Modulating Profile Examples

Using Mathematical Operators to Define a Function

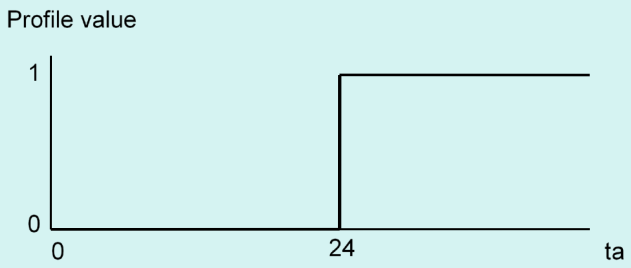
Functions can be defined by mathematical operators, remembering that the precedence weighting of operators varies, as noted if help is clicked whilst inputting a formula.

ta>=21 & to>=12

This will set the value to 1 (ON) when the inside air temperature (**ta**) is greater than or equal to 21
AND the outside air temperature (**to**) is greater than or equal to 12
and 0 (OFF) at all other times.
This is similar to the formula we created using the drop-down options, but with no band width applied.

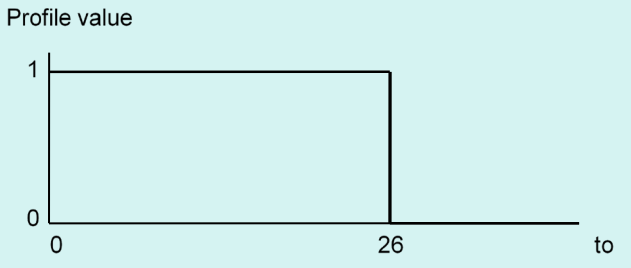
ta>to

This will set the value to 1 (ON) when the inside air temperature (**ta**)
is greater than the outside air temperature (**to**)
and 0 (OFF) at all other times.



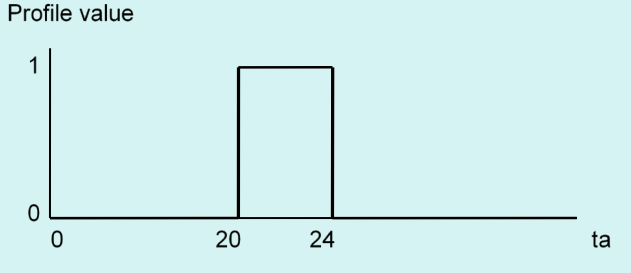
ta>24

This will set the value to 1 (ON) when the inside air temperature (**ta**) is greater than 24, and 0 (OFF) at all other times.
It could be used to open a window to cool a space.



to<26

This will set the value to 1 (ON) when the outside air temperature (**to**) is less than 26, and 0 (OFF) at all other times.



ta>20 & ta<24

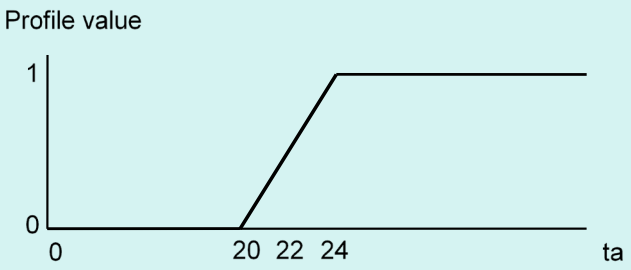
This will set the value to 1 (ON) when the inside air temperature (**ta**) lies between 20 and 24, and 0 (OFF) at all other times.

Using a fuzzy Greater than formula

These formulae use a fuzzy greater than function

gt(a,b,x)

They generate a proportional band rising linearly from 0 to 1 as **a** rises from **b-x/2** to **b+x/2**.
This is like a fuzzy version of **a > b** (hence the name), with the transition between 0 and 1 occurring over a proportional band specified by **x**.

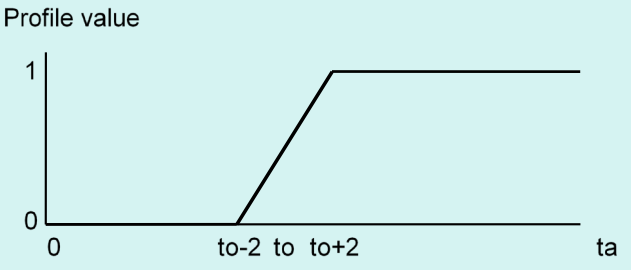


gt(ta,22,4)

This will set the value to 0 (OFF) when the inside air temperature (**ta**) is below 20, and to 1 (ON) when the inside air temperature (**ta**) is above 24 with a linear ramp in between
(a proportional band of width 4K centred on 22, so from 20 to 24)

ramp(ta,20,0,24,1)

This is an alternative to the above formula



gt(ta,to,4)

This will set a smooth rise from 0 (OFF) to 1 (ON) as the inside air temperature (**ta**) increases through the outside air temperature (**to**), with the transition occurring over a band of 4 degrees.

Using a fuzzy Less than Function

These formulae use a fuzzy less than function

lt(a,b,x)

They generate a proportional band falling linearly from 1 to 0 as **a** rises from **b-x/2** to **b+x/2**.
This is like a fuzzy version of **a < b** (hence the name), with the transition between 1 and 0 occurring over a proportional band specified by **x**.

lt(to,18,2) & lt(to,ta,4)

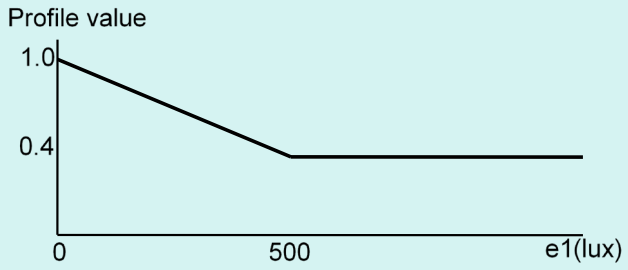
This will set the value to 1 (ON) when the outside air temperature (**to**) is less than 18, with a band width of 2
AND the outside air temperature (**to**) is less than the inside air temperature (**ta**), with a band width of 4
Setting it to 0 (OFF) at all other times.

Using a Ramp Function

These formulae use a general ramp function

ramp(a,b,c,d,e)

a = sensed variable
b = sensed value at lower end of ramp
c = returned value at lower end of ramp
d = sensed value at upper end of ramp
e = returned value at upper end of ramp.



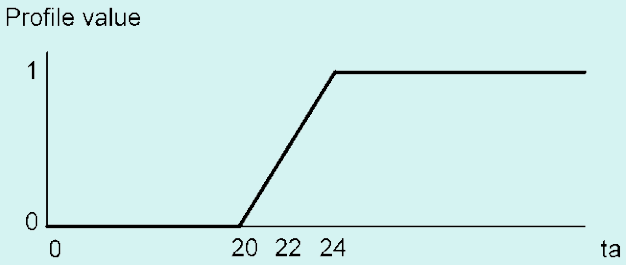
ramp(e1,0,1,500,.4)

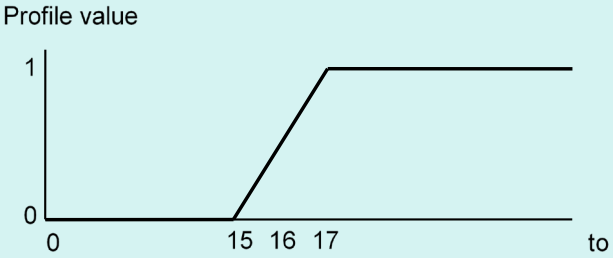
This is a formula suitable for applying as a dimming profile controlling lighting gain as a function of available daylight.
It modulates the lighting gain as a function of the illuminance on the working plane, **e1**.
The value of the profile falls from 1 at zero illuminance to 0.4 at illuminance 500 lux, thereafter remaining constant at this value.
The value 0.4 (which should be set as appropriate) represents the fraction of the room's lighting gain which is not subject to daylight control.
The illuminance **e1** must be computed using the link to sensors in Radiance.

Ramp formula can also be combined, to set limits on when they apply.

ramp(ta,20,0,24,1) & ramp(to,15,0,17,1)

By using & as an operator, both clauses need to be true to trigger the action.





When the inside air temperature (**ta**) is less than 20, a value of 0 (OFF) will be returned
When the inside air temperature (**ta**) is greater than 24, a value of 1 (ON) will be returned
There will be a smooth rise between these values of 20 and 24

AND the second criteria where

When the outside air temperature (**to**) is less than 15, a value of 0 (OFF) will be returned
When the outside air temperature (**to**) is greater than 17, a value of 1 (ON) will be returned
There will be a smooth rise between these values of 15 and 17

This could alternatively be written as

gt(ta,22,4) & gt(to,16,2)

It is a possible formula to emulate window opening controls for natural ventilation, where the window will only be opened if the internal air temperature is between 20 and 24

Absolute Profile Examples

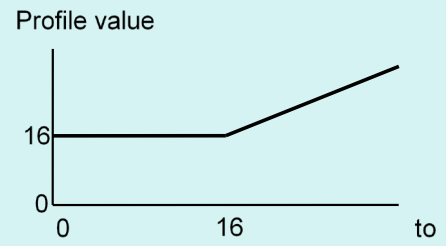
The following are some useful formulae for absolute profiles.

Using a fuzzy Logical If Function

These formulae use a fuzzy logical if function

if(condition, val1, val2)

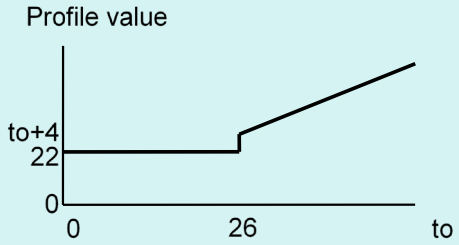
If the condition is true, it returns val1
If the condition is false, it returns val2
Otherwise it returns a weighted sum of val1 and val2, where val1's weighting = condition.



if(to<16,16,to)

This will use a value of 16 when the outside air temperature (**to**) is less than 16 and **to** when **to** is greater than 16

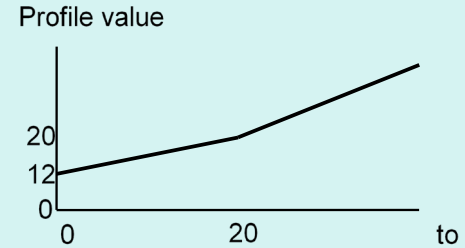
It is a possible formula for a supply condition for mechanical ventilation when heating, but not cooling, is available.



if(to<26,22,to+4)

This will set the value to 22 when the outside air temperature (**to**) is less than 26
It will set the value to the outside air temperature (**to**) +4 when it is greater than 26.
This means that when the outside temperature reaches 26, the value will step up from 22 to 30 (as a to of 26 +4), and thereafter it will climb steadily.

It is a possible formula for an adaptive room set-point.



if(to<20,to+.6*(20-to),to)

If the outside air temperature (**to**) is below 20, then the value will be set to 0.6*(20-to)
This emulates a heat recovery device with an effectiveness of 60%

If the outside air temperature (**to**) is above 20, then the value will be set to the outside air temperature (**to**).

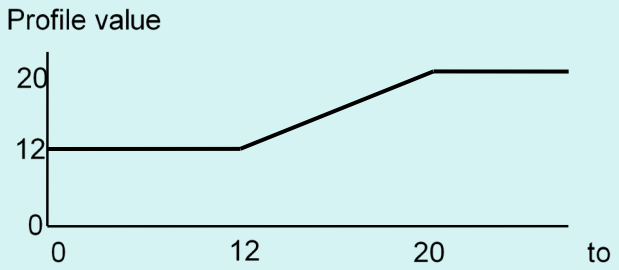
It is a possible formula to emulate a mechanical supply condition where heat recovery is applied to an outside air supply

Using a Ramp Function

These formulae use a general ramp function

ramp(a,b,c,d,e)

a = sensed variable
b = sensed value at lower end of ramp
c = returned value at lower end of ramp
d = sensed value at upper end of ramp
e = returned value at upper end of ramp.



ramp(to,12,12,20,20)

This will set a smooth rise from 12,
below which the outside air temperature (**to**) is heated to 12
Ramping up to 20,
Above which the outside air temperature (**to**) is cooled to 20.

It is a possible formula to emulate a supply condition for mechanical ventilation when both heating and cooling are available.

if(to<12,12,if(to<20,to,20))

This is an alternative to the above formula