



Briefing for U.S. House of Representatives Energy & Commerce Committee Staff

THE ASHRAE'S EPIDEMIC TASK FORCE & ASHRAE GUIDANCE FOR PROTECTING BUILDING OCCUPANTS FROM COVID-19 AND OTHER INFECTIOUS DISEASES

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2 OUTLINE

- Introductions (Ms. Yates)
- Background (Dr. Bahnfleth)
- ASHRAE Epidemic Task Force – Objectives, Structure, and Focus Areas (Dr. Bahnfleth)
- ASHRAE Task Force Activities and COVID-19 Guidance (Mr. Knight)
- Communicating ASHRAE's Guidance to the Public (Mr. Knight)
- Risk Assessment for Heating, Ventilating, and Air Conditioning (HVAC) Systems (Mr. Conlan)
- Reopening Businesses and Schools (Mr. Conlan)
- What Congress and government agencies can do – COVID-19 and future epidemics (Dr. Bahnfleth)

ASHRAE OVERVIEW

Founded in
1894

200+
Standards and
Guidelines

56,000+
Volunteer
Members

130+ countries

7,400+
Student Members
10+
Regions
190+
Chapters
400+
Student Branches

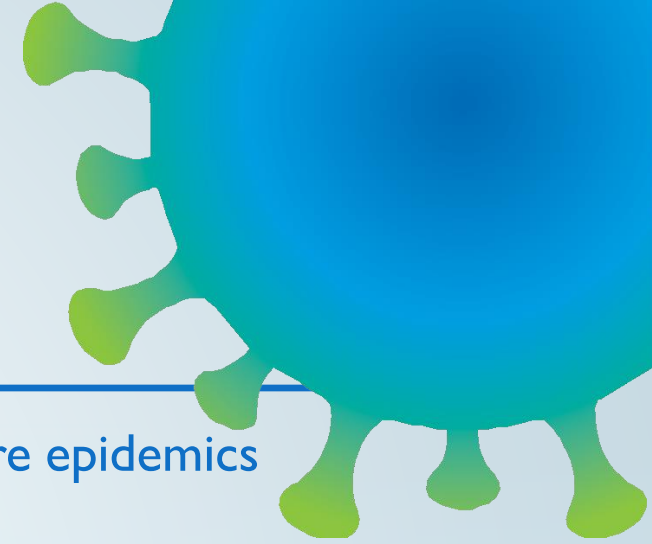


59 Active
Research
Projects
Total of 907;
\$76 million

Industry Classification

Consulting Engineers
Contractors
Manufacturers
Manufacturing Representatives
Government, Health & Education
Design Build
Architects

ASHRAE'S EPIDEMIC TASK FORCE



Formed to deploy ASHRAE's technical resources to address current pandemic and future epidemics

- HVAC System Operation During Building Shutdown
- How to Return the HVAC System to Normal Operation
- Operating of Heating/Cooling System in Home
- Riding Mass Transit and Airlines
- Upgrading filters and use of air cleaners
- Healthcare Facilities, Commercial, Residential, Schools and Universities, Residential, Transportation
- Air conditioning and heating
- Ventilation Systems
- Exhaust Systems
- Filtration and Disinfection
- BAS and Access Control Systems
- Elevator Control
- Water Systems

www.ashrae.org/covid19

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BACKGROUND

William Bahnfleth



7 THE IMPORTANCE OF INDOOR AIR QUALITY “BUILDINGS ARE FOR PEOPLE, NOT FOR SAVING ENERGY”

- People are the most valuable/expensive part of a building
- 1:10:100:1000 rule (order of magnitude)
 - \$1 of design cost
 - \$10 of construction cost
 - \$100 of operating cost (energy, water,...)
 - \$1000 of occupant cost (salary, benefits...)
- Indoor air quality (IAQ) affects
 - Safety (chronic and acute toxicity)
 - Comfort (odor perception)
 - Productivity/Learning
 - Health
 - Allergies and asthma
 - Cardiopulmonary disease
 - Infectious diseases

O(10%) performance improvement

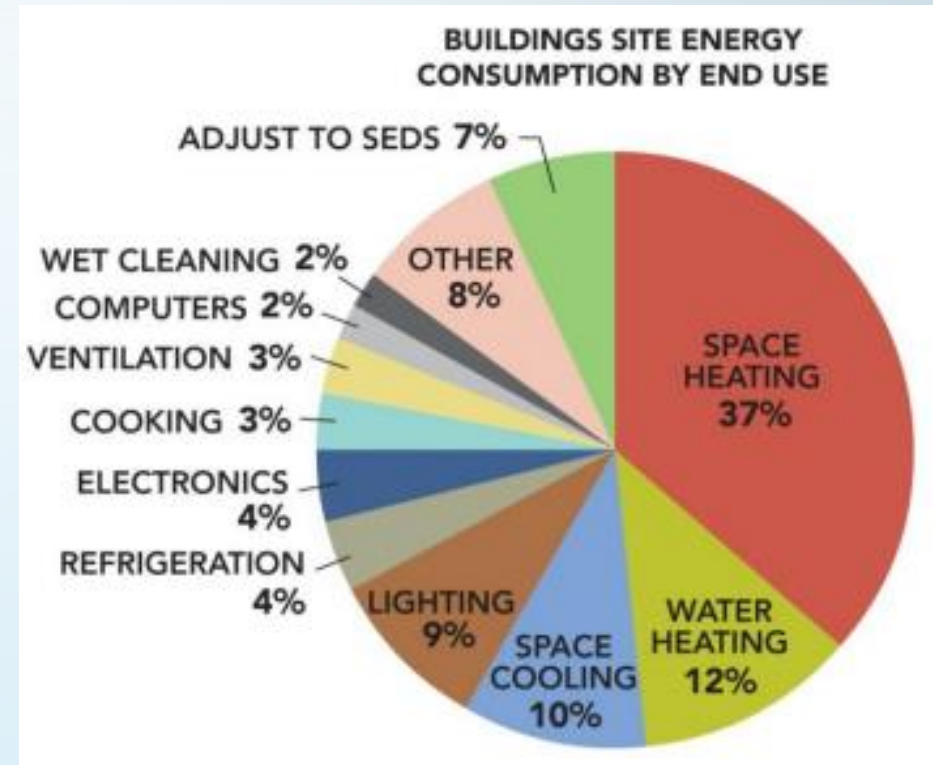
= O(operating cost)

8 IAQ CONTROL IS CONTROL OF CONTAMINANTS

- Classes of indoor air contaminants
 - Gases/vapors (e.g., VOCs)
 - Particles
 - PM2.5
 - Allergens (dust mites, dander...)
 - Microorganisms (allergens and pathogens)
 - Fungi (spores, mycotoxins)
 - Bacteria
 - Viruses
- Sources may be indoor or outdoor
- Thermal environment is coupled with IAQ
- Control methods
 - Source control – remove/reduce/substitute
 - Ventilation
 - Capture and exhaust
 - Dilute and exhaust
 - Isolate
 - Filtration
 - Gases (sorbents like activated carbon)
 - Particles (fiber and other filters)
 - Air Cleaners
 - Germicidal ultraviolet
 - Photocatalytic oxidation

9 TRADE-OFFS – COSTS

- US buildings, all types
 - Space heating 37%
 - Lighting 9%
 - Space cooling 10%
 - Ventilation 3%
 - **TOTAL 59%**
 - **HVAC 46%**
- IAQ related costs:
 - Conditioning outside air
 - Moving air through filters
 - Power to some air cleaners



Source: US DOE Buildings Energy Data Book (2011)

10 TRADE-OFFS – BENEFITS

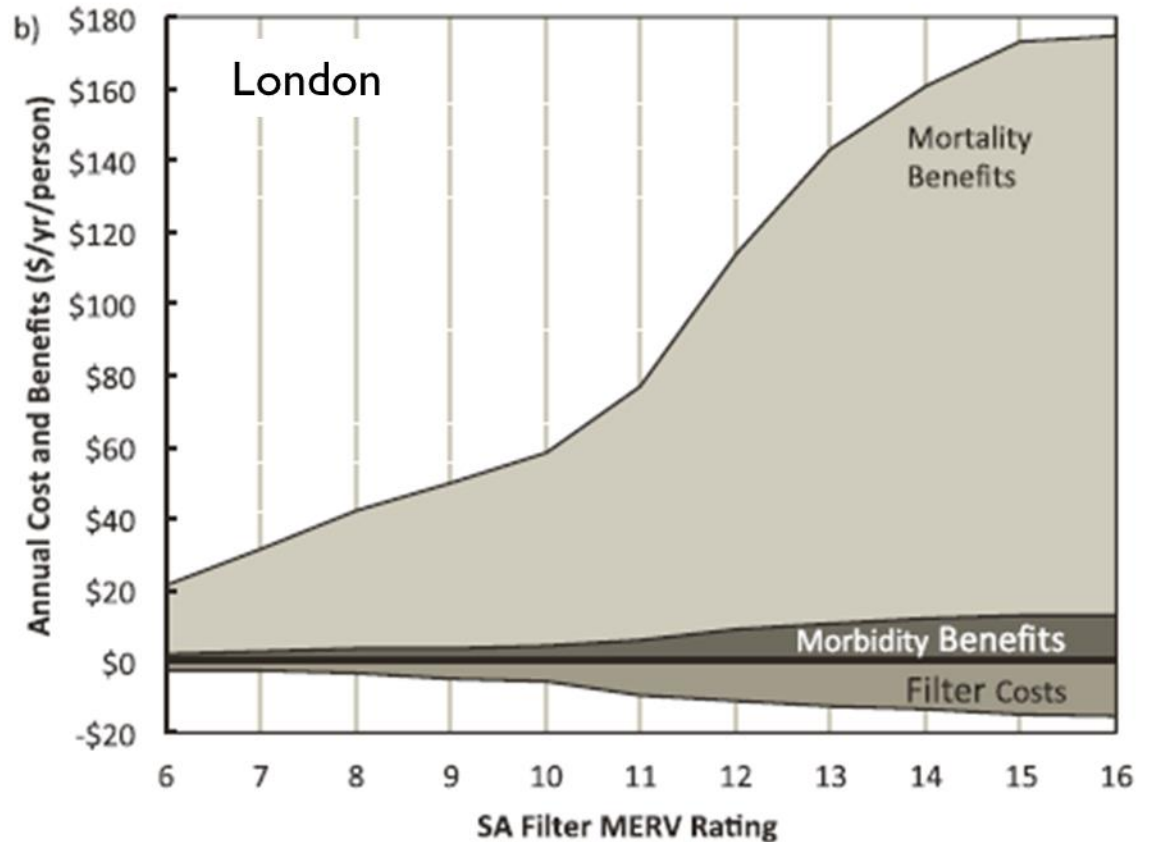
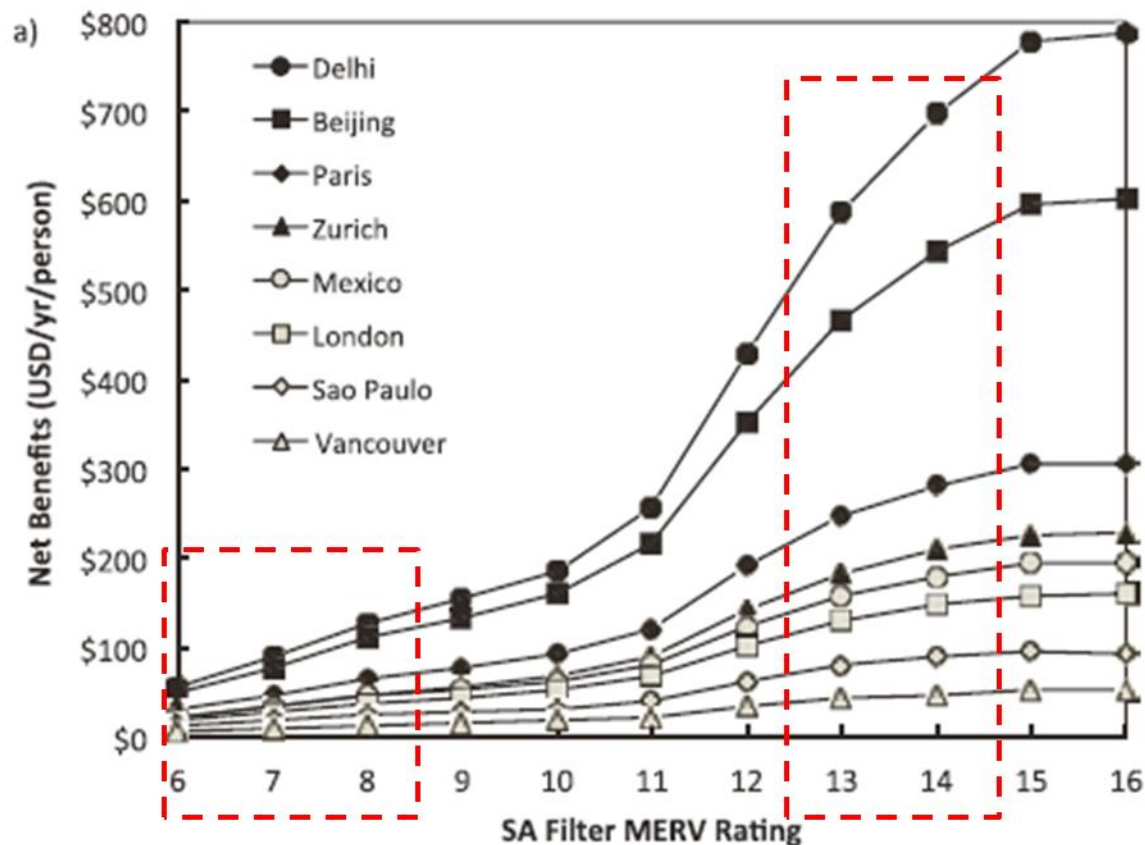
(Fisk, W. How IEQ affects health, productivity. ASHRAE J., May 2002)

Avoidable economic loss from deficient air quality, thermal environment, and lighting

Source of Gain	Potential Annual Benefits in US	Lower \$B (2017)	Higher \$B (2020)
Reduced Respiratory Illness	16 - 37 Million Avoided Cases of Common Cold or Influenza	6 (8.6)	14 (20)
Reduced Allergies and Asthma	8% - 25% Decrease in Symptoms - 53 Million with Allergies, 16 Million Asthmatics	1 (1.4)	4 (6)
Reduced Sick Building Syndrome Symptoms	20% - 50% Less SBS Symptoms at Work for ~15 Million Workers	10 (14.3)	30 (43)
Lighting/Thermal	Performance improvement	20 (28.6)	160 (229)
TOTAL		37 (53)	208 (298)

II TRADE-OFFS – BENEFITS

(Montgomery, J., C. Reynolds, S. Rogak, S. Green. 2015. Financial Implications of Modifications to Building Filtration Systems. Building and Environment 85:17-28.)



12 HVAC AND COVID-19 – AN ACUTE IAQ PROBLEM

- The SARS-CoV-2 coronavirus is a microbial air contaminant that causes COVID-19, contained in respiratory droplets/droplet residues and possibly fecal aerosols from toilets
- Infection occurs when a susceptible person receives a sufficient dose of virions
- WHO, CDC, and other health authorities believe transmission of COVID-19 is mainly by short-range/large droplet mode – limited ability for HVAC to have an impact
- Some community spread/super-spreading events suggest possibility for airborne/aerosol transmission under some circumstances, e.g., Skagit Valley choir practice, Guangzhou restaurant
- Risk of airborne/aerosol transmission can be reduced by HVAC systems by reducing airborne concentration – ventilation and air management, filtration, air cleaning all apply
- Design of non-healthcare facilities does not include infection control criteria

13 COVID-19 UNKNOWN/INCOMPLETELY KNOWN

- Source strength and infectious dose of SARS-CoV-2
 - Limits ability to make quantify control requirements, define conditions under which airborne or aerosol transmission are likely and assess risk
- Survival time of SARS-CoV-2 in the environment
 - Affects decisions about measures needed to reoccupy buildings, requirements for after-hours operation when reoccupied
- Ability to transmit through HVAC systems
 - Significant energy use implications if recirculation of air in a building is not possible and if certain energy recovery devices must be disabled
- Role of ambient particulate matter in COVID-19 transmission
- Which investments in protection now will meet objectives *and* provide the greatest benefits post-pandemic without compromising energy and environmental goals



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ASHRAE EPIDEMIC TASK FORCE - OBJECTIVES, STRUCTURE, & FOCUS AREAS

William Bahnfleth



15 ASHRAE ETF OBJECTIVES, STRUCTURE

- Formed in March, 2020
- Objectives
 - Response to COVID-19 pandemic
 - Short term
 - Reopening/2nd wave
 - Plan for the Future
 - Lessons learned
 - Research
 - Standards and guidance
 - Enhanced focus on resilience
- 17 core members, including staff liaison and three staff directors
- Interdisciplinary: experts in engineering, building operations, medicine and public health
- Steering committee for teams focused on specific areas ~120 team members
- Coordinate with ASHRAE technical and standards committees, other organizations
- Weekly meetings of task force, most teams have weekly meetings

16 ASHRAE ETF FOCUS AREAS (TEAMS) AS OF 5/18/2020

- Communications
- Grassroots
- Advocacy/developing economies
- External partnerships
- Resource inventory
- Science/literature review
- Filtration and disinfection
- Building readiness
- Healthcare
(including long-term care)
- Residential
- Commercial/retail
- Schools
- Transportation



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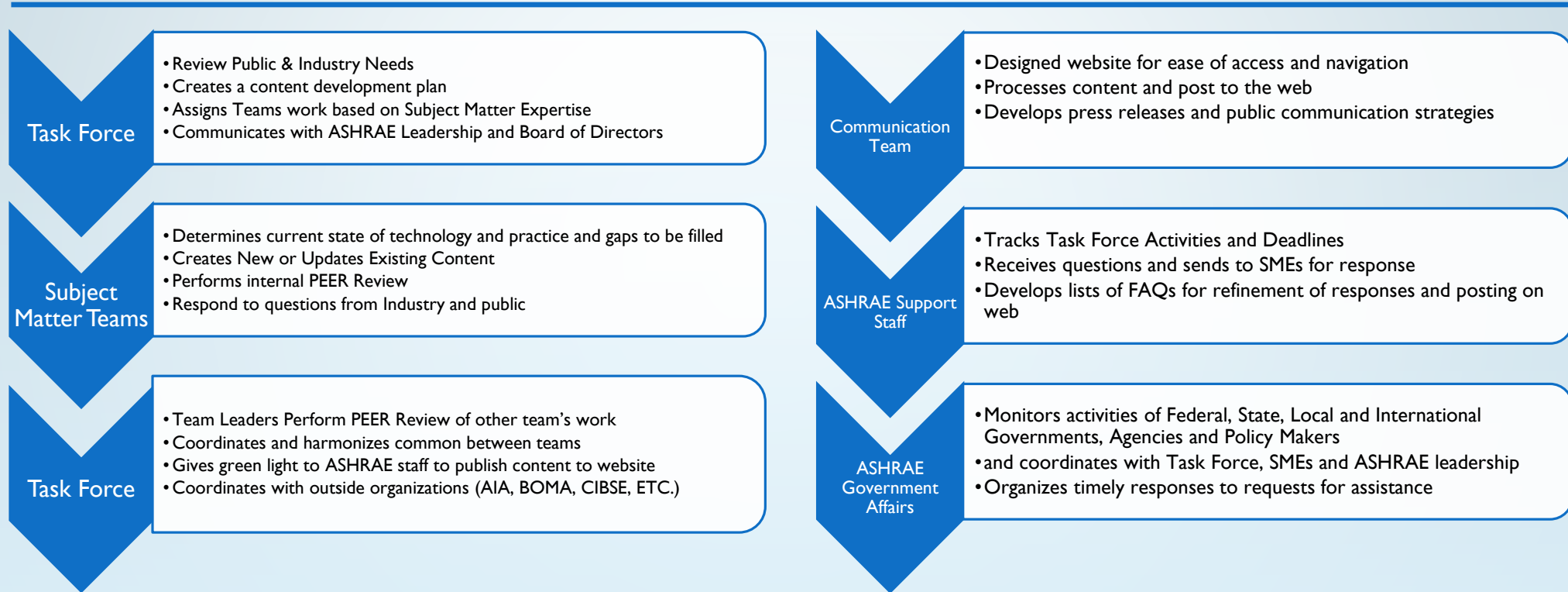
ASHRAE TASK FORCE ACTIVITIES TO DATE AND COVID-19 GUIDANCE

Dennis Knight

18 ASHRAE EPIDEMIC TASK FORCE - ACTIVITIES TO DATE

- Supported expedited update of [Position Document on Infectious Aerosols](#). Board Approved April 14, 2020. (First published in 2009)
- ASHRAE statements on SARS-CoV-2
- Emerging issue brief “pandemic COVID-19 and airborne transmission”
- COVID-19 resources/guidance page [ashrae.org/covid19](https://www.ashrae.org/covid19)
- Answers to over 300 questions to web site
- Meetings with AIA, NYSERDA, DOE, IEA
- Partnership with government on HVAC for alternate care facilities (USACE, USAF, USN, NIOSH)
- Reviewed/commented on state guidance (Florida, Michigan)
- Working on...
 - Update to residential IAQ guide
 - Reopening plan for ASHRAE HQ

19 ASHRAE COVID-19 GUIDANCE



20 ASHRAE'S COVID-19 GUIDANCE

- Providing specific, detailed guidance for the following Topics, Occupancies and Uses:
 - Healthcare Facilities, including temporary conversions to healthcare occupancy
 - Commercial Buildings
 - K-12 and Universities
 - Residential (Single family and Multi-family)
 - Transportation
 - Filtration & Air Cleaning
 - Building Readiness

21 ASHRAE'S COVID-19 GUIDANCE

- Based on the following principles and hierarchy
 - Do no harm
 - Increase amount of clean outside air being supplied to buildings and spaces
 - Increase the efficiency of filtration to MERV 13 or better, where possible
 - Install air cleaning and disinfection technologies such as UVGI
 - Supplement existing systems that cannot be modified or upgraded with
 - Portable HEPA filtration units
 - Upper room and portable UVGI

22 ASHRAE'S COVID-19 GUIDANCE

- Focused on Three Key Areas
 - Shutting down buildings
 - Re-opening buildings
 - Operation of buildings in Pandemic Mode (During three phases outlined in “Opening Up America Again”)



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COMMUNICATING ASHRAE'S GUIDANCE TO THE PUBLIC

Dennis Knight

24 COMMUNICATING ASHRAE'S GUIDANCE TO THE PUBLIC

- Developed a comprehensive communication plan from the beginning
- Regular press releases announcing new and updated content targeted specifically to:
 - Engineers,
 - Architects,
 - Contractors,
 - Building Owners
 - 600 Consumer Media Outlets (Hardest hit COVID-19 states in the U.S.)
 - Researchers and Scientists
 - Allied Organizations
- Total Epidemic Task Force media impressions to date over 556,474,545

25 COMMUNICATING ASHRAE'S GUIDANCE TO THE PUBLIC

- Organized the website for ease of use by the public
- Offer an email address and encourage questions, suggestions and feedback at top of main page
- Extensive list of FAQs with detailed answers and links to appropriate guidance
- Process to respond to specific questions within 24 hours from an appropriate subject matter expert
- Developing list of future research, design, guideline, code and standard upgrades and improvements for consideration by Standards Development Organizations (SDOs) and policy makers



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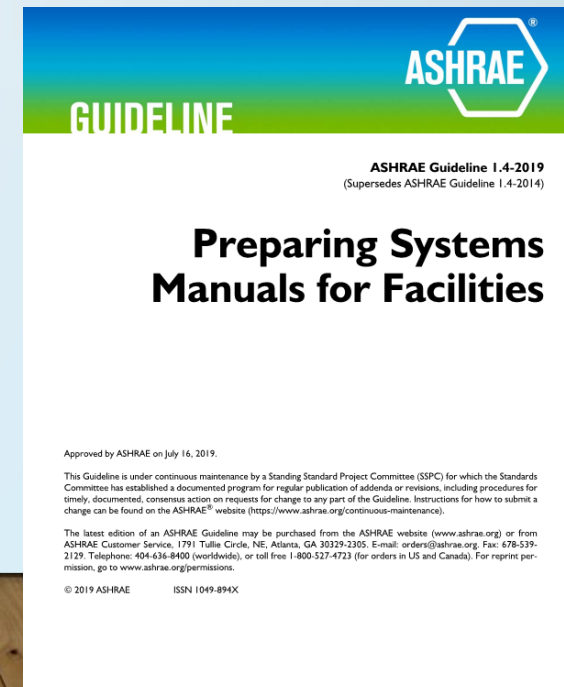
RISK ASSESSMENT FOR HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) SYSTEMS

Wade Conlan



27 HVAC RISK ASSESSMENT

- Anticipated Outcome:
 - Operational Plan for HVAC Systems to mitigate the transmission of the virus
 - ASHRAE Guideline 1.4-2019 – Preparing Systems Manuals for Facilities
 - Work Orders to correct or update issues with the system
 - Plan to monitor systems performance
 - Plan to capture the Epidemic Mode of operation for the next event
- Building Readiness Team:
 - Owner, Facility Staff, Commissioning Provider, Test and Balance company, Building Automation System (BAS) company, Design Engineer, Design Architect,



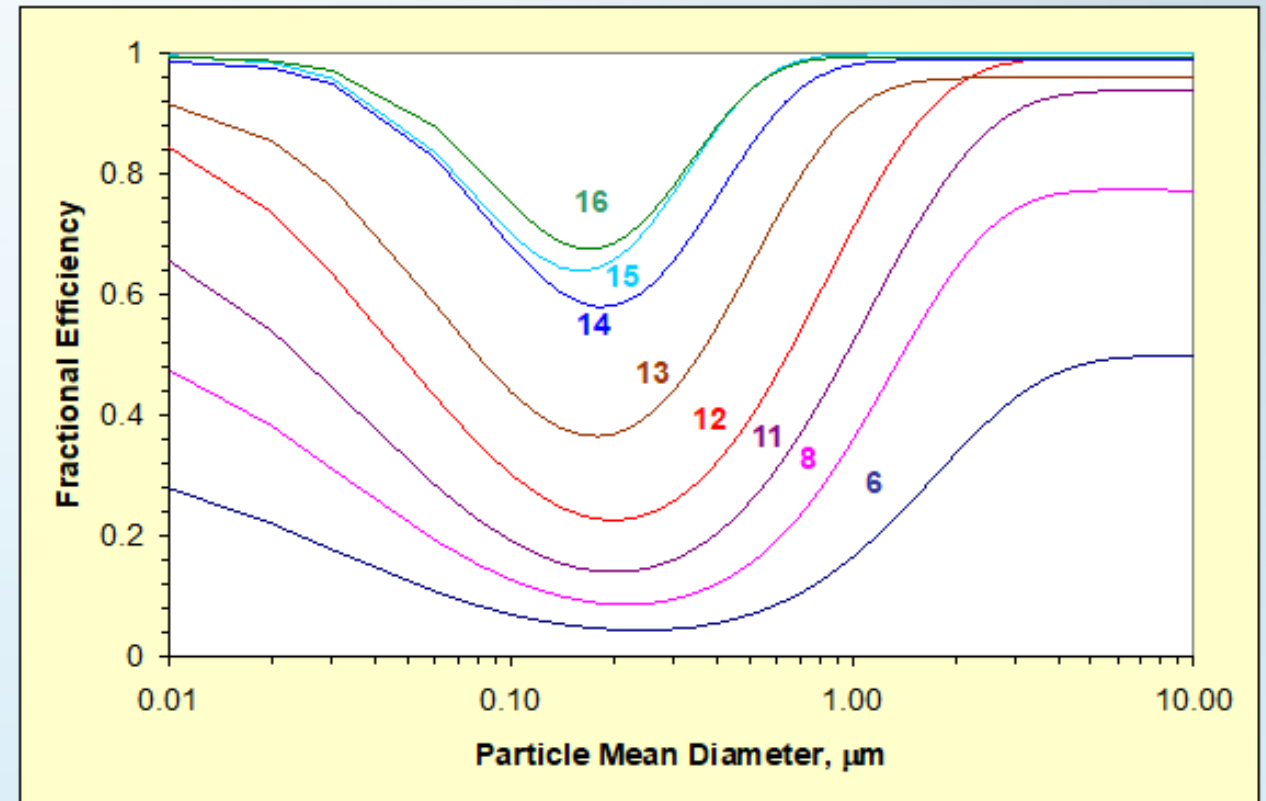
28 WHAT ARE KEY CONCERNS IN ASSESSING ...

- Age, location (climate, urban, suburban, rural), use and occupancy of facility
- Type of HVAC systems
- Age and condition of systems
- Controllability of HVAC systems
- Maintenance history
- Type of owner (small building, large building, large portfolios)
- Users
- Skills of operators and maintenance personnel

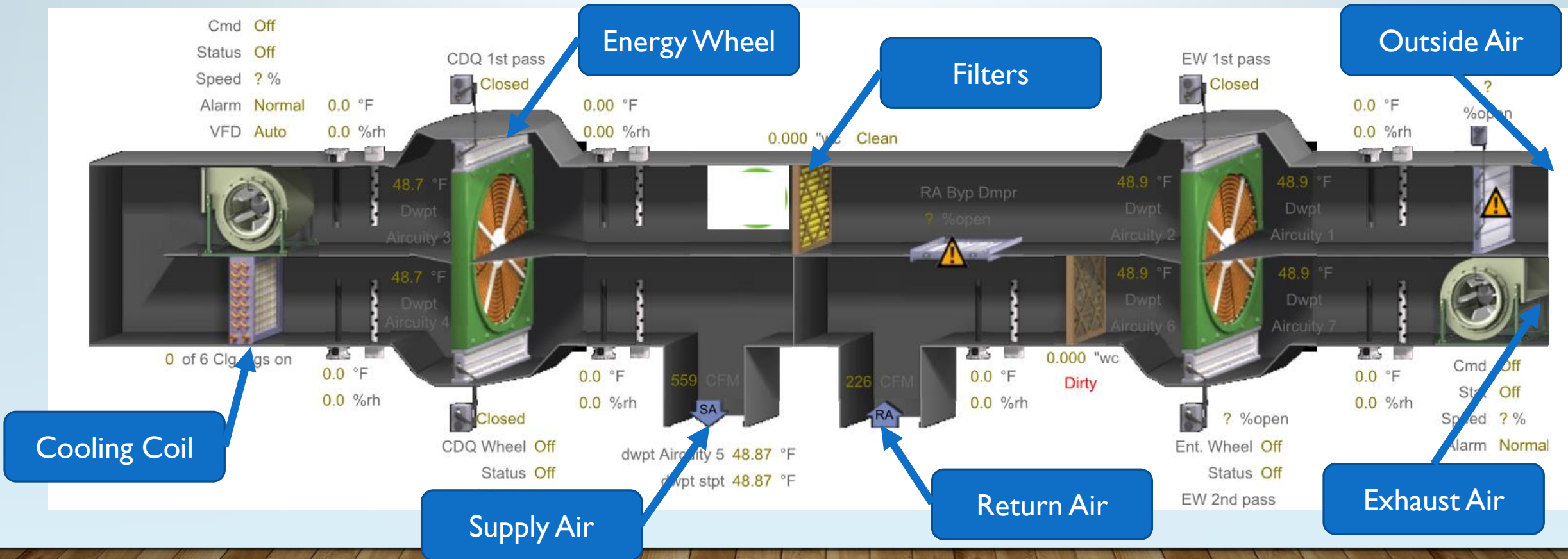


29 WHAT ARE MITIGATION STRATEGIES TO ASSESS...

- Outside Air Ventilation
 - Goal is to increase quantity
- Filtration levels (MERV Rating) in Systems
 - Increase to MERV 13 or 14
 - Consider portable
- Ultraviolet Energy Strategy
 - UVGI in Duct
- System Operation Hours
 - Pre- and Post- Flush
- BAS Capabilities
 - Temperature and RH control
 - Monitoring and alarms



30 SYSTEMS EVALUATION



3 | HVAC RISK ASSESSMENT

- Results
 - Work Orders to correct issues with the systems
 - Preventative Maintenance to be completed
 - Building Readiness Plan
- Document
 - Pre correction operation and airflows
 - Post correction operation and airflows
 - Post event operation and airflows
 - Building Readiness Plan
- Future Proof

Work Order Narrative
DOAS Unit Items:
DOAS: Cooling circuits - after the airflows are setup and operational. Stabilize the refrigeration circuits so that they cycled in parallel. Check the CDQ wheel discharge temperature deadband to be reported. This could potentially be increased to +/- 5 degrees F. (Keep an eye on space RH and that the CDQ wheel is working properly).
EW Wheel investigation to make sure that it is in proper working order. Per the Bldg Readiness Guide, check that there is appropriate PD on either side of wheel (OA post EW versus RA post EW).
Sensor calibration check in DOAS. Damper operation. Static Pressure Profile of the unit. Pressure drop across wheel in acceptable range. Establishing the new baseline to be compared to the original TAB.
Check the DOAS compressors and circuits as we are trying to make the unit Constant Volume. The 6 circuit face damper shall be constantly OPEN regardless of status. (currently working 15 minute intervals to start) (Alternative is to disconnect damper from actuator - but re-connect when turned over)
CDQ Wheel stays on. Check the EW on the wheel for performance.
Filters into CDQ to be confirmed as V8 replaced in 2015. If not, change out to MERV-13 or 14 (as per original design).
RA Filters prior to the EW to be confirmed as MERV-8. If not at least MERV-8 than they need to be replaced.
RA Damper by-pass around EW to be closed and sealed.
Need to replace the DOAS control board to avoid the intermittent false frost alarm.



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REOPENING BUSINESSES AND SCHOOLS

Wade Conlan



33 REOPENING BUSINESSES AND SCHOOLS

- Complete the HVAC Risk Assessment and Building Readiness Plan
- Understand the Mode of Operation
 - Shut Down
 - Prior to Occupancy
 - Partially or Full Occupancy
 - Epidemic or Post-Epidemic Mode
- Implement measures that will make occupants feel safer
- Provide training for tenants on safety measures
- Follow local, state, and federal requirements for your facility

34 PRIOR TO OCCUPANCY TASKS

- Implement the Work Orders to correct system performance and deficiencies
- Perform Annual Maintenance on systems
 - Refer to ASHRAE Standard 180-2018: Standard Practice for the Inspection and Maintenance of Commercial HVAC Systems
 - Check filters to see if they need to be replaced
- Check systems performance
 - Sensors are in calibration
 - Actuators are correctly moving dampers and valves
 - Check building pressure
 - Check space pressures are appropriate (toilet rooms negative)
 - Check system operation - fans, pumps, chillers, and boilers

35 PRIOR TO OCCUPANCY TASKS

- Flush the building with outside air for at least 4 hours
- Operate the HVAC Systems for 24 hours prior to occupancy
 - Review system trend data (space temperature, relative humidity, system performance)
- Flush water systems
 - Domestic – flush the hot and cold water fixtures to avoid contamination
 - HVAC – check chilled, condenser, and hot water systems for appropriate levels of water treatment
- Ensure supply chain to obtain needed HVAC parts (filters, motors, service calls)
- Engage custodial staff to properly clean the facility for EPA and CDC Guidance

36 HOW SHOULD BUILDINGS RE-OPEN?

- Depending on Phase of Re-opening, there may be some of the mitigation strategies that were enabled during the Epidemic Mode of Operation that remain
- Evaluate if the following are still needed:
 - Increased ventilation
 - Pre- and post- flush
 - Increased filtration
 - Disinfection strategies like UVGI
 - Operation hours of building
- Evaluate how to improve your systems to future proof
- Update your Systems Manual



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WHAT CONGRESS AND GOVERNMENT AGENCIES CAN DO – COVID-19 AND FUTURE EPIDEMICS

William Bahnfleth

38 WHAT CONGRESS & GOVERNMENT AGENCIES CAN DO TO HELP - RESEARCH

- Basic science
 - Respiratory aerosol generation and dynamics
 - Transmission modes, airborne infectious doses of common pathogens
 - Environmental influences on pathogen characteristics (temperature and humidity, ambient particulate matter)
- General indoor air quality research
 - Practical definition of good IAQ
 - Monetization of air quality
- Building systems research
 - Performance based infection control
 - Alternatives to ventilation - low energy/high IAQ
 - Efficient air management methods
 - Sensors and controls
 - Resilient system design approaches
 - Surge facilities

39 WHAT CONGRESS & GOVERNMENT AGENCIES CAN DO TO HELP - OTHER

- Consensus standards development support – IAQ, resilience
- Education and workforce training support
 - Architects, engineers, contractors
 - Building owner/manager
 - Tenants/users
- Incentives for workforce development, technology adoption
- Support for disaster/epidemic planning



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Questions?

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