Cement grout injection to hydraulically fracture the soil and produce horizontal grout lenses, which serve as water barriers and provide in-situ reinforcing of soils.

For:
- Moisture-related shrinking/swelling of clay soils
- Reinforcing soils on slopes
- Reinforcing soils adjacent to retaining walls and large diameter pipes
- Increasing friction and end bearing for piles and piers
- Reducing vibrations of heavy machinery
- Stabilizing loose backfill in trenches

Our Clients
Our clients include owners of commercial and industrial facilities, engineering consultants, contractors, and public agencies. Among them are the following:

Aerojet General Corporation
Aetna Insurance Company
Alyeska Pipeline Service Co.
American Airlines
Ameron Concrete & Steel Pipes
S.J. Amoroso Construction
Arizona Highway Department
Atlantic Richfield Hanford Co.
Ball, Ball and Brosamer, Inc.
Berkeley Unified School District
Bethlehem Steel Corporation
Blackhawk Corporation
Browning-Ferris Industries
Calif. State Automobile Assn.
Calif. Water Service Co.
CalTrans
Carnation Milk Company
Chevron U.S.A., Inc.
City of Pasadena
Contra Costa Water District
Dan Caputo Company
Del Monte Corporation
Dillingham Construction Co.
Dinwiddie Construction Co.
Disneyland
Dow Chemical Company
East Bay Municipal Utilities Dist.
E.I. DuPont de Nemours & Co.
Essex Realty
Foremost Foods
Freeport-McMoRan resource Ptnrs.
General Electric Co.
General Motors Co.
Granite Construction Co.
Hewlett Packard Co.
The Home Depot
IBM Corporation
Intel Corporation
Irvine Land Management Co.
Jacobs Construction
Kaiser Aluminum and Chemical Co.
Kaiser Hospitals
Kaufman & Broad
Kiewit Pacific Company
Lawrence Livermore Laboratories
Liberty High School
Sebastopol School District
Lockheed Missiles & Space Co.
Long Beach Unified School Dist.
L.A. Dept Water & Power
MCM Construction Co.
Modern Continental
Morrison-Knudsen Co.
Nevada Highway Dept.
Nordic Industries
Novato Hospital
Oceaneering International, Inc
Homer J. Olson Co.
Oregon Highway Dept.
Pacific Cement & Aggregates
Pacific Gas and Electric Co.
Perini Building Company
Phillips Petroleum Co.
P.K. Contractors, Inc.
Plant Construction
Port of Los Angeles
Port of San Francisco
Public Service Co. of Colorado
Pulite Homes
Ragu Foods, Inc.
Ranger PipeLines
Riverside Cement Co.
Rudolf & Bletten, Inc.
San Francisco Intl Airport
Santa Cruz Metropolitan Transit
Shell Oil Company
Shimmick Construction Co., Inc.
Standard Pacific Homes
Swinerton & Walberg
Tico Construction
Trans World Airlines
US Steel
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Navy
Alameda N.A.S.
Mare Island
Moffett Field
Pearl Harbor
Port Hueneme
U.S. Steel Corporation
Underground Construction Co.
United Airlines
Unocal
Vadnais Corp.
Vallejo Sanitation District
Washoe County, Nevada
West Coast Contractors, Inc.
Williams+Burrows, Inc.

Engineering Consultants
AGS, Inc.
Berlogar Geotechnical Consultants
Bromwell & Carrier, Inc.
Brown and Caldwell
CH2M Hill
Converse Consultants
Dames and Moore
Diaz Youman & Associates
H.J. Degenkolb & Assoc.
DeLeuw, Cather & Co.
Earth Mechanics Inc.
GeoLabs, Inc.
Harding-Lawson & Assoc.
Harco, Kasunich & Associates
Harza
Jacobs Engineering
Kaiser Engineers
Kleinfield, Inc.
Kennedy-Jerks Engineers
Krazman & Associates Inc.
Law/Crandall, Inc.
Leighton & Associates
Moffatt & Nichols Engineering
James M. Montgomery Cons. Engrs., Inc.
Parsons-Brinckerhoff-Quade-Douglas
Parsons-Brinckerhoff-Tudor-Douglas
PIA Group
SEA Engineers
Tudor Engineers
Treadwell & Rollo
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Wahler Associates
Western Technologies
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Lense grouting is a specialized technique for the injection of a cement grout to hydraulically fracture the soil and produce multiple, water-resisting, near-horizontal grout layers that (1) reduce the moisture related shrinking/swelling of clay soils and (2) provide in-situ reinforcing of soils.

In theory and in practice, at a given pressure, a grout with the proper viscosity (consistency) will fracture a soil mass in a plane normal to the principal stress (vertical) or along bedding planes. Based on this theory and utilizing its many years of grouting know-how, The Pressure Grout Company experimented with the technique and developed the injection of a cement grout to hydraulically fracture the soil and produce multiple, near-horizontal grout layers that (1) reduce the moisture related shrinking/swelling of clay soils and (2) provide in-situ reinforcing of soils.

Grouting with the proper viscosity (consistency) will reduce the moisture related shrinking/swelling of water-resisting, near-horizontal grout layers that (1) fracture the soil and produce multiple, near-horizontal grout layers that (2) provide in-situ reinforcing of soils.

For expansive clay soils, injections are generally made at regular intervals to a depth below the actual injections in the field.

Lense grouting has been successful in strengthening loosened soils, improperly compacted fills, soils loosened by overexcavation, etc., as shown in Figure 4.

Other Applications

The applications for lense grouting are numerous. The Pressure Grout Company has used the technique to:

1. Develop skin friction for sinking piles in soft clays, as shown in Figure 3.
2. Support uncompacted soils in deep trenches.
3. Stabilize soils loosened by over-excavation, e.g., for elevator shafts or pits,
4. Stabilize soils loosened by excavations, e.g., for elevator shafts or pits,
5. Provide water barriers for foundations in soils with subsidence characteristics, and
6. Form reinforced earth mats in collapsible soils under existing structures.

Applications

The Pressure Grout Company has developed applications and used lense grouting with success in such cases as:

- Structures — Grouting the perimeter to reduce and eliminate soil expansion and contraction
- Creep —To reduce and eliminate creep by reinforcing loose formations and expansive soils
- Soil Strengthening —To strengthen loose soils, particularly in close proximity to retaining walls
- Pipes and Piers —To increase friction and end bearing
- Trenches —To stabilize loose backfill

Experimental uses of lense grouting, based on studies carried out at Stanford University, include the in-situ reinforcement of soil to allow steep excavation slopes, earth mat foundations, and other applications.

Reduction of Expansive Clay Movements

Expansive clays are known for their shrinking and swelling with changes in moisture content. Seasonal and differential changes in the moisture content of these clays can cause heaving and settlement, as well as differential movements of structures built upon them. These effects can be reduced or eliminated by lense grouting, which introduces moisture barriers within the clay mass.

Soil Reinforcement

Soil reinforcement can be achieved by providing overlapping lenses of cement grout. The level of reinforcement can be increased by shortening the lensing interval, increasing the grout strength, and having greater overlapping of lenses. Overlapping injection pipes can be operated at distances several hundred feet from the injection site. The work of The Pressure Grout Company on a lense grouting assignment is shown in Figure 4.

The Pressure Grout Company

The Pressure Grout Company has extensive experience in all types of lense grouting for site development, new construction, and the stabilization of existing structures. We work closely with owners, engineering firms, contractors, and public agencies through the United States. We:

- Build, operate, and maintain our own equipment
- Have one of the few research and development laboratories for grout materials and mixes
- Have a staff that includes engineers with extensive knowledge and experience in soils engineering
- Are licensed contractors and members of the Associated General Contractors
- Have broad, in-depth grouting experience that extends over a period of more than 45 years