5th International Conference
"Research and Development in Mechanical Industry"
RaDMI 2005
04 - 07. September 2005, Vrnjačka Banja, Serbia and Montenegro

BUSINESS IMPROVEMENT USING HOLDING TOOLS IN LOW PRODUCTION PROCESS ENVIRONMENT

Branko Tadić , Slobodan Mitrović
Faculty of Mechanical Engineering, Kragujevac, SERBIA AND MONTENEGRO, E-mail: btadic@kg.ac.yu

Summary: *For the last few years domestic metalworking industry is featured with low production process and is facing demands for rapid production process change. In such production process environment holding tools as essential elements of production process from the unit cost aspect are significantly increased. Nevertheless, production process using holding tools has not changed significantly. In this paper possible means for improving business using holding tools in domestic predominantly specific production environment are being examined and analyzed.*
Keywords : *holding tools, production process, standard elements*

1. INTRODUCTORY ANALYSIS

Inseparable elements of processing together with tools and machine tools are holding tools. In area of metalworking machining holding tools are being used in operations including milling and drilling processes. Geometrical accuracy of processing and processed surface quality in wider sense largely depends on tool quality. Besides that costs and time necessary for launching new products and production programs depends on costs, designing time and time for producing holding tools. In addition to this, it should be stated that one of the key problems for conditions in domestic metalworking is inadequate holding tools management. Problems concerning holding tools management conditionally speaking can be regarded as technical and economic problems. From the technical standpoint holding tools are not being given appropriate attention given their role in processing and generally speaking production process. On the level of processing holding tools are almost always being regarded in designing process and calculations as static construction which is absolutely wrong. Holding tool is a part of dynamic production process, exposed to dynamic loads transferred from tools to production object and later on to machine tool. However, in practical situation holding tool calculations are being performed exclusively on the error calculation level (basing errors, production errors, processing errors, holding errors). Basing elements stability problems and carrying structure and holding system are being resolved empirically. That kind of approach in designing holding tools as a consequence frequently has redundant massive, overly stable and expensive construction. Whether speaking of special tools, group tools or assembling or disassembling tools in domestic industry the problem of oversized construction is always occurring. However, costs caused by such tool construction are not clearly recognized, there is no so called perfect construction to serve as a basis for comparison. In most cases when it comes to special tools being repeatedly designed by designers poorly informed with this kind of problems occurring costs can be extremely high. Designing tools in low production process environment is even more serious problem. Namely, special holding tools are too expensive therefore rarely being designed in specialized firms having as a consequence the same price but significantly lessened tool quality. On the other side assembling and disassembling tools (BAUKASTEM; UMA etc) are not frequently used in domestic metalworking industry on the first place due to necessary initial investing of financial means.

2. PROBLEMS OCCURING WITH HOLDING TOOLS

Special holding tools application is greatly justified in large scale production. However, even in that kind of production certain number of problems involving time necessary for designing and processing occur. According

to statistic data time required for designing special holding tools is from three to six months being big problem for quick product launching on market. In low production environment special holding tools application is largely unjustified from the economic aspect. Required tools costs are frequently unacceptable bearing in mind the fact costs significantly increase unit product cost given production circumference.
According to rough statistic estimates special holding tools costs and material cost proportion is 5:10. As well as in statistic data most of special milling and drilling holding tools costs depending on construction complexity are from 20-100.000 dinars. Few domestic firms is capable of financing and designing 50, 100 and more special holding tools for developing relatively more complex product. From the abovementioned reasons, without clear economic indicators domestic firms frequently engage in own designing and tool production. Tool designing and production costs in own sections has an advantage only from the lower instantaneous engagement of financial means. However, actual cost of tool produced in unspecialized firms will be even much higher and its quality questioned. Often designed and processed tools are being reconstructed after testing. In some cases due to errors in designing completely new constructions are being performed. Special tool constructions are rarely optimized from the aspect of tool weight, stability, technological processing and other aspects. Standard elements application and typified constructions level is low. Frequently, as an outcome high product costs occur as well as logically low market competition.

3. PROBLEMS OCCURING WITH ASSEMBLING AND DISASSEMBLING TOOLS

Assembling and disassembling tools in industry known as BAUKASTEN; UMA and other systems are featured with high flexibility and short period of time required for composing tools. Their application is economically completely justified, especially in piece and low scale production. From that aspect it would be logical that in low production environment such as domestic metalworking industry those tools be used more frequently. However, the key problem is lack of significant financial means required for initial investment in these tools. Namely, full effects of their application are recognizable after three to five years. It should be mentioned that most of developed assembling and disassembling tool systems have drawbacks from the aspect of stability (high number of elements in composition and their connections in assembly block) and level of mechanization and automation. Problems occurring with composing holding tool construction from standard elements especially in the case of complex tools require knowledge of an entire system composed of up to thousand elements. In domestic metalworking industry experts working on designing special holding tools do not have significant experience in composing assembling and disassembling tools on basis of developed systems. Technicians and engineers working for years on designing special holding tools frequently themselves present a barrier for introduction of progressive assembling and disassembling tool constructions. Industrially developed countries refuse application of special holding tools and for years apply complex systems of assembling and disassembling tools. Thanks to significant investments in those systems, knowledge and experience in working with them those countries are largely prepared to respond to all challenges market may impose on them. They rapidly adjust to new production programs products not being under influence of new tool investments.

4. POSSIBLE GUIDELINES FOR ENHANCEMENT OF HOLDING TOOL MANAGEMENT

Problems occurring in holding tools management in domestic metalworking industry is obviously stressed. Its solution should not be expected in short period of time. Introduction of expensive assembling and disassembling system tools is almost impossible given the required initial investments and status of domestic commerce. Things that can be done refer to number of factual and in author's opinion economically justified reasons. Suggestions refer to gradual development of own assembling and disassembling system tools, that is:

- Development of typified assembling and disassembling tool constructions
- Tool elements production in large scale production
- Standardization of basic tool elements (base, tool body)
- Application of developed assembling and disassembling system elements (BAUKASTEN, UMA)
- High usage of standard breeding elements (nuts, springs etc)

If certain firm intends to gradually develop own assembling and disassembling tool system in future period of time then every next tool construction should largely represent part of that system. Assembling and disassembling system is gradually developed and tools are designed on basis of highest accessibility of standard and typified elements and lowest usage of special elements. In every next construction part of special elements should as low as possible. In first step it should be tried to standardize and typify massive and expensive constructions of tools elements (bases and tool bodies). Application of relatively cheap elements, developed assembling and disassembling systems (pilots, clamps) would have great importance. In such a way physical base of elements would be gradually filled and would in few years become in serious and flexible assembling

and disassembling tool system. On this occasion an approach and a construction of basic tool plate of higher overalls.

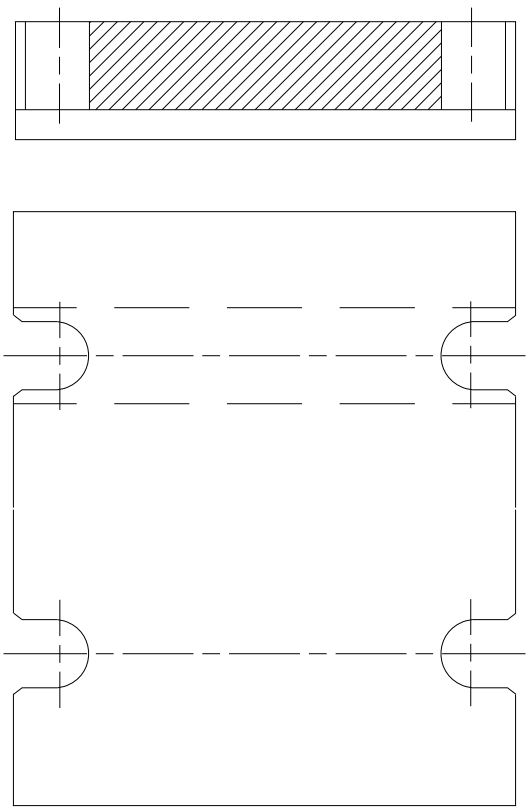

Figure 1: Basic tool plate of higher overalls

Basic plate production of higher overall requires high material spending and time for machining and adequately high price. It is featured with low flexibility for it frequently being used for specific holding tool and probability to be used in construction of other tool is very low. Starting semi-finished article for producing this tool element are usually standard plates gas cut which is increasing material spending and processing time. Manipulation and storing of these elements presents additional problem. However, cost of these plates is three to five times cheaper from plates developed using disassembling tool systems. Predominantly from that reason, regardless of low flexibility, these plates are present in domestic metalworking industry.
One of the most common basic plate constructions disassembling tools is shown on picture 2. This construction is featured with high flexibility, stability and high price especially when it is a plate of higher overalls. This element of assembling and disassembling tools is produced from alloy steel for case hardening. Processing of resting and aligning surfaces is performed by drilling with punctuality of order of magnitude 0.02 mm. Predominantly due to high price this tool element has not found its way in large scale production.
Two shown basic plates construction are significantly different, mostly from the aspect of price and flexibility. The objective of this paper is to suggest one of the possible solutions for the basic plate of higher overalls using an example which would largely feature good characteristics of previously presented solutions. That is, by special holding tool basic plate price, assembling and disassembling plate flexibility and satisfactory stability of construction. In picture 3 construction of suggested solution for basic plate of higher overalls is shown.
Suggested construction features:

- Satisfactory stability with two to three times of material saving
- High technicality of processing
- High flexibility
- Lower price compared to basic plates of special tools and basic plates of known assembling and disassembling flexible system tools.

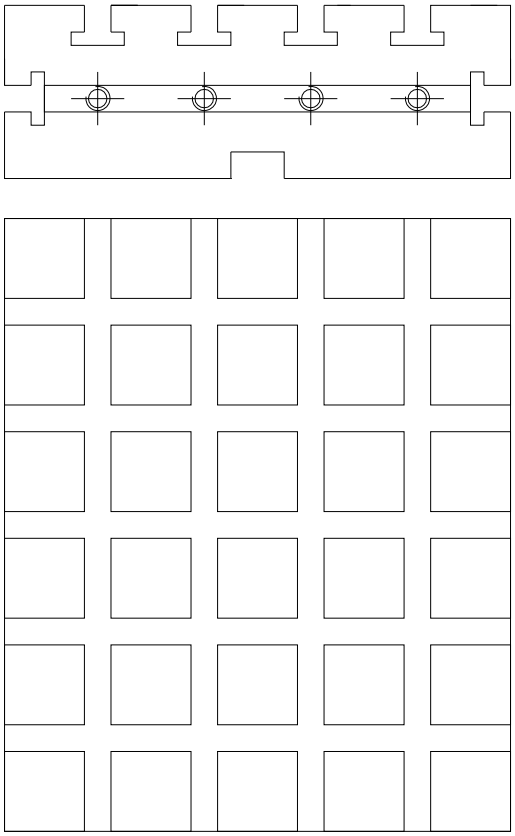

Figure 2: Basic plate constructions disassembling tools

Satisfactory as well as high stability is represented mostly in high number of double caulked seams. From the mechanic point of view construction is performed in shape of spatial lattice girder which largely increases its stability. Shape and depths of formed prismatic openings enables forming of very stable connection of basic plate with tool elements.
Entire construction is formed from standard rectangular steel profiles and screws as standard elements. Production technology can be explained as follows:

- Cutting required length bars from standard profiles
- Flute milling
- Opening drilling
- Flute and flat surfaces grinding in assembly block

According to most of technological factors (volume of cut material, possibility of processing more elements in assembly block, problem in reaching required punctuality , form complexity) this construction has many advantages compared to previously shown construction.
High construction flexibility features the following:

- It is possible to attach basic plate for milling machine table or driller over standard clamps, without using extra elements. Connection is possible on more spots which increases system stability.
- It is possible to compose plates of different overalls from the same elements
- By very construction basic plates has basic surfaces for aligning and connecting tool body and other elements
- Connection of other elements with basic plate can be achieved by inserting holding plates in an interior of a plate (like in BAUKASTEN and UMA systems) without extra work (opening, screw threads)

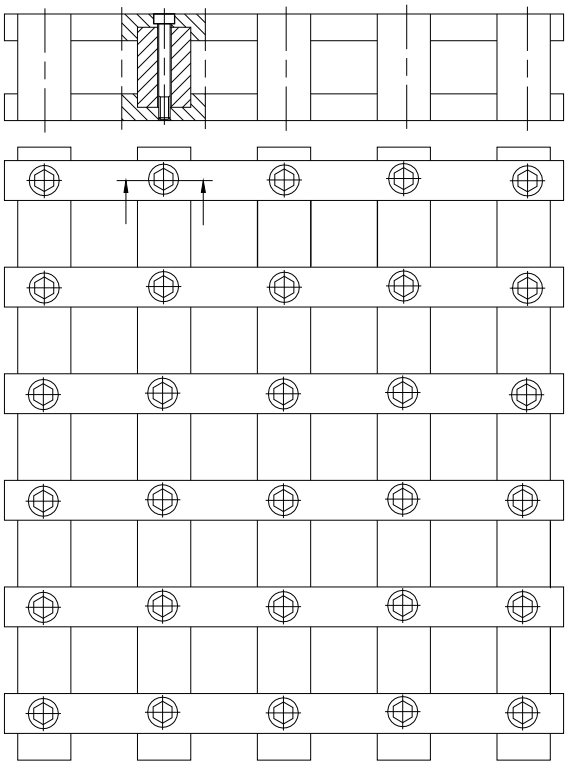

Figure 3: Basic plate of higher overalls

According to performed analysis and estimates of material spending and required processing time it is concluded that shown construction is justified from the economic aspect. According to results of the analysis, every basic plate (picture 3), with overalls higher that 250x250mm would be cheaper than special processed basic plate (picture 1). Especially high economic effects are achieved in basic plate constructions of higher overalls. In those cases high material saving and time saving required for processing are achieved.
Besides the mentioned, this construction has advantages from the aspect of transport costs as well as storing and manipulating.

5. CONCLUSIONS

According to given consideration a conclusion that output effects of production processes, even in low production process greatly depend on management level of holding tools. In domestic metalworking industry holding tools management level is at very high level. This claim is clarified by high presence of multitude of non-standard and non-typified special constructions of low level of flexibility and low presence of flexible assembling and disassembling constructions. Raising the level of management with holding tools in low production process, multitude of production processes and lack of financial means can be achieved over:

- Gradual development of own assembling and disassembling systems and if possible by firm merging in purpose developing mutual systems.
- Using cheap standardized elements of assembling and disassembling tool systems and
- Gradual removing of holding tools and their elements from usage

Transition from special holding tools to assembling and disassembling tool would be achieved by gradual introduction of flexible elements according to estimates in period of three to five years with insignificant material investments having positive effects. Namely, after certain period of time (three to five years) firms would have their own systems of assembling and disassembling tools and later investments would be minimal.

ACKNOWLEDGEMENTS

The presented research work was financially supported by the Ministry of Science of Republic Serbia. (Project No. TR-6218A).

REFERENCES

[1.] Arsovski, S, Tadic, B, Devedzic, G, Razvoj podsistema za automatsko postavljanje i stezanje delova u FTS, IV Naucni skup fleksibine tehnologije , Novi Sad, 1990.
[2.] Pajic, D, Konstrukcija i primena steznih alata, Zavod za udzbenike i nastavna sredstva Srbije, Beograd 1985.
[3.] Tadic, B, Specijalni stezni probori – zbirka resenih zadataka, Masinski fakultet u Kragujevcu, Kragujevac 2002.
[4.] Solaja, V, Pomocni pribori, Masinski fakultet u Beograd , Beograd 1970.
[5.] Milosevic, M, Pomocni pribori, Skripta, Visa tehnicka skola u Kragujevcu, Krgujevac, 2001.
[6.] Catalogs of flexible holding tools.