POLITECNICO DI TORINO

A.Y. 2024-25
MASTER DEGREE IN ICT4SS
01QWXBH - **ICT in BUILDING DESIGN**
Proff. Chiesa and Bottaccioli

Exercise IDF models

On the course page, you will find a folder named "Exercise_Building_model". Inside, you find six sub-folders with specific IDFs in line with what we have seen during the last lecture (NOTE: IDF are in EnergyPlus version 9.4 to be converted to the desired version before modifications or use in BESOS and the other exercise actions.

Please go to the google spreadsheet (https://docs.google.com/spreadsheets/d/1YY0xUmobplX6tuozecFxs-CdH8mk4GHY3DfOAxf_nTo/edit?usp=sharing) and check the name of your IDF.

Finally, you have a folder with TMY (starting weather). Additionally, there is a station with data for Turin on the weather underground. For the cold climate, check station IKASTR4, while for the hot climate, look for ISPATA5.

Such as underlined the 8th of October during the lecture on IDF, I synthesised what we discussed together and fixed it on the board.

Input:

1. Thermal insulation of walls
2. Thermal insulation of roof or last slab
3. Change of the window type: single Sgl, (Double Dbl Air,) Double LoE Arg, Triple Tpl LoE Arg
4. Set point temperatures
5. Ventilation rate (schedule nat. vent) – please on summer
6. Ventilation control thresholds (max out; min in; delta T)
7. Shading (external or internal blinds) control thresholds (temperature; solar irradiation global horizontal)
8. Mechanical ventilation rates
9. Type of lighting system
10. Window-to-wall ratio (Eppy or Geomeppy not in the IDF)
11. Others to be discussed together if interesting for you (e.g. scheduling time etc.)

Output (variable to be optimised):

a. Energy indicators:
    a. Heating energy needs
    b. Cooling energy needs
    c. Lighting energy needs
b. Thermal comfort:
    a. Indoor temperatures (or indoor operative temperatures)
    b. (or PMV/PPD POR or numbers of hours for adaptive thermal comfort thresholds)
c. Others to be discussed together if you have an interest

NOTE:

For the energy needs you need to take for:

- Heating: you can use "districtheating", which is an output that includes heating simple HVAC output. Please check for residual almost zero values for filtering. Otherwise, you may check per zone sensible heating points (pay attention in this case; you need to sum the values for all the zones). This districtheating output is in [J] and refers to the envelope needs (Net energy). It needs to be first reported to kWh (or kWh/m2) and after divided by the average seasonal COP to retrieve the energy vector value. If the COP is the one of an electrical unit, this final value is kWh electrical and may be summed to the other three energy voices (both professors may help you in this process)
- Cooling: you can use the EnergyPlus "districtcooling" output used in simple HVAC models. It is in [J] and needs again to be transformed in [kWh or in kWh/m2] and divided by a system seasonal COP to retrieve the electricity kWh values that may be summed with the the lighting ones.
- lighting output of EnergyPlus (check the Input/output manual) that expresses the electricity [kWh or kWh/m2] for lighting. Pay attention if you take equipment or a similar voice that this output point also includes lighting variations; otherwise is not applicable;

Finally, if all three voices are in electricity, you may sum them up. If one is, for example, in natural gas, all need to be translated into primary energy values (see UNI/TS 11300). See slides.

Thanks

Regards

GC

Office_IDF.idf

Materials (design optimisation)

INSULATION:

_InsulationEX_Roof_.01, !is applied to the ROOF

InsulationEX.01, !is applied to WALLS

WINDOW:

Sgl Clr 6mm - 1001

Sgl Clr 6mm - 2001 !with shading

Dbl LoE (e2=.1) Clr 6mm/13mm Arg - 1003 !without shading

Dbl LoE (e2=.1) Clr 6mm/13mm Arg - 2003 !with shading

Trp LoE (e2=e5=.1) Clr 3mm/13mm Arg - 1002 !without shading

Trp LoE (e2=e5=.1) Clr 3mm/13mm Arg - 2002 !with shading

NOTE: change window in FenestrationSurface:Detailed by modyfing the !- Construction Name field (and do the same for the shaded window name in the shading WindowShadingControl component)

OTHERS:

(facultative) link the window change to a change in the ZoneInfiltration:DesignFlowRate. To do that

A. for all Zone identify the ZoneInfiltration:DesignFlowRate element
B. change the Design Volume Flow Rate calculation method from Flow/zone to AirChanges/Hour
C. put a number there → , !- Air Changes Per Hour
D. modify the number to 0.7 for Sgl, 0.4 for Dbl, 0.2 for Tpl

LIGHTING (artificial)

Lights, Block1:OfficeXSWX1f General lighting, !- Name
Lights, Block1:OfficeXSEX1f General lighting, !- Name
Lights, Block1:OfficeXNWX1f General lighting, !- Name
Lights, Block1:OfficeXNEX1f General lighting, !- Name
Lights, Block1:CorridorX1f General lighting, !- Name
Lights, Block2:OfficeXSWX2f General lighting, !- Name
Lights, Block2:OfficeXSEX2f General lighting, !- Name
Lights, Block2:OfficeXNWX2f General lighting, !- Name
Lights, Block2:OfficeXNEX2f General lighting, !- Name
Lights, Block2:CorridorX2f General lighting, !- Name

Design choices:

7.5, !- Watts per Zone Area {W/m2} ##change this number <u>from 5 to 2</u>

NOTE: dimmer parameters can be changed using Daylighting:Controls or moving the sensor in the room Daylighting:ReferencePoint

(facultative) check the impact of changing the Illuminance Setpoint from 300 to 500

SHADING control (same logic, but applied to the different zones) – Blocco1

WindowShadingControl,11001 Block1:OfficeXSWX1f
WindowShadingControl,21001, Block1:OfficeXSEX1f
WindowShadingControl,31001 Block2:OfficeXSWX2f
WindowShadingControl,41001 Block2:OfficeXSEX2f
WindowShadingControl,51001 Block2:OfficeXNWX2f
WindowShadingControl,61001 Block2:OfficeXNEX2f
WindowShadingControl,11002 Block1:OfficeXNWX1f
WindowShadingControl,11003 Block1:OfficeXNEX1f

NOTE: Please change the shaded glazed Construction name when the glazing is changing.

Shading control arrives on:

24, !- Setpoint
120, !- Setpoint 2
On 24/7, !- Schedule name → eventually change to _Summer_Ventilation

NATURAL(or fan) VENTILATION – Blocco1

ZoneVentilation:DesignFlowRate, Block1:OfficeXSWX1f Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Block1:OfficeXSEX1f Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Block1:OfficeXNWX1f Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Block1:OfficeXNEX1f Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Block1:CorridorX1f Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Block2:OfficeXSWX2f Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Block2:OfficeXSEX2f Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Block2:OfficeXNWX2f Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Block2:OfficeXNEX2f Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Block2:CorridorX2f Nat Vent, !- Name

For Ventilative cooling control:

Airflows

A. Change the Design Volume Flow Rate calculation method from Flow/Zone to AirChanges/Hour
B. Add a number → , !- Air Changes Per Hour
C. Variate the number from 0 to 6

Control temperatures (potential changing values)

24, !- Minimum indoor temperature (degC)
0, !- Max temperature difference for operation → Delta Temperature {deltaC}
28, !- Maximum outdoor Temperature {C}

MECH Ventilation

DesignSpecification:OutdoorAir → one per zone, it can be modified the airflows by changing (or adding) values in one or more of the following fields (e.g. doubling the Air Flow per Person and/or the one per floor area):

.008, !- Outdoor Air Flow per Person {m3/s}
.0008, !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0, !- Outdoor Air Flow per Zone {m3/s}
0, !- Outdoor Air Flow Air Changes per Hour

In addition it can be possible to activate/deactivate the heat recovery of the mech. Ventilation by acting on all the Zone inside the ZoneHVAC:IdealLoadsAirSystem

Looking at the field

Sensible, !- Heat Recovery Type → changing Sensible to None

Or reducing/increasing its effectiveness (e.g. 0.5 or 0.9)

0.7, !- Sensible Heat Recovery Effectiveness

Res_flat1.idf

Materials (design optimisation)

INSULATION:

MW Glass Wool (rolls)_.0001, !is applied to the ROOF

Insulation.0001, !is applied to WALLS

Note: the "XPS Extruded Polystyrene - CO2 Blowing_.0795" is used in stairs (no need to be changed)

WINDOW:

Sgl Clr 6mm – 1002

Sgl Clr 6mm – 2002 !with shading

Dbl LoE (e2=.1) Clr 6mm/13mm Arg - 1001 !without shading

Dbl LoE (e2=.1) Clr 6mm/13mm Arg - 2001 !with shading

Trp LoE (e2=e5=.1) Clr 3mm/13mm Arg - 1003 !without shading

Trp LoE (e2=e5=.1) Clr 3mm/13mm Arg - 2003 !with shading

OTHERS:

(facultative) link the window change to a change in the ZoneInfiltration:DesignFlowRate. To do that

E. for all Zone identify the ZoneInfiltration:DesignFlowRate element
F. change the Design Volume Flow Rate calculation method from Flow/zone to AirChanges/Hour
G. put a number there → , !- Air Changes Per Hour
H. modify the number to 0.7 for Sgl, 0.4 for Dbl, 0.2 for Tpl

LIGHTING (artificial)

Lights, Blocco1:Zona3 General lighting, !- Name

Lights, Blocco1:Zona6 General lighting, !- Name

Lights, Blocco1:Zona5 General lighting, !- Name

Lights, Blocco1:Zona7 General lighting, !- Name

Lights, Blocco1:Zona1 General lighting, !- Name

Lights, Blocco1:Zona2 General lighting, !- Name

Lights, Blocco1:Zona4 General lighting, !- Name

Design choices:

3, !- Watts per Zone Area {W/m2} ##change this number from 5 to 2

(facultative) schedule lighting → change _EN16798-1_RES_light → _EN16798-1_RES_light2

NOTE: dimmer parameters can be changed using Daylighting:Controls or moving the sensor in the room Daylighting:ReferencePoint

SHADING control (same logic, but applied to the different zones) – Blocco1

WindowShadingControl,21001 ! Blocco1:Zona3

WindowShadingControl,31001, !Blocco1:Zona6

WindowShadingControl,41001 !Blocco1:Zona7

WindowShadingControl,51001 !Blocco1:Zona1

WindowShadingControl,61001 ! Blocco1:Zona2

WindowShadingControl,71001 ! Blocco1:Zona4

Here: The name of the glazed construction can change if the glazing is changing.

Shading control arrives on:

24, !- Setpoint

120, !- Setpoint 2

Summer (Northern Hemisphere), !- Schedule name → eventually change to On 24/7

NATURAL(or fan) VENTILATION – Blocco1

ZoneVentilation:DesignFlowRate, Blocco1:Zona3 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Blocco1:Zona6 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Blocco1:Zona5 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Blocco1:Zona7 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Blocco1:Zona1 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Blocco1:Zona2 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, Blocco1:Zona4 Nat Vent, !- Name

For Ventilative cooling control:

Airflows

D. Change the Design Volume Flow Rate calculation method from Flow/Zone to AirChanges/Hour
E. Add a number → , !- Air Changes Per Hour
F. Variate the number from 0 to 6

Control temperatures (potential changing values)

18, !- Minimum indoor temperature (degC)
2, !- Max temperature difference for operation
100, !- Maximum outdoor Temperature {C}

MECH Ventilation

DesignSpecification:OutdoorAir → one per zone, it can be modified the airflows by changing (or adding) values in one or more of the following fields (e.g. doubling the Air Flow per Person):

.01, !- Outdoor Air Flow per Person {m3/s}
0, !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0, !- Outdoor Air Flow per Zone {m3/s}
0, !- Outdoor Air Flow Air Changes per Hour

In addition it can be possible to activate/deactivate the heat recovery of the mech. Ventilation by acting on all the Zone inside

ZoneHVAC:IdealLoadsAirSystem

Looking at the field

Sensible, !- Heat Recovery Type → changing Sensible to None

Res_flat2_IDF.idf

Materials (design optimisation)

INSULATION:

MW Glass Wool (rolls)_.0001, !is applied to the ROOF

Insulation.0001, !is applied to WALLS

Note: the "XPS Extruded Polystyrene - CO2 Blowing_.0795" is used in stairs (no need to be changed)

WINDOW:

Sgl Clr 6mm – 1002

Sgl Clr 6mm – 2002 !with shading

Dbl LoE (e2=.1) Clr 6mm/13mm Arg - 1001 !without shading

Dbl LoE (e2=.1) Clr 6mm/13mm Arg - 2001 !with shading

Trp LoE (e2=e5=.1) Clr 3mm/13mm Arg - 1003 !without shading

Trp LoE (e2=e5=.1) Clr 3mm/13mm Arg - 2003 !with shading

OTHERS:

(facultative) link the window change to a change in the ZoneInfiltration:DesignFlowRate. To do that

I. for all Zone identify the ZoneInfiltration:DesignFlowRate element
J. change the Design Volume Flow Rate calculation method from Flow/zone to AirChanges/Hour
K. put a number there → , !- Air Changes Per Hour
L. modify the number to 0.7 for Sgl, 0.4 for Dbl, 0.2 for Tpl

LIGHTING (artificial)

Lights, Flat2:Zona3 General lighting, !- Name

Lights, Flat2:Zona4 General lighting, !- Name

Lights, Flat2:Zona2 General lighting, !- Name

Lights, Flat2:Zona1 General lighting, !- Name

Design choices:

3, !- Watts per Zone Area {W/m2} ##change this number from 5 to 2

(facultative) schedule lighting → change _EN16798-1_RES_light → _EN16798-1_RES_light2

NOTE: dimmer parameters can be changed using Daylighting:Controls or moving the sensor in the room Daylighting:ReferencePoint

SHADING control (same logic, but applied to the different zones) – Blocco1

WindowShadingControl,21001 Flat2:Zona4

WindowShadingControl,31001, Flat2:Zona2

WindowShadingControl,41001 Flat2:Zona1

NOTE: The name of the glazed construction can change if the glazing is changing.

Shading control arrives on:

24, !- Setpoint

120, !- Setpoint 2

Summer (Northern Hemisphere), !- Schedule name → eventually change to On 24/7

NATURAL(or fan) VENTILATION – Blocco1

ZoneVentilation:DesignFlowRate, Flat2:Zona3 Nat Vent, !- Name

ZoneVentilation:DesignFlowRate, Flat2:Zona4 Nat Vent, !- Name

ZoneVentilation:DesignFlowRate, Flat2:Zona2 Nat Vent, !- Name

ZoneVentilation:DesignFlowRate, Flat2:Zona1 Nat Vent, !- Name

For Ventilative cooling control:

Airflows

G. Change the Design Volume Flow Rate calculation method from Flow/Zone to AirChanges/Hour
H. Add a number → , !- Air Changes Per Hour
I. Variate the number from 0 to 6

Control temperatures (potential changing values)

18, !- Minimum indoor temperature (degC)
2, !- Max temperature difference for operation
100, !- Maximum outdoor Temperature {C}

MECH Ventilation

DesignSpecification:OutdoorAir → one per zone, it can be modified the airflows by changing (or adding) values in one or more of the following fields (e.g. doubling the Air Flow per Person):

.01, !- Outdoor Air Flow per Person {m3/s}
0, !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0, !- Outdoor Air Flow per Zone {m3/s}
0, !- Outdoor Air Flow Air Changes per Hour

In addition it can be possible to activate/deactivate the heat recovery of the mech. Ventilation by acting on all the Zone inside

ZoneHVAC:IdealLoadsAirSystem

Looking at the field

Sensible, !- Heat Recovery Type → changing Sensible to None

res_multifloor_IDF.idf

Materials (design optimisation)

INSULATION:

MW Glass Wool (rolls)_.0001, !is applied to the ROOF

Insulation.0001, !is applied to WALLS

Note: the "XPS Extruded Polystyrene - CO2 Blowing_.0795" is used in stairs (no need to be changed)

WINDOW:

Sgl Clr 6mm – 1002

Sgl Clr 6mm – 2002 !with shading

Dbl LoE (e2=.1) Clr 6mm/13mm Arg - 1001 !without shading

Dbl LoE (e2=.1) Clr 6mm/13mm Arg - 2001 !with shading

Trp LoE (e2=e5=.1) Clr 3mm/13mm Arg - 1003 !without shading

Trp LoE (e2=e5=.1) Clr 3mm/13mm Arg - 2003 !with shading

OTHERS:

(facultative) link the window change to a change in the ZoneInfiltration:DesignFlowRate. To do that

M. for all Zone identify the ZoneInfiltration:DesignFlowRate element
N. change the Design Volume Flow Rate calculation method from Flow/zone to AirChanges/Hour
O. put a number there → , !- Air Changes Per Hour
P. modify the number to 0.7 for Sgl, 0.4 for Dbl, 0.2 for Tpl

LIGHTING (artificial)

Lights, ResXfloor1:Zona3 General lighting, !- Name
Lights, ResXfloor1:Zona2 General lighting, !- Name
Lights, ResXfloor1:Zona1 General lighting, !- Name
Lights, ResXfloor2:Zona3 General lighting, !- Name
Lights, ResXfloor2:Zona2 General lighting, !- Name
Lights, ResXfloor2:Zona1 General lighting, !- Name
Lights, ResXfloor3:Zona3 General lighting, !- Name
Lights, ResXfloor3:Zona2 General lighting, !- Name
Lights, ResXfloor3:Zona1 General lighting, !- Name
Lights, ResXfloor4:Zona3 General lighting, !- Name
Lights, ResXfloor4:Zona2 General lighting, !- Name
Lights, ResXfloor4:Zona1 General lighting, !- Name
Lights, ResXfloor5:Zona3 General lighting, !- Name
Lights, ResXfloor5:Zona2 General lighting, !- Name
Lights, ResXfloor5:Zona1 General lighting, !- Name

Design choices:

3, !- Watts per Zone Area {W/m2} ##change this number from 5 to 2

(facultative) schedule lighting → change _EN16798-1_RES_light → _EN16798-1_RES_light2

NOTE: dimmer parameters can be changed using Daylighting:Controls or moving the sensor in the room Daylighting:ReferencePoint

SHADING control (same logic, but applied to the different zones) – Blocco1

WindowShadingControl,11001 ResXfloor1:Zona3
WindowShadingControl,21001 ResXfloor1:Zona2
WindowShadingControl,31001, ResXfloor1:Zona1
WindowShadingControl,41001, ResXfloor2:Zona3

WindowShadingControl,51001, ResXfloor2:Zona2
WindowShadingControl,61001, ResXfloor2:Zona1
WindowShadingControl,71001 ResXfloor3:Zona3
WindowShadingControl,81001 ResXfloor3:Zona2
WindowShadingControl,91001, ResXfloor3:Zona1
WindowShadingControl,101001, ResXfloor4:Zona3
WindowShadingControl,111001, ResXfloor4:Zona2
WindowShadingControl,121001, ResXfloor4:Zona1
WindowShadingControl,131001, ResXfloor5:Zona3
WindowShadingControl,141001, ResXfloor5:Zona2
WindowShadingControl,151001, ResXfloor5:Zona1

NOTE: The name of the glazed construction can change if the glazing is changing.

Shading control arrives on:

24, !- Setpoint
120, !- Setpoint 2
Summer (Northern Hemisphere), !- Schedule name → eventually change to On 24/7

NATURAL(or fan) VENTILATION – Blocco1

ZoneVentilation:DesignFlowRate, ResXfloor1:Zona3 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor1:Zona2 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor1:Zona1 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor2:Zona3 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor2:Zona2 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor2:Zona1 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor3:Zona3 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor3:Zona2 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor3:Zona1 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor4:Zona3 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor4:Zona2 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor4:Zona1 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor5:Zona3 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor5:Zona2 Nat Vent, !- Name
ZoneVentilation:DesignFlowRate, ResXfloor5:Zona1 Nat Vent, !- Name

For Ventilative cooling control:

Airflows

J. Change the Design Volume Flow Rate calculation method from Flow/Zone to AirChanges/Hour
K. Add a number → , !- Air Changes Per Hour
L. Variate the number from 0 to 6

Control temperatures (potential changing values)

18, !- Minimum indoor temperature (degC)
2, !- Max temperature difference for operation
100, !- Maximum outdoor Temperature {C}

MECH Ventilation

DesignSpecification:OutdoorAir → one per zone, it can be modified the airflows by changing (or adding) values in one or more of the following fields (e.g. doubling the Air Flow per Person):

.01, !- Outdoor Air Flow per Person {m3/s}
0, !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}

0, !- Outdoor Air Flow per Zone {m3/s}
0, !- Outdoor Air Flow Air Changes per Hour

In addition it can be possible to activate/deactivate the heat recovery of the mech. Ventilation by acting on all the Zone inside

ZoneHVAC:IdealLoadsAirSystem

Looking at the field

Sensible, !- Heat Recovery Type → changing Sensible to None