

# Building Energy Modelling


**prescriptive**

An alternative to

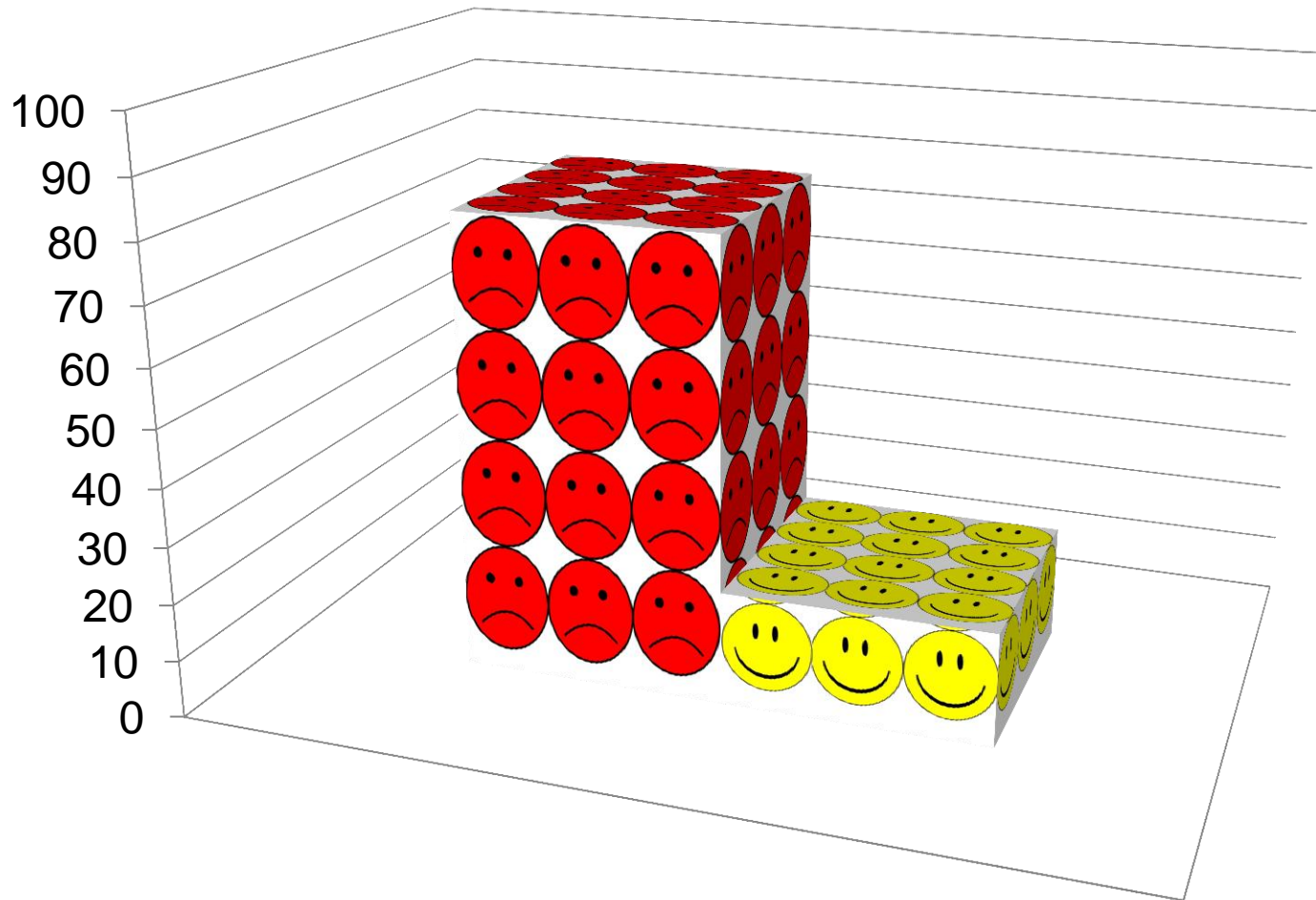
Design for SANS 10400-XA



# Contents

- Complying with the new building energy standard -  
SANS 10400-XA
- 3 Compliance options 
- Two **rational design** routes using energy modelling
- How energy models are created
- What do you gain by doing energy modelling?
- To model or not to model?

# SANS 10400-XA Architects Happiness Scale





What you  
want to do is  
this

What you *think*  
you are allowed  
to do...is this



# The road that should be less travelled ?

“Where are we going ?” – asked Piglet



“Nowhere” - said Pooh



So they all started going

# The essence of the XA Functional Regulations

## 1. Building shall be **energy-efficient** – but must still have:

1. Vertical transportation, if required
2. Thermal comfort and ventilation rates maintained
3. Adequate lighting levels
4. Adequate hot water

Lift/escalator energy

HVAC energy

Lighting energy

>50% non-resistance



## 2. Building envelope shall be **energy efficient**

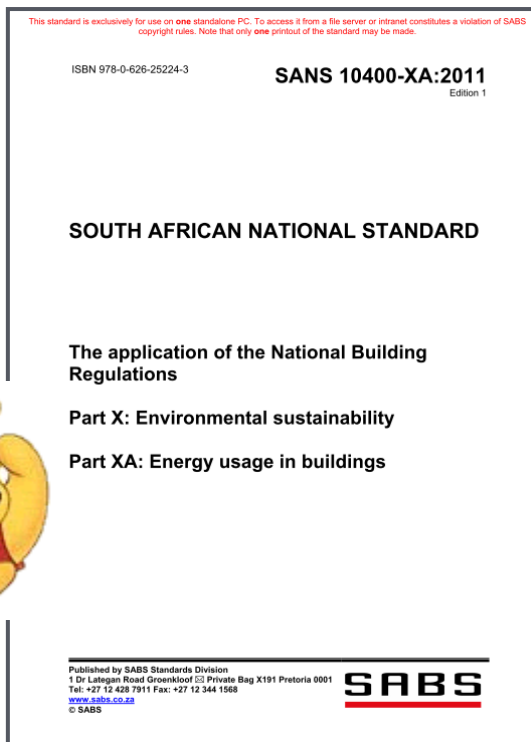
## 3. Calculating the correct **size and type of glazing** does not cover all

# Compliance: Which route to travel ?

## SANS 10400-XA COMPLIANCE OPTIONS

### PRESCRIPTIVE DESIGN

### BUILDING ENERGY MODELLING





# Compliance: Which route to travel ?

## SANS 10400-XA COMPLIANCE OPTIONS

### PRESCRIPTIVE DESIGN

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**SANS 10400-XA:2011**  
Edition 1

#### SOUTH AFRICAN NATIONAL STANDARD

#### The application of the National Building Regulations

#### Part X: Environmental sustainability

#### Part XA: Energy usage in buildings



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# Prescriptive Design – some consequences

1. **Extremely restrictive** in terms of design freedom
  - a) Allowable window (glazing) sizes are restricted
  - b) Rigorous requirements for shading and roof overhangs
2. Many prescriptive design fenestration analyses indicate a requirement for **double / high-performance glazing**
  - a) Very expensive
  - b) Limits heat loss from buildings but not always beneficial i.t.o. annual energy
  - c) Improves thermal comfort (especially cold southern façade)

# Prescriptive Design – consequences (2)

3. **Methodology** based on tables etc. and is relatively crude and incorporates large 'safety margins' 
4. Resultant designs not always optimised
5. Keep in mind that fenestration calculations alone **do not** satisfy the functional requirements

# Compliance: Which route to travel ?

**SANS 10400-XA  
COMPLIANCE OPTIONS**

**BUILDING ENERGY MODELLING**

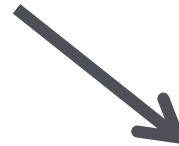


# Energy modelling – via **SANS** tables



**Actual** building  
energy model

Modelled building  
to perform better than  
stipulated thresholds



Fastest and  
cheapest  
method

Maximum energy demand <sup>a</sup> VA/m <sup>2</sup>						Maximum energy consumption kWh/m <sup>2</sup>					
Climatic zone <sup>b</sup>						Climatic zone <sup>a</sup>					
1	2	3	4	5	6	1	2	3	4	5	6
85	80	90	80	80	85	420	400	440	390	400	420
85	80	90	80	80	85	420	400	440	390	400	420
80	75	85	75	75	80	420	400	440	390	400	420
80	75	85	75	75	80	120	115	125	110	115	120
90	85	95	85	85	90	240	245	260	240	260	255
80	75	85	75	75	80	200	190	210	185	190	200
90	85	95	85	85	90	650	600	585	600	620	630

# Energy modelling – via **Reference building**

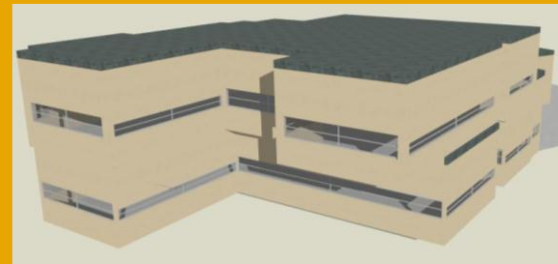
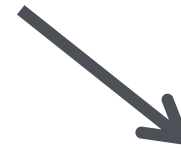


**Actual** building  
energy model

Route to take  
when no tables  
are available



Modelled actual building  
to perform better than  
equivalent reference building



**Reference** building  
energy model

# Energy modelling – some consequences

## 1. Extremely sophisticated method

- a) Takes into account hundreds of different parameters **simultaneously**
- b) Based on **actual weather data**
- c) Accurate **heat gain-** and **heat loss** calculations **every hour**
- d) Accurate **shading** calculations
- e) Determines performance of **every part of the building simultaneously**
- f) Accurate hourly **performance of building systems** (e.g. HVAC)



# Energy modelling – consequences (2)

## 2. Allows **complete design freedom**

- a) Freedom to pursue and test **any design concept**
- b) Reports **combined building energy performance**
- c) Performance gains in one area can be **offset** against losses elsewhere
- d) Can **save large amounts of money** by avoiding unnecessary installation of double glazing etc.



# Building energy modelling – The software

- SANS 10400-XA requires **certified software** for calculating energy requirements using rational design
- This software certification is performed by Agreement



# How energy models are created



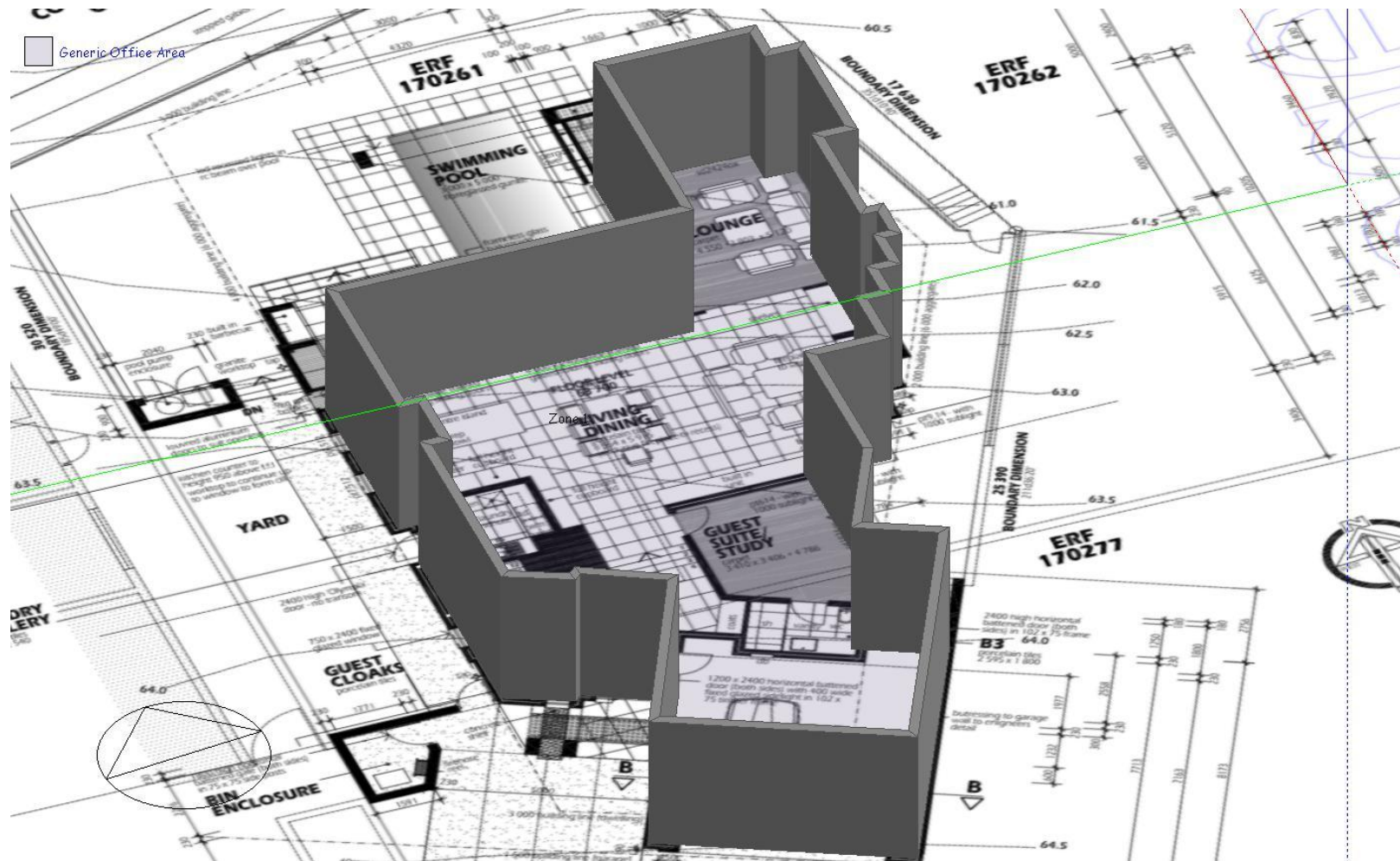
# Import 3-D *energy* model from Revit® or ArchiCAD®



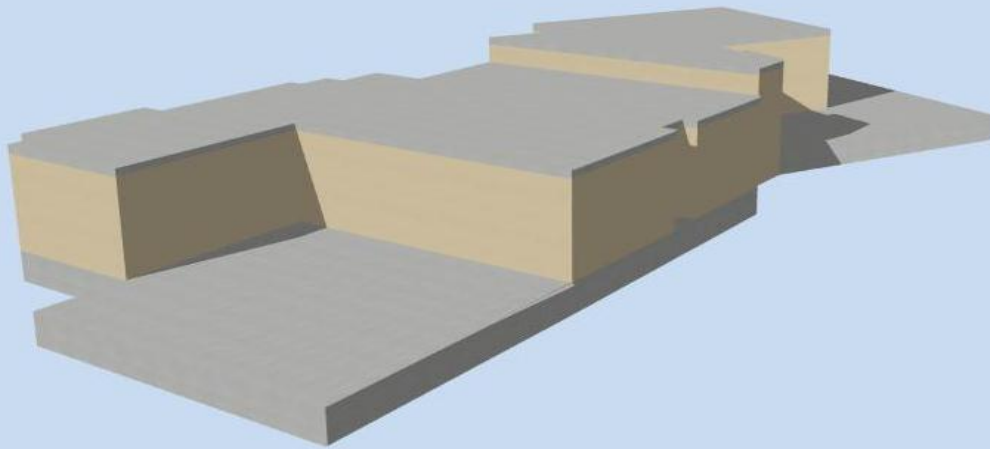
.....OR built up from architect's plans



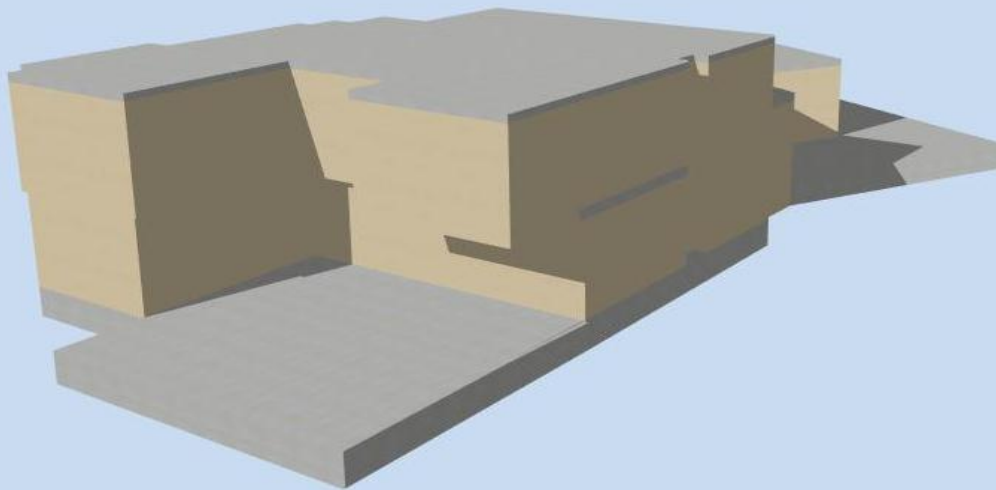
# External Walls



# Ground Floor



# Second Floor





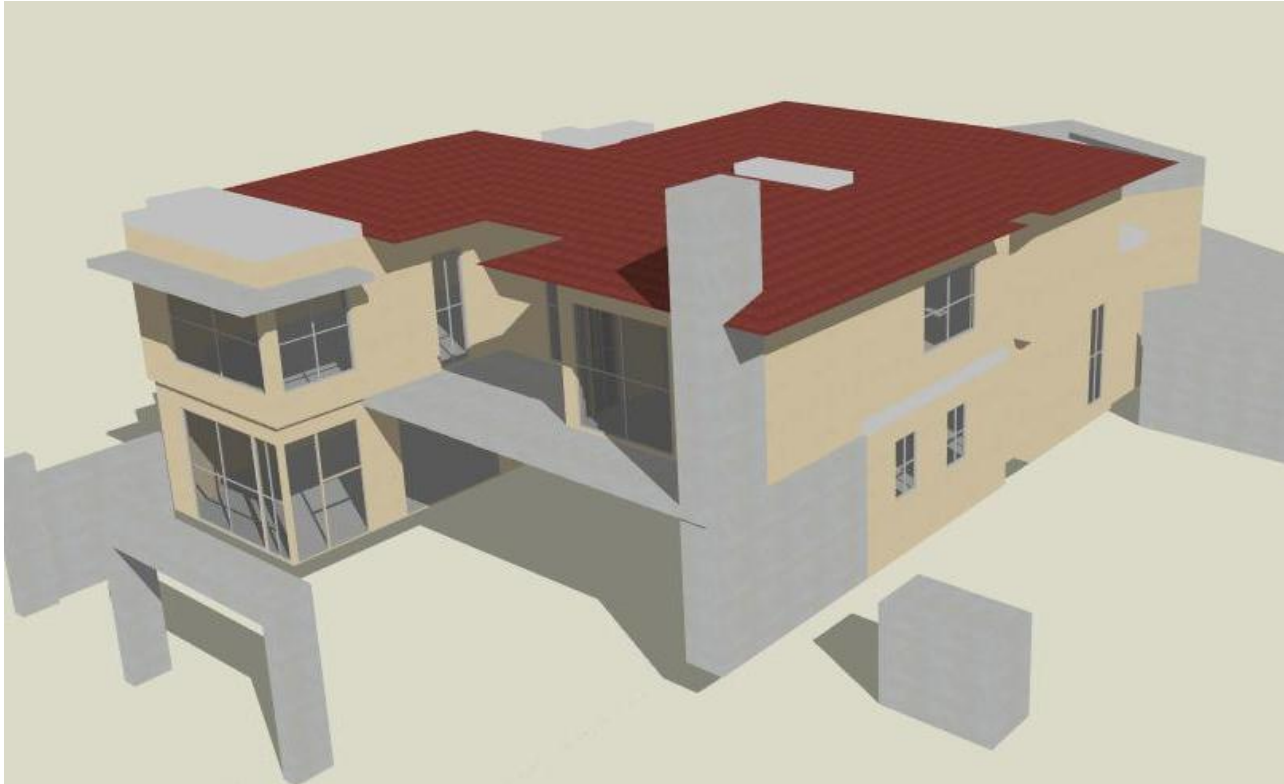
# Glazing, doors



# External details & shading



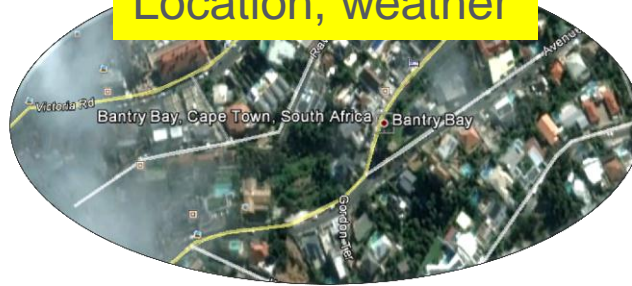
# Complete 3-D energy model





AC equipment

Location, weather



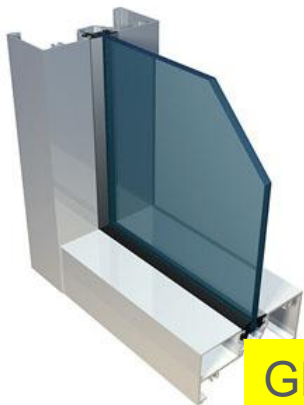
Occupation, metabolic



Lighting & loads



Fresh air, temperatures



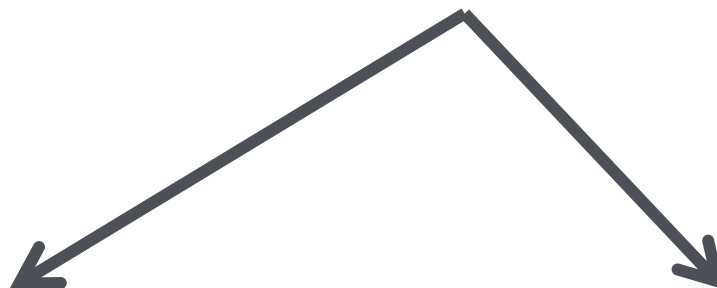
Glazing



Construction materials



**Actual** building  
energy model



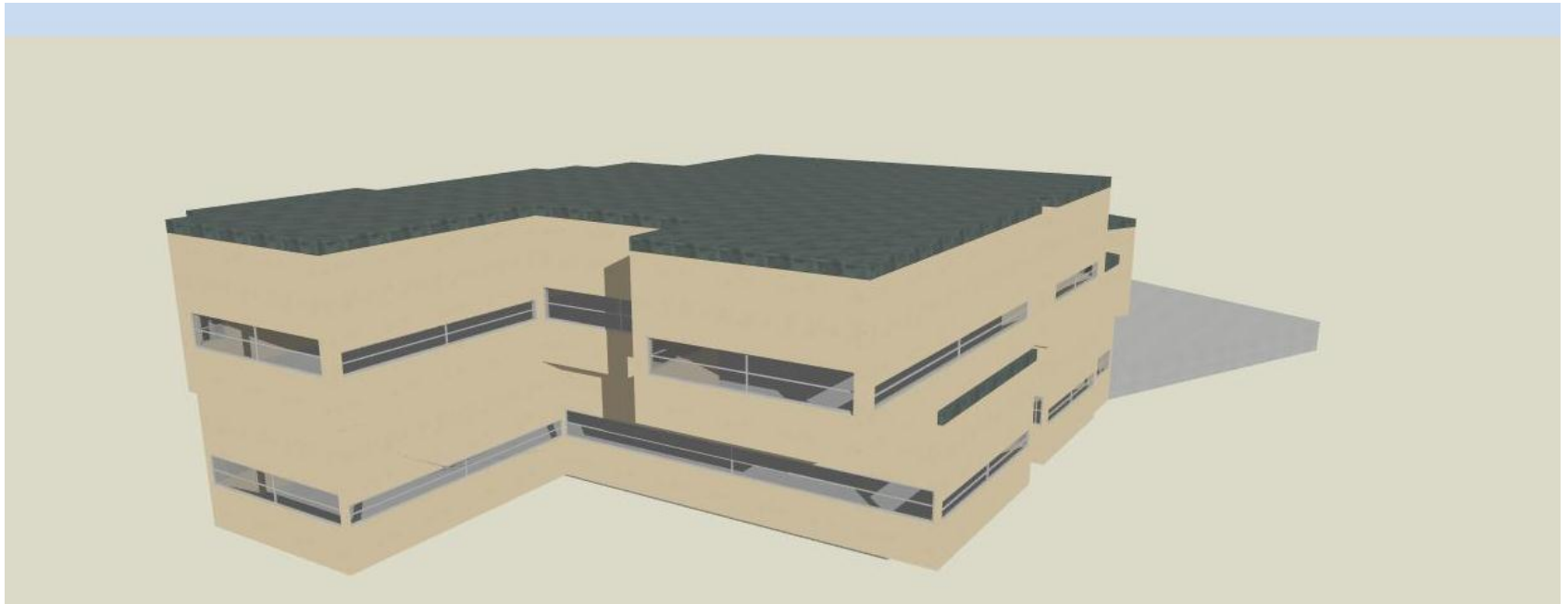
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Climatic zone <sup>b</sup>						Climatic zone <sup>a</sup>					
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80	75	85	75	75	80	200	190	210	185	190	200
90	85	95	85	85	90	650	600	585	600	620	630



**Reference** building  
energy model

# Reference building conforms to **minimum** SANS 10400-XA requirements

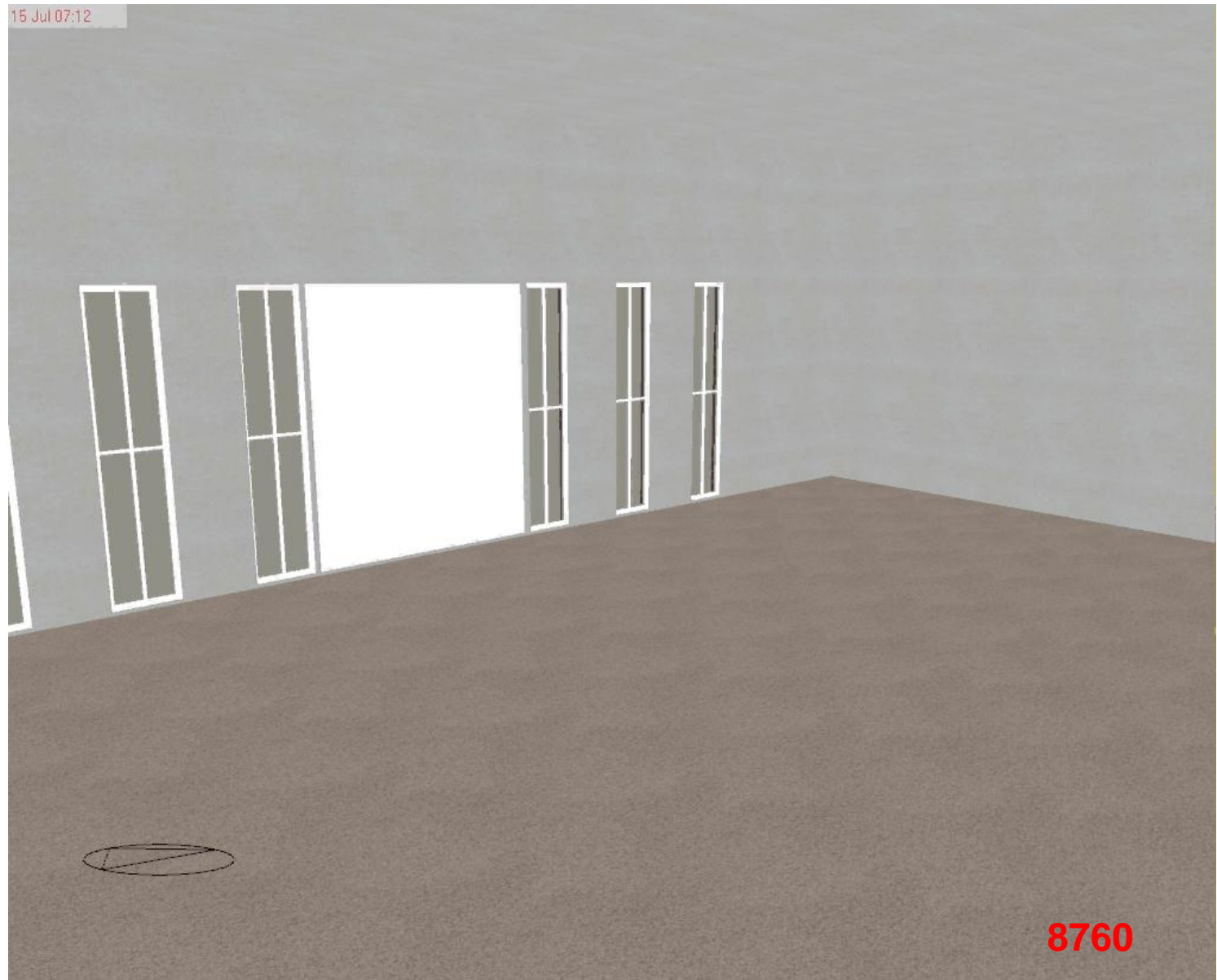
- Same building shape (but SANS walls, roof, glazing etc.)
- Remove external shading / balconies etc.
- Use worst possible (*but still legal*) performance parameters



# Running annual simulations

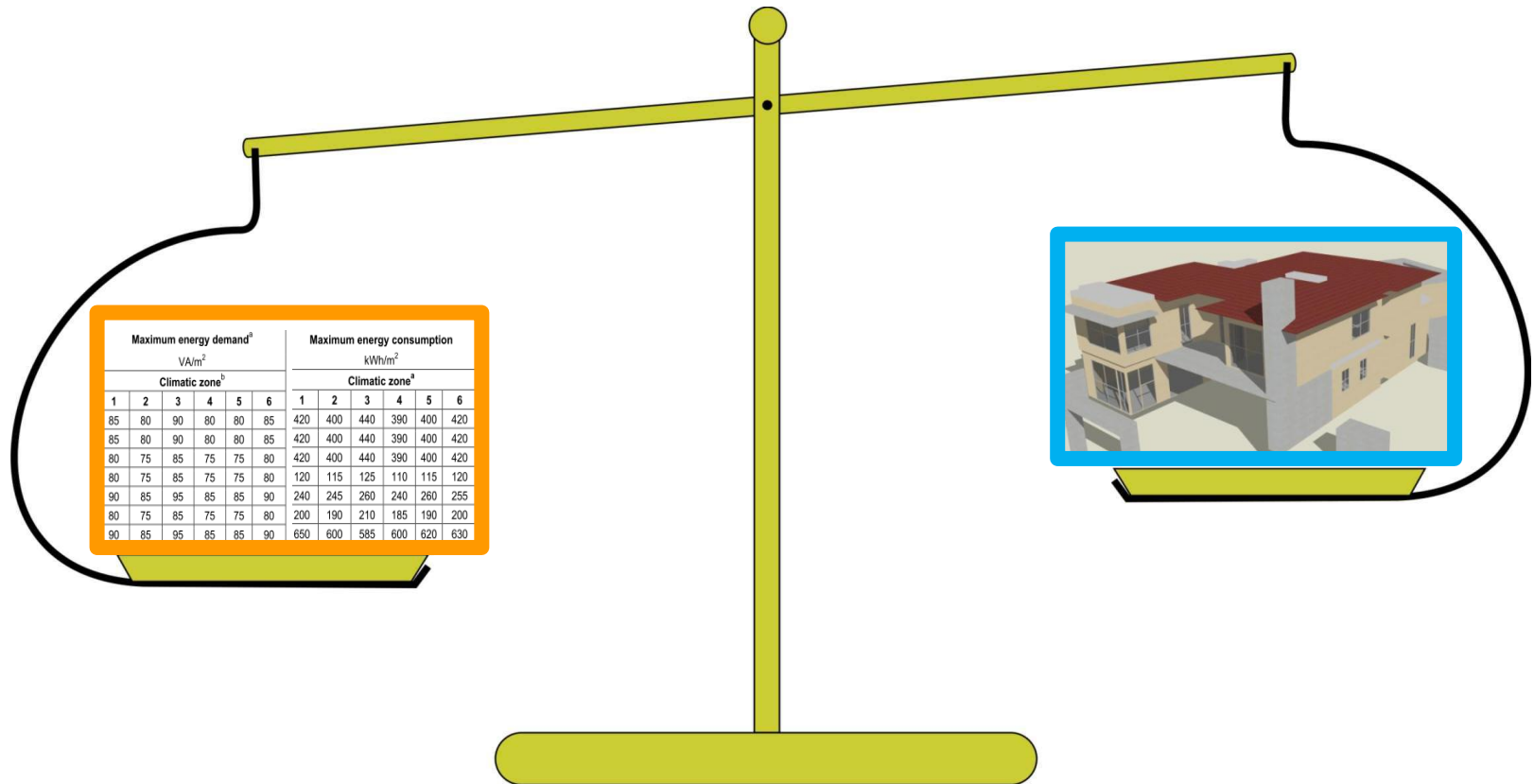


15 Jul 07:12

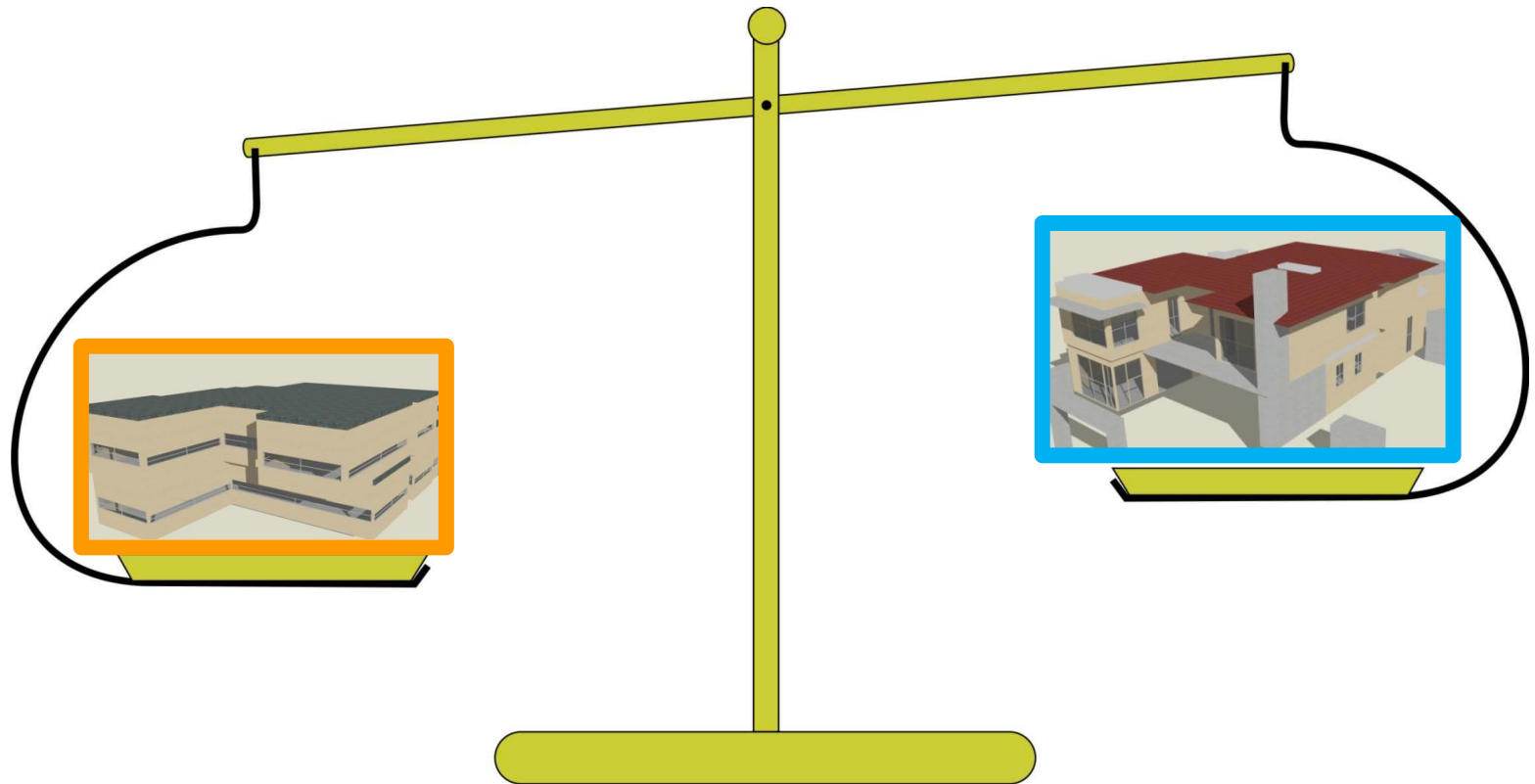


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# Actual building model versus SANS tables

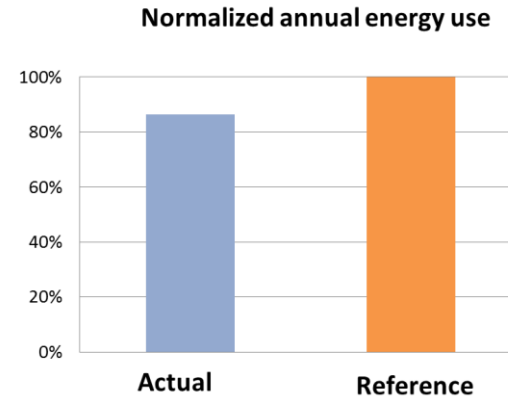


# Actual building versus Reference building

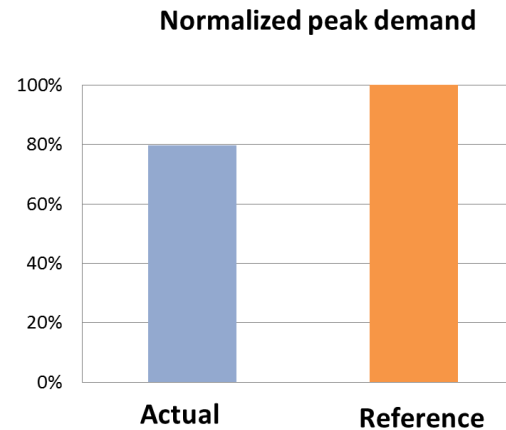


# Principal modelling results

Annual energy usage [kWh]



Peak demand



To Sum Up

# What do you gain by modelling ?

## Allows **complete design freedom**

- a) Freedom to ***pursue and test any design concept***
- b) It reports ***combined*** building energy performance
- c) ***Performance gains in one area can be offset against losses elsewhere***
- d) ***Can save large amounts of money*** by avoiding unnecessary installation of double glazing etc.



# Consider to do modelling yourself ?

- a) Buy ***certified*** building energy modelling **software**
  - a) DesignBuilder
  - b) Bsimac
- b) Do **training** to use software
- c) Immediately after training, **use software** on an actual job!





# Consider a professional service ?

Building system	Non-Eng. background	Engineering background
Simple HVAC installation	✓	✓
Complex HVAC installation	✗	✓
Complex Control systems	✗	✓
Water treatment plant	✗	✓
Variable speed fans & pumps	✗	✓
Domestic hot water with combined Heat Pumps & Solar panels	✓	✓
Lifts & Escalators	✗	✓
Lighting with daylight control	✗	✓

## Some notes on competency

# SANS 10400-XA related **duties**

## 3 **Three duties** pertain to energy



### **Duty 19**

- design & assessment of **fenestration** per SANS 204



### **Duty 20 and 21**



- rational design & assessment of
  - **annual energy consumption** and
  - **peak demand** per SANS 10400-XA

# Your legal responsibility – Form 4



hereby certify as required by section 14(2A) of the National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977) that for the above project\*

☐ → energy efficiency in buildings

for which I am responsible has, to the best of my knowledge, been designed and

This includes .....

- HVAC
- Lifts & escalators
- Lighting
- Pumps & fans etc.

What we do

# Our service

- a) Build the 3-D energy models
- b) Analyse data & discuss with architect / client
- c) Produce report (model inputs / due diligence)
- d) Declaration by appointed competent person, **Form 2** signed
- e) Do **Site inspection** & sign completion **Form 4**

# Thank you !



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