Министерство науки и высшего образования Российской Федерации

федеральное государственное автономное образовательное учреждение высшего образования

Национальный исследовательский университет ИТМО

Факультет Систем Управления и Робототехники

Дисциплина: Основы Цифрового Производства

Отчет

по практической работе № 1

Подготовка управляющей программы для фрезерного станка с ЧПУ в системе Fusion 360

Студент: Евстигнеев Дмитрий
Кулижников Евгений
Виноградов Сергей

Группа: R33423

Преподаватель: Третьяков С.Д

Санкт-Петербург

2021 г.

1. 3D-модель

Был выбран первый вариант, так как по условию вариант определяется по табельному номеру ИСУ. Мы решили взять номер Виноградова С. (№1)

В итоге моделирования была получена модель *(рис.2-4)*

Вариант 1

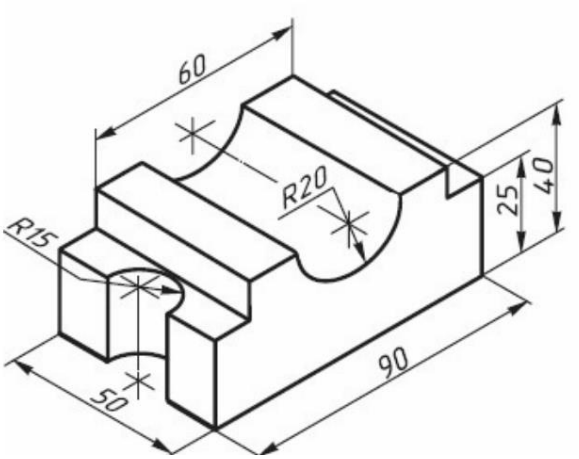


Рисунок 1. Заданный эскиз варианта 1

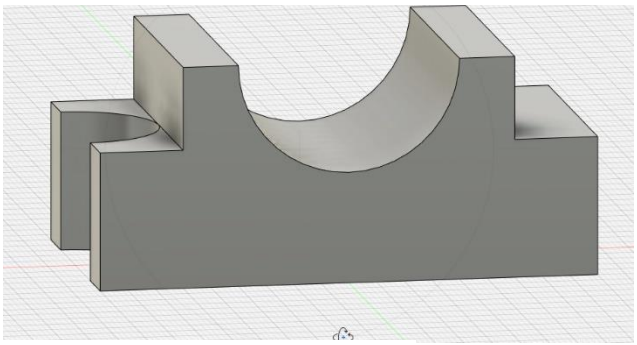


Рисунок 2. Модель в Fusion 360

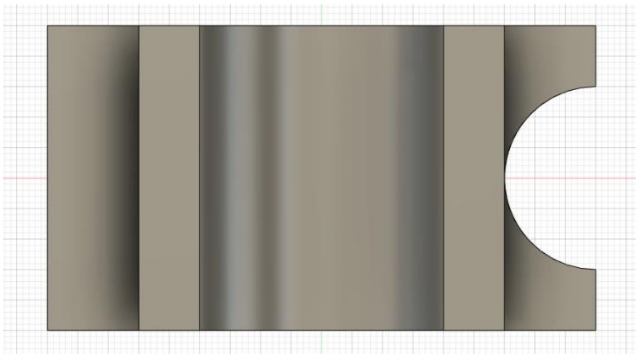


Рисунок 3. Вид сверху

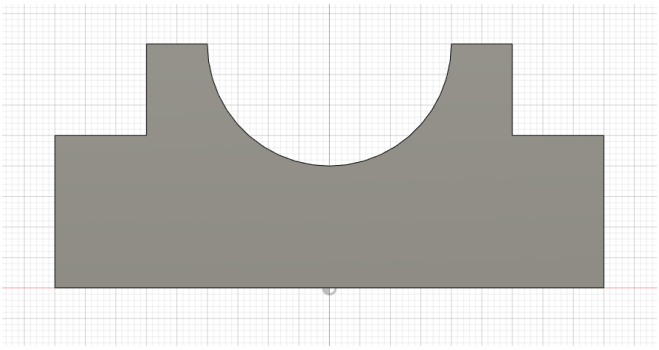
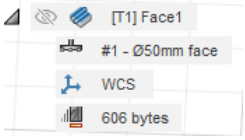
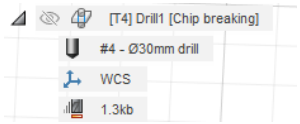


Рисунок 4. Главный вид

2. Фрезерование поверхности *(рис.5)*



3. Сверление отверстия R=15mm *(рис.6)*

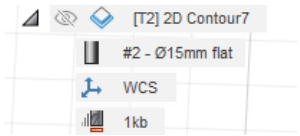


Выбранные х-ти сверла видны на (рис.8)

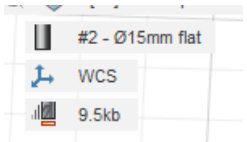
4. Сверление отверстия R=20mm *(рис.7)*

Х-ти сверла иден. (рис.8), но диам. 40мм

5. Фрезерование контура *(рис. 9)*



6. Фрезерование углуб. *(рис.10)*



7. Постпроцессинг

```
%
O01001
(Using high feed G1 F500.
instead of G0.)
(T1 D=50. CR=0. - face mill)
(T2 D=15. CR=0. - flat end mill)
(T3 D=40. CR=0.
TAPER=118deg - drill)
(T4 D=30. CR=0.
TAPER=118deg - drill)
N10 G90 G94 G17
N15 G21
N20 G53 G0 Z0.

(Face1)
N25 T1 M6
N30 S955 M3
N35 G54
N40 M11
N45 G0 A0.
N50 M10
N55 M8
N60 G1 X78.5 Y-24.375 F500.
N65 G0 G43 Z15. H1
N70 T4
N75 G0 Z5.
N80 G1 Z4. F460.
N85 G18 G3 X73.5 Z-1. I-5. K0.
N90 G1 X51.
N95 X-51.
N100 G17 G2 Y1.775 I0. J13.075
N105 G1 X51.
N110 G18 G2 X56. Z4. I0. K5.
N115 G0 Z15.
N120 M9
N125 M5
N130 G53 G0 Z0.

(Drill1)
N135 M1
N140 T4 M6
N145 S5000 M3
N150 G54
N155 M11
N160 G0 A0.
N165 M10
N170 M8
N175 G17
N180 G1 X45. Y0. F500.
N185 G0 G43 Z15. H4
N190 T3
N195 G0 Z5.
```

Description	1
Vendor	
Product id	
Product link	
Diameter	30 mm
Shaft diameter	30 mm
Tip angle	118 degrees
Overall length	130 mm
Length below holder	130 mm
Shoulder length	110 mm
Flute length	40 mm
Coolant support	no
Type	drill
Unit	millimeters
Clockwise	true

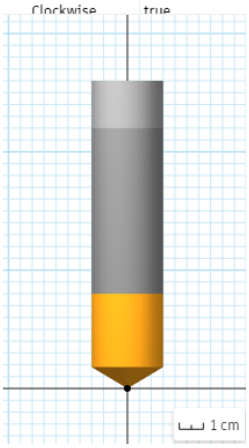


Рисунок 8. Хар-ти сверла

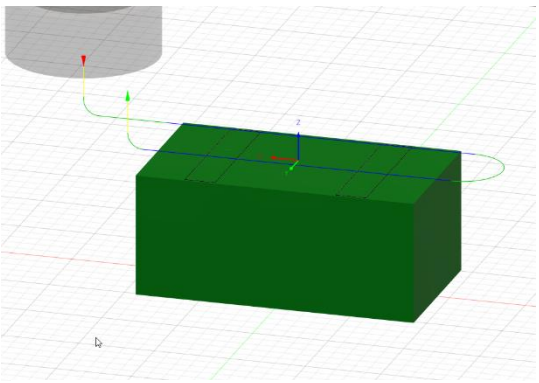


Рисунок 5. Фрезерование поверхности

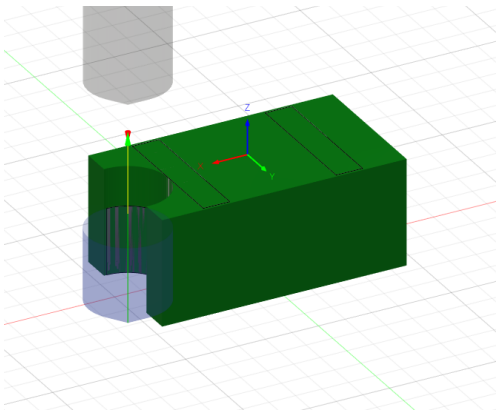


Рисунок 6. Сверление отверстия диам. 30мм

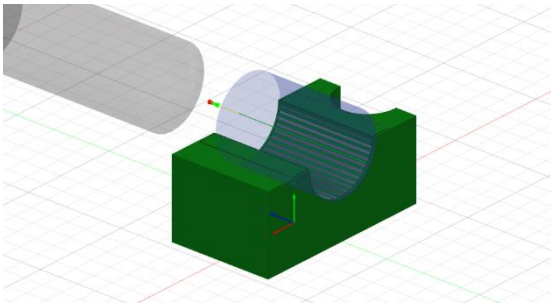


Рисунок 7. Свердление отвер. диам. 40мм

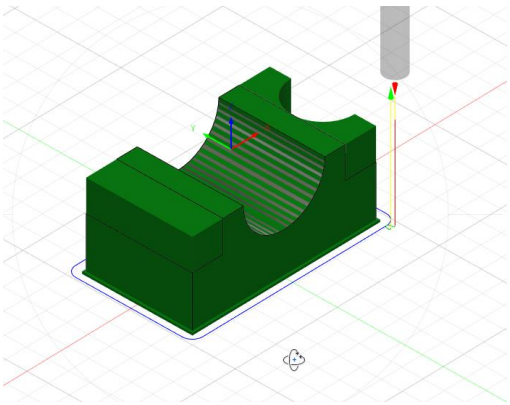


Рисунок 9. Фрез. контура

N200 G98 G73 X45. Y0. Z-52.013 R-11. Q7.5 F333.33
N205 G80
N210 G0 Z15.
N215 M9
N220 M5
N225 G53 G0 Z0.

(Drill2)
N230 M1
N235 T3 M6
N240 S5000 M3
N245 G54
N250 M11
N255 G0 A90.
N260 M10
N265 G1 X0. Y1. F500.
N270 G0 G43 Z41. H3
N275 T2
N280 G0 Z31.
N285 G98 G73 X0. Y1. Z-39.017 R30. Q10. F333.33
N290 G80
N295 G0 Z41.
N300 M5
N305 G53 G0 Z0.

(2D Contour7)
N310 M1
N315 T2 M6
N320 S3000 M3
N325 G54
N330 M11
N335 G0 A0.
N340 M10
N345 M8
N350 G1 X46.5 Y-37. F500.
N355 G0 G43 Z15. H2
N360 T1
N365 G0 Z5.
N370 G1 Z1. F266.67
N375 Z-38.5
N380 G19 G3 Y-35.5 Z-40. J1.5 K0. F800.
N385 G1 Y-34.
N390 G17 G3 X45. Y-32.5 I-1.5 J0.
N395 G1 X-45.
N400 G2 X-52.5 Y-25. I0. J7.5
N405 G1 Y25.
N410 G2 X-45. Y32.5 I7.5 J0.
N415 G1 X45.
N420 G2 X52.5 Y25. I0. J-7.5
N425 G1 Y15.
N430 G2 X45. Y7.5 I-7.5 J0.
N435 G3 Y-7.5 I0. J-7.5
N440 G2 X52.5 Y-15. I0. J-7.5
N445 G1 Y-25.

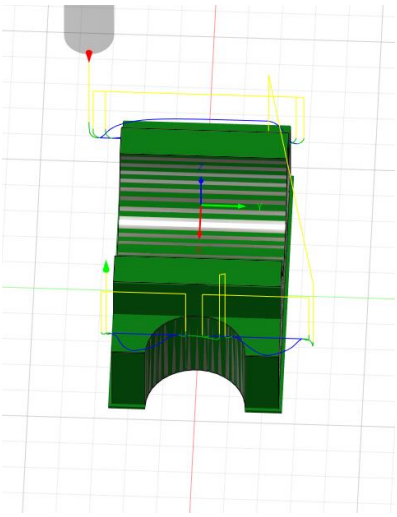


Рисунок 10. Фрез. угл

N450 G2 X45. Y-32.5 I-7.5 J0.
N455 G3 X43.5 Y-34. I0. J-1.5
N460 G1 Y-35.5
N465 G19 G2 Y-37. Z-38.5 J0. K1.5
N470 G0 Z15.

(2D Adaptive5)
N475 G1 X-41.534 Y-35.154 F500.
N480 G0 Z15.
N485 Z5.
N490 Z-12.5
N495 G1 Z-14. F800.
N500 X-41.527 Y-35.153 Z-14.147
N505 X-41.506 Y-35.149 Z-14.293
N510 X-41.471 Y-35.143 Z-14.435
N515 X-41.422 Y-35.134 Z-14.574
N520 X-41.36 Y-35.123 Z-14.707
N525 X-41.285 Y-35.109 Z-14.833
N530 X-41.199 Y-35.094 Z-14.952
N535 X-41.102 Y-35.076 Z-15.061
N540 X-40.994 Y-35.057 Z-15.16
N545 X-40.878 Y-35.036 Z-15.247
N550 X-40.754 Y-35.014 Z-15.323
N555 X-40.623 Y-34.991 Z-15.386
N560 X-40.486 Y-34.966 Z-15.435
N565 X-40.346 Y-34.941 Z-15.471
N570 X-40.202 Y-34.915 Z-15.493
N575 X-40.058 Y-34.889 Z-15.5
N580 G17 G3 X-38. Y-32.515 I-0.441 J2.461
N585 G1 Y-31.782
N590 X-38.002 Y-31.745
N595 X-38.22 Y-31.46
N600 X-38.515 Y-31.133
N605 X-38.904 Y-30.767
N610 X-39.407 Y-30.363
N615 X-40.608 Y-29.55
N620 X-41.676 Y-28.567
N625 X-42.566 Y-27.422
N630 X-43.302 Y-26.171
N635 X-43.906 Y-24.852
N640 X-44.401 Y-23.488
N645 X-44.803 Y-22.094
N650 X-45.131 Y-20.681
N655 X-45.396 Y-19.255
N660 X-45.611 Y-17.82
N665 X-45.784 Y-16.379
N670 X-45.924 Y-14.935
N675 X-46.037 Y-13.489
N680 X-46.128 Y-12.041
N685 X-46.201 Y-10.592
N690 X-46.26 Y-9.142
N695 X-46.307 Y-7.692
N700 X-46.345 Y-6.242
N705 X-46.376 Y-4.791

N710 X-46.4 Y-3.341
N715 X-46.42 Y-1.89
N720 X-46.436 Y-0.439
N725 X-46.448 Y1.011
N730 X-46.458 Y2.462
N735 X-46.467 Y3.913
N740 X-46.473 Y5.364
N745 X-46.479 Y6.815
N750 X-46.486 Y9.716
N755 X-46.491 Y12.618
N760 X-46.495 Y16.97
N765 X-46.496 Y18.421
N770 X-46.068 Y19.808
N775 X-45.243 Y21.001
N780 X-44.195 Y22.004
N785 X-43.008 Y22.838
N790 X-41.731 Y23.526
N795 X-40.394 Y24.09
N800 X-40.252 Y24.137
N805 X-39.83 Y24.312
N810 X-39.436 Y24.543
N815 X-39.077 Y24.827
N820 X-38.762 Y25.158
N825 X-38.495 Y25.529
N830 X-38.281 Y25.933
N835 X-38.126 Y26.363
N840 X-38.032 Y26.81
N845 X-38. Y27.266
N850 G3 X-38.227 Y28.009 I-1.499 J-0.052
N855 G1 X-38.305 Y28.134 Z-15.493
N860 X-38.382 Y28.257 Z-15.471
N865 X-38.458 Y28.378 Z-15.435
N870 X-38.531 Y28.496 Z-15.386
N875 X-38.602 Y28.609 Z-15.323
N880 X-38.669 Y28.716 Z-15.247
N885 X-38.731 Y28.816 Z-15.16
N890 X-38.789 Y28.908 Z-15.061
N895 X-38.841 Y28.992 Z-14.952
N900 X-38.888 Y29.067 Z-14.833
N905 X-38.928 Y29.131 Z-14.707
N910 X-38.961 Y29.184 Z-14.574
N915 X-38.988 Y29.226 Z-14.435
N920 X-39.007 Y29.257 Z-14.293
N925 X-39.018 Y29.275 Z-14.147
N930 X-39.022 Y29.281 Z-14.
N935 G0 Z5.
N940 G1 X-38.988 Y-33.825 F500.
N945 G0 Z-12.5
N950 G1 Z-14. F800.
N955 X-38.984 Y-33.819 Z-14.147
N960 X-38.973 Y-33.8 Z-14.293
N965 X-38.955 Y-33.769 Z-14.435
N970 X-38.93 Y-33.727 Z-14.574
N975 X-38.897 Y-33.673 Z-14.707

N980 X-38.859 Y-33.608 Z-14.833
N985 X-38.814 Y-33.532 Z-14.952
N990 X-38.763 Y-33.447 Z-15.061
N995 X-38.708 Y-33.354 Z-15.16
N1000 X-38.647 Y-33.252 Z-15.247
N1005 X-38.583 Y-33.143 Z-15.323
N1010 X-38.515 Y-33.029 Z-15.386
N1015 X-38.444 Y-32.91 Z-15.435
N1020 X-38.371 Y-32.787 Z-15.471
N1025 X-38.296 Y-32.662 Z-15.493
N1030 X-38.221 Y-32.536 Z-15.5
N1035 G3 X-38. Y-31.782 I-1.36 J0.809
N1040 G1 Y-28.095
N1045 X-38.005 Y-28.004
N1050 X-38.189 Y-26.565
N1055 X-38.405 Y-25.13
N1060 X-38.629 Y-23.697
N1065 X-38.847 Y-22.262
N1070 X-39.053 Y-20.826
N1075 X-39.242 Y-19.388
N1080 X-39.414 Y-17.947
N1085 X-39.567 Y-16.504
N1090 X-39.702 Y-15.06
N1095 X-39.82 Y-13.614
N1100 X-39.923 Y-12.167
N1105 X-40.011 Y-10.718
N1110 X-40.088 Y-9.27
N1115 X-40.153 Y-7.82
N1120 X-40.208 Y-6.37
N1125 X-40.256 Y-4.92
N1130 X-40.296 Y-3.47
N1135 X-40.329 Y-2.02
N1140 X-40.358 Y-0.569
N1145 X-40.381 Y0.881
N1150 X-40.401 Y2.332
N1155 X-40.418 Y3.783
N1160 X-40.432 Y5.234
N1165 X-40.444 Y6.684
N1170 X-40.453 Y8.135
N1175 X-40.461 Y9.586
N1180 X-40.348 Y11.032
N1185 X-39.892 Y12.41
N1190 X-39.243 Y13.707
N1195 X-38.486 Y14.945
N1200 X-38.276 Y15.347
N1205 X-38.124 Y15.773
N1210 X-38.031 Y16.217
N1215 X-38. Y16.668
N1220 Y24.948
N1225 G3 X-38.227 Y25.691 I-1.499 J-0.052
N1230 G1 X-38.305 Y25.815 Z-15.493
N1235 X-38.382 Y25.939 Z-15.471
N1240 X-38.458 Y26.06 Z-15.435
N1245 X-38.531 Y26.178 Z-15.386

N1250 X-38.602 Y26.29 Z-15.323
N1255 X-38.669 Y26.398 Z-15.247
N1260 X-38.731 Y26.498 Z-15.16
N1265 X-38.789 Y26.59 Z-15.061
N1270 X-38.841 Y26.674 Z-14.952
N1275 X-38.888 Y26.749 Z-14.833
N1280 X-38.928 Y26.813 Z-14.707
N1285 X-38.961 Y26.866 Z-14.574
N1290 X-38.988 Y26.908 Z-14.435
N1295 X-39.007 Y26.938 Z-14.293
N1300 X-39.018 Y26.957 Z-14.147
N1305 X-39.022 Y26.963 Z-14.
N1310 G0 Z5.
N1315 G1 X-38.988 Y-30.138 F500.
N1320 G0 Z-12.5
N1325 G1 Z-14. F800.
N1330 X-38.984 Y-30.132 Z-14.147
N1335 X-38.973 Y-30.113 Z-14.293
N1340 X-38.955 Y-30.082 Z-14.435
N1345 X-38.93 Y-30.04 Z-14.574
N1350 X-38.897 Y-29.986 Z-14.707
N1355 X-38.859 Y-29.921 Z-14.833
N1360 X-38.814 Y-29.845 Z-14.952
N1365 X-38.763 Y-29.76 Z-15.061
N1370 X-38.708 Y-29.666 Z-15.16
N1375 X-38.647 Y-29.565 Z-15.247
N1380 X-38.583 Y-29.456 Z-15.323
N1385 X-38.515 Y-29.342 Z-15.386
N1390 X-38.444 Y-29.223 Z-15.435
N1395 X-38.371 Y-29.1 Z-15.471
N1400 X-38.296 Y-28.975 Z-15.493
N1405 X-38.221 Y-28.848 Z-15.5
N1410 G3 X-38. Y-28.095 I-1.36 J0.809
N1415 G1 Y16.668
N1420 G3 X-38.227 Y17.411 I-1.499 J-0.052
N1425 G1 X-38.305 Y17.536 Z-15.493
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N1455 X-38.731 Y18.218 Z-15.16
N1460 X-38.789 Y18.311 Z-15.061
N1465 X-38.841 Y18.394 Z-14.952
N1470 X-38.888 Y18.469 Z-14.833
N1475 X-38.928 Y18.533 Z-14.707
N1480 X-38.961 Y18.586 Z-14.574
N1485 X-38.988 Y18.628 Z-14.435
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N1495 X-39.018 Y18.677 Z-14.147
N1500 X-39.022 Y18.683 Z-14.
N1505 G0 Z15.
N1510 G1 X41.534 Y35.156 F500.
N1515 G0 Z5.

N1520 Z-12.5
N1525 G1 Z-14. F800.
N1530 X41.527 Y35.154 Z-14.147
N1535 X41.506 Y35.15 Z-14.293
N1540 X41.471 Y35.144 Z-14.435
N1545 X41.422 Y35.135 Z-14.574
N1550 X41.36 Y35.124 Z-14.707
N1555 X41.285 Y35.111 Z-14.833
N1560 X41.199 Y35.095 Z-14.952
N1565 X41.102 Y35.078 Z-15.061
N1570 X40.994 Y35.059 Z-15.16
N1575 X40.878 Y35.038 Z-15.247
N1580 X40.754 Y35.016 Z-15.323
N1585 X40.623 Y34.992 Z-15.386
N1590 X40.486 Y34.968 Z-15.435
N1595 X40.346 Y34.942 Z-15.471
N1600 X40.202 Y34.917 Z-15.493
N1605 X40.058 Y34.891 Z-15.5
N1610 G3 X38. Y32.517 I0.441 J-2.461
N1615 G1 Y31.784
N1620 X38.002 Y31.747
N1625 X38.22 Y31.462
N1630 X38.514 Y31.136
N1635 X38.902 Y30.77
N1640 X39.404 Y30.367
N1645 X40.604 Y29.552
N1650 X41.673 Y28.57
N1655 X42.563 Y27.425
N1660 X43.3 Y26.175
N1665 X43.904 Y24.856
N1670 X44.399 Y23.493
N1675 X44.802 Y22.099
N1680 X44.728 Y20.65
N1685 X44.204 Y19.297
N1690 X43.459 Y18.052
N1695 X42.577 Y16.9
N1700 X41.617 Y15.812
N1705 X40.617 Y14.761
N1710 X39.597 Y13.73
N1715 X38.921 Y13.026
N1720 X38.649 Y12.705
N1725 X38.42 Y12.352
N1730 X38.239 Y11.972
N1735 X38.107 Y11.573
N1740 X38.027 Y11.16
N1745 X38. Y10.74
N1750 Y3.979
N1755 G3 X38.227 Y3.237 I1.499 J0.052
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N1775 X38.531 Y2.75 Z-15.386
N1780 X38.602 Y2.637 Z-15.323
N1785 X38.669 Y2.53 Z-15.247

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N1795 X38.789 Y2.337 Z-15.061
N1800 X38.841 Y2.253 Z-14.952
N1805 X38.888 Y2.179 Z-14.833
N1810 X38.928 Y2.115 Z-14.707
N1815 X38.961 Y2.061 Z-14.574
N1820 X38.988 Y2.019 Z-14.435
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N1830 X39.018 Y1.971 Z-14.147
N1835 X39.022 Y1.964 Z-14.
N1840 G0 Z5.
N1845 G1 X38.988 Y33.827 F500.
N1850 G0 Z-12.5
N1855 G1 Z-14. F800.
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N1865 X38.973 Y33.802 Z-14.293
N1870 X38.955 Y33.772 Z-14.435
N1875 X38.93 Y33.729 Z-14.574
N1880 X38.897 Y33.675 Z-14.707
N1885 X38.859 Y33.61 Z-14.833
N1890 X38.814 Y33.534 Z-14.952
N1895 X38.763 Y33.45 Z-15.061
N1900 X38.708 Y33.356 Z-15.16
N1905 X38.647 Y33.254 Z-15.247
N1910 X38.583 Y33.146 Z-15.323
N1915 X38.515 Y33.031 Z-15.386
N1920 X38.444 Y32.912 Z-15.435
N1925 X38.371 Y32.789 Z-15.471
N1930 X38.296 Y32.664 Z-15.493
N1935 X38.221 Y32.538 Z-15.5
N1940 G3 X38. Y31.784 I1.36 J-0.809
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N1950 G3 X38.227 Y9.997 I1.499 J0.052
N1955 G1 X38.305 Y9.873 Z-15.493
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N1965 X38.458 Y9.628 Z-15.435
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N1990 X38.789 Y9.098 Z-15.061
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N2000 X38.888 Y8.94 Z-14.833
N2005 X38.928 Y8.875 Z-14.707
N2010 X38.961 Y8.822 Z-14.574
N2015 X38.988 Y8.78 Z-14.435
N2020 X39.007 Y8.75 Z-14.293
N2025 X39.018 Y8.731 Z-14.147
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N2045 G0 Z5.
N2050 Z-12.5
N2055 G1 Z-14. F800.

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N2110 X39.35 Y6.308 Z-15.323
N2115 X39.317 Y6.179 Z-15.386
N2120 X39.282 Y6.045 Z-15.435
N2125 X39.247 Y5.907 Z-15.471
N2130 X39.211 Y5.766 Z-15.493
N2135 X39.174 Y5.623 Z-15.5
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N2150 X38.016 Y-5.452
N2155 X38.025 Y-5.601
N2160 X38.039 Y-5.751
N2165 X38.057 Y-5.9
N2170 X38.081 Y-6.048
N2175 X38.11 Y-6.195
N2180 X38.144 Y-6.341
N2185 X38.184 Y-6.486
N2190 X38.228 Y-6.629
N2195 X38.275 Y-6.771
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N2205 X38.382 Y-7.052
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N2215 X38.503 Y-7.326
N2220 X38.57 Y-7.46
N2225 X38.641 Y-7.592
N2230 X38.715 Y-7.723
N2235 X38.793 Y-7.851
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N2255 X39.13 Y-8.348
N2260 X39.221 Y-8.467
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N2270 X39.412 Y-8.698
N2275 X39.512 Y-8.81
N2280 X39.614 Y-8.919
N2285 X39.718 Y-9.027
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N2295 X39.933 Y-9.236
N2300 X40.044 Y-9.338
N2305 X41.128 Y-10.302
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N2315 X42.77 Y-12.686
N2320 X43.375 Y-14.005
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N2380 X43.137 Y-21.432
N2385 X41.96 Y-22.28
N2390 X40.686 Y-22.975
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N2400 X39.581 Y-23.483
N2405 X39.189 Y-23.763
N2410 X38.842 Y-24.097
N2415 X38.548 Y-24.479
N2420 X38.312 Y-24.899
N2425 X38.14 Y-25.349
N2430 X38.035 Y-25.819
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N2475 X38.731 Y-27.849 Z-15.16
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N2540 G1 Z-14. F800.
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N2565 X38.897 Y-3.232 Z-14.707
N2570 X38.859 Y-3.297 Z-14.833
N2575 X38.814 Y-3.372 Z-14.952
N2580 X38.763 Y-3.457 Z-15.061
N2585 X38.708 Y-3.551 Z-15.16
N2590 X38.647 Y-3.653 Z-15.247
N2595 X38.583 Y-3.761 Z-15.323

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N2610 X38.371 Y-4.118 Z-15.471
N2615 X38.296 Y-4.243 Z-15.493
N2620 X38.221 Y-4.369 Z-15.5
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N2660 X38.602 Y-26.198 Z-15.323
N2665 X38.669 Y-26.305 Z-15.247
N2670 X38.731 Y-26.405 Z-15.16
N2675 X38.789 Y-26.497 Z-15.061
N2680 X38.841 Y-26.581 Z-14.952
N2685 X38.888 Y-26.656 Z-14.833
N2690 X38.928 Y-26.72 Z-14.707
N2695 X38.961 Y-26.773 Z-14.574
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N2705 X39.007 Y-26.846 Z-14.293
N2710 X39.018 Y-26.864 Z-14.147
N2715 X39.022 Y-26.87 Z-14.
N2720 G0 Z15.

N2725 M5
N2730 M9
N2735 G53 G0 Z0.
N2740 M11
N2745 G0 A0.
N2750 M10
N2755 X0.
N2760 G53 G0 Y0.
N2765 M30

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Выводы:

В итоге выполненной работы, мы познакомились с утилитой Autodesk Fusion 360, научились строить управляющую программу для фрезерного станка с ЧПУ в системе Fusion 360