
team F

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[F]oenix Public Library, [F]oenix, AZ

agents of change workshop

january 9, 2004

team F

...is Fearless

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...is Fearless

...is Fantastic

team F

...is Fearless

...is Fantastic

...is Friendly

team F

...is Fearless

...is Fantastic

...is Friendly

...is Focused

team F

...is Fearless agents

David Scheatzle

Emily Wright

team F

…is Fantastic Followers

Leslie Bailly John Quale Alain Rivard Eric Roberts

introduction:

the burton barr central library

architect: william bruder

[F]oenix, az

280,000 sq. ft., 5-story structure

building is well known for its daylighting and innovative means of sustainable design. in particular, the low energy consumption in relation to the building size.

as a group, we were interested in the difference between the air delivery system through the plenum floor on the fifth floor in comparison to the conventional air delivery system on the other floors. we also felt a difference in comfort levels between the fifth and second floor that we wanted to further explore.

hypothesis:

the Fifth Floor of the [F]oenix Public Library is thermally more comFortable than the second Floor

Fifth Floor:
one central and one north window
structural bay

the Fifth Floor of the [F]oenix Public Library is thermally more comFortable than the second Floor

the Fifth Floor of the [F]oenix Public Library is thermally more comFortable than the second Floor

thermally:
human perception of temperature, humidity and air velocity

the Fifth Floor of the [F]oenix Public Library is thermally more comFortable than the second Floor

comFortable:
thermal sensation scale
as defined by ASHRAE

the Fifth Floor of the [F]oenix Public Library is thermally more comFortable than the second Floor

second Floor:
the same central and north window structural bays as on the Fifth Floor

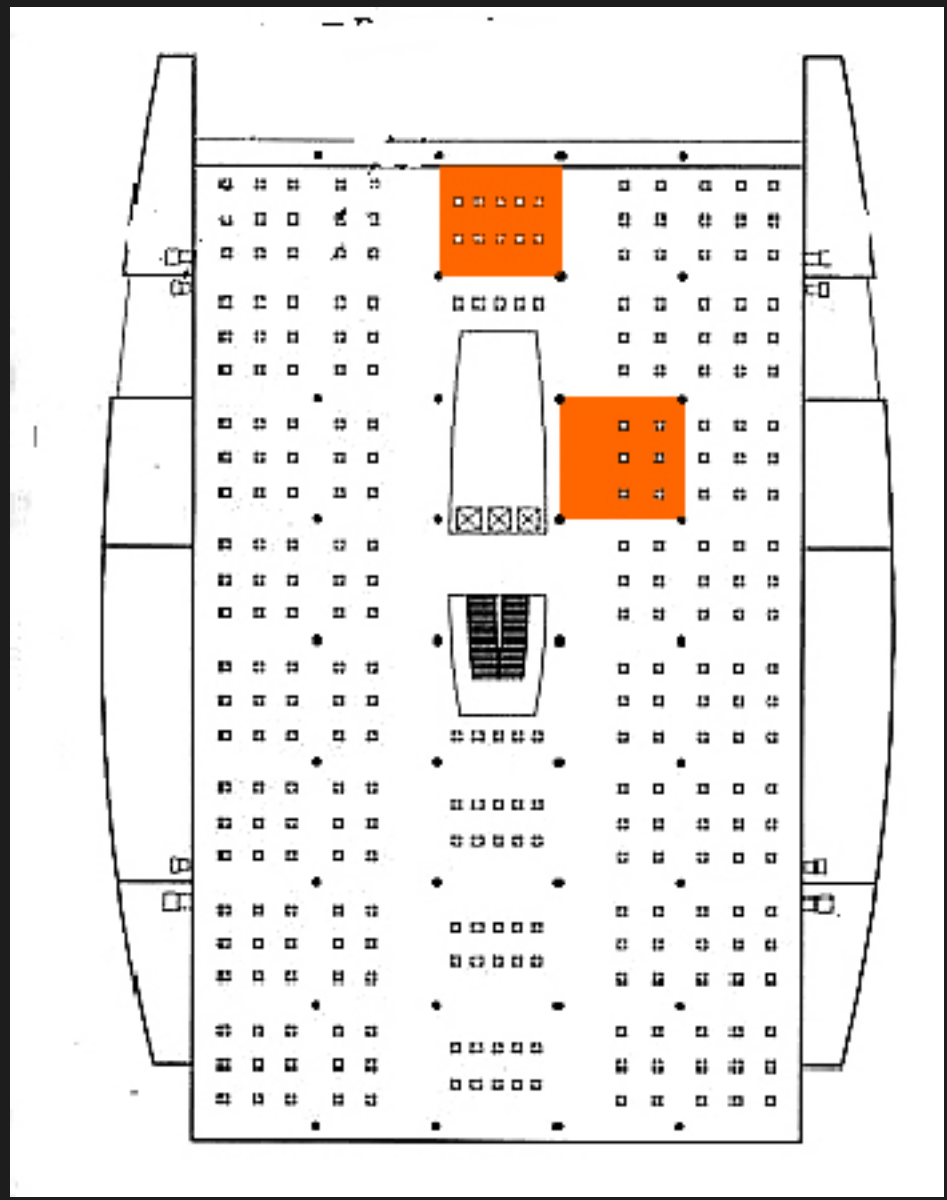
methodology:

our plan of attack was to take two similar areas on the fifth floor and second floor. (see image of keyed floor plan) measurements were taken at nine points in each area (see specific)

in order to arrive at a standard measurable level of comfort, we had to determine the dry bulb temperature, air velocity, relative humidity, and mean radiant temperature.

we used the HOBO dataloggers from onset to measure the mean radiant temperature, dry bulb and relative humidity. mean radiant temperature was measured with a thermistor inserted into a ping pong ball that was painted a mat gray color. air velocity was measured using a testo V2 velocity stick.

methodology:



methodology:

in order to prevent the tester's body heat from altering the mean radiant temperature results, the HOBO, and the ping pong ball with thermistor were attached to a pole. they were hung 3 feet above the ground away from the data collectors. measurements of air velocity were completed 3 feet above the floor at the same position that the other readings were taken. at each point, a few minutes was allowed for temperature stabilization. we aquired instantaneous readings by not launching the HOBOS but by recording the data that was displayed on the laptop.

methodology:

to have specific predicted mean votes (pmv) for each point, grid row, and specific area. the ASHRAE scale for the predicted mean vote is as follows:

thermal sensation scale

3 - hot
2 - warm
1 - slightly warm
0 - neutral
1 - slightly cool
2 - cool
3 - cold

results: 2nd floor window

area "a"									
	station								
	1	2	3	4	5	6	7	8	9
mean radiant temperature	70.39	71.08	71.08	73.15	69.71	71.08	71.08	71.77	71.77
air velocity	0	10	4	11	9	0	2	3	1
air temperature	71.08	71.08	71.08	72.46	71.77	71.08	71.77	71.77	71.77
relative humidity	29.2	28.7	28.4	27.8	28	28.4	27.6	27.6	27.6
predicted median vote	-0.62	-0.57	-0.57	-0.32	-0.53	-0.57	-0.42	-0.47	-0.47
row average		-0.59			-0.47			-0.45	
area average					-0.50				

results: 2nd floor interior

area "b"									
	station								
	1	2	3	4	5	6	7	8	9
mean radiant temperature	71.08	71.08	71.08	71.08	71.08	71.08	71.77	71.08	71.08
air velocity	3	4	0	3	2	5	2	4	3
air temperature	71.77	71.77	71.77	71.77	71.77	71.77	71.77	71.77	71.77
relative humidity	28.1	27.8	27.6	27.6	27.6	27.6	27.3	27.3	27.6
predicted median vote	-0.53	-0.53	-0.53	-0.53	-0.53	-0.53	-0.49	-0.53	-0.53
row average	-0.53			-0.53			-0.52		
area average	-0.53								

results: 5th floor window

area "c"									
	Station								
	1	2	3	4	5	6	7	8	9
mean radiant temperature	70.39	70.39	70.39	70.39	69.71	69.71	69.71	70.39	70.39
air velocity	0	0	15	60	90	15	15	230	10
air temperature	71.08	71.08	71.08	70.39	70.39	70.39	70.39	70.39	70.39
relative humidity	28.2	28.2	28.7	28.8	29.3	29	28.8	28.8	28.8
predicted median vote	-0.61	-0.61	-0.62	-0.67	-0.73	-0.72	-0.72	-1.55	-0.67
row average	-0.61			-0.71			-0.98		
area average	-0.77								

results: 5th floor interior

area "d"									
	station								
	1	2	3	4	5	6	7	8	9
mean radiant temperature	70.39	69.71	70.39	70.39	69.71	70.39	72.08	71.08	70.39
Air velocity	4	5	6	2	3	4	15	0	15
air temperature	71.08	71.08	70.39	70.39	70.39	71.08	72.46	71.77	71.08
relative humidity	28.4	28.4	28.8	28.5	28.3	28.2	27.5	27.8	27.7
predicted median vote	-0.62	-0.67	-0.67	-0.67	-0.72	-0.62	-0.40	-0.52	-0.62
row average		-0.65			-0.67			-0.51	
area average					-0.61				

analysis:

based on the data collected, our hypothesis has been disproven. data showed that the second floor was slightly more comfortable than the fifth floor during the time measured. dry bulb, relative humidity, and mean radiant temperature were about the same between the two floors. the difference in air velocity was the contributor to the difference in PMV because it was the only variable which changed significantly according to position.

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...is Flawed

conclusions:

the second floor is slightly more thermally comfortable than the fifth floor during the time period measured.

design lessons learned:

there was some question as to the integrity and accuracy of the data acquired by the velocity sticks.

we noticed very slight changes when measuring MRT using the gray ping pong ball when we moved to each location. this may indicate that we needed to take more time to allow the MRT bulb to stabilize for each measurement.

this was not an overall sampling of the whole area, nor is it indicative of an entire day within that area. our analysis and experience leads us to believe that the comfort levels change in each area depending on time of day, exterior temperatures, seasons, and the individual experiencing the environment.

we also have suspicions that other groups tried to sabotage our results by infiltrating our area with their bubbles, masking tape, and general disregard for our quest for knowledge.

references:

ASHRAE Thermal Comfort Program V.1 Copyright 1994-1995

Developed by Marc Fountain, Charlie Huizenga

acknowledgements:

William Bruder for his presentation

Rosemary Nelson and Bill Ruehle for their tour, assistance in gathering data, and technical support

The Agents of Change Organizers who so loved this project

team F

...is Finished