Virtual Library of Devices Modular Elements

DULGHERU LUCIAN¹, ILIESCU MIHAELA¹
Manufacturing Department
“POLITEHNICA” University of Bucharest
Splaiul Independentei no. 313 Street, District no. 6, zip code 060042
ROMANIA

Abstract: - Virtual library of modular elements addresses to the users of modular sets systems for devices (application to modular system SEM 64 DISROM), enabling quick access to the informations required for designing and assembling modular devices. Using this system implies creating a CAD – CAE medium and allows extension of computer use to the field of managing devices and modular elements within assembling data bases. Appart of obvious economical effects, there is, also, estimated an important increase of technical performances, by precision criteria cataloguing elements so that, modules could be used in accordance to the established target. Meanwhile, it was intended that the system involves the experience of practical designed solution to the extension of a specific assemblies virtual library.

Key-Words: modular elements devices, catalogue, virtual library, development, designing, assembly, site

1 Introduction
Designing and assembling of manufacturing devices elements, so that prescribed geometrical conditions of the machined surfaces to be obtained, involve various and important researches.

Considering the fact that, a famous Romanian professor developed an efficient theoretical and practical methodology for manufacturing devices’ design, DISROM, further research has been developed so as to, use simulation and modeling in obtaining very precise devices, used both on the required machining tools and, into the assembly lines [1], [3], [4].

So, as part of a CEEX project, there have been developed (case) studies on “Modular Elements Devices”, viewed as sub-systems of manufacturing technological system, that have an important role in influencing the flexibility of technological processes.

2 Research Targets
Initially established research objectives and other important targets, determined while the project was on, can be stated, as follows [2]:
⇒ analysis of nowadays results and achievements on the field of "Modular Elements Devices";
⇒ comparing the worldwide results, of the above mentioned field, to the ones obtained by the Romanian researchers;
⇒ establishing the modular elements components that do not exist or, are no more in concordance to the worldwide achievement;
⇒ research and design of the components, both as individual elements and integrated assemblies, of the Romanian existing systems;
⇒ creating a "Modular Elements Catalogue";
⇒ creating a 3D "Modular Elements Virtual Library";
⇒ creating a "Modular Elements Virtual Library"; with "html" elements;
⇒ creating of a “site” with "Modular Elements Catalogue", 3D "Modular Elements Virtual Library" and "Modular Elements Virtual Library"; with "html" elements;

Thus, there will be the opportunity of:
• computer aided simulation and design, of "Modular Elements Devices";
• assembling the component elements of these devices with higher precision, based on the designed projects;
• reduction of assembling time by a better managing of the whole device’s required modules;
• prior design and execution of specially required elements.

3 Important Research Achievements
Studies on the way modular elements devices are used and on their organologic development, as well as on SEM 64 (64 Modular Elements System) set structure resulted in a series of conclusions, regarding the constructive elements which are not component parts of the above mentioned set. It is
considered that these elements do need special study, so that to turn the SEM 64 into a new, modern product.

Some relevant aspects of the modular systems organising and execution, as well as of the complete systems or, only, elements delivering can be stated to be:

⇒ there is the need that modular elements or assemblies, that do form a system, to be standardized;
⇒ execution of modular elements or assemblies, part of the system to be done into plants where standard required quality can be obtained;
⇒ making the opportunity of, as fast as possible, any element delivery;
⇒ analyzing the need of, other than SEM 64, modular sets local design;
⇒ assembling, un-assembling and management of modular element devices to be performed only by BOM-DEM qualified persons (units of modular elements devices’ optimizing and assembling);
⇒ elements assembling and management, in a BOM-DEM unit, to be performed only under some program supervising.

As result of the study conclusions, some important research fields were:
A) research and design of some hydraulic fixing systems, integrated to the modular elements set, SEM 64;
B) research and design of some elements for the use of modular elements devices on the complex machining units (CNC);
C) analyze on the modular elements devices’ manufacturing – design of the virtual library modular elements;

Some examples, corresponding to the above mentioned fields, are presented by the next figures.

A) High loaded elements were checked on strain and stress by finite element programs.

- Fig. 1 Hydraulic activated simple clamp, integrated to SEM
- Fig. 2 Hydraulic activated double clamp, integrated to SEM
- Fig. 3 Hydraulic activated fixing element, integrated to SEM
- Fig. 4 Hydraulic activated self-centering vice, integrated to SEM – allows fixing different modular elements on the clamping dies.
B) Elements for modular devices on complex machining units

Fig. 5 Plates for fixing modular devices, when used on special machining units

Dimensions of the plates presented in figure 5, are shown in table 1.

Table 1 T channels plates dimensions

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Tip B1 x L1 x H1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>320 x 320 x 95</td>
</tr>
<tr>
<td>2</td>
<td>320 x 400 x 95</td>
</tr>
<tr>
<td>3</td>
<td>400 x 400 x 115</td>
</tr>
<tr>
<td>4</td>
<td>400 x 500 x 115</td>
</tr>
<tr>
<td>5</td>
<td>500 x 500 x 125</td>
</tr>
<tr>
<td>6</td>
<td>500 x 630 x 125</td>
</tr>
<tr>
<td>7</td>
<td>630 x 630 x 150</td>
</tr>
<tr>
<td>8</td>
<td>630 x 800 x 150</td>
</tr>
<tr>
<td>9</td>
<td>800 x 800 x 170</td>
</tr>
<tr>
<td>10</td>
<td>800 x 1000 x 170</td>
</tr>
</tbody>
</table>

Fig. 6 Tower – component of modular devices, when used on special machining units (CNC)

One can notice the shape of the part, called “tower” – see figure 6, that allows fixing of various modular elements on all side faces which have, both horizontal and vertical T channels. In addition, there were made, another three U channels. It is very rigid, can be used in complex devices and, allows machining under severe conditions. It is completely compatible to SEM 64 modular set and, to its, further versions. There can be mounted modular set elements or, modular elements devices for machining on CNC units. The dimensions, as well as other constructive options, should be established according to customer needs.

Fig. 7 CNC units window frame vertical element, integrated to SEM
As shown in figure 7, there can be noticed the possibility of fixing additional elements on both sides of the window frame vertical element. There are horizontal T channels and three extra, U channels, on the element’s lateral sides. Its rigidity is not so good and the devices possible to be made are of low or, medium, complexity. To be noticed that this element type is used when the components’ shape or dimensions, do need the existing window. Because of its lower rigidity, the machining parameters must be set to low or, moderate, values. There is a complete compatibility with SEM 64 set, and to its further versions. Also, there can be mounted on this element type, modular set elements or, modular elements devices, for machining on CNC units.

When checking stresses and deformations, there were obtained elements according to initial conditions [5], [6]. A simulation, of stress and deformation behaviour, in loading, is presented by figure 8.

![Simulation and checking of window frame (fig. 7) in loading – on upper end](image)

**Fig. 8 Simulation and checking of window frame (fig. 7) in loading – on upper end**

C) Modular elements devices’ manufacturing

![Unit for optimizing and assembling of modular elements devices](image)

**Fig. 9 Unit for optimizing and assembling of modular elements devices**

4 Virtual Library and “Site” of Modular Elements [6]

There has been carried out a study on the existing information on modular elements devices and, some of the resulting conclusions, are as follows:

⇒ there is the need of new designing methods for these devices type, so as to increase rigidity, precision and, why not, application fields;
⇒ new and modern product designing methods do use parametric software, with 3D solids;
⇒ these software type can be successfully used in designing modular elements devices;
⇒ using these software implies the existence of a virtual library for modular elements, that should be compatible to various the various designing software;
⇒ this paper, shortly presents, a virtual library that consists in, approximately, 630 modular elements or, modular assemblies;
⇒ the mentioned virtual library is based on codes, attributed to each of its components and, the structure of it is presented into a catalogue;
⇒ by establishing the codes, there have, also, been obtained several modular elements but, haven’t been designed, yet;
⇒ modular elements virtual library knows a continuous extent;
⇒ the structure of the virtual library, as SITE, proves, by checked examples, that it was a right and correct way of thinking and developing “things”.

The CD content, and it’s access way, are further presented.

As seen in figure 11, there is the possibility of catalogue opening, the list of modular elements groups and the list of each group’s elements.
The above figures (13, 14 and 15) show the catalogue image page, the “html” image for each basic plate and the saving possibility, as “stp” of the chosen modular element.

An example of designing a modular elements device is presented by Figure 17.

5 Conclusion
As a synthesis of all the above, some conclusion can be stated, as the following:
⇒ there is a need of new designing methods of modular elements devices;
⇒ modern designing software, using 3D solids and parametric programs, are very well fitted to designing modular elements devices;
⇒ a virtual library of modular elements is necessary, in a form accepted by various software;
⇒ the paper mentions and, shortly presents, a completely new virtual library, with, approximately, 630 modular elements or, modular assemblies, its structure being based on codes;
⇒ the modular elements virtual library is under continuous development.;
⇒ the structure of the virtual library, as SITE, proves, by checked examples, that it was a right and correct way of thinking and developing “things”. 
Fig. 17 Manufacturing device made of SEM 64 modular elements, from the virtual library

References

[6] Designing and checking programs, using "solids"