HOW MEP EQUIPMENT VARIES AND OPTIMIZES PERFORMANCE IN BUILDINGS

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Abstract & Introduction

Technology has been constantly improving the quality of engineering products which allows engineers to change the equipment they use in different buildings. For example all diffusers serve the same purpose, which is to control the flow of a fluid through a pipe or duct. However, different types of diffusers are used based upon the dimensions and the aesthetics of the space [1]. The purpose of this research is to determine how equipment used within certain buildings optimizes the condition of the space within that specific building.

In this research project, the primary pieces of equipment being compared were the fans and the diffusers. For this research the loads and the plans for a warehouse, a high school, and a clinic were used. The data collected found that the different models of fans and diffusers used were specified to accommodate for the space each fan or diffuser was located in. The fans located in high school labs and the chemistry lab fume hood in particular required a much higher horse power of ¾ which is 7.5 times higher than the horsepower needed in a general clinical room. Having specialized models of fans and diffusers made by Greenheck allows for certain rooms and spaces to carry out their required processes or functions [2]. These specialized engineering equipment follow certain codes and standards and are made to optimize the space within a building [3].

Methodology

The first step required to take in this research process is to identify which type of buildings must be compared. In order to, distinguish the type of equipment being used in buildings, it is best to use unique structures such as warehouses, schools, and health care facilities. The buildings used for this research process were a warehouse at Cedar Port, SER Niños High School, and Out Patient Clinic. The next step taken was comparing the types of fans, diffusers, fixtures, air handling units, water coolers, and other equipment used. In other to do this the schedules for all the equipment, the diffusors and air handling units in particular, had to be analyzed. A comparison of the rotations per minute and the cubic feet or air mover per minute by each fan is necessary. An even deeper analysis of this equipment could be done by using the loads which were ran at DBR Engineers. The final and most important aspect of this research process is to analyze why and how certain equipment and systems benefit the building they are located in over other buildings.

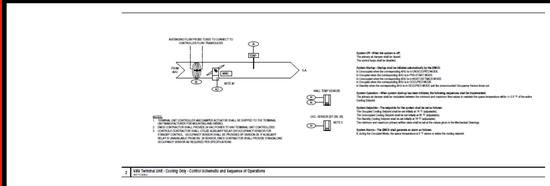
Warehouse Fan Schedules

FAN SCHEDULE			
MARK	EF-1	EF-2	EF-3
SERVES	RESTROOMS	WAREHOUSE VENT.	WAREHOUSE VENT.
TYPE/DRIVE	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT
INTERLOCK	EMCS	EMCS	EMCS
CFM	375	1,525	1,525
EXT. S.P. (IN. W.G.)	1.000	0.500	0.500
HORSEPOWER	1/4	1/2	1/2
FAN SPEED (RPM)	1,592	1,088	1,088
SONES (MAX.)	9.2	8.8	8.8
VOLTS/PHASE/HERTZ	120/1/60	120/1/60	120/1/60
MANUFACTURER	GREENHECK	GREENHECK	GREENHECK
MODEL NUMBER	G-098-VG	G-140-VG	G-140-VG
NOTES	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5

Clinic Fan Schedules

GENERAL EXHAUST FAN SCHEDULE

MARK	EF-1	EF-2	EF-3	EF-4	EF-5	EF-6	EF-7	EF-8	EF-9
SERVES	UNISEX 104,105	UNISEX 177,180	UNISEX 138, 141	UNISEX 110,112	ELECTRICAL 131	JANITOR 189	CLEAN 160, SOILED 158, BIO 156, UNISEX 154, 151	UNISEX 125,152	DRESSING ROOMS
TYPE/DRIVE	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	INLINE/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT
INTERLOCK	ECMS	ECMS	ECMS	ECMS	EMCS	EMCS	EMCS	EMCS	EMCS
CFM (MIN./MAX.)	150	150	150	150	70	75	510	150	280
EXT. S.P. (IN. W.G.)	0.300	0.300	0.300	0.300	0.250	0.200	0.350	0.300	0.300
HORSEPOWER	1/10	1/10	1/10	1/10	1/40	1/100	1/10	1/10	1/10
FAN SPEED (RPM)	1,158	1,158	1,158	1,158	1,550	1,300	1,459	1,158	1,399
SONES (MAX.)	4.9	4.9	4.9	4.9	4.0	2.5	5.7	4.9	6.2
VOLTS/PHASE/HERTZ	115/1/60	115/1/60	115/1/60	115/1/60	115/1/60	115/1/60	115/1/60	115/1/60	115/1/60
MANUFACTURER	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK
MODEL NUMBER	G-080-VG	G-080-VG	G-080-VG	G-080-VG	SQ-60-D	G-060-G	G-090-VG	G-080-VG	G-080-VG
NOTES	1,2,3,4,6	1,2,3,4,6	1,2,3,4,6	1,2,3,4,6	1,4,5,6,6	1,2,3,4,6	1,2,3,4,6	1,2,3,4,6	1,2,3,4,6



3 SER Technical Unit - Cooling Only - Control Schematic and Sequence of Operations
SCALE: NONE

High School Fan Schedules

FAN SCHEDULE										
MARK	EF-A1.1	EF-A1.2	EF-A2.1	EF-A2.2	EF-A2.3	EF-B1.1	EF-B1.2	EF-B1.3	EF-B1.4	EF-B1.5
SERVES	LVL 1 RRs	TOILETS/SHOWER	LVL 2 TOILETS	CNC MACHINE	LASER CUTTER	JANITOILETS	BOYS/GIRLS RR	KITCHEN/SERVING	JAN/RRs	JAN/RRs
TYPE/DRIVE	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/BELT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT
INTERLOCK	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS
CFM (MIN./MAX.)	150	300	150	150	500	225	300	585	305	225
EXT. S.P. (IN. W.G.)	0.500	0.500	0.500	0.500	6.000	0.500	0.500	0.750	0.500	0.500
HORSEPOWER	1/15	1/10	1/15	1/15	2	1/15	1/10	1/6	1/10	0
FAN SPEED (RPM)	1,703	1,664	1,703	1,703	4,012	1,725	1,725	1,725	1,725	1,725
SONES (MAX.)	5.5	8.2	5.5	5.5	80dBA	5.7	8.2	10.7	8.3	5.7
VOLTS/PHASE/HERTZ	120/1/60	120/1/60	120/1/60	120/1/60	460/3/60	120/1/60	120/1/60	120/1/60	120/1/60	120/1/60
MANUFACTURER	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK
MODEL NUMBER	G-70-VG	G-080-VG	G-70-VG	G-70-VG	USF-08-B1	G-070-VG	G-080-VG	CUE-095-VG	G-080-VG	G-070-VG
NOTES	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
MARK	VF-A1-01	VF-A2-01	VF-B1-01	VF-B2-01	VF-B2-02	VF-C1-01	VF-C1-02	VF-C1-03	VF-C1-04	EF-B2.1
SERVES	ELEC 126	ELEC 2007	ELEC 136	ELEC 210	ELEC 222	ELEC 166	A/V 153	ELEC 144	A/V 150	ART 211
TYPE/DRIVE	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT
INTERLOCK	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS
CFM (MIN./MAX.)	250	250	500	250	250	250	250	250	250	1,260
EXT. S.P. (IN. W.G.)	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.750
HORSEPOWER	1/15	1/15	1/15	1/16	1/15	1/15	1/15	1/15	1/15	1/3
FAN SPEED (RPM)	1,725	1,725	1,725	1,725	1,725	1,725	1,725	1,725	1,725	1,302
SONES (MAX.)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	10.6
VOLTS/PHASE/HERTZ	120/1/60	120/1/60	120/1/60	120/1/61	120/1/60	120/1/60	120/1/60	120/1/60	120/1/60	120/1/60
MANUFACTURER	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK
MODEL NUMBER	SQ-70-VG	SQ-70-VG	SQ-70-VG	SQ-70-VG	SQ-70-VG	SQ-70-VG	SQ-70-VG	SQ-70-VG	SQ-70-VG	G-130-VG
NOTES	1,3,4,5,6	1,3,4,5,6	1,3,4,5,6	1,3,4,5,6	1,3,4,5,6	1,3,4,5,6	1,3,4,5,6	1,3,4,5,6	1,3,4,5,6	1,2,3,4

EF-C1.1	EF-C1.2	EF-C1.3	EF-C1.4	EF-C1.5	EF-C1.6	EF-C1.7	EF-C1.8
CHEM FUME HOOD	CHEM STORAGE	CHEMISTRY LAB	LOCKERS/RESTROOMS	BIOLOGY LAB	PHYSICS LAB	LVL 1 & 2 GIRLS/BOYS RRs	GARDEN STORAGE
CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT	CENT/DIRECT
EMCS	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS	EMCS
750	140/280	1115/2225	1,220	900	1,015	1,200	130
0.750	0.35/1.4	0.5/2	0.500	0.500	0.750	0.500	0.500
3/4	1/2	2	1/4	1/4	1/2	1/4	1/15
2,646	1,946	1,283	1,145	1,725	1,293	1,673	1,187
20.0	11.7	18.8	8.8	10.7	9.6	10.4	5.2
120/1/60	120/1/60	480/3/60	120/1/60	120/1/60	120/1/60	120/1/60	120/1/60
GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK	GREENHECK
VK-H-12-5	G-100HP-VG	G-200HP-VG	G-130-VG	G-099-VG	G-120-VG	G-100-VG	G-095-VG
1,2,3,4	1,2,3,4,7	1,2,3,4,7	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4

Findings

From the results provided in the schedules and the calculated loads we can identify the differences between the fans used. The warehouse is shown to have 1 fan that operates at 1592 rotations per minute and 2 other fans that operate at 1088 rotations per minute. The first fan serves the restrooms whereas the other two fan serve warehouse ventilation. However, the 2 fans that serve the warehouse ventilation move an abnormally high amount of air at 1525 cubic feet per minute. The High School has many more fans but the ones this research will focus on are those in laboratories, electrical rooms, and bathrooms. Starting off with the laboratories which are unique to the high school, the fans used in these rooms are much faster, contain a greater horsepower, and move greater cubic feet per minute (CFM) than most other fans. The chemistry fume hood alone moves 750 cubic feet of air per minute and has 2646 rotations per minute (RPM). The Biology lab also has a very high CFM of 900 and an RPM of 1725. The electrical rooms in the high school all maintain a steady RPM of 1725 and a CFM of 250. Lastly the clinic maintains a relatively steady RPM and CFM in its patient rooms at 1158 RPM and 150 CFM respectively.

Discussion

These findings provide a relatively clear understanding of which spaces within certain buildings contain fans that are specialized and differ from fans within any generic space. For example, we can clearly note that the fans in the chemistry fume hood and labs move a much higher CFM of air at 750 and 900 respectively. When compared to the CFM of air moved by the fans in a clinic room which is only 150, the amount of air moved by fans in the high school lab is 5 to 6 times higher. The chemistry lab and fume hood which must rid the space of any dangerous chemicals will definitely have to move a greater amount of air per minute and will therefore rotate faster. The CFM used for warehouse ventilation is also significantly higher, but this is because the dimensions of the room and space are much larger meaning that the volume of air the fans have to move is greater. The difference in what each space is used for and the dimensions of each space allows for different models of the equipment to be used in areas that serve different purposes.
These findings and their analysis can be improved by using buildings that are even more distinct. With a relatively limited number of buildings to chose from it may be more difficult to differentiate the equipment and their purposes. However, by diversifying the types of buildings being analyzed, the results and findings can be much broader and easier to analyze.

References

1) “The American Society of Mechanical Engineers - ASME.” ASME, www.asme.org. Accessed 19 Apr. 2022.
2) “Air Movement | Greenheck.” Greenheck-USA, www.greenheck.com/products/air-movement. Accessed 19 Apr. 2022.
3) “LibGuides: Mechanical Engineering Resources: Codes and Standards.” LibGuides, libguides.msoe.edu/me/codes. Accessed 19 Apr. 2022.