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Lecture - 53 Whole Building Performance – III

Good morning. Welcome back to this third lecture for this week where we are learning the software called Design Builder. Now, before I go ahead with the talking about how to input more parameters into the software I just want to reiterate that Design Builder is just one software which can be used to perform this kind of an analysis. There are many other softwares of equal capability which are available in the market you could use any one of them, but the input parameters would remain the same. You would require activity templates, you would require the construction materials, and you would require the zones to be created and their performances to be put in into the software.

So, all that would definitely be needed. So, whether you are working with software A or software B the input parameters are going to remain the same and also the mandatory requirement is for compliance you have to use the same software for base case as well as the proposed building. So, what we are essentially doing when we are doing this energy simulation and analysis is that we are comparing the base case with the proposed case.

It is an Apple to Apple comparison at all times. Same software, same input parameters except the ones which are permitted to be changed. And, then we compare how better the proposed building is as compared to the base case that we have taken. And the base case we are taking directly from the values which has prescribed in the codes.

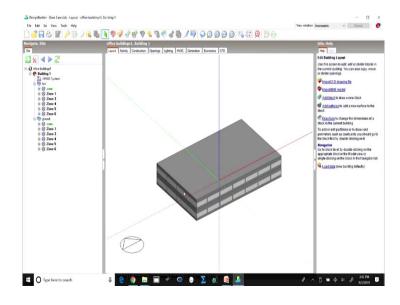
So, if we are working in India we have already seen that ECBC is the code which we normally use and the prescriptive values are already given. So, for creating the base case we would only be considering the ECBC while if they are doing the same exercise for say US and other parts of the world we may be using different codes, in America we may be going ahead with ASHRAE 90.1. For LEAD compliance even in India we may still be going ahead with ASHRAE 90.1 and like that.

So, we have to be very sure that the same software is used and it could be any software which has the same capabilities. So, today what we are going to do is we are going to

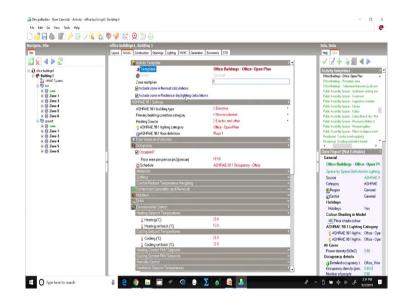
input the parameters related to the building envelope. We are going to add in the values the U values and other prescriptive values as given in ECBC for opaque walls for the roofs and also for the fenestration.

So, if you remember ECBC we have U value to be put in for the walls, we have U value to be put in for the roof, we have U value, SHGC and VLT to be put in for the fenestration. Along with that we also have window to wall ratios to be put in for the fenestration. In base case, all these values will be the prescriptive values as given in ECBC. So, let us go ahead and get started with the software and let us see how can we input the prescriptive values. So, let us switch to the screen of the software now.

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So, in the previous two lectures we have already created the geometry of the building and we have assigned the activity to the building and which has been inherited by all the different zones and wherever we wanted to change we have changed the templates for the activity.

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So, now we have a building along with its activity.

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🖻 🥐 Building 1	Construction	1	Use this screen to edit the building-wide
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* (3) Zone 5 * (3) Zone 6	Cylinternal partitions	Partition - 2 x 1 in (2x25mm) gypsum plasterboard with 4 in	group header boxes to access the construction
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8 () care	Sem-exposed wells	C21 Semi-Exterior, Wall, Steel-Framed, Pr0 (0.0), U-352 (1	To inspect the details of a selected construction, click on the icon to the left of the
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* CO Zone 5	Floars		Note: Data on the Openings tab can be used
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	GBasement ground floor	Solid basement ground floor, uninsulated	Sub-Surfaces
	 Geteinaltoer 	C21 Non-Res, External Floor, Steel-Joint, P-8 (0.0), U-35 (⁶ Sub-surfaces are exceptions to the main
	aliternal foor	Intermediate floor - 4 in (108mm) concrete stab	surface construction. Examples include cold-bridging elements such as windowlinted
	Sub-Surfaces		and opaque pands in a lightweight facade.
	internal Tharmal Mass		You can define different sub-surface
	Component Block		construction types for external walls, internal
	Geometry, Areas and Volumes		partitions and pitched roofs.
	Surface Convection		To add a sub-surface, go to the surface you wish to work on, click on the Larcut tab and
	Linear Thermal Bridging at Junctions		select the Draw sub-surface command.
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	Constant rete (ach)	0.300	can be set and is constant. You can change i infitration units on the Model options dialog
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	1000 m	200	Save Construction data to new template

So, we will move on to construction now. So, just to remind you we are still creating a base case building a baseline building and we are not doing the proposed case as yet. So, in the base case building, the template which it automatically takes is CZ 1 non-residential baseline constructions which is what is taken as default here.

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® (3) core ® (3) Zone 1	Flat root	C21 Non-Res, Root Ins Entrely above Deck, R-148c1 (2	Source	ASHRA
* 03 Zone 3	Plitched roof (occupied)	C21 Non-Res, Root Ins Entrely above Deck, R-14 lbc i (2	Category	ASHRA
· () Zone 4	Pliched roof (unoccupied)	C21 Semi-Exterior, Root Ins Entrely above Deck, R-4ci. (Region	Genere
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· (9 Zone 3	Semiexposed floor	C21 Semi-Exterior, Floor, Steel-Joist, R-010 B, U-35 /1 98	Edomal	C21 No
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in the same o	Basement ground foor	Solid besement around floor uninsulated	Semi-exposed	CZ1 Se
	e External floor	C21 Non-Res, External Floor, Steel-Joist, R-0 (0.0), U-35 (Combined Floors/Slabs	/Ceiling
	a internal foor	Intermediate floor - 4 in (108mm) concrete slab	Flat roots	CZIN
	Sub-Surfaces	-	Semi-exposed ceiling	CZ1 Se
	Internel Thermel Mass		Semi-exposed floor	C21 Se
	Component Block		Ground floor	C21N
	Geometry, Areas and Volumes	-	Basement ground floor	
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However, we can change the definitions, we can change the constructions for each one of these components. Now, as we have already discussed you know what these external walls or below grade walls or semi-exposed walls are, in this particular building we only have 4 different types of constructions. First one is external wall.

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affice buildings1	Template	CZ1 Nonresidential Baseline Constructions	Constructions	
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* (i) care	Below grade wells	C21 Non-Res. Below-Grade Wall. R-0 (0.8), C-1.14 (6.473)	CZI Non-Res. Wall. S	Steel-Fran
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8 (1) Zone 4	Backwalk angle leaf construction with insulation & plaster		Region	General
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🗏 🚯 Zone 3	(21 Sentented Wall SteelFraned 8-0(0.0) U-352(1.900) 1		Simulation solution algor	1-Defeat
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dneral	Steel-Framed, R-13.1 (2.3), U-124 (705)	Set the number of layers first then select the material		Info, Data
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leuhon	1	Britging	ramed, Fk-13.1 (2.3), U-124 🔔	General
eintonmethod	Haves .	You can also add bridging to any layer to model the effect of a relatively more conductive material bridging	Well R-0 (0.0), C-1.14 (6.473)	C21 Non-Res, Wall, Steel-Fran
culation Settings		a less conductive material. For example wooden joists		Source ASHRA
		briging an insulation layer.		Category Walls
umber of layers	· ·	Note that bridging effects are NOT used in EnergyPlus, but are used in energy code compliance checks requiring U-values to		Region General
Dutermost løyer		be calculated according to BS EN ISO 6945	ace then (would have a U value of abo	Colour
Material	0.75 in Stucco			Definition
Thickness (m)	0 0190	Energy Code Compliance You can calculate the thickness of insulation required		Definition method 1-Loyers
Brdged?		to meet the mandatory energy code U-value as set on		Calculation Settings
eyer2		* The Emergy Code tab at site level		Simulation solution algori 1-Defaul
Material	0.625 in gypsum board	This calculation identifies the 'insulation layer' as the layer having the highest ryake and requires that no		Involves metal clodding No
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So, here if we go to the external wall and if we see the definitions of whatever is being taken in this wall and we know the 2 overall value.

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aven Surface properties Image Calculated Cost Int	enal source Condensation analysis	Ha Date		
nersufete		Calculated Data		Info. Data
Convective heat transfer coefficient (W/m2-K)	2.793	This tab provides further information on the heat		Heb Corr
Radiative heat transfer coefficient (W@n2-K)	5.540	Vansmission properties of the construction. This data is used in Simple calculation methods		
Surface resistance (m2-K/W)	0.120	such as SBLM and generally NOT in EnergyPlas	1 A A A A A A A A A A A A A A A A A A A	- 100 V (R. 400) V V
Wer surface	200.022	simulations.	eline Constructions	Constructions
Convective heatwanster coefficient (W/m2-K)	27 793	Exceptions are window frame U-values and use of		Data Report (Not Editable)
Radiative heat transfer coefficient (Wim2-K)	5.540	fixed CIBSE convective heat transfer coefficients (more below)	ramed, Pi-13.1 (2.3), U-124 🔜	General
Surface resistance (m2-K/W)	0.030	U-values are shown including and excluding the effect	Wall R-0 (0.0), C-1 14 (6.473)	CZ1 Non-Res, Wall, Steel-Frane
o Bridging		of surface resistance and are calculated with and		Source ASHRAE 9
U-Value surface to surface (M(Im2-K)	0.787	without bridging effects.		Category Walls
R-Value (m2-K/W)	1.421	Note that the outer surface resitance depends on the		Region General
U-Value (W/m2·K)	0.704	exposure to wind (on the Location tab at Site level)	ace then (would have a U value of abo	Colour
W-Brdging (BSEN ISO 6946)		Convective heat transfer coefficients The convective heat transfer coefficients displayed are		Definition
Thickness (m)	0.0889	used in EnergiPlus when the CBSE Inside/Outside		Definition method 14 Layers
Km - Internal heat capacity (K.Ijm2-K)	15.5395	convection algorithm is safected. Otherwise		Calculation Settings
Uppervesistance limit (m2-K/W)	1.421	* EnergiPlus uses its' own convection algorithm as set in the simulation options and the transmission data		Simulation solution algori 1-Default
Lower resistance limit (m2-K/W)	1.421	m displayed here is not used		Involves metal cladding No
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So, here the value has been taken as 0.704 which is the default U value which is coming from the ASHRAE prescriptions. Suppose we are carrying out this whole building simulation process for compliance with ECBC or for any other rating program in India where ECBC has to be followed we will have to define our own U values.

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sifice buildingn1	Se Template	CZ1 Nonresidentia	al Baseline Constructions	Constructions	-
🕐 Building 1	Construction			Data Report (Not Editab	
ONVIC System Onvic System	Cite nal walls		Steel-Framed, Fr-13.1 (2.3), U-124 🔔	General	
* (C) care	Below grade walls	C21 Non-Res. Below	-Grade Wall, R-0 (0.8), C-1.14 (6.473)	Copy of CZ1 Non-Res	Wall Ste
· () Zone 1	Select the construction			Source	ASHRAE
· () Zone 3	Rick block wall inculated to 2000 repr			Category	Wolls
8 Q Zone 4	Bick cavity full mneral insulation 1 lightweight plaster		10 A A A A A A A A A A A A A A A A A A A	Region	General
* (3) Zone 5 * (3) Zone 6	Dick casty with device plaster		11	Colour	
e ty zone o	Bick cavity with mineral incutation & lightweight planter		-	Definition	
* f0 one	Pick casty with at loan exulation & lightweight planter Pick mental exulation therealite block & Use planter			Definition method	1-Lovers
· () Zone 1	 Bick there is notation themote block 5 for plaster Bick/block wal (notated to 1305 regs) 			Colculation Settings	
* (9 Zone 3	Bick/block wall invulated to 1995 regul			Simulation solution algori	1-Default
· () Zone 4	Bick/block wall domestic (insulated to 1985 segs)			Involves metal cladding	
* (3) Zone 5 * (3) Zone 6	Bick/block wall domentic (involuted to 1995 eegs)			Levers	110
a Q can a	Bickwork single leaf construction dense plaster			Number of layers	3 I.
	Pickwok, single leal construction epis insulation & rend Bickwok, single leal construction thre insulation & rend Disclowed, single lead construction three insulations.			Outermost layer	1
	Bickwork single leaf construction light plaster			a 0.75 in Shicco	
	Enclosed, angle leaf construction with insulation & plas	her.		Thickness (m)	0.0190
	Cavity web (EDW) 1995 Part L. Standard elemental D-		ng the methods in place there would have a U-	Bridged?	No
	Cavity wall (EDW) 2002 Part L. Cavity walks 2002 Res			Layer 2	140
	Copy of CC1 May Res. Wall. Steel Framed. Re111127 CC1 Non-Res. Wall. Steel Framed. R 13 112 31 U 124	0.0-124 (105) -15 in (400m) On Center (15 in	(Ethno) Depth Franking	S 0.625 in gypsumbe	
	The Product of the Proof and A starting of the Proof in the Proof of t	And WER AF - All Provide Content of Early Pro-	Visit Course	Thickness (n)	0.0159
	•	State of the second second	,	Bridged?	No
	💠 😼 📝 🗶 🗹 Sot		Cercel OK	Laver 3	140
	R Model infitration			Board insulation (G	
		0.300		Thickness (m)	0.0381
	Constant rate (ac/h)	0 310 On 24/7		Bridged?	No
	Chedule Schedule			Innermost lever	140
	Delta T and Wind Speed Coefficient		-	.~ 0.625 in gypsum bo	100
	Cost			Thickness (m)	0.0159
				Bridged?	No
				Outside Surface	NO NO
				Fix convective heat trans	

In that case again we will have to create a copy of the external wall.

(Refer Slide Time: 06:14)

		Help		
vers Surface properties Image Calculated	Cost Internal source Condensation analysis	Info Dec.		liner lateration
Name ECBC Wall		Set the number of layers first, then select the material		Info, Data
Name ECBC Well	ASHRAE Standard 90 1 (Appendix A)	and thickness for each layer.		Help Data
Calegory	Wells	+ insettaver	•	V 2 + b x 4 >
- Calegory FrRegion	General	X Delete laver	eline Constructions	Constructions
Colour	Cleaner	~ contraint		Data Report (Not Editable)
leaco		Bridging	Vall, Steel-Framed,	General
Defection method	1-Layers ·	You can also add bridging to any layer to model the	Wall R-0 (0.0), C-1.14 (6.4	Copy of CZ1 Non-Res. Wall. Ste
Iculation Settings		effect of a relatively more conductive material bridging a less conductive material. For example wooden joists		Source ASHRAE
		briging an insulation layer.		Category Walls
Number of levers	4 .	Note that bridging effects are NOT used in EnergyPlus, but are	^	Region General
Outermost laver	1	used in energy code compliance checks requiring U+alues to be calculated according to BS (2V /SO 6945)	ice then would have a U value of abo	Colour
Material	0.75 in Stucco			Definition
Thickness (m)	0.0190	Energy Code Compliance	and.	Detailor method 1-Levers
Bidged?		You can calculate the thickness of insulation required to meet the mandatory energy code U-value as set on		Colculation Settings
Løyer 2		³ The Energy Code tab at site level.		Simulation solution algori 1-Default
SMaterial	0.625 is gypsum board	This calculation identifies the Insulation layer as the		Involves metal cledding No
Thickness (m)	0.0159	layer having the highest r-value and requires that no		Layers
Bridged?		bridging is used in the construction.		Number of levers 4
Layer 3	1	2 Set U.Value		Outermost Inver
Material	Board insulation (Glass fiber board)			Se 0.75 in Shecco
Thickness (m)	0.0381	Reverse condituction lavers		Thickness (m) 0.0110
Bidged?				Bridged? No
nnermost lever				Layer 2
SyMaterial	0.625 is gypsum board			3 0.625 in gypsum board
Thickness (m)	0.0159			Thickness (m) 0.0159
Bidged7				Bridged? No
-			Carcel OK	Layer 3
				 Board insulation (Glass fiber bo Thickness (m) 00301
				Bridged? No
				Innermost leyer
			8	0.625 in gypsum board Thickness (m) 0.0159
fodel data	insert layer Delete layer	Heb Cancel DK		Bridged? No
	Surface Convection			Outside Surface
	Linear Themail Bridging			Fix convective heet trens No
	Linear Interna Cooping		•	Inside Surface

So, this is the copy. Suppose I rename it. I change it to ECBC wall which is what we are going to be taking and we change the construction methods.

(Refer Slide Time: 06:32)

astructions		Help		
ven Sufaceproperties Image Calculated C	at Hand state Contractor and an	Pro Con		
totic		Construction Layers		Info. Data
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Source	ASHRAE Standard 90 1 (Appendix A)	and thickness for each layer.		
Collegary	Wells	🔶 wsettaver		
-Region	General	× Detete larer	eline Constructions	Constructions
Colour		Contraction of the second seco	1	Data Report (Not Editable)
linnen		Bridging	Wall, Steel-Framed,	General
Netntonmethod	1-Layers -	You can also add bridging to any layer to model the	Wall R-0 (0.0). C-1.14 (6.4	Copy of CZ1 Non-Res. Wall. Ster
Iculation Settings		effect of a relatively more conductive material bridging a less conductive material. For example wooden joists		Source ASHRAE
Simulation solution algorithm	1-Defeat	briging an insulation layer.	1	Category Walls
] Involves metal cladding		Note that bridging effects are NOT used in EnergyPlus, but are	^	ARajon General
Vers		 votet is energy code compliance checks requiring U-values to be calculated according to d5 EN ISO 6945. 	ace then would have a U-value of abo	Colour
Number of levers	4 .			Definition
Outermost lever		Energy Code Compliance Yes can calculate the thickness of insulation required	and .	Definition method 1-Lovers
Syliaterial	0.75 in Stucco	to meet the mandatory energy code U-value as set on		Colculation Settings
Thickness (m)	0 0190	³ the Energy Code tab at site level		Simulation solution algori 1-Default
Birdged?		This calculation identifies the 'Insulation layer' as the		Involves metal cladding No
Leyer 2		Layer having the highest r v alue and requires that no bridging is used in the construction.		Layers
Material	0.625 in. gypsum board			Number of levers 4
Thickness (m)	0.0159	all Set U.Value		Outermost Inver
Bridged?				a 0.75 in Shecco
Layer 3		Reverse condituction lavera		Thickness (m) 0.0190
Material	Board insulation (Glass liber board)			Bridged? No
Thickness (m)	0.0688			Layer 2
Brdged?				Sy 0.625 in gypsumboard
internottiever		3	,	Thickness (m) 0.0159
SMaterial	0.625 in gypsumboard		Carcal OK	Bridged? No
Thickness (m)	0.0159		Carta Car	Layer 3
Bidged?				Board insulation (Glass fiber board)
				Thickness (m) 0.0381
			1	Bridged? No Innermost lever
		0	8	0.625 in gypsum board Thickness (m) 0.0159
fodel data	Inset layer Delete layer	Heb Cancel DK	•	Bridged? No
	E MILLIO MALINIA	Million and American Street Stre		Outside Surface
	Surface Convection			Fix convective heattrans No
	Linear Themail Bridge			Inside Sarlace
	B	In the second seco		THE REAL PROPERTY AND ADDRESS OF

So, we may change the layers individually or we may just change the overall value. So, suppose I want to define the U value. I do not know what the layers are going to be.

(Refer Slide Time: 06:43)

onstructions Laven Surface properties Image Calculated Cost	Internal source Condensation analysis	Help Ho Der				
		Construction Layers			Julo Data	_
Oxformer: Byce Sylderind UVdue fut/ro2() Thickness (rin) () 444 Sylderind () 444 <	A SHIA! Seeded to (pyperdux) yrads Greent Hayes - Calent Hayes - Calent - C	Set the number of layers 1 and thickness for each lay thickness for each lay this set layer Children Delete layer Original Original Yee can also add bridging offect of a relatively more	to an layer to model the conductive manned to doging To are anothe working the second second second second to do the second second second to do the second second second to conduct second to conduct second to conduct second to conduct second to conduct to conduct t	Allen Costitucione	Category Relation Colour Definition Calculation northod Calculation settings Simulation colours allowers Layers Number of Layers Outermas Layers Outermas Layers Distances (m)) Wall Ster ASHRAE's Walls General 1-Layers 1-Default No 4 00110
S-Materiel Thickness (m) Bridged? Entomotilinyou S-Material	Board insulation (Glass Morr board) 0.0381 0.625 m. gyptum board			Carcel DK	Layer 2 30 625 in gypsumboe Thickness (n) Bridged?	No rd 0.0159 No
Theoloness (m) ☐ Bholged? Medial dista	0.0159 Investiger Detrictiges Extent Connections Linetter Thermal Elissions of		Cancel DK	5 .	Bridged? Incorroot layer Gr 0.625 in gypsumbor Thickness (m)	8.0381 No nd 8.0159 No

So, we may just define the U value. So, we may just set the U value. So, suppose as per ECBC if the U value is defined as 0.44.

(Refer Slide Time: 07:04)

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am (13/kergeneris) (am), (16/kerg) (16/kerg) Convectors between software confident (Win-21) Rather in the transfer confident (Win-21) Suffice an attrastic per S2(W) for an attrastic per S2(W) Suffice an attrastic confident (Win-21) Rather in the transfer Suffice an attrastic confident (Win-21) Rather in the transfer Suffice and transfer Sufficient (S2) Suffice and transfer Suffice and transfer Sufficient (S2) Suffice and transfer Sufficient (S2) Sufficient (S3) Sufficient (S4) Sufficient (S4) Suffici	2233 5500 0223 22735 0220 0220 0220 0221 02224 0.015 72224 0.015 72224 0.2224 0.2224 0.2224 0.2224 0.2224 0.2224 0.2224 0.2224 0.2224	In the second seco	alite Constructions Vall Short France, Vest Red Big C11164 re the readfue St of all of the re	bifs bas bifs bas
Model dato	Sufficiency - Association Suffice Convection Linear Thermal Bidge		, ,	Intermost layer Status (m) 1990 Thickens (m) 1935 Beiged? No Outside Surface Fix convective heat trans. No Incide Surface

So, I will set the U value here and the calculated value will be brought to 0.44 by defining the layers which are already here or if I want to define the layers I may just define the layers.

(Refer Slide Time: 07:19)

onstructions Loven Suface projetes Image Calculated	Cost Internal source Condensation analysis	Help Ma Dari		
and the second second		Construction Layers		Jelo Data
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⊴Julanial Thckrast (n) Bridged1 Model date	Bood Availados A (Sass Ram Acass) 9 (Sast Bosen base Sada Constantin Sada Constantin Sada Constantin	Halp Canal Of	Gent B	Bedged? 100 Layer 2 0.055 opposed Technology 0.010 percent Bedged? 100 Layer 3 00 Declaration (2005) Declaration Declaration (2005) Declaration (2

So, suppose I have 3 layers. I may then go on to define these individual 3 layers and along with that I may define the U value.

(Refer Slide Time: 07:29)

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Leweneviatere in all (n24/W) UV-Valen entrock (Min242) R-Valen (m24/M) UV-Valen (M/m2-F)	2175 0.454 D; 2275 0.450	- displayed here is to deased	Carcel (XK	Incolver metal dedding i No Leyens - Handre of layers 4 Outermost layer - (V 5% Stock) - Thockness (a) 01110 Dedgerl No Leyer 2 - (V 5% opportune) Thockness (a) 01519 Dedgerl No Leyer 3
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(Refer Slide Time: 07:34)

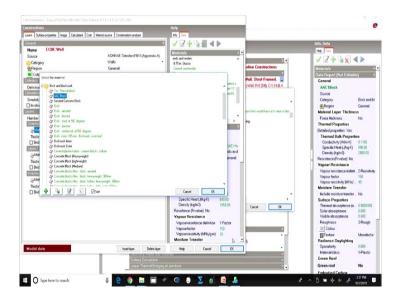
onstructions		Help		
Largen Surface properties I image Calculated I	Cost Hemai source Condensation analysis	Info Construction Levers		
Beneral				Info, Data
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Region	General	× Dateta Jaren	eine consugations	Constructions
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Defention	Haar	You can also add bridging to any layer to model the	Wall R-0 (0.8) C-1.14 (6.4	General
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	1-Datesit	a less conductive material. For example wooden joists briging an insulation layer.		Source ASHRAE
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	0 / 3 III 54000	to meet the mandatory energy code U-value as set on the Energy Code tab at site level.		Calculation Settings
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Material	0.625 in gyptum board	bridging is used in the construction.		Layers Number of layers 4
Thickness (m)	0.0159	all Set U.Value		Outermost layer
Thickness (m)	0.0+53			S 0.75 in Stacco
Internost layer		Reverse condituction lavera		Thickness (m) 0.0110
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C) and gen.			, ^v	Thickness (m) 0.0159
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				Sy Board insulation (Glass fiber boa
				Thickness (m) 0.0381
			1	Bridged? No
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		1	5	S 0.625 in gypsum board
Model data	Incent lawer Delete lawer	Heb Carcel DK		Thickness (m) 0.0159
				Bridged? No
	Surface Convection		16	Outside Surface
	Lines/ Thermal Bindiging (Fix convective heattrans. No Inside Surface
				Inside Sanace

So, if I have to define the U values if I have to define the external walls as per ECBC I will have to check for both.

(Refer Slide Time: 07:40)

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Here you can change the construction materials to bring in whatever layers we want.

(Refer Slide Time: 07:49)

aven Surface properties Image Calculated	Cost Internal source Condensation analysis	Ma Data		
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Name ECBC Wall		· · · · · · · · · · · · · · · · · · ·		Heb Carl
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Calegory	Walls .	AAL Block A Americal Concerte Block	• 10	
Region	General	Incl	eline Constructions	Materials
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alculation Settings	t	Exci - service at SIC degrees		Source
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Involves metal cladding		Brokwolt Amer Brokwolt Outer		Region General
ayera		Conert/plane/monar centre blocks cellular	ace then I would have a U value of abo	Material Layer Thickness
Number of layers	. t	· · · · · · · · · · · · · · · · · · ·	-	Force thickness No
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S Material	AAC Block	Genoral		Detailed properties Yes
Thickness (m)	0 0190	AAC Block		Thermal Bulk Properties
Brdged?		Source		Conductivity (W/m-K) 01100
Leyer 2		Category Bick and blo		Specific Heat (J/kg/t) 896.00 Density (kg/m3) 2800.00
Material	0.625 in: gypsum board	Region General		Resistance (R-value) No
Thickness (m)	0 0159	Material Layer Thickness		Vapour Resistance
Bidged?		Force thickness No		Vapour resistance definit, 2-Resist
imemostlayer		Thermal Properties		Vapour factor 150
Material	Board insulation (Glass fiber board)	Detailed properties Yes		Vepour resistivity (MNs/4)
Thickness (m)	0.0688	Thermal Bulk Properties		Moistere Transfer
Bridged?		Conductivity (W/m-K) 0.1100	~	Include moisture trensfer No
		Specific Heat (Mig-II) 816.00	,	Surface Properties
		Density (kg/m3) 2800.00	Carcal DK	Themal absorptance (e., 0.90000
		Resistance (R-value) No	and the second s	Solar absorptance 0.600
		Vapour Resistance		Visible absorptance 0.600
		Vapour resistance definition 2-Resistvity		Roughness 3-Rough
		Vapourfactor 150 Vapourresistivity (MNs/gm) 40		
		Moisture Transfer ·	•	Bediance Daylighting
			15	Specularity 0.000
Model data	Inset layer Delete layer	Heb Cancel DK		Meterial class 1-Plastic
	Ministration of the second sec			Green Roof
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Tackess (e) 01% 01% 00% 00% 00% 00% 00% 00% 00% 00%	oyers Number of loyers Outcompatitive	1	Cemerbiplatin/horar - ppurrylatin sand aggregate Cemerbiplatin/horar - ppurrylatinny C	ace then) would have a U value of abo	Moterial Layer Thickness Force thickness No Thermal Properties
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Hostince (Freduct) (b Vagare instance	Substantial Substantial Thickness (m)		Thormal Properties Detailed properties Yes Thormal Balk Properties Canductive (With K) 0 1500 Specific Heat (Alkg K) 1150.00		Vepsur resistivity (MNs/4) Moistere Transfer Include moisture transferNo Surface Properties
Model data Deben type Deben type Malp Caneal DK. Material Cases 14Ptes/sc Model data Second and Annual Second and Annual Second Se			Resistance (R-value) No Vapour Resistance Vopour resistance definition 1-Factor Vapour factor 150 Vopour resistivity (MNs/gm) 10	Carcol DK	Solar absorptance 0.500 Visible absorptance 0.500 Paughness 3-Rough Colour Texture Manufactu
	Medel date	MINIMUM WALKINGTON			Specialeity 0.000 Meterial class 1-Plastic

(Refer Slide Time: 07:51)

constructions		Help		Ø
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Source	ASHRAE Standard 90 1 (Appendix A) Walls	del A		
Conlegary Region	General	05 m (127 mm) gpmm board	eline Constructions	Materials
Cold	General	0625 in genus boad	and constructors	Data Report (Not Editable) #
Select the material			Wall, Steel-Framed,	General
Definition (1) Control (1) Con		A gregate	Well R-0 (0.8), C-1.14 (6.4	0.625 in. gypsum board
Entertained (R 🕐 Capets and floor coverings)				Source ASHRAE H
Simulate a Ganet				Category Plaster
I levely a State		92~14	î.	Region US General
Loyars 🛛 🖲 👩 Gravels, beddings, etc.		B+Drys	ace then (would have a U value of abo	Moterial Loyer Thickness
Number R housing naterals		, [×]		Force thickness No
Metals 1		in the second	ng.	Thermel Properties
Stal a Otte				Detailed properties Yes
Thicke (i) Phase change				Thermal Bulk Properties
Ci Ded		AAE His		Conductivity (W/m-K) 01600
Record Rector				Specific Heat (J/kg/K) 1150.00 Density (kg/m3) 640.00
And it of Sands, stores and sols		eneral		Resistance (Rivelue) No
Thicke (R) Screeds and renders			1	Vapour Resistance
	d Merical Dreak (Vapour resistance definit. 1-Factor
a Mater				Vepour factor 150
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🛛 Bid 🍨 💁 😰 😒] Sat	Cancel OK	v .	Include moisture transfer Yes
		Specific Heat (JAg-R) 1150.00		Moisture transfer sett. Generic Gy
		Density (kg/m3) 640.00	Cancel DK	Surface Properties
		Resistance (R-value) No		Themal absorptance (e. 0.9000000
		Vepour Resistance		Soler absorptance 0.700
		Vapour resistance definition 1/Factor		Visible absorptance 0.700 Roustness 3-Rough
		Vapourfactor 150 Vapourresistivity (MNs/g m) 10		
		Moisture Transfer ·	•	Colour
				Texture Brushed flat Rediance Daylighting
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	Surface Convection	10:41		Material class 1-Plastic
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So, suppose I want to use AAC block and then in between I want insulation; so, all these materials and their templates are already available.

(Refer Slide Time: 07:56)

	(1998) In 1997 (1997 (1997 (1997 (1997				
astruction		Cost Internal source Condensation analysis	Help		
anerel	e propertes mage Caculareo	Cost Hema source Consensation analysis			Info, Data
Name	ECBC Well		·		Heb Data
Source	COPO THE	ASHRAE Standard 90 1 (Appendix	A) Materials 5		
Calegon	/	Walls	der 05 n (127 nm) gournboad	· ·	V 2 + 9 x 4 >
Region		General	0625 in gpoun board	eline Constructions	Materials
Colo	ciect the material		In againer to a second se		Data Report (Not Editable)
fin/ficn			graphe	Wall, Steel Framed,	General
Definition		lation Mineral Iber(Elective Tranes)/cavity Binature at 15 in on- fation Mineral Iber(Elective Tranes)/cavity Binature at 24 in on-	(mm)	Available for the second second	Board insulation (Glass liber bor
Similate		R 22 Environment Expanded polystylene molded beads (Effect			Source ASHRAET Celesory Insulation
] knyphy		R 30 Disculation. Expanded polystyrerie molded beads (Effect R 33 Simulation: Expanded polystyrerie molded beads (Effect)		^	Region US General
Nels.		R-336 Insulation Expanded polyntaene milded beats Effect		ace ther I would have a U-value of abo	Material Laver Thickness
Number		N-247 Insiation Expanded projectivene milded beads (Effect			Force thickness No
Outerrac		R 26 6 Insulation Expanded polystylene molded beads (Effect R 33 2 Insulation Expanded polystylene molded beads (Effect		wg.	Thermal Properties
Sylla		IN 23 2 Instalation & spanded polyriponial installed based (Effecti IN 29 5 Instalation - Expanded polyriponial installed based (Effecti			Detailed properties Yes
Thicke	St En deph carly B Sten	laton Mineral (Ber(Ellipctive Lanerg)/cavity PL value at 15 in care	enter)		Thermal Bulk Properties
Brd		Bation Minesal (Ber)[[Bective Transg/Cavity F) value at 24 in: on r			Conductivity (W/m-K) 0.0360
Leyer2		P. 30.4 Insulation. Expanded polystyreme: molded breads (Effect) PL44.0 Insulation. Expanded polystyreme: molded breads (Effect)			Specific Heat (J/kg/l) 040100
SMA		II 50 4 Insulation Expanded polyotaene midded beatigEffect			Densily (kg/m3) 110.00
Thicks	Sy Aerated Concrete		Accession 1		Resistance (R-value) No Vapour Resistance
Bed	Stabestos wated notwah				
imerno	Stand mutation (Class Fiber St Celulose Celulose 200 m				Vepour resistance definit. 1-Factor Vepour factor 150
SHal	E. Cathan Band	an and some party of	· · · · ·		Vapour recistivity (MNs/ 10
Thicke			· · · ·		Moisture Transfer
Brd	8 8 8 8	Ø Sat	Cancel DK	v	Include moisture transfer Yes
			Specific Heat (JAg-R) 1150.00	3	Moisture transfer sett. Generic GI
			Density (kg/m3) 640.00	Carcel DK	Surface Properties
			Resistance (R-value) No		Thermal absorptance (e. 0.9000000
			Vepour Resistance		Soler absorptance 0.700
			Vapour resistance definition 1 Factor		Visible absorptonce 0.700
			Vapour lactor 150		Roughness 3-Rough
			Vapourresistivity (MNs/gm) 18 Moisture Transfer		Colour
_				5	Texture Brushed fle
Aodel dal	a	Insert layer Delete I	ayer Help Cancel DK	· ·	Rediance Daylighting Specularity 0.000
		MANDAL PROPERTY AND			Specularly 0.000 Material class 3-Plastic
		Surface Convecto		-	Green Root
		Linear Thormal Br	dging at Junchons	۰ ۲	
					Green roof No

We can choose any construction material in case construction material that you have to use is not available.

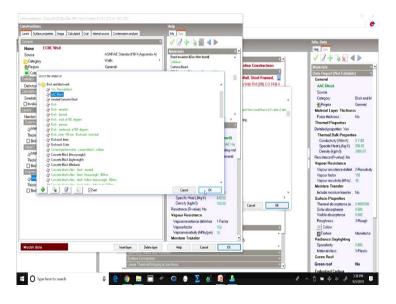
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Class ford Class f		of Herry source Conferention analysis			
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Green Boot	Model data	E ELEVISION CONTRACTOR	Vapour Resistance Vapour resistance definition Vapour testistion Vapour resistivity (WRsigm) Monstare Transfer Heb Carcel		Soler nhroptesce 0.700 Visible absoptance 0.700 Poughness 3-Rough III Colour Difference Daylighting Specularity 0.000
Lines I nome boging is section.		Linear Thermal Bridging a		· · · ·	

(Refer Slide Time: 08:14)

astructions		Help		
	Atted Cost Internal source Condensation analysis	Mo Data		
eneral	1	V 2 + 2 1 + 2		Info, Data
Name ECBC Wall		Materials 3		Help Data
Source	ASHRAE Standard 10 1 (Appandex A)	Board mulaton (Glass Iber board)	1	V 2+ xx 4>
Calegory Begion	Wells .	Cellatore Crahem Board	eline Constructions	Materials
Cold	Grand	Useen scars	-	Data Report (Not Editable)
Select the material			Wall, Steel-Framed,	General
Nefector (8) 🔿 System		*	wall R-0 (0.0) C-1.14 (6.4	Board insulation (Glass liber bo
Control (R) Asphalts and other roots				Source ASHRAE
Simulate + 5 Bick and blockwork	ungi			Category Insulating
] ItivoMr (ii 👩 Carpets and floor covers	Ψ			Region US Geren
Serie (R) Concretes			ace then (would have a U value of abo	Meterial Layer Thickness
Number + Glass			ing.	Force thickness No
				Thermal Properties
SyMal (a) imported				Detailed properties Yes Thermal Bulk Properties
Brd Reals		iard)		Conductivity (W/m-K) 0.0360
property (i) 🕐 Other		WE Ha		Specific Heat (J/kg/f) 840.00
Mal R Phase charge		ding met		Densily (kg/m3) 160.00
Thicky (1) Plance, sold		enerel		Resistance (R-value) No
Bid R D Rubber				Vapour Resistance
permanent (#) 🔁 Sandt, shows and sols				Vapour resistance definit. 1-Factor
Screeds and renders				Vapovr factor 150
Thicks in a tau	er shipping and Piernal break c	*		Vepour resistvity (MNs/
🗆 Brd 🌵 🚱 📝	X Sot	Carcel OK		Include moisture transfer
ber a prime being a street		Specific Heat (JAp-43 840.00	, , , , , , , , , , , , , , , , , , ,	Moisture transfer sett. Generic G
		Density (kg/m3) 160.00		Surface Properties
		Resistance (R-value) No	Carcel DK	Themal absorptorce (e. 0.9000000
		Vepour Resistance		Soler obscriptence 0.700
		Vapour resistance definition 1-Factor		Visible absorptance 0.700
		Vapourfactor 150		Roughness 3-Rough
		Vapour resistivity (MNs/gm) 10	· · ·	Colour
		Moisture Transfer .	5	Texture Brushed II
Aodel data	Inset Isuer Delete Isuer	Heb Carcel DK	· ·	Rediance Daylighting
	Manual Manual Annual Annua	ALMA .		Specularity 0.000
	Surface Convection			Material class 1-Plastic
	Linear Thomal Bridging		· · ·	Green Root
				Green roof No

(Refer Slide Time: 08:20)



You may define the material and you may change bring in the template for that material as well as we have been doing. So it is possible to create any construction material any template depending upon your requirement.

(Refer Slide Time: 08:23)

onstructions				
aven Surface properties Image Calculated C	Cost Internal source Condensation analysis	Mg Cas		
General	1			Info. Data
Name ECBC Wall Source Collegary Region Colour	ASHRAE Stenderd 10 I (Appendix A) Walts General	Motionals 3 - AAC Block A America Concerte Block A America Concerte Block Block Block Block - Block - America America Block - America	eline Constructions	Help Cara V 2 + 2 2 4 Materials Data Report (Not Editable)
Difference Defentee method Reference Sertings	Hayers .	Rick and at 500 degrees Rick parents Rick antifaced at 500 degrees	Wall R-0 (0.0), C-1.14 (6.4	General AAC Black Source
Simulation solution algorithm Involves metal cladding	1-Detout •	Brick week 105 mm Brickweik Odern Brickweik Outer	n nce free I would have a U value of abo	Category Brick and Pergron General
Number of layers Outermost layer	1 ·	Conext/Jacks/horter conext blocks, cellula Conext/Jacks/Conext blocks, cellula Dista Resport (Not Edulable)	ing.	Material Layer Thickness Force trickness No Thermel Properties
Sylfatental Thickness (m) Bidged? Invest2	AAC Block 0 0190	y Genoral AAC Block Source		Detailed properties Yes Thermal Bulk Properties Conductivity (W(m-K) 0.1100 Specific Heat (Jkg-K) 896.00
⊕Material Thickness (m) □ Bridged?	Board insulation (Glass fiber board) 0 0159	Category Brick and blo Region General Material Layer Thickness Force thickness No		Density (kg/m3) 20000 Pesistence (R-velue) No Vapour Resistance
Thickness (m) Bidged?	AAC Block	Thermal Properties Detailed properties Thermal Bulk Properties Conductive (Win-K) 01100		 Vapour resistance definit. 2-Resista Vapour factor 150 Vapour resistvity (MPa/40 Moisture Transfor Include mointure transforNo
		Specific Heal (JAg-F) 816.00 Density (kg/m3) 2000.00 Resistance (R-value) No Vapour Resistance Vapour resistance definition 2-Resistvity	Carcel DK	Surface Properties Themal absorptance (e. 0.900000 Solar absorptance 0.600 Visitle absorptance 0.600 Roughness 3-Rough
		Vapourfactor 150 Vapourresistivity (MNx/gm) 40 Moisture Transfer •		Colour Texture Manufact Rediance Daylighting
Model data	Inset layer Delete layer	Help Carcol OK		Specularity 0.000 Material class 1-Plastic Green Roof
	Lines: Themal Bidging a	a Auctora		Green roof No Embodied Centron

(Refer Slide Time: 08:28)

inven Surface properties I image Calculated	Cost Hemai source Condensation analysis	Ho Day		
laneral	1	Construction Layers Set the number of layers first, then select the material		Info, Data
Neme CRCWdd Soral CRAption CRAption CRAption CRAPT CRAPTIC CRA	A34542 Studed 191 (Appendix A) Valids General 1 FLayers 1 1 - Default 3 - Charles 3 - Char	Hardmann of a give VII, then see the matter a set of the second secon	the CostNation Vel Bold Child I vel Bold Child I vel Bold Child I vel Bold I vel I vel Cost	Po Po Po Po Po Po Po
Model date	Inset type: Dotest type: En annual your annual source Statest Convector	Hep: Carcel DK		Texture Manufectur Radiance Daylighting Specularity 0.000 Material class 1.Flastic Greeen Rual
	Unear Thermal Bridging			Green root No

So, AAC block of 0.15 meters an insulation of 0.001 meters and 0.1 again.

(Refer Slide Time: 08:52)

aven Surface-properties Image Calculated Co	at Internal source Condensation analysis	Info Dec		
Anne CCC Well Name CCC Well Originy Originy Corpore Control marked	ASHIAE Standard 90 1 (Appendix A) Waltis General F-Layies 1-Default	Construction Layers Set the number of layers first, then select the material and thickness for each layer.	Ant. Constructions Ant. Source France. Ant. So	bifs bols ■ the bols
Indencolinger GMAttend Thickares (m) ☐ Bedged?	AVC Duok. g1		Cercel 05	Vigour wisches detti. 2 Festiske Vigour testiske ABA, 40 Missieur Statuske ABA, 40 Missieur Transfer Indiane missieur Statuske ABA, 40 Sole ehoopstere Biol Visite ehoopstere Biol Visite ehoopstere Biol Reughness 37 Reugh Colour Biol Biole ABA, 40 Missieur Biol Manders Charles Biol Scendeller Biol
Model data	Inset lajer Delete lajer			Specularity 0.000 Material class 1-Plastic Green Roof
	Linear Thermal Bridg	ing at Junctora		Green roof No Embodied Cothon

And along with this I set the U values to be 0.440.

(Refer Slide Time: 08:59)

Loven Surface properties Image Calculated	Cost Internal source Condensation analysis	Ho Day			
Deneral Name ECBC Wall	1	Construction Layers Set the number of layers first, then select the material		Info, Data	
Source Sources Sources Sources Catological Control Catological Control Control Catological Control	ADHAT Shorker BB (Appendix A) With General I Katyen 1 1 Contral 3 3 4 C Dirok 8 132 8 Boerd Hysters (Class Nor Leon) 8 800 8 100	In the Horsen See wash later in the See See See See See See See See See S	Attine Consolutions	Progen Ge Medicinal Layer Thickness Force thickness Into Thermal Properties Detailed poperties Conduct your fail (Control of the Control Conduct your (Control Conduct your (Contro) Conduct your (Control Conduct your (Control Control	ick and I aneral 0 1100 600 0000 Residud 0
Thakess (n) ☐ Bhdged? Model data	57	Help Canol OC	5 6 7	Colour Colour Madiance Daylighting Specularity 0.0	9000000 900 900 Rough anufactur 900 Plastic

(Refer Slide Time: 09:00)

Layers Surface properties Image Calculated Cost In	ternal source Condensation analysis	Ho Day		
imer sufece		Calculated Data This tab provides further information on the heat		Info, Data
Convective heathcaster coefficient (W/m24)	2.793	this tap provides further information on the field transmission properties of the construction.		Help Data
Padiative heat transfer coefficient (Wiin24)	5.540	This data is used in Simple calculation methods	1	V Z+ WX 4>
Surface resistance (m2-K/M)	0.120	such as SBEM and generally NOT in EnergyPlan	the party of the local data was not a second data was a second data was a second data was a second data was a s	
Tuter surface	100.00	simulations.	eline Constructions	Hoterials
Convective heattransfer coefficient (W/m2-K)	27.793	Exceptions are window trame U-values and use of		Data Report (Not Editable)
Radiative heat transfer coefficient (W(m2-K)	5.540	fixed CIESE convective heat transfer coefficients (more below).	Wall, Steel-Framed, 📕	General
Surface resistance (m2-K/W)	0.030	U-values are shown including and excluding the effect	Well, R-0 (0.0), C-1.14 (6.4	AAC Block
io Bridging	1919/10 March 1919	of surface resistance and are calculate dwith and		Source
U-Value surface to surface (M(hs2-K)	0.421	without bridging effects.		Category Brick and
R-Value (m2-K/W)	2.273	Note that the outer surface resitance depends on the		Region General
U-Value (W/m2-K)	0.440	exposure to wind (on the Location tab at Site level)	ice then would have a U-value of abo	Material Layer Thickness
		Convective heat transfer coefficients		Force thickness No
Thickness (m)	02333	The convective health ansfer coefficients displayed are used in EnergyPlus when the CIBSE Inside/Outside	ng.	Thermal Properties
Km - Internal heat capacity (K.Ijm2-K)	250 8000	convection algorithm is selected. Otherwise		Detailed properties Yes
Upper resistance limit (w2+VW)	2.273	^b EnergiPlus uses its' own convection algorithm as set in the simulation options and the transmission data		Thermal Bulk Properties
Lowerresistance limit (m2-8/W)	2.273	in the simulation options and the transmission data		Conductivity (W/m-K) 01100
U-Value surface to surface (W3w2+3)	0.421			Specific Heat (J/kg/K) 896.00
R-Value (m2-KW)	, 2.273			Density (kg/m3) 2000.00
U-Value (W/m2-K)	0.440			» Resistance (R-velue) No
a rass (riting rit				Vapour Resistance
				Vapour resistance definit. 2-Resistiv
				Vepour factor 150
				Vepour resistivity (MNs/4)
				Moistere Transfer
			v	Include moisture transfer No
			,	Surface Properties
			Carcel DK	Themel absorptance (e0.9000000
				Soler absorptance 0.500
				Visible absorptance 0.600
				Roughness 3-Rough
				Colour
				Texture Manufactu
		II	8	Rediance Daylighting
Model data		Heb Carcel DX	- ·	Specularity 0.000
	REAL PROPERTY AND INCOME.	and the second se		Material class 1-Flastic
	Surface Convecto			Green Roof
	Linear Thormal Br			Green roof No
	the second secon			Embodied Control

So, now with the given layers the reduction in insulation thickness is now resulting in a U value which is prescribed as per ECBC.

(Refer Slide Time: 09:10)

	office buildings 1, Building 1 Layout Activity Construction Openings Lighting HVAC	Generation Economics C/D	Info, Data
X < > 2	Q Constructor Template	1 A	V 2 + k x 4 >
Iffice buildings1 Publing 1 Juildings diffice buildings diffice diffice diffice b	Cambodo Cantoco Caternal walls Caternal walls Select the completion grade walls	C21 Nonresidential Boxeline Constructions Copy of C21 New Res, Wall, Steel Framed, C21 Non-Res, Below-Grade Wall, R4(0)(), C-114(6.4)	Moheriala Dinis Roport (Not Editable) General AAC Block
 ⊕ Zone 1 ⊕ Zone 3 ⊕ Zone 4 ⊕ Zone 4 ⊕ Zone 5 ⊕ Zone 5 ⊕ Tore ⊕ Zone 4 ⊕ Zone 4 ⊕ Zone 5 ⊕ Zone 5 ⊕ Zone 5 	Beards raph for construction by plating location and platic construction beards of the Care of BEN WITH EL. Constructions of the areas of the Care of BEN WITH EL. Constructions of Care of the Physical Ben Ben Beard (2018) (59:03570 (300m) On Comm 3.579 (20m) Opph Terring (100m) Content - 559 (20m) Opph Terring 547 (300m) Content - 559 (20m) Opph Terring 547 (300m) Content - 359 (20m) Opph Terring 147 (300m) Content - 359 (20m) Content - 359 (20m) Content - 350 (20m)	Source Caregoy Bick and Physics Careful Material Lyer Thickness Ho Thread Paymen Yes Consciency Works 1111 Special Intel Payment Yes Consciencing (News) 1110 Special Intel (News) 101 Desky (Special Intel
		Carcel 0K	Surface Properties Themel absorptance (e. 0.900000 Solar absorptance 0.600
	Maximum transmittance Transmittance schedule Photovolteic Options	0 010 On 24/7	Visible absorptionce 0.600 Roughness 3-Rough Will Colour
		1-Smple ·	Texture Manufact

And we just accept it as the ECBC prescribed wall which will now take the U value which is defined in ECBC.

(Refer Slide Time: 09:15)

vigeto, Site	office buildings 1, Building 1 Layout Activity Construction Openings Lighting HV	WC Generation Economics CFD		Info, Data	
】x ◀ ▶ ଅ	Construction Templete		•	V 2 + 4x 4	
j slice buldege1	Template	C21 Nonresidential Baseline Construct	ions	Constructions	
🖯 🅐 Building 1	Construction			FulyMed50mmm worl/14050	
(INVIC System)	External walls	ECBC Wall		Fully Med PSemmer wool U+0 41 Holes and vents	
* Q care	Below grade walls	C21 Non-Res. Below-Grade Wall, R-0 (0.8), C		IRT Suface	
· () Zone 1	C)Flat roof	C21 Non-Res. Root Ins Entirely above Deck.		Lightweight concrete block at gap	L plasteboa
* () Zone 3	Fliched roof (occupied)	C21 Non-Res. Root ins Entrely above Deck.		Lightweight concrete block gip inst	
* (3) Zone 4 * (3) Zone 5	Fitched root (unoccupied)	C21 Semi Exterior, Root, Ins Entrely above D		Lightweight concrete block poly in	
* (0) Zone 5 * (0) Zone 6	ginternal partitions	Pattion -2 x 1 in (2x25mm) gypsum plasterb	perd with	Lightweight concrete clad wall (no Lightweight curtain wall (mulated)	
e ty zone o	Sem-Exposed			Lightweight outain wall inculated to	
* () cree	Semi-exposed walls	C21 SemiExterior, Wall, Steel-Framed, Pr0 (Lightweight superinculated	
(e) Zone 1	Sem-exposed ceiing	C21 Semi-Exterior, Caling, Steel-Joint P-0 (8		Livi body	
⊕ (3) Zone 3 ⊕ (3) Zone 4	Semi-exposed floar	C21 Semi-Exterior, Floor, Steel-Joist, Pr0 (0 II	U-35 (1	Metal clad wall (novlated to 1995)	
* 0 Zare 5	Floars			Part Ltest Cav wall with lightweigh	reacony lea
* (9 Zana 6	Ground floor	C21 Non-Res. Slab-On-Grade Floor, Unheate	rd, FI-0 (0	Data Report (Not Editabl	6)
	CBasement ground floor	Solid basement ground floor, uninsulated		General	
	Extensi for	C21 Non-Res, External Floor, Steel-Joint, R-0	(0.0), U-3	* ECBC Well	
	Conternal ficor	Intermediate floor - 4 in (108mm) concrete sta	b	Source	ASHRAE
1	Sub-Surfaces			Category	Wals
	Internal Thermal Mass			Region	General
	Component Block			Colour	
	Shades and reflects			Definition	
	Level	1-Building		Defation method	Hovers
	-uMoterial	Component block material		Celculation Settings	. cojen
	Flet surface position	1-Upper surface		Simulation solution algori	1.Defail
	Maximum Intermitteere	0.010		Involves metal cladding	
	12 Transmittance schedule	On 24/7		Leyers	140
	Photovoltaic Options		1	Number of layers	3
	Performance type	1-Smple		Outermost layer	
	Performance model	PV Constant Efficiency = 0.15		Sy AAC Block	
	Heat transfer integration mo			Thickness (m)	01332
	Geometry, Areas and Volumes	and the second sec	100	Bedged?	No
D	Surface Convection		1 m	Laver 2	10000
-	Linear Thermal Bridging at Junctic			Sy Board insulation (GI	

(Refer Slide Time: 09:24)

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te de la construction de la constru	Layout Activity Construction Openings Lighting HVAC Gener	ation Economics CFD	Help Data
	Construction Template	1.	124 4 4 4
all dice buildrant	Template	CZ1 Nonresidential Baseline Constructions	Constructions
ence colorgi	Construction		Internal Wall - Section 6 2015 Rotorial Public
(INVIC System)	C External walls	ECBC Wall	Internal wall sub-surface construction
e 🕲 kat	Below grade wells	C21 Non-Res. Below-Grade Wall R-0 (0.8). C-1.14 (6.4	Lightweight 2 x 12mm Residuald with 100mm of
* (i) core * (i) Zone 1	Platroot	C21 Non-Res. Poot Ins Entrely above Deck, R-148c i	Lightweight 2 x 25mm gaptum plasterboard with
* G Zone 3	Pitched roof (occupied)	C21 Non-Res. Root ins Entrely above Deck, R-14 llc.i	Lightweight party-wall-dunestic Lightweight planterboard parties
* () Zane 4	Pitched roof (unoccupied)	C21 Semi-Exterior, Root Ins Entrely above Deck, R-4c	Parition 2 x 1 in (2/25ma) gpour plastebo
8 (9 Zone 5	Carternal partitions	Pertion - 2 x 1 in (2x25mm) gypsum plesterboard im	sold breeze blocks (glasted both sides)
· (9 Zone 6	Sam-Exposed	121	Sold party wall -domestic
⊖ 💱 pound ⊛ til care	Servexposed walls	C21 Semi-Extense Walt Steel-Framed, R-0 (0.0), U-35	themalte
# 00 Zone 1	Sam-exposed ceiing	C21 Semi-Exterior, Calling, Steel-Joint Pr0 (0.0), U-35 (
· (9 Zone 3	Semesposed floor	C21 Semi-Exterior Floor Steel-Joint P-010 Ib U-35/1	Receiption and the second seco
🛞 🚱 Zone 4	Flore	1	Brok, an IV-w concrete block & hall mentral would
* (3) Zone 5 * (3) Zone 6	Ground floor	C21 Non-Res. State-On-Grade Floor, Universed, R-8(0)	Data Report (Not Editable)
in the same of	Basement ground foor	Solid basement ground floor, uninsulated	General
	<	C21 Non-Res, External Flotz, Steel-Joist, R-9 (8/8), U-3	
	Chitemal foor	Intermediate floor - 4 in (100mm) concrete slab	Partition - 2 x 1 in. (2x25mm) g
	Sub-Subaces		Source Design Category Partico
	Istanse Thermal Mass		
	Component Block	1	
	Shades and reflects		Colour
	Lavel	1-Buildeg	
		Component block material	
	Flet suffece position	1-Upper sufface ·	Calculation Settings
	Maximum transmittance	0.010	Simulation solution algori. 1-Defau
	Transmittance	0x24/7	Involves metal cladding No
	Photovoltaic Options	GROW .	Leyors Number of Instein
	Performance type	1-Smple ·	Number of layers 3 Outermost layer
	Performance type	PV Constant Efficiency = 0.15	
		1-Decoupled ·	Gypsum Plasterboard Thickness (m) 0.0250
	Heat transfer integration mode Geometry, Areas and Volumes	- Cecupier	Bedged? No
	Surface Convection		Linver 2
	Unear Themal Bridging at Junctions		Sy Argop 10mm
	contract memory bridging in selectorie	•	Thickness (m) (1000

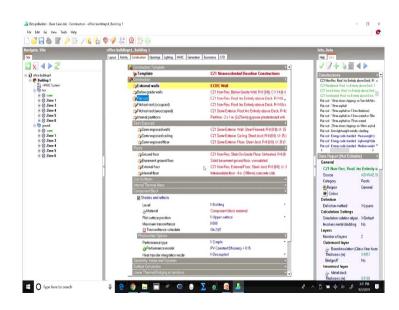
Similarly we change for internal partitions which are not defined. So, we can take it whatever material we want. It is not defined in ECBC.

(Refer Slide Time: 09:33)

tvigete, Site te	office buildings 1, Building 1 Layout Activity Construction Openings Lighting HVAC Gene	ration Economics CFD	Tefo, Data Help Cara
	Construction Templata	1	V 2+ 3 4 >
a) slice buildings 1	Template	CZ1 Nonresidential Baseline Constructions	Constructions
B P Building 1	Construction	1	Continued service exposed root. Emerge code stars:
21 (HVAC System)	External walls	ECBC Wall	Contined seni-exposed sol. Energy code stars
🖯 😰 het	Below grade wells	C21 Non-Res: Below-Grade Wall R-0 (0.8): C-1.14 (6.4	Continent servi exposed soll. Energy code stand
· O care	Film root	C21 Non-Res. Root Ins Extently above Deck, R-148	Contined servi exposed root. State of the at -H
* (i) Zone 1 * (i) Zone 3	Pliched roof (occupied)	C21 Non-Res. Root Ins Enhely above Deck, R-14 lbc i	Contined service poind sol. State of the at -U Contined service poind sol. State of the at -M
in 03 Zone 4	Fitched roof (unoccupied)	C21 Semi-Exterior, Root Ins Extremy above Dridk, R-4c	Contract two exponents of Tapcal sterrore
* (3 Zone 5	pinternel partitions	Patton - 2 x 1 in (2x25mm) gypsum plasterboard with	Conbined zeroi exposed rock Typical reference-
🛞 🚯 Zone 6	Semi-Exposed	Particle - C x Hit (Creating When here account of	Conbined seni-exposed root - Typical reference-
⊖ 😵 gourd ⊛ t0 care	Servex posed wells	C21 SemiExterior Wall Steel Framed, Pr0 /0 (0, U- 35	Conbined temi-exposed rack. Uninsulated: Hear
* O Zane 1	Semilexposed reling	C21 Semi-Exterior Caling, Steel-Joint R-0 (80), U-35 (Conbined seni-exposed sol: Unerstated Light Conbined seni-exposed sol: Unerstated Mid
* 03 Zone 3	Serviceposed floar	C21 SemiExterior Floor, Steel-Joint R-010 B U-351	(Z1 Non-Res Real Ins Entroly above Deck, R-
· () Zone 4	Elena a	CET SHIPEMENT FUEL SHEP WAS PROVIDED TO STOLE	(21 Renderial Roal, Int Entrely above Deck.)
* (9 Zone 5	Ground floor	C21 Non-Res. Slati-On-Grade Rook. Universited R-010	()
🗷 🚱 Zone 6	Basement ground foor	Solid basement ground floor, uninsulated	Data Report (Not Editable)
	Cosement ground foor Cosement ground foor	C21 Nov-Res, External Floer, Steel-Joist, R-0 (0.0), U-3	General
			CZ1 Non-Res, Root, Ins Entirely
	ginternal ficor	Intermediate floor - 4 in (108mm) concrete stab	Source ASHRAE
	Sub-Surfaces Internel Mess		Category Roofs
	Component Block		Region General
			Colour
	Shades and reflects		Definition
	Level	1-Building •	Definition method 14 Loyers
	Material	Component block material	Calculation Settings
	Flat sufface position	1-Upper surface *	Simulation solution algori. 1-Default
	Maximum transmittance	0.000	Involves metal cladding No
	Transmittance schedule	On 24/7	Leyors
	Photovoltaic Options		Number of layers 2
	Performance type	1-Smple ·	Outermost layer
	Performance model	PV Constant Efficiency = 0.15	Sy Board insulation (Glass fiber bo
	Heat transfer integration mode	1-Decoupled ·	Thickness (m) 0.0957
	Geometry, Azens and Volumes	· · · · · · · · · · · · · · · · · · ·	Bridged? No
	Surface Convection	•	Incernost layer
	Linear Thermel Bindging at Junctions		Sy Metal deck

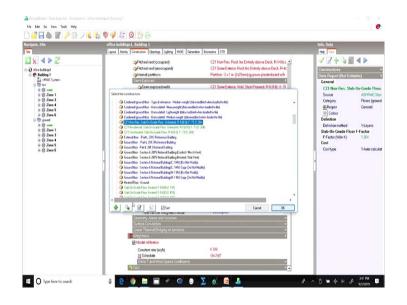
The flat roof again the U value has been defined. So, exactly in the same manner we can create a template for the flat roof. We have to create the template for the fenestration which we will see in openings.

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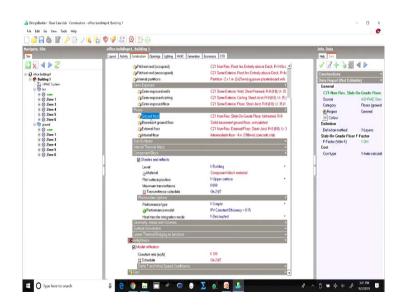
So, here for the construction we are mainly concerned with external walls and the flat roof. Once we have created the templates for these based upon ECBC or any other code that is supposed to be recommended along with that we will take whatever the ground floor slab is going to be.

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So, we may for greener constructions where we are deliberately selecting materials which are environment friendly or which have a higher thermal mass or which are more absorbing or act as heat sink we may select these different materials for the ground floor and also the internal partitions.

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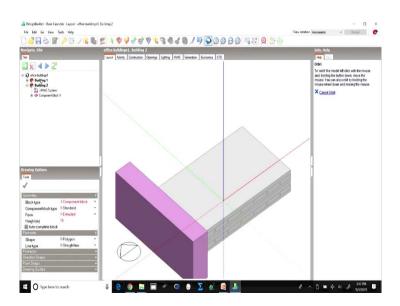
They will add, they will affect the overall thermal perform because of their thermal mass, but since they are not participating in the heat exchange between indoors and outdoors, they will not have as much impact on the overall heat exchange as external walls and flat roof. So, we change them as per the ECBC. In addition there is another block which is called the component block. So, if I go back to the layout and I go at the building level my building, the building in question, might have another building which is adjacent to it which is not included in the thermal calculations.

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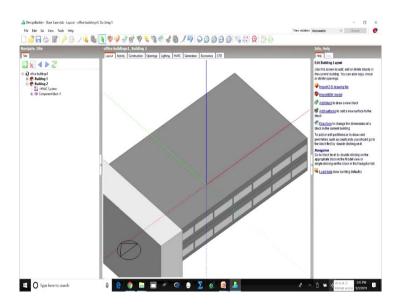
But it is taken into account because of it is shading properties because of the shading that it cast on the building.

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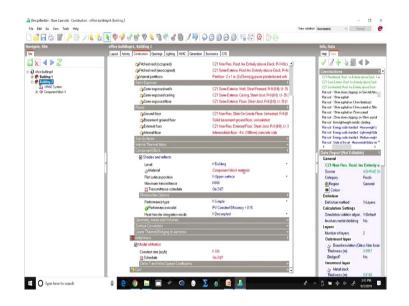
Now, that building will be created as a component block. So, we can create a component block at this site level and this component block. Suppose I make it as a 15 meter high component block. So, this component block will not participate in the thermal calculations, but the shading because of this component block will be accounted for when we are calculating, when we are taking the heat stresses, when we are analyzing the heat stresses in this building.

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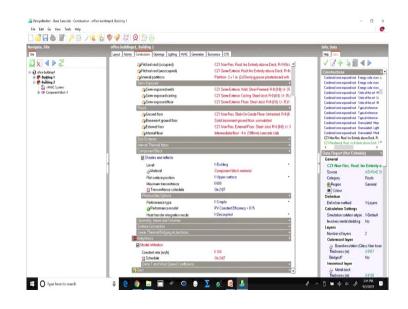
So, this is how a component block is created. Now the properties of this component block.

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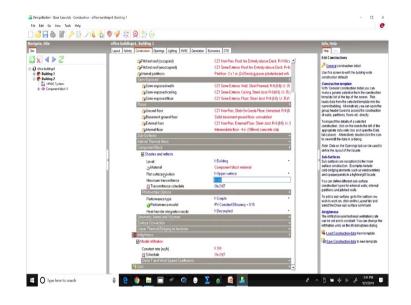


So, suppose I go to building 2. So, the properties which we have for this component block will be defined here. In our case we did not have a building block a component block. So, that is where we did not define what this component block is going to be. The reflective properties the surface properties of this component block will be taken into account, when the building 1 is going to be simulated.

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So, in our case there is no component block, but if there was we would talk about these different types of these different properties where they talked about in case there is a photovoltaic we would take the photovoltaic options.



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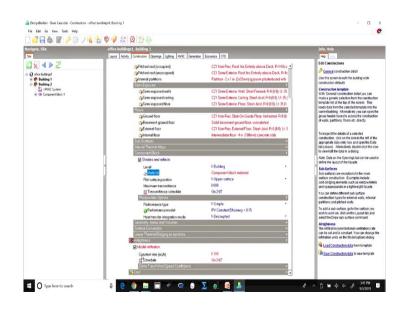
igate, Site	office buildings1, Building 1 Layout Activity Construction Openings Lighting, HVAC Generation Econ	unica CFD	Info, Data	
Image: State State State Image: State State Image: State Im	Fitched real (unoccupied) Internal particles SemiExported	C21 Non-Res, Root Ins Entrely above Deck, Pr148c1 C21 Smm-Externs, Root Ins Entrely above Deck, R-14E Patiton-2 x 1 in (2)/Smm9 gyptum plasteritoard with C21 Smm-Externs, Vial, Sme1Frenext, R-0.8 (t.U-3)	A sterials Data Report (Not Editable General Component block mater Source	
	a) Judie orden singleson by Judie orden and Jusp box and Jus	Cativy)	Category @fileson Material Layer Thickness Force thickness Thermel Properties Condexity (Wink) Scredic Hers (Layer) Densy (spin) Persistance (Freislande Vapour assisted (Mith) Migour assisted (Mith) Migour assisted (Mith) Mitoria Transfer	No 8 0.3800 1000.00 1200.00 2:Resistor 150 80
	Caronery: Aras and Volumes Suince Convectori Linner Themas Disriper at Ancolons Content in the Content of the Content Constant in the (Content	Greet D.	Soler absorptance Visible absorptance Roughness I Cobur Texture Rediance Daylighting Specularly	

In case it is not we would talk about the transmittance values, we would talk about the surface positions and we would talk about the component block material. Now, this component block material may also be changed we can take it to concrete or brick and automatically the surface properties of these materials will be brought along.

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vigate, Site	office buildings1, Building 1 Lavor Active Construction Openings Lighting HVAC		Info, Data
	Layout Activity Construction Openings Opting HVAC	Generation Economica 0-0	
3 🗶 🔺 🕨 🖉	CoFlicted root (occupied)	C21 Non-Res, Plaat Ins Entrely above Deck, P-14 Bc.i 🔺	✓ 📝 🕂 👰 🗐 🔍 🕨
(i) affice buildings1	Pitched roof (unoccupied)	C21 Semi-Exterior. Root Ins Entrely above Deck, R-4c	Moterials
🖲 🕐 Building 1	ginternal partitions	Partition - 2 x 1 in (2x25mm) gyprum plasterboard with	Data Report (Not Editable)
Building 2	Sem-Exposed		General
Orivic, system Orivic,	Semi-exposed walls	C21 Sem-Exterior, Wall, Steel-Framed, R-0 (0.0), U-35	Component block material
	Sem-exposed ceiling	C21 Semi-Exterior, Ceiling, Steel-Joint Fr0 (8.0), U-35 (Source
	Semi-exposed floar	C21 Semi-Exterior, Floor, Steel-Joist, Pr-9 (0.9), U-35 (1.	Category Concretes
	Floars	the second s	Region General
	Ground floor	C21 Non-Res. Stab-On-Grade Ploor, Unheated, R-8 (0	Material Layer Thickness
	Basement ground foor	Solid basement ground floor, uninsulated	Force Bickness No
	Contract Con	C21 Non-Res, External Flotr. Steel-Joist R-0 (0.0). U-3	Thermal Properties
	conternal floor	Intermediate floor - 4 in (108mm) concrete slab	Detailed properties Yes
	Sub-Surfaces		Thermal Bulk Properties
	Internal Thermal Mass Component Block	7	Conductivity (W/m-K) 0.3800 Specific Heat (JKpH) 100.00
			Specific Heat (J/kg-K) 1000.00 Density (kg/m3) 1200.00
	Stades and reflects	tear to	Resistance (R-value) No
	e Level	1-Building .	Vepour Resistance
	Material	Component block material	Vapour resistance defait, 2-Resistur
	Flat surface position	1-Upper suffece	Vepour factor 150
	Maximum transmittance	0.010	Vepour resistivity (MNs/
	Transmittance schedule	On 24/7	Moistere Transfer
	Photovoltaic Options		Include moisture trensfer Yes
	Performance type	1-Smple *	Moisture transfer sett. Generic C
	Performance model	PV Constant Efficiency = 0.15	Surface Properties
	Heat transfer integration mode	1-Decoupled •	Thermal absorptionce (e. 0.9000000
	Geomeny, Areas and Volumes		Soler absorptance 0.600 Visible absorptance 0.600
	Surtece Convectors Linear Thermal Bridging at Junctions		Roughness 3-Rough
	Artichhess		III Colour
	Model infituation		Tartere Brushed ft
		0.310	Rediance Daylighting
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	Colors T and Wind Speed Costion		Material class 1-Plastic
	Dots 1 and Wind Speed Coeffice		Green Roof
	-CON	•	Green roof No

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So, that is what the component block would mean. Another thing which is important is the air tightness. So, whenever we are talking about the model and we are calculating the heat gain or loss because of infiltration this is where these values will matter. So, when we are defining these values for infiltration depending upon how tight air tight the model is these values will change and ASHRAE 62 usually defines the rate of exchange in case of infiltration. Here since we are following the ASHRAE templates we would keep it as the default value of 0.3 which is coming directly from the code.

So, we leave it as it is and that is how we have completed defining the construction. So, currently I will delete this building 2 and I have only building 1, but in case you have other objects other components which are present and which will impact only because of shading then we may create all those components using the component block. Another thing that is part of construction is the fenestration the openings.

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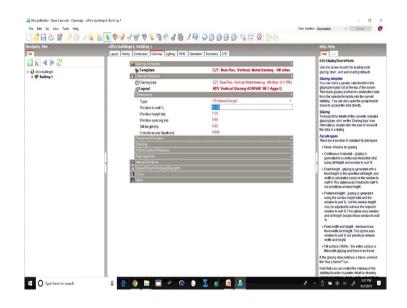
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evigeto, Site Se	office buildings 1, Building 1 Layout Activity Construction Openings Lighting HVMC	Generation Economics CFD		Info, Data	
	Clining Template	CZ1, Non-Res, Vertical, Metal Ire	1	< 2 + 2 ₪ •	
Q) urice halfspil ≥ ∉ bulding 1		C21 Non-Res Vertical Meet Issuing 49% Vertical Glosses ASHRAE Se Service Control (Control Control Dates), Fightman Control (Control Dates), Fightman Control (Control Dates), Fightman Control Control (Control Control (Control Dates), Control (Control (Control Dates), Control (Control (Control)), Control Dates), Control (Control), Control Control (Control), Control (Control), Control Control (Control), Control (Control), Control Control (Control), Control Con	- All other, U-1 199 (Claining templates Data Report Not Editable C21. Non-Res. Vertice Caregory Region Estamend Claring (Claining France construction Notaning Claining (Claining Claining (Claining Claining (Claining) (Claining (Claining)	
	C 11 Martin Vince Mort Range (Instruct of C 11 Martin Vince Instructions) (Salyr C 11 Martin Vince Instructions) (Salyr) C 11 Martin Vince I	o Tugging model, San Hane, 2015 er und o Tugging model, San Ha H 2023 er und o Tugging model, San H 2025 er und wirk Car Baine, 2023 A struct wirk Car Baine, 2023 A struct wirks Car Baine	ŬK.	% Gasing area opens Reof Glazing Glazing Firme construction % Giszing area opens Estemail Shading Detailed Shading Dat Wedow shading Root window shading Local theding Local theding	20 C21, Non-File Painted Woo D No No No

Now, the template here which has been taken is CZ1 for non residential which is for vertical windows which are metal framed. In case we want to change the template we

can change the template and we can change the glass type and all the frame type for matching the corresponding values which are given in ECBC. The first thing which we have to check is this the window to wall ratio which has been by default defined as 40 percent. ECBC also defines it as 40 percent.



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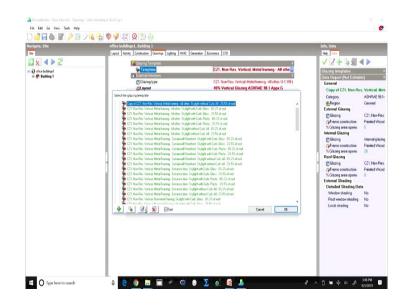
So, here it is as per ECBC in case it was not we would just change the number here and this 40 percent has window height of 1.5 meter the window spacing of 5 meters and the cell height of 0.8 meters. It would result a WWR or 40 percent would result in a geometry like this where all the facades uniformly have 40 percent WWR at each level. This is what this 40 percent WWR implies. For a base case we have to define a uniform WWR and hence a definition or defining of window to wall ratio at this level is required.

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vigate, Site	office buildings 1, Building 1 Layout Activity Construction Openings Lighting HVAC G	mention Generation (11)	Info, Help
	Layou Achily Cantedon Opining Uping MVX: Cementon Economics CO		Edit GlazingDoors/Vents
a) slice buildingn1	Q. Template	CZ1. Non-Res. Vertical. Metal framing - All other.	Use this screen to edit the building-wide
e gy snice building 1 ⊛ 🕐 Building 1	External Windows		glazing, door, vent and shading defaults Glazing remotione
	() Glozing type	C21, Non-Res, Vertical Metal training - All other, U-1 199 (You can make a generic selection from the
	(Layout	40% Vertical Glazing ASHRAE 90.1 Appx G	glazing template list at the log of the screen. This loads glazing and frame construction da
	Dimensions		from the selected template into the current
	Type	3-Preferred height •	building. You can also open the group hear brokes to access the data directly.
	Window to well %	40.00	Glazing
	Window height (m)	150	To inspect the details of the currently selecte
	Window specing (m)	5.00	glazing type, click on the 'Glazing type' icon. Alternatively double-click the icon to viewied
	Sill height (m)	0.00	Alternatively double-clicit the icon to viewin the data in a dialog
	Outside reveal depth (m)	0.009	Facade types
	France and Deviders		There are a number of standard facade type
	Stading		 None - there is no glazing.
	Arrise Control Windows		 Continuous torizontal - glazing is ornecated in a continuous herizontal strip
	Free Apenure		generated in a continuous hercontar stro using sill height and window to wall %
	Intensi Windows		· Fixed theight - placing is generated with a
	Sloped Root Windows/Skylights		fixed height at the specified sill height, an
	Doors		width is calculated based on the window wall % This option uses Window to wall
	E Verts		but prioritis es window height.
			Preferredheight - glazing is generaled
			using the window height data and the window to wall %, but the window height
			may be adjusted to achieve the required
			window to wall % This option uses winds and sill height but prioritises window to v
			%
			· Fixed width and height - windows have
			fixed width and height. This option uses window to wall % but prioritises window
			window to wall to but phones window width and height
			Fill surface (100%) - the entire surface is
			filed with glazing and there is no frame.
			If the glacing does not have a frame, unched the Has a frame? box
			Note that you can control the makeup of the
			building facades in greater detail by drawing

So, we have already defined this. Now we can also define the frames and dividers by changing the template.

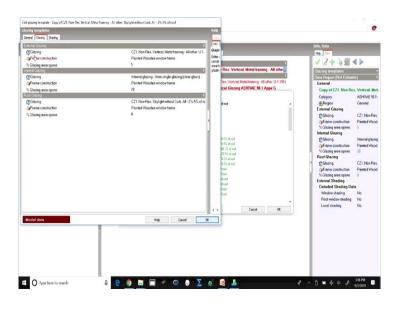
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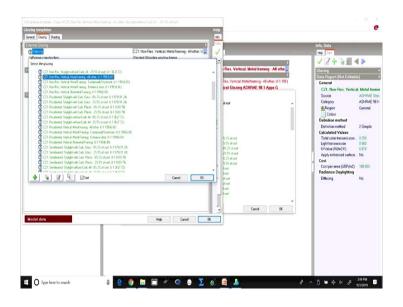
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Medid date. Note: Carear (M.	Root window sheding	No No

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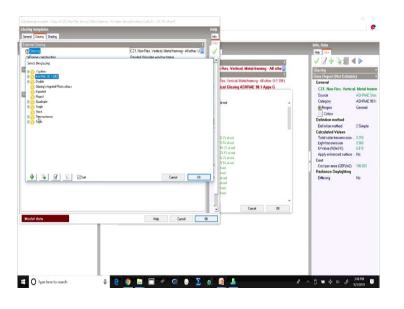
So, suppose I have to change the template and I have to change the different parameters. So, first of all it is the external glazing. So, what kind of glazing is going to be used?

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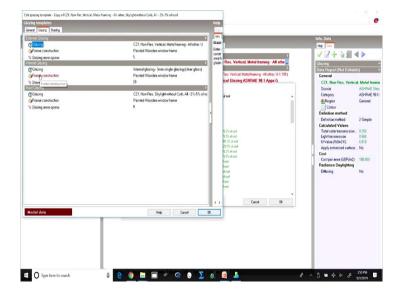
What is the glass type? So, we can select different glass types which come with different U values and SHGC as predefined.

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So, the glass which is going to be taken in is taken from the International Glazing Database IGDB. And we can select any glass type that we want. So, here the default glass type has been taken with a U value of 6.8 and a total SHGC of 0.25. However, if you look at the ECBC values they require a glass with a U value of 3.3. So, we can define we can create a template, we can create a new glass type, we can edit it to meet

the requirement for this U value, we can set the U value to 3.3 or as defined by ECBC, we can set the SHGC and also the VLT as defined by ECBC in a similar fashion.



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So, overall it will give the U value for the window on the basis of the glazing that has been selected. This is for internal glazing. Suppose we have internal windows which in this case we do not have and also in case we have the skylight the roof glazing. So, as per ECBC even the roof glazing and the values are defined. So, individually we can define the U value SHGC and VLT for each of these window types and also the frame construction. Once we have done that the building geometry is complete.

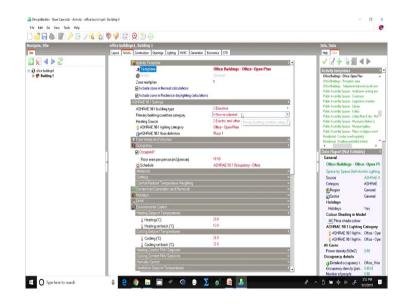
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rigate, Site	office buildings1, Building 1 Layout Actives Construction Openings Lighting HVAC Ge	neration Economics CFD	Info, Help
	Glazing Templata	1	Edit GlazingDoorsVents
a) stice buildings1	Ge Template	CZ1, Non-Res. Vertical. Metal framing - All other.	Use this screen to edit the building-wide glazing, door, vent and shading defaults
🗴 🥐 Bułding 1	Classing type Classing type Clayout Dimensions	C21, Nan Ros, Vertcal, Motal haming - Ali offier, U-1 193 (40% Vertical Glozing ASHRAE 50, 1 Appx G	Grang singles The can mail a priority cardinal test of the test The can mail a priority cardinal test of the test the bank option and there can candidate on the test of the single cardinal test of the cardinal bandles. The card also spee the graph hash tests to access the data directly. Cardinal priority bank of the data directly. Cardinal test of the data directly bank of the data priority bank of the data directly bank of the data directly. Cardinal test of the data directly bank of the data directly bank of the data priority bank of the data directly bank o
	Type Window to wall %	3-Protoned height + 40.00	
	Window height (m) Window spacing (m) Sill height (m)	150 500 000	
	Cutside reveal depth (m) Fromo and Devident	0.000	Facade types There are a number of standard facade type
	Plas e keme/dividers?		None-thereis no glazing
	Shedroj	-1	Continuous horizontal - glazing is generated in a continuous horizontal strip using sill height and window to wall %
	Local shading Airlow Compt Windows Frite Agenure Mitmeel Windows	* *	 Transformative Transformation State State
	Stoped Root Window/Shylights Doors External Auto generate Operation Internal		
	Auto generate Operation	-	
	Internal Verifype	Grile, small, light slats	Fill surface (100%) - the entire surface is filled with glazing and there is no frame
	Auto generate		If the placing does not have a frame, unched the Has a frame? box
	Operation	1.0	Note that you can control the makeup of the building facades in greater detail by drawing

In addition we can add the window shading. So, suppose we want to have window shading or local shading, we may have to provide them here. However, in base case we will not define the shading here. However, for the base case we will not define the shading as we have already seen in the compliance approach the base case will always be simulated without shading and with fenestration equally uniformly divided on all the facades as per the given prescribed WWR.

Also, if you want to add ventilation ventilators and doors we can auto generate them here, but for the base case we would usually not keep the these options on because it would require the natural ventilation to be taken into account while in this case we are not having natural ventilation enabled for this building.

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So, with this we have completed the activity construction and openings which, largely for construction and openings, are the passive features and activity remains constant for both the base case and the proposed case. So, in the next lecture I would expect that you would have completed all these details and giving the inputs as far as construction and openings are concerned and activity is concerned and we will move on to the active systems which are Lighting and HVAC.

So, see you again tomorrow and kindly complete the exercise which has been done so far. I hope you are following it along with me. So, see you again tomorrow.

Thank you, bye bye.