP/DOMDEC does not allow having twice the same curve in a single graph.
- The conditions for "Create Graph" to be available are:
  - The graph name must be entered.
  - For an XY-Graph TOP/DOMDEC expects the user to select one curve from List 1. Otherwise, TOP/DOMDEC expects the user to select either a ***Scalar*** or a ***Vector Results*** from respectively List 3 or List 4.
  - If a Node Graph is being created TOP/DOMDEC expects the user to enter a valid node number.
- When adding a curve to a graph, TOP/DOMDEC checks if the curve type (Node or XY) corresponds with the graph type (Node or XY). TOP/DOMDEC does not allow mixed curve types in a single graph.

3.2.3.11 Stereoscopy

This is a new option in this version of TOP/DOMDEC. It simulates 3D viewing to see the object with a real depth factor.
This option is available if TOP/DOMDEC has been launched with the "-s" option. Otherwise a warning error is displayed. To use this option, the user must have a special pair of glasses connected to the computer.

3.3 Redraw Button & Animation Controller

Beneath the Main Menu Options described in the previous sections appears the Redraw button and the Animation Controller. These are shown in figure 3.55.

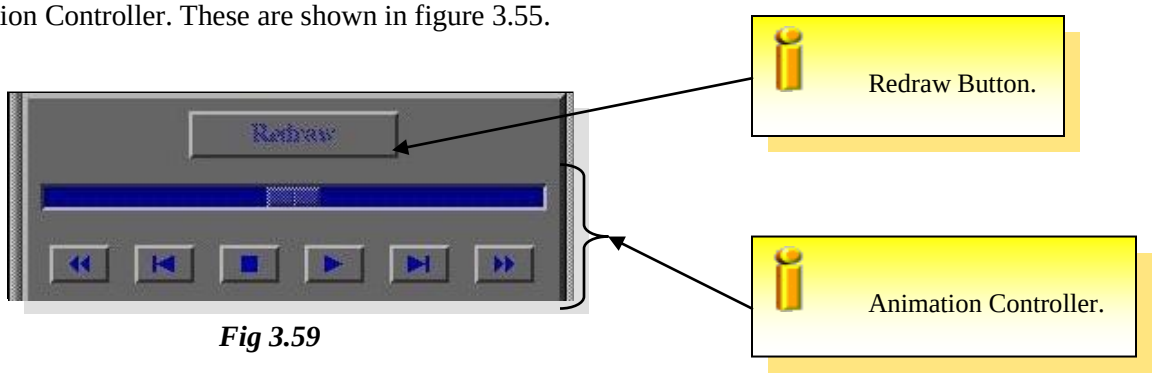


Fig 3.59

3.3.1 Redraw Button

The Redraw is used to redisplay all active **Display Window**s. Usually, this button must be clicked whenever TOP/DOMDEC needs to create a new object in the **Display Window**(s). For instance, when an ***Element Set*** has been selected the user must click on the Redraw button to draw the ***Element Set*** in the selected **Display Window**.
While drawing, TOP/DOMDEC displays a black and white watch icon and the user cannot perform any other action.

3.3.2 Animation Controller

The Animation Controller is composed of a slider and a set of buttons as shown in figure 3.55.

The Speed Slider

The speed slider is used to control the animation speed for all active **Display Window**s. For the default speed, this slider is placed in the middle as shown in figure 3.55. The user may set the speed faster or slower by sliding the cursor respectively to the right or to the left.
Note that this slider is available only when at least one ***Element Set*** is selected in a **Display Window**. This slider has no effect if dynamic results have not been selected for this **Display Window**.

The Control Buttons
This set of buttons is used to simultaneously control the animation of all active **Display Window**s. These six buttons are much like "VCR" controls. They are described in figure 3.56.

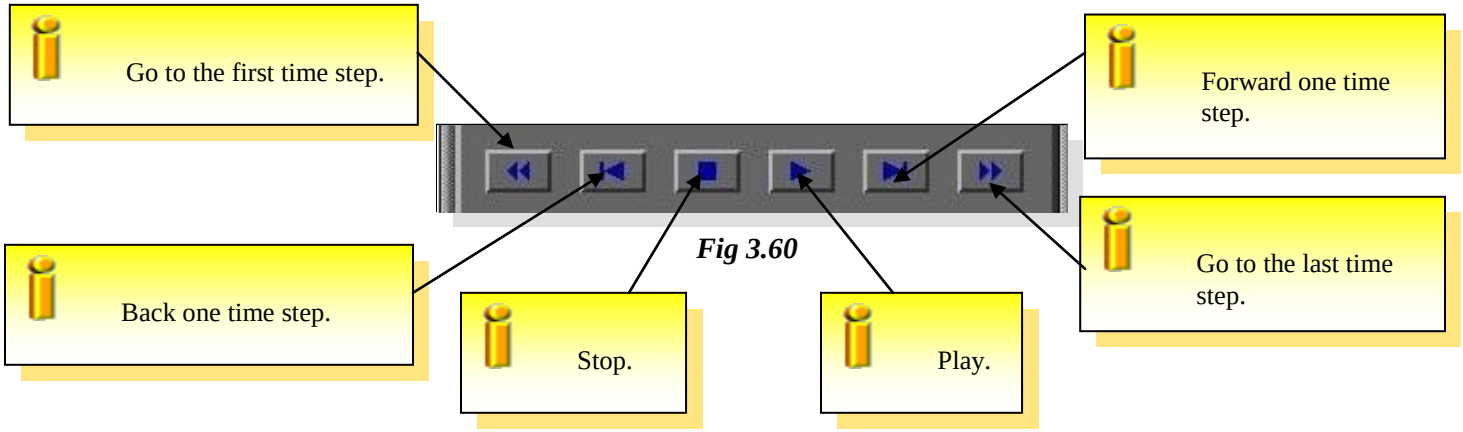


Fig 3.60

3.4 Object Display

The Object Display is a single browser, which displays the list of ***Element Set (s)*** in the selected **Display Window**. Each item in this browser is an ***Element Set*** in the TOP/DOMDEC database. The browser is shown in figure 3.57.

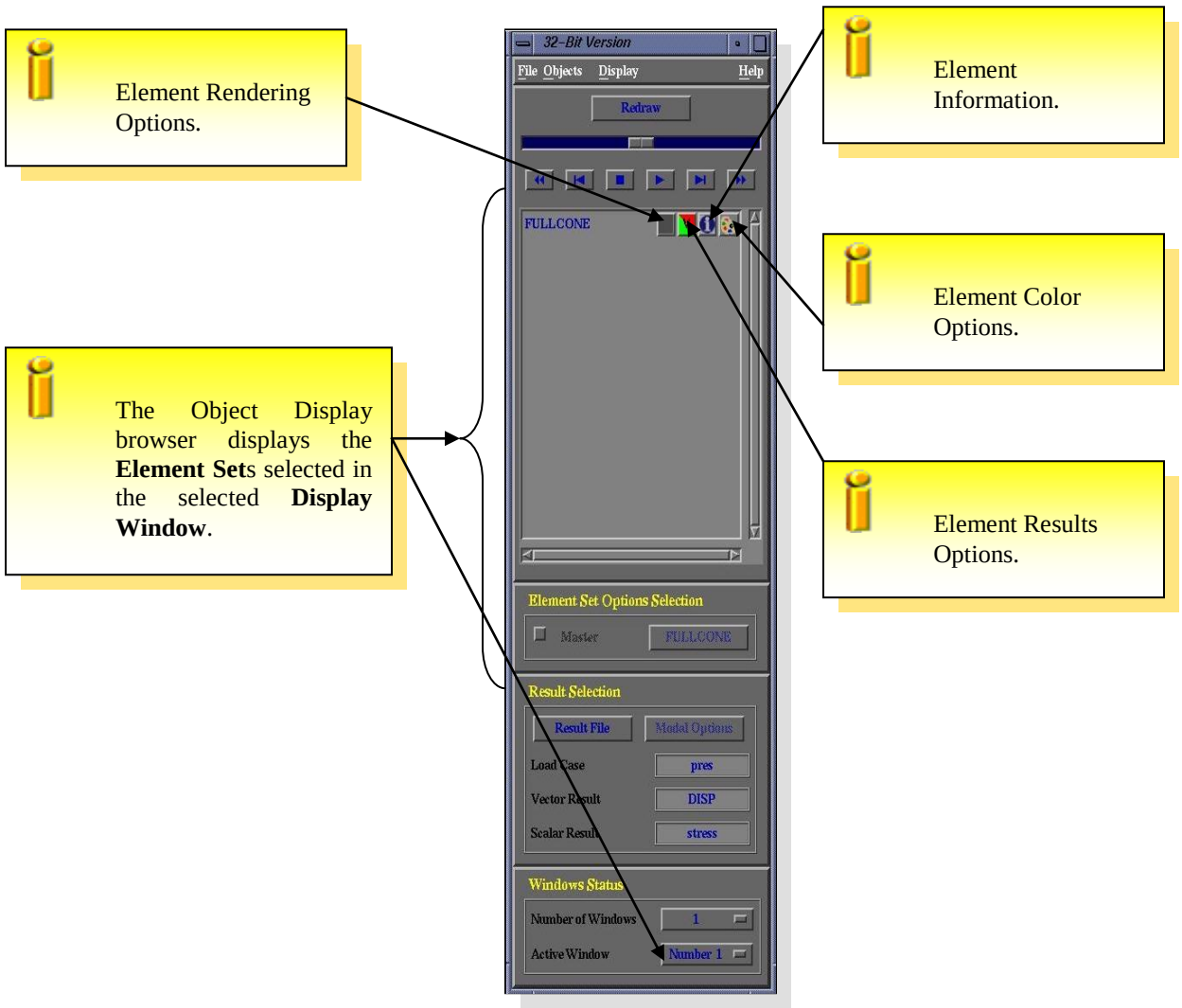


Fig 3.61

Each of the ***Element Sets*** in this browser is displayed with four choosers at its right. Clicking on them causes TOP/DOMDEC to open new windows to select more options. The options present in each button affect only the ***Element Set*** for which the particular window has been opened. These buttons are respectively from left to right: Element Rendering Options, Element Result Options, Element Information, and Element Color Options. Each button is explained in the following sections.

3.4.1 Rendering Options

The first button of a single ***Element Set*** of the Object Display browser is Rendering Options. This button option controls the rendering of the nodes and elements of the selected ***Element Set***. Clicking on it opens a Rendering Options Window to select how to render the elements and nodes. The Rendering Options Window is shown in figure 3.58.

Figure 3.58 shows the Rendering Options Window for the "FULLCONE" ***Element Set***.

ATTENTION

In the case where a Master Element Set has been selected, this name will display a general label, "All Element Sets" which means that all options of this window will apply to all the ***Element Sets*** of this **Display Window**. See section 3.5 "Master Element Set Selection".

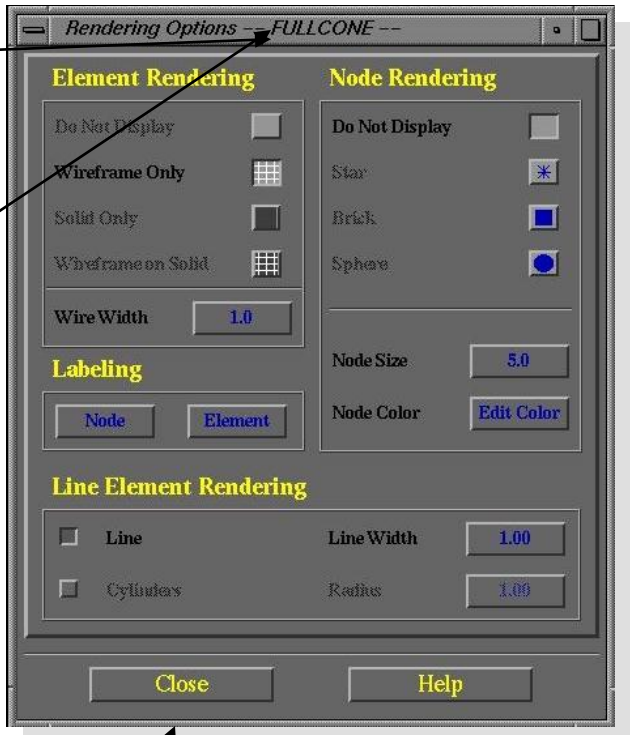


Fig 3.62

This is a single item from the Object Display browser.

The following sections describe each part of the Rendering Options Window.

Element Rendering

For each ***Element Set*** there are four different types of rendering: No Rendering, Wireframe, Solid, and Wireframe on Solid. Only one of the rendering types can be selected at a time. When a rendering type is selected, the label on the left is black and any previous type is automatically unselected. The current type of rendering is displayed in the Element Rendering button of the Object Display browser. This button is automatically updated as the user makes changes in this window.

Underneath the group of button choosers the user may set the width of the wireframe of the ***Element Set***. Clicking on the button to the right of the label "Wire Width" opens an Input Window in which the user may enter the width for the wireframe (for more information about inputting a number refer to section 1.4.6 (Input Window)). Note that this option is available only when the element rendering type is "Wireframe" or "Wireframe on Solid".

By default TOP/DOMDEC draws an ***Element Set*** using Wireframe rendering.

Clicking on the Element Rendering button of the Object Display browser with the middle or right button of the mouse automatically changes the element rendering type without opening the Element Rendering Options Window.

Node Rendering

For each ***Element Set*** there are four different types of node rendering: No Rendering, Star, Brick, and Sphere. Only one node rendering type can be selected at a time. When selected, the label on the left of the chosen type is black while other labels are gray.

Underneath this set of button choosers, the user can set the color and size of the node rendering. The default size of the node rendering is 5.0 and the default color is blue. Clicking on either button opens a window to set the corresponding option (for more information about inputting a number see section 1.4.6 (Input Window) and for information on setting colors see section 1.4.9 (Color Selection)).
By default TOP/DOMDEC does not render the nodes of the ***Element Set***.

Line Element Rendering

In this section the user selects how to render the line elements of the selected ***Element Set***.
TOP/DOMDEC can render the line elements as wires or as shaded cylinders (for more information about the object types in TOP/DOMDEC see section 1.3 (Objects in TOP/DOMDEC)).
If TOP/DOMDEC does not find any line elements in the selected ***Element Set***, this option has no effect.
By default TOP/DOMDEC draws line elements objects as wires.
The user may change the size of each rendering by clicking on the buttons next to each option and entering a new size or cylinder radius (for more information about inputting a number see section 1.4.6 (Input Window). The default size and cylinder radius are both set to 1.0.

Labeling

Clicking on either the “Node” or “Element” button under the yellow label “Labeling” opens respectively the Node or Element Labeling Window. This window allows the user to label the nodes and elements in this ***Element Set***. The Labeling Window is presented in figure 3.59.

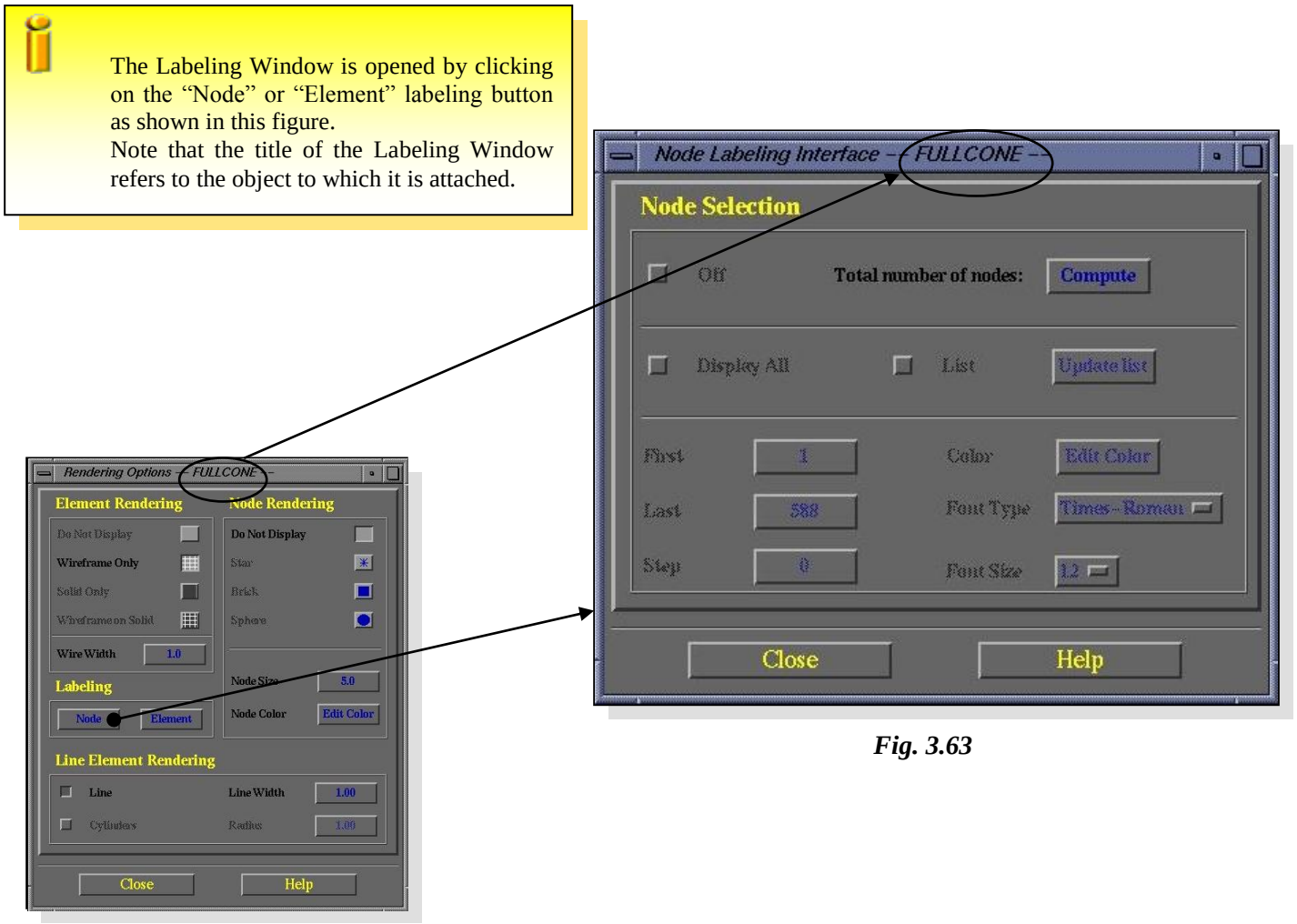


Fig. 3.63

The following sections describe the Labeling Window.

3.4.1.1 Labeling Windows (Nodes & Elements)

This window is identical for both “Node” and “Element” labeling and is shown in figure 3.60.

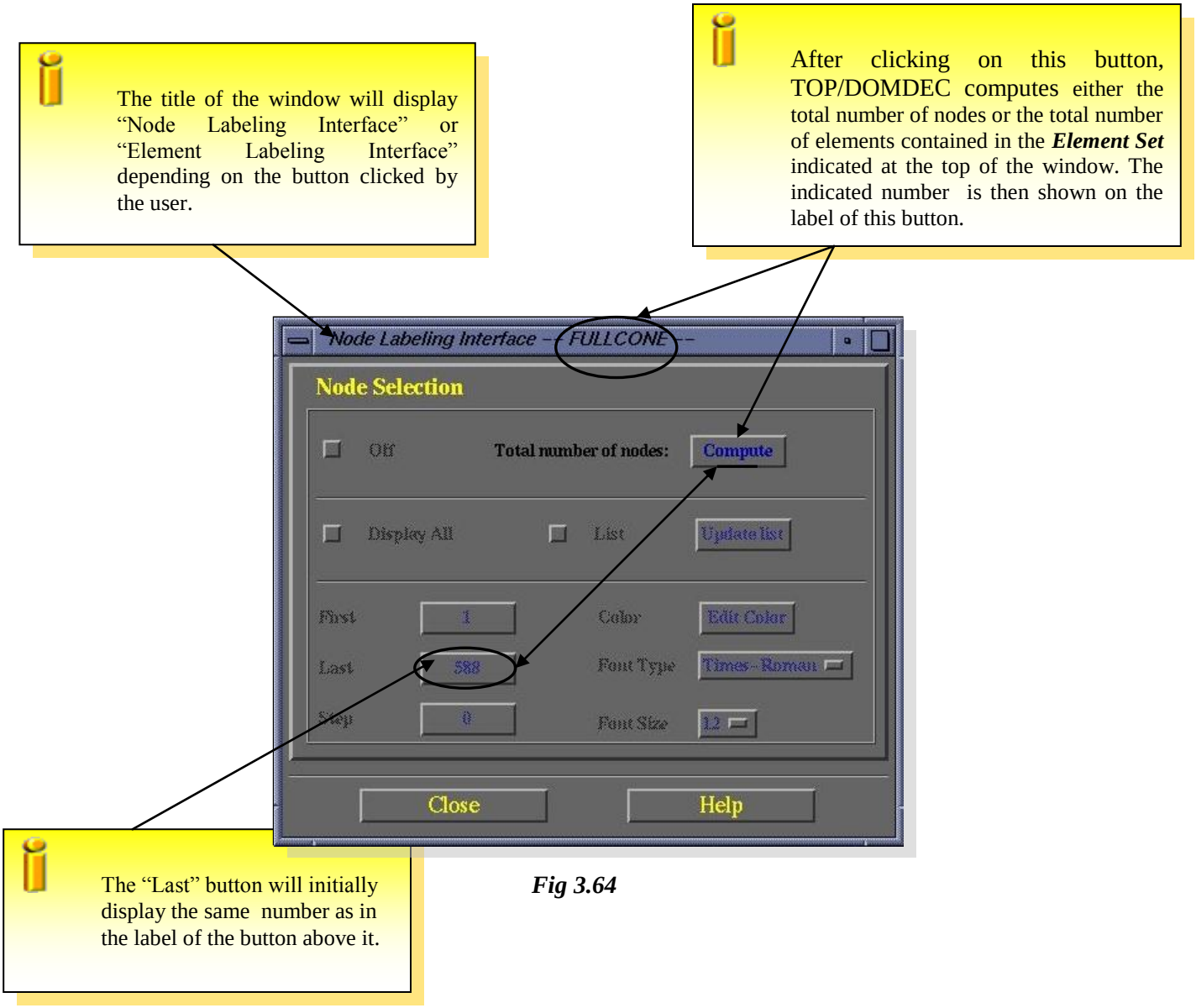


Fig 3.64

IMPORTANT!

- If nodes are being labeled, nodes inside a volumetric object will be displayed, even if, the internal wireframe is not displayed.
- If elements are being labeled, elements inside a volumetric object cannot be displayed.

The next sections explain the different choices available in this window.

Active

The user must click on this option in order to label nodes (or elements) in this ***Element Set***. By turning this option "On" the user enables the window for more options. Tuning "Off" this option will disable all labeling options and TOP/DOMDEC will not display the node (or element) labels.

Display All

Clicking on this option labels all nodes (or elements) in this ***Element Set***. This will disable the "List" option discussed below and update the "First", "Last" and "Step" button labels respectively to "1", maximum of nodes (or elements), and "1".

First, Last & Step

Clicking on the "First", "Last" or "Step" button opens an Input Window to enter the respective number (for more information on how to input numbers see section 1.4.6 (Input Window)). These options allow the user to label a set of consecutive nodes (or elements). If desired, the user may set a step number, n, which causes TOP/DOMDEC to label every n^{th} node (or element). If an out-of-range number is entered TOP/DOMDEC displays an error message.

Color, Font Type, Font Size

These choosers select the appearances of the labels. Clicking on the "Color" button opens a Color Selection Window (see section 1.4.9 (Color Window) for more information on how to select a new color) in which the user can select a new color for the labels. By default node labels are red and element labels are yellow.
"Font Type" and "Font Size" select respectively the font type and the font size of the labels. By default, the font type is "Time-Roman" and the font size is set to 12 for both node and element labels.

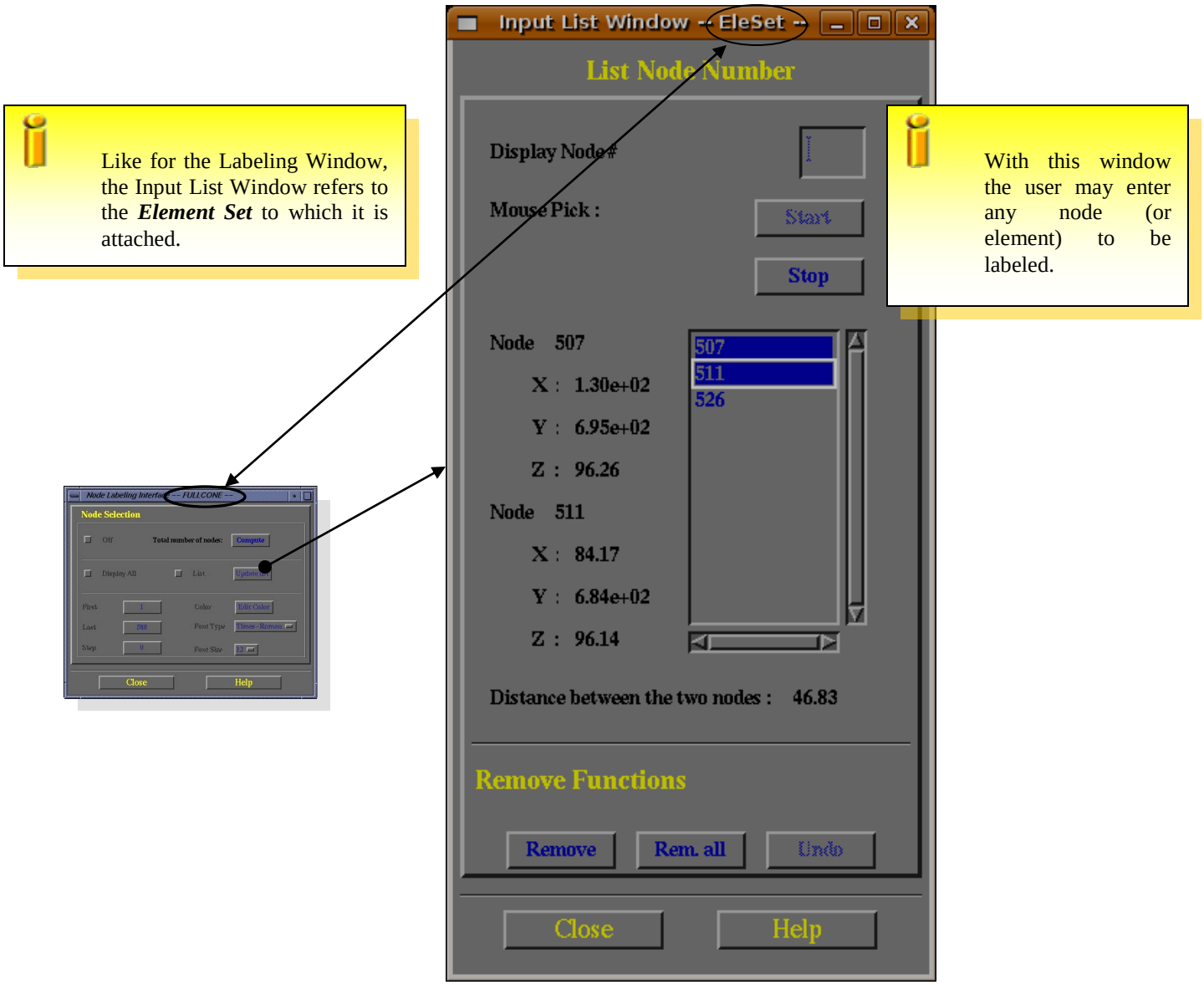
When labeling the nodes and elements of a ***Partitioned Mesh***, TOP/DOMDEC labels only the nodes and elements of the selected subdomain.

Compute

If the user clicks on this button, TOP/DOMDEC computes the number of nodes (or elements) that the corresponding mesh uses. Once this computation is made, TOP/DOMDEC displays the result in place of "Compute" so that it does not need to redo this computation.

List

This option allows the user to specify a node (or element) to be labeled, either by inputting its id number or by using the mouse, pointing at it and clicking. Clicking on the button chooser to the left of the label "List" makes the button "Update List" available. This button opens a window for managing the labeling process.
The Input List Window is shown in figure 3.61.



The following discuss the features of the Input List Window.

3.4.1.1.1 Input List Window

Prompt box

In the prompt box the user may enter the desired node (or element) to be labeled. Next, the user must push on the "Enter" key for TOP/DOMDEC to label the node (or element) and list the new entry into the browser below this prompt box. If nodes are being labeled, TOP/DOMDEC displays the coordinates of the new node number to the left of the browser. If an invalid id number is entered, TOP/DOMDEC displays an error message and the user will have to re-enter a correct id number.

Browser

The browser in this window is a multiple selection browser and does not support the double-click feature (for more information about browsers see section 1.4.7 (Single and Multiple Selection Browsers)).

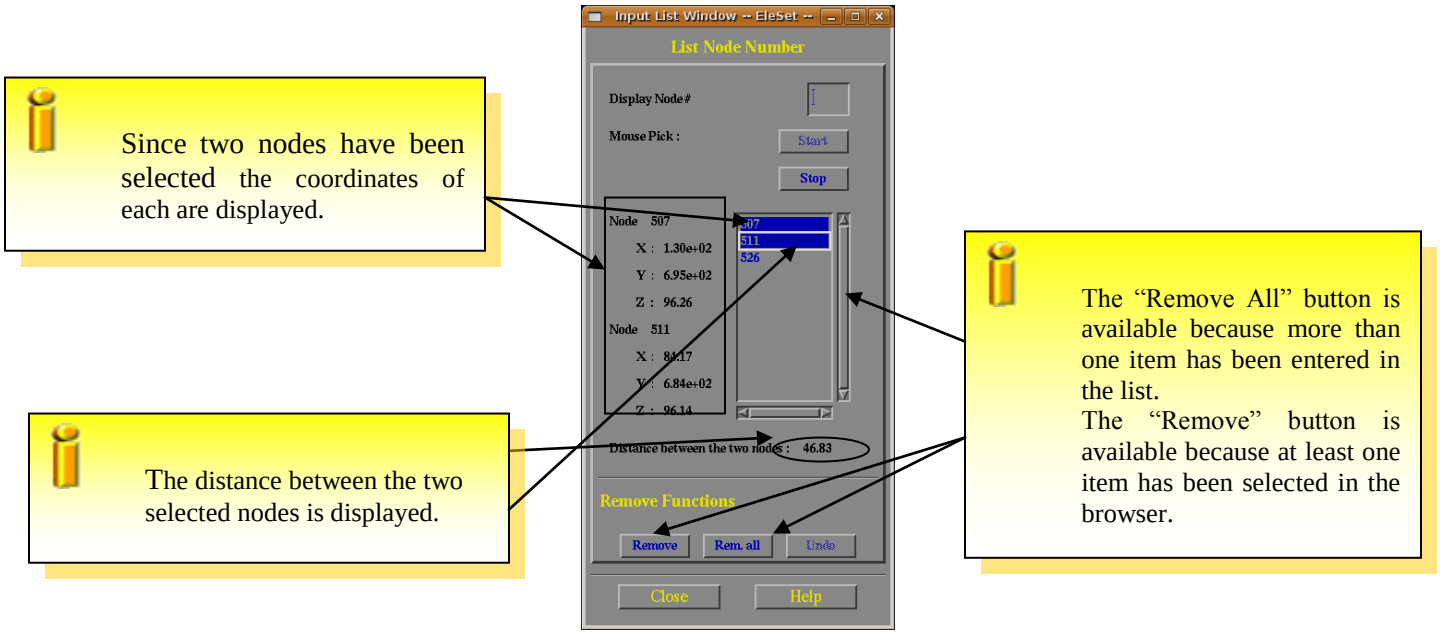
Selecting items from this browser makes the "Remove" button available.

If the window is used to label the nodes:

- If a single node is selected TOP/DOMDEC displays its coordinates to the left of this browser.
- If exactly two nodes are selected TOP/DOMDEC displays the coordinates of each. It will also show the distance between the two selected nodes.

Buttons

The button "Remove All", beneath the browser, is available when there is at least one item listed in the browser. Clicking on it removes all the items from the list and removes the node (or element) labels.
Selecting items from the browser enables the button "Remove". Clicking on this button removes the selected item(s) and removes the label from the selected node(s) (or element(s)).
After removal, the button "Undo" is available. The button allows the user to retrieve the last node(s) (or element(s)) that have been removed from the list.



Mouse Pick (Nodes only)

The mouse pick option allows the user to select a node for labeling directly in the main display window using the mouse. To start selecting nodes with the mouse, press the “Start” button. You may still move the displayed objects with the mouse as before. When you are ready to select a node, press the Control Key, point at the node and click. TOP/DOMDEC will calculate the closest node to the mouse location you picked, display its id number and add it to the Browser. You may move the mesh to another position and select another node, or if you are done, hit the “Stop” button to end the point and click process.

3.4.2 Results Options

The second button of the Object Display for each ***Element Set*** is the Results Options. Using this button, the user determines which types of results are to be displayed with the selected ***Element Set***.
Clicking it with the left mouse button opens the Result Options Window as shown in figure 3.63.

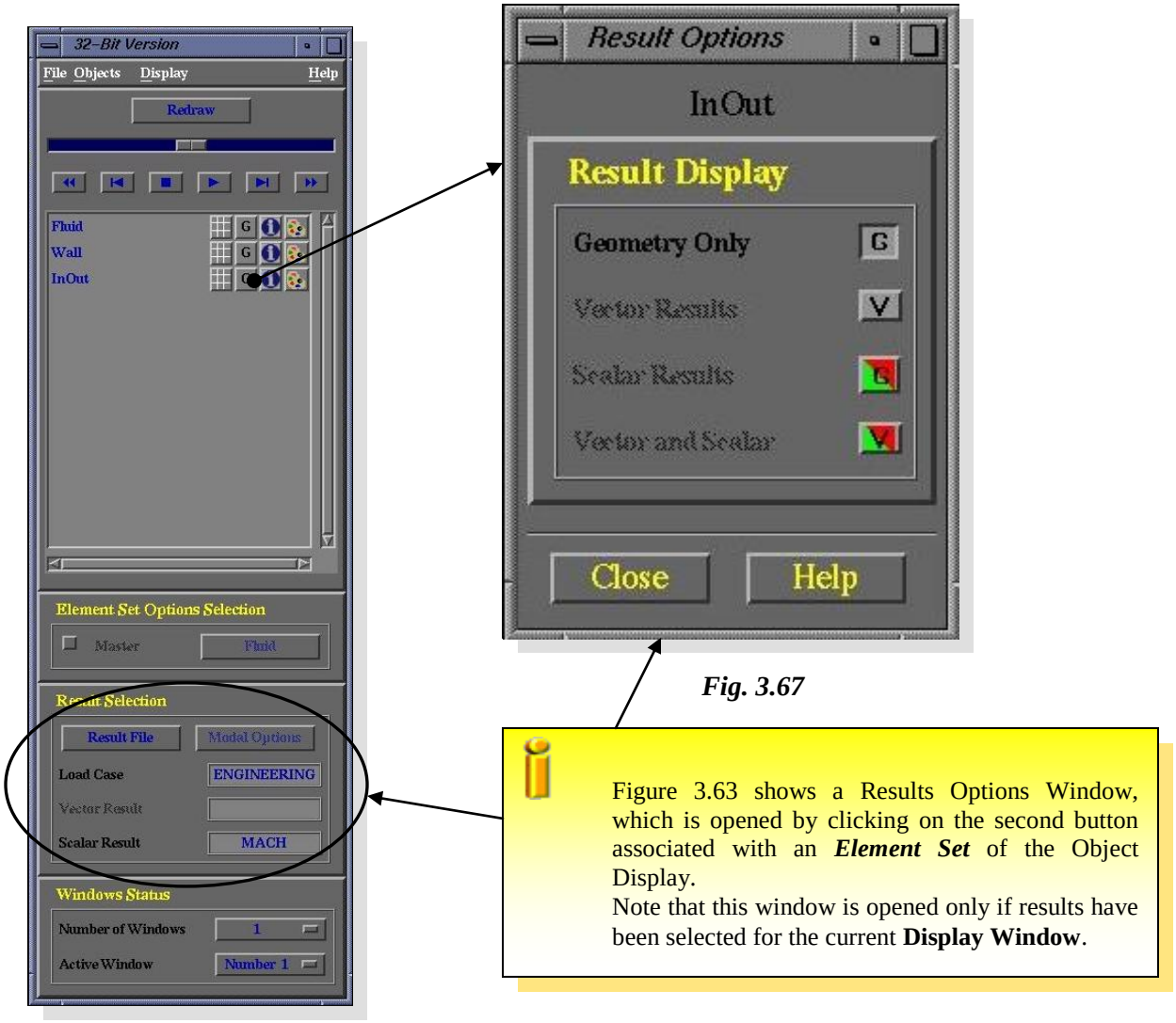


Fig. 3.67

The user may select one of the four available ways to display the results. The choices are: “Geometry Only”, “Vector Results”, “Scalar Results”, and “Vector and Scalar Results”.

Geometry Only

Selecting this option does not draw results with the selected ***Element Set***.

Vector Results

Selecting this option displays the selected ***Vector Results*** with the selected ***Element Set***. This option is available if ***Vector Results*** have been selected for this **Display Window**. For more details on how to select a ***Vector Results*** for a given **Display Window** see section 3.5 (Result Selection).

Scalar Results

Selecting this option displays the selected ***Scalar Results*** with the selected ***Element Set***. This option is available if ***Scalar Results*** have been selected for this **Display Window** and if the element rendering mode is Solid or Solid/Wireframe (refer to section 3.4.1 (Rendering Options) for more information about element rendering mode).
For more details on how to select a ***Scalar Results*** for a given **Display Window** see section 3.5 (Result Selection).

Vector and Scalar Results

By selecting this option TOP/DOMDEC displays both the selected ***Vector*** and ***Scalar Results*** of a **Display Window** with the selected ***Element Set***. To select this option, both the ***Vector*** and ***Scalar Results*** must have been selected for this **Display Window**.

Clicking on the Result Options button of the Object Display browser with the middle or right button of the mouse automatically changes the type of results to be displayed without opening the Results Options Window.

3.4.3 Information Window

Clicking this button opens one of two different versions of a statistical window. The first version of the window is for a non-decomposed mesh**,** while the second version refers to a ***Partitioned Mesh***.
The next sections explain these two windows.

3.4.3.1 Information Window for Non-Decomposed Mesh

Upon clicking the Information Button as shown in figure 3.64, a statistical window for a non-decomposed mesh is displayed.

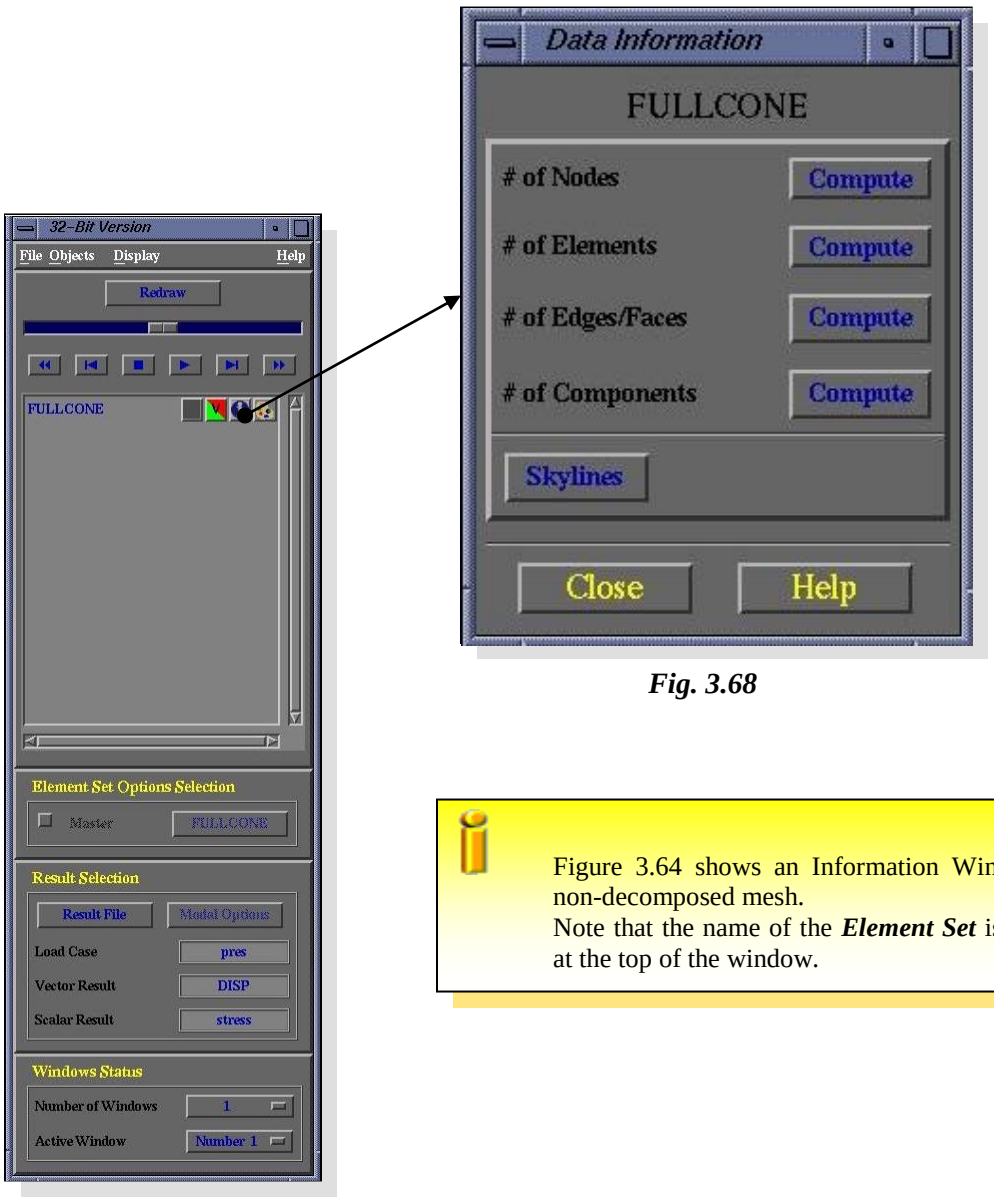


Fig. 3.68

Figure 3.64 shows an Information Window for a non-decomposed mesh.
Note that the name of the ***Element Set*** is displayed at the top of the window.

This window contains various information about the selected ***Element Set***. The following sections describes the information given by this window.

# of Nodes.

Clicking on the button on the right of this label TOP/DOMDEC computes and displays the number of nodes in the ***Node Set*** used by the selected ***Element Set***.

# of Elements.

Clicking on the button on the right of this label TOP/DOMDEC computes and displays the number of ***Elements*** in the selected ***Element Set***.

# of Edges/Faces.

Clicking on the button on the right makes TOP/DOMDEC computes and displays the number of Edges and Faces in the selected ***Element Set***. The computation may take a few seconds for ***Element Sets*** with a large number of elements. During the computation of this data TOP/DOMDEC displays a black and white watch icon and the user cannot perform any other action.

# of Components.

Clicking on the button on the right makes TOP/DOMDEC computes and displays the number of components that compose the selected ***Element Set***. Like for the number of edges and faces, this data is computed before opening the Information Window.

At the bottom left of the Information Window appears a "Skylines" button which opens a second statistical window called the "Skyline Window". This window is shown on figure 3.65 and it is explained in the next section.

Figure 3.65 shows the Skyline Window opened by clicking on the "Skylines" button as shown. Note that this window has a title, which refers to the selected ***Element Set***.

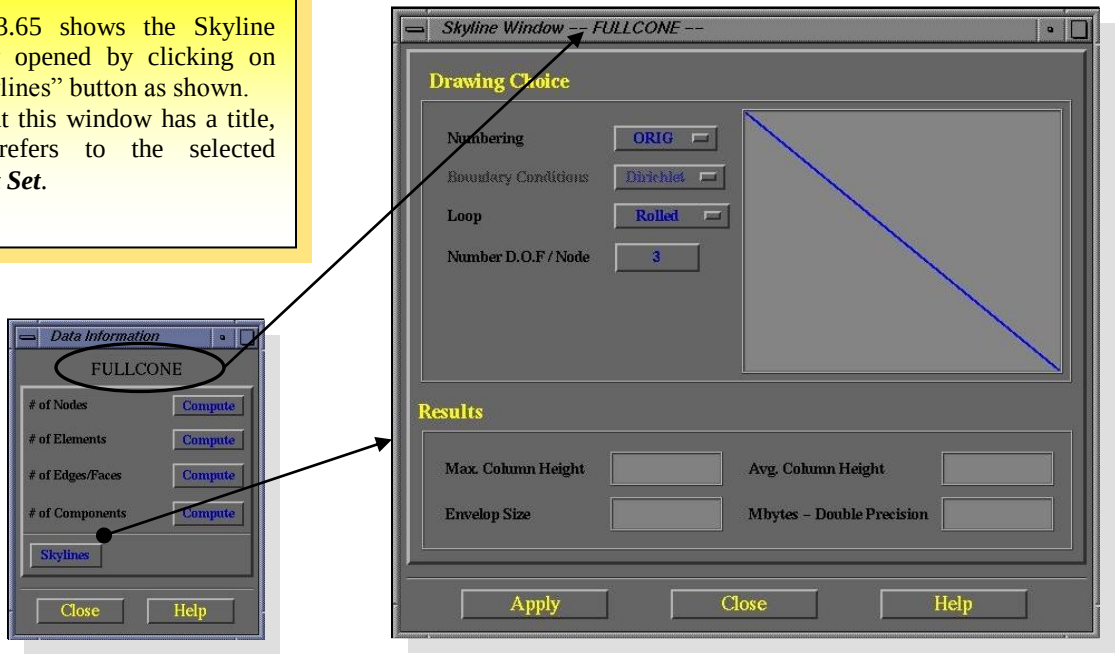


Fig. 3.69

3.4.3.1.1 Skyline Window

This window allows the visualization of the Skyline profile of matrices which would be generated for a finite element problem corresponding to the mesh.

Drawing Choices

Different Skylines may be generated based on the renumbering technique, the boundary conditions, and the number of degrees of freedom per node. The user may change any of these options with the choosers listed on the left of this window. For more information about how to make choices in TOP/DOMDEC see section 1.4.4 (Button and Choosers).
After making the choices the user must click on the "Apply" button to draw the skyline in the area on the right. Note that TOP/DOMDEC displays only the upper part of the skyline.

Results

After drawing, TOP/DOMDEC displays statistical information about the skyline including: the maximum column height, the average column height, the envelope size, and the estimated memory usage in megabytes.

3.4.3.2 Information Window for Decomposed Mesh.

When displaying a ***Partitioned Mesh*** the user may obtain a variety of statistical data. The figure 3.66 shows the Information Window that is displayed by clicking the Information button for a ***Partitioned Mesh***.

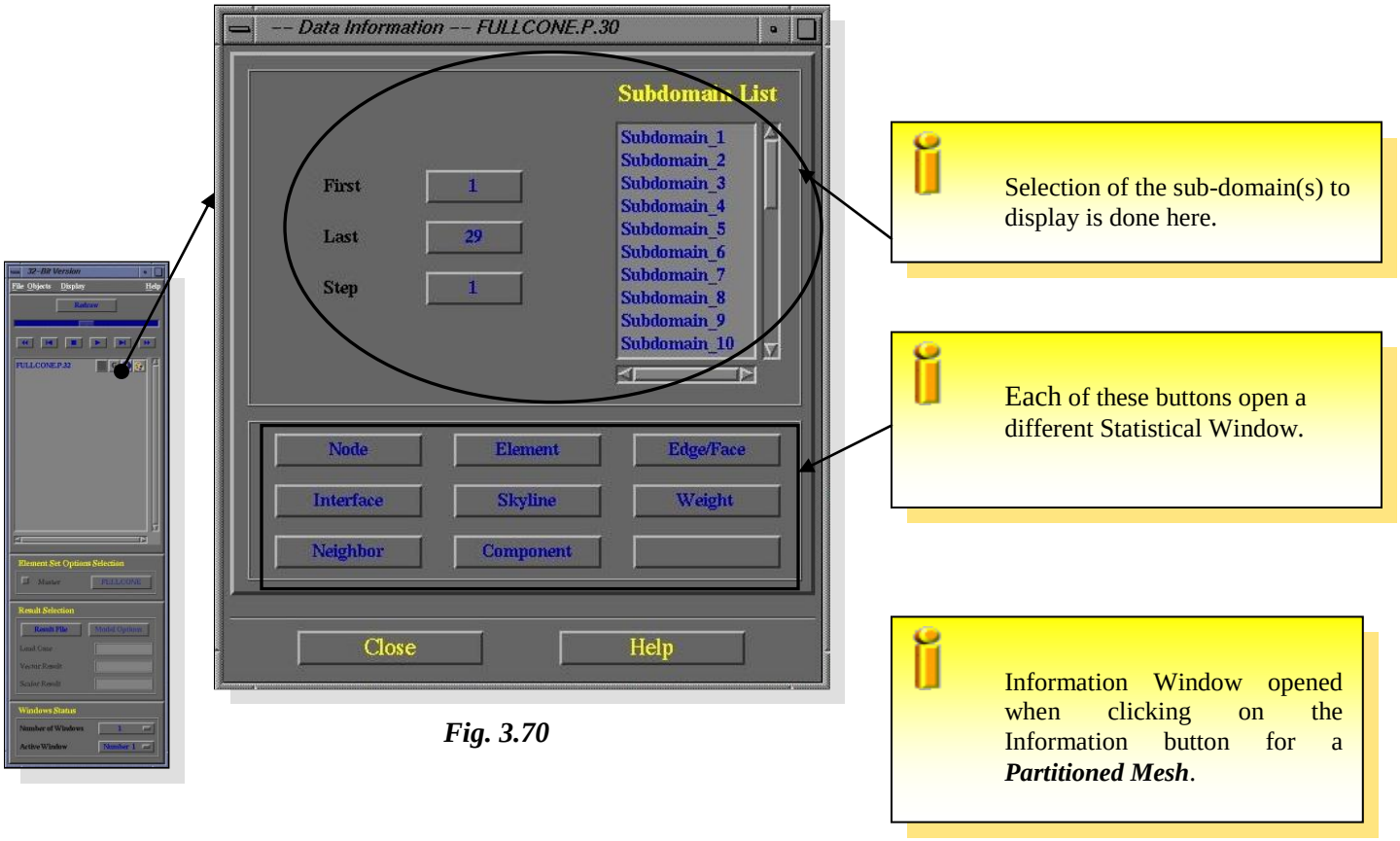


Fig. 3.70

The following sections explain the usage of the Information Window for a ***Partitioned Mesh***. This window contains two main parts: the selection of subdomain(s) to display and the selection of statistical information about the displayed subdomain(s).

Selection of the subdomain(s) to be displayed.

When visualizing a mesh partition the user may select which subdomain(s) to view. In the top part of this window, the user can click on one of three provided buttons: "First", "Last", and "Step". These three buttons work exactly as in the Picture Window (Section 3.2.3.5) or in the Labeling Windows (Section 3.4.1.1). Entering any of the corresponding numbers will display only the selected subdomain(s). The user must then click on the "Redraw" button of the Animation Controller to view the selected subdomain(s).
At the right of the window appears a browser, which lists the displayed subdomains. Items may not be selected from this browser. This list is automatically updated as the user enters new First, Last, and Step values.

Selection of the Statistical Window.

The bottom part of this window features several buttons, which provide several types of detailed statistical data about the displayed subdomain(s).

Clicking on Node, Element, Interface, Component, Edge/Face, or Weight opens a type of Statistical Window shown in figure 3.67.
Clicking on Neighbor opens another type of Statistical Window shown in figure 3.68. Clicking on "Skyline" opens the last available type of Statistical Window shown in figure 3.69.

The next sections explain these three types of Statistical Window.

3.4.3.2.1 "Regular" Statistical Window

A Regular Statistical Window allows the user visualize data about each displayed subdomain.
The window features a browser on the left side listing the displayed subdomain(s) and corresponding data. There is no effect when selecting an item from this browser.
On the right side appears a rectangle that draws the corresponding data in a histogram to visualize the statistical data for all displayed subdomains.
Beneath the histogram other statistical information is displayed such as the minimum, maximum, and average values.

In this example, the browser lists the displayed sub-domains. The list is exactly the same as the list appearing in the parent window. Each item of the browser gives the name of each displayed sub-domain plus the number of node(s) (or other data).

The histogram of this window displays the number of nodes (or other data) for each displayed sub-domain. This allows the user to have a global view of the distribution of the nodes over the entire ***Partitioned Mesh***.

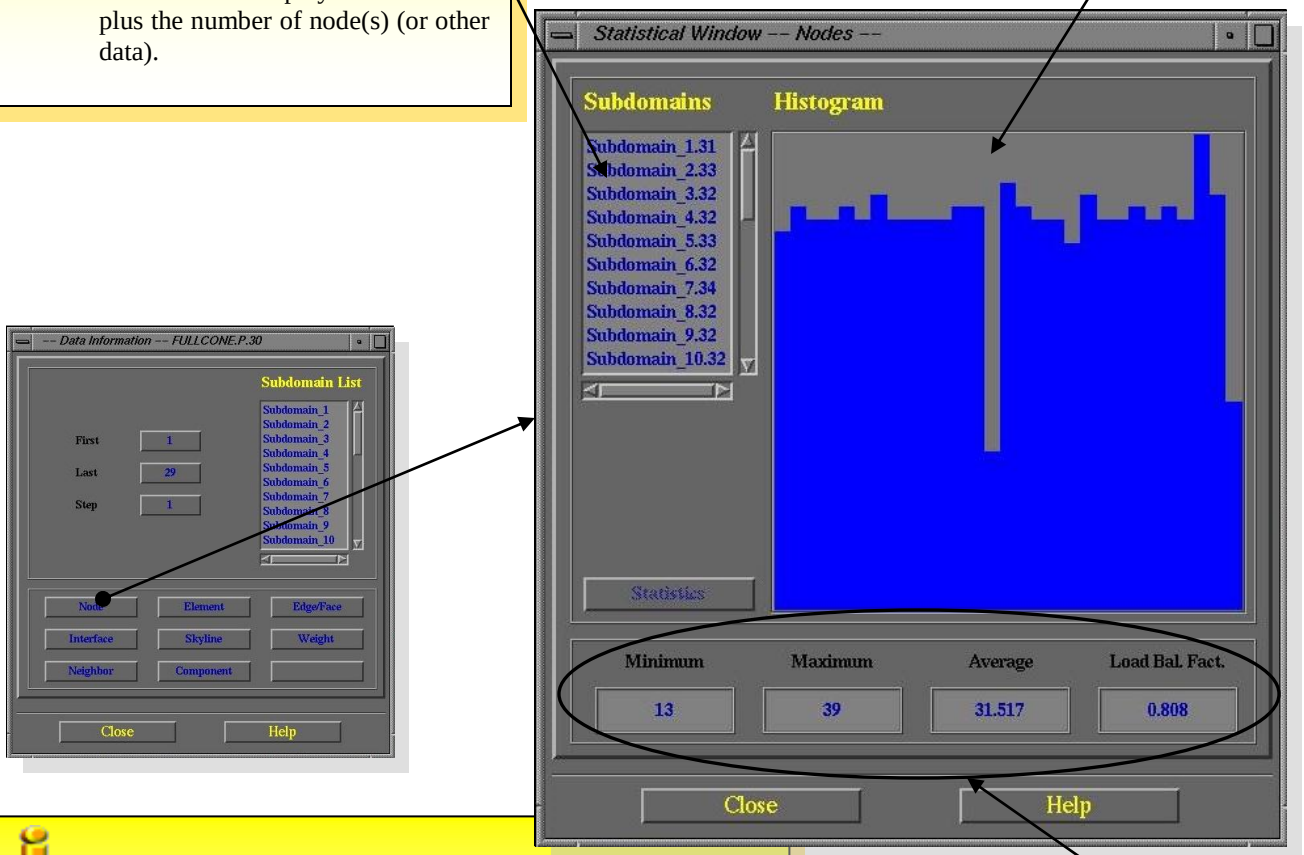


Fig. 3.71

Figure 3.67 shows a "Regular" Statistical Window which has been opened by clicking on the "Node" button of the Data Information Window. It could also have been opened also with the Element, Interface, Component, Edge/Face or Weight buttons. The data inside the Statistical Window would be different according to the button clicked.

Some additional statistical data is displayed here.

Understanding the histogram

Each blue bar represents the number of nodes (or other data) of a single subdomain. The first subdomain is on the left side of the histogram. The maximum of the histogram corresponds to the maximum number of nodes in a single subdomain among the displayed subdomains. Thus, the maximum number, along with the histogram, changes as the list of displayed subdomains is adjusted.

The additional statistical data are in order from left to right, the maximum, minimum, average and load balance factor numbers. These numbers are computed for all displayed subdomains.

Maximum

The maximum is the maximum number of nodes (or other data) in a single subdomain among the displayed subdomain(s).

Minimum

The minimum is the minimum number of nodes (or other data) in a single subdomain among the displayed subdomain(s).

Average

The average is the average number of nodes (or other data) in the subdomains.

The Load Balance Factor

This is the ratio between the average and the maximum numbers described above. TOP/DOMDEC computes the average number divided by the maximum number and displays the result in this field.

Beneath the browser of this window appears a “Statistic” button which is un-available for this type of statistical window.

3.4.3.2.2 Neighbor Statistical Window

This Statistical Window is opened by clicking on the "Neighbor" button of the Information Window of a ***Partitioned Mesh***. The window looks like the "regular" Statistical Window except for the histogram. The Neighbor Statistical Window is shown in figure 3.68

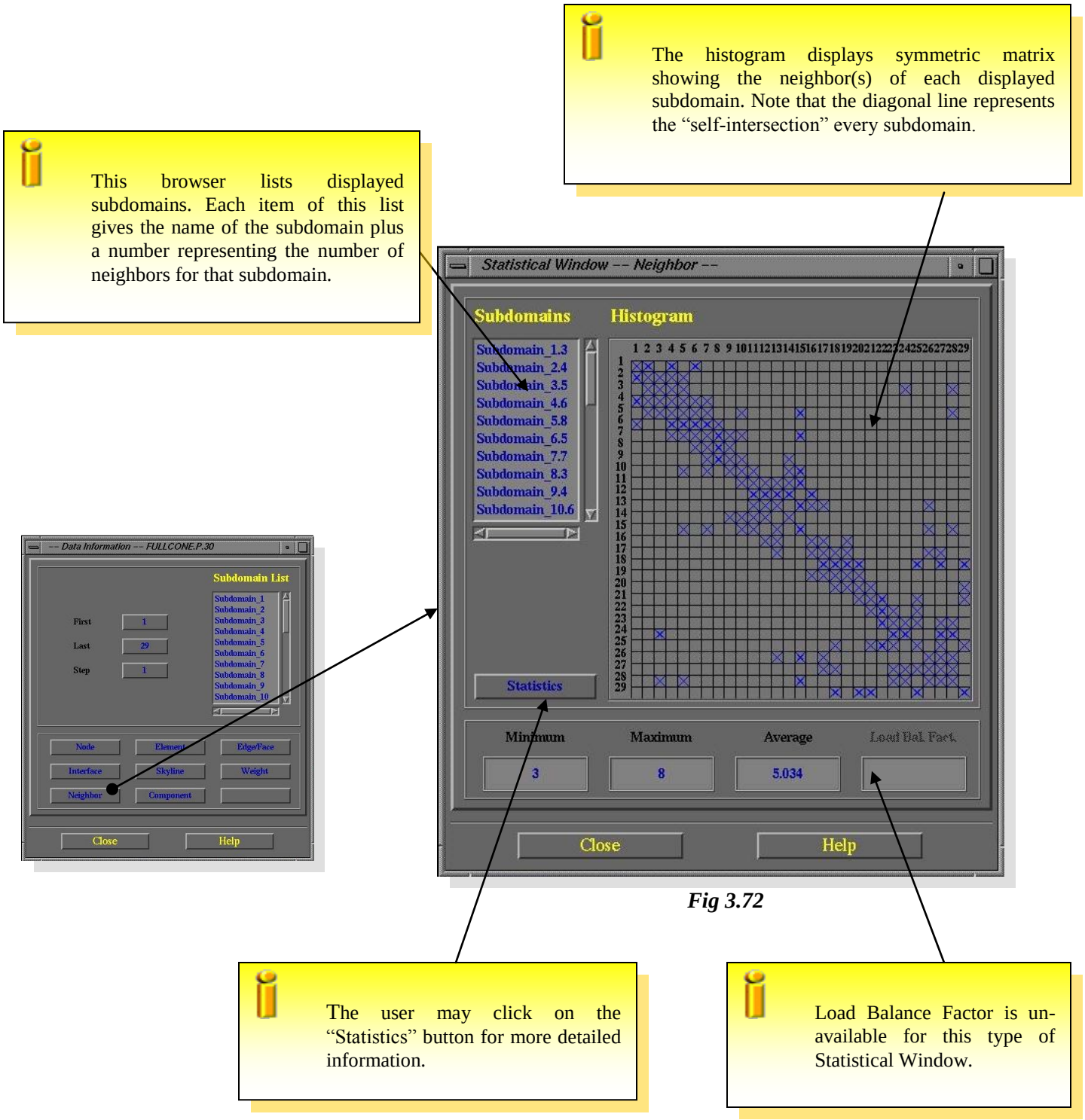


Fig 3.72

The next section discusses the Window opened by clicking on the "Statistics" button of this window.

3.4.3.2.2.1 Statistical Neighbor Window

This window allows the user to analyze numerically the communication pattern of a mesh partition and assess its impact on network traffic. It is shown below in figure 3.69.

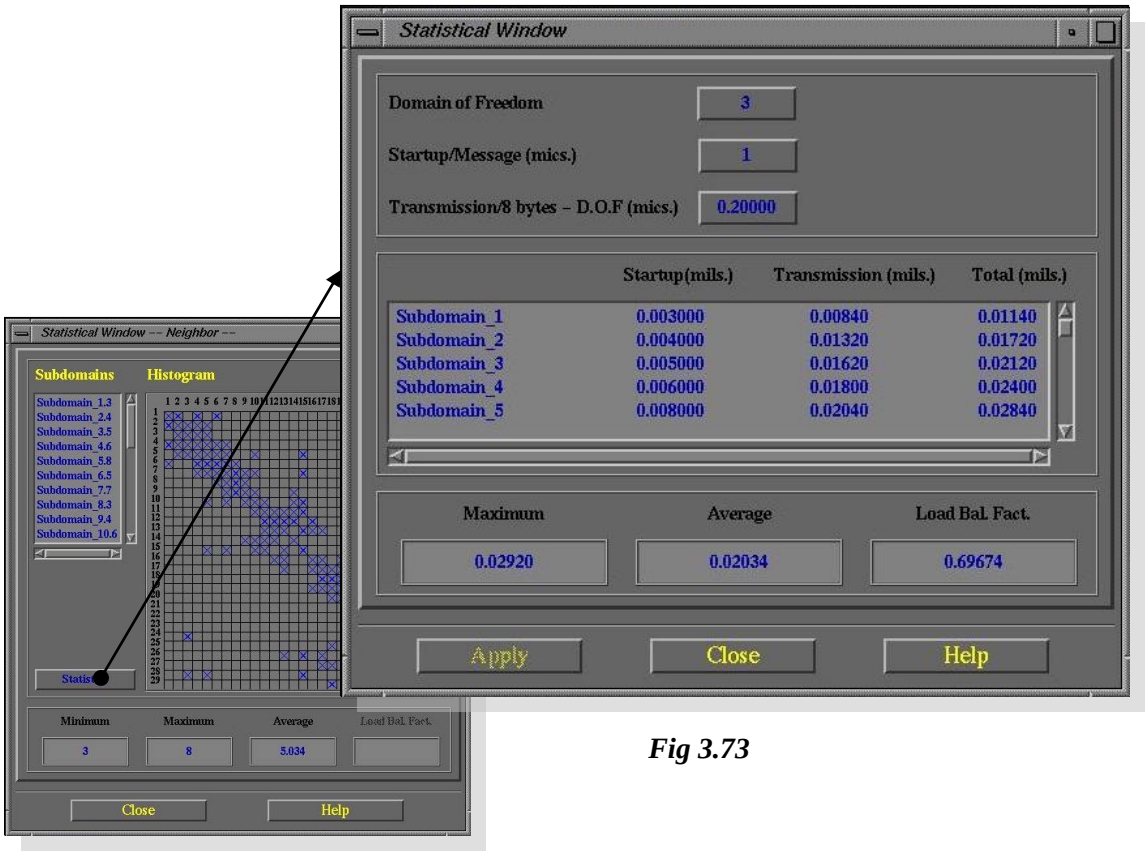


Fig 3.73

3.4.3.2.3 Skyline Window for Decomposed Mesh

The last type of Statistical Window for a decomposed mesh is the Skyline Statistical Window. This window is opened by clicking on the "Skyline" button of the Information Data Window for a ***Partitioned Mesh***, as shown on figure 3.74

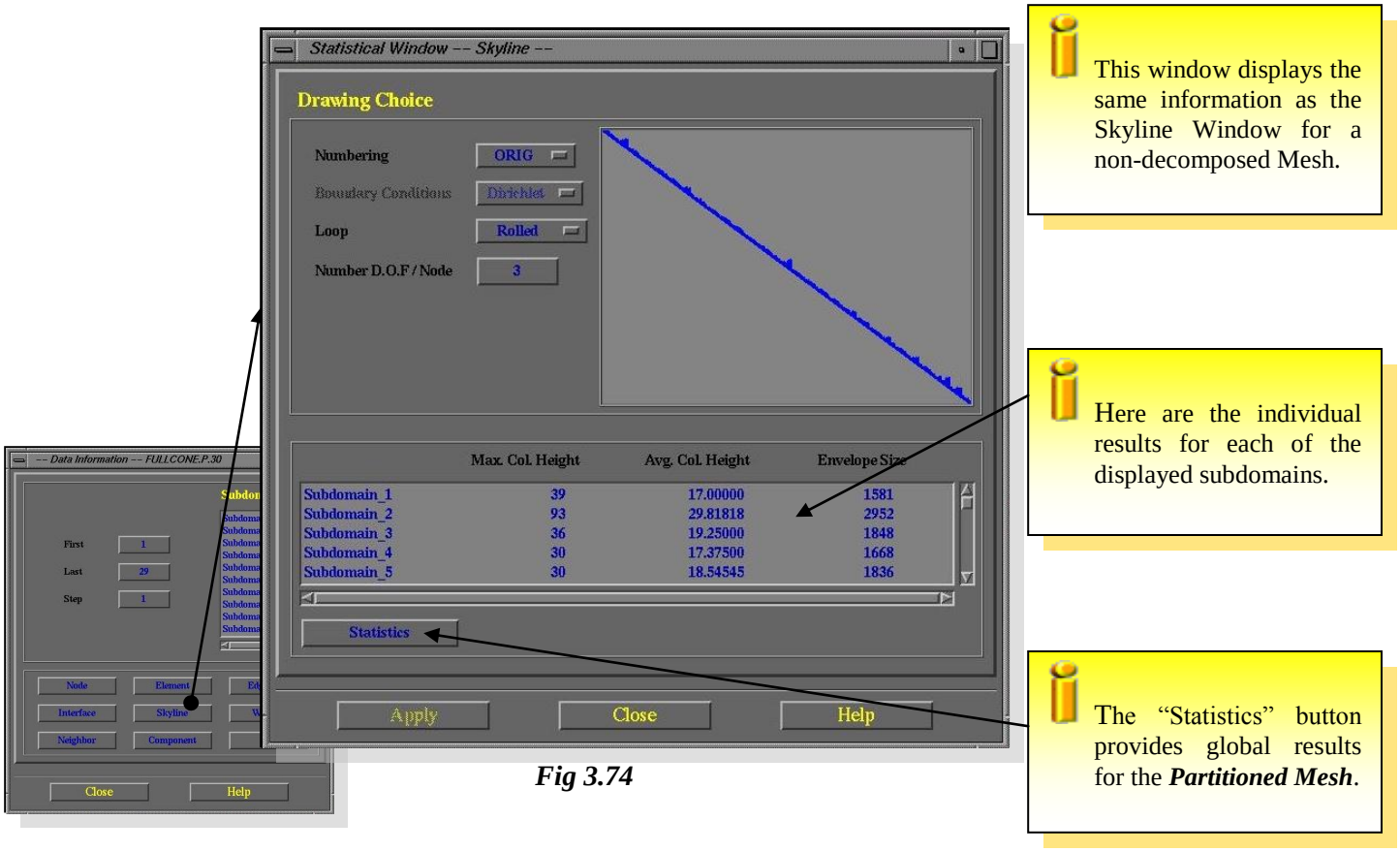


Fig 3.74

This window is very similar to that for a non-decomposed mesh (see section 3.4.3.1.1. Skyline Window.) The main difference is that this window displays, Maximum Column Height, Average Column Height, and Envelop Size for each of the displayed subdomains. This window has a "Statistics" button which opens another Statistics Window shown in figure 3.75

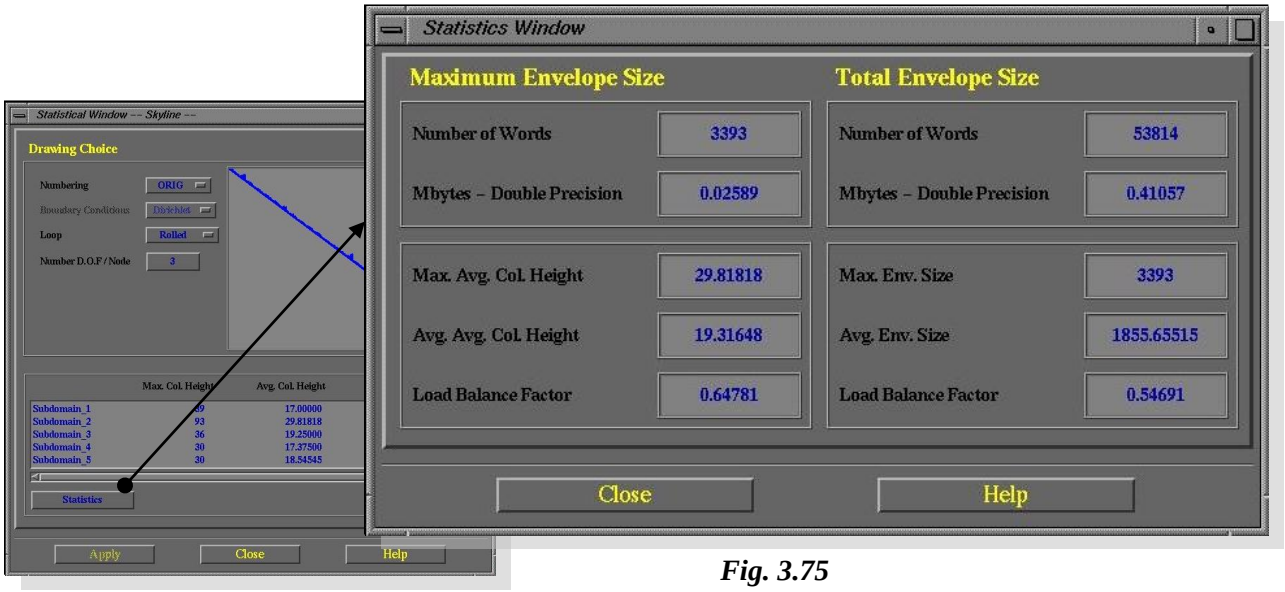


Fig. 3.75

Figure 3.75 shows the Statistical Window opened by clicking on the "Statistics" button. This window displays general information about the ***Partitioned Mesh***. The data are the same type as the data displayed in the parent window, except here the data are global for all displayed subdomains.

3.4.4 Color Windows

The last button attached to an ***Element Set*** is the color button. Clicking on this button opens different windows depending whether it is attached to an ***Element Set*** or a ***Partitioned Mesh***. In both cases, the Color Windows opened by this button will affect both the wireframe and the material colors of the selected ***Element Set***.
The following sections explain these windows.

3.4.4.1 Color Windows for Non-Partitioned Mesh

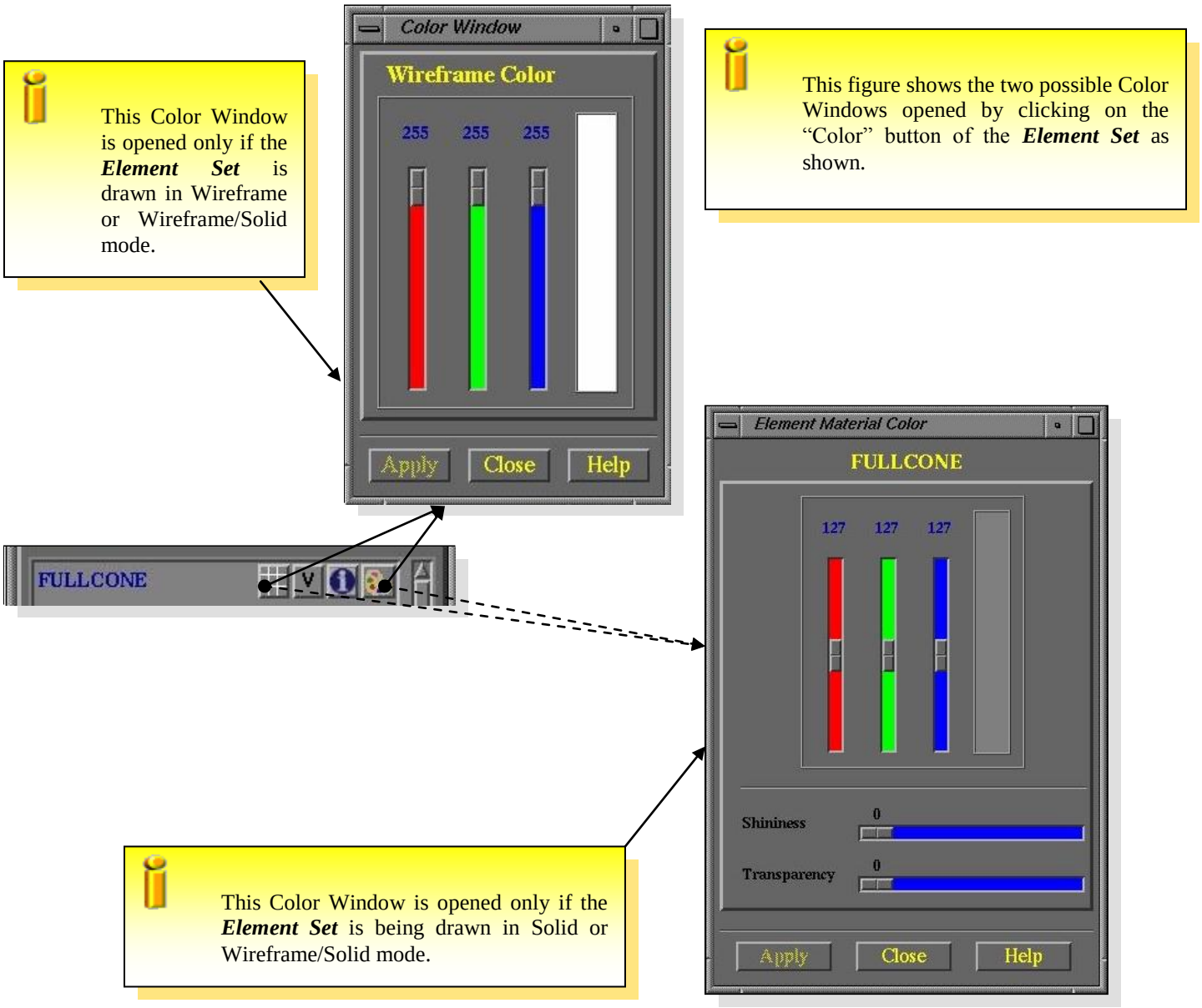


Fig. 3.76

The following sections explain of these two types of Color Window.

Wireframe Color Window

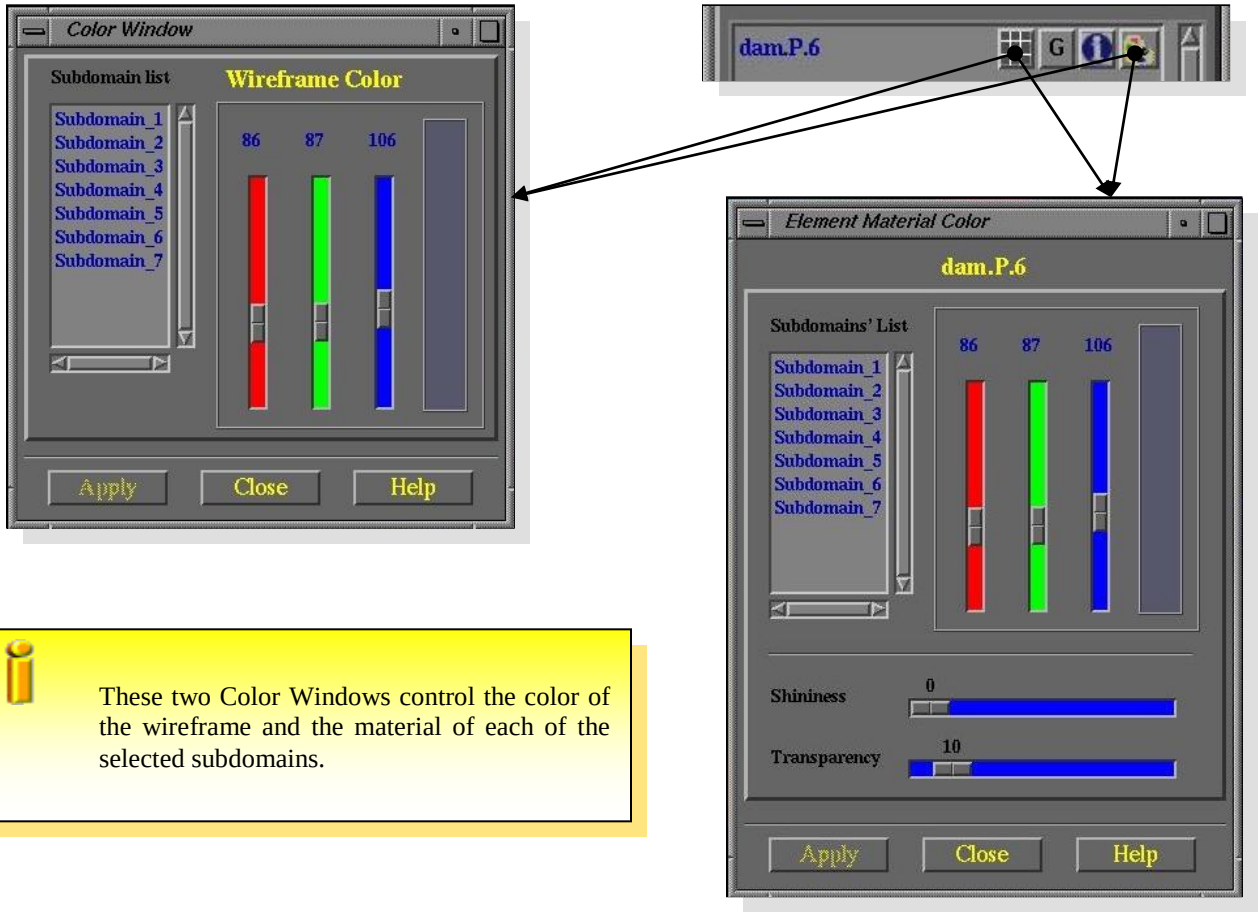
This window is a simple Color Window like others previously discussed. For more information about regular Color Windows see section 1.4.9 (Color Selection). This window sets the color of the wireframe of the selected ***Element Set***.

Element Material Color Window

This window works the same way as regular Color Window. However, in addition to modifying the color of the material of the selected ***Element Set,*** the user may change the transparency and the shininess. Beneath the color selection area appears two sliders: transparency and shininess.
The slider controlling the shininess of the material is not yet implemented. The second slider controls the transparency of the material. Moving the slider to the right increases the degree of transparency of the material.

Changing either the wireframe or the material color of a non-partitioned mesh will also change the wireframe and material color of the Element Rendering button (the left-most button) of the selected ***Element Set***.

3.4.4.2 Color Windows for Partitioned Mesh



These two Color Windows control the color of the wireframe and the material of each of the selected subdomains.

Fig. 3.77

The following sections describe the usage of these two Color Windows.

Wireframe Color Window

This window resembles the Wireframe Color Window of a non-partitioned mesh. However, this window contains an additional browser. This browser is a single selection browser and does not allow the double click feature. (See section 1.4.7 Single and Multiple Selection Browsers for more information about the browsers in TOP/DOMDEC).
This browser lists the displayed subdomain(s) and is automatically updated as the user changes the display subdomain(s) in the Information Window of a ***Partitioned Mesh*** (see section 3.4.3.2 Information Window for Partitioned Mesh).
The selection of one item in the list makes the color area show the color of the wireframe of the selected subdomain.
The user may then change the color of the selected subdomain and click on the "Apply" button. The selected subdomain will then appear with the new color.

Element Material Color Window

This window resembles to the Element Material Color Window for a non-decomposed mesh, except for the presence of the browser. Like in the Wireframe Color Window of a ***Partitioned Mesh*** the user may select a subdomain from the list and change its material color. The two choices, shininess and transparency, at the bottom of this window work the same way as for a non-decomposed mesh (see section 3.4.4.1 (Color Windows for non-partitioned meshes)).

Changing either the wireframe or the material color of a ***Partitioned Mesh*** will not change the wireframe and material color of the Element Rendering button (the left-most button) of the selected ***Element Set***.

ATTENTION!

Although the Wireframe and Material Color Windows of a non-decomposed mesh will set individually the color of the wireframe and the material of the selected ***Element Set***, the Wireframe and Material Color Windows of a ***Partitioned Mesh*** will set the colors of the wireframe and the material of the selected Partitioned Mesh identically. Thus the wireframe color of a ***Partitioned Mesh*** is always the same as its material color.

3.5 Master Element Set Selection

This option allows TOP/DOMDEC to replicate the settings of a particular ***Element Set*** to any of the other ***Element Set***s that are in a same **Display Window**.

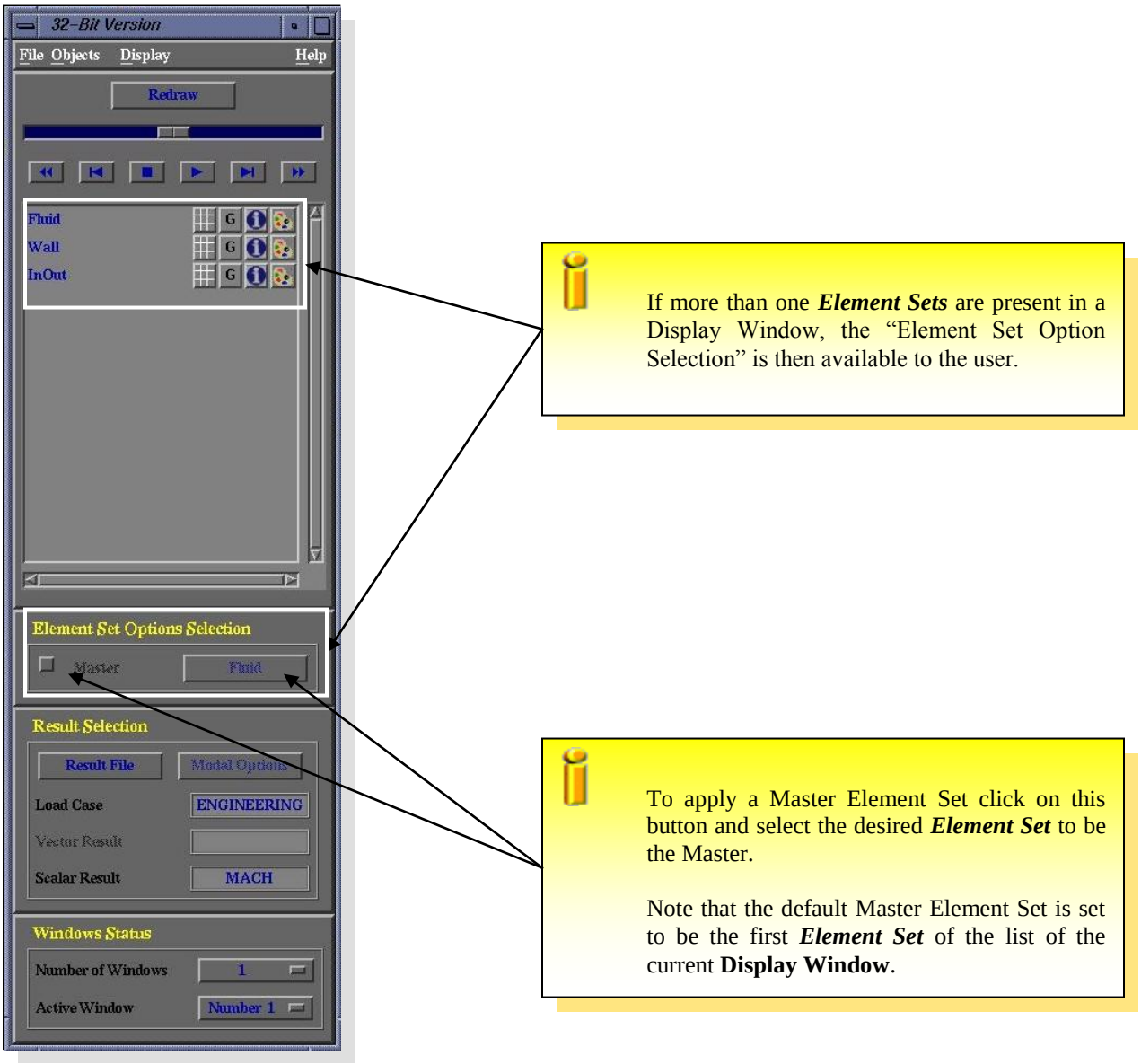


Fig 3.78

As shown in figure 3.78, the user may choose a "Master" ***Element Set*** to control all the choices made in this particular ***Element Set***.

The next section describes how to recognize a "normal" ***Element Set*** from its "Master".

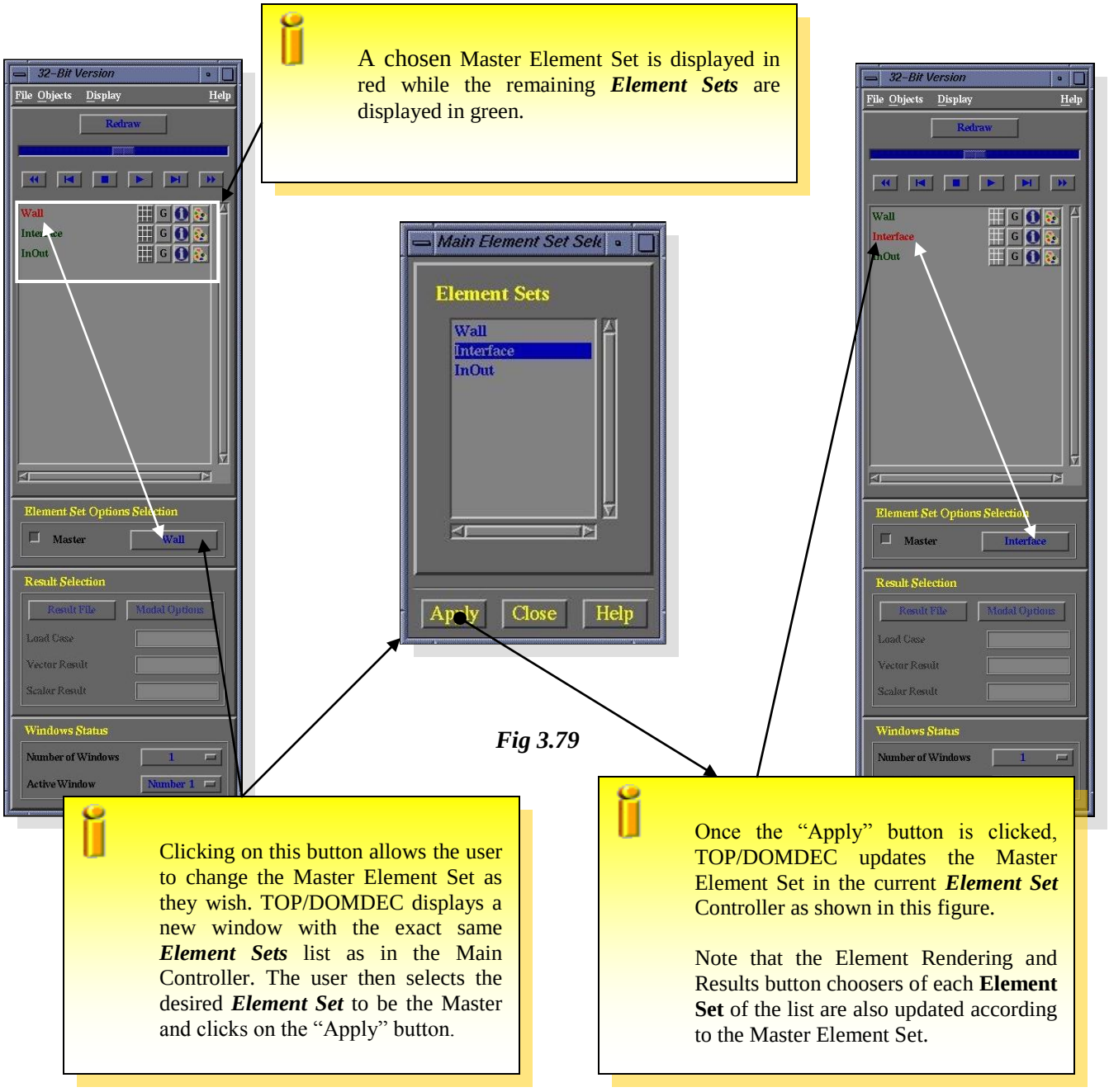


Fig 3.79

When a Master ***Element Set*** is selected, only its corresponding Element Rendering and Results button choosers are active. Any setting fixed in the Element Rendering Options Window for the Master ***Element Set*** is applied to the rest of the ***Element Set*** list of the **Display Window**.

The next section explains what happens if the user clicks on either the Element Rendering Option or the Result Option of each ***Element Set*** of the list.

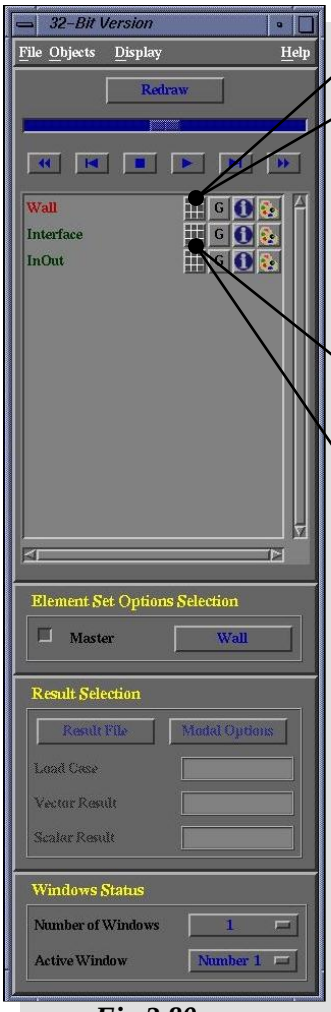


Fig 3.80a

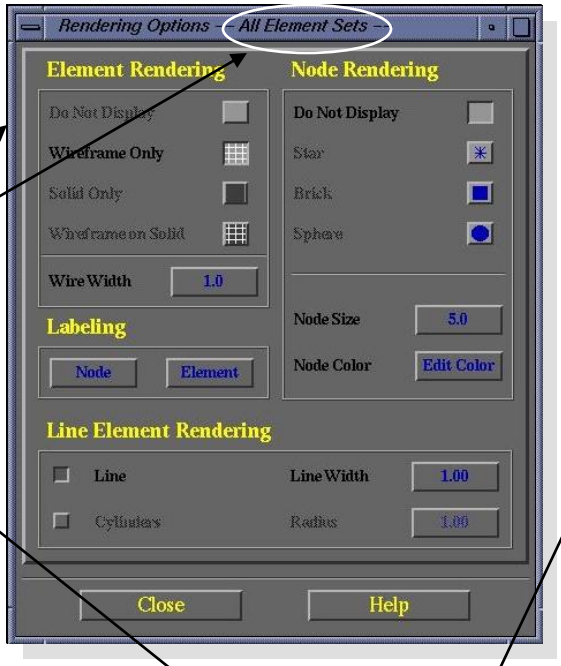


Fig 3.80b

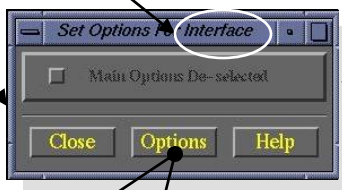


Fig 3.80c

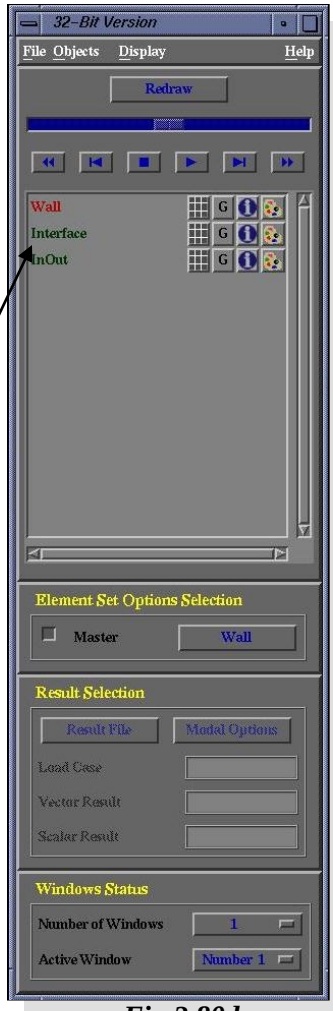


Fig 3.80d

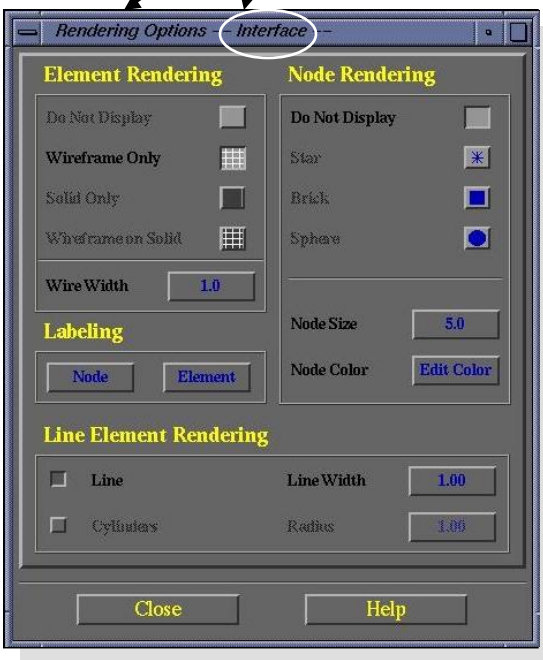


Fig 3.80e

Figure 3.80a shows the Main Element Controller with its ***Element Set*** list in which the first ***Element Set*** has been set as the master. Clicking on the Element Rendering Option button as shown in the figure opens the Element Rendering Options Window shown in Figure 3.80b. Note the title label of this particular window display "All Element Sets". This means that any changes made in this window is applied to all the ***Element Sets*** that are currently in this Element Controller.

To set a particular ***Element Set*** so that its Element Rendering options do not follow those of the Master ***Element Set***, click on the Element Rendering Option button of this particular ***Element Set*** as shown in figure 3.80a and TOP/DOMDEC opens a window called "Set Options For – ", shown in figure 3.80c. From this window, click on the only option button and it will set this particular ***Element Set*** as "normal". Consequently, this ***Element Set*** will not inherit any setting made in the Master ***Element Set***. When a particular ***Element Set*** does not follow its Master, it appears in blue color as shown in figure 3.80d.

The user is then allowed to set the options for this particular ***Element Set*** by clicking on the "Options" as shown in figure 3.80c and TOP/DOMDEC opens the Element Rendering Options Window for this particular ***Element Set***. The window is shown in figure 3.80e. Note the title of this window which displays the name of this particular ***Element Set*** instead of "All Element Sets".

Adding a new ***Element Set*** when a Master Element Set is applied will automatically set the options of the new ***Element Set*** to those of the Master of the current **Display Window**.

If the Master Element Set is removed from the **Display Window** or from the TOP/DOMDEC database, the new Master Element Set is set to be the first one in the list of the **Display Window**.

3.6 Result Selection

The Result Selection section of the Main Controller controls the results to be displayed with the selected ***Element Set*** of the selected **Display Window**. This section is shown in figure 3.81 and it is explained in the following sections.

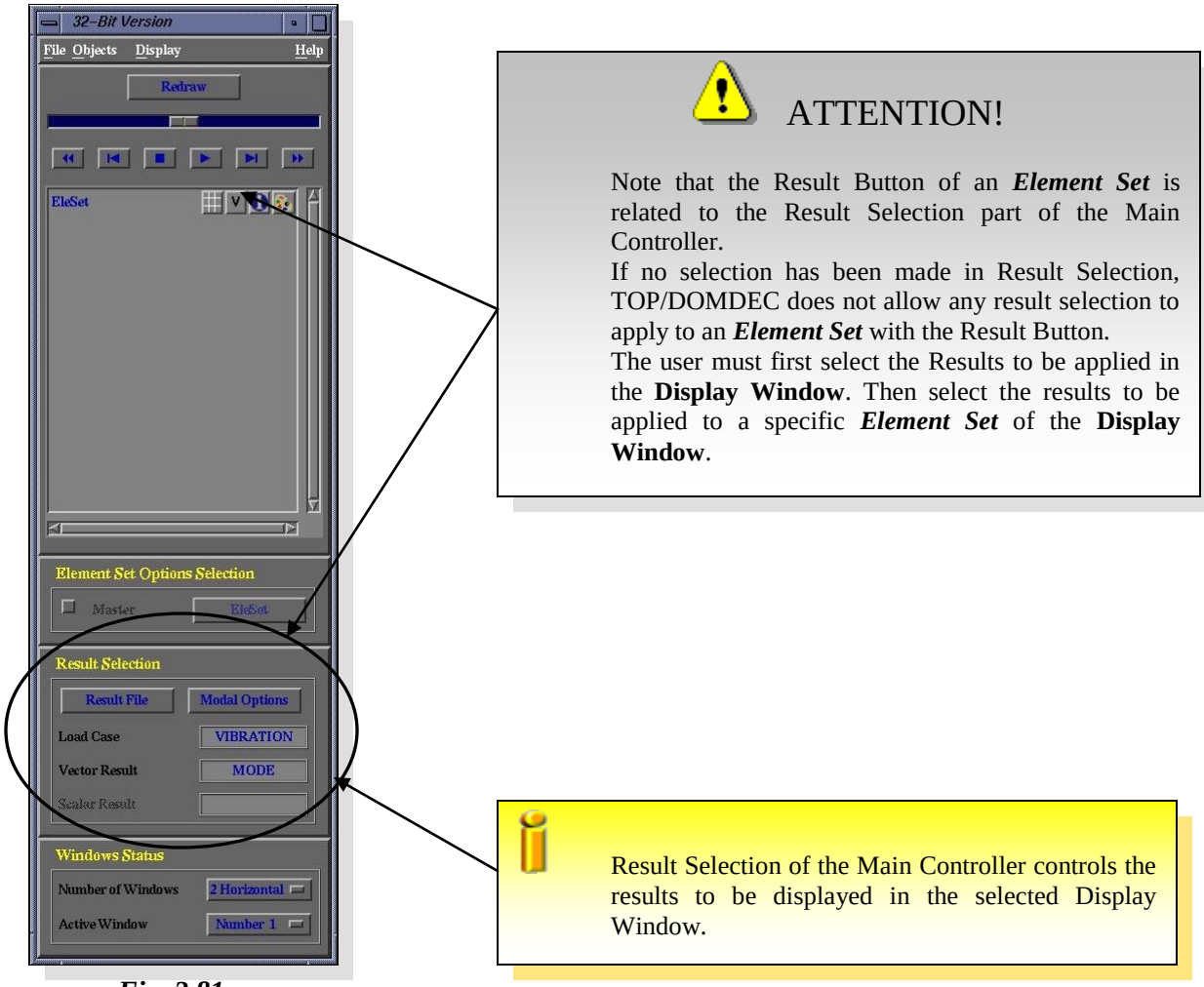


Fig. 3.81

In Result Selection appears two buttons: "Result File" and "Modal Options". It also has three labels: "Load Case", "Vector Results", and "Scalar Results".

The Result File Button

Two conditions have to be fulfilled for this button to be available:

- At least one ***Element Set*** has been selected in the current **Display Window**.
- TOP/DOMDEC has recognized that at least one of the ***Load Cases*** present in the database applies to one of the ***Element Sets*** of the **Display Window** (for more information about how TOP/DOMDEC knows when a specific ***Element Set*** uses a specific ***Load Case*** see section 2.5 (Load Case and Results)).

The following is the Result Selector Window opened by clicking on the Result File button when available.

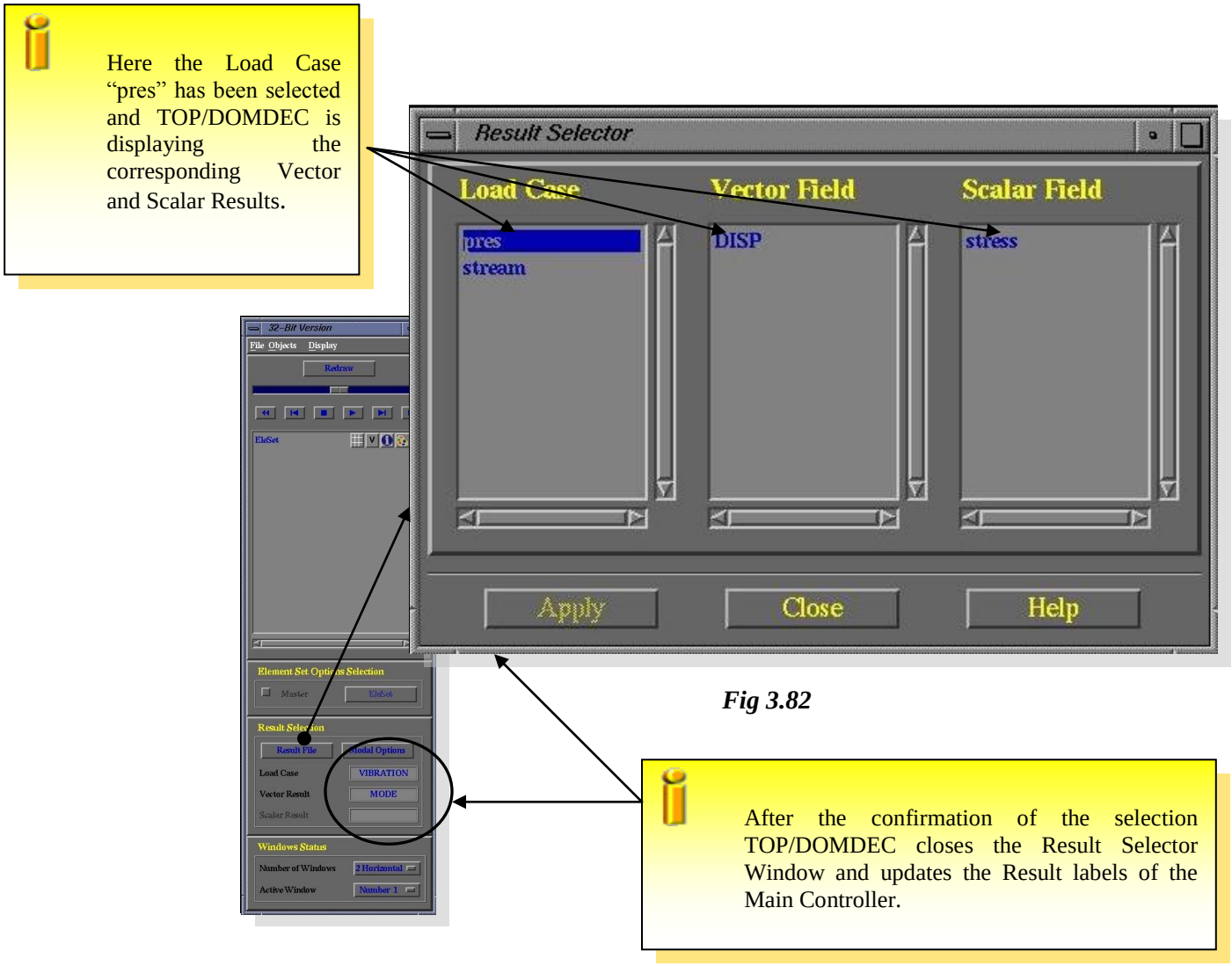


Fig 3.82

The Result Selector Window allows the user to select the Results to apply to the current **Display Window**. This window feature three single selection browsers. The first browser, "Load Case", does not allow the double-click feature, while as the other two, "Vector Field" and "Scalar Field", do allow this feature. For more information about the browsers in TOP/DOMDEC see section 1.4.7 (Single and Multiple Selection Browsers).

Load Case browser

This browser lists the current ***Load Cases*** present in the database. This list is automatically updated as Load Cases are added to or removed from the database.
When selecting an item from this list, TOP/DOMDEC displays the ***Vector Results*** (if any) and the ***Scalar Results*** (if any) attached to the selected ***Load Case*** in their respective browsers.

Vector and Scalar Field browsers

When available, the user may choose any of the items present in these browsers. These two browsers allow the double-click feature. TOP/DOMDEC will then update the Result labels of the Main Controller and close this window.
When a selection is made in either of the browsers the "Apply" button becomes available. The user must click on this button to confirm the result selection.
Clicking on the "Apply" button closes this window and updates the Result labels of the Main Controller as shown in figure 3.74.

ATTENTION!

When selecting Results, TOP/DOMDEC checks if the selected results can be applied to the ***Element Sets*** in the current **Display Window**. (For more information about how results can be applied to an **Element Set** see section 2.5 (Load Case and Result)).
If the selected results do not apply to any of the ***Element Sets*** in the **Display Window** TOP/DOMDEC displays an error message.

Modal Option Button

The "Modal Option" button is next to the Result File button in the Main Controller. This button is available when the selected ***Vector Results'*** name is "MODE". This tells TOP/DOMDEC that these results contain mode shapes (eigenvectors). For more information about this type of ***Vector Results*** see section 2.5.2 (Vector Results).

Clicking on this button opens a window where the user may choose which mode shape to display. This window is shown in figure 3.83 and is described in the following sections.

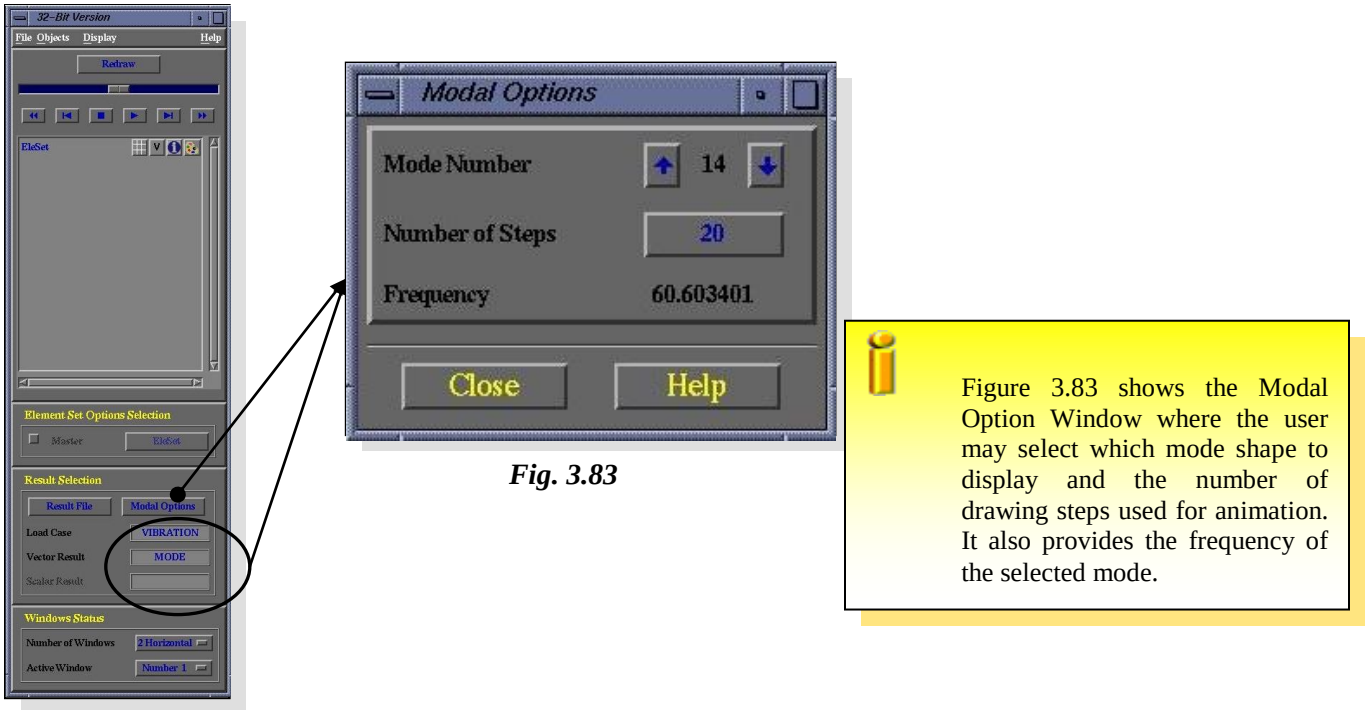


Fig. 3.83

Figure 3.83 shows the Modal Option Window where the user may select which mode shape to display and the number of drawing steps used for animation. It also provides the frequency of the selected mode.

The Modal Options Window allows the user to select the mode shape to display and the number of steps used for animation.

Mode Number

The mode shape for display is selected with the two buttons with blue arrows. Clicking on the left button, with the up arrow, increases the mode shape id number by one. Clicking on the right button, with the down arrow, decreases the mode shape id number by one. The last mode shape id number is determined from the corresponding ***Vector Results*** read and stored in the database. The first mode shape id number is 1.

Number of Steps

Clicking on this button opens an Input Window (see section 1.4.6 (Input Window) for more information about how to input numbers in TOP/DOMDEC). The user may then enter the desired number of drawing steps for the animation. The default value is 20. The greater the number of steps the smoother the animation.

Frequency

The frequency is displayed at the bottom of the window. This field is automatically updated as the user changes the mode shape number.

When changing the mode shape number or the number of steps, the user must click on the "Redraw" button of the Main Controller to see the selected mode shape drawn with the selected number of steps.

3.7 Window Status

The last part of the Main Controller is Window Status. In this area the user may select the number of **Display Window**s.

The **Main Display Window** can be divided into two or four smaller **Display Window**s. This option gives the user the ability to render different perspectives and/or results for a single object. This option also allows the user to render more than one object, at the same time.

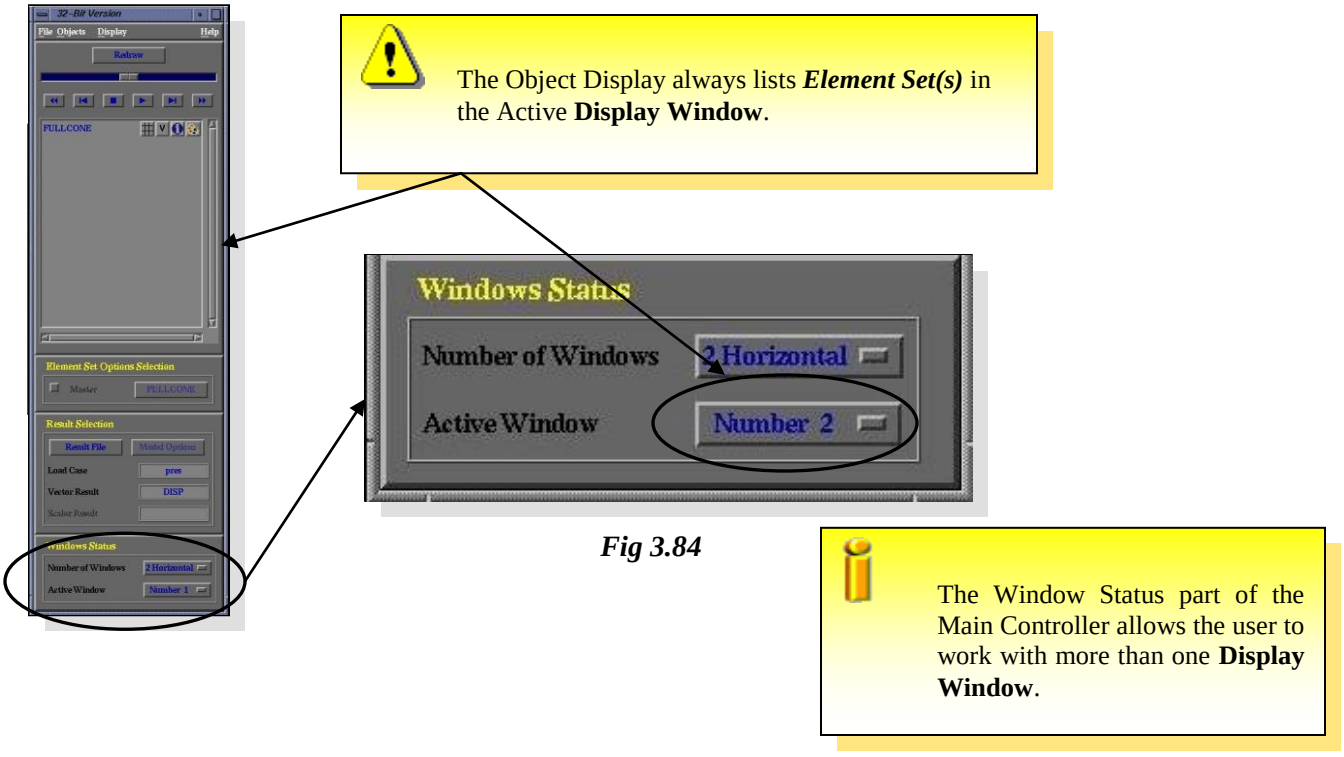


Fig 3.84

As shown in figure 3.84, the Window Status has two choosers: "Number of Windows" and "Active Window".

Number of Windows

With this chooser the user may adjust the number of **Display Window**s. The choices are: "1", "2 Horizontal", "2 Vertical" and "4". When the **Main Display Window** is split in several smaller **Display Window**s, TOP/DOMDEC distinguishes the windows by number. TOP/DOMDEC numbers them from left to right and top to bottom. So, the first window is the top-left quarter of the **Main Display Window** (when split in 4 windows) and **Display Window** number 4 is the bottom right quarter. When changing the number of **Display Window**s TOP/DOMDEC resets the Active Window to the first.

Active Window

With this chooser the user may change the active window in all option windows described in the previous sections. Recall that some option windows can re-select the "local" active window with the window chooser on top of each window (see section 1.4.3 (The Windows)). This feature appears in figures throughout this manual.

Chapter 4: Quick & Easy Start

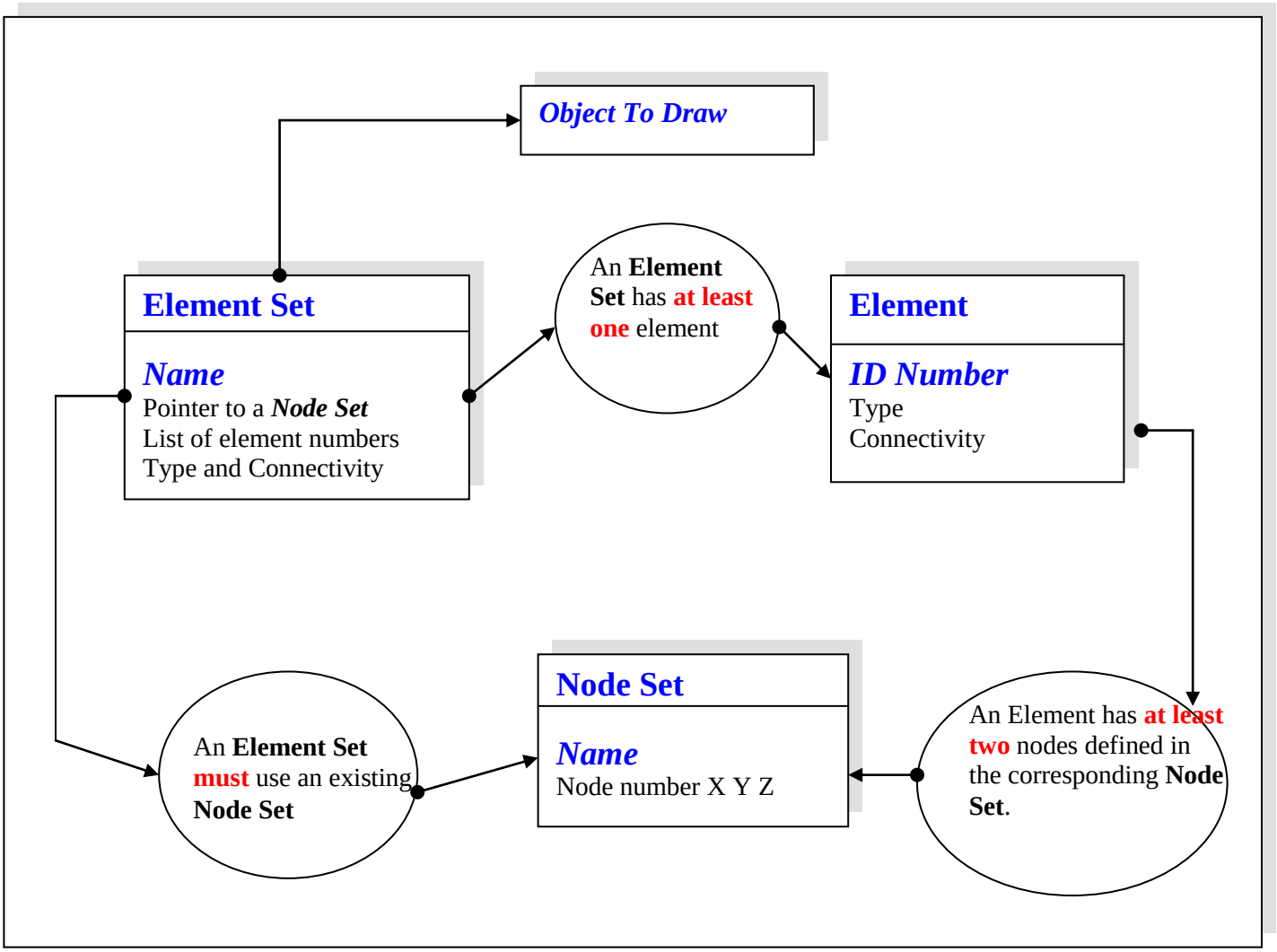
4.1 Introduction

This chapter answers questions that a novice might ask when using TOP/DOMDEC for the first time. It describes basic, yet important, operations and notions that the new user should know for a quick and easy start with TOP/DOMDEC.

4.1.1 Simple visualization of objects

A quick and easy explanation of the structure of the database of TOP/DOMDEC will help the novice to understand how TOP/DOMDEC draws objects.

In the TOP/DOMDEC database an object is represented by an ***Element Set*** that uses a ***Node Set***. The ***Element Set*** and ***Node Set*** are composed respectively of elements and nodes. The following scheme may help the novice understanding the organization of the database more accurately.



Looking at the previous figure the user can see three main entities: ***Node Set***, ***Element***, and ***Element Set***. They are closely related to each other. The following section describes a brief explanation of each of them and the relations among them.

Node Set

A ***Node Set*** is a collection of nodes. The nodes have three coordinates: X, Y, and Z. To be usable a node must be listed under a set of nodes, which this manual refers to as a ***Node Set***. Reading a ***Node Set***, TOP/DOMDEC expects to find a name, which distinguishes a ***Node Set*** from another, followed by the list of nodes that composes the ***Node Set***. (See section 2.3 (Node set) for more information on the layout of the input file containing a Node Set).

Element

An element is composed of nodes. There are twelve different types of element that TOP/DOMDEC recognizes and these are listed in section 2.4 (Element set). Each of them has a specific number of nodes that must be specified in the form of a connectivity. The simplest element that TOP/DOMDEC can draw is the Line type object with two nodes.
While reading a file containing ***Element Sets***, if the number of nodes read for an element does not correspond to the expected number defined by the type of the element, TOP/DOMDEC issues the user an error message. (See section 2.4 (Element Set) for more information on the layout of the input file containing an Element Set).

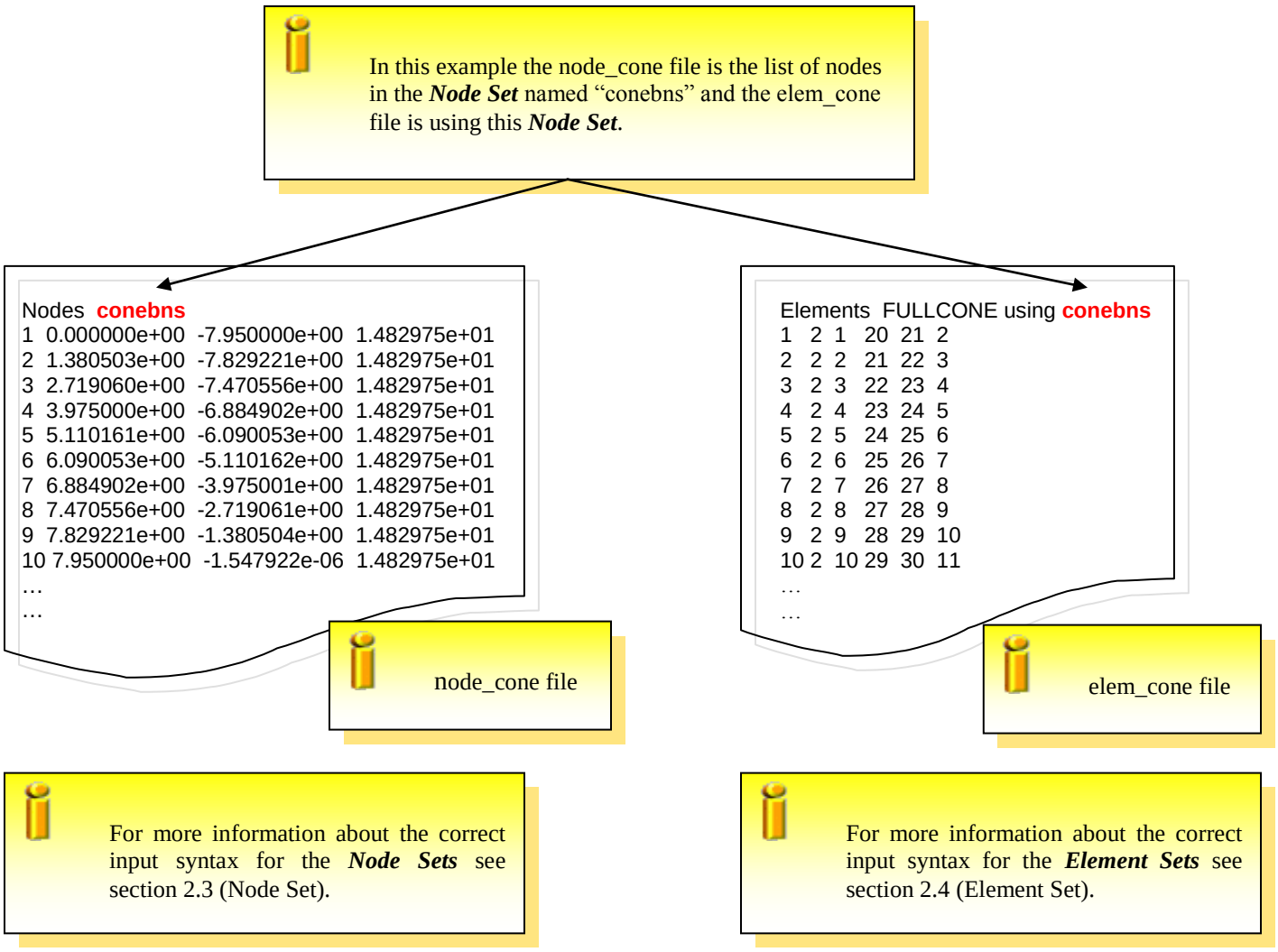
Element Set

TOP/DOMDEC draws an object according to the name of this object, which corresponds to the name of an ***Element Set*** in its database. As the novice can see in the above figure, in an ***Element Set*** declaration TOP/DOMDEC must have the name of the ***Element Set*** followed by a ***Node Set*** name where the nodes of the elements are defined. If one of these fields is missing, TOP/DOMDEC issues the user an error message.
(See section 2.4 (Element Set) for more information on the layout of the input file containing an Element Set).

The following section gives a five-step action for visualizing a simple object using TOP/DOMDEC.

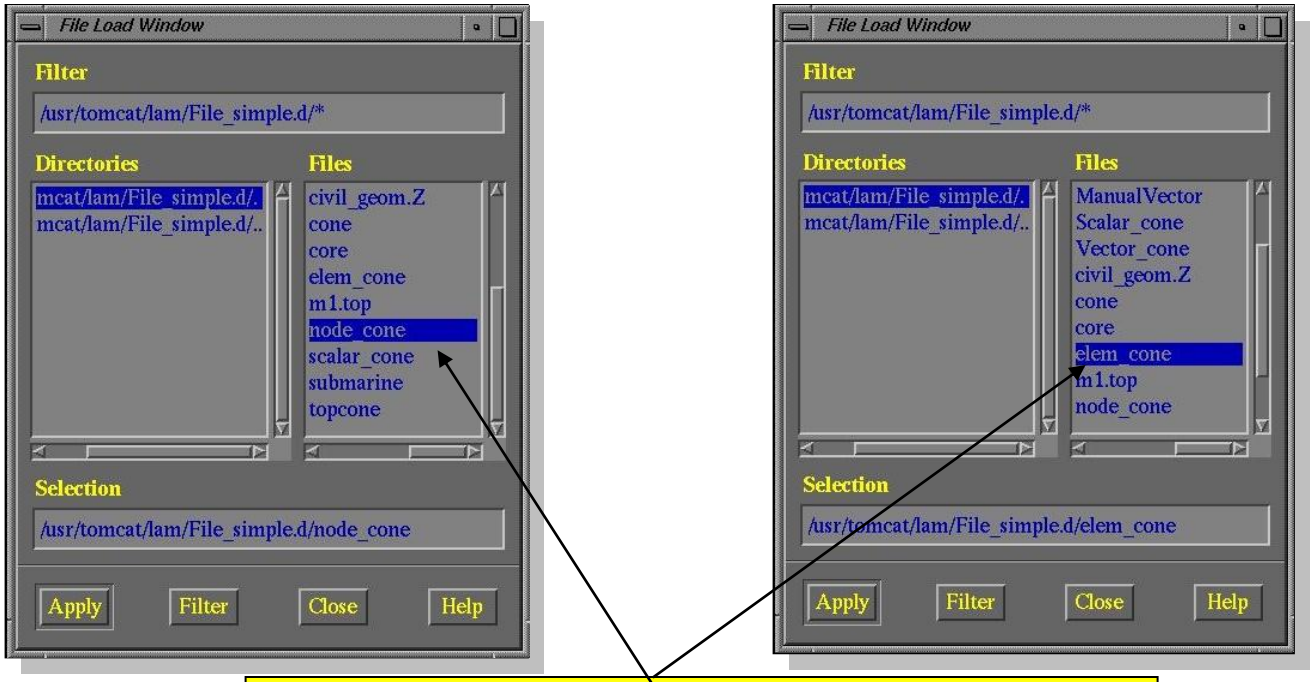
Step 1: Preparing the input file(s)

First, the user must prepare the input files containing an ***Element Set*** and a ***Node Set*** (They do not need to be in two different files). These files must be in the format that TOP/DOMDEC recognizes and which are described in Chapter 2 of this manual. The following is a detailed explanation of how to make an ***Element Set*** connected to a ***Node Set***.



Step 2: Reading the input file(s)

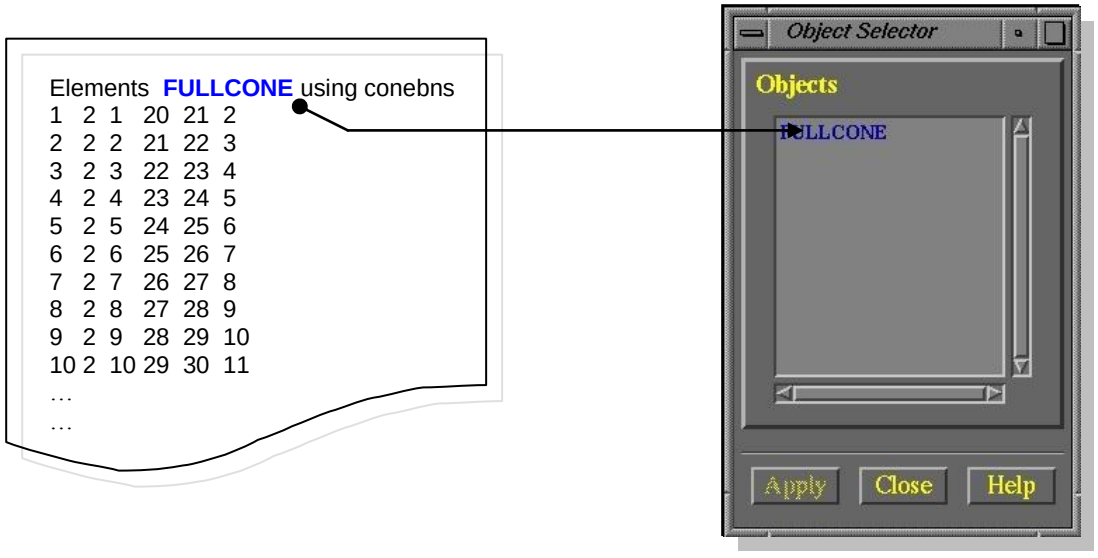
Next, the user is ready to instruct TOP/DOMDEC to read these two files. To do so, they must open the Load File Window and load both files as shown below.



The user is about to read each of the files described above. But remember that both the ***Element Set*** and ***Node Set*** can be loaded from a single file. See Chapter 2 (Input Data Layout) for more details.

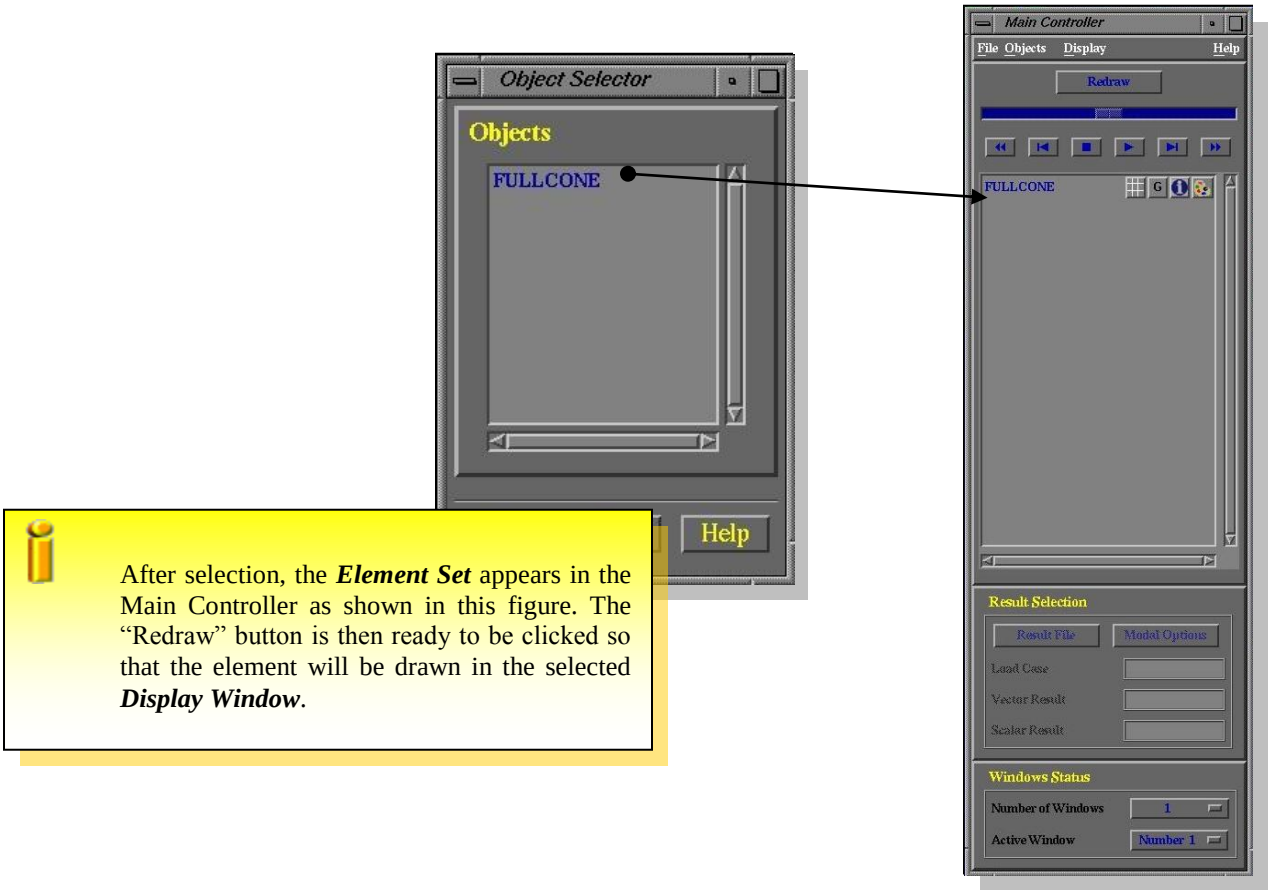
Set 3: Checking the presence of the object in the database

Once an ***Element Set*** has been read it is listed in the Select Window as described in section 3.2.2.1 (Select). The user must select this ***Element Set*** from this window in order to visualize it.



Step 4: Selecting the object

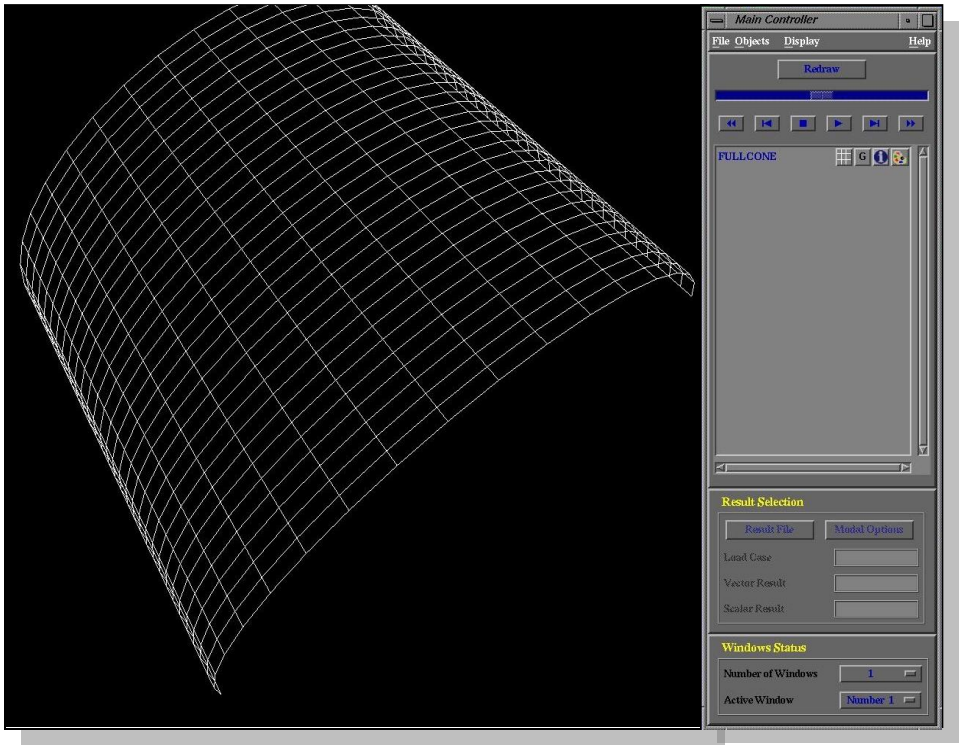
When an ***Element Set*** has been selected it is then listed in the current Object Display as described in section 3.4 (Object Display). At this point, TOP/DOMDEC awaits for the user to click on the "Redraw" button of the Main Controller to draw the object.



After selection, the ***Element Set*** appears in the Main Controller as shown in this figure. The "Redraw" button is then ready to be clicked so that the element will be drawn in the selected ***Display Window***.

Step 5: Drawing the object

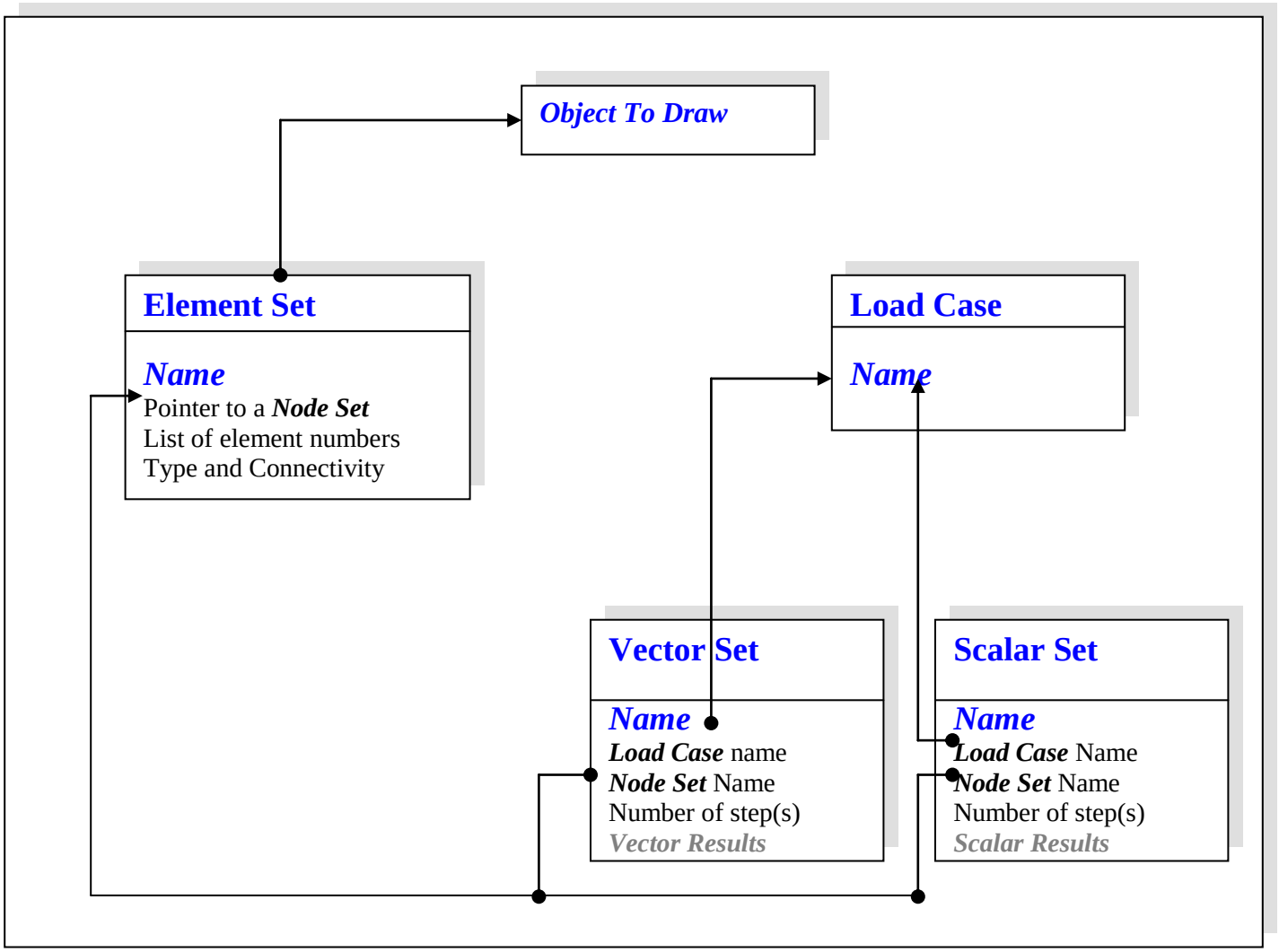
Finally, once the user has clicked on the "Redraw" button, the selected ***Element Set*** appears in the selected **Display Window** as shown below.



4.1.2 Visualization of objects with associated results

This section describes the steps the user must go through in order to visualize static/dynamic ***results***.

To understand how TOP/DOMDEC applies ***results*** to an object the following figure describes the relations between ***results*** and an object.



In the above figure, the user can see three new entities: ***Load Case***, ***Vector Set***, and ***Scalar Set***. All three represent ***results***. As the reader can notice, a ***Vector Set*** and a ***Scalar Set*** can be related by the name of the ***Load Case*** and the name of the ***Node Set*** they refer to. So, if an ***Element Set*** uses a ***Node Set*** that is used by a ***Vector Set*** and/or a ***Scalar Set*** then the user can visualize the ***results*** on the ***Element Set***.

Load Case

A ***Load Case*** is a collection of ***Vector*** and/or ***Scalar Sets***. It is defined implicitly through the definition of ***Vector*** and/or ***Scalar Set***.

Scalar Set

A ***Scalar Set*** is a collection of values corresponding to the value at each node of the ***Node Set*** it refers to. These values are read sequentially and automatically matched with the order of the nodes defined in the ***Node Set*** that the ***Scalar Set*** uses. A ***Scalar Set*** can contain multiple time steps. In this case, for each time step a node of the ***Node Set*** has its corresponding value. Typical ***Scalar Sets*** represent Stress, Pressure, or Temperature.

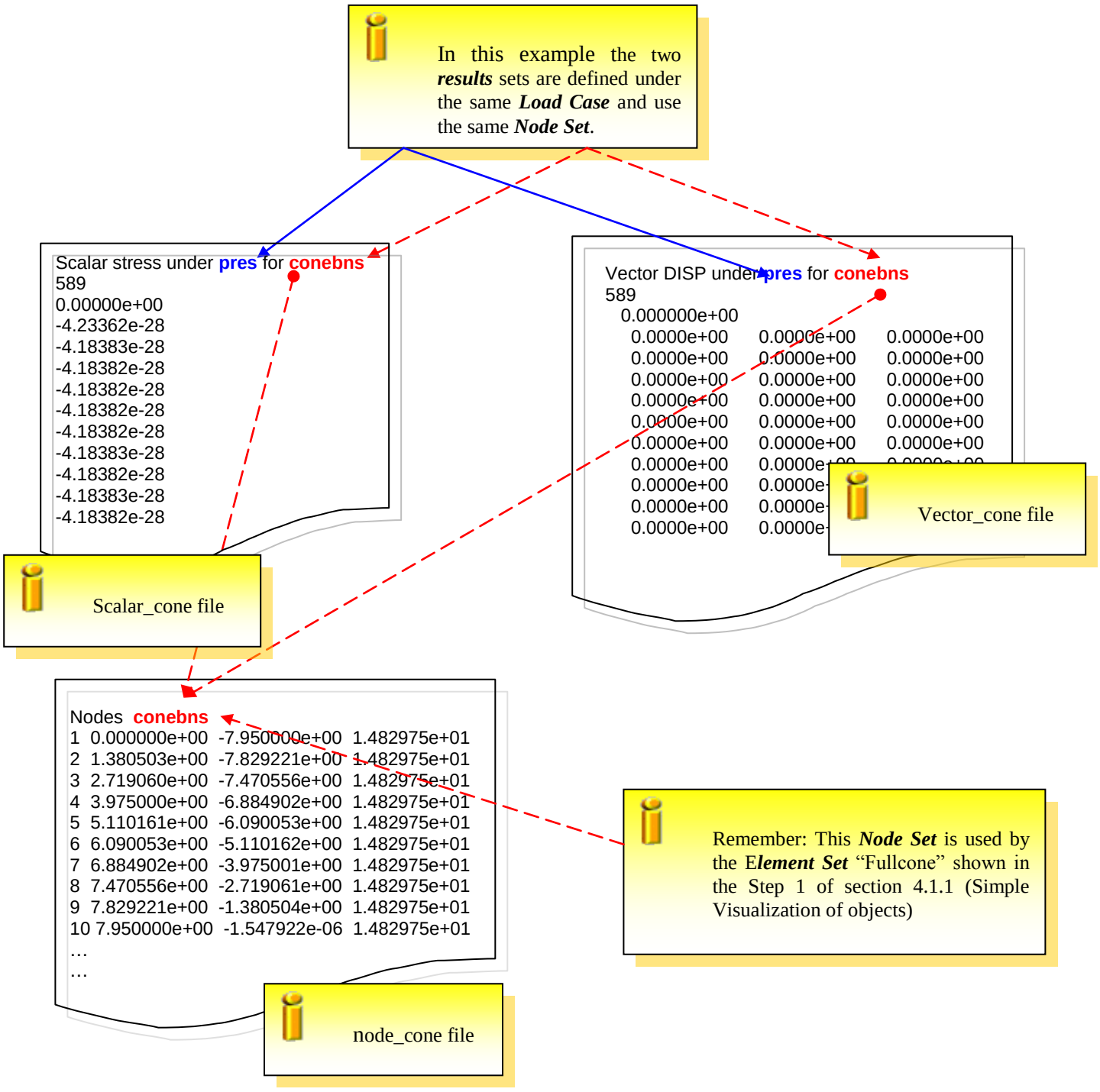
Vector Set

A ***Vector Set*** is a collection of floating values corresponding to the displacement of each node of the ***Node Set*** it refers to. In the case of a ***Vector Set***, TOP/DOMDEC expects to read, for each node, three values corresponding to the displacement of each coordinate X, Y and Z of the node. TOP/DOMDEC reads the values sequentially and assigns the values respectively to X, Y and Z coordinates of the node. If one of the values is omitted TOP/DOMDEC assigns the default value of zero to the missing coordinate. Like for a ***Scalar Set***, the ***Vector Set*** values are automatically matched with the order of the nodes defined in the ***Node Set*** that the ***Vector Set*** uses. A ***Vector Set*** can contain multiple time steps. In this case, for each time step a node of the ***Node Set*** has its corresponding values.

The following section describes a five-step action for applying and visualizing ***results*** on an ***Element Set***.

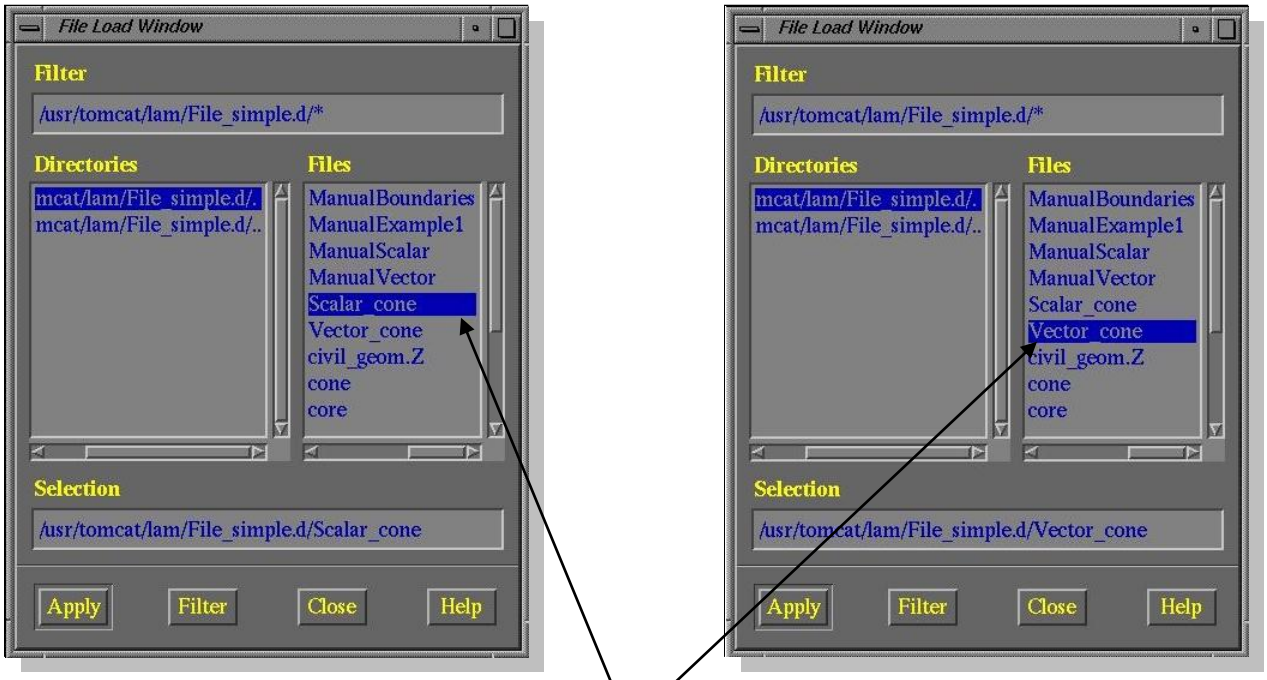
Step1: Preparing the input file(s)

First, the user should prepare the input files that contain the ***results*** to be visualized. The following scheme shows how to do so. (The ***results*** do not need to be in separate files. Everything can be stored in a single input file.) These files must be in the formats that TOP/DOMDEC recognizes and which are described in Chapter 2 of this manual.



Step 2: Reading the input file(s)

Next, the user is ready to instruct TOP/DOMDEC to read these ***results*** files. Like for the ***Element Set*** and the ***Node Set***, they should open the Load File Window and load the ***results*** files.



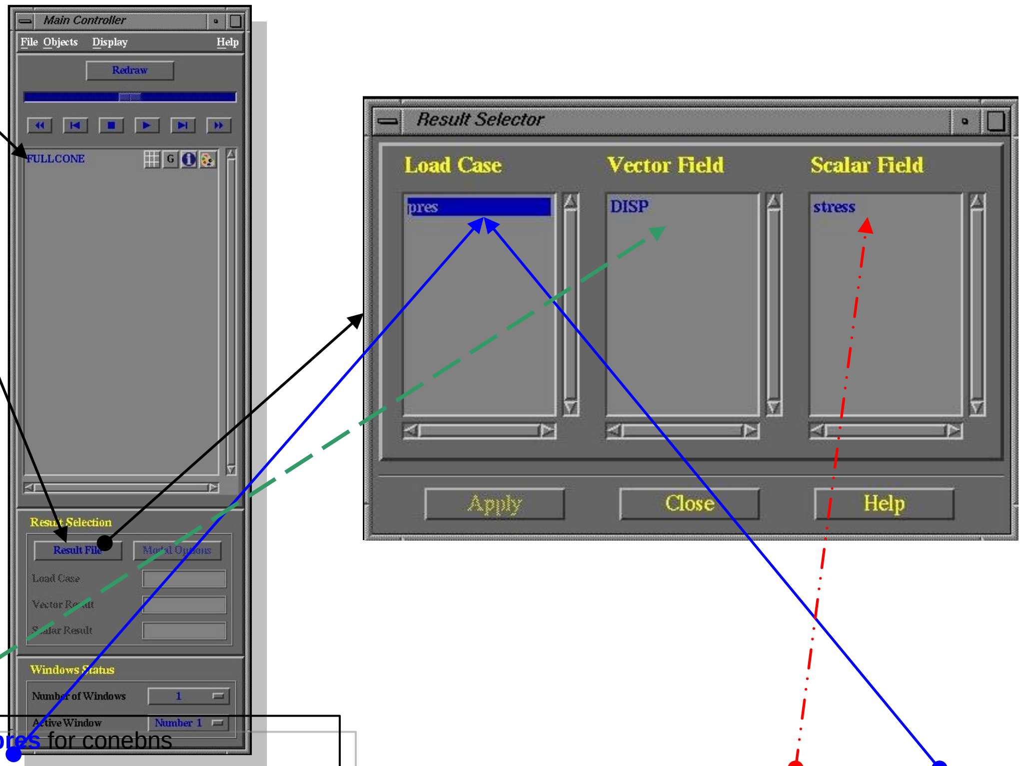
The user is loading the two result files, Scalar_cone and Vector_cone.
Note that both the ***Vector*** and ***Scalar Results*** could have been in a single file. For more information see section 2.5 (***Load Cases*** and ***Results***).

Step 3: Selecting the results

Once the ***Element Set*** has been selected from the Select Window as described in section 4.1.1 (Visualization of objects), if either a ***Vector Set*** or a ***Scalar Set*** uses the same ***Node Set*** as the selected ***Element Set,*** then the user can proceed and select either or both to be visualized. In this case, the user should click on the "Result Selection" button, beneath the Object Display browser, and select the desired set of ***Load Case*** and the ***Vector Set*** and/or the ***Scalar Set*** as described in the section 3.5.

Because Fullcone ***Element Set*** uses the ***Node Set*** "conebns" and the ***results*** loaded in the database use the same ***Node Set*** (see Step 1) the user can now click on the "Result File" button to select the ***results*** to be applied to the Fullcone.

Once the Result Selector is opened, the user can select the desired ***results*** to be applied to the Fullcone. In this example, clicking on the "pres" ***Load Case*** shows the corresponding ***Vector*** and ***Scalar Results***. One can deduce how they are connected from this figure.



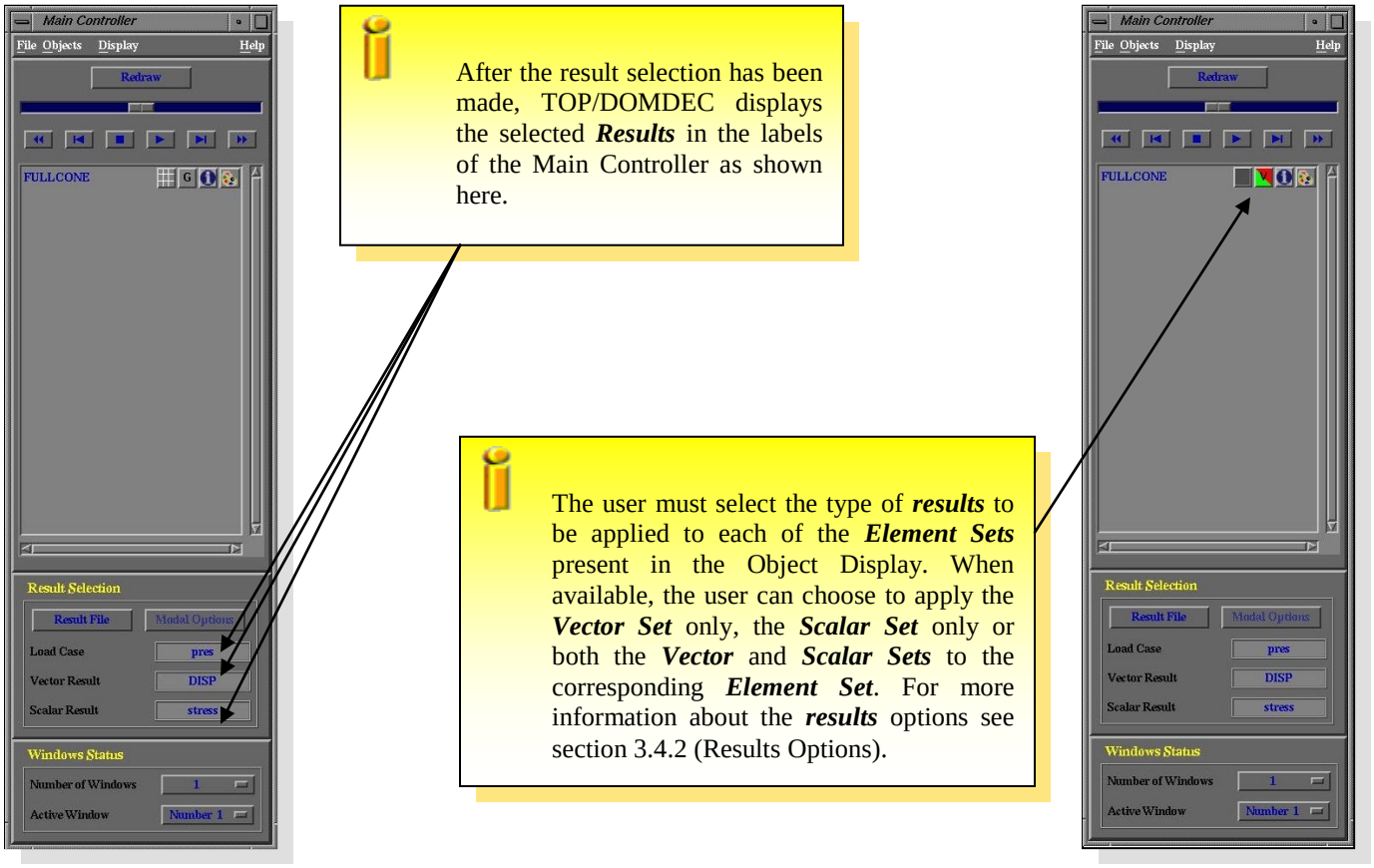
Vector DISP under pres for conebns
589
0.000000e+00

0.0000e+00	0.0000e+00	0.0000e+00
0.0000e+00	0.0000e+00	0.0000e+00
0.0000e+00	0.0000e+00	0.0000e+00
0.0000e+00	0.0000e+00	0.0000e+00
0.0000e+00	0.0000e+00	0.0000e+00
0.0000e+00	0.0000e+00	0.0000e+00
0.0000e+00	0.0000e+00	0.0000e+00
0.0000e+00	0.0000e+00	0.0000e+00
0.0000e+00	0.0000e+00	0.0000e+00
0.0000e+00	0.0000e+00	0.0000e+00

Scalar stress under pres for conebns
589
0.00000e+00
-4.23362e-28
-4.18383e-28
-4.18382e-28
-4.18382e-28
-4.18382e-28
-4.18382e-28
-4.18383e-28
-4.18382e-28
-4.18383e-28
-4.18382e-28

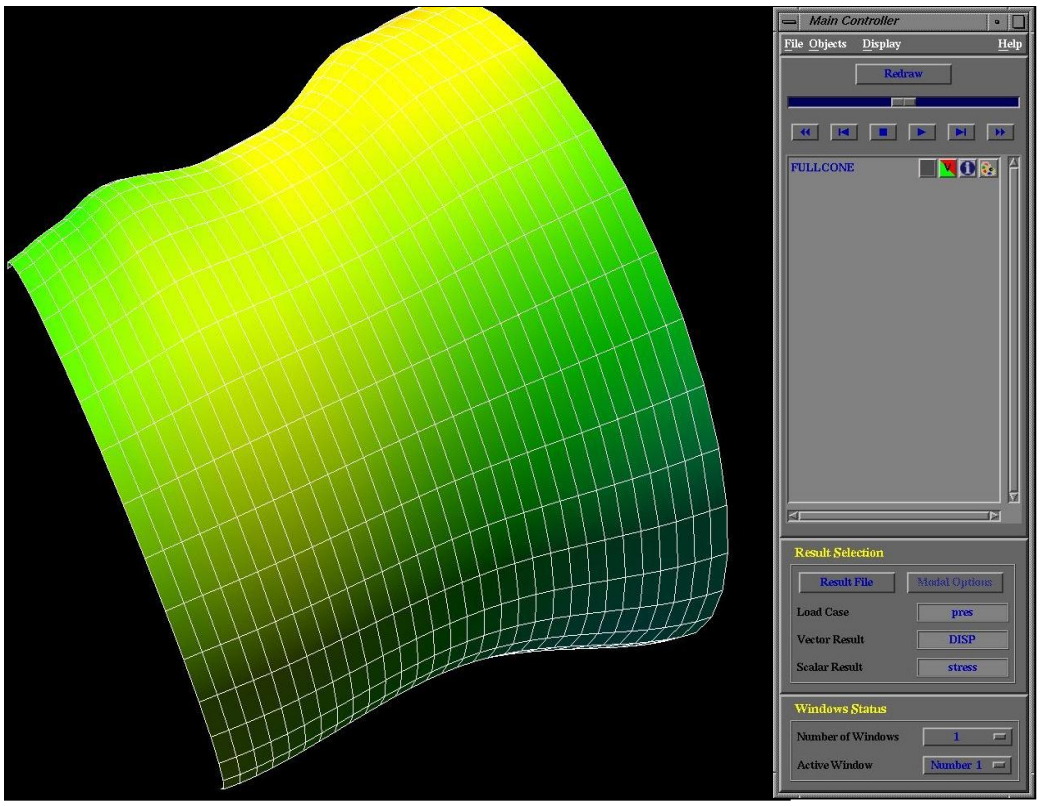
Step 4: Applying the results

After the ***results*** have been selected, TOP/DOMDEC displays them in the ***results*** labels of the Main Controller. The user can then apply these ***results*** to all ***Element Sets*** that have been selected in this **Display Window** and which share the same ***Node Set*** as these ***results***. To apply the specific ***results*** to an ***Element Set,*** the user can click on the Result Options button of the corresponding ***Element Set*** and select the type of ***results*** to apply to this ***Element Set*** as explained in section 3.4.2 (Results Options).



Step 5: Visualizing the results on the corresponding object

Finally, the user should click the "Redraw" button of the Main Controller then the "Play" button of the Animation Controller as shown in section 3.3.2 (Animation Controller), which will result in TOP/DOMDEC rendering the ***Element Set (s)*** and the dynamic (or static) ***results*** applied to the ***Element Set (s)***.



Note that the "Fullcone" ***Element Set*** has been rotated and zoomed on for visualization purposes.

This figure shows the "Fullcone" ***Element Set*** with the corresponding ***Vector*** and ***Scalar Sets*** applied to it.
Note that an amplification factor of 35 has been applied to the deformation of the ***Element Set***.

INDEX