LAS VEGAS PLASTIC PIPES XIX

Conference and Exhibition

LAS VEGAS, NEVADA
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PLASTIC PIPES CONFERENCE ASSOCIATION

Polyethylene pipeline performance against earthquake

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Contents

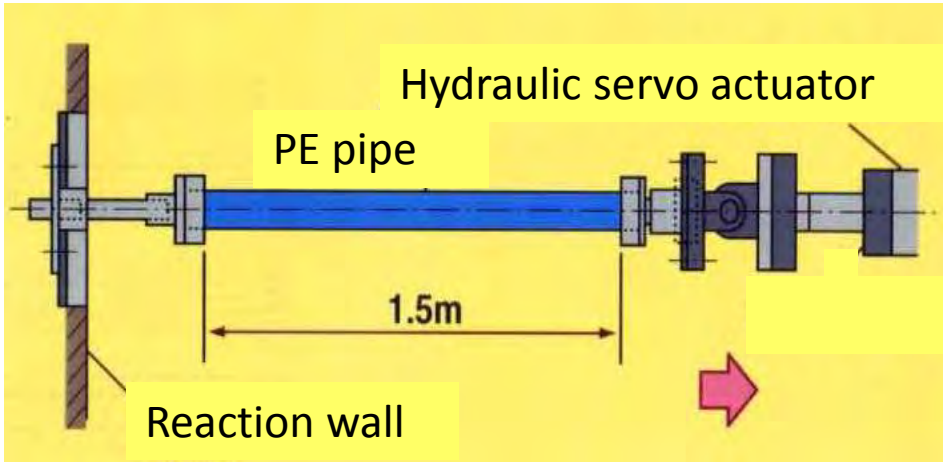
In Japan , polyethylene (PE) pipe have been used for a long time , but its usage is limited for water service(low density PE/PE50) and gas service(medium density PE/PE80).

However , after 1995 Hyogoken Nanbu Earthquake ,it started to sell PE pipeline (hige density PE/PE100) for water distribution applications , because no damage on PE pipes at the earthquake was high evaluated.

We have been verified the characteristics of PE pipeline (PE100) from the viewpoint of seismic performance.

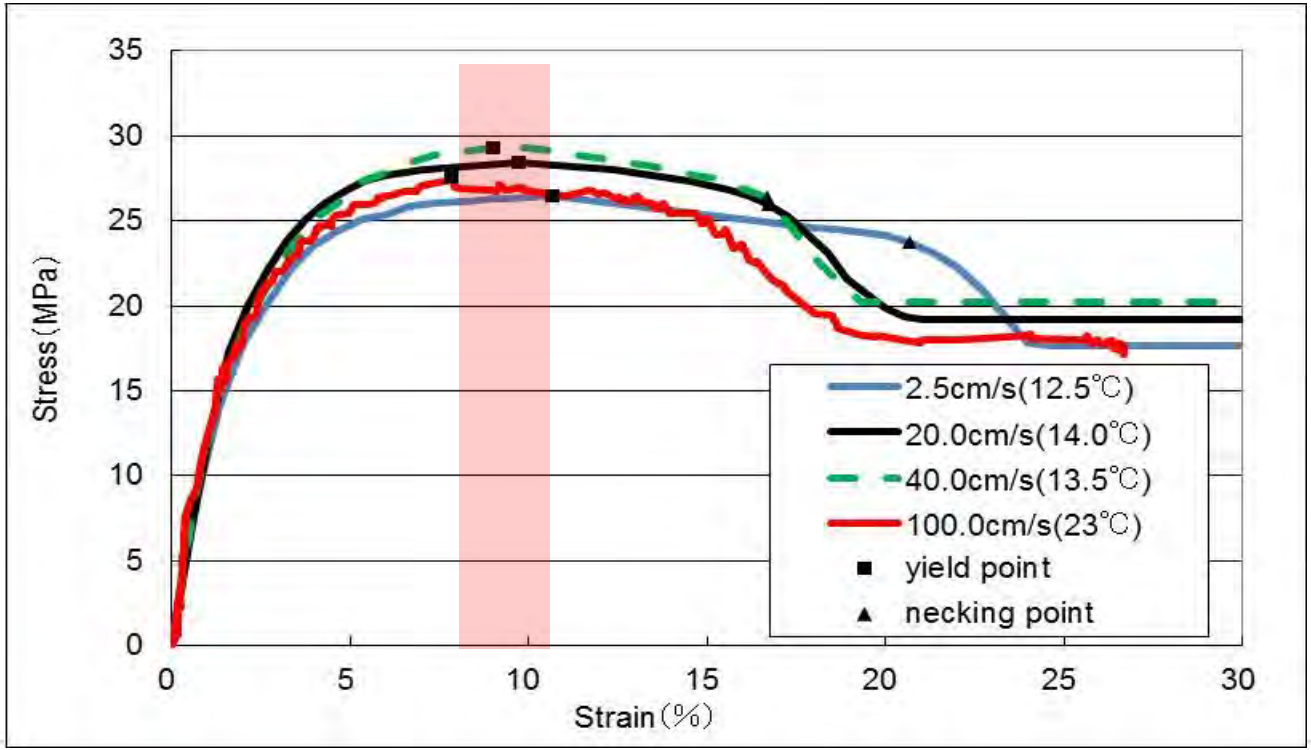
1. Material property of Polyethylene （Tensile and compression ）

Outline of the longitudinal stretch experiment



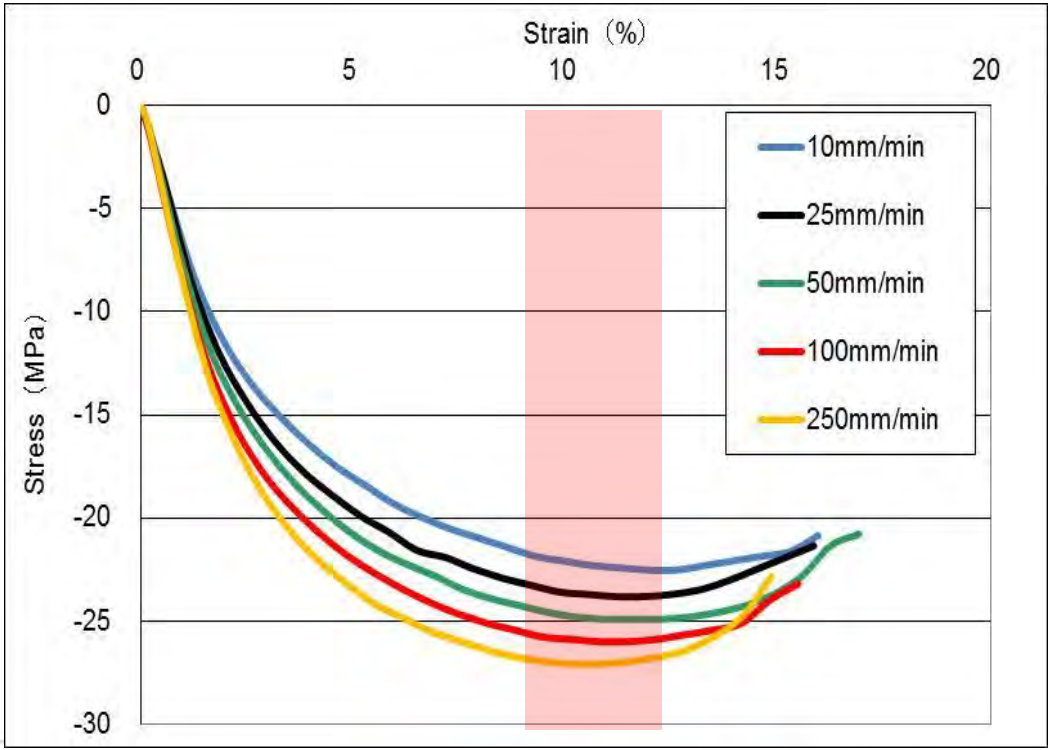
D=90mm
t =8.2mm
(SDR11)

Tensile stress-strain curve



Compression stress-strain curve

D=180mm
t =16.4mm
(SDR11)
L=500mm

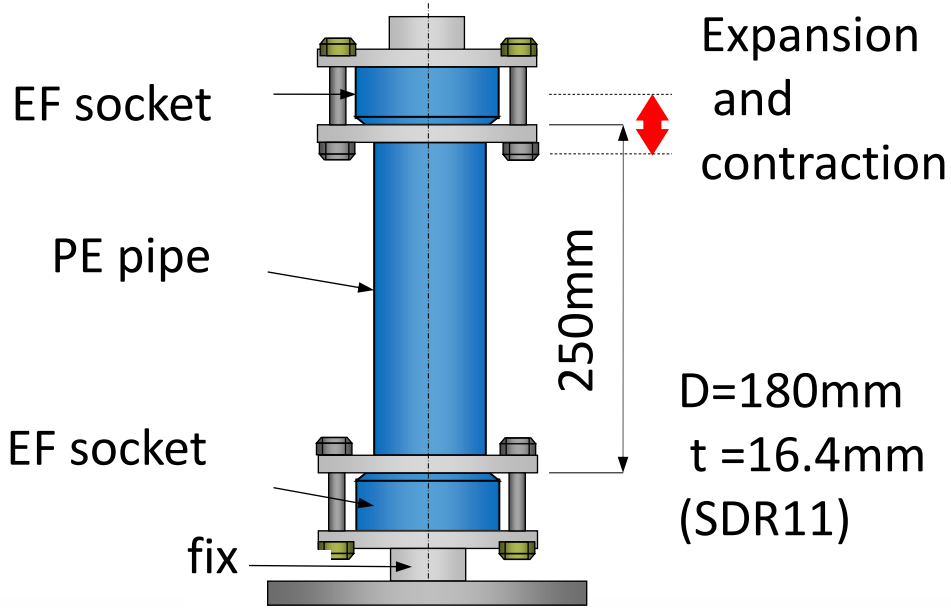


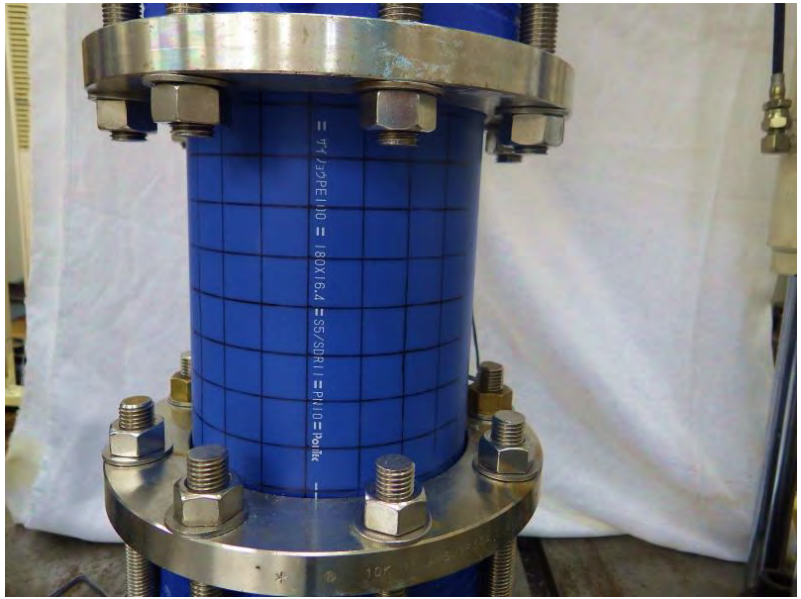
2.Seismic test

（Repetitive expansion and contraction test）

Seismic test

（Repetitive expansion and contraction test）

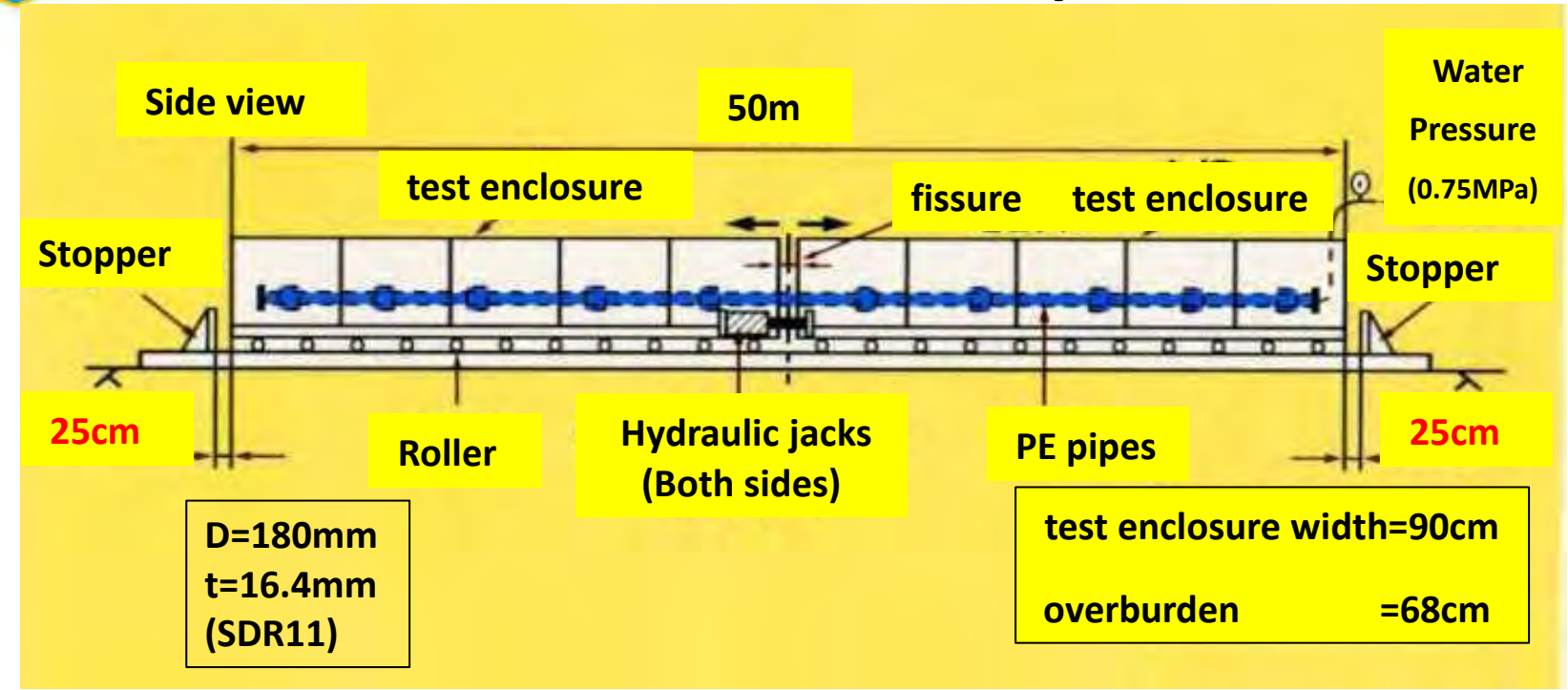




3.Real scale simulated test

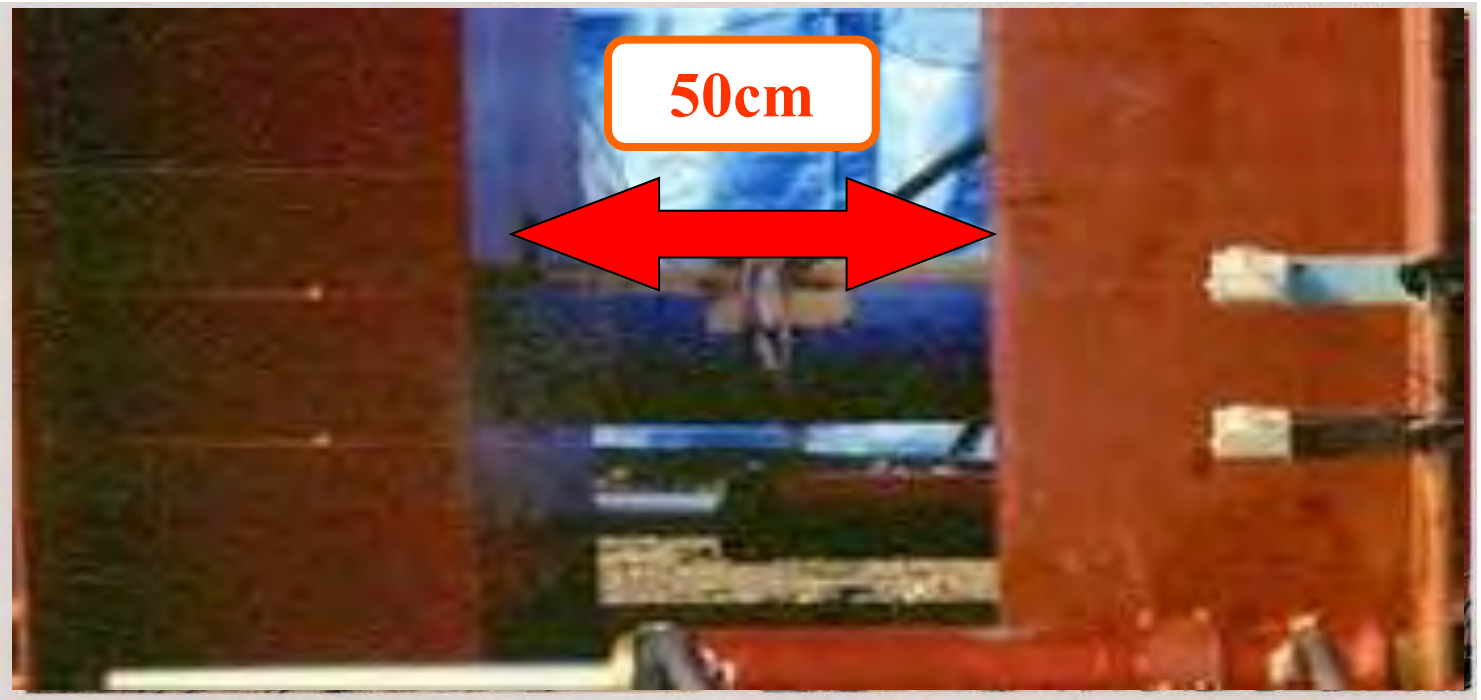
Real scale simulated test

Outline of the Fissure experiment



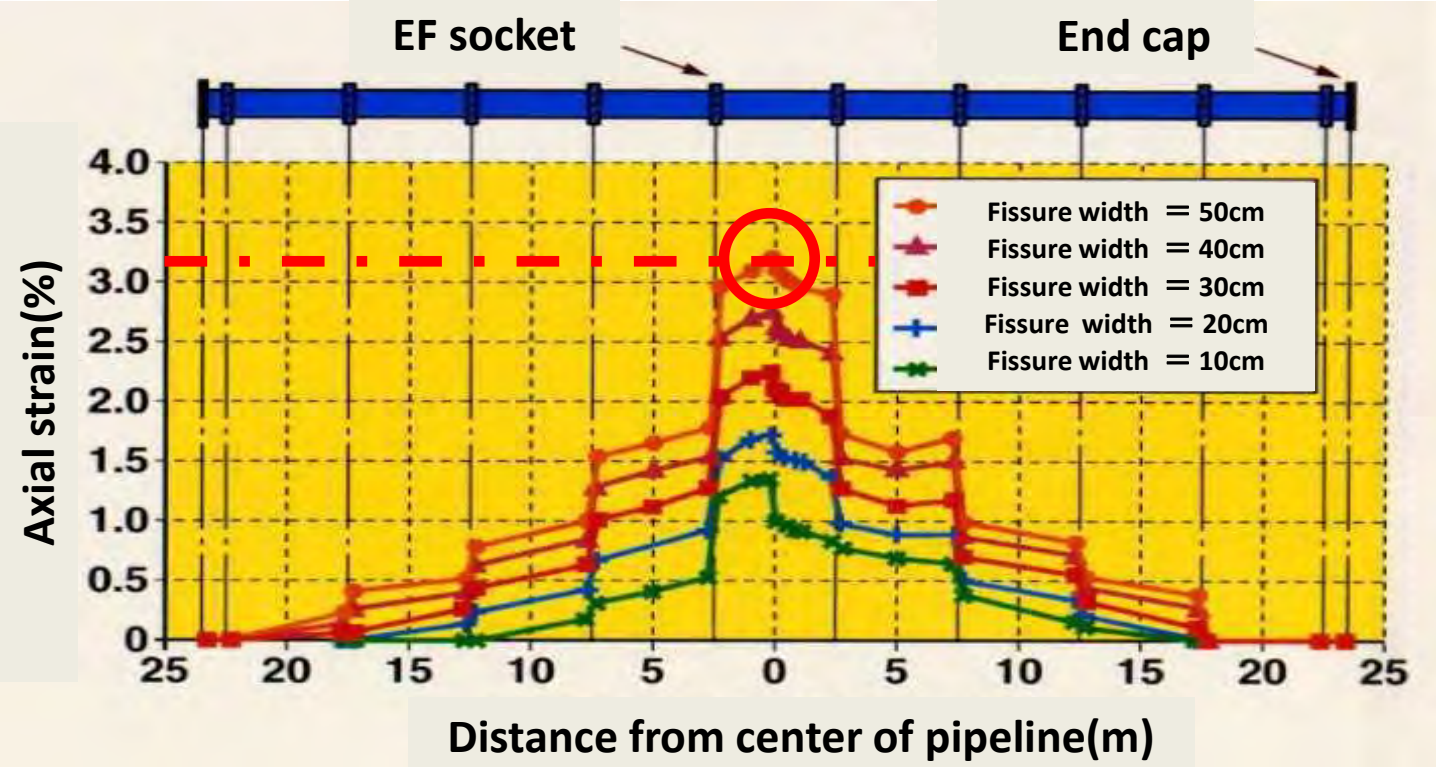
Real scale simulated test

Outline of the fissure experiment



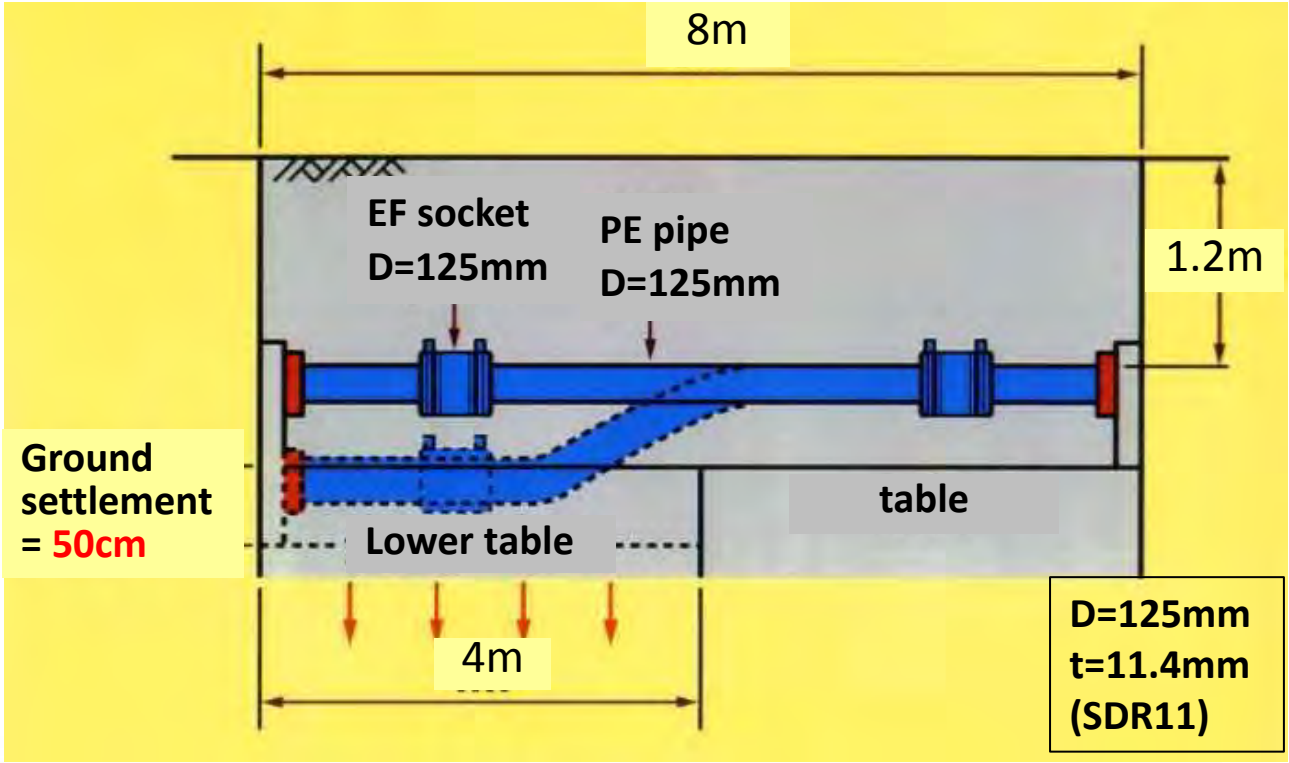
Real scale simulated test

Longitudinal strain distribution



Real scale simulated test

Outline of the Ground Settlement experiment



Real scale simulated test

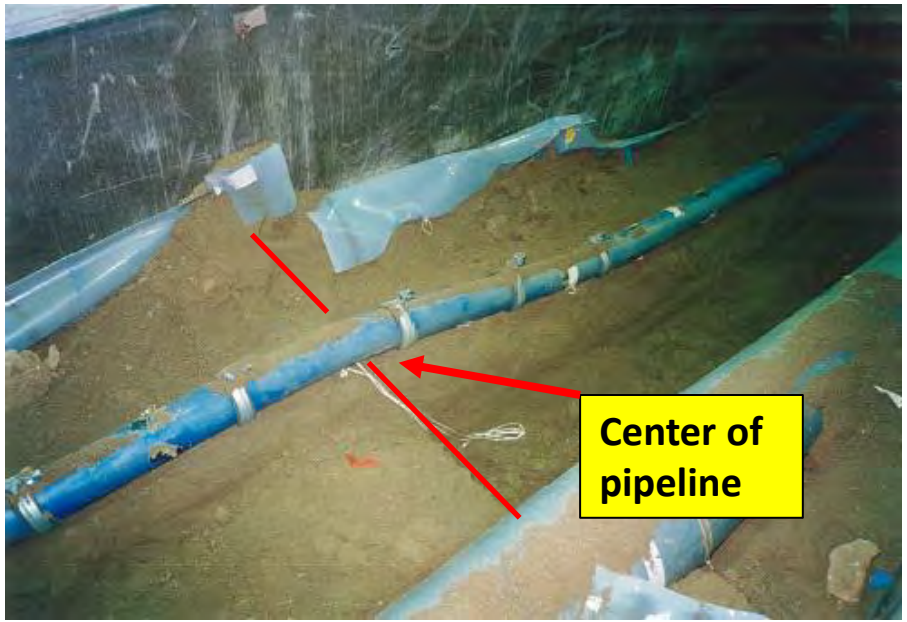
Outline of the Ground Settlement experiment

Before experiment

After experiment

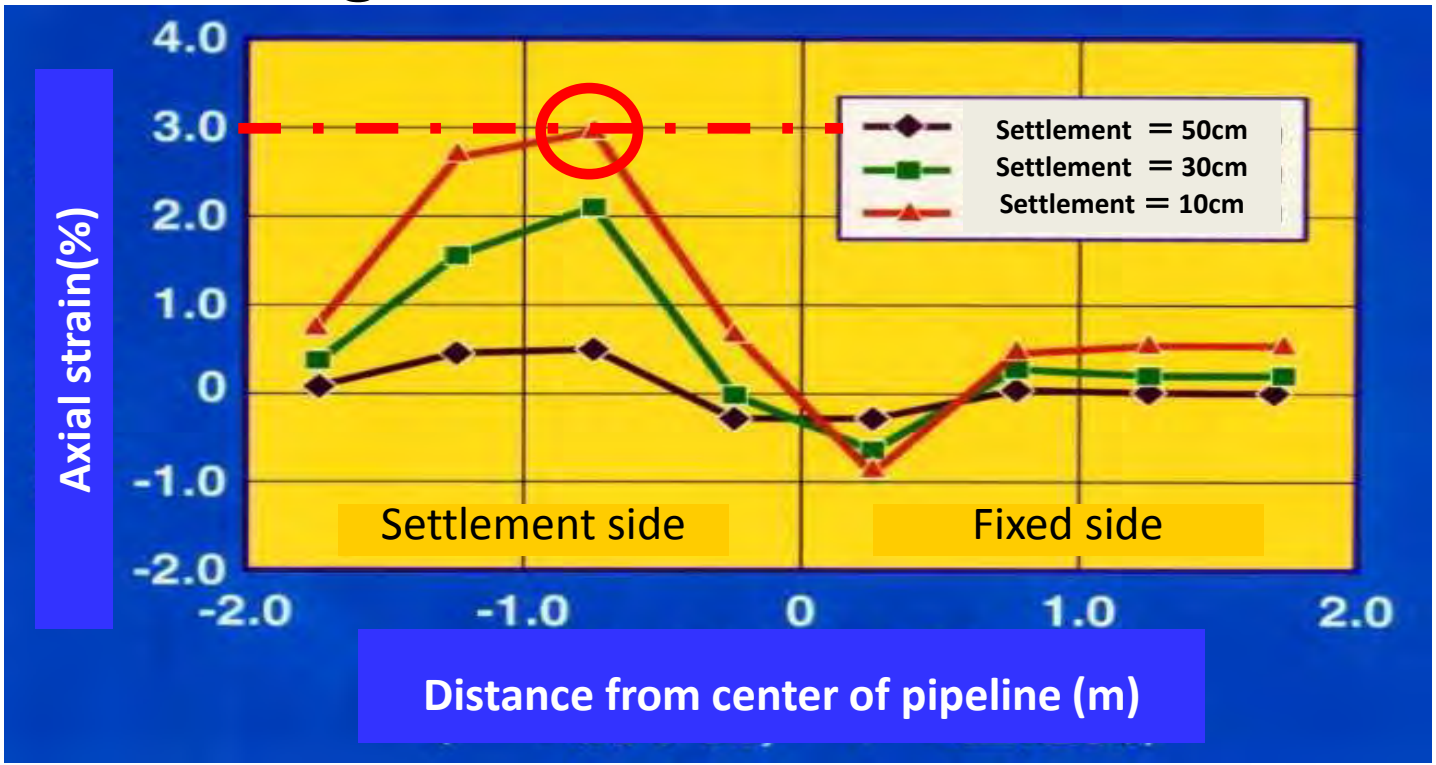
Real scale simulated test

Outline of the Ground Settlement experiment



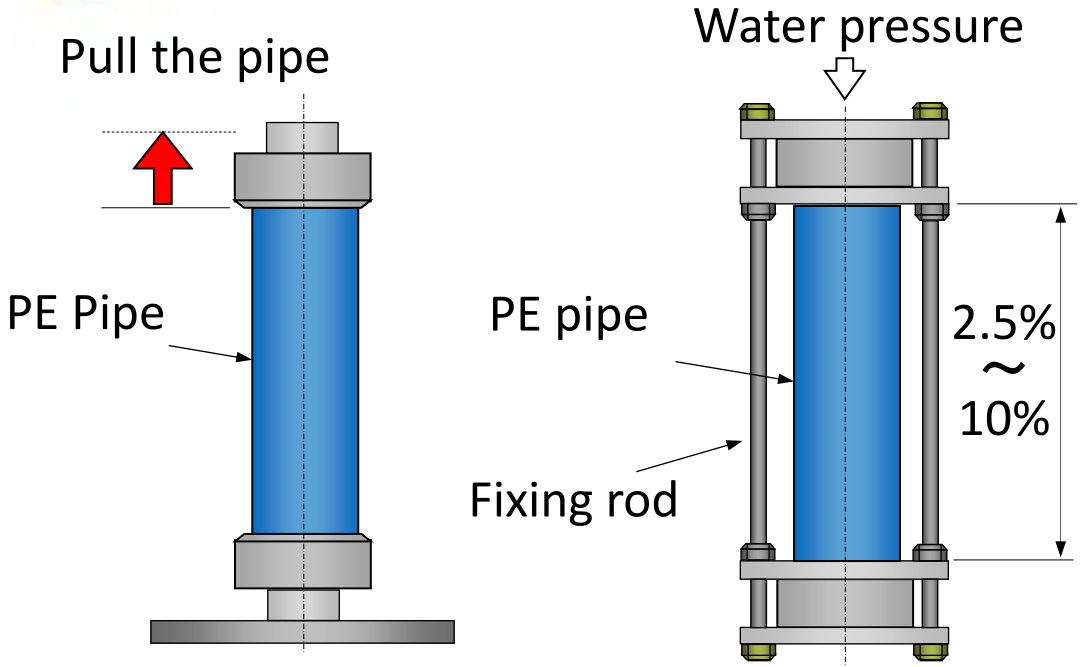
Real scale simulated test

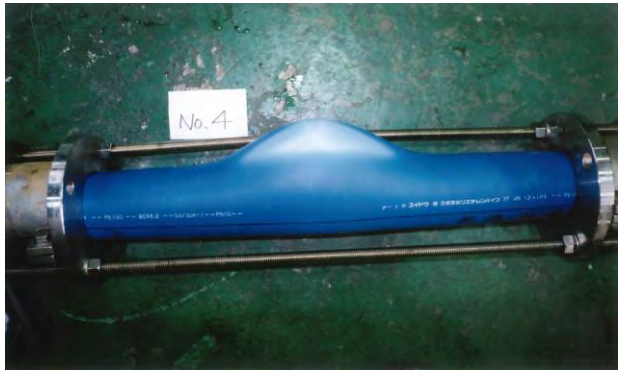
Longitudinal strain distribution



Real scale simulated test

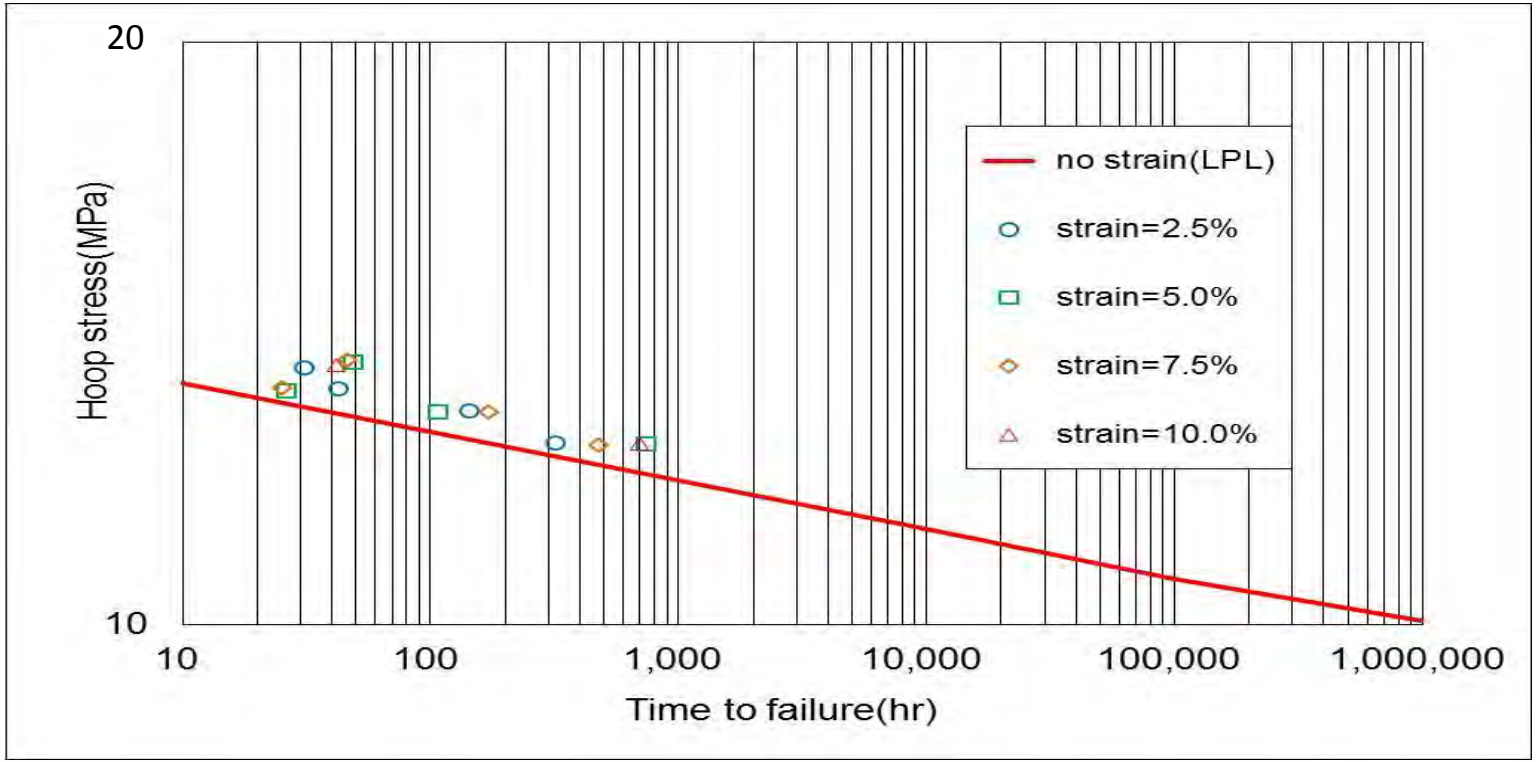
Hydrostatic strength of straind pipe





Real scale simulated test

Hydrostatic strength of straind pipe



4. Investigation of PE pipeline after earthquake

Investigation of PE pipeline after earthquake

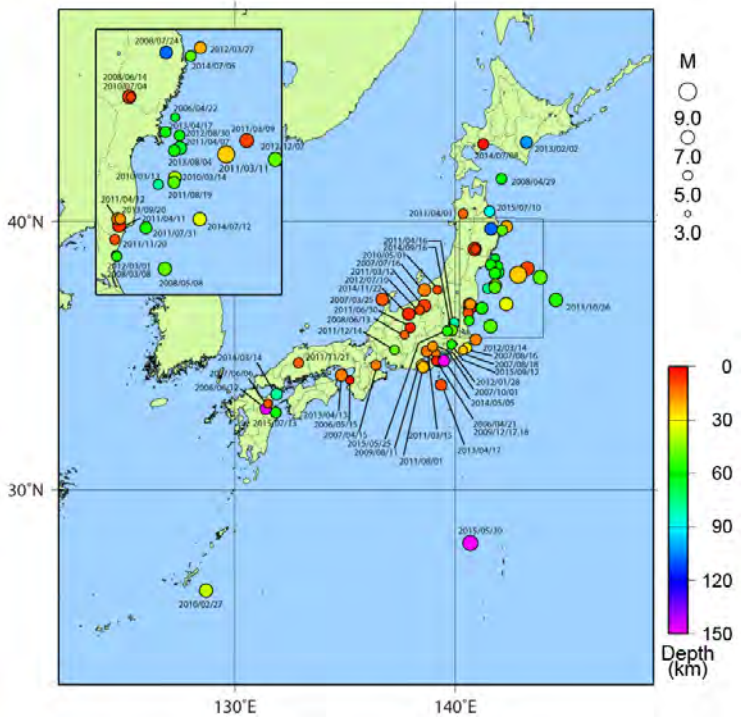
Name of earthquake	Magnitude	Total length of PE	Damage
2003 Miyagiken Hokubu Earthquake	6.4	10km	None
2003 Tokachi-oki Earthquake	8.0	2.6km	None
2004 Mid Niigata Prefecture Earthquake	6.8	11.4km	None
2004 Noto Hanto Earthquake	6.9	2km	None
2007 Niigataken Chuetsu-oki Earthquake	6.8	13km	None
2008 Iwate-Miyagi Nairiku Earthquake	7.2	47.4km	None
2011The Great East Japan Earthquake	9.0	996km	None
2016 Kumamoto Earthquake	7.3	147.7km	None

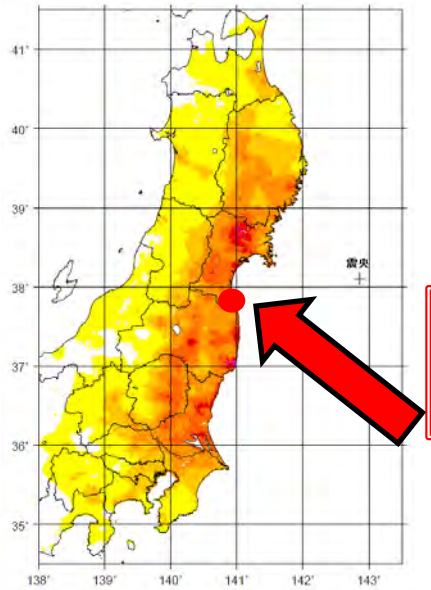
※ Except for extreme cases like tsunami and ground collapse

Investigation of PE pipeline after earthquake

“Tsunami” of 2011 The Great East Japan Earthquake

The earthquake occurred in Japan



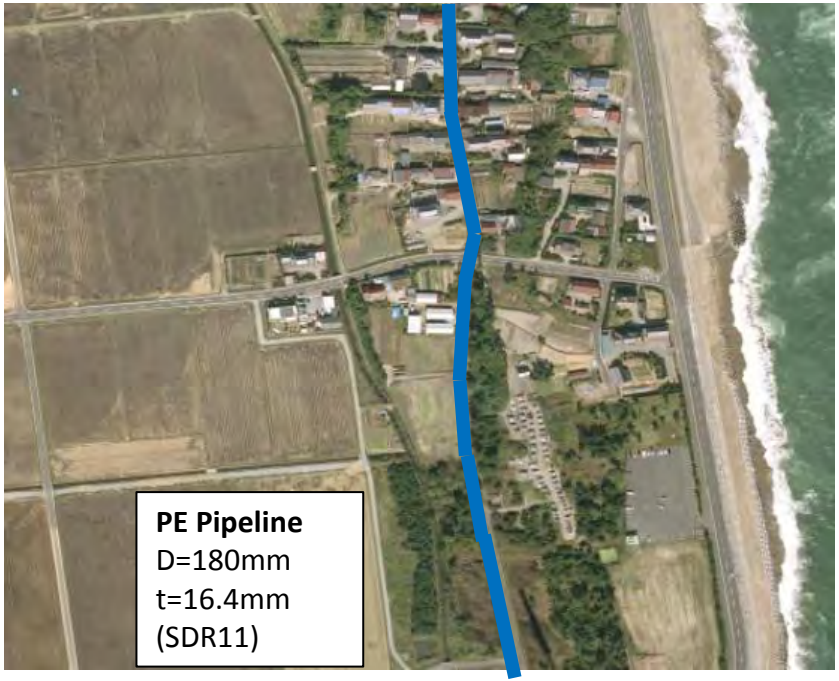


Shinchi-machi
Fukushima Prefecture

Web : Japan Meteorological Agency

Investigation of PE pipeline after earthquake

"Tsunami" of 2011 The Great East Japan Earthquake



Before "Tsunami"

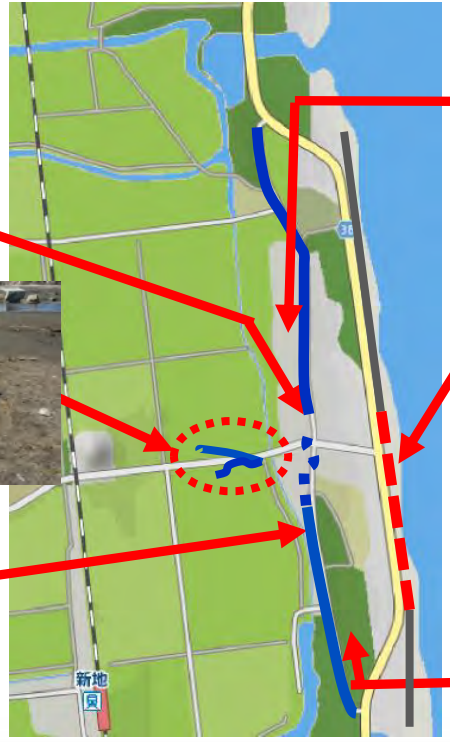
After "Tsunami"

Investigation of PE pipeline after earthquake

"Tsunami" of 2011 The Great East Japan Earthquake

Northside Breakpoint

Southside Breakpoint



Destroyed seawall

PE Pipe was not broken where the seawall is not destroyed.

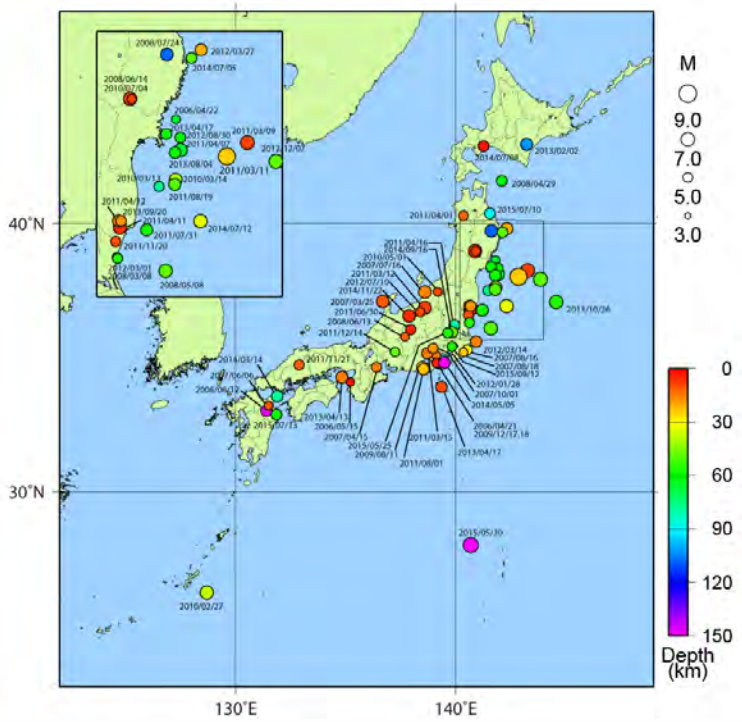
Test result of PE pipe scoured by “Tsunami”

No.	Characteristic	Requirement	Result	standard
1	Elongation at break	≧350%	613%	ISO 4427-2
2	Yield stress	≧20MPa	28MPa	JWWA K 144※
3	Hydrostatic strength at 20℃	No failure 12.4MPa 100h	No failure	ISO 4427-2
4	Hydrostatic strength at 80℃	No failure 5.4MPa 165h	No failure	ISO 4427-2
5	Destroying water pressure	≧4.0MPa	5.5MPa	JWWA K 144※

※ Japan Waterworks Association (JWWA) Standard

Investigation of PE pipeline after earthquake

2014 Nagano prefecture Kamishiro fault Earthquake



Hakuba village
Nagano Prefecture

Investigation of PE pipeline after earthquake

2014 Nagano prefecture Kamishiro fault Earthquake

Reverse Fault

Before earthquake

After earthquake

Investigation of PE pipeline after earthquake

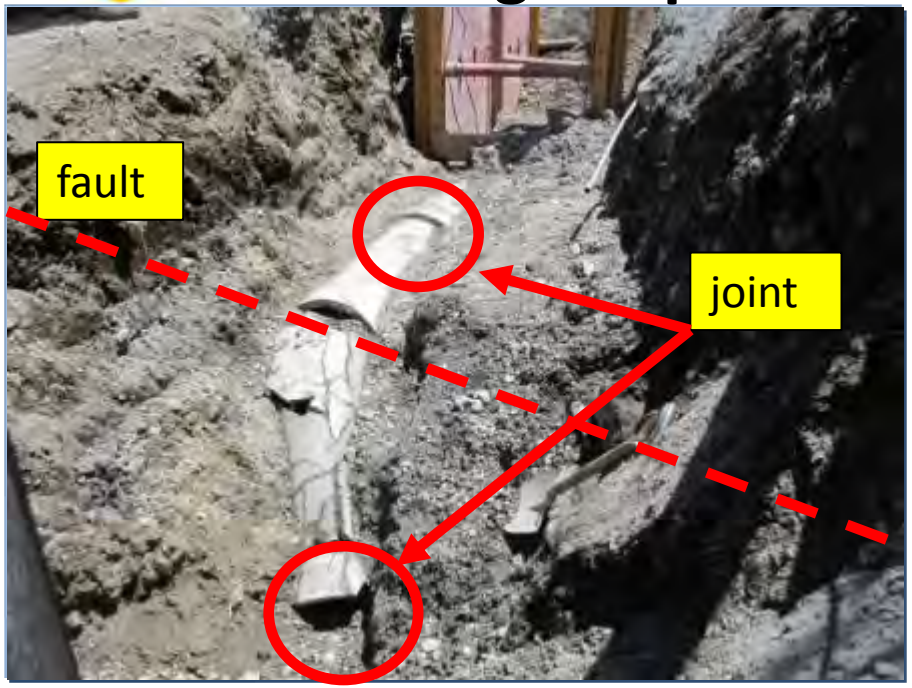
2014 Nagano prefecture Kamishiro fault Earthquake

Investigation of PE pipeline after earthquake

2014 Nagano prefecture Kamishiro fault Earthquake

Investigation of PE pipeline after earthquake

2014 Nagano prefecture Kamishiro fault Earthquake



Destroyed sewer pipeline (Reinforced concrete pipe :450mm)

5.Conclusions

Conclusions

1. The yield strain of the PE pipe for both longitudinal tensile and compressive was about 8%,and,until reaching the yield point ,the pipe deformed evenly.

2. The maximum pipe strain obtained by the 50cm fissure and uneven ground settlement experiments was about 3%.

3. We investigated PE pipeline damages after actual earthquakes. There was no damage by ground deformation, seismic motions and liquefaction, except for extreme cases like *tsunami* and ground collapse.

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