THESIS

AN INVESTIGATION OF THE VETILATION SYSTEM

OF THE

R. E. OLDS HALL OF ENGINEERING

F. O. STANG

1918

An Investigation of the Ventilation System of the R. E. Olds Hall of Engineering.

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By

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THESIS

Bibliography.

Vol.I. Harding & Willard, "Heating & Ventilating," chapter on hot blast heating, including method of measurement of flow of air under low pressure, and design of ducts, both by the velocity and friction pressure loss method.

American Society of Heating & Ventilation Engineering. Vol.19, page 202. Discusses methods of taking readings of air flow from a register face.

Vol.18 - Report on School Room Ventilation, suggested requirements given as a result of investigation of conditions existing in schools.

Heating and ventilating magazine, Jan., Feb., March, and April issues for 1918. Discussions of tests of ventilating systems in several Chicago schools. These discussions include data taken during the test and conclusions drawn.

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INTRODUCTION.

The subject of ventilation is one which has occupied the attention of many engineers, and as yet is not by any means entirely mastered. This statement is quite evident after reading reports of the meetings of the American Society of Heating and Ventilating Engineers. The question as to what system of ventilation is to be employed for a church, assembly hall, theatre, etc., will bring forth as many opinions as to the right and wrong system as there are people in the discussion. It is hardly an exaggeration to say that a small percentage of public buildings are ever properly ventilated.

The object of this thesis is to check the distribution of air to the various rooms of the building, and to change the design of the system where necessary by means of baffle plates to meet the requirements.

The present building was placed on the foundations of the old one destroyed in 1915, and for that reason the same plans were used practically throughout. The inlet to the fan is located on the west side of the steam laboratory, and the incoming air is taken through a plenum chamber, and is heated by passing over the coils before it reaches the fan. This system is known in practice as the draw-through

arrangement; that is, the fan is installed between the heater and the main ducts. Directly below the basement hallway is the tunnel into which the air is delivered from the fan. At the east end of the building the main tunnel is intercepted by a tunnel at right angles, this second tunnel being necessary, due to the arrangement of the rooms on the east end. The inlets to the ducts leading to the various rooms are located in the walls of this tunnel. These openings extend back a distance of a foot or so, and then turn to the vertical position. The duct is no more than an opening in the brickwork, through which the air is delivered to the rooms. Diffusers are placed at the outlet of the ducts into the rooms. The diffusers consist of vanes set vertically in a framework which fits the outlet and radially with respect to a vertical line located some place back of the outlet. These diffusers tend to spread the air about the room, rather than allow it to flow directly across the room as is the case with an open duct. The scheme used for distributing the air in the assembly room is unique, and worthy of some attention here. Three ducts extend from the tunnel to the second floor level, and enter a chamber over the hallway. This chamber is noticeable, as the ceiling over the hallway at the west end is lower than at the east end. From this chamber the air enters the assembly room through five outlets,

travels in a downward direction beneath the platform at the front of the room, then up the duct in the east wall, and finally through the outlet in this wall. The inlet to the ducts leading to the assembly room from the tunnel, and the outlet in the east wall are equipped with vanes, the opening and closing of which are controlled by compressed air. The reason for this is apparent, for if the assembly room is not in use, the vanes may be closed, and the air that the fan has to deliver will be greatly lessened, and what is of most importance, the power required will also be diminished.

After considering different schemes of obtaining the results required, it was decided that the easiest way would be to measure the flow of air at the inlet of the ducts, rather than at the outlet; the latter system being the one used by the Commission of Ventilation for the City of Chicago in its tests of the ventilating systems of various schools of that city, but was hardly applicable in the case of the Engineering Building.

The instrument used for measuring the velocity was an anemometer. While it is possible to do a great deal more work with one of these instruments than with some of the other devices on the market, its accuracy is questionable, and given by most authorities as checking within a probably error of from one to five percent, and velocity

limits of from one to forty feet per sec. The calibration curve for the anemometer used will be found on Plate 1., and shows the correction to be added to the instrument reading. Knowing the velocity of the air and the area of the duct, the quantity delivered can be obtained by the formula: velocity times area equals quantity.

In regard to the amount of air required for ventilation, authorities differ, specifying amounts varying from five hundred to twenty-four hundred cubic feet of air per hour per person. The quantity most often required by the state laws for such buildings as the one under consideration is eighteen hundred cubic feet per hour per person, and this was the figure used throughout, except in the case of room 10, where a large portion of the students' time is used in chemical analysis work, and in this instance a figure of 3000 cubic feet.per hour per person was used. Harding & Willard give 3500. Reference to the data sheets following will show that in many cases the requirement is far exceeded, while in others the quantity necessary is greater than that delivered. It is evident from this that the system is not balanced; and in order to overcome the difficulty, baffle plates should be used to increase the quantity where the required amount is not met, and lessen the volume delivered to others to the amount necessary. In Plate 2 the basement and foot-

ing plans of the building are shown. The figures alongside the ducts are taken from the log sheets, and are the quantities of air delivered when the fan is operating at the highest speed, which is about 150 r.p.m.

The tabulated data on the log sheets following include the complete set of readings for each test, the average reading, the quantity delivered, and the quantity required. The readings were taken at five different speeds of the fan, and show a marked variation in some instances at the same speed. This illustrates that outside conditions have an important effect on the efficient working of a ventilating system. This effect will tend to become less as the construction more nearly approaches air tight conditions.

CONCLUSIONS.

Some of the conclusions drawn from this test have been given in a general way in the previous description. Without an attempt to border on the humorous side of the situation, I would say that it seemed a rare coincidence indeed that the piers used for supports are all situated near a group of ducts, so that the air is deflected in such a way that one or two of them receive an excess, while others receive a smaller proportion of air. An attempt was made to locate the duct to room 413, but as

no results were obtained, it was concluded that the passage was blocked up. On the south side of the tunnel and just west of the fan outlet, are two ducts which do not apparently connect up to any room, and in that case they should be closed, because the air pumped into them simply finds its way out again. Referring to Plate 3, these ducts are marked A and B, and the quantity of air delivered is given on sheet No.(9). The ducts which are closed or do not register any flow of air are marked on Plate 3 as (zero) cu.ft.

The condition in which the chamber was left when the work was completed on the building is something that should not be overlooked. A considerable quantity of mortar, broken bricks, and concrete was left, and gave evidence that the inspector did not use due care in exercising his duty. The presence of dust in the air was very evident by its being deposited on the polished surface of the anemometer box. I would suggest that before any attempt was made to change the quantity of air delivered to various rooms, that the quality be improved by cleaning out the useless material now present.

It is to be regretted that time does not permit of a continuation of the work to lay out a system of baffles as has been suggested earlier.

To conclude, it should be clearly understood that this subject was not taken up with the idea of finding fault, nor were the remarks in the last few paragraphs directed at any particular person. The work was undertaken to gain some knowledge in the ways of ventilation and means of overcoming existing difficulties.

Acknowledgments.

This page is devoted to the expression of my indebtedness to Dean Bissell for his timely suggestions and advice; to Mark's "Mechanical Engineer's Handbook," for the use of air meters and their limits; to Harding & Willard's "Heating & Ventilation"; and the "Transactions of the American Society of Heating & Ventilating Engineers," for discussions of ventilating systems and requirements for good ventilation.

Miscellaneous.

The ducts to rooms 6-108 and 206 are all very narrow in proportion to their height, and to lessen the error, the lower part of the duct was closed up, leaving a height of about seven or eight inches. By this means, the velocity was increased, and the error of reading accordingly decreased. The data given below were obtained under these conditions.

Room No.	Vel.Ft. Per Min.	Area of Duct. Sq.Ft.	Cu.Ft. Per Hr. Delivered.	Cu.Ft. Per Hr. Required.
6	210	0.425	5370	
108	195	0.5	5820	1800
206	195	0.525	6140	3600

The curve on Plate 2 shows the relation between the speed of the fan and the volume of air as measured at the inlet of the fan.

R.P.M.Fan 90.

Room No.	Area Dust Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. /Hr.Re- quired.
1	0.66	0					0	3600
2	1.415	40	45	115	79	76	6300	1800
3-103	1.33	0					0	36000
4	2.24	65	10	100	59		6700	18000
5	3.25	100.	130	120	110	114	22200	18000
6	1.5	0					0	1800
7	3.2	90	120	90	97	97	18600	18000
9	1.415	60	60	85	67	60	5100	3600
10	2.79	170	200	205	191	209	35000	30000
11	2.67	145	120	120	136	146	23400	22000
12	4.0	180	180	205	179	197	47250	22000
13-114	1.335	230	380	270	245	259	20800	3600
14-312	1.415	110	265	230	179	196	16600	14400
14-313	1.5	130	220	90	170	186	16700	
							33,300	

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. / Hr.Re- quired.
			- First Floor -					
101-201	1.5	110	195	160	136	146	13150	3600
102-202	1.415	120	155	120	134	144	12200	2700
104	1.375	0					0	1800
105	2.84	80	10	70	62	53	9500	86000
105	1.46	0					0	
107	3.33	95	140	140	105	107	21400	75500
108	1.5	0					0	1800
109	4.0	75	110	110	101	101	24200	18000
110 L	0.84	140	170	130	132	141	7100	18000
110 R	1.41	20	80	50	50	40	4240	18000
111	5.0	70	140	130	112	115	34500	
111	7.0	50	90	80	70	63	25500	434000
111	7.17	100	130	130	121	127	54500	
							114,500	
113	4.0	0					0	25200
115	2.84	175	320	180	231	247	42000	36000

Total for 102-202 = 5400 required, 27650 delivered.

Room No.	Area Duct. Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. / Hr.Re- quired.
			- Second Floor. -					
202	1.58	120	185	195	150	163	15450	2700
203	2.92	120	120	130	142	153	26800	59400
204	2.84	50	10	75	44	35	5970	10800
204	3.02	20	5	30	26			
205	3.4	105	140	115	111	115	23400	45000
206	1.625	0					0	3600
207	4.0	90	110	105	106	108	21600	52200
208	5.0	60	140	130	100	100	30000	36000
209	2.75	150	260	140	169	184	30400	1800
210	2.75	180	315	200	219	237	39000	55750

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. / Hr.Re- quired.
			- Third Floor. -					
301	2.67	140	205	160	171	187	29900	59400
302	2.84	0					0	59400
303	2.62	55	80	65	62	53	8350	45000
304	3.25	100	105	130	165	180	35100	59400
305	1.58	0					0	1800
306	3.33	40	60	80	62	53	12400	50400
308	2.84	150	130	120	141	152	25900	45000
309	4.0	180	240	170	187	205	49250	37800
310	1.415	110	140	130	132	140	11900	3600
311	2.75	115	190	185	164	179	29500	37800
311	2.92	130	220	170	160	175	30600	
							60,100	

Room No.	Area Dust. Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. / Hr.Re- quired.
			- Fourth Floor -					
401	2.0	220	260	255	231	247	29600	36000
402	1.83	170	180	160	160	175	19200	36000
403	2.0	75	120	110	95	95	11400	19800
405	3.4	110	145	135	127	135	27500	36000
406	1.33	0					0	1800
407	3.33	90	125	95	106	108	25900	59400
409	2.84	145	150	140	139	150	25600	5400
410	4.0	125	200	170	157	171	41000	45000
411	1.415	0					0	1800
412	2.67	140	280	220	185	203	32500)	45000
412	3.0	110	175	155	150	139	25000)	
							57,500	
413	Refer to Page ( ) above.							1800
414	2.08	130	150	70	117	122	15200	3600

R.P.M. Fan. 111.

Room No.	Area Duct Sq. Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu. Ft. Per Hr.	Cu. Ft. Per Hr. Required.
1	0.66	0					0	3600
2	1.415	150	150	170	166	181	15400	1800
3-103	1.33	0					0	36000
4	2.24	170	140	190	165	180	24200	18000
5	3.25	160	200	185	174	190	37000	18000
6	1.5	0					0	18000
7	3.2	80	100	0	79	76	13900	18000
9	1.415	105	90	125	110	114	9450	3600
10	2.79	230	250	150	225	241	40500	30000
11	2.67	280	240	170	239	254	40500	22000
12	4.0	215	230	300	244	258	62000	22000
13-114	1.335	380	330	390	369	372	29800	3600
14-312	1.415	330	190	320	280	290	24600	14400
14-315	1.5	280	190	280	255	268	24100	
							98,700	

Room No.	Area Dust Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
			- First Floor.-					
101-201	1.5	145	245	255	206	224	20200	3600
102-202	1.415	160	170	190	177	194	16500	2700
104	1.375	0					0	1800
105	2.84	115	90	125	109	111	18900	86000
105	1.46	0					0	
107	3.33	180	170	220	181	198	39800	75500
108	1.5	0					0	1800
109	4.0	100	110	50	90	89	21400	1800
110 L	0.84	195	165	135	171	187	9450	1800
110 R	1.41	100	170	135	129	137	11700	1800
111	5.0	180	265	90	166	181	54250	
111	7.0	140	110	90	110	114	48000	434000
111	7.17	215	195	175	199	218	94000	
							196,250	
113	4.0	0	0	70	17		0	25200
115	2.84	305	275	310	308	315	53600	36000

Total for 102-202 = 38600 delivered, 5400 required.

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
			- Second Floor. -					
202	1.58	200	200	240	215	233	22100	2700
203	2.92	305	260	280	272	290	50800	59400
204	2.84	110	95	130	115	120	20450	10800
204	3.02	70	60	60	66			
205	3.4	200	155	200	179	196	40000	45000
206	1.625	0					0	3600
207	4.0	110	120	110	119	125	30000	52200
208	5.0	190	205	205	200	219	65500	36000
209	2.75	215	175	225	202	221	36500	1800
210	2.75	335	200	335	274	285	48600	55750

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
			- Third Floor.-					
301	2.67	290	250	340	300	308	49200	59400
302	2.84	0					0	59400
303	2.62	140	95	95	110	113	17800	45000
304	3.25	200	145	160	169	185	36000	59400
305	1.58	0					0	1800
306	3.33	120	120	30	102	102	20400	50400
308	2.84	190	180	130	182	200	34000	45000
309	4.0	215	270	220	214	232	55500	37800
310	1.415	160	170	180	185	203	17200	3600
311	2.75	140	220	270	214	232	38200	37800
311	2.92	245	245	280	252	265	46500	
							84,700	

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per.Hr.	Cu.Ft. Per Hr. Required.
			- Fourth Floor.-					
401	2.0	285	280	410	334	339	40600	36000
402	1.85	190	210	225	204	225	25600	36000
403	2.0	150	140	185	157	170	20400	19800
405	3.4	180	180	195	184	202	41200	36000
406	1.35	0					0	1800
407	3.33	100	105	160	124	150	26000	59400
409	2.84	220	165	140	196	215	36600	36600
410	4.0	195	320	270	240	255	61000	45000
411	1.415	0					0	1800
412	2.67	260	310	360	294	302	54500	45000
412	3.0	200	240	240	225	242	38800	
							93,300	
413								1800
414	2.08	225	130	160	182	199	24800	3600

R.P.M.Fan.129.

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rtd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required
1	0.66	0					0	3600
2	1.415	220	175	210	195	214	18200	1800
3-103	1.33	0					0	36000
4	2.24	185	195	195	192	209	28100	18000
5	3.25	220	210	195	214	231	45000	18000
6	1.5	0					0	18000
7	3.2	145	170	120	121	127	23400	18000
9	1.415	140	120	80	110	114	9700	3600
10	2.79	245	295	275	272	283	47500	30000
11	2.67	275	220	250	269	280	44800	22000
12	4.0	235	220	220	225	241	51750	22000
13+114	1.335	420	360	410	397	399	31900	3600
14+312	1.415	265	360	350	332	338	38800	14400
14+313	1.5	230	280	240	237	252	22700	
							61,500	

Room No.	Area Duct. Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
			- First Floor. -					
101+201	1.5	195	230	290	227	245	21800	3600
102+202	1.415	150	150	200	172	188	16000	2700
104	1.375	0					0	1800
105	2.84	130	135	105	125	132	22500	86000
105	1.46	0					0	
107	3.53	210	225	215	220	237	47400	75500
108	1.5	0					0	1800
109	4.0	120	130	145	125	132	31700	18000
110	L 0,84	110	225	230	199	218	11000	18000
110	R 1.41	25	95	90	52			18000
111	5.0	230	205	245	231	247	74000	
111	7.0	150	185	155	160	174	73000	434000
111	7.17	245	230	240	247	261	112000	
							259,000	
115	4.0	0					0	25200
115	2.84	285	345	360	317	324	55200	36000

Total for rooms 102-202 = 38100 delivered.

Room No.	Area Dust. Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
			- Second Floor -					
202	1.58	170	190	265	216	233	22100	2700
203	2.92	260	285	310	291	300	52500	59400
204	2.84	135	140	125	129	137	23400	10800
204	3.02	80	110	90	90			
205	3.4	190	215	205	206	225	45800	45000
206	1.625	0					0	3600
207	4.0	140	145	175	152	165	39600	52200
208	5.0	185	165	175	180	197	59500	36000
209	2.75	225	220	205	210	228	37600	1800
210	2.75	275	360	310	316	323	53300	55750

Room No.	Area Dust Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per.Hr.	Cu.Ft. Per Hr. Required
			- Third Floor. -					
301	2.67	285	285	310	297	305	48800	59400
302	2.84	0					0	59400
303	2.62	140	135	135	134	144	22600	45000
304	3.25	230	255	205	226	242	47200	59400
305	1.58	0			.		0	1800
306	3.33	120	145	95	106	109	21800	50400
308	2.84	195	190	180	189	207	35300	45000
309	4.0	260	300	295	281	291	70000	37800
310	1.415	195	190	215	195	214	18200	3600
311	2.75	270	270	325	279	289	47600	37800
311	2.92	295	290	320	301	309	54000	
							101,600	

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required
			- Fourth Floor.-					
401	2.0	300	345	445	357	361	43300	36000
402	1.83	220	225	235	225	241	26400	36000
403	2.0	155	165	175	166	180	21600	19800
405	3.4	210	210	215	215	233	47500	36000
406	1.33	0					0	1800
407	3.33	155	165	170	165	179	35800	59400
409	2.84	235	210	200	209	228	39000	36600
410	4.0	210	210	305	245	259	62100	45000
411	1.415	0					0	1800
412	2.67	270	260	260	269	280	44800	45000
412	3.0	225	205	200	204	223	40250	
							85,050	
413								1800
414	2.08	210	215	170	191	208	26000	3600

R.P.M.Fan 142.

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per.Hr. Required
1	0.66	0					0	3600
2	1.415	185	210	190	205	224	19050	1800
3-103	1.33	0					0	36000
4	2.24	230	205	215	215	233	31300	18000
5	3.25	240	235	245	236	251	49000	18000
6	1.5	10	45	45	27		0	18000
7	3.2	180	220	155	252	265	50750	18000
9	1.415	115	105	150	122	129	11000	36000
10	2.79	310	340	340	310	316	53000	30000
11	2.67	280	280	330	291	299	48000	22000
12	4.0	245	245	250	245	259	62250	22000
13+114	1.335	480	405	440	439	440	35300	3600
14+312	1.415	395	405	425	409	411	35000	14400
14+313	1.5	290	270	290	321	327	29400	
							64,400	

Room No.	Area Dust Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
				- First Floor.-				
101+ 201	1.5	255	310	220	271	282	25400	3600
102+ 202	1.415	185	210	205	202	221	18800	2700
104	1.375	0					0	1800
105	2.84	155	140	150	144	156	26600	86000
105	1.46	0					0	
107	3.33	260	280	260	266	278	55500	75500
108	1.5	20	20	35	24		0	1800
109	4.0	195	135	140	149	161	38600	18000
110L	0.84	245	250	270	246	260	13100	18000
110R	1.41	40	65	120	69	62	5250	18000
111	5.0	260	285	295	272	283	85000	434000
111	7.0	205	210	195	191	209	88000	
111	7.17	290	280	280	277	288	124000	
							297,000	
113	4.0	0					0	25200
115	2.84	365	345	380	361	365	62250	36000

Total for rooms 102-202 = 42900.

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
			- Second Floor. -					
202	1.58	250	255	220	239	254	24100	2700
203	2.92	345	365	310	336	341	44500	59400
204	2.84	150	125	155	144	156	26600	10800
204	3.02	115	90	95	104	106	19200	
							45,800	
205	3.4	225	250	235	227	244	49000	45000
206	1.625	0					0	3600
207	4.0	160	170	195	165	180	43250	52200
208	5.0	270	200	195	224	241	72250	36000
209	2.75	205	225	270	244	258	42600	18000
210	2.75	400	370	405	389	392	64800	55750

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver.. Vel.	Corr'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required
			- Third Floor.-					
301	2.67	360	360	328	345	350	56000	59400
302	2.84	0					0	59400
303	2.62	155	160	160	156	169	26600	45000
304	3.25	230	205	220	217	235	26000	59400
305	1.58	0					0	1800
306	3.33	150	140	150	156	146	29200	50400
308	2.84	255	245	205	231	247	42100	45000
309	4.0	315	320	320	326	332	79600	37800
310	1.415	205	200	205	204	223	18900	36000
311	2.75	310	295	290	306	315	52000	37800
311	2.92	350	310	345	326	332	58250	
							110,250	

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required
			- Fourth Floor.-					
401	2.0	405	415	370	417	419	50400	36000
402	1.83	270	245	255	262	274	30000	36000
403	2.0	215	195	200	204	223	26800	19800
405	3.4	215	250	220	232	248	50500	36000
406	1.33	0					0	1800
407	3.33	195	190	185	177	193	38600	59400
409	2.84	235	245	225	229	245	41750	36600
410	4.0	240	260	260			0	45000
411	1.415	0					0	1800
412	2.67	330	305	335	266	278	44500	45000
412	3.0	260	255	270	255	268	48200	
							92,700	
413								1800
414	2.08	255	235	265	275	287	35800	3600

R.P.M.Fan 149.

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
1	0.66	0					0	3600
2	1.415	210	230	290	239	254	20600	1800
3-103	1.33	0					0	36000
4	2.24	235	230	265	250	263	36300	18000
5	3.25	260	225	255	252	265	51750	18000
6	1.5	Refer to note page (9).						18000
7	3.2	125	180	180	159	175	33200	18000
9	1.415	180	160	150	162	175	14900	3600
10	2.79	375	350	410	382	388	65000	30000
11	2.67	320	340	330	327	333	53300	22000
12	4.0	280	265	305	284	293	70250	22000
13-114	1.335	555	545	555	557	555	44500	3600
14-312	1.415	425	475	440	447	448	38000	14400
14-315	1.5	380	360	470	394	396	35600	
							73,600	

Room No.	Area Dust Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required
				- First Floor.-				
101+ 201	1.5	290	270	305	276	287	25800	3600
102+ 202	1.415	255	250	255	249	263	22300	2700
104	1.375	0					0	1800
105	2.84	175	150	180	174	190	32400	86000
106	1.46	0					0	
107	3.33	275	270	295	289	298	59500	75500
108	1.5	Refer to note Page (9).						1800
109	4.0	130	160	155	151	164	39400	18000
110L	0.84	285	260	300	281	291	14650	18000
110R	1.41	90	100		98	98	8300	18000
111	5.0	340	345	340	341	346	104000	434000
111	7.0	240	230	205	220	236	99000	
111	7.17	345	305	380	331	337	145000	
							348,000	
113	4.0	40	40	35	39	39	7200	25200
115	2.84	490	510	410	475	475	81000	36000

Total for rooms 102-202 = 48700 delivered.

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
			-Second Floor.-					
202	1.58	280	300	260	267	278	26400	3600
203	2.92	355	350	385	267	278	48700	59400
204	2.84	150	160	140	157	170	29000	10800
204	3.02	120	170	140	141	152	27400	
							56400	
205	3.4	260	240	220	245	259	52800	45000
206	1.625	Refer to note Page (9).						
207	4.0	195	190	220	196	215	51500	52200
208	5.0	220	235	240	236	251	75300	36000
209	2.75	300	295	325	302	307	50600	1800
210	2.75	470	480	470	486	486	80250	55750

Room No.	Area Duct Sq.ft.	Vel. Ft./ Min.	Vel.	Vel. - Third Floor -	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
301	2.67	410	420	425	417	419	67100	59400
302	2.84	0					0	59400
303	2.62	180	215	190	196	215	33800	45000
304	3.25	235	220	240	241	256	50000	59400
305	1.58	0					0	1800
306	3.33	180	160	150	164	179	35800	50400
308	2.84	325	290	255	291	300	51100	45000
309	4.0	350	335	360	337	342	82000	37800
310	1.415	280	260	240	251	264	22400	3600
311	2.75	320	340	335	351	337	55600	37800
311	2.92	400	340	380	385	388	68000	
							123,600	

Room No.	Area Duct Sq. Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
			- Fourth Floor -					
401	2.0	440	470	465	439	440	52800	36000
402	1.83	270	250	290	274	284	31200	36000
403	2.0	220	245	250	244	258	31000	19800
405	3.4	240	240	270	251	264	53800	36000
406	1.33	0					0	1800
407	3.33	210	200	205	204	223	44500	59400
409	2.84	280	310	265	285	294	50000	36600
410	4.0	340	365	310	334	339	81300	45000
411	1.415	0					0	1800
412	2.67	300	400	380	357	361	57750	45000
412	3.0	305	250	270	277	287	57600	
							115,350	
413								1800
414	2.08	260	430	395	362	367	45700	3600

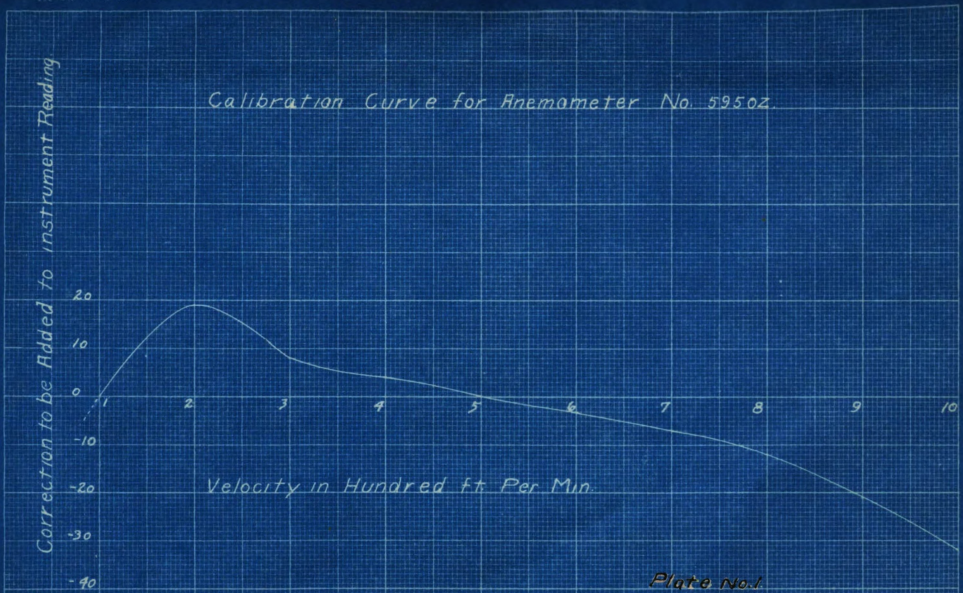
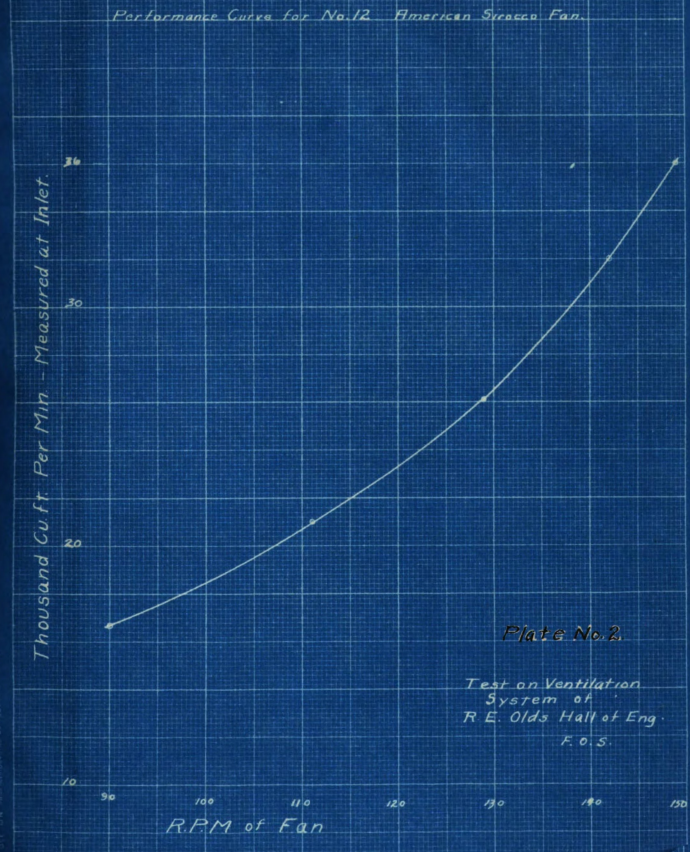

Calibration Curve for Anemometer No. 5950z.
Correction to be Added to Instrument Reading
20
10
0
-10
-20
-30
-40
1
2
3
4
5
6
7
8
9
10
Velocity in Hundred ft Per Min.

Plate No. I


Performance Curve for No. 12 American Sirocco Fan.
Thousand Cu ft. Per Min. - Measured at Inlet.
10
20
30
40
90
100
110
120
130
140
150
R.P.M of Fan
Plate No. 2.
Test on Ventilation System of R. E. Olds Hall of Eng.
F. O. S.

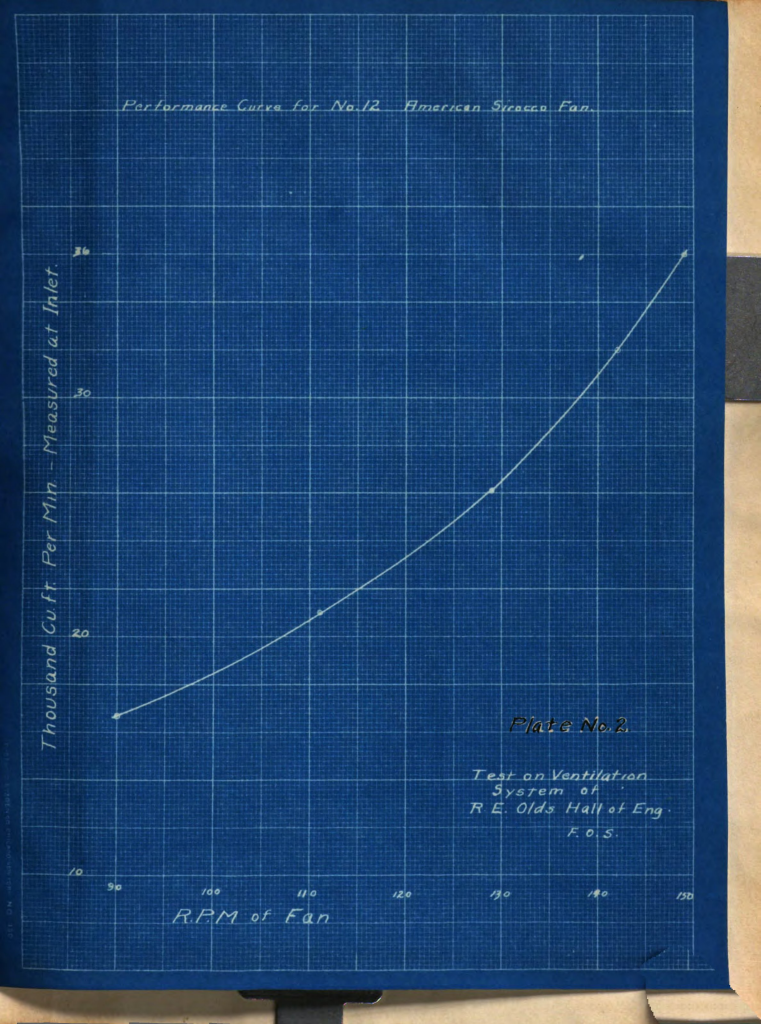

Performance Curve for No. 12 American Sirocco Fan.
Thousand Cu. ft. Per Min. - Measured at Inlet
36
30
20
10
90
100
110
120
130
140
150
R.P.M of Fan
Plate No. 2
Test on Ventilation System of R. E. Olds Hall of Eng.
F. O. S.

Plate No. 3.

R.P.M.Fan 149.

Room No.	Area Dust Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
1	0.66	0					0	3600
2	1.415	210	230	290	239	254	20600	1800
3-103	1.33	0					0	36000
4	2.24	235	230	265	250	263	36300	18000
5	3.25	260	225	255	252	265	51750	18000
6	1.5	Refer to note page (9).						18000
7	3.2	125	180	180	159	175	33200	18000
9	1.415	180	160	150	162	175	14900	3600
10	2.79	375	350	410	382	388	65000	30000
11	2.67	320	340	330	327	333	53300	22000
12	4.0	280	265	305	284	293	70250	22000
13-114	1.335	555	545	555	557	555	44500	3600
14-312	1.415	425	475	440	447	448	38000	14400
14-315	1.5	380	360	470	394	396	35600	
							73,600	

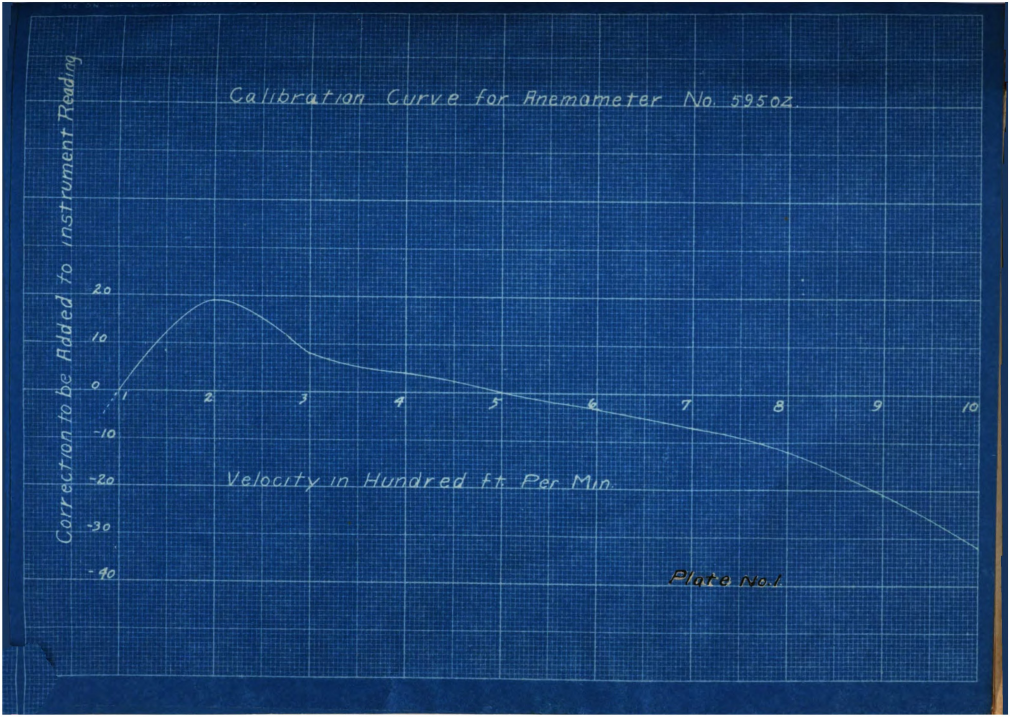
Room No.	Area Dust Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required
				- First Floor.-				
101+ 201	1.5	290	270	305	276	287	25800	3600
102+ 202	1.415	255	250	255	249	263	22300	2700
104	1.375	0					0	1800
105	2.84	175	150	180	174	190	32400	86000
105	1.46	0					0	
107	3.33	275	270	295	289	298	59500	75500
108	1.5	Refer to note Page (9).						1800
109	4.0	130	160	155	151	164	39400	18000
110L	0.84	285	260	300	281	291	14650	18000
110R	1.41	90	100		98	98	8300	18000
111	5.0	340	345	340	341	346	104000	434000
111	7.0	240	230	205	220	236	99000	
111	7.17	345	305	380	331	337	145000	
							348,000	
113	4.0	40	40	35	39	39	7200	25200
115	2.84	490	510	410	475	475	81000	36000

Total for rooms 102-202 = 48700 delivered.

Room No.	Area Duct Sq.Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Corr't'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
			-Second Floor.-					
202	1.58	280	300	260	267	278	26400	3600
203	2.92	355	350	385	267	278	48700	59400
204	2.84	150	160	140	157	170	29000	10800
204	3.02	120	170	140	141	152	27400	
							56400	
205	3.4	260	240	220	245	259	52800	45000
206	1.625	Refer to note Page (9).						
207	4.0	195	190	220	196	215	51500	52200
208	5.0	220	235	240	236	251	75300	36000
209	2.75	300	295	325	302	307	50600	1800
210	2.75	470	480	470	486	486	80250	55750

Room No.	Area Duct Sq.ft.	Vel. Ft./ Min.	Vel.	Vel. - Third Floor -	Aver. Vel.	Cor- rt'd.	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
301	2.67	410	420	425	417	419	67100	59400
302	2.84	0					0	59400
303	2.62	180	215	190	196	215	33800	45000
304	3.25	235	220	240	241	256	50000	59400
305	1.58	0					0	1800
306	3.33	180	160	150	164	179	35800	50400
308	2.84	325	290	255	291	300	51100	45000
309	4.0	350	335	360	337	342	82000	37800
310	1.415	280	260	240	251	264	22400	3600
311	2.75	320	340	335	331	337	55600	37800
311	2.92	400	340	380	385	388	68000	
							123,600	

Room No.	Area Duct Sq. Ft.	Vel. Ft./ Min.	Vel.	Vel.	Aver. Vel.	Cor- rt'd	Cu.Ft. Per Hr.	Cu.Ft. Per Hr. Required.
			- Fourth Floor -					
401	2.0	440	470	465	439	440	52800	36000
402	1.83	270	250	290	274	284	31200	36000
403	2.0	220	245	250	244	258	31000	19800
405	3.4	240	240	270	251	264	53800	36000
406	1.33	0					0	1800
407	3.33	210	200	205	204	223	44500	59400
409	2.84	280	310	265	285	294	50000	36600
410	4.0	340	365	310	334	339	81300	45000
411	1.415	0					0	1800
412	2.67	300	400	380	357	361	57750	45000
412	3.0	305	250	270	277	287	57600	
							115,350	
413								1800
414	2.08	260	430	395	362	367	45700	3600


Calibration Curve for Anemometer No. 5950Z.
Correction to be Added to Instrument Reading
20
10
0
-10
-20
-30
-40
1
2
3
4
5
6
7
8
9
10
Velocity in Hundred Ft Per Min.
Plate No.1

Performance Curve for No. 12 American Sirocco Fan.

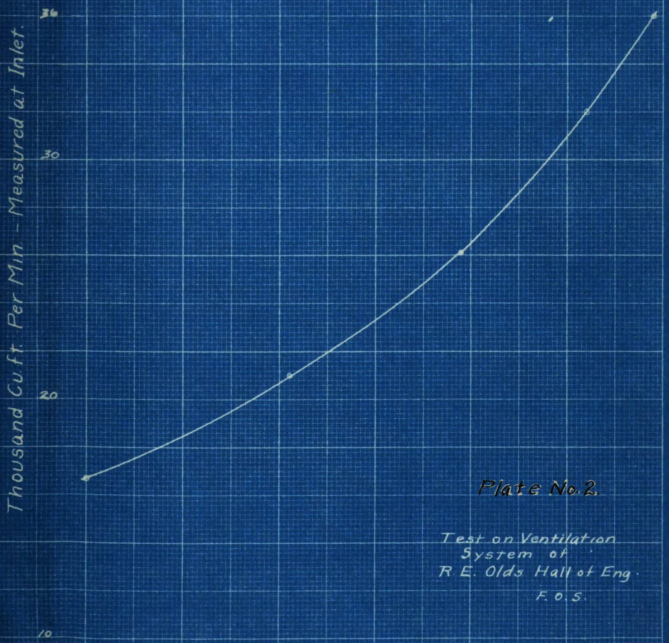


Plate No. 2.

Test on Ventilation System of R. E. Olds Hall of Eng. F. O. S.