NAMELIST MODIFICATION FOR BEM + ROAD ORIENTATIONS

BEM model activation and general options in SURFEX/TEB

The Namelist NAM_TEB controls the activation and the general options of BEM. Here are the variables of this namelist corresponding to BEM options

Fortran name	Fortran type	values	default	description
CBEM	character (LEN=3)	'DEF' 'BEM'	'DEF'	'DEF' is for the original version of TEB (Masson et al., 2002) 'BEM' is to activate the Building Energy Model (Bueno et al., 2012)
LAUTOSIZE	logical		F	Autosizing of DXCOIL or FINCAP systems
CCOOL_COIL	Character (LEN=5)	'IDEAL' or 'DXCOIL'	'IDEAL'	'IDEAL' is for an ideal system than can always cope with the demand and has the nominal performance. 'DXCOIL' is for a real system that will have a finite capacity and for which performance will vary in function of load and outdoor conditions
CHEAT_COIL	character (LEN=5)	'IDEAL' or 'FINCAP'	'IDEAL'	'IDEAL' is for an ideal system than can always cope with the demand and has the nominal efficiency. 'FINCAP' is for a real system that will have a finite capacity. Efficiency remains constant.
NFLOOR_LAYER	integer	3 to 9	5	Number of floor layers for the computation of conduction through the floor. The higher, the better but more time consuming.

BEM model inputs

All the BEM inputs have to be specified by the user in the namelist NAM_DATA_BEM

Fortran name	Fortran type	values	default	description
NPAR_FLOOR_LAYER	integer	1 to 9	1	Number of floor and thermal mass layers for **description** only
XUNIF_HC_FLOOR(1 to NFLOOR_LAYER)	real		none	Volumetric Heat Capacity of the floor layers in $J.K^{-1}m^{-3}$ (uniform case)
CFNAM_HC_FLOOR(1 to NFLOOR_LAYER)	Character (LEN=28)		''	File names of Volumetric Heat Capacity of the floor layers in $J.K^{-1}m^{-3}$
CFTYP_HC_FLO	character (LEN=6	'DIRECT', 'BINLLF',	none	Type of the files

OR(1 to NFLOOR_LAYER)	)	'BINLLV', 'ASCLLV'		of volumetric heat capacity of the floor layers
XUNIF_TC_FLOOR(1 to NFLOOR_LAYER)	real		none	Thermal conductivity of the floor layers in $W.K^{-1}m^{-1}$ (uniform case)
CFNAM_TC_FLOOR(1 to NFLOOR_LAYER)	Character (LEN=28)		"	File names of Thermal conductivity of the floor layers in $W.K^{-1}m^{-1}$
CFTYP_TC_FLOOR(1 to NFLOOR_LAYER)	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of thermal conductivity of the floor layers
XUNIF_D_FLOOR(1 to NFLOOR_LAYER)	real		none	Depth of the floor layers in m (uniform case)
CFNAM_D_FLOOR(1 to NFLOOR_LAYER)	Character (LEN=28)		"	File names of the depth of the floor layers in m
CFTYP_D_FLOOR(1 to NFLOOR_LAYER)	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the depth of the floor layers
XUNIF_T_COOL_TARGET	real		none	Set point of the air cooling system in K (uniform case)
CFNAM_T_COOL_TARGET	character(LEN=26)		"	File names of the set point of the air cooling system in K
CFTYP_T_COOL_TARGET	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the set point of the air cooling system
XUNIF_T_HEAT_TARGET	real		none	Set point of the air heating system in K (Uniform case)
CFNAM_T_HEAT_TARGET	real		"	File names of the set point of the air heating system in K

CFTYP_T_HEAT_TARGET	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the set point of the air heating system
XUNIF_F_WASTE_CAN	real	Between 0 and 1	none	Fraction of the waste heat from the building released in the street canyon
CFNAM_F_WASTE_CAN	real		"	File names of the fraction of the waste heat from the building released in the street canyon
CFTYP_F_WASTE_CAN	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the fraction of the waste heat from the building released in the street canyon
XUNIF_COP_RAT	real		none	Coefficient of Performance of the cooling system (typically between 2 and 4)
CFNAM_COP_RAT	real		"	File names of the Coefficient of Performance of the cooling system
CFTYP_COP_RAT	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Coefficient of Performance of the cooling system
XUNIF_EFF_HEAT	real		none	Efficiency of the heating system (between 0 and 1)
CFNAM_EFF_HEAT	real		"	File names of the Efficiency of the heating system
CFTYP_EFF_HEAT	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Efficiency of the heating system
XUNIF_QIN	real		none	Internal heat gains in the building from metabolism or specific use of

				energy in W/m²[Floor]
CFNAM_QIN	real		"	File names of the Internal heat gains of the building in W/m²[Floor]
CFTYP_QIN	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Internal heat gains of the building
XUNIF_QIN_FLAT	real	Between 0 and 1	none	Fraction of the internal heat gains in the building from metabolism or specific use of energy that is latent heat
CFNAM_QIN_FLAT	real		"	File names of the Fraction of the internal heat gains in the building from metabolism or specific use of energy that is latent heat
CFTYP_QIN_FLAT	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Fraction of the internal heat gains in the building from metabolism or specific use of energy that is latent heat
XUNIF_QIN_FRAD	real		none	Fraction of the non latent internal heat gains in the building from metabolism or specific use of energy that are longwave radiative fluxes
CFNAM_QIN_FRAD	real		"	File names of the Fraction of the non latent internal heat gains in the building from metabolism or

				specific use of energy that are longwave radiative fluxes
CFTYP_QIN_FRAD	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Fraction of the non latent internal heat gains in the building from metabolism or specific use of energy that are longwave radiative fluxes
XUNIF_SHGC	real	Between 0 and 1	none	Solar heat gain coefficient of the window (fraction of the incident solar radiation that is transmitted or absorbed by the window)
CFNAM_SHGC	real		"	File names of Solar heat gain coefficient of the window
CFTYP_SHGC	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Solar heat gain coefficient of the window
XUNIF_SHGC_SH	real	Between 0 and 1	none	Solar heat gain coefficient of the ensemble window + shading device (fraction of the incident solar radiation that is transmitted or absorbed by the window)
CFNAM_SHGC_SH	real		"	File names of Solar heat gain coefficient of the window + shading device
CFTYP_SHGC_SH	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Solar heat gain coefficient of the window +

				shading device
XUNIF_U_WIN	real		none	Heat transfert coefficient of the window in W/(m².K)
CFNAM_U_WIN	real		"	File names of the heat transfert coefficient of the window in W/(m².K)
CFTYP_U_WIN	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the heat transfert coefficient of the window in W/(m².K)
XUNIF_GR	real		none	Fraction of the glazing ratio of the facade in m²(window)/m²(facade)
CFNAM_GR	real		"	File names of the Fraction of the glazing ratio of the facade
CFTYP_GR	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files Fraction of the glazing ratio of the facade
XUNIF_FLOOR_HEIGHT	real		none	Height of each floor level in m
CFNAM_FLOOR_HEIGHT	real		"	File names of the height of each floor level in m
CFTYP_FLOOR_HEIGHT	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files height of each floor level in m
XUNIF_INF	real		none	Infiltration airflow rate in the building in ACH (Air Building Volume Change per Hour)
CFNAM_INF	real		"	File names of the Infiltration airflow rate
CFTYP_INF	character (LEN=6	'DIRECT', 'BINLLF',	none	Type of the files

	)	'BINLLV', 'ASCLLV'		of the Infiltration airflow rate
XUNIF_V_VENT	real		none	Mechanical ventilation airflow rate in the building in ACH (Air Building Volume Change per Hour)
CFNAM_V_VENT	real		"	File names of the Mechanical ventilation airflow rate in the building
CFTYP_V_VENT	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Mechanical ventilation airflow rate in the building
XUNIF_HR_TARGET	real	Between 0 and 1	none	Relative humidity set point inside the building
CFNAM_HR_TARGET	real		"	File names of the Relative humidity set point inside the building
CFTYP_HR_TARGET	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Relative humidity set point inside the building
CHEAT_COIL	character(LEN=6)	'IDEAL' 'FINCAP'	none	Type of heating system: IDEAL is always able to cope with the heating demand; FINCAP has a limited capacity.
LAUTOSIZE	Logical	.T. or .F.	.F.	Activate autosize calculation of heating and cooling systems in case of DXCOIL cooling system and FINCAP heating system
XUNIF_F_WATER_COND	real	Between 0 and 1 or < 0	"	Fraction of heat released by the condensers that is

				latent heat. If < 0, no atmospheric releases are considered
CFNAM_F_WATER_COND	real	“	"	File names of the Fraction of heat released by the condensers that is latent heat.
CFTYP_F_WATER_COND	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Fraction of heat released by the condensers that is latent heat.
XUNIF_CAP_SYS_RAT	real		none	Rated capacity of the cooling system in W/m²[BLD] to be filled if LAUTOSIZE=.F.
CFNAM_CAP_SYS_RAT	real		none	File name of the rated capacity of the cooling system
CFTYP_CAP_SYS_RAT	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the rated capacity of the cooling system
XUNIF_CAP_SYS_HEAT	real		none	Capacity of the heating system in W/m²[BLD] to be filled if LAUTOSIZE=.F.
CFNAM_CAP_SYS_HEAT	real		none	File name of the capacity of the heating system
CFTYP_CAP_SYS_HEAT	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the capacity of the heating system.
XUNIF_M_SYS_RAT	real		none	Rated air mass flow capacity of the cooling and heating system in $kg.s^{-1}.m^{-2}$[BLD] to be filled if LAUTOSIZE=.F.
CFNAM_M_SYS_RAT	real		none	File name of the Rated air mass flow capacity of

				the cooling and heating system
CFTYP_M_SYS_RAT	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Rated air mass flow capacity of the cooling and heating system
XUNIF_T_ADP	real		none	Appartus temperature dew point in K
CFNAM_T_ADP	real		none	File name of the Appartus temperature dew point
CFTYP_T_ADP	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of tAppartus temperature dew point
XUNIF_T_SIZE_MAX	real		none	Maximum outdoor air temperature used for autosize calculation
CFNAM_T_SIZE_MAX	real		none	File name of the Maximum outdoor air temperature used for autosize calculation
CFTYP_T__SIZE_MAX	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Maximum outdoor air temperature used for autosize calculation
XUNIF_T_SIZE_MIN				Minimum outdoor air temperature for autosize calculation
CFNAM_T_SIZE_MIN	real		none	Minimum outdoor air temperature for autosize calculation
CFTYP_T_SIZE_MIN	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the Minimum outdoor air temperature for autosize calculation

XUNIF_SHADE	real	0 or 1	none	Are shading devices activated: 0 no, 1 yes.
CFNAM_SHADE	real		none	File name of the activation of the shading devices
CFTYP_SHADE	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the shading devices activation
XUNIF_NATVENT	real	0, 1, 2	none	Surventilation system (opening windows): 0 = no surventilation possible, 1 = manual surventilaion, 2 = automatic surventilation.
CFNAM_NATVENT	real		none	File name of the surventilation system
CFTYP_NATVENT	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the files of the surventilation system

ROAD orientations activation and general options in SURFEX/TEB

TEB offers now the possibility to choose the orientations of the streets. It can be done by using the following OPTIONS and namelists :

namelist &NAM_TEB

Fortran name	Fortran type	values	default	description
NTEB_PATCH	integer	1 to 9	1	Number of TEB patches that can run simultenaously

Namelist &NAM_PREP_TEB

Fortran name	Fortran type	values	default	description
CROAD_DIR	character (LEN=4)	'ORIE' 'UNIF'	'UNIF'	'UNIF' is for original version with isotropic distribution of streets orientation 'ORIE' is for new version with street orientation
CWALL_OPT	character (LEN=4)	'TWO' or 'UNIF'	'UNIF'	'UNIF' is the representation of an average wall of both sides of the street canyon 'TWO' is the representation of the two opposite walls of the canyon

Namelist &NAM_DATA_TEB

Fortran name	Fortran type	values	default	description
XUNIF_ROAD_DIR	real	0 to 360	0	Direction of the road per patch
CFNAM_ROAD_DIR	character (LEN=26)		None	Name of the file for the road orientation data
CFTYP_ROAD_DIR	character (LEN=6)	'DIRECT', 'BINLLF', 'BINLLV', 'ASCLLV'	none	Type of the file for the road orientation data

BEM model outputs

Prognostic variables

Field Name	Unit	Description
QI_BLD	$kg.kg^{-1}$	Indoor specific humidity
T_WIN1	K	Outdoor surface temperature of the window
T_WIN2	K	Indoor surface temperature of the window
T_FLOOR(1 to NFLOOR_LAYER)	K	Mid-layer temperature of the different floor layers. 1 is for indoor surface layer. NFLOOR_LAYER is for the deep floor layer.
T_MASS(1 to NFLOOR_LAYER)	K	Mid-layer temperature of the different internal mass layers. 1 is for indoor surface layer. NFLOOR_LAYER is for the deep internal mass layer.

Diagnostic variables

Field Name	Unit	Description
H_BLD_COOL	$W.m^{-2}$[BLD]	Sensible heat demand for the cooling to the temperature T_COOL_TARGET of the building per surface unit of the building on ground.
LE_BLD_COOL	$W.m^{-2}$[BLD]	Latent heat demand for the drying/moistering of the building to HR_TARGET and T_COOL_TARGET per surface unit of the building
T_BLD_COOL	$W.m^{-2}$[BLD]	Total heat demand of the building to maintain both T_COOL_TARGET and HR_TARGET (sum of H_BLD_COOL and LE_BLD_COOL) per surface unit of the building
H_BLD_HEAT	$W.m^{-2}$[BLD]	Sensible heat demand for the heating to the temperature T_HEAT_TARGET of the building per surface unit of the building on ground.
LE_BLD_HEAT	$W.m^{-2}$[BLD]	Latent heat demand for the drying/moistering of the building to HR_TARGET and T_HEAT_TARGET per surface unit of the building

H_WASTE	$W.m^{-2}$[URB]	Sensible heat released to the urban environment by the building by the systems (heating or cooling) and the infiltration/ventilation/natural ventilation per surface unit of urban ground
LE_WASTE	$W.m^{-2}$[URB]	Latent heat released to the urban environment by the building by the systems (heating or cooling) and the infiltration/ventilation/natural ventilation per surface unit of urban ground
HVAC_COOL	$W.m^{-2}$[BLD]	Energy consumption by the cooling system per surface unit of building on the ground
HVAC_HEAT	$W.m^{-2}$[BLD]	Energy consumption by the heating system per surface unit of building on the ground
CAP_SYS	$W.m^{-2}$[BLD]	Actual capacity of the cooling system in the case of 'DXCOIL' cooling system per surface unit of building on the ground
M_SYS	$kg.s^{-1}m^{-2}$[BLD]	Actual mass flow rate of the cooling system in the case of 'DXCOIL' cooling system per surface unit of building on the ground
COP		Actual COP of the cooling system in the case of 'DXCOIL' cooling system
Q_SYS	$kg.kg^{-1}$	Specific humidity of the air supplied by the cooling system
T_SYS	K	Temperature of the air supplied by the cooling system
TR_SW_WIN	$W.m^{-2}$[BLD]	Solar radiation transmitted to the building through the windows per surface unit of building on the ground
FAN_POWER	$W.m^{-2}$[BLD]	Power consumption of the fans for the heating/cooling system
T_RAD_IND	K	Indoor mean radiant temperature
SWA_WIN	$W.m^{-2}$[WIN]	Solar radiation absorbed by the windows per surface unit of the windows.

LWA_WIN	$W.m^{-2}$[WIN]	Long wave (infrared) radiation absorbed by the windows per surface unit of the windows.

Modification of outputs with road orientation activation

When using several patches in TEB for road orientation, the outputs have a prefix TEBn_ with n varying between 1 and the number of patches.