COST EFFECTIVE
4TH GENERATION
DISTRICT HEATING CONCEPTS
LAYING METHODS
PRESENTATION AND BACKGROUND

• Kim Rolin

• 1994 Diplom-Eng. in buildings.


• 2002 - Ramboll

• 2002-2004 Worked together with Peter Randløv (Ramboll) Convenor of WG13 – (EN 13941)

• 2003 - Expert-member of WG 13 and S 190 (Danish Mirror committee)
The first district heating plant in Denmark was finished in 1903 in the centre of Copenhagen for burning waste due to lack of landfiling space. The plant was at first just supplying the local poorhouse with steam.

The chimney and plant house is protected and now standing next to a modern 200MV peak load oil fired boiler plant.
It started with steam systems in the larger cities but after a couple of decades hot water systems came up. At that time all systems were made with pipes in concrete ducts where pipe stress was eliminated with anchors and compensators or expansion loops.
In 1959 something happened ...

Mr. Ege Andersen, managing a plumbing and coppersmith company in the small city of Løgstør found in late 1950th a way to put a steel pipe in a casing pipe and insulate the space between the pipes with PU-foam.

The pre-insulated pipe was invented.

He founded a company called LOGSTØR RØRindustri today known as LOGSTOR.

In the 1960th and 1970th most pre-insulated pipe systems were still fully or partly compensated with no or low pipe stress constructed with either expansion loops or the "sliding" system where the steel pipe moved freely inside the insulation and with anchor blocks and compensators.

The "sliding" system was used up until the 1980th.
In 1982 the first Danish standard for design and installation of district heating concrete and pre-insulated pipe systems was published. 3 Ramboll engineers participated in making the standard.

The Danish standard was the foundation for the EN standard 13941 we use today and Ramboll has always been represented in both the Danish and EN standard committees.

The purpose for making this standard has from the beginning been to make more efficient and reliably district heating systems.

The standard committee is working continuously to improve and include new discoveries and experience to make sure the standard always will represent best practise and be state of the art.

Together with EN 13941 there is a numbers of associated standards which describe how all parts of a complete DH system must be made and to which quality.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.
HISTORY OF STANDARDS SHORT

DK-Standard for DH: 1982 - (DS 448)
EN-standard for: 1990 – (EN 253 – max DN600)
DH-komponents
EN-standard 13941: 2003 (first version)
Design and installation
Current version 2010
New version expected 2018
DISTRICT HEATING LAYING METHODS

Compensated systems (reduction of axial forces)

- Pipe-systems preheated in open trench - sections made with Z-bends and U-bends
- Pipe-systems compensated with L, Z and U-bends without preheating or with preheating after backfilling of trench but with open trench at the bends.
- Pipe-systems with E-compensators (SUC=Single use compensator).

Cold-laying (High Axial Stress-systems):

- Pipesystems without preheating or compensations-elements as bends and SUC.
Pipe network - The Danish way
Benefits in design ...

Lower temperature =
Longer expected lifetime

100 °C  >  100 year
115 °C  =  50 year
120 °C  =  30 year
Benefits in design ...

Expansion loops / Pre-stressing elements

Example: DN 100 / 4" series 2 - g114.3/221

F (m) = 55 m x 2 = 110 m
U = 2,1m = Due to pre-installing joints U > 3m

Extra approx.:
- Total length: civil work and pipe handling - 5.5m = 7% OHL
- 4 pcs, 90 bends - 300%
- 7 pcs welding and joint casing - 90%

Expansion loops is typically made on both supply and return. Pre-stressing elements only on supply.

RAMBØLL

AALBORG UNIVERSITY DENMARK
Benefits in design...
FAST LAYING OF LONG SECTIONS

RENOVATING DN700/1000
FAST LAYING OF LONG SECTIONS

RENOVATING DN700/1000
FAST LAYING OF LONG SECTIONS

NEW TRANSMISSION LINE DN250/450
FAST LAYING OF LONG SECTIONS

NEW TRANSMISSIONLINE DN250/450
Aksialt spændingsniveau

Grænse EN 13941

Grænse lokal ustabilitet (Buckling)

Flydespænding stål

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EN 1025
COST EFFECTIVE 4TH GENERATION DISTRICT HEATING PIPE CONCEPTS
12+13 SEPTEMBER 2017
STRESSES OVER YIELD-STRESS

IS THAT POSSIBLE?
AND WHAT TO BE AWARE OF
HIGH AXIAL STRESS
PRINCIPLES OF FORCES

![Diagram showing axial stress principles](image_url)
Aksialt spændingsniveau
Stabilitet - lokal / global
TOPICS TO CONSIDER WHEN USING SYSTEMS WITH HIGH AXIAL STRESS.

- The risks of parallel excavations near DH-pipes (other utilities)
- Necessary soilcover when using curved pipes.
- Limitation in the use of angular deviations at welds.
- Reductions of pipes (only 1 dimension at a time)
- Special attention for branches, both prefabricated and “in-situ” – fatigue are the main-topic.
- Larger deformations at the bends.
COST EFFECTIVE 4TH GENERATION DISTRICT HEATING PIPE CONCEPTS
12+13 SEPTEMBER 2017
LOWERING THE STRESSES BY USING E-COMPENSATORS. (SUC)
LOWERING THE STRESES BY USING E-COMPENSATORS. (SUC)
TOPICS TO CONSIDER WHEN USING E-COMPENSATORS.

How long are the period from welding in the E-compensator to making the final “closing” of the E-compensator?

Is it possible to come back for closing at the time of commissioning or shall the E-compensator be closed “before leaving working-area”?

E-compensators must only be connected to straight pipes. Elastic bending on sections with E-kompensators are not allowed.

Using of E-kompensators with preset gap or with “full gap”.
HOW TO HANDLE (LARGE) DEFORMATIONS AT THE BENDS

Sandcushions – only suitable for open field and only for small deformations (recommended not to be used)

Foamcushion - Maximum allowable deformation 70% of 120mm = 84mm (may require extra strong foam at bends)

“open bends” - Area around bends are backfilled after “first-time” expansion. (reducing of deformation)

Special Constructions - making space to allow pipes to expand without soil pressure.
Figure 12 — Possibilities for expansion cushions of the outer casing
COST EFFECTIVE 4TH GENERATION DISTRICT HEATING PIPE CONCEPTS

12+13 SEPTEMBER 2017
BENEFITS FROM USING E-COMPS OR HIGH AXIAL STRESS SYSTEMS ACC. EN 13941

- Reducing amount of weldings and joints significant, (and the risk of failures)
- Lowering the cost of components and pipework, welding/mounting.
- Lower cost of civil-works due to more simple routing, better workflow (no preheating) easier handling of the traffic (no U or Z-bends needed) and shorter construction time (shortening of the time with open trenches means less traffic-handling and maintenance of trences and working-area ).
If you want all the benefits of using the EN 13941 for designing, you have to use all of the standards.

This means among others:

- Pipes, fittings and joints shall be according the EN standards
- Weldings shall be according EN 13941. high quality and strict demands for misalignments.
- If doing so, it's possible to make projects in project class A+B mainly by using design-manuals from pipesupplyer = lowering the cost for designing.
EXAMPLE FROM BELGIUM - 2017
EN 13941 IN THE FUTURE
THANK YOU FOR
YOUR ATTENTION