Mansoura Engineering Journal

Volume 16 | Issue 1 Article 21

5-1-2021

A Suggested Blending Routing for Iron Ore from El-Gedida Mines.

E. Rasoul
Professor and Chairman., Industrial Production Engineering Department., Faculty of Engineering., El-Mansoura University., Mansoura., Egypt.

A. Etman
Retired EX-Associate Professor., Assiut University.

Abobakr El-Saiedy
Retired EX-Assistant Professor., Al-Munifiya University.

Recommended Citation

Rasoul, E.; Etman, A.; and El-Saiedy, Abobakr (2021) "A Suggested Blending Routing for Iron Ore from El-Gedida Mines.," *Mansoura Engineering Journal*: Vol. 16 : Iss. 1 , Article 21.
Available at: https://doi.org/10.21608/bfemu.2021.169783

A SUGGESTED BLENDING ROUTING FOR IRON ORE FROM EL-GEDIDA MINES

E.M.A. Rassoul[+], A.M. Etman[x], Abobakr A. El-Saiedy[+x]

+ Prof.and Chairman, Industerial Production Engineering, Mansoura University.
x Retired Ex-Assos. Prof. Assiut University,
+xRetired Ex-Assist. Prof. Al-Munifiya U&niversity.

نظام خلط مقترح لخامات حديد الجديدة بالواحات البحرية

الملخص العربى :

ان خام الحديد الموجود بمنطقة الجديدة بالواحات البحرية هو الخام الوحيد الذى تستعمله شركة الحديد والصلب . تقع هذه الخامات فى ثلاث مواقع مختلفة وكل منطقة تحتوى مكونات مختلفة وكذلك كميات مختلفة كما يلى منطقة الهضبة (٣٩ر٦ مليون طن بها ٥٨ر٢ ٪ حديد) ومنطقة الوادى الغربى (٦٠ مليون طن ٥٠ر٢ ٪ حديد) ومنطقة الوادى الشرقى (١١ر٩٨ مليون طن ٤٨ر٨٢ حديد) وتحتاج شركة الحديد والصلب الى ٦٦٦٦ طن فى اليوم من خام الحديد (٢ر٤ مليون طن فى السنة) بالمواصفات التالية :
اكبر من ٥١ ٪ حديد واقل من ٠ر٦ ٪ كلور واقل من ٢ر٤ ٪ اكسيد منجنيز واقل من ٠ر٠٨٥ ٪ ثانى اكسيد المنجنيز واقل من ٠ر٣٦٥ ٪ اكسيد الومنيوم وخلافه .
طبقت اساليب الامثلة لاستنباط خطة لاستخدام خام حديد الجديدة فى شركة الحديد والصلب . وقد اجريت الحسابات اللازمة للحفاظ على نسب الحديد والكلور واكسيد المنجنيز كما بحثت بدائل اخرى لتعظيم فترة الاستعمال او فترة الانتفاع بالخام .
وقد وجد ان الزمن الذى يستعمل فيه كل خامات المواقع الثلاث بخليط يفى لمتطلبات شركة الحديد والصلب هو ستة وعشرون عام ونصف فى حالة ما اذا كان باستطاعة شركة الحديد والصلب التعامل كيماويا وفيزيائيا مع خليط من الخام يحتوى على ٥٢ر٨٩ ٪ حديد و ٢ر٦٨ اكسيد منجنيز و ٠ر٥٣٨٩ ٪ كلور و ٦ر٨ ٪ سليكون لانتاج المحددات المطلوبة فان ذلك يتسبب فى اطالة الفترة عشر سنوات اخرى .

ABESTRACT

TheIron ore deposits of El-Bahariya Oasis at El-Gedida are the only ores used by the Iron and steel Company (Hadisolb). These ores are located in three different regions with different contents and quantities : Platau (39.6 mt., 58.2 % Fe). West Valley (60 mt., 50.2 % Fe) and N.E.and East Valley (11.98 mt.. 48.82 % Fe).

Hadisolb requires 6666 mt/D (2.4 mt/Y) of a blend containing Fe > 51 %, Cl < 0.6 %, Mn < 2.4 %, SiO_2< 0.085 % and Al_2O_3 < 0.365 % .

Optimization techniques were applied to produce a plan for the use of El-Gedida ores. Calculations fo: the proper amounts of ore to be blended to suit the cut-off limits for Fe, Cl, and MnO set forth by Hadisolb were made. Other alternatives to maximize the time span of utilization and produce a blend that Hadisolb can treat effectively were searched.

The time to use all three localities to produce a blend satisfying the limit of the set restrictions for Fe, Cl, and MnO is found to be 36.9 years for the Platau, 59.9 years for the West Valley and 36.9 years for N.E. and E.Valley. Therefore, thirty seven years is the limit set by the consumption of the platau ore with high Fe and Cl and low Mn contents.

THe maximum time to consume all three localities at the same time was found to be forty six and half years, but it will produce a blend having the following composition : 52.89 % Fe, 2.68 % MnO, 0.5389 % Cl, and 6.8 % SiO. If Hadisolb can treat such a blend chemically or physically to produce its required limitations, it will lengthen the time span of utilization of all these localities by about ten years.

KEYWORDS

Iron ores, Localities, restrictions, optimization techniques, cut-off, blend, material balance, alternatives.

INTRODUCTION

Blending of different streams to produce suitable mixtures or blends is a typical an optimization problem. Himmelblau(1) explained the techniques to set up material balances for the total mass or seperate components. Wild (3,4) explained optimization techniques and defined it as finding the best way to do things. This is important in the practical world of production, trade and even politics, where small change in efficiences can spell the difference between success or disaster, as the stated in the introduction of his book. Dynamic programming is used to solve complex optimization problems (2), where as linear programming may be used to solve simple problems when the suggested routine does not change as the process develops toward completion.

For the sake of initial trials to find the time and compostion of blends that will enable Hadisolb to utilize El-Gedidas location for the longest period possible, the problem is simplified by assuming the following condition.

1) Only three (or five) main components are essential to consider, namely, Fe, Cl, and MnO (also SiO_2 and others).

2) The input streams or ores from each locality have constantaverage composition as shown in table 1 .

3) Hadisolb requires that the blend compostion is satisfactory if it contains more than 51% Fe, less than 0.6% Cl and less than 2.4% MnO. Silicon should be less than 8.5% and others less than 36.5% + 0.5% .

4) The average daily need of iron ores is 6666 + A set of oneequation and five inequalities for material balances for the total mass, and component masses were defined, and written out to be solved for the three unknowns, namely the amount to be repeated daily as the average composition of inputs or outputs may change.

TABLE (1)

Region one Plalau - Region two valley
Region three North East and East Valley

Region	Fe	Cl	MnO	SiO	Al_2O_3	Total 10 tons
1	50.2%	0.74%	1.4%	3.2%	36.46%	39.60
2	50.2%	0.47%	3.76%	8.1%	37.47%	60.00
3	48.82%	0.22%	1.54%	12.2%	37.22%	11.98

Procedure

The process of mining the ore from all three localities and storing each in a separate storage before feeding each to a separate battaries of crushers to grind it to a suitable size and uniform mass of known average chemical composition before feeding to a large mixer or blender is shown in a qualitative flow sheet in fig (1).

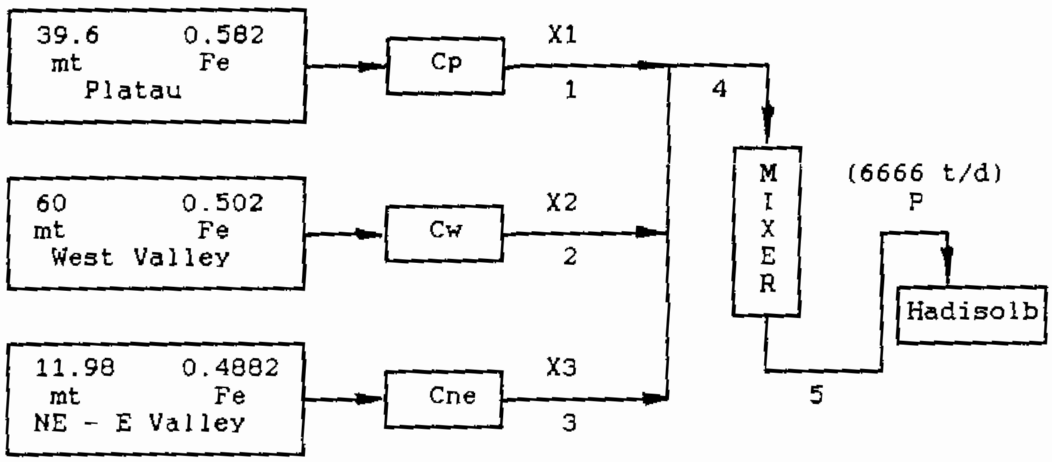


FIGURE (1) FLOW SHEET

The actual calculations of both the crushing process and blending are not considered here. The efficiencies of these process are assumed to be unity (they should be determined experimentally and considered) . The amount of ores produced after crushing should be devided by the corresponding efficiency to give actual daily up - take from each locality, making the time spen of use of each locality shorter than is reported here .

CALCULATIONS :-

Let the basis be : one day requirement of 6666 t/D
Total mass balance

1)	X^1	$+X^2$	$+X^3$	6666 t/D
Iron (Fe) balance				
2)	$0.582X^1$	$+0.502X^2$	$+0.4882X^3$	>/0.51X6666
MnO balance				
3)	$0.014X^1$	$+0.0376X^2$	$+0.0154X^3$	< 0.24X6666
C1 balance				
4)	$0.0074X^1$	$+0.0047X^2$	$+0,0022X^3$	< 0.006X6666
$S^1 O^2$ balance				
5)	$0.032X^1$	$+0.081X^2$	$+0.122X^3$	< 0.085X6666
Al_2O_3 balance				
6)	$0.3646X^1$	$+0.3747X^2$	$+0.3722X^3$	<0.085X66666

These are only three unkowns, namely X^1, X^2 and X^3 are the amounts of ore fed to the blender from each locality, where 1 referto the Platau, 2 refers to West Valley and 3 refers to North - East and East Valley regions, and one equation and five inequalities.

By solving this problem we get

X^1=2981.4 t/D
X^2=278.6 t/D
X^3=902 t/D

The time period of use for each locality (assuming a unit efficiency for the crushing, blending and transporting operations) is as follows :-

t^1= 39.6 X 10_6 /2981.4 =36.9 years
t^2= 60 X 10_6 /2782.6X360=59.9 years
t^3= 11.98 X 10_6 /902X360=36.9 years

This means that this blending routine will allow hadisolb to use these locations for a period not exceeding 36.9 years when regions 1 and 3 will be consumed up before region 2 .

An increase 54.2% in the ores of both region 1 and region 3 will allow Hadisolb to use ores from the three regions for 59.9 years.

It may be desired to find the maximum time period to consume all three localities as it the same time .Then :

$t^1=t^2=t^3=t$
tX^1=39.6mt
tX^2=60 mt
tX^3=11.98 mt
$X^1+X^2+X^3$=6666 t/D

Therefore :

X^1=2365.8 t/D
X^2=3584.5 t/D
X^3=715.7 t/D

The blend is found to have the following compositions :- 52.89 % Fe, 2.68% Mno, 0.5389 C1 and 6.8% SiOzand allow Hadisolb to use iron ores for 46.5 years .

This composition of the final blend is acceptable to Hadisolb for all elements except Mno which is only 0.28% in excess of its stated limit . If Hadisolb can treat chemically or physically such a blend to bring it to its desired limit it will lengthen the period of use of such locality by 10 years than the previous routine . Another trial for extending the total period of exploitation of the ores was made .

The results are give in table 2. Table 2 shows the required ore to be found of the same composition of regions 1&3 to corresponding Mno % in the blend.

TABLE (2)

Required Ore to be found if the same composition & regions 1 & to be used with the total amount in Region 2 .

Required ore to be found (mt)	Total required from 1&3 or any other 10 c to be researched for (mt)	Max. oeriod years	Daily production 2	Daily production 1&3	Mno
000.00	51.58	46.40	3591.95	3087.88	2.68
7.91	95.49	49.79	3347.39	3318.94	2.60
19.07	70.65	54.44	3061.47	3604.89	2.50
32.54	84.12	60.06	2775.00	3890.55	2.40
49.11	100.69	66.96	2489.05	4177.04	2.30
69.68	121.59	75.66	2202.84	4462.95	2.20
97.08	148.66	86.95	1916.81	4749.22	2.10
133.68	185.26	102.20	1630.79	5035.33	2.00

Conclusions

1- To use the iron ores fron the three region by ratios which fulfill the limits of the company . In this case it can use the iron ores for only 36.9 years .

2- To use the iron otes of the three regions in ratios so that all of them will be consumed for the same period and in this case the period will increase10 years , but treated chemically .

3- It was found that if the reserves of both 1&2 can be increased by about 50% , the life time of EL - Gedida mines will be extended almost by the same ratio .

REFERRENCES

1- Himmelblaw, David " Basic Principles and calculation in Chemi cal Engineering " Prentice - Hall 1974
2- Nemhauser, George L. , " Introduction to dynamic programming "Wiley 1966
3- Wild Dovglass J., "Optimization seeking methods Prentice -Hall. 1964
4- Wild , Douglass J. and Charles S. Beighter ," Foundations of optimization "Prentice Hall 1967

EXPANDING THE RULE OF INTERCHANGING CAD DATABASE FOR AUTOMATIC GENERATION OF NC PROGRAMS FOR ROTATIONAL PARTS

تصميم برامج ماكينات خراطة التحكم الرقمى أوتوماتيكيا باستخدام الحاسب الآلى

T. T. EL-MIDANY and M. A. EL-BAZ

Associate Professor — Research Assistant

Industrial Production Engineering Department
Faculty Of Engineering, Mansoura University 35516
Mansoura-Egypt

تبر عمليات خراطة الاجزاء الدورانية من العمليات الهامة فى مجال الإنتاج الصناعى ، وبانتشار اكينات خراطة التحكم الرقمى ، تصاعدت مشكلة برمجة هذه الماكينات للأجزاء المراد تشغيلها. وقد قام لناشرون فى بحث سابق بتصميم نظام هدفه تصميم برامج ماكينات تفريز التحكم الرقمى ، وفى هذا بحث يقدم الناشرون نظام هدفه تصميم برامج ماكينات خراطة التحكم الرقمى أوتوماتيكياً بالربط مع ستخدام الكمبيوتر فى الرسم- وتشمل عمليات الخراطة ، الخراطة الطولية longitudinal ، الخراطة لوجهية Facing ، الخراطة المائلة Sloping، shouldering وقد تم تجربة هذا النظام على العديد من لمشغولات فى معمل هندسة الإنتاج - كلية الهندسة - جامعة المنصورة - وقد حقق هذا النظام نتائج الية الدقة.

ABSTRACT

In recent years, improvement in Computer-Aided part programming (CAPP) together with reductions in computing costs, have made the manufacture of the components with the aid of Numerically Control (NC) machine tool more aecurate. Now, NC ean quickly programmed to machine the majority of the complex forms found in different components. As a result, NC can make an important contribution for increasing the productivity of scare tool makers (in case of extremely complex shapes). The machining of complex shape in case of turning has never been as easy task. This paper describes how the programmer can generate automatically in a systematic way, the required NC program in case of turning components. The developed system analysis the required part drawing to determine the paths to be cut, and how to cnt it. Lathing, from facing to cut off and all operations in between, the developed system smoothly perform all tasks required to produce turned parts. Different turning components have been tested, excellent results are obtained, i.e great reduction in the processing and working times. Entry errors are completely avoided. Thus significant savings in cost are obtained.

INTRODUCTION

The machining of complex shape either in case of milling or turning has never been an easy task. Designers always want to manufacture a component whose tooling is full of awakward features, such as sharp corners, deep slots, undefined blends and non analytic doubly curved surfaces. After achieving the best machined finish, the operator resorts hand work to achieve the final detail and desired surface finish. Part programmers is an area where available personnel are in short supply. Therefore, new systems such as the present work and the previous one (AUTOGMC) [1,2] for automatic generation of NC programs for different machining components are most appreciated. A method has presented for exchanging drawing-data between different models of a CAD/CAM data base. The need to exchange drawing data between different CAD/CAM data base model is now becoming greater than ever as CAD/CAM use becomes more widespread [3]. This results from the expectation that being able to exchange drawing-data without sending papers beyond a particular company will bring great benefits to industry. The national standards of data exchange such as DXF (Data Interchange File) and IGES (Initial Graphic Exchange Specification) are set to meet this kind of needs. It is important to recognize that the real object of the exchange is not a mere physical picture, but an organized relation between pictures and information about engineering or production objects which is the substantial eontent expressed in CAD/CAM drawing data base. Even in the case of manual drafting, various kinds of drawing are originally made for the purpose of transferring required information to others, so that a series of tasks from design to manufacture can be shared between a number of people.

THE DEVELOPED SYSTEM

In our previous work (AOTOGMC) [1], a system to generate automatically the NC programs for milling components had been developed. That system overcomes the problems of programming the complex profiles. In the present work, we expand the idea of translate the existing information on the turned components which previously drawn by the aid of AUTOCAD [4], into data which can be processed to generate a complete NC program for that component. The program has a function to determine optimum feed and speed for different cutting conditions. The machining operations include profile, eonvex and concave radii facing, shouldering, and longitudinal turning are shown in Figure 1.

The NC program is a series of blocks, each showing a set of function and/or co-ordinates [5]. The typical format which has been carried out for the BOXFORD 125 TCL (CNC Lathe) at the Production Engineering Laboratory (PEL), Faculity of Engineering, Mansoura University [6] is as the following :

N	*G*	*M*	*X*	*Z*	*I*	*K*	*F*	*S*

Where :
N : block number,
G : preparatory code,
M : miscellaneous function code,
X : x co-ordinate to change depth of cut,
Z : Z co-ordinate measured along the axis of the billet,
I : interpolator parameter (additional information as needed),
K : interpolator parameter (additional information as needed),
F : feed rate (mm/min),
S : spindle speed (rev/min).
Axes commands is shown in Fig. 2.

The use of preparatory codes GO2 and GO3 make it possible to program the tool to move clockwise and counter-clockwise respectively, in a circular arc within a single quadrant. The newcomer/user to part programming is confronted with two problems before being able to use these codes :

1. Roughing the surplus material from the billet, so that the maximum depth of cut is not exceeded, and

2. Calculating I and K parameter values needed for the part program.

USER'S PROCEDURE

The required geometric analysis which performed by the developed system is best demonstrated through the following example :

1. The user starts with drawing the upper half view of the part outline of the workpiece provided that, the vertical distauce between the center axis of the workpiece and the x-axis of the screen must be equal to the radius of the bar stock by the aid of a CAD system which in turn has the facility to produce DXF files.

2. The user changes the half part outline of the workpiece into a DXF [1] file from left to right. The DXF file will be changed into data base file by the developed system. Table 1, depicts the first main data base file, for the part outline shown in Figure 2.

The developed system extracts the data of Arcs and Lines, and assign these data in a secoud main data base file. Table 2, illustrates this DBF.

The developed system scans the previous file to determine the maximum value for x or x1-coordinates which represent the Zero point of the NC part program x1 = 97.8763 (illustrated in Figure 3). This value will be used to determine the cutting strock length.

The available data in the previous file will be used to determine the number of cut paths and the length of each path corresponds to recommended depth of cut (d = 2 mm. per diameter recommended in this example) as a rough cutting operation. The length of each rough cutting path will be halted at distance smaller than one millimeter from the actual cutting length. The rough cutting operations will be followed by a finish cutting operation. The required analysis for each part drawing element will be calculated according to the equations shown in Figure 4. In case of finishing operation for Arcs found at two quadrant. The developed system divides these Arcs into two Arcs, and calculate the required data for each sub-arc. All results obtained from the previous calculations will be assigned in a third data base file shown in Table 3.

The developed system uses this DBF for processing these data to generate the NC part program as shown in Table 4. Figure 5 summaries the process sequence for generating NC part program in case of turning operations.

CONCLUSION

A system for automatic generation of NC programs is developed, offers substantial cost, speed and consistency advantage for NC part programming. It can be implemented and adapted for any lathe machine tool; no doubt that it greatly reduces the range of skills needed for the NC programming. The system eliminates the repetitive work because the system ability can retrieve data, calculate, and perform the required operation. With this system, entry errors are impossible, great reduction in programming time and program checkout is not necessary.

REFERENCES

1. *El-midany, T. T., and El-baz, M. A.*, "A New Approach for Automatic Generation of NC programs for Milling Components (AUTOGMC), "Ain Shams University, Engineering Bulletin, Vol. 25, No. 2, August, 1990, pp 308-317.

2. *El-midany, T. T., and El-Baz, M. A.*, "A Comparative Evaluation for Manual and Computer Graphics Based System for NC Programming, "Mansoura Engineering Journal MEJ, Vol. 15, No. 2, Dec 1990, pp M. 175-M. 184.

3. *Yamamoto, Y., and Murahashi, Y.*, "Common Language for Multilateral Communication Between Different CADCAM Drawing Databases, "Computer-Aided Design, Butterworths, Vol. 21, No. 10, Dec 1989, p. 630.

4. *Autocad User Reference, 1985.*

5. *Groover, M. P., and Zimmers, E. W.*, "CAD/CAM Computer-Aided Design and Manufacturing, "Prentic-Hall, inc., New Jersey, 1984.

6. *BOXFORD 125 TCL, Training Center Lathe Manual, U. K.*

7. *Omura, G., "Mastering Autocad,* "2nd edition, Tech Publication, Singapore, 1988.

8. *DBASEIV manual, 1988.*

Table 1: First Main Data Base File

```
0
SECTION
2
ENTITIES
0
ARC
8
0
10
50.554089
20
80.355632
40
30.473514
50
221.911183
51
264.958714
0
LINE
8
0
10
67.876273
20
40.0
11
47.876273
21
50.0
0
LINE
8
0
10
67.876273
20
40.0
11
97.876273
21
40.0
0
ENDSEC
0
EOF
```

Table 2 : Second Main Data Base File

TYPE	X	Y	X1	Y1	C1	C2	R	S1	S2	CHAR
ARC	27.8763	60.0000	47.8763	50.0000	50.5541	80.3556	30.4735	221.9112	264.9587	
LINE	67.8763	40.0000	47.8763	50.0000	0.000000	0.000000	0.000000	0.000000	0.000000	
LINE	67.8763	40.0000	97.8763	40.0000	0.000000	0.000000	0.000000	0.000000	0.000000	

Table 3 : Third Main Data Base File

TYPE	X	Y	X1	Y1	C1	C2	R	S1	S2	CHAR
LINE	30.8451	58.0000	97.8763	58.0000	0.000000	0.000000	0.000000	0.000000	0.000000	
LINE	33.2391	56.0000	97.8763	56.0000	0.000000	0.000000	0.000000	0.000000	0.000600	
LINE	36.2565	54.0000	97.8763	54.0000	0.000000	0.000000	0.000000	0.000000	0.000000	
LINE	40.3919	52.0000	97.8763	52.0000	0.000000	0.000000	0.000000	0.000000	0.000000	
LINE	48.8761	50.0000	97.8763	50.0000	0.000000	0.000000	0.000000	0.000000	0.000000	
ARC	27.8763	60.0000	47.8763	50.0000	50.5541	80.3556	30.4735	221,9112	264 9587	02
LINE	52.8763	48.0000	97.8763	48.0000						
LINE	56.8763	6.0000	97.8763	46.0000	0.000000	0.000000	0.000000	0.000000	0.000000	
LINE	60.8763	4.0000	97.8763	44.0000	0.000000	0.000000	0.000000	0.000000	0.000000	
LINE	64.8763	42.0000	97.8763	42.0000	0.000000	0.000000	0.000000	0.000000	0.000000	
LINE	67.87	40.0000	97.8763	40.0000	0.000000	0.000000	0.000000	0.000000	0.000000	
LINE	67.8763	40.0000	47.8763	50.0000	0.000000	0.000000	0.000000	0.000000	0.000000	

Table 4 : A Complete NC Program List

Rec#	G	M	X	Z	I	K	F	S
1	90							
2	71							
3			65	10			1	
4		04						1600
5			65	0				
6	01		-1				60	
7			1					
8			58.00					
9	01			-67.00			60	
10			59.00	1				
11			56.00					
12	01			-64.63			60	
13			57.00	1				
14			54.00					
15	01			-61.61			60	
16			55.00	1				
17			52.00					
18	01			-57.48			60	
19			53.00	1				
20			50.00					
21	01		-49.00				60	
22	02		60.00	-70.00	30.35	2.677	60	
23			61.00	1				
24			48.00					
25	01		-45.00				60	
26			49.00	1				
27			46.00					
28	01		-41.00				60	
29			47.00	1				
30			44.00					

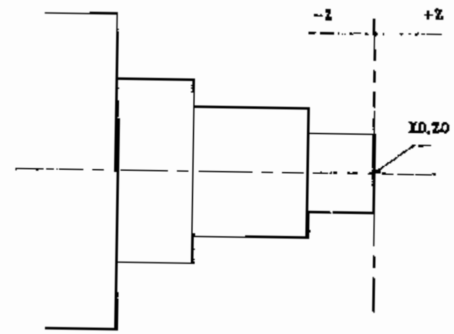


Figure Axes Commands

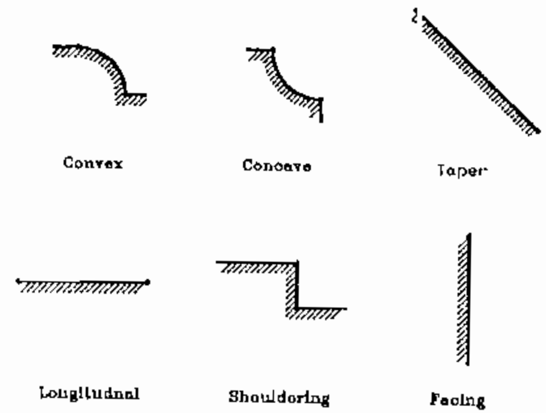


Figure Turning Machining Operations

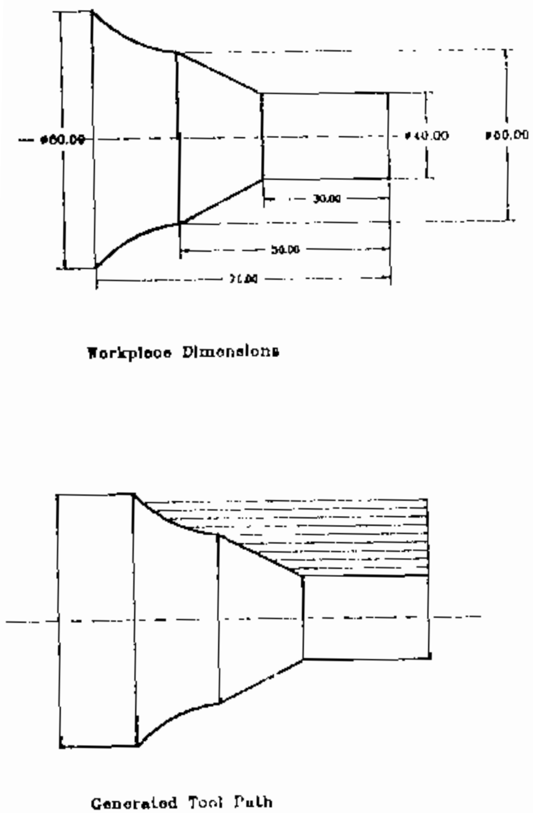
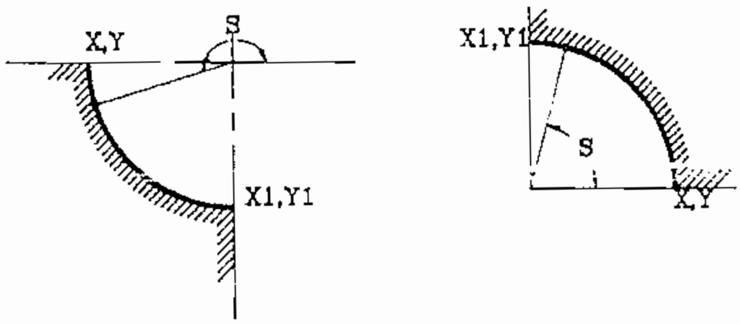
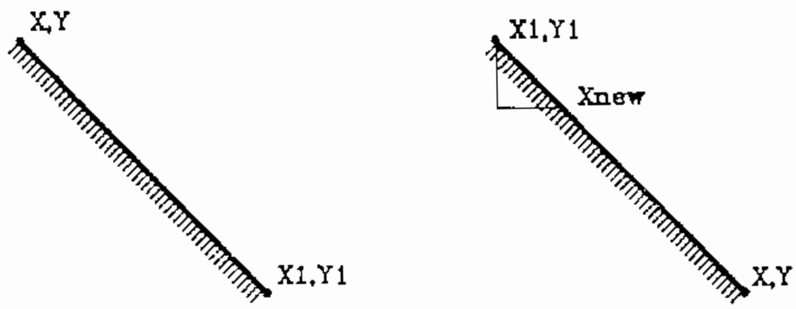


Figure 3 A Sample Example



Ynew= Y−2	Ynew= Y1−2
B = (Ynew−C2)/R	B = (Ynew−C2)/R
S = ASIN (B)	S = ASIN (B)
Xnew= C1+R*COS(S)	Xnew= C1+R*COS(S)
Xnew1= Xnew+1	Xnew1= Xnew+1



T= (Y−Y1)/(X1−X)	T= (Y1−Y)/(X−X1)
Ynew= Y−2	Ynew= Y1−2
Xnew= X1−((Ynew−Y1)/T)	Xnew= X−((Ynew−Y)/T)
Xnew1= Xnew+1	Xnew1= Xnew+1

Figure 4 Equations for Calculated Tool Paths

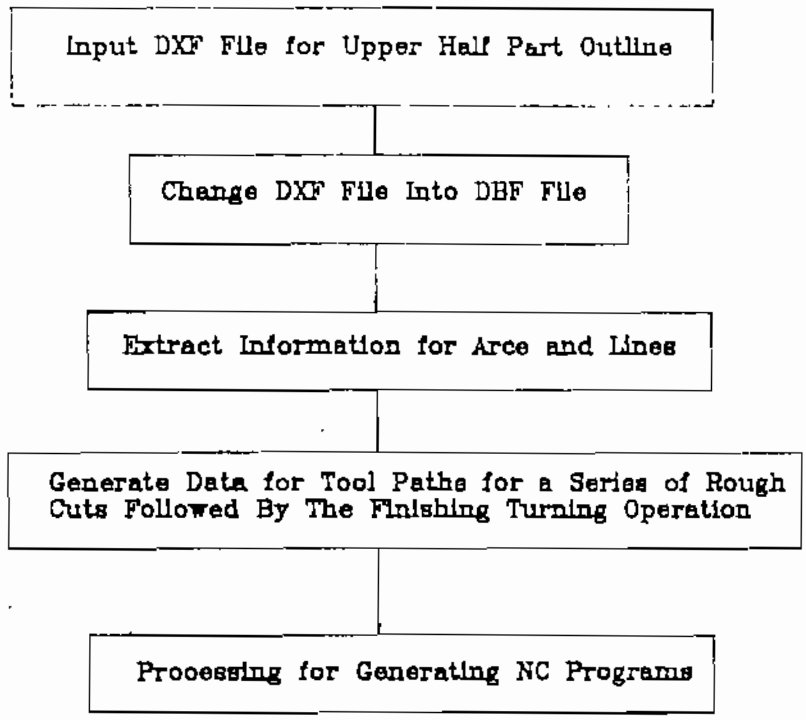


Figure 5 Process Sequence In Case of Turning Operation