![Encardio Rite logo] ENCARDIO **RITE**

ONE STOP MONITORING SOLUTIONS | HYDROLOGY | GEOTECHNICAL | STRUCTURAL | GEODETIC
Over 50 years of excellence through ingenuity

ONLINE MONITORING OF BUILDINGS, MONUMENTS, STRUCTURES & BRIDGES

1   Introduction

Encardio-rite offers online web based monitoring services for the following:

- Safety of existing multiple storey buildings, hotel complexes, corporate offices and buildings of critical importance
- Safety of old and depleted buildings and structures subject to long-term movement or degradation of materials
- Safety of buildings, monuments and structures during nearby construction activity (like construction of Metros, deep excavation for high rise buildings etc.)
- Safety of monuments and structures of historical importance
- Safety of buildings and structures in hills and landslide prone areas
- Safety of old rail and road bridges.

2   Structural monitoring solutions

For buildings, structures and bridges etc., it is recommended that Structural Health be continuously monitored to ensure proper maintenance and safety of man and material. A basic system offered by Encardio-rite that can be used for most structures essentially consists of the following:

- Encardio-rite model EAN-92M-B biaxial tilt meter mounted at one or more locations on the structure. The tilt meter should ideally be installed at an indoor location or in shade to prevent effect of large temperature fluctuations on the monitored results. Readings should possible be retrieved in the morning hours when temperature induced stresses in the buildings are minimum.
- Encardio-rite model ESDL-30 data logger with integral GSM/GPRS modem for storing and transmitting data to a server with the service provider.
- Encardio-rite online web data monitoring service (WDMS)

Tilt meter installed with datalogger

Collapse of a building or bridge is often preceded by change in tilt of affected areas. The above instrumentation is a standardized low cost system effectively used to online monitor different type of structures to give timely warning on impending danger. The purpose is to assist and inform owner/designer/contractor/architect about continued performance of structures under gradual or sudden changes to their state. The main factors affecting the performance is degradation of structure with age, undue settlement/tilt due to soil conditions or nearby construction activity, vibrations due to traffic, ground water level, atmospheric conditions and movement of slopes in hilly areas etc. This may be reflected in abnormal changes in tilt and settlement values.

Data is available online with alarms through Encardio-rite Web Monitoring Services. For buildings and structures built on a hill or a mountain, this is a good low cost service for monitoring their stability with time. It msay give forewarning of ground movement during rainfalls.

2.1   Public Cloud Based Web Data Monitoring Service (WDMS)

The heart of the online structural monitoring instrumentation system is a Public Cloud Based Web Data Monitoring Service offered by Encardio-rite for retrieving data from the ESDL-30 SDI-12 data logger, archiving the data in a SQL database, processing the data and presenting the processed data in tabular and most

suitable graphical forms for easy interpretation of the logged data. The tables and graphs related to any site or sites can be accessed by authorized personnel who can login to their site using the supplied login ID and access password from anywhere in the world over the internet. No special software is needed for accessing the user sites as the information can be viewed using most standard and popular web browsers like Microsoft Internet Explorer, Mozilla Firefox, Google Chrome etc.

Data from Encardio-rite cloud based web monitoring service can be accessed from just about any type of device that supports a standard web browser like a desktop or laptop PC, Tablet, smart phone or most other mobile computing devices.

A graphic like a map, ground plan or a photograph is put on the opening screen marked with position of installed sensor/sensors represented as square dots. As soon as the mouse pointer is brought over any sensor location the corresponding sensor details like sensor identification Tag, last recorded sensor reading, and the values of the programmed alert levels pop up in a box. If any one of the alarm level is exceeded the sensor location turns to a red dot. Clicking the pop up table with the mouse brings up an associated data window where the sensor data can be seen either as a table or as a graph.

Site administrators can set two alarm limits which are generally considered as "alert level" and "evacuate level". Other users can only view the data and alarm status but cannot make any changes.

The WDMS can also be programmed to send SMS alert messages or e-mail to selected users as soon as any sensor data crosses its predefined alarm levels, either while going above or going below
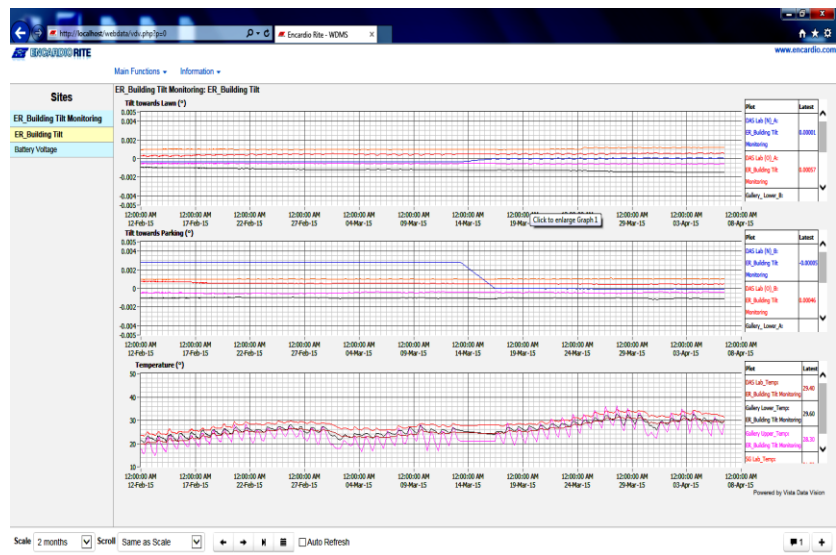
the alarm level. It can also be programmed to send the health status of the system to selected users.

Encardio-rite cloud services work on a rental model. User has to pay a small setup fee for first time and then a monthly rental has to be paid for accessing the data over the cloud as long as required.

2.2   Reference guidelines for building damage classification

Classification of building damage as summarized from **Burland et al, 1977 by Boscardin and Cording 1989.**

Building damage classification			Approximate. equivalent ground settlements and slopes *(after Rankin 1988)*	
Risk category	**Description of degree of damage**	**Approximate. crack width (mm)/number of cracks**	**Max slope of ground**	**Max settlement of building (mm)**
1	Negligible	0.1 to 1	<1:500	<10
2	Slight	1 to 5	1:500 to 1:200	10 to 50
3	Moderate	5 to 15/no. of cracks > 3	1:200 to 1:50	50 to 75
4	Severe	15 to 25/also on no. of cracks	1:200 to 1:50	>75
5	Very severe	> 25/also on number of cracks	>1:50	>75

Note: *For more details and case histories, please refer to our Application note AN-1501 "Online Safety Monitoring Solutions for Buildings, Monuments and Bridges"*