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# Transfer Air for Exhaust Air Makeup

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# Acknowledgements

California Statewide Codes and Standards Team

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# Background

- Adopted by ASHRAE 90.1 in 2013.
- It applies to most spaces that have a process exhaust airflow rate that exceeds the airflow required for heating or cooling and that are adjacent to spaces that do not have high exhaust requirements.
- This eliminates the wasteful practice of providing 100 percent outside air or 100 percent supply air to spaces with high exhaust rates and at the same time relieving air from other spaces in the same building, when the relieved air could have been transferred to the high exhaust space to reduce the total heating/cooling load.

# Background

- It is common practice, for example, to serve a toilet room with a VAV box sized to match the toilet exhaust requirement when the cfm required to meet the toilet room heating/cooling load or ventilation requirement is much smaller than the exhaust requirement.
- A more efficient design is to only provide enough supply air to the toilet room to meet the cooling/ventilation loads and use transfer air to make up the difference of the required makeup air.

# Background

- The payback for this measure is immediate because it reduces both first cost and energy cost compared to 100 percent supply air to spaces with high exhaust rates.
- As a result of this proposed change, the standards will provide requirements for systems that were not regulated previously
  - Currently there were no limitations on the amount of conditioned air that could be used to replace air being exhausted.
- Similar requirement for Commercial Kitchen Ventilation, Section 140.9(b)2
  - This code change proposal expands this requirement to more spaces

# Energy Analysis

- Prototype building selected was the Medium Office/Laboratory
- Exhaust driven in lab spaces
- Balanced exhaust air flow with outdoor air for each Climate Zone

| Prototype ID | Occupancy Type (Residential, Retail, Office, etc.) | Area (ft2) | Number of Stories | Statewide Area (million ft2) |
|---|---|---|---|---|
| **Prototype 1** | Medium office-lab | 53,628 | 3 | 1.39 |

# Energy Analysis – First Year Impact

| Climate Zone | Electricity Savings (kWh/ft2-yr) | Peak Electricity Demand Reduction (kW/ft2) | Natural Gas Savings (therms/ft2-yr) | TDV Energy Savings (TDV kBtu/ft2-yr) |
|---|---|---|---|---|
| **1** | 0.176 | 5.65 x 10-4 | 0.029 | 9.86 |
| **2** | 0.251 | 7.21 x 10-4 | 0.029 | 13.08 |
| **3** | 0.213 | 6.29 x 10-4 | 0.025 | 10.73 |
| **4** | 0.268 | 6.39 x 10-4 | 0.025 | 12.75 |
| **5** | 0.218 | 5.99 x 10-4 | 0.029 | 11.14 |
| **6** | 0.300 | 6.50 x 10-4 | 0.022 | 13.34 |
| **7** | 0.303 | 6.68 x 10-4 | 0.020 | 12.81 |
| **8** | 0.324 | 7.37 x 10-4 | 0.022 | 14.58 |
| **9** | 0.323 | 1.26 x 10-4 | 0.021 | 14.01 |
| **10** | 0.324 | 7.95 x 10-4 | 0.022 | 13.36 |
| **11** | 0.321 | 6.00 x 10-4 | 0.027 | 14.03 |
| **12** | 0.289 | 8.52 x 10-4 | 0.027 | 13.59 |
| **13** | 0.325 | 7.78 x 10-4 | 0.026 | 14.93 |
| **14** | 0.267 | 1.10 x 10-4 | 0.019 | 11.79 |
| **15** | 0.412 | 5.20 x 10-6 | 0.020 | 15.11 |
| **16** | 0.169 | 6.14 x 10-4 | -0.004 | 3.51 |

# Energy Analysis – 15 Year Cost Savings per ft$^2$

| Climate Zone | 15-Year TDV Electricity Cost Savings (2020 PV$) | 15-Year TDV Natural Gas Cost Savings (2020 PV$) | Total 15-Year TDV Energy Cost Savings (2020 PV$) |
|---|---|---|---|
| **1** | $0.40 | $0.48 | $0.88 |
| **2** | $0.69 | $0.48 | $1.16 |
| **3** | $0.55 | $0.40 | $0.96 |
| **4** | $0.73 | $0.41 | $1.13 |
| **5** | $0.52 | $0.47 | $0.99 |
| **6** | $0.82 | $0.37 | $1.19 |
| **7** | $0.82 | $0.32 | $1.14 |
| **8** | $0.95 | $0.35 | $1.30 |
| **9** | $0.90 | $0.35 | $1.25 |
| **10** | $0.82 | $0.37 | $1.19 |
| **11** | $0.80 | $0.45 | $1.25 |
| **12** | $0.76 | $0.45 | $1.21 |
| **13** | $0.90 | $0.43 | $1.33 |
| **14** | $0.73 | $0.32 | $1.05 |
| **15** | $1.03 | $0.32 | $1.34 |
| **16** | $0.38 | $0.07 | $0.31 |

# Cost Effectiveness – Lifecycle Cost per ft$^2$

| Climate Zone | Benefits TDV Energy Cost Savings + Other PV Savings1 (2020 PV$) | Costs Total Incremental PV Costs2 (2020 PV$) | Benefit-to- Cost Ratio |
|---|---|---|---|
| **1** | $0.88 | $0 | infinite |
| **2** | $1.16 | $0 | infinite |
| **3** | $0.96 | $0 | infinite |
| **4** | $1.13 | $0 | infinite |
| **5** | $0.99 | $0 | infinite |
| **6** | $1.19 | $0 | infinite |
| **7** | $1.14 | $0 | infinite |
| **8** | $1.30 | $0 | infinite |
| **9** | $1.25 | $0 | infinite |
| **10** | $1.19 | $0 | infinite |
| **11** | $1.25 | $0 | infinite |
| **12** | $1.21 | $0 | infinite |
| **13** | $1.33 | $0 | infinite |
| **14** | $1.05 | $0 | infinite |
| **15** | $1.34 | $0 | infinite |
| **16** | $0.31 | $0 | infinite |

# Energy Analysis – Statewide Savings per ft$^2$

| Climate Zone | Statewide Construction in 2020 (million ft2) | First-Year Electricity Savings (GWh) | First-Year Peak Electrical Demand Reduction (MW) | First-Year Natural Gas Savings (million therms) | Lifecycle2 Present Valued Energy Cost Savings (PV$ million) |
|---|---|---|---|---|---|
| **1** | 0.0071 | 0.001 | 0.004 | 0.000 | $0.01 |
| **2** | 0.0410 | 0.010 | 0.030 | 0.001 | $0.05 |
| **3** | 0.1827 | 0.039 | 0.115 | 0.005 | $0.17 |
| **4** | 0.0922 | 0.025 | 0.059 | 0.002 | $0.10 |
| **5** | 0.0179 | 0.004 | 0.011 | 0.001 | $0.02 |
| **6** | 0.1144 | 0.034 | 0.074 | 0.003 | $0.14 |
| **7** | 0.0942 | 0.029 | 0.063 | 0.002 | $0.11 |
| **8** | 0.1605 | 0.052 | 0.118 | 0.003 | $0.21 |
| **9** | 0.1886 | 0.061 | 0.024 | 0.004 | $0.24 |
| **10** | 0.1379 | 0.045 | 0.110 | 0.003 | $0.16 |
| **11** | 0.0347 | 0.011 | 0.021 | 0.001 | $0.04 |
| **12** | 0.1689 | 0.049 | 0.144 | 0.005 | $0.20 |
| **13** | 0.0691 | 0.022 | 0.054 | 0.002 | $0.09 |
| **14** | 0.0244 | 0.007 | 0.003 | 0.000 | $0.03 |
| **15** | 0.0184 | 0.008 | 0.000 | 0.000 | $0.02 |
| **16** | 0.0417 | 0.007 | 0.026 | 0.000 | $0.01 |
| **Total** | **1.3936** | **0.403** | **0.854** | **0.032** | **$1.60** |

# Proposed Code Language

SECTION 140.4 – PRESCRIPTIVE REQUIREMENTS FOR SPACE CONDITIONING SYSTEMS:

**(o) Exhaust System Transfer Air.** Conditioned supply air delivered to any space with mechanical exhaust shall not exceed the greater of:

1. the supply flow required to meet the space heating or cooling load;
2. the ventilation rate required by the authority having jurisdiction, the facility Environmental Health and Safety department, or by Section 120.1
3. the mechanical exhaust flow minus the available transfer air from conditioned spaces or return air plenums on the same floor, not in different smoke or fire compartments, and that at their closest point are within 15 feet of each other.

# Proposed Code Language

Available transfer air is that portion of outdoor ventilation air that:

i. is not required to satisfy other exhaust needs,

ii. is not required to maintain pressurization of other spaces, and

iii. is transferable according to applicable codes and standards and to the class of air recirculation limitations in the California Mechanical Code

**EXCEPTION 1 to Section 140.4(o):** Biosafety level classified laboratories 3 or higher.

**EXCEPTION 2 to Section 140.4(o):** Vivarium spaces.

**EXCEPTION 3 to Section 140.4(o):** Spaces that are required by applicable codes and standards to be maintained at positive pressure relative to adjacent spaces.

**EXCEPTION 4 to Section 140.4(o):** Spaces where the highest amount of transfer air that could be used for exhaust makeup may exceed the available transfer airflow rate and where the spaces have a required negative pressure relationship.

# Proposed Code Language

SECTION 140.9 – PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES:

(d) **Exhaust System Transfer Air.** The exhaust system transfer air requirements in section 140.4(o) also apply to covered processes.

SECTION 141.0 – (ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL…)

To be revised where necessary to clarify that the new transfer air requirement does not apply to alterations and repairs but would apply where new exhaust systems are added to existing buildings

# Questions?

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Comments Due by July 7th
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