roger ota. diane armpriest. rob pena. megan compton. harvey bryan. jennifer johnson. robert rayner

Agents of Change Investigation

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air movement in the crystal canyon

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The Building

- 5-story building with central atrium;
- pre-cast concrete frame;
- 12 inch concrete wall with perforated copper screened service area to the exterior on east & west side;
- north & south shaded glass curtain wall.
- 5th Floor: Underfloor displacement ventilation
- 2nd Floor: Variable Air Volume, ceiling delivery and return (mixing)

Preliminary Observations

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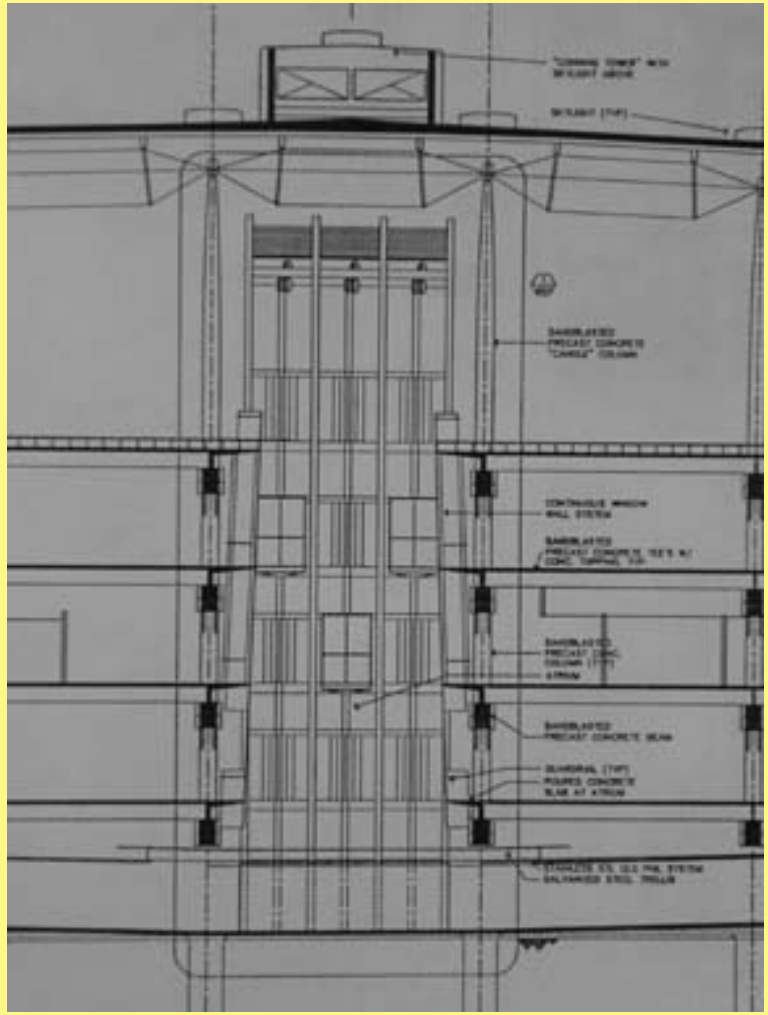
Questions:

- What are the air movement patterns in the atrium?
- Does heated air flow up the stack of a five story atrium?
- Does chilled air from the fifth floor flow spill down into the atrium?
- Are temperatures uniform across the atrium section at each floor?
- Are temperatures uniform vertically in the atrium?
- Is air moving both up and down the atrium.



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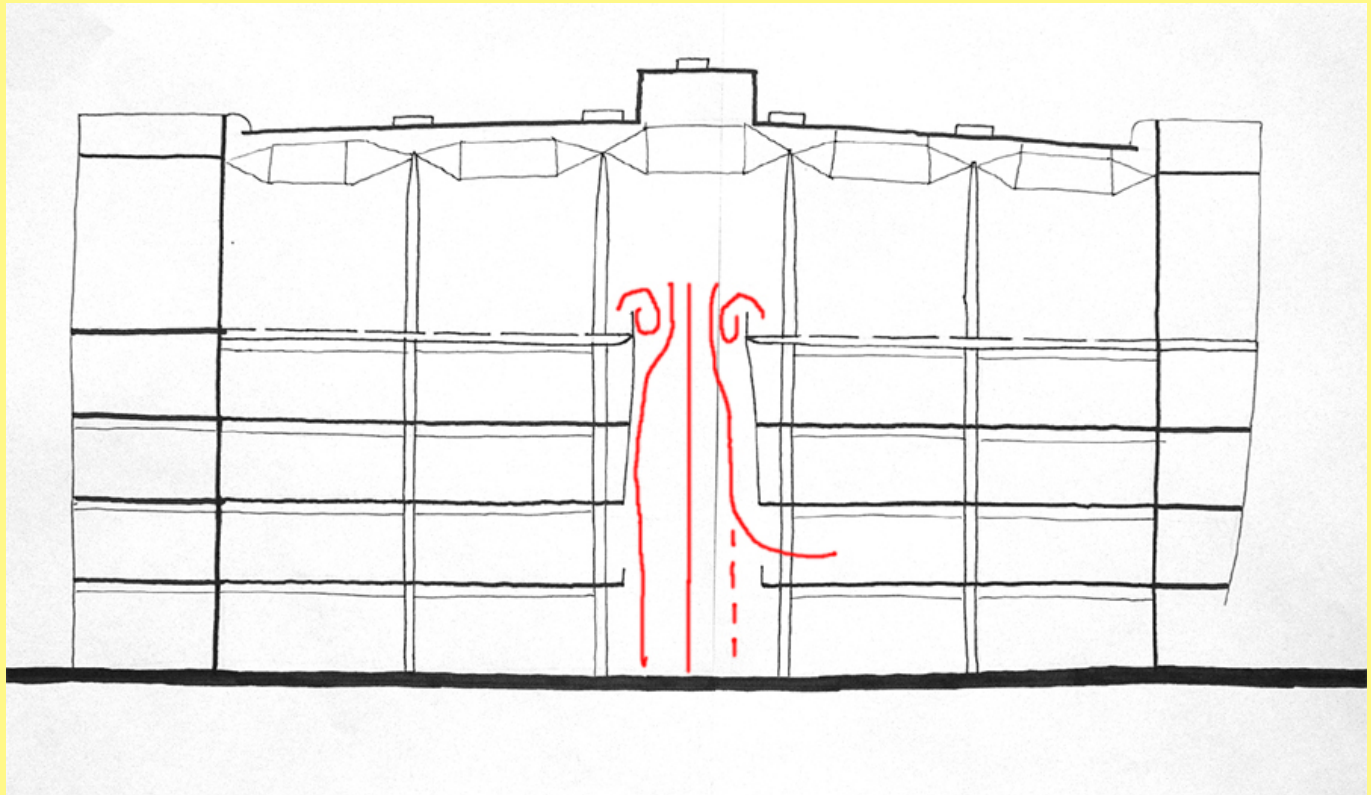
Hypothesis

Air moves both up and down across the atrium section.



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Methodology

1. Measure dry bulb temperatures across the atrium section at the 2nd and 5th floors.

Five temperature HOBOS were attached to a line strung across the atrium section at the 2nd and 5th levels.

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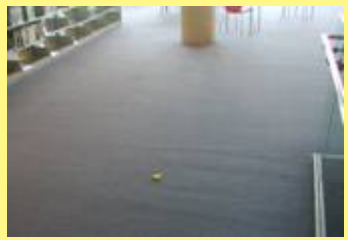
Methodology

2. Use feathers to visualize air movement in the atrium.



Five colored feathers were attached to a line stretched across the atrium opening at the 5th level. The feathers at each location were observed and timed as they fell.

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Methodology

3. Use powder to visualize air movement in the atrium.

A chalk-line was modified with talcum powder,was stretched across the atrium and then snapped to create a “powder puff”.

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Methodology

4. Use smoke to visualize air movement in the atrium.

A smoke stick was attached to a line and moved across the atrium opening at the 5th level.

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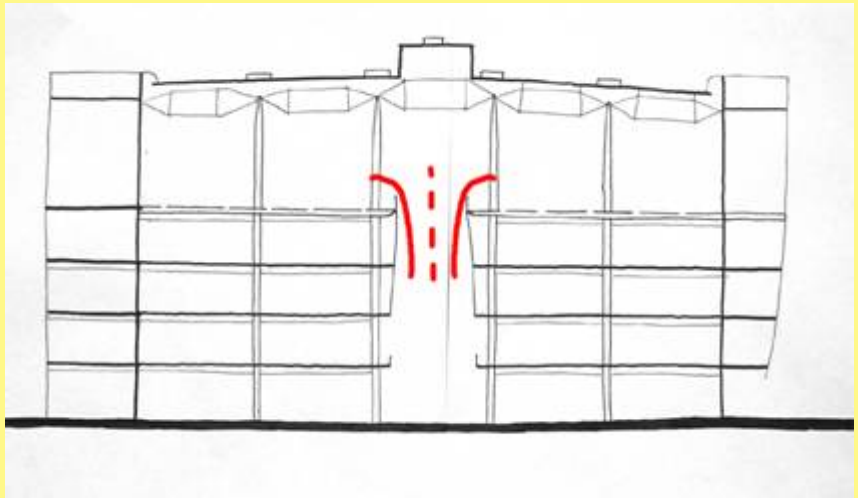
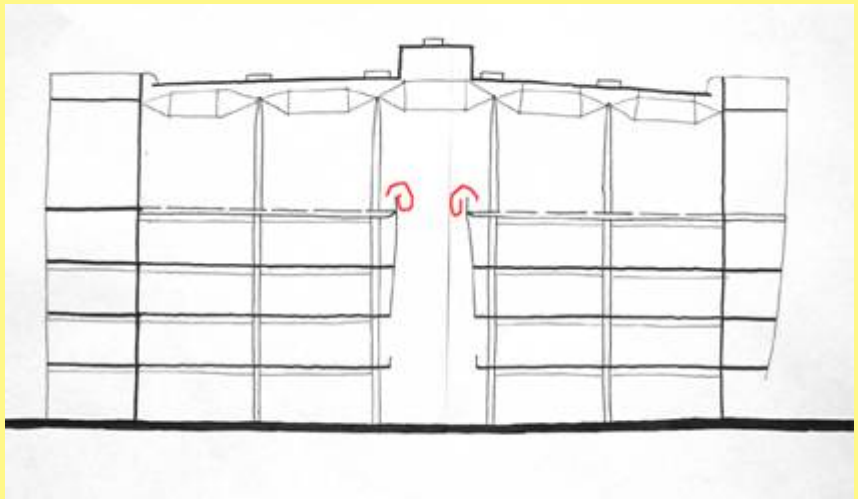
Air-flow Data





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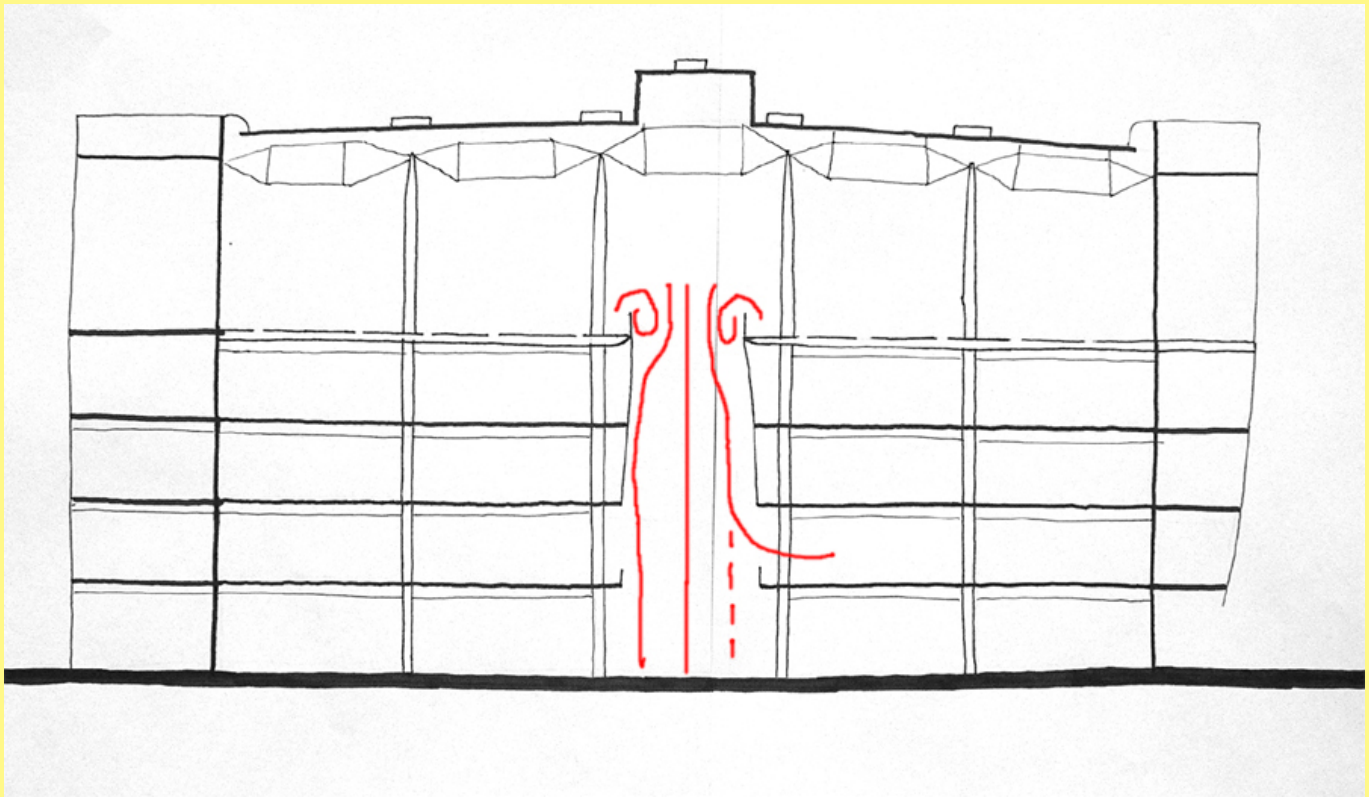
Air-flow Data



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Analysis and Conclusions

- Generally, air movement moved in one direction: down
- Air movement was slightly faster toward the center of the atrium.
- The atrium is working as an active plenum for the building.
- Air temperatures were within a two-degree range with a slight east-west variation.
- The 2nd floor is short-circuiting the return effect.
- The air was moving NW as it fell, particularly at the 2nd floor.
- A local back-eddy exists at the balcony edge on the 5th floor.

Further Study

Variables to test:

- Time of year
- Day vs. Night
- Variation across plan (elevator to outside edge)
- HVAC Variations

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