

## 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  
Devcon Construction, Inc.  
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 Ptrns.  
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. Olsen Co.  
Oregon Highway Dept.  
Pacific Cement & Aggregates  
Pacific Gas and Electric Co.  
Perini Building Company  
Philips Petroleum Co.  
PK Contractors, Inc.  
Plant Construction  
Port of Los Angeles  
Port of San Francisco  
Public Service Co. of Colorado  
Pulte Homes  
Ragu Foods, Inc.  
Ranger Pipelines  
Riverside Cement Co.  
Rudolf & Sletten, Inc.  
San Francisco Int'l Airport  
Santa Cruz Metropolitan Transit  
Shell Oil Company  
Shimmick Construction Co., Inc.  
Standard Pacific Homes  
Swinerton & Walberg  
Tico Construction  
Trans World Airlines  
USS Posco  
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 Yourman & Associates  
H.J. Degenkolb & Assoc.  
DeLeuw, Cather & Co.  
Earth Mechanics Inc.  
GeoLabs, Inc.  
Harding-Lawson & Assoc.  
Haro, Kasunich & Associates  
Harza  
Jacobs Engineering  
Kaiser Engineers  
Kleinfelder, Inc.  
Kennedy-Jenks Engineers  
Krazan & Associates Inc.  
Law/Crandall, Inc.  
Leighton & Associates  
Moffatt & Nichols Engineering  
James M. Montgomery Cons. Engrs., Inc.  
Parsons-Brinckerhoff-Quade-Douglas  
Parsons-Brinckerhoff-Tudor-Douglas  
PRA Group  
SEA Engineers  
Tudor Engineers  
Treadwell & Rollo  
URS  
Wahler Associates  
Western Technologies  
Woodward-Clyde Consultants



1975 National Avenue  
Hayward, CA 94545-1709  
Tel: 510.887.2244

1330 W. Gaylord Street  
Long Beach, CA 90813-2714  
Tel: 562.432.4100

P.O. Box 1582  
Mukilteo, WA 98275-1582  
Tel: 206.621.0900



*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.*

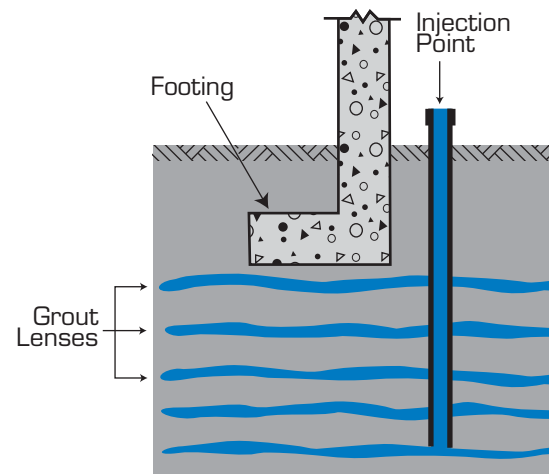
For

- ▲ Reducing 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

**THE PRESSURE GROUT COMPANY**

**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



**WATER BARRIERS FOR EQUALIZATION OF SOIL MOISTURE AROUND THE PERIMETER OF A STRUCTURE**

Figure 1

In its applications, lense grouting uses a cement base grout with the consistency of thick cream. This grout is injected into the soil mass, fracturing it horizontally and creating multiple lenses. Each lense is designed to be about 10 feet in diameter and 1/8 of an inch thick. The formation of these lenses has been demonstrated by the excavation of actual injections in the field.

For expansive clay soils, injections are generally made at regular intervals to a depth below the seasonal wetting/drying zone. The result is the creation of multiple water barriers, as shown in Figure 1.

## 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
- ▲ Piles and Piers—To increase friction and end bearing
- ▲ Trenches—To stabilize loose backfill

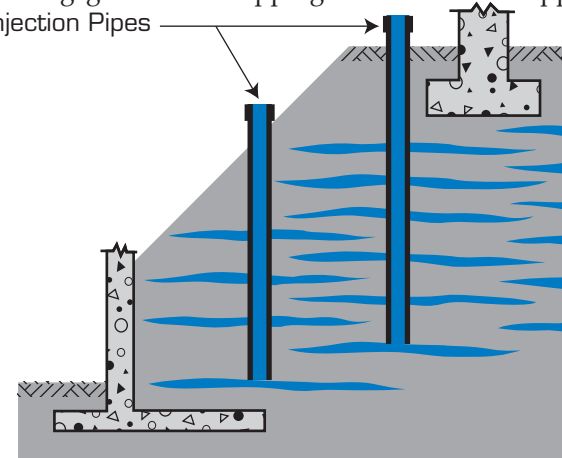
Experimental uses of lense grouting, based on studies carried out at Stanford University, include the in-situ reinforcement of soil to allow steep excavation slopes, earth mat foundations, and other applications.

### 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



**LENSE GROUT REINFORCEMENT WITH OVERLAPPING**

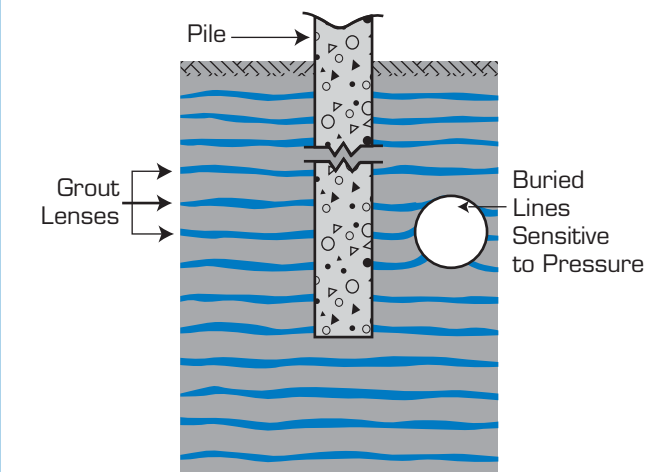
Figure 2

lense grouting has been successful in strengthening loosened soils, improperly compacted fills, soils loosened by overexcavation, etc., as shown in Figure 2.

### 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) Strengthen soils loosened by over-excavation, e.g., for elevator shafts or pits,
- 4) Strengthen soils loosened by excavations,
- 5) Provide water barriers for foundations in soils with subsidence characteristics, and
- 6) Form reinforced earth mats in collapsible soils under existing structures.



**IMPROVEMENT OF SKIN FRICTION AND BEARING FOR PILES**

Figure 3

### Equipment

The Pressure Grout Company has designed and built specialized mixing, pumping, and injection equipment for lense grouting. This equipment 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



Figure 4

We know and understand your problems, and welcome your inquiries:

### The Pressure Grout Company

1975 National Avenue  
Hayward, CA 94545-1709  
Tel: 510.887.2244

1330 W. Gaylord Street  
Long Beach, CA 90813-2714  
Tel: 562.432.4100

P.O. Box 1582  
Mukilteo, WA 98275-1582  
Tel: 206.621.0900

