

FRP/RTRP/GRP-Piping system for all Industrial Applications with in Middle East from 30 years

AMIAANTIT PIPE SYSTEMS



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Sadath A Khan

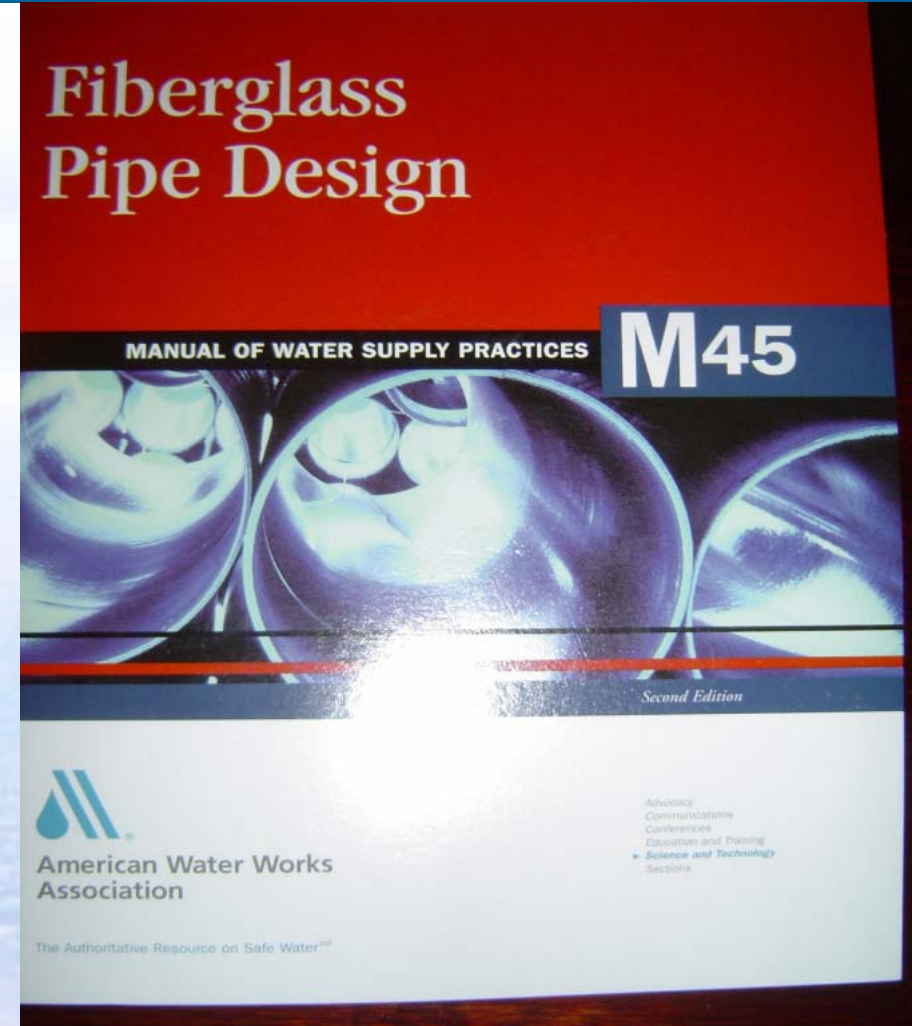
Engineering Manager

GRP/PE Division-Amiantit Dammam

A Member of Standards Committee

AWWA C-950 and M45-for GRP Pipes

AWWA-D-120 for GRP Tanks



Presentation Topic

AMIAANTIT PIPE SYSTEMS

-  Introduction
-  Characteristics of Middle East Region
-  Reported Failures of Various Materials
-  Optimal Choice of Materials
-  Literature Survey Regarding FRP Usage
-  FRP or GRP or RPMP or RTRP
-  Initiative By Amiantit to Supply FRP in 1977
-  30 Years Journey of GRP
-  30 Years of Supplies to KSA and GCC-ME
-  Conclusions and Recommendations

Middle East

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- Arid (Dry) Region
- Little or No Rain
- Lack of Fresh Water Resources
- Surrounded by Red Sea,
- Arabian Gulf

Typical Characteristics are

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-  Varying Geomorphic Conditions
-  Changing Climates
-  Oscillating Water Tables
-  High Salted “Sabkha” Soils
-  Fluctuating Humidity's
-  Low Electrical Resistivity of Soils
-  Fast Track Construction

In Middle East

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Sea Water is Desalinated for

Domestic Requirements

Construction Requirements

Industrial Demands etc.

**Desalination / Power / Chemical / Oil and Gas Plants
are Being Built**

along the Coasts of Red Sea and Arabian Gulf.



Factors Affecting Traditional Materials

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Seawater of Arabian Gulf and Red Sea

TDS ranges from 40,000 to 65, 000 ppm

It contains Dissolved Gases

Decaying Organics, In-Organic and Other aggressive elements

**Acting alone or simultaneously
produces various forms of Degradation**

Factors Affecting Traditional Materials...

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Chemical Factors

Oxygen, H₂S, Chlorine

Solubility, pH, Carbonate Solubility

Physical Factors

Velocity: Air Bubbles, Suspended Solids, Silt

Temperature and Pressure

Factors Affecting Traditional Materials...

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Biological Factors

Bio Fouling:

Hard Shell, Semi Mobile and Mobile Types

Plant Life and Animal Life:

Oxygen Generation, Carbon Consumption

Common Degradation Process

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Piping and other Equipments

General Corrosion Attack of Material

Impingement Attack

Erosion By Suspended Solids

Crevice Corrosions

Stress Corrosions Cracking (SCC)

HAZ(Weld and Heat Affected Zones)

Resulting

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Resulting

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Resulting

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Resulting

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Selection of Materials....

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Cost

Plant Life Desired

Feed Characteristics

Material Compatibility

Maintenance Capabilities

Ease of Availability

Overall Life Cycle Capital Cost Constraints

Design and Operating Conditions



Material of Choice for All Applications

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Fiberglass Reinforced Plastics

FRP / GRP / GFRP

RTRP / RPMP

FRP-Pipe Wall Construction

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Resin

Glass
Fiber

Sand
Core



FRP-Pipe Wall Construction



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Nomenclature

Fiber Reinforced Plastics (FRP)

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FRP Fiberglass Reinforced Plastic (or Polyester)
or Fiber Reinforced Plastic (or Polyester)
(European Standards)

GRP Glassfibre Reinforce Plastic (or Polyester)
(BS Standards)

RTRP Reinforced Thermosetting Resin Pipe

RPMP Reinforced Plastic (or Polymer) Mortar Pipe
(American Standards)

FRE Fiberglass Reinforced Epoxy

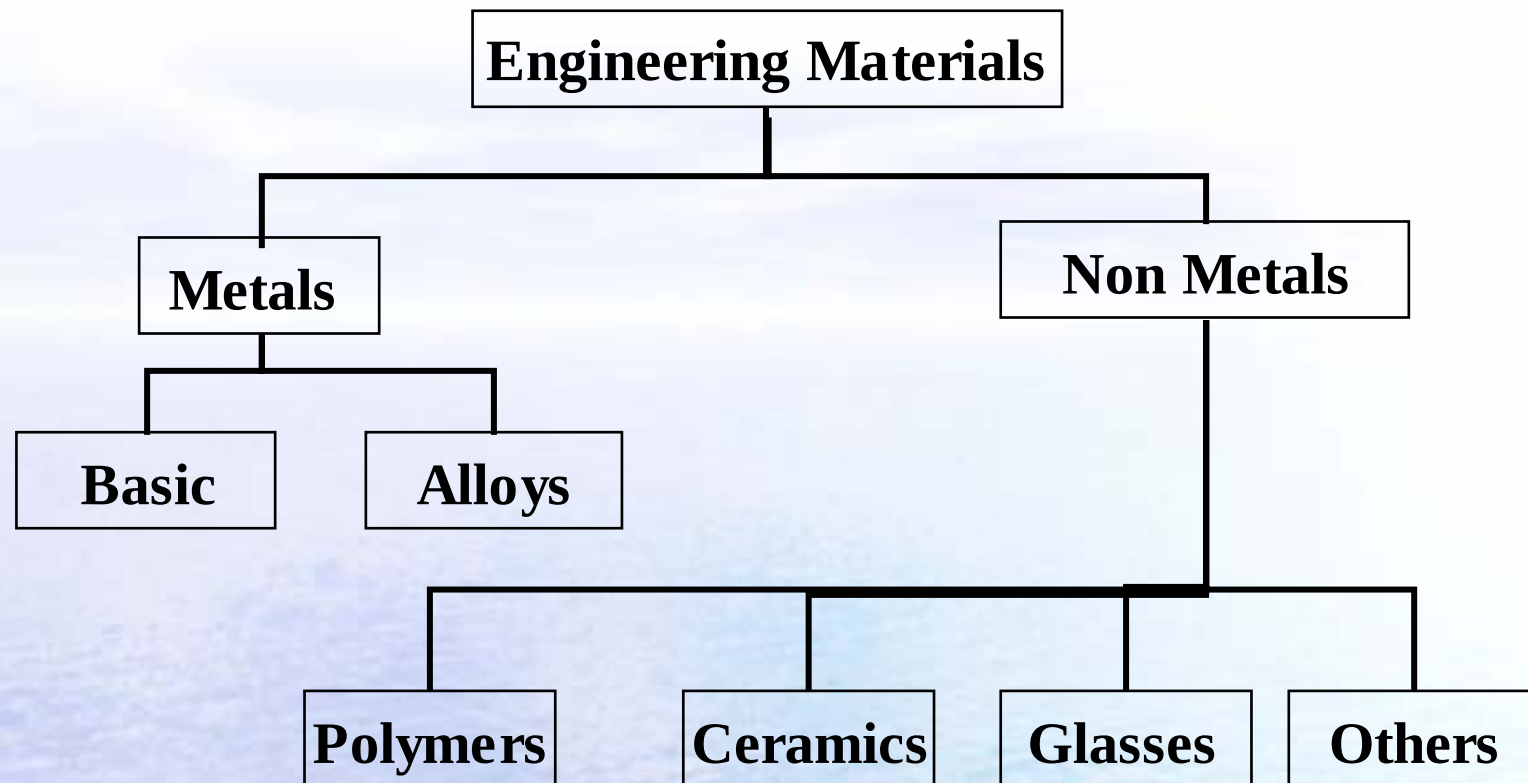
GRE Glassfibre Reinforced Epoxy

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Classification

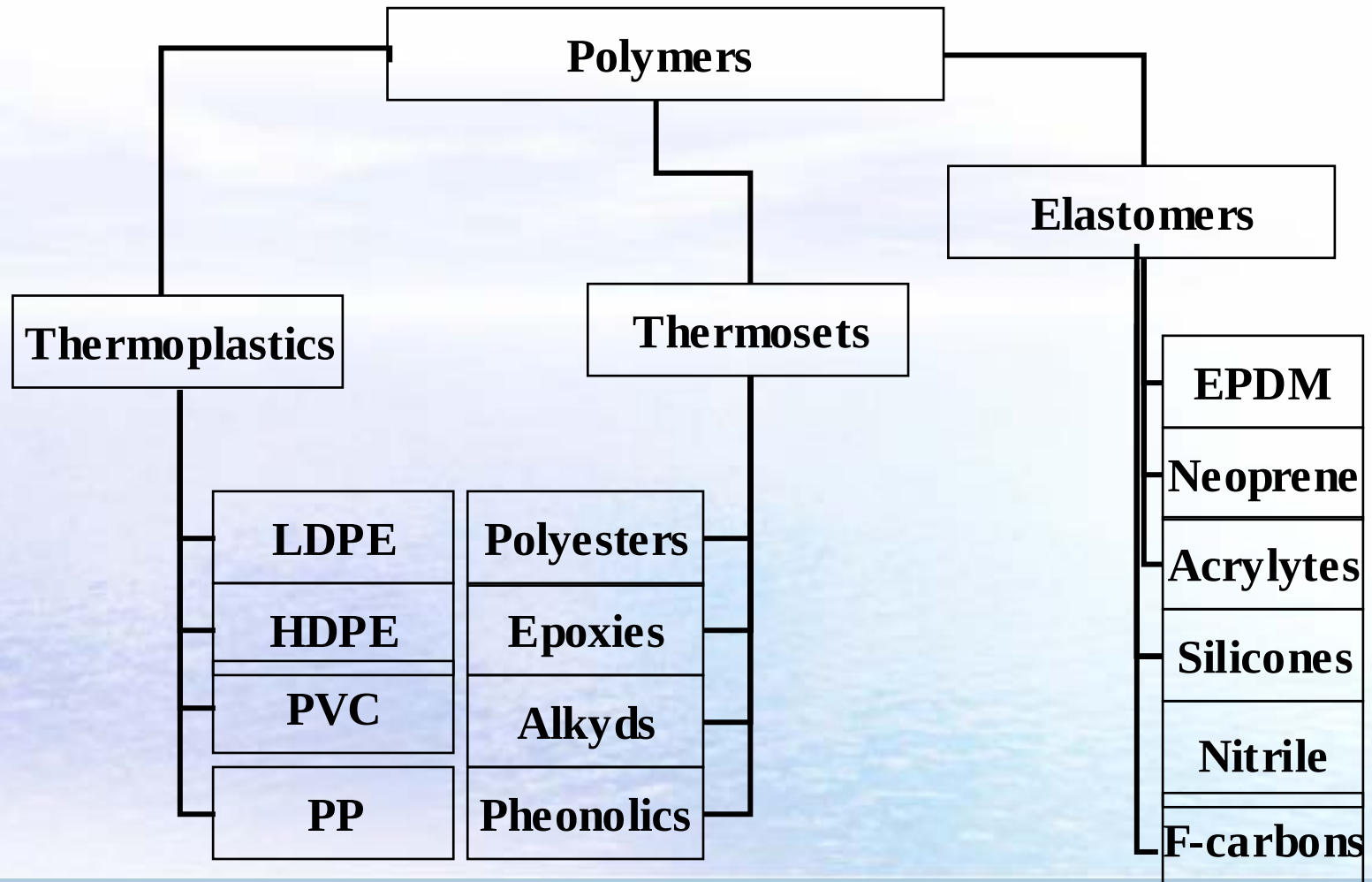
Classification based on Engineering Materials

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Classification based on Engineering Materials

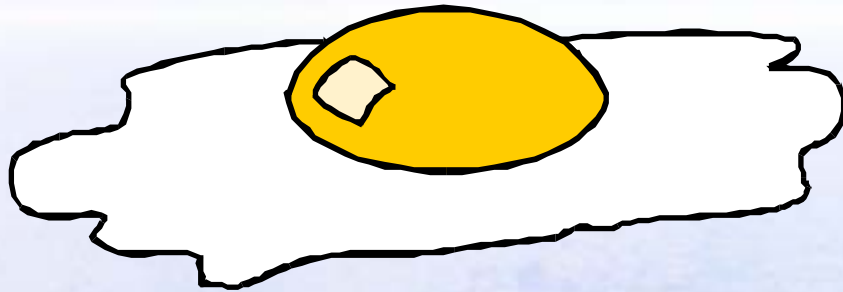
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FRP-Pipe Wall Construction-Chemistry

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Thermoset



Egg

Thermoplastic



Candle

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How / Where FRP can be Used ?

Usage of FRP based on Resins

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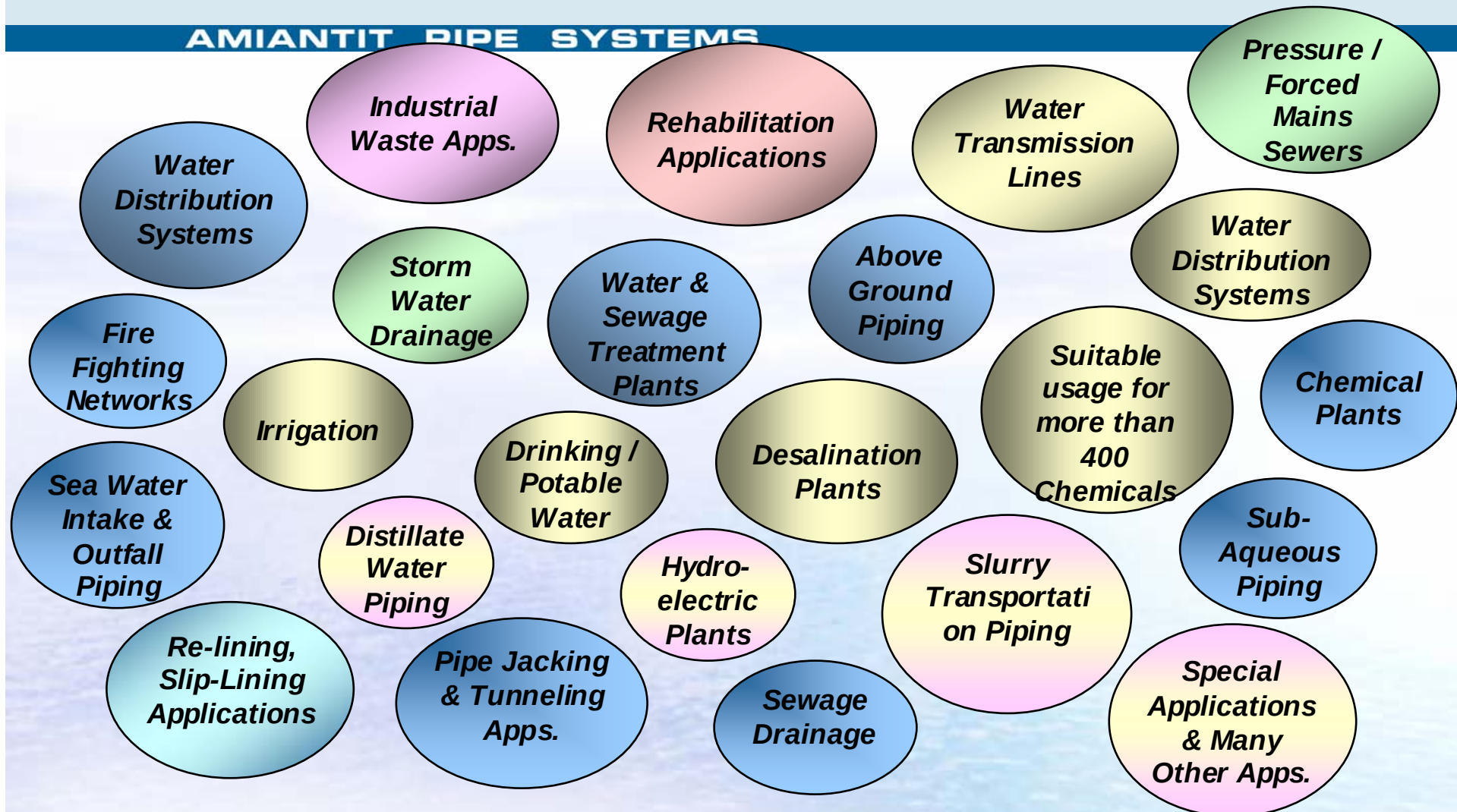
Properties	FRP Polyester Piping	GRE Epoxy Piping
Resin	Polyester / Vinyester	Epoxy
Temperature	Up to 65 °C / 90 °C	Up to 150 °C
Pressure	Gravity to 40 Bar G / Full Vacuum	Gravity to 200 Bar G / Full Vacuum
Can Handle	All-Moderate Corrosive Fluids	All-High Corrosive Fluids

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Applications

FRP can be used for all types of fluids

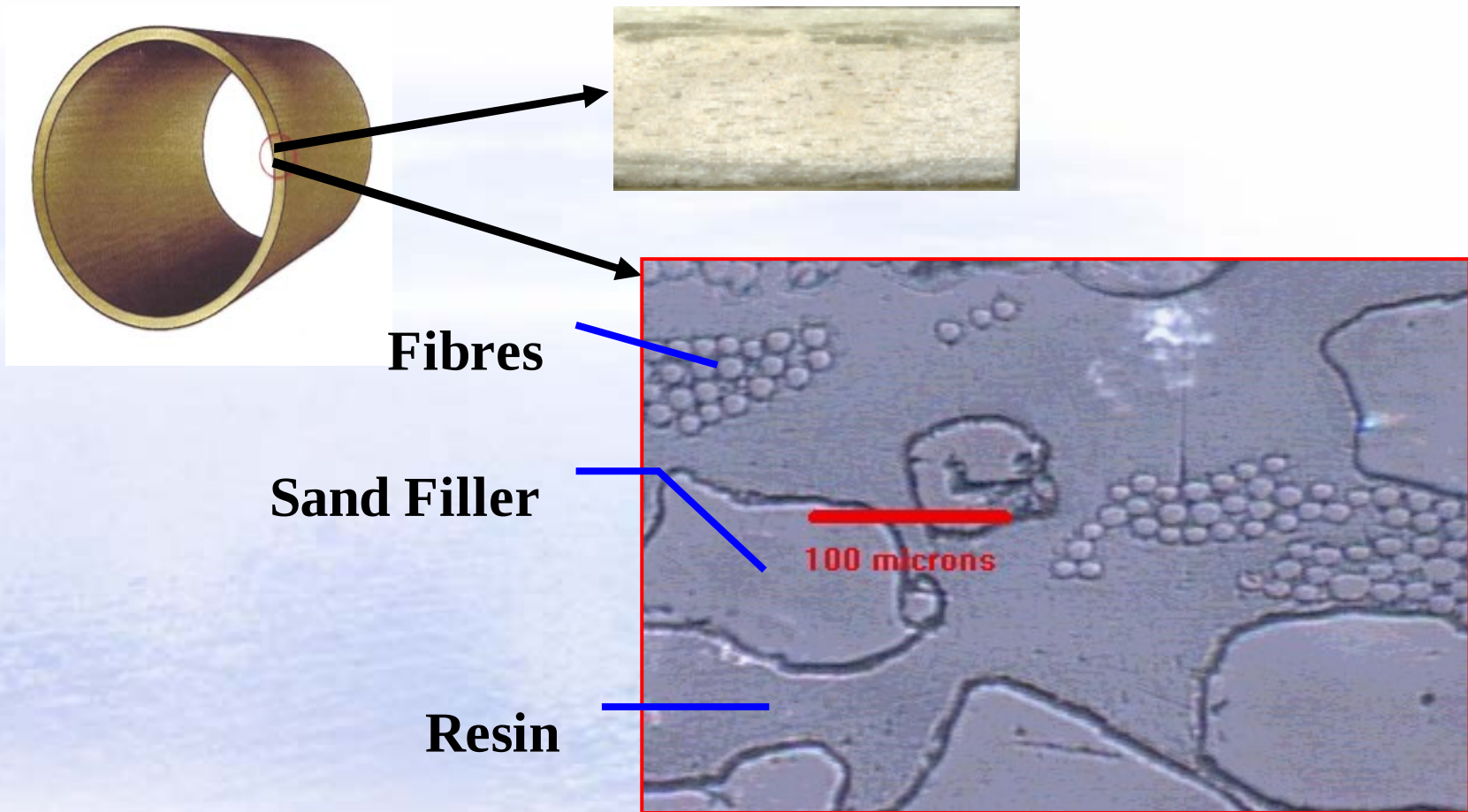
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Peep in to FRP Stress Strains- Strength

FRP-Pipe Wall Enlarged Cross Section

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FRP-Pipe Stress- Strain

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Isotropic materials:

- mechanical properties the same in all directions
- strength and stiffness not dependent on direction
- ex. thermoplastics, metals

steel: $E = 210000 \text{ MPa}$

Orthotropic materials (GRP):

- mechanical properties direction dependent,
- strength and stiffness dependend on direction
- ex. reinforced concrete, fibre reinforced polyester

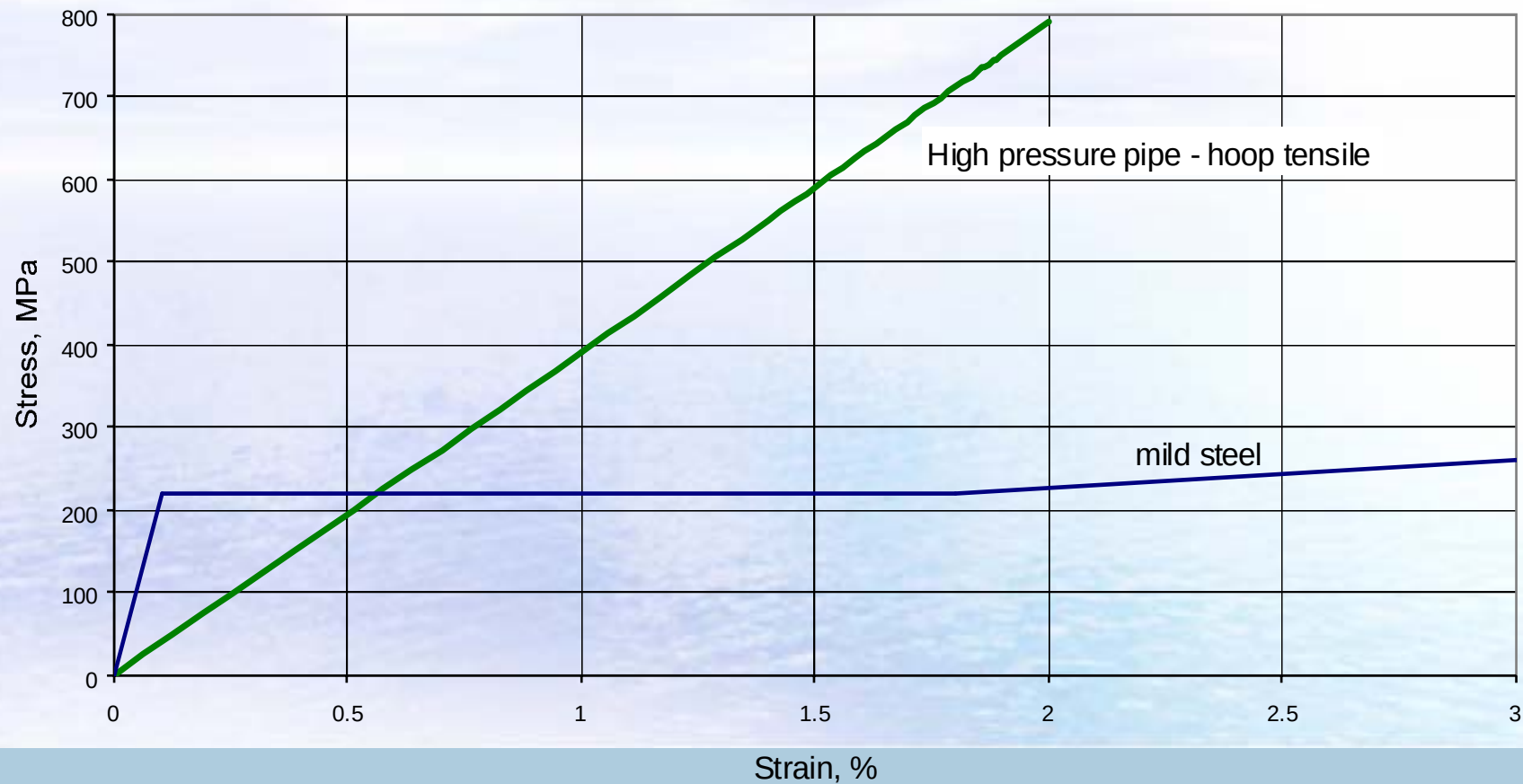
polyester: $E = 3000 - 4000 \text{ MPa}$

continuous glass: $E = 72000 - 76000 \text{ MPa}$

FRP-Pipe Stress- Strain

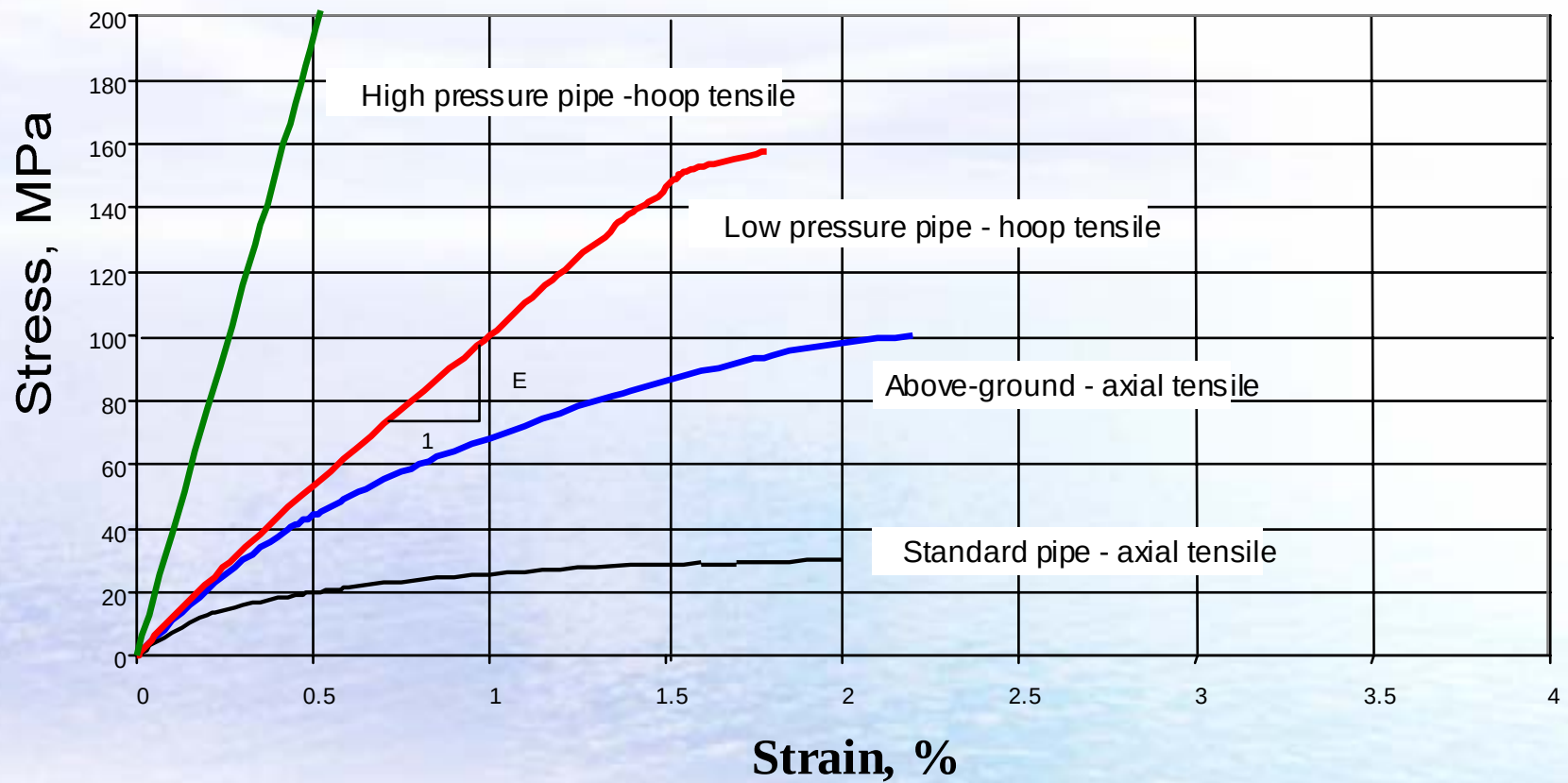
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Flowtite vs Steel
Stress-Strain Curves



FRP-Pipe Stress- Strain

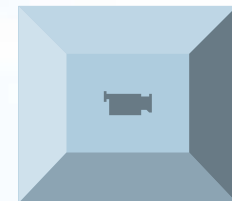
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FRP-Pipe Stress- Strain

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A 10 Bar G – FRP pipe was allowed to BURST and guess expected failure pressure



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Comparisons to Various Materials

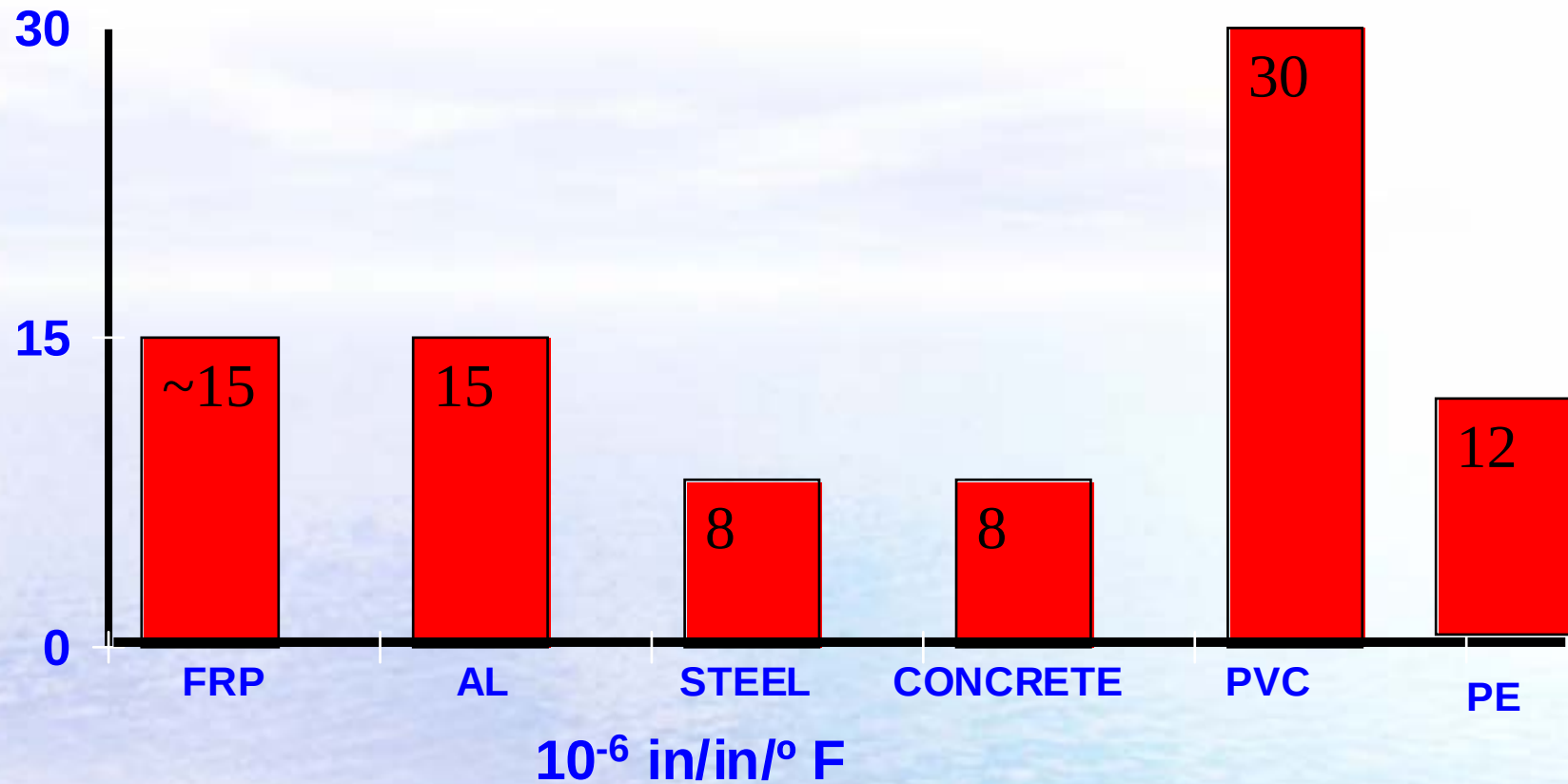
Pipe Wall-Specific Gravity

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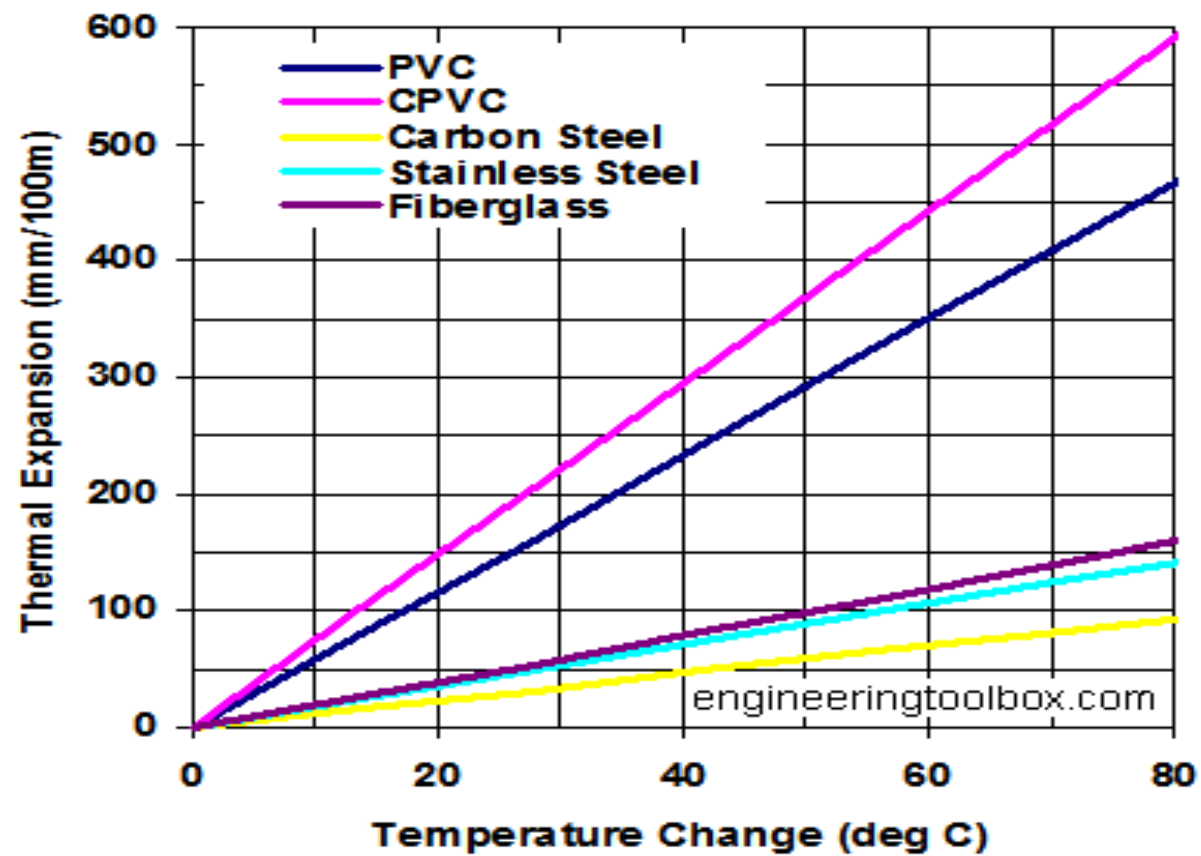


Coefficient Of Thermal Expansion

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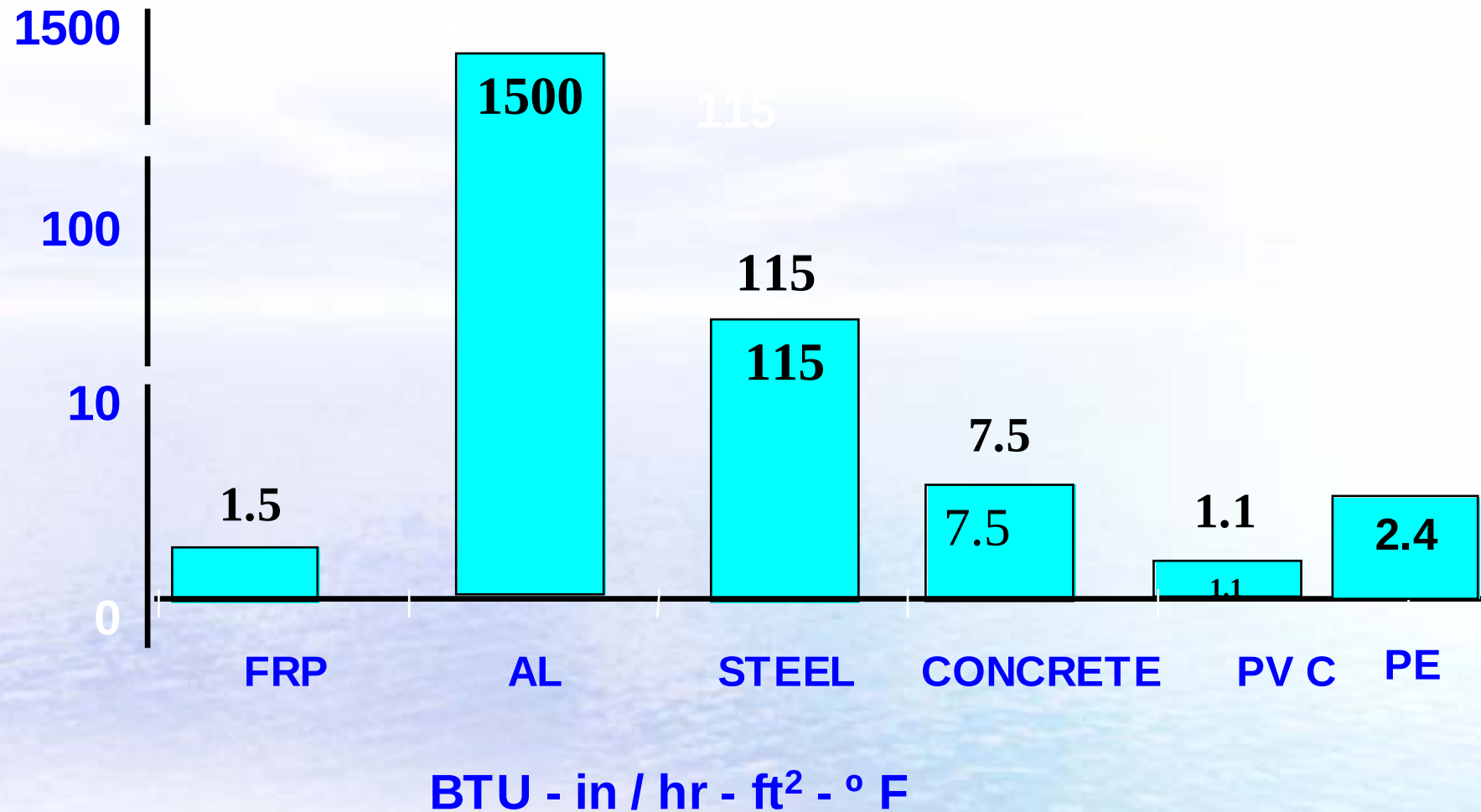


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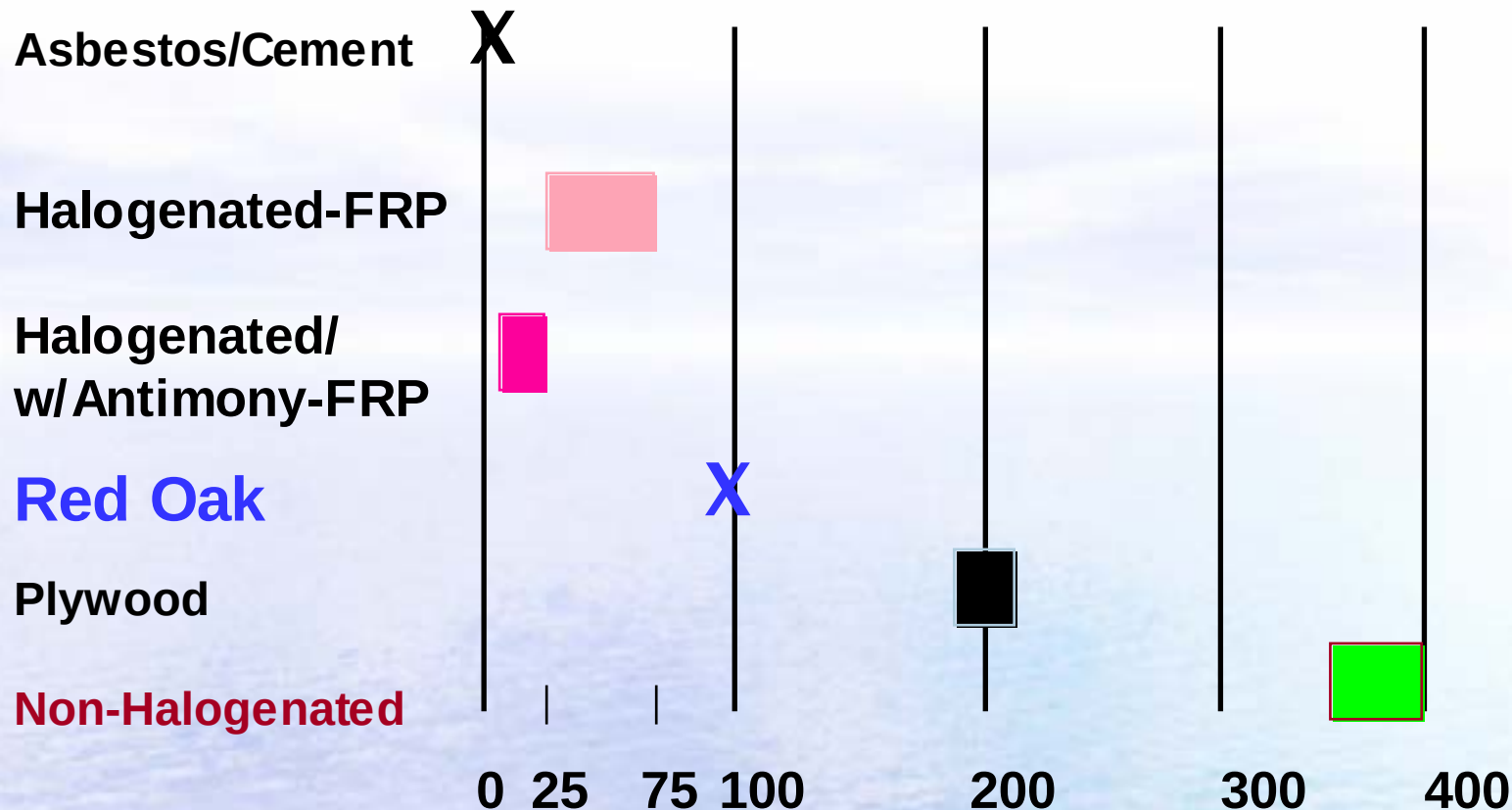
Thermal Conductivity

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ASTM E84 Flame Spread for FRP

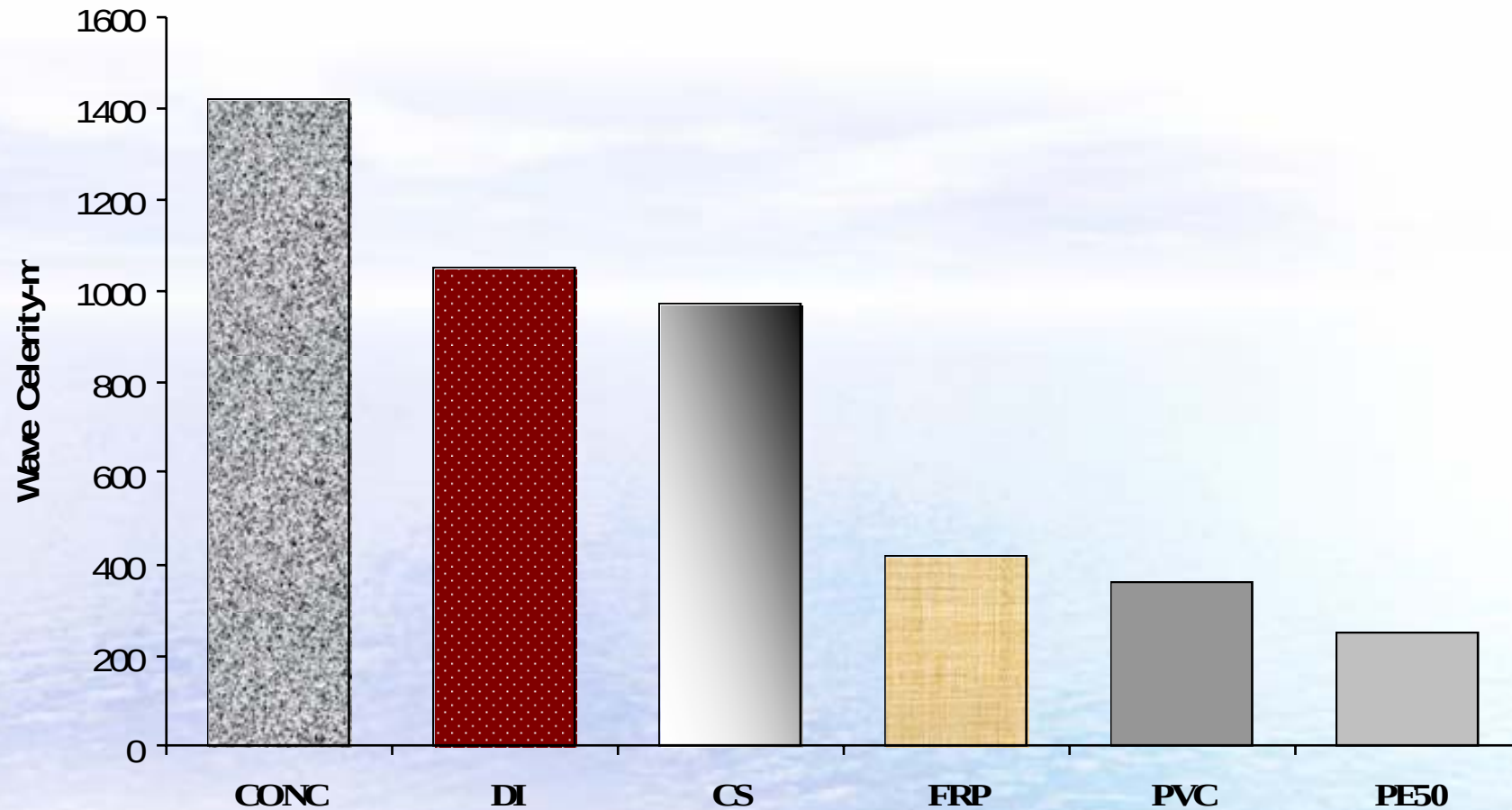
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Consult data sheets for specific information.

Surge and Water Hammer-Surge wave celerity

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Usage of FRP World Wide- Literature Survey

Usage of FRP World Wide- Literature Survey

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- In 1970, ϕ 1350 mm - Canada
- In 1974, ϕ 1200 mm - Peru
- In 1975, Office of Saline Water - USA, recommends GRP in Desal Plants
- In 1980, Reynolds recommends GRP in Distribution and Other Systems
- In 1981, Ainsworth recommends GRP for Different Applications
- More Reported Literature ... available

FRP-Life Cycle Costs

Saving Time and Money-Life Cycle Costs

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Saving Time and Money-a Real Example

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	1400 Dia. Steel (C)	1400 Dia. GRP	1300 Dia. GRP	1200 Dia. GRP
Head, mtr	105	60	82	115
Pump, KW	3156	1803	2464	3456
Pipe Cost, \$ Mil	13.75	15.68	13.75	12.10
Pump Cost, \$ Mil	0.27	0.15	0.21	0.29
Instal Cost, \$ Mil	14.02	15.83	13.96	12.39
Comparison	100%	113%	100%	88%
Power cost, \$ Mil	2.03	1.16	1.59	2.22
Annuity, Af=0.106 @ 10%, for 30yrs	19.17	10.94	14.95	20.97
Project Cost, \$ Mil	33.19	26.77	28.91	33.36
Comparison	100%	81%	87%	101%

Amiantit Initiative- GRP Plant in 1977 In Dammam – Saudi Arabia

Amiantit Initiative-1977 Start of GRP Plant

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- Saudi Arabian Amiantit Company – SAAC- Started GRP Plant in **1977**
- JV with Owens Corning (OC)/Flowtite/SAAC
- SAAC-overtake OC in 2000
- Globalization Commences in 2000
- One of the worlds biggest capacities
- More than 15 Machines
- Continuous production-365/7/24

30 Years of Journey of GRP

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- **AFIL-Dammam-1977**
- **AFIL-Jeddah-2000**
- **FPCL: Fiberglass Pipe Company Limited-2001**
- **DPFCL: Dubai Pipe Factory Company-2002**
- **AQAP: Amiantit Qatar Pipes Company-2008**
- **ABHL: Amiantit Bahrain Holding Limited-2010**



30 Years of Journey of GRP... ..

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8 - Machines at **AFIL - Dammam**

6- Machines at **AFIL-Jeddah**

2 machines at **FPCL- Dammam**



2500 Machine at **DPFC- Dubai**



4000 mm machine at
Qatar-2008

4000 mm machine at **Bahrain-2010 is coming up**



Product Range

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- O Diameter** : 80 mm to 4000 mm
- O Pressure** : Gravity to 40 Bars (464 psi)
- O Stiffness** : 1250, 2500, 5000, 10,000
12,500 Pa
- O Joint System** : Couplings, Butt-strap, Flngs
- O Installation :** Underground, Aboveground
Under Sea Applications
- O Resin** : Polyester, Vinylester & Epoxy
- O Tanks** : U/G Up to 48,000 USG
A/G H Up to 35,000 USG
A/G V Up to 30,000 USG
- O Structural MH & Liner:** 1000 & 1200 mm Dia

FRP-Pipe Production - Range

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Diameters

80 mm

4000 mm

Pressure

Gravity

40 Bars G

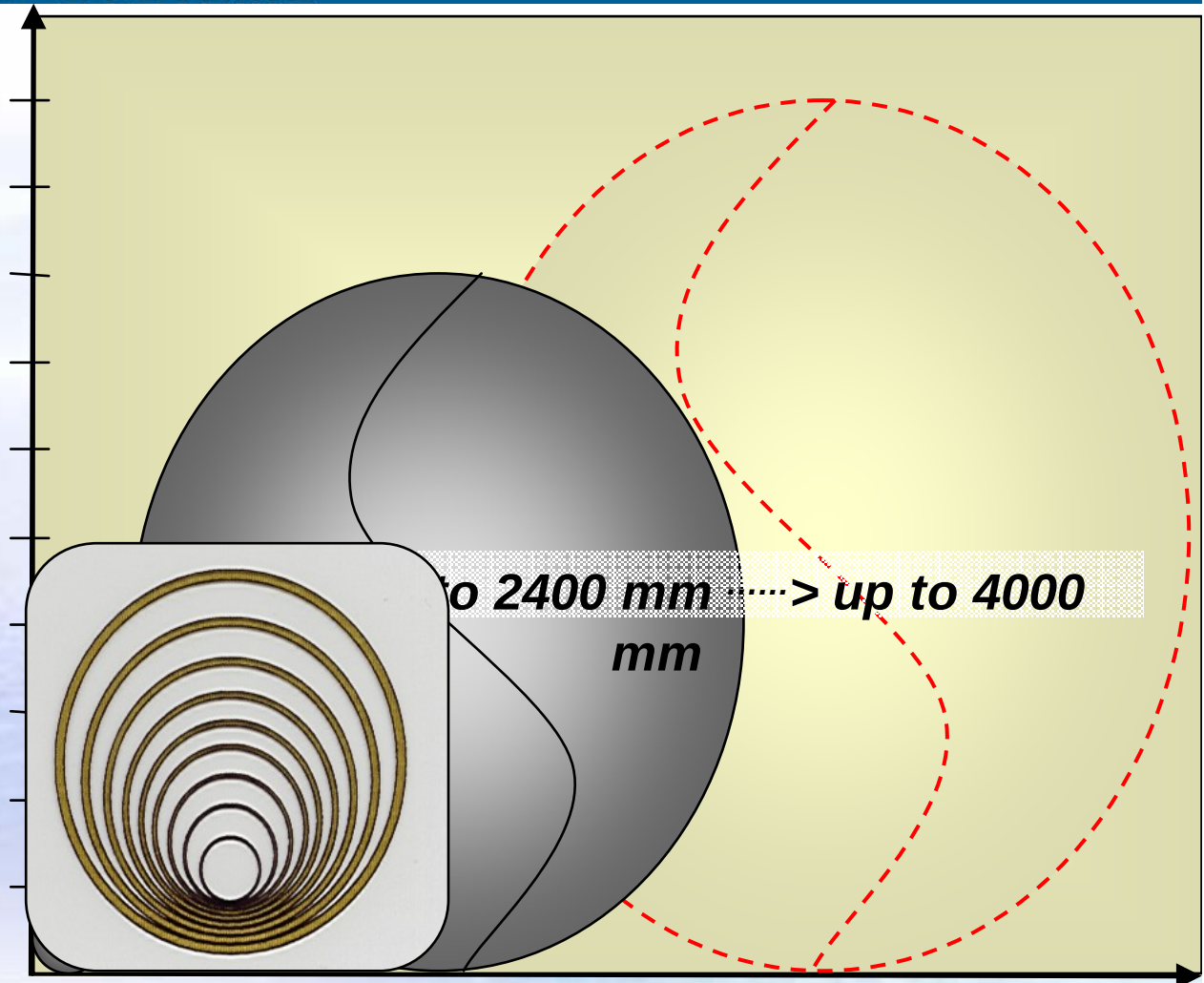
Application

UG

AG

Under Sea

Relining



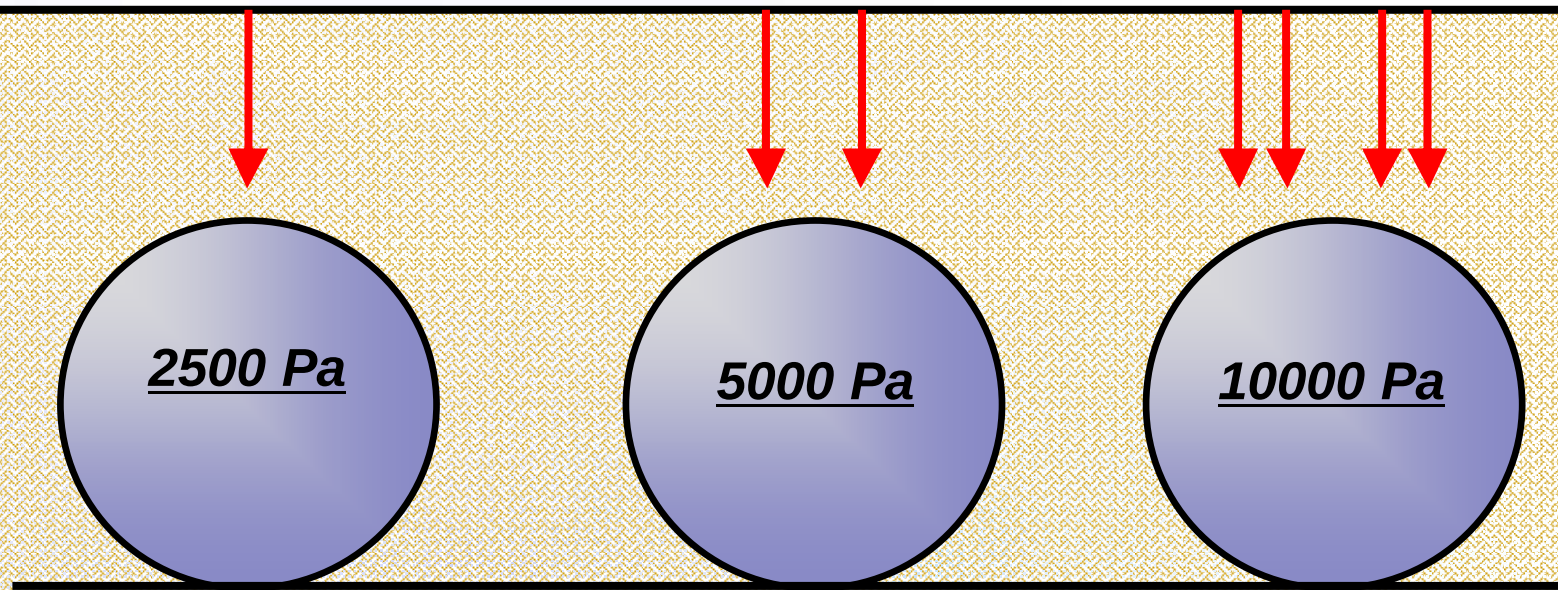
FRP-Pipe Stiffness - Range

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Load = P

$2 \times P$

$4 \times P$



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أمياتيت ترحب

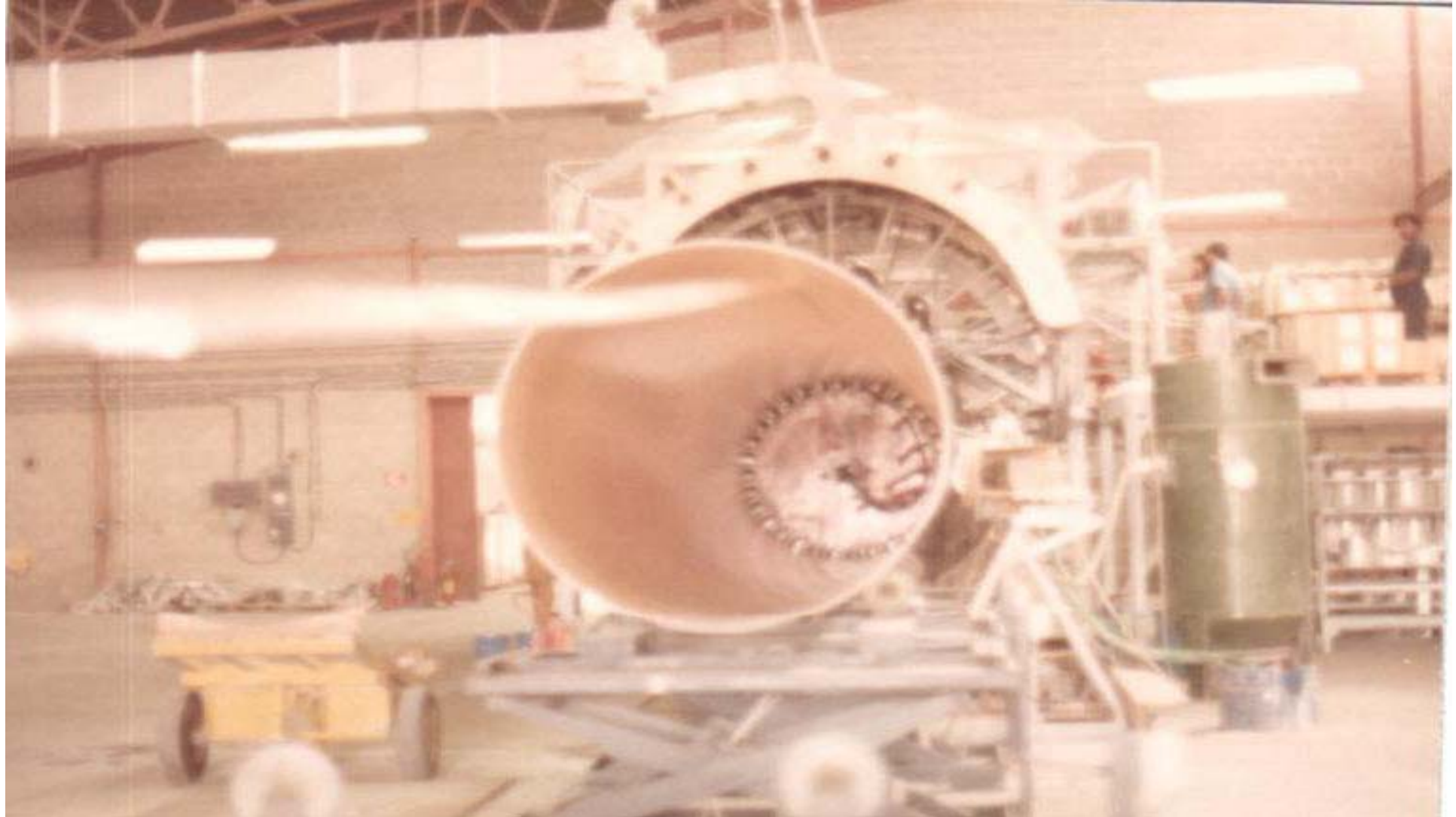
بمدير جامعة الملك فهد للبترول والمعادن ومراقبيه



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30 Years Supplies and Applications

📁 Under Ground

📁 Above Ground

📁 Under-Sea / Off-Shore

📁 On Ground

📁 Slip Lining













19 4 2007

































 **Under Ground**

 **Above Ground**

 **Under-Sea / Off-Shore**

 **On Ground**

 **Slip Lining**















ALL Types of Fittings Were Fabricated



Elbows, Tees, Reducers, Flanges, Blind





14 13:59

All Types of Fittings are Possible

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 Under Ground Above Ground **Under-Sea / Off-Shore** On Ground Slip Lining

Under-Sea Continued....

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Around 50 Projects were already under operation

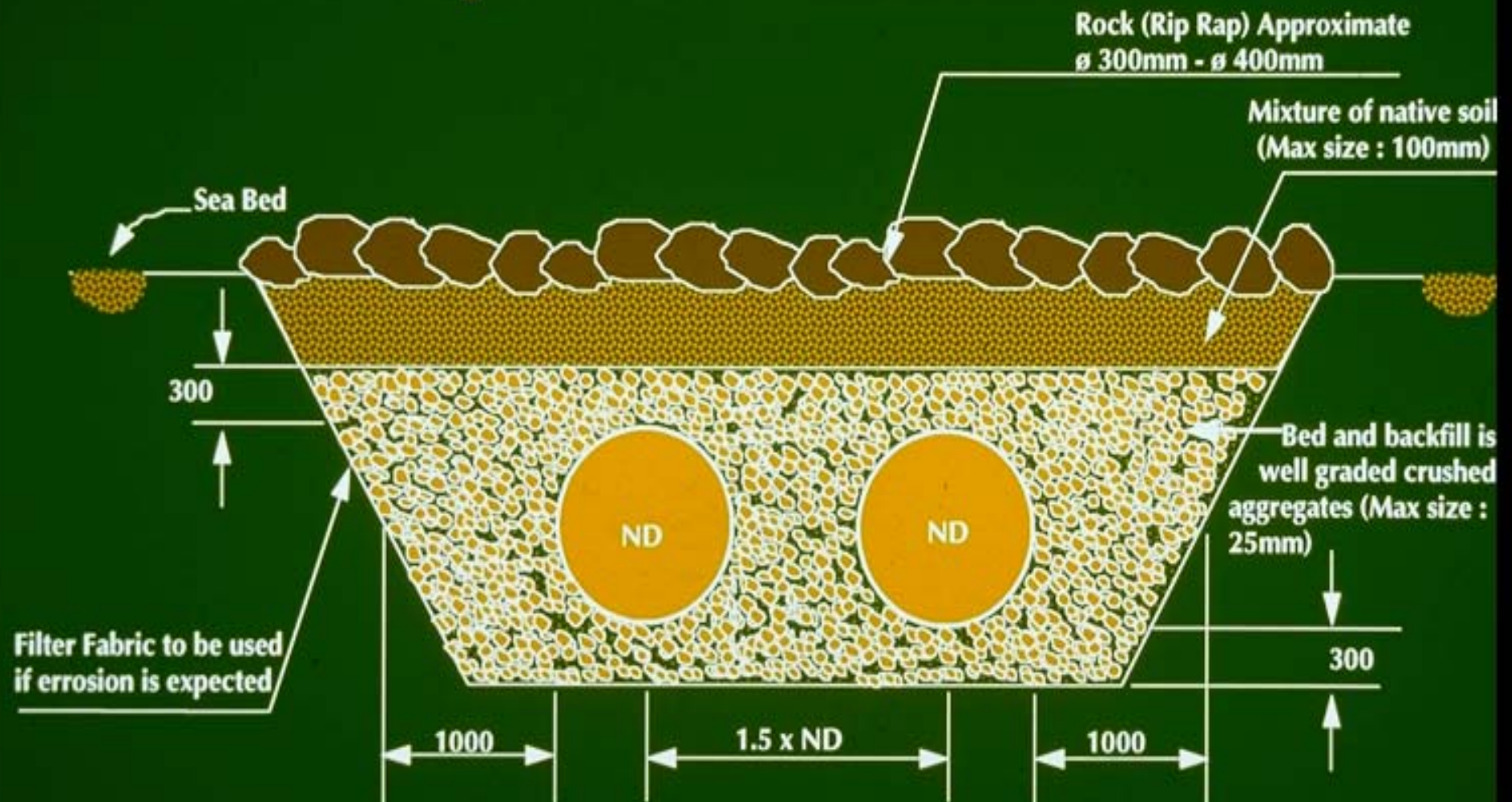
Diameters Up to 3700 mm

Supported in Design/ Installation in Various Projects

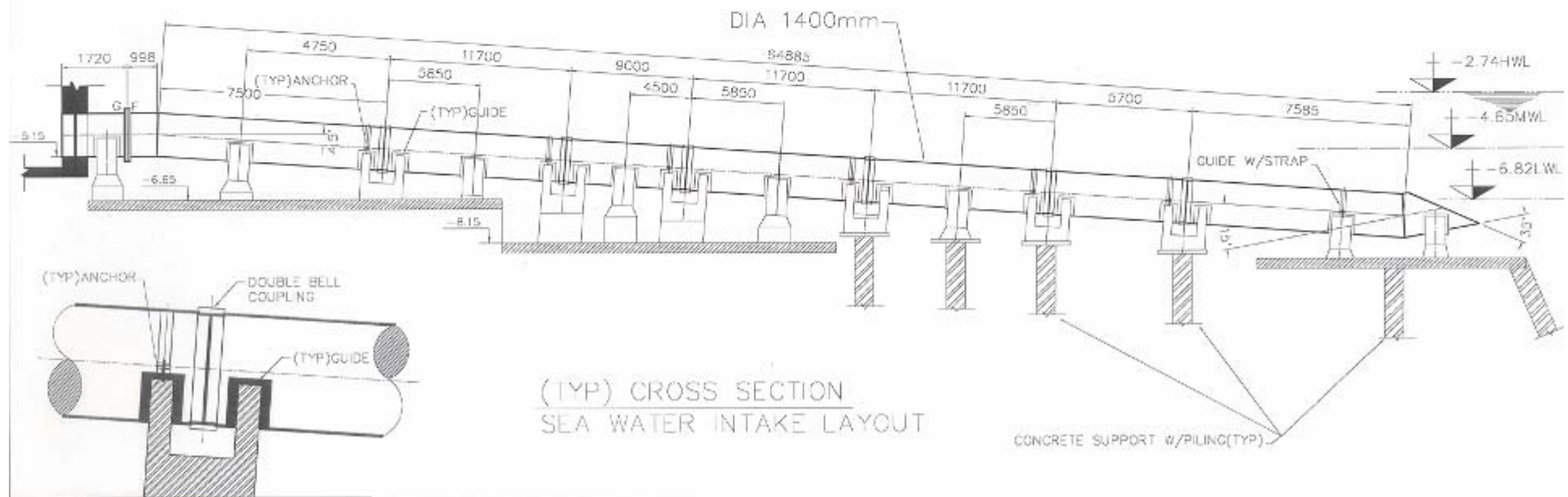
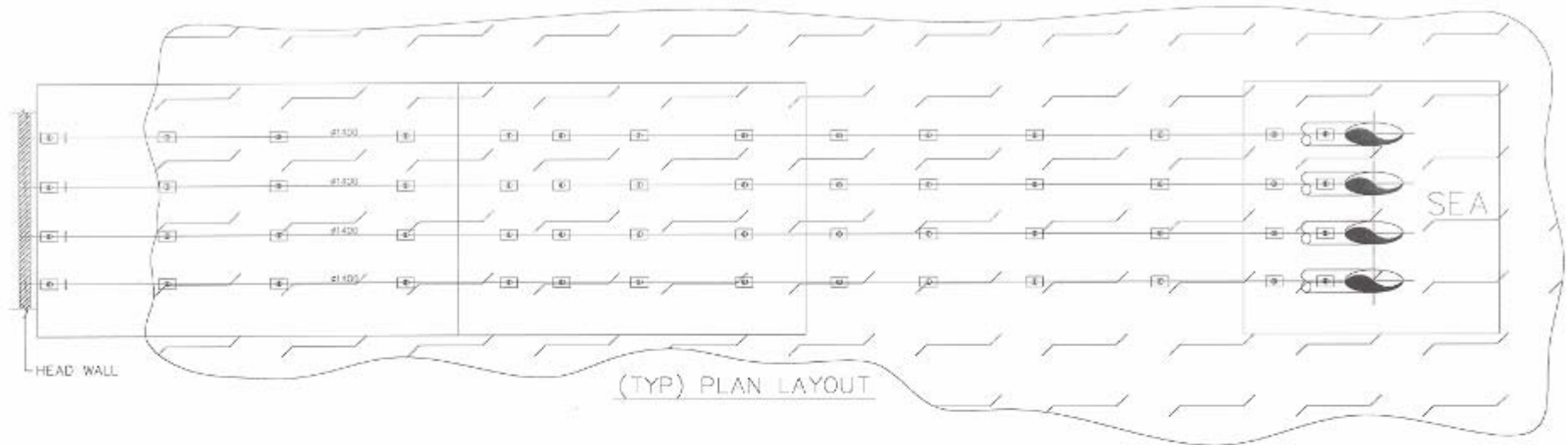
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Sub-Aqueous Installation



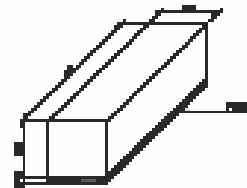
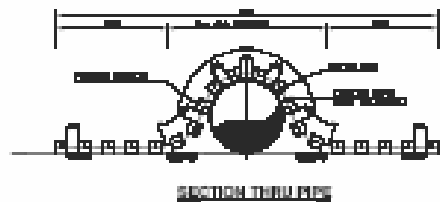
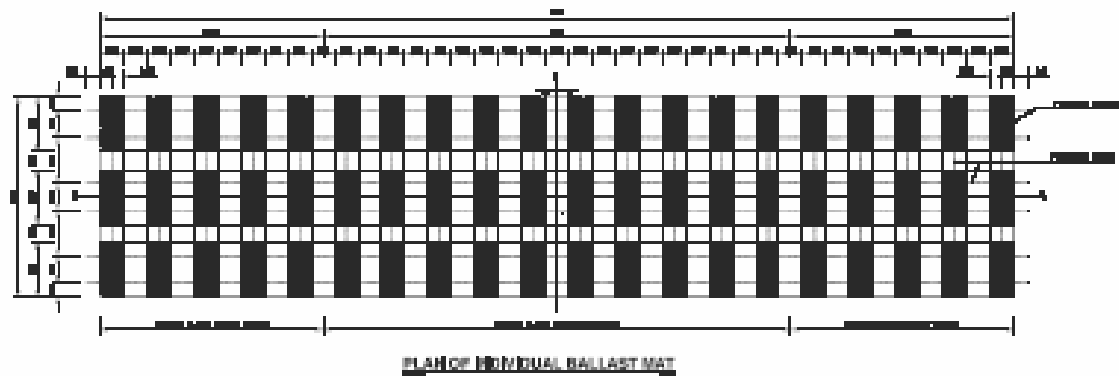
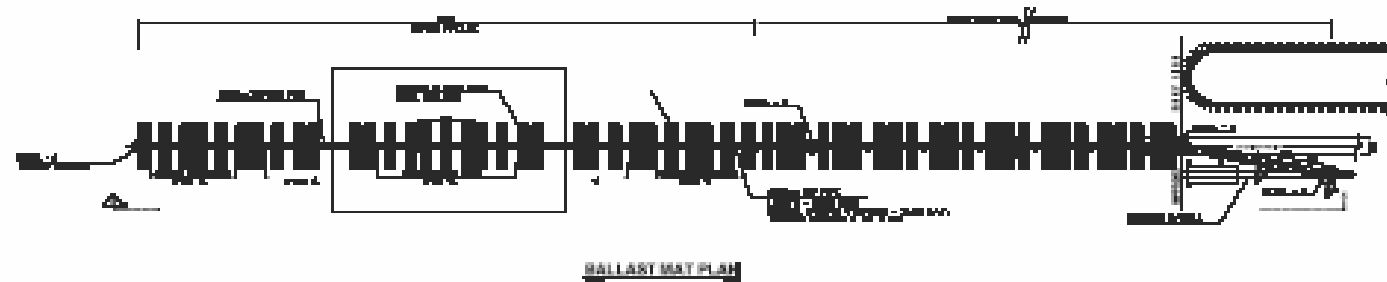












**FRONT VIEW OF PRECAST CONCRETE BLOCK
FOR CH. TRAIL, SEE CP. MAT**

DISCUSSION

- FROM DIRECTORIAL & ISSUES DIVISION, CLARK-DEAN-DEAN
- FROM DIRECTORIAL & ISSUES DIVISION, CLARK-DEAN-DEAN

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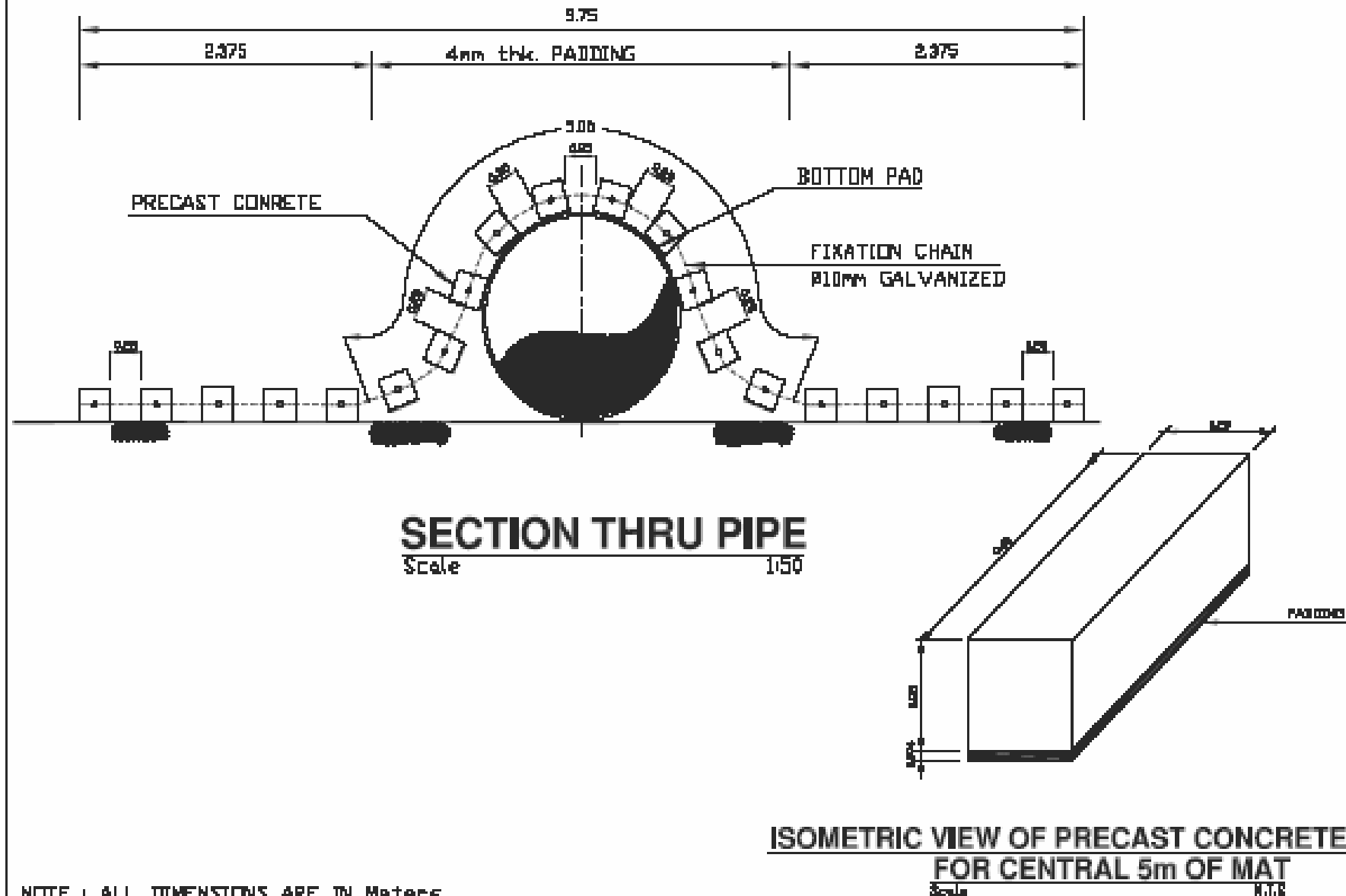
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ILLUSTRATION AND LAYOUT & DETAILS

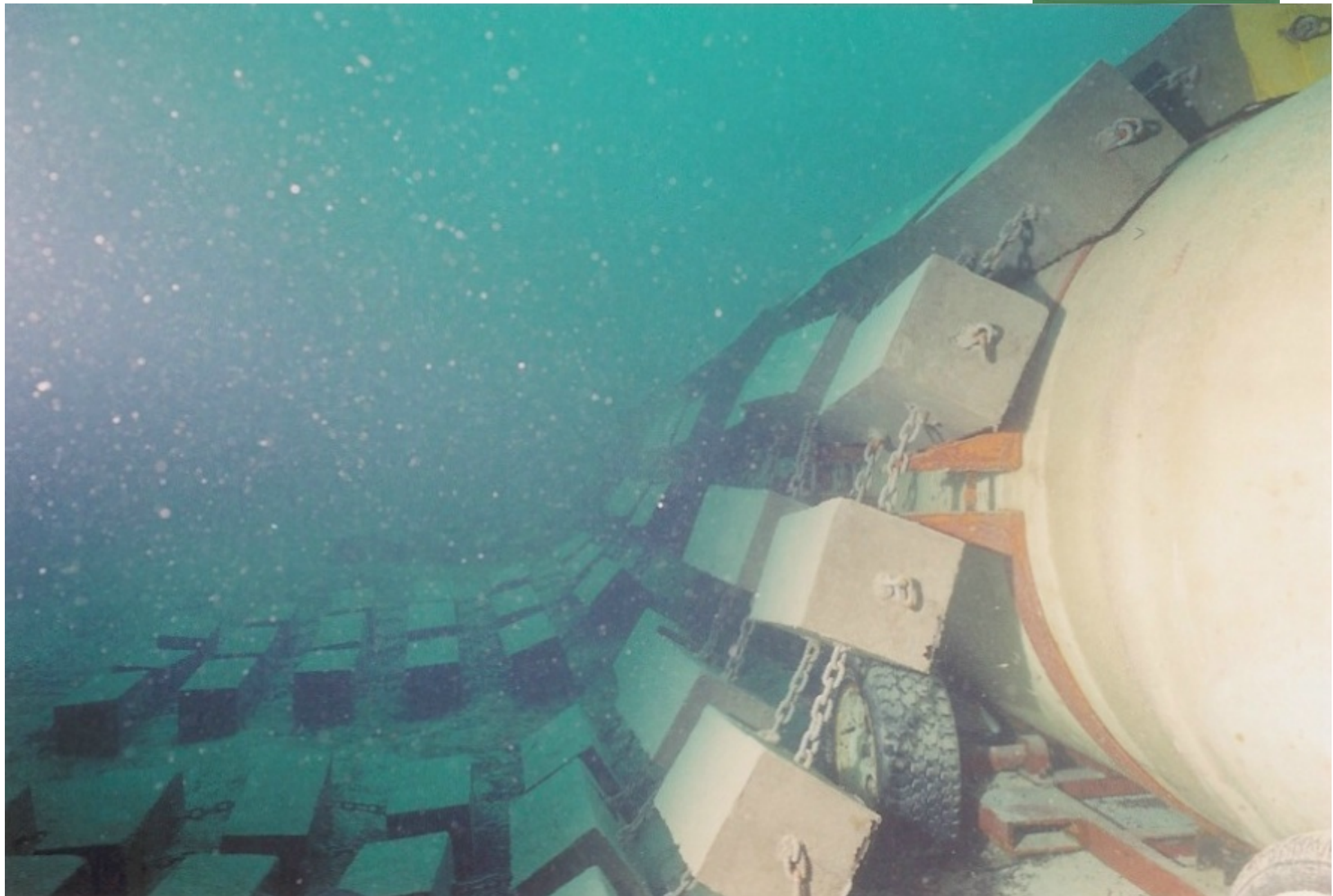
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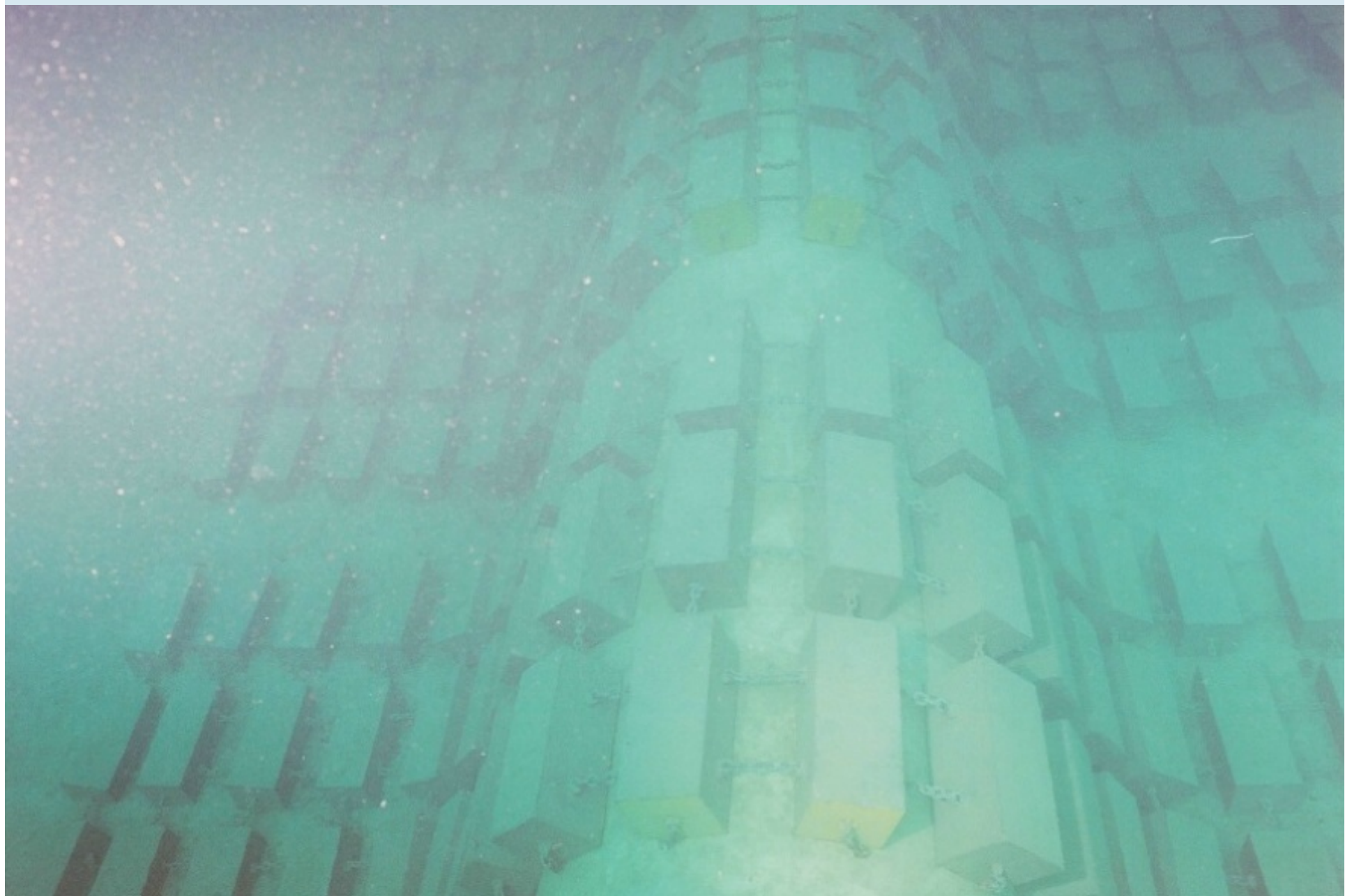
HUTA-SETE
MARINE EQUIPMENT

















AMIA

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Performance of FRP in P and D Plants

- 📁 Under Ground
- 📁 Above Ground
- 📁 Under-Sea / Off-Shore
- 📁 **On Ground**
- 📁 Slip Lining



On Ground Applications

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- For Sewage and Water Line With Flexible Couplings and Special Supports
- Useful for Rugged Terrain
- Can be Used for Slopes
- Similar Lines Under Operation



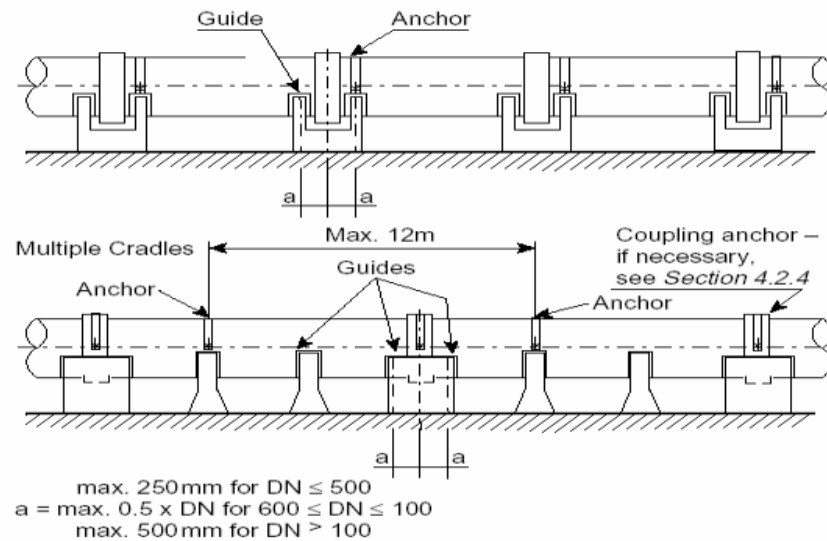


Figure 4.1
Flowtite® pipes. Typical support arrangement

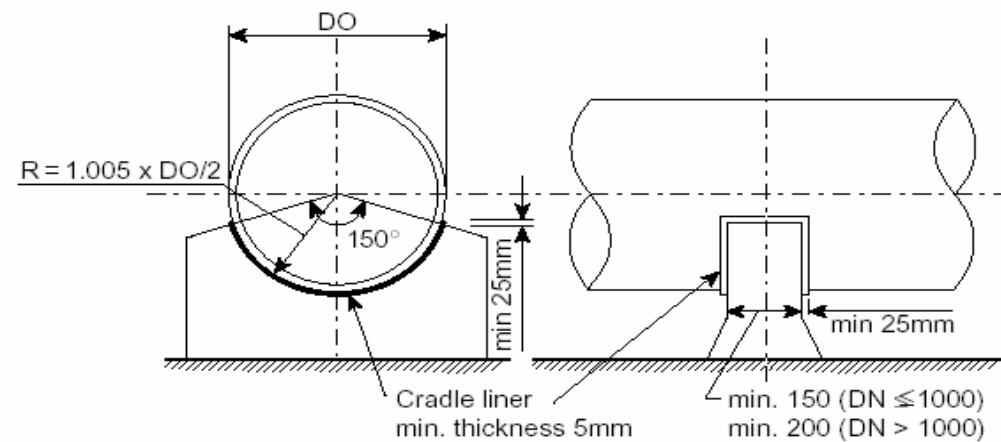


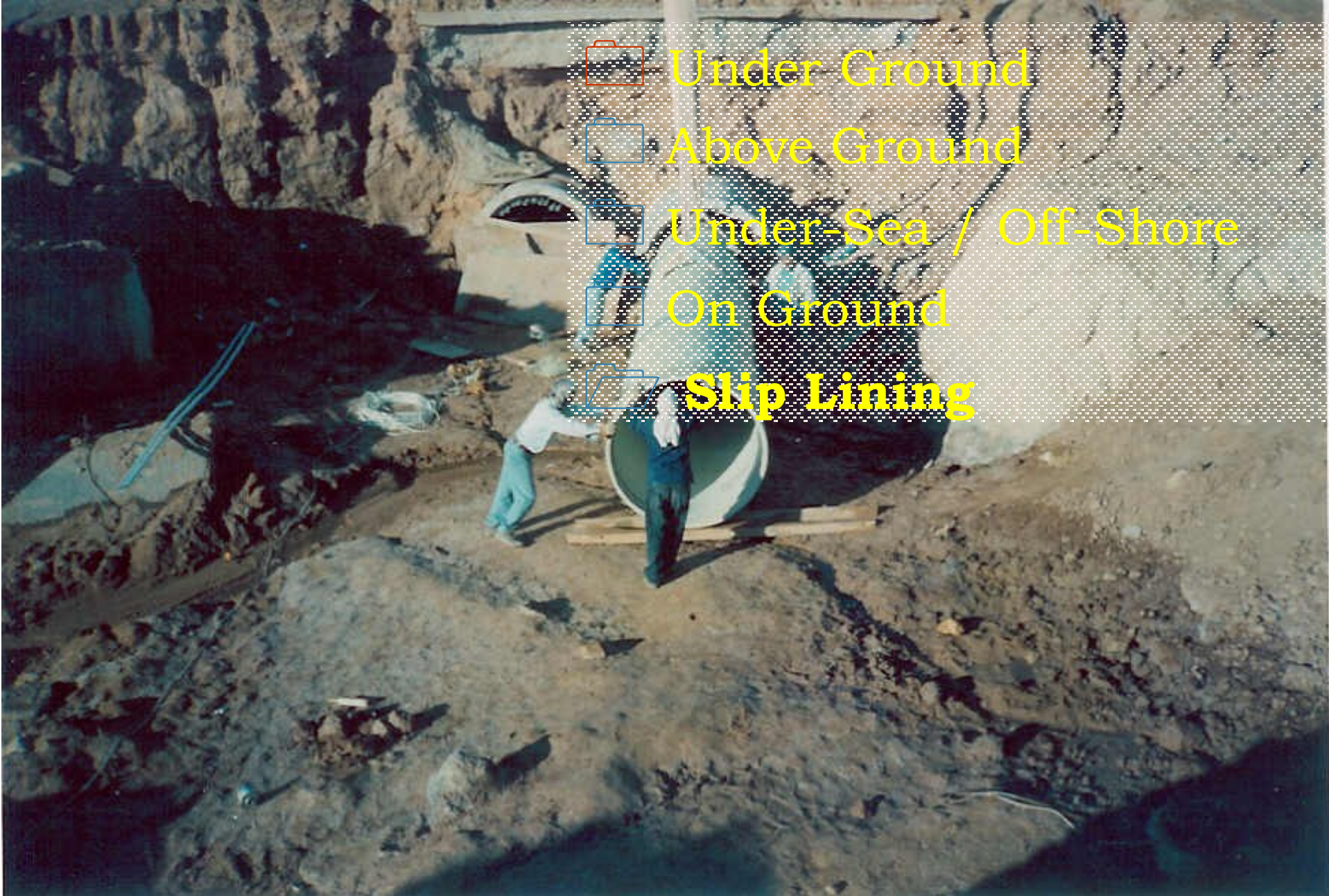
Figure 4.2
Cradle design









- 
- ☒ Under Ground
 - ☐ Above Ground
 - ☐ Under-Sea / Off-Shore
 - ☐ On Ground
 - ☒ Slip Lining













AMIAANTIT PIPE SYSTEMS

Typical Oldest Case Histories >25 Years

Results of GRP pipe Installed in 1980

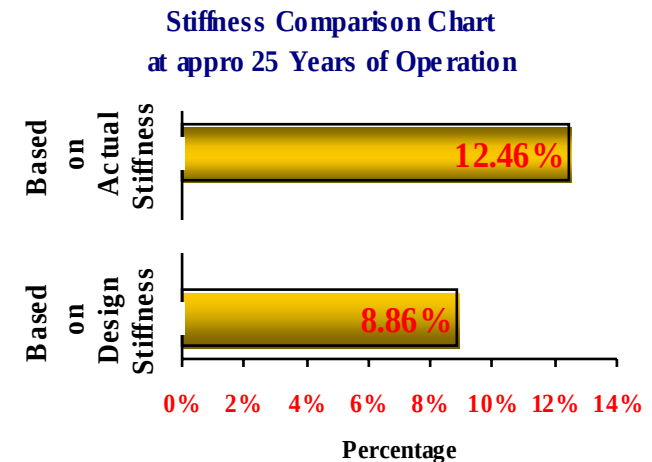
AMIAANTIT PIPE SYSTEMS

Traceability and Pipe Identification

● Pipe Nominal Diameter	1800 mm
● Pipe Identification number	2B-1910-X
● Pipe production date	09 th July 1980
● Nominal Pipe wall thickness	22.71 mm
● Pipe nominal Pressure rating	H-010 K Pa
● Pipe Nominal Stiffness	1388 Pa STIS
● Pipe Actual Stiffness	1432 Pa STIS

Hoop Tensile Strength 45 MPa

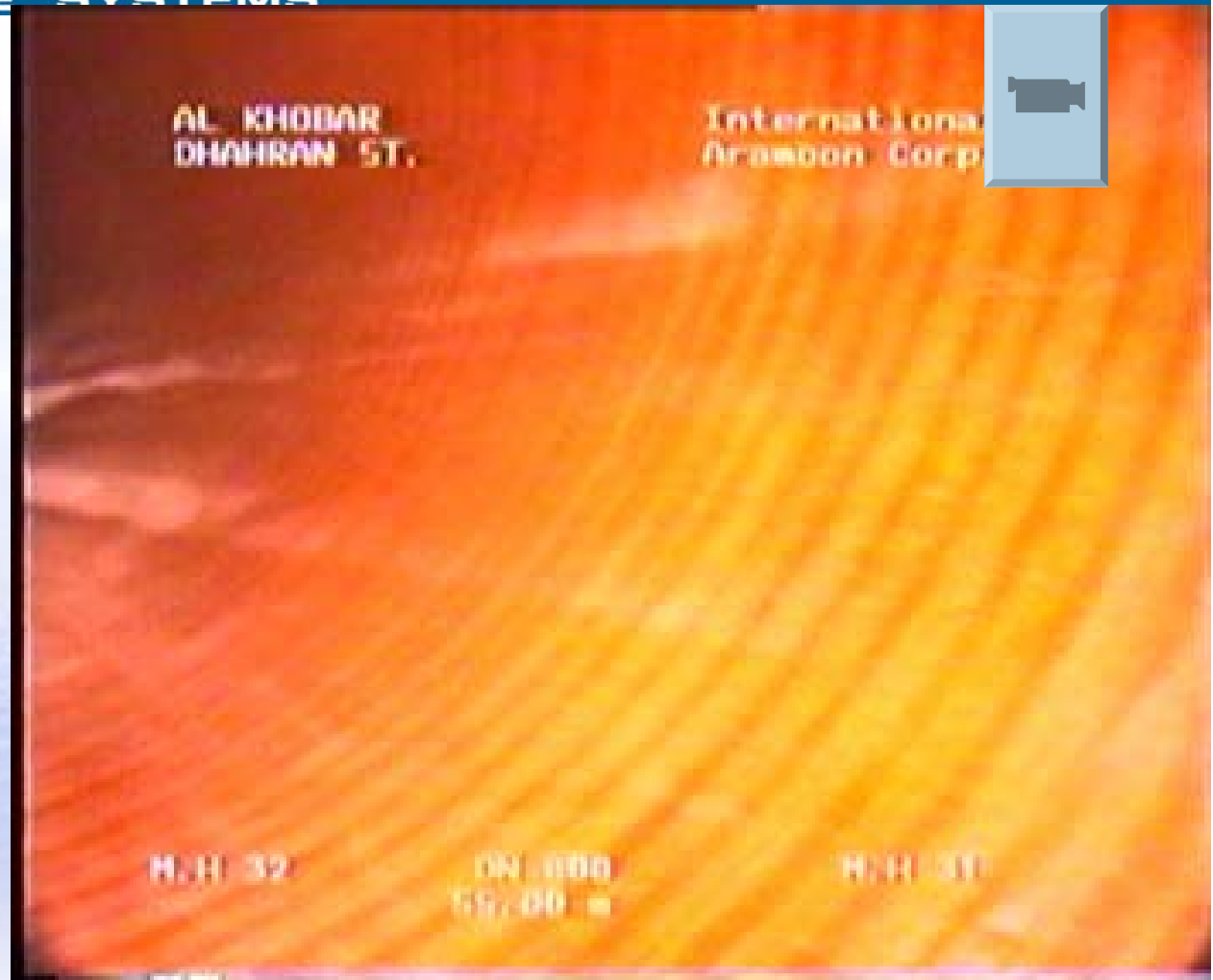
Axial Tensile Strength 25 MPa



Results of GRP pipe Installed in 1980...



PIPE SYSTEMS



AMIAANTIT PIPE SYSTEMS

To Conclude and Summarize.....

Summary of 30 Years GRP Supplies

AMIAANTIT

Diameters

80 mm

4000 mm

Pressure

Gravity

40 Bars G

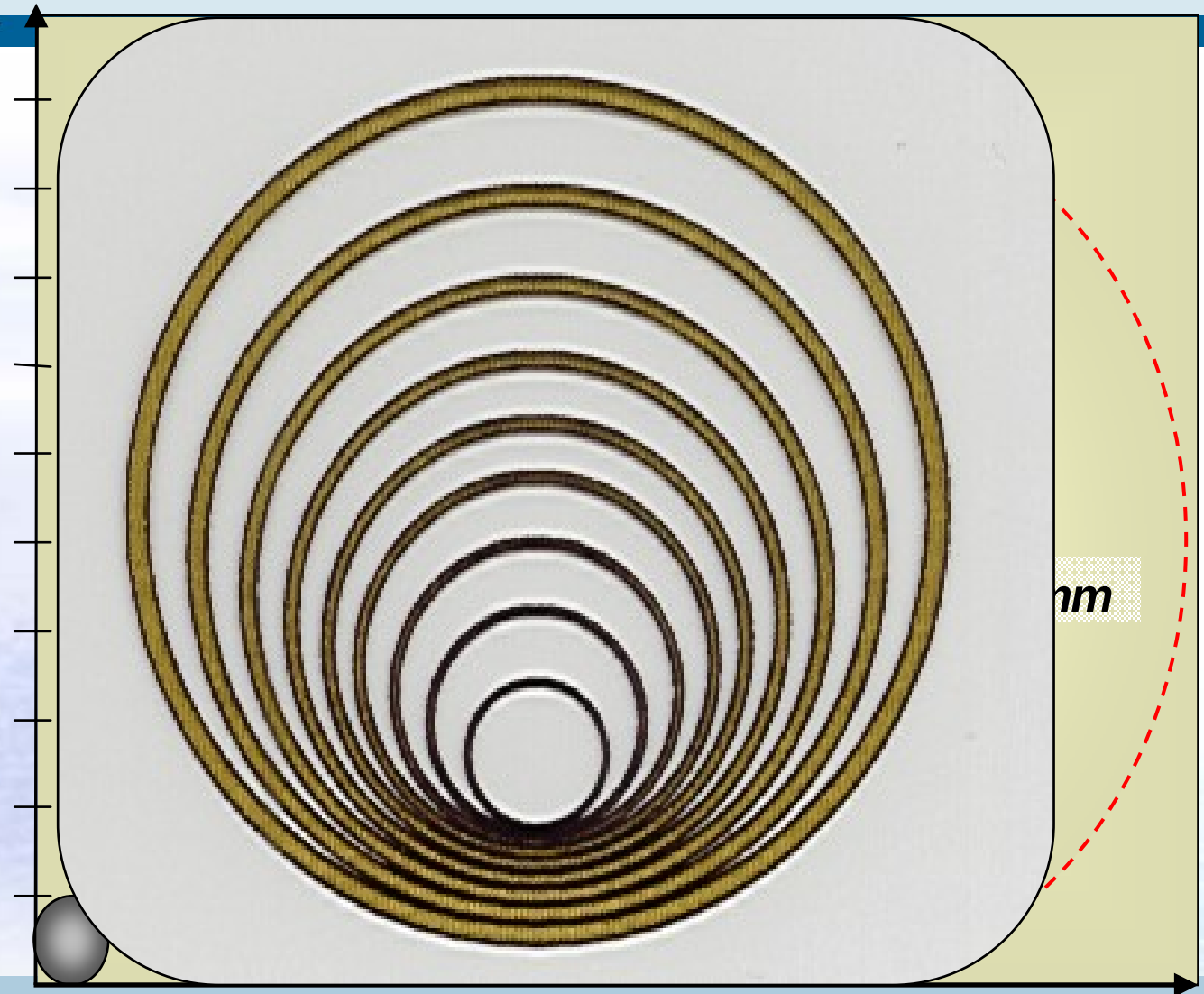
Application

UG

AG

Under Sea

Relining



mm

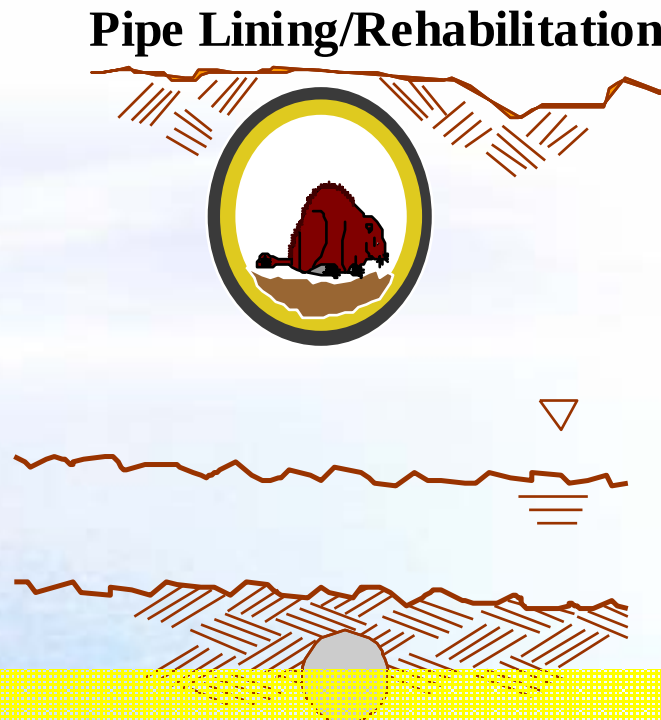
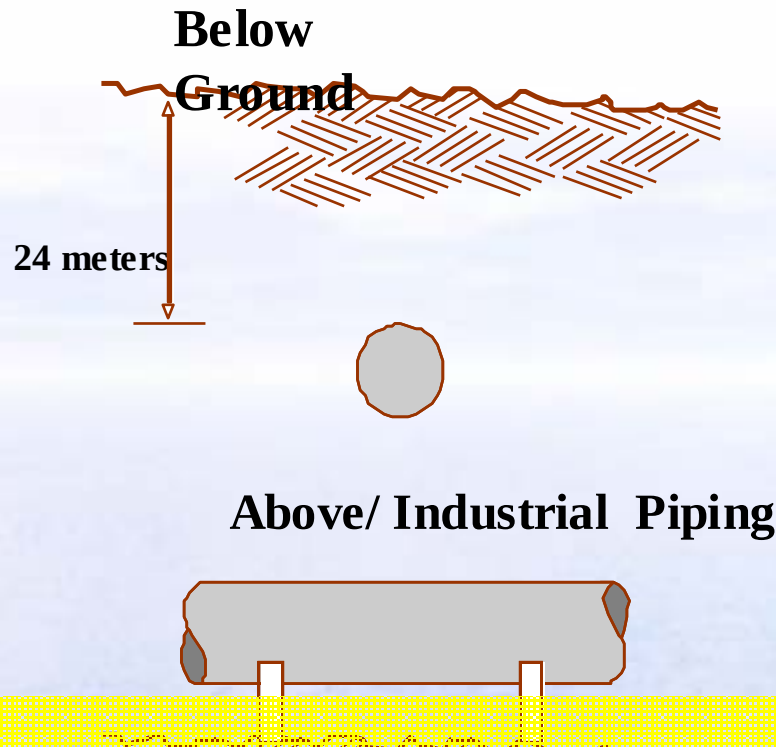
Summary of 30 Years GRP Supplies...

AMIAANTIT PIPE SYSTEMS

Type of Production	Quantity	Unit
Aboveground Horizontal Tanks	1,648	pcs
Aboveground Vertical tanks	1,243	pcs
Underground storage tanks	5,111	pcs
Large diameters for Sewer	4,321,795	Meters
Large diameters for water	1,983,848	Meters
Small Diameters Pipes for Sewer	3,814,540	Meters
Small Diameters Pipes for Water	504,350	Meters
Aboveground Pipes	285,420	Meters
Perforated Pipes	101,176	Meters

Summary of 30 Years GRP Supplies... ..

AMIAANTIT PIPE SYSTEMS



A Total of 11, 559 Km - GRP supplied

AMIAANTIT PIPE SYSTEMS

Finally Some Interesting Applications.....

















AM

30 Years

Un limited Inspiration

Conclusions and Recommendations

AMIAANTIT PIPE SYSTEMS

- GRP Pipes are suitable for All Applications better than that of Traditional Materials
- No Maintenance, **INSTALL it** FORGET it
- Not in Theory but Exists over **30** Years
- Commercially Viable
- Greater Flexibilities
- Need to Adopt Now in All Applications

QUESTIONS & ANSWERS

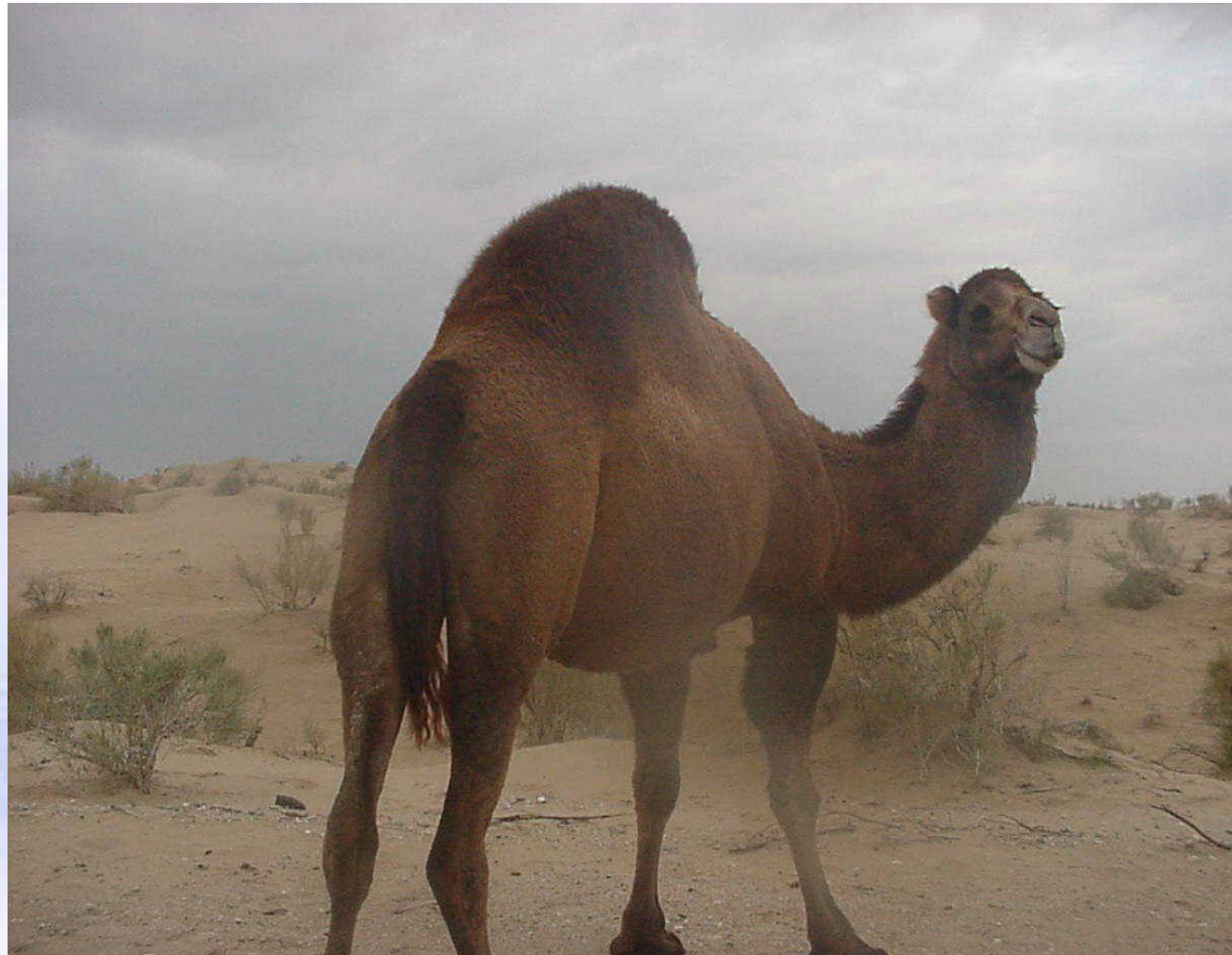
30 Years

AMIAANTIT PIPE SYSTEMS

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Middle East Region

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