Ex. topics

ICT for Building Design

AY 2020-21

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Ex. flowchart

building MODEL
model & info.

SIMULATION
*.idf
building energy simulation

optimisation

PARAMETRIZATION
generation sim. scenarios
EPPY, BESOS
output collection

SENSITIVITY Analysis
Input parameters
design & operational
Input scenarios

results' analysis

regression

plots

optimised solution

*.idf

WEATHER
TMY database
E+. Meteonorm
cloud weather data
weather underground

*.epw

COMM.
receiver

*.csv
send data
MQTT

Politecnico di Torino
ICT4SS - AY 2020-21

ICT in Building Design
proff. Chiesa & Bottaccioli

dashboard grafana
telgram

store
Influx DB
energy signature

PREDICTION
feed prediction model
test on new sim. output

SENSORING

04/10/2020

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Main overview – step I (design optimization)

Building type	Variable to be optimized			Climate
	U-values		WWR	
Residential	X		X	Cold, temperate, hot
Office	X		X	

Group	Type	Variable	Climate
#1	Residential	U-value	Oslo
#2	Residential	U-value	Rome
#3	Residential	U-value	Athens
#4	Office	U-value	Oslo
#5	Office	U-value	Rome
#6	Office	U-value	Athens
#7	Residential	WWR	Moscow
#8	Residential	WWR	Geneva
#9	Residential	WWR	Larnaca
#10	Office	WWR	Moscow
#11	Office	WWR	Geneva
#12	Office	WWR	Larnaca
#13 +	Residential/Office	U/WWR	New York; Miami; Antofagasta

Main overview – step II (profiling & control)

Building type	Variable to be optimized				Target
	ACH	% opening	Scheduling eq.	Shading	
1 building conf.	a.	b.	c.	d.	Q or Temp. or ACH

Group	Target var.	Main season
#i	a.Q	S
#ii	a.T	S
#iii	b.Q	S
#iv	b.T	S
#v	b.ACH	S/W
#vi	c.Q	S/W
#vii	d.Q	S
#viii	d.T	S

Better defined together with prof. Bottaccioli

Group #1-3 | U-value Residential - Step I

- Main objective: describe energy need variations varying the U-value of of opaque surfaces and the U-value of windows.

- seasonal and yearly values are analysed to define correlations using polynomial regressions

- Three WWR configurations are considered (5% - 15% - 50%)

- Two ventilative cooling mode (on/off) (scheduled)

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Group #1-3 | U-value Residential – step I

- Target variable: Q [kwh/m2] (separately summer and winter + annual)

- Input variables: – U-value of opaque surfaces, U-value of windows – To change the U-value, change insulating layer (0-35cm) in Energy plus for opaque surfaces and change the windows* (0.7-5) (or define at least 3 window configurations) – Use design builder to get a translation to U-value or you can use the formula in the lectures directly inside the python script

- Scenario variables: ventilative cooling on/off (in summer) (on mode = 6 ACH with external temperature 24 to 18°C 24hs/7day, while a critical difference between building temperature and external one is set to 3 K for effective convection)

- Energy signature will be calculated and different scenarios compared

*Please discuss the way you choose for Window U-value changes.

Group #4-6 | U-value Office - Step I

- Main objective: describe energy need variations varying the U-value of opaque surfaces and the U-value of windows.

- seasonal and yearly values are analysed to define correlations using polynomial regressions

- Three WWR configurations are considered (15% - 50% - 90%)

- Two ventilative cooling mode (on/off) (scheduled)

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Group #4-6 | U-value Office – Step I

- Target variable: Q [kwh/m2] (separately summer and winter, and annual)
- Input variables: – U-value of opaque surfaces, U-value of windows – To change the U-value, change insulating layer (0-35cm) in Energy plus for opaque surfaces and change the windows* (0.7-5) (or at least 3 window configurations) – Use design builder to get a translation to U-value or you can use the formula in the lectures directly inside the python script
- Scenario variables: ventilative cooling on/off (in summer) (on mode = 6 ACH with external temperature from 24 to 10°C during night (19:00-7:00), while a critical difference between building temperature and external one is set to 3 K for effective convection)
- Energy signature will be calculated and different scenarios compared

*Please discuss the way you choose for Window U-value changes.

Group #7+ | WWR – Step I

- Main objective: describe energy need variations varying the WWR.
- yearly values are analysed to define correlations using polynomial regressions
- 3 configurations are assumed by modifying the same reference building: not insulated (e.g. envelopes of 50-60's), insulated (current U-value limits for climate zone), highly insulated (U wall half of the limit; Uwind. A/B 1.4; C/D 1, E/F 0.6),
- Two ventilative cooling modes (on/off) (scheduled) - summer
- Two shading modes (on/off) - summer

Group #7+ | WWR – Step I

- Target variable: Q [kwh/m2] (year balance) assuming all electrical – heating + cooling + lighting

- Input variables: window percentage in respect to outdoor facing wall

- Scenario variables: – 3 configurations are assumed by modifying the same reference building: not insulated (e.g. envelopes of 50-60's), insulated (current U-value limits for climate zone), highly insulated building (U value walls = …; U value windows = …) + 2 shading configurations (on/off) + 2 CNV summer configurations (on/off) (schedule)

- Energy signature will be calculated and different scenarios compared

- Each group is characterized by working in a specific climate.

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Office

Residential

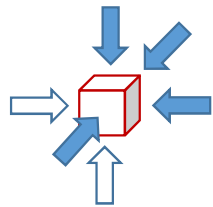simulated office unit

Other floors
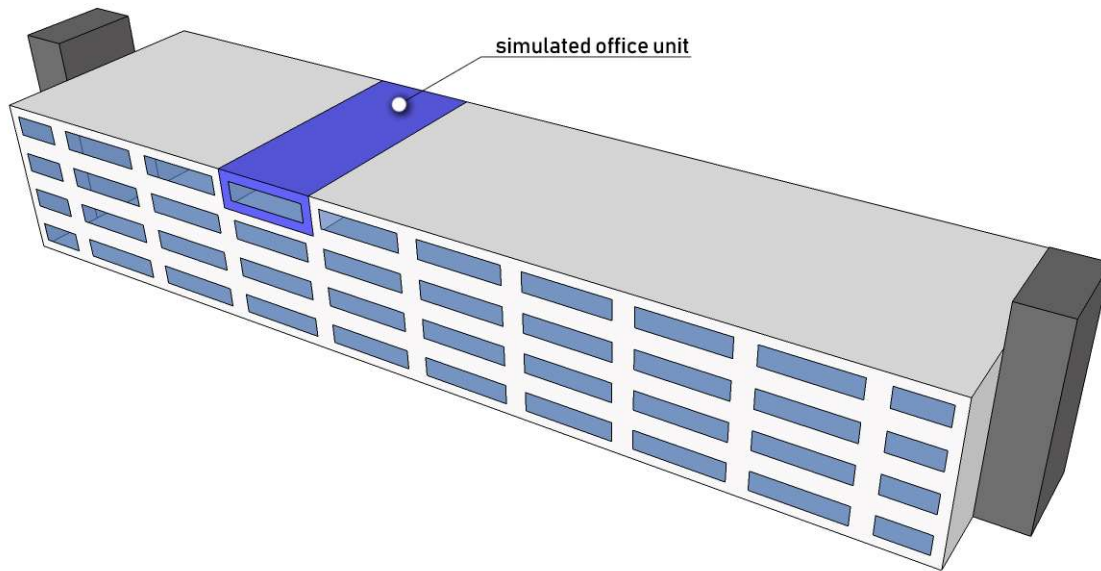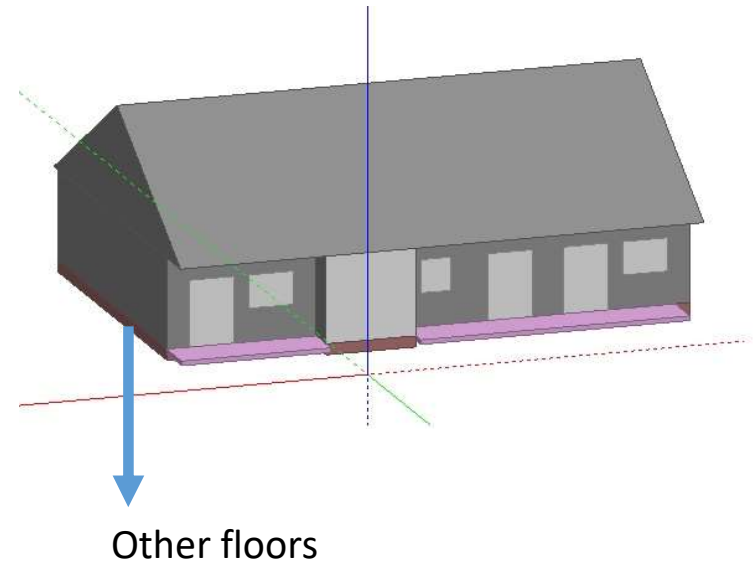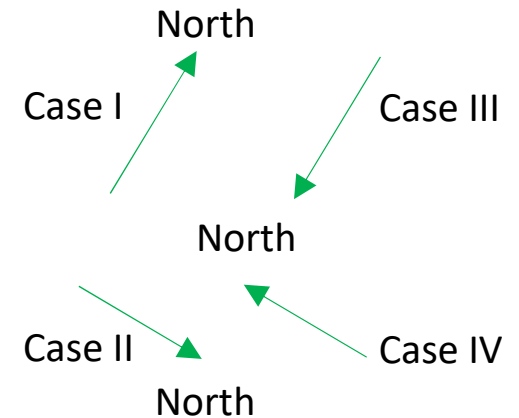
Group #1-3 | U-value Residential

min. windows' area = 1/8 pavement
(min 7.5 m^2 → 3.75 for façade)

Domestic Bedroom
Domestic Lounge
TM59_Studio
Domestic Kitchen
Domestic Bathroom

Residential - Dwelling unit (with kitchen)
Domestic Toilet
Domestic Bedroom

Zone 2
Zone 5
Zone 1
Zone 3
Zone 6
Zone 4

Zone 2
Zone 1
Zone 3

Not-adiabatic
adiabatic

North
Case I
Case III

North
Case II
Case IV
North

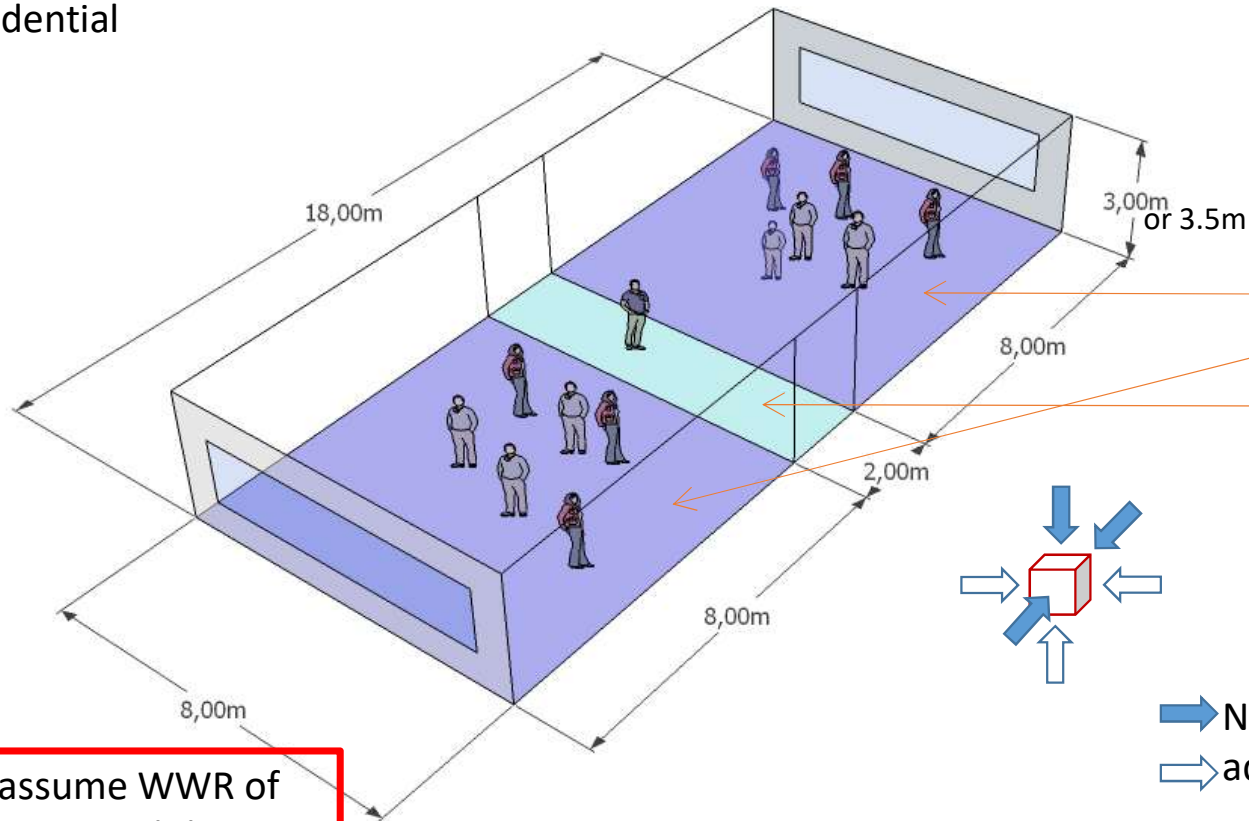Alternative design
configurations are accepted

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8

Group #4-6 | U-value Office

min. windows' area = 1/8 pavement – you can also consider continuous windows – in office is general bigger than in residential
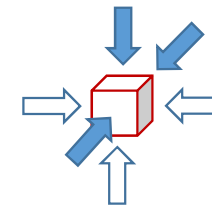
North

Case I

Case II

North

Symmetry N-S & E-W

18,00m

3,00m or 3.5m

8,00m

2,00m

8,00m

8,00m

Occupancy from Design Builder schedule for the specific activity
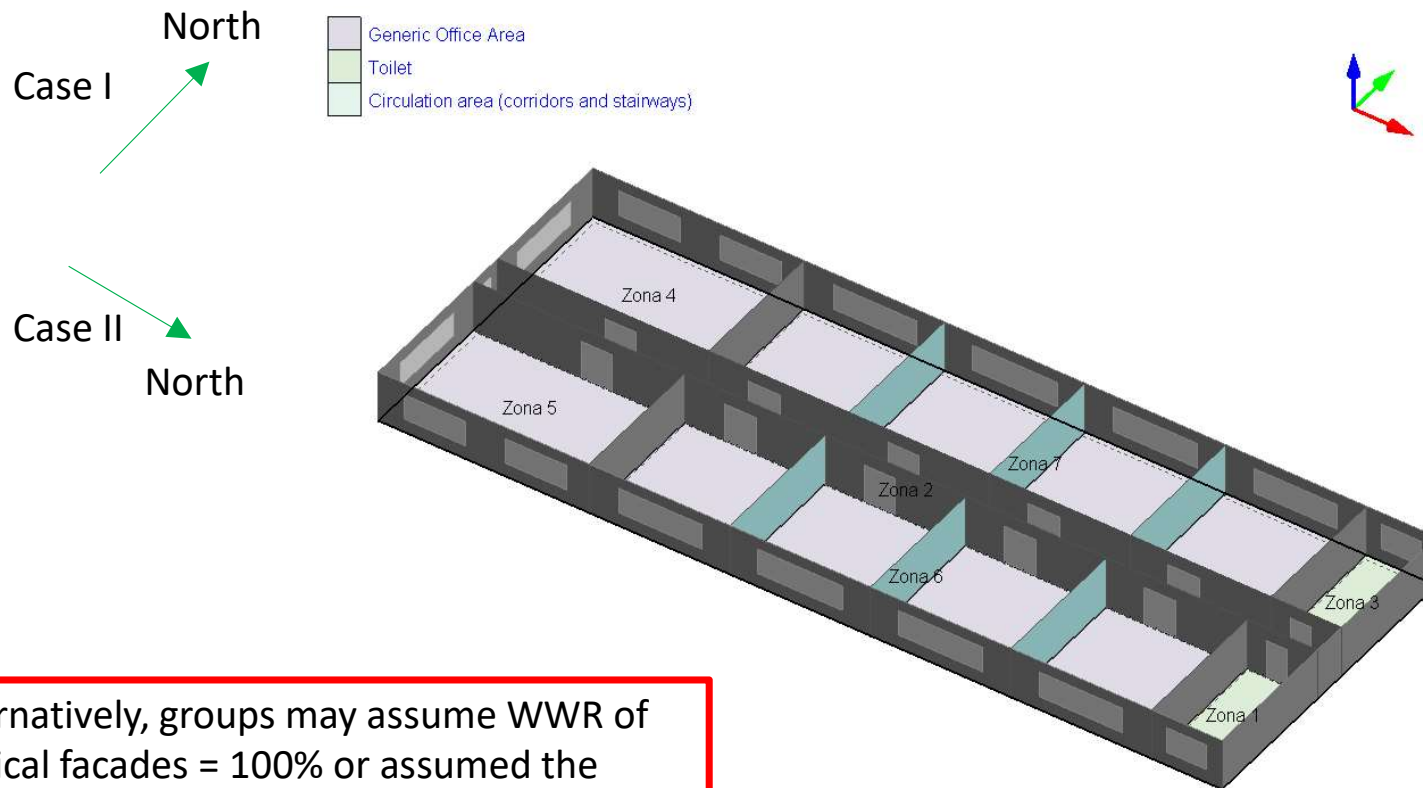
Office schedule

Office corridor schedule

Not-adiabatic

adiabatic

Alternatively, groups may assume WWR of vertical facades = 100% or assumed the following design configuration (or another)
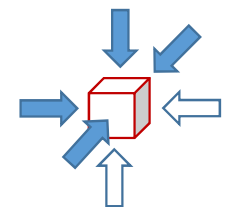
04/10/2020

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4

Group #4-6 | U-value Office

min. windows' area = 1/8 pavement – you can also consider continuous windows – in office is general bigger than in residential

North

Case I

Generic Office Area
Toilet
Circulation area (corridors and stairways)

Occupancy from Design Builder schedule for the specific activity

Case II

North

Zona 4

Zona 5

Zona 7

Zona 2

Zona 6

Zona 3

Zona 1

Not-adiabatic
adiabatic

Alternatively, groups may assume WWR of vertical facades = 100% or assumed the following design configuration (or another)

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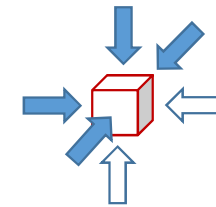
4

Group #7+ | WWR Residential

windows' area from 0% to 100% of WWR

Domestic Bedroom
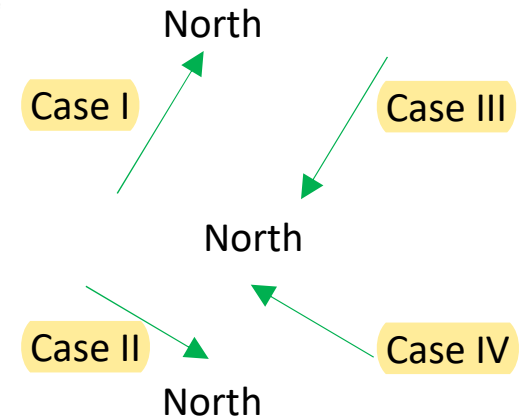Domestic Lounge
TM59_Studio
Domestic Kitchen
Domestic Bathroom

Residential - Dwelling unit (with kitchen)
Domestic Toilet
Domestic Bedroom

Not-adiabatic
adiabatic

North

Case I   Case III

North

Case II   Case IV

North

Alternative design configurations are accepted

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48

Group #7+ | WWR Office

windows' area from 0% to 100% of WWR

North

Case I

Case II

North

Symmetry N-S & E-W

Alternative design
configurations are accepted

18,00m

3,00m

8,00m

2,00m

8,00m

8,00m

Occupancy from Design
Builder schedule for
the specific activity

Office
schedule

Office
corridor
schedule

Not-adiabatic

adiabatic

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24