Methods of reducing the district heating return temperature from the local substations

– Sensible regulation and smart control

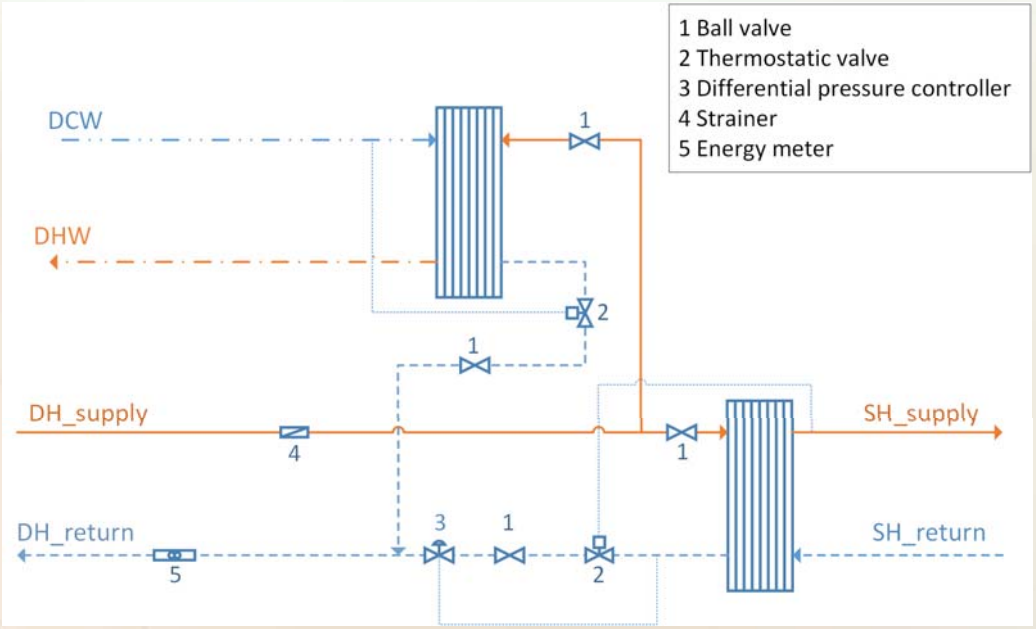
Xiaochen Yang, Postdoc
Department of Civil Engineering, DTU
Contact: xiay@byg.dtu.dk

Background

- 1. Why LTDH?
- 2. Why low return temperature?
- 3. Difficulties
  - Thermal comfort
  - Dynamic heating load
  - Deviation between the design and practical situation

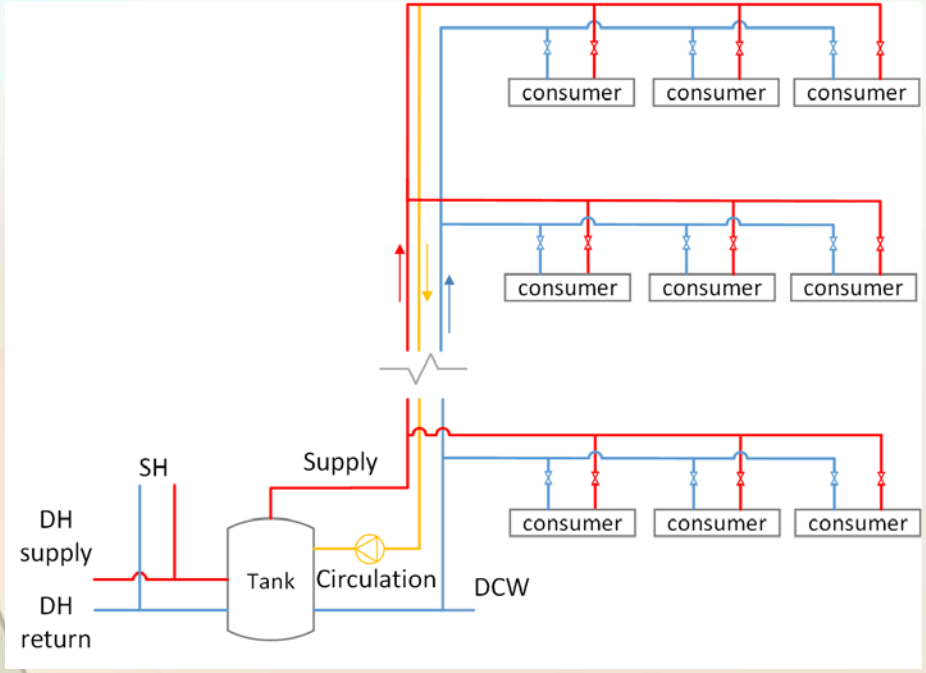
Reasons & substation layout

- Typical substation layout
  - HEX for DHW preparation



Reasons & substation layout

– Storage tank for DHW preparation

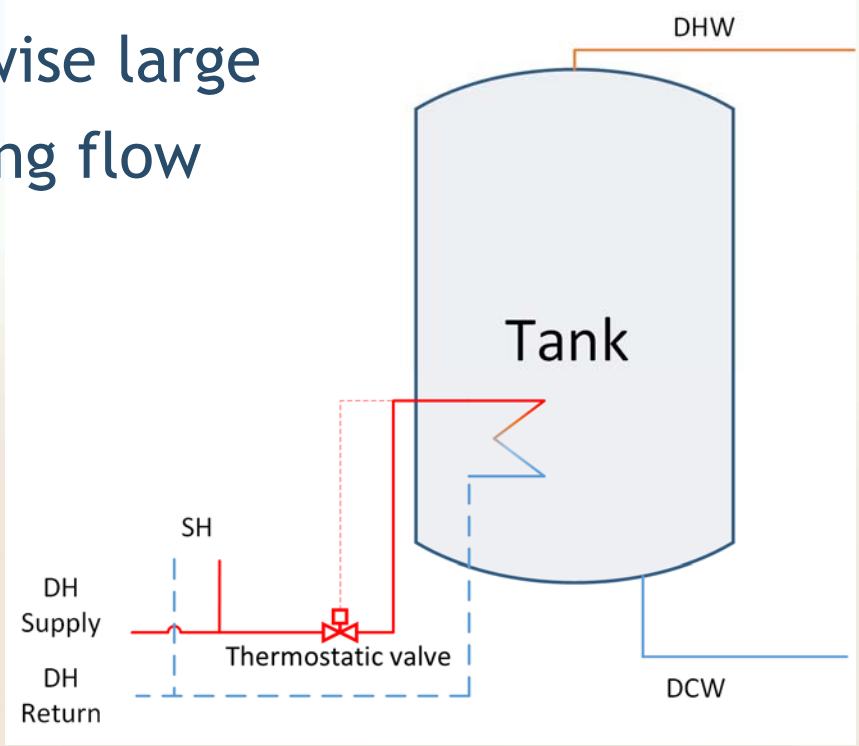


1. *Less peak load ???*
2. Set point T of the tank
3. Circulation is necessary for comfort requirements

1. Problematic tank charging program
2. Large circulation heat loss
3. High DH return temperature

Proposed solution

- Piecewise large charging flow



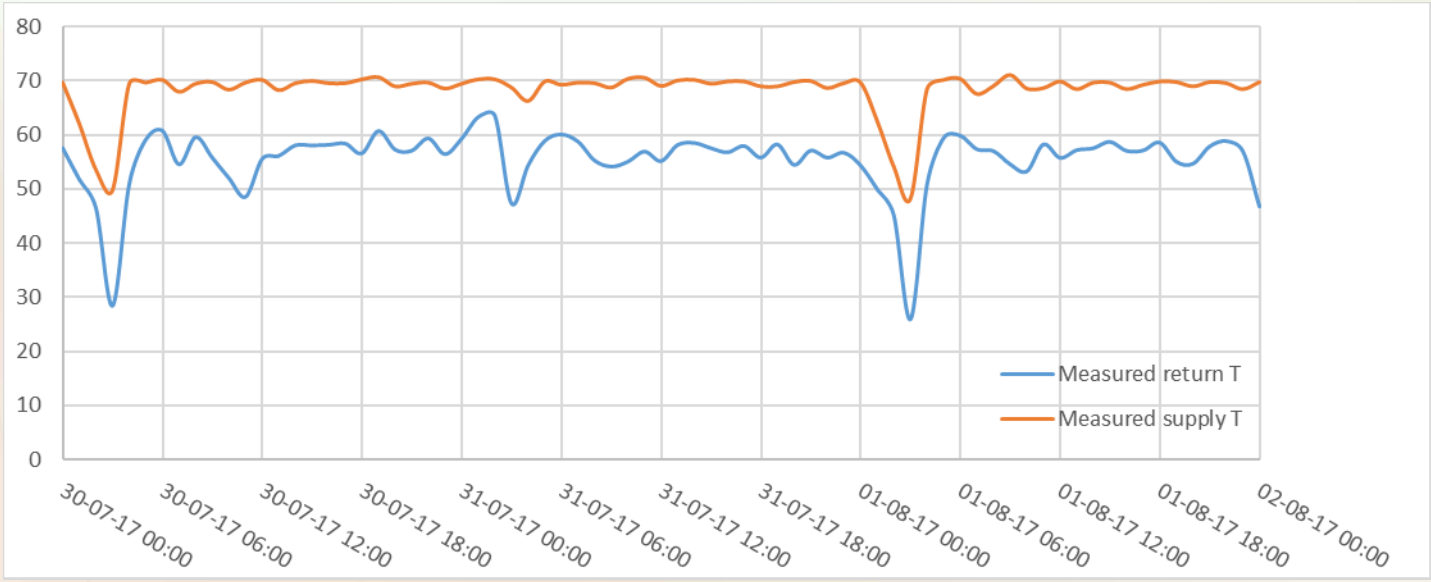
- Small constant charging flow

Determination of the minimum charging flow

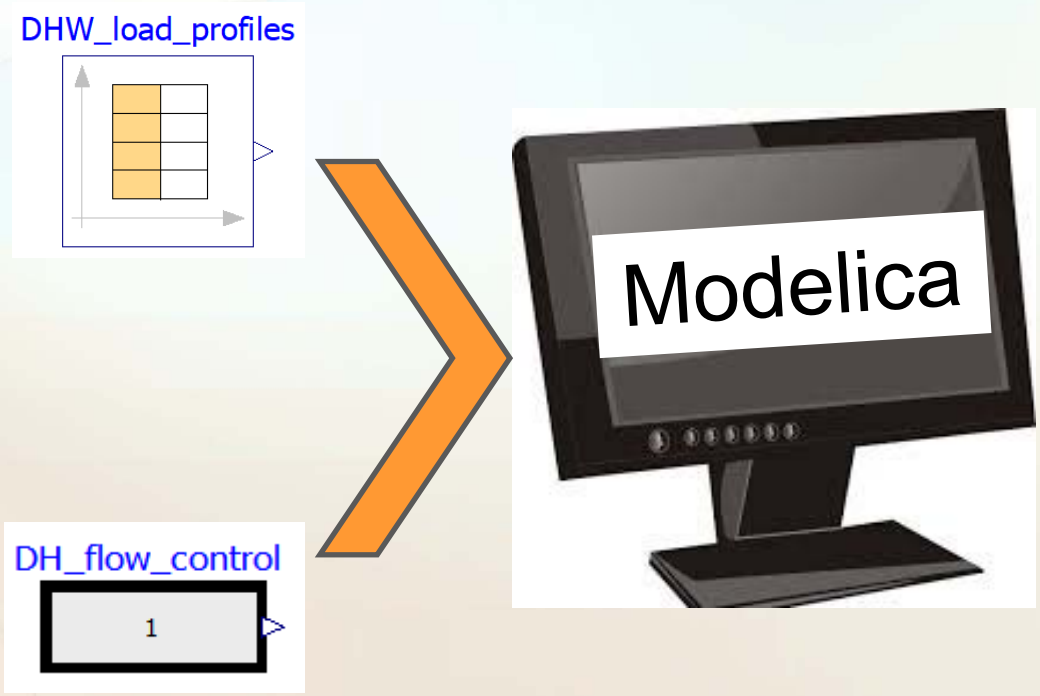
- Maintain required DHW temperature during any draw-off period
- Provide sufficient heat including the DHW consumption and heat loss
- Return temperature as low as possible

Demonstration building and dynamic modeling

- Typical multi-storey building in Copenhagen, 15 flats, 750 L tank, daily heat supply 142kWh, 50% for heat loss



Demonstration building and dynamic modeling

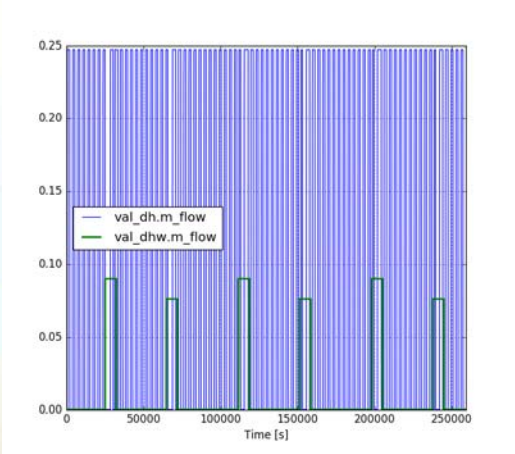


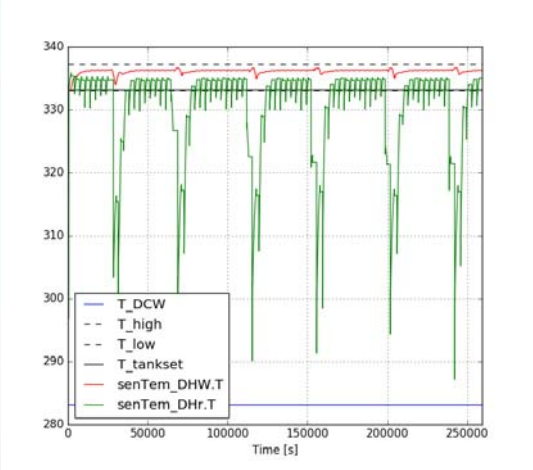
Dynamic results :

1. All temperatures
2. Heat flowrates in any heat transfer process
3. System hydraulic regulation

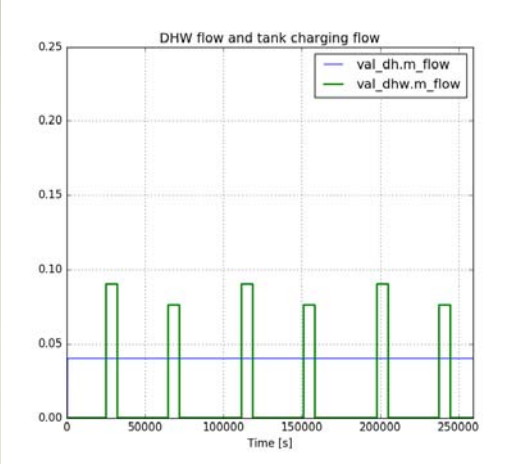
Model results

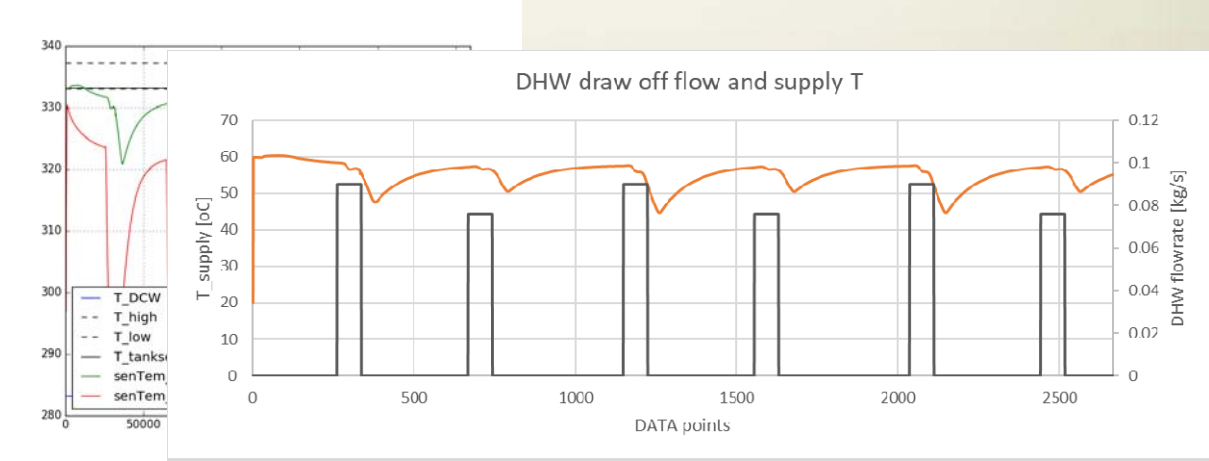
Piecewise charging





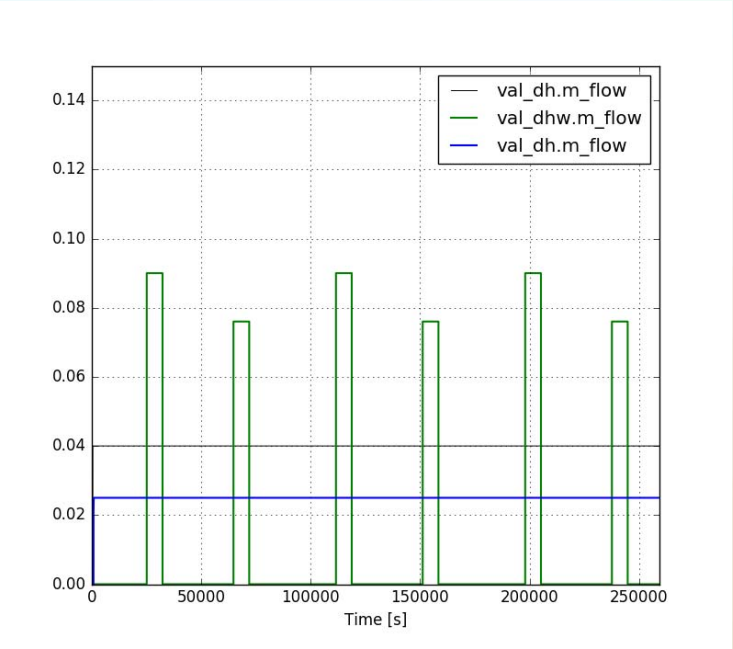
Constant charging flow



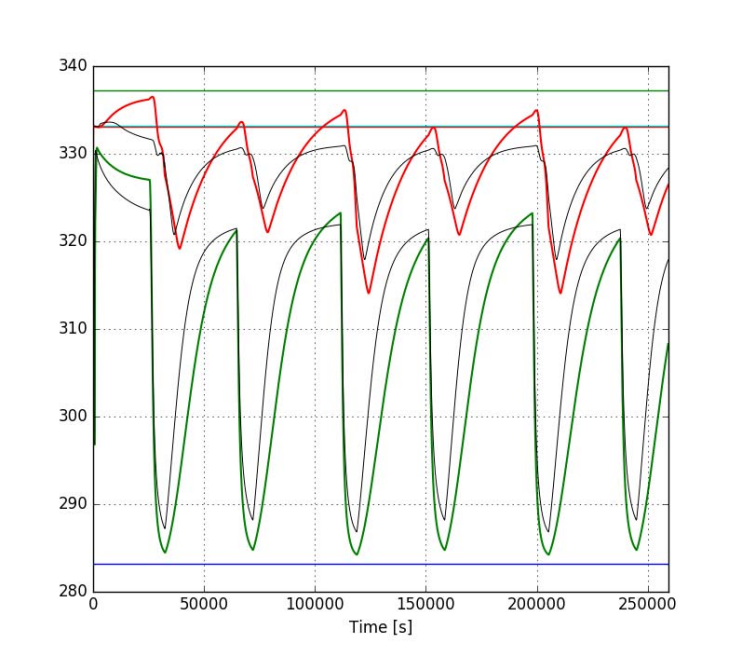


Model results

- Reduce the heat loss 50%-> 30%



Necessary charging flowrate

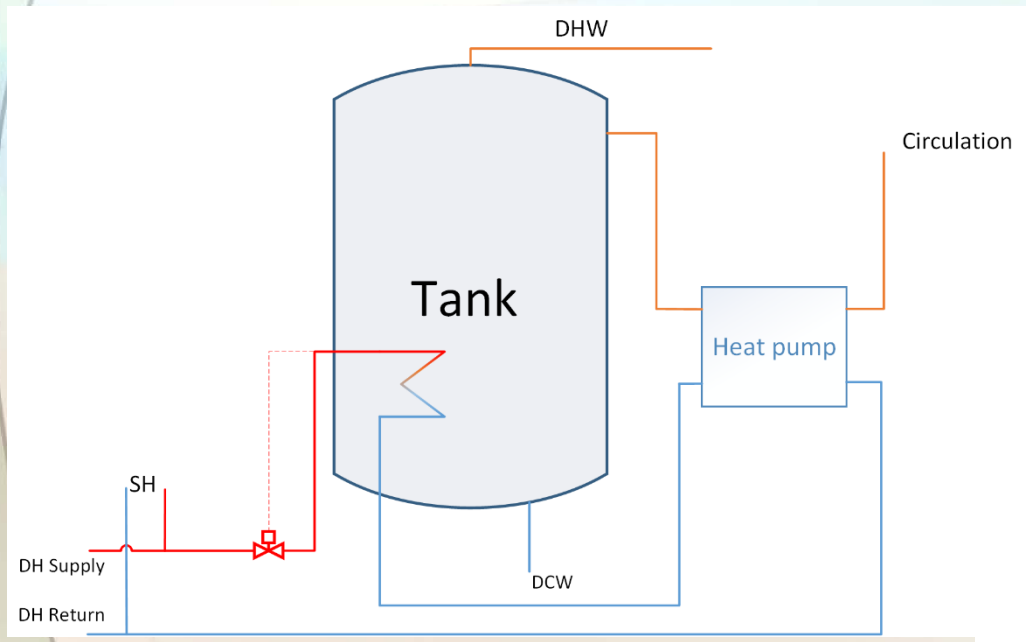


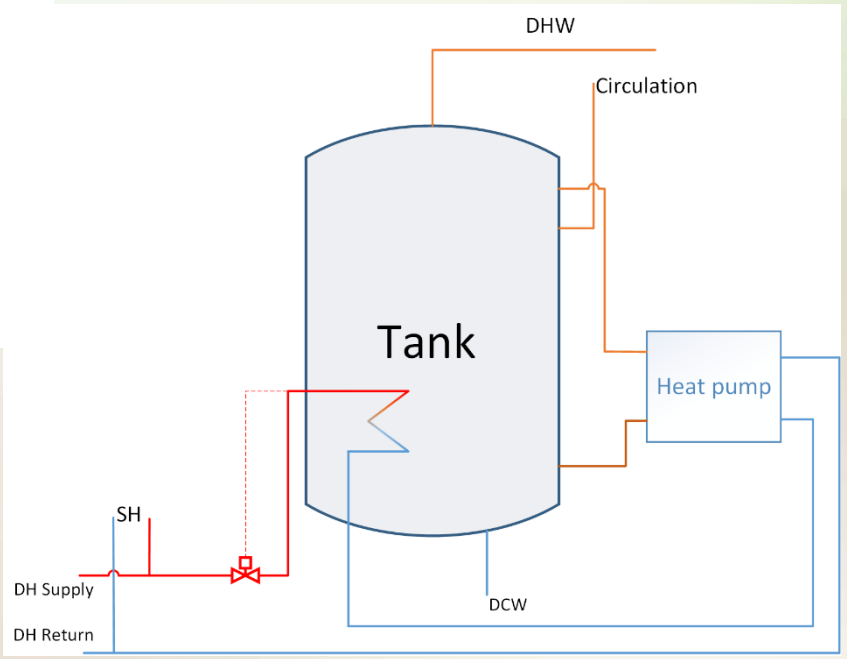
Critical temperatures

Results comparison

	Measurements	Simulated cases		
		Reference case	50% heat loss	30% heat loss
Peak Flowrate [kg/s]	0.25	0.25	0.04	0.025
Avg. Return T [°C]	57.6	55.9	38.0	33.1
Average cooling [°C]	10.6	14.1	32	36.9

Further improvement





Conclusion

- The DH return temperature from the conventional storage tank system can be reduced with better regulated charging flow
- Reduce the system heat loss can help to reduce the average DH return temperature
- Pracital DHW load profile is of great importance for the control
- Theoretically, the DH return temperature can be further cooled down by installing a circulation heat pump
- Future work:
  - Investigate the system performance with heat pump
  - Compare possible systems with different layouts

Thank you !

Xiaochen Yang
xiay@byg.dtu.dk
Department of Civil Engineering
Technical University of Denmark