Designing clamps using CAD programs and C++ language

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Abstract: The main goal of this work is creating an good strategy for design beta clamps using CAD programs, par example, AutoCAD and SolidWorks. The second part of this paper is designing an C++ software, developed for the database processing of the clamps form HRSB. This method gives the possibility to store a large amount of information about clamps and accessing such in a short time. The initial sketches, drawing in AutoCAD, named pattern sketches, for pipe clamps, were associated to some clamps form HRSB drawing groups. DXF file, generating with the HRSB.CPP application, gives final drawings. These entire programs are necessary in the constructive and technological design of beta clamps family.

Keywords: Clamp HRSB, C++ language, databases, AutoCAD, DXF files.

1 Introduction

During the past years, due to the increased complexity of the industrial equipment, the design and the construction of clamping items and support thereof have a special importance. This paper is focused on a new design in the field of clamps of pipes, form HRSB - beta clamp, in industrial equipment (Fig. 1) [1,2].
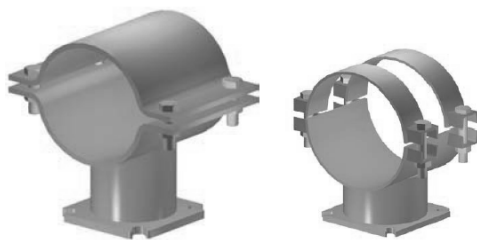

Fig. 1 Clamps form HRSB

The figure below presents the pipe clamps family developed in the Solid Works **Design Library** (Fig. 2).
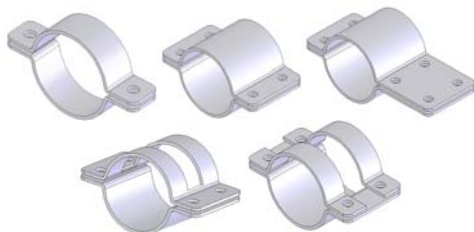

Fig. 2 The Clamps family form HRSB

In order for designing a clamps family one can started from the complex clamp form. The complex beta clamp is shown in the following AutoCAD figure with parameterized sizes. For large tubes, safety, one accepts the long area of constriction.

This AutoCAD drawing can be associated to a simple construction drawing or to a flowchart.
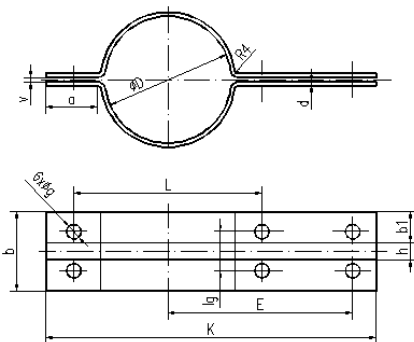

Fig. 3 The complex clamp form HRSB

2. Databases for HRSBG clamps

Every beta clamp has organize using a new symbol: HRSB21, HRSB27, an using the online clamp catalogue [2]. The symbol number defined the diameter of the pipe.

The database (Fig. 4) named HRSB.txt is written in Notepad.

Fig. 4 HRSB.txt file

3. The HRSB application

The HRSB application is written in C++ language, programmed to read the database, to insert the variable data, to make all the necessary operations, to list the results on a display or on the printer and to complete the DXF files. The DXF files should first generated in AutoCAD from the pattern drawing [5].

This DXF pattern drawing will be displayed and modified, for the second escape. This file should receive at the end the new dimensions, in the DXF format, calculate in the HRSB application. The scheme (Fig. 5), is an algorithm for illustrating the schematic design computer activity.

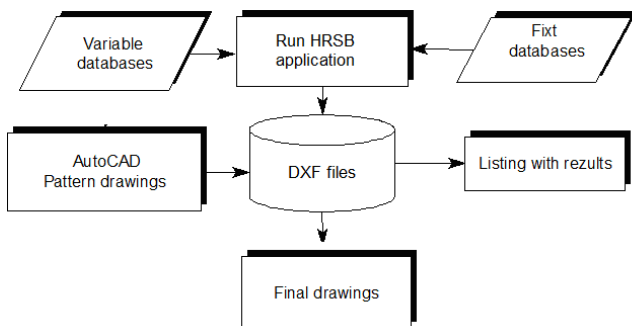DXF files can be developed for every clamp type and include all the calculated data, by running the HRSB application.

Fig.5 The HRSB application schema

HRSB application uses the POO technology. This C++ application includes suggestive function like: password(), help(), main(), calculus(), results(); DXF(), display(), costs(). This application is developed also for other clamps type [3, 4].

The input data, for the every pipe clamp family, can be declared in the "struct Stra", "struct Strb", "struct Strg" and "struct Strd".

This application should be organised in a project with two files, one of them is named DXF.CPP for generating DXF files and other is named HRSB.CPP and is the body of the application. HRSB application is processed with Dev-C++.

DXF.CPP defines two functions DXF::open and DXF::close for open DXF and close the new DXF completed.

Function DXF::WriteDxf offered below add the corresponding text parameters in DXF existing file

```
int DXF::open( char *dest, char *sursa )
{char *buf;
if ( ( buf = new char[BLOC] ) == NULL )
   return err=1;
if ( ( fsursa = fopen( sursa, "rb" )) == NULL )
   { err=2; delete buf; return err; }
if ( ( fdest = fopen( dest,  "wb" )) == NULL )
   { err=3; fclose( fsursa ); delete buf; return err; }
```

```
fseek( fsursa, 0L, SEEK_END );
long int len = ftell( fsursa );
fseek( fsursa, 0L, SEEK_SET );
long int len1 = 0;
while ( len > BLOC )
   {fread( buf, (size_t)BLOC, 1, fsursa);
    fwrite( buf, (size_t)BLOC, 1, fdest );
    len1 += BLOC;
    if ( ftell( fdest ) != len1 )
      { // eroare la scriere
      err=4;
      fclose( fdest );
      fclose( fsursa );
      delete buf;
      return err;   }
   len -= BLOC;      }
len1 += len;
fread( buf, (size_t)len, 1, fsursa );
fwrite( buf, (size_t)len, 1, fdest );
if ( ftell( fdest ) != len1 )
   {   // eroare la scriere
   err=4;
fclose( fdest );   }
fclose( fsursa );
delete buf;
return err;
}
```

The figures bellows presents captures from HRSB.CPP program (Fig.6, 7).

Fig.6 The HRSB application read the databases

In case the data proposed by the user are not in the HRSB.txt database, user has the possibility to introduce data from the keyboard step by step, because the program ask all the dates (Fig. 6). In this situation offers the possibility of developing a new database with new input dates.

DXFfile() function from HRSB.CPP coordinates the development of DXF file, this function include the coordinate of the new dimensions (Fig. 7).
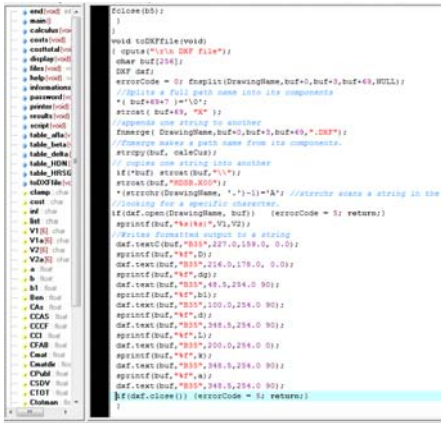
Fig.7 The DXFfile() function

By running the HRSB application a popup window will appear, asking the password, listing the data, the calculations and generated the DXF files.

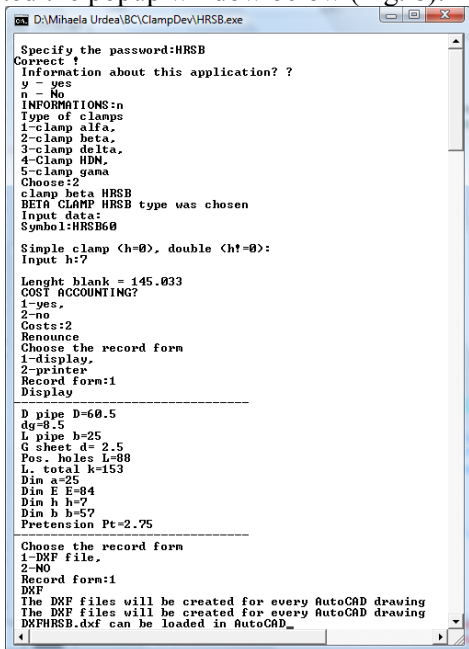To provide an example for HRSB60, one presented the popup window below (Fig. 8).

Fig.8 The HRSB popup window

4. The final drawing

The DXF file resulted represented the final drawing, filled up with dimensions for the choosing clamp by the user. These values will be associated to the dimensions lines. Figure 9 presents the construction drawing for HRSB60, namely pipe diameter equal 60.

In the same way one can developed the strategy for design the flowchart clamps.

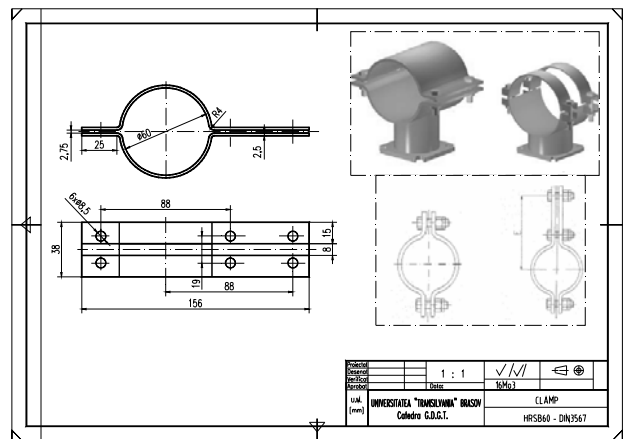**Fig.9** The construction drawing for HRSB60

5. Device for manufacturing the beta clamp.

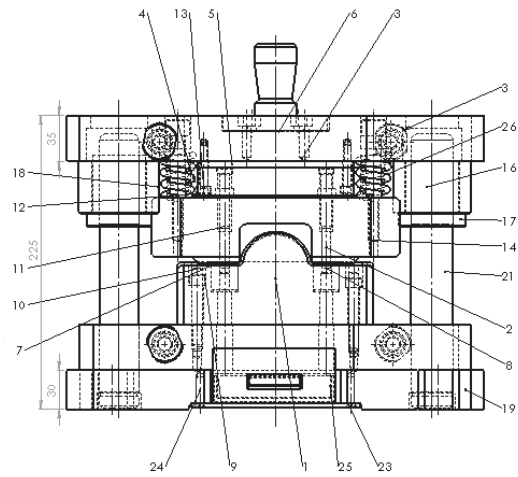To perform a cold pressing is used a clamps press.

Fig. 9 The clamp press

This modular press can be designed for a lot of clamp dimension. The plate moulds and the die of perforation must be changed. Figure 10 presents the modular press modeled in SolidWorks.
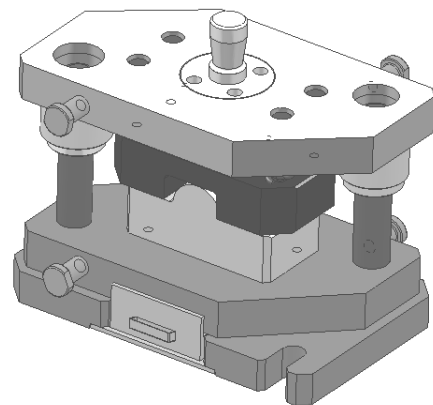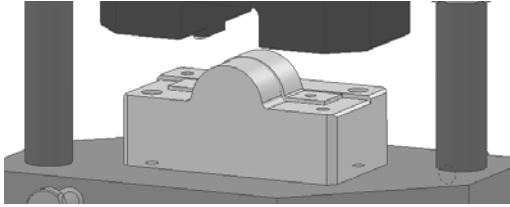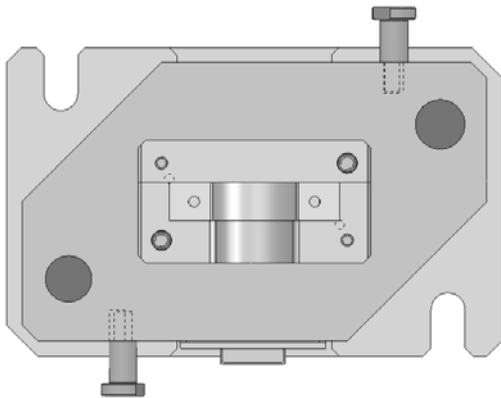

Fig. 10 The modular press for clamps

Bending and drilling is done simultaneously, result the form of clamp and the holes. In the capture below (Fig. 11,12) one can see the lower mould with one part of clamp.


Fig. 11 The press with the lower mould

Fig. 12 The press with the lower mould-top view

6. Assemblages with clamps

Modeling an assembly with clamps using SolidWorks is necessary to make that an overview of clamps design.

The components of the body pipe clamp assembly are simple beams, beta and gamma clamps, supports screws and nuts. Most of beams will be created with Sheet Metal and Weldments module from SolidWorks (Fig. 13) [6].
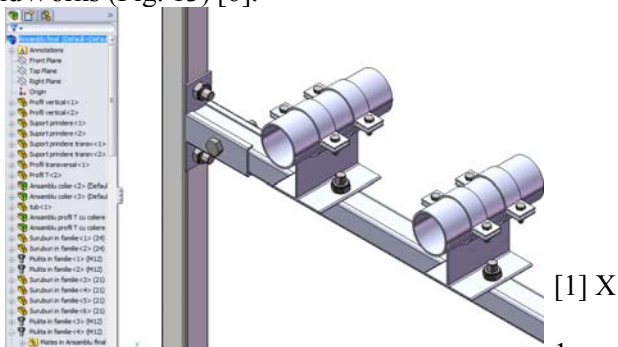
Fig. 13 Assembly with beta clamps

This design method by modeling in SolidWorks is a quick checking method of the assembly, by viewing it.

4 Conclusion

This work presents an own method for process the clamp database and to model press and clamps assemblies in SolidWorks.

The central and original result of the work is the HRSB application written in C++ language. This application can be developed also for other clamp [4].

This paper offers a solution to design the pipes clamps assembly, using Hilti documentation [2].

As a novelty, these assemblies were in this way designed and visualized, before their physical construct; this method could be also generalized for other same pipes clamps platforms.

References:
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[2] www. hilti.ro
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[6] Scheibner, E., Urdea, M., A computerized method for designing assemblies with pipes clamps, International Conference on Computing and Solutions in Manufacturing Engineering CoSME'08 2008, *Academic Jurnal of Manufacturing Engineering Supplement, University of Timişoara,* No. 2, 2008, pp.150-156.