TriNet/CISN Engineering Strong Motion Data Center and the Internet Quick Report

Kuo-Wan Lin, Anthony Shakal
Strong Motion Instrumentation Program, Calif. Dept. Conservation/Div. Mines & Geology,
Sacramento, California

and

Christopher Stephens
U.S. Geological Survey

Abstract

The development of the TriNet/CISN Engineering Data Center is in progress. As one part of the Engineering Data Center, the California Division of Mines and Geology's Strong Motion Instrumentation Program has developed a prototype Internet Quick Report (IQR) that uses Internet technology to distribute processed strong-motion data immediately after an earthquake. The IQR is dynamic and cumulative, containing an up-to-date table listing recorded peak ground and structural accelerations arranged in either epicentral distance or alphabetical order. Also, users will have direct access to processed strong-motion data and detailed information on instrumented stations from the IQR. The Engineering Data Center is in the process of compiling detailed structural information on instrumented stations to assist users in utilizing the strong-motion data and to allow users to search for data from specific structure types.

Introduction

Earthquake monitoring in California is a multi-institutional effort involving state, federal, and private agencies. The TriNet project, funded by the Federal Emergency Management Agency (FEMA) through the California Office of Emergency Services (OES), is a cooperative effort of three agencies, the California Division of Mines and Geology, the California Institute of Technology and the Pasadena Office of the U.S. Geological Survey.

Based on the TriNet project, the California Integrated Seismic Network (CISN) is a newly formed consortium of institutions engaged in earthquake monitoring and will extend to include statewide coverage with two additional core members, the Menlo Park Office of the U.S. Geological Survey and the University of California, Berkeley. The OES serves as an ex-officio participant in the CISN.

A key component of the CISN is the Engineering Strong Motion Data Center. The data center will be operated by the California Department of Conservation's Strong Motion Instrumentation Program (CSMIP) in cooperation with the USGS/National Strong Motion Program (NSMP). A primary goal of the Engineering Data Center as well as the other two Data Management Centers in CISN is to provide rapid information after an earthquake, ranging from the ShakeMap to distribution of the data and calculated parameters. Under the TriNet project the

CSMIP has established backup ShakeMap production in Sacramento. Currently it is in the process of expanding the coverage area of ShakeMap from southern California to statewide backup under the CISN project. In addition, the Engineering Data Center will assemble strong-motion data sets for the earthquake engineering community incorporating data from all CISN stations. To effectively disseminate strong-motion data for engineering applications right after major earthquakes, an Internet-based Quick Report has been developed, based on the concept of the traditional hardcopy Quick Report method.

Internet Quick Report

The purpose of the Internet Quick Report (IQR) is to rapidly distribute strong-motion data and related information in standard World Wide Web format by using advanced Internet technology. The design concept for the IQR not only transforms the traditional Quick Report into an Internet page for rapid, broad, and convenient distribution, but also streamlines the Quick Report production process in an automatic fashion. To accomplish this, a suite of computer utilities and modules have been developed that serve as an add-on capability to the CSMIP monitoring system.

Upon the occurrence of an earthquake, the IQR programs will be activated during a period of time after the event. While the IQR modules are active, they develop and maintain a list of triggered strong-motion stations and a list of processed strong-motion data that is available for download. Peak ground and structural acceleration values recorded at stations are parsed from a summary table of peak accelerations in the CSMIP monitoring system and from incoming data from partner CISN agencies. The immediate outputs of the IQR programs are two Internet pages such as shown in Figure 1 and 2. They list all data recorded up to that time in two tables, one sorted for user convenience in increasing epicentral distance order and the other in alphabetical order by station name/location. The contents of these two Internet pages are cumulative and are updated continuously as the number of call-in stations increases and more data has been processed and made available for public access.

Each IQR Internet page is based on an internal key table of peak acceleration values of strong-motion data recorded at stations. As shown in Figure 1, at the top of the IQR Internet page is the name and the date of the earthquake and links to earthquake related information at other CISN sites regarding location, magnitude, and the ShakeMap. The contents of the table are sorted in either alphabetical or epicentral distance order. Each row of the table represents one record entry including station name, station number, network, epicentral distance, and peak acceleration on the ground and the structure. The buttons that are linked for viewing and downloading processed strong-motion data are enabled when data becomes available at the Engineering Data Center. Since the list of the recorded stations is dynamic and cumulative, the IQR tables are expanded by insertion of new station data into the IQR tables when it is received, either from the CSMIP monitoring system or from the CISN partners. At the same time, the status of the View and the Download buttons for each record are also updated based on file availability through or at the Data Center.

Internet Pages for Strong-motion Stations

There are four general types of the strong-motion stations, ground response, building, lifeline (bridge and dam), and special (geotechnical array and other). To help users acquire site and structural information for the recording stations, the Engineering Data Center is preparing Internet pages for CISN strong-motion stations. At the time of this paper, we are still in the process of creating Internet pages for the CSMIP stations. For ground response stations, a total of more than 600 Internet pages have been completed. For each station, the page contains information on location, elevation, and site geology, and also a photograph of the station. Also included are the modification date of the Internet page and the source of the station data. Figure 3 shows an example of a typical page for a ground response station.

For the other station types, detailed information regarding the instrumented structure is included to describe the station. Shown in Figure 4 is an example of a building Internet page. In the figure, basic data as well as detailed design information and sensor layouts of the instrumented building are listed. Also, the image of the building sensor layout is available at full scale so that users can click on the link to view the image full size as shown in Figure 5. Figure 6 shows another example of a building Internet page for a building station instrumented by USGS/NSMP. Internet pages of lifeline and special station types such as bridges, dams and geotechnical arrays will have similar formats as the building page with changes in some field entries. An example for a dam station is shown in Figure 7. Creation of the Internet web pages for structural stations is in progress.

Once the Internet pages for the CISN strong-motion stations have been prepared, the contents of the station Internet pages will be updated when there are changes to station lists. A utility program module has been developed to automatically update the station Internet pages.

The TriNet/CISN Engineering Data Center and the COSMOS Virtual Data Center

The COSMOS virtual data center (Archuleta, 2000) is a web based virtual library of primarily ground response strong-motion data from networks and stations throughout the world. The primary features of the virtual data center are to allow users to search its database, to provide users easy access to the data, and to allow data collecting agencies to be the source of the data. In terms of functionality, the COSMOS virtual data center and the TriNet/CISN Engineering Data Center complement and will be linked to each other. The TriNet/CISN Engineering Data Center provides data immediately after earthquakes and provides detailed information on structural stations not available in the COSMOS data center. The large database search and access of ground motion records that the COSMOS data center has developed will not be duplicated in the TriNet/CISN Engineering Data Center.

Even though the TriNet/CISN Engineering Data Center will not support full database search and access features, it will allow users to search for recorded strong-motion data and information on various structures. The design of the search function of the TriNet/CISN Engineering Data Center is to provide engineers a tool to access strong-motion records based on structure system such as structure design type, structure height, and the level of ground accelerations, etc. Structural engineers will be able to quickly access records of structural response for the type of building of interest for different earthquakes without going through every event in the Data Center. The search function of the Engineering Data Center is currently in prototype stage development, and will be finalized with engineering staff of CSMIP and NSMP in conjunction with the compilation of structure design information for structure Internet pages of the CISN stations.

Future Plans

The Governor signed the California budget in July 2001, which includes funds for the CISN. The primary missions of the CISN are to operate statewide seismic monitoring and to provide tools for emergency responders and earthquake engineers to reduce damage from earthquakes. As to the Engineering Data Center, the development of the data center is continuing as planned and it will become fully operational under CISN. In terms of data exchange and communication, we plan to increase the interactions with the other CISN Data Centers and to improve robustness of established data communication pathways. Methods of data exchange for strong ground motion and station data with collaborative agencies, primarily NSMP, are in development. With integrated data, the IQR will be a key feature of the Engineering Data Center. Site and structural information of CISN instrumented stations will be compiled for Web access. When the compilation of site and structural information of stations is completed, the search feature of the TriNet/CISN Engineering Data Center will become available. The station data will be updated routinely as new stations are installed and/or existing stations are upgraded.

Summary

The TriNet/CISN Engineering Data Center will manage strong-motion data for applications in earthquake engineering and the development of the data center is summarized below:

- A prototype Internet Quick Report has been developed to provide earthquake engineering users rapid and easy access to strong-motion records and processed data for recent earthquakes recorded by all five CISN institutions. The prototype IQR is currently linked to the CSMIP web site and can be accessed via the Internet address:

  http://docinet3.consrv.ca.gov /csmip/iqr_dist.htm

- The Engineering Data Center will provide users rapid, detailed information on instrumented structures and other stations including location, site geology, structure system, sensor layouts, etc.

- Developing station information pages in web accessible format is continuing with more than 600 ground response station pages and eight structure pages completed.

- The Engineering Data Center will provide users a search function for accessing strong-motion data from various earthquakes based on the designs of instrumented stations instead of the sources of earthquakes.

References

Archuleta, R. (2000). "COSMOS Virtual Data Center", in SMIP2000 Seminar on Utilization of Strong-Motion Data, 2000, 97-114.

Shakal, A.F. and C.W. Scrivner (2000). "TriNet Engineering Strong Motion Data Center", in SMIP2000 Seminar on Utilization of Strong-Motion Data, 2000, 115-124.

Combined TriNet/CISN Strong-Motion Data Set

Internet Quick Report

Portola Earthquake of Aug 10, 2001

Information on Earthquake : Location, magnitude and TriNet/CISN ShakeMap

Stations listed in **Increasing Epicentral Distance** (Alternatively, select alphabetical listing)

Station Name	Station No./ID	Network	Dist. (km)	Horiz Apk (g)		View	Download
				Ground	Struct.		
Nevada City - New Bullards Bar Dam	77756	CDMG	65	.004	.061		- -
Martis Creek Dam	01133	ACOE	72	.017	.022	- -	- -
Reno - SP Power Co.	02023	USGS	85	.014	- -	- -	- -
Palermo - Fire Station	77350	CDMG	90	.011	- -		- -
Carson City - Nevada Community College	02019	USGS	103	.005	- -	- -	- -
Meyers - South Lake Tahoe	66038	CDMG	120	.007	- -	- -	- -
Silver Springs - Fire Station	02018	USGS	130	.010	- -	- -	- -
Sacramento - 801 K St Basement	67990	CDMG	157	.004	- -	- -	- -
Sacramento - State Capitol Bldg	67508	CDMG	158	Trig.	- -	- -	- -

Return to Home Page

Figure 1. An example of the prototype Internet Quick Report table sorted in epicentral distance order for the M5.5 earthquake near Portola, CA on Aug. 10, 2001. The two stations in the table with processed strong-motion records available for viewing have the View buttons enabled.

Combined TriNet/CISN Strong-Motion Data Set

Internet Quick Report

Portola Earthquake of Aug 10, 2001

Information on Earthquake : Location, magnitude and TriNet/CISN ShakeMap

Stations listed in **Alphabetical Order** (Alternatively, select increasing epicentral distance listing)

Station Name	Station No./ID	Network	Dist. (km)	Horiz Apk (g)		View	Download
				Ground	Struct.		
Carson City - Nevada Community College	02019	USGS	103	.005	- -	- -	- -
Martis Creek Dam	01133	ACOE	72	.017	.022	- -	- -
Meyers - South Lake Tahoe	66038	CDMG	120	.007	- -	- -	- -
Nevada City - New Bullards Bar Dam	77756	CDMG	65	.004	.061		- -
Palermo - Fire Station	77350	CDMG	90	.011	- -		- -
Reno - SP Power Co.	02023	USGS	85	.014	- -	- -	- -
Sacramento - 801 K St Basement	67990	CDMG	157	.004	- -	- -	- -
Sacramento - State Capitol Bldg	67508	CDMG	158	Trig.	- -	- -	- -
Silver Springs - Fire Station	02018	USGS	130	.010	- -	- -	- -

Return to Home Page

Figure 2. The Internet Quick Report table sorted in alphabetical order of station name/location for the M5.5 earthquake near Portola, CA on Aug. 10, 2001.

Los Angeles - Temple & Hope	Sta.No. 24611
Network:	CDMG/CSMIP

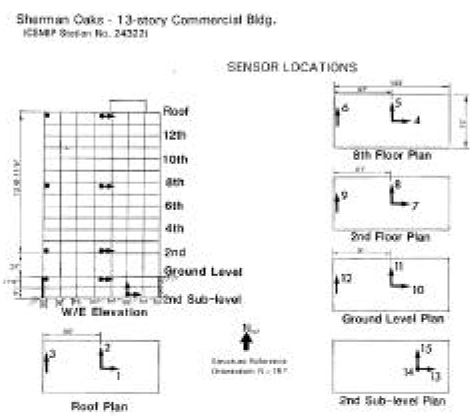
Latitude	34.059N
Longitude	118.246W
Elevation	117M
Site Geology	Rock (sedimentary)

Page Last Updated: 22 Aug 2001 16:38 Sta. List Ver. 3.9

Press* **[Back] *button in your web browser to return to the previous page.*

Figure 3. An example Internet page for a ground response station. In the page, basic information including location and site condition of the station as well as a photograph are included. The update date and the source of station data are shown at the bottom of the page.

Sherman Oaks - 13-story Commercial Bldg **(CSMIP Station No. 24322)**
Instrumented by: CDMG/SMIP



(Sensor Layout - click to enlarge)

Latitude	34.154N
Longitude	118.465W
Elevation	215M
Site Geology	Alluvium

No. of Stories above/below ground	13/2
Plan Shape	Rectangular
Base Dimensions	209 x 125 ft (63.7 x 38.1 m)
Typical Floor Dimensions	193 x 75 ft (58.8 x 22.9 m)
Design Date	1964
Instrumentation	1977, 15 accelerometers, on 6 levels

Vertical Load Carrying System	4.5 in. (11.4 cm) concrete slabs supported by concrete beams and columns.
Lateral Force Resisting System	Moment resisting concrete frames in both directions for the upper stories; concrete shear walls in the basements.
Foundation Type	Concrete piles.
Remarks	The building was retrofit with friction dampers after the 1994 Northridge Earthquake.

Sta. Last Updated: 16 Aug 2001 09:40 Sta. List Ver. 3.9

Press **[Back] button in your web browser to return to the previous page.*

Figure 4. An example Internet page for a building station. Details on the structural system of the instrumented building are included in addition to the basic station data.

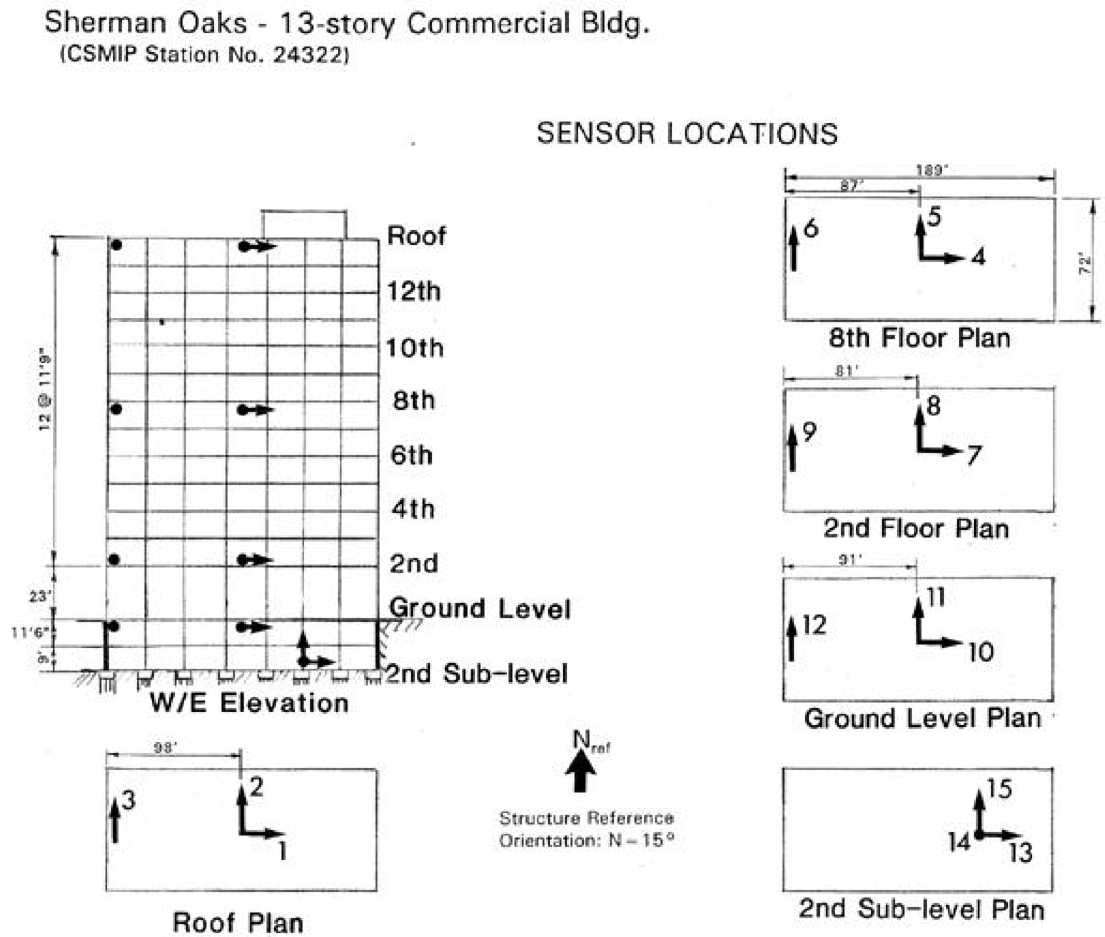
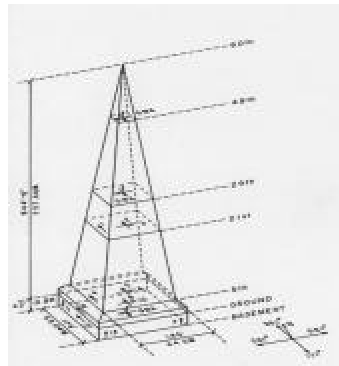


Figure 5. An image of the sensor layout for the building page shown in Figure 4. The full scale image is displayed when users click on the link to the sensor layout in the building page.

San Francisco - 60 story Office Bldg **(USGS Station No. 1239)**

Instrumented by: USGS/NSMP



(Sensor Layout - click to enlarge)

Latitude	37.795N
Longitude	122.401W
Elevation	4m
Site Geology	Alluvium, 150 ft (50m) over rock

No. of Stories above/below ground	60/3
Plan Shape	Square
Base Dimensions	174 x 174 ft (53 x 53 m)
Typical Floor Dimensions	Decreases with height
Design Date	1980
Instrumentation	1985, 22 accelerometers, on 6 levels

Vertical Load Carrying System	Concrete slabs on metal decks supported by steel beams and columns.
Lateral Force Resisting System	Steel moment frames in the upper stories; concrete shear walls in the basements.
Foundation Type	9 ft (2.7 m) concrete mat foundation.
Remarks	Landmark pyramidal building in San Francisco.

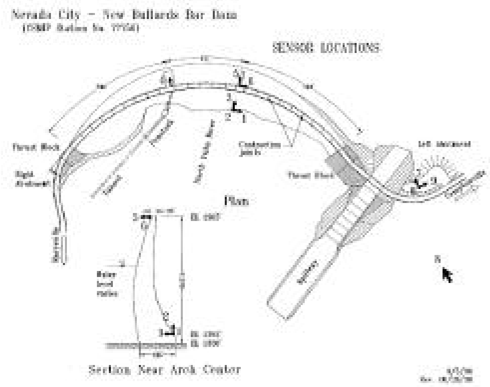
Page Last Updated: 06 Sep 2001 17:20

Press **[Back] button in your web browser to return to the previous page.*

Figure 6. An example Internet page for a building station instrumented by USGS/NSMP.

Nevada City - New Bullards Bar Dam **(CSMIP Station No. 77756)**

Instrumented by: CDMG/SMIP



(Sensor Layout - click to enlarge)

Latitude	39.393N
Longitude	121.141W
Elevation	604M
Site Geology	Granitic rock

Height	Dam Height 645' (19.7m)
Plan Shape	Multi-radius circular
Base Dimension	- -
Structure Dimension	Crest Length 1918' (585m)
Design Date	- -
Instrumentation	1998, 9 accelerometers, on crest, toe and abutment

Vertical Load Carrying System	Concrete arch (thickness varies from 35' on crest to 185' at foundation) dam
Lateral Force Resisting System	Concrete arch dam
Foundation Type	- -
Remarks	- -

Page Last Updated: 22 Aug 2001 16:38 Sta. List Ver. 3.9

Press **[Back] button in your web browser to return to the previous page.*

Figure 7. An example Internet page for a lifeline structure station. The format of the page is similar to the building page shown in Figure 4 except that some field designations are unique for this structure type.