# INFLATED RUBBER DAM

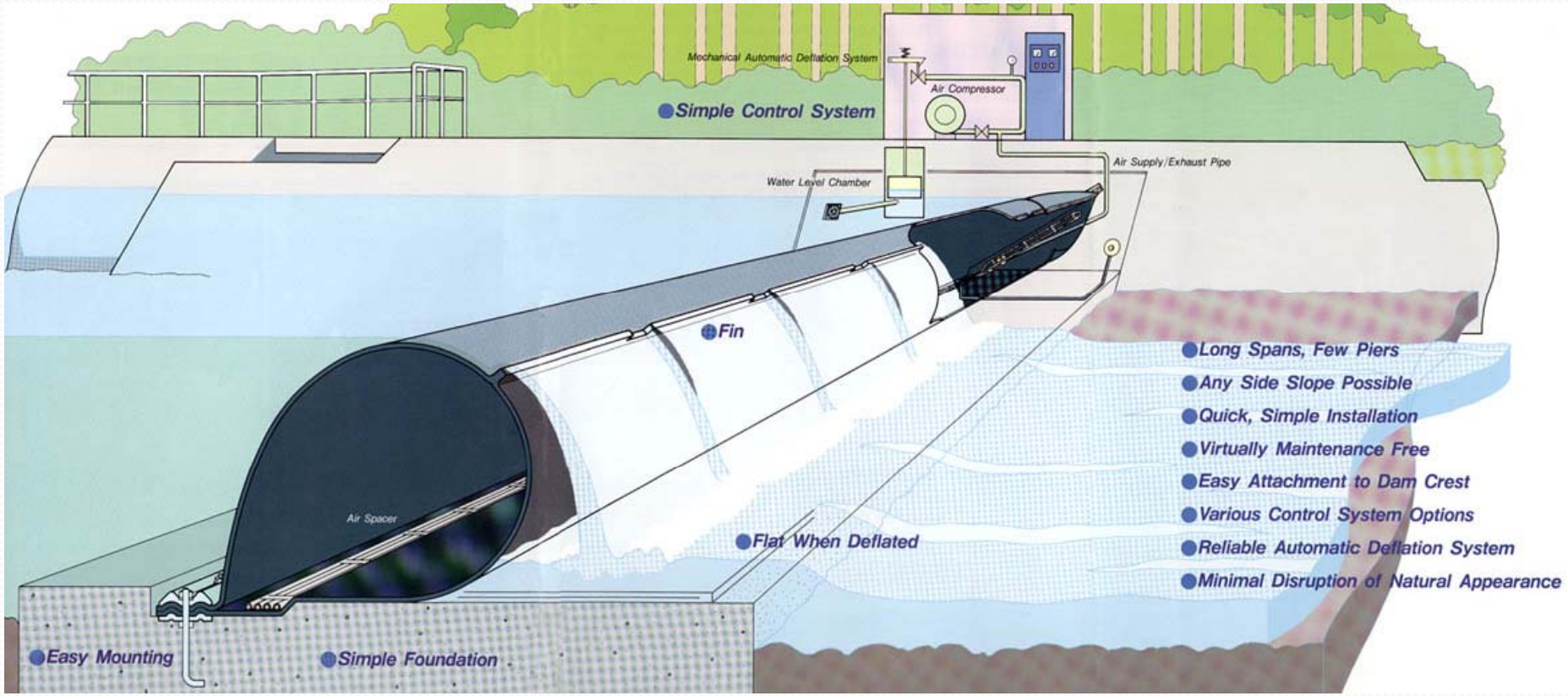
KİLİTTAŞI Mühendislik

YOOIL ENGINEERING, S. Korea

# Introduction to inflated rubber dam

- Rubber dams are cylindrical rubber fabrics placed across channels, streams and weir, or dam crests to raise the upstream water level when inflated.
- Mainly consists of four parts:
  - Rubber dam body
  - Concrete foundation
  - Control room housing mechanical and electrical equipment (air blower/water pump, inflation/deflation mechanism)
- Inlet and outlet piping system

# Introduction to inflated rubber dam



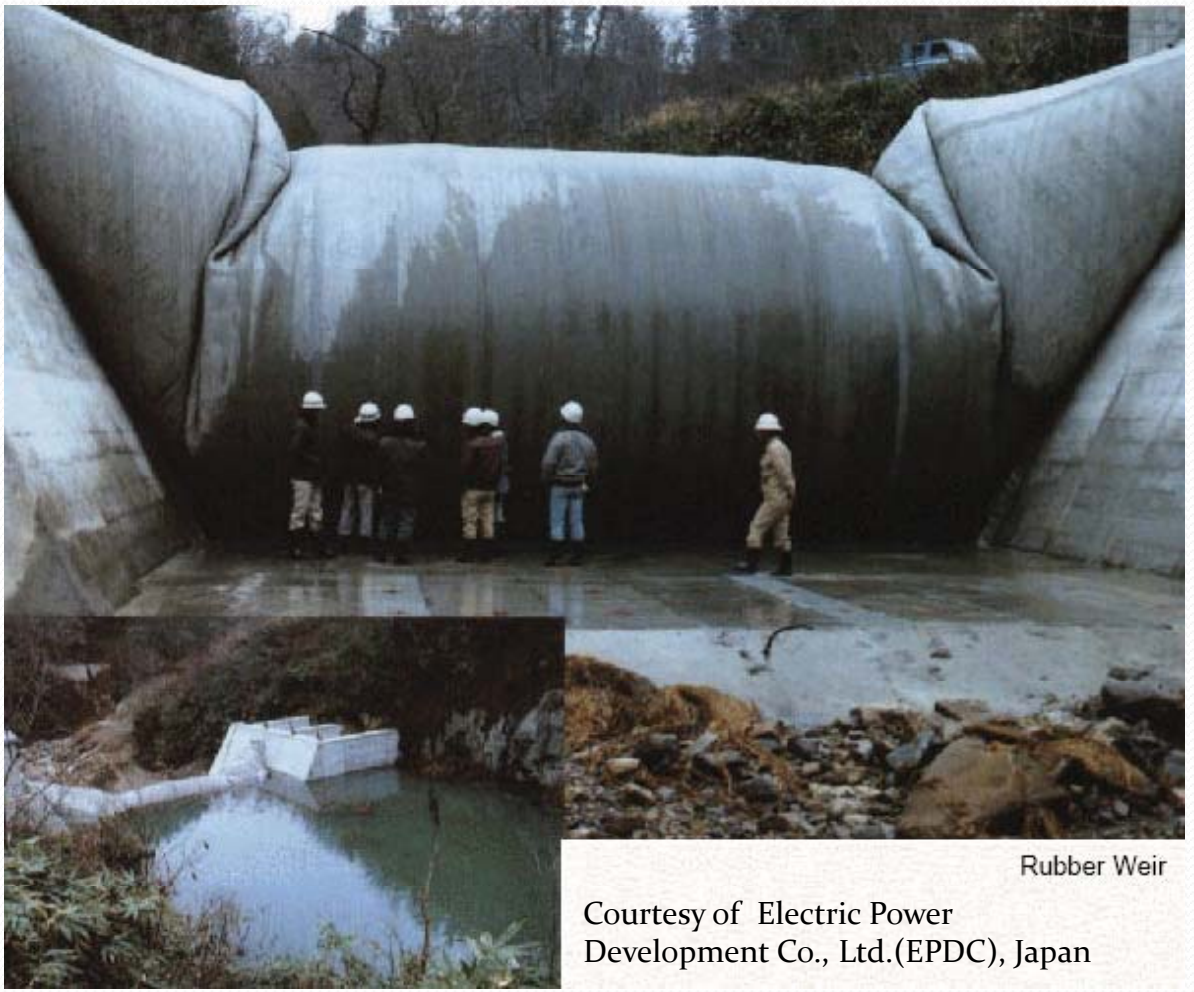

Ref: Michael Gebhardt," Hydraulic and structural design of tubular weirs" PhD Thesis, Water and Environmental Engineering– University of Karlsruhe, 2006, p.5.

# Rubber dam height

Air filled rubber dams can be up to 6 m height.

The side picture shows 5-m height rubber dam project located in Japan.

Yooil Engineering has the capability to manufacture and install rubber dam up to 5-m height.

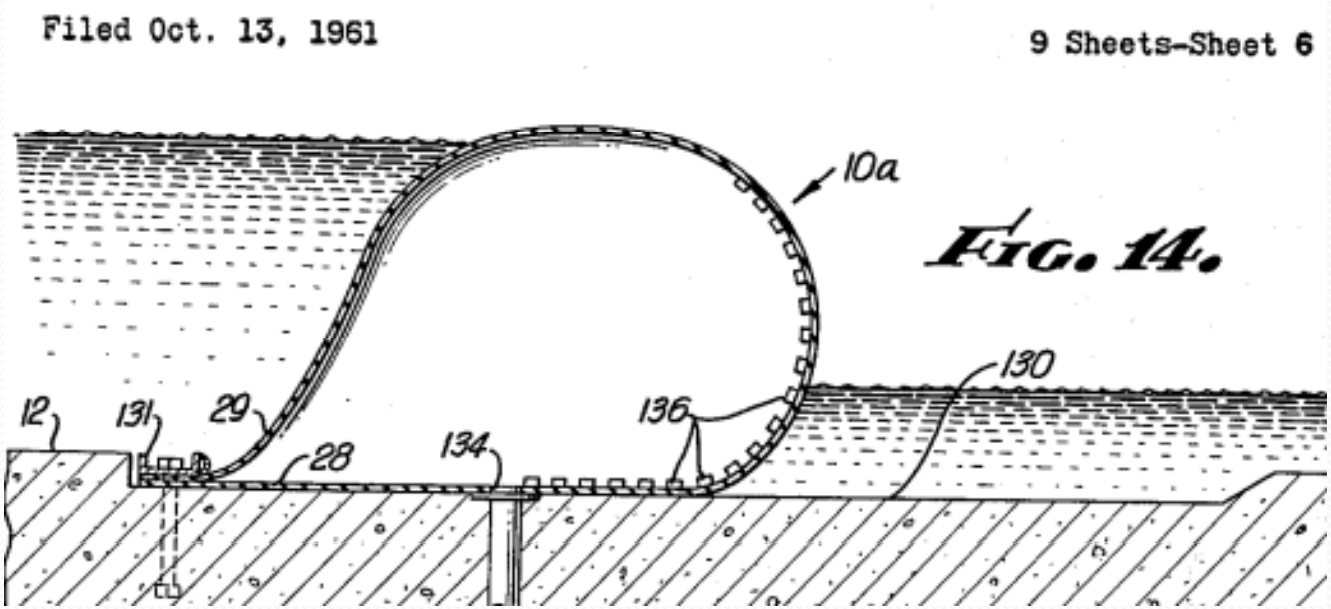


Rubber Weir

Courtesy of Electric Power Development Co., Ltd.(EPDC), Japan

# History

- The first concept of rubber dam was developed in the 1950's by N.M. Imbertson of the Los Angeles Department of Water and Power,
- And manufactured as Fabridams by the Firestone Tire and Rubber Co.
- The first Fabridam was installed on the Los Angeles River, California, for groundwater recharge and flood mitigation as water filled system.
- Early rubber dams were water filled systems.




A conceptual design of early rubber dams, 1961.

# History

- In 1978, Bridgestone Corporation introduced an air-inflated rubber dam.
- By 2002, there were more than 2500 rubber dams all around the world.
- Majority of them were located in Asia.

# History

- Of this 2500 rubber dam projects,
  - % 89.4 : air filled
  - % 10.4 : water filled
  - % 0.2 : air-water filled
- The rubber dam has experienced continuous improvements and innovations since then.
- In Turkey, it has just began to be known. Thanks to the hydroelectric power plant projects developed by private investors.

*Ref: “Flexible structures,” International Water Power and Dam Construction, 3 Jan 2007.

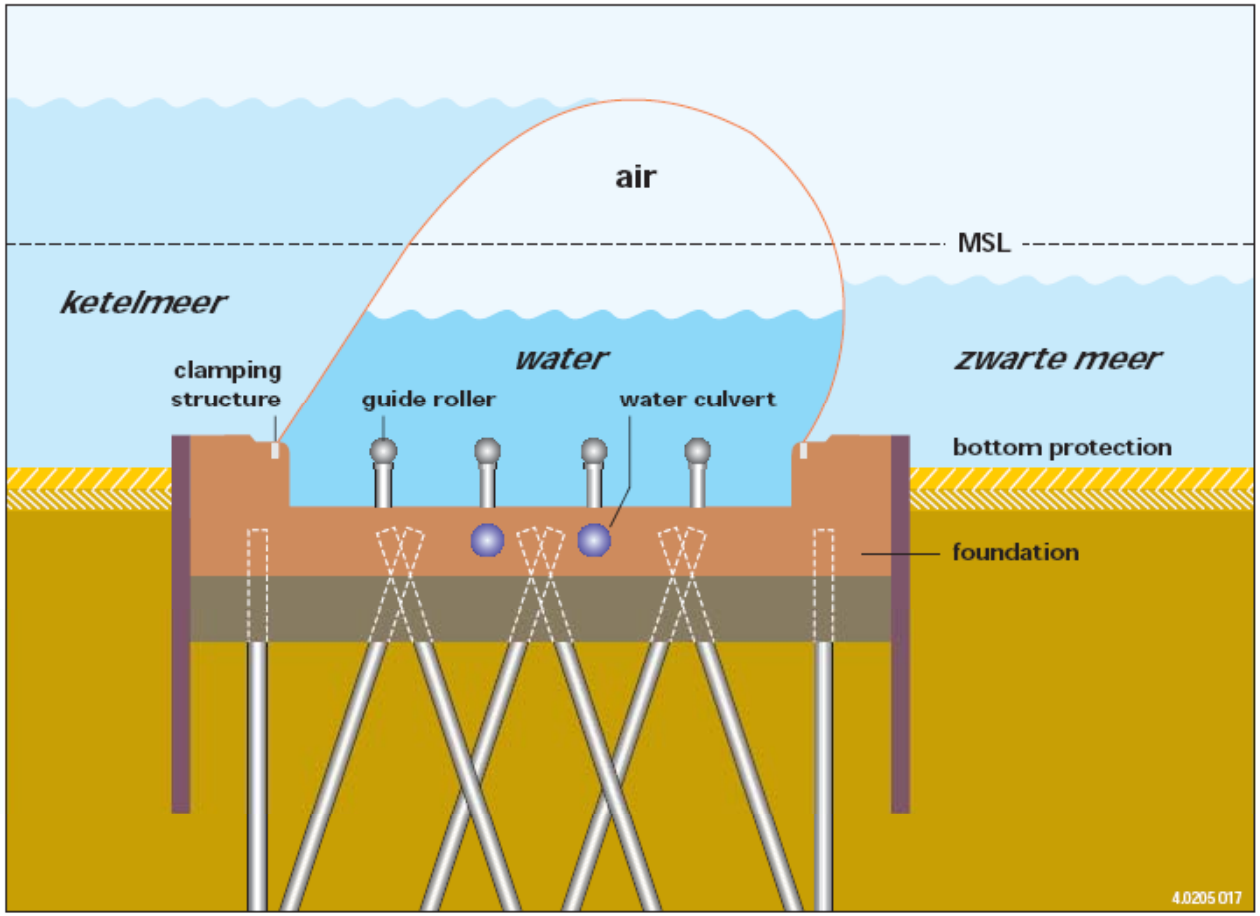
YOOIL ENGINEERING KİLİTTAŞI

# Types of rubber dam

- There are three types of rubber dam system:
  - Air filled ruber dam
  - Water filled rubber dam
  - Hybrid rubber dam (filled with both air and water)

# Types of rubber dam

- A schematic picture of hybrid rubber dam




Courtesy of Delft Hydraulics, www.widelft.nl

# Comparison of air vs. water filled rubber dam systems

- Air is used more often than water as the filling medium for the following reasons*:
  - Water and water-borne debris can corrode and clog pipes
  - The design and construction of air-filled dams are simpler.
  - Water-filled dams require a more complex piping system and often need a pond to store water for filling the dams when river water levels are low.
  - The inflation and deflation time of an air-filled dam is much shorter than that of a water-filled dam of the same size.
  - Due to the weight of water, the water-filled dam has a squat shape, requiring more rubber material than an air-filled dam of the same height.
  - The circumference of a water-filled dam is about 4.8 times its height, compared to 3.5 times for an air-filled dam. To accommodate the dam body, the foundation of a water-filled dam must be wider than that of an air-filled dam of the same height.

*Ref: "Flexible structures," International Water Power and Dam Construction, 3 Jan 2007.

YOOIL ENGINEERING KİLİTTAŞI

# Comparison of air vs. water filled rubber dam systems

- However, air-filled dams are less stable and suffer more from vibration than the water-filled ones, which are more preferable when hydraulic conditions are more demanding

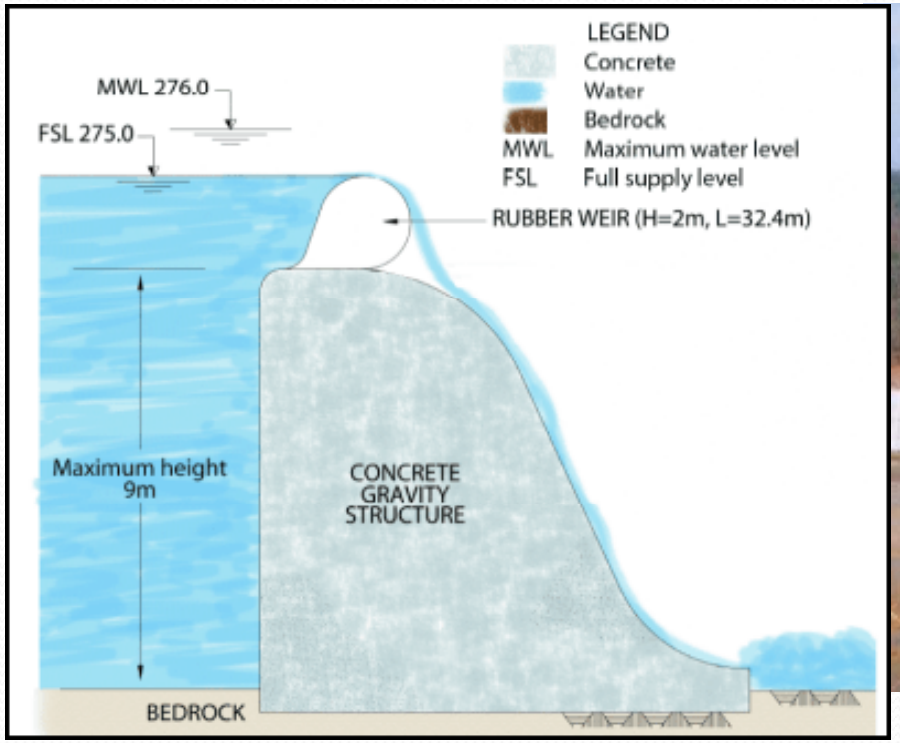
*Ref: “Flexible structures,” International Water Power and Dam Construction, 3 Jan 2007.

# Applications of rubber dams

- Rubber dams can be used as a weir body, and
- A good alternative for radial gates

# Applications of rubber dams

- Increasing the crest elevation of existing dams and weirs.




# Applications of rubber dams

- Debris, garbage and other wastes behind the dam can be flushed downstream easily with rubber dam when it is deflated,
- On river and ponds, it can be used for recreation purposes (as seen in picture given below).

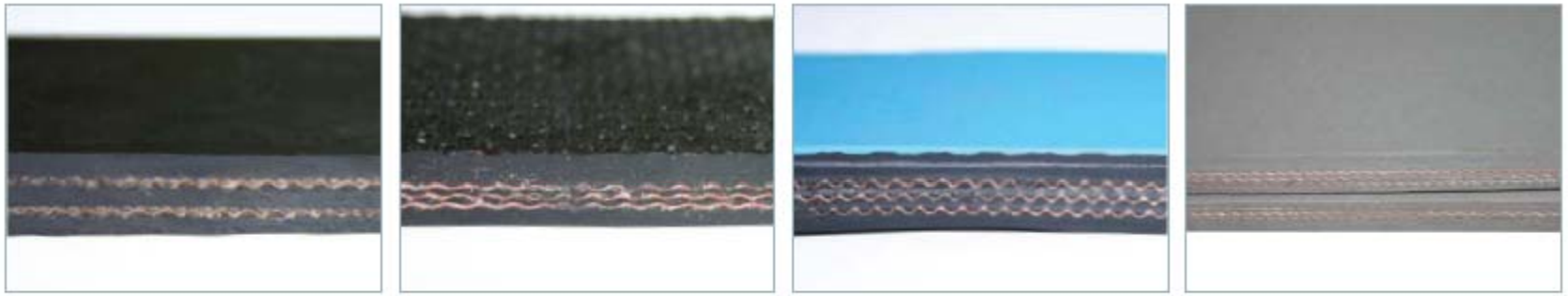
Courtesy of YOOIL Engineering

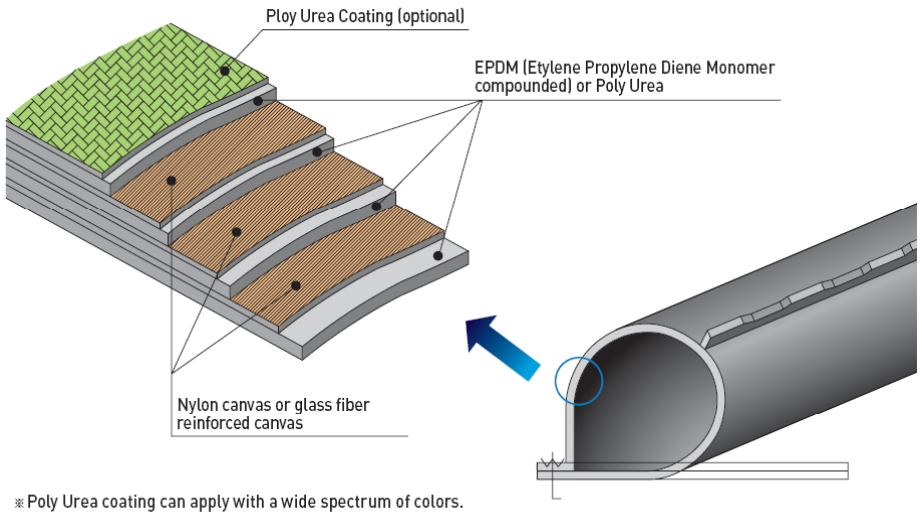
# Applications of rubber dams

- Rubber dams are widely used in hydro electric power plant projects for the following purposes:
  - Increasing the energy production capacity by increasing the gross head (through increasing the crest elevation of the weir)
  - Used as weir body
  - Used instead of radial gates
  - Increasing the weir body height
  - Increasing the crest elevation of existing weirs and dams.
  - Can be used on spillways so that increase the reservoir/pond elevation (e.g. settling basin and head pond side spillway).

# Rubber body material

- Rubber body material



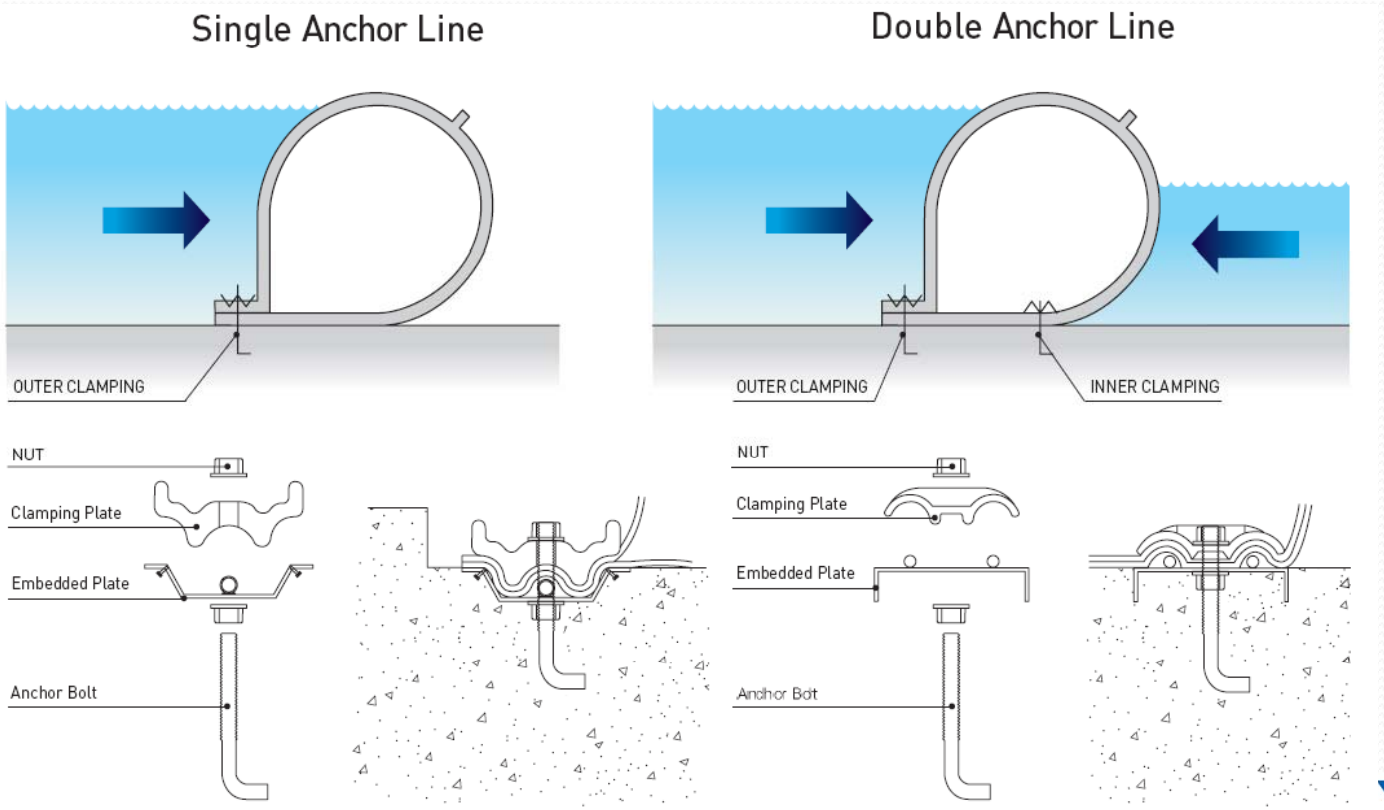




※Poly Urea coating can apply with a wide spectrum of colors.
UV treated coating can increase the service life up to 5 more years.

Courtesy of YOOIL Engineering

# Installation

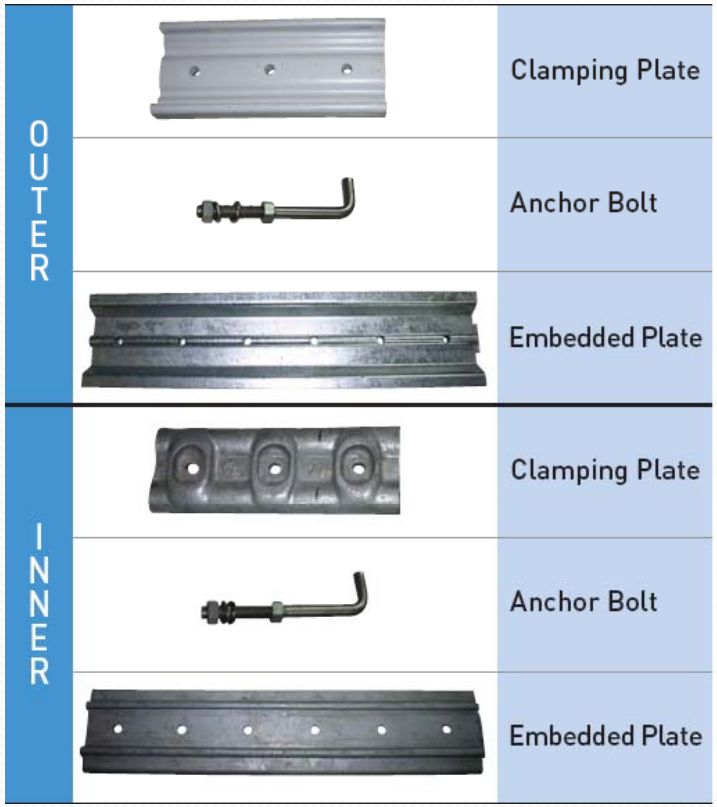
- The rubber dam body is fixed onto a concrete foundation
- Depending on rubber height, it is fixed by single or double anchor line.

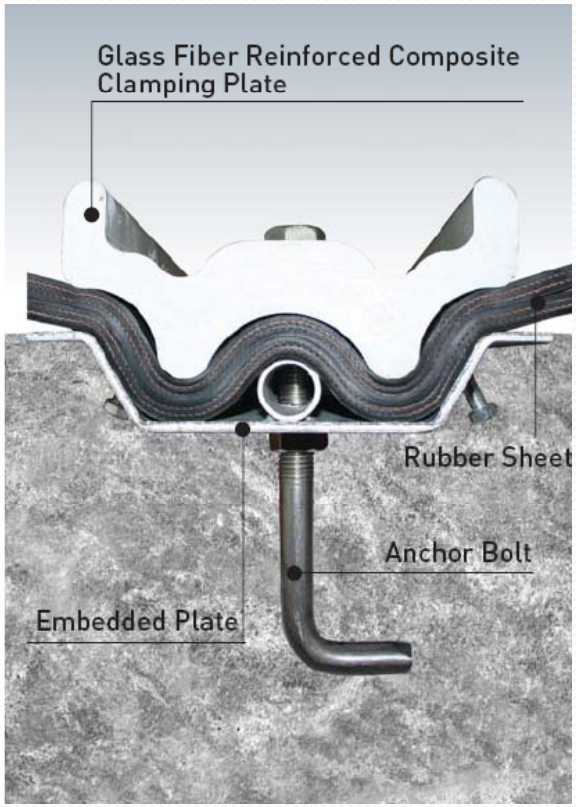



Courtesy of YOOIL Engineering

# Installation of rubber dam

- Anchors used for clamping can be made up of from the following materials: Stainless steel, cast iron or carbon material.




Courtesy of YOOIL Engineering

# Economic and Technical Benefits

- Rubber dam has the following advantages against the radial gates:
  - Long span and adaptable to different side slopes
    - Long rubber dams can be installed in broad rivers without piers.
    - They are adaptable to virtually any side slope angle.
    - Little work is needed to modify riverbanks.
    - For a steel gate, intermediate piers are generally needed for about every 20m. Furthermore, steel gates cannot be installed unless the side slopes are vertical.
  - Short construction period
    - Compared with a conventional steel gate the rubber dam body is lighter and easier to handle.
    - It can be fabricated in one piece at a factory and rolled up for easy transportation to the dam site.
    - The rubber dam only requires a simple light foundation with a 10 to 15cm recess, while steelgates normally have a 50 to 80cm recess .
    - The construction of the concrete foundation and installation of the rubber body can be completed quickly, easily and economically.
    - A single or double-line clamping plate is used to anchor the rubber body onto the foundation.

*Ref: “Flexible structures,” International Water Power and Dam Construction, 3 Jan 2007.

# Economic and Technical Benefits

- Easy maintenance and repair
  - Minimal maintenance is needed for rubber dams.
  - There is no need for painting, greasing, or lubrication.
  - With a steel gate, various maintenance expenses are needed, such as removal of rust, repainting and changing of hydraulic oil.
- Low project life cycle cost
  - The life cycle cost of a rubber dam project is low due to prefabrication of the dam body, little modification to riverbanks, light concrete foundation, quick construction and installation, easy operation and minimal maintenance
- Earthquake resistant
  - The simple and light upper structure, uniform load on the rubber body, and light concrete foundation make a rubber dam project more earthquake-resistant than other structures serving similar functions.

*Ref: "Flexible structures," International Water Power and Dam Construction, 3 Jan 2007.

YOOIL ENGINEERING KİLİTTAŞI

# Economic and Technical Benefits

- Adaptable to adverse conditions
  - Rubber dam is operable in very cold climatic conditions, under which a steel gate may be inoperable (see the picture below)
  - Resistant to corrosive conditions.
    - For example, in the Santa Ana River rubber dam, California, US, steel gates were not selected because of the corrosive environment.

Şişme savak, Mississquoi River, Highgate Falls, Vermont, USA.
Courtesy of US Army Corps of Engineers

*Ref: "Flexible structures," International Water Power and Dam Construction, 3 Jan 2007.

# Installation

- First step is to construct the concrete foundation body.
  - Anchor, clamping plates and pipes are installed
  - Pictures show the installation steps.



Courtesy of YOOIL Engineering

# Şişme Savak: Kurulumu

- On top of the concrete foundation, rubber body is installed.




Courtesy of YOOIL Engineering

# Şişme Savak: Kurulumu

- Control room and Scada system is installed.


Closed-Circuit Television(CCTV)

Remote Control System

Integrated Monitoring System

Courtesy of YOOIL Engineering

# Rereference

- YOOIL Engineering
  - has more than 150 application in South Korea
  - Also manufactured and installed rubber dams for water projects in Canada and Philippines.
    - 2010 and 2011, 8 new rubber dam will be delivered to Canada

# Contact Information

- KİLİTTAŞI Müh. Müş. İnş. Ltd
  - www.kilittasi.com.tr
  - Ceyhun Atuf Kansu Cad. No: 152/15 Cevizlidere/Balgat Ankara
  - Tel: +90 312 472 77 67
  - Fax: + 90 312 472 77 68
- YOOIL Engineering
  - www.yooileng.co.kr

YOOIL ENGINEERING CO., LTD.
#824 Unitech-Vill, 1141-2 Baekseok-Dong, Ilsandong-Gu, Goyang-Si, Gyeonggi-Do, Republic of Korea 410-722
TEL : +82-31-973-2394 FAX : +82-31-973-2399 E-mail : yooileng@yooileng.co.kr
www.rubberdam.co.kr

# YOOIL Engineering
# CloudWorks Upper Stave River / Canada
# Inflated Rubber Dam Project
# YOOIL Engineering

Courtesy of YOOIL Engineering

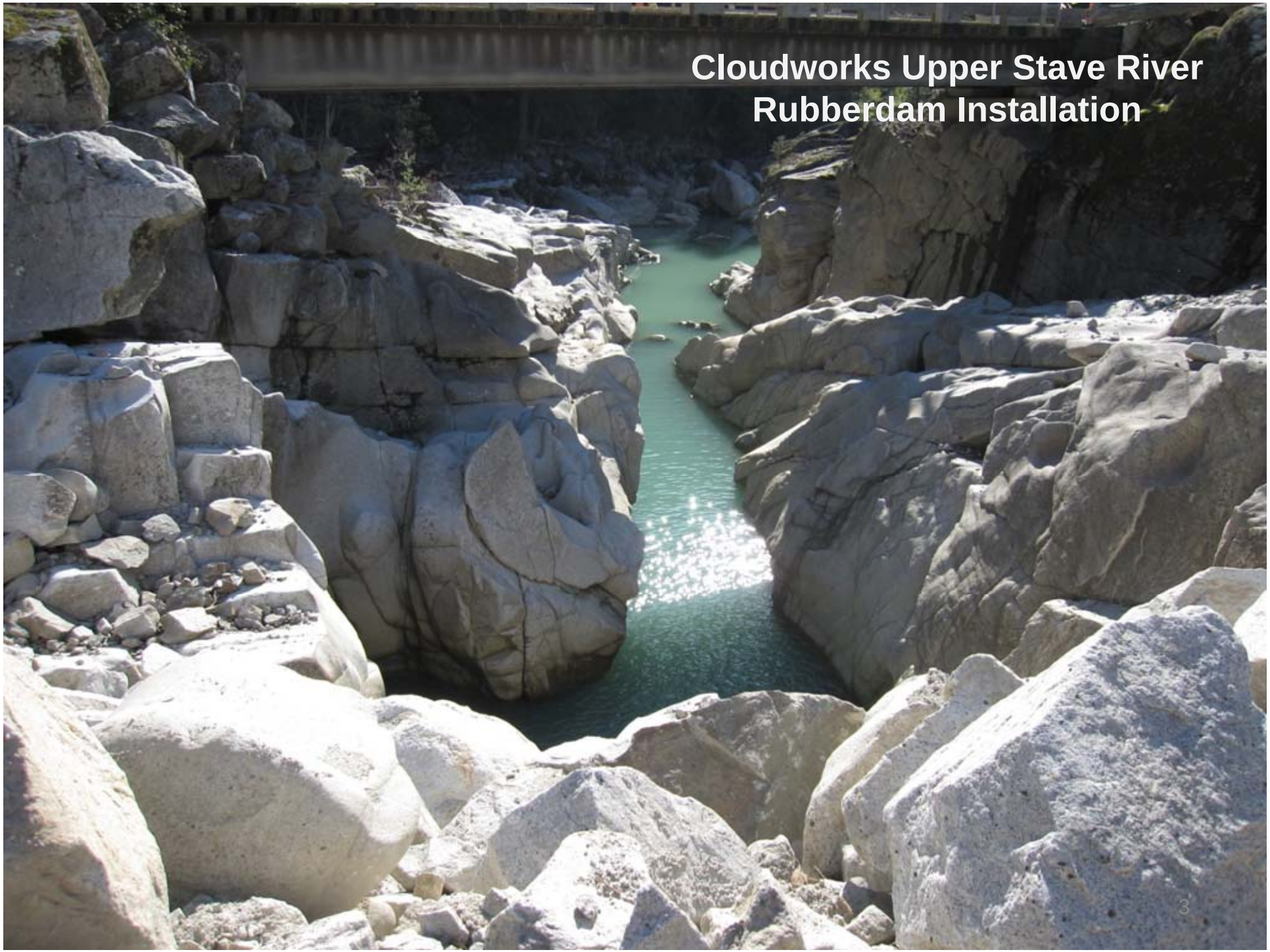
# CloudWorks Upper Stave River Rubber Dam by YOOIL Engineering

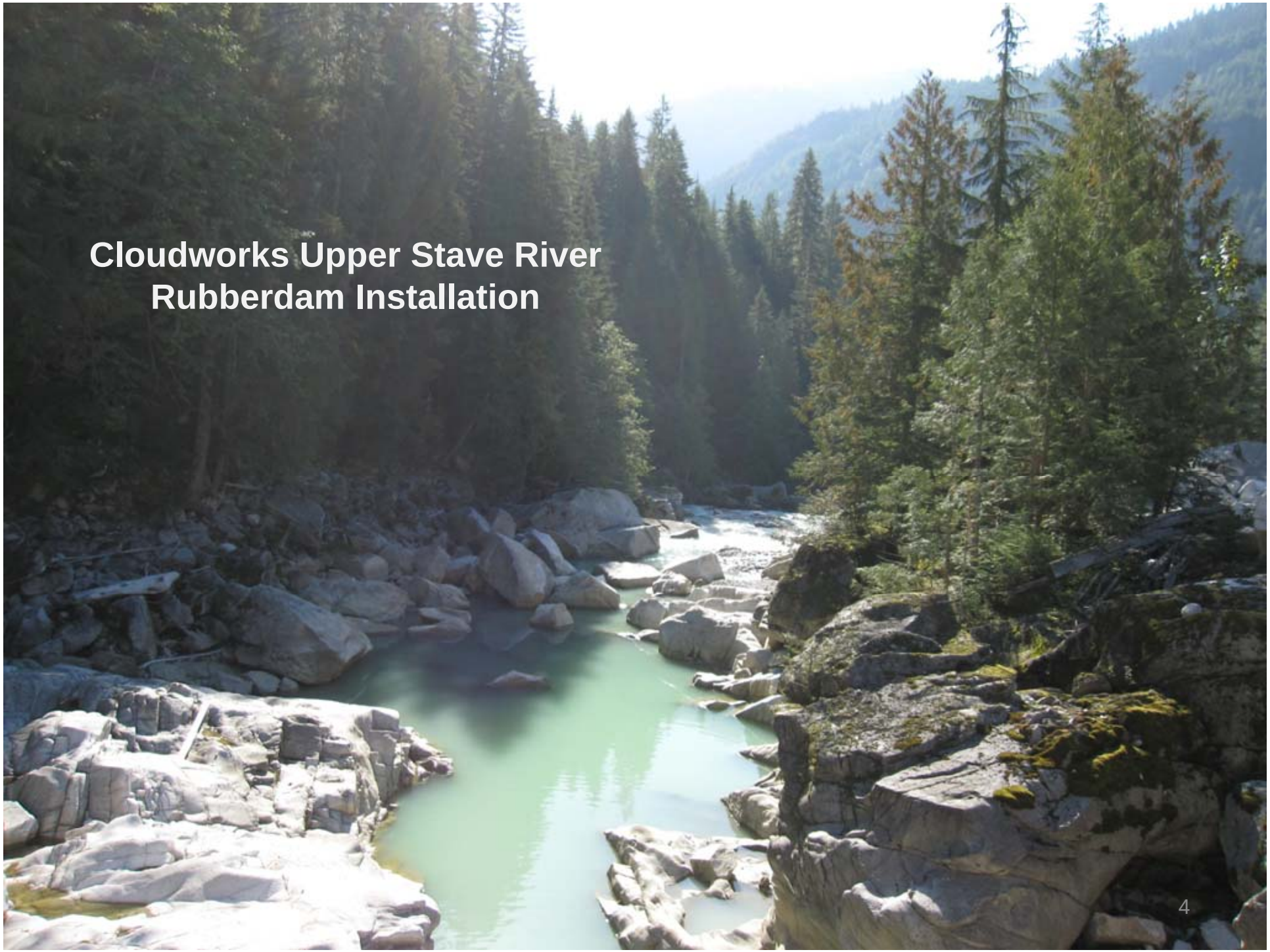
## (3mH x 24mL)

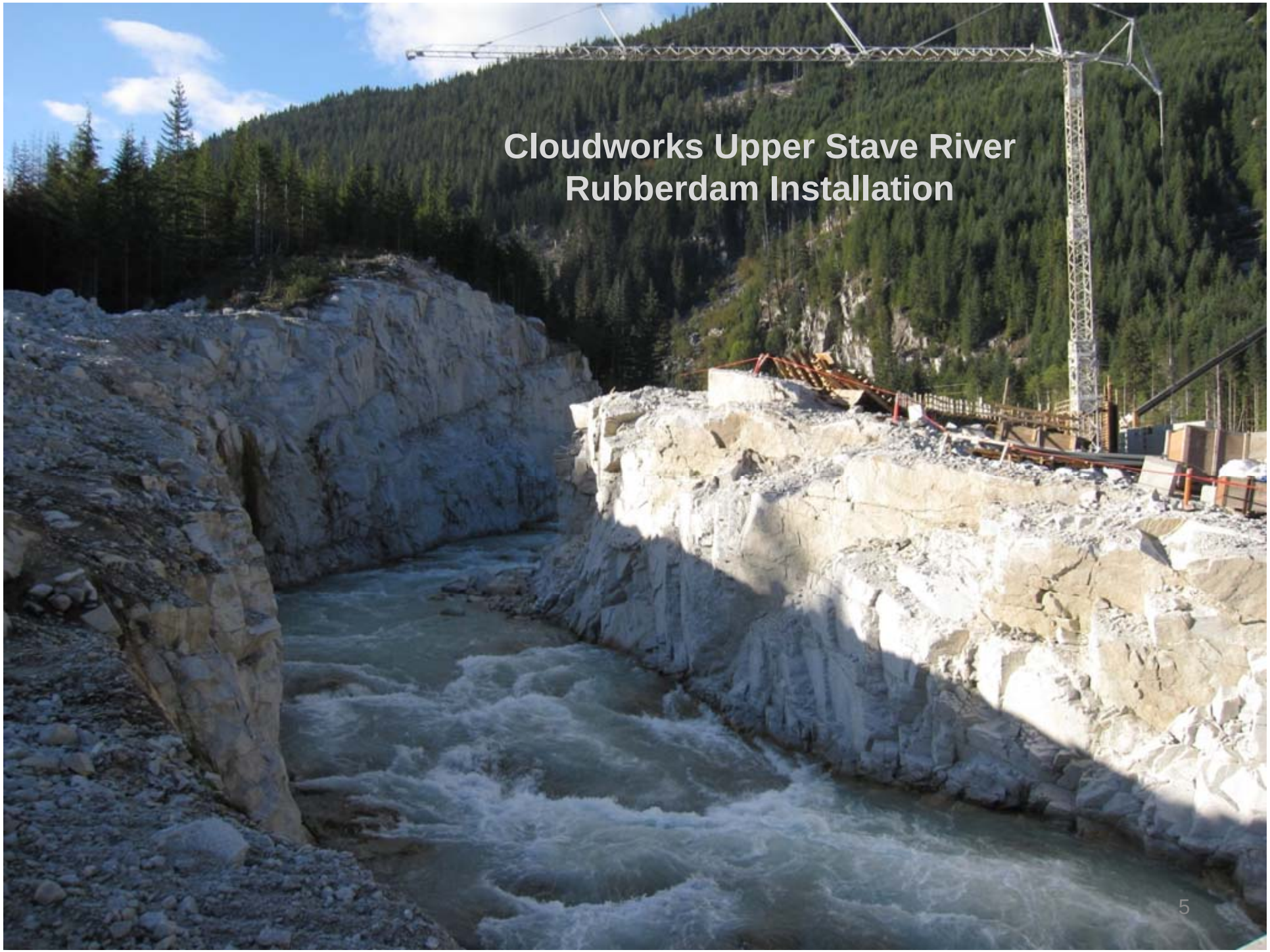
## (Sept. 2009)

- PETER KIEWIT Sons. Co.
- Knight Piesold
- YOOIL Rubberdam Engineering


Cloudworks Upper Stave River
Rubberdam Installation


Cloudworks Upper Stave River
Rubberdam Installation


Cloudworks Upper Stave River
Rubberdam Installation


Cloudworks Upper Stave River
Rubberdam Installation

# CloudWorks Upper Stave River

Cleaning for
Rubberdam Installation


Concrete Slab for
Rubberdam Installation


**Concrete Slab for Rubberdam Installation**


Cloudworks Upper Stave River
Rubberdam Installation


Cloudworks Upper Stave River
Rubberdam Installation
(3mH x 24mL)
Rubber Sheet Lifting


Laying down the Rubber Sheet

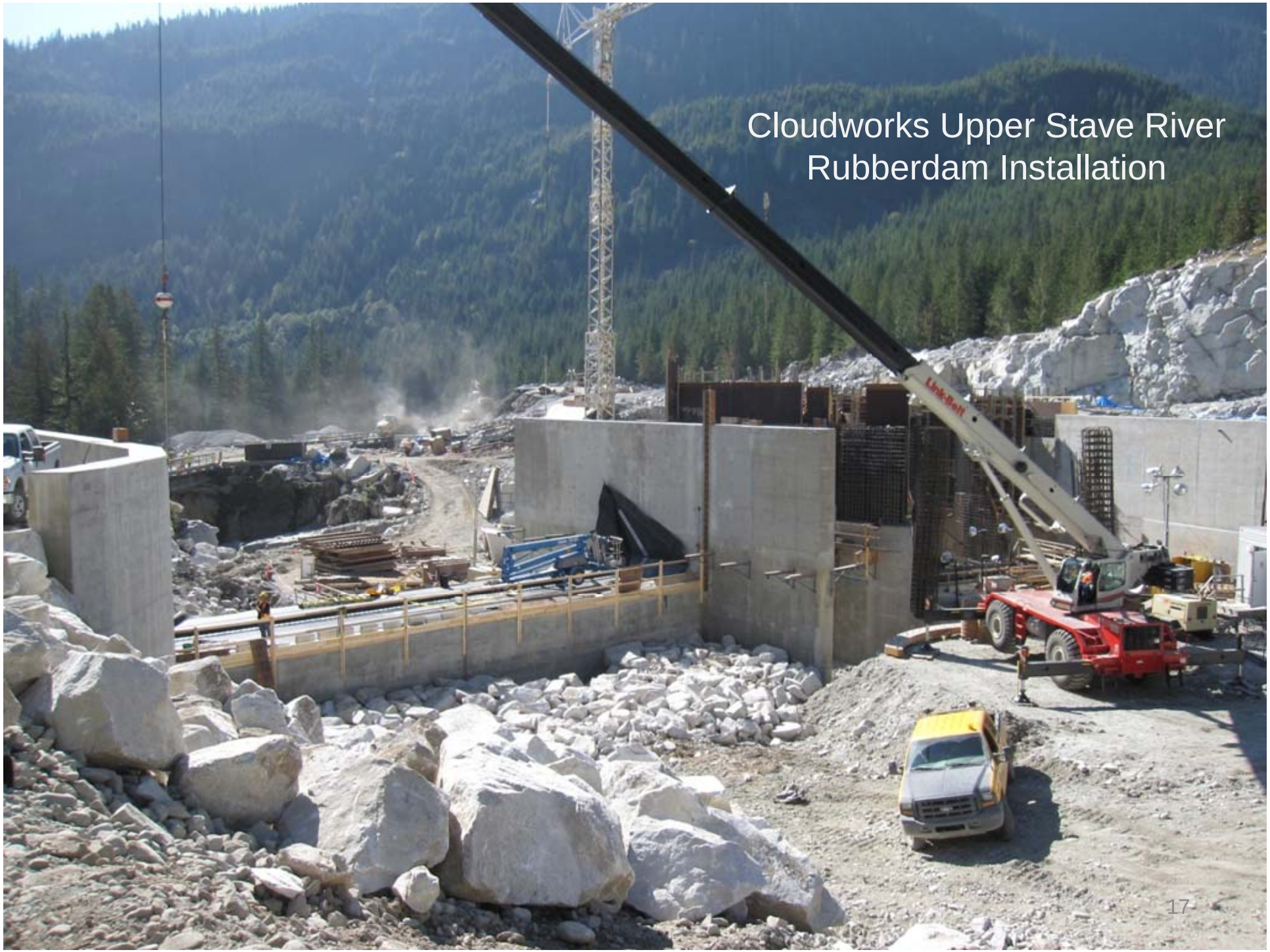

Rubber Sheet Lifting
3mH x 24mL
CAT


**Cloudworks Upper Stave River**
**Rubber Sheet Rolling**


Anchoring of the inner fixing line


Anchoring of the inner fixing line


Rubberdam Installation
On Vertical 90 Degree
Abutment


Cloudworks Upper Stave River
Rubberdam Installation


Anchoring of Outer Fixing Line
with rust-free Fiber Glass
Clamping plates


Anchoring of Outer Fixing Line
with rust-free Fiber Glass
Clamping plates

**Anchoring of Outer Fixing Line with rust-free Fiber Glass Clamping plates**

**Anchoring of Outer Fixing Line with rust-free Fiber Glass Clamping plates**

YOOIL and KIEWIT Crews

**Fully Inflated RubberDam**


Fully Inflated RubberDam