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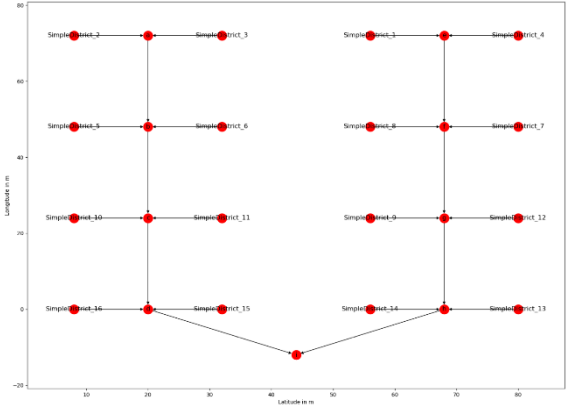
Contributions to the DH network simulation test cases

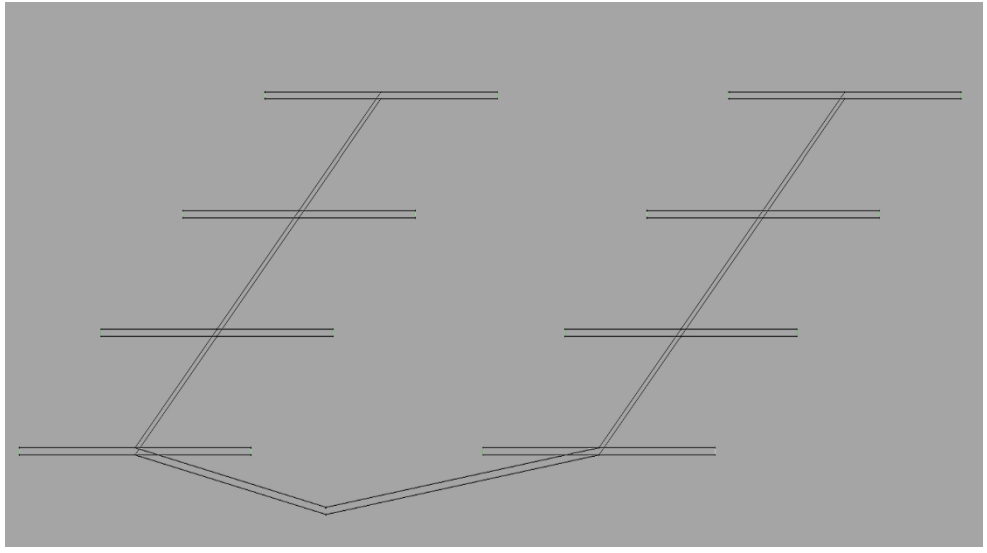
IBPSA Project 1 WP 3 coordination meeting

23.09.2020

Current state of work

- No Interest in building simulation test cases so far (other test cases available and successfully passed, e.g. BESTEST ASHRAE 140)
- Focus is on the DH network simulation test case(s)
  - ✓ Setup of first test case has been started;
  - ✓ some findings can be reported
  - ✓ A student project has been initiated where (hopefully) a 5 month work effort can be contributed
  - ✓ Simulation programme: TRNSYS-TUD

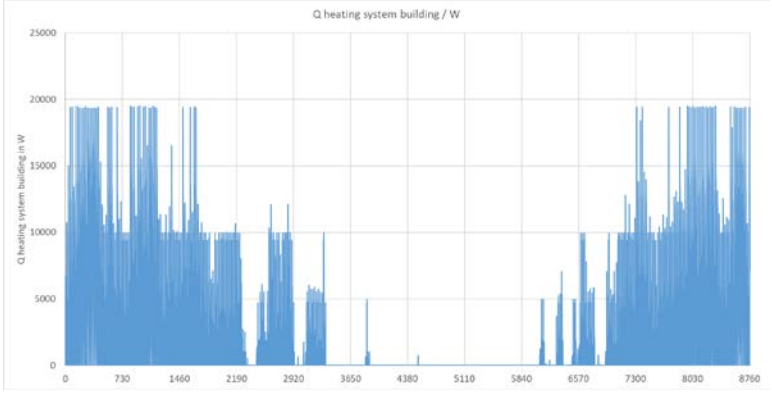




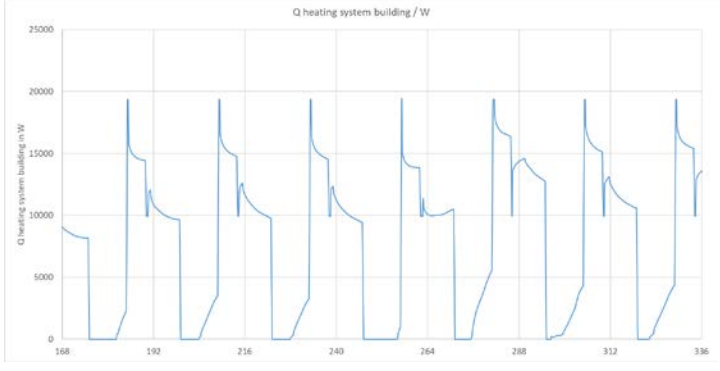
Findings I

- load profile of a single building:
  https://github.com/ibpsa/project1/blob/master/wp_3_1_destest/Buildings/SimpleDistrict/Results/SimpleDistrict_IDEAS/SimpleDistrict_SimpleDistrict_1.csv

Annual profile



weekly profile

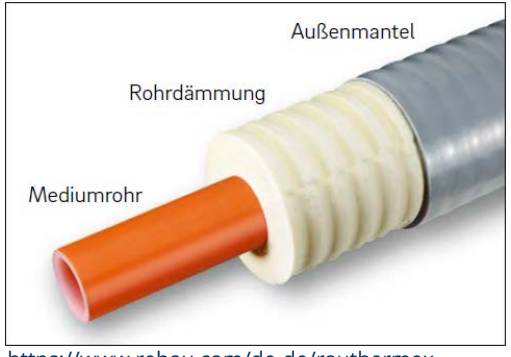


→ Check time mapping: no heating during lunchtime; peak in early afternoon?

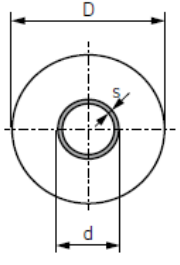
Findings II

- Information about pipes and insulation missing:
- Thickness of insulation

➔ parameters used in the Modelica simulation:
Roughness = 2.5e-5m
Specific heat capacity = 2300 J/kgK (PE)
Density = 930 kg/m³ (PE)
Thickness = 0.0035m



https://www.rehau.com/de-de/rauthermex-nah-fernwaermerohr



Typ	d [mm]	s [mm]	D[2] [mm]
UNO 25/91	25	2,3	93
UNO 32/91	32	2,9	93
UNO 32/111[1]	32	2,9	113
UNO 40/91	40	3,7	93
UNO 40/126[1]	40	3,7	128
UNO 50/111	50	4,6	113
UNO 50/126[1]	50	4,6	128

Beginning Node	Ending Node	Length [m]	Inner Diameter [m]	Insulation Thickness [m]
SimpleDistrict_7	f	12	0,02	0,045
SimpleDistrict_1	e	12	0,025	0,0425
SimpleDistrict_13	h	12	0,02	0,045
h	i	36	0,05	0,045
SimpleDistrict_12	g	12	0,02	0,045
d	i	36	0,05	0,045
SimpleDistrict_6	b	12	0,02	0,045
SimpleDistrict_2	a	12	0,025	0,0425
f	g	24	0,04	0,0425
g	h	24	0,05	0,045
SimpleDistrict_8	f	12	0,02	0,045
SimpleDistrict_16	d	12	0,02	0,045
SimpleDistrict_9	g	12	0,02	0,045
c	d	24	0,05	0,045
a	b	24	0,032	0,0465
SimpleDistrict_5	b	12	0,02	0,045
SimpleDistrict_15	d	12	0,02	0,045
SimpleDistrict_14	h	12	0,02	0,045
b	c	24	0,04	0,0425
SimpleDistrict_4	e	12	0,025	0,0425
SimpleDistrict_10	c	12	0,02	0,045
SimpleDistrict_11	c	12	0,02	0,045
e	f	24	0,032	0,0465
SimpleDistrict_3	a	12	0,025	0,0425

Inner diameters available: 20.4 | 26.2 | 32.6 | 40.8 | 51.4
Insulation thickness: 25 | 21.5 | 25 | 30 | 31.5
Insulation thickness: 34 | 30.5 | 26.5 | 31.5 | 32.5
Insulation thickness: 34 | 40.5 | 44 | 39 | 40.5

https://www.fernwaerme-rohr.de

Typ	Abmessungen		
	Rohraußen-Ø Da in mm	Wandstärke s in mm	Mantelrohraußen-Ø Da in mm
IPX-H-ER 25	25,0	2,3	75
IPX-H-ER 32	32,0	2,9	75
IPX-H-ER 40	40,0	3,7	90
IPX-H-ER 50	50,0	4,6	110
IPX-H-ER 63	63,0	5,8	125
IPX-H-ER 75	75,0	6,8	140
IPX-H-ER 90	90,0	8,2	160
IPX-H-ER 110	110,0	10,0	180

Recommendations

- More comfortable and less confusing test descriptions
- Diagnostic capabilities → see BESTEST ASHRAE140
- Key performance indicators: simple, significant, meaningful, practical relevant
  e.g.: pipe material, ground coupling, pump control, pressure losses, insulation, …
- Test conditions: steady state vs. transient, important impacts to be identified

KPI	Unit	Description
Heat losses	W	$\dot{Q}_{heat\ loss} = \dot{Q}_{generator} - \Sigma\ \dot{Q}_{building\ i}$
Pressure drop between inlet and outlet of most peripheral substation	Pa	$\Delta p = p_{in-sub\ peripherical} - p_{out-sub\ peripherical}$
Return temperature at plant	°C	$T_{return-plant}$
Temperatures at substation in flow and return line at first and most peripheral substation	°C	$T_{in-sub\ first}$: temperature in flow line at the nearest substation from the HUB $T_{in-sub\ peripheral}$: temperature in flow line at the farthest substation from the HUB $T_{out-sub\ first}$: temperature in return line at the nearest substation from the HUB $T_{out-sub\ peripheral}$: temperature in return line at the farthest substation from the HUB

- Heat loss per type of pipe (diameter)
- heat loss related to heat generated

- Normally pressure drop at substation is given and/or controlled
- What about pressure drop at heat generator / circulation pump?
- What about electric energy consumption of the circulator?
- Return temperature is very important!

- Temperature difference thus also Return temperature at substations are given, why to report them?
- Temperature drop in supply and return line
- Temperature at certain network nodes

Questions?

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