Prefabricated Vertical Drain Sources

Ali-drain	Dougherty Foundation Products, Inc. 7 Washington Avenue, Patterson, New Jersey 07503 (201) 337-5748
Mebra-drain	International Construction Equipment, Inc. 301 Warehouse Drive, Matthews, N.C. 28105 (800) 438-9281, (704) 821-7681 L. B. Foster Co., 415 Holiday Drive, Pittsburgh, PA 15220 (412) 928-3475
Geodrain	Terrafigo A.B., Kungsgatan 32, S-111 35 Stockholm, Sweden (08)-11-03-32
Bando	Harry Fukuzawa & Associates, 6129 Queenridge Drive Rancho Palos Verdes, CA 90274 (213) 377-4735
Sol Compact	Moretrench American Corporation, P.O. Box 316 Rockaway, NJ 07866 (201) 627-2100
Colbond (CX-1000)	American ENKA Company, Enka, NC 28728 (704) 667-7110
Amerdrain (Type 407)	International Construction Equipment, Inc. Corporate Offices, 301 Warehouse Drive Matthews, NC 28105 (800) 438-9281
Vinylex	Vinylex Corporation, P.O. Box 7187 Knoxville, TN 37921 (615) 690-2211
Hitek	Burcan Manufacturing, Inc. 100 Union Street, Suite 16 Bridgeville, PA 15017 (412) 257-2751 Attention: Alvin W. Berthold
Castleboard	Harquin International Corporation 3112 Los Feliz Boulevard Los Angeles, CA 90039 (213) 669-8332

Field Experiences

Since the start and completion of the described test program, the New York State DOT has had three installations of wick drains. These were installed on two separate projects in the central part of the state, one in the vicinity of Syracuse, New York, the other near Utica, New York.

The Utica installation involved the construction of 30± ft high embankments over 20 ft of soft, wet, organic soils. Of concern was the potential for instability of the foundation soils. This was compounded by long-term settlement of the embankments.

The wick drain selection to stabilize the foundations soils through rapid consolidation and strength gain was made over the conventional excavation of these soils and replacement with granular material at a savings of over $3 million.

The wick drains were installed in a triangular pattern, with 4 ft spacings. The performance of the installation verified the anticipated results based on the previously described laboratory test program.

The two installations on the Syracuse project involved the construction of 35 to 40 ft. embankments over 15± ft. of miscellaneous fill, underlain by 20± ft. of marl over 30± ft. of soft silts and clays.

The wick drains were installed on spacings ranging from 4 to 7 ft. Previous construction in the area had used a conventional sand drain installation to accelerate the consolidation of the weak, fine grained foundation soils. At this time there is no estimate of total savings by the use of the wick drains, although, they are estimated at approximately half the cost of conventional sand drains.

As in the Utica project, the wick drains performed as anticipated from the laboratory test program.

References

1. Suits, L.D., Gemme, R.L., Masi, J.J., The Effectiveness of Prefabricated Drains on the Laboratory Consolidation of Remolded Soils, ASTM D18, Symposium, January, 1985.

CONSTRUCTION CONTROL for WICK DRAIN SYSTEMS

by
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In most cases, wick drains will be installed on projects involving questionable foundation stability. Indeed, the function of the drains is to provide a relatively rapid drainage path in order to accelerate consolidation and thus improve the strength of soft foundation soils. Strip load embarkment construction such as that for highways and railroads is particularly vulnerable because failure can occur on both side slopes and foreslopes. Good construction control is essential in order to assure success.

In "high risk" situations, such as that where wick drains are installed for ground improvement, a well conceived instrumentation system to monitor ground movements and pore water pressures is essential. Carefully selected instruments, installed by qualified personnel and continuously observed will provide data to confirm design assumptions or indicate potential problems; to indicate the drainage wicks are functioning properly and to control construction rates, so construction can proceed as rapidly as is consistent with project safety.

For construction control, certain basic instrumentation is essential. The amount and sophistication of any instrumentation should be related to the size and importance of a project and to the consequences of failure.

On the Caltrans project at Dumbarton in the South San Francisco Bay, where wick drains were installed, various instruments were employed; some being primarily for research purposes.

Instrument stations were set up at 500 foot intervals.

The instruments used were:

- o pipe riser settlement platforms
- o open tube piezometers
- o horizontal profile gages
- o anchor post settlement gages
- o inclinometers
- o heave stakes

A reliable monitoring system is dependent upon the quality of the instruments, the care of installation, the competence of the installer-observer-recorder; and of course the interpretation being made by an experienced, knowledgeable engineer.

Of these, the settlement platforms and piezometers are considered essential on projects of this type.

The horizontal profile gage was installed at five locations and performed well to a settlement depth of 3 to 3.5 feet. Below that depth the gage literally came apart and was no longer functional. Within the limits of the gage a good bottom of fill profile was obtained.

The anchor post settlement gages were installed at selected locations in the soft foundation soil primarily for research purposes, i.e., in an attempt to measure the amount of consolidation occurring at various depths.

"Inclinometers" or "slope indicators" were employed only where stability was considered critical and adjacent improvements could be affected. At Dumbarton a radio station was located in the mud flats immediately adjacent to the new roadway embankment and could have been jeopardized by a slope failure.

Heave stakes generally reveal little about what is happening until after it happens. When employed under certain conditions, however, heave stakes are considered appropriate and can be installed at relatively low cost.

The simplest instrument is usually the best. Thus, the pipe riser settlement platform was chosen over the hydraulic settlement gage or settlement sensor. The open tube piezometer was also used effectively and showed very rapid response to increased loading. Increased pore pressure due to added loading was reflected within one day. This device is inexpensive and can be installed at low cost using a drill rig.

The "key" instruments in soft soils are the settlement platform and the piezometer. The importance of proper installation and monitoring of these devices cannot be over emphasized. A recommended minimum of one settlement platform per centerline station and two or three piezometers installed at variable depths at each centerline and hinge point location are needed for pore pressure verification. Once the critical height of fill has been reached and stability is marginal, the decision to stop, delay, or advance will be based on an interpretation of the data developed from these devices.

A rule-of-thumb used by Caltrans Engineers in applying restraint to construction progress is to cease fill placement when piezometric readings reach 50% of the applied load. However, readings exceeding 60% of applied load were recorded at Dumbarton and on other Caltrans wick drain projects without the development of instability. This was due possibly to the amount and rate of strength gain plus other stability considerations at these greater pore pressures. Re-evaluation of the 50% rule of thumb is therefore suggested when the effects of reinforcing or stabilization fabrics beneath the embankment are considered. Sixty percent of the applied load may be a reasonable value when using fabrics.

The sequence of instrumentation installation is also important and the following is a recommended sequence:

Settlement Platforms:	Before placement of fill if possible or immediately as a suitable working table is established.
Piezometers:	Immediately following installation of wicks, in order to avoid loss of instruments to wick driver.
Horizontal Profile Gage:	Before placement of any fill, if possible, or trench through first 3 to 5 feet of fill. Also modify wick installation to miss instrumentation.
Anchor Post Settlement Gages:	Place through first 3 to 5 feet of fill.
Inclinometers:	Through completed strut fill but only as specifically required.
Heave Stakes:	After placement of first 5 feet ± of fill.

A reliable monitoring system is dependent upon the quality of the instruments employed, the care of installation, the competence of the installer-observer-recorder; and of course the interpretation being made by an experienced, knowledgeable engineer.

The best system in the world will be useless unless continuously observed, recorded and analyzed. The Soils Engineer will then be in a position to confidently advise the Construction Engineer on control of the project.

IMPACTS OF DESIGN AND SPECIFICATION REQUIREMENTS ON ACTUAL WICK DRAIN CONSTRUCTION

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While it is very important to carefully design a wick drain installation and include specifications that will result in the intended aims of the design, consideration of the practical and economical effects of the design and specification process on the actual installation of wick drains may be equally important. Frequently, standard design procedures or specifications are often used without recognizing their cost and/or practical effects on the project. From actual projects, examples include: (1) specifying wick drains to be installed at an elevation below water when stability and eventual fill height allowed installation above high tide; (2) specifying fixed exact depths which resulted in the need to install some drains into rock or very dense layers; (3) scheduling drains after bridge construction without proper headroom clearance to install drains under the bridge; and (4) solely specifying installation methods or types of drain materials which do not lend themselves to project climatic conditions (example: a jetting method with paper filter in freezing conditions). Therefore, an understanding