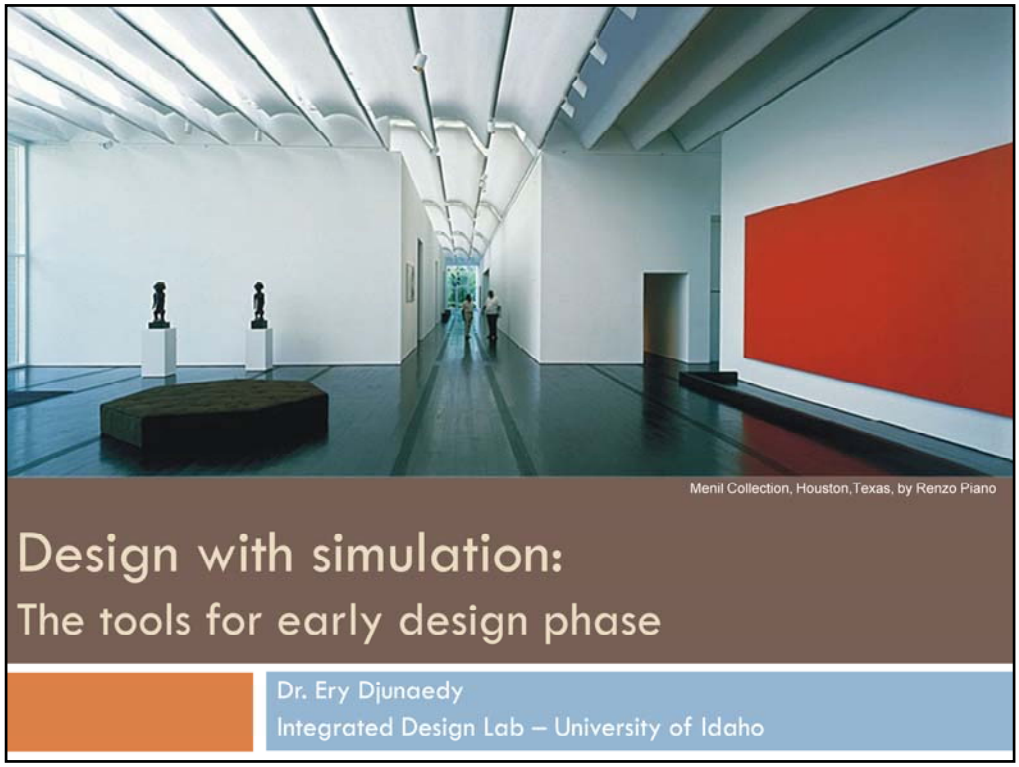


This presentation is prepared for panel discussion on Energy Modelling Tools for Early Design Phase, organized by Cascadia GBC and BetterBricks, presented on 13-Mar-2008 in Seattle and 14-Mar-2008 in Portland.

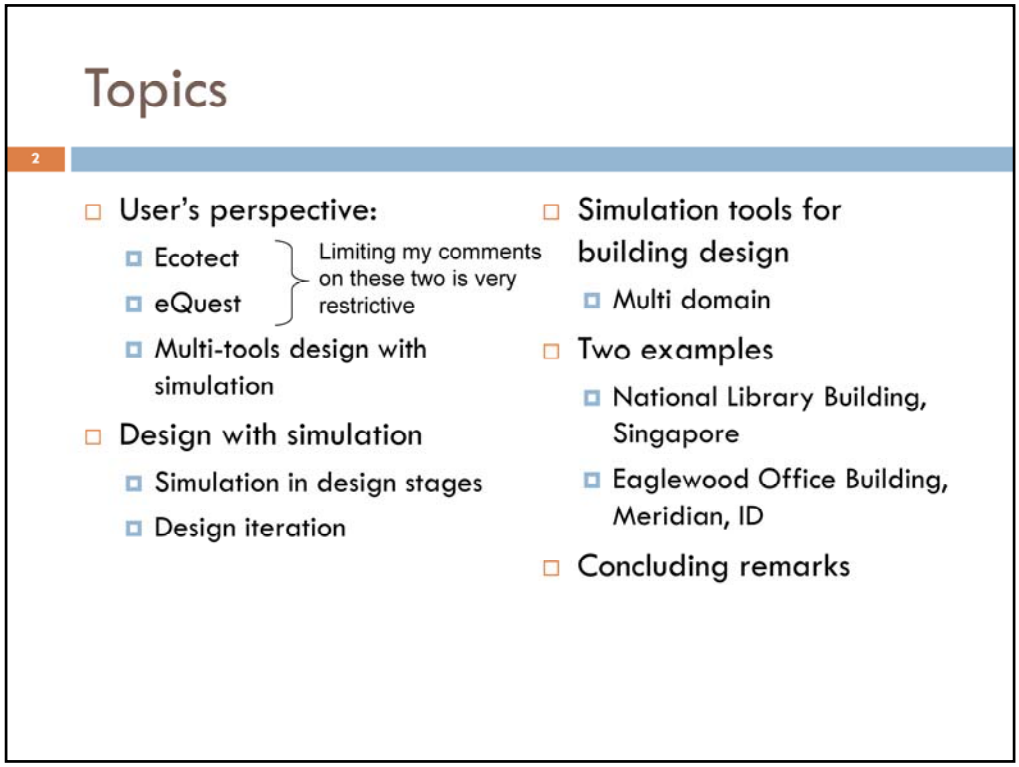
Subject: Welcome statement and opening remarks.

Narration:

This slide to remain on screen until start of presentation.

Images:

- Menil Collection, Houston TX by Renzo Piano. (Source: http://rpbw.r.ui-pro.com/)



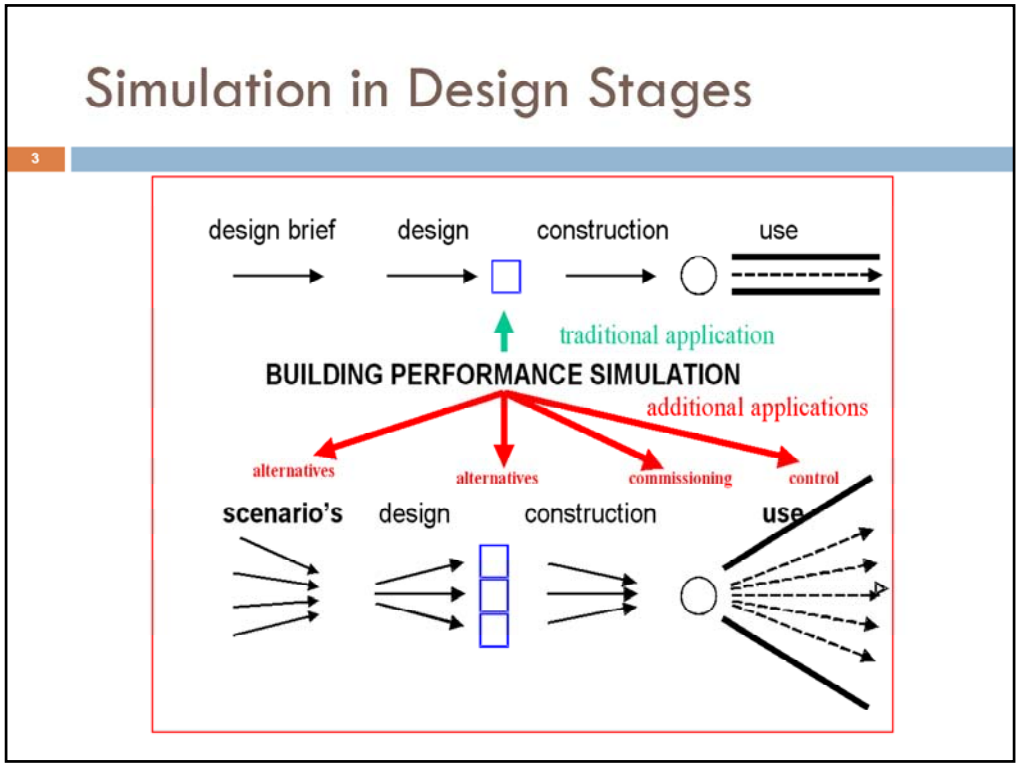
Subject: Topics covered in this presentation.

Narration:

- The presentation will cover the user's perspective on simulation tools. The organizer asked to comment on two simulation tools (Ecotect and eQuest), however I took the liberty to expand the presentation to cover multi-tools building design.
- It will start by a discussion on the place of simulation works within the stages of building design, how it is traditionally done and how we want it to be.
- And then it will discuss design iteration as an important advantage of using simulation in the building design process.
- The emphasis on multi-domain simulation using many tools is discussed in two case studies.

Images:

- None



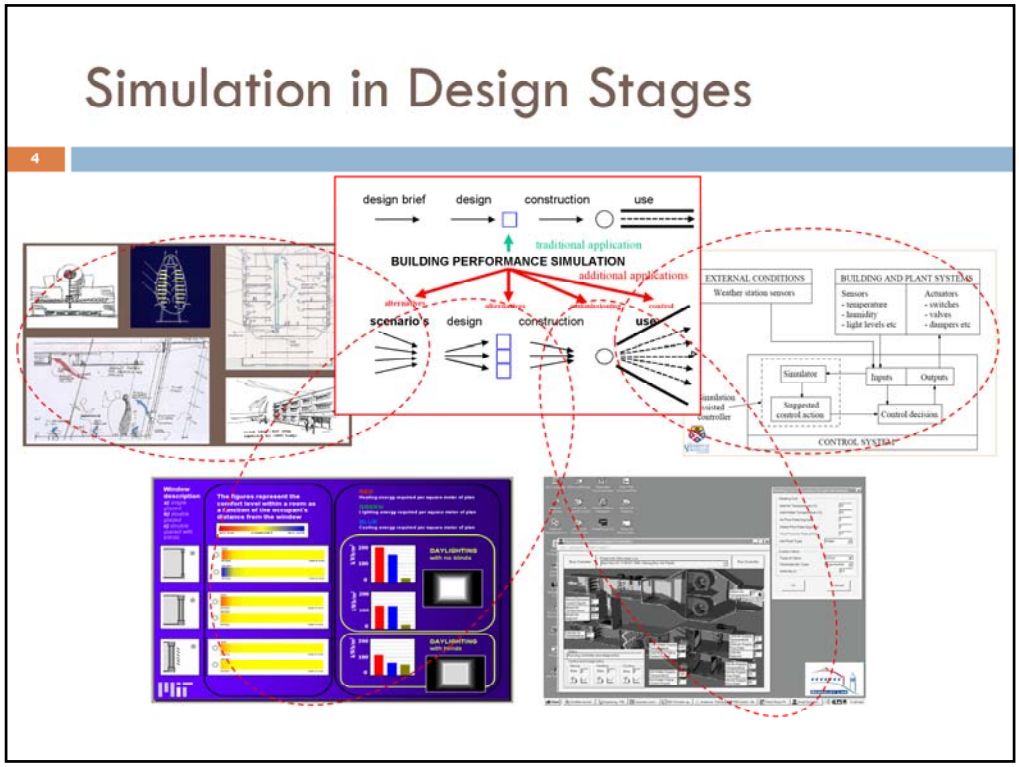
Subject: Simulation in design stages

Narration:

- The top of the picture shows the major stages in the building design. The traditional application of building performance simulation work is when the final design has been completed. The architect will ask the simulationist to do the simulation mainly for code compliance.
- We want to move from the traditional application of building performance simulation, and look at the potentials if we move the application time to various stages.

Images:

- BPS in design stages (source: Hensen, JLM, et al., presentation in PLEA 2004)



Subject: Simulation in design stages (cont.)

Narration:

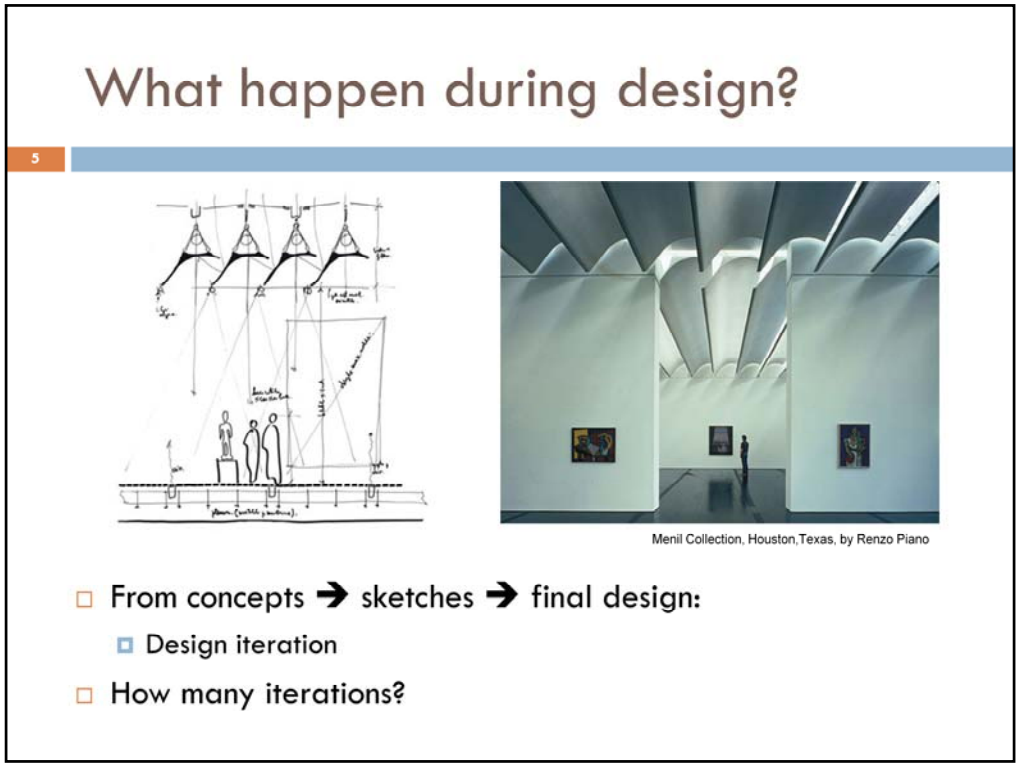
- [Left picture] What can we do if we only have design sketches?
- [Bottom left picture] What can we do if we want to test several design options?
- [Bottom right picture] Can we use simulation for commissioning?
- [Right picture] What can we use simulation for after the building operates? Can we use it during renovation?

Images:

- BPS in design stages (source: Hensen, JLM, et al., presentation in PLEA 2004)
- Sketches of several building design
- Screen shots of several software

Effects:

- The pictures representing different design stages will show up on mouse click



Subject: What happen during design?

Narration:

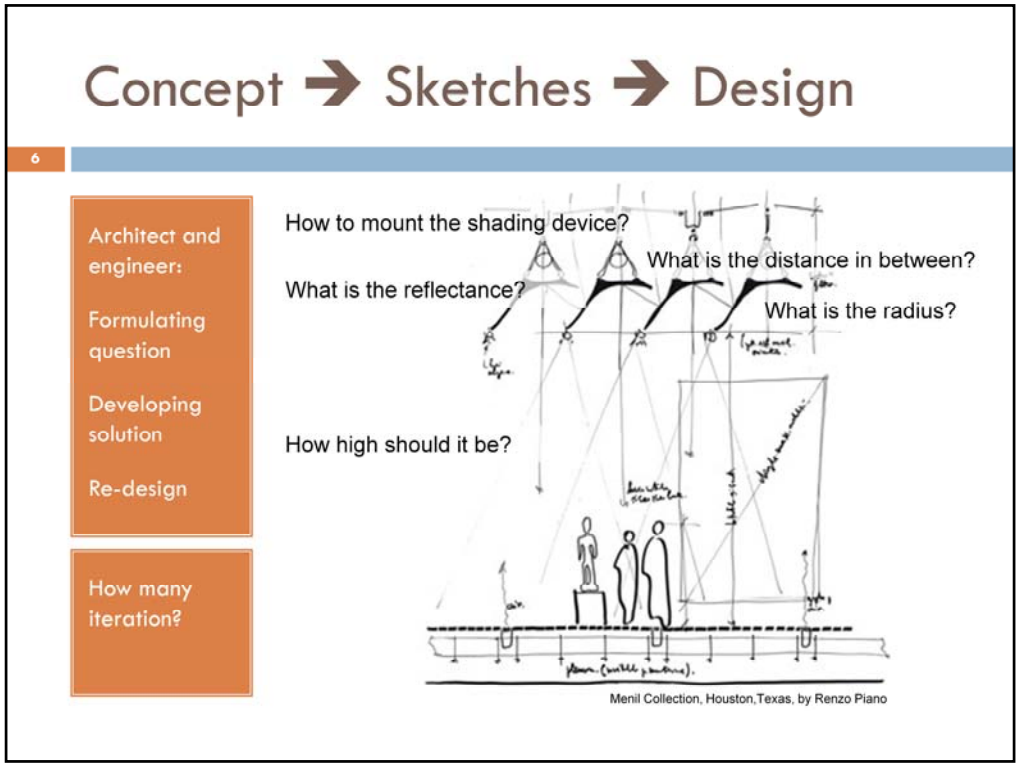
- What happen between the sketches to the final design? If you look at the sketch on the left, there are many design questions that needs to be answered. Both architects and engineers need to communicate from early design stage to find solutions to the design questions.
- The simulation tool will enable the design to evolve along the design stages towards the most optimum design.
- How many iterations should there be?

Images:

- Menil Collection, Houston TX by Renzo Piano. (Source: http://rpbw.r.ui-pro.com/)

Effects:

- None



Subject: Design questions

Narration:

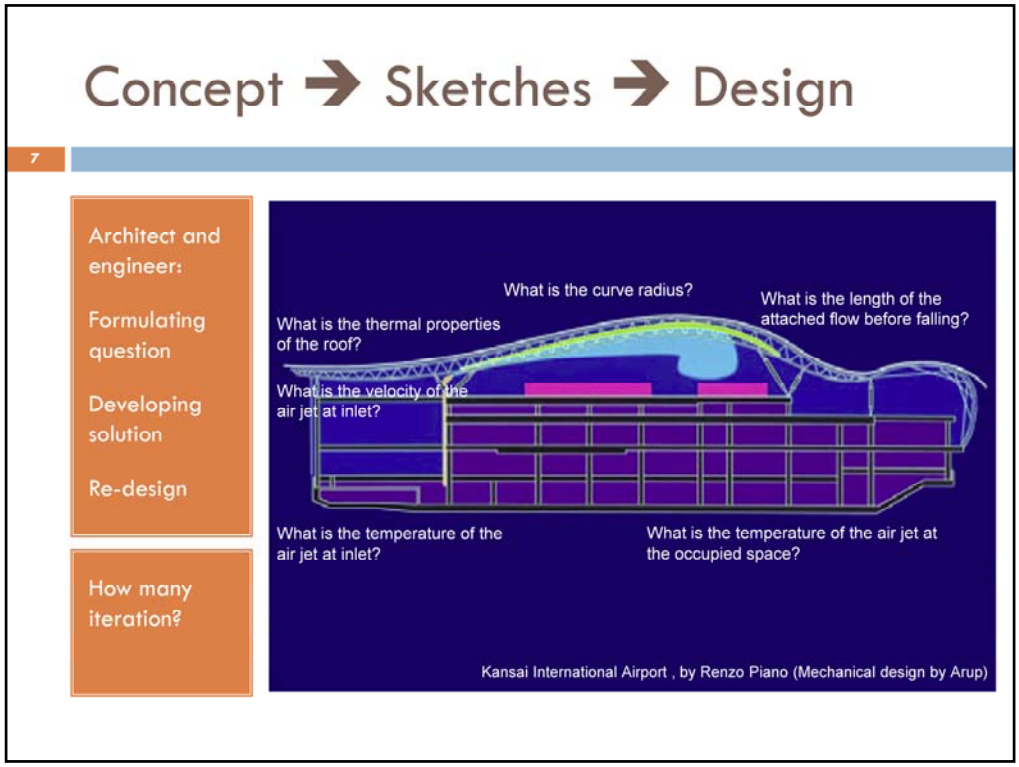
- Provided by slide.

Images:

- Menil Collection, Houston TX by Renzo Piano. (Source: http://rpbw.r.ui-pro.com/)

Effects:

- None



Subject: Design questions

Narration:

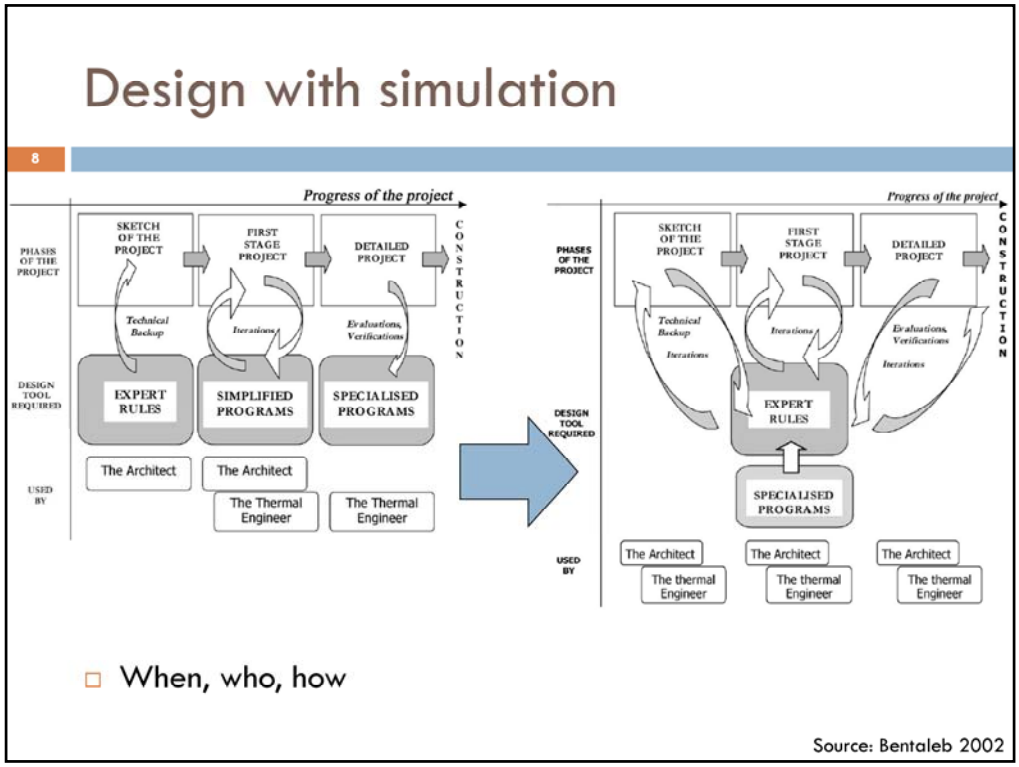
- Provided by slide.

Images:

- Kansai International Airport, Kansai, Japan, by Renzo Piano, and mechanical design by Arup (Source: Chown, M., (2003), *Building simulation as an aide to design*, Building Simulation 2003, Eighth International IBPSA Conference, Eindhoven, Netherlands, August 11-14. http://www.ibpsa.org/proceedings/BS2003/BS03_0019_30.pdf)

Effects:

- None



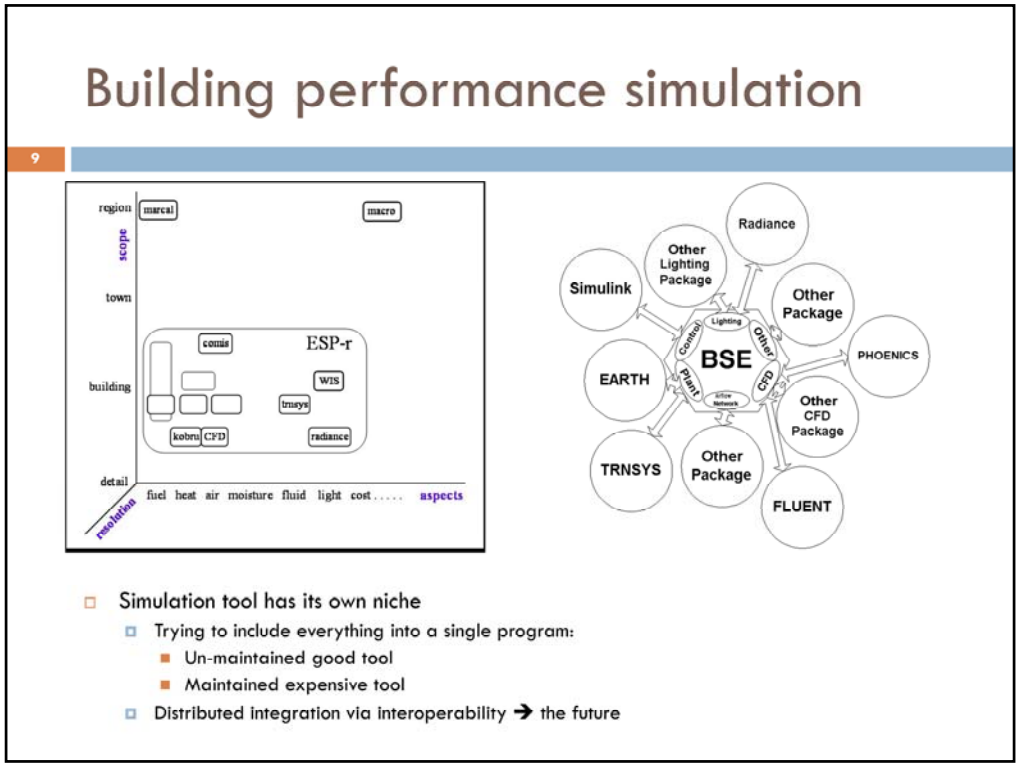
Subject: Design with simulation

Narration:

- On the left picture there is a clear distinction on what tools to use and who is using the tool. The architect stats from the very beginning working with experts rule or rule-of-thumbs. And as the design matures, the engineer will get involved. At the later stage where the specialized program is used, the engineer will work alone.
- On the right picture, collaboration starts very early in the process, and there is no clear distinction on what tool to use in a certain stage of the design process. Any tool will be used as appropriate at any stage of the design process.
- We want to move towards the right picture.

Images:

- Two images from F. Garde-Bentaleb et al. (2002), Bringing scientific knowledge from research to the professional fields: the case of the thermal and airflow design of buildings in tropical climates, Energy and Buildings, Vol. 34, No. 5, Pages 511-521.



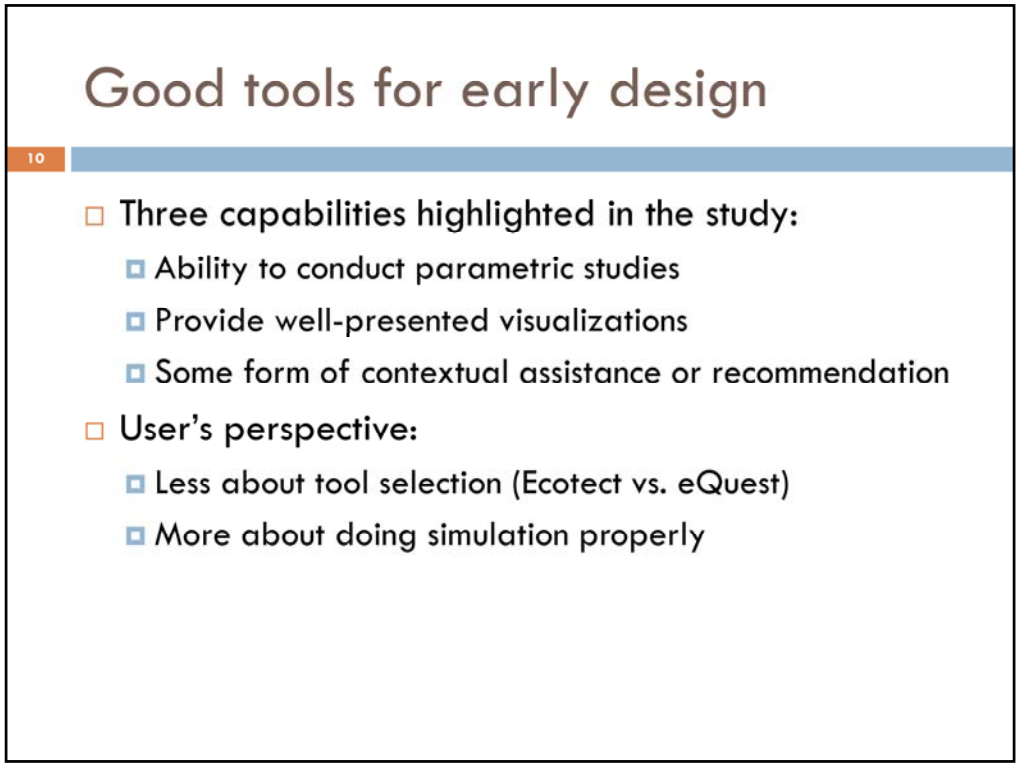
Subject: Building performance simulation

Narration:

- [Left picture] We can put all of the simulation tools into a 3D axis. In the horizontal axis, we have different domains or aspects. In the vertical axis, we have different scale from the detail level, building level, town level and region level. On the other axis, we can have different resolution of the problem.
- We can put all of the domains inside a single building simulation environment (BSE). The BES will have CFD module for detailed airflow simulation, lighting calculation module, control system module, etc. If we try to include all domains into a single program, what we end up with is either unmaintained good tool (which will quickly be outdated) or a good quality maintained tool (but will be very expensive because it has to maintain and update the development in all fields/domain)
- [Right picture] What we want is a distributed integration, i.e. we integrate simulation tools as we need it, and when we need it we can use the best tool available for a certain domain.

Images:

- Map of all simulation tools (source: Hensen, JLM, et al., presentation in PLEA)
- Distributed integration (source: Djunaedy et al., presentation in Roomvent 2002)



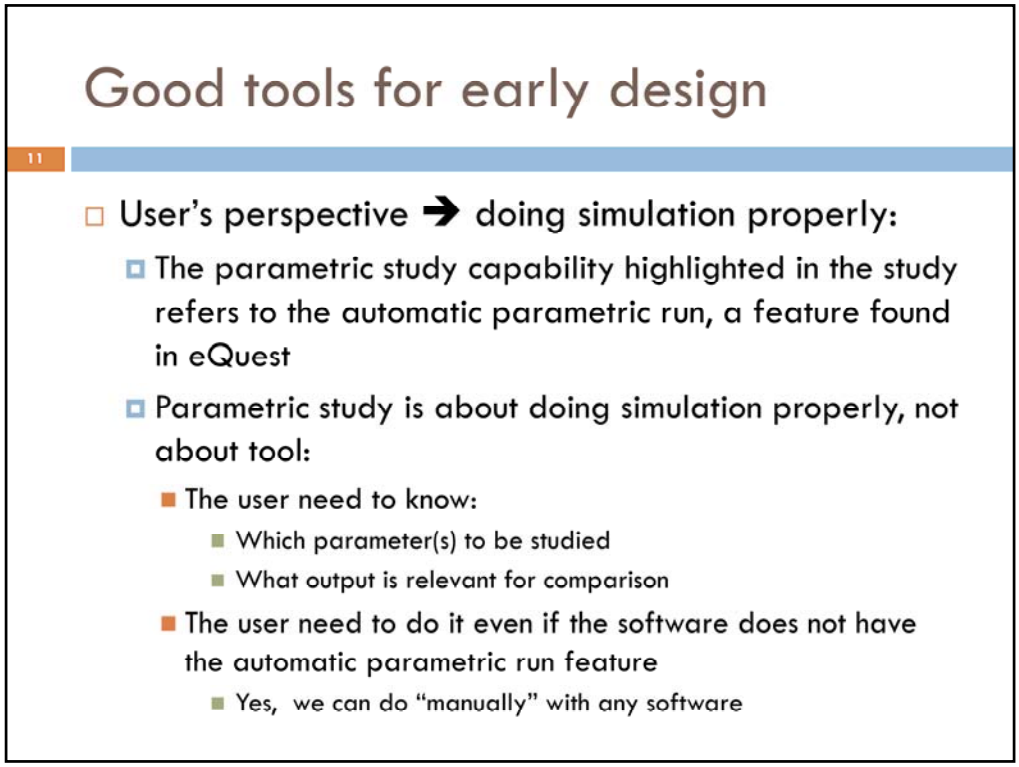
Subject: Criteria for good tools

Narration:

- The study highlighted three capabilities that a software needs to have so that it can be used for early stages in the building design. (In the slide)
- From the user's perspective, these capabilities are too tool-centric. What is more important than the three capabilities is the skill to do the simulation work properly

Images:

- None.



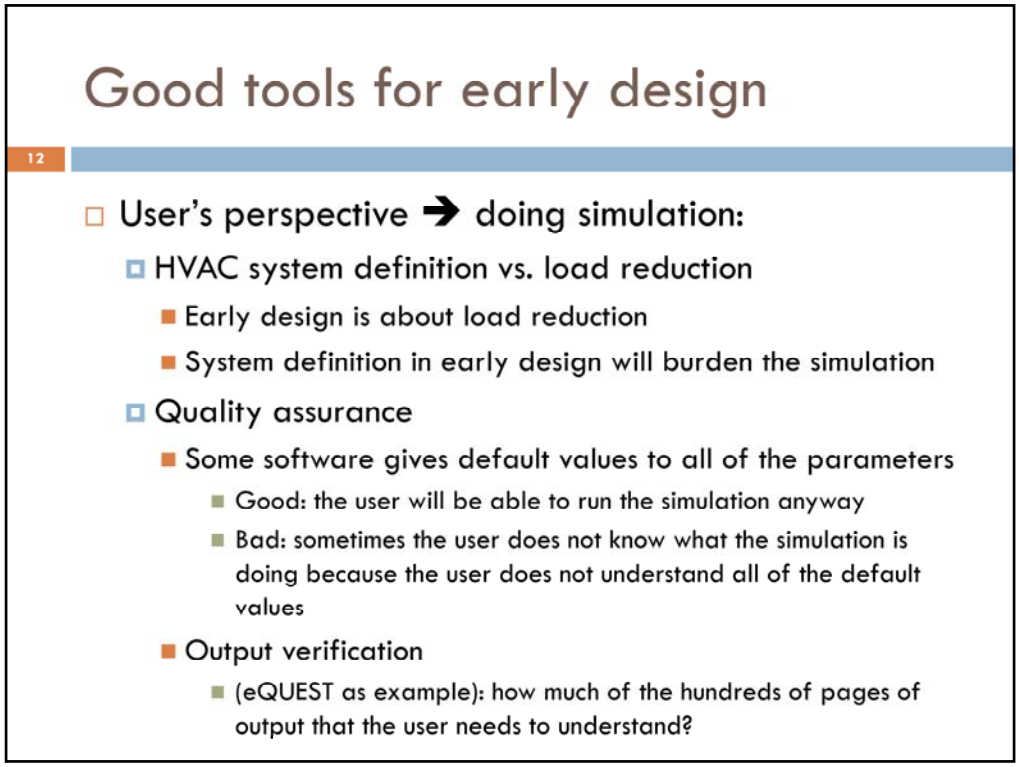
Subject: Criteria for good tools (cont.)

Narration:

- Doing simulation properly is more important than the tool itself. The example for this is about "automatic parametric run" that is one of the features in eQUEST.
- The ability to do a parametric study is one of the reasons we want to do simulation in the first place. You have to do this with ANY software, and you can do this even if the software does not have the "automatic parametric run" feature like eQUEST.
- To do a parametric study, the user has to know (1) which parameters to be studied and (2) which output is relevant for comparison. No software will offer this information for the user, i.e. the skill to do the simulation properly is more important than the tool.

Images:

- None.



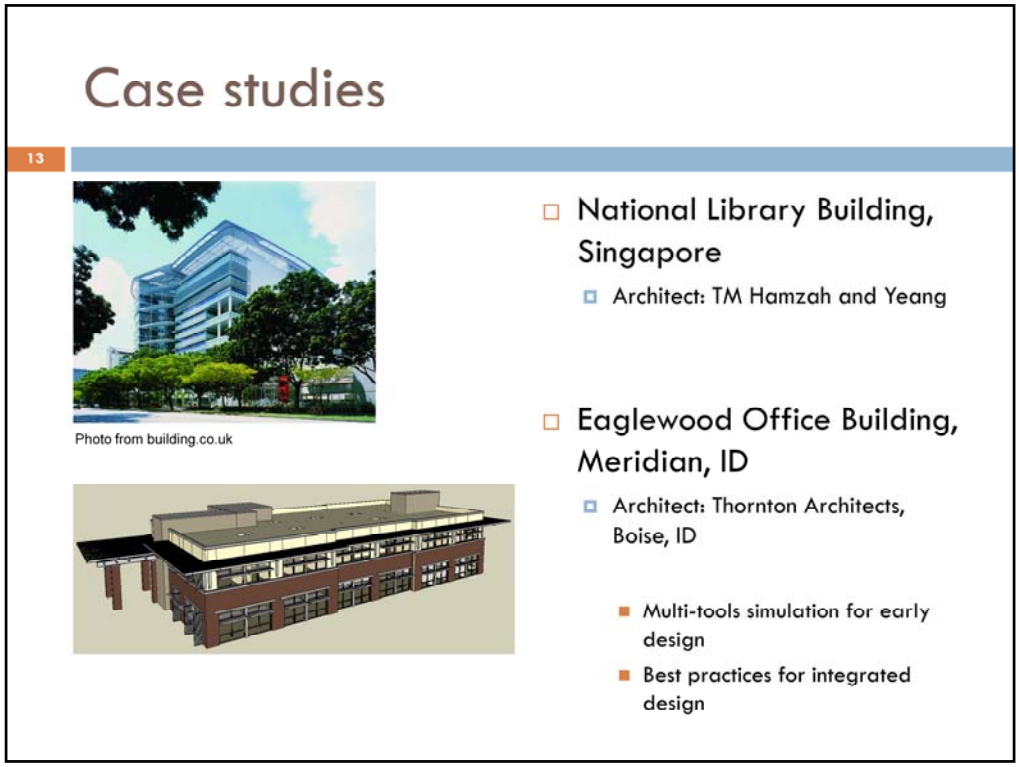
Subject: Criteria for good tools (cont.)

Narration:

- Other examples of the importance of doing simulation properly.
- Load reduction: in early design stages, we want to focus on load reduction. We do not want to define the HVAC system until later at the design stage, only after the load has been reduced to an optimum level.
- Quality assurance: (in the slide)

Images:

- None.



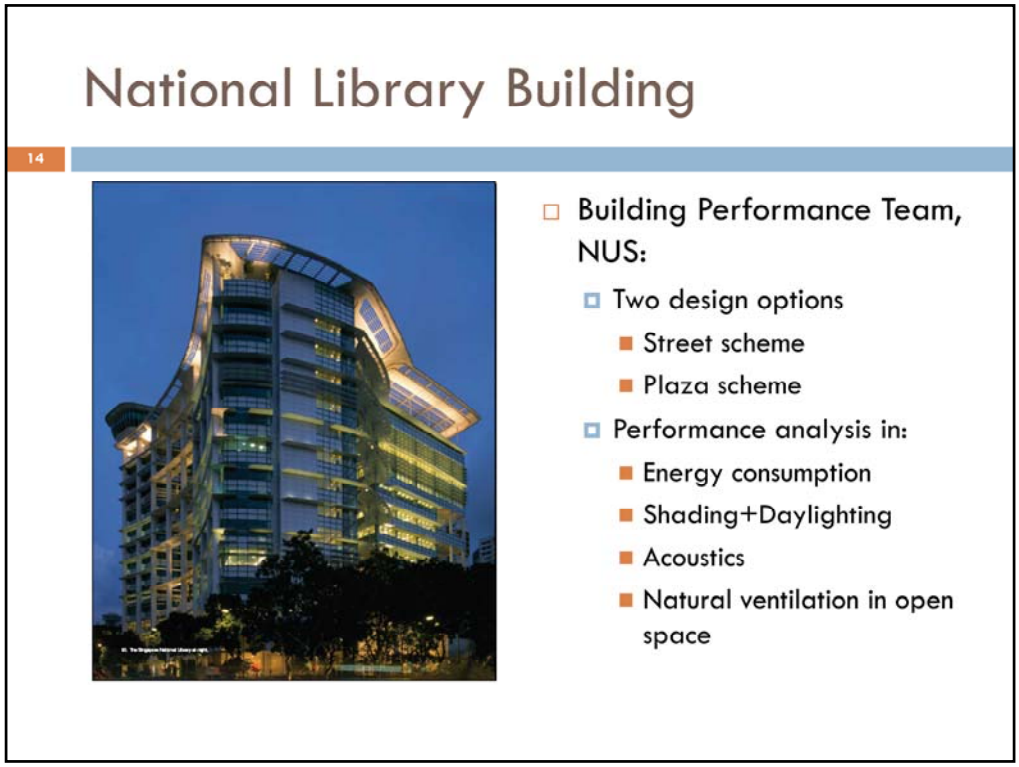
Subject: Case studies

Narration:

- Two examples as case studies

Images:

- National Library Building, Singapore (source: http://www.building.co.uk).
- Eaglewood office building (source: IDL Boise archive).



Subject: National Library Building

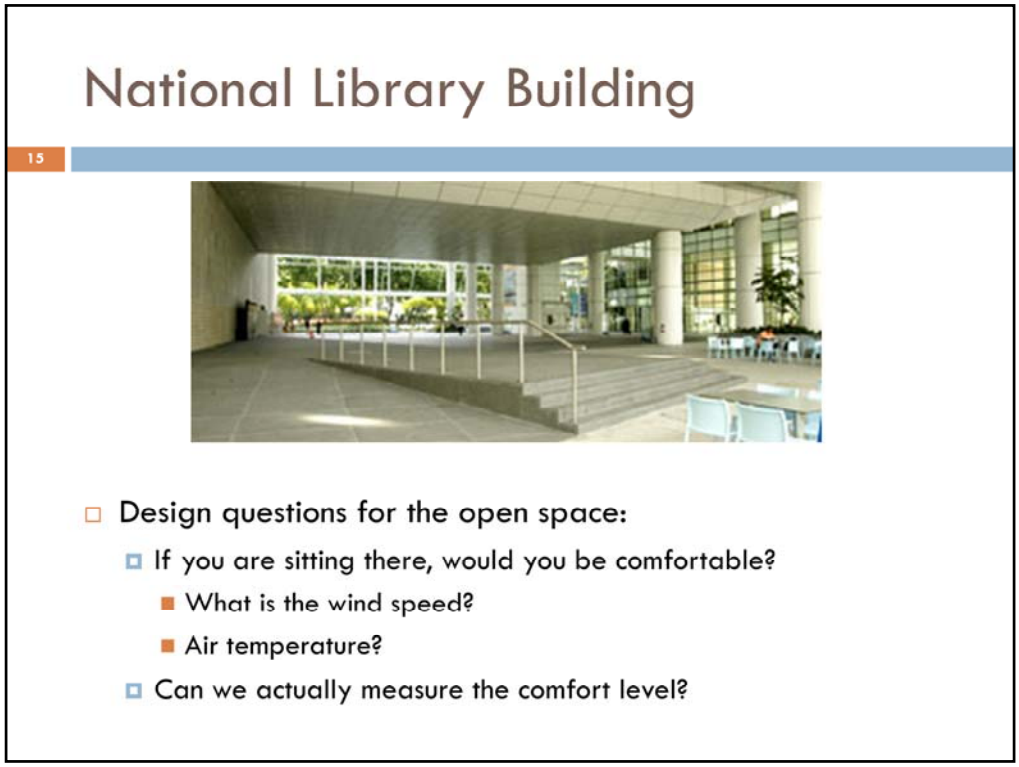
Narration:

The tasks of Building Performance Team from the National University of Singapore.

The presenter was part of this team, and did analysis on the natural ventilation in open space using computational fluid dynamic (CFD) simulation and comfort survey.

Images:

National Library Building, Singapore - source: Arup Newsletter (www.arup.com).



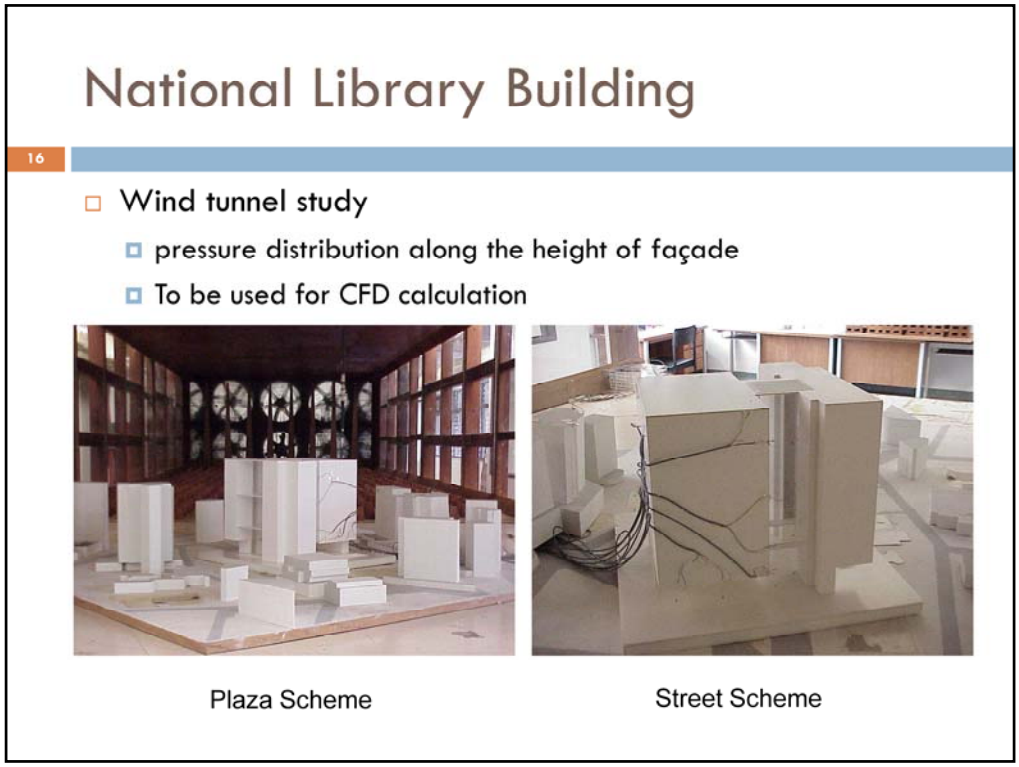
Subject: National Library Building (cont.)

Narration:

🖫(in the slide)

Images:

🖫Open space in the ground floor of National Library Building, Singapore - source: NLB website (www.nlb.gov.sg).



Subject: National Library Building (cont.)

Narration:

🖫(in the slide)

Images:

🖫Wind tunnel study - source: presenter's personal archive.

National Library Building

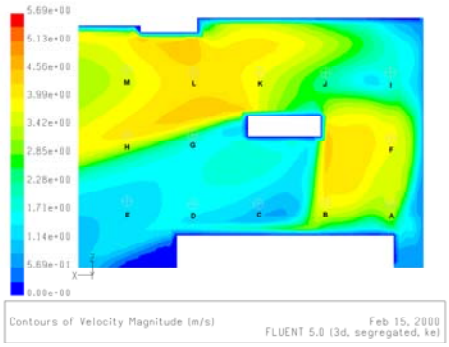
17

- Comfort Study

Table 2: PMV and PPD Values for Several Locations

	Velocity (m/s)	Temperature (°C)	Humidity = 80%	
			PMV	PPD
A	3.237	28.44	1.4	44.9
B	3.856	28.07	1.2	37.6
C	1.092	28.03	1.4	45.2
D	1.395	28.03	1.4	43.4
E	1.257	28.02	1.4	43.9
F	3.695	27.94	1.2	35.7
G	2.460	27.92	1.3	37.9
H	4.047	28.04	1.2	36.8
I	1.741	28.06	1.3	42.4
J	2.571	28.04	1.3	39.5
K	3.801	28.08	1.3	37.8
L	4.179	28.08	1.2	37.3
M	3.586	28.06	1.3	37.8

PMV and PPD calculation



Plan view at 1m height

Subject: National Library Building (cont.)

Narration:

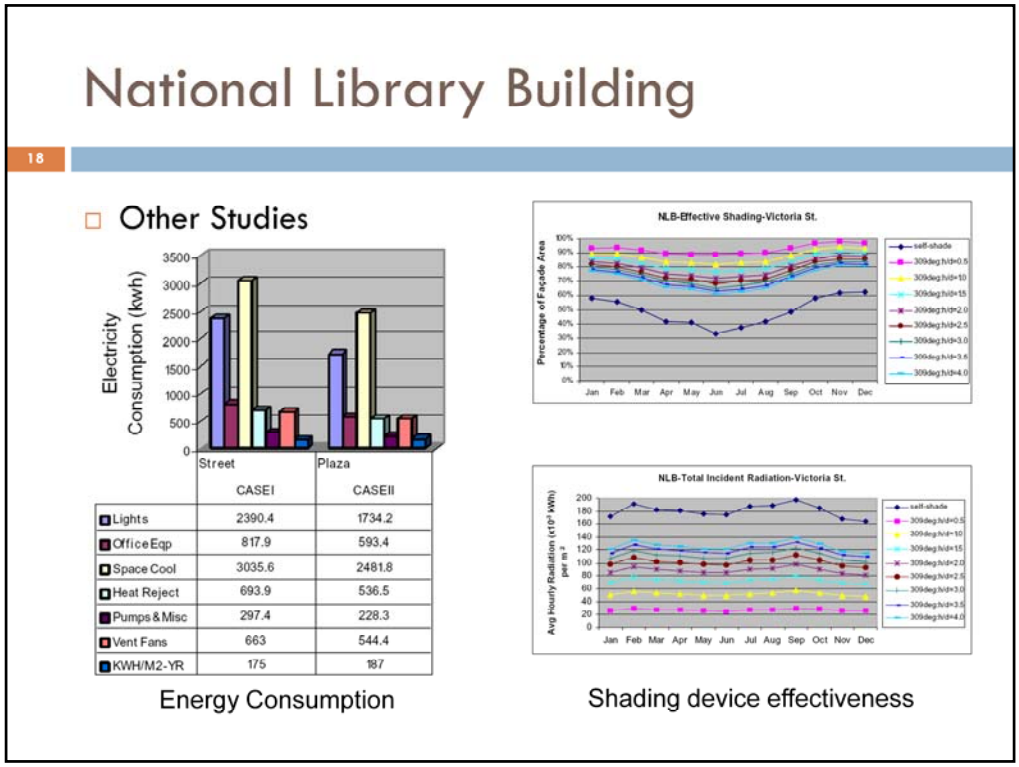
The graph shows one of the CFD simulation results. What is interesting to note is that the comfort indices shows that the thermal condition is uncomfortably warm and many people (around 40%) will be dissatisfied with the thermal environment.

The results actually raised a question on the suitability of the comfort indices to be used for natural ventilation in the tropics. Both indices (PMV and PPD) was developed for indoor air environment where the air is conditioned and there is not much air movement. These assumptions are not applicable in this case: the space is in the tropics, naturally ventilated, unconditioned and air movement is actually encouraged. The lack of suitable metric lead to another research project in the area of thermal comfort in the tropics.

Images:

A table summarizing the CFD results and the calculated comfort indices at various locations and one of CFD simulation results.

Both of the above pictures are taken from Lam, K.P. et al. (2001), The use of multiple building performance simulation tools during the design process -- a case study in Singapore, Building Simulation 2001, downloadable at: www.ibpsa.org/proceedings/BS2001/BS01_0815_822.pdf.



Subject: National Library Building (cont.)

Narration:

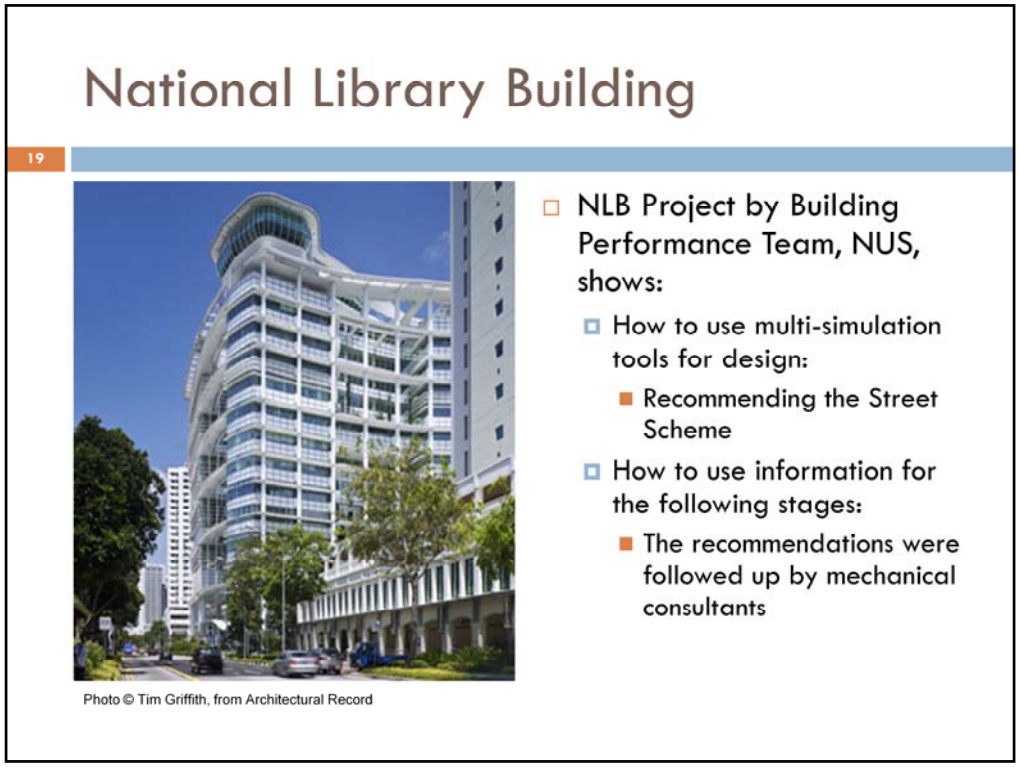
Other studies that was done in the performance assessment.

Images:

A graph and table summarizing the energy simulation results done in DOE-2.

Charts showing the results of shading analysis.

Both of the above pictures are taken from Lam, K.P. et al. (2001), The use of multiple building performance simulation tools during the design process -- a case study in Singapore. In Building Simulation 2001, Proceedings of the 7th International IBPSA Conference, Rio de Janeiro, Brazil., p. 815-822. Downloadable at: www.ibpsa.org/proceedings/BS2001/BS01_0815_822.pdf.



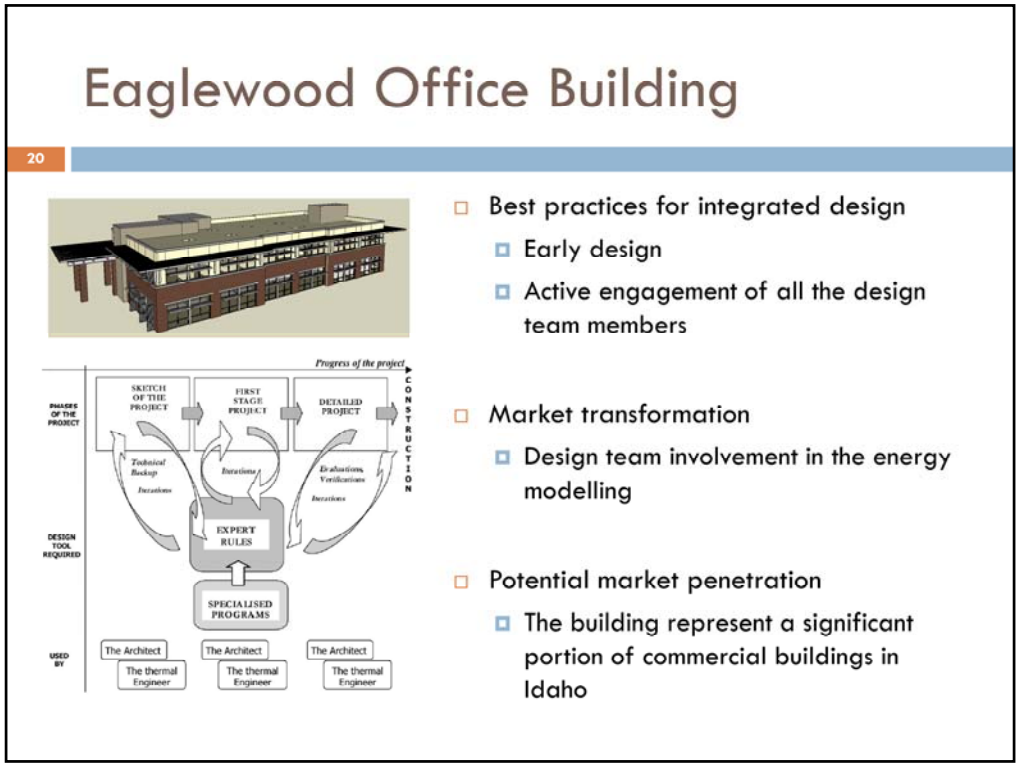
Subject: National Library Building (cont.)

Narration:

🖫Some conclusions from this case studies: (in the slide).

Images:

🖫National Library Building, Singapore - source: Architectural Record (Photo © Tim Griffith).



Subject: Eaglewood Office Building

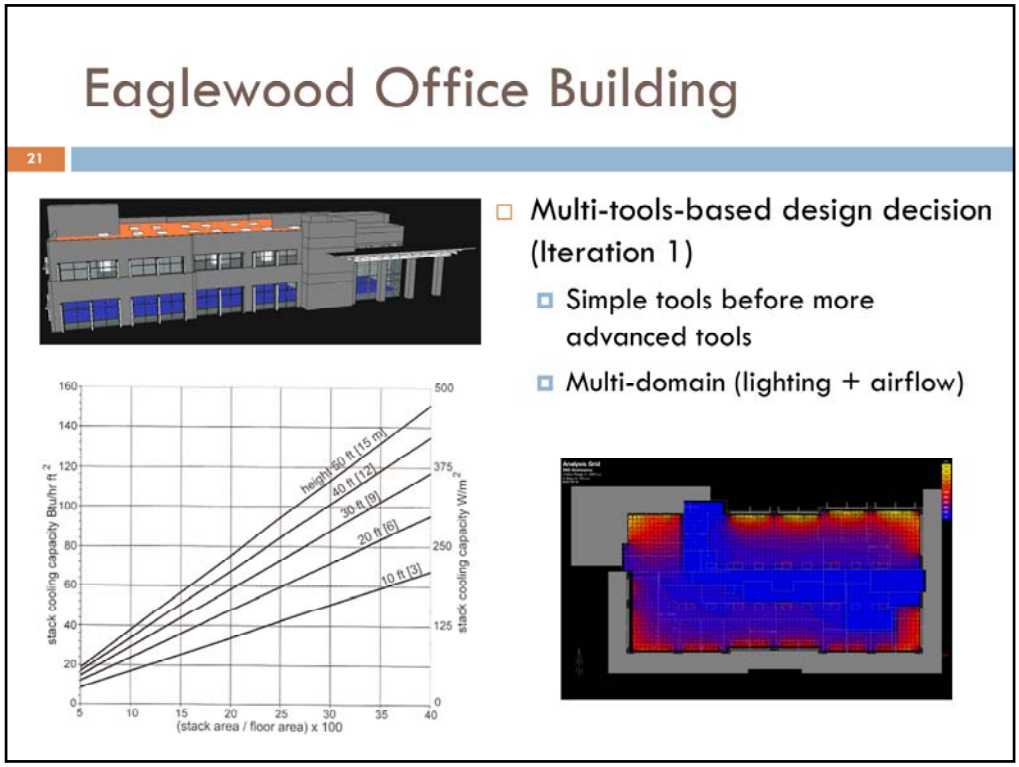
Narration:

Why this case is selected: (in the slide).

Images:

Eaglewood office building (source: IDL Boise archive).

Building simulation in the design process – source: F. Garde-Bentaleb et al. (2002), Bringing scientific knowledge from research to the professional fields: the case of the thermal and airflow design of buildings in tropical climates, Energy and Buildings, Vol. 34, No. 5, Pages 511-521.



Subject: Eaglewood Office Building (cont.)

Narration:

One of important lesson from this project is that architects need to be able to test their ideas, and engineers need to respond quickly to the ideas.

The example is when the architect wanted to make shafts that goes down from the roof the ceiling of the first floor. The shafts can act as both the skylight and ventilation chimney. IDL Boise did the calculation for both the ventilation and lighting.

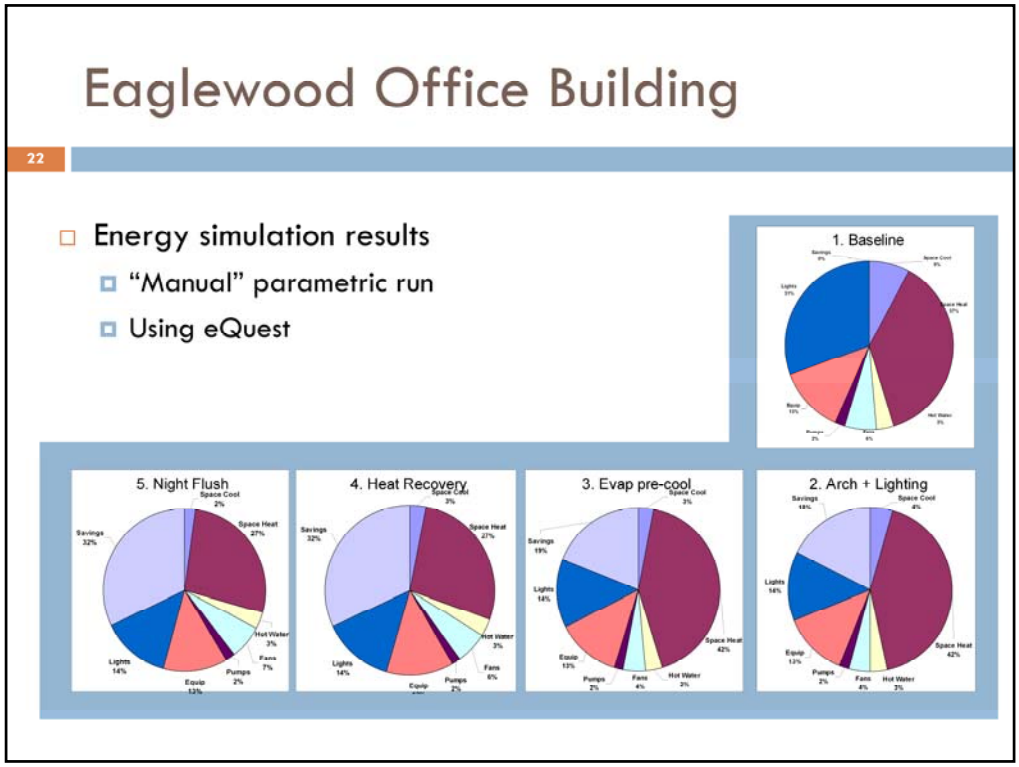
For ventilation, we did a quick calculation using a simple chart that proved that the chimney height and the total opening is not enough to provide the stack effect that can carry all the load in the space. (An example of this calculation is available in “Sun, Wind and Light” by GZ Brown)

For the lighting analysis, we used the exported model from Ecotect to run a simulation in Radiance. The results (bottom right) shows that there is not enough lighting from the shaft to justify the cost of building such shafts.

Images:

Eaglewood building and Radiance simulation result (source: IDL Boise archive).

A chart to calculate the stack flow based on the total openings and the stack height. Source: “Mechanical and Electrical Equipments in Buildings” by Stein et al.



Subject: Eaglewood Office Building (cont.)

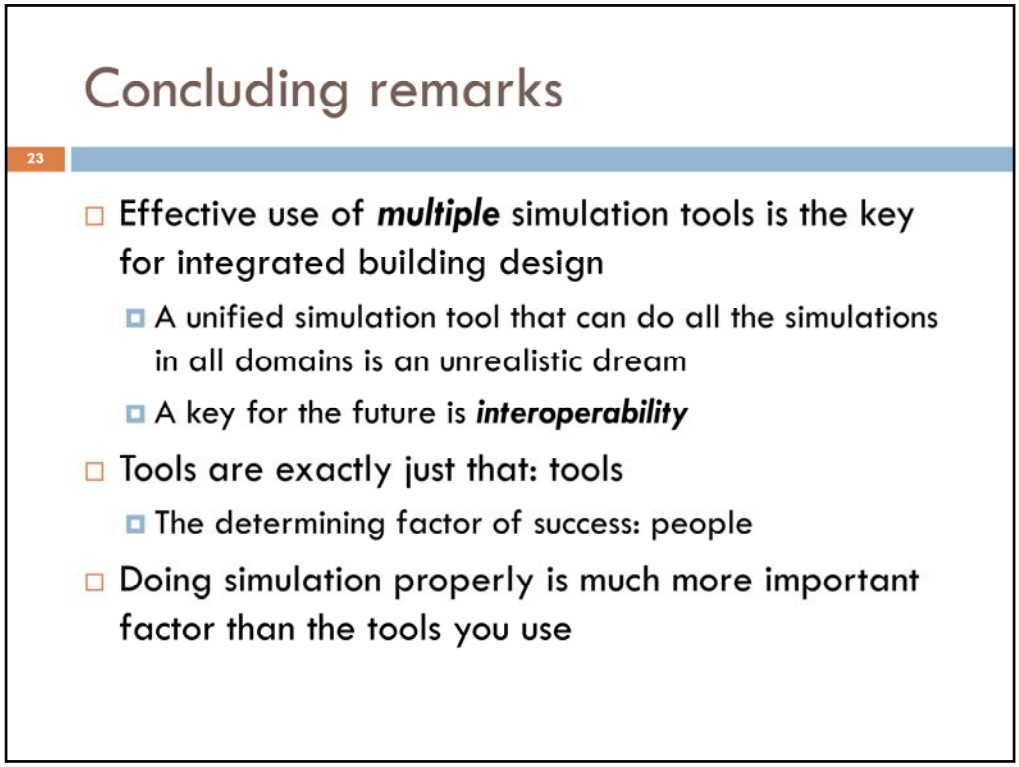
Narration:

Energy simulation: result of parametric study using eQUEST

The parametric study was carried out without using the "automatic parametric run" feature in eQUEST.

Images:

Pie charts showing simulated end-use energy consumption (source: IDL Boise archive).



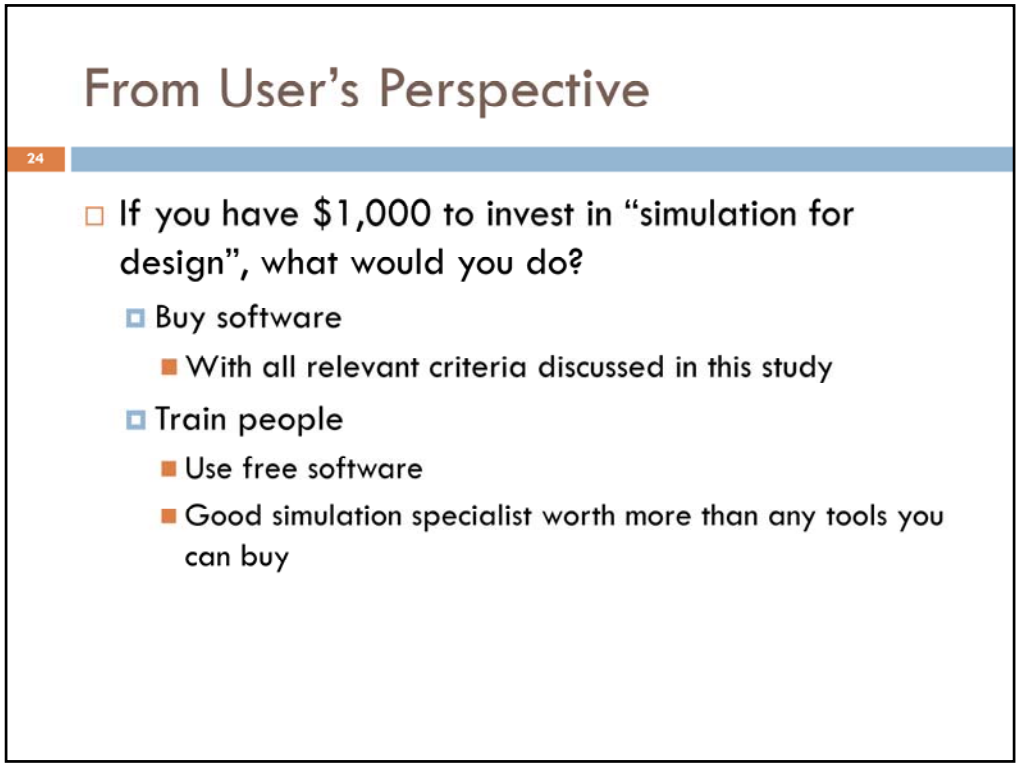
Subject: Concluding remarks

Narration:

🖫(in the slide)

Images:

🖫None.



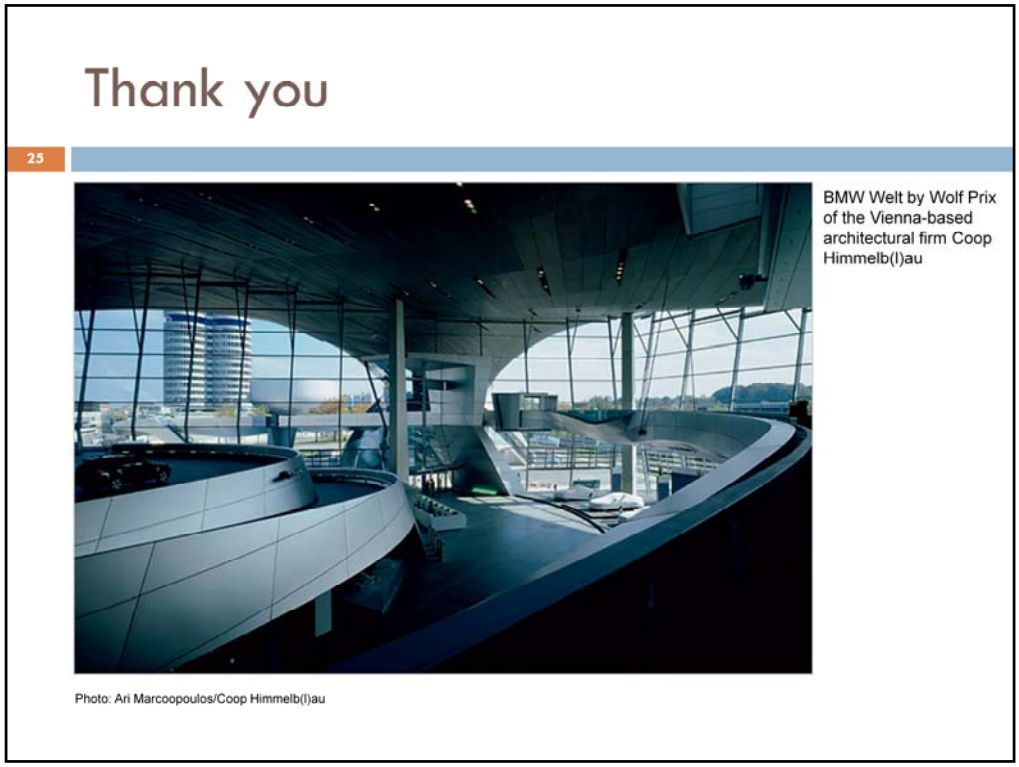
Subject: Concluding question

Narration:

My biased opinion: train people. Simulationist who understand how to do simulation properly can use any software. The ability to use multiple simulation tools to answer different problems along the design stages is very important, at least until we have one single software that can do things in a push of single button, which will not be here for in the near future, if at all.

Images:

None.



Subject: Thank you

Narration:

What I like about this picture is the high dynamic range technique used, where you can see both the space right inside of the glazed wall and also the far away buildings on the other side of the glazed wall.

The building is an auto showroom where you can actually drive inside the buildings, on those curvy roads. Pretty cool, huh! (Imagine how they handle the exhaust fume!)

Images:

BMW Welt by Wolf Prix of the Vienna-based architectural firm Coop Himmelb(l)au, photo: Ari Marcoopoulos/Coop Himmelb(l)au, source: The New York Times (www.nytimes.com).