Protection against humidity

- Moisture penetration
  - bulk moisture
  - capillary action
  - air leakage
  - vapor diffusion
### Protection against humidity

#### Condensation from humid air infiltration

- **sources of water vapor and typical humidity production [g/h]:**
  - Resting person: 30 to 50
  - Active person: 200 to 300
  - Cooking water: 100 to 200
  - Bath: 2000
  - Shower: 2400
  - Apartment plant: 10
  - Washing machine (laundry): 50 to 200
  - Dryer (laundry): 500

**Total for apartment:** 400 to 1600 \( \text{i.e.} \ 7 \text{ to } 11 \text{ kg/day} \)
Protection against humidity

- Condensation from humid air infiltration
  - reaching of dew-point °T
  - assess condensation risk

higher if thermal bridges
or poor ventilation

Image by MIT OCW.
Protection against humidity

- Condensation from humid air infiltration
  - reaching of dew-point °T
    - assess condensation risk
    - calculate amount of condensed water
    - account for evaporation (summer)
Protection against humidity

- Condensation from humid air infiltration
  - reaching of dew-point °T
    - assessing the condensation risk

\[ J_{\text{vap}} = S \Delta p / R_{\text{vap}} \]

\[ R_{\text{vap}} = \sum R_{\text{vap} i} = \sum \frac{d_i}{\lambda_{\text{vap} i}} \]

<table>
<thead>
<tr>
<th>Material</th>
<th>( \lambda_{\text{vap}} ) [mg / m h Pa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>0.64</td>
</tr>
<tr>
<td>Concrete</td>
<td>0.004 – 0.010</td>
</tr>
<tr>
<td>Brick</td>
<td>0.10 – 0.175</td>
</tr>
<tr>
<td>Mineral wool</td>
<td>0.32 – 0.64</td>
</tr>
</tbody>
</table>

Image by MIT OCW.
Protection against humidity

- Condensation from humid air infiltration
  - reaching of dew-point °T
  - prevention measures

Exterior roughcast permeable to water vapor

Exterior

Load-bearing wall

Slab

Airtight foil necessary

Interior

Exterior

Interior

Airtight foil
Protection against humidity

- Condensation from humid air infiltration
  - reaching of dew-point °T
  - prevention measures
    - vapor retarder on warm side (before insulation)
      (vapor barrier)

Images by MIT OCW.
Thermal Insulation, Condensation/moisture

- Reading assignment from Textbook:
  - "Introduction to Architectural Science" by Szokolay: § 1.4.3 - 1.4.4 + § 1.5.4

- Additional readings relevant to lecture topics:
  - "How Buildings Work" by Allen: Chap 8, Chap 12
  - "Heating Cooling Lighting" by Lechner: Chap 15