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About the Book: Tool Design (SIE) This text offers detailed understanding on tool designing and tool-making. The content is basic in nature and the topics are written in simple language covering important fundamental design aspects of tools. Complete SI metrication of the text with inclusion of.

To remove greatest amount of material in the shortest length of time consistent with finish requirements, work and tool rigidity, available power of the machine, and relative cost of labour and cutting tools. Recommended tool geometry for single point cutting turning tools [2] Lecture Notes of Chinmay Das 2 Permissible Cutting Speed, Feed and Depth of Cut Depth of cut has the greatest influence upon the cutting force, followed by feed, with cutting speed having the least influence. Feed has the greatest effect on surface finish when it is set according to nose radius. The cutting speed has maximum influence on temperature generated at cutting zone during machining. Considering all above factors, the tool designer has to make correct compromise so as to get best machining operation under the given condition. A general rule used by many production people to achieve the greatest machining efficiency is to use the heaviest feed that will allow the required surface finish, use the maximum depth of cut consistent with available power and rigidity of workpiece and machine, and then establish the cutting speed to give the desired tool life. Too fast a cutting speed will increase tool costs and down time for tool changing. Too slow a speed simply cannot produce enough pieces to make a profit. Somewhere between too fast and too slow is a cutting speed that will give the best tool life for overall efficiency. Usually the best cutting speed is the one that will reduce the total cost of machining to a minimum cost per piece. However, cost may be secondary, the objective may be to set the maximum production rate. Many variables like the cost of labour on the machines, over head costs, set up time, tool costs, tool changing time, time to machine the workpiece, tool grinding time, grinding room labour costs etc. The majority of these variables may be changed to known quantities for a particular job. When these quantities are determined, it is possible to plot costs and production rates vs. The resulting graph will show speeds for minimum cost and maximum production rate. The theoretical best cutting speed will lie between the points of minimum cost and maximum production. Cutting speeds and feeds for turning non-ferrous materials [3] Cutting Forces during Turning The single point cutting tools being used for turning, shaping, planing, slotting, boring etc. But that force is resolved into two or three components for ease of analysis and exploitation. Tangential or Cutting Force, Pz This acts in the direction tangent to the revolving member and is sometimes referred to as turning force. It is usually the highest of the three forces and constitutes approximately 99 percent of the total power required by the tool. Longitudinal or Feed Force, Px This acts in a direction parallel to the axis of the work. It averages about 40 percent as high as the tangential force. Since the feeding velocity is very low, the power required is usually 1 percent of the total. Lecture Notes of Chinmay Das 5 Figure 4. It is the force that holds the tool to the correct depth of cut. It is the smallest of the three tool forces-only 20 percent as large as the tangential force. It requires no power in that there is no velocity in the radial direction. It should be kept to a minimum to reduce deflection, vibration and chatter. The angle relationship reasonably accurately applicable for ductile metals is [4. Cutting Tool Cross Section The shank of a cutting tool is generally analyzed for strength and rigidity. The tool is assumed to be loaded as a cantilever by tool forces at the cutting edge as shown in Figure 4. The deflection at the cutting edge is limited to a certain value depending on the size of the machine, cutting conditions and tool overhung. The tool overhung Le is related also to the shank size as well as to end fixity conditions. The common value for Le is 25 to 40 mm. We know that the bending moment due to cutting force Pz is Pz Le at the tool post. Types of Cutting Tool Cross section The numerical values obtained for height and width of cutting tool from above equation should be standardized as per BIS specification. The designation of a tool shank section shall indicate the diameter, or the height and width in case of rectangular or square shanks and IS number. Lecture Notes of Chinmay Das 8 Example 1: A shank having a circular cross section of 8 mm diameter shall be designated as: Shank Section 08 IS: Shank Section IS: Chip breakers may be added to a cutting tool for this purpose. Types of Chip Breaker: Several types of chip breaking devices are in use. Sometimes a small step or shelf is ground on the tool face for this purpose.

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Its depth is usually from 0. If the size of the shelf is properly chosen, it will break a continuous chip into short pieces. This type of chip breaker considerably increases the tool cost on carbide tools. A cutting tool with a groove and ridge type chip breaker has a groove of 2. A narrow Lecture Notes of Chinmay Das 9 ridge or land is provided along the cutting edge for strength. With this form of tool face , the chip flows into the groove and is forced into curl. The closer the groove is to the cutting edge, the smaller the radius will be and the tighter the chip will curl. In semifinish and finish turning of steel, the chip will break into short coiled pieces. This type of chip breaker, requiring power consumption and depending less upon feed or depth of cut than other types, is suitable for high feeds. Separate type chip breakers, often adjustable are also in use in tipped tools, particularly with throwaway type inserts. Types of Chip Breakers-I Figure 4. Types of Chip Breakers-II Lecture Notes of Chinmay Das 10 Design of Tool Tips The extensive application of cemented carbides in single point metal cutting practice has led to the introduction of tipped tools when an insert is either brazed or clamped on to the shank. The carbide tip must be so designed as to ensure that the resultant force P always passes through the nest of tip in the shank and keeps the tip in compression. Various tip designs are employed depending on the type of processing, feed and depth of cut. The seat or recess for the tip in the shank may be either open, semi-open, closed or of the slot type. Typical Tip Styles Figure 4. Design a HSS cutting tool to machine mild steel work piece in a lathe. Since not much data available to solve above problem, we have to make following assumptions. Factor of Safety for rough machining is Shank of Tool Section is square. Tool Over Hung is 30 mm. Chip Reduction Co-efficient is 2. Therefore cross section of tool shank selected is 12 mm x 12mm. The design of chip breaker is optional. Manufacturing Science-II by A. Tool Design by Cyril Donaldson, page 3. Metal Cutting- Theory and Practice by A. Bhattacharyya, page 5.

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