



**37TH INTERNATIONAL
NO - DIG
FLORENCE 2019**

Fortezza da Basso • FLORENCE (Italy)

30th September • 2nd October 2019

**DESIGN&BUILDING CONTRACTS AS A PERFORMING
OPPORTUNITY TO C.I.P.P. SEWERS REHABILITATION –
BRIANZACQUE CASE STUDY**

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What we are going to see Today

Important sewer rehabilitation done whit C.I.P.P. (Cured In Place Pipe)



key elements

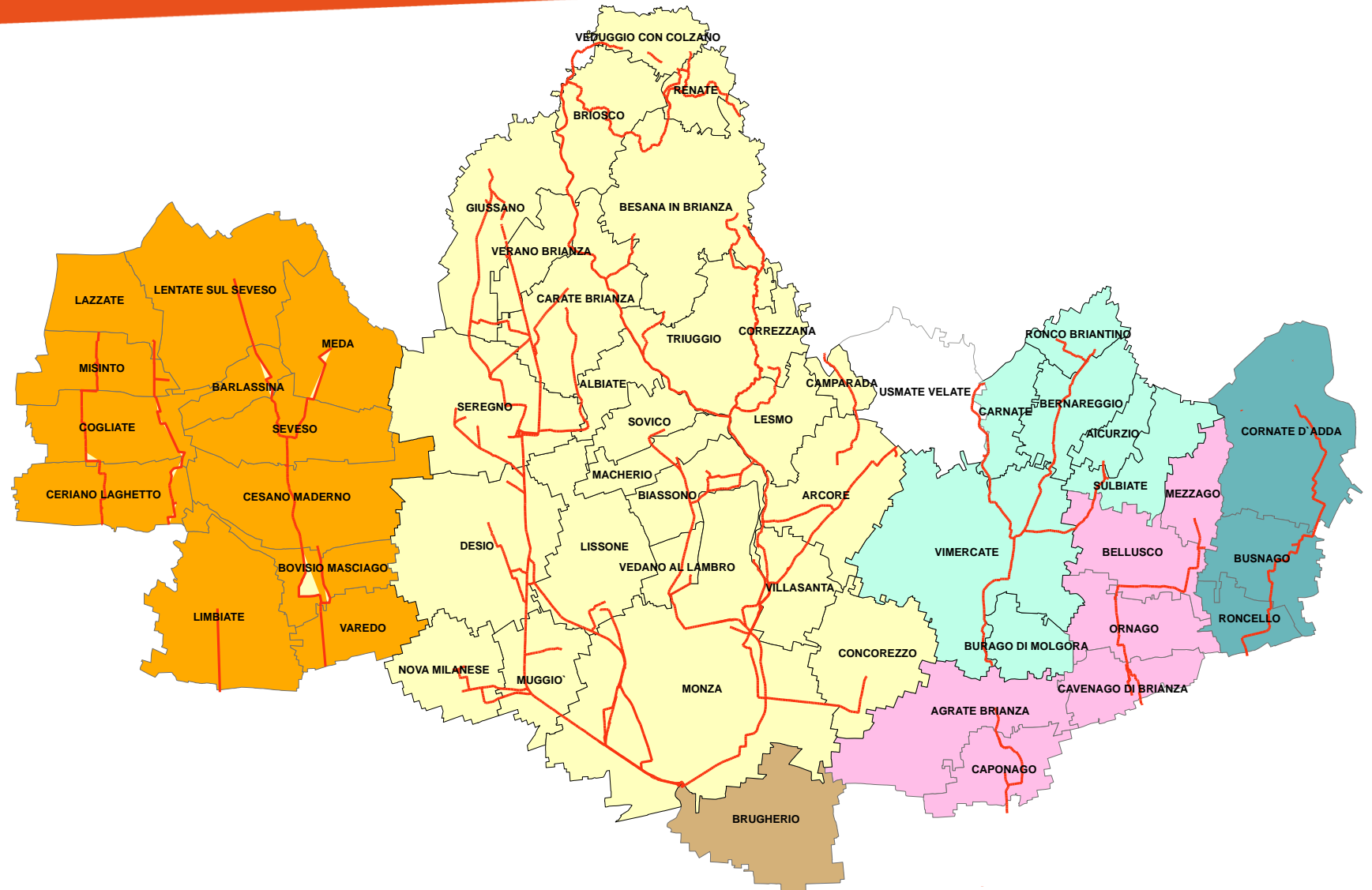
- 1 - **AREA** - densely populated area in the north of Milan
- 2- **LENGTH and SIZE**: 2.5 km of a large ovoid-shaped sewer
- 3 - **BUDGET**: 3 million euro



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- 55 City
- 405 km² (square kilometers)
- 870.000 people
- More then 2.600 km of Sewer pipes

INCREASE KNOWLEDGE



Brianzacque to develop the knowledge of the geometric and hydraulic characteristics of the sewerage network, realized THE RIMODEL PROJECT

Video-inspection

Modeling

Measures

Sewerage Plan



System able to provide a global board of the problems to be solved, to identify the consequent rehabilitation interventions, as well as to define their priority and the related cost

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- 1 Problems related to the hydraulic insufficiency of the pipes, which causes flooding and superficial flooding;
- 2 Problems of structural criticality and water tightness, connected to the age of the pipes;



		Priority	
		Urgent	Low
Severity	Critical	Key feature does not work	Feature that is rarely used does not work
	Non-Critical	Company logo is the wrong color	The caption on an image is written in the wrong font

Identification
of priority
based on
gravity



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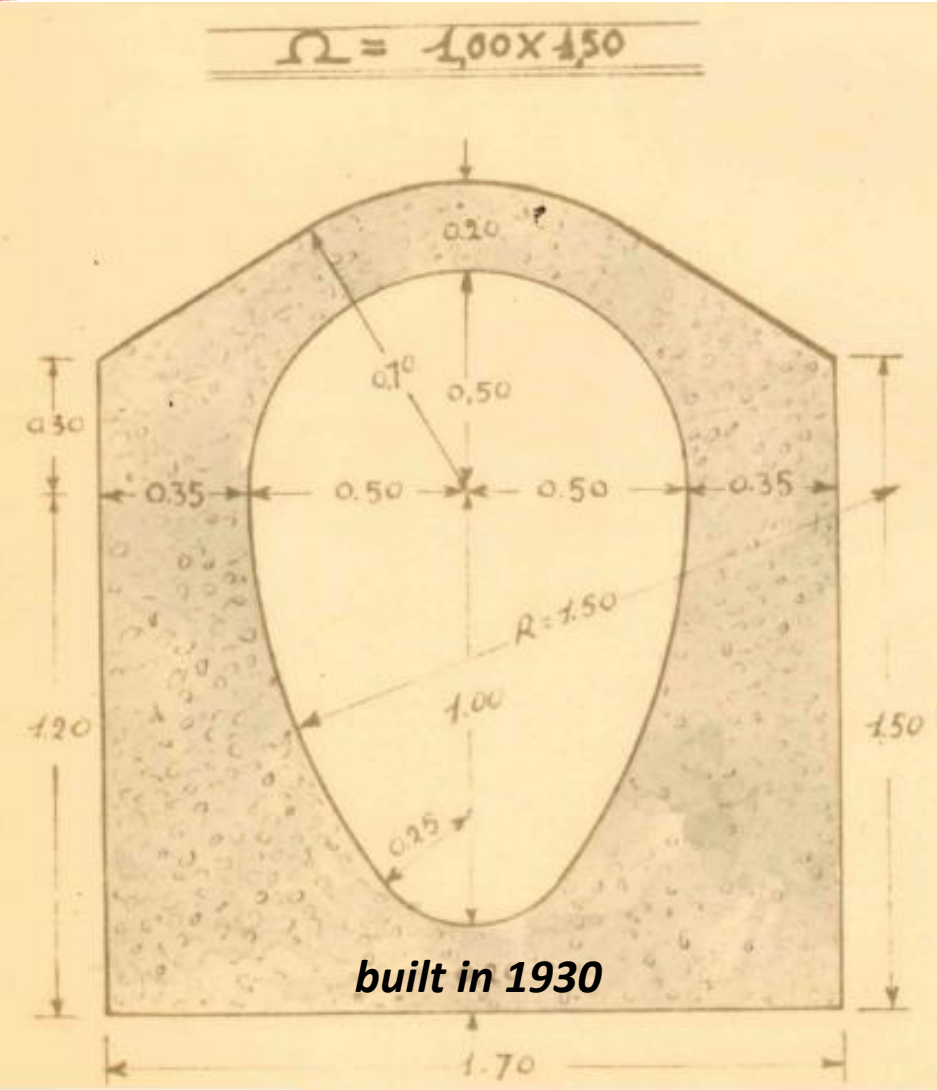
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Structural problems



Punctual Collapses



Different Diameters



We decided to replicate the shape of the pipeline with a structure

Problems with video-inspection



Important wastewater flow

Not all the pipelines was investigated



How is the best practise to solve the structural problem?

Parameters	Remove the old pipeline and lay the new pipeline	trenchless technology
useful life of the pipeline	60/80 years	50 years
Cost of the work	€ 12 milion	€ 3 milion
execution times	2 years	5 mouth
social costs	VERY HIGHT	LOW
environmental advantage in terms of reducing CO ₂	2.394.048 Co2 [kg]	84.917 Co2 [kg] -96%

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Choose the type of Contract



**INCREASE
KNOWLEDGE**

Highly specialized work



**INTEGRATED
TENDER**

Use the skills of people who
work with technology

ROTECH
risanamento e rinnovamento tubazioni



W DOTT. ING. MARIO VALDEMARIN
DR. ING. DIETER SCHÖLZHORN

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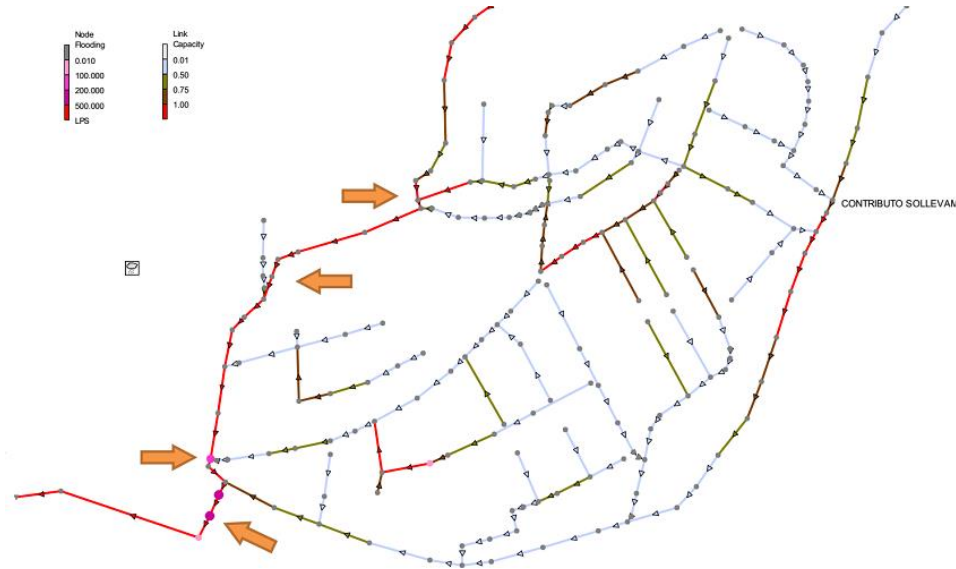
**DESIGN&BUILDING
CONTRACTS**

30 days for the Project
103 days for the rehabilitation

Criticality to solve

The management of wastewater during all the
Sewer rehabilitation

Mathematical Model → 3 Pumps 110 l/s



Change Flow of the waste water



By-pass

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The static calculation in order to determine the thickness of the liner to be inserted into the existing pipeline.

Section (mm)	Position	Damage class	DWA-A 143-2 Software EasyPipe:	UNI 11681 Diametro equivalente formula FALTER	ASTM 1216	DWA-A 143-2 Software: FEM	Liner thickness chosen
800/1200	Road/Green area	Partially deteriorated	Not considered	Not considered	Not considered	Not considered	Not considered
800/1200	Road/Green area	Completely deteriorated	9.5 mm	11.81 mm	10.2 mm	9.5	12.1 mm
800/1200	Railway	Completely deteriorated	9.5 mm	14.10 mm	13.73 mm	12.5 mm	14.2 mm
1000/1500	Road/Green area	Partially deteriorated	Not considered	Not considered	Not considered	Not considered	Not considered
1000/1500	Road/Green area	Completely deteriorated	12.5 mm	13.65 mm	12.89 mm	12.5	14.2 mm
1000/1500	Railway	Completely deteriorated	12.5 mm	16.04 mm	14.95 mm	12.5 mm	16.3 mm

Why we have chosen uv liner?

- 01 – No excavations**
- 02 - No water**
- 03 – Less Co2**

we decided the most precautionary solution

How we are able to control the execution? We built a Control Plan

1 check – Datasheets



Technical
datasheets and
certifications
are compared
with the static
project report.



Static project

Modulo di elasticità tangenziale a breve termine	=	21.209	N/mm ²
Tensione a flessione a breve termine	=	380	N/mm ²
Coefficiente di Poisson	=	0,22	
Fattore di riduzione A ₁	=	1,23	
Modulo di elasticità tangenziale a lungo termine	=	17.243	N/mm ²
Tensione a flessione a lungo termine	=	309	N/mm ²

Certification of the liner

Liner "Alphaliner 1800" e "Alphaliner 1800 HP" con resina PU:

Modulo E anulare a breve termine secondo DIN EN 1228¹²:

21.209 N/mm²

Modulo E anulare a lungo termine:

17.243 N/mm²

Sforzo fessionale a breve termine σ_{fB} secondo DIN EN ISO 11296-4²

o DIN EN ISO 178¹³:

380 N/mm²

Sforzo fessionale a lungo termine σ_{fB} :

309 N/mm²

Fattore riduzione A dopo 2.000 h:

1,23

In the building site – **2 check before inserting the liner**



After the cleaning



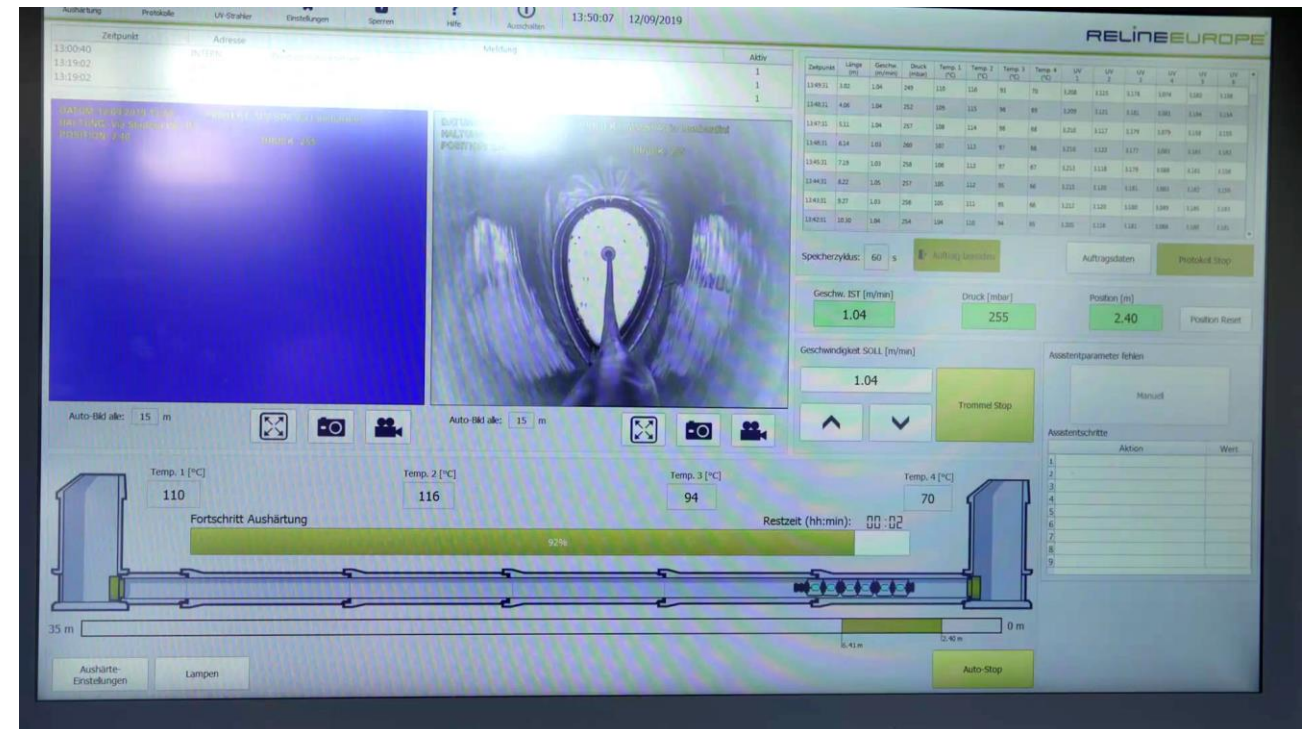
Before the insertion



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In the building site – **3 Check during the insertion and the catalysis of the liner**
we supervise the processes and procedures - guidelines UNI EN 11296/4



Software for checking the process of catalysis



In the building site – **4 Check the report**



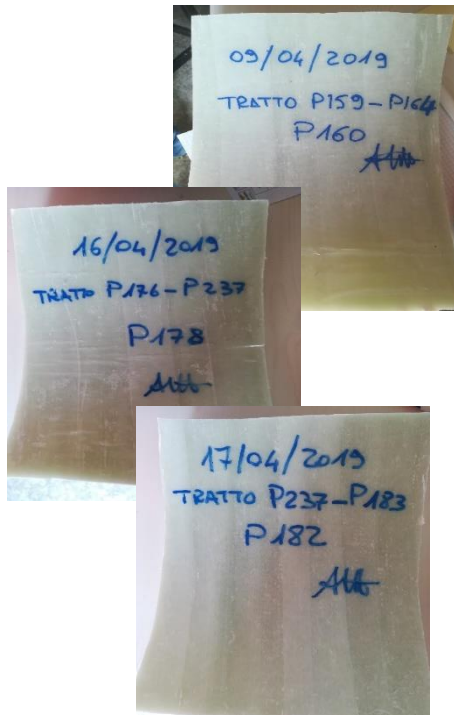
At the end of the insertion process, we analyze the report.

From this report we can understand if there have been executive problems



Datum & Zeit	Länge	Geschwindig.	Druck	Temperaturen				UV-Lampen									
Zeitstempel	(m)	(m/min)	(mbar)	T1 °C	T2 °C	T3 °C	T4 °C	1	2	3	4	5	6	7	8	9	10
18.04.19 14:49:12 W. Europe Daylight Time	117,20	0,20	255.000	83	60	69	40	3,222	3,147	3,174	3,142	3,188	3,207	0	0	0	0
18.04.19 14:50:12 W. Europe Daylight Time	117,00	0,21	252.000	86	64	74	41	3,218	3,151	3,174	3,141	3,188	3,191	0	0	0	0
18.04.19 14:51:12 W. Europe Daylight Time	116,77	0,39	252.000	87	68	78	42	3,229	3,156	3,179	3,133	3,184	3,187	0	0	0	0
18.04.19 14:52:13 W. Europe Daylight Time	116,37	0,40	254.000	89	71	77	42	3,221	3,148	3,170	3,136	3,182	3,189	0	0	0	0
18.04.19 14:53:13 W. Europe Daylight Time	115,97	0,40	255.000	91	75	78	43	3,218	3,155	3,174	3,139	3,188	3,186	0	0	0	0

In the building site - **5 Check**



we take a sample for
analysis – UNI EN 11296/4

short-term flexural

VS

Static project
long-term flexural

reduction factor

Test

Procedura	Parametri	Unità di misura	Valore medio	Deviazione standard
#DIN EN ISO 178	Spessore del composito	mm	12,7	0,2
	Spessore complessivo	mm	14,0	0,2
	Modulo di elasticità alla flessione	MPa	20138	1201
	Tensoflessione	MPa	411,6	33,2

Static project

Modulo di elasticità tangenziale a breve termine	=	21.209	N/mm ²
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Modulo di elasticità tangenziale a lungo termine	=	17.243	N/mm ²
Tensione a flessione a lungo termine	=	309	N/mm ²

How we can have the
long term flexural of the
material proposed?

UNI EN 11296/4



Annex C

(normative)

Cured-in-place pipes — Determination of long-term flexural modulus under dry or wet conditions

C.1 General

This annex specifies a method for determining the long-term flexural modulus of CIPP material subjected to a constant flexural stress under dry or wet conditions. The specified test period is 10 000 h, and the result of the test is expressed as a value of long-term modulus extrapolated to 50 years. The method of extrapolation used also, however, allows determination of long-term modulus at any other time between 10 000 h and 50 years.

Hydraulic seal and Quality - Connections and existing wells



finishing and sealing of the connections



finishing and sealing of the liner

Hydraulic seal and Quality - restoration of the existing wells



hydro-scarifying 400 Bar



stakeout the Walls



mortar spraying 2 times

Connections and restoration of the existing wells - **Hydraulic seal and Quality**



Wells restored



Tear test on grout for wells recovery



Problems on going: Erosion of the pipeline more than we thought



estimated in the
project

20% of the pipelines

Reconstruction whit
bricks and cement

Costs about 3% of
the contract

UNIVERSITY Politecnico di Milano and Rotech S.r.l. proposed a test with Optical fiber to measure the flow of the wastewater.



The goal is to correlate the recorded vibrations measured by the optical fiber to the measures of the fluid speed made by a flow meter



- 1) monitoring of piping condition
- 2) report waste water leaks
- 3) structural damage in the pipeline



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