Design Tools

- **General objectives**
  - visualisation of the luminous environment of a daylighting design
  - prediction of daylight factors in a space lit by diffuse daylight
  - identification of glare sources and evaluation of visual comfort
  - prediction of potential energy savings from daylighting
  - control of the penetration of the sun’s rays
  - visualisation of the dynamic behaviour of sunlight

- **Improvements allowed in the design process**
  - prevent errors
  - test innovative daylighting solutions
Design Tools

- Often used at late stages of design
  - window schemes and surface reflectance = inputs
  - analytic approach
  - computer-based tools more dominant
  - integrated tools: including energy, comfort and cost analysis

- Need for alternative approaches
  - early stages of design to avoid unsatisfactory compromises
  - generative methods
Design Tools

- Study about design tools use and dissemination in late 90’s
  - 42% architects never made predictions (used intuition)
  - majority used manual methods (hand calculations)
  - specialists’ method selection depends on problem to solve
### Manual design tools

- **simple geometries and sky conditions**
- **less used today**

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<th>T Y P E</th>
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<th>Energetic behaviour/daylight autonomy</th>
<th>Shadow &amp; reflection analysis/sunshine duration</th>
<th>Visual comfort</th>
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Figure by MIT OCW.
**Manual design tools**

- calculation of daylight factor of given window scheme
  - lumen method
  - split-flux method (daylight factor method)
  - chapter 8 in *IESNA Handbook*
  - § 5.1 in *Daylighting Performance and Design*
Design Tools

- Manual design tools
  - calculation of daylight factor of given window scheme
  - impact of obstructions on daylight availability
    - sun chart or daylight availability chart
    - fish-eye camera or CAD

Figure by MIT OCW.
Design Tools

- Manual design tools
- Scale models
  - qualitative (visualization) and quantitative (meters) assessments
Design Tools

- Manual design tools
- Scale models
  - qualitative (visualization) and quantitative (meters) assessments
    - testing of different alternatives to seek for optimum

Images courtesy of Prof. B. Paule, Estia SA, Lausanne, Switzerland.
Design Tools

- Manual design tools
- Scale models
  - qualitative (visualization) and quantitative (meters) assessments
  - experimental set-up
    - scale choice (often 1:20 or 1:30)
    - reference photometer
    - similar surface materials
Design Tools

- Manual design tools
- Scale models
  - sky simulator
    - mirror sky
    - sky dome
    - spotlight sky simulator
    - scanning sky simulator

Images courtesy of Prof. B. Paule, Estia SA, Lausanne, Switzerland.
Design Tools

- Manual design tools
- Scale models
  - sky simulator
  - sun simulator

Figure by MIT OCW.
Design Tools

- Manual design tools
- Scale models
- Computer-based tools
  - radiosity method

Figure by MIT OCW.
Design Tools

- Manual design tools
- Scale models
- Computer-based tools
  - radiosity method
  - ray-tracing techniques

Figure by MIT OCW.
Design Tools

- Manual design tools
- Scale models
- Computer-based tools
  - radiosity method
  - ray-tracing techniques
  - analytic methods
Design Tools

- Manual design tools
- Scale models
- Computer-based tools
  - radiosity method
  - ray-tracing techniques
  - analytic methods
  - integrated tools
Design Tools

- Manual design tools
- Scale models
- Computer-based tools
  - radiosity method
  - ray-tracing techniques
  - analytic methods
  - integrated tools
  - variants of the above
    - commercial softwares
    - web-based