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CAM PARAMETERS SETTINGS AND NC MILLED SURFACE QUALITY

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Abstract: *Generally CAD system allows realising required shape surface quality relatively easily. On the other hand the parameters of copying accuracy of plane by cutter have some influence to number of lines of programme, operation time on one hand and to and to quality of surface on the other hand. Optimisation of these parameters is important, as we need to minimize operation time and to achieve required quality of surface. Exact and optimal specification of CAM parameters with reference to surface roughness and effectively of economic cost is possible by means of computer simulation of manufacturing. This paper deals with setting CAM parameters to quality of surface made by manufacturing of concave and convex surface that are used as radius transition between planes.*
Key words: *Manufacturing, FMS, CAD, CAD/CAM, CNC Milling*

1. INTRODUCTION

Great demands to manufacturing technology (Kuric et al., 2002) of pressing tools are required at present state of development of manufacturing (Katalinic, 2003) of free shape parts for automotive and consumer industry (complicated shapes, short developing time, high quality, …etc) (Fedorko & Molnár, 2006, Fedorko et al., 2006). Using of integrated design (Tichkiewitch & Brissaud, 2004) of products by CAD (Stanová et al., 2009) and generating of data by CAM modules for modern 3-5 axle CNC machine centres (Fabian & Spisak, 2009) provides possibility to fulfil requirements for quality of surface and shape of final products formulated by of designer and users too (Molnár & Fedorko, 2007). Many aspects have significant effect to quality of surface and shape (manufacturing technology, cutting accuracy, operation strategy and tool profile, …etc.) in advance technology (Fedorko & Molnár, 2006).

Influence of various strategies and parameters to surface quality of machining shape is presented at this paper with accent to quality of surface made by manufacturing of concave and convex surface.

2. THE INFLUENCE OF MANUFACTURING TECHNOLOGY TO QUALITY OF SURFACE AND SHAPE OF MANUFACTURED PARTS

By means of CAD system we are able to design shape of function surface of moulds. Particular parameter adjustment of CAM and appropriate strategy of tool path make possible to us to influence to quality of surface.

Precision of copying required shape of surface, to which we are able to set up by various features of precision pre-set parameters at CAM modulus of CAD system has great influence to result surface quality. Surface quality of mechanical products is frequently discussed. Quality is connected with utility properties, as well as with achieved accuracy of dimensions.

Still raising requirements to precision of finished components increase criteria to surface properties. Simply said in processing of surface the tool profile is transmitted to surface.

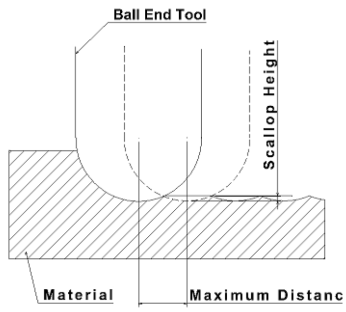

Fig. 1. SH (Scallop Height) – high of milling divided from distance of two next tool paths

Therefore from above mentioned, the effect precision of copying of CAD model by tool on surface quality of manufacturing shape is the result of investigation. Precision of the surface copying by tool has influence on number of program lines and manufacturing lead-time of processing. This precision is possible to modify by variables, which we are able to adjust in CAM modulus when we insert parameters of tool path. So parameter is value of distance between two next tool paths (MD-Maximum Distance) alternatively high of milling, which is acceptable after two next tool paths (MSH-Maximum Scallop Height, Fig. 1.). Following setting either one or another from above mentioned parameters program will compute distance between two next tool paths. The effect of setting of these parameters results to quality of machined surface.

3. QUALITY OF CONCAVE AND CONVEX MANUFACTURING

In models as transition between surfaces are made by connection mostly by shape „chambers“. These shapes could be concave or convex. This paper deals with quality of surface made by manufacturing of concave and convex surface that are used as radius transition between planes.

For case-study was used example of manufacturing above-mentioned surfaces so mode that lateral work movement of tool will be in vertical direction and roughness will be measured and evaluated across to tool trajectory. (Fig. 2.) Consequently the surface roughness of specimens manufactured by so approach was measured.

Measurement was made using digital roughness-meter (MITUTOYO). The moving of roughness-meter sense probe was realized in direction across the cut tool trajectory. Under normal conditions average arithmetical variance of profile Ra was measured for manufactured surfaces. Value of milling parameter was associated with measured value Rz - maximum depth of roughness.

Both shapes of surfaces were machined with end milling cutter and copying cutter with the diameter D=5mm and D=10mm. There were used two kinds of values MSH (MSH=50µm and MSH=10µm).

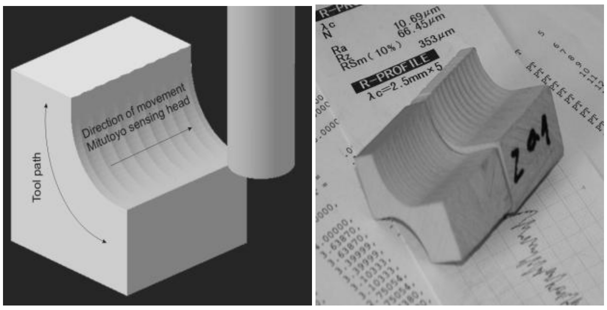

Fig. 2. Tool path and comparison of results for two various pre-set CAM attributes of milling (concave manufactured shape).

4. CONCLUSIONS

On the base of made experiments we can formulate some partial issues. In the case of manufacturing of concave surface in vertical direction there are following influences:

- Influence of tool diameter - using of flat milling tool in cutting manufacturing gives better values of Rz for tools with smaller diameter Rz=34-40μm on the one hand and Rz=46-52μm for tool with greater diameter. Similar rule exists for ball tool.
- Influence of machining strategy - various strategies have no significant influence to final quality of surface.
- Influence of tool shape - if roughness is measured in across direction, qualitative parameters are better if surface is manufactured using flat milling tool as using ball milling tool (in case of tool diameter D=5mm.
- Influence of precision improving of manufactured surface (reduction of scallop height) – with selection of parameter MSH=50μm resultant values of Rz were Rz = 48-57μm for flat milling tool and Rz=61-68μm for ball milling tool. Received values are close to software-selected parameters. In case of precision enhancement to MSH=10μm resultant values of Rz were Rz=34-40μm for flat milling tool and Rz=38-46μm for ball milling tool. For for flat milling tool with diameter D=10mm is Rz=46-52μm and for ball milling tool is Rz=42-46μm.

From experiences as the best variant for manufacturing with flat milling tool with diameter D=5mm is MSH=50μm. By increasing of operation accuracy we will receive surface with better quality. The most quality surface we will receive with flat milling tool with diameter D=5mm is MSH=10μm.

In the case of manufacturing of convex surface in vertical direction there are following influences:

- Influence of tool diameter - using of flat milling tool in cutting manufacturing gives better values of Rz for tools with smaller diameter Rz=32-35μm on the one hand and Rz=40-47μm for tool with greater diameter. But for ball tool it is reversal and surface with better quality we will receive for tool with diameter D=10mm Rz=34-40μm on the one hand and Rz= 39-44μm for tool with diameter with diameter D=5mm.
- Influence of machining strategy - various strategies have no significant influence to final quality of surface.
- Influence of tool shape - if roughness is measured in across direction, qualitative parameters are better if surface is manufactured using flat milling tool as using ball milling tool (in case of tool diameter D=5mm. If tool with diameter D=5mm is used, better surface is received using ball tool.
- Influence of precision improving of manufactured surface (reduction of scallop height) – with selection of parameter MSH=50μm resultant values of Rz were Rz = 53-57μm for flat milling tool and Rz=63-69μm for ball milling tool. Received values are close to software-selected parameters. In case of precision enhancement to MSH=10μm resultant values of Rz were Rz=32-35μm for flat milling tool and Rz=39-44μm for ball milling tool. For for flat milling tool with diameter D=10mm is Rz=40-47μm and for ball milling tool is Rz=34-40μm.

From experiences as the best variant for manufacturing with flat milling tool with diameter D=5mm is MSH=50μm. By increasing of operation accuracy we will receive surface with better quality but not with significant effect. The most quality surface we will receive with flat milling tool with diameter D=10mm is MSH=10μm.

Parameters of precision of surface copying by tool have significant influence to number of program lines, lead time, as well as to quality of surface and shape. Therefore it is important to optimise these parameters so way that we receive valid value quality of surface and shape with reasonable lead-time. Usually it is applicable transfer by milling "information" to tool (moulds) about surface. Then required final value superficies is not insufficient. This value could be consequently reached using another finishing operation, e.g. grinding and polishing. Exact and optimal specification of CAM parameters with reference to surface roughness and effectively of economic cost is possible by means of computer simulation of manufacturing.

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