MANUFACTURING PROCESSES (TA-202)

AXIS DESIGNATION IN NC PART PROGRAMMING

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FUNCTIONS PERFORMED BY THE CONTROL SYSTEM OF NC MACHINE TOOL

- DISPLACEMENT OF SLIDE MEMBERS.
- ANGULAR ROTATION OF THE CIRCULAR TABLE.
- STOP / START – MAIN SPINDLE.
- CHANGE SPINDLE SPEED.
- REVERSE SPINDLE DIRECTION OF ROTATION.
- CHANGE FEED RATE.
- ROTATE TOOL TURRET.
- CHANGE TOOL.
- CUTTING FLUID – ON /OFF.
- LOCK TABLE IN POSITION.

FUNCTIONS PERFORMED BY THE CONTROL SYSTEM OF NC MACHINE TOOL

- M/T
  - MANUAL
  - SEMIAUTOMATIC → LESS EXPENSIVE
  - AUTOMATIC → EXPENSIVE

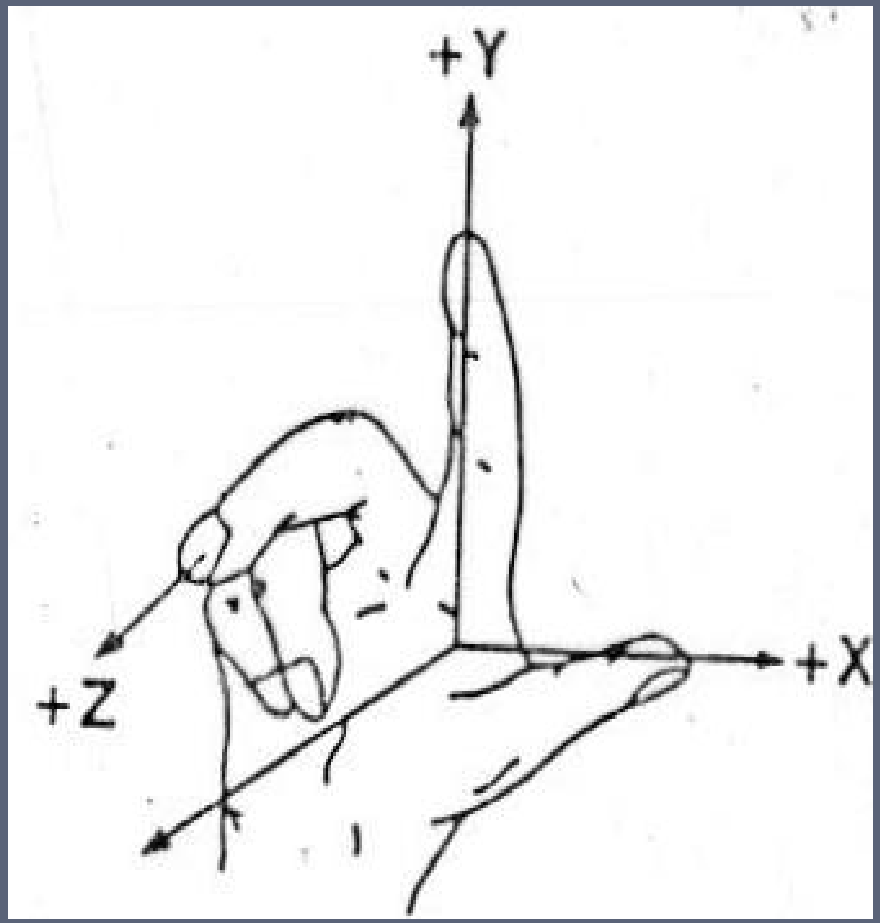
MAIN FUNCTION TO BE PERFORMED BY THE M/T

SLIDE DISPLACEMENT

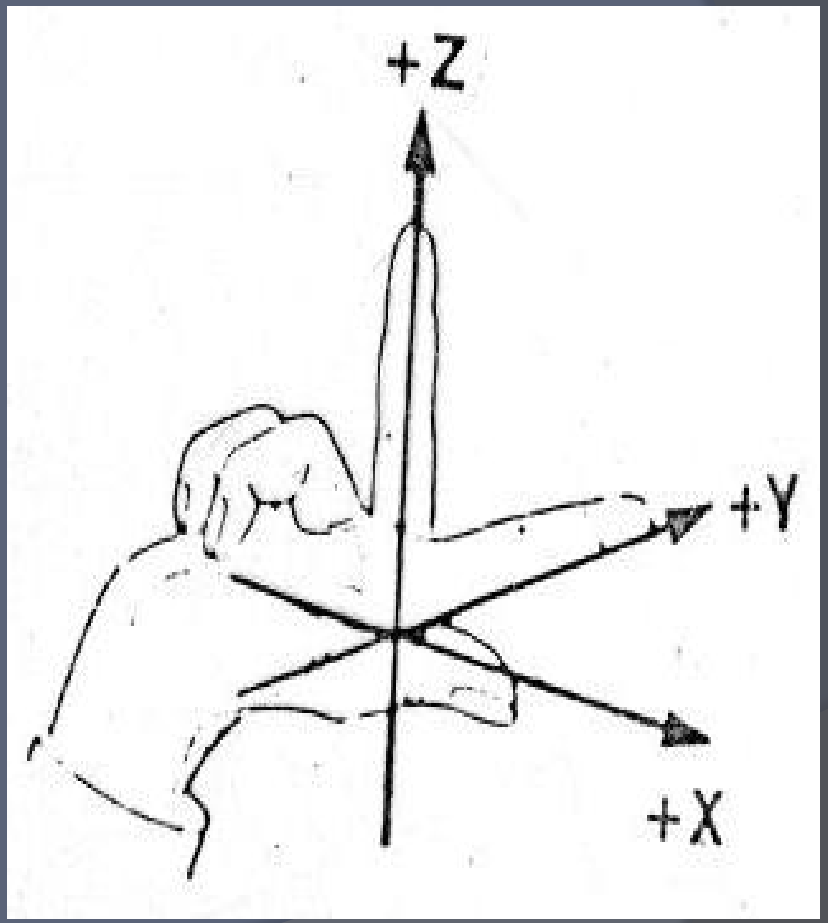
RELATIVE MOTION BETWEEN TOOL & W/P

- → X , Y & Z DIRECTIONS. ROTATION ABOUT X,Y AND Z AXES
- → FINAL COMPONENT

RIGHT HAND RULE FOR MACHINE TOOL AXES DESIGNATION



AXIS DESIGNATION FOR HORIZONTAL Z-AXIS

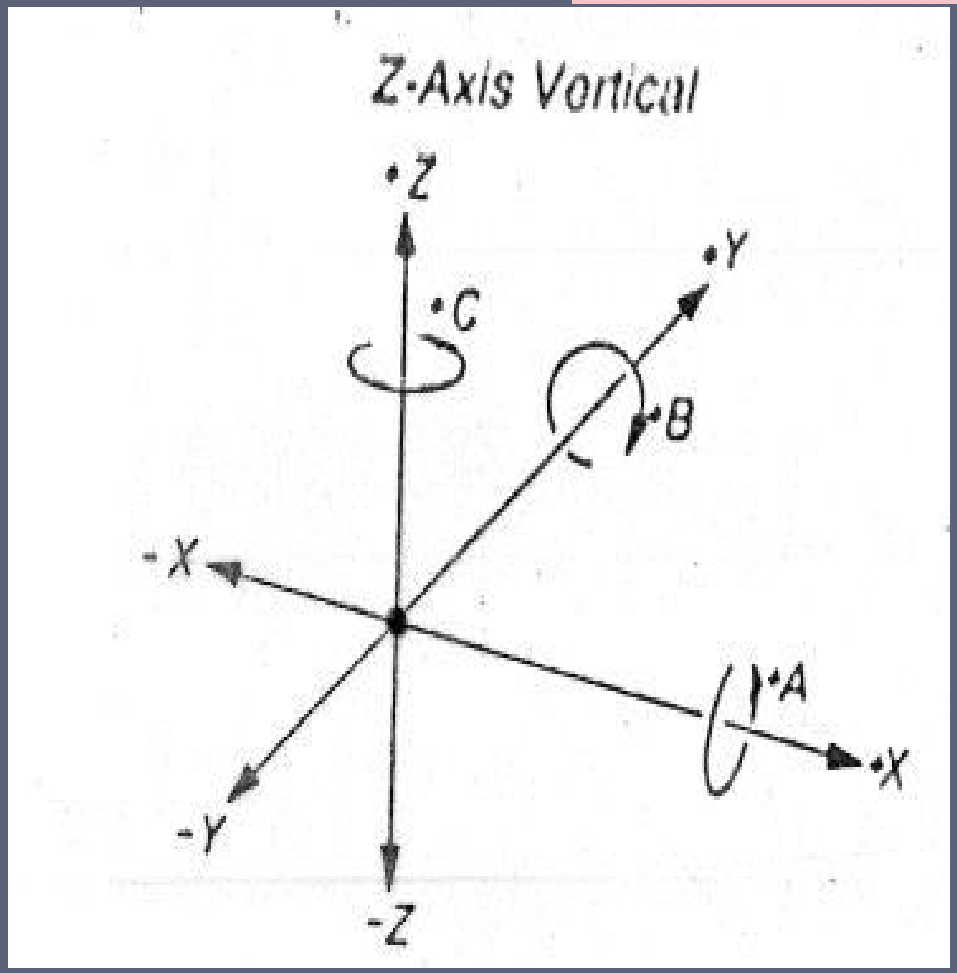


FOR VERTICAL M/C Z-AXIS

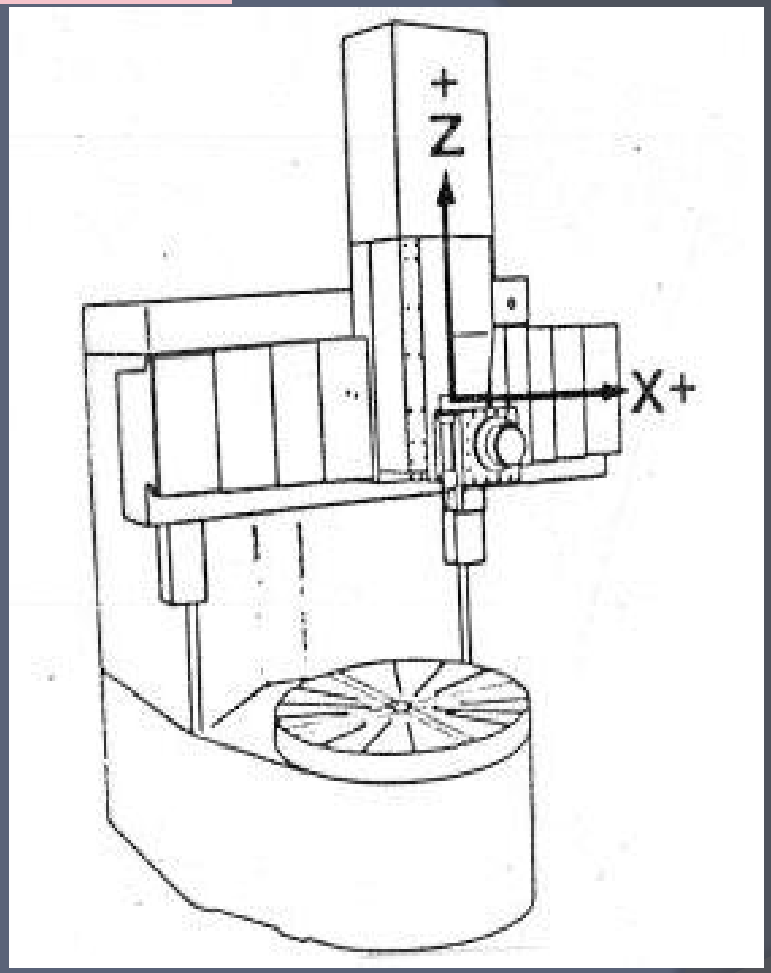
HOW TO DEFINE AN AXIS

- **EACH ROTARY MOTION MUST BE UNDER DRIVE MOTOR CONTROL TO BE CALLED – *AN AXIS***
- **ROTATION OF THE CUTTING TOOL ON THE SPINDLE – AN AXIS OR NOT ? NO**
- **AN INDEXING TABLE – MOVES A SPECIFIC AMOUNT ON A COMMAND SIGNAL FROM THE CONTROL UNIT – *AN AXIS***
- **CONSIDERED AN AXIS ONLY WHEN CONTROLLED FROM TAPE / CD INSTRUCTIONS AND HAVING OPEN LOOP OR CLOSED LOOP DRIVE.**

HOW TO DEFINE AN AXIS



CARETSIAN CO-ORDIANTE SYSTEM FOR DESIGNATING MAIN AXES OF NC M/T



TWO AXES VERTICAL LATHE

IDENTIFICATION OF THE MOTION

- **MOTIONS OF NC M/T IN X,Y AND Z DIRECTIONS HAVE BEEN STANDARDIZED AND ARE FOLLOWED BY MANUFACTURERS.**
- **IT IS THE RELATIVE MOTION OF THE CUTTING TOOL W.R.T. THE W/P THAT DETERMINES + OR – SIGN.**
- **BOTH THE M/T OPERATORS & THE JOB PLANNERS ALWAYS CONSIDER *TOOL TO BE MOVING ABOUT THE W/P*, EVEN IF THE W/P ACYUALLY MOVES AND THE CUTTING TOOL DOES NOT.**
- **A MOVE OF C/T W.R.T. W/P TO THE RIGHT IS TAKEN AS + AND TO THE LEFT AS – .**
- ***NOT EVERY MOTION OF A M/C QUALIFIES AS AN AXIS*** – Z MOVEMENT WOULD NOT BE A Z-AXIS IF Z MOTION IS SET AND CONTRLLED BY THE OPERATOR.
- THE AXES ARE DECIDED WHEN LOOKING AT THE MACHINE *FROM THE FRONT* IN CASE OF *VERTICAL M/C* AND *FROM THE BACK* IN CASE OF *HORIZONTAL M/C*.

NC CO-ORDINATE SYSTEM

- STANDARD AXIS SYSTEM TO SPECIFY RELATIVE POSITIONS – TOOL AND W/P
- USUSALLY W/P IS STATIONARY & TOOL IS MOVING.
- GUIDELINES :

Z AXIS

- THE MAIN SPINDLE (AXIS OF TOOL SPINDLE OR W/P ROTATES) IS TREATED – Z AXIS.
- +VE DIRECTION AWAY FROM THE W/P AND TOWARDS TOOL SPINDLE HOLDER.
- IN CASE OF MULTIPLE SPINDLES – ONE SPINDLE IS SELECTED AS PRINCIPAL SPINDLE & ITS AXIS AS Z AXIS.

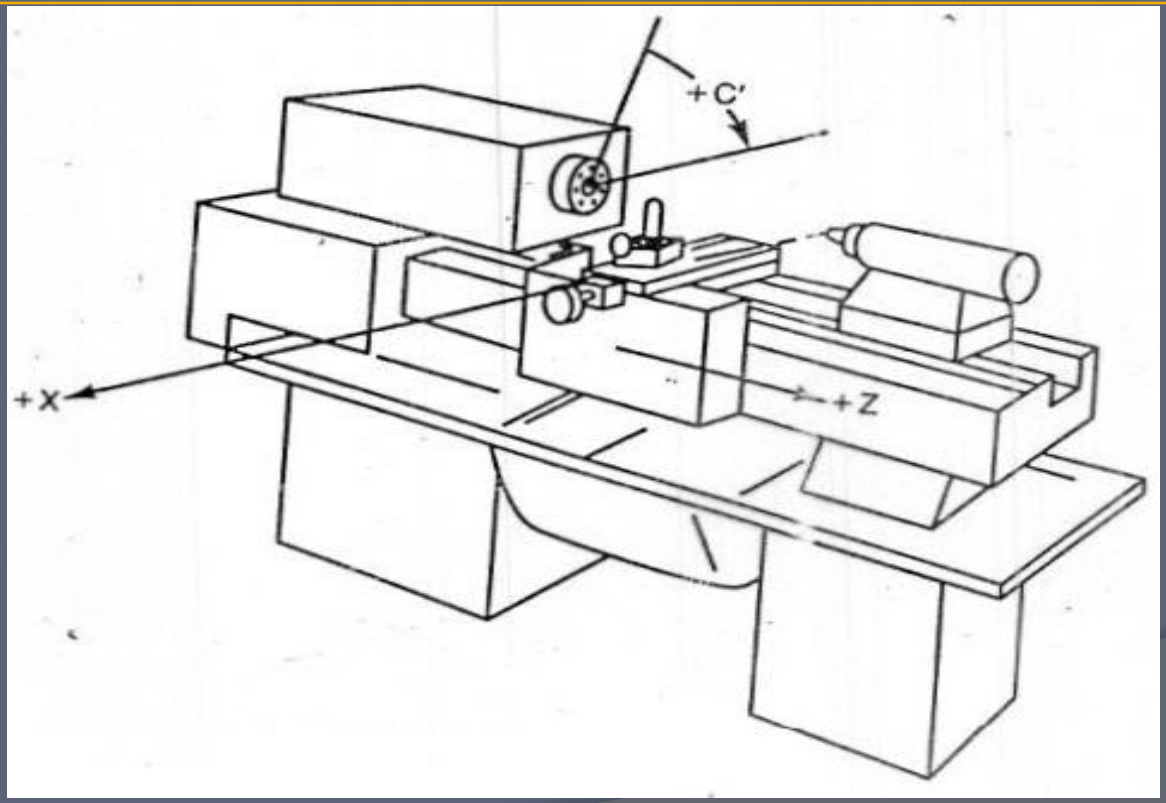
X AXIS

- HORIZONTAL & PARALLEL TO THE WORKING SURFACE.
- WHEN Z -AXIS IS HORIZONTAL : +VE X-AXIS TO THE RIGHT WHEN LOOKING FROM SPINDLE TOWARDS THE W/P .
- WHEN Z -AXIS IS VERTICAL : +VE X -AXIS – TOWARDS RIGHT – LOOKING FROM THE SPINDLETOWARDS SUPPORTING COLUMN.

NC CO-ORDINATE SYSTEM

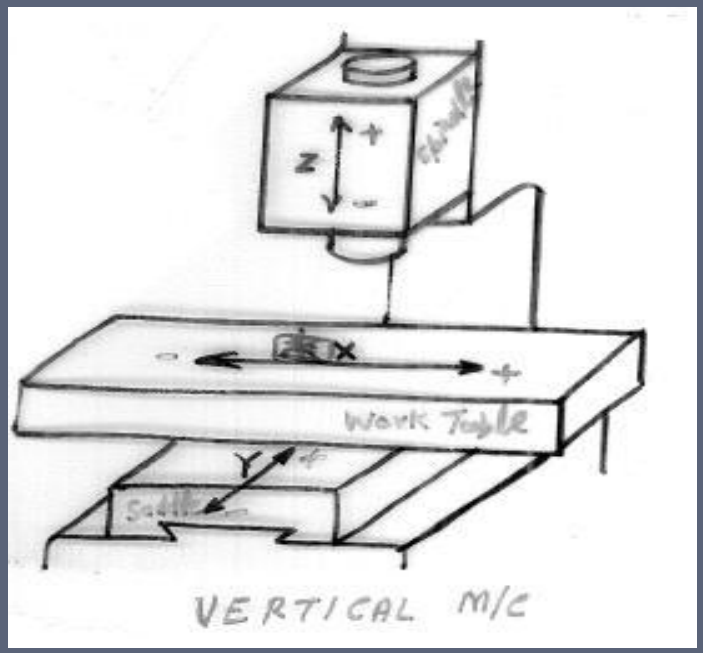
Y AXIS

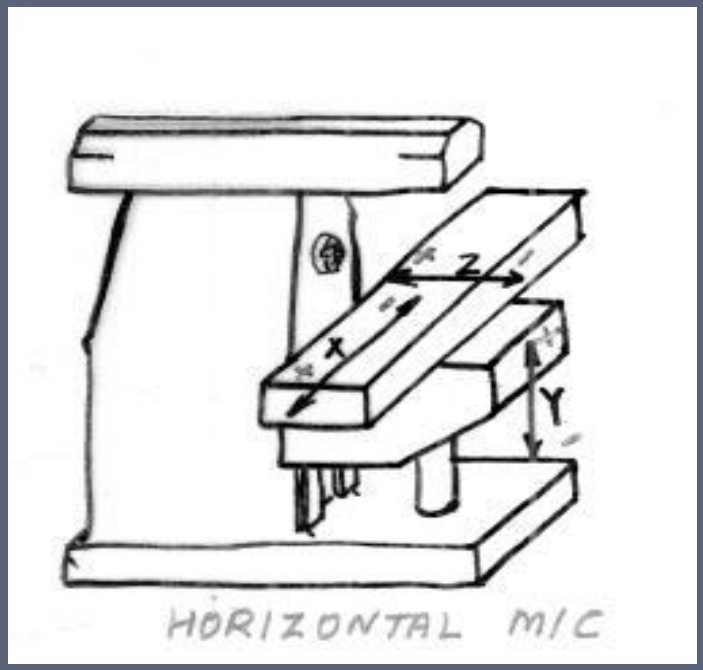
- **PERPENDICULAR TO BOTH X- AND Z - AXIS.**
- **FOR +VE Y DIRN – ROTATE X AXIS – ADVANCE RIGHT HAND SCREW IN +VE Z DIRECTION.**



ENGINE LATHE CUTTING TOOL MOVES ONLY ON THE X AND Z AXES

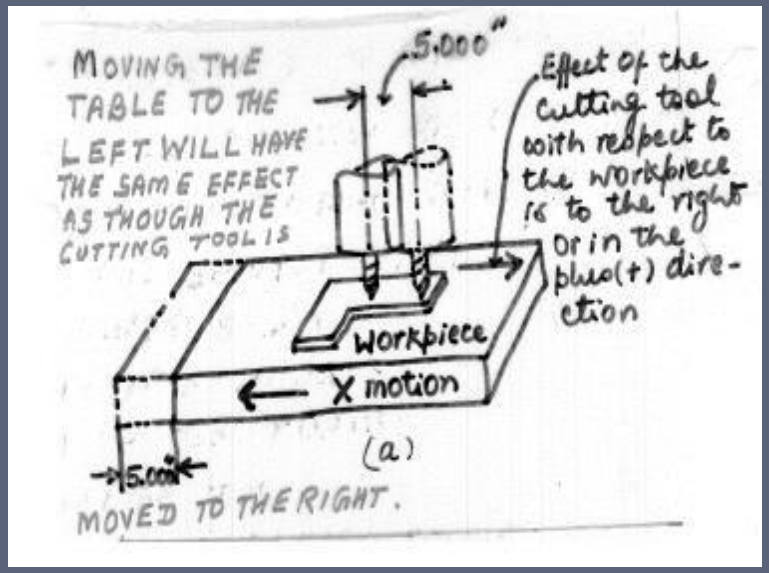
NC CO-ORDINATE SYSTEM

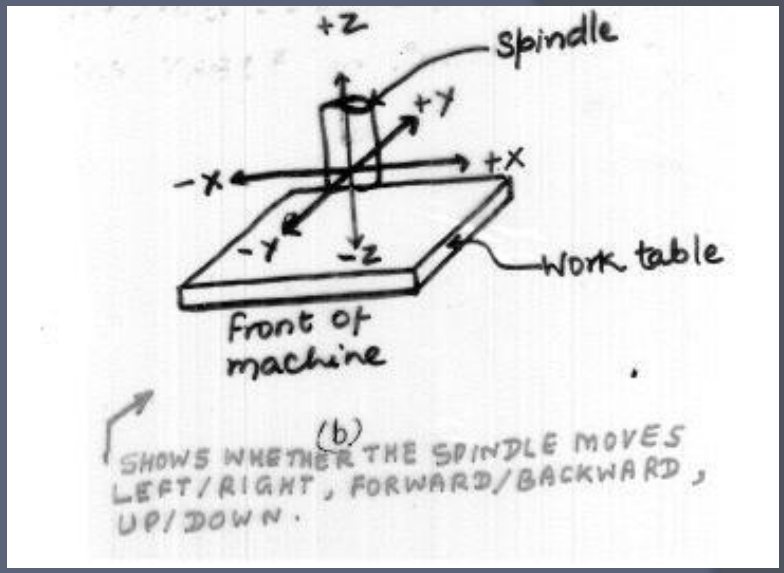


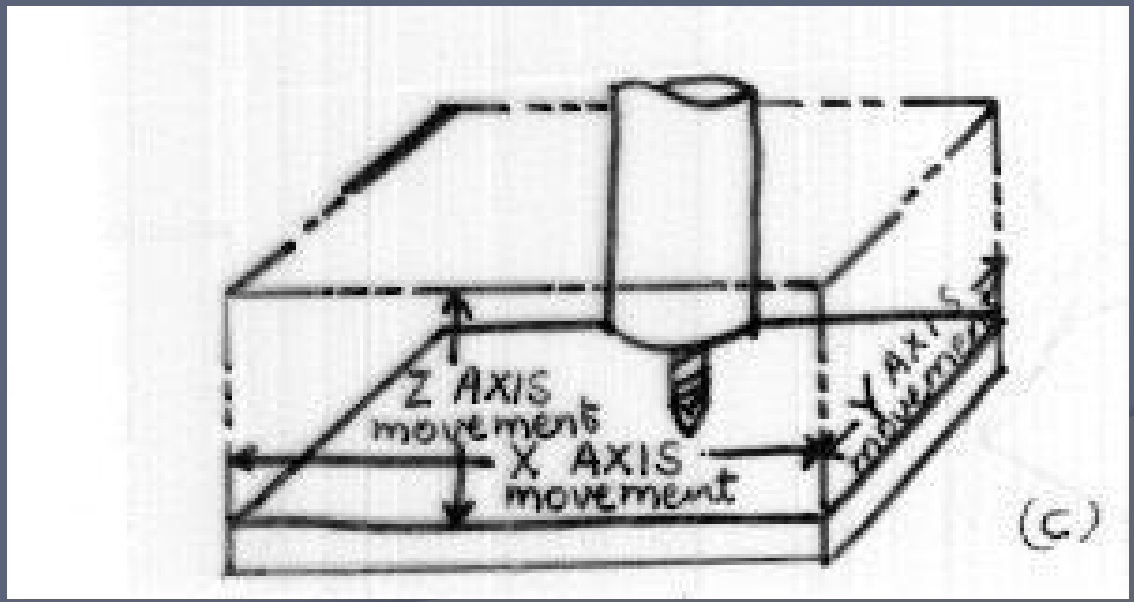


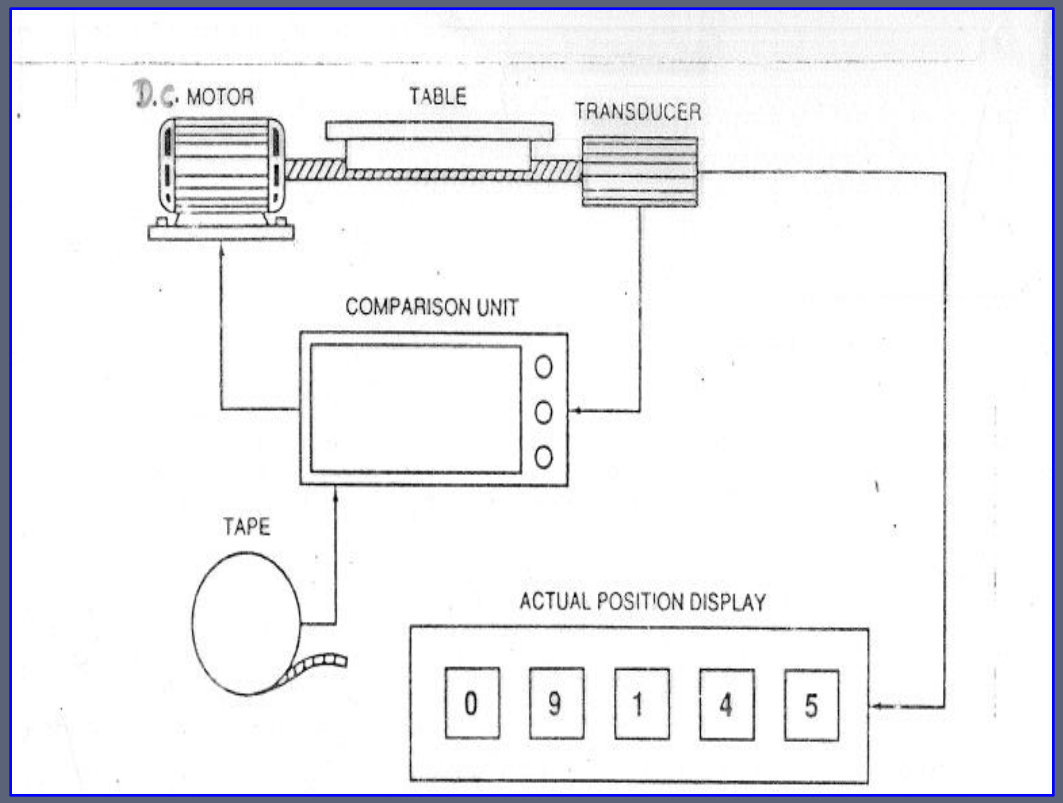
- ***X -AXIS*** **– A RIGHT MOVE OF THE C/T WRT W/P IS +VE AND ITS MOVE TOWARDS LEFT IS – VE.**
- ***Y AXIS*** **– IF A TOOL MOVES AWAY FROM THE OPERATOR - +VE IF TOWARDS THE OPERATOR –VE**
- ***Z AXIS*** **- +VE Z IF SPINDLE MOVES AWAY FROM THE W/P –VE Z IF SPINDLE MOVES TOWARDS THE W/P.**

ILLUSTRATION: NC CO-ORDINATE SYSTEM

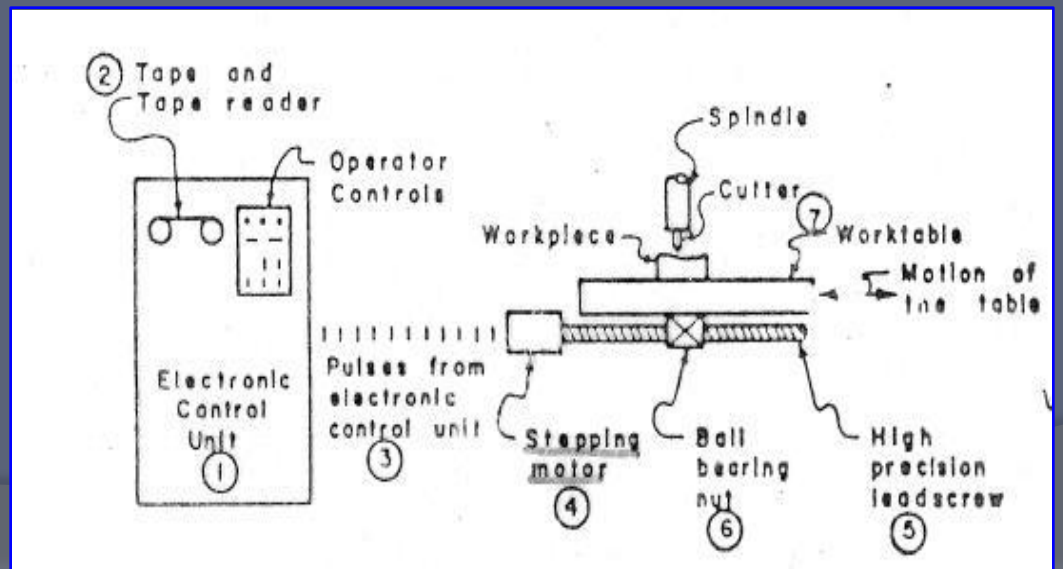








CLOSED LOOP SYSTEMS CONTAIN SOME TYPE OF FEEDBACK DEVICES TO MAKE SURE THAT THE MACHINE TABLE IS IN THE EXACT POSITION CALLED FOR BY THE MCU



PULSES ARE GENERATED BY THE ELECTRONIC CONTRL UNIT (1) IN ACCORDANCE WTH THE INSTRUCTIONS PUNCHED ON THE TAPE (2) THREE PULSES (3) DRIVE A STEPPING MOTOR (4) WHICH ROTATES A HIGH PRECISION LEAD SCREW (5). THE LEAD SCREW MOVES A BALL BEARING NUT (6) WHICH IS ATTACHED TO THE MOVINNG PART OF THE MACHINE TOOL SUCH AS THE WORKTABLE (7) OR THE SADDLE.

CUTTER SIZE COMPENSATION

- RESET IN DRILLING AND BORING.
- REDUCES SIZE IN MILLING.

TOOL DIAMETER COMPENSATION

- REGISTER MANUALLY THE COMPENSATION
- MODIFIES CUTTER PATH – MCU.
- COORDINATES NEED TO BE INCREASED / DECREASED DECIDED BY THE POSITION OF THE MACHINED SURFACE.

TOOL LENGTH COMPENSATION

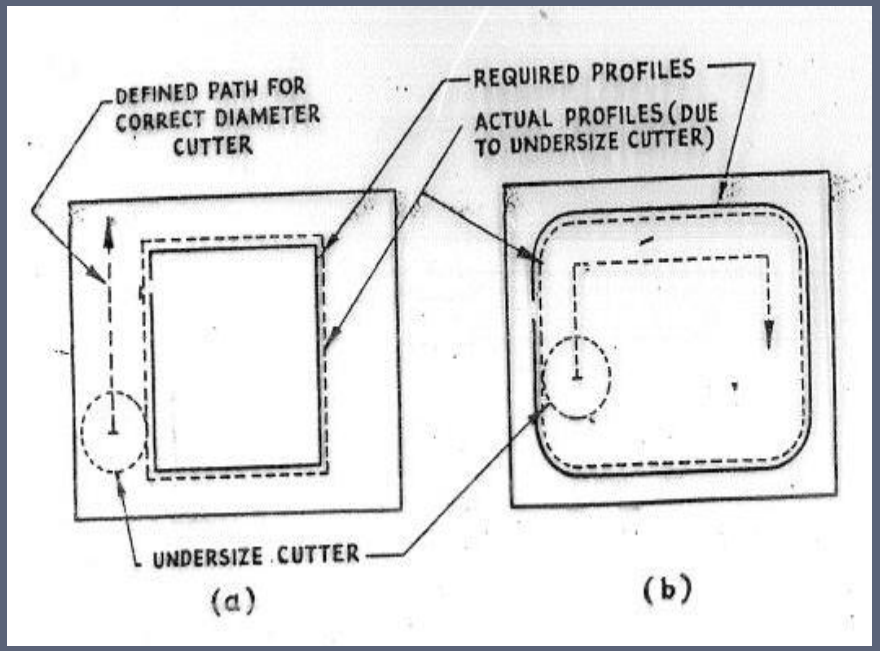
- **EASIER TO APPLY COMPENSATION**
- **SHORT OR LONG – DIAL THE ERROR AND ITS DIRECTION ON CONSOLE.**

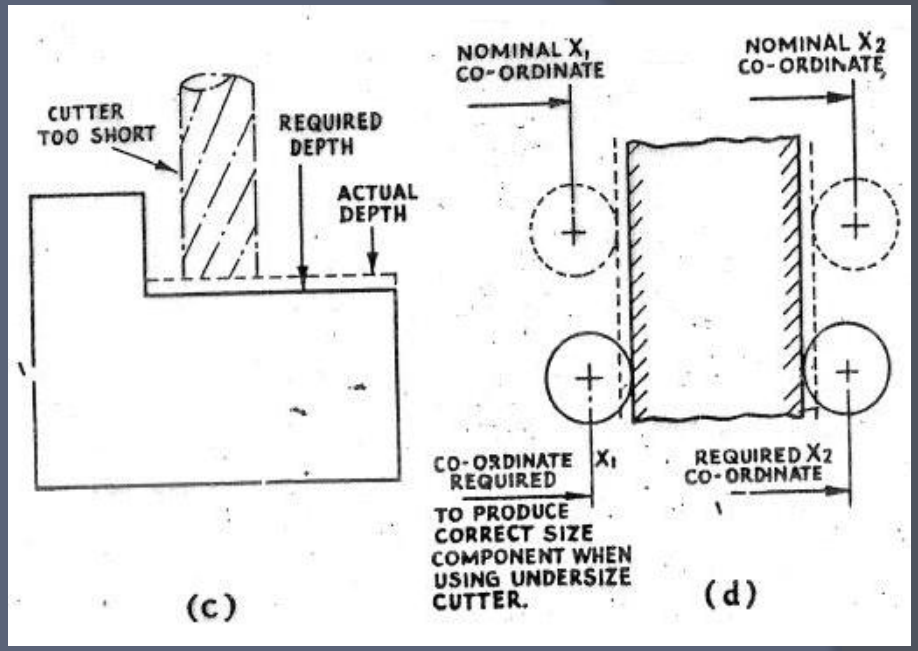
POCKET MILLING

- CAN BE PROGRAMMED BY DEFINING THE PATH STEP BY STEP – TEDIOUS JOB.

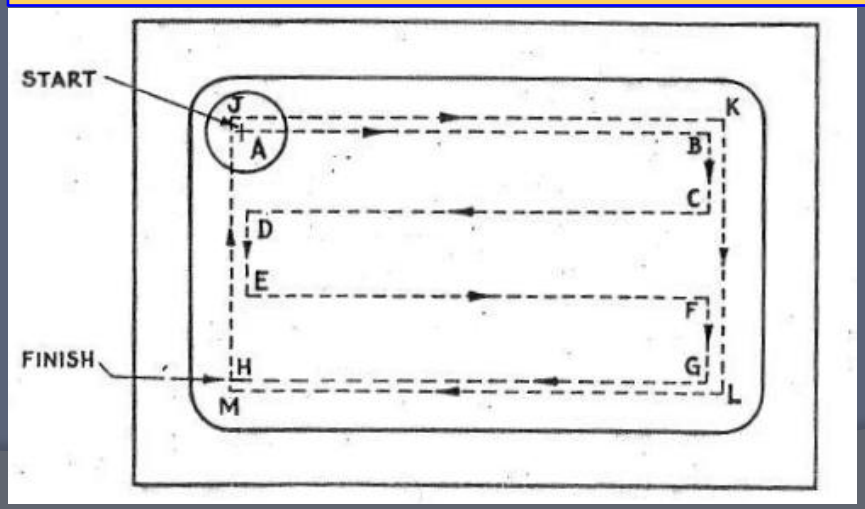
OR

- INCORPORATE A SUBROUTINE IN MCU. SPECIFY ONLY CUTTER SIZE AND POCKET SIZE.

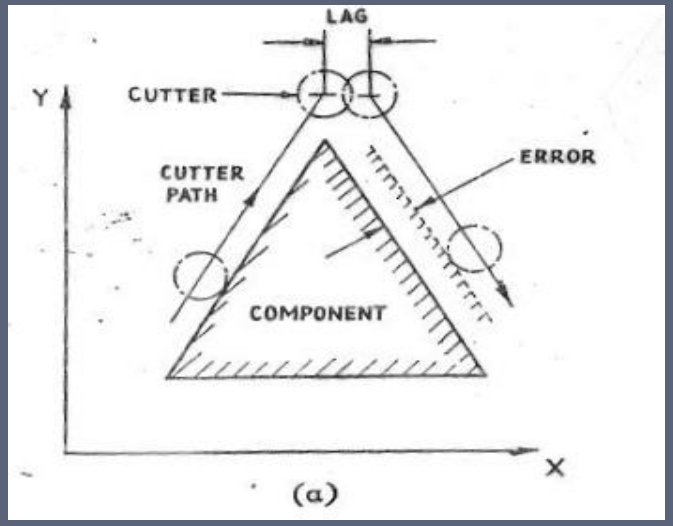


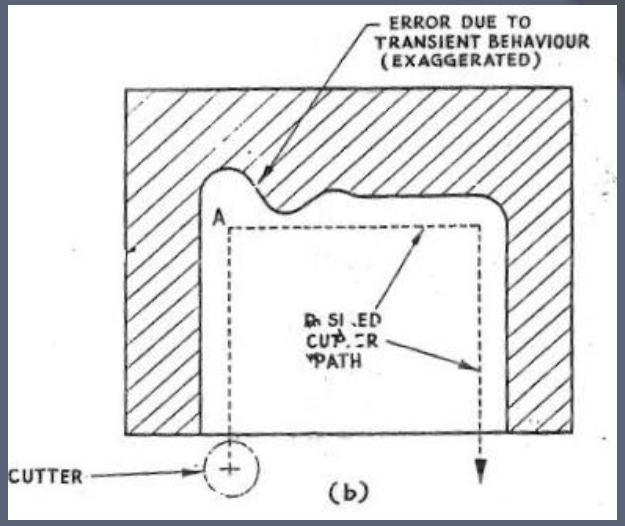


EFFECT ON THE SIZE OF A COMPONENT WHEN AN UNDERSIZE CUTTER IS USED **(A) MILLING AN EXTERNAL CONTOUR, (B) MILLING AN INTERNAL CONTOUR, (C) MILLING A HORIZONTAL SURFACE, (D) SOME COORDIANTES ARE INCREASED OTHER DECREASED TO COMPENSATE FOR AN INCORRECT DIAMETER CUTTER.**

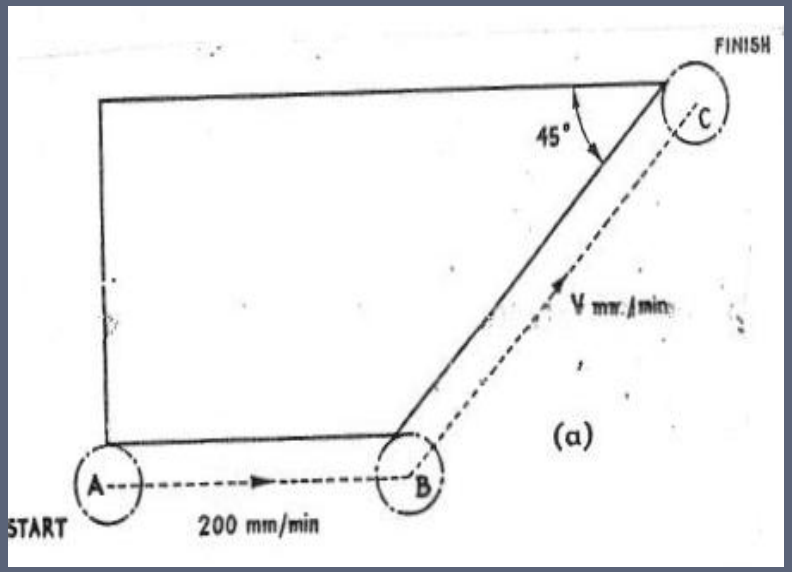


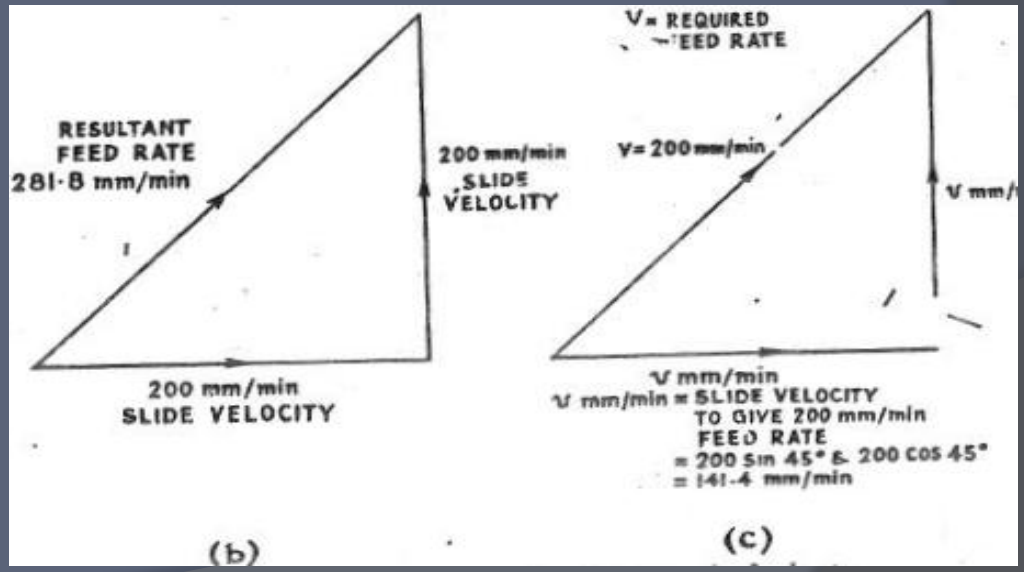
POCKET MILLING – THE FIRST COUTS ARE TAKEN ALONG THE PATH A TO H. TO PRODUCE AN EVEN SURFACE ON THE SIDES OF THE POCKET, A FINAL CUT IS TAKEN FOLLOWING THE PATH KLMJ.





EFFECT OF TRANSIENT SLIDE BEHAVIOUR ON THE ACCURACY OF THE MACHINING ERROR SHOWN ARE DUE TO THE (A) SLOW RESPONSE (B) **HUNTING OF THE SLIDE.**





THE EFFECT OF SLIDE VELOCITY ON TE FEED RATE

THANK YOU