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

AMIANTIT PIPE SYSTEMS
A Member of the AMIANTIT Group

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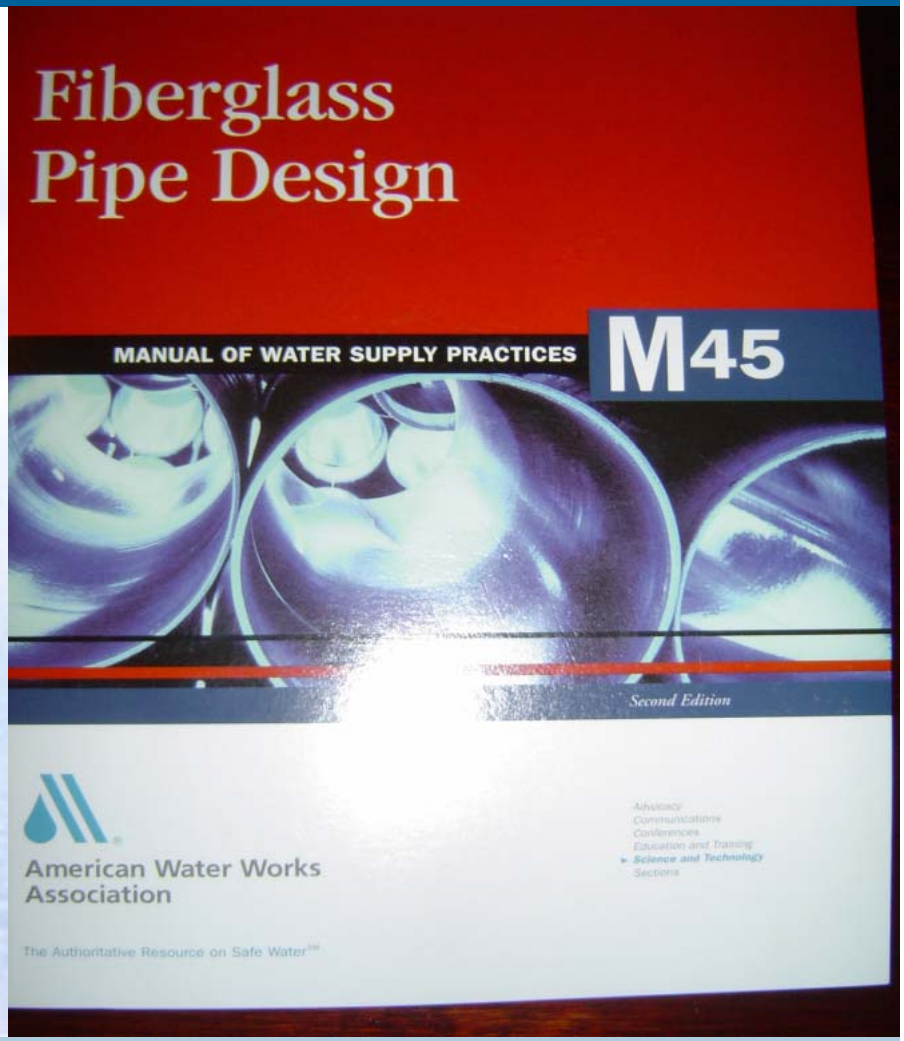
AMIANTIT PIPE SYSTEMS

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



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Presentation Topic

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- 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

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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

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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.


Jordan
Iraq
Iran
Kuwait
Kingdom of Saudi Arabia
Red Sea
Arabian Gulf
Oman Gulf
QATAR
U.A.E.
Oman
Yemen
Arab Sea
Adan Gulf
HAQL
TABUK
DUBA
ALWAJH
UMMLUJ
KHAIBAR
YANBU
MEDINA
RABIGH
JEDDAH
MAKKAH
TAIF
SHUAIBA
ABHA
KHAMIS MUSHAYT
ALBIRK
AHAD RAFIDA
SHUGAIG
NAJRAN
JAZAN
OKAD
FARASAN
HAIL
BURAYDAH
SHAGRA
RIYADH
KHAFJI
JUBAIL
AL KHOBAR
BAHRAIN
DAMMAM
DHAHRAN
QATEEF
SAYHAT
SAFWA
RAS TANNURAH
Keys
SWCC Plant
Served City
Pipeline
Pipeline
(Under Construction)

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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

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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

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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)

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Resulting

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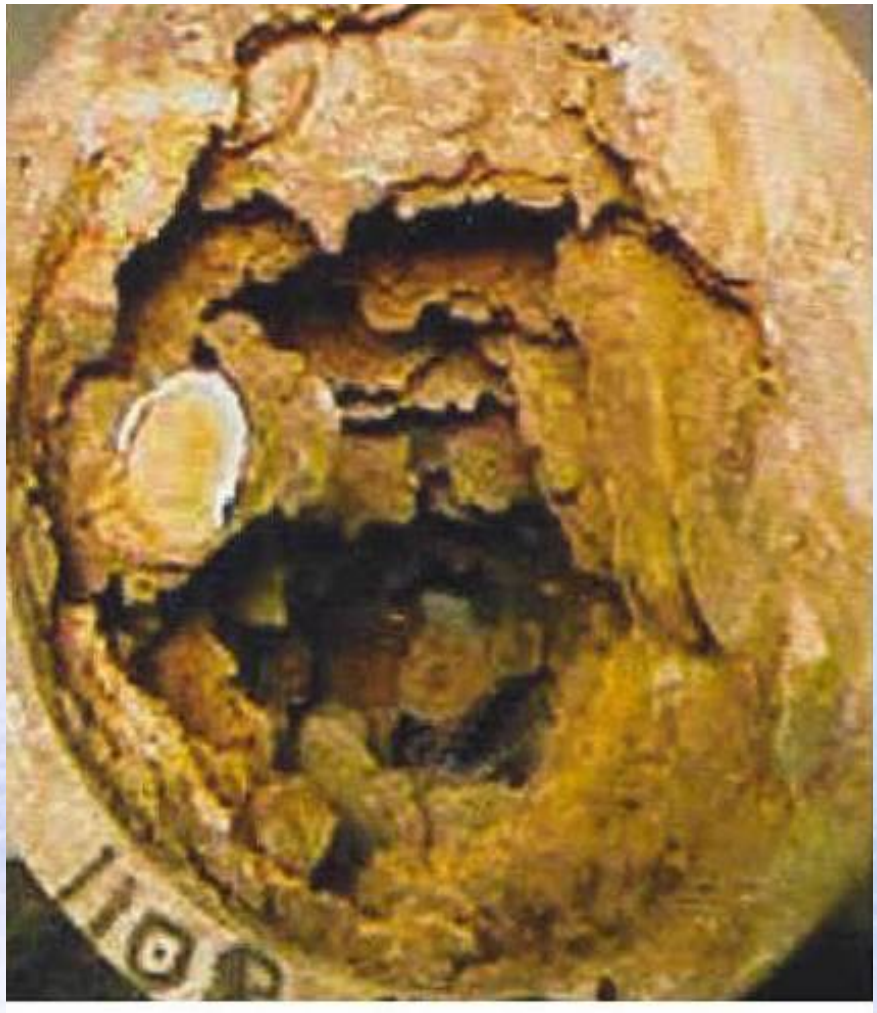

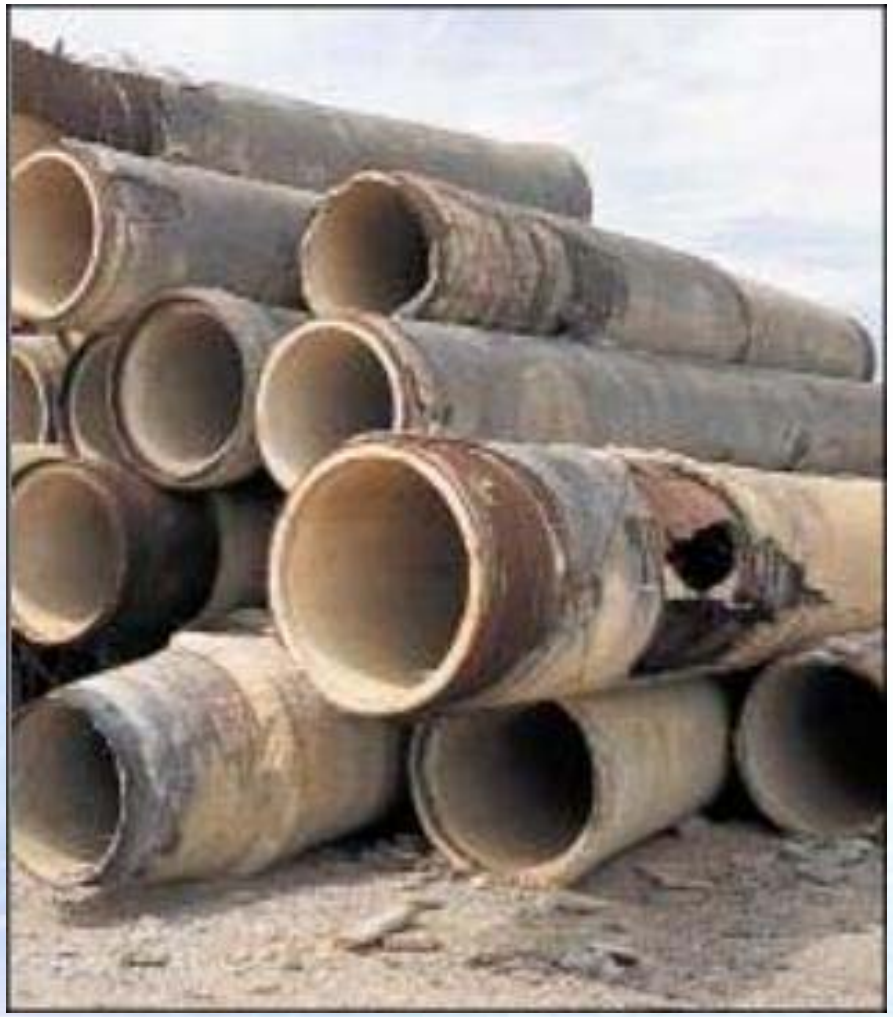

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Resulting …..

AMIANTIT PIPE SYSTEMS

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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

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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

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FRP-Pipe Wall Construction

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Nomenclature

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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

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Classification based on Engineering Materials

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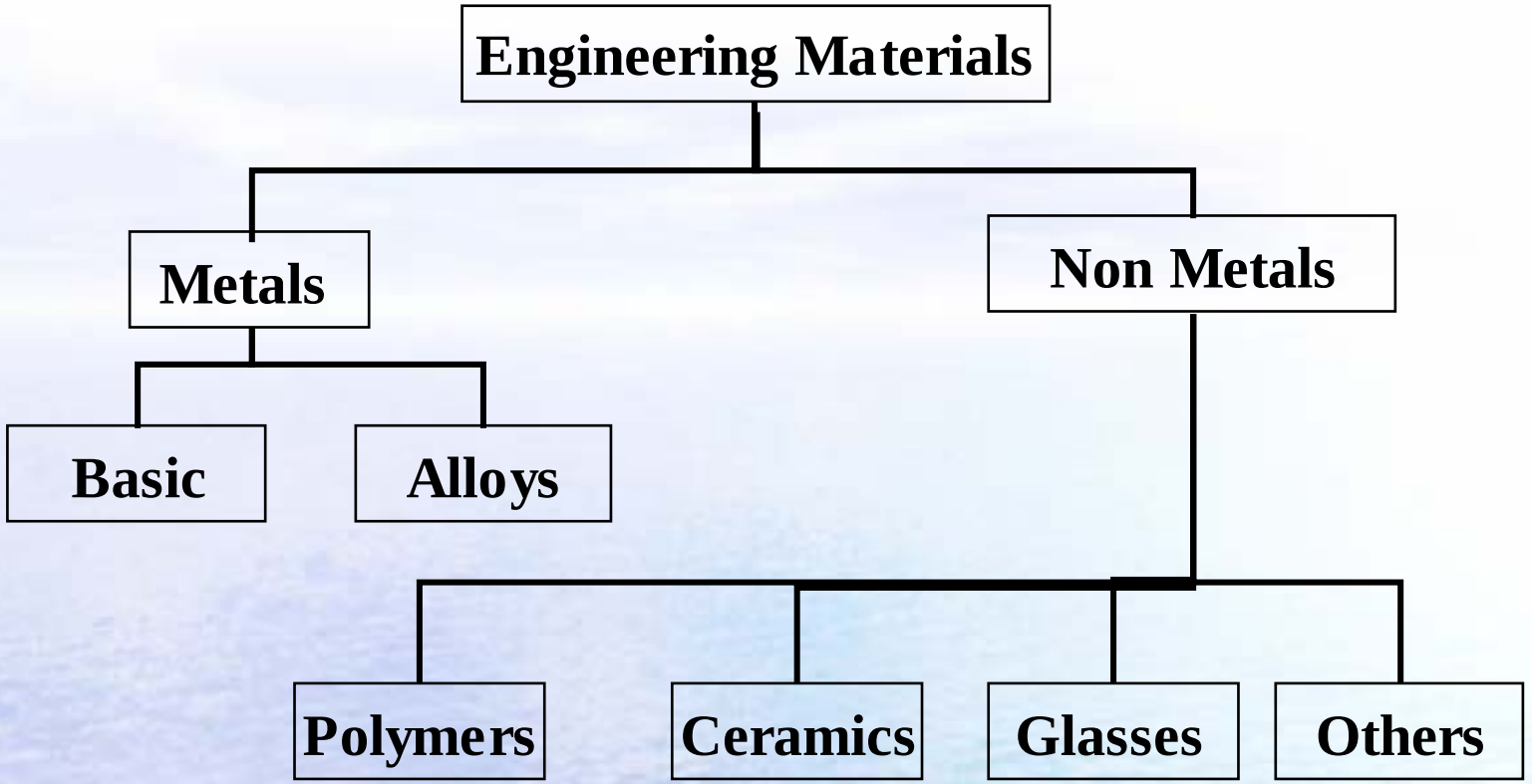

Classification based on Engineering Materials

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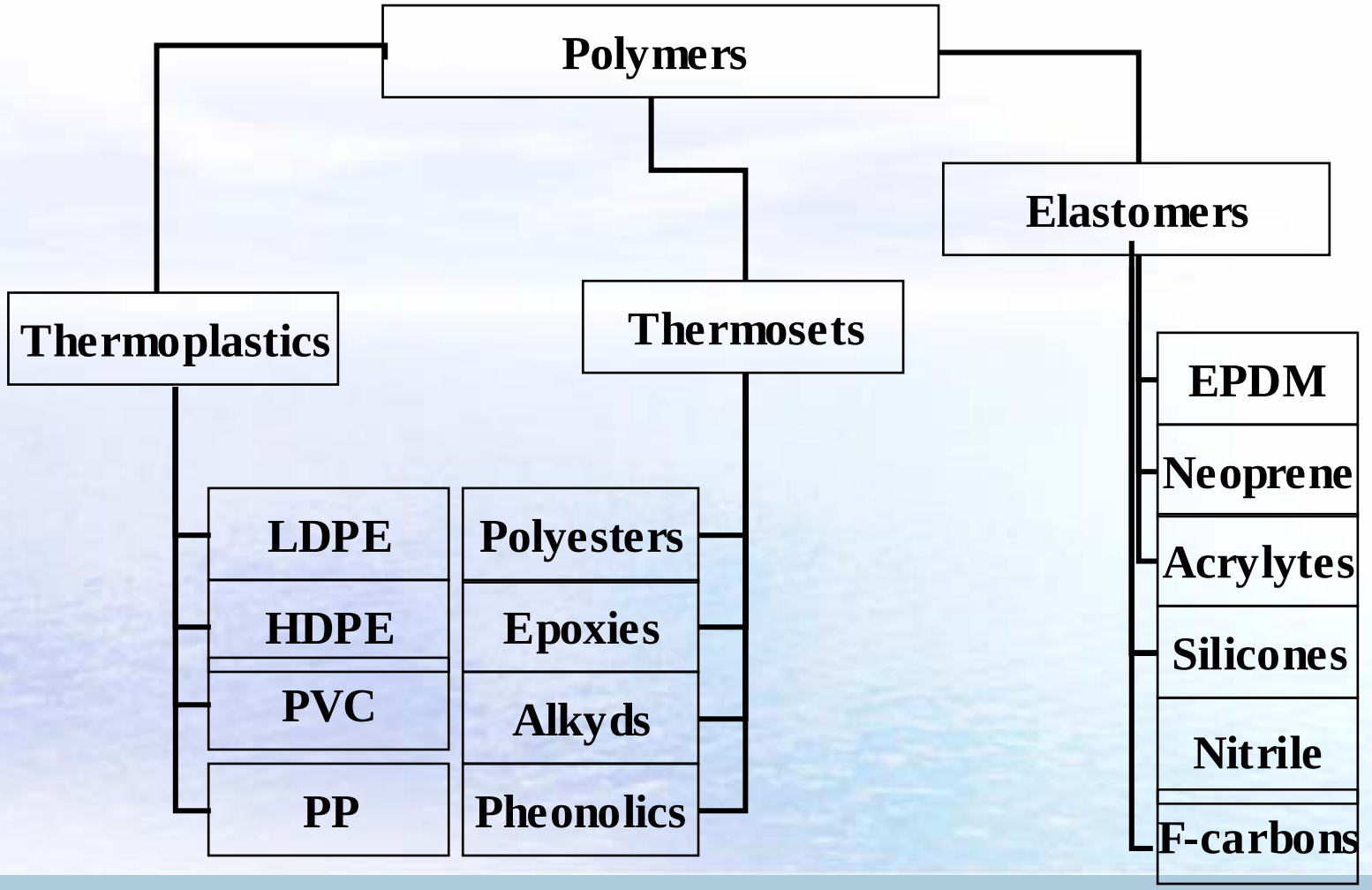

FRP-Pipe Wall Construction-Chemistry

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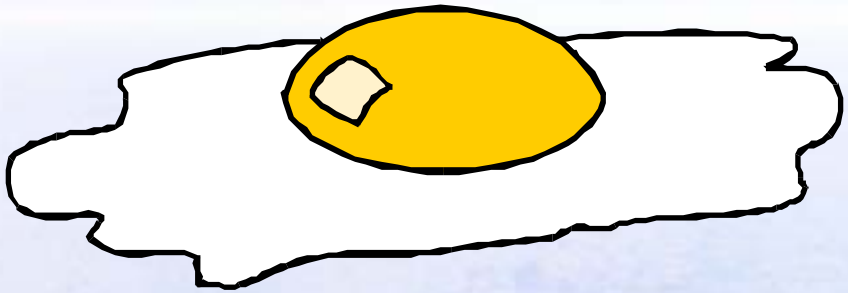
Thermoset



Egg

Thermoplastic

Candle

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How / Where FRP can be Used ?

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Usage of FRP based on Resins

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Properties	FRP Polyester Piping	GRE Epoxy Piping
Resin	Polyester / Vinyester	Epoxy
Temperature	Up to65 ℃ / 90 ℃	Up to150 ℃
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

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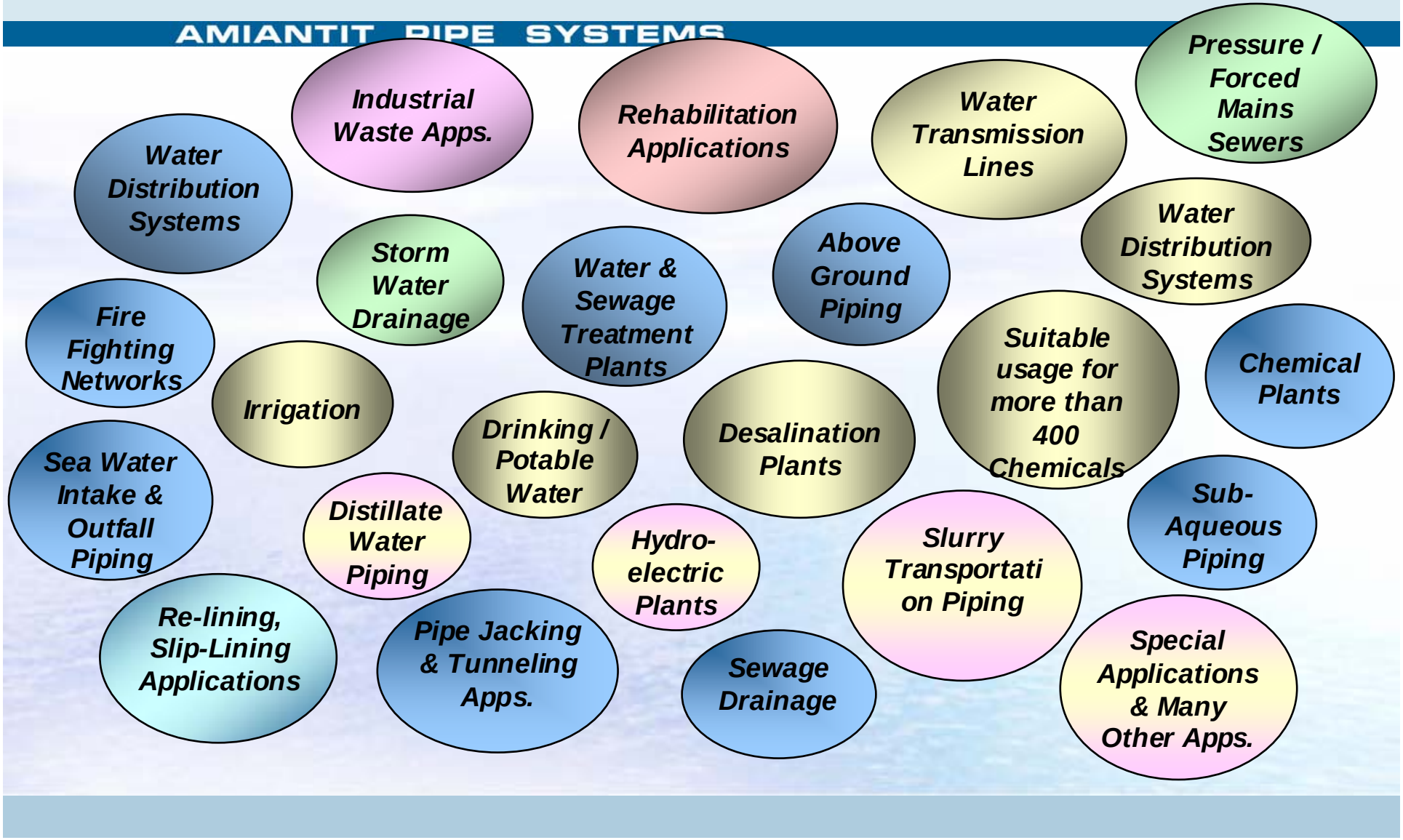
FRP can be used for all types of fluids



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Peep in to FRP
Stress Strains- Strength

FRP-Pipe Wall Enlarged Cross Section

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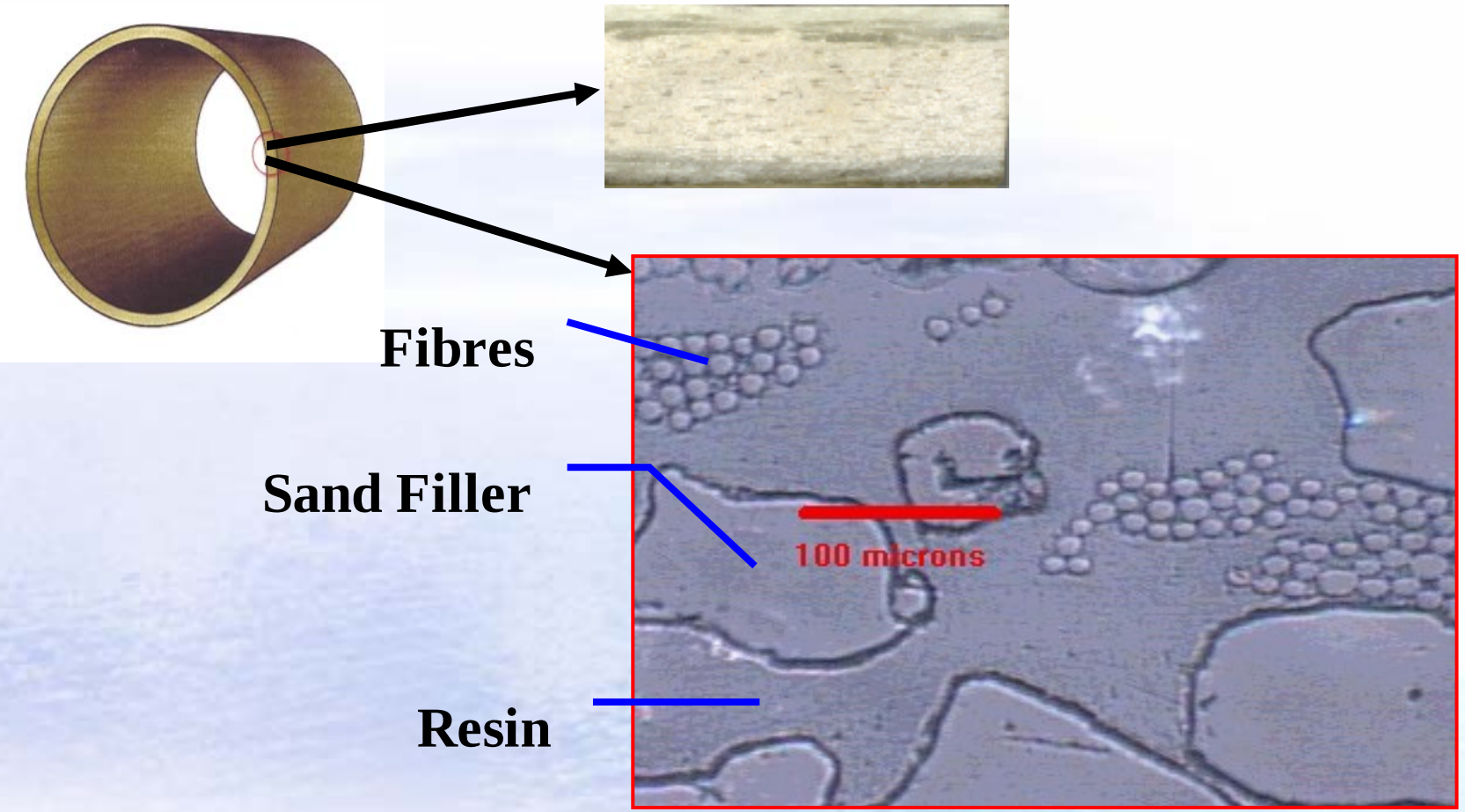

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FRP-Pipe Stress- Strain

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Isotropic materials:

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

  steel: $E = 210000\ MPa$

Orthotropic materials (GRP):

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

  polyester: $E = 3000 – 4000\ MPa$

  continuous glass: $E = 72000 – 76000\ MPa$

FRP-Pipe Stress- Strain

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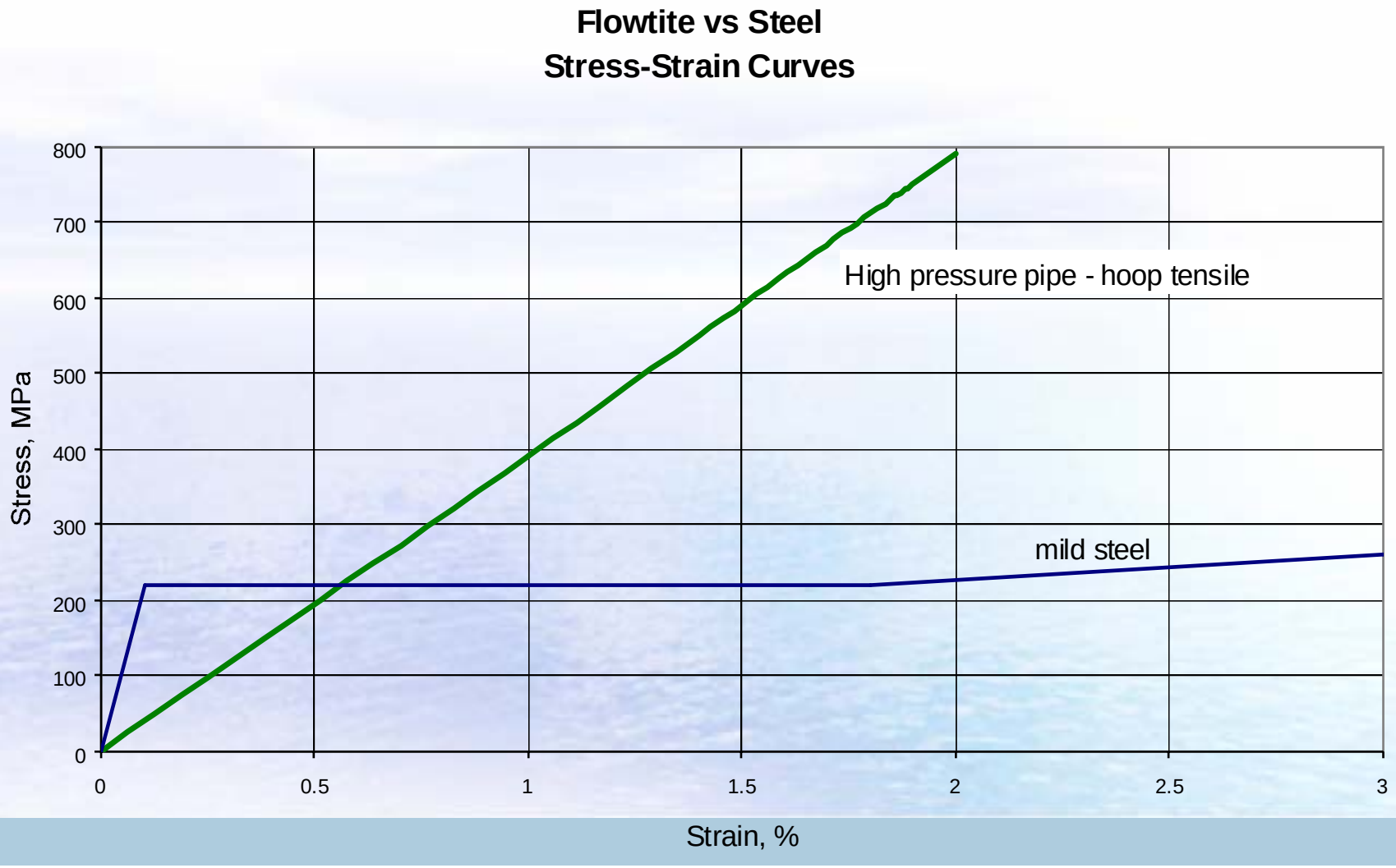

FRP-Pipe Stress- Strain

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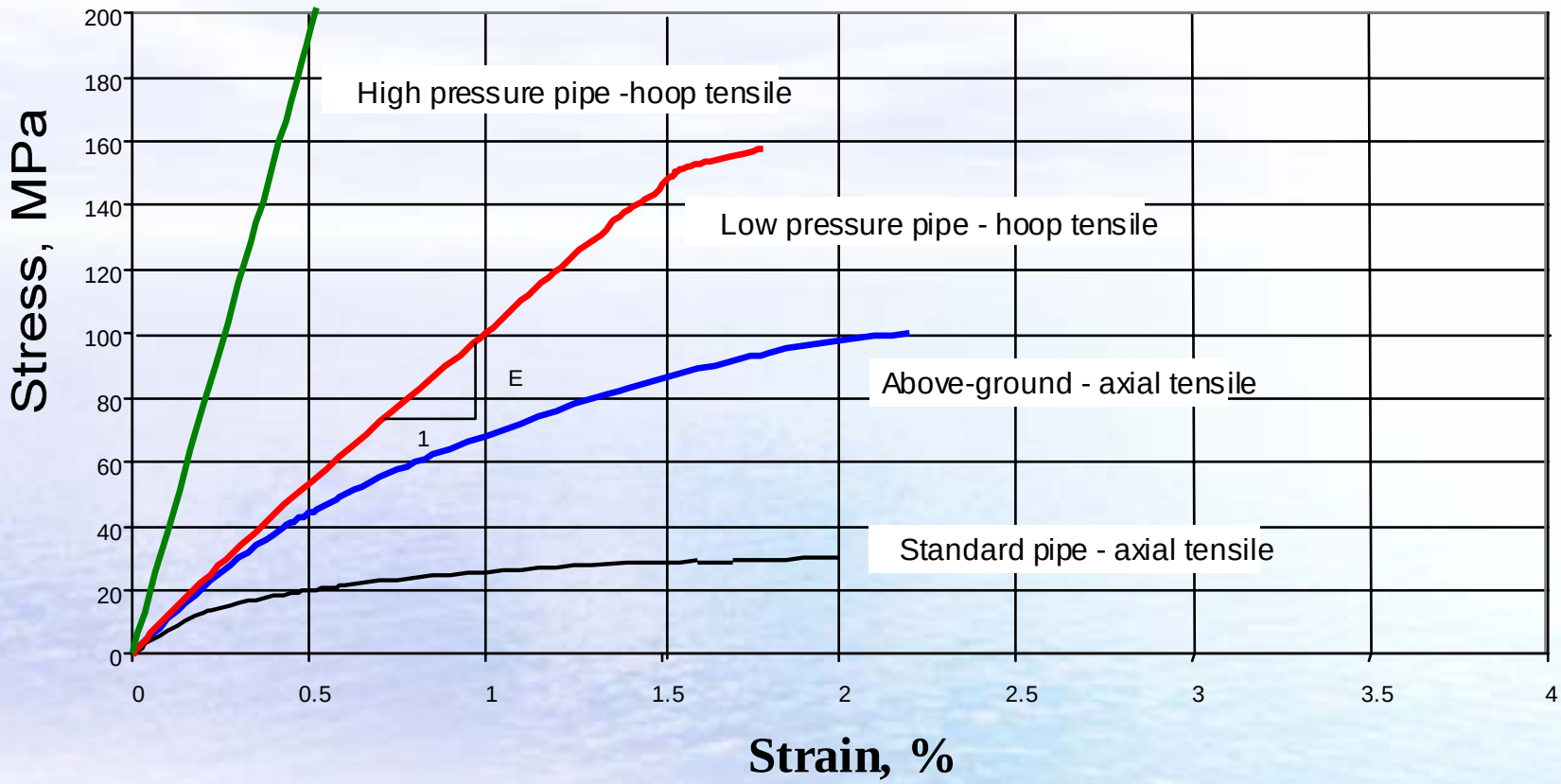

FRP-Pipe Stress- Strain

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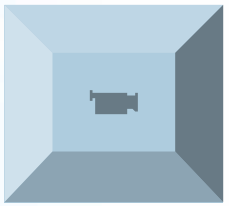
A 10 Bar G – FRP pipe was allowed to BURST and guess expected failure pressure



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Comparisons to Various Materials

Pipe Wall-Specific Gravity

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Coefficient Of Thermal Expansion

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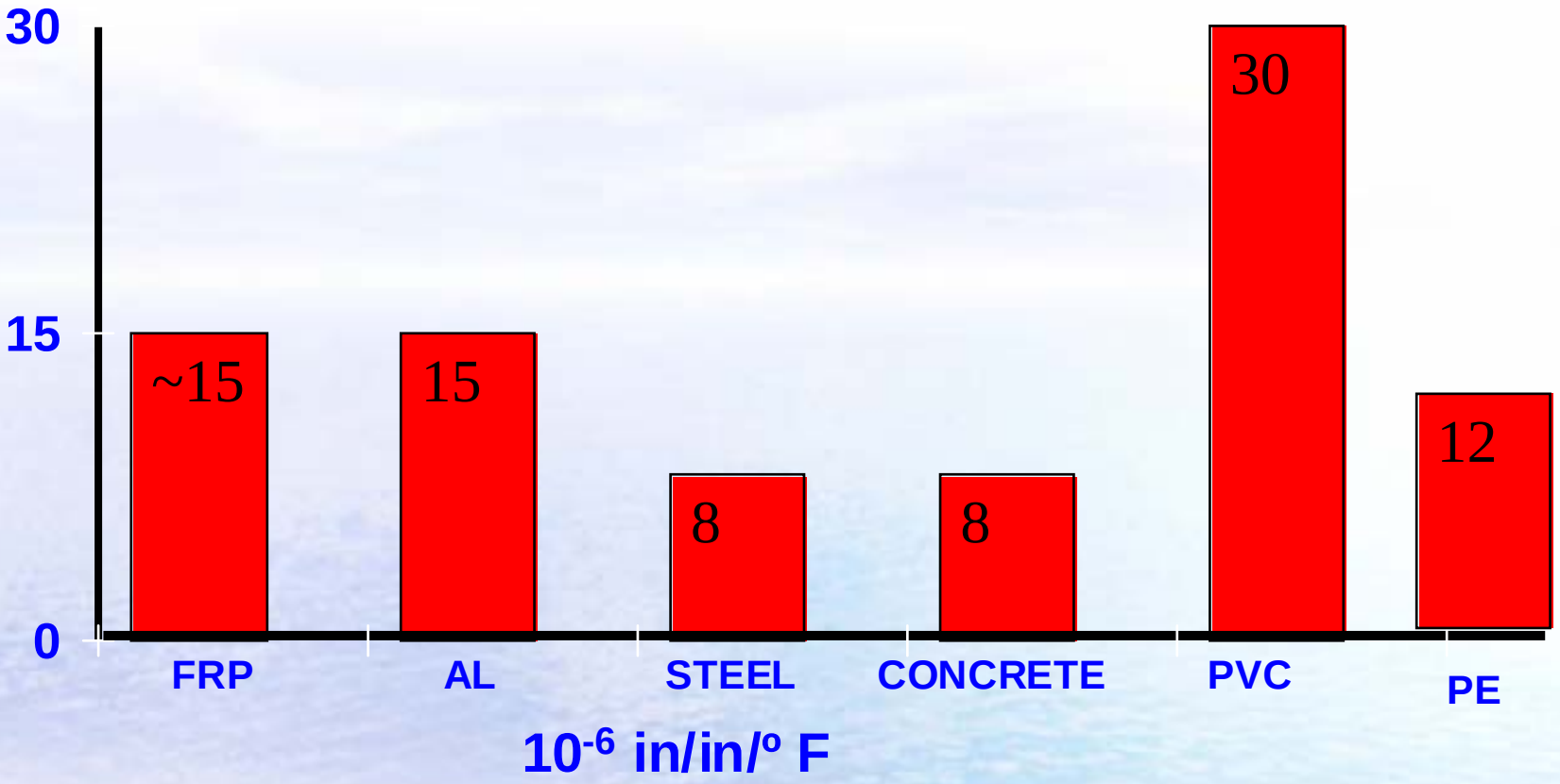

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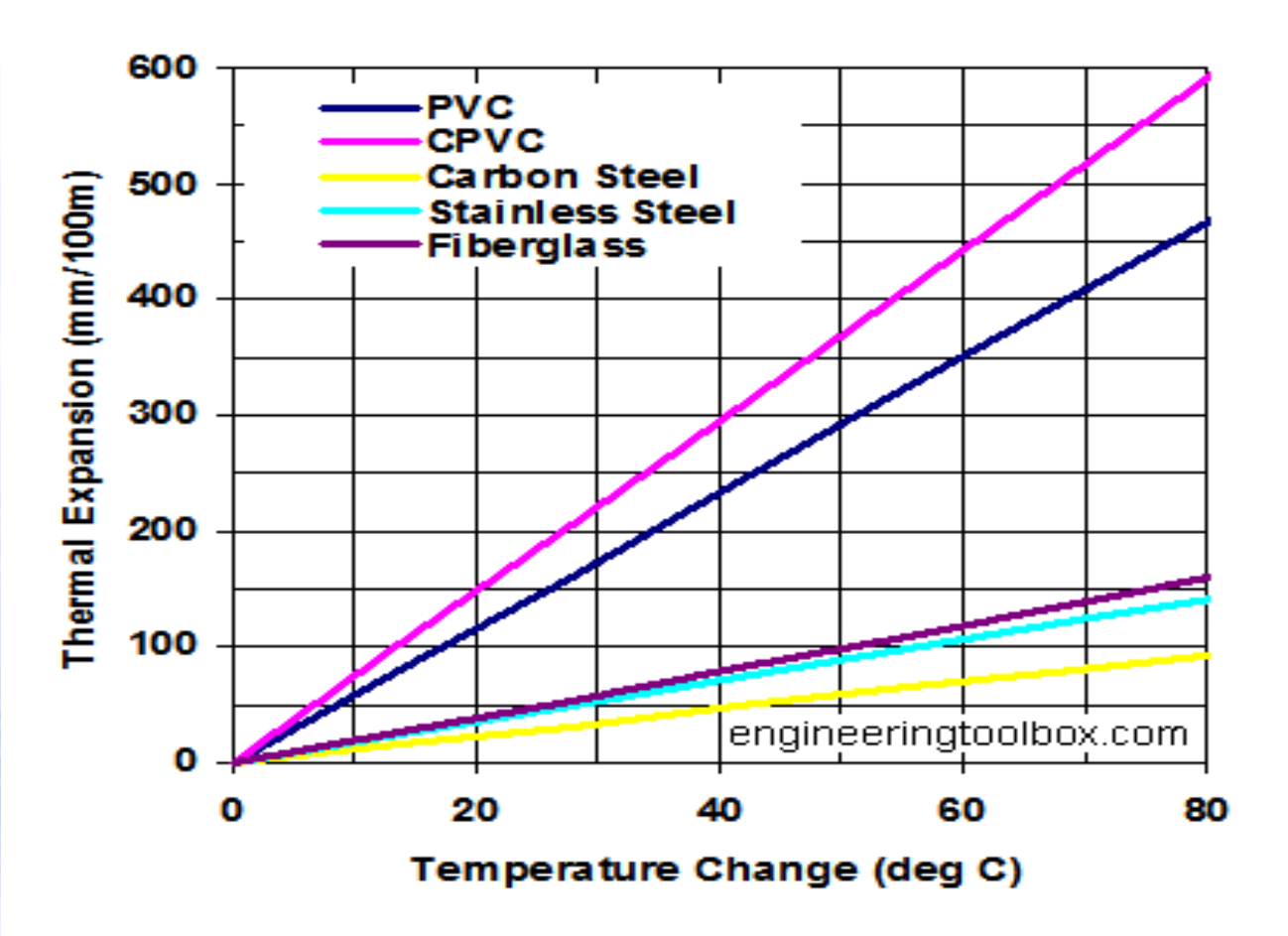

Thermal Conductivity

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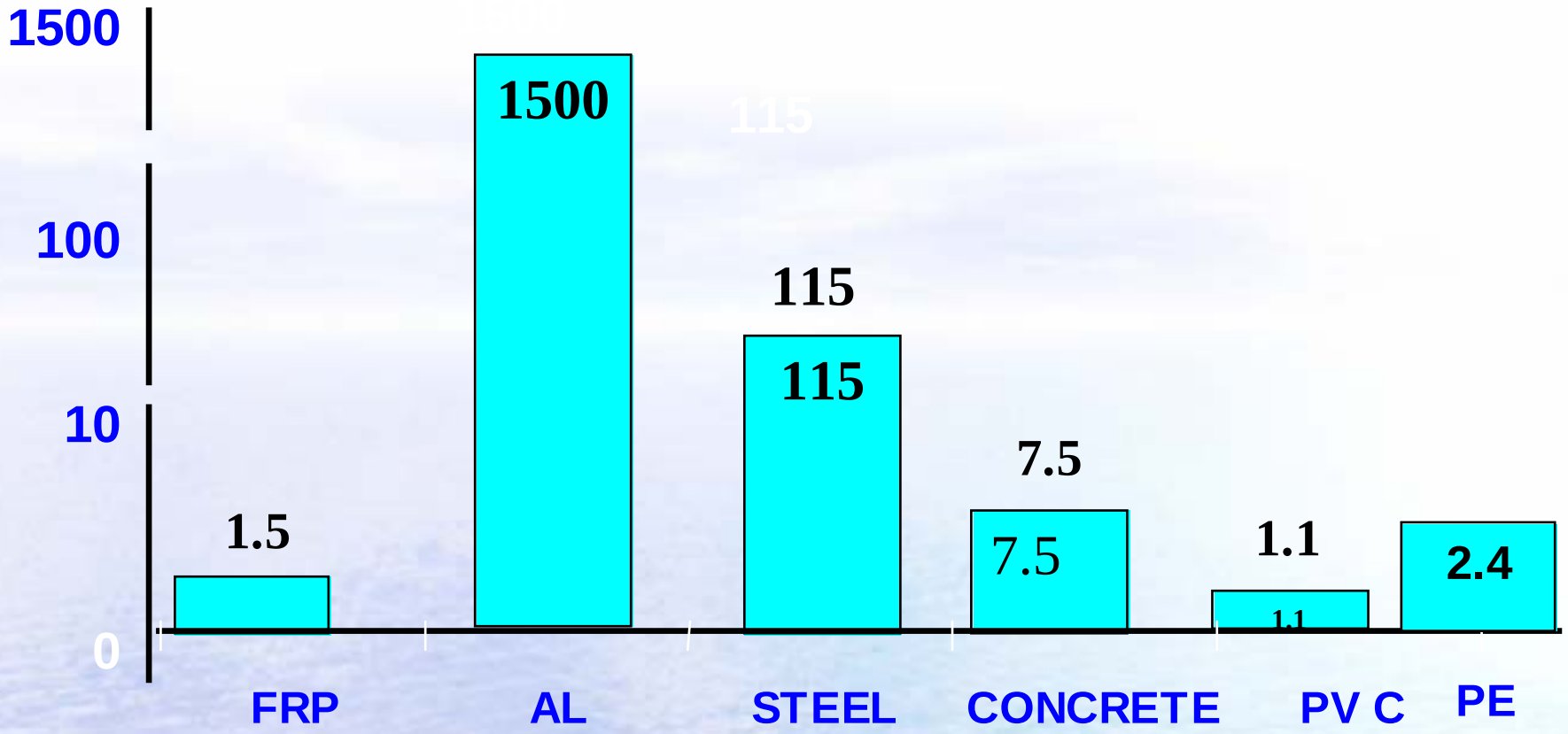

BTU - in / hr - ft^2 - ° F

ASTM E84 Flame Spread for FRP

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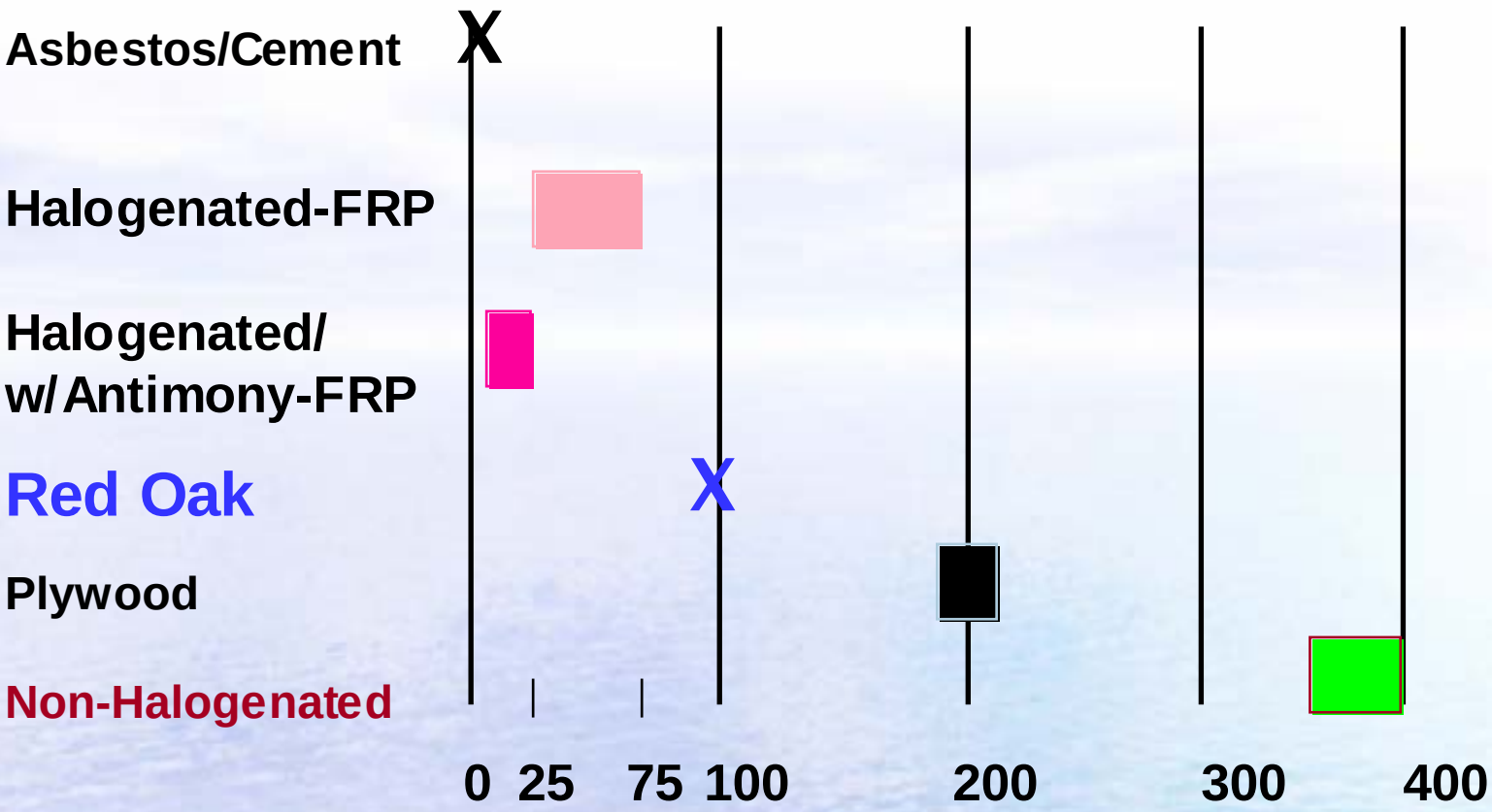

Consult data sheets for specific information.

Surge and Water Hammer-Surge wave celerity

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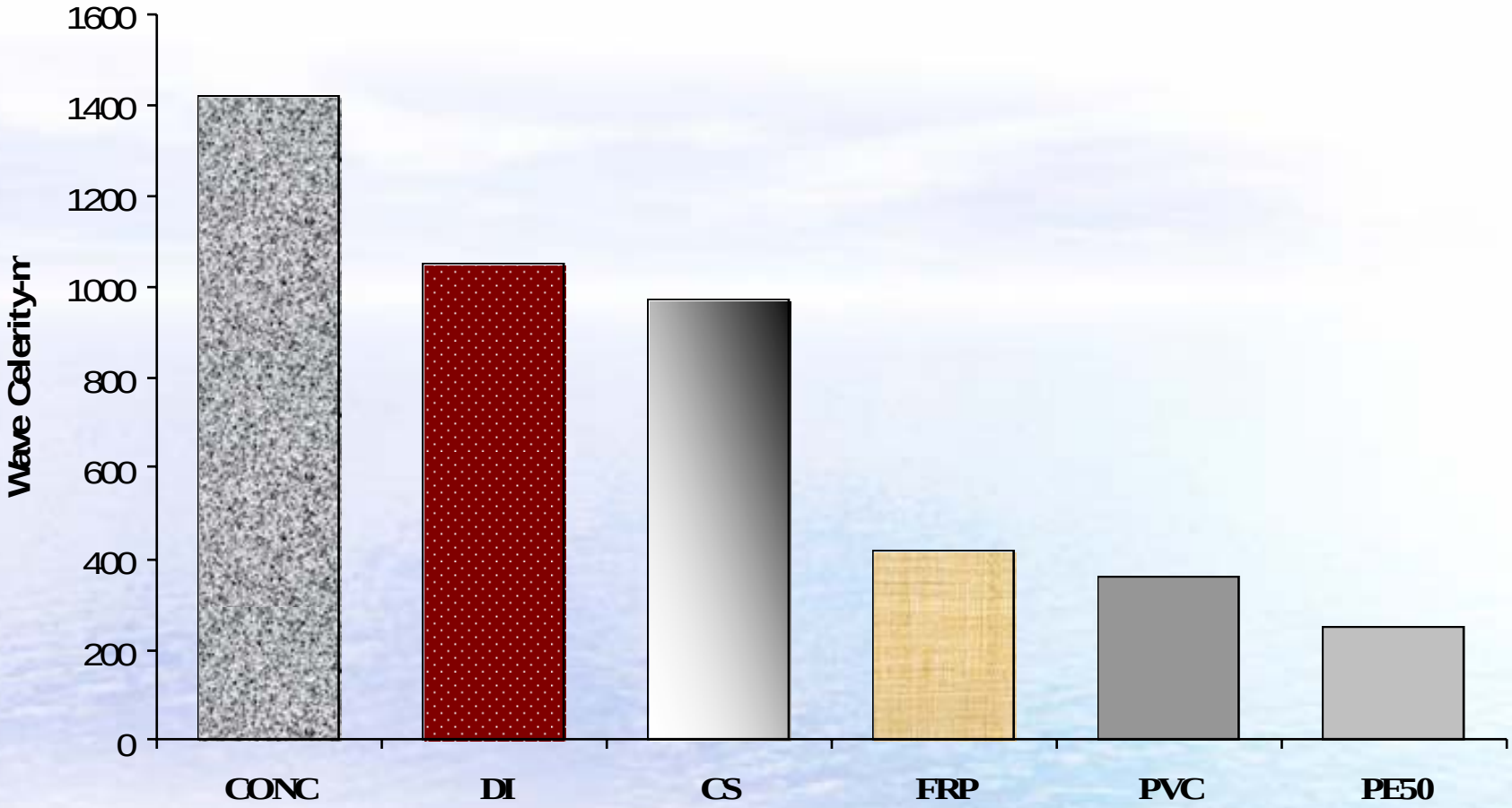

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Usage of FRP World Wide- Literature Survey

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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

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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%

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

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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

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30 Years of Journey of GRP

AMIANTIT PIPE SYSTEMS

- **AFIL-**Dammam**-1977**
- **AFIL-**Jeddah**-2000**
- **FPCL**: **F**iberglass **P**ipe **C**ompany **L**imited-**2001**
- **DPFCL**: **D**ubai **P**ipe **F**actory **C**ompany-**2002**
- **AQAP**: **A**miantit **Q**atar **P**ipes **C**ompany-**2008**
- **ABHL**: **A**miantit **B**ahrain **H**olding **L**imited-**2010**

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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**

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Product Range

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

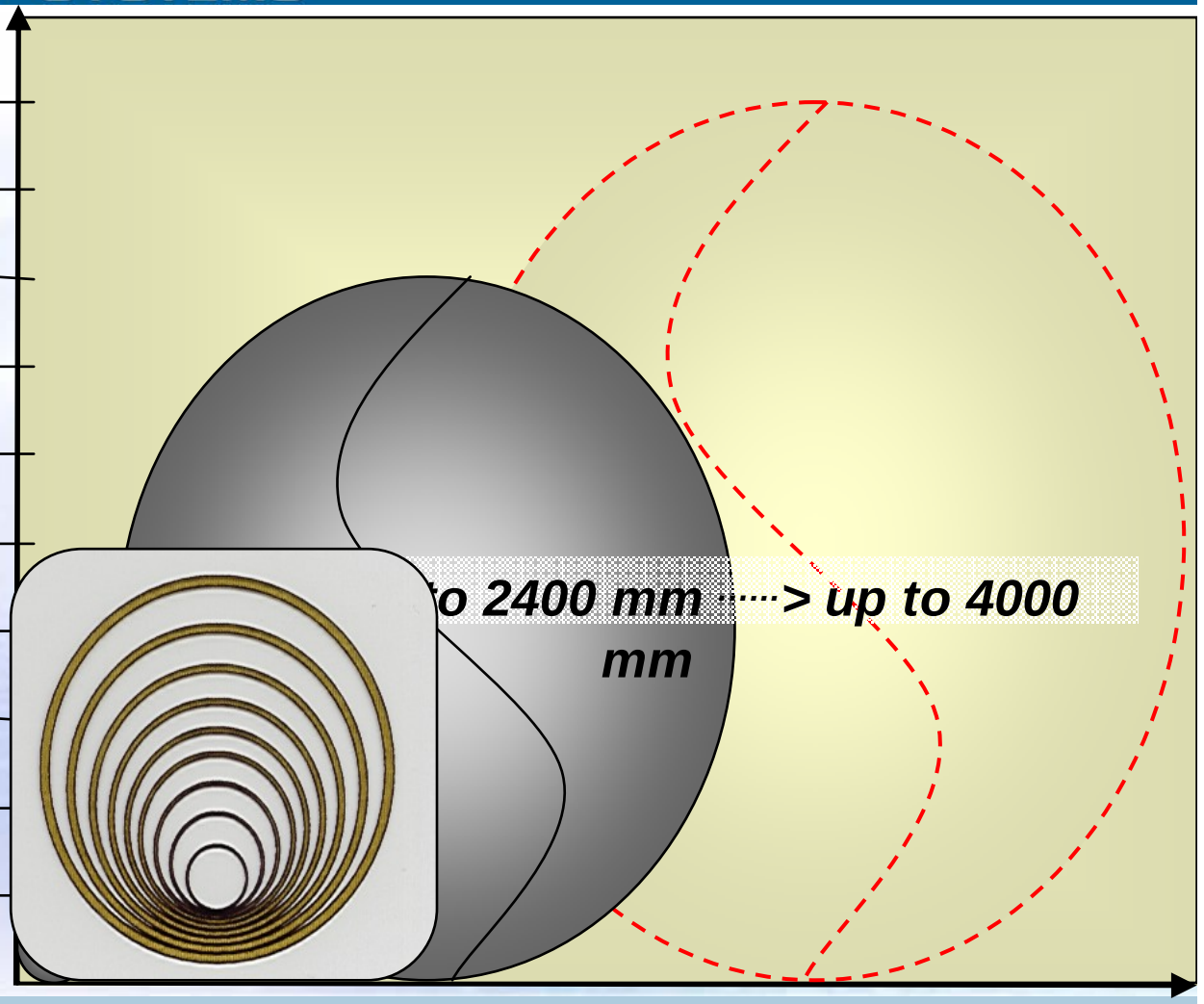
Application

UG

AG

Under Sea

Relining



FRP-Pipe Stiffness - Range

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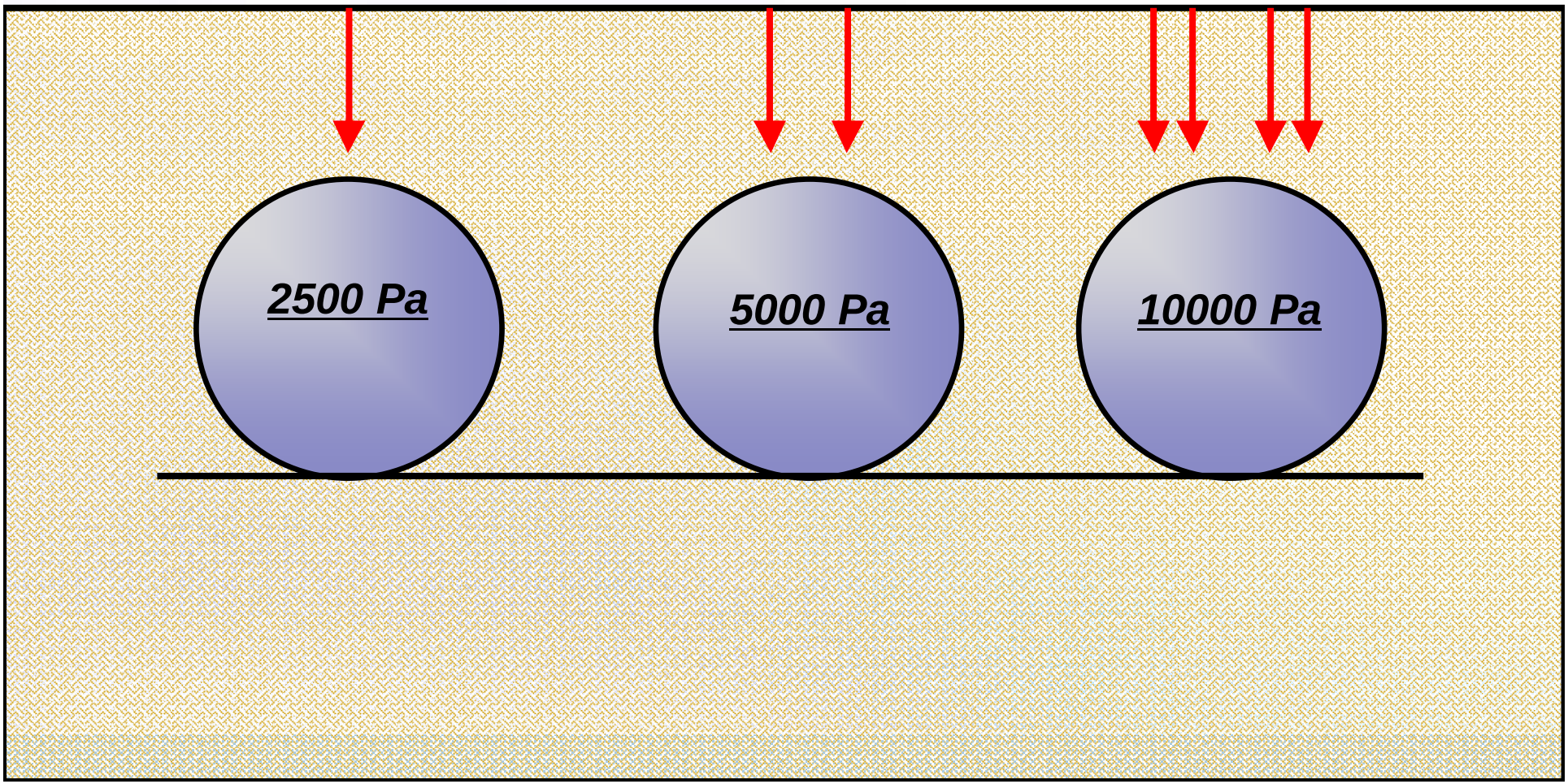

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أميانتيت
AMIANTIT
40 YEARS OF EXCELLENCE
أميانتيت ترحب
بمدير جامعة الملك فهد للبترول والمعادن ومرافقيه

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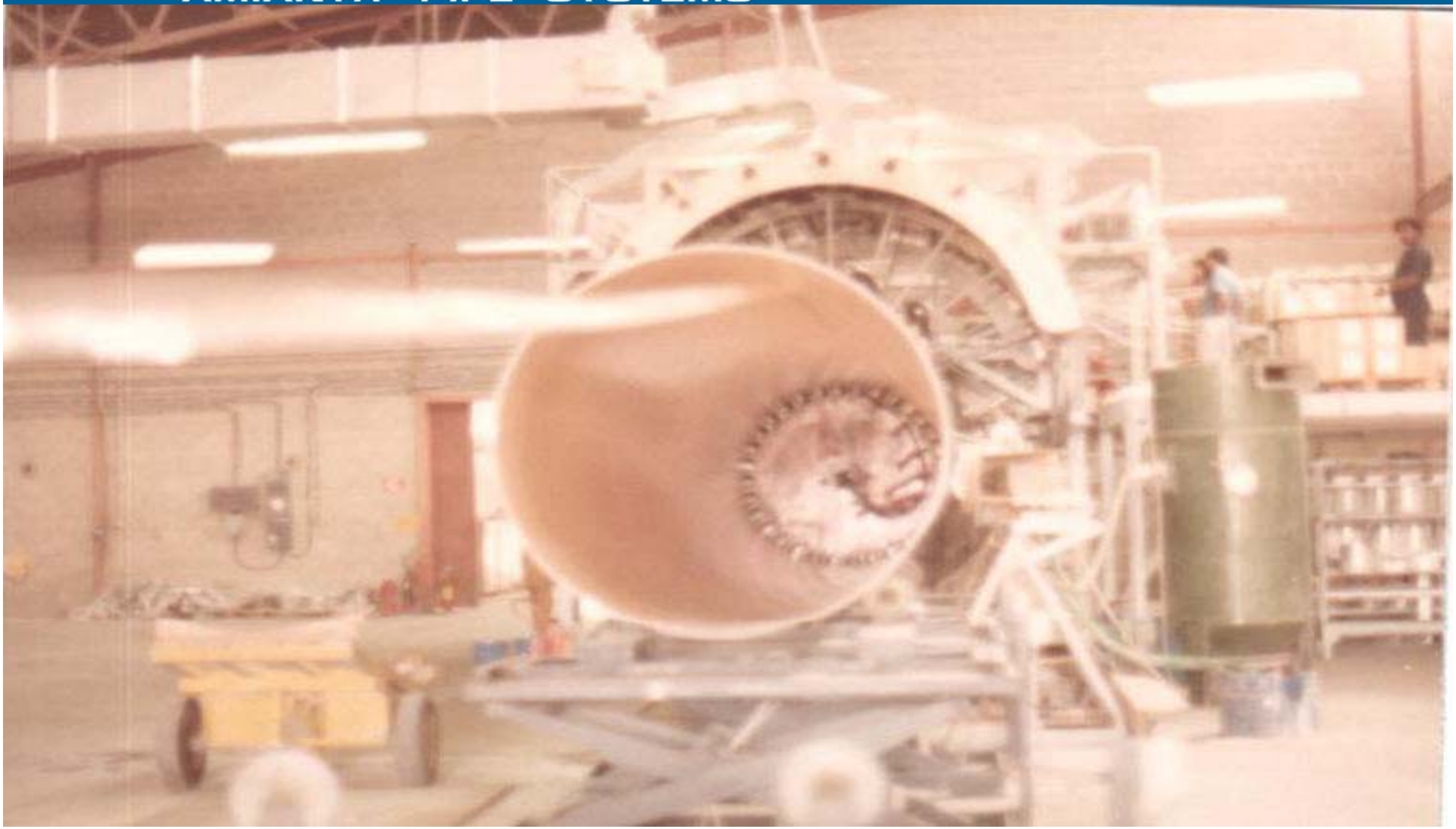


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30 Years Supplies and Applications


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


'97 9 2


Shuwayer


19 4 2007


DYWIDAG


14 3 2007

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Jubail RC

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Amiantit FIBERGLASS امیانتیت فیبرغلاس

Under Ground

Above Ground

Under-Sea / Off-Shore

On Ground

Slip Lining

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ALL Types of Fittings Were Fabricated

Elbows, Tees, Reducers, Flanges, Blind

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All Types of Fittings are Possible

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15 14:31


15 15:51

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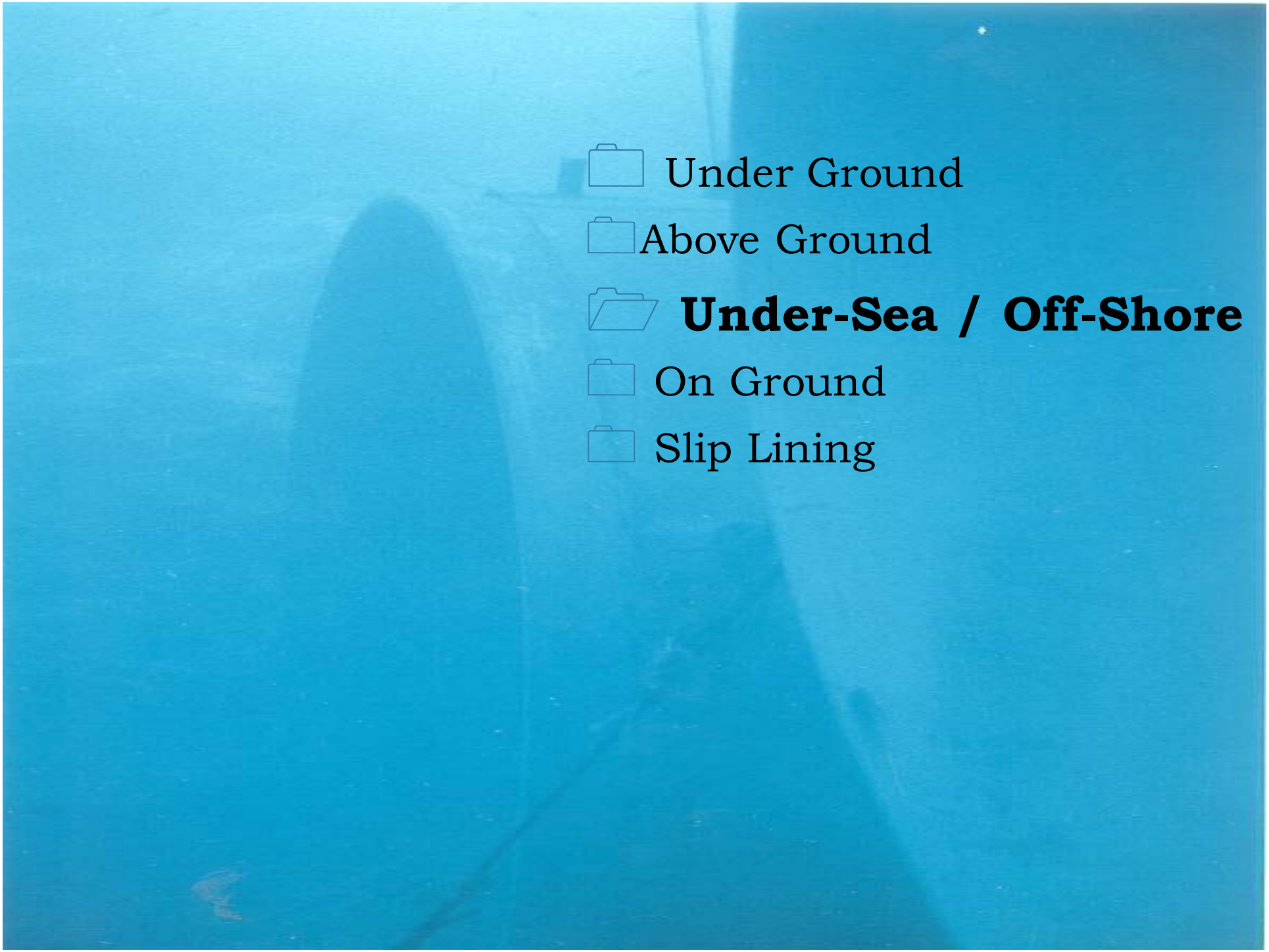
Under Ground
Above Ground
Under-Sea / Off-Shore
On Ground
Slip Lining

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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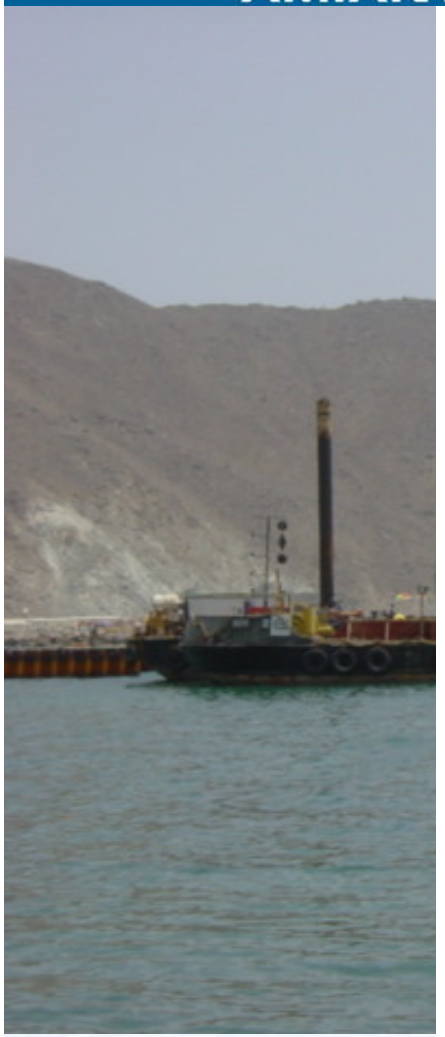
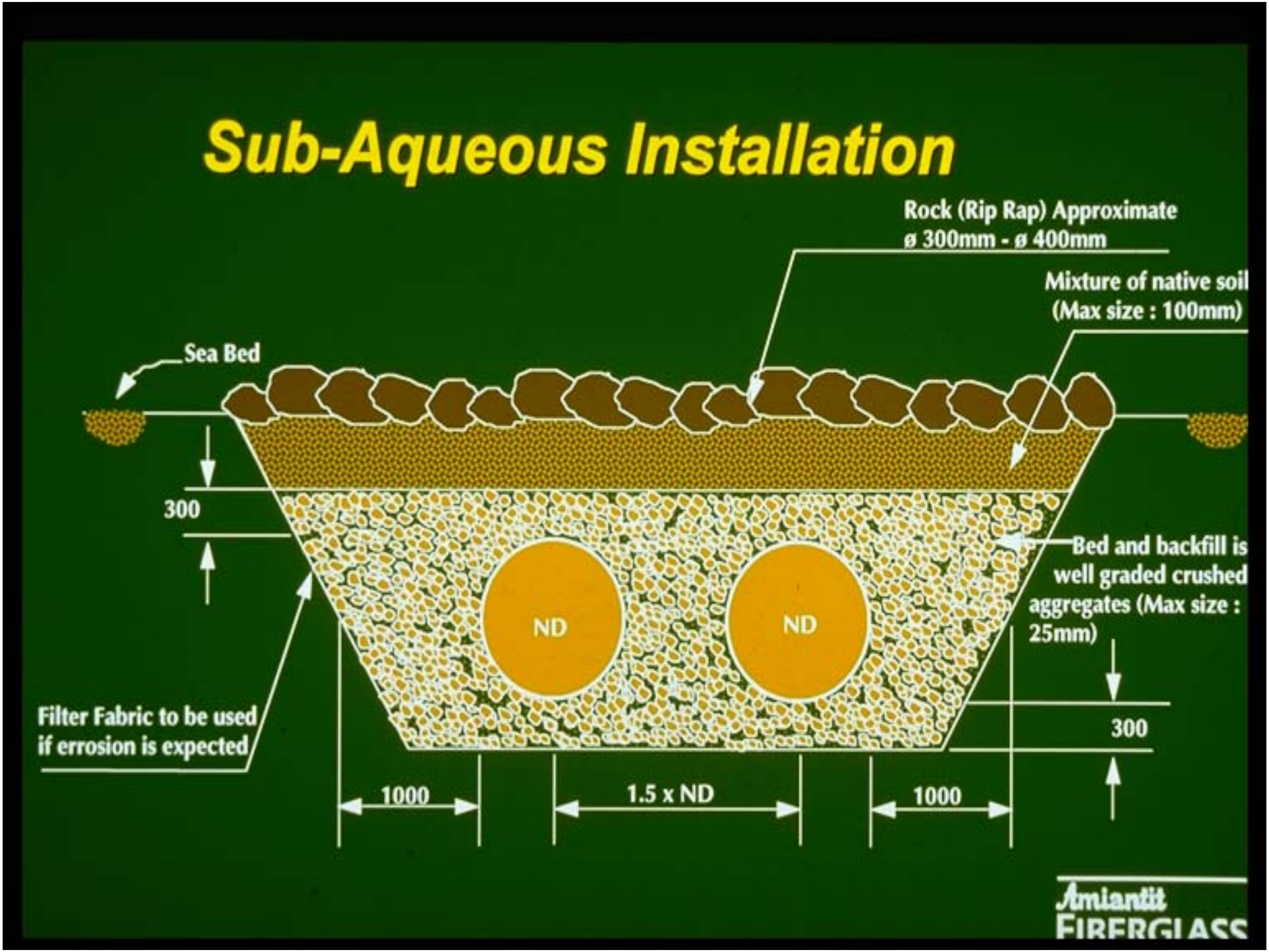
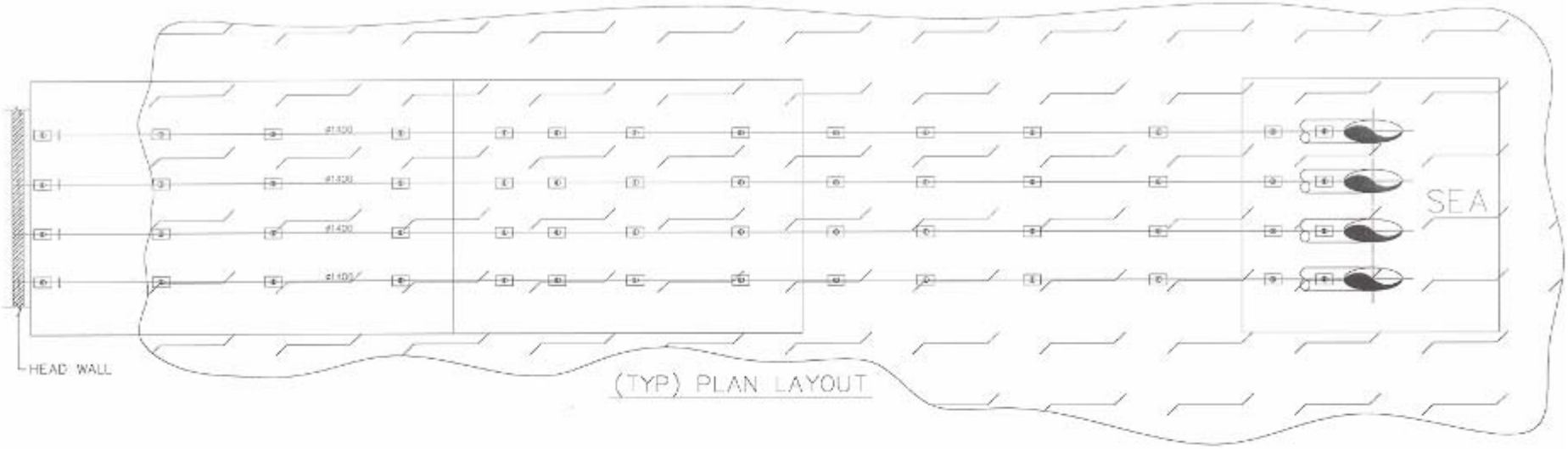
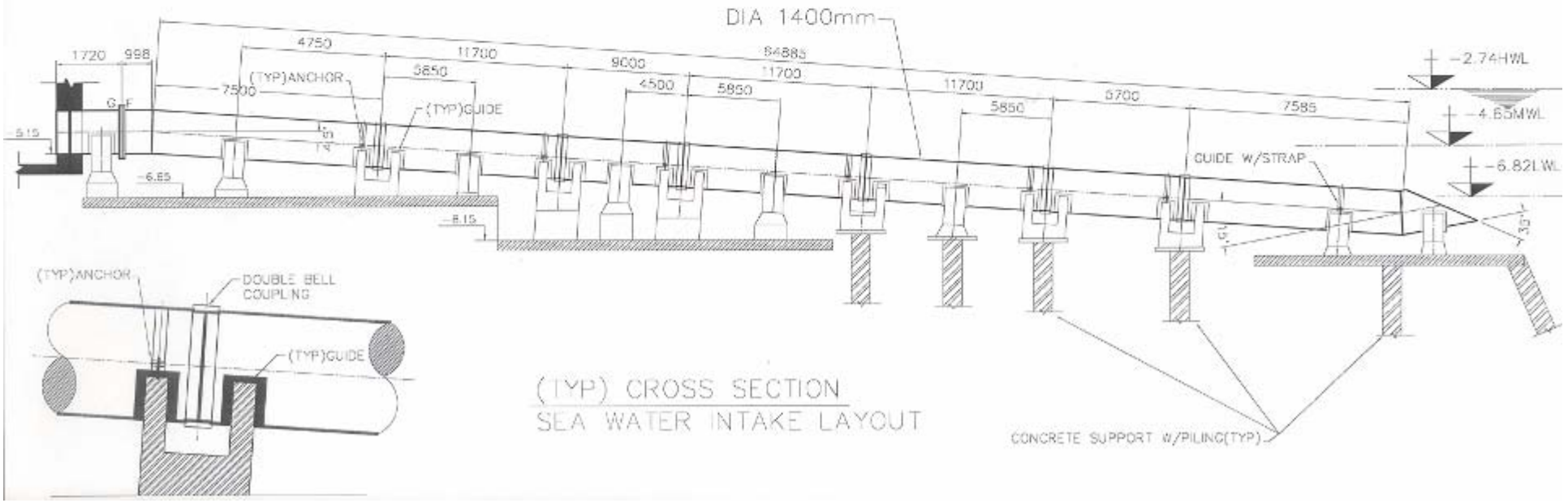


Sub-Aqueous Installation





(TYP) PLAN LAYOUT



(TYP) CROSS SECTION
SEA WATER INTAKE LAYOUT

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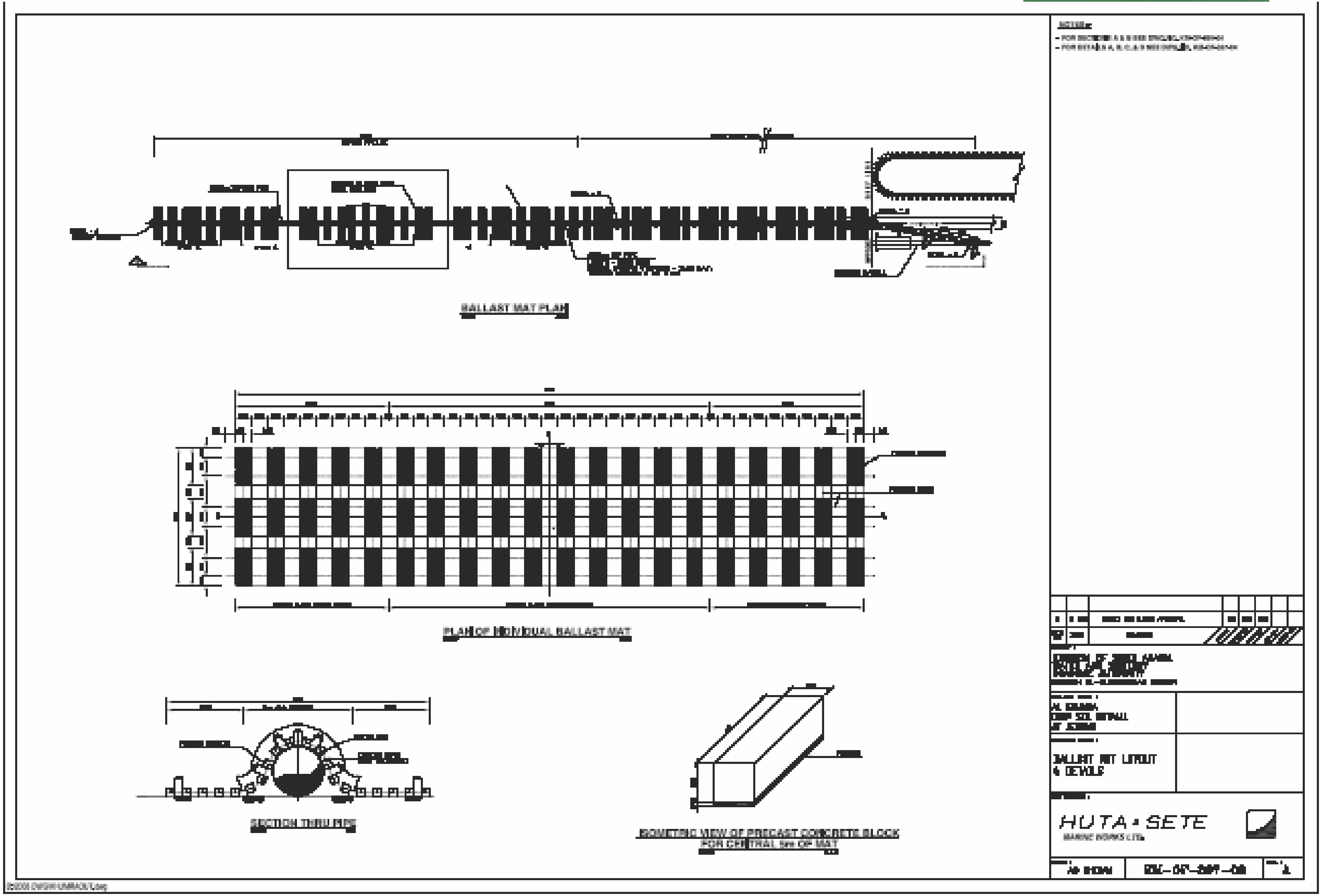
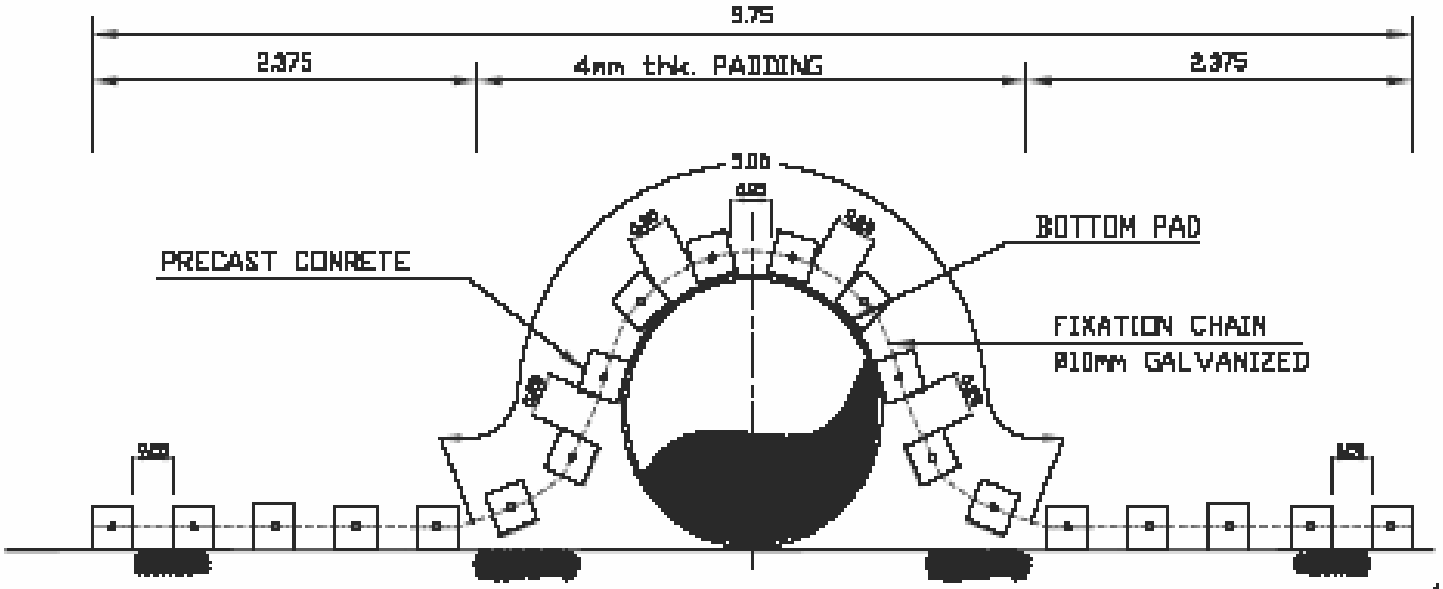
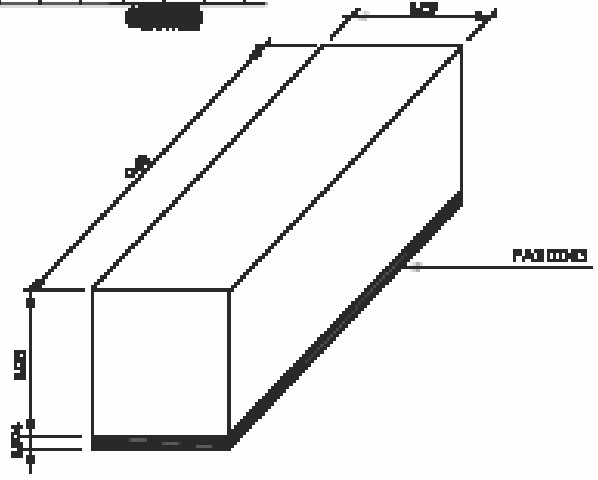




SECTION THRU PIPE

Scale 1:50



ISOMETRIC VIEW OF PRECAST CONCRETE BLOCK FOR CENTRAL 5m OF MAT

Scale N.T.S

NOTE : ALL DIMENSIONS ARE IN Meters.

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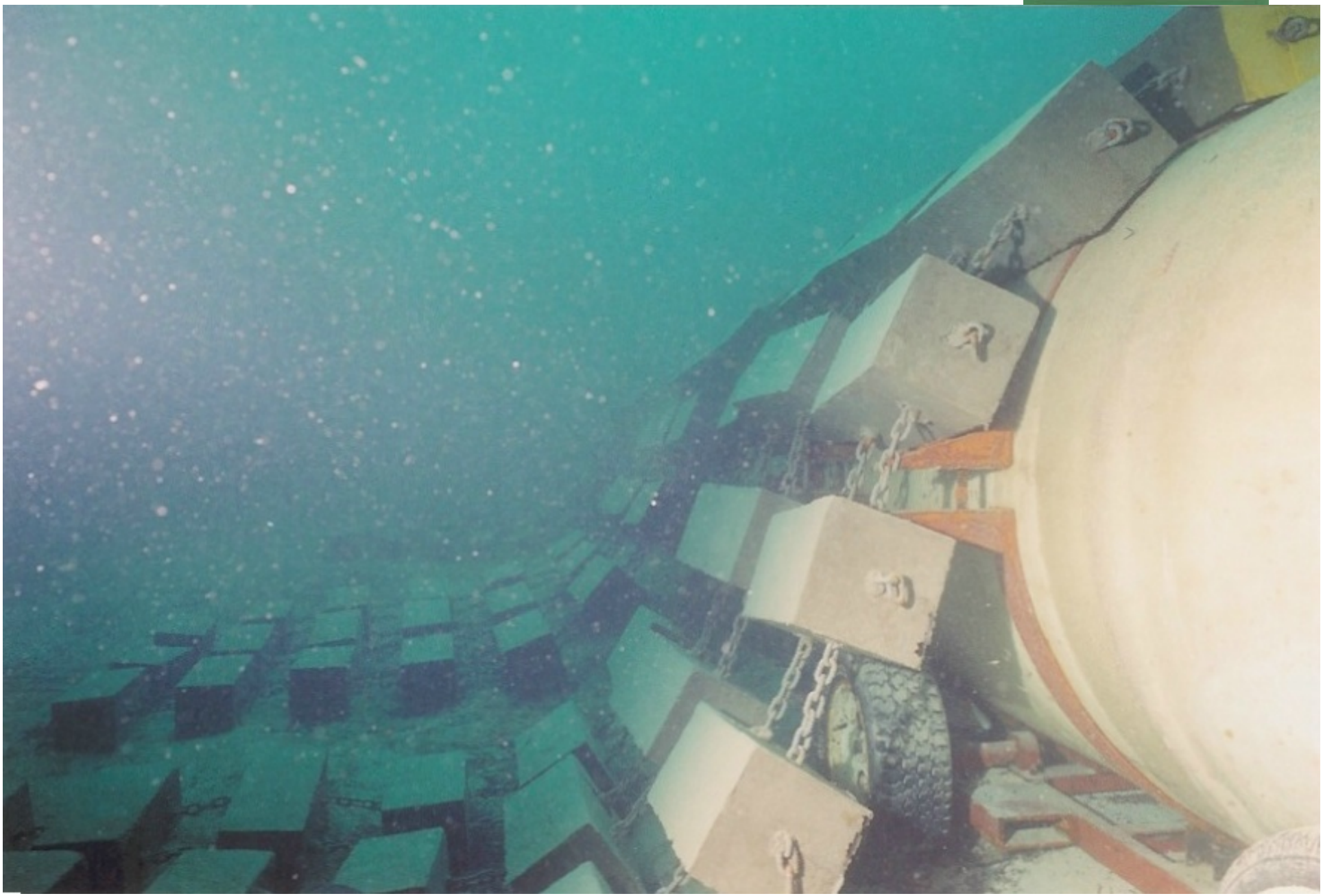

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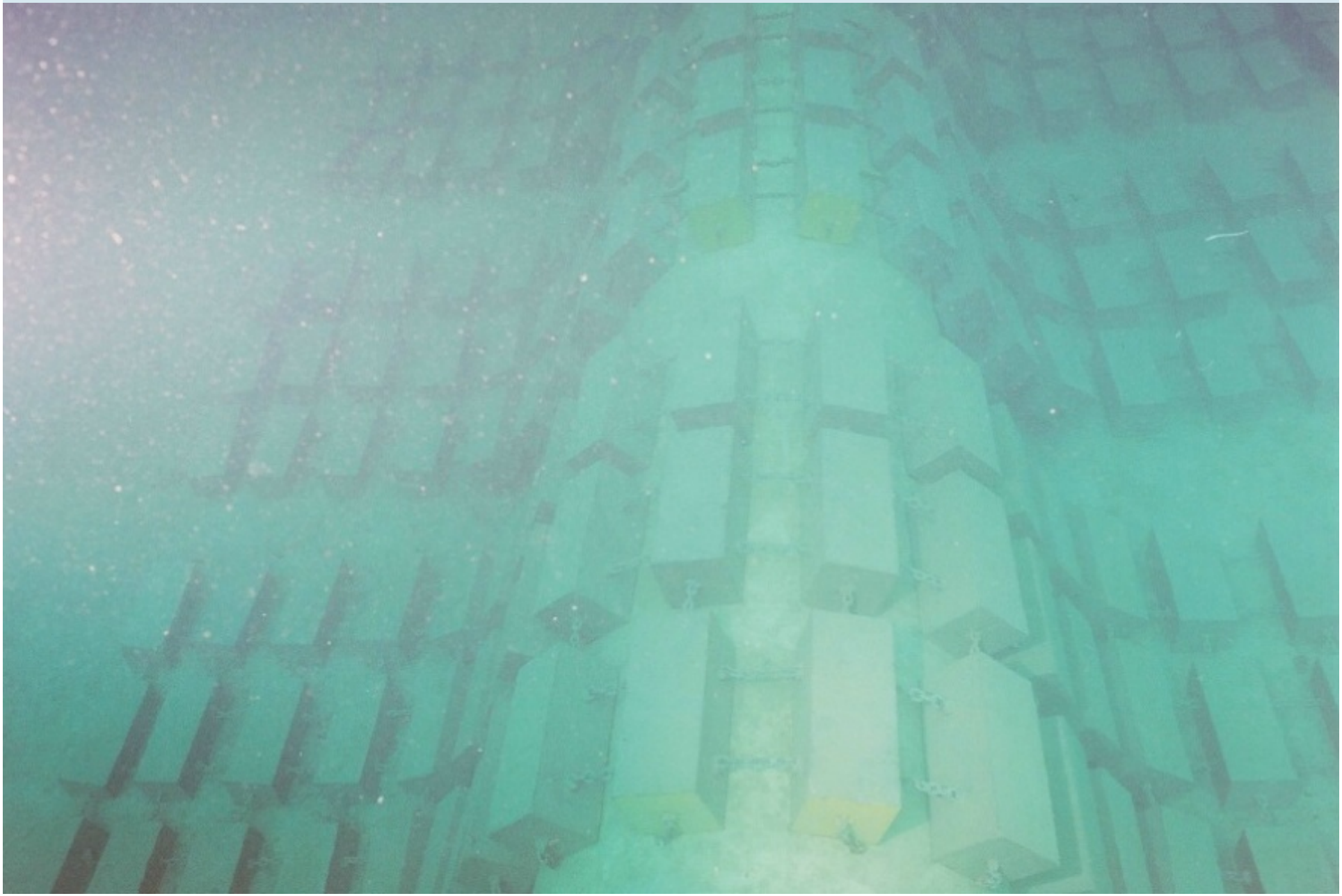

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Performance of FRP in P and D Plants

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

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On Ground Applications

AMIANTIT PIPE SYSTEMS

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

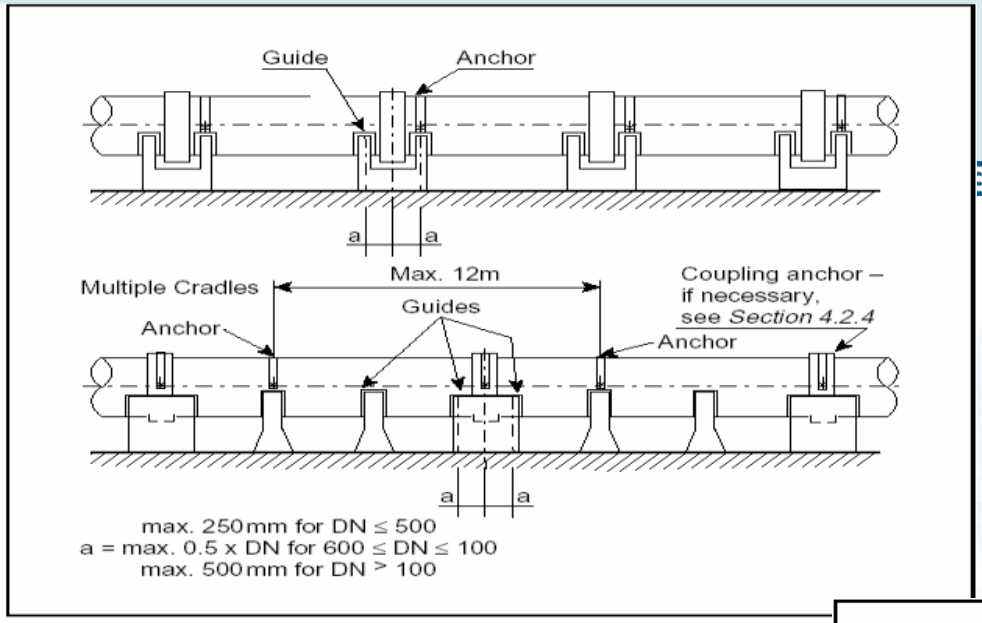

Figure 4.1
***Flowtite*' pipes. Typical support arrangement**

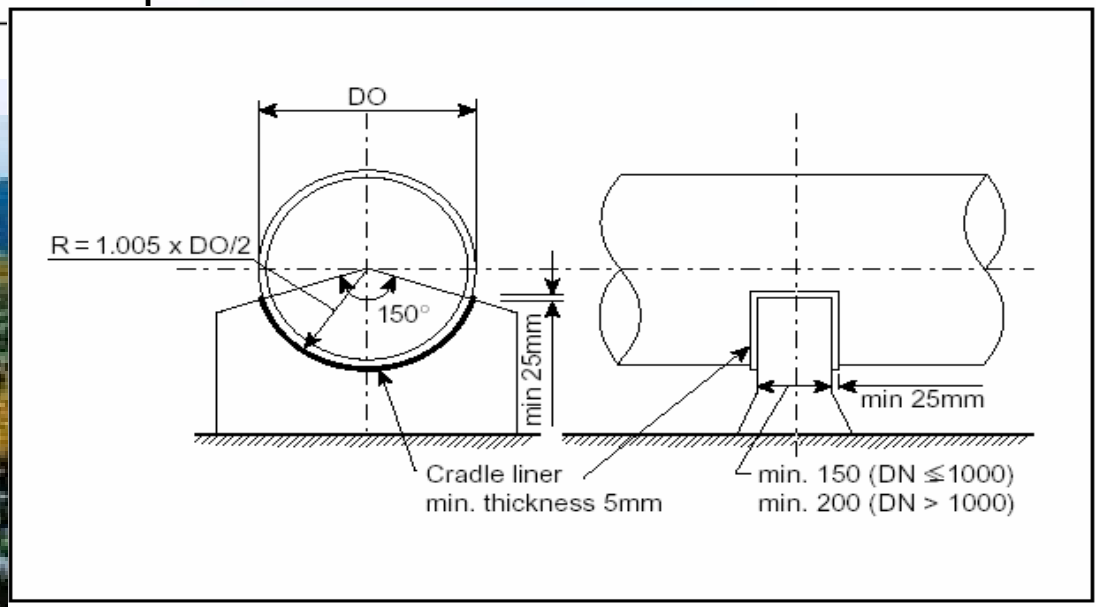

Figure 4.2
Cradle design

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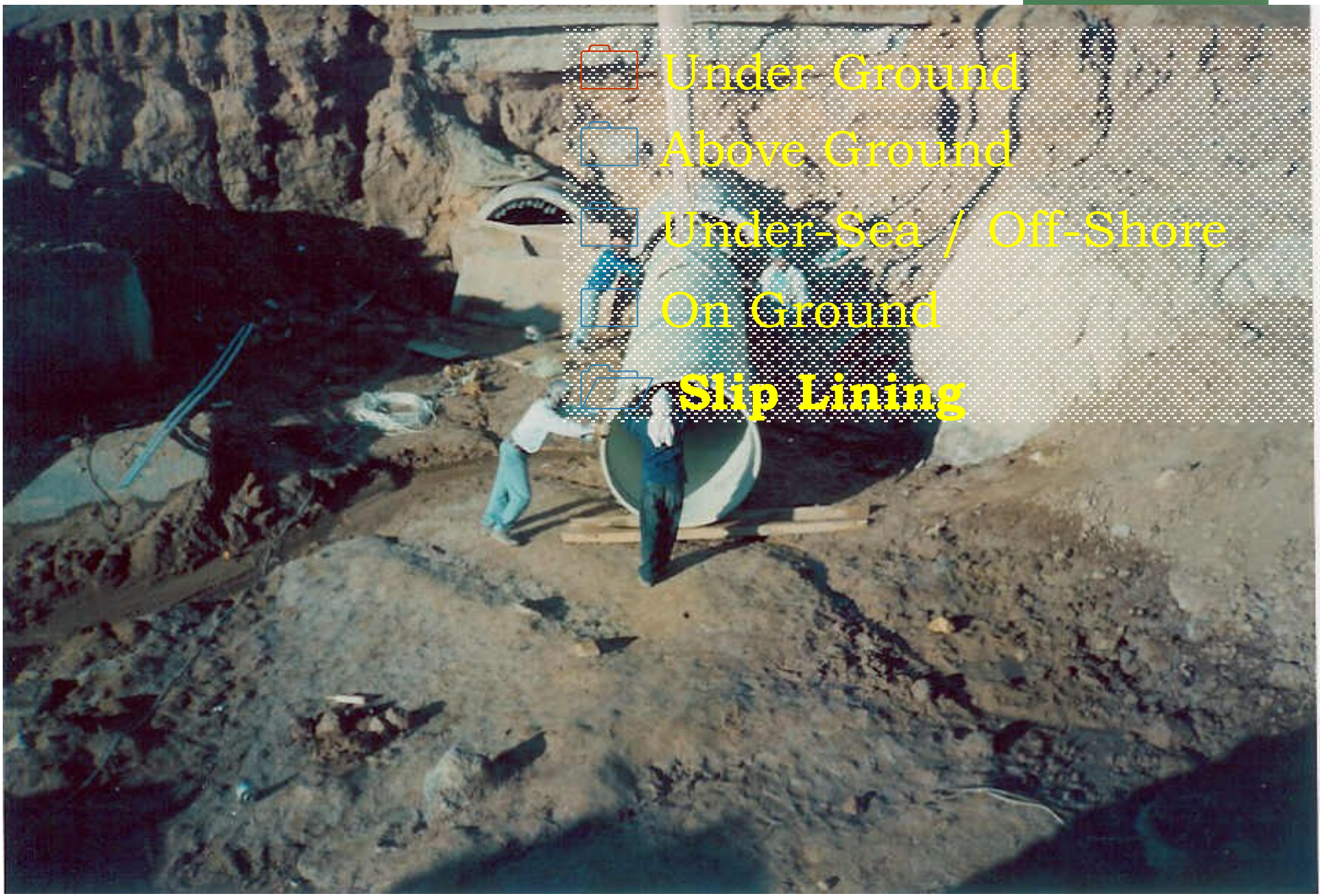

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Typical Oldest Case Histories >25Years

Results of GRP pipe Installed in 1980

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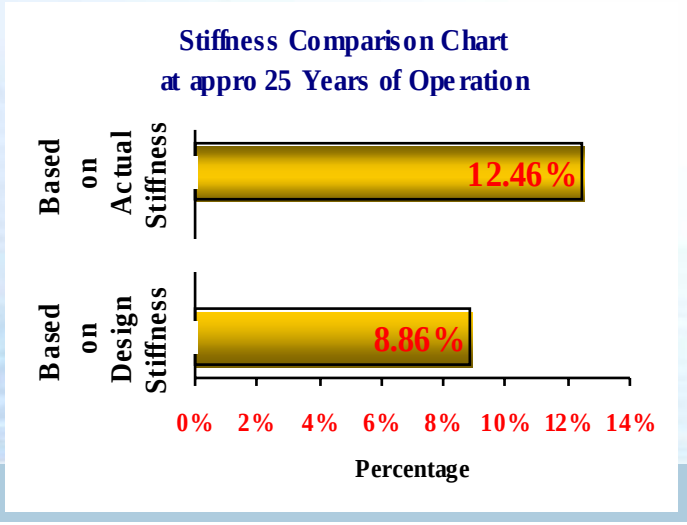
Traceablity and Pipe Identification

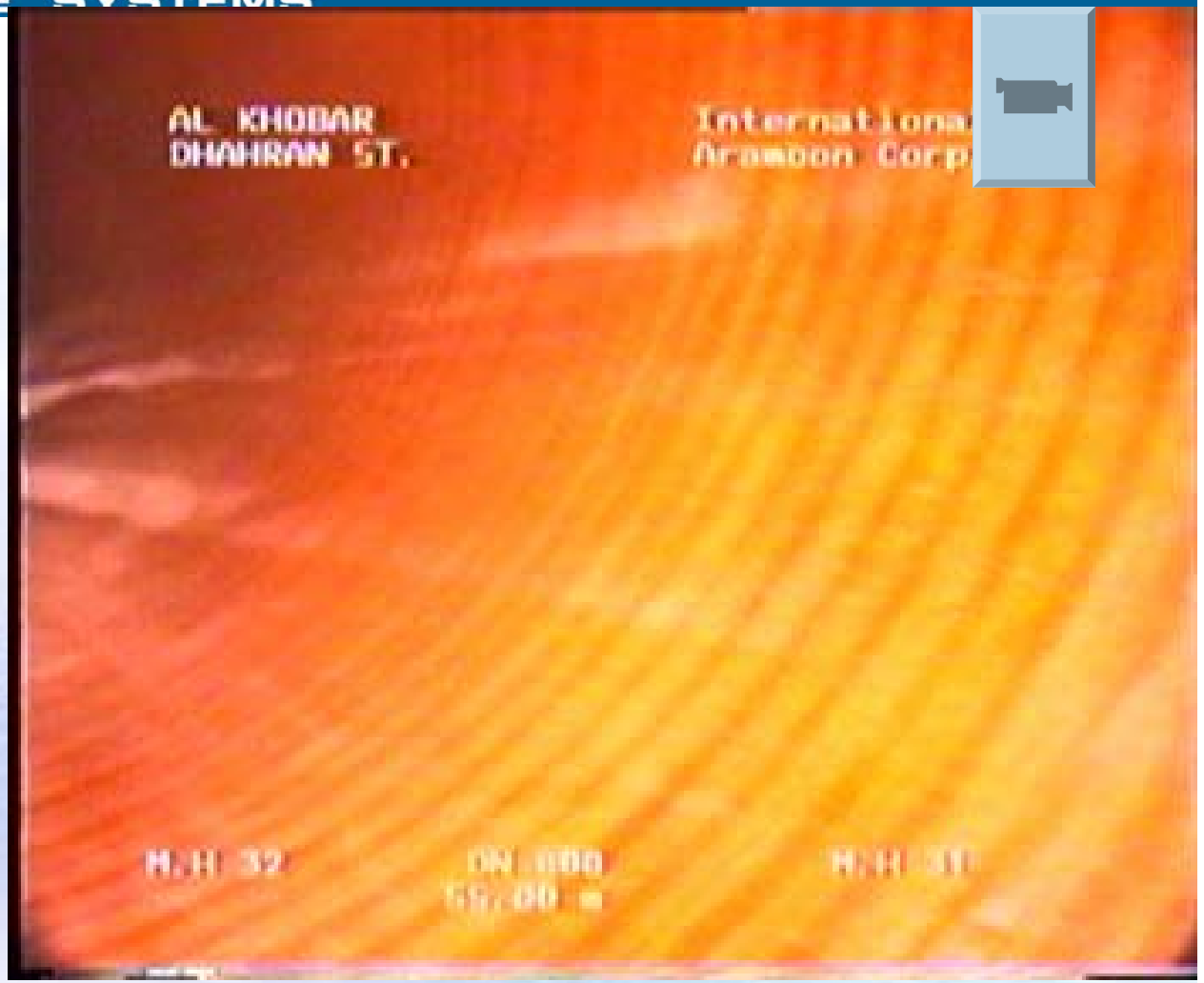
● Pipe Nominal Diameter	**1800 mm**
● Pipe Identification number	**2B-1910-X**
● Pipe production date	**09th July 1980**
● Nominal Pipe wall thickness	**22.71** mm
● Pipe nominal Pressure rating	**H-010** K Pa
● Pipe Nominal Stiffness	**1388** Pa STIS
● Pipe Actual Stiffness	**1432** Pa STIS

Hoop Tensile Strength **45** MPa

Axial Tensile Strength **25** MPa



Results of GRP pipe Installed in 1980…



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To Conclude and Summarize…….

Summary of 30 Years GRP Supplies

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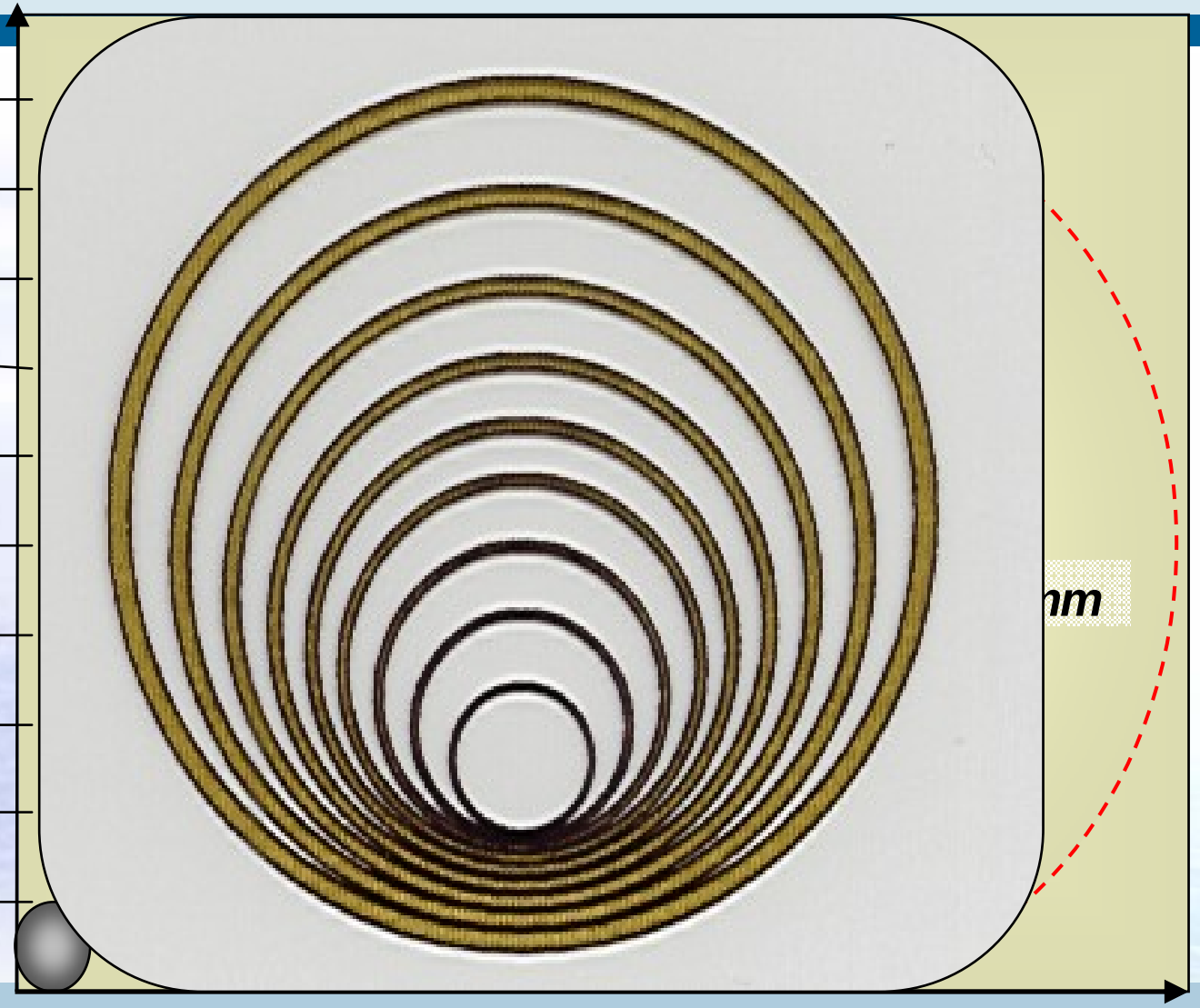
Diameters

80 mm
4000 mm

Pressure
Gravity
40 Bars G

Application
UG
AG
Under Sea
Relining



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Summary of 30 Years GRP Supplies...

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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… …

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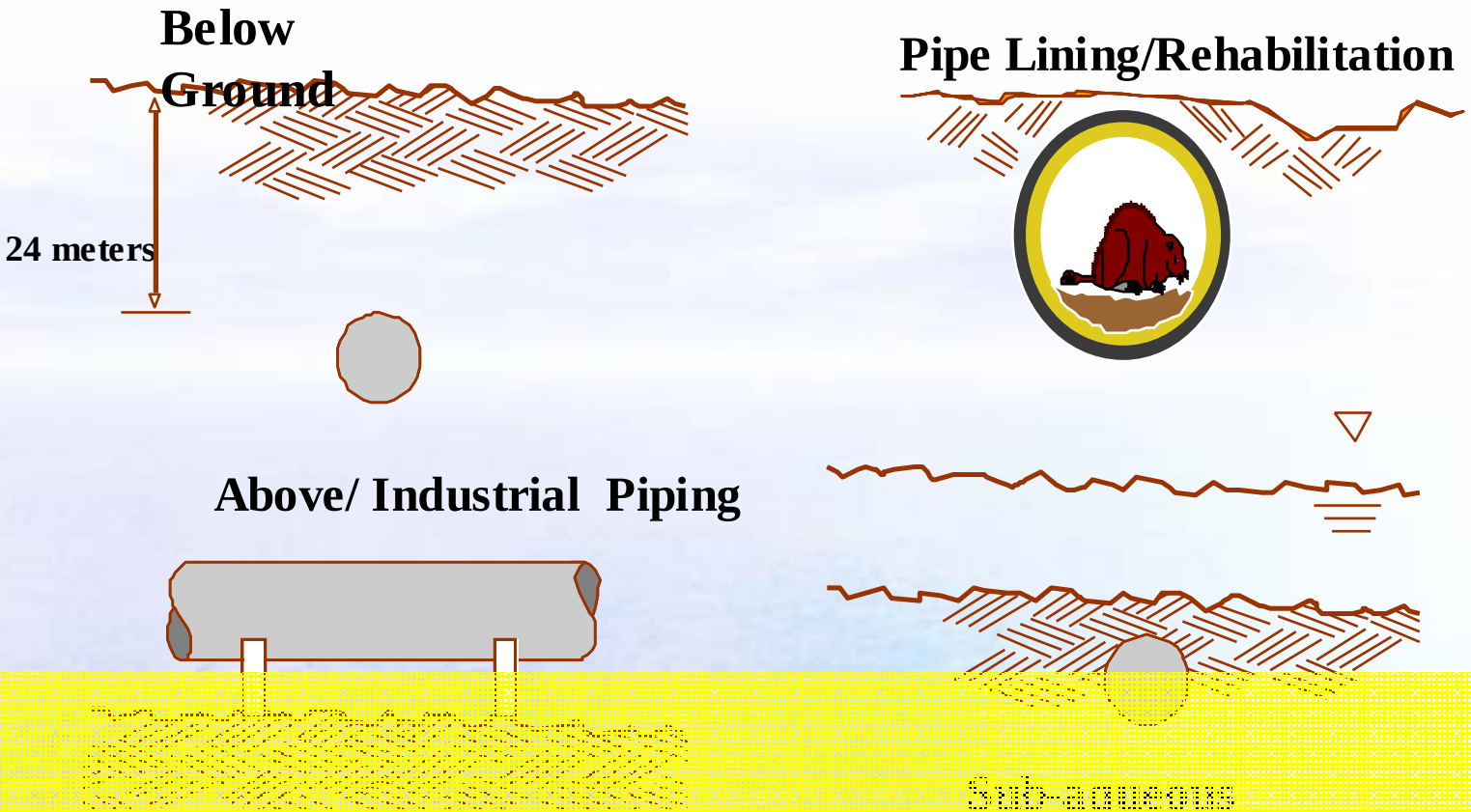

A Total of 11, 559 Km - GRP supplied

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Finally Some Interesting Applications……

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Conclusions and Recommendations

AMIANTIT 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

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Middle East Region

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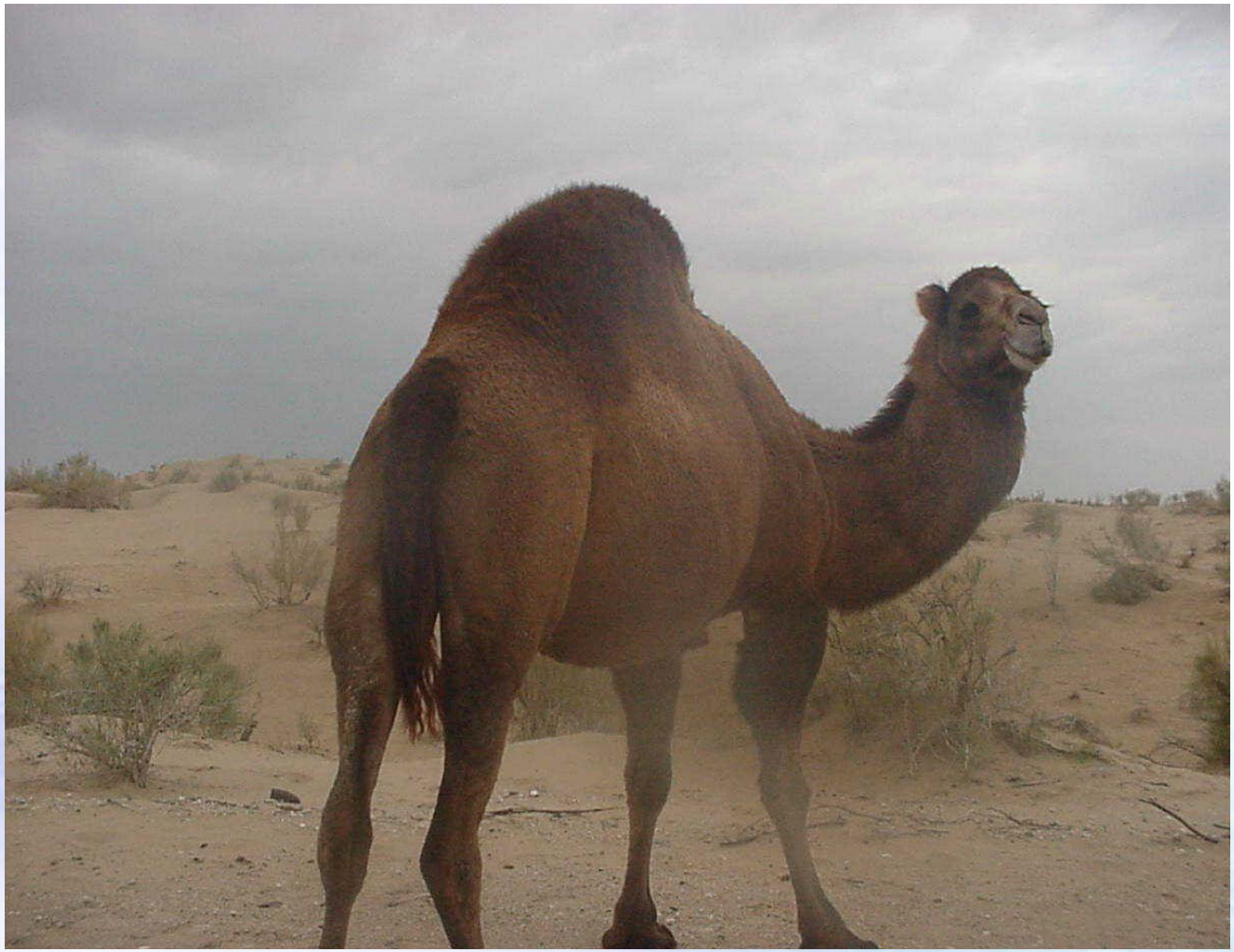

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Middle East Region

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