

Cost Effective District Heating & Cooling Networks¹

Cold Installation of Rigid District Heating Pipes (1999: T3.1)

Today, thermal pre-stressing of the pipes is generally avoided when they are laid by the cold installation method.

With today's practice of cold pipe installation the design stress parameters are no longer limited by the material's 0,2% yield strain.

Of all possible options cold pipe installation is the simplest kind of laying technology, which opens new and effective possibilities of construction-site organization. With appropriate preparation the activities can be performed in a single-day-construction manner.

The static stresses caused by cold pipe installation exceed the stresses resulting from the 0.2% yield strain. The design is governed by a fatigue analysis based on the appropriate number of load cycles for district heating. Hence, the material's mechanical stress resistance is used to an extensively high degree.

With cold pipe installation resulting stresses can reach the stresses of the actual yield strain. As a consequence, the pipe endings, which are generally located in the expansion zone, undergo considerable displacements. Solutions have been worked out to control the high stresses and strains. These are described in this report. In general, operating the system at moderate temperatures, cuts back some of the disadvantages and restrictions of the cold pipe installation method.

The method of cold pipe installation is definitely applicable today. The decisive questions concerning material stresses are solved both theoretically and experimentally. An increasing number of companies do apply cold pipe installation using several years of experience particularly those made in Denmark, Sweden and Germany. Further investigations will be likely to bring along simplifications in the design of service connections.

1. This project consists of three reports Cold Installation of Rigid District Heating Pipes (T3.1), New Ways of Installing District Heating Pipes (T.3.2) and Reuse of Excavated Materials (T3.3)

The predominant advantage of cold pipe installation is the reduction of construction time and costs. Extensive investigations of the time span of construction have shown that construction time decreases to 67% and costs to 81% when compared to pipe laying by ways of thermal pre-stressing.

The supply with district heating, which is regarded as less-polluting and resource conserving, can be expanded as much further as pipelines can be installed more cost-efficient. Therefore, many initiatives aim at the reduction of pipeline construction costs. One of the possible solutions is the cold installation of pipes. In contrast to the commonly applied laying technology it takes advantages of an increased utilization of the pipe-system's mechanical strength. However, cold installation techniques require a more detailed stress analysis as a basis for design.

Nowadays, bonded pre-insulated pipes are used almost exclusively when buried district heating pipeline systems are installed. These systems are international state-of-the-art. As they use rigid steel pipes as medium pipes only these systems are being dealt with in this report. A series of European Standards already exists on technical specifications of the raw material, another standard is currently being prepared for the design, layout and laying of this pipe system. Besides this, flexible pre-insulated pipes are coming up on the market and will become more important in future.

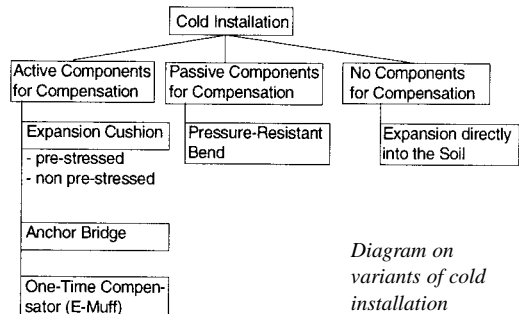


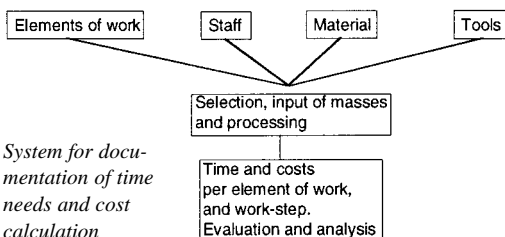
Diagram on variants of cold installation

Advantages	Disadvantages
<ul style="list-style-type: none"> • no costs for preheating • reduced excavation costs for trench braces • fewer provisional bridges for residents • early backfilling of the trench possible • reduced traffic obstruction • lower expense for traffic guiding • cold installation makes the single-day-construction possible • simplified repair technique in the zone of restrained pipe when preheated 	<ul style="list-style-type: none"> • reinforcement of weak components, like tees, reducers, etc. calls for high material strength in the fully restrained and transition zones • require strengthened valves • limited angular misalignment permissible • not applicable for large nominal diameters from • DN 400 (stability) • Increased planning and safety efforts at subsequent parallel excavation • problems if infrared joint-inspection is desired

Table 2-2: Advantages and disadvantages of cold installation, cost effects

Construction-Times, Construction Costs

Cold installation reduces construction costs. A detailed calculation of the savings is difficult to do since construction costs are always a result of a specific construction site and each site has its unique cost relations. It gets even more complicated when costs are compared between different companies and especially involved for international comparisons. There are certain similarities between countries, e.g. Sweden, Germany et. al., according to which the ratio of excavation/backfilling to pipe installation as civil engineering costs for BPP-systems are in the order of 60 to 40; for further details please refer to the report. On the other hand this ratio is almost inverted in Finland to 40 over 60, where details are also provided. In Finland the lower civil engineering costs are probably caused by a high share of construction under unpaved surfaces.



In Germany (Mannheim) very detailed investigations of actual construction times were performed by means of which one is able to rank the different construction techniques from a more universal point of view. The labor for workers as well as for machines were divided into elements and simulated with computer. The calculation model was tuned by comparison with actual construction projects. Cost comparisons are started with the creation of a specific construction case. The calculation solves for the most cost-efficient construction-technique.

In a number of simulation runs the experience was verified that reduced construction times lead to lower construction costs. Obviously, shorter construction time means a better utilization of resources.

Also the cold installation was analyzed for single-costs and the results compared to those of the common thermal pre-heating laying technology. The results are presented in this report.

The cost analysis was performed using a model construction site, which was rated typi-

cal by several district heating utilities. Nominal diameters of DN 65 up to DN 100 were prevailing whereas the length of pipe route totaled 500 m.

The cross sections of the trench for the analyzed laying technologies

- Variant 1: thermally pre-stressed
- Variant 2: cold-installed

are presented in this report. Figures will show that variant 2 could be done by proceeding day-by-day, so-called single-day-construction, where no trench side support was required. Day-by-day proceeding means, that the route was divided into short length segments for each of which excavation, pipe laying and

back-filling could be done during a single day. Day-by-day proceeding becomes feasible, if the construction site is well prepared (asphalt layer is cut, pipes are welded and checked for leak-tightness) and also finishing work-steps are permitted (reinstallation of the street's wear layer). Here, the single-day-construction lengths were about 40 m; also, a single-day progress of 100 m for DN 80 has already been accomplished.

The single-day-construction technique responds to the time-limited stability of the trench walls by reducing time and thereby saving the braces to support the trench. The soil remains stable for almost always a minimum duration of one day in which the pipe is buried and the trench back-filled.