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Objective:

To design and create a prototype that can be installed quickly and easily by two employees and will reduce fan noise levels to 80 decibels, without reducing fan airflow by more than 10%. This will allow employees to work around fans without hearing protection.

Background:

ADM uses these fans on site to keep grain in condition, these fans produce sounds in excess of 115 decibels. This puts ADM in a bind, they need these fans to keep grain from spoiling, but the noise they produce requires employees to wear hearing protection. The noise also puts strain on relations with the community surrounding the elevator.

Economics

	Actual	Budgeted
Sound Abatement Material	\$577.92	\$3,000.00
Metal		\$3,500.00
Silencer Shell	\$105.42	
Baffles	\$43.20	
Track	\$52.74	
Miscellaneous	\$27.60	\$1,000.00
Testing Equipment		\$500.00
Decibel Reader	\$198.17	
Velocity Meter	\$106.76	
Total	\$1,111.81	\$8,000.00

Table 1: This show the difference on what we actually spent on the project and what was budgeted

Recommendations:

We ran multiple test setups with varying success. Our test results indicated the biggest noise reduction when the silencer had baffles installed, and the opened end was pointed into the air.

We recommend squaring off and extending the shell an additional 12-18"

We also recommend using a different type of sound abatement material. Our results indicated an average of 0.85 decibel loss with AcustiBlok installation.

Installation of handles would greatly improve handling of prototype.

Findings:

230 V FAN @ SHOP W/O SILENCER									
Decibels					Speed (mph)				
Test Point	Test 1	Test 2	Test 3	Average	Test Point	Test 1	Test 2	Test 3	Average
1	119.5	119.9	119.6	119.7	1	39.5	34.4	31.9	35.3
2	103.2	103.2	102.4	102.9	2	36.4	35.3	34.6	35.4
3	99.8	99.8	97.6	99.1	3	33.5	34.2	36.6	34.8
4	99.3	99.3	99.1	99.2	4	1.1	1.5	2	1.5
5	93.6	99.6	91.9	95.0	5	39.5	38.4	38.4	38.8
				Average					Average
				103.2					29.2

Table 2: This is data collected on the fan at the ABE Shop without a silencer

230V FAN @ SHOP SILENCER W/ BAFFLES & ACUSTIBLOK POINTED UP									
Decibels					Speed (mph)				
Test Point	Test 1	Test 2	Test 3	Average	Test Point	Test 1	Test 2	Test 3	Average
1	94.9	95.4	94.6	95.0	1	4.4	7.1	2.6	4.7
2	89.3	90.1	88.1	89.2	2	23.9	17.8	20.1	20.6
3	95.1	96.2	95.6	95.6	3	22.5	19.6	21.4	21.2
4	90.3	90.7	90.7	90.6	4	24.8	23	24.1	24.0
5	82.7	82.9	92.9	86.2	5	4.2	3.3	3.3	3.6
				Average					
				91.3	6	16.3	14	15.8	15.4
					7	16.1	14.3	14.9	15.1
					8	16.5	18.3	15.2	16.7
					9	27.2	27.9	26.1	27.1
					10	20.8	17.8	17.6	18.7
					11	13.1	11.1	13.1	12.4
					12	5.8	6.4	7.1	6.4
									Average
									15.5

Table 3: This is the data collected on our last silencer design change at the ABE Shop

Results:

After three design changes and testing after each change we have found that we were able to reduce decibels to 95 at the fan while only losing 1.52% airflow. Upon further analysis of the fan and silencer we have found that we can be within 18-20 feet of the fan and be under 85 dBs, whereas without the silencer it was 55 feet.

Testing the Data:

We designed our own testing procedure to test the effectiveness of our silencer. Our procedure includes multiple testing points at set intervals to allow for consistent measurements to be taken.

Decibels and Airflow Layout:

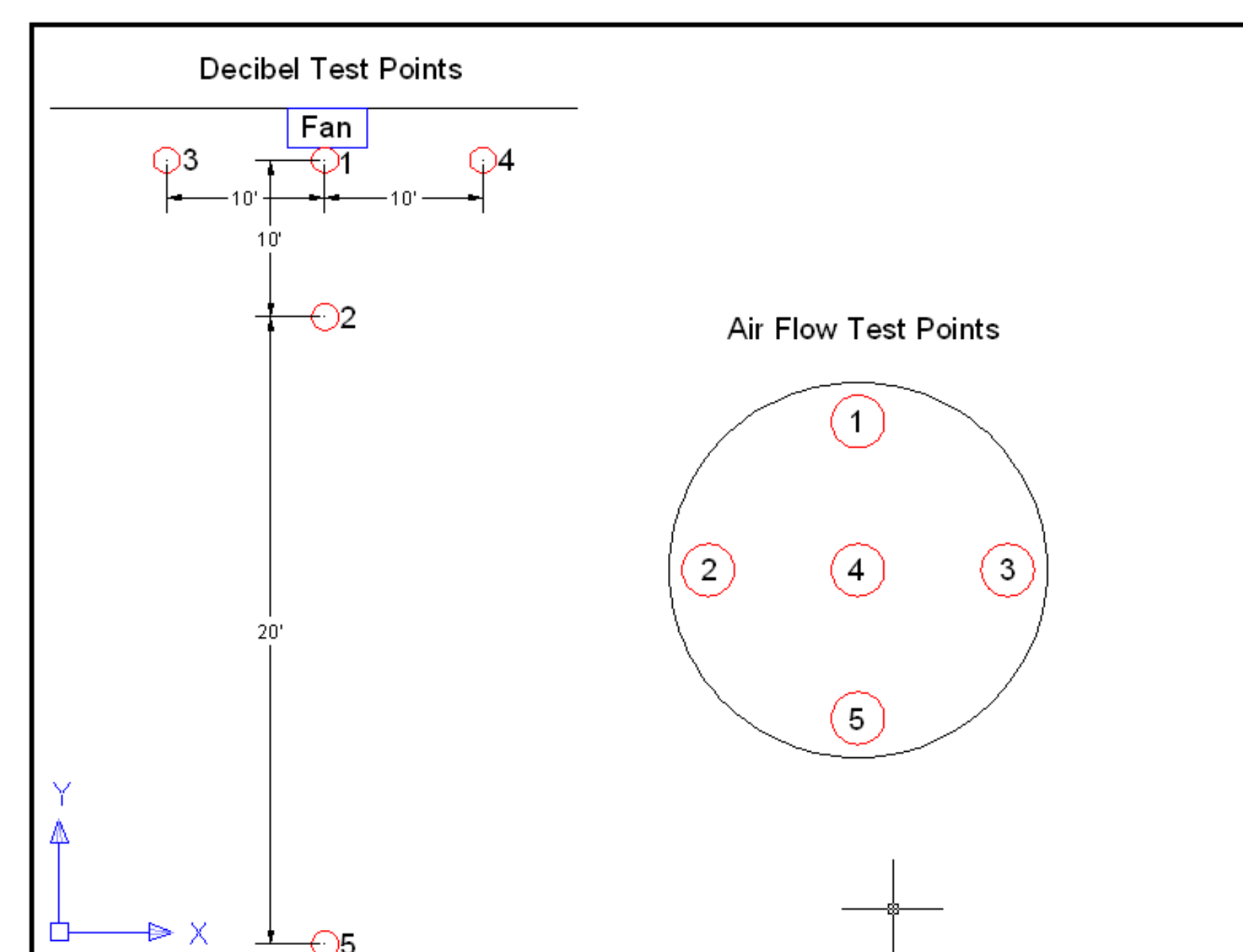


Figure 3: Testing pre-silencer installation and with silencer point-up

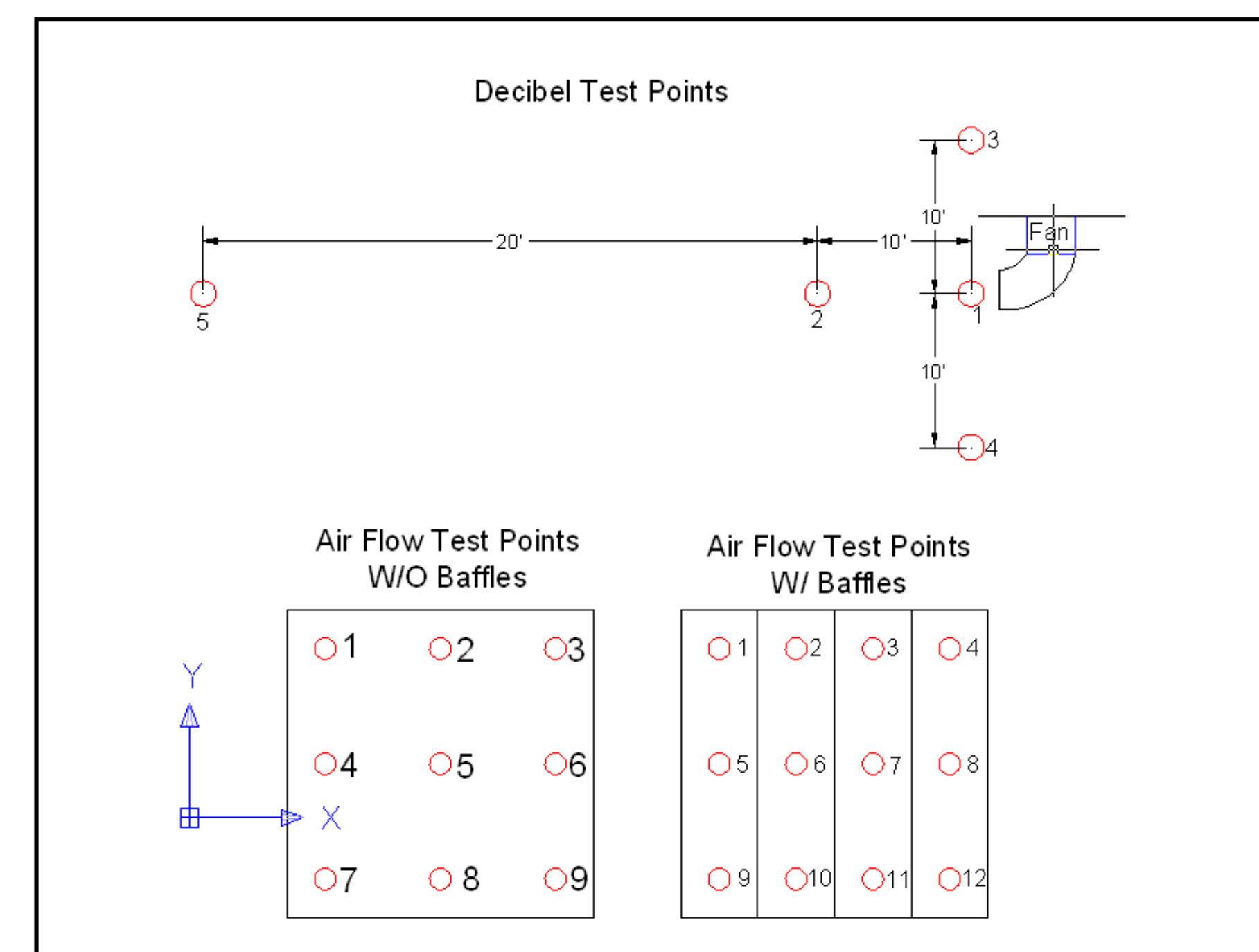


Figure 4: Testing with silencer and with baffles installed

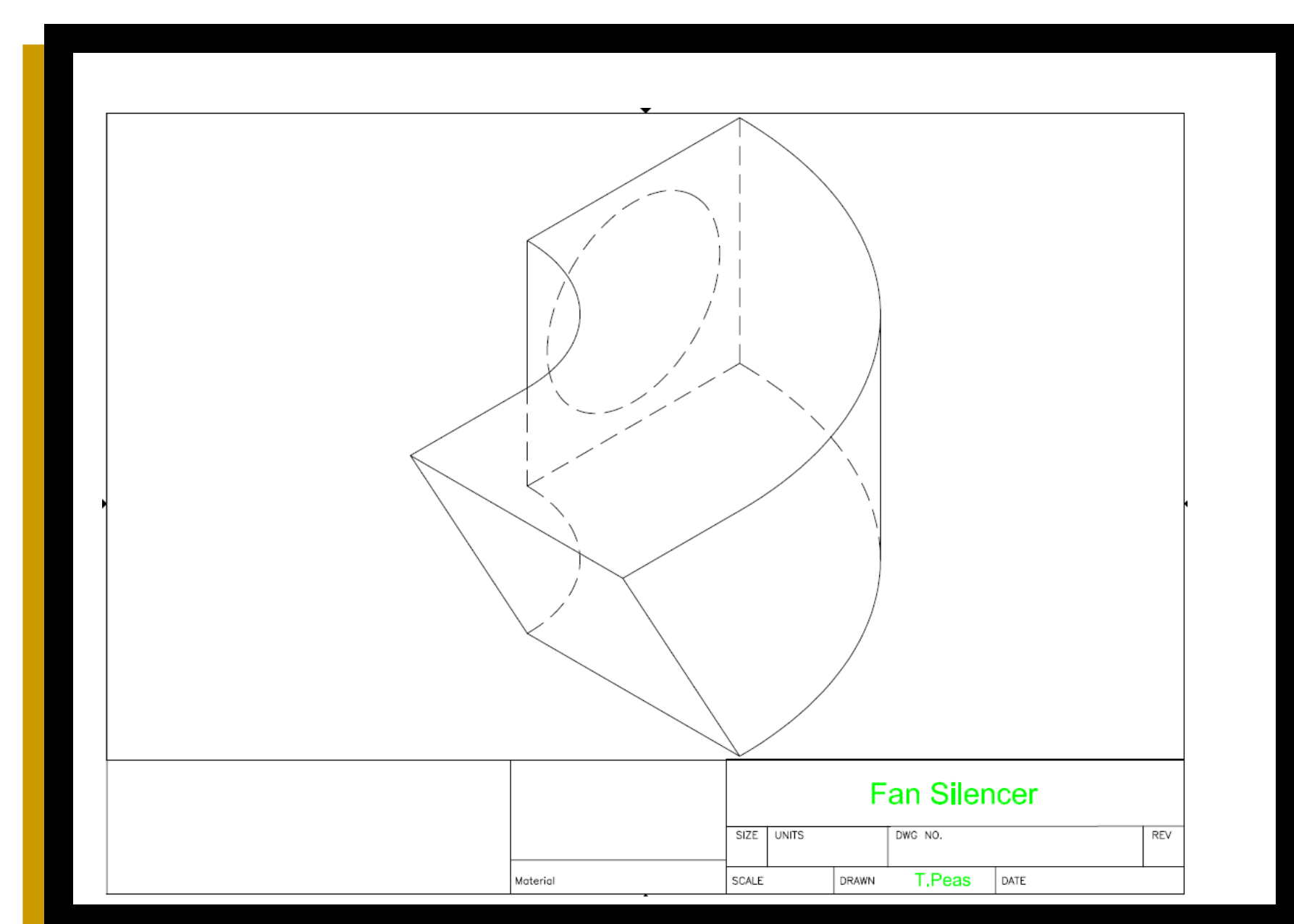


Figure 1: Original AutoCAD drawing

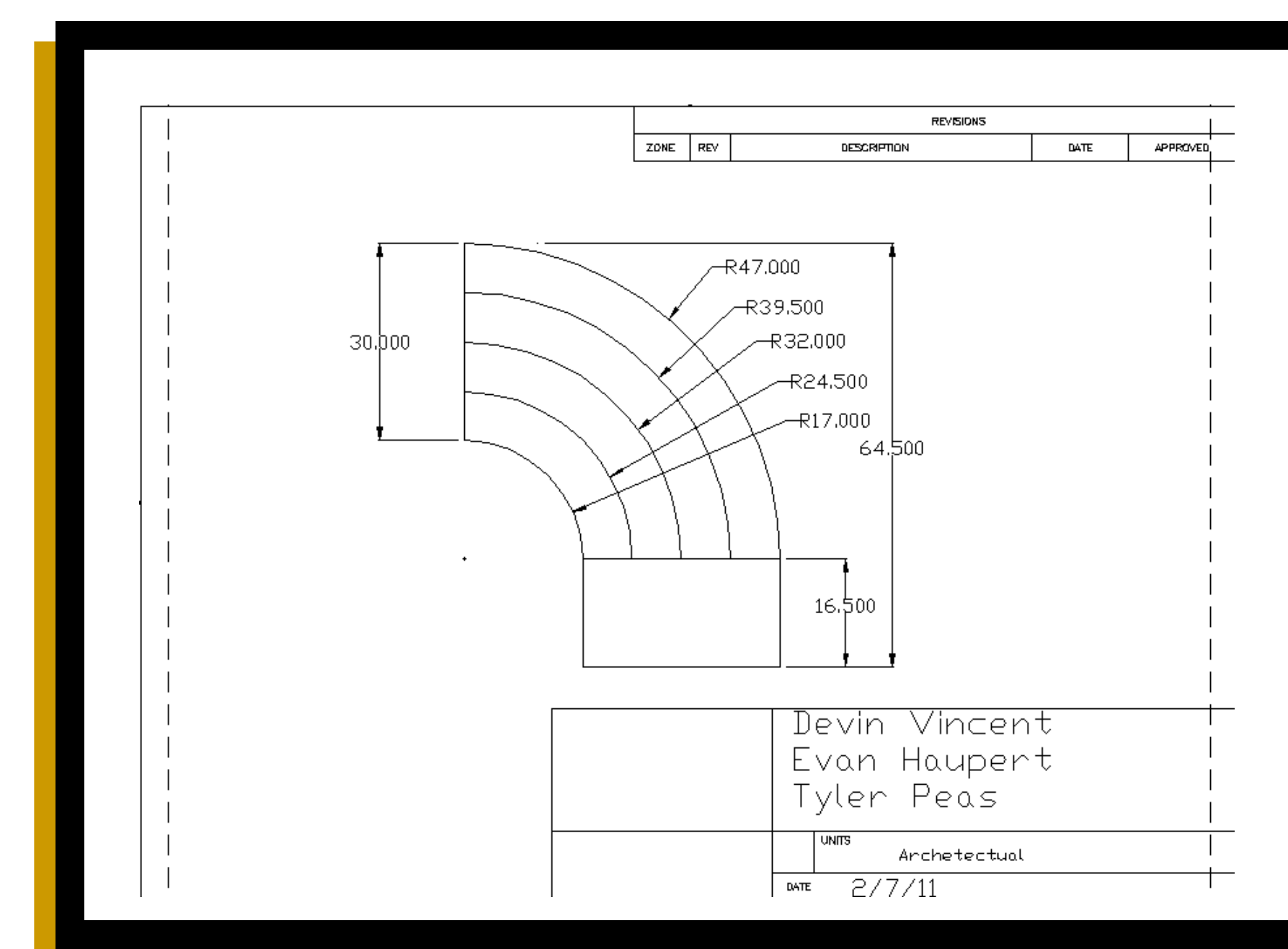


Figure 2: AutoCAD drawing implementing baffles