

Post-Occupancy Evaluation (POE) Methodologies for School Facilities



Andre A. Larroque, AIA, CSI, CCCA, CCS, REFP Building Standards Coordinator New Mexico Public School Facilities Authority

Marcel Harmon, PhD, PE, LEED-AP O+M Sr. Associate / Applied Anthropologist M.E. GROUP

Nate Maniktala, LEED-AP BD+C, MBA Principal | Vice President M.E. GROUP

New Mexico Public School Facilities Authority



GENUINE | PROGRESSIVE | ADVOCATES

WORKSHOP OVERVIEW

Subheading if needed



- 1. Overview of V. Sue Cleveland High School POE
- 2. Building Side Methods
- 3. Occupant Side Methods
- 4. Recommendations from V. Sue Cleveland High School POE Case Study

POE DEFINITION NMPSFA POE Handbook Draft



The systematic investigation of a Facility to determine the success or failure of one or more design elements within the project to be performed by a thirdparty Evaluator after the User has occupied the Facility."

POE PURPOSE NMPSFA POE Handbook Draft:



Key Purpose of the POE: "...to investigate, analyze, qualify, and report the successes and weaknesses of the school and design for future replication or repair."

Some Benefits:

- Improve statewide design & sustainability guidelines.
- Improve state processes for project delivery & management
- Recommend remedies for specific building deficiencies
- Recommend behavioral changes to improve M&O



BUILDING DATA

418,000 s.f. 2,350 Students \$112M Construction \$11.5M FF&E + Tech 7 Academies

NM1

Slide 5

NM1 Insert more photos. Nate Maniktala, 9/4/2012

PROJECT GOALS

From VSCHS Program

PLANNING GOALS

- Strong career pathways
- High academic standards
- Engage every learner
- Access to up-to-date technology
- Academy organization & concepts
- Engage with community
- Utilize community resources
- Safe school environment
- Collaborative teaching & learning
- Personalize learning
- Advance potential of block scheduling.

LEARNING GOALS

• Safe and secure setting



- Commons area for whole school
- Variety, inclusiveness, and flexibility
- Special use spaces
- Integrated information technology
- Computer access for all students and staff



POE SCOPE

NMPSFA Hi-Performance (HiP) School Pilot Projects

Analyze Overall Process and Design Approach

- Integrated Design (HiP requirement)
- LEED

Evaluate Effectiveness of Design Tools & Resources.

• Performance Goals & Sustainability

Evaluate Impact of Design on Owner/Users

- Educational Mission (Learning Environment)
- Project and Operating Costs
- Health, Safety, & Security
- Function, Efficiency, Flow
- Psychological, Social, Cultural



POE APPROACH



NMPSFA coordination with District & School Kick-off Meeting with evaluators and key participants Lead-Off Survey (LOS)

- On-line Survey identifies major trends prior to field work
- **On-Site Investigation (OSI)**
 - Methodology flexible depending on nature of project and professional recommendations of Evaluator.
 - Archival research
 - Interviews
 - Observations
 - Energy performance measurements
 - Photography
 - Others as agreed to

Individual Space Assessments

Instantaneous Measurements

• Via hand-held meters



• Via data loggers and BMS

Types of Data Recorded

- Temperature and relative humidity
- Lighting levels
- Occupancy & lights on/off
- CO2 levels
- Sound levels



DATALOGGERS & HAND-HELD METERS

Individual Space Assessments



INSTALLING DATA LOGGERS



HAND-HELD MEASUREMENTS



THERMAL IMAGING OF ENVELOPE & EQUIPMENT





Individual Space Assessments

unoccupied.



For time period measured, the lights were enabled 'ON' an average of 28.05% when the space was unoccupied.

Individual Space Assessments



Analysis: ANSI/ASA S12.60-2010 PERMITS GREATEST WEIGHTED SOUND LEVEL OF 35 DB FOR CORE LEARNING SPACES LESS THAN 10,000 GSF and 40 dB for Core learning spaces greater than 10,000 GSF. The large core learning areas are substantially over the permitted tolerances, and the HVAC is specifically scheduled "OFF" when these classrooms are occupied.



Individual Space Assessments



 $\mathcal{O}^{\mathcal{H},\mathcal{SC}}$

O&M Interviews / Assessments

Conducted to evaluate the effectiveness of existing O&M processes and procedures

Methods generally consist of:

- Reviewing survey results from building occupants and O&M staff
- Reviewing documented policies/procedures and manuals
- Interviewing and shadowing custodial staff, building engineers and district maintenance
 - How general tasks are performed
 - How the BMS is used
 - How O&M interacts with the building occupants
- Making interpretations from general building observations /occupant interviews



O&M Interviews / Assessments

VSCHS Example Survey Comments

- "teachers' restrooms not always cleaned each night;"
- "inadequately salted/sanded icy parking lots during inclement weather;"
- "chairs leaving marks on the floor (and not cleaned);"
- "selection of exterior trash cans of poor design (and possibly more needed);"

VSCHS Policies / Procedures Issues

- •Potential Knowledge Gap
 - -Assemble a building operating plan
 - -Assemble a custodial "best practices" manual
 - -Common repository of documentation needed on-site
- •Work Order Process
 - -Streamline / remove duplication
- •Adequate Staffing



O&M Interviews / Assessments

VSCHS Training/Education – O&M and Occupant

- Recycling Policies/Procedures
- Classroom technology
- Blinds/shade use
- LEED/sustainable educational material
- Automatic drinking fountains
- •O&M reference repository in building
- Custodians best practices manual



O&M Interviews / Assessments

VSCHS Facility Elements Impacting O&M

- Heat Pump flow sensors
- Battery operated faucets
- Low VOC paint
- Corridor window/door seals
- Sled-style legs on student chairs
- Catwalk needed in Gymnasium



Sand/dust penetrating window/door seals and collecting on the floor.



Utility Analysis – Energy Model Assessment

v. Sue Clevelanu High	17 me	m	D			
Area		410,848	sf	01	IKC	
LEED 2009 Energy Cos	st Savings			00		
	Electric Rate	0.109191	\$/kWh	de	sign+	green
	Gas Rate	1	\$/Therm			
END USE	ENERGY TYPE		DESIGN CASE		BASELINE CASE	
		KBTU/YEAR	COST \$/YEAR	% End Use	KBTU/YEAR	COST \$/YEAR
Lighting	Electricity	3,434,300	\$109,872	27.52%	3,701,500	\$105,779
Electric Space Heating	Electricity	63,800	\$2,041	0.51%	917,900	\$26,231
Nat. Gas Space Heating	Natural Gas	101,100	\$1,011	0.25%	365,200	\$3,652
Space Cooling	Electricity	1,599,400	\$51,169	12.82%	3,394,700	\$97,011
Pumps	Electricity	67,800	\$2,169	0.54%	489,700	\$13,994
Heat Rejection	Electricity	53,400	\$1,708	0.43%	1,848,300	\$52,819
Fan Energy	Electricity	2,854,500	\$91,323	22.87%	4,833,300	\$138,123
Plug Loads	Electricity	2,491,900	\$79,723	19.97%	2,499,500	\$71,429
Electric Base Utilities	Electricity	1,727,400	\$55,264	13.84%	2,082,400	\$59,509
Nat. Gas Base Utilities	Natural Gas	496,400	\$4,964	1.24%	496,400	\$4,964
Total		12,890,000	\$399,245	100%	20,628,900	\$589,519
Percentage of	37.51%	Percentage of Energy Cost Savings			32.28%	
					KBTU/SF/YR	31.4



Comparing the modeled annual energy consumption with actual usage.

Provides a means toevaluate:Modeling assumptionsModeling proceduresModeling software



Utility Analysis – Energy Model Assessment

Discrepancies

- Actual end use load break out is unknown discrepancy could be substantially due to process / plug loads and not HVAC, lighting or domestic hot water systems.
- Scheduling and weather data inaccuracies
- Changing rate structures
- Inaccurate energy source allocations
- Unforeseen/unanticipated uses (related to the first bullet point)
- Building system operational issues and/or occupant usage issues

This emphasizes the importance of installing adequate metering for measurement and verification



BUILDING SIDE METHODS Utility Analysis – Peer Group Comparison NSCHO 50000000 Linear fit (3063382 +55.84x) 1.8 54 45000000 ----- 95% CI 4000000 95% Prediction interval **A** 35000000 Line represents peer group - Total I 3000000 baseline "average". - 102-0102 20000000 Predicted, somewhere down here. 0 15000000 10000000 Actual... Excellent! 5000000 250000 300000 350000 400000 450000 500000 550000 Total Sq. Ft.

Regression analysis of total energy (kBTU) by total square foot

Utility Analysis – EUI Comparisons

EUI Comparisons

- Design (energy model) EUI: 32
- Actual 2010-2011 EUI: 41
- Target Finder average building EUI: 66
- Peer group baseline EUI: 59 64

In this case Energy Star's average building baseline is a close approximation of the peer group baseline



Design / Construction Assessment

Examine the overall effectiveness in determining and meeting community, district, school and end user needs.

Methods generally consist of:

- Reviewing relevant pre-planning/charrette documentation, design documents, bid documentation, value engineering records and construction administration and commissioning documentation
- Examining the facility's performance
- Survey design, construction and commissioning team members
- Reviewing survey results from building occupants, O&M staff, parents/guardians and community members
- Making interpretations from general building observations /occupant interviews



Design / Construction Assessment

Community Involvement

- Helps identify community values
- Aides in establishing community buy-in
- Generally successful for Sue Cleveland

-Community's perception of the school rated at just under "well" (3.95), on a scale of 1 to 5, with 1 being "perceived very poorly" and 5 being "perceived very well"



Design / Construction Assessment



Box plots of school perception in local community



Design / Construction Assessment

Administrative/Teacher/Staff Involvement

- Perception is that this was more heavily weighted towards administrative staff
 - Involve teachers, staff and students who will actually be using the school
- Solicit O&M staff involvement
- Consider ethnographic type evaluations as more the norm than exception



Design / Construction Assessment

Overall Pluses and Minuses

- + High quality information provided to design team
- + Qualifications based selection process
- +/- Commissioning Process
- +/- VE Process
- District's facility standards could more specifically address performance requirements
- Multiple funding sources
- Schedule (design completed after construction had started)



Design / Construction Assessment

Different Perspectives

• Designers, contractors, administrators often have different perspectives than the final end users, which can lead to unintended consequences.



VE/Defer Landscaping



Increased Cleaning & Poorer IAQ



Design / Construction Assessment

Different Perspectives

• Designers, contractors, administrators often have different perspectives than the final end users, which can lead to unintended

consequences.

Ar eren a

Visibility Issues

VE Blinds/Shades on North, East and West Facing Windows

Ad Hoc Solutions





Science of Behavior





Behavior

is a function of the

Individual and the Environment

Kurt Lewin, 1936 *Principles of Topological Psychology*



Behavior & Environment





Thermal Comfort Example



- Activity Levels
- Clothing Insulative Properties



- Air Temperature
- Mean Radiant Temperature



- Air Movement / Velocity
- Relative Humidity

Systematic analyses of human interactions in a defined space and time, with a focus on ritual (habits, processes, procedures, and events), performance, and power.







Ethnography

Ethnographies seek to determine if what people say they do on a daily basis differs from what they actually do.

For POEs, ethnographies focus on how the built environment influences the interactions and performance of people, and vice versa.


Ethnography

Behavioral Patterns Provide Insight Into:

- social/cultural norms present
- if occupant needs are being met
- impacts on productivity, health and building performance
- how to improve situation











Importance of Context

The interrelated conditions within which something occurs or exists – where the action occurs.





Importance of Context

- Discover details and intricacies of occupant behavior, O&M processe and interactions among occupants/O&M and with the facility itself.
 - What people say they do and what they actually do are often two different things.
 - Helps to jog occupant and O&M memory.
- Helps you embrace occupant perspective (and let go of your own).



Image from Portigal Consulting Presentation, 2010.

Influence of Perspective

A set of pre-conceived assumptions and beliefs

- Acknowledge your own point of view biases
- Recognize that occupants and O&M staff have their own biases and personal agendas





Perception: Designer/Occupant Gap Exercise



Field Methods



SURVEYS

FOCUS GROUPS



OBSERVATIONS





FOCUS GROUPS





Create a Plan

- Form a team, including as many stakeholders as possible
- Create a General Plan



- Brainstorm target groups, target systems/equipment, target locations, target activities/tasks, questions, and assumptions
- Remove or revise items participants cannot answer
- Remove or revise "personally-biased" questions
- Organize remaining items. Create categories and groups
- Review the General Plan with the team
- Finalize a path for your ethnographic work

Surveys

Groups Surveyed

- Teachers
- Administrators / Staff
- Students (middle school age and above)
- Custodians / Maintenance
- Parents / Guardians
- Community Members / Neighbors
- Design / Construction Team Members



Surveys

Types of Questions Asked

- Demographic information
- Thermal comfort / temperature control
- Indoor air quality
- Acoustics
- Lighting / lighting control / views
- Automated building systems / components
- Occupant training / education
- Classroom / work area
- Cleanliness and operations / maintenance
- Engagement & general satisfaction
- Parent / guardian & neighbor / community perception
- Design / construction team feedback



Surveys

Question: Are any of the following conditions true for the lighting in your primary classroom(s) or work area(s)? Please check all that apply.



- (1) The light fixtures provide enough light by themselves.
- (2) I can sometimes work by daylight only.
- (3) Reflected images of light fixtures appear on my work surface, PC monitor, and/or on the smart board/white board/chalk board.
- (4) Reflected images of the windows/skylights appear on my work surface, PC monitor, and/or on the smart board/white board/chalk board.
- (5) Light fixtures create glare in my field of vision as I work.
- (6) Windows/skylights create glare in my field of vision as I work.
- (7) Direct sunlight falls on my work surface, PC monitor, and/or on the smart board/white board/chalk board, washing it out and making it difficult to see what I'm working on.
 - (8) The light fixtures produce an audible hum.
 - (9) The light fixtures noticeably flicker.



Focus Groups

Conducted with different occupant groups. For VSCHS:

- Secretaries / bookkeepers / administrative support
- Teachers
- Students
- Counselors
- Principal / vice principals

- V. Sue Cleveland High School
- Teacher Focus Group





Focus Groups

Occupants assume the role of architect / designer

- What they would "keep"
- What they would "change"

Conducted earlier in field work

- Help focus subsequent interviews / observations
- Help focus subsequent space condition assessments

V. Sue Cleveland High School

• Student Focus Group





Focus Groups

Code	Category	No. of Votes	Participant Categories	No. of Participant Categories Represented
K1	Commons Areas	14	S, P and C	3
K2	Stadium and stadium design	12	T, S and P	3
КЗ	Computer labs in library	9	S, P and C	3
	Smart boards and other			
K4	technology	9	T and S	2
K5	View of mountains	8	T and C	2
K6	Concert Hall	7	S	1
K7	Windows and Natural Light	6	T, S, SA, P and C	5
K8	Layout/openness of library	6	S and C	2
К9	Library extra rooms/classrooms	6	C	1

Top "Keep" Items



Top "Change" Items

Code	Category	No. of Votes	Participant Categories	No. of Participant Categories Represented
	Long Distances to Traverse Across			
C1	Campus	22	T, S, SA and C	4
C2	Better control of daylight	21	T, S, P, and C	4
C3	Improve Security/Control	18	T, S, SA, P, C	5
C4	Inadequate Parking	18	T, SA, P and C	4
C5	Revise Thermostat and Call Button Locations in Classrooms	13	T, SA, P and C	4
C6	White Boards - Add and Revise Locations	13	T, S and P	3
C7	Improve Temperature control/thermal comfort	11	T, S, and C	3

Observations & Interviews

Formats

- Scheduled classroom, lab, other observations/interactions
- Scheduled one-on-one or small group interviews
- Impromptu observations/interviews



Observations & Interviews

Methods / Techniques

- Person-Oriented Record (POR)
- Setting-Oriented Record (SOR)
- Task (or Process) Oriented Record (TOR)
- Desk Tour
- Shadowing
- Student-Day-in-the-Life



Observations & Interviews

Tools:

- Forms (planned, passive observations and/or questions)
- iPad or pen / paper
- Photography (Digital)
- Video (Digital)
- Audio (Digital)







Observations

Sue Cleveland High School POE A2116 - Charles Couly Portly Landy

Observation Notes

A – Activities are goal directed set of actions – things which people want to accomplish	E – Environments are the entire arena where activities take place	I – Interactions between a person and someone else, then building blocks of activities	O – Objects are building blocks of the environment, key elements sometimes put to complex or unintended uses, changing their function, meaning and context	U – Users are the occupants, the people providing the behaviors, preferences, and needs
Teeching Some Lab work	No B Shapes On Whomas Chirul Windows Lights confectively day) Tables; Porsucher Islands One island & "front" for backer Scened a little state/staty C time of visit. Shelving on (2) sides of yours; mostly used + shelves on either Side of while bound. I Probably holps of visual Contrast.	Some interchas occurring among students as hear speaks ; solding and while silting together arowned tables "encourages" cellaternition, bost also "encourages" unwanted conversations ; students con "choose" to not turn i face board or teacher	Used the Norryshine System -distribut noise Smart & Bonness on Some well as windows (Abbels) -Board side of Board) -Board Side of Board) -Board Stractly wash out board; but their is contrast issues haven but in field at view: sheeles still needed that tacks uses for deat -Naroon to push chan back in place under island to put hegs.	Teachar + Gicle? (1) Shuddeds -17



Occupant Observations

Observations

Things to look for when conducting formal and impromptu observations

- Physical work space details
- Work flow, including intentions, tasks and sequences
- Tools/equipment/supplies used locations, commonly vs. rarely used, etc.
- Validation or non-validation of design elements
- Actions taken by occupants in specific setting





Observations

- Things to look for when conducting formal and impromptu observatio
 - Occupant's and O&M staff's words
 - How people work together
 - Organizational structure and cultural influences
 - Note gender, age, attire, marriage (presence of wedding ring) other social/cultural clues that may inform on their perspective
 - Opportunities and problems





Observations





V. Sue Cleveland High School

 Unintended Benefits Discovered Through Observations

Interviews

- Introduction
 - Introduce yourself & obtain permission to record
 - Articulate your focus/goals
 - Establish your master/apprenticeship relationship
- Transition
- Observe work and interpret
 - Take notes
 - Follow your focus; alternate between letting the occupant lead and drawing the occupant towards your primary questions
 - Interpret and obtain validation
 - Co-design with the occupant
- Wrap-up
 - Summarize your understandings
 - Thank the user
 - Leave the door open for future meetings



Questions



- People can easily answer things they know about:
 - What they do
 - How they do things
 - Their opinions about their current activities
 - Their complaints about their current activities
 - How much they like or dislike something they know about, as compared to another thing they know about

Questions



- People have trouble answering things they don't know about, but they will often try (and sometimes fail):
 - Deciding what they would do, like or want
 - Imagining themselves in hypothetical situations
 - Determining how much they like things without a point of reference
 - Estimating anything related to time
 - Estimating most anything at all

Questions

- Try not to lead the interviewee
- Ask what they were doing in the space in which the interview takes place.
- Ask for anecdotes and stories; check for deviant cases (When did something not work or function as expected)?
- Use open-ended questions:
 - "What are you doing?"
 - "Why are you doing ...?"
 - "Is that what you expect to happen?"





Interviews – Keys to Listening

Focus: Give the interviewee all of your attention; acknowledge what the communicating





by Heather Gorham www.heathergorham.com

Calm your chattering monkey mind

Interviews – Keys to Listening

Show that you are listening. Use your body language and gestures to indicate this.





Fascinating! Tell me more!



When will this guy shut up?

Interviews – Keys to Listening

- **Reflect back.** Paraphrase and summarize once in a while to demonstrate that you understand what is being said to you.
- **Defer judgment.** Allow the speaker to finish without interrupting.

• **Respond appropriately.** Your responses should be candid and open.





Interviews – Keep the Conversation Flowing

Echoing. Repeat the last words/phrases back to them as a question.

- Occupant: "I'm hot most of the time."
- You: "...most of the time..."
- Occupant: "Well...mostly in the afternoon, after I get back from lunch."





Interviews – Keep the Conversation Flowing



Tell stories to get stories. When all else fails, tell a story – when people hear a story they are often compelled to respond with their own.

- You: "Does your lighting control schedule appear to meet the needs of the current occupants and space functions?"
- **O&M:** "Yes."
- You: "When was the last time you had to adjust the schedule?"
- **O&M:** "2 months ago."
- You: "How much of an adjustment did you make?"
- O&M: "Adjusted the turn off time for Zone 1 back ½ hour."

Interviews – Things to Look For

- Stories, anecdotes, complaints, praises, etc., that you hear from more than one source.
- Stories, anecdotes, complaints, praises, etc., or images that have lots of detail.
- Stories, anecdotes, complaints, praises, etc., or images that illustrate daily occurrences the owner and/or O&M would be interested in.



Interviews – Things to Look For

Stories, anecdotes, complaints, praises, etc., or images that surprise or contradict common beliefs, design goals, or intended messages, but are clear, simple and compelling.







Interviews

- The "stories" that occupants and O&M personnel tell provide insight their needs, concerns and interests, as well as help create a shared degree of understanding among all involved.
- This provides further insurance that the project will be successful for all involved.





Focus Group Exercise



INTEGRATED ANALYSIS

Thermal Comfort – V. Sue Cleveland HS

Survey Responses

- <u>Teachers, Staff and Administrators</u>: Spaces are only thermally acceptable (ASHRAE definition) during the fall (ranges from 66% - 75% for other three seasons)
- <u>Students</u>: Not thermally acceptable during any season (ranges from 32% 51% for all four seasons).







INTEGRATED ANALYSIS

Thermal Comfort – V. Sue Cleveland HS

Complaints centered on:

- Temperature extremes of too hot or too cold (majority being too cold)
- Swings between too hot and too cold over the course of the day in the same space; difficulties in maintaining consistent temperatures
- Large temperature deltas within the same space at the same time (i.e., near the window vs. interior of the space)
- Delayed system response and/or system overcorrection
- Student access to thermostats (a complaint of both teachers and students).



INTEGRATED ANALYSIS

Thermal Comfort – Data Logger Correlations

Temperature deltas:

- Temperature gradients measured within12 rooms/spaces
 - Ten (83%) had maximum temperature deltas of 5°F or greater
 - Seven (58%) had average temperature deltas of 2°F or greater.
- Measured temperature deltas would sometimes last for several hours at a time, spanning multiple class times.

Temperature fluctuations:

 Confirmed fluctuations in temperatures of 2+°F (at the BAS thermostat and/or data logger sensor) within a timeframe of 15 minutes or less in several spaces corresponding to occupant complaints


Thermal Comfort – Acoustics Connection

Unoccupied Mode

- BAS was set to "unoccupied" for the first floor high ceiling classrooms without a lay-in ceiling, disabling the HVAC system, in order to minimize distracting noise.
- Contributed to temperature measurements outside of the 68 °F- 74°F range 41% 51% of the time in two of the spaces measured.



Thermal Comfort – Current HVAC Design Standards

Limitations

- ASHRAE Standard 55-2004 and the ISO 7730 Standard for Moderate Thermal Environments are based on experimental studies of adults, not children [or young adults].
- New 'adaptive' models of thermal comfort have not generally been incorporated into current school HVAC systems standards. Student metabolic rates vary as they move between rooms or activities (sometimes walking long distances).
- HVAC system design focuses almost exclusively on the thermal and humidity specifications as directed by building codes. Internal mixing, air velocities, and vertical temperature gradients are rarely explicit design considerations and are rarely assessed.

Committee to Review and Assess the Health and Productivity Benefits of Green Schools (National Research Council, 2006:65-66)



Thermal Comfort – Student & Adult Differences

Benefits of Personal Control

- <u>Surveys, focus groups and interviews</u>: Expressed strong appreciation and desire for sole temperature control in their own spaces.
- Research has shown productivity increases with increasing personal control over temperature and ventilation.
- Having control seems to mitigate some of the negative perceptions associated with non-optimal HVAC system performance
 - "being able to monitor my own classroom temperature ... is GREAT!!!"



Thermal Comfort – Student & Adult Differences

Correlation Between Temperature Control and Thermal Comfort Ratings

- <u>Spearman's Rho test</u>: found a positive moderate correlation between adult temperature control effectiveness ratings and their thermal comfort ratings (for each season).
- Likely a contributing factor for the more positive adult thermal comfort ratings.



Thermal Comfort – Student & Adult Differences

Clothing Variability

- Observations made the week of February 8th, 2011 and April 4th, 201
- Student clothing more variable than adult clothing
- During the warmer months, student and adult females on average had more skin exposed than the males, though the difference was more pronounced for the students.
- The higher variability in clothing/skin coverage for the students (particularly during the warmer months) adds an additional difficulty in meeting more the students' thermal comfort needs.



Thermal Comfort – Student & Adult Differences

Clothing Variability



al H. SCHO.

Thermal Comfort – Student & Adult Differences

Clothing Variability







Messages using images, graphics, text, student generated videos displaying / promoting desired behavior

Spread using existing school means or others – be creative and relevant to your audience









Lighting Controls - Consistency

- Use the same type of lighting controls in the same types of rooms (i.e., all conference rooms have occupancy sensors)
- Interviews & Observations: Inconsistent location of occupancy sensors leads to lights being left on in the rooms without occupancy sensors.
- Dataloggers indicated that lights were being left on in unoccupied spaces 15% of the time for the sample of spaces measured.



Improve Classroom Acoustics

- Revisit the design of high ceiling spaces to improve their acoustics to current conditions at V. Sue Cleveland.
- Will likely require combination of alternate finishes, strategically located sound absorbing panels/materials, careful design and commissioning of HVAC systems to ensure airflow rates do not exceed diffuser sound ratings, and the input of an acoustical engineer.
- Negative impact on intelligibility / comprehension and thermal comfort.



Smart / White Board Mounting & Locations

- Tilt smart / white boards 5-10^o away from the wall at the base so that the specular reflection component is directed towards the ceiling.
- Use smart / white boards with low visible sheen (to minimize specular reflection).
- Never using projectors with general white boards, as they typically have higher visible sheens.
- Do not locate smart / white boards adjacent to windows to eliminate the resulting high visual contrast within the visual field.



HVAC Filters

At a minimum, specify MERV 13 filters on the outside and MERV 8 filters on the inside.

- Successful at V. Sue Cleveland. Indoor air quality was generally rated high by the occupants (more than 80% of the adults were satisfied with their indoor air quality).
- Further improvements might be had by increasing the interior filters to MERV 13 as well.



Improve Value Engineering Process

Attempt to quantify the resulting impacts on a) productivity/performance and health, b) operations & maintenance, or c) other building systems.

- Value engineering the shades on the north side windows greatly limited the ability to control daylight in these classrooms, eliminate glare and allow dimming for presentations.
- The use of these classrooms as instructional spaces was compromised.
- Glare was estimated to be costing the school **\$169,457** in lost productivity among the teachers and staff annually, and potentially negatively impacting student math scores by **-1.50%** and reading scores by **-0.91%**.



Building Operating Plan

Publish a Building Operating Plan to capture the knowledge of the building engineer and head custodian of the building systems and their daily operation.

- V. Sue Cleveland was operating without a Building Operating Plan, risking the loss of knowledge regarding daily operations.
- Most of the processes and procedures for operating and maintaining the school were in the heads of the building engineer and head custodian.



Qualification Based Selection (QBS) Process

- Deemed a success for the selection of contractors on this project. It focuses on quality and value, as opposed to price (though that can still be a consideration).
- It rewards the organizations and the people who can anticipate success through teamwork and who can demonstrate proactive behavior.
- It elevates construction to a service profession and helps to ensure that the resulting facility meets the original design intent and owner expectations



IMPLEMENTATIONS

Actions Taken by NMPSFA

- Modify or re-affirm standard planning guidelines for:
 - Glare & daylighting
 - Acoustics
 - Energy modeling.
 - Building envelope design;
 - Room occupancy sensors;
 - Space recommendations (e.g., Commons areas in high schools)
- PSFA planning & project management improvements;
- Fine-tune and finalize the POE Handbook draft;
- Continue to assess the value of LEED certification;
- Contribute to a new data base of statewide facility attributes;
- Potentially correct some building deficiencies at VSCHS;
- Assist the District in making adjustments and improvements in building operations including maintenance and user education.

