Stood 4.1

User's Manual

part III: Detailed Design

1. Textual formalism

Unlike most of other methodologies, **HOOD** specifies a graphical and a textual formalism to describe software **Applications**. Whereas graphical formalism is mainly used to support architectural design phase, textual formalism acts as a framework for detailed design.

In order to fully support all tasks required for detailed design phase, **HOOD** textual formalism has been defined on a structured way. Part of this formalism may be used to document design choices and other to include coding sections.

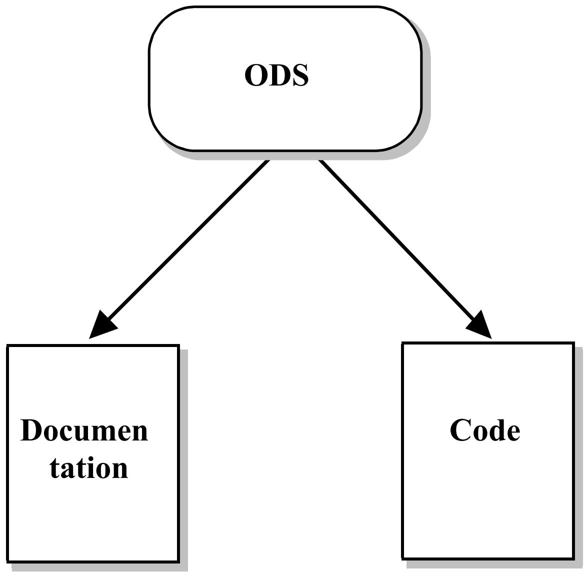
The strong advantage of a textual formalism is to be able to include simply an exhaustive representation of the overall **Application**. Graphical formalisms generally loose their readability when becoming exhaustive. Practically, graphical descriptions we presented in part II of this documentation (**HOOD** diagrams, **S**tate-**T**ransition **D**iagrams (**STD**), **D**esign **T**rees, **I**nheritance **T**rees) become at the end elements of the textual structure.

Another benefit in using a formalized textual description is the availability of simple storage and interchange processes. **S**tandard **I**nterchange **F**ormat (**SIF**) which is defined in **H**ood **R**eference **M**anual (**HRM**) is based on this textual formalism.

Finally, a textual formalism may be easily extended or filtered to fit special requirements. **STOOD** internal organization fully enables this kind of customization to take into account external constraints.

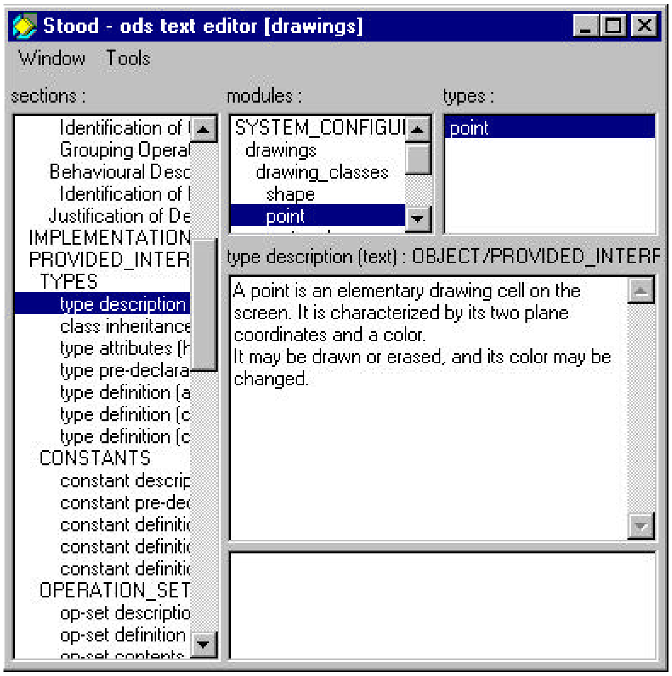
HOOD textual formalism is based on **O**bject **D**escription **S**keletons (**ODS**). An **ODS** should be defined for each **Module** that was defined during architectural design phase. **STOOD** provides a full standard **ODS** plus additional sections to include checking rules reports and generated code.

A set of **STOOD** extended **ODS** contains thus an exhaustive representation of the overall **Application**, which, when fully completed, may become the reference from which coherent production of both documentation and code may be performed.



Extended **ODS** may be customized by editing `DataBase` configuration file, and must be filled in with generic *text editors*. Following chapter describe how to use *text editors* of **STOOD**.

2. Text editors



A point is an elementary drawing cell on the screen. It is characterized by its two plane coordinates and a color.
It may be drawn or erased, and its color may be changed.

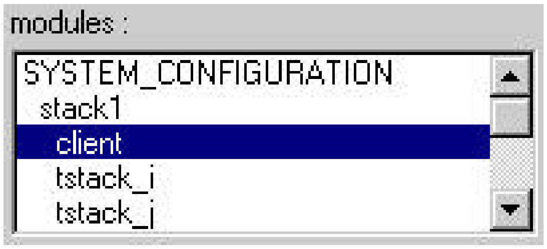
STOOD *text editors* are a set of generic browsers that are used to fill in or visualize textual information related to an **Application**. This chapter describes general contents and behaviour of *text editors*. To get further details about precise contents and use of each editor, please refer to relevant chapter:

• *ods text editor*	refer to § 3
• *checks text editor*	refer to part IV
• *test text editor*	refer to part IV
• *ada text editor*	refer to part IV
• *c text editor*	refer to part IV
• *cpp text editor*	refer to part IV

These *text editors* are all defined and may be customized within `DataBase` configuration file (refer to part I). Other specialized *text editors* may also be created if needed. Each *text editor* is bound to a document editor from which a printable document may be set up and produced. Please refer to § 5 for further details about documentation production.

STOOD *text editors* are all composed of three selection lists, a text input area, a symbol table for code sections and two menus, one of them being fully user customizable. To open a *text editor*, use *editors* menu of *main editor*. Textual edition is related to only one dedicated **Module** at a time. This **Module** should be selected within top center list. As regard the kind of selected **Module** (refer to part II to get more information about supported kinds of **Modules**), right list is updated with appropriate sections. Some sections are global to current **Module**, other are local to a **Component** belonging to current **Module**. In this last case, relevant **Component** should be designated within top right list. Finally current contents of selected section appear inside text input area, and may be changed there (if not read only). Symbol table is updated when accepting a code section.

2.1. Module selection list

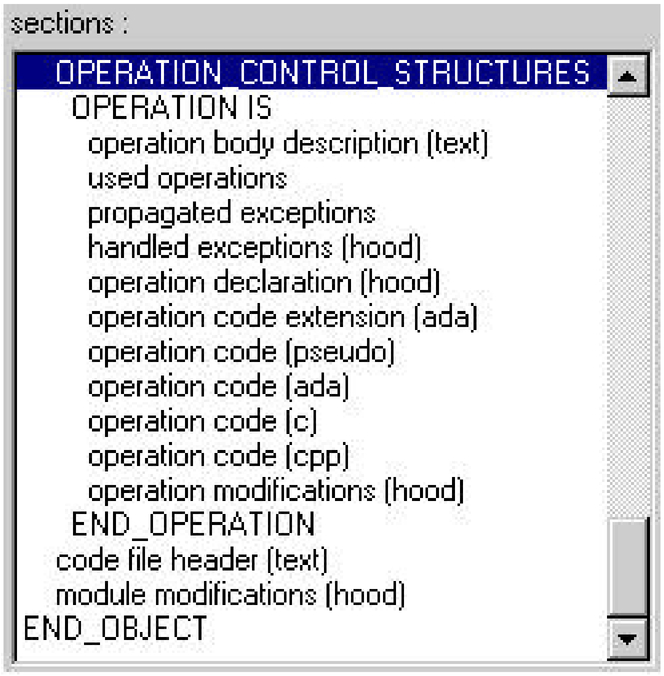


```
SYSTEM_CONFIGURATION
  stack1
    client
    tstack_i
    tstack_j
```

When an **Application** is selected in *main editor*, top center area of any text editor displays the list of all known **Modules** for this **Application**. **Modules** should have been created previously with *graphic editor* (refer to part II). There is no way to create, delete nor rename a **Module** at this level.

Include relationship is represented by an additional indentation step in the list of **Modules**. The list order is depth first, and at a given level, the oldest **Module** first. This list cannot be reordered without deleting, creating or moving **Modules** in a *graphic editor*.

2.2. Section selection list



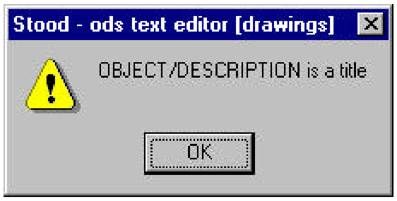
```
sections :
  OPERATION_CONTROL_STRUCTURES
    OPERATION IS
      operation body description (text)
      used operations
      propagated exceptions
      handled exceptions (hood)
      operation declaration (hood)
      operation code extension (ada)
      operation code (pseudo)
      operation code (ada)
      operation code (c)
      operation code (cpp)
      operation modifications (hood)
    END_OPERATION
  code file header (text)
  module modifications (hood)
END_OBJECT
```

When a **Module** is selected in top center selection area, the list of relevant textual sections is displayed within left area.

This list is differently configured for each *text editor*, and may also vary as regards the kind of currently selected **Module**. In addition, some code sections may be hidden by setting `DiscardedLanguages` property inside `.stoodrc` file (for **UNIX**) or `stood.ini` file (for **Windows**).

Text sections may be of following kinds:

- Titles which aim is to provide a clear structure for textual edition, and to highlight main detailed design steps. When selecting a title section, it will not be possible to save any text:



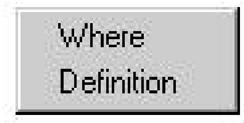
OBJECT/DESCRIPTION is a title

- Free text to be used for design documentation or comment sections. **STOOD** stores such information without any processing nor checking action. These sections may be identified by `(text)` string at the end of their label.

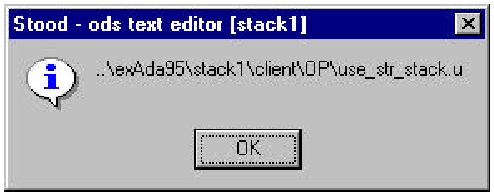
- **HOOD** syntax sections. These sections are generally automatically filled in by **STOOD**, from internal model that was set up with *graphic editor* or other inputs. If such a section should be updated manually, please take care to follow **HOOD** syntactic rules defined in **H**ood **R**eference **M**anual, else warning or error messages could occur during **SIF** file exchanges. These sections may be identified by a `(hood)` string at the end of their label.

- Target language code sections (**Ada**, **C**, **C++**, ...). These sections may be filled in manually like free text ones. They may be left empty to indicate to code generator to produce automatically relevant code when possible (refer to part IV). When saving a code section, its contents will be parsed by a dedicated lexical analyser which result will be displayed within symbol table. These sections may be identified by `(ada)`, `(c)`, `(cpp)` or `(pseudo)` string at the end of their label. If one of these language was listed in `DiscardedLanguages` property, relevant sections will be hidden.

While pressing center mouse button (for **UNIX**), or right mouse button (for **Windows**), and locating mouse pointer inside section selection area, a pop-up menu shows following items:

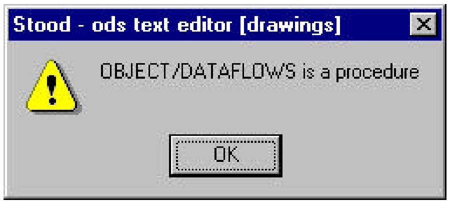


Where: provide information about actual storage location of selected section. A dialog box shows actual location of storage file, if any (external storage area):


Stood - ods text editor [stack1]

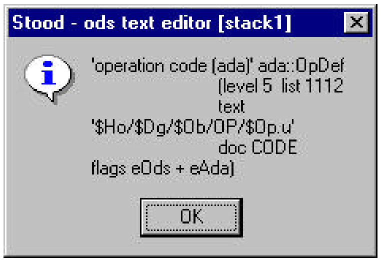
..\exAda95\stack1\client\OP\use_str_stack.u

If regarding information is deduced from internal model by a procedure, following message is displayed (internal storage area):



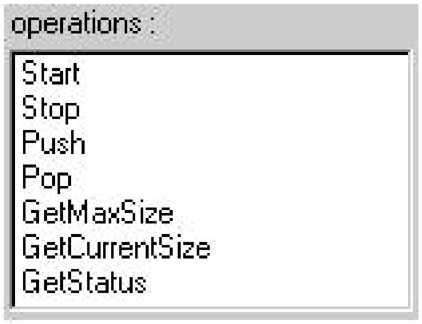
```
OBJECT/DATAFLOWS is a procedure
```

Definition: show the record from `config/DataBase` configuration file which describes selected section (refer to part I).



```
'operation code (ada)' ada::OpDef
                (level 5  list 1112
                text
'$Ho/$Dg/$Ob/OP/$Op.u'
                doc CODE
flags eOds + eAda)
```

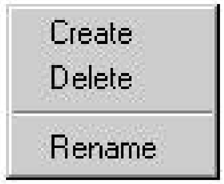
2.3. Component selection list



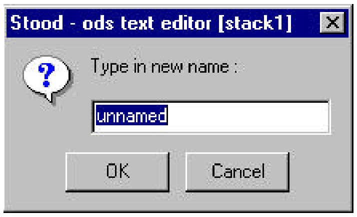
Some text sections refer to a particular **Component** (**Operation**, **Type**, **Constant**, **Exception**, **Data** element, **State** or **Transition**), or in particular cases to an extra parameter (check category). This additional selection should be performed within top right list.

If required element is an **Operation**, a **Type**, a **Constant**, a **Data** element or an **Exception**, They may be created, deleted or renamed at this level with local pop-up menu commands. There is no need to use a *graphic editor* in that case, but effect of these actions will be automatically propagated to other editors.

On the contrary, if required element is a **State**, a **Transition** or a check category, then no create, delete nor rename action is allowed, and a warning message will be displayed while activating these menu items.



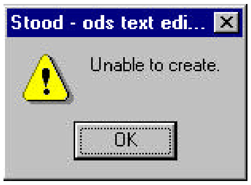
Create: add a new **Component** to the list, in a similar way to create actions in *graphic editor* (refer to part II).


Stood - ods text editor [stack1]

Type in new name :

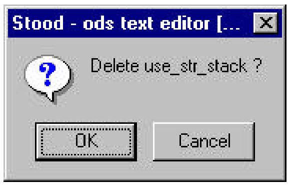
unnamed

or


Stood - ods text edi...

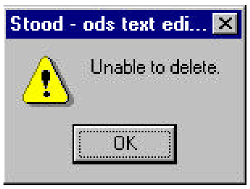
Unable to create.

Delete: remove selected **Component** from the list, in a similar way to delete actions in *graphic editor* (refer to part II).


Stood - ods text editor [...

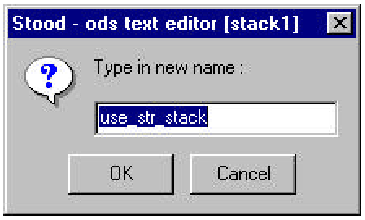
Delete use_str_stack ?

or


Stood - ods text edi...

Unable to delete.

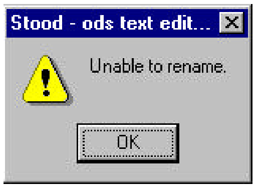
Rename: rename selected **Component** in the list, in a similar way to rename actions in *graphic editor* (refer to part II).


Stood - ods text editor [stack1]

Type in new name :

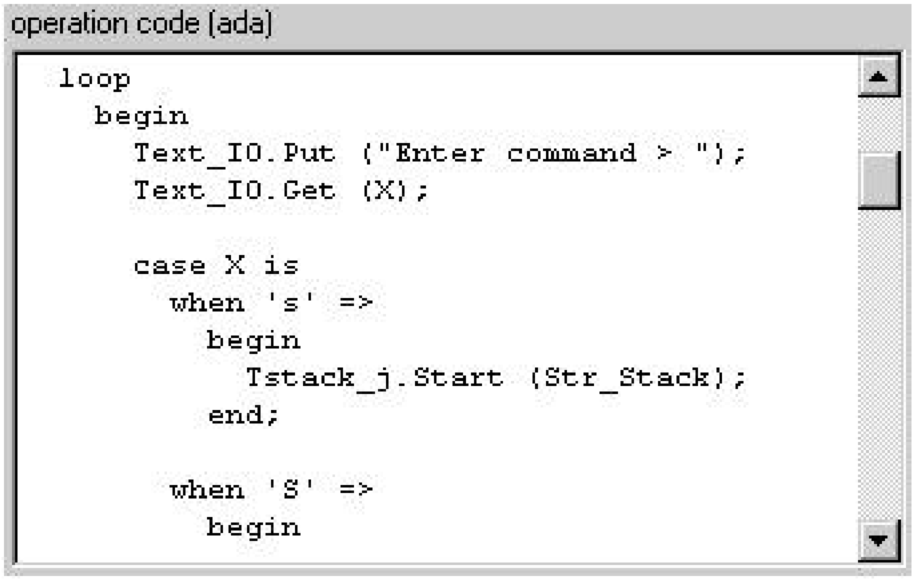
use_str_stack

or


Stood - ods text edit...

Unable to rename.

2.4. Text input area



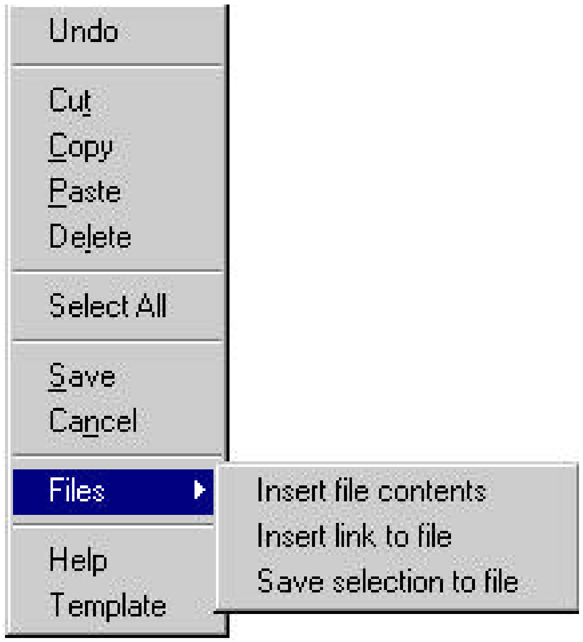
```
loop
  begin
    Text_IO.Put ("Enter command > ");
    Text_IO.Get (X);

    case X is
      when 's' =>
        begin
          Tstack_j.Start (Str_Stack);
        end;

      when 'S' =>
        begin
```

Text input area shows current contents of selected section for selected **Module**, and if required, selected **Component** or other extra parameter. This information may come from two different storage areas:

- Internal storage area, which roughly deals with architectural design actions (refer to part II). **STOOD** internal procedures are used to extract relevant information, to display it inside text input area, and in some case to update it from user input. Such information is stored in `stood.dg` file inside **Application** directory, and is updated only when saving the **Application** with *save* item of *window* menu of *main editor*.

- External storage area, which is a hierarchy of directories and files. Each section is bound to an independent file, which filename may be obtained by *where* pop-up menu item of sections selection list. This external storage structure may be fully customized with `DataBase` configuration file. Such information may be updated incrementally with *accept* item (for **UNIX**) or *save* item (for **Windows**) of text input area pop-up menu.

While pressing center mouse button (for **UNIX**), or right mouse button (for **Windows**), and locating mouse pointer inside text input area, a pop-up menu provides general purpose text editing functions:



Undo: Cancel previous text change or *cut*, *paste* or *delete* command.

Cut : Copy to a text buffer and erase currently selected text.

Copy : Copy currently selected text to a text buffer.

Paste : Paste text buffer contents at insertion point.

Delete : Erase currently selected text.

Select All : Select all contents of text input area.

Save : Save text changes. Note that, in text input area, pushing button acts as *save* command.

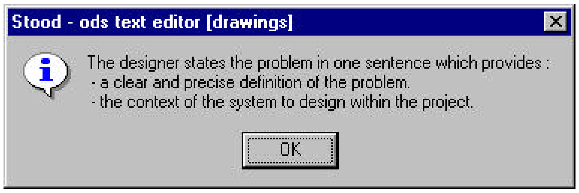
Cancel : Restore previously saved version of the text.

Insert file contents : Open a standard dialog box to select a file which contents will be pasted at current insertion point.

Insert link to file : Open a standard dialog box to select a file which location will be used as a include link for some documentation tools.

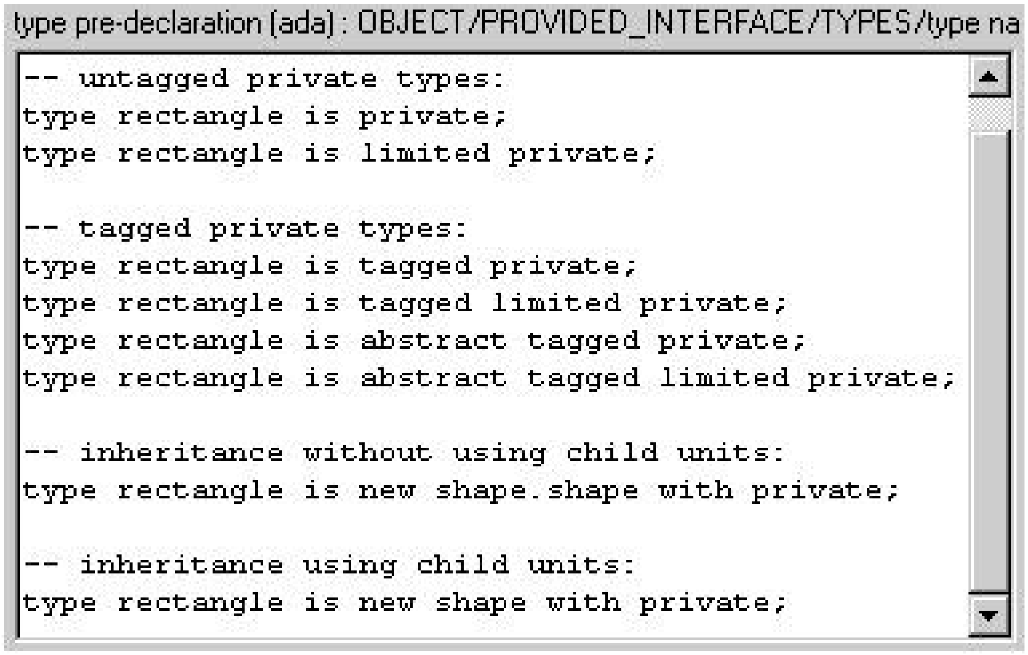
Save selection to file : Open a standard dialog box to select a file in which current text will be copied.

Help : provide contextual help regarding current textual edition. These help files may not be all filled in. Anyway they may be customized by editing the files contained in `config/ods_help` configuration directory.


Stood - ods text editor [drawings]

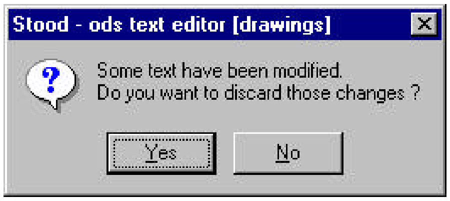
The designer states the problem in one sentence which provides :
- a clear and precise definition of the problem.
- the context of the system to design within the project.

Template : Provide a template current textual edition. Please refer to detailed chapters related to each kind of graphical entity. These template files may be customized by editing the files contained in `config/ods_template` configuration directory (refer to part I of this User's Manual).


type pre-declaration (ada) : OBJECT/PROVIDED_INTERFACE/TYPES/type na

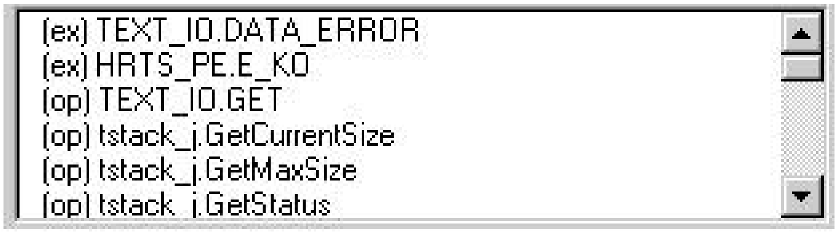
```
-- untagged private types:
type rectangle is private;
type rectangle is limited private;

-- tagged private types:
type rectangle is tagged private;
type rectangle is tagged limited private;
type rectangle is abstract tagged private;
type rectangle is abstract tagged limited private;

-- inheritance without using child units:
type rectangle is new shape.shape with private;

-- inheritance using child units:
type rectangle is new shape with private;
```

Note that changed text should be saved (or cancelled) before changing current selection in *modules*, *sections* or secondary list. Else, a warning message will be displayed:


Stood - ods text editor [drawings]

Some text have been modified.
Do you want to discard those changes ?

2.5. Symbol table



```
[ex] TEXT_IO.DATA_ERROR
[ex] HRTS_PE.E_KO
[op] TEXT_IO.GET
[op] tstack_j.GetCurrentSize
[op] tstack_j.GetMaxSize
[op] tstack_j.GetStatus
```

If selected section is a target language code section, entered text is supposed to comply with lexical and syntactic rules of specified language (**Ada**, **C**, **C++**, **Pseudo** code, or other). In order to properly manage code units dependencies, **STOOD** performs source code analysis and displays results into a symbol table, below text input area.

First step is a simple lexical analysis. There is an external lexical analyser for each supported target language. They may easily be customized if required. To perform this task, **STOOD** uses temporary files to communicate with lexical analyser. These files are named `tmp1` (input file) and `tmp2` (output file) and are created in the directory from which **STOOD** was launched. Please take care to get write rights at this level. During this step, comments and language keywords are withdrawn from symbols list. Composed notations may be recognized, like some **Ada** dotted notations.

Second step consists in symbol identification. Each symbol or group of symbol is compared to **Application Modules** and **Components** name, and a formatted string is set up and displayed inside symbol table.

Each symbol is structured as follow:

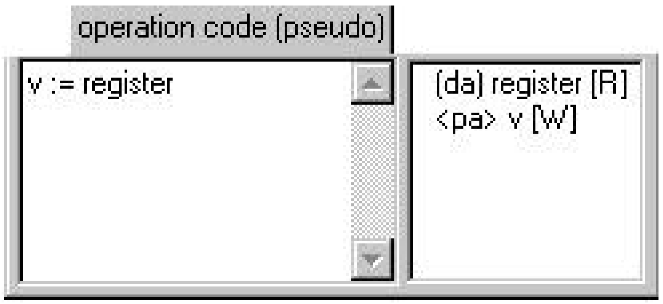
```
i_flag symb_kind mod_name.symb_name access_mode
```

`ignore_flag`	is a \ character and specifies that tagged symbol must not be taken into account for dependency analysis.
`symbol_kind`	is one of the following:

- `?` undefined. Should be manually specified.
- `(op)` **Operation**
- `(ty)` **Type**
- `(co)` **Constant**
- `(ex)` **Exception**
- `(da)` **Data**
- `<pa>` **Operation Parameter**
- `<at>` **Class Attribute** or record **Type** element
- `<en>` enumeration element
- `<tp>` local variable
- `<ta>` task
- `<wi>` user defined dependency

`module_name`	is the name of one of known **Module** of current **Application**, or `?` if unrecognized.
`symbol_name`	is the name of found lexical element.

`access_mode` for data values only, specifies wether the access is in read only `[R]`, write only `[W]` or read write mode `[RW]`. Note that this information will be correct only when parsing pseudo_code sections, for which a specific syntax must be used:



```
v := register
```

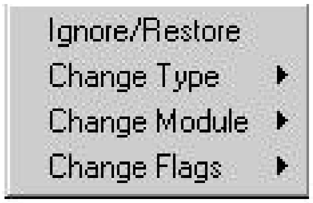
```
(da) register [R]
<pa> v [W]
```

This information may be used to draw data access charts from cross-references tables. When another language than **Pseudo Code** is used, access_mode always takes the value `[R]`.

When a given symbol matches several **HOOD Components**, all valid solutions are proposed, but only most likely one is left without ignore flag. Valid solutions are those allowed by **HOOD** visibility rules, and most likely one is the closest reference: local to current **Module**, sibling **Modules**, uncle **Modules**, or **Environments**.

Due to some lack of information, and to the fact that only lexical and no syntactic analysis is performed, **STOOD** automatic recognition is often incomplete and sometimes erroneous. User's intervention may thus be required.

Identified problems may be fixed manually with local pop-up menu that may be activated by selecting a symbol and pressing center mouse button (for **UNIX**) or right mouse button (for **Windows**):



Ignore/Restore : control `ignore_flag` for selected symbol. Same effect will be obtained by double-clicking on symbol label. An ignored symbol will not be taken into account for dependency analysis.

Change Type : change `symbol_kind` to one of those proposed in a predefined list. This is useful to identify non-**HOOD** entities like enumeration elements or local variables, or to solve ambiguousness due to homonyms (for instance, in **C++**, constructors of a **Class** have the same name as the **Class** itself).

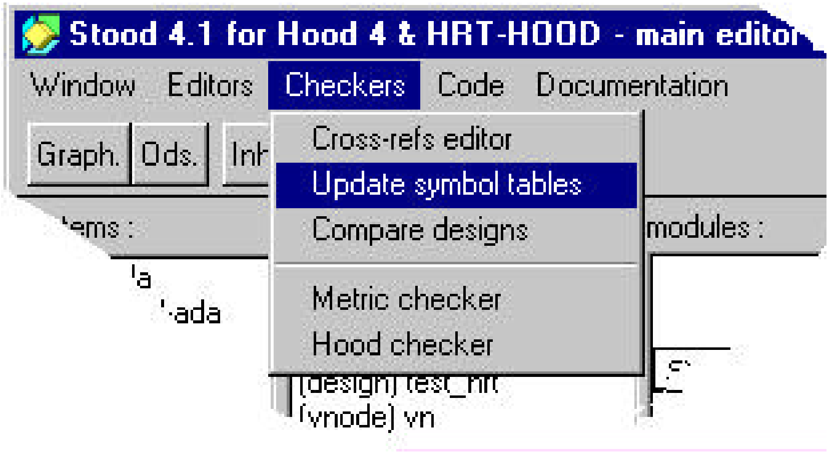
Change Object : when **Module** providing selected symbol (`module_name`) cannot be properly identified automatically by **STOOD**, it may be specified in a dedicated sub-menu, with a few special choices:

`<unknown>` :	`module_name` field will be set to: `?`
`<none>` :	symbol is local to current **Module**.
`<type in...>`	to enter a **Module** name manually.

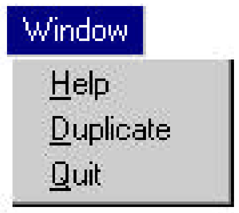
Change Flags : change `access_mode` to one of the possible values: `[R]`, `[W]` or `[RW]`.

Each symbol table is stored at the same time and the same location as storage file of selected section. They may be processed later by a *cross references table* (refer to § 4), and in order to be able to manage properly code dependencies, no unknown identifiers (`?`) should be left for not ignored symbols.

Update of a single symbol table is only feasible by saving code inside a text input area, of a *text editor*, or an appropriate tab of a *graphic editor* (to customize tabs of *graphic editor*, please refer to part I). Sometimes a global update of several symbol tables may be required. Instead of accepting each section individually, *update symbol tables* command of *checkers* menu in *main editor* can be used to perform this task:

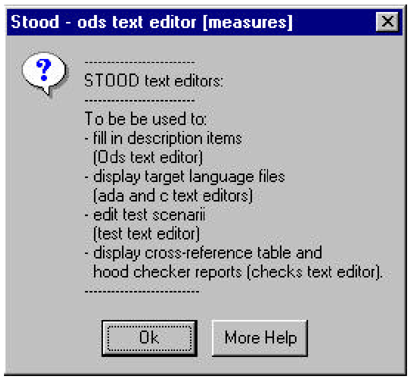


2.6. Window menu



Window menu of *text editors* offers only usual services provided for each window of **STOOD**:

Help : display an informational dialog box. Contents of this dialog box may be customized by editing `txt` and `txt.more` files in `config/help` configuration directory (refer to part I).



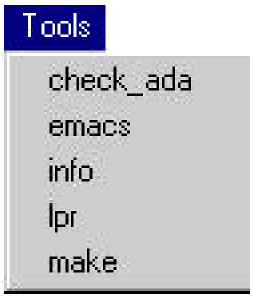
Stood - ods text editor [measures]

```
------------------------
STOOD text editors:
------------------------
To be be used to:
- fill in description items
  (Ods text editor)
- display target language files
  (ada and c text editors)
- edit test scenarii
  (test text editor)
- display cross-reference table and
  hood checker reports (checks text editor).
-------------------------
```

Duplicate : open another similar *text editor*.

Quit : close current window.

2.7. Tools menu



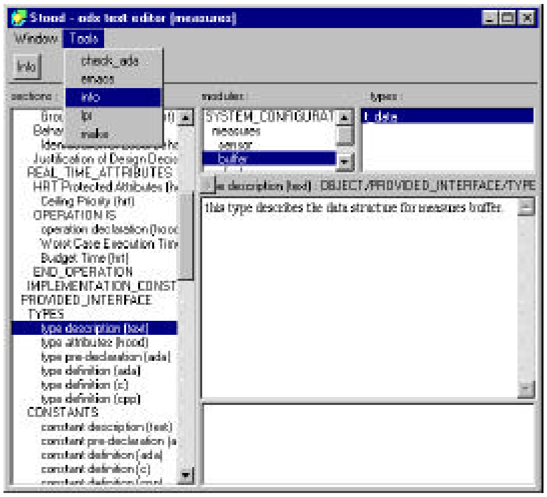
The *tools* menu is a fully customizable. Each item refers to a shell script file located inside `config/externalTools` configuration directory. Proposed items may be removed or modified, and others may easily be added to the list. Each file should have a `.sh` suffix to be automatically included into *tools* menu items list.

On a **Windows PC**, to get a full interoperability with **Unix** platforms, it is also recommended to use an Unix shell emulator, like **bash** product from Cygnus (`http://www.cygnus.com`). Doing this, the same shell scripts may be written to be used in a similar way on an **UNIX** or a **Windows** platform.

These `externalTools` may be useful to perform actions on selected section of a text editor. A set of parameters identifying current **Application**, **Module**, **Component**, section, and relevant filename, is sent to the shell script, and its standard output is redirected to a **STOOD** dialog box.

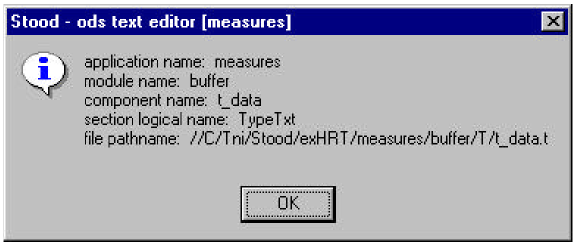
Following example shows:

- a text editor, in which a **Module**, a **Constant** and a section have been selected and *info* item of *tools* menu has been activated.



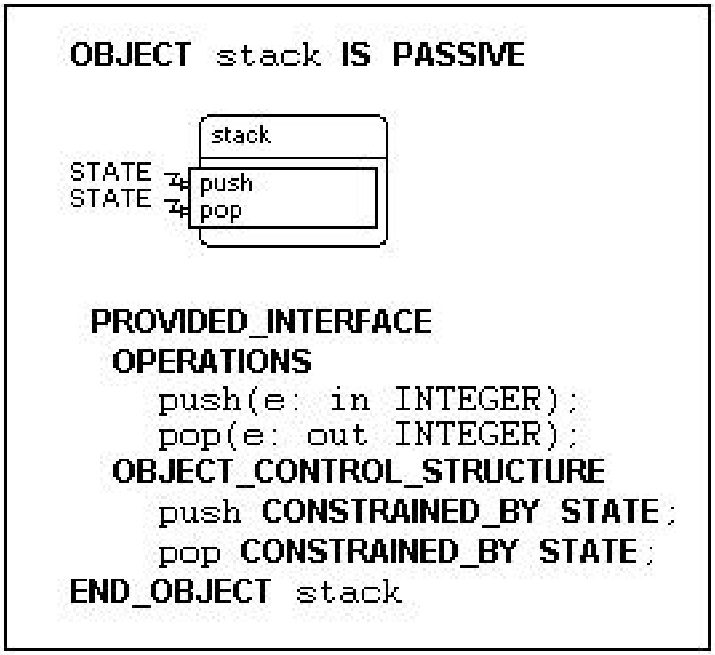
this type describes the data structure for measures buffer.

- and corresponding result in output dialog box:



```
application name:  measures
module name:  buffer
component name:  t_data
section logical name:  TypeTxt
file pathname:  //C/Tni/Stood/exHRT/measures/buffer/T/t_data.t
```

3. Object Description Skeleton



```
OBJECT stack IS PASSIVE

 PROVIDED_INTERFACE
  OPERATIONS
    push(e: in INTEGER);
    pop(e: out INTEGER);
  OBJECT_CONTROL_STRUCTURE
    push CONSTRAINED_BY STATE;
    pop CONSTRAINED_BY STATE;
END_OBJECT stack
```

Hood **R**eference **M**anual defines a precise list of sections to be filled in for each **Module** of an **Application**. This structured list is called **O**bject **D**escription **S**keleton. This chapter describes **STOOD** implementation of standard **HOOD4 ODS**, and all extensions that was required for operational use and automatic code generation. In addition, Real-Times attributes as defined by **HRT-HOOD** have been introduced. When producing **SIF** files, extended sections are propagated via dedicated **Pragmas**.

A standard **ODS** is composed of six main parts:

• a Header
• a **Description** part
• a **Provided Interface** part
• a **Required Interface** part
• an **Internals** part
• a Footer

ODS actual contents differ as regards the kind of corresponding **Module**. Please refer to part II, § 3.2 to get more details about **HOOD Modules** kinds:

- **Terminal** or **Non Terminal Modules**
- **Passive** or **Active Modules**
- **Object** or **Class Modules**
- local or **Environment Modules**
- **Generic**, **Instance_Of** or **Op_Control Modules**.
- **HRT-HOOD Cyclic**, **Sporadic** or **Protected Objects**.

STOOD ODS are customizable, and only default configuration is presented here. If `config/DataBase` configuration file was customized by toolset administrator (refer to part I), following explanations may be incomplete or irrelevant.

ODS sections may be of following kinds:

- structuring sections (*titles*)
- textual informal descriptions (*text*)
- **HOOD** syntactic sections (*hood*)
- **HRT-HOOD** sections (*hrt*)
- target language coding sections (*ada*, *c* or *cpp*)

ODS sections storage may be internal (automatically extracted from internal model), in which case a procedure number is provided: auto(xx), or external in which case a file pathname is provided (relative to `SavePath` property defined in `stood.ini` or `.stoodrc` initialization file).

3.1. Header

ODS Header provide general information about selected **Module**. In general case, it only contains **Module** name, **Module** kind and **HOOD Pragmas**. In the particular case of an **Instance_Of**, values of actual parameters is the only required information to complete **ODS** description.

3.1.1. General case

section:	*contents:*
`OBJECT`	automatically filled in by STOOD (17)
`module type`	automatically filled in by STOOD (18)
`pragma (hood)`	`file: PRAGMA`

Object and *module type* sections are automatically deduced from relevant **HOOD** diagram. In the **ODS**, they are both considered as titles and cannot be changed. If a **Module** name or king needs to be changed, please operate from a *graphic editor*.

3.1.1.1. pragma

pragma section contains a list of **HOOD** directives that are usually managed when preparing code generation. Refer to part IV to get further information.These **Pragmas** may however be edited here, but take care to comply with **HOOD** syntax. Else, code extractors initialization could fail and produced **SIF** file could raise warning messages when imported back.

```
(73)pragma ::=
        PRAGMA `pragma_`identifier
        [pragma_parameter_part74] [";"]

(74)pragma_parameter_part ::=
        "("  pragma_parameter75
        {comma pragma_parameter75} ")"

(75)pragma_parameter ::=
        `parameter_`identifier "=>"
        pragma_parameter_value76
    |   pragma_parameter_value76

(76) pragma_parameter_value ::=
        op_reference
    |   numeric_literal
    |   free_text
```

3.1.2. Instance_Of

section:	*contents:*
`instance range (hood)`	auto (16)
`instance parameters (hood)`	auto (17)

When selected **Module** is an **Instance_Of Generic**, actual parameters need to be specified within *instance parameters* section. These parameters match formal parameters of the **Generic**.

3.1.2.1. instance range

This section is only relevant for **Instance_Of Modules** and, if used, should comply with following syntax:

```
(57)instance_range ::=
        INSTANCE_RANGE integer "." "." integer
```

Note that **STOOD** does not manage multiple **Instance_Of** (so, this section is useless for **STOOD**).

3.1.2.2. instance parameters

```
(53)parameter_association_section ::=
      TYPES
     association54 {association54}
    | TYPES NONE
    | CONSTANTS
     association54 {association54}
    | CONSTANTS NONE
    | OPERATIONS
     association54 {association54}
    | OPERATIONS NONE
    | OPERATIONS_SETS
     association54 {association54}
    | OPERATIONS_SETS NONE

(54)association ::= identifier "=>" reference
```

Actual parameters are described in three categories (**STOOD** doesn't manage formal **Operation Sets** as described in the **HOOD R**eference **M**anual). For each parameter of each category, a valid value should be specified. This value must be a reference to a visible **Component** of the same kind, or a numeric value for **Constants**.

For instance, if a **Generic Module** is a `stack` with a formal **Type** `element`, each **Instance_Of** this `stack` must specify an actual value for `element`, that should be another **Type** provided by any sibling, uncle or **Environment Module**.

3.2. Description

In first versions of **HOOD** (until v3.0) this part of the **ODS** was strongly codified by the **H**ood **R**eference **M**anual. Since **HRM** 3.1, **Description** section may be customized to best fit **Projects** requirements. A generic format was then defined to be able to include relevant information within **SIF** files.

STOOD default implementation proposes a list of sections which keeps general "spirit" of previous structure, but highlights new features of **HOOD4**, like **Classes** and **STD**s.

For those who prefer using old style sections, a downwards compatibility mapping is provided, and **STOOD** may easily be configured to follow this requirements if needed.

3.2.1. Description of the Problem

section:	*contents:*
`DESCRIPTION`	title
`PROBLEM`	title
`Statement of the Problem (text)`	`DOC/StaPro.t`
`Referenced Documents (text)`	`DOC/RefDoc.t`
`Analysis of Requirements`	title
`Structural Requirements (text)`	`DOC/StrReq.t`
`Functional Requirements (text)`	`DOC/FunReq.t`
`Behavioural Requirements (text)`	`DOC/BehReq.t`
`Local Environment`	title
`Parent General Description (text)`	`DOC/ParDes.t`

3.2.1.1. statement of the problem

This section should be used to explain which part of the problem is covered by current **Module**. For **Root Module**, it should be an abstract of informal requirements for the overall **Application**. For other **Modules**, it should clearly refer to a limited domain of the problem.

3.2.1.2. referenced documents

The list of all relevant document references should be inserted within this section. For lower level **Modules**, only new references should be included, and references already listed within higher level **ODS** are not worth being included again.

3.2.1.3. structural requirements

This section should extract relevant data structures for current **Module**, and from requirement analysis phase. For instance, classes identified during Object Oriented requirement analysis process (**OMT** or **UML** static models), could be listed here, and will help identifying later **HOOD Types** and/or **Classes**.

3.2.1.4. functional requirements

From functional requirement analysis process (**SADT**, **SA-RT**, functional models of Object Oriented methods), a list of relevant provided functional services should be defined here for current **Module**.

3.2.1.5. behavioural requirements

This section should explain how previously identified services must interact to provide required external behaviour of current **Module**. Part of dynamic models from functional or Object Oriented requirement analysis process (**SA-RT**, **UML** state transition or sequence diagrams) could be used to provide this information.

3.2.1.6. parent general description

Each description refer to a context. This section should be used to recall current context. Within a **HOOD** hierarchy, context of a **Module** is a description of its parent **Module**. For **Root Module**, this section could describe interactions with **Environment Modules**. For other **Modules**, it could describe shortly interactions with uncle **Modules**.

3.2.2. Description of the Solution

section:	*contents:*
SOLUTION	title
General Strategy (text)	DOC/GenStra.t
Identif. of Child Modules (text)	DOC/IdeChi.t
Structural Description	title
Identif. of Data Structures (text)	DOC/IdeStr.t
Functional Description	title
Identif. of Operations (text)	DOC/IdeOpe.t
Grouping Operations (text)	DOC/GroOpe.t
Behavioural Description	title
Identif. of local Behaviour (text)	DOC/IdeBeh.t
Justif. of Design Decisions (text)	DOC/JusDes.t
IMPLEMENTATION CONSTRAINTS	DOC/ImpCon.t

3.2.2.1. general strategy

For a given stated problem, several solutions may generally be identified. This section should be used to express general design strategy for current **Module**. Roughly, three main design strategies may generally be applied within **HOOD** top-down process:

- function oriented strategy
- data (or object) oriented strategy
- behaviour oriented strategy

Each strategy often leads to a different solution. It is important to choose and follow a well defined strategy, which should be explained and justified here.

3.2.2.2. child modules

If current **Module** has to be broken down, its child **Modules** should be listed and shortly described here, as an introduction to their own **ODS**. Consistency with graphical description should be ensured manually.

3.2.2.3. data structures

Main data structures of current **Module** should be described here, as part of design solution. They may refer to structural requirements, or be pure solution elements. Consistency with **Types** defined within current **Module** should be ensured manually. When producing design documentation, *type* view of current **HOOD** diagram will be inserted below this section.

3.2.2.4. operations

Main functional services of current **Module** should be described here, as part of design solution. They may refer to functional requirements, or be pure solution elements. Consistency with **Operations** defined within current **Module** should be ensured manually. When producing design documentation, *operation* view of current **HOOD** diagram will be inserted below this section.

3.2.2.5. grouping operations

Grouping **Operations** into **Operation Sets** should follow logical rules that must be explained within this section. Usual grouping rules are the following ones:

- purely functional abstractions : same functional category
- related to a given data structure : **OO** member functions
- related to a given child **Module** : **Operation** dispatching

3.2.2.6. local behaviour

This section should contain an informal description of how previously identified **Operations** must interact together with their environment to produce required external behaviour. This could include information about **Operations** receptivity as regards **Module States**, and communication protocols between client and current **Modules**. Consistency with **Operation** constraints, **States** and **Transitions** defined in **HOOD** diagrams and **S**tate **T**ransition **D**iagrams should be ensured manually. When producing design documentation, **S**tate **T**ransition **D**iagram (if any) will be inserted below this section.

3.2.2.7. design decisions

Previous sections were used to explain current design strategy and choices. This section may be used to justify this solution as opposed to other possible solutions for the same stated problem.

3.2.2.8. implementation constraints

In some cases, design choices are not the result of a well followed strategy, but are in fact part of initial requirements. For instance, **Module** breakdown may be constrained by prescribed target architecture. Such constraints should be listed here.

3.2.3. Compatibility with HOOD3.x

Following table shows the correspondence between **STOOD** v4 and **HOOD3** Description sections. This information could be useful when importing a **SIF** file from an older **Application** or another tool.

STOOD v4	*HOOD3*
DESCRIPTION	**DESCRIPTION**
PROBLEM	**H1 Problem Definition**
Statement of the Pb.	H1.1 Statement of the Pb.
Referenced Documents	H1.2.1 Referenced Docs
Analysis of Req.	**H1.2 Analysis and ...**
Structural Req.	
Functional Req.	H1.2.3 Analysis of Func.
Behavioural Req.	H1.2.4 Analysis of Beh.
Local Environment	
Parent General Desc.	H1.2.2 System Environ.
SOLUTION	
General Strategy	H2.2 Informal Strategy
Identif. of Child Mod.	H3.1 Identif. of Objects
Structural Desc.	
Id. of Data Struct.	
Functional Desc.	
Id. of Operations	H3.2 Identif. Opers
Grouping Operations	H3.3 Grouping Opers
Behavioural Desc.	
Id. of Behaviour	
Justif. of Decisions	H3.5 Justif. of Dec.
IMPLEMENT. CONSTRAINTS	IMPLEMENT. CONSTRAINTS

3.2.4. Real-Time Attributes (HRT_HOOD)

When selected **Module** is an **HRT-HOOD Object**, that it is a **Cyclic**, **Sporadic** or **Protected Object**, additional information is required in the **Description** part of the **ODS**. These additional fields are grouped into a dedicated section called Real-Time Attributes.

These sections are organized as follow:

- Real-Time attributes for **Protected Objects**
- Real-Time attributes for **Cyclic Objects**
- Real-Time attributes for **Sporadic Objects**
- Thread Real-Time attributes for **Cyclic** and **Sporadic Objects**
- Operation Real-Time attributes for all **HRT Objects**

Please note that in **HRT-HOOD** standard definition, these attributes should be defined for each operating mode of the **Application**. **STOOD** only supports a unique set of Real-Time attributes, for now. In **STOOD**, the thread must be explicitly defined as an **Internal Operation** named `thread`.

Next table shows the list of Real-Time attributes sections in **STOOD** *ods text editors*. Of course, only relevant sections are displayed regarding the actual kind of the selected **Module**.

A individual description is also provided for each section. Proposed descriptions are directly issued from "*HRT-HOOD: A Structured Design Method for Hard Real-Time Ada Systems*", Alan Burns & Andy Wellings, Elsevier editor. For further information, please refer to this book, as there is no **HRT-HOOD** Reference Manual.

section:	*contents:*
REAL_TIME_ATTRIBUTES	title
HRT Protected Attributes	title
Ceiling Priority (hrt)	DOC/CeiPri.hrt
HRT Cyclic Attributes	title
Period (hrt)	DOC/Period.hrt
Offset (hrt)	DOC/Offset.hrt
HRT Sporadic Attributes	title
Minimum Arrival Time (hrt)	DOC/MinTim.hrt
Maximum Arrival Frequency (hrt)	DOC/MaxFreq.hrt
HRT Thread Attributes	title
Deadline (hrt)	DOC/Ddline.hrt
Ceiling Priority (hrt)	DOC/CeiPri.hrt
Priority (hrt)	DOC/Priori.hrt
Precedence Constraints (hrt)	DOC/PreCon.hrt
Execution Time Transformation (h	DOC/TimTra.hrt
Importance (hrt)	DOC/Import.hrt
OPERATION IS	title
operation declaration (hood)	auto(22)
Worst Case Execution Time (hrt)	OP/$Op_wcet.hrt
Budget Time (hrt)	OP/$Op_budg.hrt
END_OPERATION	title

3.2.4.1. ceiling priority

Each **Protected**, **Cyclic** or **Sporadic Object** must have a defined *ceiling priority*. This priority is no lower than the maximum priority of all the threads that can call the constrained operations. A simple integer value should be entered here.

3.2.4.2. period

Each **Cyclic Object** must have a defined *period* of execution. A simple integer value should be entered here.

3.2.4.3. offset

Each **Cyclic Object** may have a defined *offset* which indicates the time that the thread should delay before starting its cyclic operations. Each **Sporadic Object** may also have a defined *offset* which indicates the time that the thread should delay before starting each invocation. If used, a valid time duration value should be entered here.

3.2.4.4. minimum arrival time & maximum arrival frequency

Each **Sporadic Object** must have either a defined *minimum arrival time* for requests for its execution, and/or a *maximum arrival frequency* of request. For each used section, an appropriate numeric value should be entered here.

3.2.4.5. deadline

Each **Cyclic** and **Sporadic Object** may have a defined deadline for the execution of its thread. An appropriate numeric value should be entered here.

3.2.4.6. priority

Each **Cyclic** and **Sporadic Object** must have a defined *priority* for its thread. This *priority* is defined according to the scheduling theory being used (for instance, according to the thread's period or its deadline). A simple integer value should be entered here, or automatically inserted by an appropriate schedulability analysis tool.

3.2.4.7. precedence constraints

A thread may have *precedence constraints* associated with its execution. This attribute indicates which **Object** must execute before and after it.

3.2.4.8. execution time transformation

A **Cyclic** or **Sporadic Object** may need to be transformed at run-time to incorporate extra delays. This may be required, for example, as a result of period transformation during the schedulability analysis phase of the method.

3.2.4.9. importance

Each **Cyclic** or a **Sporadic Object** must have a defined *importance*. This *importance* represents whether the **Object** is a Hard Real-Time thread or a Soft Real-Time **Object**. Typical possible values are:

```
importance := HARD | SOFT | BACKGROUND
```

3.2.4.10. worst case execution time

Each **Cyclic** and **Sporadic Object** may have a *worst case execution time* (**WCET**) defined for its thread of execution. In **STOOD** the thread is a dedicated **Internal Operation** which needs to be created with the reserved name `thread`. The worst case execution time for the thread is the thread's *budget time* plus the budget time of the internal error handling operation. If a thread overruns its **WCET** then it is terminated for the current invocation. An appropriate time duration value should be entered here.

3.2.4.11. budget time

Each **Cyclic** and **Sporadic Object** may have a *budget execution time* defined for each activation of its thread of execution. An overrun of the budgeted time results in the termination of the activity being undertaken. Each **Cyclic** and **Sporadic Object** may have an **Internal Operation** which is to be called if its thread's *budget execution time* is violated. An appropriate time duration value should be entered here.

3.3. Provided Interface

Provided Interface sections should be used to add textual information related to **Components** that were created during architectural design phase while adding an element within interface box of a **Module**, or from top right list pop up menu (refer to § 2.3).

Operations, **Exceptions**, and **Operations Sets** declarative parts may be fully described within *graphic editor* textual area. **HOOD** general rules consider that a **Provided Constant** value is part of the **Internals**, and in the case of structured **Types**, their declarative part may be deduced from architectural design information (super **Classes**, **Attributes**). **Provided Interface** sections are thus strongly independent from target language code syntax.

Practically, some **Types** definitions and **Constants** definitions need to be expressed within **Provided Interface** part of the **ODS** for **Terminal Modules**, and should comply with target language syntax to be inserted into generated code.

Provided Interface sections may thus contain:

- textual information related to each **Provided Component** (*text*).
- target language sections for **Types** or **Constants** (*lang*).
- **HOOD** syntax sections for **Types, Operations**, **Exceptions** (*hood*).

lang denotes here one of the suuported target languages: *ada*, *c* or *cpp*

Provided Interface part of the **ODS** differs as regards the kind of current **Module**. Following cases are described in detail below:

- **Non Terminal Modules** without **OBCS**
- **Terminal Modules** without **OBCS**
- **Provided OBCS**
- other kinds of **Modules**

3.3.1. Non Terminal Modules without OBCS

section:	*contents:*
PROVIDED INTERFACE	title
TYPES	title
type description (text)	T/$Tp.t
class inheritance (hood)	auto(30)
type attributes (hood)	auto(31)
child type (lang) definition	auto(42)
CONSTANTS	title
constant description (text)	C/$Cp.t
child constant (lang) definition	auto(43)
OPERATION_SETS	title
op-set description (text)	OPS/$Os.t
op-set definition	auto (37)
op-set contents	auto (81)
OPERATIONS	title
operation spec. description (text)	OP/$Op.t
operation declaration (hood)	auto (22)
EXCEPTIONS	title
exception description (text)	X/$Ex.t
exception declaration (hood)	auto (32)

3.3.1.1. component description sections

Each **Provided Component** (**Type**, **Constant**, **Operation**, **Exception**) or **Operation Set** may be described at this level, within relevant textual section. This information is stored in an independent file for each **Component**. This text may be used to be later included inside design documentation and as an option, to comment generated code.

These informal sections should not be neglected, as they provide a very efficient way to document the **Application** step by step, and not to postpone globally this task at the end of detailed design phase.

3.3.1.2. child sections

Components declared within **Provided Interface** of **Non Terminal Modules** do not locally include any implementation. They refer to lower level **Modules** which actually contain relevant implementation.

It is anyway often convenient to get a direct access to final implementation of selected **Component** of a **Non Terminal Module**. **STOOD** provide such a feature to avoid browsing the **ODS**. These child sections are actually simple logical links to relevant **Terminal Module** information, if any.

3.3.1.3. op-set definition and contents

These two sections show information that may only be updated within text input area of *graphic editor*, when an **Operation Set** is selected. In **HOOD** syntax, *op-set definition* contains nothing but **Operation Set** name itself. To change it, please simply rename the **Operation Set**. *op-set contents* shows a textual representation of **Set** structure.

This structure may only be modified by dragging **Operations** within drawing area of *graphic editor* (please refer to § 3.4.3 of part II).

3.3.1.4. operation declaration

This section recalls *operation declaration* field of text input area of *graphic editor* when a **Provided Operation** is selected. Same editing actions as in *graphic editor* may be performed here (please refer to § 3.3.3 of part II). Any change which occurs while editing **Operation** declarative part within *graphic editor* or *text editors* is automatically propagated to other editors.

3.3.1.5. exception declaration

This section recalls *exception raised* by field of text input area of *graphic editor* when an **Exception** is selected. Same editing actions as in *graphic editor* may be performed here (please refer to § 3.5.3 of part II). Any change which occurs while editing **Exception** declarative part within *graphic editor* or *text editors* is automatically propagated to other editors.

3.3.2. Terminal Module without OBCS

Only sections that were not already described above are detailed after next table. In particular, please refer to previous explanations as regards **Components** *textual description* sections, *op-set definition* and *contents* sections, *operation* and *exception declaration* sections

section:	*contents:*
PROVIDED INTERFACE	title
TYPES	title
type description (text)	T/$Tp.t
class inheritance (hood)	auto(30)
type attributes (hood)	auto(31)
type pre-declaration (ada)	T/$Tp.s
type definition (ada)	T/$Tp.u
type definition (c)	T/$Tp.h
type definition (cpp)	T/$Tp.hh
CONSTANTS	title
constant description (text)	C/$Cp.t
constant pre-declaration (ada)	C/$Cp.s
constant definition (ada)	C/$Cp.u
constant definition (c)	C/$Cp.h
constant definition (cpp)	C/$Cp.hh
OPERATION_SETS	title
op-set description (text)	OPS/$Os.t
op-set definition	auto (37)
op-set contents	auto (81)
OPERATIONS	title
operation spec. description (text)	OP/$Op.t
operation declaration (hood)	auto (22)
EXCEPTIONS	title
exception description (text)	X/$Ex.t
exception declaration (hood)	auto (32)

3.3.2.1. class inheritance

This section recalls *class inheritance* field of text input area of *graphic editor* when a **Provided Type** is selected. Same editing actions as in *graphic editor* may be performed here (please refer to § 3.7.3 of part II). Any change which occurs while editing **Type** declarative part within *graphic editor* or *text editors* is automatically propagated to other editors.

3.3.2.2. type attributes

This section recalls *type attributes* field of text input area of *graphic editor* when a **Provided Type** is selected. Same editing actions as in *graphic editor* may be performed here (please refer to § 3.7.3 of part II). Any change which occurs while editing **Type** declarative part within *graphic editor* or *text editors* is automatically propagated to other editors.

3.3.2.3. type and constant ada pre-declaration

In the particular case when target language is **Ada**, and use of private types or deferred constants is required, these two sections may be used to insert **Type** or **Constant** pre-declarations that will be included inside public part of relevant package specification.

If these sections remain empty, relevant **Types** and **Constants** full declaration will be inserted inside public part of package specification. If they contain pre-declarations, full declarations will be inserted inside private part of package specification. Please refer to part IV to get further details.

3.3.2.4. component language definition

Ada, C or **C++** definition of **Provided Types** and **Constants** may also be inserted within the **ODS**. Part IV of this manual provides detailed information about coding phase. Nothing forbids simultaneous use of **Ada**, **C** and **C++** coding sections (and even other languages), but usually, only one of them is required for a given **Project**.

Useless code sections (for instance **C** and **C++** for an **Ada Project**) may be removed from **ODS** sections list, by editing `DiscardedLanguages` property in `.stoodrc` (for **UNIX**) or `stood.ini` (for **Windows**) initialization file.

3.3.3. Provided OBCS

Provided Interface of a **Terminal** or **Non Terminal Module** that contains **Constrained Operations**, will be described by an extended **ODS**, showing following additional section:

section:	*contents:*
`OBJECT_CONTROL_STRUCTURE`	title
`obcs spec. description (text)`	`STD/obcs.t`
`constrained operations`	auto (34)

3.3.3.1. obcs specifications description

OBject **C**ontrol **S**tructure of a **Module** providing **Constrained Operations** may be documented within relevant **ODS**. **OBCS** documentation is split into two parts: *obcs spec. description* which should explain external behaviour, and *obcs body description* to describe how this behaviour is implemented. This latter section will be found in the **Internals**.

3.3.3.2. constrained operations

This section recalls *trigger label* field of text input area of *graphic editor* when an **Operation** is selected. Same editing actions as in *graphic editor* may be performed here (please refer to § 3.3.3 of part II). Any change which occurs while editing **Operation** declarative part within *graphic editor* or *text editors* is automatically propagated to other editors.

3.3.4. Op_Control, Environment and Instance_Of

ODS of an **Op_Control Module** contains no **Provided Interface**. **Provided Interface** of an **Instance_Of** is a local copy of the one of relevant **Generic Module**. Same rules apply for **Environments**, which local **Provided Interface** is a copy of relevant remote **Application**.

For these two last cases, **ODS** is automatically updated by **STOOD** each time the **Application** is loaded, but please note that file storage sections contents are never propagated by this way, and that no persistent change may be performed locally.

3.4. Required Interface and Flows

Required Interface is supposed to provide an exhaustive list of all remote **Components** that are used locally. This list should be structured as follow:

```
(15)required_interface_section ::=
        REQUIRED_INTERFACE
        required_object16 {required_object16}
    |   REQUIRED_INTERFACE NONE

(16)required_object ::=
        required_object_header17 semi_colon
        required_entity_section18
        {required_entity_section18}
    |   required_object_header17 semi_colon NONE

(17)required_object_header ::=
        OBJECT `object_`identifier
    |   FORMAL_PARAMETERS

(18)required_entity_section ::=
        TYPES {pragma}
        reference semi_colon {reference semi_colon}
    |   TYPES {pragma} NONE
    |   CONSTANTS {pragma}
        reference semi_colon {reference semi_colon}
    |   CONSTANTS {pragma} NONE
    |   OPERATIONS {pragma}
        reference semi_colon {reference semi_colon}
    |   OPERATIONS {pragma} NONE
|     OPERATION_SETS {pragma}
      reference semi_colon {reference semi_colon}
|     OPERATION_SETS {pragma} NONE
|     EXCEPTIONS {pragma}
      reference semi_colon {reference semi_colon}
|     EXCEPTIONS {pragma} NONE
```

This information do not need to be inserted manually. **STOOD** may automatically update this field from *cross references editor*. When any change invalidates cross references, following message is displayed within required interface section:

```
--{ cross references are out of date }--
NONE
```

Cross references are related to a given target language (**Ada**, **C** , **C++**, or **Pseudo**). Please, take care to set correct default language (*option* item of *window* menu of *main editor*), in order to get appropriate **Required Interface**.

To update **Required Interface** section of an **ODS**, open a *cross references editor*, check current language and press *update* button. See below an example of an updated **Required Interface** for a Module which requires:

- **Type** `instruments.Acc`
- **Operations** `instruments.Set_Name`,
- `instruments.Display_Values`
- **Operations** `io.Put`, `io.Get`, `io.Put_Line`, `io.New_Line`

```
OBJECT instruments;
    TYPES
         Acc;
    CONSTANTS
         NONE
    OPERATION_SETS
         NONE
    OPERATIONS
         Set_Name; Display_Value;
    EXCEPTIONS
         NONE

OBJECT io;
    TYPES
         NONE
    CONSTANTS
         NONE
    OPERATION_SETS
         NONE
    OPERATIONS
         Get; Put; Put_Line; New_Line;
    EXCEPTIONS
         NONE
```

In addition to the **Required Interface** itself, this part of the **ODS** also recalls all **DataFlows** and **Exception Flows** related to current **Module**, and that was defined within drawing area of *graphic editor*:

section:	*contents:*
`REQUIRED_INTERFACE`	auto(36)
`DATAFLOWS`	auto(4)
`EXCEPTION_FLOWS`	auto(5)

Note that these three sections are in read-only in text editors. To change their values, use a graphic editor (refer to part II, § 3.6.5 and § 3.6.6).

3.5. Internals

Internal sections should be used to add textual information related to **Components** that were created either by adding graphically an element within body box of a **Terminal Module**, either from top right list pop up menu of a text editor (refer to § 2.3).

Like **Provided** ones, **Internal Operations** declarative parts may be fully described within *graphic editor* textual area. **HOOD** general rules consider that there should be no **Internal Exceptions** nor **Sets**. On the contrary, **Internal Data** are allowed whereas they are forbidden inside **Provided Interface**. In addition, **Internals** is the place where all **Operation** and **OBCS** bodies should be included.

Internal sections may thus contain:

- textual information related to each **Internal Component** (*text*).
- target language declaration sections for **Types**, **Constants** or **Data** (*ada*, *c* or *cpp*).
- **HOOD** syntax sections for **Operations** (*hood*).
- target language body sections for **OPCS** or **OBCS** (*ada*, *c*, *cpp* or *pseudo*).

Internal part of the **ODS** differs as regards the kind of current **Module**. Following cases are described below:

- **Non Terminal Modules** without **OBCS**
- **OBCS** of **Non Terminal Modules**
- **Terminal Modules** without **OBCS**
- **OBCS** of **Non Terminal Modules**
- other kinds of **Modules**

3.5.1. Non Terminal Module without OBCS

When a **Module** is **Non Terminal**, its **Internals** contains only other **Modules**. Relevant **ODS** simply recalls information already provided by **HOOD** diagrams. There is no way to insert or modify thes informations directly with an *ods text editor*:

Next table describes the **ODS** sections that appear when a **Non Terminal Module** without any constrained **Operations** is selected:

section:	*contents:*
`INTERNALS`	title
`OBJECTS`	auto(1)
`TYPES`	title
`implemented_by`	auto(62)
`CONSTANTS`	title
`implemented_by`	auto(63)
`OPERATION_SETS`	title
`implemented_by`	auto(66)
`OPERATIONS`	title
`implemented_by`	auto(61)
`EXCEPTIONS`	title
`implemented_by`	auto(64)

3.5.1.1. objects

This section shows a list of child **Modules** that were defined graphically within drawing area of *graphic editor*. This textual section is read-only and any change to child **Modules** list should be performed graphically.

3.5.1.2. component implemented_by sections

Each **Component Provided** by a **Non Terminal Module** should be attached to an **Implemented By** link connecting it to another **Provided Component** of a child **Module** (refer to § 3.10 of part II). These **Implemented By** links may only be edited within drawing area of *graphic editor*, but are textually presented within this section.

3.5.2. OBCS of a Non Terminal Module

When a **Non Terminal Module** provides at least one **Constrained Operation**, its behaviour may be described textually within **Internals** part of the **ODS**. Actual implementation of this behaviour will be found inside **Terminal Modules** implementing **Constrained Operations**.

section:	*contents:*
OBJECT_CONTROL_STRUCTURE	title
obcs body description (text)	STD/obcs.t2
implemented_by	auto(35)

3.5.2.1. obcs body description

This section may contain a textual and informal description of required behaviour for selected **Non Terminal Module**. Consistency with actual implementation within relevant child **Modules** should be ensured manually.

3.5.2.2. obcs implemented_by

This section recalls which child **Modules** actually implement behaviour of current **Non Terminal Module**. This information is automatically deduced from graphic edition, and no change is allowed at this level.

Please note that there is no formal **Implemented By** link for **S**tate **T**ransition **D**iagrams. There is no general rules to automatically ensure consistency between a high level **STD** and child **STD**s. This is particularly true for **States**: if modular breakdown was not performed to dispatch known **States** of a parent **STD** into child **Modules**, there will be no easy one to one mapping between parent and child **States**. On the contrary, **Transitions** are directly linked to **Constrained Operations** for which a one to one **Implemented By** link should be defined.

3.5.3. Terminal Module without OBCS

Internals ODS of **Terminal Modules** should contain all textual information that misses to complete design documentation and code generation. It contains sections to document and code **Internal Components**, and bodies of all **Operations** (**Provided** and **Internal**) and of the **OBCS**, if any.

Following table describes the **ODS** sections that are displayed when a **Terminal Module** without any constrained **Operations** is selected:

section:	*contents:*
INTERNALS	title
TYPES	title
type description (text)	T/$Tp.t
type attributes (hood)	auto(31)
type definition (ada)	T/$Tp.u
type definition (c)	T/$Tp.h
type definition (cpp)	T/$Tp.hh
CONSTANTS	title
constant description (text)	C/$Cp.t
constant definition (ada)	C/$Cp.u
constant definition (c)	C/$Cp.h
constant definition (cpp)	C/$Cp.hh
OPERATIONS	title
operation spec. description (text)	OP/$Op.t
operation declaration (hood)	auto(22)
DATA	title
data description (text)	D/$Da.t
data declaration (ada)	D/$Da.s
data declaration (c)	D/$Da.c
data declaration (cpp)	D/$Da.cc
data access from code	auto(91)

3.5.3.1. internal component description sections

Each **Internal Component** (**Type**, **Constant**, **Operation**, **Data**) may be described at this level, within relevant textual section. This information is stored in an independent file for each **Component**. This text may be used to be later included inside design documentation and as an option, to comment generated code.

These informal sections should not be neglected, as they provide a very efficient way to document the **Application** step by step, and not to postpone globally this task at the end of detailed design phase.

3.5.3.2. internal type attributes

This section recalls *type attributes* field of text input area of *graphic editor* when an **Internal Type** is selected. Same editing actions as in *graphic editor* may be performed here (please refer to § 3.7.3 of part II). Any change which occurs while editing **Type** declarative part within *graphic editor* or *text editors* is automatically propagated to other editors.

3.5.3.3. internal operation declaration

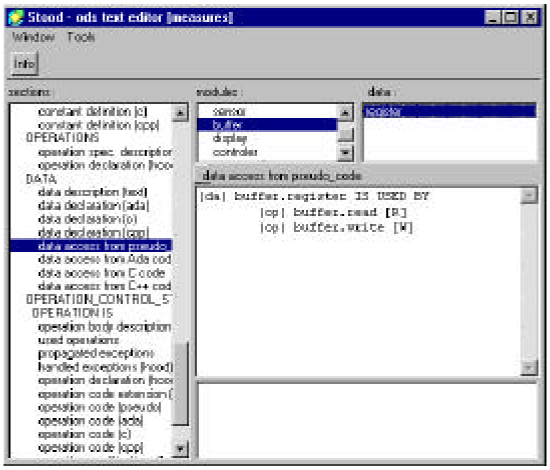
This section recalls *operation declaration* field of text input area of *graphic editor* when an **Internal Operation** is selected. Same editing actions as in *graphic editor* may be performed here (please refer to § 3.3.3 of part II). Any change which occurs while editing **Operation** declarative part within *graphic editor* or *text editors* is automatically propagated to other editors.

3.5.3.4. internal component coding sections

Ada, C or **C++** definition of **Internal Types**, **Constants** or **Data** may also be inserted within the **ODS**. Part IV of this manual provides detailed information about coding phase. Nothing forbids simultaneous use of **Ada**, **C** and **C++** coding sections (and even other languages), but usually, only one of them is required for a given **Project**. Useless code sections (for instance **C** and **C++** for an **Ada Project**) may be removed from **ODS** sections list, by editing `DiscardedLanguages` property in `.stoodrc` (for **UNIX**) or `stood.ini` (for **Windows**) initialization file.

3.5.3.5. data access from code

This section displays the list of all known components which require selected **Data** element. This information is deduced from the *cross references table*, which needs to be updated. If cross references were calculated from **Pseudo** Code sections, information about access mode (`[R]`, `[W]` or `[RW]`) will also be available:



```
|da| buffer.register IS USED BY
        |op| buffer.read [R]
        |op| buffer.write [W]
```

section:	*contents:*
`OPERATION_CONTROL_STRUCTURE`	title
`OPERATION_IS`	auto(20)
`operation body description (text)`	`OP/$OP.t2`
`used operations`	auto(23)
`propagated exceptions`	auto(33)
`handled exceptions (hood)`	`OP/$OP.hx`
`operation declaration (hood)`	auto(22)
`operation code extension (ada)`	`OP/$OP.x`
`operation code (pseudo)`	`OP/$OP.p`
`operation code (ada)`	`OP/$OP.u`
`operation code (c)`	`OP/$OP.c`
`operation code (cpp)`	`OP/$OP.cc`
`call tree from code`	auto(94)
`operation modifications (hood)`	`OP/$OP_modif`
`END_OPERATION`	auto(21)

3.5.3.6. operation body description

Each **Provided** or **Internal Operation** of a **Terminal Module** has an **OP**eration **C**ontrol **S**tructure part in the **ODS**. This **OPCS** should be used to document and code body of each **Operation**. This particular section should be used to provide textual information on actual contents of selected **OPCS**. Please note that there are two *operation description* sections for each **Operation** of a **Terminal Module**. One of them is supposed to document it externally, and the other internally.

3.5.3.7. used operations

Like **Required Interface** section, *used operations* section is automatically deduced from *cross references* update for appropriate target language. This section is read only. To update it, changes should be made within *opcs code* section, and a *cross references* update should be performed.

```
(33)used_operations_section ::=
        USED_OPERATIONS
        reference semi_colon {reference semi_colon}
    |   USED_OPERATIONS NONE
```

3.5.3.8. propagated and handled exceptions

Operation bodies (**OPCS**) may raise or handle **Exceptions**. When an abnormal situation occurs while executing **OPCS** code, a possible error management strategy is to raise an **Exception** to **Operation** caller. Caller may thus manage this error locally (within an exception handler) or propagate it to its own caller.

When declaring an **Exception**, raised by field of textual area of *graphic editor*, or *exception declaration* section of the **ODS**, contain the list of **Provided Operations** which may raise the **Exception**. If this information was correctly entered, **STOOD** uses it to automatically fill in *propagated exception* section of relevant **OPCS**s. This section is read only, and may only be modified by changing **Exception** declarations:

```
(34)propagated_exceptions_section ::=
        PROPAGATED_EXCEPTIONS
        reference semi_colon {reference semi_colon}
    |   PROPAGATED_EXCEPTIONS NONE
```

On the contrary, as **STOOD** code analysers are purely lexical and not syntactic, there is no easy way to automatically deduce which **Exceptions** are actually handled by a given **Operation** body. This information should be entered manually within handled exceptions section of the **ODS**. Note that **HOOD** syntax should be used in order to ensure correct **S**tandard **I**nterchange **F**ormat input or output. **STOOD** does not provide any syntactic verification while filling in this section.

```
(35)handled_exceptions_section ::=
           HANDLED_EXCEPTIONS
           reference semi_colon {reference semi_colon}
    |      HANDLED_EXCEPTIONS NONE
```

3.5.3.9. operation code extension

For **Ada** coding of **Operations**, this section may be used optionally to insert an extra piece of code just after the declarative part. Typical use of such a feature is to insert an **Ada** pragma:

```
-- Ada 83:
pragma INTERFACE(C, op_name);
-- Ada95:
pragma IMPORT(C,op_name,"C_function");
```

When this section is filled in, no code will be produced for relevant **Operation** body during **Ada** code generation.

3.5.3.10. opcs code sections

Pseudo code**, Ada, C** or **C++** code for each **OPCS** (**Operation** body) may also be inserted within the **ODS**. Part IV of this manual provides detailed information about coding phase. Nothing forbids simultaneous use of **Pseudo** code, **Ada**, **C** and **C++** coding sections (and even other languages), but usually, only one of them is required for a given **Project**. Useless code sections (for instance **C** and **C++** for an **Ada Project**) may be removed from **ODS** sections list, by editing `DiscardedLanguages` property in `.stoodrc` (for **UNIX**) or `stood.ini` (for **Windows**) initialization file.

Pseudo code is not formally defined by **HOOD**. In **STOOD**, it follows same lexical rules as **Ada**, except that an additional comment syntax may be used to insert incomplete or syntactically incorrect code. **Pseudo** code sections may be used to fill in the *cross references table* without entering all relevant target language code. Following example shows **Pseudo** code that could be used to update *used operations* section:

```
[functional dependencies at code level]
motor1.start
motor2.start
```

In addition, access to **Data** may be analysed more precisely with **Pseudo** code. Reading or writing **Data** will be identified if `:=` or `=` operators are used. **Operation Parameters** passing mode (`in`, `out` or `in out`) is also analysed in this case. Result of this analysis is stored in symbol tables (`[R]`, `[W]` and `[RW]`), and is used to display *data access from pseudo code* section (§ 3.5.3.5), and display data access charts.

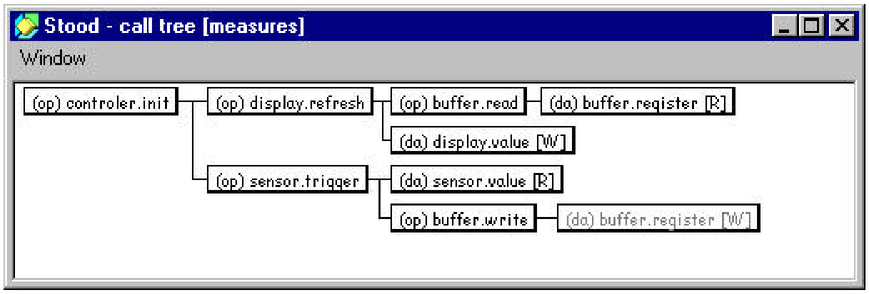
3.5.3.11. operation modification

In order to keep track of **OPCS** changes, this section should include a listing of all modification actions. Although no syntactic check is performed by **STOOD**, this text should preferably comply with following structuring rules:

```
MODIFICATIONS :

Release-Id : <date, version-Id, author>
Comments : <any comments you think useful>
FA-Id : <num> <DD\MM\YY>     <other informations>
DM-Id : <num> <DD\MM\YY>     <other informations>

END MODIFICATIONS
```

3.5.3.12. call tree from code

When cross references table is up to date for a given target language, a call tree may be produced for each **Operation**:



3.5.4. Internal OBCS of Terminal Module

When a **Terminal Module** provides **Constrained Operations**, additional **Internal** sections should be filled in to document and code its **OBCS**:

3.5.4.1. obcs body description

In the same way as for **Operations**, an **OBCS** need to be described twice. Once externally within **Provided Interface** to explain external behaviour of current **Module**, and once internally within the **Internals**, to explain how this behaviour is actually implemented.

3.5.4.2. state description

States **T**ransitions **D**iagram may have identified several **States** for current **Module**. This section should be used to document individually each of them.

3.5.4.3. state entering and exiting transitions

While drawing **S**tates **T**ransitions **D**iagram for current **Module**, **Transitions** may have been defined to express that some **Events** induce a change of internal **State** of the **Module**. Consequently, each **State** may be linked to entering and exiting **Transitions**. This section only recalls information extracted from current **STD**, and cannot be modified here.

section:	*contents:*
OBJECT_CONTROL_STRUCTURE	title
obcs body description (text)	STD/obcs.t2
STATES	title
entering transitions	auto(226)
exiting transitions	auto(225)
state description (text)	STD/$Se.t
state assignment (ada)	STD/$Se_set.u
state test (ada)	STD/$Se_get.u
state assignment (c)	STD/$Se_set.c
state test (c)	STD/$Se_get.c
state assignment (cpp)	STD/$Se_set.cc
state test (cpp)	STD/$Se_get.cc
TRANSITIONS	title
transition event	auto(224)
transition from	auto(227)
transition to	auto(228)
trans description (text)	STD/$Se.t2
trans condition (ada)	STD/$Se_cnd.u
trans exception (ada)	STD/$Se_exc.u
trans condition (c)	STD/$Se_cnd.c
trans exception (c)	STD/$Se_exc.c
trans condition (cpp)	STD/$Se_cnd.cc
trans exception (cpp)	STD/$Se_exc.cc
OBCS CODE	title
obcs code (pseudo)	STD/obcs.p
obcs code (ada)	STD/obcs.u
obcs code (c)	STD/obcs.c
obcs code (cpp)	STD/obcs.cc

3.5.4.4. state assignment and test sections

A **S**tates **T**ransitions **D**iagram does not include any information on how identified **States** are related to actual **Data** of current **Module**. These two sections should be used for that purpose. They need to comply with target language syntactic rules in order to be directly included inside generated code.

Each **State** should be defined by two code expressions: an assignment of state variables, and a test of these same state variables. For a given **State**, testing code will be used as a pre-condition for an exiting **Transition**, whereas assignment code will be used as a post-condition for an entering **Transition**.

Please, note that **STOOD** does not perform any semantic check to ensure that only valid state variables are used, neither that assigned values actually match corresponding **State** identified in the **STD**.

3.5.4.5. transition description

States **T**ransitions **D**iagram may have identified several **Transitions** for current **Module**. This section should be used to document individually each of them.

3.5.4.6. transition event

Each **Transition** is triggered by an **Event**. In **HOOD** design model, an **Event** must be raised by a call of one of the **Provided Operations** of current **Module**. This information is entered while designing a **Transition** in **S**tates **T**ransitions **D**iagram. This section recalls this information within the **ODS**, but cannot be modified at this level.

3.5.4.7. transition from and to sections

While drawing **S**tates **T**ransitions **D**iagram for current **Module**, **Transitions** may have been defined to express that some **Events** induce a change of internal **State** of the **Module**. Consequently, each **Transition** may be linked to origin (*from*) and destination (*to*) **States**. This section recalls information extracted from current **STD**, and cannot be modified here.

3.5.4.8. transition condition and exception sections

A **S**tates **T**ransitions **D**iagram does not include any information on how identified **Transitions** behave in case of non deterministic situations (several destination **States** may be reached from a same origin **State** and a same **Event**), or when pre-conditions are not satisfied. These two sections should be used for that purpose. They need to comply with target language syntactic rules in order to be directly included inside generated code.

Each **Transition** should be defined by two code expressions: an optional condition to solve non deterministic situations, and an exception code to deal with **Event** refusal. For a given **Transition**, condition code will be used as a pre-condition, whereas exception code will be used as a post-condition. Please, note that theoretically, this exception code should be related to the **Event** itself, not to all triggered **Transitions**.

3.5.4.9. obcs code sections

OBject **C**ontrol **S**tructure should contain all the code required to manage behavioural aspects of current **Module**. This covers internal **States** and **Transitions** management and all **Operation Constraints** related code.

Ideal solution is to define code generation rules in order to automatically produce **OBCS** code from design information (**S**tate **T**ransition **D**iagram, **Operation Constraints**). A large number of behavioural mapping rules have been defined for **Ada** (tasking, protected types), and for **C** (calling **R**eal-**T**ime **O**perating **S**ystems primitives).

STOOD code generators may easily be enhanced to take into account specific coding environments (**R**eal **T**ime **O**perating **S**ystems, libraries), but when these improvements cannot be undertaken, **OBCS** code may have to be inserted manually within *obcs code* sections of the **ODS**.

Pseudo code**, Ada, C** or **C++** code for **OBCS** may thus be inserted within the **ODS**. Part IV of this manual provides detailed information about coding phase. Nothing forbids simultaneous use of **Pseudo** code, **Ada**, **C** and **C++** coding sections (and even other languages), but usually, only one of them is required for a given **Project**. Useless code sections (for instance **C** and **C++** for an **Ada Project**) may be removed from **ODS** sections list, by editing `DiscardedLanguages` property in `.stoodrc` (for **UNIX**) or `stood.ini` (for **Windows**) initialization file.

As for *opcs code* (refer to § 3.5.3.10), **Pseudo** code sections may be used to fill in the *cross references table* without entering all relevant target language code.

3.5.5. Op_Control, Environment and Instance_Of

Environment and **Instance_Of Modules** have no **Internal ODS**, and **Op_Control Internal ODS** contains only appropriate **OPCS**.

3.6. Footer

Each **ODS** terminates with a small footer where general purpose sections may be added.

section:	*contents:*
`code file header (text)`	`DOC/header`
`module modifications (hood)`	`modif`
`END_OBJECT`	auto(19)

3.6.0.1. code file header

This section may be used to define a textual header for each file that will be produced during code extraction. Relevant text will be inserted as target language comments. Proposed template is:

```
-----------------------------------
PROJECT:
COMPANY:
-----------------------------------
```

Note that this template may be customized by editing `header` file in `config/ods_template/name/DOC` configuration directory.

3.6.0.2. module modification

In order to keep track of current **Module** changes, this section should include a listing of all modification actions. Although no syntactic check is performed by **STOOD**, this text should preferably comply with following structuring rules:

```
MODIFICATIONS :

Release-Id : <date, version-Id, author>
Comments : <any comments you think useful>
FA-Id : <num> <DD\MM\YY>     <other informations>
DM-Id : <num> <DD\MM\YY>     <other informations>

END MODIFICATIONS
```

3.6.0.3. end object

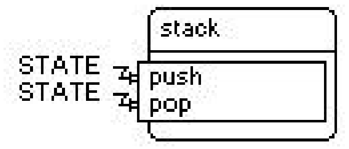
This section is automatically filled in by STOOD and is read-only. It simply contains following line:

```
END_OBJECT object_name
```

3.7. Example

To illustrate previous explanations regarding **HOOD** textual formalism, and especially for a **S**tate **T**ransition **D**iagram, here is a short example of a simple **Terminal ODS**. Chosen example is the same as in **HOOD R**eference **M**anual (**HRM4**, 10/12/95, page 11), but it has been modified and completed in order to make code generation possible.

OBJECT `stack` **IS PASSIVE**



PROVIDED_INTERFACE

OPERATIONS

`push`
operation spec. description : add an INTEGER to the FIFO
operation declaration : `push(e : in INTEGER);`

`pop`
operation spec. description : remove an INTEGER from the FIFO
operation declaration : `pop(e : out INTEGER);`

EXCEPTIONS

`too_much`
exception description : last push was refused
exception declaration : `too_much` **RAISED_BY** `push;`

`not_enough`
exception description : last pop was refused
exception declaration : `not_enough` **RAISED_BY** `pop;`

OBJECT_CONTROL_STRUCTURE
obcs spec. description : FIFO over and under flows are controlled
constrained operations :
`push` **CONSTRAINED_BY STATE**;
`pop` **CONSTRAINED_BY STATE**;

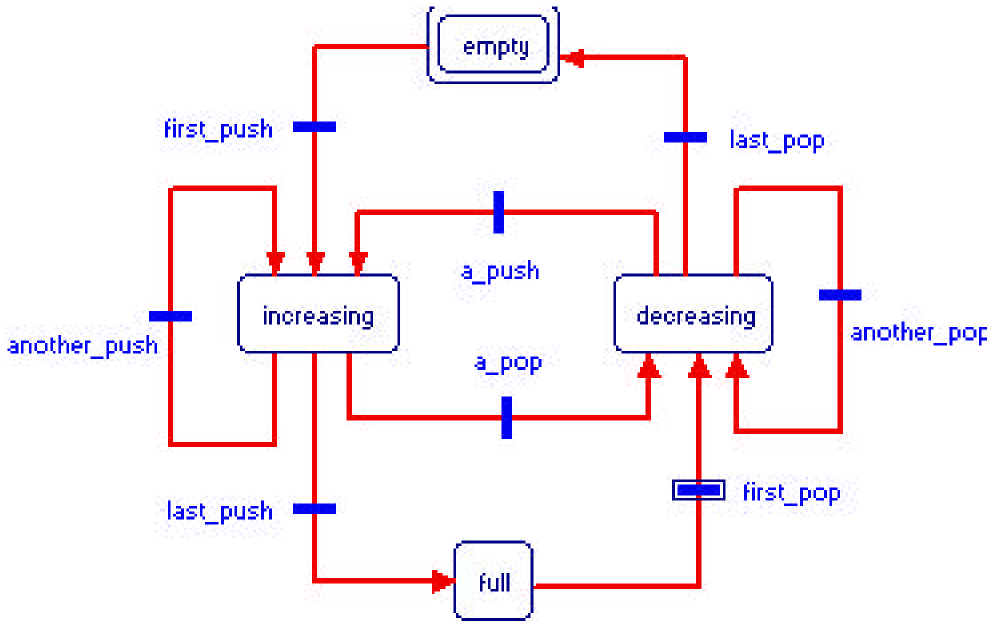
INTERNALS

DATA

`count`
data description : current number of elements in the FIFO
data declaration : `count : INTEGER range 0 .. 10 := 0;`

`elements`
data description : the FIFO itself
data declaration : `elements : array(1..10) of INTEGER;`

OBJECT_CONTROL_STRUCTURE



obcs body description **:**
four states and eight transitions were identified

STATES

`empty`
entering transitions **:** `last_pop`
exiting transitions **:** `first_push`
state description **:** FIFO is empty: no more pop allowed
state assignment **:** `count := 0;`
state test **:** `count = 0`

`increasing`

entering transitions: `first_push, a_push, another_push`

exiting transitions: `a_pop, another_push, last_push`

state description: last action was a push

state assignment: `count := count + 1;`

state test: `count > 0 and count < 10`

`decreasing`

entering transitions: `first_pop, a_pop, another_pop`

exiting transitions: `a_push, another_pop, last_pop`

state description: last action was a pop

state assignment: `count := count - 1;`

state test: `count > 0 and count < 10`

`full`

entering transitions: `last_push`

exiting transitions: `first_pop`

state description: FIFO is full: no more push allowed

state assignment: `count := 10;`

state test: `count = 10`

TRANSITIONS

`first_push`

transition event: `push`

transition from: `empty`

transition to: `increasing`

trans description: FIFO receives its first element

trans condition:

trans exception: `raise too_much`

`a_push`
 transition event: `push`
 transition from: `decreasing`
 transition to: `increasing`
 trans description: additional element and change state
 trans condition:
 trans exception: `raise too_much`

`another_push`
 transition event: `push`
 transition from: `increasing`
 transition to: `increasing`
 trans description: additional element without changing state
 trans condition: `count < 9`
 trans exception: `raise too_much`

`last_push`
 transition event: `push`
 transition from: `increasing`
 transition to: `full`
 trans description: FIFO receives its last element
 trans condition: `count = 9`
 trans exception: `raise too_much`

`first_pop`
 transition event: `pop`
 transition from: `full`
 transition to: `decreasing`
 trans description: FIFO looses its last element
 trans condition:
 trans exception: `raise not_enough`

`a_pop`
transition event: `pop`
transition from: `increasing`
transition to: `decreasing`
trans description: one element less and change state
trans condition:
trans exception: `raise not_enough`

`another_pop`
transition event: `pop`
transition from: `decreasing`
transition to: `decreasing`
trans description: one element less without changing state
trans condition: `count > 1`
trans exception: `raise not_enough`

`last_pop`
transition event: `pop`
transition from: `decreasing`
transition to: `empty`
trans description: FIFO looses its first element
trans condition: `count = 1`
trans exception: `raise not_enough`

OBCS CODE
obcs pseudo code: not required
obcs code: not required

OPERATION_CONTROL_STRUCTURES

OPERATION `push` **IS**

operation body description: copy parameter at the top of FIFO

used operations: `NONE`

propagated exceptions: `too_much`

handled exceptions: `NONE`

operation pseudo code:

operation code:
```
begin
   count := count + 1;
   element(count) := e;
```

END_OPERATION

OPERATION `pop` **IS**

operation body description: copy top elem. of FIFO into parameter

used operations: `NONE`

propagated exceptions: `not_enough`

handled exceptions: `NONE`

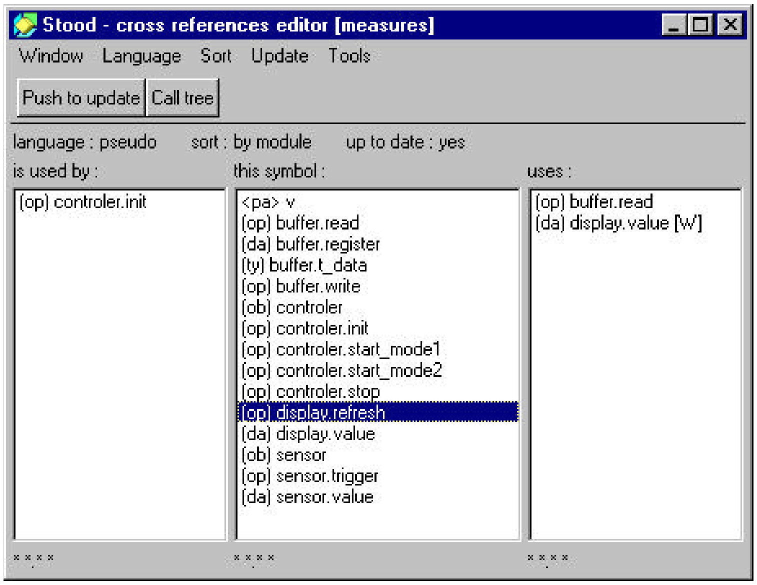
operation pseudo code:

operation code:
```
begin
   count := count - 1;
   e := element(count);
```

END_OPERATION

END_OBJECT `stack`

4. Cross-References Table


Stood - cross references editor [measures]
Window Language Sort Update Tools
Push to update
Call tree

language : pseudo sort : by module up to date : yes

is used by :
(op) controler.init

this symbol :
<pa> v
(op) buffer.read
(da) buffer.register
(ty) buffer.t_data
(op) buffer.write
(ob) controler
(op) controler.init
(op) controler.start_mode1
(op) controler.start_mode2
(op) controler.stop
(op) display.refresh
(da) display.value
(ob) sensor
(op) sensor.trigger
(da) sensor.value

uses :
(op) buffer.read
(da) display.value [W]

Symbol tables associated to source code sections of the **ODS** may be globally processed to create a *cross-references table*. This *cross-refs table* provides an exhaustive list of all code significant symbols used within the **Application**, and an interactive display of **Modules** dependencies. This feature provides a powerful mean to check **Application** completeness before code generation and compilation.

As detailed in § 2.5, each identified symbol should be associated to a **Module**, and characterized by a symbol kind. Results of lexical analysis depends on the way the symbol was entered (with simple or full name), and on completeness of current **HOOD Application**.

For each selected symbol, *cross references table* shows all **Components** which uses this symbol on the one hand, and all the **Components** that are used by the selected symbol on the other hand. Sorting and filtering features are also provided to create selective lists of symbols. A search function is also provided to look for selected symbol or dependency within all open editors.

In some cases, it could be required to build all symbol tables related to the whole **Application** at the same time. One usual case is reverse engineering, before which text input was entered with an external editor, or, more frequently when **Components** references have changed. Such global update may be performed with *update symbol tables* item of *checkers* menu of *main editor*.

HOOD design process is based on maximizing cohesion and minimizing coupling between **Modules**. Resulting architecture have recognized qualities as regards lots of software engineering criteria. These coupling relationships may be explicitly defined during architectural design phase by drawing **Use** links or other dependency links between **Modules** (refer to part II). Anyway, such graphical descriptions will not prevent other dependencies to be defined during detailed design and coding phases. For the same reason, graphical **Use** relationships may not necessarily be implemented into source code sections of the **ODS**. In these cases, architectural and detailed design models could become incoherent.

Symbol tables created by lexical analysis while accepting code sections of the **ODS** contain a list of actual elementary dependencies found at code level. On the same way, *cross references table* provides an exhaustive list of all dependencies for the overall design. These dependencies may thus be scanned, analysed and corrected if needed, before code generation.

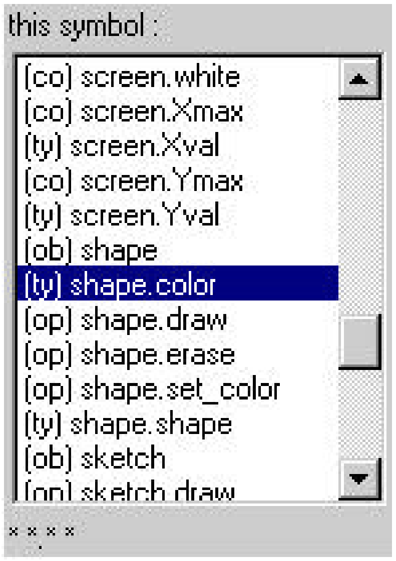
Other features of **STOOD** also use cross references information to improve their own processing. For instance, *hood checker* (refer to part IV) will verify coherence between graphical **USE** relationships and code dependencies; *code extractors* (refer to part IV), will use lexical dependencies to build compilable files, by inserting correct visibility clauses (`with` in **Ada**, `#include` in **C** and **C++**), and reordering dependent declarations.

Cross reference table may also be used to automatically update some **ODS** sections. These sections are **REQUIRED INTERFACE** for each **Module**, and **USED OPERATIONS** for each **Operation**. Cross references information may also be reached from a dedicated textual editor (*check text editor*). Data access charts and Operation call trees may also be drawn from cross references.

Please note that *cross references table* contents depends on current target language (**Ada**, **C**, **C++**). Please, take care to check current target language before updating cross reference table. Also note that *cross references table* may be used even if coding work was not completed yet. Practically, to use *cross references table* features, **ODS** code sections just need to contain a list of remote dependencies. For **OBCS** and **OPCS** sections (which generally contain most of applicative code), **Pseudo** code sections may be used for that purpose (refer to chapters 3.5.3.8 and 3.5.4.9).

Cross references editor may be launched only from *checkers* menu of *main editor*, and is composed of a menu bar, and three symbol selection areas. A specific cross reference table can be created for each installed target language (**Ada**, **C**, **C++** or **Pseudo**).

4.1. Main symbol selection list



4.1.1. Displaying symbol list

When opening a *cross references editor*, the user should first check that selected target language is the right one (default target language may be specified with *options* item of *window* menu of *main editor*). Current target language for *cross references table* may also be changed locally from *language* menu.

Cross references table is automatically updated only in some specific situations (code extraction, rules checking). It must generally be updated manually by pressing *update* button or using *update* menu. Center list of *cross references* table may be considered as a symbol directory for current **Application**. Secondary left and right lists should be used to show lexical dependencies.

4.1.2. Symbol structure

Each displayed symbol is a record composed of four fields. For large **Applications**, symbol list may be very long. **STOOD** provides sorting and filtering features applicable to symbol lists.

```
(prefix) module.component (suffix)
```

`(prefix):`	indicates one of the symbol kinds listed below. Note that symbols classified as to-be-ignored (those prefixed by a \ within symbol area of *text editors*) won't be displayed in cross ref.

- `?` undefined.
- `(op)` **Operation**
- `(ty)` **Type**
- `(co)` **Constant**
- `(ex)` **Exception**
- `(da)` **Data**
- `<pa>` **Operation Parameter**
- `<at>` **Class Attribute** or record **Type** element
- `<en>` enumeration element
- `<tp>` local variable
- `<ta>` task
- `<wi>` user defined dependency

`module:`	indicates a recognized **Module** providing selected **Component**. If no Module was recognized, n undefined label `?` is displayed.

`component:` indicates symbol name.

`(suffix):`

a) within center list: indicates an eventual referencing error:

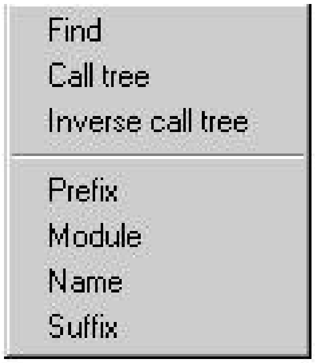
- `(?module)`: specified **Module** is unknown within current context.
- `(?name)`: specified **Component** is unknown within specified **Module**.

b) within right list: indicates access mode for Data:

- `[R]` : read access to the **Data** element.
- `[W]` : write access to the **Data** element.
- `[RW]` : read-write access to the **Data** element.

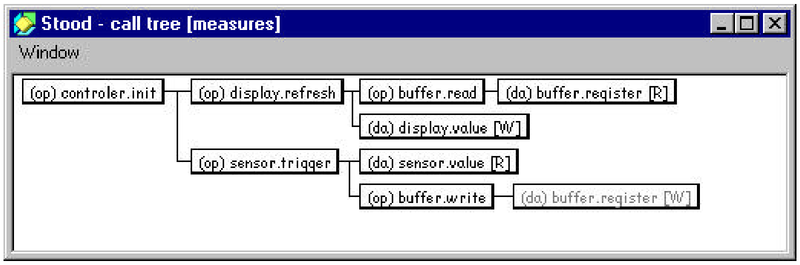
4.1.3. Main list pop-up menu

While pressing center mouse button (for **UNIX**), or right button (for **Windows**), and locating mouse pointer inside center symbol list, a pop-up menu provides search and select functions:

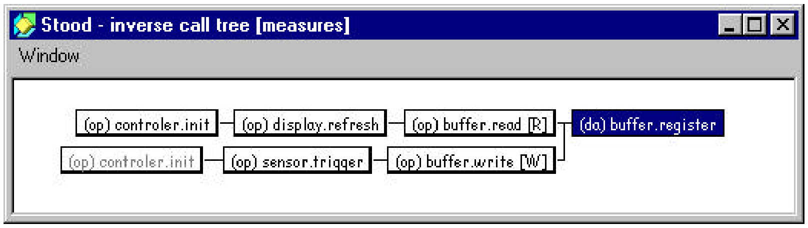


Find: search selected symbol in all open editors. Search will stop at first found occurrence. To search for a symbol dependency (from which piece of code does this dependency come ?), select also another symbol in left or right list.

Call tree: open a call tree from selected Operation, to display downstream control flows:



Inverse call tree: open a inverse call tree from selected **Component**, to display upstram control flows:



Other menu items are the same in the three lists and should be used to control list contents by filtering it by selective criteria. A separate criteria (pattern matching) may be specified for each of the four fields of symbol structure:

Prefix: hide or show all symbols which prefix field is not the one of the symbol currently selected. Filtering indicator specifies whether the list is exhaustive or not:

- * *.* *: means that the list is exhaustive.
- (op) *.* *: means that the list only shows **Operations**.

Module: hide or show all symbols which module field is not the one of the symbol currently selected. Filtering indicator specifies whether the list is exhaustive or not:

- * *.* *: means that the list is exhaustive.
- * line.* *: means that the lists only shows symbols from **Module** `line`.

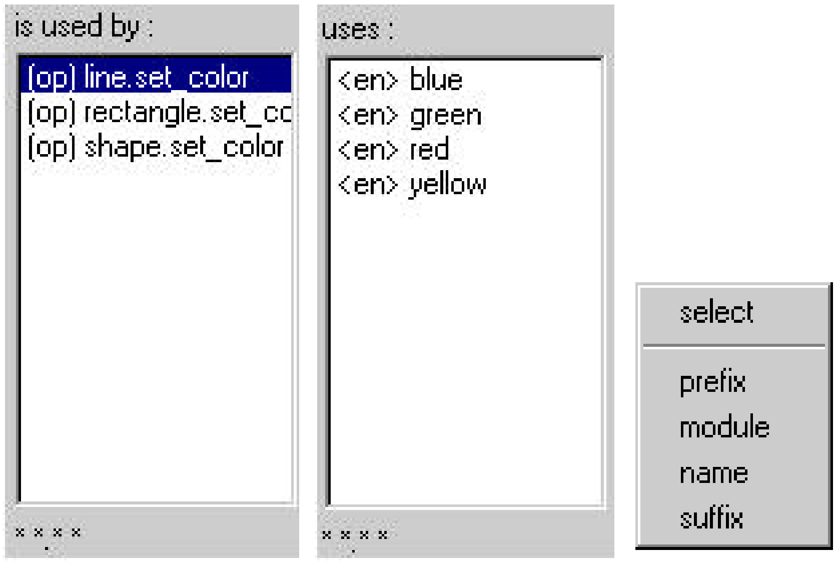
Name: hide or show all symbols which name field is not the one of the symbol currently selected. Filtering indicator specifies whether the list is exhaustive or not:

- * *.* *: means that the list is exhaustive.
- * *.draw * means that the list only shows symbols named `draw`.

Suffix: hide or show all symbols which name field is not the one of the symbol currently selected. Filtering indicator specifies whether the list is exhaustive or not:

- * *.* *: means that the list is exhaustive.
- * *.* (?module): means that the list only shows symbols which **Module** name is unreferenced.

4.2. Secondary symbol selection lists

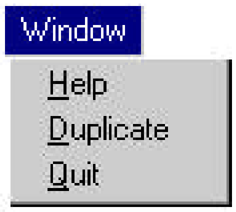


Left and right symbol lists behave like center one. When a symbol is selected within center list, left list (*is used by*) shows all "client" symbols, whereas right list (*uses*) shows all "server" symbols. For instance, if an **Operation** A returns a value of **Type** B that has an **Attribute** C, if B is selected in center list, A will be shown in left list (B *is used by* A), and C will be shown in right list (B *uses* C).

Left and right lists pop-up menus provide the same filtering functions as center one. Only first menu item differs:

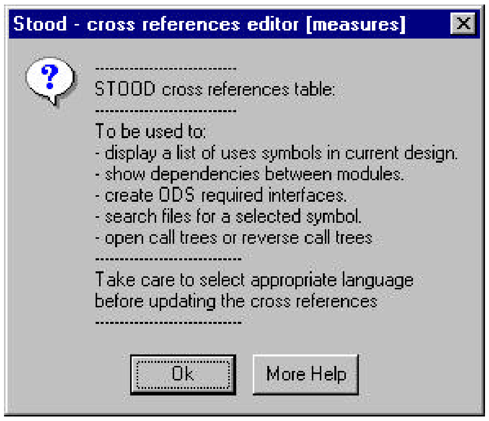
select: make symbol selected in current (left or right) list the new selection for center list. This feature is useful to navigate along dependencies.

4.3. Window menu



Window menu offers similar functions as in the other editors:

Help : display an informational dialog box. Contents of this dialog box may be customized by editing `crf` and `crf.more` files in `config/help` configuration directory.


Stood - cross references editor [measures]

STOOD cross references table:

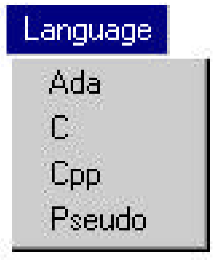
To be used to:
- display a list of uses symbols in current design.
- show dependencies between modules.
- create ODS required interfaces.
- search files for a selected symbol.
- open call trees or reverse call trees

Take care to select appropriate language
before updating the cross references

Duplicate: open another cross references table.

Quit: close this window.

4.4. Language menu



Default language should be defined globally for the **Application** within *option* dialog box that may be opened from *window* menu of *main editor*. A new *cross references table* always displays symbols related to default language coding sections of the **ODS**. An indicator shows current language:

language : ada

This language may be changed locally with *language* menu items:

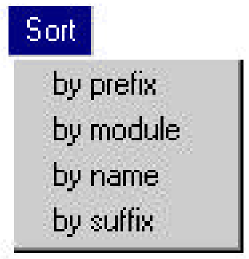
Ada: use **Ada** coding sections of the **ODS** to compute cross references.

C: use **C** coding sections of the **ODS** to compute cross references.

Cpp: use **C++** coding sections of the **ODS** to compute cross references.

Pseudo: use **Pseudo** code sections of the **ODS** to compute cross references.

4.5. Sort menu



Symbols that are displayed in left, center and right lists may be sorted. Sorting criteria may be any of the four fields composing symbol structure. Current sorting criteria is displayed in an indicator:

sort : by module

This sorting criteria may be changed with *sort* menu items:

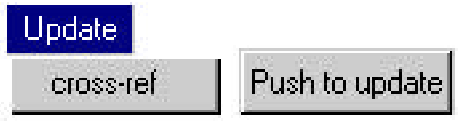
by prefix: use `prefix` field to sort symbols.

by module: use `module` field to sort symbols (default criteria).

by name: use symbol name for sorting.

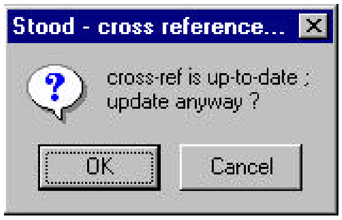
by suffix: use `suffix` field to sort symbols.

4.6. Update menu



Current status of *cross references table* is shown in an indicator:

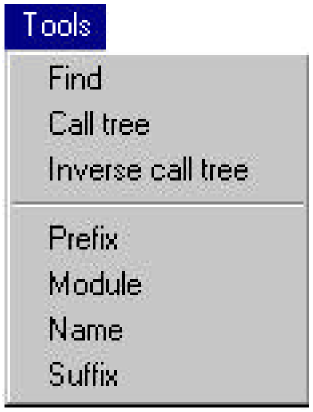
Update menu or associated button should be used to update *cross references table*. If the indicator specifies that the table is already up to date, an alert message will be displayed:



Stood - cross reference...

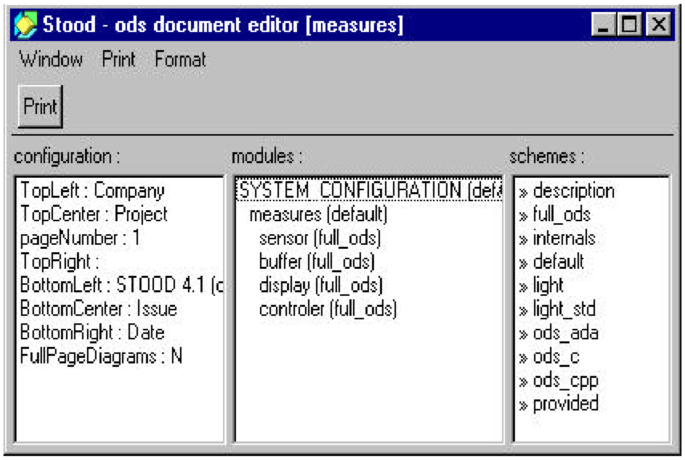
cross-ref is up-to-date ; update anyway ?

4.7. Tools menu



Tools menu offers the same services as the contextual menu of center selection list. Please refer to § 4.1.3 to get detailed information about these menu commands.

5. Documentation



```
TopLeft : Company
TopCenter : Project
pageNumber : 1
TopRight :
BottomLeft : STOOD 4.1 (c
BottomCenter : Issue
BottomRight : Date
FullPageDiagrams : N
```

```
SYSTEM_CONFIGURATION (defa
 measures (default)
  sensor (full_ods)
  buffer (full_ods)
  display (full_ods)
  controler (full_ods)
```

```
» description
» full_ods
» internals
» default
» light
» light_std
» ods_ada
» ods_c
» ods_cpp
» provided
```

Generation of a full paper or electronic document containing all graphical and textual information with a smart setup, is an essential output from a design work.

Each **STOOD** textual editor (*ods text editor*, *checks text editor*, *ada text editor* , *c text editor*, *cpp text editor*, and *test text editor*) is associated to a document editor (*ods document editor*, *checks document editor*, *ada document editor* , *c document editor*, *cpp document editor*, and *test text editor*) where the user can perform documentation setup. For each **Module**, the user may select sections to be printed. These selections can be saved into local documentation schemes, stored in application files. **STOOD** also provides global documentation schemes that must be managed by toolset administrator. Please refer to § 6 for further information about documentation schemes.

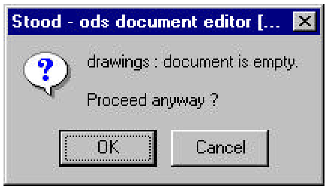
All graphics drawn in **STOOD** editors (**H**OOD **D**esign **T**rees, **HOOD** diagrams, **S**tate **T**ransition **D**iagrams, Inheritance Trees, Call Trees and Inverse Call trees), may be inserted in any printable documentation with encapsulated **PostScript™** format (**EPSF** 2.0). For **HTML** documentation, graphics are drawn by **Java** applets, or converted into an appropriate graphical format. Several document formats can be generated from **STOOD**:

- **PostScript** format, allowing direct text and graphics printing.
- **TPS**, to generate an input file for **Interleaf™**.
- **MIF**, to generate an input file for **FrameMaker™**.
- **RTF**, to generate an input file for **MS Word™**.
- **HTML**, to generate an input file for an hypertext navigator.
- **LaTeX**

Other document formats may be added easily. Please contact technical support for specific needs.

Documentation editors may only be launched from *documentation* menu of *main editor*, and are all composed of a menu bar, a **Modules** selection list, a documentation scheme selection list, and a printing parameters selection list. To produce a printable document, operate as follow :

-1- select a documentation scheme in right hand list.
-2- if required, modify selected scheme with *doc schemes editor* (see § 6).
-3- within center list, select the **Modules** to which you want to allocate this documentation scheme. Newly allocated document scheme enclosed by commas appears at the right side of each **Module**.
-4- repeat steps 1-2-3 for each required scheme.
-5- within center list, select all **Modules** to be printed. If `(default)` scheme was left allocated, relevant **Module** documentation will be empty, and a warning message will later appear in a dialog box:


Stood - ods document editor [...

drawings : document is empty.

Proceed anyway ?

-6- select required printing format from format menu.
-7- within left hand list, optionally change any printing parameter which needs to be customized.
-8- press print button, and specified filename to be created.
-9- as regards current platform and configuration options, document will be printed on a default **PostScript** printer, or simply stored in specified file.

5.1. Schemes selection list

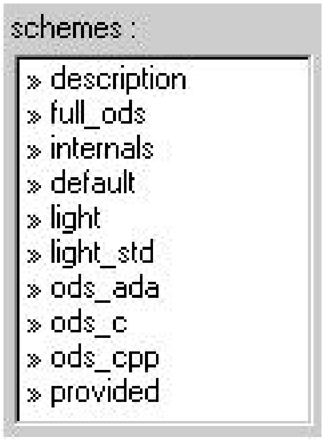
5.1.1. Documentation schemes

A document scheme is a sub-list of sections defined in one of **STOOD** text editors. Schemes should be used to pre-define document patterns to best fit **Project**, company style, or **Module** kind requirements. A few pre-defined schemes are provided by **STOOD**. They may be fully customized with d*oc scheme editor* (refer to § 6 below).

Schemes may be global to **STOOD** configuration, and thus shared by all **Projects**, or local to a given **Application**. Global schemes may be identified by a >> symbol on the left side of their name.

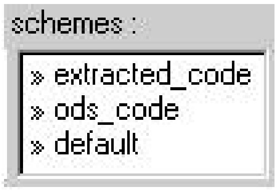
Local documentation schemes may be saved into **Application** storage area while using *save* item of *window* menu. To create a global scheme, a local scheme must first be defined and saved. Toolset administrator will then copy `_doc_schemes/editor$L1` file from **Application** storage directory, into `doc_schemes/editor$L1` file, in **STOOD** configuration directory, where `$L1` represents editor number (1 for *ods document editor* , 2 for *ada document editor* , 3 for *c document editor*, 4 for *cpp document editor*, 5 for *test document editor* and 6 for *checks document editor*).

5.1.2. Pre-defined schemes for ODS document editor



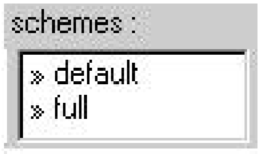
description: select **Description** part of the **ODS** only.
full_ods: select all **ODS** sections.
internals: select **Internals** part of the **ODS** only.
default: empty scheme.
light: select a few sections within the overall **ODS**.
light_std: same as above plus **STD** description.
ods_ada: same as *full_ods* but with **Ada** code only.
ods_c: same as *full_ods* but with **C** code only.
ods_cpp: same as *full_ods* but with **C++** code only.
provided: select **Provided Interface** part of the **ODS** only.

5.1.3. Pre-defined schemes for code document editor



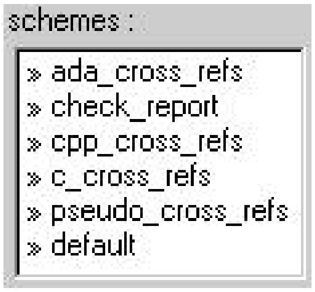
ods_code: select all coding sections of the **ODS** (**Ada**, **C** or **C++**).
extracted_code: select only generated files (**Ada**, **C** or **C++**).
default: empty scheme.

5.1.4. Pre-defined schemes for test



full: select all testing sections
default: empty scheme.

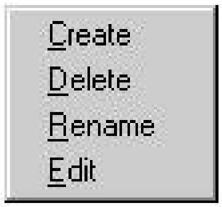
5.1.5. Pre-defined schemes for checks



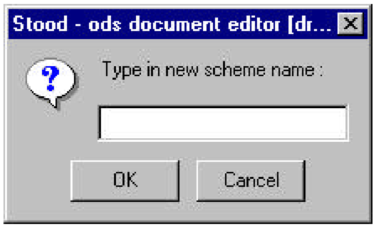
check_report: select rules checking output files only.
ada_cross_refs: select cross references table for **Ada**.
c_cross_refs: select cross references table for **C**.
cpp_cross_refs: select cross references table for **C++**.
pseudo_cross_refs: select cross references table for **Pseudo** code.
default: empty scheme.

5.1.6. Create, delete and rename schemes

While pressing center mouse button (for **UNIX**), or right button (for **Windows**), and locating mouse pointer inside schemes list, a pop-up menu provides following functions:

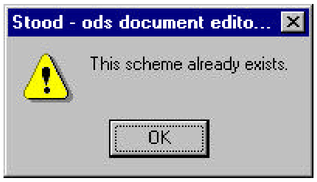


Create: create a new local scheme. Scheme name should be entered within a dialog box:



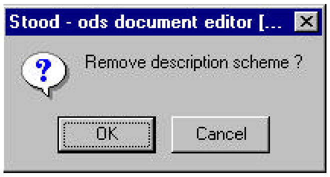
Type in new scheme name :

Please note that schemes name should be unique within merged list of global and local schemes. Any attempt to create a new scheme which name is already used, will raise following dialog box:



This scheme already exists.

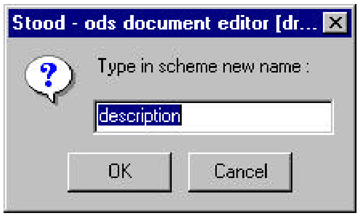
Delete: removes temporarily selected scheme from the list. This action should be confirmed first:



Remove description scheme ?

If selected scheme was global, or if *document editor* changes was not explicitly saved (with *save* item of *window* menu), relevant scheme will reappear next time a same *document editor* is opened.

Rename: change name of selected scheme:

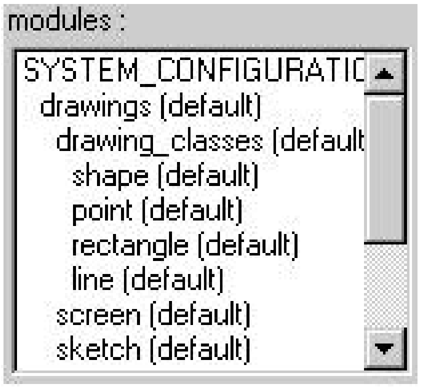


Type in scheme new name :

description

Edit: open a *document schemes editor* for selected scheme. Please refer to § 6 for further details.

5.2. Modules selection list



```
SYSTEM_CONFIGURATIC
  drawings (default)
    drawing_classes (default
      shape (default)
      point (default)
      rectangle (default)
      line (default)
    screen (default)
    sketch (default)
```

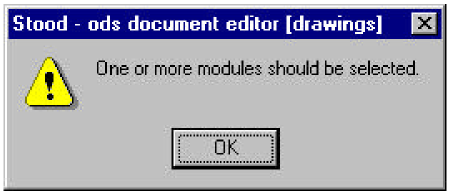
5.2.1. Use of center list

This center selection list may be used for two purposes in documentation setup process.

First use is allocating a scheme to each **Module**. Currently allocated scheme is mentioned at right side of **Module** name. `(default)` scheme is an empty one. To allocate another scheme to one or several **Modules**, operate as follow:

- select required **Modules** in center list.
- select chosen scheme in right side list.
- new allocated scheme, enclosed by commas, appears at right side of each selected **Module** name.

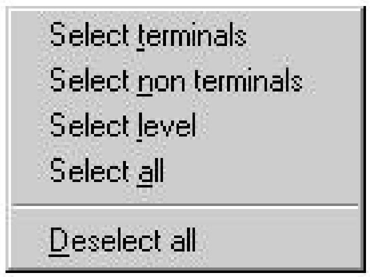
Second use is to select all **Modules** that will actually be documented. This selection should be performed before activating any *print* command. If no **Module** is selected before printing, following alert message will be displayed:


Stood - ods document editor [drawings]

One or more modules should be selected.

5.2.2. Selecting and deselecting Modules

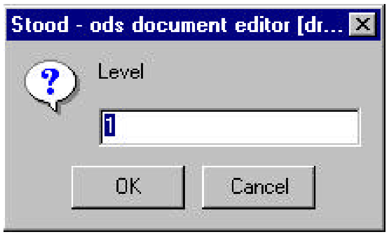
While pressing center mouse button (for **UNIX**), or right button (for **Windows**), and locating mouse pointer inside modules list, a pop-up menu provides selecting functions:



Select terminals: add all **Terminal Modules** to selected elements of the list.

Select non terminals: add all **Non Terminal Modules** to selected elements of the list.

Select level: add all **Modules** of a specified level in the **HOOD** hierarchy, to selected elements of the list. Required level should be entered inside a dialog box:


Stood - ods document editor [dr...

Level: 1

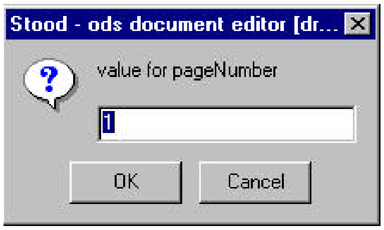
Select all: select all Modules in the list.

Deselect all: erase all Module selections.

5.3. Configuration of printing parameters

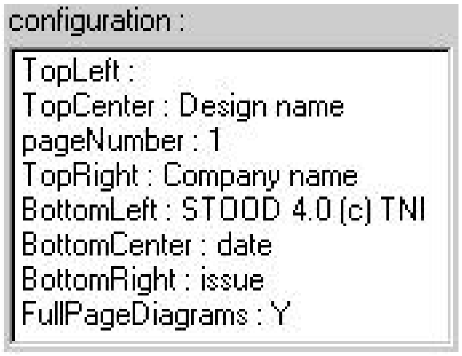
As soon as a printing format has been chosen with format menu (refer to § 5.6), left side list of *document editor* contains printing parameters which value may be customized before producing documentation.

After having clicked on one of these parameters, a dialog box appears to enable any change of its current value:



Default value of parameters may be changed within a file named `variable.cfg` in configuration directory for each installed documentation format. Below are printing parameters for most used document formats.

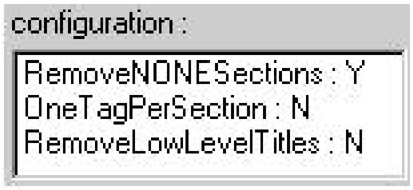
5.3.1. parameters for ps_p format


configuration :

```
TopLeft :
TopCenter : Design name
pageNumber : 1
TopRight : Company name
BottomLeft : STOOD 4.0 (c) TNI
BottomCenter : date
BottomRight : issue
FullPageDiagrams : Y
```

TopLeft, *TopCenter* and *TopRight* strings will be inserted inside page header, *BottomLeft*, *BottomCenter* and *BottomRight* strings will be inserted inside page footer. *PageNumber* (integer) defines be the number of first page, and *FullPageDiagrams* (`Y/N`) specifies whether diagrams spread over a full or an half page.

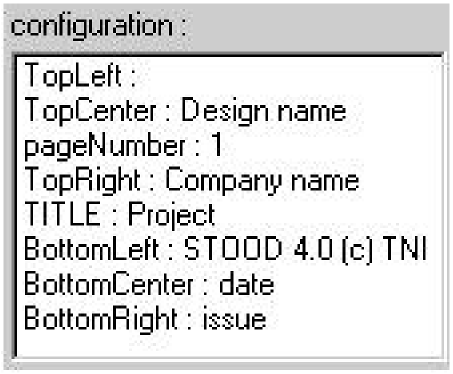
5.3.2. parameters for mif_p format


configuration :

```
RemoveNONESections : Y
OneTagPerSection : N
RemoveLowLevelTitles : N
```

RemoveNONESections (`Y/N`): if set, no title section with empty contents will be included inside printed document. *OneTagPerSection* (`Y/N`): if set, a specific paragraph tag is created for each section. Else, a specific paragraph tag is created only for each level of **HOOD** hierarchy. *RemoveLowLevelTitles* (`Y/N`): if set, lower level titles will be removed from produced document.

5.3.3. parameters for tps_p format



```
TopLeft :
TopCenter : Design name
pageNumber : 1
TopRight : Company name
TITLE : Project
BottomLeft : STOOD 4.0 (c) TNI
BottomCenter : date
BottomRight : issue
```

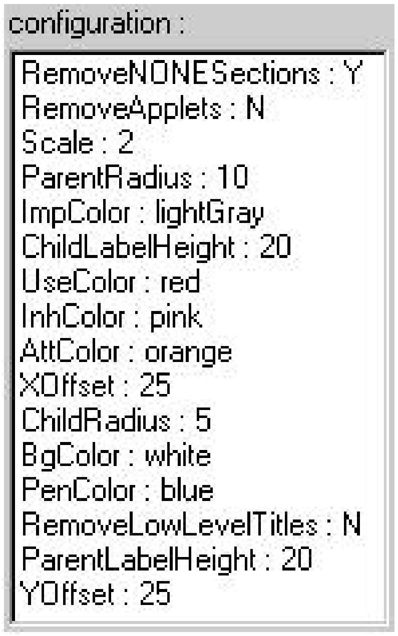
TopLeft, *TopCenter* and *TopRight* strings will be inserted inside page header, *BottomLeft*, *BottomCenter* and *BottomRight* strings will be inserted inside page footer. *PageNumber* (integer) defines be the number of first page, and *TITLE* specifies the string which will be used for title page.

5.3.4. parameters for rtf format

No default parameters are specified for **R**ich **T**ext **F**ormat. When a **RTF** document is generated, documentation tool automatically inserts links to standard variables that may be controlled directly from Word application.

Note that when **RTF** format is used, **ODS** sections may contain links to other document that will be automatically included if their syntax is recognized by Word. Use insert link to file command to create such a reference (see § 2.4)

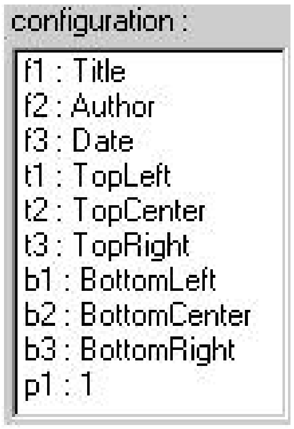
5.3.5. parameters for html_p format



```
configuration :
RemoveNONESections : Y
RemoveApplets : N
Scale : 2
ParentRadius : 10
ImpColor : lightGray
ChildLabelHeight : 20
UseColor : red
InhColor : pink
AttColor : orange
XOffset : 25
ChildRadius : 5
BgColor : white
PenColor : blue
RemoveLowLevelTitles : N
ParentLabelHeight : 20
YOffset : 25
```

RemoveNONESections (`Y/N`): if set, no title section with empty contents will be included inside printed document. *RemoveLowLevelTitles* (`Y/N`): if set, lower level titles will be removed from produced document. *RemoveApplets* (`Y/N`): if set, disable **Java** applets (no diagram will be inserted). The other parameters may be used to control diagram drawing with **Java** applets. *BgColor*, *PenColor*, *UseColor*, *ImpColor*, *AttColor* and *InhColor* specify which color will be used for background, **Module** borders and strings, **Use** links, **Implemented_By** links, **Attributes** links and **Inheritance** links. Possible colors are: `black`, `white`, `lightGray`, `gray`, `darkGray`, `red`, `pink`, `orange`, `yellow`, `green`, `magenta`, `blue` and `cyan`. *Scale*, *ParentRadius*, *ChildRadius*, *ParentLabelHeight*, *ChildLabelHeight*, *XOffset* and *YOffset* control finely **Module** box shapes.

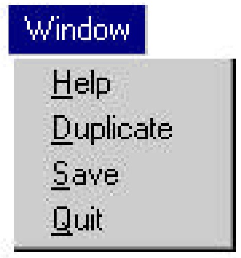
5.3.6. parameters for LaTeX format


```
configuration :
f1 : Title
f2 : Author
f3 : Date
t1 : TopLeft
t2 : TopCenter
t3 : TopRight
b1 : BottomLeft
b2 : BottomCenter
b3 : BottomRight
p1 : 1
```

f1,*f2* and *f3* contain `Title`, `Author` and `Date` information that will be inserted inside title page. *t1*, *t2* and *t3* contain `TopLeft`, `TopCenter` and `TopRight` variables to be inserted inside page headers. *b1*, *b2* and *b3* contain `BottomLeft`, `BottomCenter` and `BottomRight` variables to be inserted inside page footers. *p1* defines number of first page.

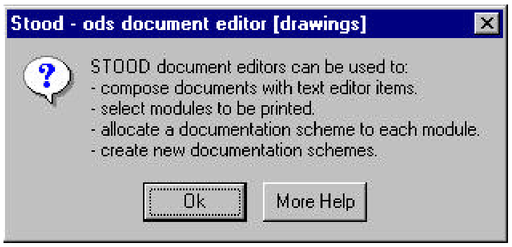
These parameters are also used by default for other formats implemented by **easyDoc** technology. Formats which name ends with *_p* use the same technology as rules checkers and code generators: they are implemented by a set of **Prolog** rules, that may easily be customized externally.

5.4. Window menu



Window menu offers similar functions as in the other editors:

Help : display an informational dialog box. Contents of this dialog box may be customized by editing `doc` and `doc.more` files in `config/help` configuration directory.

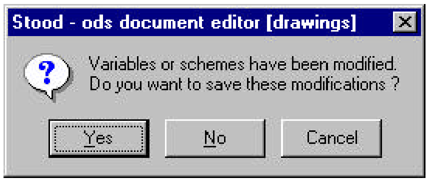

Stood - ods document editor [drawings]

STOOD document editors can be used to:
- compose documents with text editor items.
- select modules to be printed.
- allocate a documentation scheme to each module.
- create new documentation schemes.

Duplicate: open another document editor.

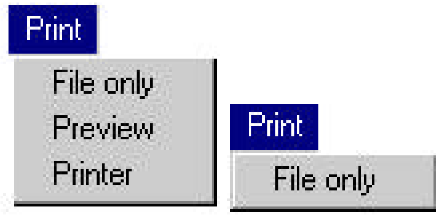
Save: save current settings. Printing parameters values and schemes configuration need to be saved not to be lost. Schemes allocation to **Modules** are always saved

Quit: close this window. If no recent save action was performed, an alert dialog box will be displayed:



Variables or schemes have been modified.
Do you want to save these modifications ?

5.5. Print menu



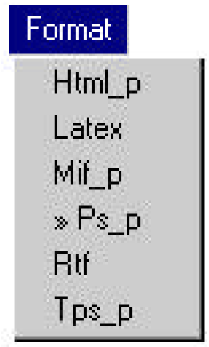
When all settings have been performed, *print* menu should be used to produce documentation. *Print* menu contents may vary as regards selected format, and some functions may not work correctly without previous configuration (default printer) or additional installation (previewers).

File only or Print: these menu item and button are always proposed, and generate one or several files at the location specified in a standard file navigator. Default documentation location is `_doc` directory within **Application** storage directory.

Preview: this optional function requires the presence of a specific tool to display produced documentation. These tools are not provided with **STOOD**. When activated, this command first performs a standard *file_only* command to produce a document file, then launches a shell script which contents may be customized. This script file is named `preview.sh` (refer to part I).

Printer: this optional function activates a shell script after having produced a documentation file like with standard *file_only* command. This script file is named `printer.sh` and should be customized first to define default **PostScript** printer queue. Refer to part I to customize **STOOD** internal tools.

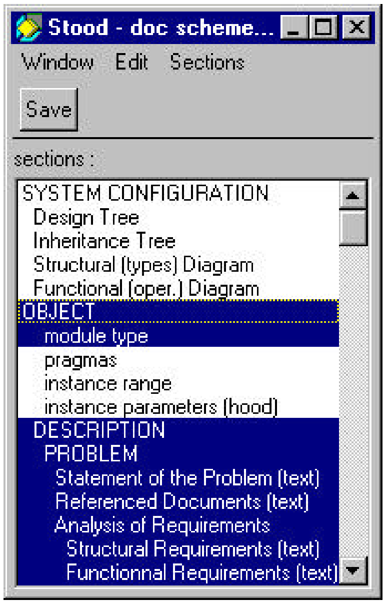
5.6. Format menu



This menu should be used to select documentation output format. Only a few formats are available in standard **STOOD** delivery. Other may be obtained from technical support if required. This menu may be customized easily by adding, removing or renaming directories within `doc_extractors` configuration directory (refer to part I of this User's Manual).

Default format may be specified with `Default` property of doc category in `.stoodrc` file for **UNIX** platforms, `stood.ini` file for **Windows** platforms. Refer to part I, § 1.2.7 to set default documentation format. Currently selected format may be identified by >> symbol at its left side.

6. Documentation schemes editor



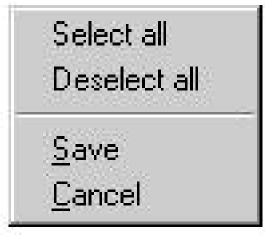
SYSTEM CONFIGURATION
Design Tree
Inheritance Tree
Structural (types) Diagram
Functional (oper.) Diagram
OBJECT
module type
pragmas
instance range
instance parameters (hood)
DESCRIPTION
PROBLEM
Statement of the Problem (text)
Referenced Documents (text)
Analysis of Requirements
Structural Requirements (text)
Functionnal Requirements (text)

Local schemes used in *document editors* may be customized with *doc scheme editor*. To launch a *doc scheme editor*, activate *edit* item of pop-up menu of *scheme* selection list of a *document editor*.

Doc scheme editor displays an exhaustive list of all sections that was attached to selected *document editor* (*ods document editor*, *ada document editor*, *c document editor*, *cpp document editor*, *test document editor* and *checks document editor*). Selecting new sections or deselecting already selected ones will modify current documentation scheme.

To edit a global documentation scheme, relevant files should be copied first within an **Application** storage directory, in order to be edited like local schemes. After modifications, they will need to be copied back to global configuration directory.

While pressing center mouse button (for **UNIX**), or right button (for **Windows**), and locating mouse pointer inside *sections* list, a pop-up menu provides following commands:



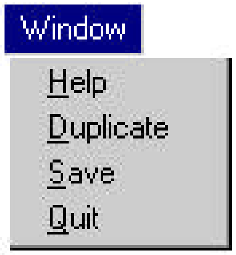
Select all: select all sections in the list.

Deselect all: deselect all sections in the list.

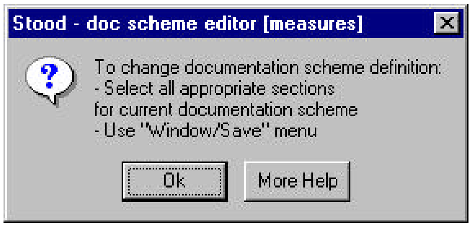
Save: keep recent changes for selected scheme.

Cancel: discard recent changes for selected scheme.

Doc scheme editor also provides a menu bar, that may be used as follow:



Help : display an informational dialog box. Contents of this dialog box may be customized by editing `sch` and `sch.more` files in `config/help` configuration directory.

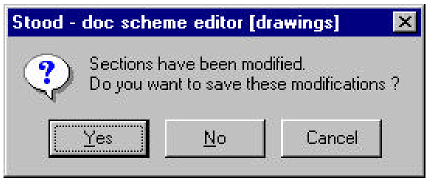

Stood - doc scheme editor [measures]

To change documentation scheme definition:
- Select all appropriate sections
for current documentation scheme
- Use "Window/Save" menu

Duplicate: open another *doc scheme editor*.

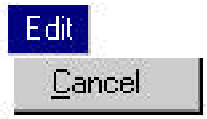
Save or Save button: save current settings.

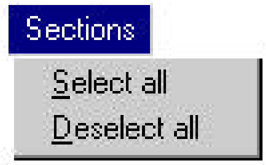
Quit: close this window. If no recent save action was performed, an alert dialog box will be displayed:


Stood - doc scheme editor [drawings]

Sections have been modified.
Do you want to save these modifications ?

The other two menus provide another access to pop-up menu functions:


Edit
Cancel


Sections
Select all
Deselect all