

I. Construction Innovation Forum • NOVA Award Nomination

Instructions

Step 1 Enter a Descriptive Name for the Process/Method/Technique you are nominating on line A of this page.

Step 2 Complete this page.
"I. Construction Innovation Forum • NOVA Award Nomination"

- a. Be sure to provide original signatures in Section B and E on this page. Your nomination cannot be reviewed without them.
b. If you need additional space for names and addresses you may attach additional pages for names and address information.
You may attach extra pages only for sheet I.

Step 3 "II - Innovation Description" — attach one (one only) 8-1/2" X 11" page that gives a succinct written description of the innovation. Put the name of the innovation at top of page. Tell us what you think is innovative about this. You should include:

- What the innovation is
- Why it is innovative
- What it changed or replaced
- Where and when it originated, has been used, and is expected to be used in the future
- If the nomination is for an innovative project, specifically identify its innovations.

Please type, with 1" margins, 10 characters per inch, 6 lines per inch.

Step 4 "III - Innovation Illustration" — attach one (one only) 8 1/2" X 11" page that contains one or more photographs, drawings, tables, graphs, clauses, etc., that visually describe the innovation. Do not submit more than one page of visuals. The jurors will see only one sheet for review. Put the name of the innovation at top of page.

Other You must submit 12 (twelve) sets of sheets I, II and III (a total of 36 pages)

Nominations are due September 15 mailed or delivered to:

The Construction Innovation Forum, 1000 Campus Drive, Suite 100, Ann Arbor, MI, USA 48104-6792, Phone: 313-995-1855, Fax: 313-975-5002

A. Name of Innovation: Osterberg Load Cell for testing capacity of drilled shafts and driven piles

B. Person(s) and /or Organization(s) Primarily Responsible for the Innovation (Those to whom NOVA Award should be presented.)

Name: Dr. Jorj O. Osterberg

Title: Professor Emeritus

Affiliation: Northwestern University

Address: 16416 E. Powers Place

Aurora, Colorado 80015

Phone: (303) 699-1816

Signature: Jorj Osterberg

(Signature(s) indicate acceptance of the nomination and consent to have CIF research and make presentations on the innovation for the purpose of jurying and publicizing awards.)

C. Other Primary Sources of Information on the Innovation: (in addition to the persons nominated above.)

Name: Mr. Barry Berkovitz

Title: S.E. Area Geotechnical Eng.

Affiliation: Federal Highway Admin.

Address: 1720 Peachtree Rd. Ste. 200

Atlanta, Georgia 30367

Phone: (404) 347-4167

Mr Charles L. Guild

Title: Founder

Affiliation: American Equip. & Fabricating Corporation

Address: 100 Water Street

East Providence, RI 02914

Phone: (401) 431-4049

Dr. John Schmertmann

Title: Schmertmann & Crapps Consul. Eng.

Address: 4509 N.W. 23rd Ave., Ste 19

Gainesville, FL 32606

Phone: (904) 378-3717

D. Independent Reference(s) familiar with the use of the Innovation

Name: Mr. Dennis Millgard

Title: President

Affiliation: The Millgard Corp.

Address: 12822 Stark Road

Livonia, MI 48151

Phone: (313) 425-8550

Mr. John O'Malley

Title: President

Affiliation: Case International Inc.

Address: P.O. Box 40

Roselle, IL 60172

Phone: (312) 625-1250

Mr. Mark Haley

Title: Vice President

Affiliation: Haley & Aldrich

Address: 58 Charles Street

Cambridge, MA 02141

Phone: (617) 494-1606

E. Person(s) making nomination:

Name: Mr. Larry P. Jedele

Title: Senior Consultant

Affiliation: Soil and Materials Engineers, Inc.

Address: 43980 Plymouth Oaks Blvd.

Plymouth, MI 48170

Phone: (313) 454-9900

Signature: Larry P. Jedele

Mr. Clyde Baker

Title: Chairman

Affiliation: STS Engineers

Address: 111 Pfingsten Road

Northbrook, IL 60062

Phone: (708) 272-6520

Signature: Clyde N Baker

Mr. Scot Litke

Title: Executive Director

Affiliation: Assoc. of Drilled Shaft Cont.

Address: P.O. Box 289379

Dallas, Texas 75228

Phone: (214) 343-2091

Signature: Scot Litke

(Signature(s) indicate familiarity with the the innovation and signify that information contained in the nomination is correct to the best of one's knowledge.)

OSTERBERG LOAD CELL

When designing drilled pier foundations, geotechnical engineers initially estimate the bearing capacity of the supporting soil/bedrock based on soil borings and analyzing test results. On site load tests are often performed on piers to more accurately estimate the soil characteristics during the design phase. The goal of the load test is to determine the load carrying capacity of the supporting material.

Two load test methods are commonly used where the load is applied at the top of the pier by a hydraulic jack. In one method, the pier is jacked against a large box filled with dead weight constructed over the test pier. The other method involves jacking the test pier downward against a beam system connected to a series of reaction piers on opposite sides of the test pier. For both methods, considerable time and expense are involved in set-up and disassembling the testing equipment. Also, the reaction box method presents a higher risk of maintaining safety of workers during the test.

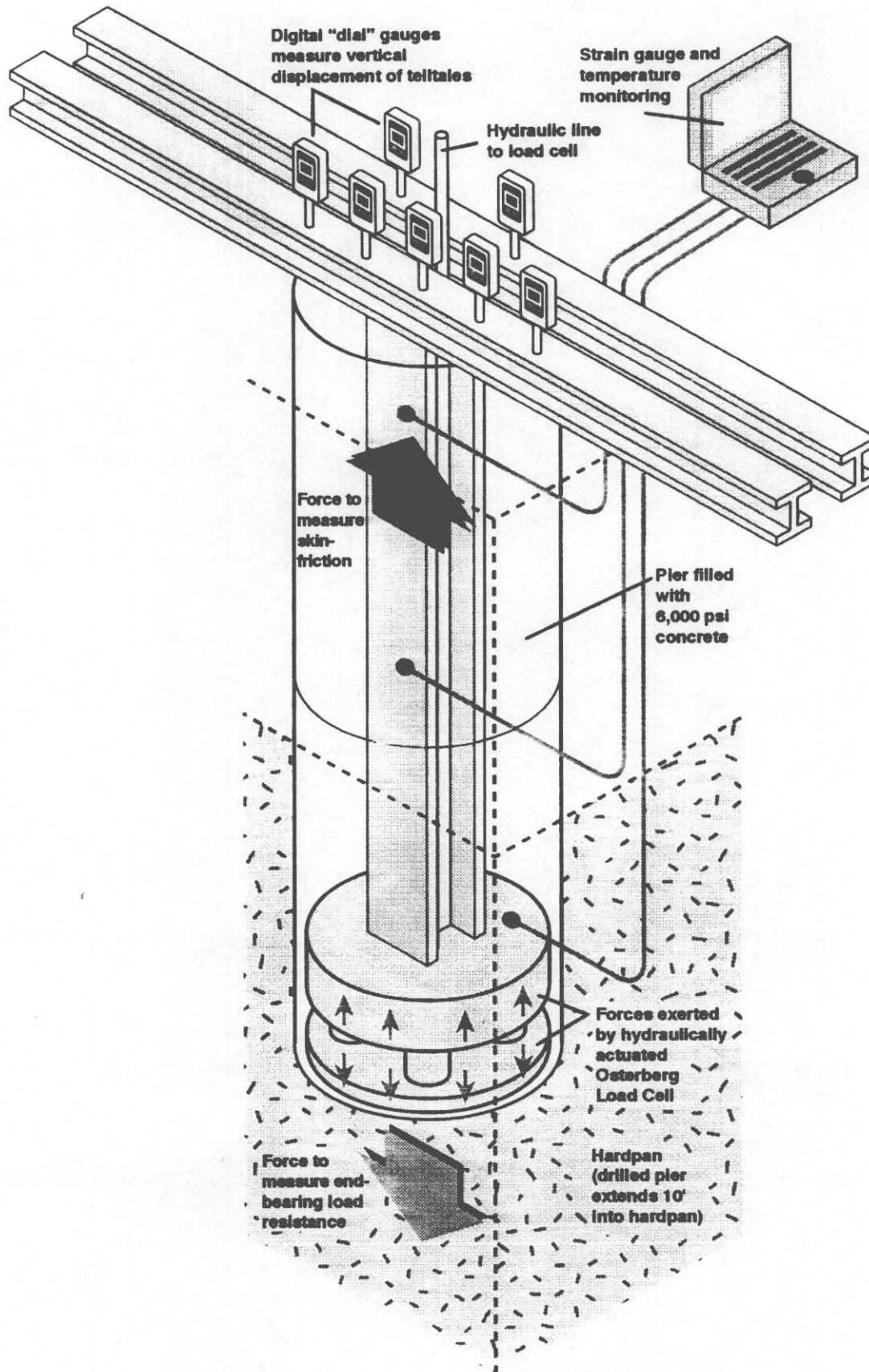
A major disadvantage of traditional load tests is the difficulty distinguishing between the portion of the test load resisted by skin friction along the sides of the drilled shaft and the portion resisted by end bearing at the bottom of the pier. The relative contributions of skin friction and end bearing are important considerations in determining the size and number of piers to support the structure being planned.

A new technique has been developed to address some of the shortcomings of traditional load testing. The Osterberg Load Testing Procedure involves a specialized load cell which is placed at the bottom of the drilled test pier. The pier excavation is then filled with concrete as shown by the "Innovation Illustration" on the next page. A hydraulic line pressurizes the load cell, causing it to expand vertically. The downward force of the bottom of the cell is resisted by the bearing stratum while the upward force of the top of the cell is resisted by the weight of the pier and skin friction along the sides of the pier. This technique has been referred to as the "Upside-Down Load Test" because the load is applied at the bottom of the drilled pier and the displacement of the pier is upward, rather than downward.

The method is superior to the conventional load test methods, since it separates the end bearing and skin friction components for resisting applied loads. As a result, this test method permits more accurate estimation of pier capacity, thus allowing geotechnical engineers to design, and contractors to construct more cost-effective foundations. The expense of unnecessary conservative designs can be reduced and the risk of underdesigned foundations can be minimized. Further benefits of using this method over conventional methods include saving many days for the testing and it can be used in open bodies of water and in otherwise inaccessible test locations. Unlike conventional methods, it does not interfere with other work in progress at a site. It also has been used on driven piles as long as 145 feet.

The load cell and test procedure was developed by Dr. Jorj Osterberg, Professor Emeritus of Civil Engineering Northwestern University and Consulting Geotechnical Engineer. The load cell technology is being offered through Loadtest, Inc. It has been used about 50 times worldwide, but is anticipated to become more popular as word gets around. In one recent application at the Veterans Administration Medical Center in Detroit, Michigan the Osterberg technique was used to demonstrate the bearing layer (hardpan) could support 40 percent more end bearing than would otherwise have been allowed by local building code, in addition to skin friction in the hardpan and overlying clays. Using these increased values, the geotechnical engineer was allowed to design a more cost-effective foundation system, saving about \$400,000 in construction costs. At another application in Kentucky, a total of 3,000 tons was developed in both end bearing and skin friction, resulting in a combined 6,000 ton load test which is believed to be the largest load test ever conducted. As a result, considerable savings in foundation costs were realized for that project. Furthermore, many tests have been used to determine the friction between the concrete and rock in rock socketed drilled shafts and in every case, the test results allowed the engineer to shorten the depth of the sockets, thus resulting in considerable savings in drilling and concrete costs.

"Upside-Down" Load Test



AWARD MANAGER'S SUMMARY
Nomination 9417

OSTERBERG LOAD CELL

The Innovation

The Osterberg Load Cell allows geotechnical engineers to determine the capacity of drilled shafts, piers, and driven piles. It is used to test for the bearing and skin friction forces that can be developed in the soil through which the shaft, pier, or pile is placed.

The Osterberg Load Cell is a specialized pressure cell that is placed at the bottom of the excavation for a drilled test pier or pile. It has a hydraulic line extending from the cell to the top of the excavation. After placement, the pier excavation is filled with concrete.

The cell is designed to expand both upward and downward when it is pressurized by way of the hydraulic line. The downward force from the bottom of the cell is resisted by the bearing stratum while the upward force from the top of the cell is resisted by the weight of the pier and by skin friction along the sides of the pier. The test pier is instrumented with telltales to measure the upward and downward displacements of the cell.

This technique has been referred to as the "Upside-Down Load Test" because the load is applied at the bottom of the drilled pier and the displacement of the pier is upward, rather than downward.

A load test made with the Osterberg Load Cell is different from a conventional load test, since there is a separation of the end bearing and skin friction components for resisting applied loads. Consequently, this test method allows geotechnical engineers to more accurately estimate pier capacity and to design and construct more cost-effective foundations. The expense of unnecessary conservative designs can be reduced and the risk of underdesigned foundations can be minimized.

Very large loads can be applied with the Osterberg Load Cell. Test piers can be constructed vertically, slanted, in a building, in water, or in otherwise inaccessible locations.

Setting up a test requires little time and saves many days in obtaining the necessary data.

Unlike conventional methods, the use of the Osterberg Load Cell does not clutter the site or interfere with other work in progress.

Because of the simpler configuration of an Osterberg test, workers are in a safer environment than if weights or reaction beams are used.

Tests using the Osterberg Load Cell are reported to be 20% to 50% less expensive than conventional load tests.

Because the Osterberg Load Cell is permanently in place, a retest of the pier can be conducted at any convenient time. A test may be repeated at any time in the future, even after the structure is completed.

Background of Innovation

The Osterberg Load Cell and test procedure was originated and developed by Dr. Jorj O. Osterberg, Professor Emeritus of Civil Engineering at Northwestern University and Consulting Geotechnical Engineer.

When designing drilled pier foundations, geotechnical engineers initially estimate the bearing capacity of the supporting soil or bedrock from soil borings and on-site load tests. The goal of a load test is to determine the load carrying capacity of the supporting material.

Two load test methods are commonly used. In both cases, the load is applied at the top of the pier or pile by a hydraulic jack. In one method, the pier or pile is jacked against a large reaction box filled with dead weight that is constructed over the test pier. In the other method, the test pier is jacked downward against a beam system connected to a series of reaction piers on opposite sides of the test pier. For both methods, considerable time and expense are involved in setting up and disassembling the testing equipment.

A major disadvantage of these traditional load tests is the difficulty in distinguishing between the portion of the test load resisted by skin friction along the sides of the drilled pier and the portion resisted by end bearing at the bottom of the pier. The relative contributions of skin friction and end bearing are important considerations in determining the size and number of piers to support the structure being planned. Another disadvantage is that the reaction box method presents a high risk to worker safety during the test.

Professor Osterberg has been working on ideas to improved field loading tests for the last 10 years. Initially, he was concerned with the complicated, cumbersome, and unsafe traditional methods being used and he formulated the concept of the load cell. He created a small model cell in his laboratory, but he was unable to develop it further because of a lack of financial support.

About eight years ago he was successful in obtaining financing through Mr. John O'Malley of the Case Foundation and Mr. Charles L. Guild of the American Equipment Corporation. This assistance allowed Dr. Osterberg to do some preliminary testing of the cell using Case International facilities. Mr. Guild

helped with the fabrication and debugging of the cell and contributed much encouragement. Also, Mr. Barry Berkovitz of the Federal Highway Administration became interested in the cell for the testing of bridge foundations. He supplied test sites and some money.

Serious and significant field tests were started about 4 to 5 years ago. The load cells can be made of different sizes and capacities. There were some problems with seals and leaks for the large capacity cells. These problems have been resolved.

The cell has been in productive use for about five years.

The cell is patented in Dr. Osterberg's name.

Application

The Osterberg Load Cell has been used about 50 times worldwide. One recent application was at the Veterans Administration Medical Center in Detroit, Michigan. The Osterberg technique demonstrated that the bearing layer (hardpan) could support 40 percent more end bearing than would have been allowed by the local building code, and saved about \$400,000 in construction costs.

At another application in Kentucky, a total of 3,000 tons was developed in both end bearing and skin friction, resulting in a combined 6,000 ton load test that is believed to be the largest load test ever conducted. As a result, considerable savings in foundation costs were realized for that project.

It is anticipated that the use of the Osterberg Load Cell will become more popular as word gets around. There do not seem to be any serious problems with the cell.

The load cell technology is being offered through Loadtest, Inc.

Notes on Nominated Persons

Dr. Jorj O. Osterberg is a well known former faculty member of the Civil Engineering Department at Northwestern University. His field is Geotechnical Engineering and he has made significant contributions to that field apart from the load cell for which he is nominated.

Dr. Osterberg confided that he had been given an Innovation in Civil Engineering Award for the Osterberg Load Cell by the American Society of Civil Engineers (ASCE). After receiving the award, Dr. Osterberg was asked to make his invention open. As this would negate his patent protection and because he had spent a considerable amount of his own money during the development, he refused to sign such a statement and the award was withdrawn by

ASCE. (Editor's note: The applicable statement in the requirements for the Innovation in Civil Engineering Award reads as follows: "For each entry the innovator shall also provide the following: ... (e) a statement that the concept is submitted for free use as a voluntary contribution to the profession.")

Professor Osterberg does not know of anything similar to his load cell. He thinks that future applications of the cell will save lots of money for its users, as much as 20% to 50% below conventional methods. It will provide a flexible and fast method for soil data acquisition. High loads can be used if needed.

Opinions of Outside Persons

Mr. Clyde Baker

Mr. Clyde Baker is Chairman of STS Engineers and is one of the nominators of the Osterberg Load Cell. He has acted as a sounding board to Professor Osterberg and has provided encouragement and moral support. He has also arranged for sites to test the cell. Mr. Baker is using the Osterberg Cell now as he considers it to be the most cost effective method for bearing load plus skin friction measurements.

Mr. Baker says that the most innovative aspect is the load cell, itself. It has made measurements easy and very time-cost effective. Also, safety is great when compared to conventional methods. He cannot recall anything similar to the Osterberg Cell and he does not know of any alternative item.

Mr. Baker thinks that there will be future growth. Most impacts will be on cases where the separation of skin friction and bearing load capacities is highly desirable for design purposes.

Mr. Mark Haley

Mr. Mark Haley is Vice President of Haley and Aldrich, Consulting Engineers. Mr. Haley was one of the early users of the Osterberg Load Cell.

Mr. Haley likes to use the Osterberg Cell in the Boston area where the Boston Blue Clay and the deteriorated bedrock need reliable measurements. He is presently involved in some expressway work near Boston South Station and he thinks that the Federal Highway Administration likes the Osterberg cell.

Mr. Haley says that the Osterberg cell is most useful for high loads and special applications. For small jobs, conventional methods may be able to compete on costs with the Osterberg rig, but not in other ways nor in safety. Mr.

Haley thinks that Osterberg's goal is to reach a level of about 100 Osterberg Load cell jobs a year and do so in as short a time as possible.

Mr. Larry P. Jedele

Mr. Larry P. Jedele is Senior Consultant of Soil and Materials Engineers, Inc. He is a nominator of the Osterberg Cell. Mr. Jedele has used the cell on two sizable projects and hopes to use it in the future. He is enthusiastic about the method.

Mr. Jedele says that he has not had any problems with the method. It is simple and rugged. Apparently loads up to 3000 tons can be applied. It is difficult to apply such loads by conventional surface reaction methods. The future looks bright for the method.

Mr. S. Scot Litke

Mr. Scot Litke is Executive Director of the Association of Drilled Shaft Contractors. He is one of the nominators of the Osterberg Load Cell. Mr. Litke helped Professor Osterberg to obtain test sites and some seed money.

Mr. Litke says that the Osterberg Cell has revolutionized the procedure for measuring soil bearing and skin friction. It permits more rigorous and economical designs for shafts and piles. The static load frame and load boxes are tedious and cumbersome and should become a thing of the past. The Osterberg test is simple and easy to interpret.

Mr. Litke does not know of a load cell system similar to this. However, he has heard that in Europe work is in progress in this area.

Mr. Litke believes that the future is already here. The use of the cell is developing fast. The Federal Highway Administration is especially interested, as are several state highway departments. The future looks great.

Mr. V. Dennis Millgard

Mr. V. Dennis Millgard is President of The Millgard Corporation of Livonia Michigan. Mr. Millgard has known Dr. Osterberg for about 35 years. About ten years ago, Dr. Osterberg started to work on his load cell. Since then, Mr. Millgard has given him encouragement and is using the cell on his projects.

Mr. Millgard says that the Osterberg system enables engineers to test a foundation and get reliable and accurate

results for design purposes. It is simple and cost effective.

Mr. Millgard believes that the use of the cell is growing. It is cost effective and can be used in places where conventional loading schemes do not work; for instance, in water.

Mr. Jerry Parola

Mr. Jerry Parola is an executive of Case International, Inc. He responded to a call to Mr. John O'Malley, the President of Case International.

Mr. Parola saw a Canadian STATNAMIC demonstration in Seattle in 1990. Essentially, a charge of explosives is detonated on top of the pile and the total capacity is estimated from the response. Data reliability is in question. The method is limited as to load. Load bearing and skin friction are not separated. Safety may be of concern since the explosive is detonated on top of the pile. Mr. Parola also thinks it is complicated and expensive.

Award Managers' Comments

The Osterberg Load Cell appears to be a major advancement in the testing of soil bearing and shear capacities for shafts, piers, and drilled piles. There does not seem to be any other load cell procedure available. The significant aspect is the ability of the method to separate bearing and shear forces in the soil. It is safe and easy to use.

SELECTED INTERVIEW SUMMARIES

Phone Interviewer: Tons
Date: 11/17/93

#9417
No. 1

Name: Dr. Jorj O. Osterberg
Title: Professor Emeritus (Northwestern University)
Affiliation: 16416 E. Powers Place
Aurora, CO 80015

1. Professor Osterberg says that the primary innovation is that you load a test pile by pushing from the bottom while using the soil for the reaction. You measure the load bearing and frictional components separately. You can apply any load. You can apply it vertically, slanted, in a building, or under the high seas. It is a fast moving operation without cluttering the construction site with reaction boxes (weights) or loading beams and reaction piles.
2. Professor Osterberg does not know of anything similar to this.
3. The alternative tests are mentioned in the summary sheet of the 3-page nomination material. (Weight box loading and cross-beam reaction setup.)
4. Prof. Osterberg has been working on an idea to improve field loading tests for the last 10 years. He was tired of the complicated, cumbersome, and unsafe present methods. He first made a small model cell in his laboratory but had no financial support. Then some 8 years ago he got some help from the Case Foundation and Charles L. Guild, of American Equipment Corporation. (See front page of nomination papers.) Also, Barry Berkovitz of the Federal Highway Administration got interested in the cell for bridge foundation testing. Mr. Berkovitz supplied test sites and some money. Mr. Clyde Baker, STS Engineers, has been giving moral support and getting test sites. (One just coming up in Malaysia.)
5. Prof. Osterberg says he was the inventor. Mr. Charles Guild helped with the fabrication and debugging of the cell.
6. The first use was about 8 years ago. It started with some backyard testing using Case International facilities (O'Malley), then Federal Highway (Berkovitz), then testing in the Boston area (Mark Haley), and then in other areas, including foreign sites. Prof. Osterberg will supply us with summaries on the sites.
7. Prof. Osterberg thinks that future applications will save lots of money for users. (20%-50% below conventional methods.) It will provide a flexible and fast method for data acquisition. High loads can be used if needed.
8. Prof. Osterberg has a patent.
9. Prof. Osterberg will send us FHWA reports, summaries of jobs, and patent data.

NOTE: It is understood that ASCE had given an Innovation Award to Prof. Osterberg. After Prof. Osterberg refused to make his invention open, ASCE withdrew the award.

From listening to Prof. Osterberg, advantages of his method can be listed as follows:

- (a) Safety
- (b) Skin friction and end bearing load measurements separately measured.
- (c) Setup is simpler than conventional.
- (d) Less time in the procedure than conventional.
- (e) Less interference with other work at the site.
- (f) Cheaper by 20%-50% than conventional.
- (g) A Saving of \$400,000 in Detroit hardpan.
- (h) Concrete can be poured one day; tested the next day.
- (i) A retest can be made at any later time.

Phone Interviewer: Tons
Date: 11/17/93

#9417
No. 2

Name: Mr. Clyde Baker
Title: Chairman
Affiliation: STS Engineers
111 Pfingsten Road
Northbrook, IL 60062

1. Mr. Baker says that the most innovative aspect is the load cell, itself. It has made soil measurements easy and very time-cost effective. Also, safety is great as compared to conventional methods.
2. Mr. Baker cannot recall anything similar to it, and he does not know of any alternative item.
3. Mr. Baker says that as far as he can remember , the idea started seven or eight years ago. Dr. Osterberg had a hard time to get financial support. Then Charles Guild (American Equipment) helped and development went fast. The cell has been in productive use for about five years.
4. Mr. Baker acted as a sounding board. He encouraged Dr. Osterberg. Mr. Baker is also using the cell now as he considers it to be the most cost effective method for bearing load plus skin friction measurements.
5. Mr. Baker says that Osterberg has a record of uses. He should be asked for it.
6. Mr. Baker is using the cell in his work and apparently there are no serious bugs.
7. Mr. Baker thinks that there will be future growth. Most impacts will be in cases where the separation of skin friction and bearing load capacities is highly desirable for design purposes.
8. Mr. Baker refers to Mr. Scot Litke of the Association of Drilled Shaft Contractors.
9. Baker says that Osterberg has a patent on the cell.
10. Baker says that there are FHWA reports on the cell. Ask Osterberg for one page summaries.

Phone Interviewer: Tons
Date: 11/18/93

#9417
No. 3

Name: Mr. S. Scot Litke
Title: Executive Director
Affiliation: Association of Drilled Shaft
Contractors
P.O. Box 289379
Dallas, TX 75228

1. The Osterberg cell has revolutionized the procedure for measuring soil bearing and friction and permits a more rigorous and economical design for shafts and piles. The static load frame and load boxes are tedious and cumbersome and should be the thing of the past.
2. Mr. Litke does not know of a load cell system similar to this. However, he has heard that in Europe work is in progress in this area. He could not elaborate.
3. There may also be other alternative tests invented. Mr. Litke knows of a so called STATNAMIC device developed in Canada by Patrice Birmingham. An explosive charge is used for loading impulse. In his opinion, the equipment is very elaborate and the test is complicated. Dr. Osterberg's test is simple and easy to interpret.
4. The originator of the cell was Dr. Osterberg. There were people (including Litke) who have been encouraging and helping during the last 8 to 10 years, but the idea comes from Dr. Osterberg.
5. Mr. Litke helped Dr. Osterberg get test sites and some seed money.
6. Serious and significant field tests were started about 4 to 5 years ago. The load cells can be made of different sizes and capacities. There were some problems with seals and leaks for the large capacity cells. These problems have been resolved.
7. For other subsequent uses, ask Dr. Osterberg. He has records.
8. The future is already here. The use is developing fast. The Federal Highway Administration is especially interested as are several state highway departments. The future looks great.
9. There are many people who are familiar with the cell and could give information. The nomination gives 10 names. Mr. Litke added two more: Dr. Townsend, University of Florida, 904-392-0926, and Dr. O'Neil, University of Houston, 713-743-4252. Dr. Osterberg will tell about the patents.

Phone Interviewer: Tons
Date: 11/18/93

#9417
No. 4

Name: Mr. Larry P. Jedele
Title: Senior Consultant
Affiliation: Soil and Materials Engineers, Inc.
43980 Plymouth Oaks Blvd.
Plymouth, MI 48170

1. Mr. Jedele says the most innovative aspects are the speed of setup, analytical value (skin friction and load bearing components) to help design, and safety.
2. Mr. Jedele has not heard of the Canadian STATNAMIC device. He says that it is important to measure creep and he is not sure that STATNAMIC can do it.
3. Dr. Osterberg was the prime initiator and inventor.
4. Larry used the cell on two sizeable jobs: The Allied Center in Southfield about three years ago, and the Veterans Administration Building in Detroit about two years ago. He is enthusiastic about the method.
5. Mr. Jedele did not have any problems with the method. It is simple and rugged. Apparently loads up to 3000 tons can be applied. It is difficult to apply such loads by conventional surface reaction methods.
6. The future looks bright for the method.
7. Larry says we have ten references already, do we need more? He does not know of any competitors.
8. Larry will supply us with additional information on other award activities concerning the Osterberg Cell.

Phone Interviewer: Tons
Date: 11/19/93

#9417
No. 6

Name: Mr. Mark Haley
Title: Vice President
Affiliation: Haley & Aldrich
58 Charles Street
Cambridge, MA 02141

1. Mr. Haley says that the innovation is the ability to load a pile safely from the bottom up and get end bearing and skin friction values for more rigorous engineering design purposes. Reliability is good.
2. Mr. Haley knows of nothing similar.
3. Mr. Haley was looking for a practical way of testing high load applications in shafts and caissons. He contacted Charles Guild (see references) but there was nothing available. Then about 10 years ago Dr. Osterberg contacted Mr. Guild and eventually Mr. Haley got what he wanted. He likes to use the cell in the Boston area where the Boston Blue Clay and the deteriorated bedrock need reliable measurements. The cells can be made in different sizes for different loads.
4. Mr. Haley has had no real problems with the cell.
5. Mr. Haley is presently involved in some expressway work near Boston South Station. Federal Highway Administration likes the Osterberg cell.
6. The Osterberg cell is most useful for high loads and special applications. For small jobs, the conventional methods may be able to compete cost-wise with the Osterberg rig, but not in other ways nor in safety. Mr. Haley thinks that Osterberg's goal is to reach a level of about 100 Osterberg Load cell jobs a year and do so in as short a time as possible.

Phone Interviewer: Tons
Date: 11/19/93

#9417
No. 7

Name: Mr. Jerry Parola
Affiliation: Case International Inc.
P.O. Box 40
Roselle, IL 60172

Mr. Parola substituted for Mr. John O'Malley, President of Case International.

1. Mr. Parola says that the most innovative aspect is the ability to rapidly and economically get a load test of high capacity when needed.

2. Jerry has seen the Canadian STATNAMIC demonstration in Seattle in 1990. Essentially a charge of explosives is detonated on top of the pile and the total capacity is estimated from the response. Data reliability is in question. The method is limited as to load. Load bearing and skin friction are not separated. Safety may be of concern since the explosive is detonated on top of the pile. Jerry also thinks it is complicated and expensive. Upon request, Jerry will send us some literature about the STATNAMIC test which he has in his file.
Jerry Parola, FAX: 708-529-2995

Phone Interviewer: Tons
Date: 11/22/93

#9417
No. 8

Name: Mr. Dennis Millgard
Title: President
Affiliation: The Millgard Corporation
12822 Stark Road
Livonia, MI 48151

1. The Osterberg system enables us to test a foundation and get reliable and accurate results for design purposes. It is simple and cost effective.
2. Mr. Millgard has known Dr. Osterberg for about 35 years. About ten years ago, Dr. Osterberg started to work on his load cell. Mr. Millgard has given him lots of encouragement and he is using the cell on his projects.
3. The use of the cell is growing. It is cost effective and can be used in places where conventional loading schemes do not work; for instance, in water.
4. If we need more detailed information, he will connect us with Mr. David Coleman, one of his helpers.

CONTACTS MADE

Contacts Made

Name: Mr. Clyde Baker, Chairman
Title: Chairman
Affiliation: STS Engineers
111 Pfingsten Road
Northbrook, IL 60062

Name: Mr. Mark Haley
Title: Vice President
Affiliation: Haley & Aldrich
58 Charles Street
Cambridge, MA 02141

Name: Mr. Larry P. Jedeke
Title: Senior Consultant
Affiliation: Soil and Materials Engineers, Inc.
43980 Plymouth Oaks Blvd.
Plymouth, MI 48170

Name: Mr. S. Scot Litke
Title: Executive Director
Affiliation: Association of Drilled Shaft
Contractors
P.O. Box 289379
Dallas, TX 75228

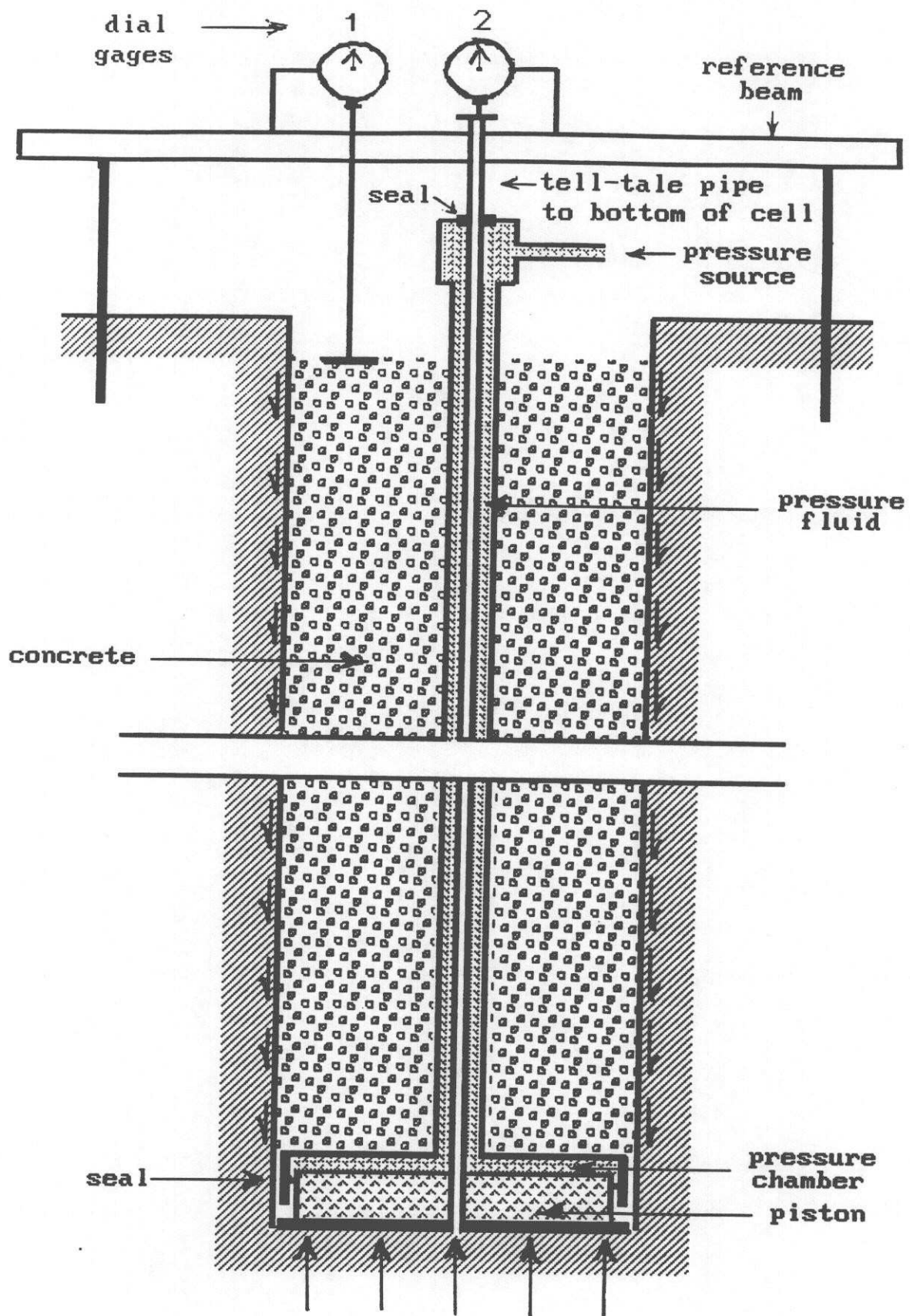
Name: Mr. V. Dennis Millgard
Title: President
Affiliation: The Millgard Corporation
12822 Stark Road
Livonia, MI 48151

Name: Dr. Jorj O. Osterberg
Title: Professor Emeritus (Northwestern University)
Affiliation: 16416 E. Powers Place
Aurora, CO 80015

Name: Mr. Jerry Parola
Affiliation: Case International Inc.
P.O. Box 40
Roselle, IL 60172

Name: Dr. John H. Schmertmann
Title: Principal
Affiliation: Schmertmann & Crapps
Consulting Engineers
4509 NW. 23rd Ave, Suite 19
Gainesville, FL 32606

PRIMARY EXHIBITS



Osterberg Cell Sets Record in Kentucky

by Jeffrey W. Goodwin

The following article was supplied by Jeffrey W. Goodwin, Loadtest, Inc., Jacksonville, Florida. An early stimulus for the development of this device was a 1984 ADSC Request for Proposals to design a low-cost, reliable, mobile, load test device. Several major testing breakthroughs have occurred in the past eight years. The Osterberg Cell has been tested on projects throughout the world. Past test results have been reported in FOUNDATION DRILLING Magazine. (Editor)

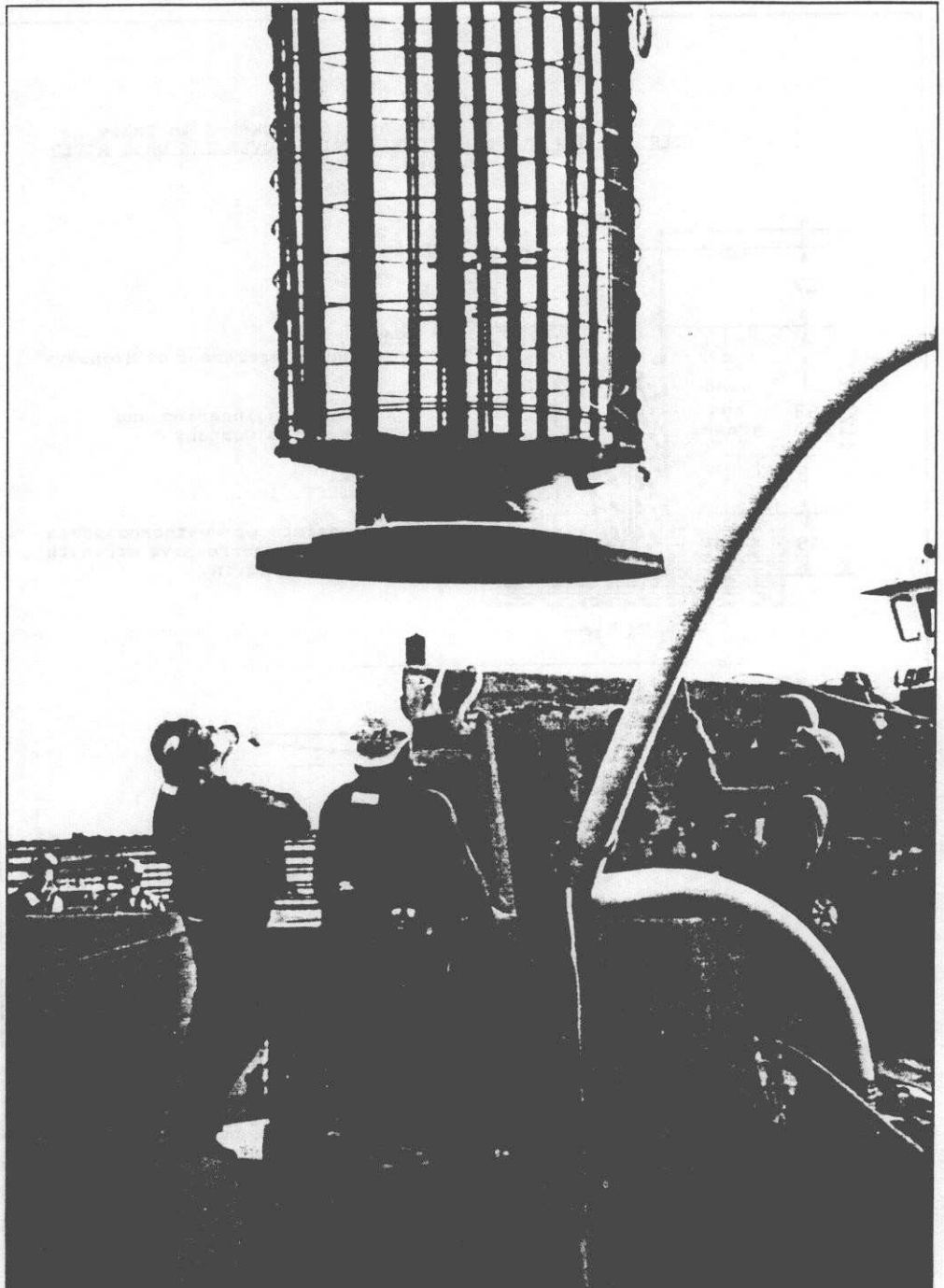
A pair of Osterberg Cell load test have just been completed near Owensboro, Kentucky which we believe may have set a world record for static foundation testing at **6000 tons!** The foundation work is the first phase of a 5 year project headed by the **Kentucky Transportation Cabinet and Federal Highway Administration.**

Foundation work for the new US 231 bridge across the Ohio River was begun last summer with the construction of two cofferdams to contain the main bridge piers. Each main foundation pier consists of 44 drilled shafts with rock socket diameters of 70 inches and socket lengths of 15 feet at the northern most pier and 45 feet at the southern pier. Top of shaft elevations were almost 60 feet below the work platform area, making conventional load testing virtually impossible. The Osterberg Cell advantage of loading from the bottom of the shaft with no reaction beams required, made it the choice for testing of the shafts.

At each pier location, one production drilled shaft was designated for Osterberg Cell load testing. The cased drilled shafts went through sand and gravel deposits to the top of rock at a depth of about 90 feet. The

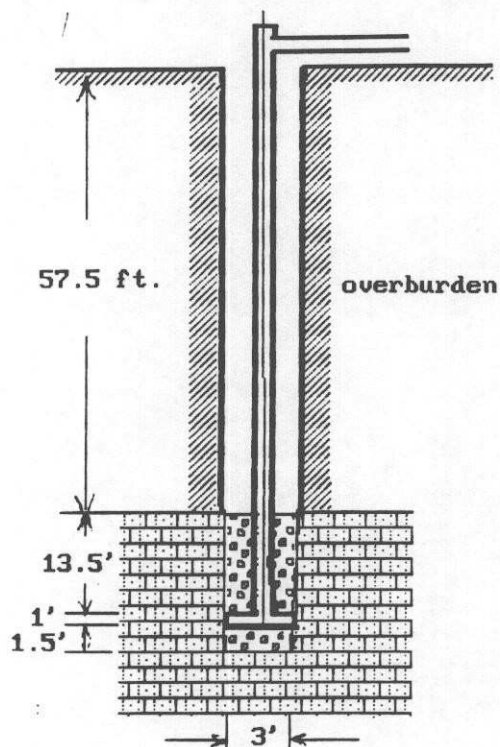
rock socket was drilled through a soft shale, which at the southern pier contained a 4 feet thick zone of coal and underclay. Uncon-

finied compression tests of the shale indicated compressive strengths of 300 - 450 psi in the
(continued on page 22)



Osterberg Cell ready for placement in shaft, the top of which was 60' below the platform area.

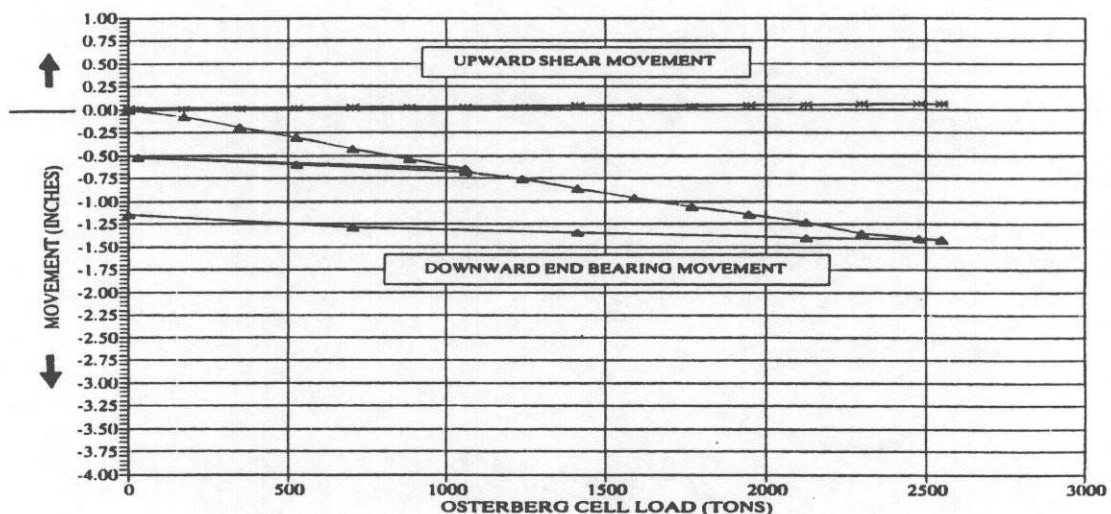
Osterberg Load Test on Shaft Socketed in Limestone
U.S.31 Bridge over Tennessee River, Decatur, Alabama



Owner:
Alabama Highway Dept.

Foundation Contractor:
Drillers Inc.

Testing:
LOADTEST Inc.



Purpose: To verify that the design load of 1,000 tons can be applied to the shaft with an adequate factor of safety.

Rock: Massive hard limestone - compressive strengths - 15,000 to 22,000 psi.

Method: Overburden drilled and cased off to rock. 3 ft. diameter hole drilled 15 feet into limestone with an air rotary tool. Bottom of socket cleaned with bottom cleanout bucket followed by an airlift. Because 34 inch cell could not be lowered less than 1 foot from bottom due to reduced diameter, 1.5 ft of concrete was pumped into the socket under water and cell placed. The remaining 13.5 ft was filled with pumped concrete to the top of the socket.

Results: At 5,100 tons (up + down), no failure occurred with only 0.06 in. upward and 1.42 in. downward movements.

OSTERBERG LOAD TEST DEVICES

Load Test Devices For Drilled Shafts

Available for immediate delivery (As of June 1, 1993)

Capacity Tons	Diameter inches	Stroke inches	Height inches	Weight pounds	Number Available
75	5-1/4	3	5-3/16	32	2
300	13	6	11-5/8	300	3
1000	21-1/4	6	11-5/8	800	9
3000	34-1/4	6	12-1/8	2200	4

For larger diameter holes, a stiff plate slightly smaller than the diameter of the hole can be welded to the bottom of the device. Also, capacities larger than 3,000 tons and strokes larger than 6 inches can be supplied in diameters larger than 34 inches on special order.

Load Test Devices for Driven Piles

For 18 inch pipe piles, 800 ton capacity and 6 inch stroke, one is available on 60 days notice

For 14 inch precast concrete piles, 475 tons capacity and 6 inch stroke, 3 are available on 15 days notice.

Other capacities and sizes for many types of driven piles are available on special order.

Osterberg Load Cell Finding Applications

by S. Scot Litke

Several years ago, Dr. Jorj Osterberg, then at Northwestern University, Evanston, Illinois, developed a relatively low-cost, simple down hole load test device now known as the Oster-

berg Load Cell (see August 1984 issue of FOUNDATION DRILLING Magazine). Osterberg currently resides in Aurora, Colorado, having retired from a full time academic life. He has, how-

ever, continued to vigorously pursue his career as a consulting geotechnical engineer and

Summary of Load Test Results Using The Osterberg Load Cell

Pipe piles

Type	Location Soil Profile	Embedded Length	Hammer	Final Blows/in	Failure Mode
18" O.D. x 0.50" wall	Sangus River Mass. 105ft. soft clay over hard till	105 ft.	Delmag D62-26 105,600 ft. lbs.	10 per 1/2in.	friction 142 tons 570 lbs/sq.ft.
18" O.D. x 0.50" wall	Pines River Mass. 90 ft. soft clay over hard till	93 ft.	Delmag D36-13 83,100 ft. lbs.	10 per 1/2in.	friction 218 tons 770 lbs/ sq.ft.

Drilled Shafts (Caissons) (Bored Piles)

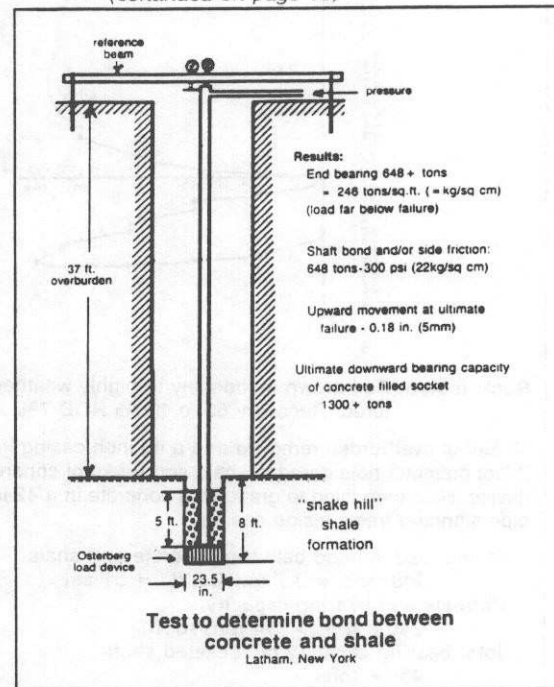
Location	Soil Profile	Hole Diam.	Embed. Length	Rock Embed.	Failure Mode	Ultimate Capacity
Port Orange, Florida	71 ft. silty sandy to stiff clay over weak sandy coral limestone	36 in.	82 ft.	10.8 ft.	end bearing 180 tons 24.8 tons /sq. ft.	920 tons
Port Orange, Florida	75 ft. silty sandy to stiff clay over weak sandy coral limestone	54 in.	80 ft.	14.9 ft.	end bearing 350 tons 24.4 tons /sq. ft.	700 + tons
Jacksonville, Florida - four 36 inch shafts socketed in soft sandy coral limestone. Failure loads all in end bearing. Varied from 210 to 640 tons. Report in preparation. Full details not yet available.						
Latham, New York	37 ft. overburden cased off. 8 ft. socket drilled in shale. 5 ft. length concrete filled over load cell	23.5 in.	8 ft.	5 ft.	side friction 648 tons 21 tons /sq. ft.	1300 + tons
Edison, New Jersey	37 ft. overburden cased off. 7 ft. socket drilled in highly weathered fractured shale 6 ft. of concrete in socket over load cell	36 in.	7 ft.	6 ft.	side friction 210 tons 3.7 tons /sq. ft.	900 + tons
Rochester New York	21 ft. overburden cased off. 7.5 ft. socket drilled in sandstone. 5.8 ft. of concrete filled over load cell	23 in.	7.5 ft.	5.8 ft.	side friction 450 tons 13 tons /sq. ft.	900 + tons

In every one of these cases, the shear value assumed in bond for the design was greatly under the values found by using the test results with a suitable factor of safety, allowing considerable savings by using shorter depths of sockets.

to refine his innovative deep foundation load test device.

The most frequent use of the device has been to test the bond/friction between concrete and rock in a drilled shaft rock socket. Tests have been made on weak shale, medium strength shale, sandstone, sandy coral

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SECONDARY EXHIBITS

13th Central PA Geotechnical Seminar, Hershey PA, 12-14 Apr-93

THE BOTTOM-UP, OSTERBERG CELL METHOD FOR STATIC TESTING
OF SHAFTS AND PILES

John H. Schmertmann
Schmertmann & Crapps, Inc.
Gainesville, FL

1. What is an Osterberg Cell?

- o A state-of-the-Art, static load testing device. An Osterberg cell load test uses an especially designed and fabricated hydraulic jack and associated fittings for use with pressures up to 8,000 psi. The Osterberg-cells are typically circular, but can also be made square. Current maximum size is 34" diameter with a weight of approximately 2,000 lbs and developing a thrust of 3000 tons.
- o Patented by Dr. Jorj O. Osterberg (Prof. Emeritus of Civil Engineering, Northwestern Univ.) in the USA (1986) and Canada (1988), as well as in Europe and Japan.
- o Typically cast at the base of a shaft or placed at the tip of a driven pile. However, many variations are possible.
- o The maximum cell expansion is typically 6", but can be special-ordered to 24".

2. How is it used?

- o Placed at or near the bottom of a shaft via the reinforcing cage or small I-beam and connected to the surface with a center pressure pipe, which in turn encloses a bottom-movement telltale.
- o Can be placed in shafts made by either wet or dry construction methods. Can also be placed at the bottom of a pile, either before or after driving -- the latter if there is a central access area.
- o The cell is pressurized and expanded without the need for any surface reaction system. Using the soil system for reactions, the bottom of the cell moves down to test end bearing and the top of the cell moves up to test side friction. Figure 1 shows a schematic comparison with a conventional, surface reaction, load test.
- o The cell is expanded until the expansion force is some desired proof multiple of the design loading, or one of the two components, side friction or end bearing, reaches some defined failure condition, or the cell reaches its maximum expansion.
- o At the completion of the test the cell can be filled with grout to reestablish its integrity and permit the test shaft or pile to become a production shaft or pile.

- o Minimum surface work area -- Eliminating the surface reaction system frees the area around the shaft/pile for other operations, which may be a major consideration in congested sites.

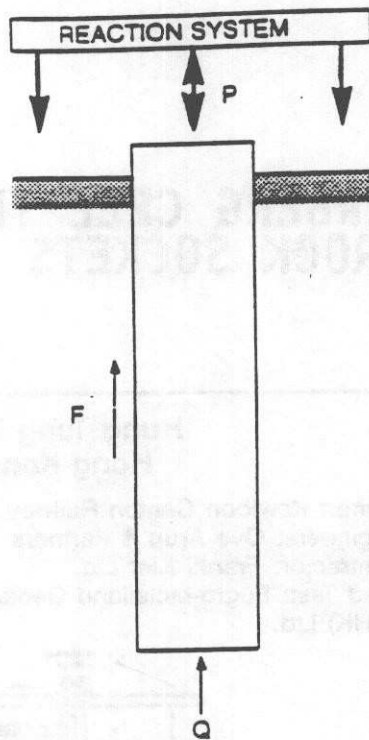
4. Disadvantages

Of course, as with any new method, it also has some disadvantages with respect to a conventional load test that one might need to consider:

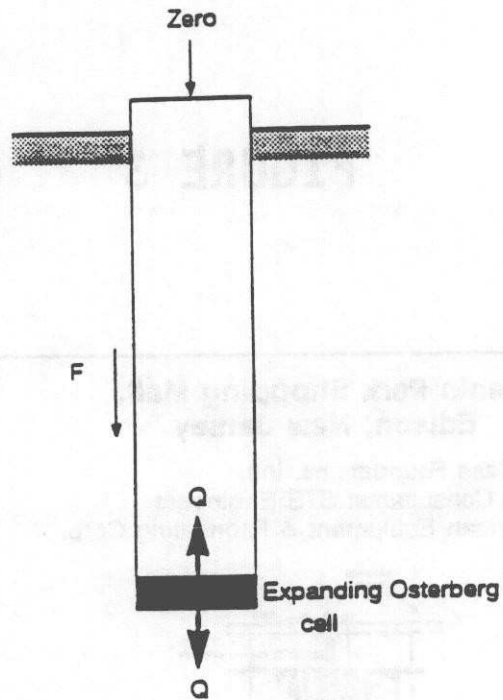
- o Need for planning -- The test cannot be used on an already placed shaft or pile. There must be prior planning and installation.
- o Fails bearing or friction -- The cell fails only one component, and the other component may or may not be close to failure at that time. Special measures may be needed to enhance end bearing or side friction if these would otherwise provide insufficient reaction to test the other component.
- o Limited movement -- Movement limited to the expansion capability built into the cell (typically 6").
- o Reconstructed curve -- The equivalent surface load-deflection curve is reconstructed from the up and down movement curves obtained during an Osterberg cell load test, rather than obtained directly. This involves assuming that the downward friction-deflection in an Osterberg test matches the upward friction-deflection in a conventional test. Engineers generally believe this to be a conservative assumption. (see Figs. 1 and 4)
- o Pile limitations -- It may prove difficult or impossible to install Osterberg cells on some types of piles, for example H-piles. Solid, PSC piles would need to have the cell(s) installed at the time of casting. Augercast piles would need to have the cell lowered through the concrete before it has time to set.
- o Sole source -- The Osterberg cell and testing method is patented, and therefore is a sole source item.

5. LOADTEST, INC. (LTI)

- o Formed by geotechnical engineers in July, 1991, with headquarters in Gainesville FL, and with the primary purpose of furnishing equipment and engineering services associated with the Osterberg cell load test methods. LTI maintains an inventory of Osterberg cells for quick delivery.
- o To date (Feb 93) LTI has performed 13 tests on shafts up to 6' diameter at 7 sites in the eastern USA, to a maximum Osterberg-cell load of 3000 tons (6000 tons equivalent surface loading). Many more tests have been performed worldwide and before July 1991.



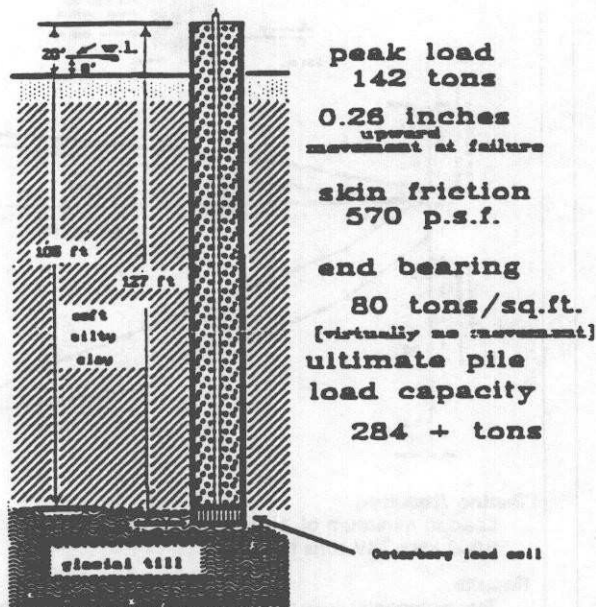
CONVENTIONAL



OSTERBERG

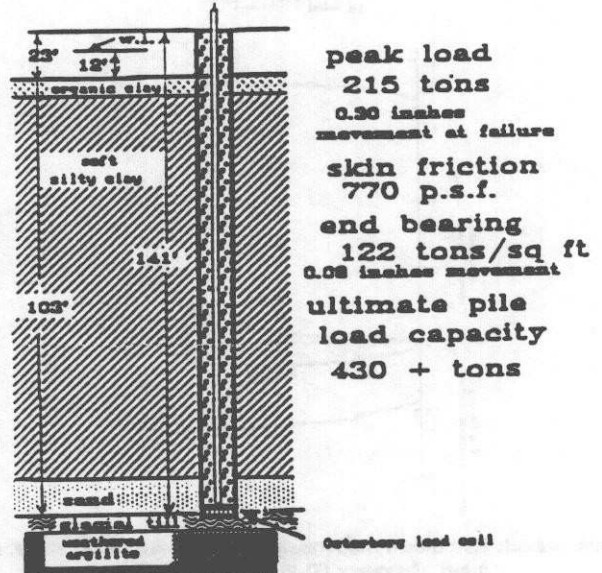
FIGURE 1

SCHEMATIC COMPARISON BETWEEN OSTERBERG CELL AND CONVENTIONAL LOAD TESTS



18 in.O.D. 1/2 in. wall concrete filled pipe pile
driven with a Delmag D 82-22 hammer
to 37 blows/6" and 10 blows last 1/2 "

**Saugus River Bridge
Massachusetts**



18 inch O.D. 1/2 in. wall
concrete filled pipe pile
driven with a Delmag D36-13
hammer to 10 blows last 1/2"

**Pines River Bridge
Massachusetts**

FIGURE 2

DRIVEN PILES

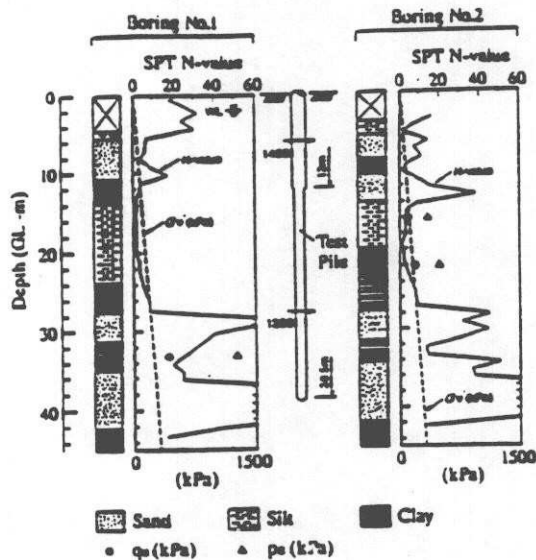


Fig.1 Soil Conditions and Pile Profile

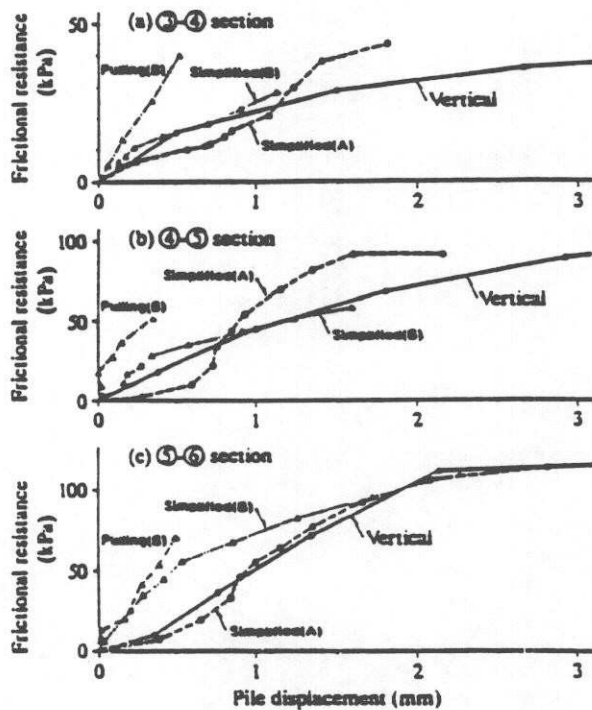


Fig.11 Relationships between Skin Friction and Pile Displacement at Three Pile Sections

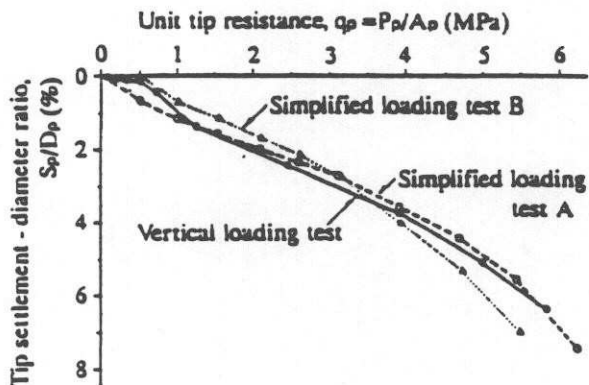


Fig.12 Relationship between Unit Tip Resistance and Tip Settlement-Diameter Ratio

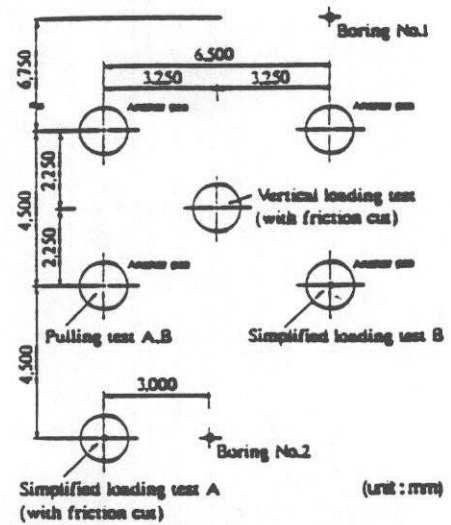


Fig.2 Arrangement Plan of Test Piles

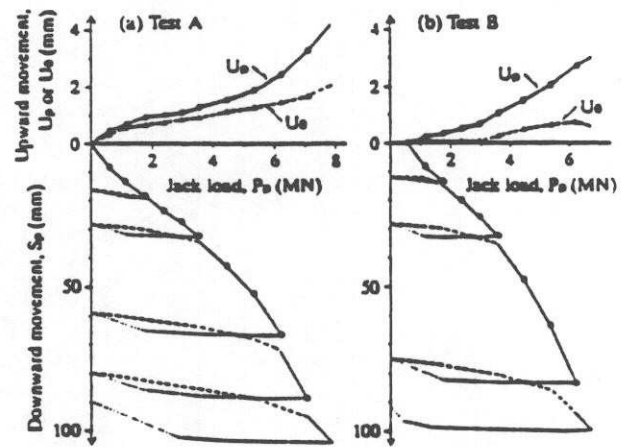


Fig.9 Relationships of Jack Load with Upward and Downward Movements in Simplified Loading Tests

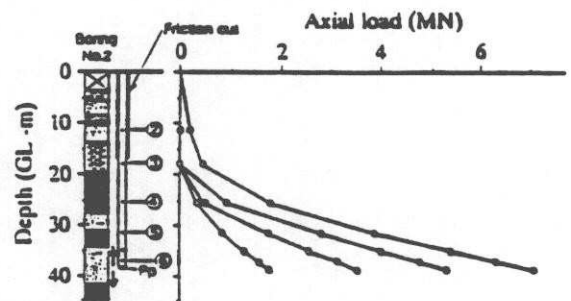


Fig.10 Load Distribution Curves in Simplified Loading Test A

FIGURE 4

DETAILED COMPARISON
BETWEEN OSTERBERG
AND CONVENTIONAL TESTS
IN OSAKA