



Our Title: Inmate Health and IAQ in Correctional Facilities

Author's Title: Indoor Air Quality Investigation and Health Risk Assessment at Correctional Institutions

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Design Issue:

Purpose: A study was conducted on the interior and exterior air quality at a correctional facility in New Jersey, which was located on a reclaimed tidal marshland landfill. Researchers determined if indoor air quality (IAQ) was affecting the health of inmates and correctional workers in response to ongoing health complaints by both populations that began a few years after the facility was constructed.

Rationale:

- Health complaints ranging from eye tearing, respiratory distress, facial/skin rashes, headaches, nausea, and vomiting were reported by both correctional workers and inmates, though most ongoing testing showed no violations of either American Conference of Governmental Industrial Hygienists (ACGIH) or federal or state allowable thresholds for contaminants.
- Characteristics of correctional workers' and inmates' complaints presented conditions similar to sick building syndrome or building-related illness according to Public Employees Occupational Safety and Health Program (PEOSH).
- Due to the limited amount of time inmates spend outdoors and number of years they reside indoors, the two populations experience different health effects from IAQ.
- Satisfactory IAQ for state employees is legislated by the New Jersey Administrative Code as regulated by PEOSH. Previous evaluations indicated inadequately maintained HVAC systems and substandard housekeeping practices.

Design Criteria:

The author identified the following design criteria:

- Provide adequate fresh air to help ensure good IAQ and require ongoing maintenance and periodic evaluation of HVAC systems to reduce the contaminant load in the air as advocated by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) and per manufacturers' specifications.
- Consider creating a schedule for annual testing for IAQ contamination in correctional institutions where inmates spend the majority of their time indoors.

InformeDesign identified the following design criteria:

- Evaluate site soil and groundwater conditions for the presence of VOCs and metals.
- Be aware that VOC off-gassing can migrate from the soil through foundation cracks and locations where utilities pierce the building envelope. New construction can free VOC from the soil and as a building settles, additional transfer of contaminants can occur.



- Be aware of chemicals and hazardous substances contained in maintenance and cleaning products that might contaminate the air and provide adequate, protected storage for them.
- Consider engineering of HVAC systems to accommodate contaminants that might be contributed by building occupants, such as smoking or incense burning.

Key Concepts:

- Sick building syndrome is detected when persons' symptoms (headache; eye, respiratory, throat, or skin irritation; difficulty concentrating) are only present when in the building, but dissipate after they leave, which is not possible for inmates. In contrast, building-related illness (including Legionnaire's disease, asthma) refers to persons' symptoms (irritations similar to those from sick building syndrome, chills, congestion, muscle aches, pneumonia) that do not dissipate when they leave the building and is typically found to affect fewer individuals. Both conditions are identified if they cannot be attributed to a known illness.
- Causes of building-related illness are typically allergic reactions to biological or microbial contaminants or chemicals.
- IAQ is most positively impacted by adequate fresh air being introduced into the building (PEOSH); poorly maintained HVAC systems contribute to poor IAQ by allowing accumulation of contaminants.
- In a preliminary evaluation of the facilities' buildings, 'hot spots' of contamination were not found.
- Findings of the IAQ readings indicated that the PEOSH threshold for carbon dioxide concentration (1,000 ppm) was exceeded (3,058 ppm) in several locations. Also, four metals (beryllium, cadmium, thallium, and mercury) were found at levels in excess of the U.S. Environmental Protection Agency (EPA) guidelines.
- All other readings found levels of VOCs, metals, fungal spore counts, benzene, trichloroethylene, and tetrachloroethylene, but none exceeded the U.S. Occupational Safety and Health Administration's acceptable exposure levels.
- Contamination sources were identified as subsurface soil and groundwater contaminated with VOCs and metals, in excess of levels indicated as acceptable by the NJ Department of Environmental Protection. Additionally, application and storage of chemicals used in cleaning and maintenance, smoking and incense burning, and liquefied petroleum gas were found to negatively impact IAQ.
- Results from the risk-assessment model indicated that cancer risk was within the USEPA acceptable range for the workers at both 50% and 95% exposure values and for the inmates at the 50% level. For inmates, trichloroethylene at the 95% exposure level exceeded the USEPA acceptable level of risk.

Research Method:

- This study was commissioned by the New Jersey Department of Corrections in response to IAQ related complaints and associated health impacts. A single correctional facility was evaluated that included air sampling (both exterior and indoor) and health risk-assessments of both correctional workers and inmates.



- Preliminary evaluation of the IAQ was conducted to determine if 'hot spots' were present using direct reading instruments, analysis of air and wiping samples for chemical and microbial contaminants, and the building envelope. Also, outdoor air readings were taken to compare to indoor air readings as a baseline of ambient air quality.
- Buildings (17) that included inmate housing (11), administration, hospital, kitchen/dining, and chapel were evaluated using 65 sampling locations.
- Readings were evaluated using the ASHRAE threshold of 80% of occupants rating the IAQ as comfortable, without complaint.
- Air samples were used to detect semivolatile organic chemicals (SVOCs), metals, volatile organic compounds (VOCs), fixed gasses (including methane), polychlorinated byphenyls (PCBs), and fungal spores were taken in the morning and afternoon to avoid timing impacts on the readings. Samples were evaluated in a laboratory setting.
- Health risk-assessment was applied to the correctional worker population (diverse in race and gender) and the inmate population (primarily black and male). IAQ readings were modeled on two sets of criteria, best guess (50%) exposure and worst case (95%) exposure in context with exposure time (hours/day), exposure frequency (days/year), exposure duration (number of years), inhalation rate, and body weight.
- The US EPA human health risk-assessment was used for guidance as well as the American Petroleum Institute's Decision Support System Model. It was assumed that IAQ contaminants were universally evident across the buildings at the correctional facility.
- Air sampling data were analyzed using the Shapiro-Wilk and Kolmogorov-Smirnov tests that found the data were not normalized, based on the great number of samplings that did not detect contaminants.

Limitations of the Study:

The author identified the following limitations:

- Modeling exposure to contaminants and estimating risk introduces variability and uncertainty in the results of the analysis.

Commentary: Additional information about specific contaminants, metals, and other pollutants is provided. The construction date of the building, the time of year and duration of the air sampling, and the population sizes (correctional workers and inmates) were not identified. The author notes that the building was about 20 years old and was constructed on a reclaimed tidal marshland site (formerly a landfill with the probability of illegally-deposited waste), which may have impacted the findings relative to soil and ground water characteristics.

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