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DEVELOPMENT A GROUP FIXTURE SYSTEMS FOR MACHINING CENTERS

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Abstract: *A special problem in the construction of the fixture is a limited workspace of machines and large overall dimensions of the workpiece. This problem is especiall pronounced during machining in more work plane at machining centers. In these cases, recognize fixture systems can not be applied. The dedicated fixture systems, in parinciple, could satisfay the basic function but have a number of disadvantages in terms of high costs and low flexibility, especially when it comes to machining process of geometrical and technological similar workpiece. This paper presents a model of group fixture system that allows cutting process with different cutting tools in four work plane. Construction of group fixture system has been optimized from the aspect the minimum required workspace of machines. This very complex problem of design was solving through optimization phase of a large number of conceptual solutions, phases of numerical analysis of structures and phase of calculate making errors.*
Key words: *group fixture, finite element analysis, stiffness.*

Razvoj sistema grupnih pribora za obradne centre. *Poseban problem prilikom konstruisanja pribora je ograničen radni prostor mašine alatke i velike gabaritne dimenzije radnog predmeta. Ovaj problem je posebno izražen u procesu obrade u više ravni rezanja na obradnim centrima. U ovim slučajevima, postojeći sistemi pribora se ne mogu primeniti. Specijalni sistemi pribora, u principu, ispunjavaju osnovne funkcije, ali imaju brojne nedostatke u pogledu visokih troškova i niske fleksibilnost, posebno kada je reč o procesu obrade geometrijski i tehnološki sličnih radnih predmeta. U radu je prikazan model grupnog sistema pribora koji obezbeđuje proces rezanja sa različitim reznim alatima u četiri ravni obrade. Konstrukcija grupnog sistema pribora je optimizovana sa aspekta minimuma potrebnog radnog prostora. Izuzetno kompleksan problem projektovanja je rešen kroz optimizaciju faze velikog broja konceptualnih rešenja, fazu numeričke analize konstrukcija i fazu proračuna grešaka izrade.*
Ključne reči: *grupni pribori, metod konačnih elemenata, krutost.*

1. INTRODUCTION

Design of fixture systems in conditions of limited workspace of machines is a very complex problem. Especially when cutting processing is performed on the thin-walled workpieces in more work plane, which is more often case in cutting process on horizontal milling machine centers [1]. Small dimensions of workbenches machining center, in the processing of parts of larger dimensions, disabling the formation of stable structures of the fixture systems [2].

In the theory of fixture, systems have been developed many techniques related to the fixture layout optimization to achieve optimal effects. Developed techniques finite element analysis (FEA), artificial neural networks (ANN), genetic algorithms (GA) and many other combined techniques allow solve many problems. Chen et al. [3] presented the results related to the fixture layout design and clamping force optimization procedure based on the GA and FEA. Deng et al. [4] presented a model-based framework for determining the minimum required clamping force, which ensures the dynamic stability of a fixture workpiece during machining. Xiuwen et al. [5] reported a model for improving workpiece location accuracy by optimizing the clamping force. Ishikawa and Aoyama [6] used the GA to determine the optimal clamping condition for an elastic workpiece. Kaya [7] presented a GA-based continuous fixture layout optimization method. Krishnakumar and Melkote [8] presented a GA-based discrete fixture layout optimization method to minimize the deformation of the workpiece under static conditions. Liu et al. [9] is proposed a method to optimize the fixture layout in the peripheral milling of a low-rigidity workpiece. Liao [10] used the GA to find the optimal numbers of locators and clamps as well as their optimal positions in sheet metal assembly such that the workpiece deformation and variation are minimized. Mittal et al. [11] presented a dynamic model of the fixture-workpiece system to analyze the fixturing stability of the system. Meyer and Liou [12] presented a methodology to generate the configuration of fixture, which was under dynamic machining. Padmanaban et al. [13] used an ant colony algorithm-based discrete optimization method and optimized the fixture layout under dynamic conditions. Tan et al. [14] described the modeling, analysis, and verification of optimal fixturing configurations by the methods of force closure, optimization and finite element modeling. Zuperl et al. [15] developed an intelligent fixturing system, which adaptively adjusts variable clamping forces to achieve minimum elastic deformation of the workpiece according to the cutter position and the dynamic cutting forces. Tian et al. [16] presented an approach for optimally selecting the locating positions of workpieces and identifying