INSTITUT FÜR SOLARTECHNIK

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TRNSYS Type 709

Ground Model

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Abstract

This TRNSYS Type simulates the ground in 2D with internal boundary conditions such as a buried ice storage.

Contents

1. List of parameters

The total number of parameters are

$$n_{Par} = 55 + n_{mat} \cdot 4 + n_X \cdot n_Y + 2(n_X + n_Y) = 55 + n_{mat} \cdot 4 + n_X \cdot n_Y + 2n_{XY} \quad (1)$$

If the material is internal boundary condition, then use -1 -1 -1 for λ, c_p and ρ

Nr.	Description	Name	Units
1	Number of fluid Cv	n_{cv}	
2	Number of ground zones in X	n_X	
3	Number of ground zones in Y	n_Y	
4+i	Number of Cv for Zone i in X direction	xCv_i	
⋮	for i=1 i $\leq n_X$ i=i+1	⋮	⋮
$5+n_X+j$	Number of Cv for Zone j in Y direction	yCv_i	
⋮	for j=1 j $\leq n_Y$ j=j+1	⋮	⋮
$5+n_{XY}$	Number of materials	n_{mat}	
$6+n_{XY}$	Mesh concentration factor	α_{mesh}	
	Definition of materials		
$6+n_{XY}+4(n-1)$	code of the material	n	
$7+n_{XY}+4(n-1)$	Heat conductivity of material n	λ_n	$[W/mK]$
$8+n_{XY}+4(n-1)$	Heat capacity of material n	cp_n	$[J/kgK]$
$9+n_{XY}+4(n-1)$	Density of material n	ρ_n	$[kg/m^3]$
	Definition of zones		
⋮	for n=1 n $\leq n_{mat}$ n=n+1	⋮	⋮
⋮	for ij=1 ij $\leq n_X n_Y$ ij=ij+1	⋮	⋮
	Definition of boundary conditions (boco)		
$10+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Left boco 0=temperature 1=flux Newman 2= U		
$11+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Right boco		
$12+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Top boco		
$13+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Bottom boco		
	Initialization of ground data		
$14+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Initial time model	$model_g$	
$15+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Initial ground temperature	T_g^0	$[^oC]$
$16+4n_{mat}+n_X \cdot n_Y+n_{XY}$	TRNSYS unit for initial temperature file		
$17+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Ambient average T	$T_{amb,avg}$	$[^oC]$
$18+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Ambient amplitude T	$T_{abm,amp}$	$[^oC]$
$19+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Month with maximum T_{amb}		
$20+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Start simulation day		
$21+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Albedo (ground reflectance)		
$22+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Ground emissivity		
$23+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Ground averaged conductivity	$[W/mK]$	
$24+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Ground averaged specific capacity	$[J/kgK]$	
$25+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Ground averaged density	$[kg/m^3]$	

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Nr.	Description	Name	Units
$26+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Print data (1 : yes , 0 : no)		
$27+4n_{mat}+n_X \cdot n_Y+n_{XY}$	TRNSYS unit for saving ground temperature 2D file		
$28+4n_{mat}+n_X \cdot n_Y+n_{XY}$	Time 1 where 2D T are saved	$t_{save,t}$	[h]
$\vdots$	for t=1 t $\leq$ 12 t=t+1	$\vdots$	$\vdots$
$40+4n_{mat}+n_X \cdot n_Y+n_{XY}$	x position of sensor i,j	$x_{ts}(i,j)$	$[m]$
$41+4n_{mat}+n_X \cdot n_Y+n_{XY}$	y position of sensor i,j	$y_{ts}(i,j)$	$[m]$
$\vdots$	for s=1 t $\leq$ 10 s=s+1	$\vdots$	$\vdots$

2. List of inputs

Nr.	Description	Name	Units
1	Left temperature BoCo	$T_{l,Boco}$	$[^oC]$
2	Left Heat Flux BoCo	$Q_{l,Boco}$	$[W/m^2]$
3	Left Heat transfer BoCo	$UA_{l,Boco}$	$[W/m^2K]$
4	Right temperature BoCo	$T_{r,Boco}$	$[^oC]$
5	Right Heat Flux BoCo	$Q_{r,Boco}$	$[W/m^2]$
6	Right Heat transfer BoCo	$UA_{r,Boco}$	$[W/m^2K]$
7	Top temperature BoCo	$T_{t,Boco}$	$[^oC]$
8	Top Heat Flux BoCo	$Q_{t,Boco}$	$[W/m^2]$
9	Top Heat transfer BoCo	$UA_{t,Boco}$	$[W/m^2K]$
10	Bottom temperature BoCo	$T_{b,Boco}$	$[^oC]$
11	Bottom Heat Flux BoCo	$Q_{b,Boco}$	$[W/m^2]$
12	Bottom Heat transfer BoCo	$UA_{b,Boco}$	$[W/m^2K]$
13	Bottom Ground to fluid internal BoCo	$Q_{g-f,Boco}$	$[W/m^2K]$
13+i	Right side ground to fluid internal BoCo (from bottom to top)	$Q_{g-f,i}$	$[W/m^2K]$
$\vdots$	for i=1 t $\leq nCv$ i=i+1	$\vdots$	$\vdots$
$14+nCv$	Top ground to fluid internal BoCo	$Q_{g-f,top}$	$[W/m^2K]$

3. List of outputs

Nr.	Description	Name	Units
1	Error in steady state	$error_{SS}$	$[W]$
2	Error in solver	$error_{solver}$	$[W]$
3	Number of solver iterations	$nIte_{solver}$	
4	Heat flux through the East side	Q_E	
5	Heat flux through the West side	Q_W	
6	Heat flux through the North side	Q_N	
7	Heat flux through the South side	Q_S	
8	Heat generated in the ground	Q_V	
9	Heat accumulated in the ground	Q_{acum}	
10	Heat imbalance in the ground	Q_{imb}	
11	Bottom Ground to fluid internal BoCo temperature	$T_{g-f,Boco}$	$[^oC]$
11+i	Right side ground to fluid internal BoCo temperature	$T_{g-f,i}$	$[^oC]$
⋮	for i=1 t $\leq nCv$ i=i+1	⋮	⋮
$12+nCv$	Top ground to fluid internal BoCo temperature	$T_{g-f,top}$	$[^oC]$
$12+nCv+s$	Sensor s temperature	$T_{sensor,s}$	$[^oC]$
⋮	for s=1 s ≤ 10 s=s+1	⋮	⋮