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*Make Harmony between Technology and Nature, and Your Mind will Fly Free as a Bird*
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# DESIGN OF ACTIVE PARTS IN CLAMPING MECHANISM

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***Abstract:*** *This paper deals about criteria of active component clamping device design. Individual criteria are discussed. For a comprehensive evaluation of all possible design configuration of the fixture is appropriate to use a combination of methods of functioning of the proposed search mechanism. Each of the clamp assembly is in the form of kinematic pairs and their spherical models. Based on the evaluation of advantages and disadvantages of different principles selects the best solution is then treated as a specific design proposal*
***Key words:*** *shape, model, clamping, kinematic pair*

## 1. INTRODUCTION

Sustainable development is recorded in the clamping fixture branch, which is consistent with the progressive improvement and development of production machinery.

Fixtures consist of structural elements. Each element in the joint report provide a different function. Basic fixture design features can be divided into:

- fixture body,
- retaining elements,
- locating elements,
- holding devices,
- elements determining the position of the fixture in relation to the production machine,
- the elements determining the tool position relative to the fixture,
- separation devices,
- connecting parts and other ancillary elements.

Clamping device is a subsystem of the fixture. They allow to draw the necessary clamping force and ensure its operation for clamping a workpiece to be due to cutting or other forces has not changed its position. The mechanism is capable of clamping devices amplify induced power, and if necessary change its direction (Danisova & Velisek 2010).

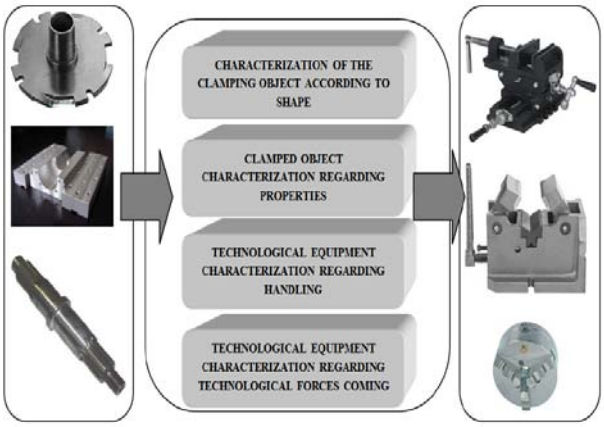

Fig. 1. Criteria of active component clamping device design

## 2. CRITERIA OF ACTIVE COMPONENTS CLAMPING DEVICE DESIGN

When designing a suitable clamping fixture solution the clamping object must be assessed according to various criteria.

### 2.1 Characterization of the clamping object according to shape

Before making decision about clamping principle, it is to carry out detailed analysis of the clamped object features. It is to find out the basic and prevailing shape of the object within the first step of the said analysis because the object shape influences construction design of the clamping by principal way. Regarding the object basic shape, the objects are divided into objects with an: angular surface, cylindrical surface, ball-shaped surface, conical surface, various profile surface, general shape surface (fig.1).

When looking for clamping principle, the basic shape of the workpiece surfaces can be created by outer surfaces or it can be featured by openings and cavities being on the workpiece.

When taking into consideration the shape, it is to evaluate also secondary shape elements and consider as important those, which could be significant when setting the workpiece into fixture jig. Further it is to take into consideration dimensions of the workppiece, their size and direction with regard to coordinate system. In connection with workpiece material they influence application point and value of the gravity force.

### 2.2 Clamped object characterization regarding properties

The properties of the fixed object, as stiffness and shape stability under action of technological and fixing forces are evaluated. Through this analysis, it is necessary to eliminate possibility of deformation formation, which could result in production inaccuracy. It is necessary to take into consideration temperature of the workpiece when putting it into chucking fixture, and possible temperature increase and thermal dilatation of the workpiece and fixture parts as well during the pertinent working operation.

### 2.3 Technological equipment characterization regarding handling

Regarding consideration process, when taking decision about fixation of an object of technological machining, it is necessary to consider access of the working tool on the workpiece. It means to familiarize with the concrete working equipment mentioned for technological operations with one workpiece fixation and also to evaluate handling space for the working tools utilized.

The way of putting and taking away of the working object is related to size, shape and location of the minimum handling space needed and also to its interlocking regarding working equipment.

### 2.4 Technological equipment characterization regarding technological forces coming into existence

System of the workpiece fixation and system choice are connected with securing of certain value of the fixing force. When determining the value of the pressere fixing force needed, it is necessary to take into consideration the point of work, direction and orientation of the said force. When doing proposal for intensity of the fixing force producing by operating parts of the fixing device, it is to know technological forces with regard to their point of action, magnitude, direction and orientation. When determining cutting forces, it comes out from parameters, which are given by technological process sequence (Velíšek & Košťál 2004).

It is important to know specific cutting resistance of the machined material and cross section of the cuttings withdrawn by cutting tool. Cuttings withdrawing modifies geometry of the cutting tool what results in modification of the cutting force depending on time. Action sequence of the technological forces can be considered from the point of dynamics within cutting operations featured by interrupted action of the cutting forces or with specific simplification from the point of statics within cutting operations featured by continuous action of the cutting forces.

## 3. THE CLAMPING MECHANISM STRUCTURE SUGGESTION

In the clamping fixture design time we can use the combination method of functional principle finding. This method enable find set of all existing suitable mechanism structures for the solving case. In this method we proceed from set of trinomial mechanism to multinomial sets of mechanisms. This method is based on stereostatic principles. These principles describe relations between number of mechanism elements, degrees of freedoms its kinematics pairs and resultant degrees of freedom for whole mechanisms.

The kinematics pair is statically determined when the elements of this pair has maximal 6 discrete touching points. This means that in case of acting the external force to one of element, we can determine the acting points, values and directions of all reacting forces by methods of statically equilibrium using.

In case of inaccurate manufacturing is so hard achieve more than 6 touching points, because this can cause preloading in system. In case (hypothetical) when the real systems are manufactured as spheric models – absolutely statically determined, its assembly means only compose the elements by using not very big forces the elements got the right position in case of inaccurate manufacturing too.

### 3.1 Grubler's Criterion of stereostatic analysis

For the analysis solving is created the idealized model (Fig. 2).

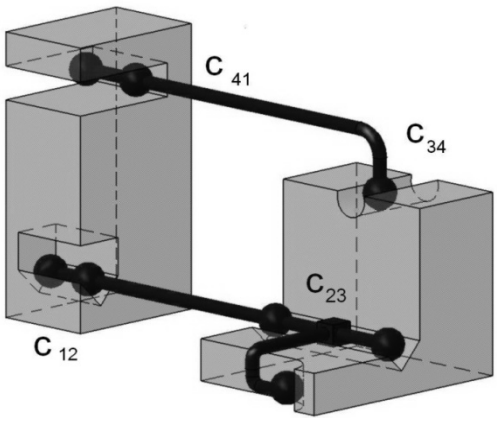


Fig. 2. Model of stereostatic analysis

We needed evaluate the statically determination of mechanism, because we want prevent the potential assembly difficulties caused by inaccurate manufacturing in assembling time (Kostal et al., 2007).

To DOF determination for 3D model has relevance a follow formula:
it is also true that

$$\lambda = c_i + f_i \tag{1}$$

which leads to Grubler's Criterion:

$$F = \lambda(n - j - 1) + \sum_{i=1}^{j} f_i \tag{2}$$

Define

$F$ = mechanism degrees-of-freedom
$n$ = number of mechanism links
$j$ = number of mechanism joints
$c_i$ = number of constraints imposed by joint $i$
$f_i$ = degrees-of-freedom permitted by joint $i$
$\lambda$ = degrees-of-freedom in space in which mechanism functions

## 4. CONCLUSION

The great variety of design options with different clamping principles complicates choosing the appropriate fixture solutions according to specific requirements. For this reason, come to the fore the need to develop a reflection on the methodological design for different input clamping limiting conditions. Design methodology by defining sequential steps, methods and analysis support the clamping fixture design. It also will streamline the selection process and suggest solutions. This methodology allows to eliminate possible errors in designed fixture and still in draft stage.

## 5. ACKNOWLEDGEMENTS

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