Geotechnical Instrumentation NEWS

Geotechnical Instrumentation News

John Dunnicliff

Introduction

This is the fifty-third episode of GIN. Three articles this time.

Early History of Vibrating Wire Gages

The first article tells about some 'fun' history. I've written an introduction at the head of the article.

International Symposium on Field Measurements in Geomechanics (FMGM), September 2007

The 7th International Symposium on Field Measurements in Geomechanics (FMGM) was held in Boston, MA during September 24-27, 2007. The second article is a report by Allen Marr, Chairman of the Organizing Committee.

Apart from the pleasure of meeting many old friends and learning from the technical sessions and the exhibits, there were two significant plusses for me. First, a walk along the length of the dismantled Central Artery—having lived in the Boston area for thirty years and worked on the 'Big Dig' project, it was truly motivating to marvel at what our civil engineering community has done to create a new atmosphere in the city, without that ugly and divisive barrier. Second, being at Fenway Park when the scoreboard showed that the As had come back from a 5-1 deficit to beat the hated Yankees—an uproar much louder than the one that greeted the Red Sox win! I'm writing this on the day after the olde towne team clinched the World Series. Having suffered as a Faithful fan (Stephen King will understand why the 'F' is in upper case) year after year, being buoyed until near the end of the season, only to face yet another slump, this and 2004 have felt very strange! Where are you now, Billy Bucks?

Our Instrumentation Website

The third article is by Elmo DiBiagio, heroic creator of and webmaster for www.fmgm.no. This is an update on his announcement of the website in GIN-32, September 2002.

As Elmo requests, **please** take a look at the FMGM website and contribute to it. Your help with any of the identified tasks, or any other contribution you feel appropriate to the goals of the site, will be greatly appreciated and acknowledged.

Search Function for Instrumentation Book

I've just discovered that there is a search function for words in my instrumentation book, and have found this more useful than the index. If you want to use it, visit http://www.amazon.com/Geotechnical-Instrumentation-Monitoring-Field-Performance/dp/0471005460 and click on "search inside this book".

Because there is no electronic copy of the book, I was puzzled about how the search function came about, so asked a colleague in the book publishing business. The response:

> *Amazon worked with publishers from the beginning and created an "opt-in" system where we were able to choose which of our books to include. When we started with the Amazon project, sales of books with searchability increased. It essentially gave people the same chance to browse a book online as they have in a store, and since books like yours almost never appear in bookstores, online is the best market for them. Having the book in these services gives the contents of the book a presence online and, increasingly, if it's not online, it doesn't exist.*

Interesting!

Closure

Please send contributions to this column, or an article for GIN, to me as an e-mail attachment in MSWord, to *john@dunnicliff.eclipse.co.uk, or by fax or mail: Little Leat, Whisselwell, Bovey Tracey, Devon TQ13 9LA, England. Tel. and fax +44-1626-832919.*

Zum wohl! (Austria)

Choice of a Strain Gauge

J.F. Baker

Introduction

The number of tests which had been carried out on actual buildings at the time the Committee [Steel Structures Research Committee] started work was surprisingly small. There were records of strain readings taken on the stanchions of two American buildings, the Equitable Building, Des Moines, Iowa, and the American Insurance Union Building, Columbus, Ohio, but nothing had been done in this country [England]. The American results, incomplete though they were, showed how necessary it was that further work of a similar nature should be undertaken. The observed stresses were, in every case, greater than those assumed in design, but the tests were not sufficiently comprehensive to give any guide to more accurate design assumptions.

This delightful historical account of the development of the vibrating wire strain gage was sent to me by Dr. Jamie Standing, Senior Lecturer in Soil Mechanics at Imperial College, London. It is reprinted from Chapter 3 of a 1960 book by J.F. Baker, Fellow of Clare College, Professor of Mechanical Sciences and Head of the Department of Engineering at the University of Cambridge, and formerly Technical Officer to the Steel Structures Research Committee. The title of the book is "The Steel Skeleton", and this chapter is in Volume 1, "Elastic Behaviour and Design", published by Cambridge University Press. The chapter is reprinted with the permission of Cambridge University Press.

The initial concept of vibrating wire strain gages goes all the way back to 1888, tests were made in 1928, but commercial development did not begin until 1931 in France, when André Coyne obtained a patent for a vibrating wire sensor, then called an acoustic indicator. Beginning in the 1930s the use of vibrating wire sensors for monitoring of dams became worldwide practice. The two early manufacturers were Maihak in Germany, founded in 1936, and Telemac in France, founded by André Coyne in 1947. As you know, we now have many manufacturers worldwide.

My first experience with vibrating wire gages was during the construction of Dokan Dam in Kurdistan, northeast Iraq, in 1956, when Maihak embedment strain gages and piezometers were read by using a cathode-ray tube, as described in this chapter. The strain measurements within the concrete arch dam turned out to be of no value, because we hadn't understood the difficulty of converting measured strain to stress.

Perhaps you won't read all this text. But please be aware of the folksy and clear style of writing, and **read the last four paragraphs**. Tests on a brass bedstead in a hotel room in about 1940 – the scene is wondrous!

Text in square brackets is mine

John Dunnicliff

Choice of Strain Gauge

The measurement of strains in real as distinct from model structures calls for a technique quite different from that used in similar work carried out in the laboratory. While a high order of accuracy is essential it has to be maintained under conditions of dirt, vibration, exposure and hurry which would seem intolerable to the laboratory worker.

Accurate knowledge of structural behaviour is lacking mainly because of the difficulties facing the investigator. The most modest civil engineering structure is too expensive to warrant the construction of full-scale examples for test purposes only. While in many branches of mechanical and aeronautical engineering it is not beyond the resources of individual firms to test their actual products so that empirical methods can be used to guide development, economic considerations have ruled this out in most branches of civil engineering. All that the civil or structural engineer can hope for is access to an existing structure or one in course of erection on which he can make tests that do not interfere with the occupancy or with construction. It is clear, therefore, that elaborate apparatus is out of the question and that the time available for testing is strictly limited. These considerations influence profoundly the choice of the instrument used for measuring strains.

In both the American investigations already referred to, the same type of strain gauge had been used for measuring the distance between two holes, drilled in the member under test [presumably a type of mechanical strain gauge, perhaps an early version of the Whittemore strain gauge]. Its attractive features for work of this kind are obvious. It is inexpensive, because strains can be measured at any number of positions with one instrument and, apart from the drilling of the small holes, the structure is unaffected. Nothing is left permanently attached to it. Unfortunately, the American investigators estimated their possible error of observation at 1000 1b. per sq.in., an unacceptable figure which was confirmed by trials of a gauge working on a similar principle. The chief source of error appeared to be in the temperature correction which had to be made. Temperature correction could only be avoided by using a gauge made of the same material as the structure, attached and left in position throughout the test so as to undergo the same temperature changes. In the first gauge designed for the Committee this principle was adopted.

The conditions which are experienced on an actual frame under construction, where such upsetting devices as pneumatic riveting tools may be in operation close by, make it essential that the gauge and any magnifying device incorporated in it should be robust and unaffected by shocks. A solution was obtained by making that part of the gauge which was attached permanently to the structure as simple as possible and keeping the magnifying device distinct from it.

Figure 1 shows the part of the instrument which was attached to the member. Two tapered pins A and B were driven into the member 12 in. apart. A carried a mild steel bar, the free end of which was separated from B by a gap of 0.008 in. Any relative movement of the two pins resulting from the strain in the member over the 12 in. gauge length was the same as the relative movement of the free end of the bar and the pin B. This movement could be conveniently measured by means of a micrometer microscope which was only brought into position when a reading was required.

The chief difficulty was to obtain reliable reference marks on the end of the bar and on the pin B. Satisfactory results were obtained by soldering a strip of unworked stainless steel to the free end of the bar and a top of similar steel to the pin. The stainless steel surfaces were then carefully prepared with a fine emery paper and an indentation was made on each with a diamond similar to that used in the Vickers Diamond Hardness Test. The marks produced in this way appeared under the microscope as black squares, and the distance between their corners, which were sharp and undistorted, could be read fairly accurately. A bridge piece C was also attached to the member and served two purposes. A spring forced the bar against a half-round stop soldered inside the bridge piece and thus prevented the bar rotating about A, while leaving it free to move longitudinally. The milled-headed screw in the top of the bridge piece enabled the bar to be depressed slightly so as to bring the surface of the stainless steel tip to the same level as the surface of the pin.

The strain gauge, when erected on the member, was protected by a cast-iron bottomless box, 16 in. long, 3 in. wide and 21 in. deep, attached to the member by set screws passing through three lugs.

It will be appreciated that the accuracy of the instrument depended on the ability of the observer to read to the same points when making each observation on a gauge. It was important, therefore, that throughout a test the condition of the indentations should remain unchanged. Trials showed that it was only after considerable exposure that the surface of the stainless steel was affected and the corners of the indentations became less well defined. During a short duration test, therefore, there appeared to be no necessity to protect the gauges except from dust.

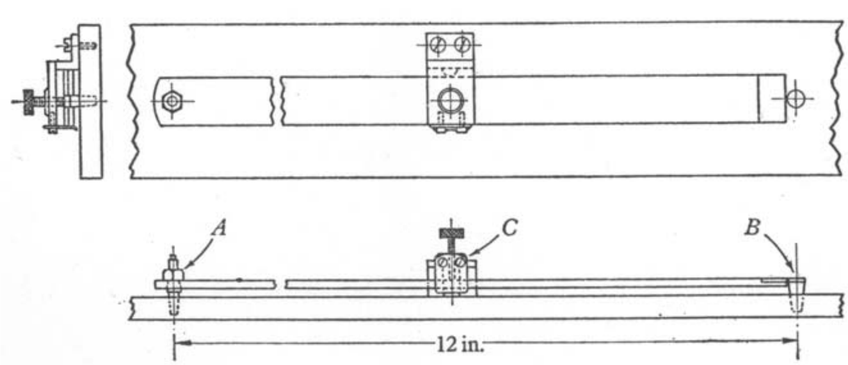

Figure 1. Strain gauge.

Calibration tests carried out under as near actual working conditions as possible indicated that an observer could obtain readings to an accuracy of at least ± 250 1b. per sq.in., but considerable care and skill were required. These limits included any variation arising from temperature changes of the order likely to be experienced during real tests.

Fifty-four of these gauges were used in tests carried out on the new Geological Museum, South Kensington. This is a five-story building, part of which consists of a series of galleries around a central well. Attention was concentrated on one of the inside gallery stanchions forming the well and the beams connected to it. Conditions during the erection of this building were somewhat unusual, in that the steel framework was completed many months before it was clothed. This made it possible to erect a tower of scaffolding carrying eight platforms, 3 ft. 6 in. wide, running round all four faces of the stanchion, but not touching it. This luxurious provision was necessary for the successful fitting of the gauges, which called for the skill of an instrument-maker, and for their subsequent reading.

It was quite clear that conditions like this would not occur again. While the gauge proved reliable enough in the Geological Museum tests, it took so much time and trouble to fit and to read that it was virtually impracticable for the tests visualized on buildings erected under normal commercial conditions. There, owing to the speed of erection usual before World War II, not more than three days would be available for fitting the gauges, completing the tests and removing the gauges again. All this had to be done without the advantage of elaborate scaffolding, the presence of which would be intolerable to a contractor.

The Maihak Gauge

Every known type of strain gauge was examined to see if one could be modified to fit the rigorous specification, and further development work was put in hand. In the course of this activity a brochure was obtained describing an instrument, the Maihak extensometer, of German origin. The claims made for it seemed so fantastic that the brochure was relegated to the waste-paper basket. When all other hope had gone the waste-paper basket was searched and the brochure again studied. The Maihak extensometer, as described there, and shown in Figure 2, consisted of a central receiver A to which any number of the gauges B could be connected. The essential part of each gauge was a 12 cm. length of high tensile steel wire a stretched between two knife-edged blocks b which could be clamped into the member under test. A small electromagnet c, fixed above the gauge wire, was connected to the central receiver. By pressing a Morse key in the receiver the gauge wire was made to vibrate and the note was heard in a pair of ear-phones. A standard wire, similar to the gauge wire, was contained in the receiver; it was fitted with a micrometer adjustment by means of which the tension in the wire was controlled. The standard wire could also be set into vibration and the note from it heard superimposed on the note from the gauge wire. By adjusting the tension in the standard wire until the two notes were the same, a simple matter of eliminating beats, a measure of the tension in the gauge wire was obtained from the reading of the graduated head of the micrometer adjustment. The strain in the member under test was deduced from the difference between the readings taken before and after loading.

The description of this instrument satisfied so much of the specification which had been drawn up that it was felt worth examination in the hope that the claims of accuracy and reliability made in the brochure could be even approximately substantiated. A gauge was obtained and was attached to a specimen in a tensile testing machine. The ear-phones were put on, the wires were set vibrating and a beat at last detected. The micrometer adjustment was made and within the short time before the note faded the beat was eliminated, a reading had been made using this unusual aural method. Load was applied to the specimen, a further reading was taken and so the calibration progressed. However, when the results were examined they were disappointing. Other observers were called in, some with an ear for music, some without. The results were uniformly bad, and so with regret the agent, who had brought the instrument to the test house, was dismissed. Another type of gauge had, apparently, failed to live up to the claims made for it.

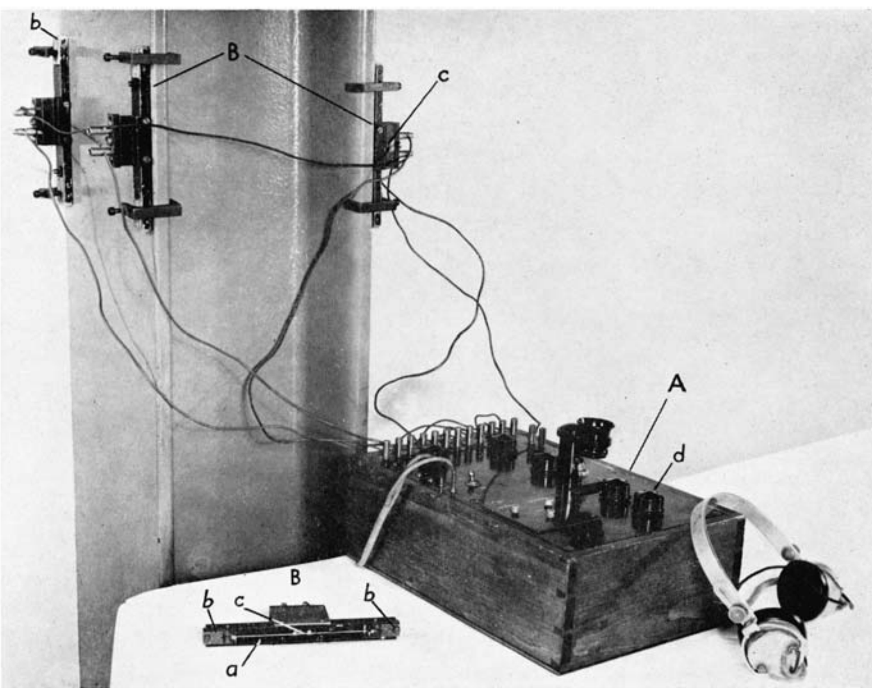

Figure 2. Maihak extensometer.

This was particularly sad as the Maihak instrument had so many qualities that fitted it for the outdoor tests which were to be made. It was relatively inexpensive, for any number of gauges could be connected by leads of any length to the one central receiver which could, therefore, be placed under cover, enabling the operator to work in some comfort. The gauges appeared robust and required no instrument-maker to fit them. It was already clear how even an unskilled man might put four gauges, eight clamps and a screwdriver in his pocket and, unencumbered, move about the framework as a steel-work erector does and, using no more scaffold than he, fit the gauges in ten minutes or so at any section of the structure where strains were to be measured. It was these qualities which made the instrument so desirable. In addition, it was temperature-compensating, since the knife-edge blocks and wire were of steel, and was so robust that, by the use of heavy clamps, the gauge could be fitted so firmly that no vibration arising from the construction of the building would disturb it. Once clamped in place it could be covered to protect it from sun and rain and not approached again until it was time to remove it to another position.

These virtues were obvious almost before the agent was out of the gate. The underlying principle was sound, and it seemed clear that greater accuracy could have been obtained if the notes had been sustained long enough for more exact matching. Greater amplification should have made this possible. Before the night was out it was decided that the Maihak extensometer was the only possible instrument for the work ahead and that it must be tried out more thoroughly without loss of time. Fortunately, the agent had mentioned where he was staying and a telephone call was put through to ask him to delay his departure. For the second test, which took place in the agent's hotel bedroom, the investigator provided an amplifier of greater power than that built into the central receiver. A gauge was clamped to the rail of the brass bedstead and the scene was set. The Morse key was pressed and a strong sustained note was heard. The investigator, full of hope, proceeded to match the notes, easily detected the beats and attempted to eliminate them by turning the micrometer head. Just when success seemed to be within his grasp, the beats would mysteriously appear again, then disappear and so on. For the second time the instrument was about to be condemned when it was noticed that just as the beats were being eliminated the agent, who was also listening in, would lean over to get a better view of the micrometer head reading. In doing so his weight came on the bed rail and so subjected it to a not inconsiderable strain which the gauge recorded. When this disturbance was eliminated, repeated readings were obtained with surprising accuracy. Triumphantly the party returned to the test house and, in a short time all and sundry were obtaining readings with an accuracy in terms of stress of about 100 lb. per sq.in. The way was open to successful tests on buildings in course of construction.

It will be obvious from the accounts of those tests which follow that all the advantages foreseen that night were fully realized. The Maihak extensometer was an ideal instrument. Though twenty years have passed and in that time the ubiquitous electric resistance strain gauge, invaluable for measuring transient strains, has been introduced, the Maihak gauge can still be said to be an ideal instrument for outside work on full-scale structures. In 1943, before the Admiralty Ship-welding Committee embarked on an ambitious programme of strain measurement in merchant ships, a further study of suitable instruments was made and more development undertaken; again, however, the vibrating wire type was found unrivalled except for such detailed work as the mapping of strains around hatch corners, where a small gauge length was essential, and for which electric resistance gauges were used. For this ship work a development of the original Maihak, made by the Building Research Station, was adopted. In this the wire was maintained in vibration, instead of being merely plucked, but otherwise the method of making an observation was unchanged. Later, a visual method of matching the tension in the standard wire to that in the gauge, developed by the German Maihak Company, was used. Signals from the vibrating wires were fed into a cathode-ray tube, the tensions being matched when the resulting pattern became stationary. Though most observers prefer to match the tensions by eye rather than by ear there is little doubt that when further work is undertaken on structures in course of erection the original instrument will still be found unrivalled because of its simplicity and of the absence of electrical distortion which, when the cathode-ray tube is introduced, can affect the accuracy of the readings.

The Seventh International Symposium on Field Measurements in GeoMechanics (FMGM-2007) A Wrap-up

W. Allen Marr

The Seventh International Symposium on Field Measurements in GeoMechanics opened with two short courses and a workshop on Sunday, October 23, 2007. Each full-day short course, one on instrumentation and the other on inclinometers, had over twenty participants. Forty-five people from more than ten countries participated in the workshop, "Innovations in Instrumentation, Installation and Data Acquisition." Workshop leader, Dr. Barry Christopher described the goal of the all-day session to provide a forum to present the latest practical instrumentation technology and an opportunity for participants to exchange ideas and to answer questions. Barry summarized the main points of the day's work as: (1) wireless technologies are the future, (2) fiber optic sensors will come to geotechnical engineering as the technologies are now well established in other fields, and (3) there is a lot of interest in a common data exchange format for instrumentation, such as the one presented by called "DIGGS " (Data Interchange for Geotechnical and Geoenvironmental Specialists). An informal sampling of participants in Sunday's activities indicated great satisfaction with the day's events and encouraged more of these in the future.

Invited Theme Lecturers Set the Stage

The technical program opened on Monday morning with welcomes and introductions. Jerry DiMaggio introduced the three main themes for the conference: State-of-the-Art and Future Trends, Case Studies and the Business Side of Instrumentation. Eight invited lecturers and eighteen technical sessions would focus on these themes. Jerry then invited me to deliver the keynote lecture titled "Why Monitor Performance?" My key point was that effective performance monitoring can save money by helping to reduce risk. I gave an example of the Central Artery/Tunnel project where performance monitoring during construction of this $15 billion project decreased the risk exposure from damaged property and construction delays by more than $500 million. I argued that performance monitoring must be a part of every risk management strategy for constructed facilities. I urged the instrumentation community to more clearly define and document the purposes and benefits of instrumentation in terms that non-technical people can understand.

Monday's theme lectures highlighted geotechnical instrumentation used to provide early warnings and monitor safety of major earthworks. Elmo DiBiagio described his work to provide an early warning system to villages downstream of a massive earthen dam created by an enormous landslide. Professor Leung reviewed several major excavations made in Singapore with the aid of geotechnical monitoring systems.

Tuesday's theme lectures examined state-of-the-art monitoring technologies with applications to long term monitoring of bridges, dams, supported excavations and seabed logging for petroleum exploration. We had the opportunity to hear the latest word on bridge performance monitoring from Ian Friedland of the U.S. Federal Highway Administration, who is helping lead the failure investigation into the collapse of the I-35 bridge in Minneapolis. Ian emphasized the growing realization that significant bridges must be monitored throughout their lives and the monitoring effort must include the substructure as well as the superstructure. James Stowell of Leica Geosystems illustrated the marriage of GPS and automated total station systems to monitor Δx, Δy, Δz movements to sub-millimeter accuracy. Richard Finno presented his team's efforts to use real-time monitoring data to update numerical predictions of future performance. Their aim is to develop ways to use measured performance from the early stages to improve the reliability of predictions of final performance. John Løvholt described a major advance achieved by geotechnical instrumentation professionals working in petroleum exploration. The success resulted from marrying high resolution geophysical surveys with advanced signal processing software to locate geological features with a high probability of containing gas.

Wednesday's theme lectures considered data evaluation and use of data to help manage risk. Giorgio Pezzetti and his associate, Alessandro Fasso, used advanced statistical methods to identify specific changes in measured performance masked within a time stream of data with daily fluctuations from temperature. Ton Peters showed how a program of performance measurements was a key part of a major effort to minimize damage to major historic structures in Delft that might result from the cessation of deep pumping.

The theme lectures set the tone for the more specific topics and discussions that occurred in the technical sessions. A major success of the conference was that all but two of the 105 authors showed up and delivered their presentations. All papers and three of the eight theme lectures plus the keynote lecture are available on CD from ASCE as Geotechnical Special Publication 175. Electronic copies of all of the theme lectures are available online at *www.fmgm.no.*

Helmut Bock, from Germany, contributing to the wrap-up session.

Exhibits for What's Happening

Instrumentation manufacturers are a core component of the geotechnical instrumentation team. Thirty two of the premier suppliers of monitoring instrumentation and systems participated in the symposium. The exhibits were of outstanding quality with great graphics. The hall was packed and many people lingered well after the intended closing time to learn what's new in gadgets, exchange ideas, and catch up with old friends. My casual observations revealed a lot of emphasis on remote data logging with wireless data transmission and systems to deliver data to a personal computer quickly. Lunch and breaks were provided in the exhibit hall to encourage more interchange among symposium participants and the exhibit area was located immediately adjacent to other symposium activities. The Organizing Committee had hoped to make the exhibits and vendors an integral part of the symposium and we were successful.

What Did We Learn?

The Organizing Committee pulled representative participants from the symposium into a panel for the wrap-up session and asked them to comment on their take home messages from the symposium. John Zagaj of U.S. Federal Energy Regulatory Commission noted that

FMGM Attendees in Exhibit Hall.

there are many technologies in use that get customized to the application. One must know the limitations of each. He suggested there might not be enough testing of systems and software for high reliability. Art Hoffman of Gannett Flemming described the situation where lots of data exist that mean something to us but are white noise to our clients. He stressed the need for us to talk about the value of instrumentation in terms our clients can understand. He feels the future is bright in the infrastructure business for monitoring.

Elmo DiBiagio of the Norwegian Geotechnical Institute has witnessed the transition of focus from sensors to systems. He predicts future focus will be on the entire system and more automation to get meaningful data directly to the user. He also sees monitoring systems playing an important role in risk management. John Dunnicliff got value from participating in the technical sessions, schmoozing with colleagues, whale watching and cheering the Red Sox to a win at Fenway Park.

Doug Baker of BC Hydro found lots of ideas from the symposium to take home and help him with his sweeping review of their dam monitoring systems. A big driver to him for more automation of instrumentation is the shortage of qualified manpower. Joel Volterra of Mueser Rutledge Consulting Engineers valued the opportunity to develop relationships within the instrumentation community. He lamented the difficulties convincing colleagues and clients of the value of instrumentation and appealed to the participants to provide more cases that show the direct benefits of monitoring programs.

Jerry DiMaggio of US Federal Highway Administration summed up with the view that instrumentation and monitoring have a fantastic opportunity in the infrastructure market. He urged us to broaden our language to include considerations of several high priority words prevalent in the transportation industry today: risk management, sustainability, life cycle costs and interdisciplinary communication, cooperation and coordination.

What's Next for FMGM?

A one-hour session at the end of Tuesday focused on the future of FMGM. Elmo DiBiagio of the Norwegian Geotechnical Institute and key participant in all past FMGM symposia reviewed the history of FMGM and the FMGM web site (www.fmgm.no). Elmo expressed a desire to identify ways to maintain the future viability of the FMGM symposia and web site as he transitions to retirement. Dr. Joerg Gattermann of Technical University of Braunschweig, Germany, announced his willingness to organize FMGM-2011, to be held in Germany and to take over the management of the FMGM web site. This action received enthusiastic applause from those in attendance. Professor Colin Leung then suggested that we should expect to see strong interest for Asia to organize FMGM-2015. There were also suggestions that FIGES (Federation of International Geo-engineering Societies) and ISSMGE (International Society for Soil Mechanics and Geotechnical Engineering) be looked at as possible homes for FMGM going forward.

W. Allen Marr, Chairman of the Organizing Committee for FMGM-2007, Geocomp Corporation, 1145 Massachusetts Avenue, Boxborough, MA, USA, 01719, Tel. (978) 635-0012, email: wam@geocomp.com

The Field Measurements in GeoMechanics Web Site: http://www.fmgm.no. An Update

Elmo DiBiagio

Historical Background

The idea of creating a web site for geotechnical instrumentation was proposed by Giorgio Pezzetti (Italy) at the International Symposium on Field Measurements in GeoMechanics (FMGM-1999) in Singapore. Giorgio's suggestion was to create a site where all kinds of useful information relating to field instrumentation would be readily accessible to everyone, including a discussion forum for exchange of ideas and practical experience, or simply a place to raise questions.

In February 2001 a draft version of the site was put on the Internet for testing. The basic idea was to have a neutral, non-commercial site not dominated by any one individual or organization, a site where anyone interested in field instrumentation can meet, exchange ideas, find useful information and communicate with others interested in instrumentation. An international review board was informed of the site and asked to review the contents and format, as were all major instrument manufacturers. Their comments were then integrated into the site development plans which consist of the following sections or *pages*.

- Home Page
- News and Events
- Theory and Practice
- Publications
- Discussions
- Links
- Glossary
- Feedback
- I Want to Help
- Credits

The Norwegian Geotechnical Institute (NGI) purchased the domain name *fmgm.no* for the site and put it on NGI's server. In June 2002 the site was opened to the public primarily to provide a convenient and efficient means of distributing information about the forthcoming FMGM-2003 Symposium, which was to be held in Oslo. This proved to be quite successful. At the 2003 FMGM Symposium the intent was to have a general discussion about the role of the web site in the future, how it should be administrated and by whom. Unfortunately, there was not enough time during the FMGM-2003 Symposium to do that.

At the FMGM-2007 Symposium in Boston in September this year there was some discussion of the web site in the wrap-up session. The general consensus was that it was very desirable to continue development of the site. It was also apparent that many of the persons present had no previous knowledge of it. Thus, there is a need to promote it internationally.

Present Status of the Web Site

The site, in its present form, is by no means complete or in its final form. Some pages don't contain any information yet, except for a few comments to indicate what type of information will ultimately appear there. However, the contents and structure indicate how this site will be according to current development plans. The most active pages have been the *discussion page* and the *publications page*. The latter contains a database with approximately 900 instrumentation reference publications which can be searched by key-word or author.

Future Plans for Development of the FMGM Web Site

The conclusion from the discussion at the FMGM-2007 Symposium is that development of the web site should continue. This will certainly be done together with the organizers of the next symposium, FMGM-2011, which will be held in Germany.

The original plans for administration and development of the site are summarized on one page in the present web site. To access this page do the following:

- Open the Home page of the site and navigate to the "About this site" page
- Then click on the link "History and site development plans"

Take a look at the FMGM website and the page mentioned above. If you have any comments or suggestions for improvement of the site please send them by email to the current webmaster or use the "*Feedback Page*" provided in the site. Development of the site is based entirely on voluntary contributions, which have been limited to date. If you would like to help in the development of the site, go to the "*I Want to Help Page*" and check the list of tasks to be worked on. Your help with any of these tasks, or any other contribution you feel appropriate to the goals of the site, would be greatly appreciated and acknowledged.

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