

U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NUCLEAR WASTE TECHNICAL REVIEW BOARD
PANEL ON STRUCTURAL GEOLOGY & GEOENGINEERING

**SUBJECT: TECHNOLOGY TO SEAL
SHAFTS AND RAMPS**

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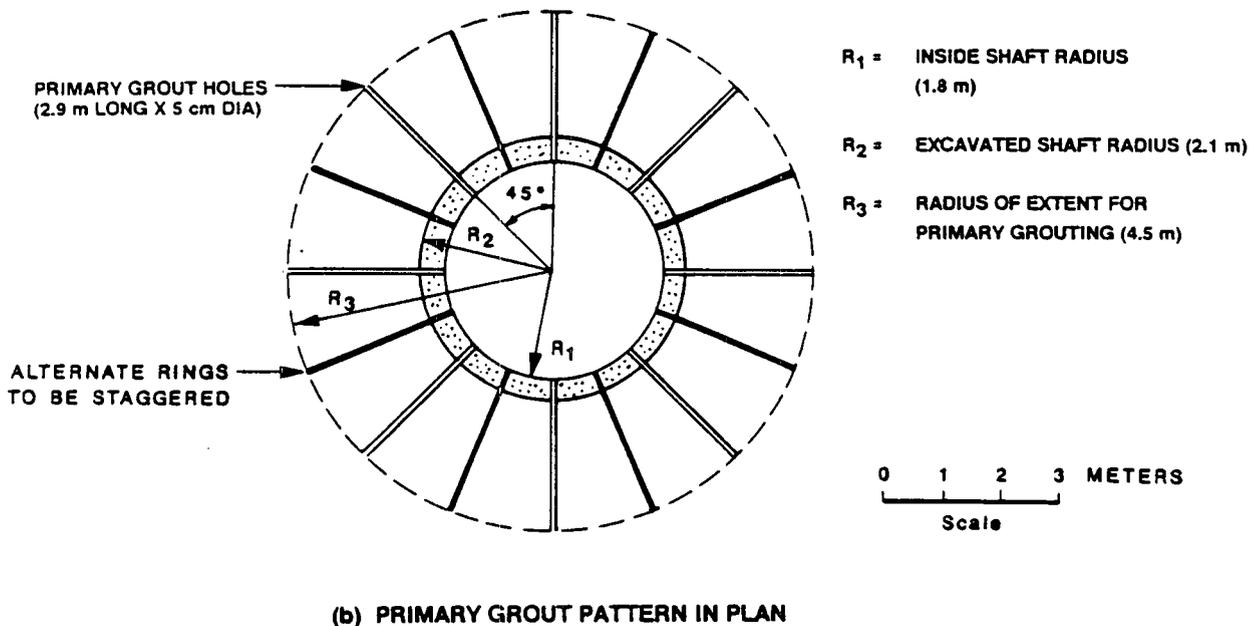
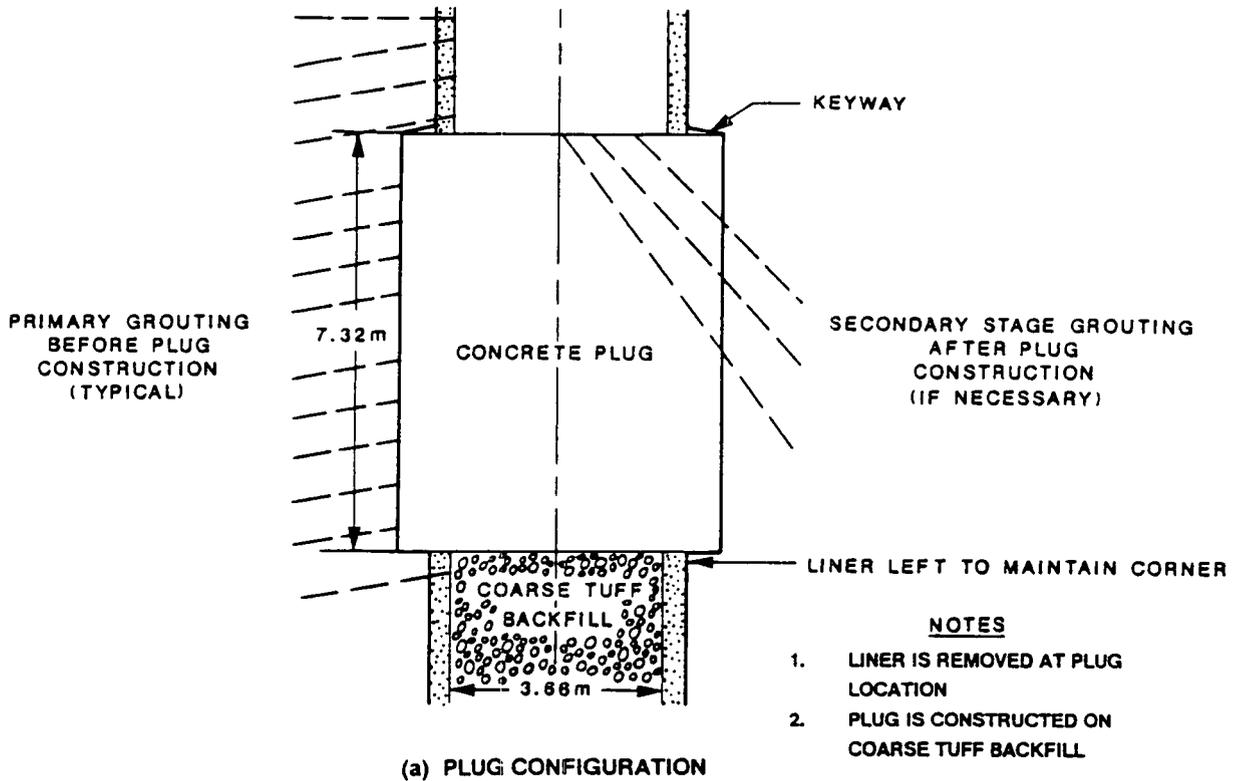
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Outline of Presentation

- **Primary grouting of the Modified Permeability Zone**
- **Construction methods for liner removal**
 - **Fragmenting the liner**
 - **Mucking broken liner to the ground surface**
- **Placement of backfill**
- **Excavation of keyway**
- **Placement of concrete**
- **Secondary grouting of the Interface Zone and Modified Permeability Zones**

Restoration of the Modified Permeability Zone and Emplacement of the Shaft Seal

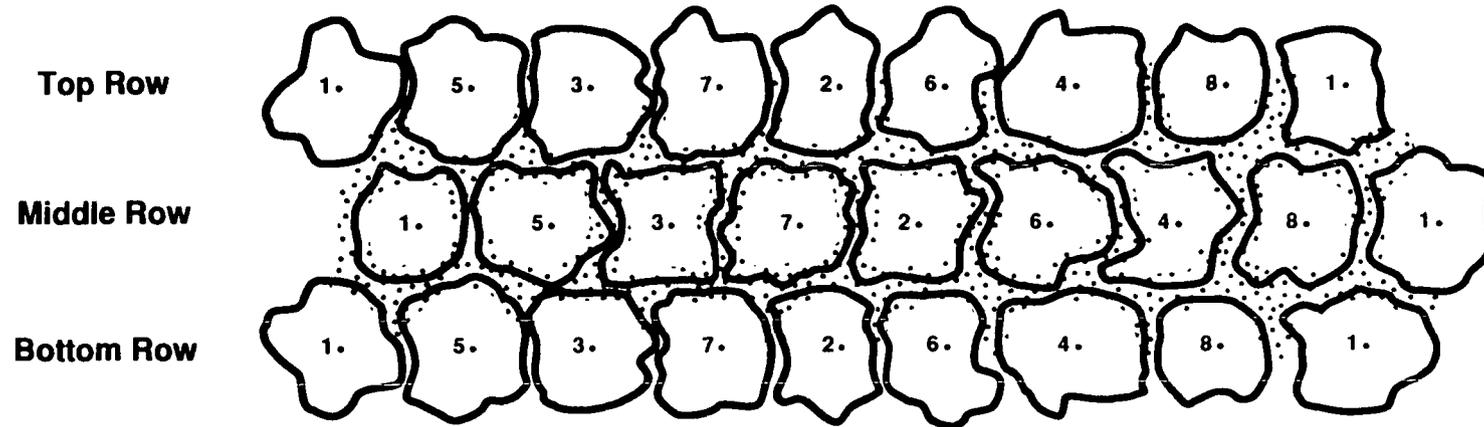


Picture of Shaft Stage

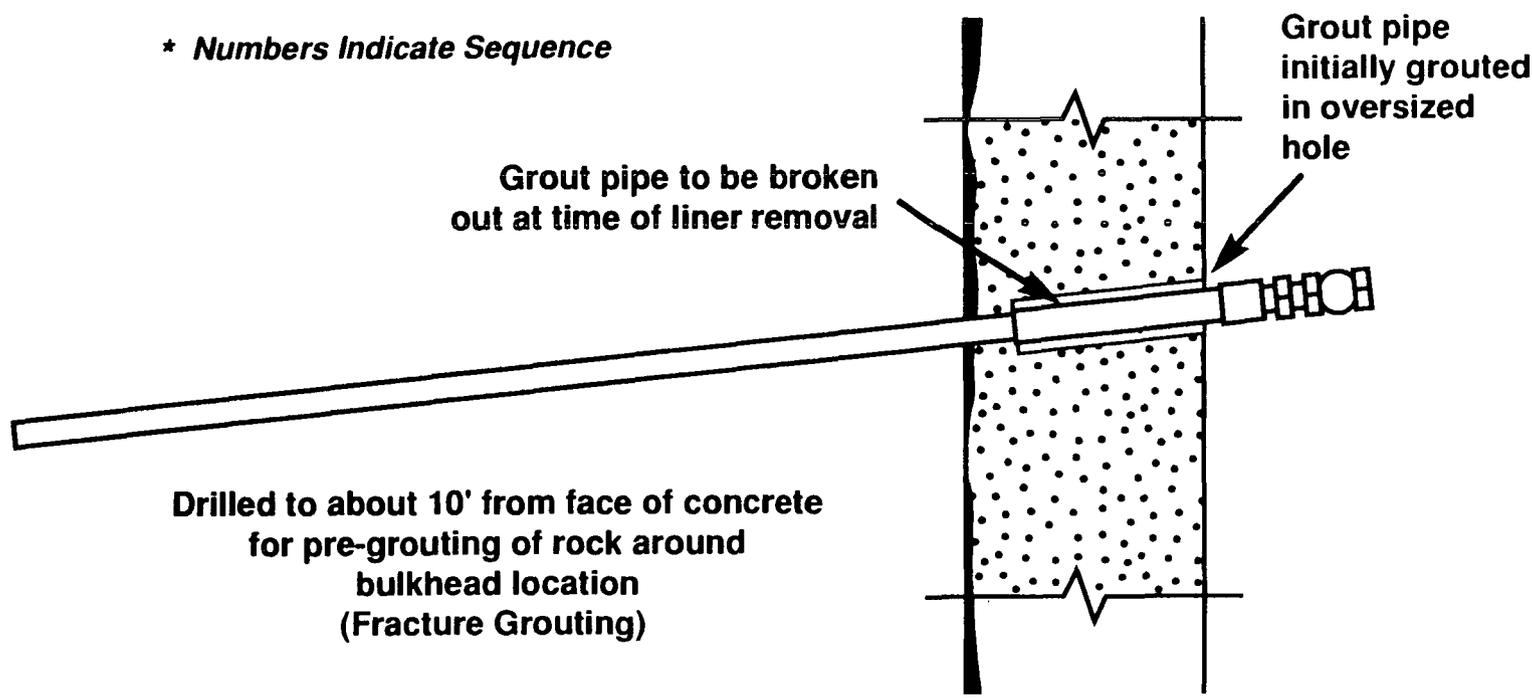
Primary Grouting of Modified Permeability Zone

- **Grouting performed prior to liner removal**
- **Obtain information from a series of tests usually from one or two boreholes for cement selection**
- **Obtain safe working pressure $0.8 * \text{depth of cover}$. Pump with range of 20 to 700 PSI at a pumping rate of 1 to 15 GPM satisfactory**

Grout Pattern for a Series of Three Rows



* Numbers Indicate Sequence



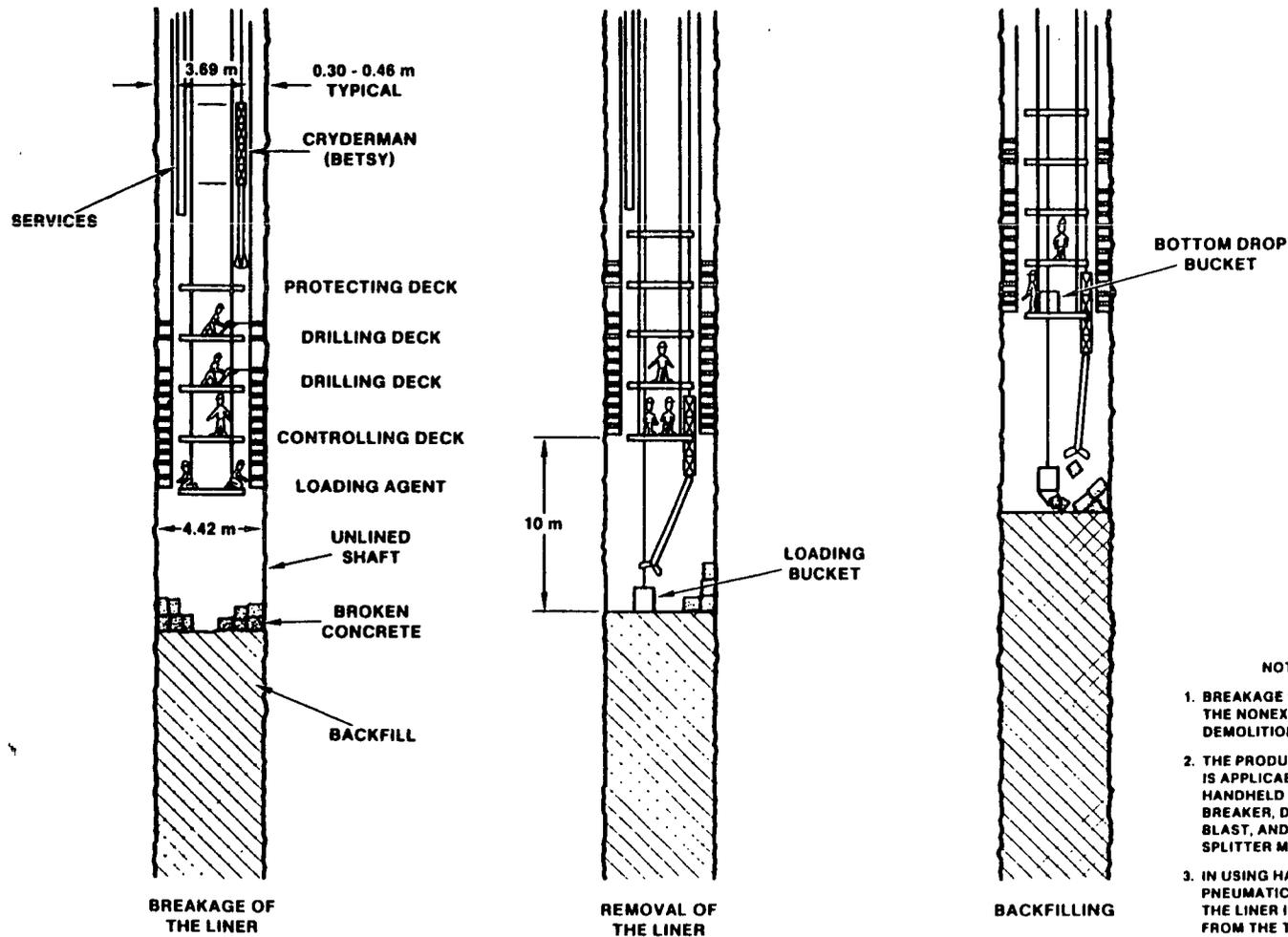
Picture of Circular Rail With Drilling Jumbo

Liner Removal Methods

- **Handheld pneumatic breakers**
- **Drill and blast**
- **Drill and use hydraulic splitters**
- **Drill and use nonexplosive drilling agent**
- **Impact breaker**
- **Roadheader boom method**

First four methods are performed from a single stage. For the last two methods, the impact breaker or roadheader is mounted on one stage, and mucking and backfilling occur from a second stage

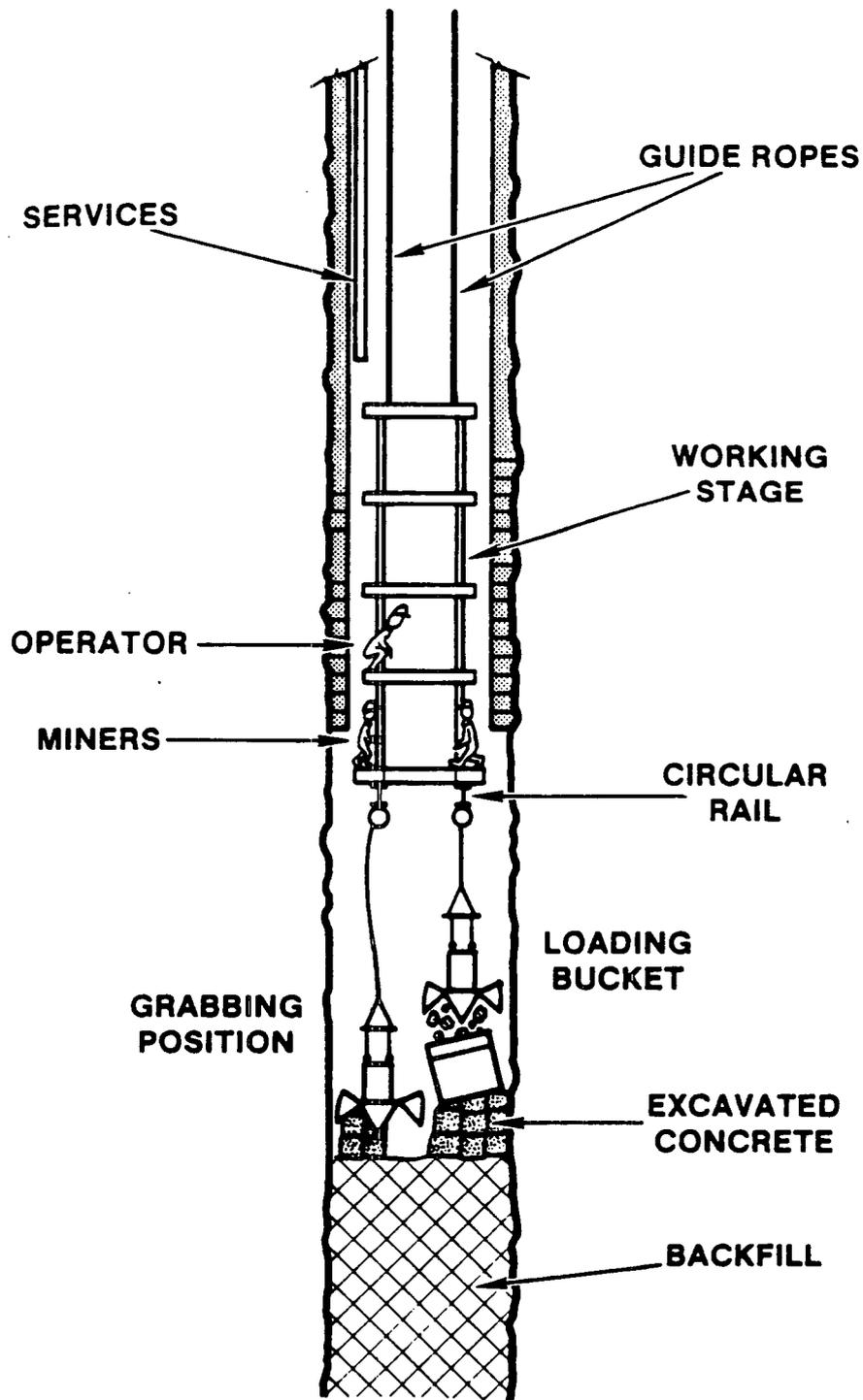
Production Cycle for Breaking and Removing the Liner and Placing the Backfill



NOTES

1. BREAKAGE SHOWN IS BY THE NONEXPLOSIVE DEMOLITION AGENT
2. THE PRODUCTION CYCLE IS APPLICABLE TO THE HANDHELD PNEUMATIC BREAKER, DRILL AND BLAST, AND HYDRAULIC SPLITTER METHODS
3. IN USING HANDHELD PNEUMATIC SPLITTERS, THE LINER IS BROKEN FROM THE TOP DOWN OVER 10 m.

Removing the Pieces of Concrete Using the Orange-Peel-Grab Unit

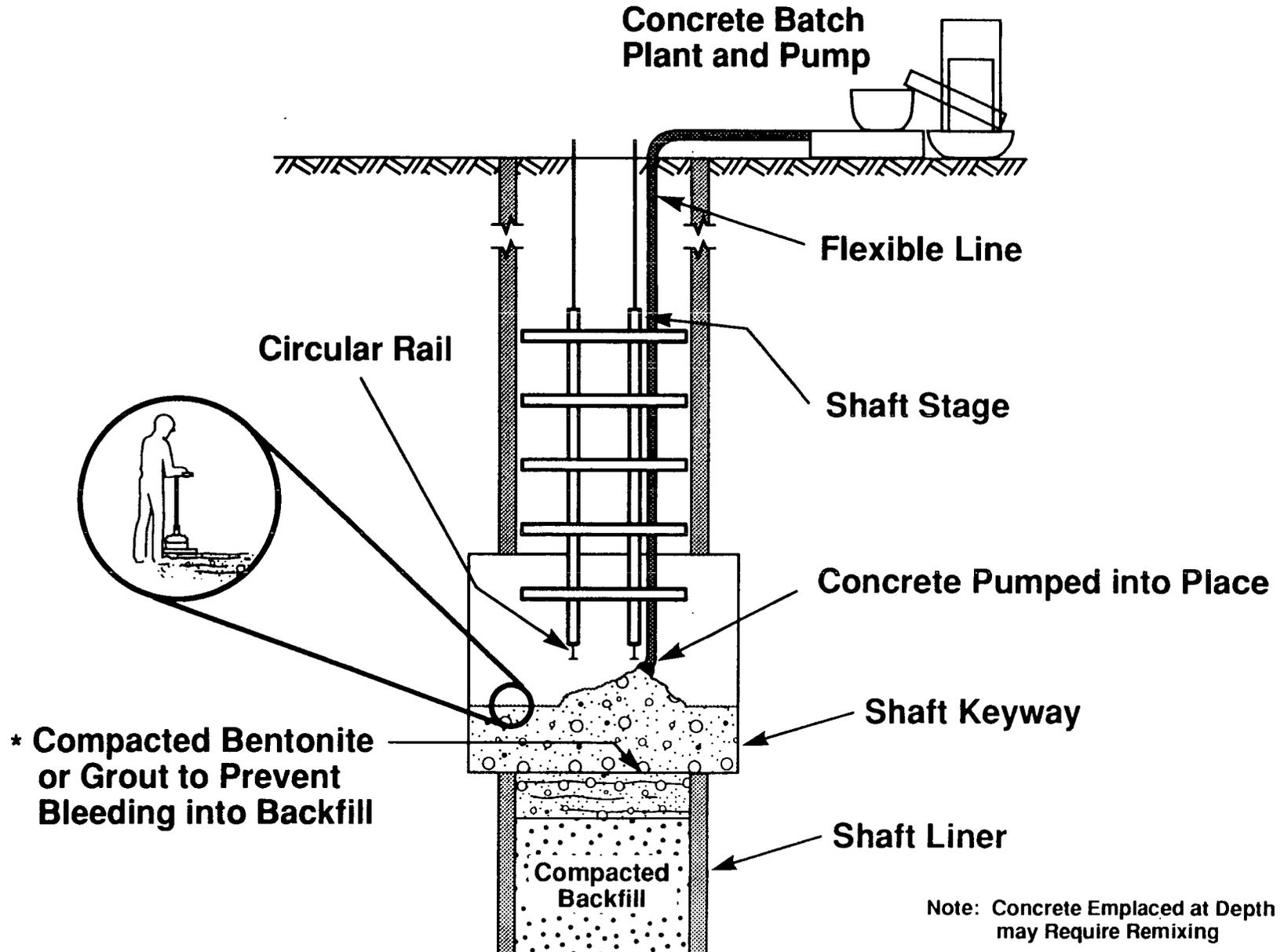


Picture Showing Rotary Underdeck Mucking Unit

Picture Showing Cactus Grab

Picture Showing Impact Breaker

Emplacement of Cementitious Seal



Contact Grouting of Interface Zone

