**The International Students Olympiad in Hot Bulk Forging Technologie****s**

CODE 758

University Politehnica of Bucharest

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**1.Task**

The task of this olympiad was the following: the company taken an order to produce 30,000 "Coupling" parts, (presented in Fig 1.1). It is necessary to develop the technological process for manufacturing of forgings for further machining taking into account the drawing of the minimum allowances for machining. The following equipment is available:

- hydraulic press (10 MN, 10 mm/c)

- steam-air hammer (2 t, 50 kJ).

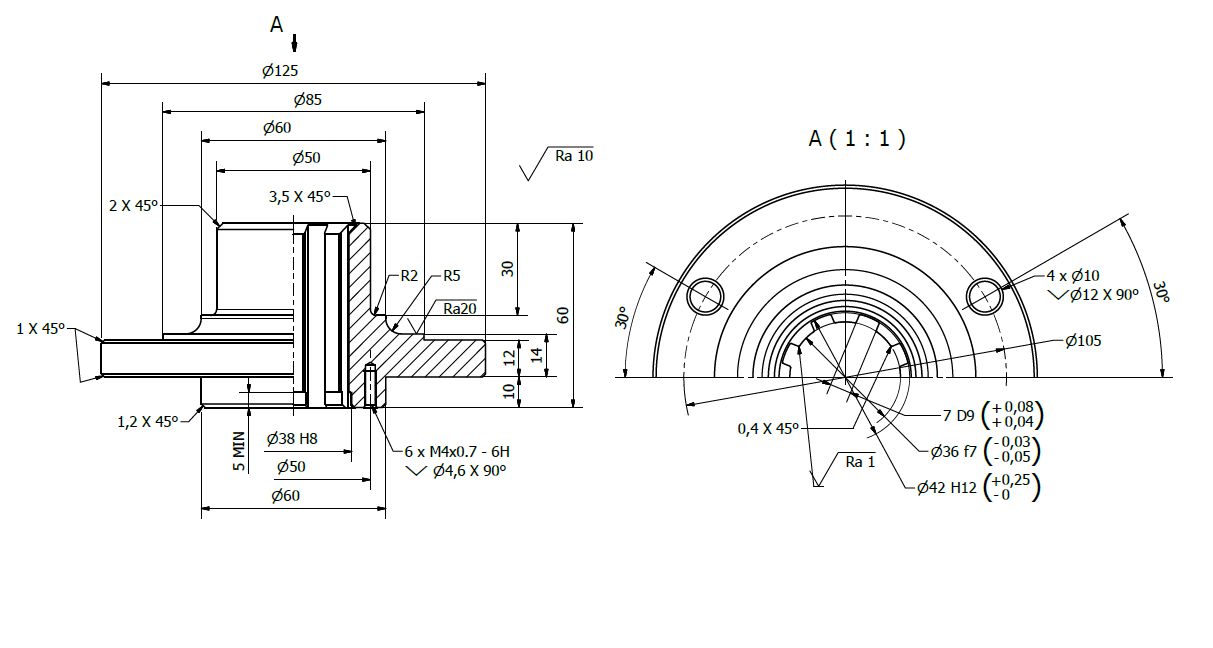


Fig 1.1 Drawing of a machined coupling

**2. Design of the forged part**

**Step 1.**

In terms of die-forging precision, the pieces were divided into two classes according to the dimensional precision obtained at die-forging:

* Class 1 for forged parts having high dimensional accuracy and smaller tolerances;
* Class 2 for forged parts in classical conditions where machining additions and limit deviations have normal values

The quality of the steel used to mold the parts is taken into account by the two M1 or M2 groups, so:

* The M1 group for steel parts with a carbon content of less than 0.65% and the sum of alloying elements (Mn, Ni, Cr, Mo, V, and W) of less than 5%;
* The M2 group for parts with carbon content greater than 0.65% and the sum of alloying elements (Mn, Ni, Cr, Mo, V and W) greater than 5%;

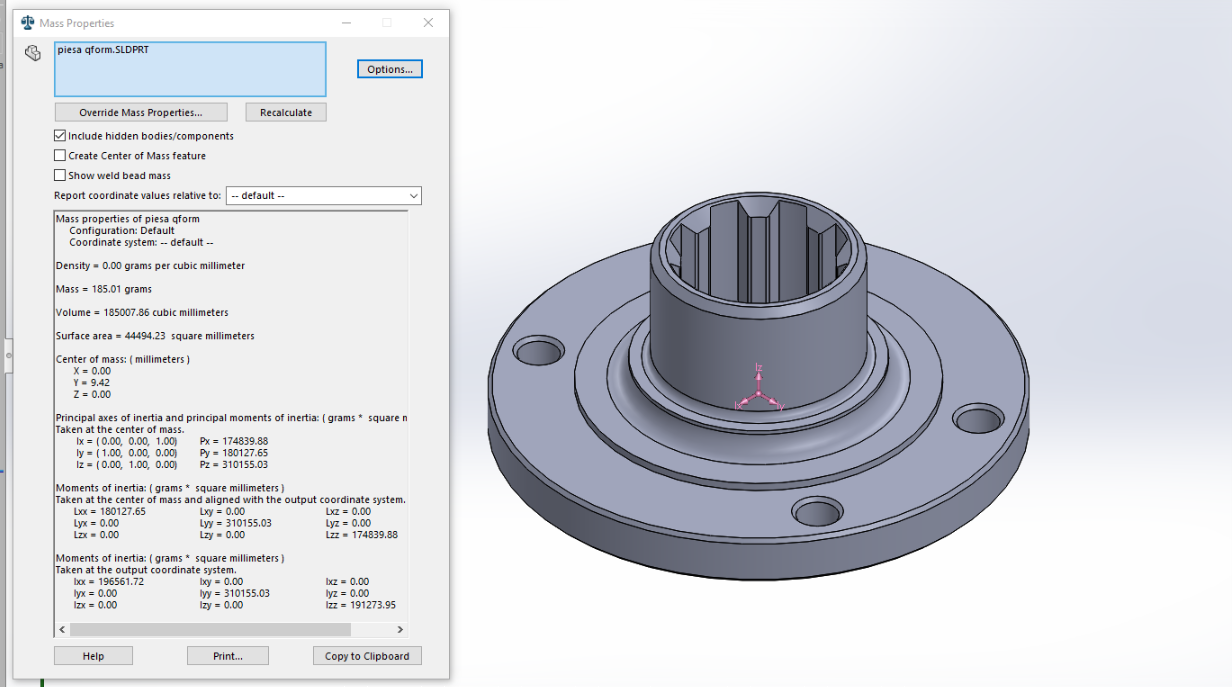


Fig 1.2 3D Model of the forged part

The volume of the piece is V=185.007,86 m3

M= 185.007,86 \* 7,85 = 1,4523 kg

According to SR EN 20277-2:2008 the density of the material C45 is 7850 kg/m3.

The complexity of the shape of the forged piece is determined by the factor S that is determined by the relation:

- weight of the piece

- The mass of the body geometrically formed with the maximum dimensions of the piece

= the volume of a cylindrical body heaving the diameter of 125mm (the maximum diameter of the part) and the height of 60mm (the height of the part)

=\*h= 736.310,78

S== 0,2513

I set the weight of the piece, forging class 2, steel grup M1, complexity group S3 (0,16…0,32) and I chose the value of the processing allowance. Also the machining addition is chosen for the maximum size of the piece, length, width, thickness and has a single value for all parts that are machined by cutting.

To ensure the correct execution of the forging operation, the processing additions must be supplemented with technological additions.

Considering the calculate of parameters weight, die forging class, steel quality, shape complexity factor, maximum dimension of the according to SR-EN 10243-1:2003 the diamension of machining padding it is 2,5mm.

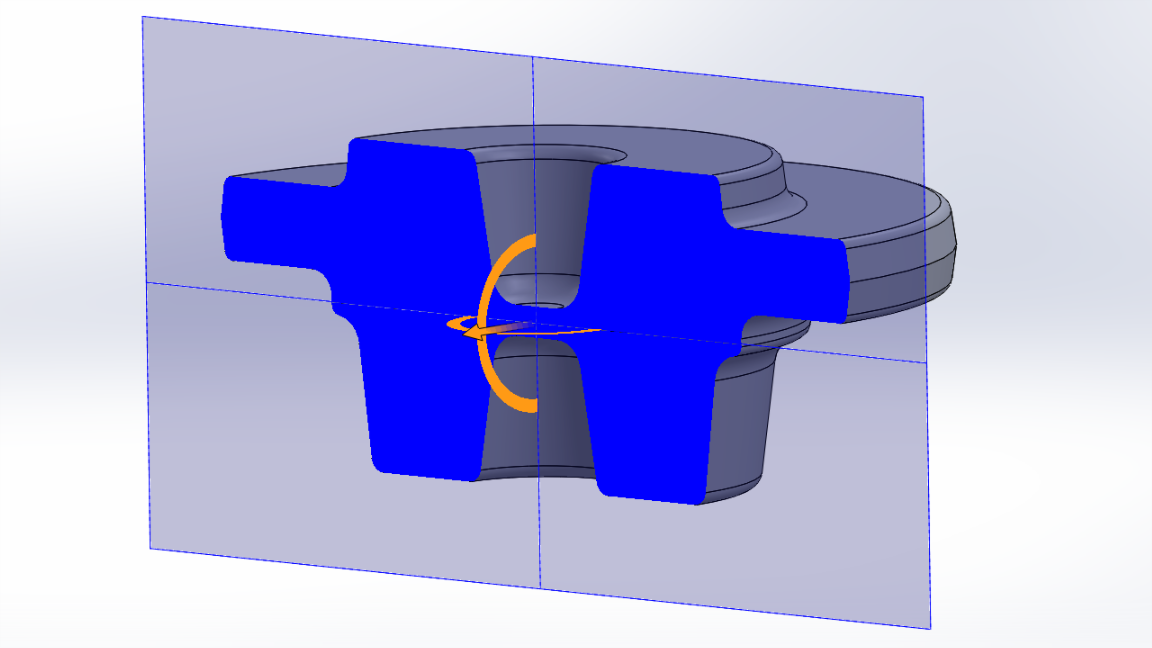
Cosidering that the height of the part is in normal limits (not a flat product) and that the forgind process is performed using steam-air hammer, according to SR-EN 10243-1:2003 its results that the surfaces ungles for the forged part are:

* 10 degrees for interior surfaces
* 7 degrees for exterios surfaces

The values of the fillets for the forged par were established according to the same standard SR EN 10243-1:2003

In general, that through the forging process, it is not possible to produce a hole. Because of this fact, there is a bottom remaining in the middle of the forging and is 6,12.

**3. Design of the forging technology**

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**Operation 1. Upsetting**

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Vfp = 652928,44 mm3

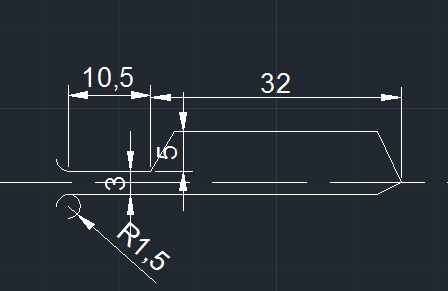
Vf = 114232,75 mm3

Vox = 23014,84 mm3

Vbillet = 790176,04 mm3

Dcalc = 73,8257 > Dstandard = 75 mm

Hbillet = 178,85 mm

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**Operation 2. Profiling**

Operation 2 consists in profiling the upsetted billet for obtaining a shape close to the final part shape. A profiling die was designed for this operation considering the final dimensions of the forged part.

**Operation 3. Final forging**

The dimensions of the flash channel are showed in figure 1.4. These dimensions were adopted considering the calculated dimension for h1=0,015 \* = 2,1718 mm

It results that the cross-section of the flash chanel is 244 mm2.

P = 2π \* 106,444 = 668,81 mm (the perimeter drawn through the center of gravity of the figure).

Vfc = 163.189,64 mm3

Considering a flash channel filling coefficient of 0.7 (70%) is results that the flash volume is Vf = 114.232,748 mm3

These calculation also considered when the volume of the billet was estabilished.

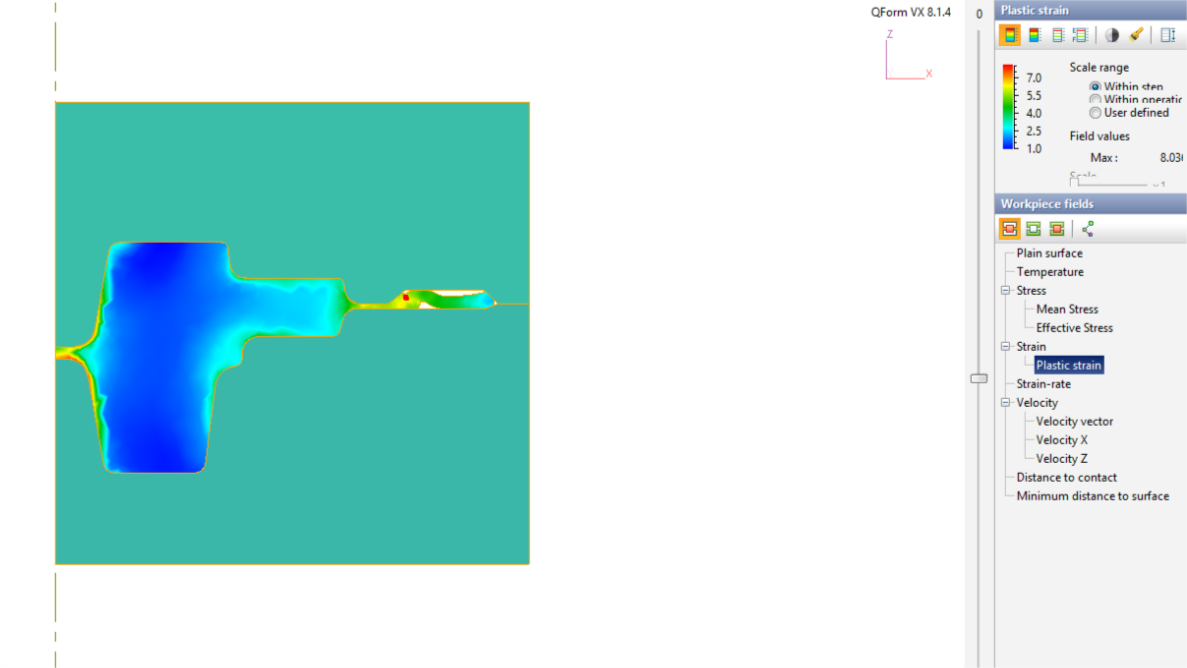
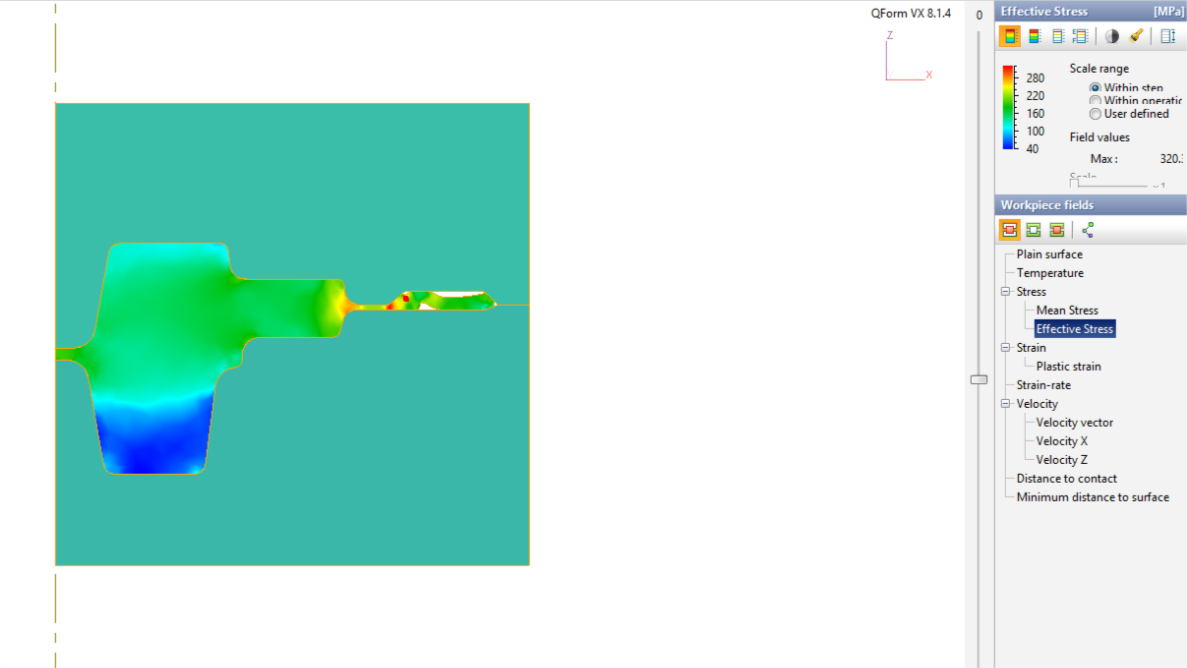
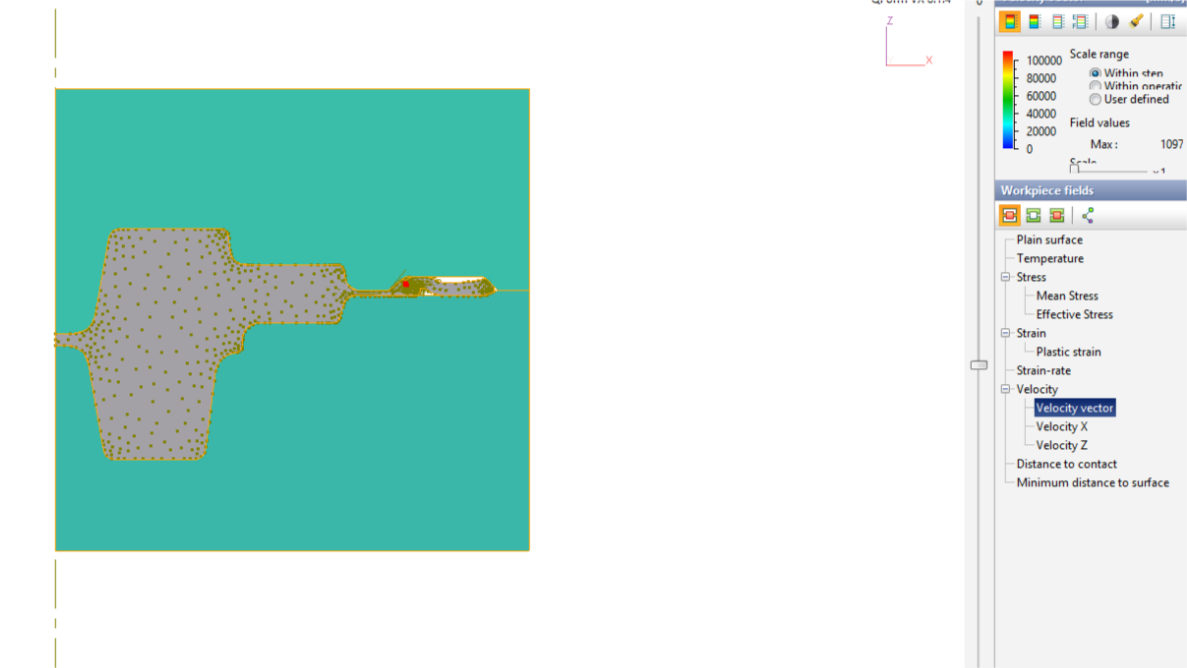
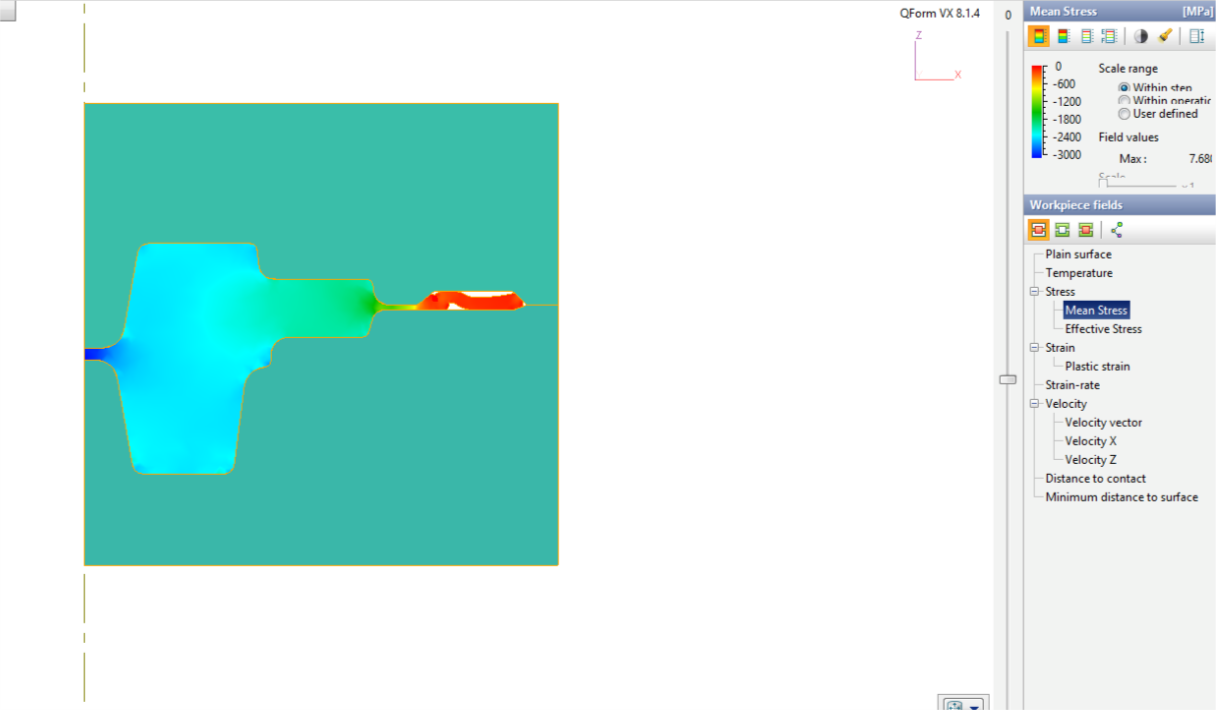
**4. Simulation results**

The simulation parameters are shown in the following table:

|  |  |
| --- | --- |
| Material | C45 |
| Forging temperature | 1200 °C |
| Lubricant | Graphite and water |
| Press drive tool 1 | Steam-air Hammer (2t,50kj)  motion into negative z-Axis |
| Press drive 2 | Stationary |
| Material of the tool | L6 |
| Temperature of the tool | 200 °C |
| Environment | Air, 20°C |
| Strokes | At OP1: 2 stroke  At OP2 : 3 stroke and OP3: 6 strokes |

**5. Simulation results :**

One can observe that the most representative simulation results are presented in the followind figures :



**6. Conclusions**

From the desing of the forging tehnology developed for this Olympiad it can be observed that this needs furthering improvements especially for the profiling operations for the volume of the billet, being observed also that the steam-air hammer available in the company its over loaded and a bigger hammer would be necessary.