

## WEB-based monitoring of vibrations

By

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### Introduction

This paper describes the iSite-VM internet based vibration monitoring system. This is a real-time WEB based vibration monitoring system. The configuration of the system is quite flexible. The implementation model is based on seismographs located in areas that are accessible by telephone. Clients interact with the system using pagers, email and the Internet. The primary feature of the system is to use the public telephone network and a WEB browser to provide remote access to seismograph data. One of the primary benefits of the system is that it enables the seismograph to initiate actions that send messages by pager or email indicating that alarm levels have been exceeded. All vibration data are downloaded to a centralized database. The clients interact with the system and receive formatted reports using WEB browsers. The site is currently located at <http://www.isitecentral.net>

### State of practice

The OLIVE system has been designed to meet the requirements of a typical construction vibration-monitoring program. Vibration monitoring is typically specified in construction documents for projects involving pile driving, basting and demolition. Third party specialist usually provides the monitoring. There is a growing trend to specify limits on construction vibrations in terms of threshold and limiting values. The threshold value is a vibration level for which there is uncertainty regarding disturbance and the limiting value is a vibration level above which disturbance is likely. These values are often used in the construction specifications to control the reporting frequencies and implementation of pre-planned remedial and mitigate actions.

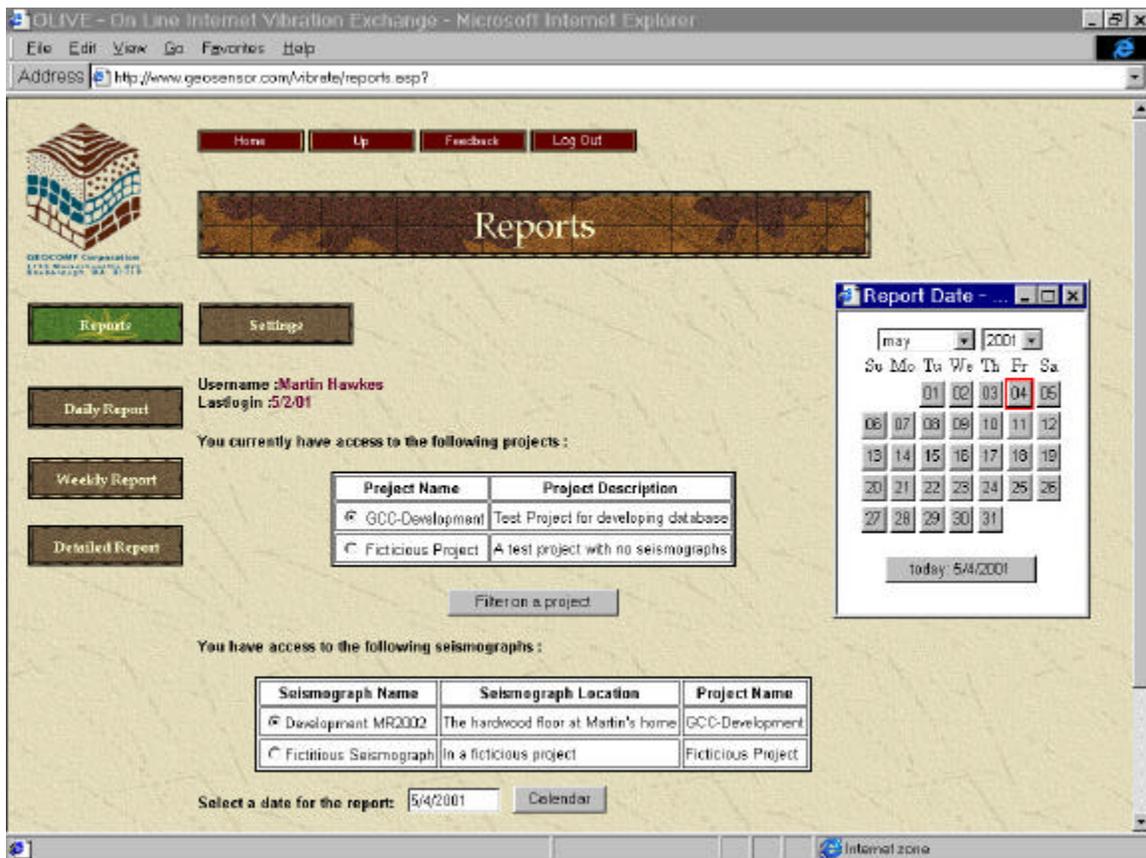


Figure 1: Data access WEB page

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### Overview of the OLIVE system

The OLIVE system is a client-server system that accesses seismographs remotely using a Smart Alarm Modem. The modem may use a cellular, satellite or a landline connection. Clients access the server using an Internet browser. No specialized software is required on the client's computer other than a WEB browser and Internet access. The system can be set up through the WEB to send pager messages when vibration levels reach a specified level. A daily report can be automatically emailed with no user intervention. An example of a report created by the system is shown at the end of this paper. A schematic of the system components is shown in Figure 2.

The components on the left of Figure 2 are available to the client. These include: the seismographs, email, pagers and web browsers. The components on the right are hidden from the user. These components are common to all clients. Interaction with these components is available to the client by way of a WEB browser.

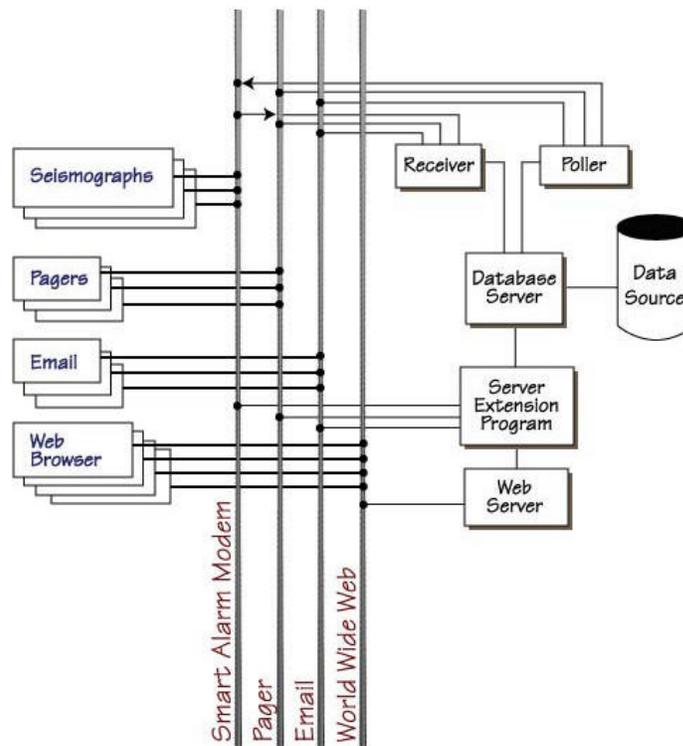


Figure 2 : A schematic of the On Line Internet Vibration Exchange

### Alarms

The Smart Alarm Modem initiates alarms. When the alarm status of the seismograph is set the modem dials the GEOCOMP telephone exchange and transmits the alarm information to the Receiver program located at GEOCOMP (see Figure 2). The receiver program logs the information and sends out an alarm notification (email or pager message). The receiver program can also initiate an automatic download from the seismograph of all the vibration data. The data will be available on the Internet as soon as the download is completed.

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### ***Reports***

Reports are generated on request from the client's browser using the Server Extension Program (see Figure 2). An example of a web report is presented at the end of this paper. All data that have been downloaded from the seismograph into the database server are immediately available for generating reports. The time required to create the report is small in comparison to the time required to transmit the data. Reports can be formatted as HTML pages for viewing in a browser or in PDF format. The PDF format is widely available on the Internet due to the abundance of the free Adobe Reader program. The PDF format has a number of benefits for generating reports through the Internet. First, the content of the report page is fixed. This means that the report can be formatted for the printed page and that the content of the page cannot be modified (as compared to distributing a MS Word or Excel type of document). Second, the PDF file can be emailed. This enables the reports to be automatically sent every day, or every time an alarm level is reached. Thirdly, because the format of the report is fixed, the report can be printed on any computer and printer that can read Adobe PDF files.

### ***Automatic Downloads***

Data can be automatically downloaded at regular intervals from the seismograph. Downloads are performed by the Poller program located at GEOCOMP (see Figure 2). The data are placed directly into the WEB accessible database. All downloaded data is immediately available for report generation using the WEB. Reports can also be automatically emailed at preset intervals.

### ***WEB Access and Reporting***

All settings and commands are available using a WEB browser. Access to the settings and vibration data is restricted by username and password. Data are accessed by project name, seismograph, and date. Figure 1 shows how the data are accessed. An example daily report is presented at the end of this paper. A detailed report (Figure 4) contains a summary table of all events and data files. Comments may be submitted through the WEB page. The comments are saved in the database and are printed on all the reports.

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### WEB Seismograph Settings and Control

It is possible to configure the seismograph directly from the WEB page. Figure 3 presents the seismograph settings WEB page.

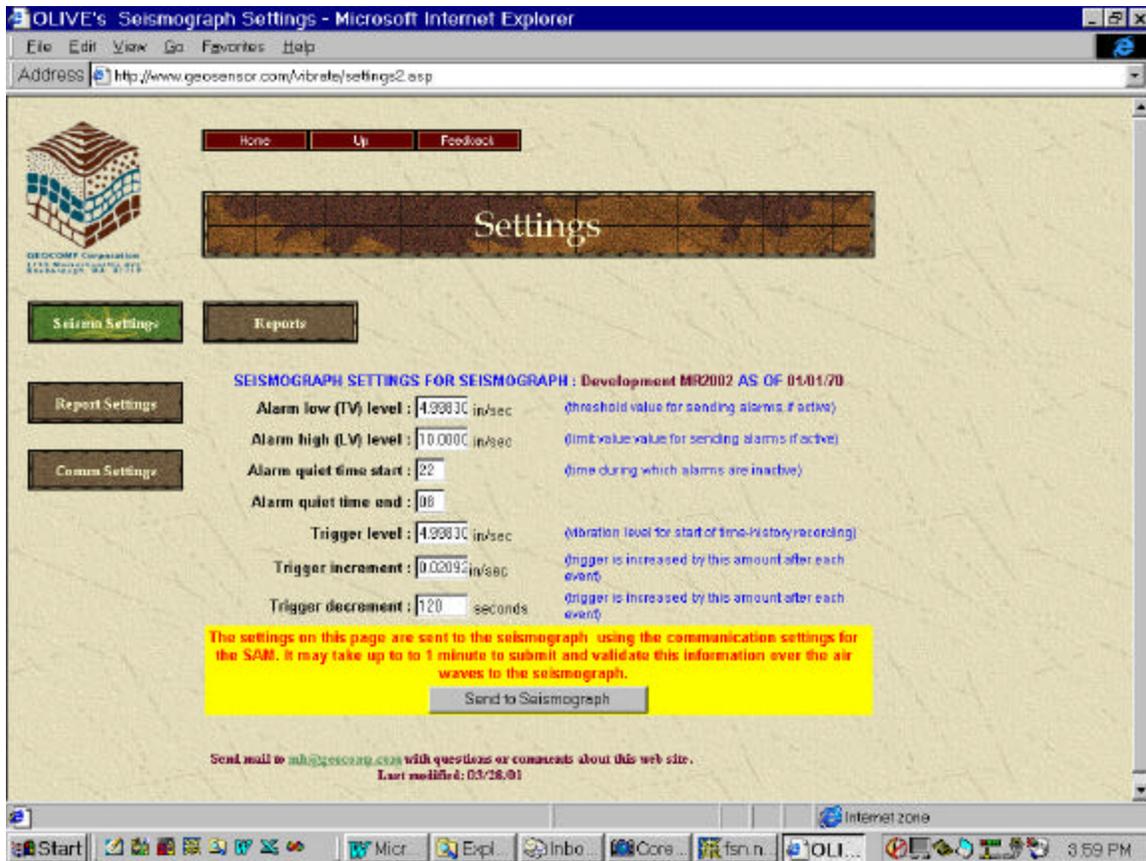


Figure 1: Seismograph Settings Web Page

When the *Send to Seismograph* button is clicked, the information from the page is submitted to a Server Extension Program that connects to the Smart Alarm Modem. The connection information such as phone number is entered on a different WEB page and is stored in the database. Once the connection is established the WEB page is updated as the settings are changed on the seismograph.

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### Downloading Native Data Files

In addition to presenting data in reports, the data may be downloaded as binary data files. These files are in the same format as they would be if downloaded directly from the seismograph. Figure 4 shows the detailed report WEB page that links to all the native data files. The native data files provide detailed time history data. The data files are downloaded by clicking on the links shown in the detailed reports in Figure 4.

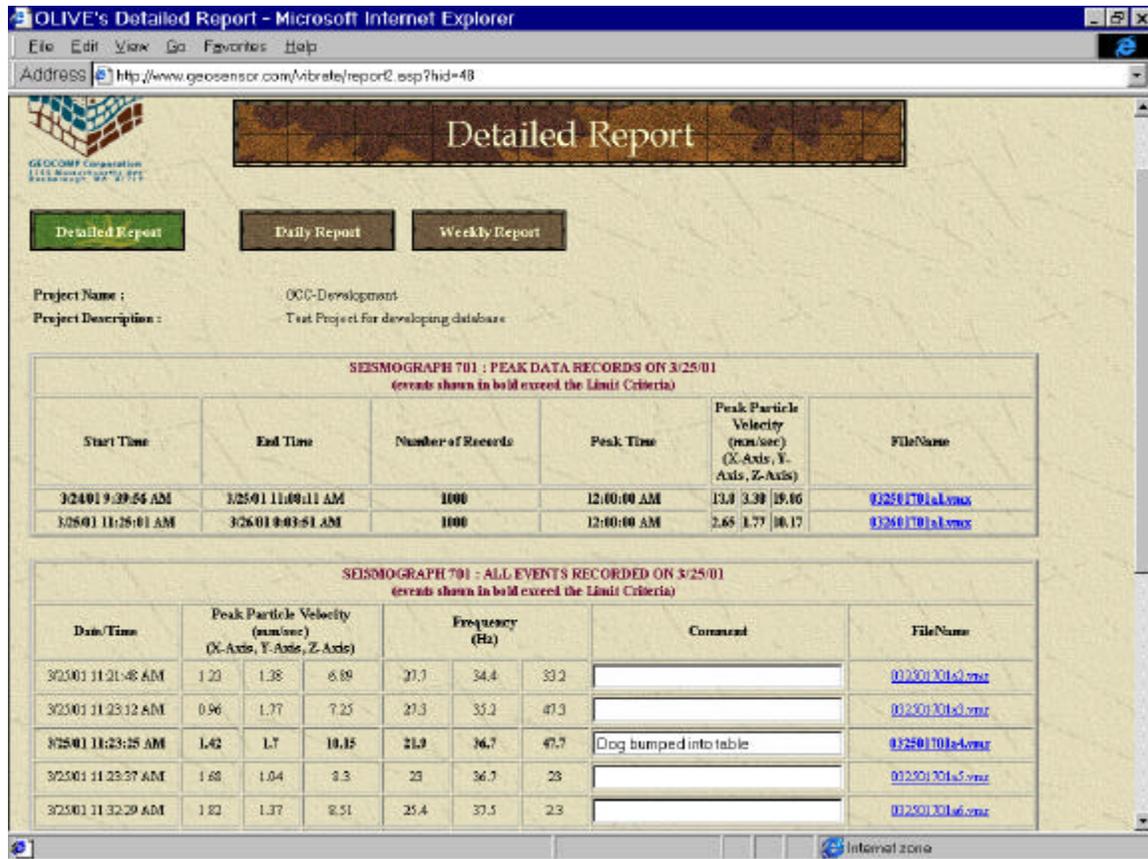


Figure 2: Detailed Report WEB page

### Summary and Conclusions

There are several significant benefits of the system described in this paper:

- ?? Alarm notification is proactive allowing better control over construction vibrations
  - ?? Data can be accessed from a WEB browser. Access is easy and always available.
  - ?? Data can be accessed by project, location and date. It is not necessary to remember filenames.
  - ?? Faster reporting greatly reduces the delay between the vibration event, data collection and data reporting.
  - ?? Automated reporting saves time and money by having reports available without having to collect and format data.
  - ?? No special software is needed. All that is needed to access the system is a WEB browser and Internet access
  - ?? File management is simplified. The data are loaded and accessed from a centralized database. Data files can also be downloaded in the native binary format.
- PDF formatted reports provide fixed format reports that can be emailed and compiled into project reports.

The On Line Internet Vibration Exchange is available as a service provided by GEOCOMP Corporation.

## WEB-based monitoring of Vibration

OLIVE's Daily & Weekly Reports



**GEOCOMP Corporation**  
 1145 Massachusetts Ave.  
 Boxborough, MA 01719

**Project Name :** GCC-Development  
**Project Description :** Test Project for developing database

**SUMMARY OF DATA FROM 3/25/01 4:00:00 AM TO 3/25/01 8:00:00 PM**

**Location ID :** 701  
**Location Description :** Development MR2002 : The hardwood floor at Martin's home  
**Last Download date :** 3/28/01  
**Threshold Value :** 4.998304 (mm/sec)  
**Limit Value :** 10.000096 (mm/sec)  
**Number of Limit Events :** 2  
**Number of Threshold Events :** 10  
**Maximum Event :** 10.17 (mm/sec) on Channel-Z at 3/25/01 6:09:07 PM

Recording from : 3/24/01 9:39:56 AM to : 3/25/01 11:08:11 AM

Recording from : 3/25/01 11:25:01 AM to : 3/26/01 8:03:51 AM

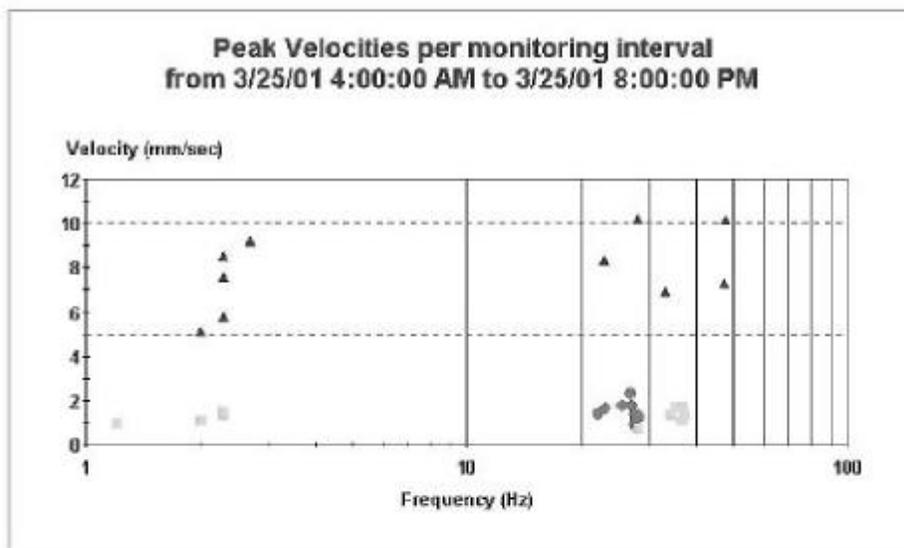
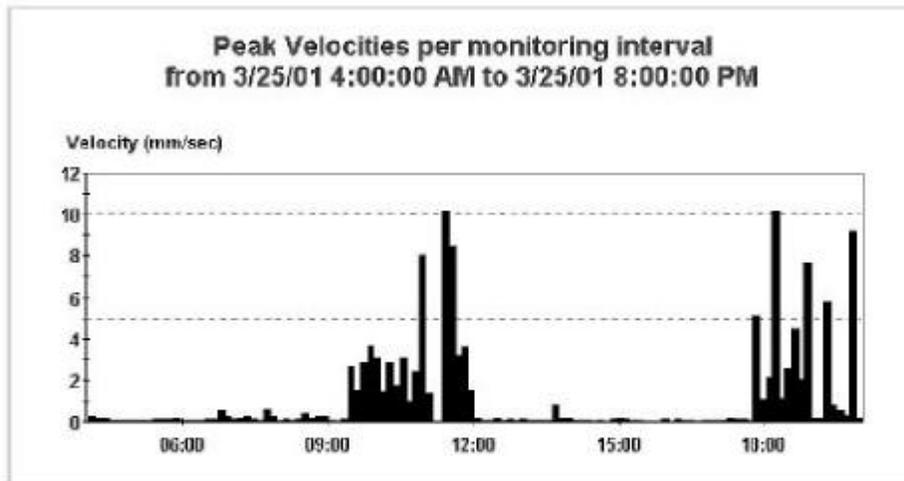
**EVENTS THAT EXCEED THE PROJECT CRITERIA FROM 3/25/01 4:00:00 AM TO 3/25/01 8:00:00 PM**  
 (events shown in bold exceed the Limit Criteria)

Date/Time	Peak Particle Velocity (mm/sec) (X-Axis, Y-Axis, Z-Axis)			Frequency (Hz)			Comment
3/25/01 11:21:48 AM	1.23	1.38	6.89	27.7	34.4	33.2	
3/25/01 11:23:12 AM	0.96	1.77	7.25	27.3	35.2	47.3	
<b>3/25/01 11:23:25 AM</b>	<b>1.42</b>	<b>1.7</b>	<b>10.15</b>	<b>21.9</b>	<b>36.7</b>	<b>47.7</b>	
3/25/01 11:23:37 AM	1.68	1.04	8.3	23	36.7	23	
3/25/01 11:32:29 AM	1.62	1.37	8.51	25.4	37.5	2.3	
3/25/01 5:48:49 PM	1.29	1.04	5.08	28.1	2	2	
<b>3/25/01 6:09:07 PM</b>	<b>1.27</b>	<b>0.77</b>	<b>10.17</b>	<b>28.1</b>	<b>28.1</b>	<b>28.1</b>	Dropped a load of books
3/25/01 6:30:43 PM	2.37	1.52	7.61	26.6	2.3	2.3	
3/25/01 7:12:58 PM	1.44	1.35	5.75	27.3	2.3	2.3	
3/25/01 7:30:02 PM	1.63	0.9	9.23	27	1.2	2.7	

This report was generated by GEOCOMP's OLIVE at <http://www.geocomp.com/vibrate>

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