

## POSSIBILITIES OF RETROFITTING AT THE HORIZONTAL MILLING CENTRE TMA AL 550 TO 5 AXES MACHINING AND FLEXIBLE CELL FUNCTIONS EXTENSION

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### Abstract

Keyword: *Five axes machining, flexible cell extension*

As results of the new relationship with the italian partner UCIMU, the University from Oradea received one milling centre TMA AL 550. The furnisher of this machine is Tacchella Machine, as member into italian UCIMU organization. Now this machine was introduced into machine tool laboratory, in order to develop one new computerized and integrated system laboratory at University from Oradea, Faculty of IMT.

### INTRODUCTION

In the past year 2007 Faculty of IMT from Oradea University begin the new relationship with UCIMU Italia, and his president Mr. Alberto Tacchella was decorated by award ceremony as Doctor Honoris Causa of Oradea University.

On this context the IMT Faculty started the developing of one integrated machine tool and flexible system laboratory, having the UCIMU support, by the receiving of one milling center TMA AL 550 type.

As next step this laboratory will be developed with the own capacity of the Faculty IMT, having the following objectives:

- the machine retrofitting to 5 axes machining, by changing of the actual axes structure of 3+1/2 axes (3 linear CNC axes and one rotary PLC-Hirth axis) to 5 CNC continuous axes (3 linear and 2 rotary CNC axes);
- the laboratory to be equipped with 5 axes robot for the automatic flexible function AWPC (Automatic Work Piece Changing) on the pallet;
- one load station for the parts;
- the intelligent device developing for the machining cell level;
- the automatic logistic of the resource flows for: parts, tools, off-sets, etc;
- the computerized net with the access of the students at the CAD-CAM software and the process control.

### ABOUT THE ACTUAL MACHINE

The machine TMA AL 550 is one horizontal machining centre with 3 continuous linear axes and one rotation PLC/Hirth axis, equipped with ATC unit (Automatic Tool Changer) and APC system (Automatic Pallet Changer) with two stations.

The main characteristics of the machine are presented in the next list as follows.

The machine construction is presented in **fig.1**; the ATC is presented in **fig.2**, the layout in **fig.3**, the cube of the work space in **fig.4**, [1].

This machine is equipped with Sinumerik 3M control unit, linear Heidenhain scales on all axes, AC brushless synchronous servomotors, machine guarding, chip conveyor, hydraulic installation, lube system, cooling installation.

That means we have one machining center good enough (it was performed in 1996), but ready for retrofitting, in order to be modernized to arrive at the actual level.



## alesatrice "TMA AL550"

### *Caratteristiche principali*

**ANNO DI COSTRUZIONE: 1995**

matr. 1057

### **DATI TECNICI:**

- CORSA IN X:	mm 650
- CORSA IN Y:	mm 650
- CORSA IN Z:	mm 450
- AVANZAMENTI LAVORO:	mm/min 0÷2000
- RAPIDI:	mm/min 0÷10000
- POTENZA MOTORE MANDRINO:	KW 10
- VELOCITA' MANDRINO (2 gamme):	RPM 4500
- CONO D'ATTACCO MANDRINO:	ISO 40
- DISTANZA MIN ASSE MANDRINO-PIANO TAVOLA:	mm 0
- DISTANZA MIN NASO MANDRINO-PIANO TAVOLA:	mm 70
- DISTANZA MIN FILO MANDRINO-CENTRO TAVOLA:	mm 145
- TAVOLA DI LAVORO:	n° 2 pallet 500 x 500
- FORO DI CENTRAGGIO:	mm 50 H7
- RETICOLO DI FORI:	M12 passo 50
- CAPACITA' MAGAZZINO UTENSILI:	n° 34
- MAX DIAMETRO UTENSILI AFFIANCATI:	mm 95
- MAX LUNGHEZZA UTENSILE:	mm 250
- TEMPO CAMBIO UTENSILE:	sec 6
- PESO MAX UTENSILE:	Kg 10
- POTENZA MOTORE MAGAZZINO UTENSILI:	KW 0.12
- QUANTITA' REFRIGERANTE:	litri 50
- LUBRIFICAZIONE:	forzata ad impulsi
- CONTROLLO NUMERICO:	siemens sinumerik 3M
- ALIMENTAZIONE:	V 380 Hz 50

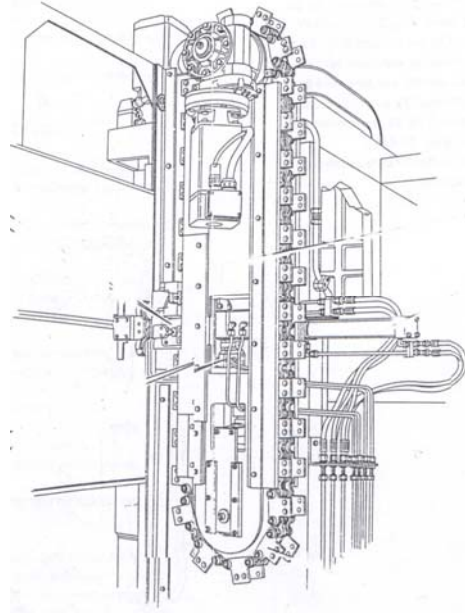
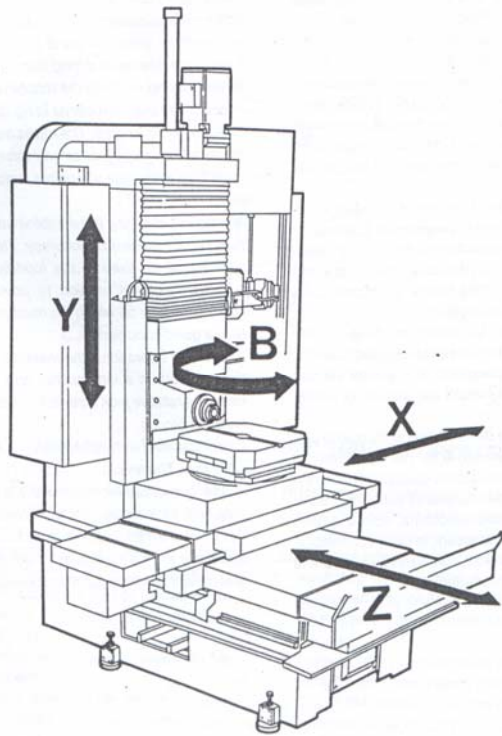


Fig. 1 – TMA AL 550 (left);

Fig.2 – ATC unit (over)

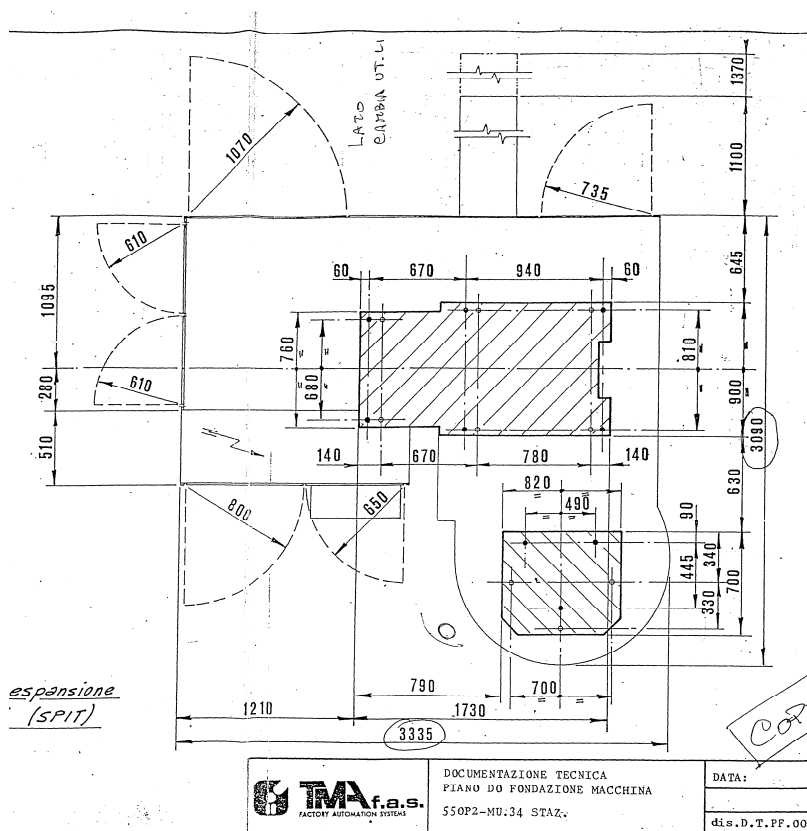


Fig. 3 – Layout of TMA AL 550

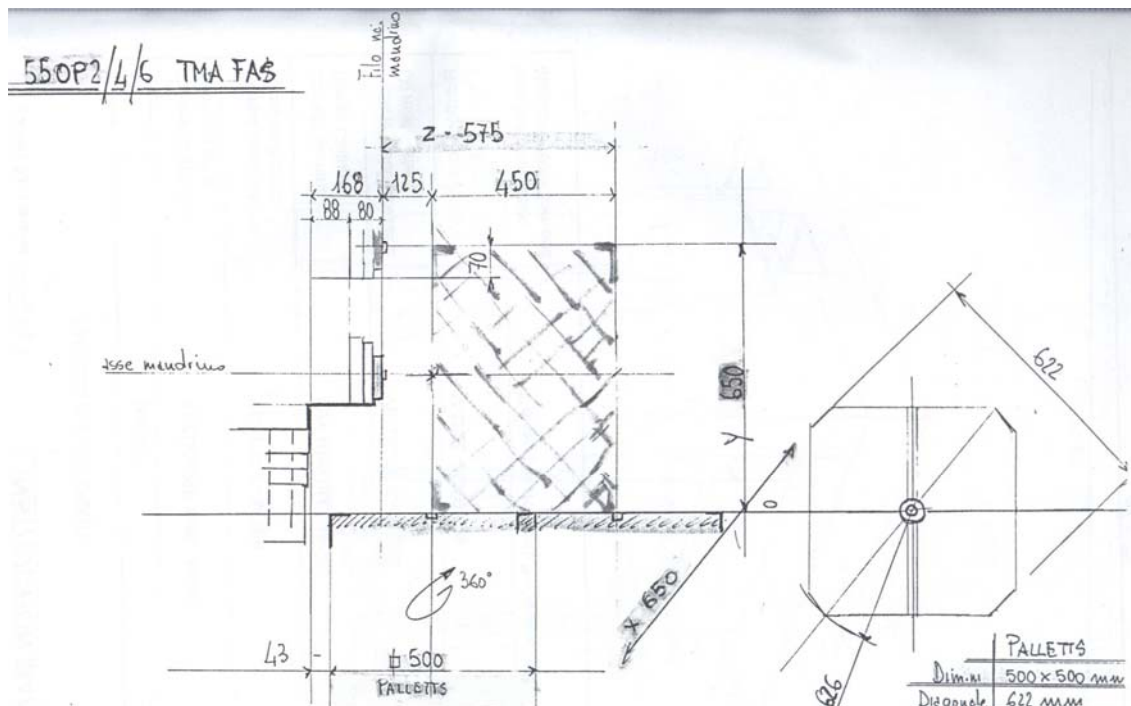


Fig. 4 – The cube of the work space

## ABOUT THE PLANED DEVELOPMENT OF THE LABORATORY

In order to have one modern machine and the integrated laboratory system, it is necessary to perform the machine retrofitting and the laboratory extension as follows:

### -- Development of the machine structure to five axes machining

For this objective it is necessary to modify the actual table feed mechanism in order to obtain the continuous movement and backlash system at the table rotation instead the actual Hirth coupling, to introduce the 4-th axis (with the scale transducer in middle of the table), the large precision bearing, the actuation by AC servomotor (and keeping of the pallet hydraulic lifting).

On the other hand, it is necessary to introduce the 5-th axis as the secondary smaller rotary table with diameter of 250 mm (table on table system), with similar conditions as for the 4-th axis, but on the board of one pallet. This table can be evacuated with the first pallet, or received ready to work with the machining part.

Also, it is necessary to change the CNC unit with 5 axes equipment TNC i530 Heidenhain and all the software functions included.

The principle of this machine is presented in **fig. 5**, inspired from the actual level [2].

### -- Laboratory extension with 5 axes robot.

This robot exists in the laboratory, but it need to be modernized on the electric part.

Here it is necessary to change the servomotors and drivers with new generation AC servomotors, with equipment of new generation, etc.

The robot function need to be used to made the table loading - unloading (the standard function AWPC – Automatic Work Piece Changing) on intelligent device on the board of the second pallet, with all the specific attributes.

Also, we need to perform more objectives in the future (the next one and half year):

- the retrofitting at the 5 axes robot;
- the new load-unload station, having 4 angular programmable positions;

- the new intelligent device (tombstone type), programmable by PLC;
- one automatic conveyor for the working parts;
- one new method for automatic part off-set acquisition and monitoring;
- one Regal lager for the different materials, accessible by the robot, PC controlled;
- about the tools, it need to solve the automatic off-set acquisition, considering the tool set actualization solved by increasing of the ATC capacity only;
- computer control for the entire system by the Ethernet structure;

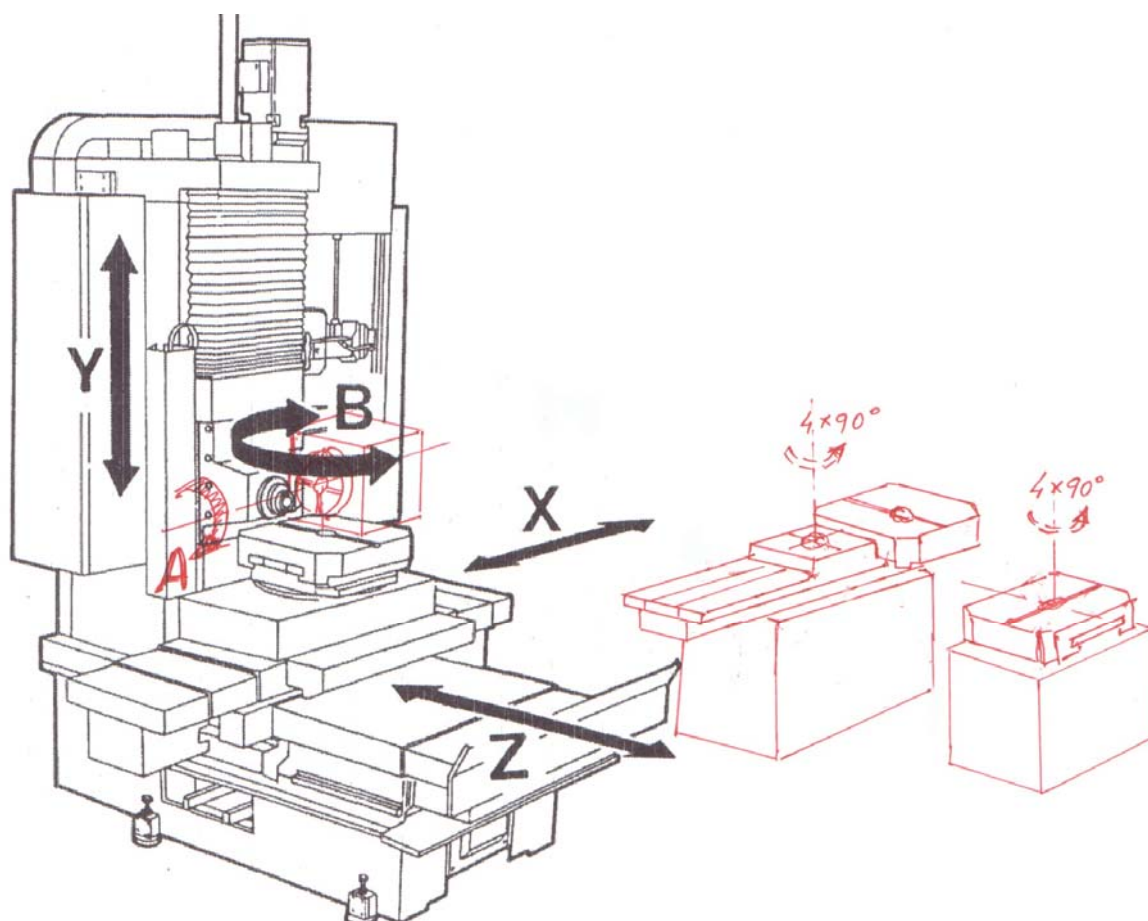
The new layout of the laboratory is presented in **fig. 6**.

Also, the APC system of the machine having two pallets, it is used as follows:

- the first pallet charged with the small table as 5-th axis, in the case of 5 axes machining;
- the second pallet charged with the tombstone device, in the case of using of AWPC function and the robot loading-unloading function.

Both cases are computer assisted in order to prepare by the students the programs and to control the process.

In the case of AWPC function the robot can be completed with Regal lager or conveyor system, and also device for automatic off-set parts caption, shoved in the new layout.



*Fig. 5 – TMA AL 530 with 5 axes and APC on load station*

## CONCLUSIONS

The authors of the present paper work planed to perform by retrofitting the modernization of the Machine Tools and Flexible Systems Laboratory of the IMT Faculty at Oradea University. The objectives of this action regard the five axes machining, the

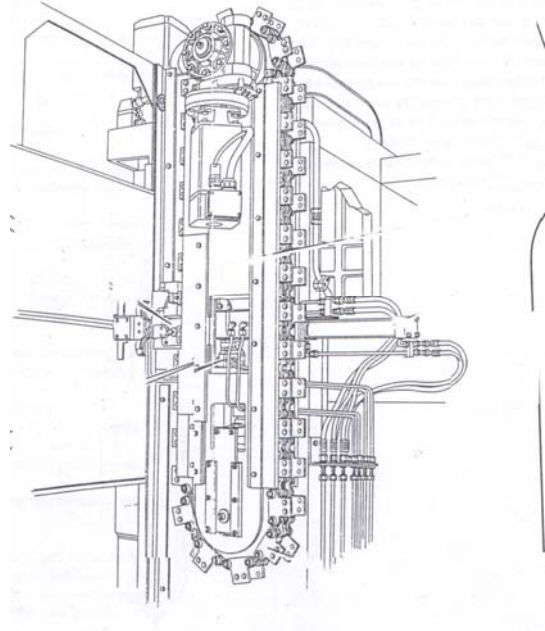
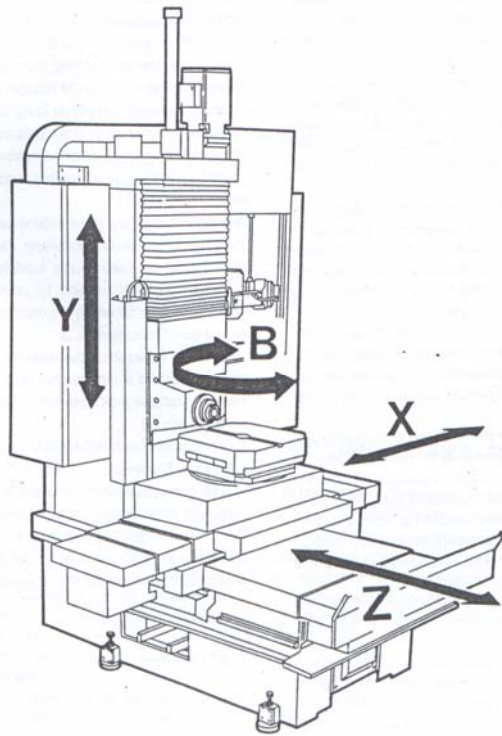


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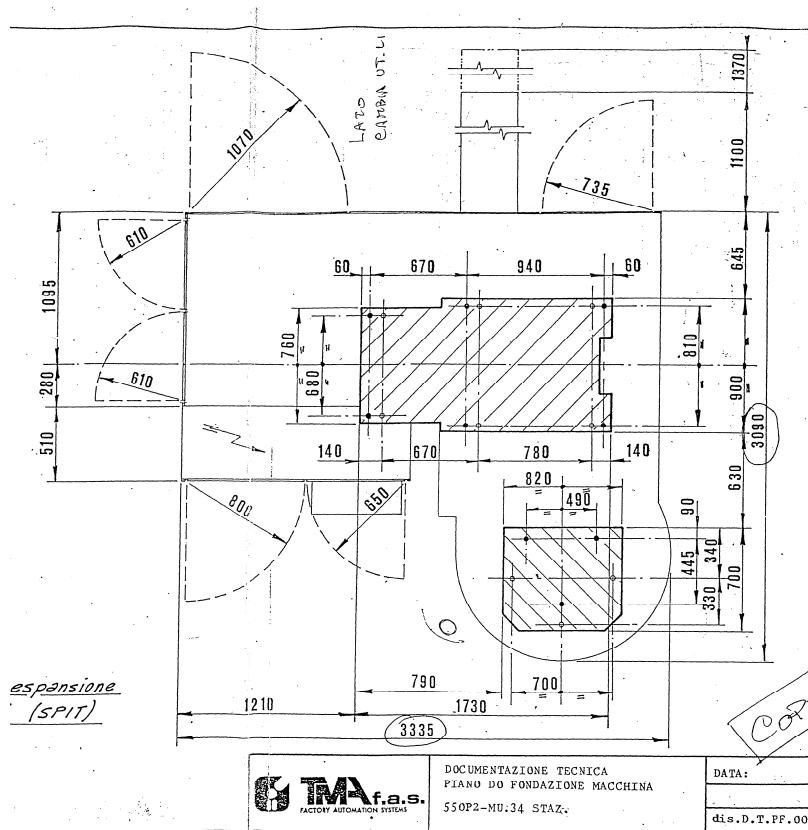


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