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2nd IWA Leading-Edge Conference & Exhibition on

Strategic Asset Management

Evaluation of the pipeline replacement project for drinking water supply system using performance indicators

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LESAM 2007 – Lisbon 17-19 October 2007

1 Earthquake Country Japan

Big Earthquakes in Japan Recently

1 KOBE EARTHQUAKE

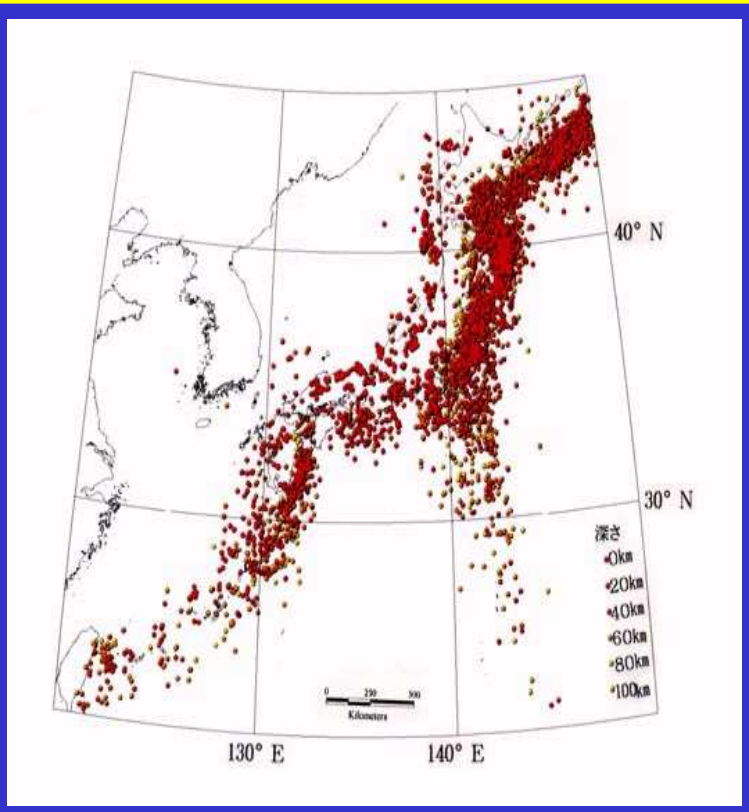
1995 M= 7.3

2 KUSHIRO EARTHQUAKE

2003 M= 8.0

3 NIIGATA EARTHQUAKE

2007 M= 6.8



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2 AGED PIPE RUPTURES
KOBE EARTHQUAKE

3 AGED PIPE > 40 years old
by public Accounting Law

- Cast Iron Pipe, Asbestos Cement Pipe, Hard PVC
- No Earthquake Resistant joint
- Pipe material (FC) weak to shock
- Leakage, Failure, Rupture
- Rust colored water

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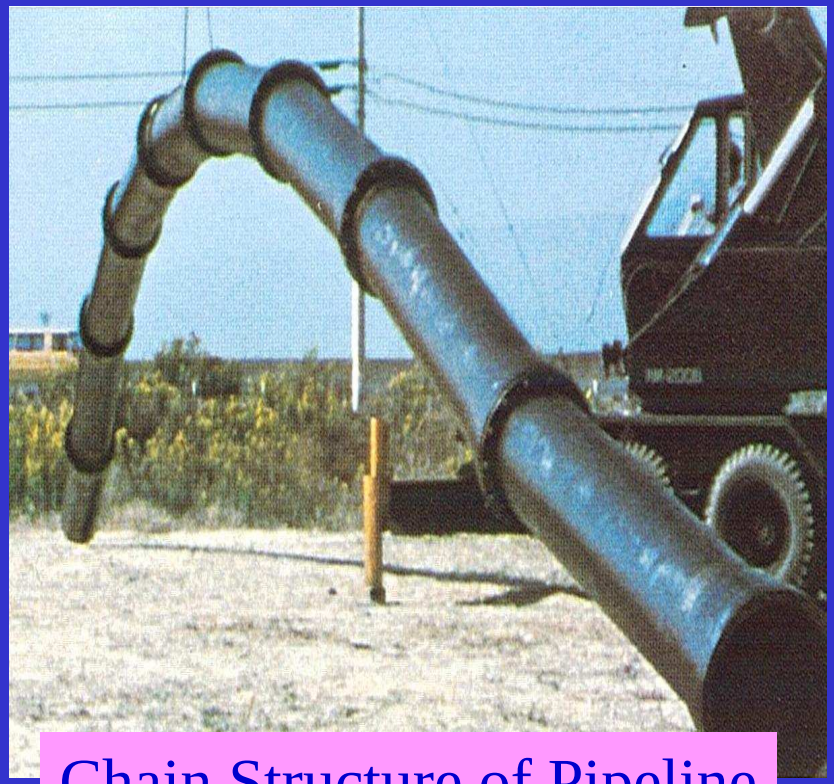
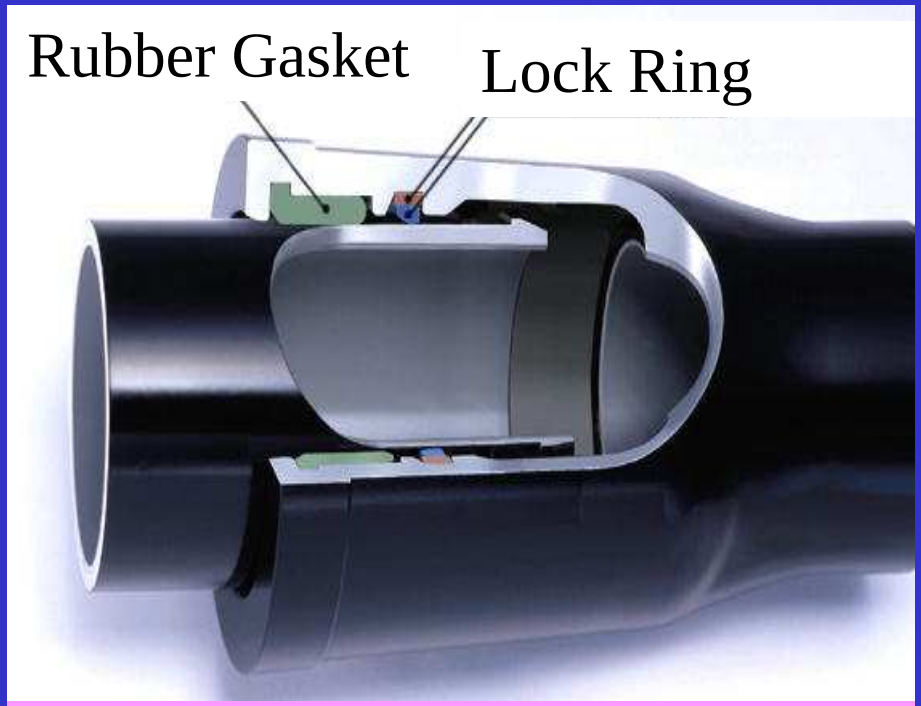
4 New Pipe : Ductile Iron Pipe with earthquake-resistant joint

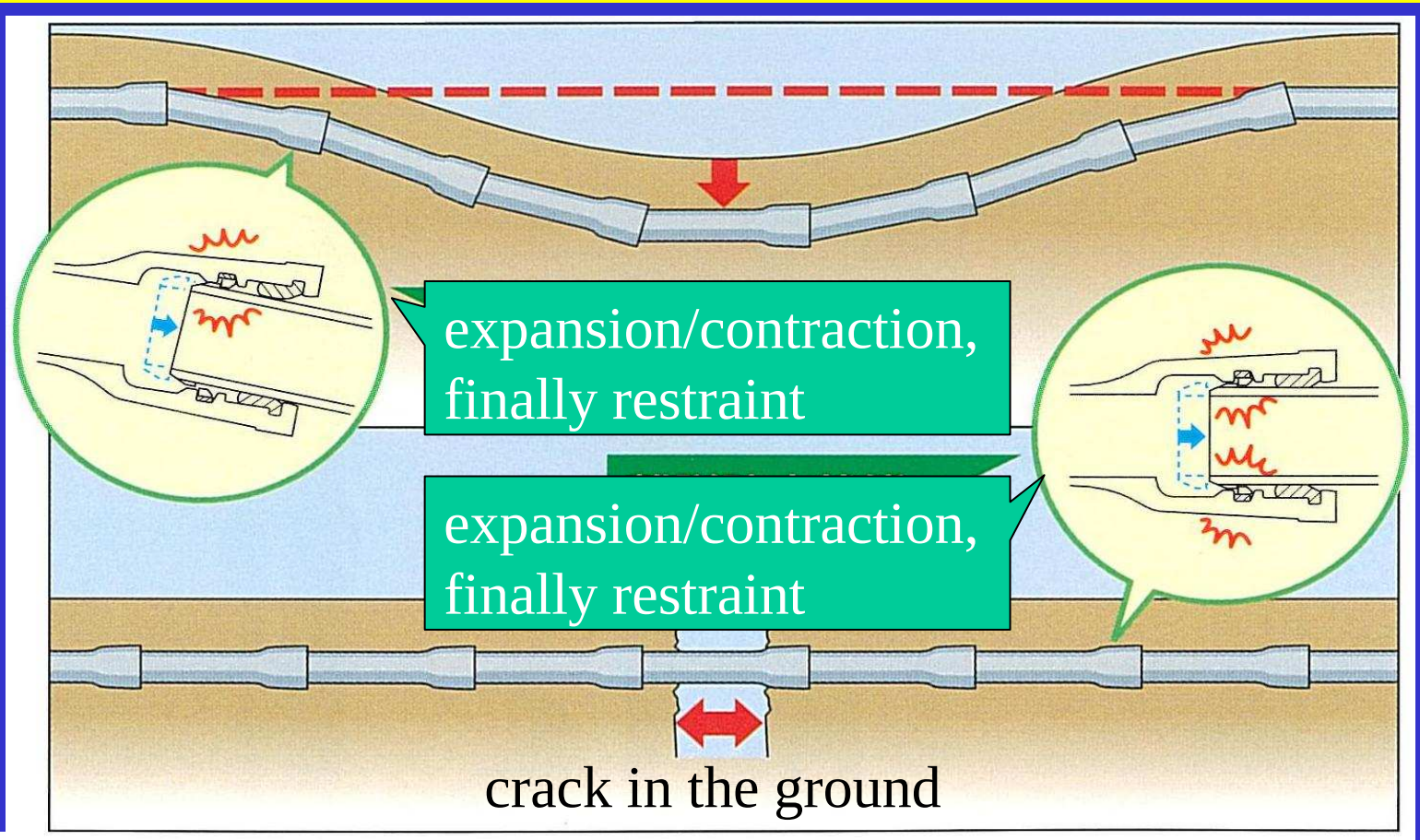


Chain Structure of Pipeline

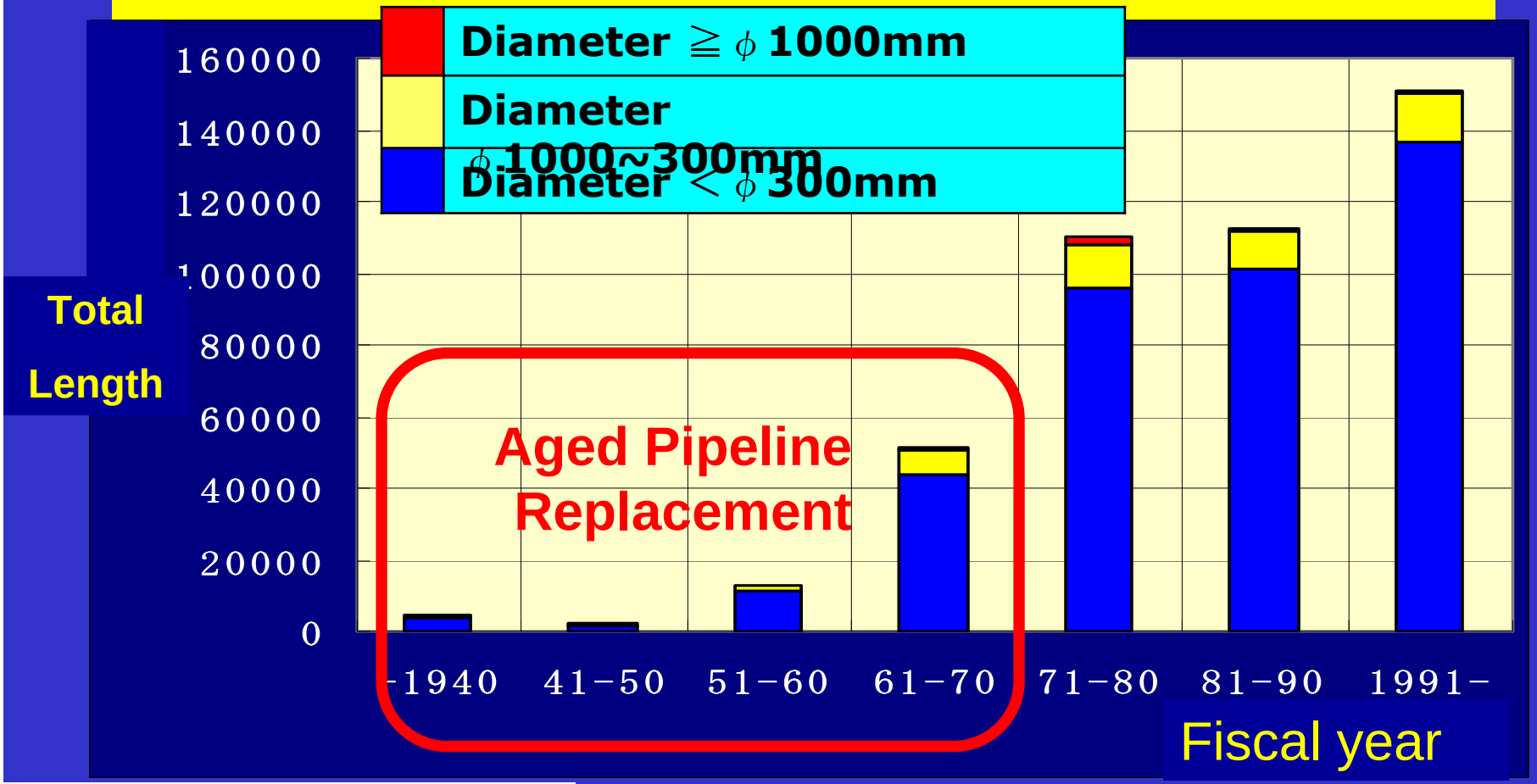


NS-type Joint (Ductile Iron Pipe)

5 Illustration of performance of earthquake-resistant joint



6 Total Length of Pipeline



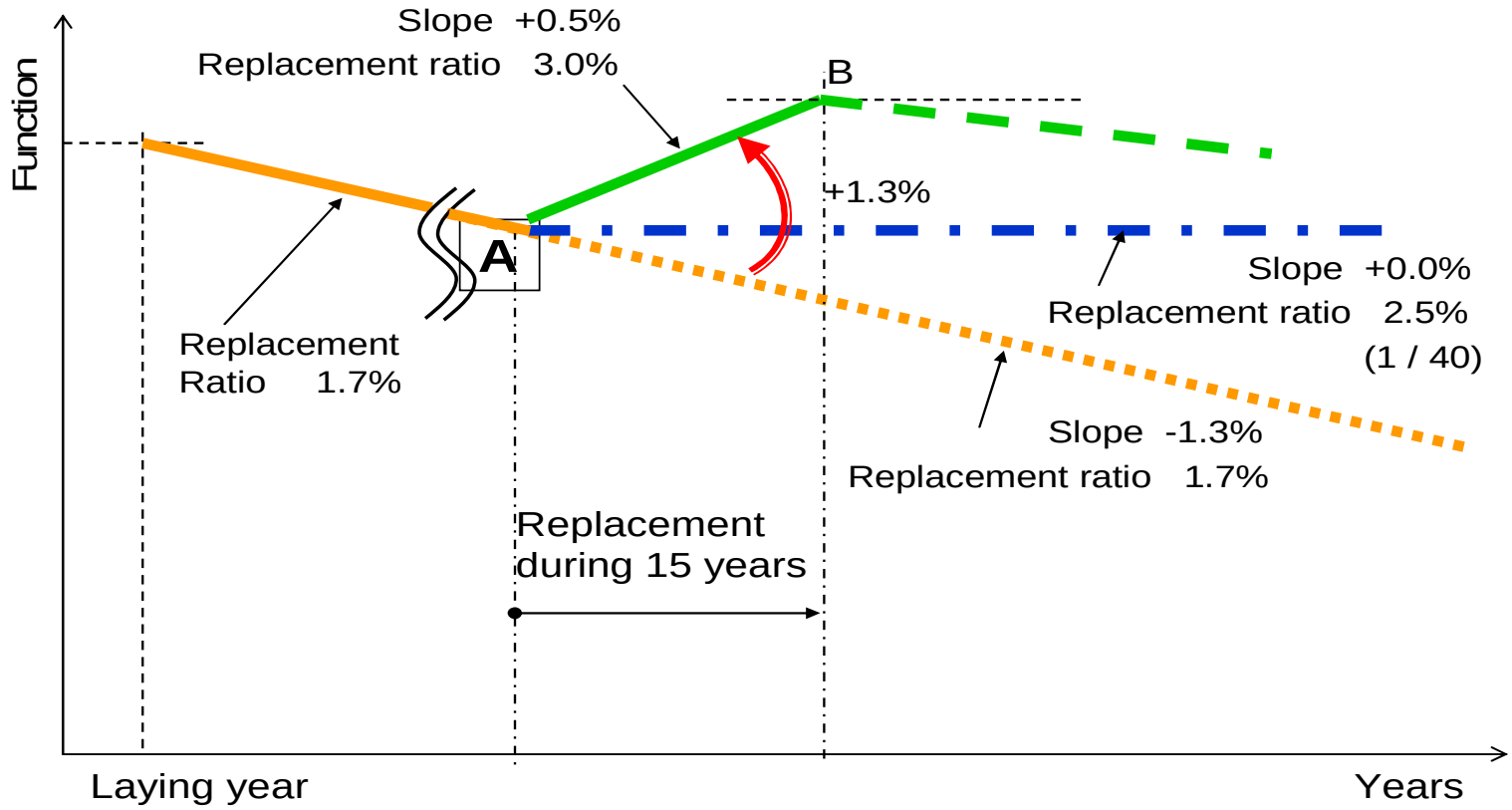
出典：水道ビジョン基礎データ

7 Basic conditions of City S

Terms	Units	Values
Population served	person	57,180
Annual amount of water intake	1,000m^3	9,334
Average daily supply	m^3/day	25,380
Capacity of daily supply	m^3/day	45,000
Mains length	km	421
Number of employees	person	41
Aged pipe ratio	%	19

Av. 6

8 Conceptual relationship between the decrease in function of pipelines and its replacement



9 Assumption for Calculation

- Replacement Ratio

  1.7 % （present） ⇒ 3.0 % (15 years)

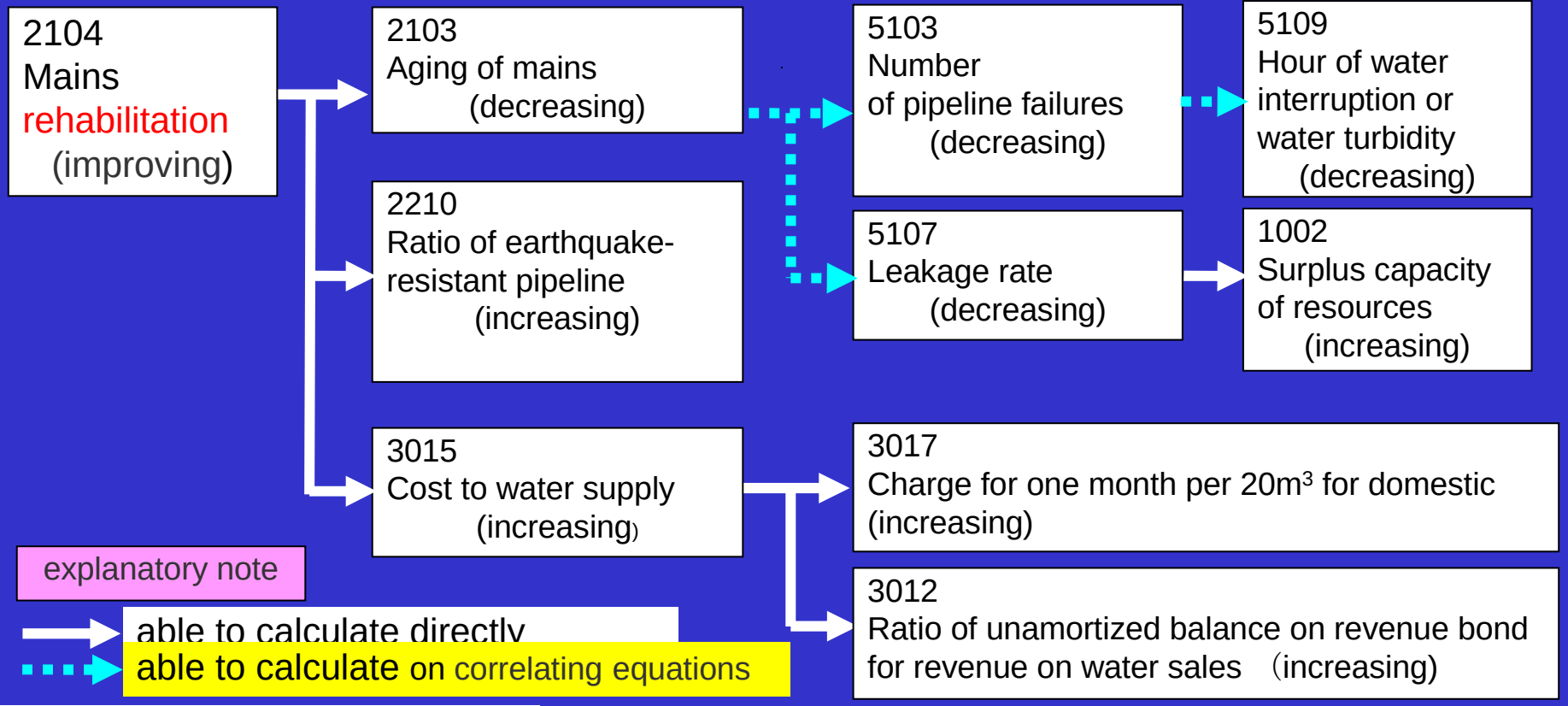
- Other condition the same
- Replacement Cost

  ϕ 75mm ～300mm ￥ 70,700 /m

  ϕ 300mm ～ ￥ 100,000 /m

- Lead service pipe shall be replaced

10 Reciprocal relationship of PIs and costs



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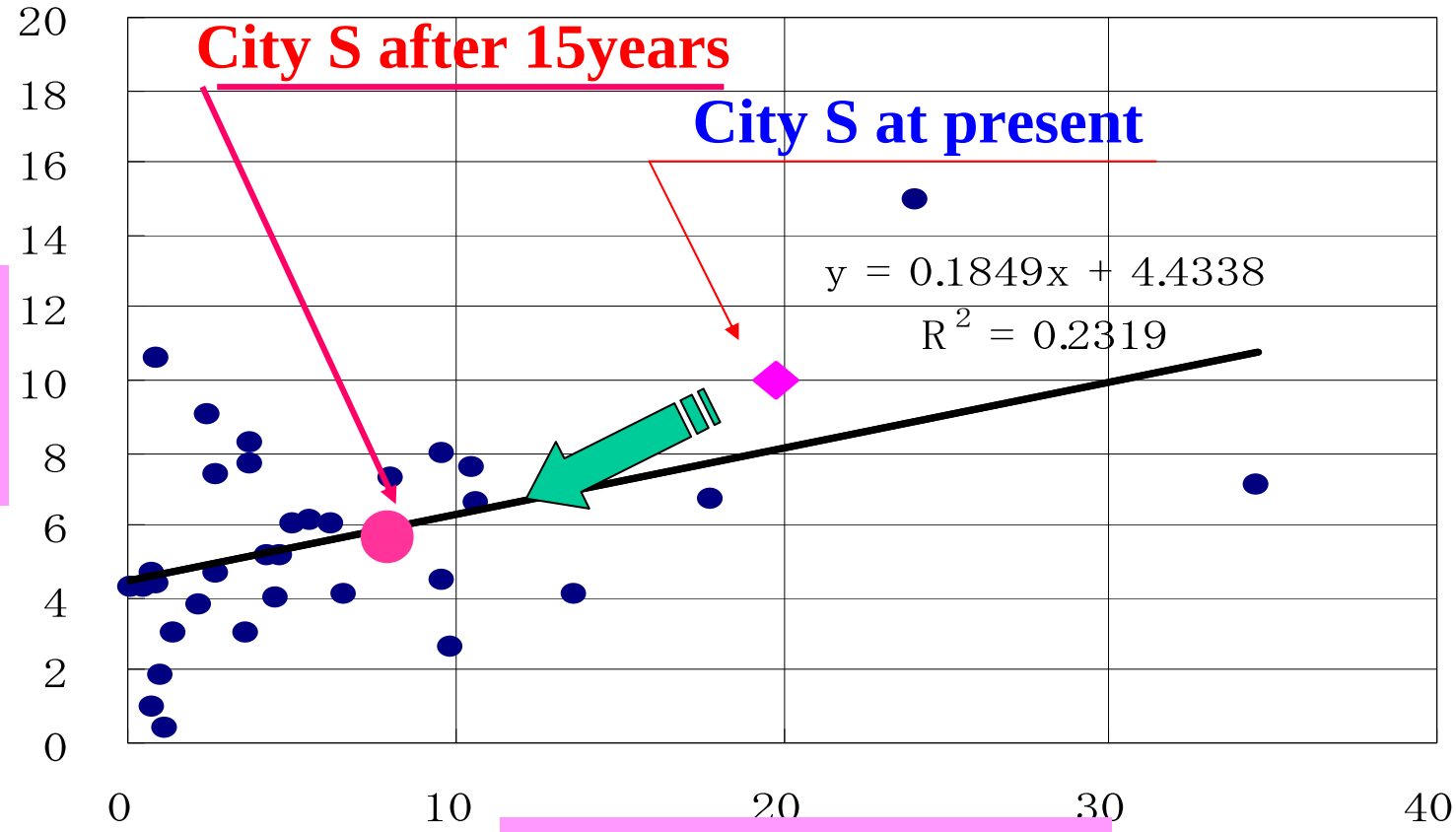
11 Correlation between Aging of mains and Leakage rate



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12 PIs affected by the promotion of pipeline replacement (1)

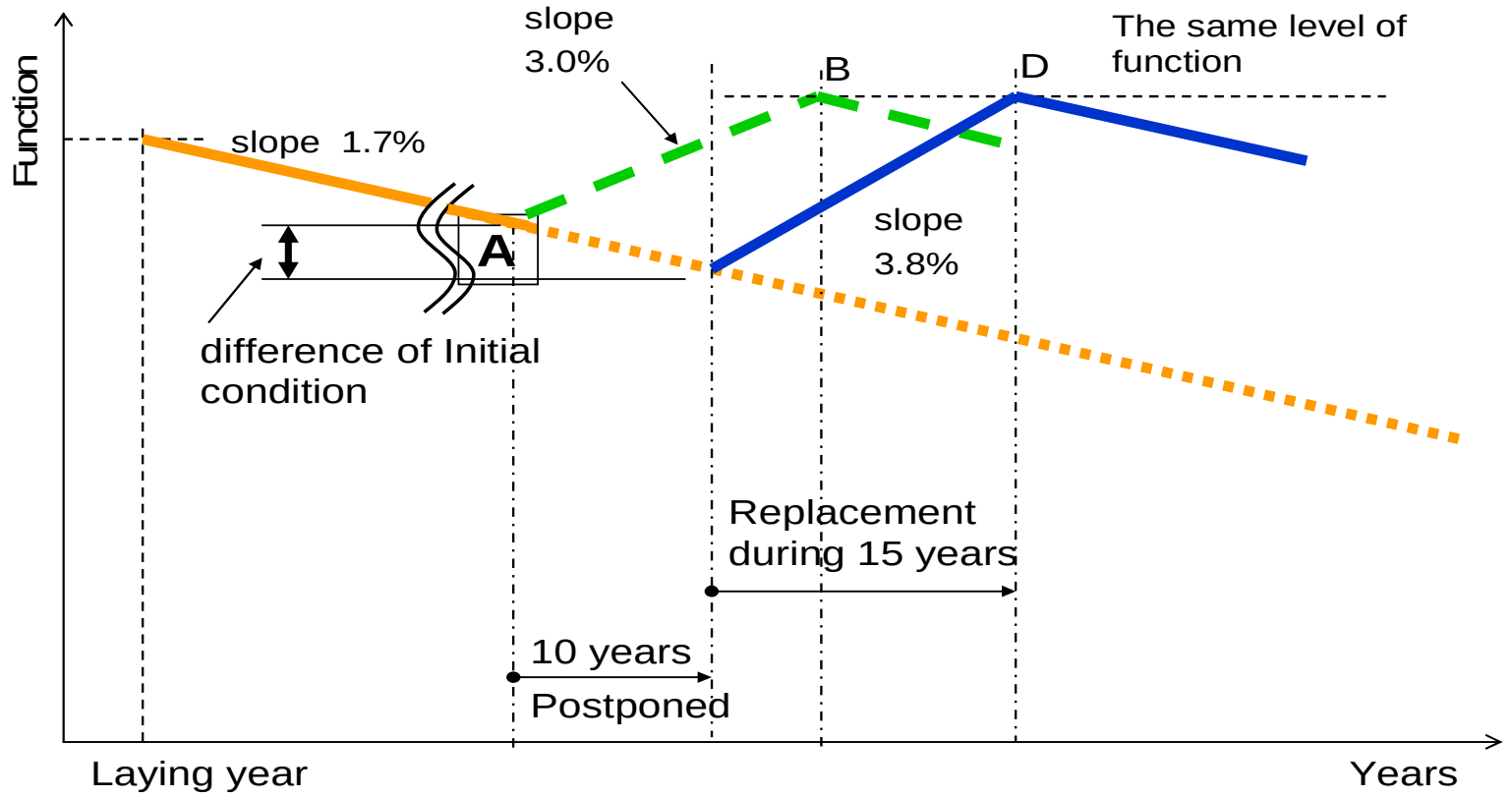
(1) Assumption

No.	PIs	Units	Assumption
2104	Mains rehabilitation	%	raising mains rehabilitation from the current 1.7% to 3.0% for 15 years

(2) Results

No.	PIs	Units	At present	15years later
2103	Aging of mains	%	19.8	7.3
2210	Ratio of earthquake-resistant pipeline	%	0.1	45.1
1117	Ratio of lead service lines	%	86.0	38.7
3015	Cost to water supply	Vm^3	181.2	238.4
5103	Number of pipeline failures	No./100km	25.7	7.6
5107	Leakage rate	%	10.0	5.8
2203	Available water volume in an accident	%	40	75

13 Conceptual relationship in case of a 10-year postponement



14 PIs affected by the promotion of pipeline replacement (2)

(1) Assumption

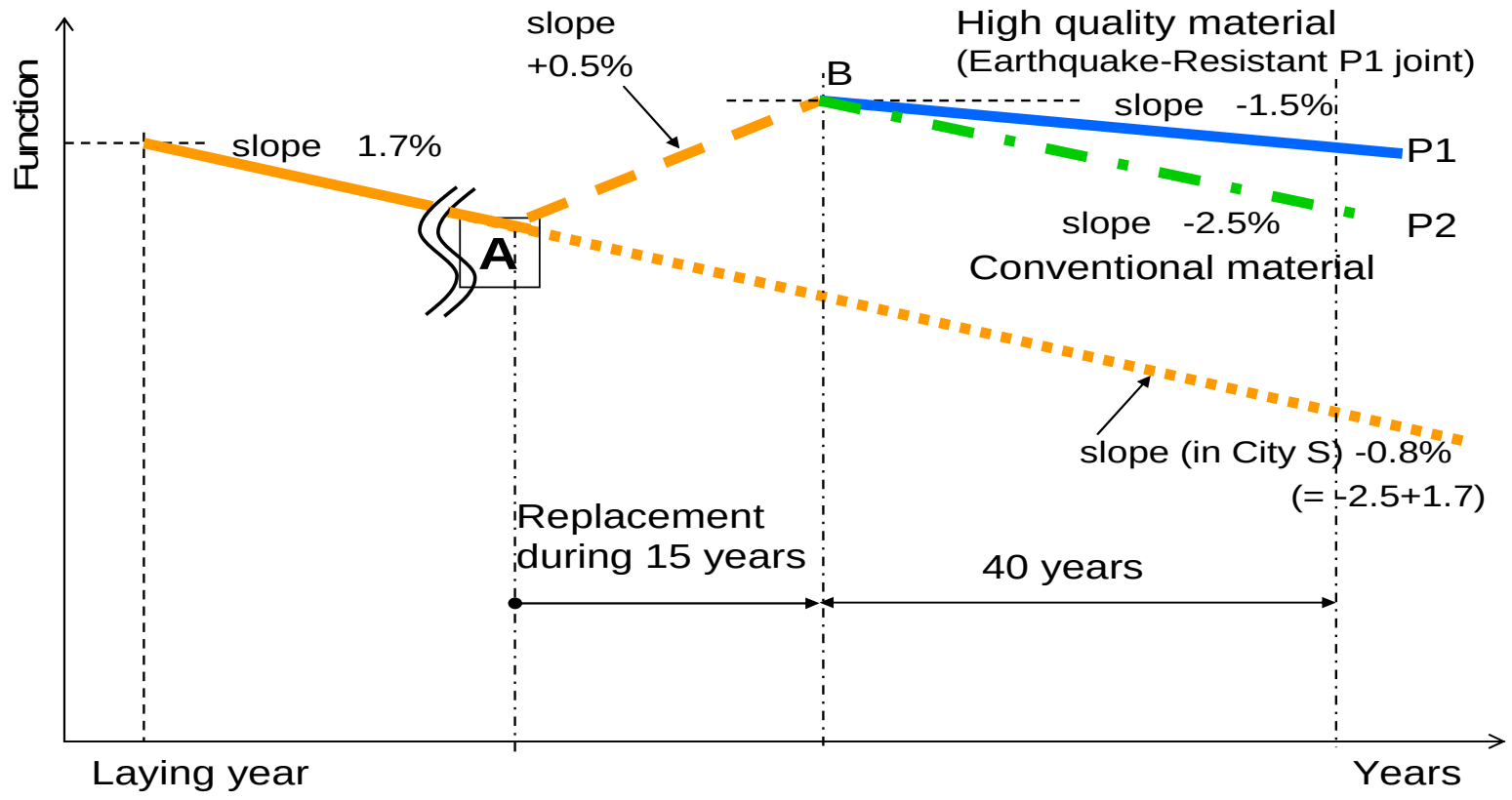
No.	PIs	Units	Assumption
2104	Mains rehabilitation	%	remaining the current 1.7% for 10 years and raising to 3.8% for 15 years

(2) Results

No.	PIs	Units	At present	10years Later[1)]	15years later
2103	Aging of mains	%	19.8	27.8	8.7
2210	Ratio of earthquake-resistant pipeline	%	0.1	17.1	74.7
1117	Ratio of lead service lines	%	86.0	68.1	7.6
3015	Cost to water supply	\/m^3	181.2	181.2	271.3
5103	Number of pipeline failures	No./100km	25.7	27.1	4.0
5107	Leakage rate	%	10.0	11.5	6.0
2203	Available water volume in an accident	%	40	35	75

1) In this time, mains rehabilitation will raise.

15 Difference between High quality material and Old material



16 PIs make it possible to Indicate a logical concept in an objective and quantitative manner

Niigata Earthquake

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17 Conclusion

PIs show :

- Need for speedy replacement
- Disadvantages of postponed replacement
- Replacement with high-quality pipe materials

Thank you for your Attention !!

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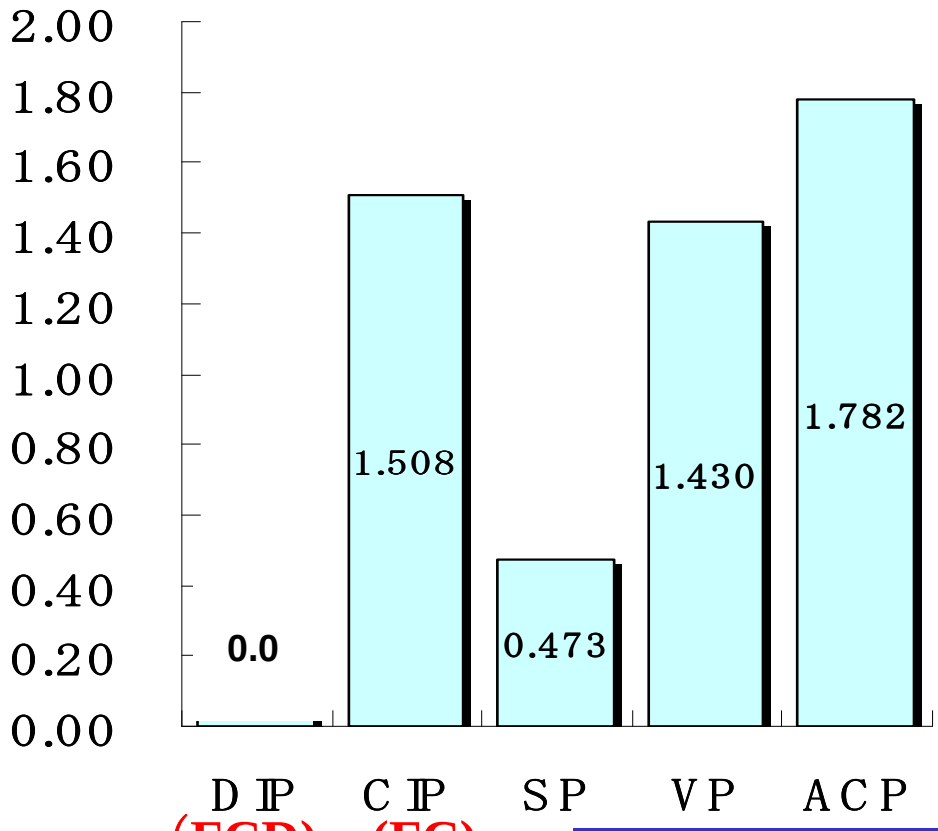
Pipeline failures for earthquake (1995)

Number of pipeline failures (No./km)



(Reference)

DIP Ductile iron pipe (FCD)

CIP (with Ns joint)

SP Cast-iron pipe (FC)

VP Hard PVC pipe

ACP Asbestos cement pipe

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