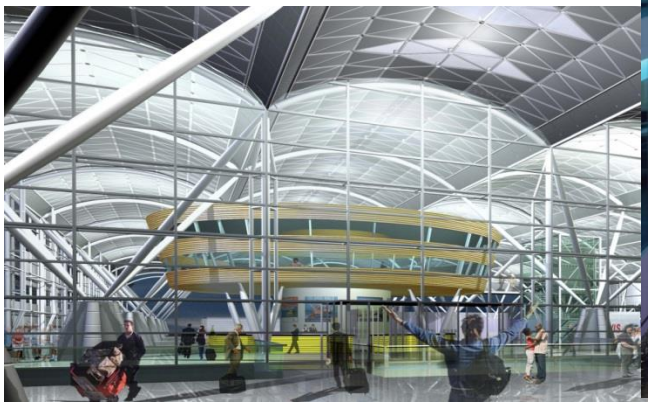
Chapter 2: Quality Assurance in Building Performance Modelling



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Quality of building

- Safety, health and comfort
- Functional
- Low environmental impact
- Architecture and aesthetics

Quality of building performance modelling

- Influences quality of the building

Quality Assurance

- Ensures quality of building performance modelling
- Reduces the risks and liabilities
- Instils confidence in clients & staff

What do we mean by Quality Assurance?

- Not a from filling exercise
- Not imposing a bureaucratic process
- … Although some may be necessary
- A system for getting it right on every job!

How?

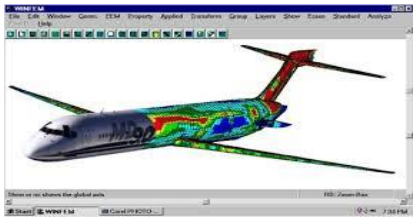
- Understand what influences the quality of building performance modelling
- Follow good practice: Documented QA procedures
- Review work at key stages
- Document decisions and results: Facilitating audit and repeat/revision of work

Quality of building performance modelling depends on

- Understanding the needs of the client
- Tools
- Knowledge, skill and experience
- Communication

QA Chapter

- Benefits, training, understanding the building and its systems, the design process (2.1)
- Communication and documentation (2.2)
- Accuracy of and uncertainty in predictions (2.2)
- Software capabilities and validation (2.3)
- Software Selection (2.4)
- Setting up QA (2.5 & Appendices A, B and C)
  - Performance Assessment Method (PAM) as a QA Procedure (2.5)



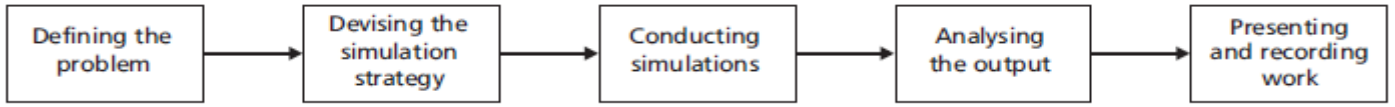
Setting up QA

People & Processes

Modelling process

- Five stages are identified
- Software choice is important, but not a frequently occurring step – Appendix C deals with software selection

- For each stage AM 11 gives some generic advice on how to set up a procedure or checks - Appendix B gives a more concise summary



Setting up QA

People

Modelling team

- Team Manager
- Modeller

Abilities of each given in AM11 2.5 and Appendix A

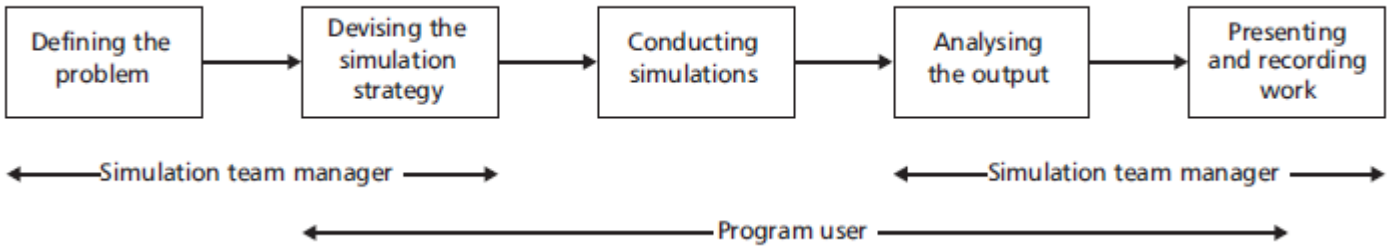


Figure 2.2 of AM11

Software Choice

Appendix C: A form to be completed by software vendors

Allows Assessment and comparison of:

- software capabilities,
- pedigree, validation,
- cost,
- training
- support, etc.

BREEAM requires the software selection is made in accordance with AM11 for some credits.

First year user / licence fee	
Annual maintenance fee	
Total cost of software and data	

C2.10 Accuracy

Has the program been evaluated? Yes ☐ No ☐

Does the vendor exercise routine in-house quality testing? Yes ☐ No ☐

Describe testing regime (available from vendor).....

.....

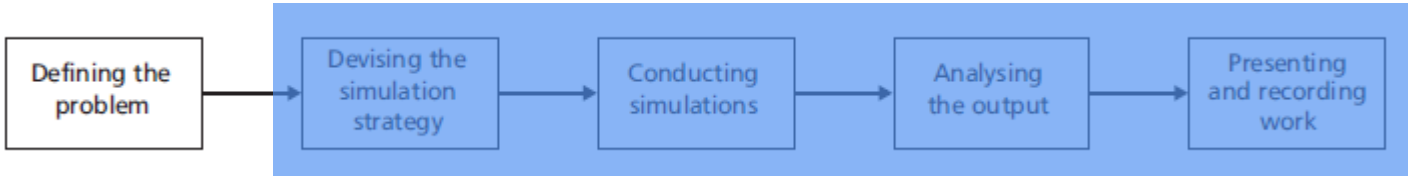
.....

Complete the table below to document the validation history

Technique	Method		Evidence/certification
Code checking	Has the computer code been checked line by line?	Yes ☐ No ☐	
Analytical tests	Has the computer code been checked line by line?	Yes ☐ No ☐	
Inter-program comparisons	Have predictions been compared with those from other simulation programs supplied with equivalent data input?	Yes ☐ No ☐	
Empirical validation	Have predictions been compared with real building measurements?	Yes ☐ No ☐	
Quality independence	Were the predictions made without knowledge of actual measured performance (i.e. blind)	Yes ☐ No ☐	
	Were the predictions made without knowledge of actual measured performance (i.e. blind)	Vendor ☐ Third Party ☐ Both ☐	

C3 Thermal simulation programs: theoretical basis

Parameter	Type		Specify other / comments / notes
Conduction and thermal storage solution method[1]*	Explicit finite difference	☐	
	Implicit finite difference	☐	
	Response factor	☐	
	Weighting factors	☐	
	Heat balance	☐	
	Other	☐	
Time step length	User specified	☐	
	Calculated by program	☐	
Opaque surface: conduction model	One-dimensional	☐	
	Three-dimensional	☐	

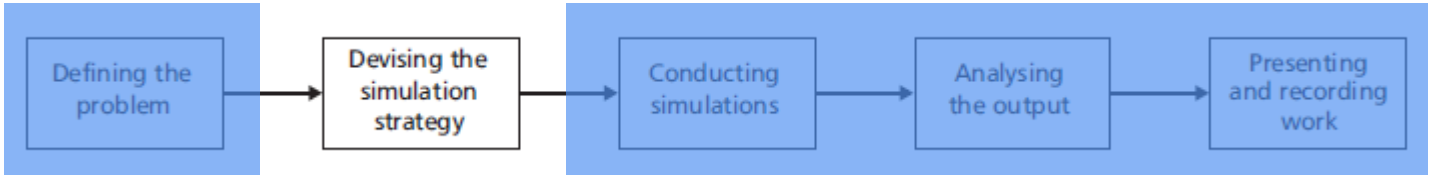


Defining the Problem

- The design question is not normally clearly defined
- Modelling team to understand, define and agree the objectives

Example:

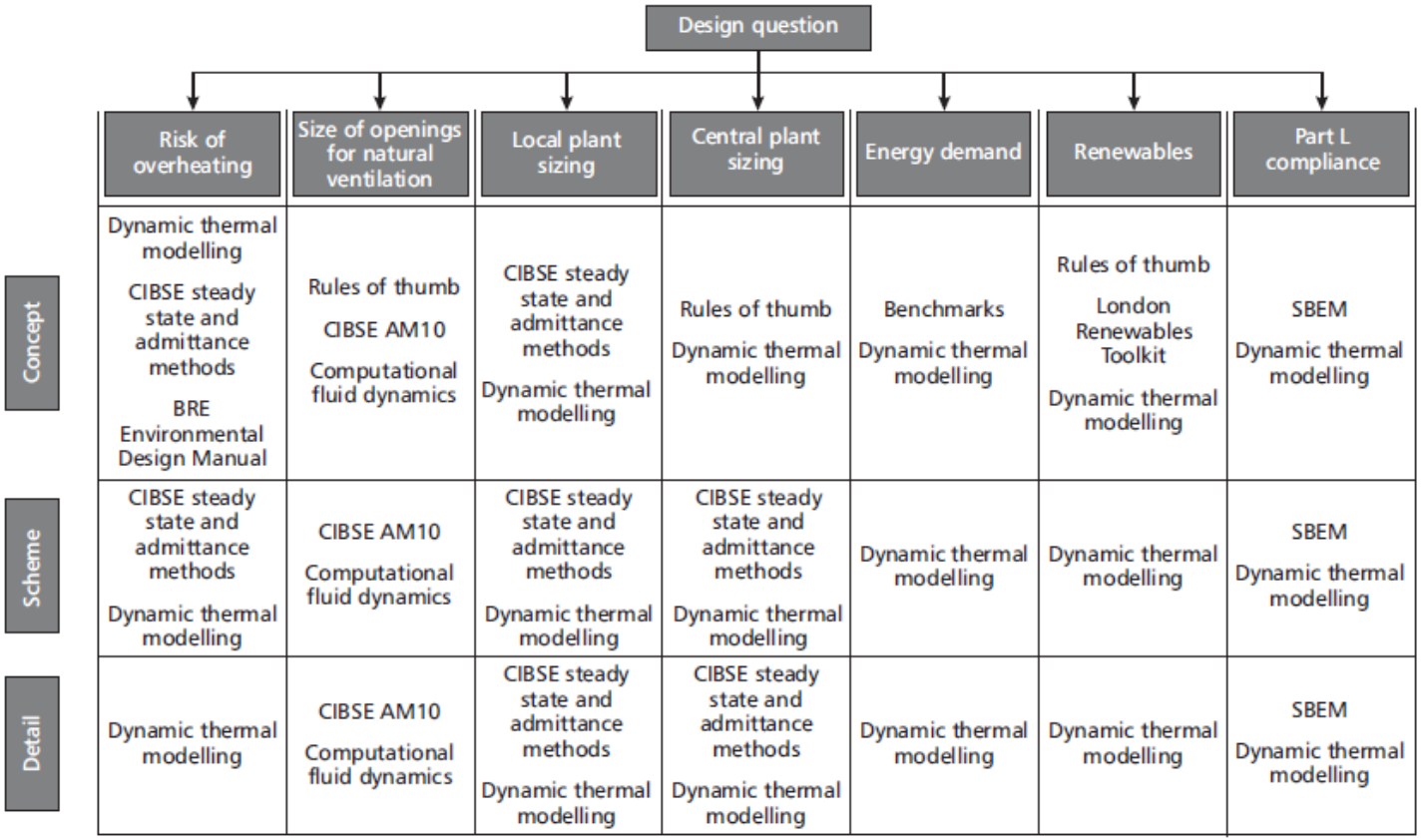
- Client : Comfort in residential buildings
- Modelling team may need to think about:
  - Which standard? Is it just GLA driven assessment that the client needs?
  - Sample dwellings? All dwellings? Worst case?
  - Noise problems/requirements?
  - Natural ventilation? Mechanical ventilation?
  - Assess the design as given? Pass/fail results?
  - Provide a solution, e.g. window size & glazing properties, openable area or mechanical ventilation?



Devising modelling strategy

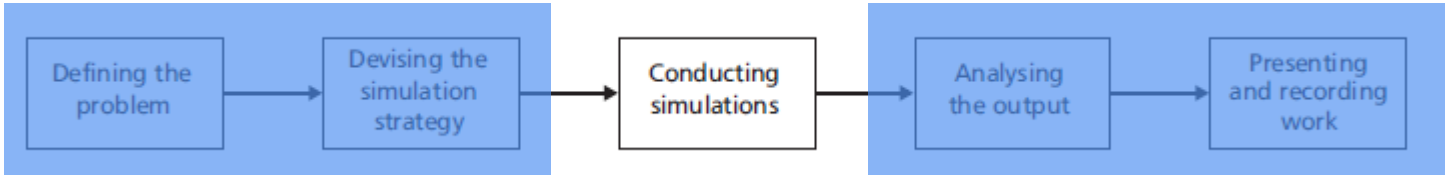
- Software selected for the objectives and stage of design
- Information available studied
- Request for Information (RFI) for important parameters
- Assumptions made and agreed with the client
- Zoning
- Level of modelling detail determined on the basis of information available
- Do we need sensitivity analysis?
- Time and resources allowed

Software Selection



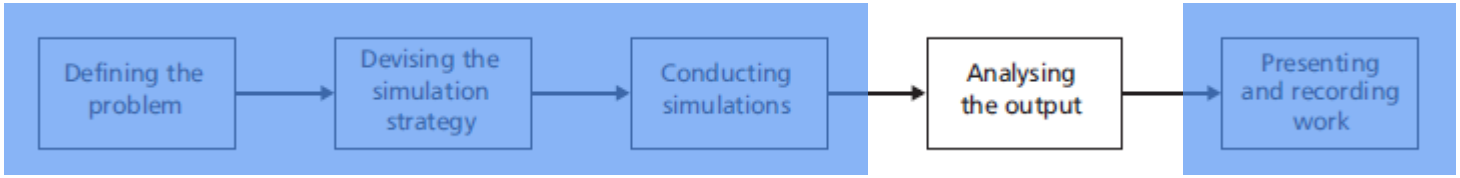
	Risk of overheating	Size of openings for natural ventilation	Local plant sizing	Central plant sizing	Energy demand	Renewables	Part L compliance
Concept	Dynamic thermal modelling CIBSE steady state and admittance methods BRE Environmental Design Manual	Rules of thumb CIBSE AM10 Computational fluid dynamics	CIBSE steady state and admittance methods Dynamic thermal modelling	Rules of thumb Dynamic thermal modelling	Benchmarks Dynamic thermal modelling	Rules of thumb London Renewables Toolkit Dynamic thermal modelling	SBEM Dynamic thermal modelling
Scheme	CIBSE steady state and admittance methods Dynamic thermal modelling	CIBSE AM10 Computational fluid dynamics	CIBSE steady state and admittance methods Dynamic thermal modelling	CIBSE steady state and admittance methods Dynamic thermal modelling	Dynamic thermal modelling	Dynamic thermal modelling	SBEM Dynamic thermal modelling
Detail	Dynamic thermal modelling	CIBSE AM10 Computational fluid dynamics	CIBSE steady state and admittance methods Dynamic thermal modelling	CIBSE steady state and admittance methods Dynamic thermal modelling	Dynamic thermal modelling	Dynamic thermal modelling	SBEM Dynamic thermal modelling

Figure 2.1 Examples of design questions and suggested type of software to apply at various design stages (CIBSE, 2015)



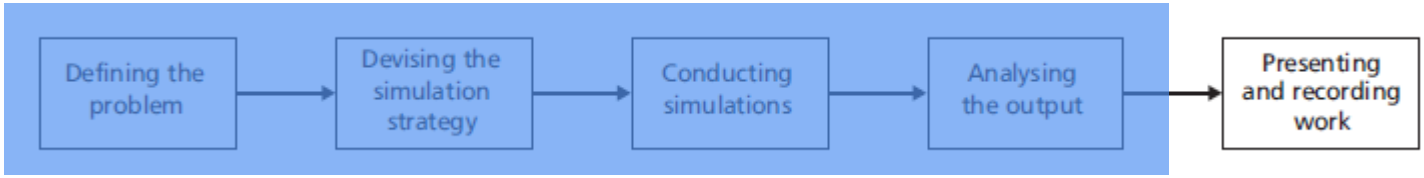
Conducting the simulation

- Level of detail of the model
- Building geometry
- Non-geometric component data
- Usage data, occupancy, internal gain, set-points, etc.
- Boundary conditions
- Initial conditions if dynamic simulation
- Run the model
- Analyse results
- Assess any need for repeat of model run
- Back up of model files



Analysing the output

- Post processing results
- It is healthy to suspect results
- Compare with rules of thumb or benchmarks
- Ensure other performance aspects are still fine, e.g. comfort, daylight
- Assess needs for iterations



Presenting and recording work

- Successful presentation and reporting of results
- Review of report by a colleague
- Approval
- Documentation of models, files, runs, data sources, versioning of models

Performance Assessment Method (PAM)

- A template for documenting how to carry out Building Performance Assessment
- Called PAMDOC
- Is recommended by CIBSE Guide A and AM 11
- Use as QA procedure as it includes the process defined in AM 11
- Download the template (PAMDOC) from Guide A Supplementary files for Chapter 0:
  http://www.cibse.org/Knowledge/Guide-A-2015-Supplementary-Files/Chapter-0

0 PAM Identification

Identifier	CIBSE002
Purpose	Calculation of summertime temperatures using the CIBSE cyclic method
Application	Any single space
Program	Spreadsheet ID 1234
Date	15/11/2014
Author	CIBSE
Address of author	CIBSE, Balham

1 Definition of performance assessment

1.1	Purpose	To calculate summertime temperatures in a space using the CIBSE simple dynamic model given in CIBSE Guide A, section 5.10.5

1.2	Applicability	
1.2.1	Building type	Residential; non-residential
1.2.2	Environmental Control Systems	Natural ventilation, mechanical ventilation
1.2.3	Climate zone	Any
1.2.4	Program	Spreadsheet
1.2.5	Resources	CIBSE Guide A, section 5.10.5 (source of method).
1.2.6	Further information	

Summary

- QA helps getting it right first time, every time
- QA helps saving time, reducing risks and liability
- QA influences the building performance
- QA should be developed by an organisation to suit its size
- QA means:
  - Understanding the objectives and agreeing with clients and documenting it
  - Identifying the best tool for carrying out an assessment
  - Reviewing work at each stages of the process
  - Routinely questioning the results and comparing with experience of similar, benchmarks, RofT
  - Documenting the work and results and saving models
- PAMDOC: Could be used as QA procedure
  - Download from Additional files to CIBSE Guide A
  - Would like to hear from your experience of PAMDOC