

VW Embedment Strain Gauge

52640199

Copyright ©2004 Slope Indicator Company. All Rights Reserved.

This equipment should be installed, maintained, and operated by technically qualified personnel. Any errors or omissions in data, or the interpretation of data, are not the responsibility of Slope Indicator Company. The information herein is subject to change without notification.

This document contains information that is proprietary to Slope Indicator company and is subject to return upon request. It is transmitted for the sole purpose of aiding the transaction of business between Slope Indicator Company and the recipient. All information, data, designs, and drawings contained herein are proprietary to and the property of Slope Indicator Company, and may not be reproduced or copied in any form, by photocopy or any other means, including disclosure to outside parties, directly or indirectly, without permission in writing from Slope Indicator Company.

SLOPE INDICATOR

12123 Harbour Reach Drive
Mukilteo, Washington, USA, 98275
Tel: 425-493-6200 Fax: 425-493-6250
E-mail: solutions@slope.com
Website: www.slopeindicator.com

Contents

Introduction	1
Installation.....	2
Taking Readings	4
Data Reduction	7

Introduction

- Applications** VW Embedment Strain Gauges are used to measure strain in reinforced concrete and mass concrete.
- Operation** The body of the strain gauge is a steel tube with flanges at either end. Inside the body, a steel wire held in tension between the two flanges. Strain in the concrete causes the flanges to move relative to one another, increasing or decreasing the tension in the wire.
- The tension in the wire is measured by plucking the wire with electromagnetic coils and measuring the frequency of the resulting vibration. Strain in the wire is calculated by squaring the frequency reading and multiplying a gauge factor and a batch calibration factor.

Installation

Testing

Test each sensor before installing it. Use a readout and an ohm meter to conduct these tests.

- The VW sensor reading should be about 895 Hz
- The RTD reading should be close to the ambient temperature.
- Resistance between the orange/white and orange leads should be about 300 ohms.
- Resistance between blue/white and blue leads should be about 2k ohms.

General Concerns

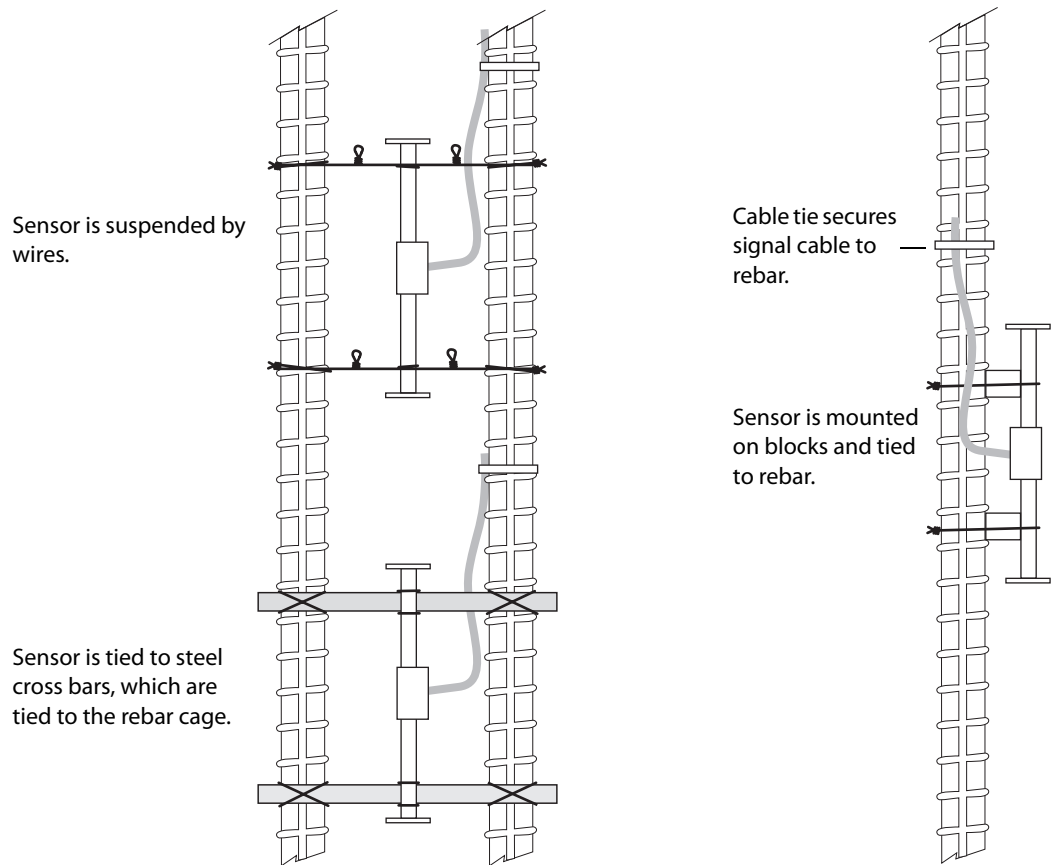
Sensor Handling: Do not twist or pull on the end flanges of the sensor. This may cause non-repairable damage to the sensor.

Sensor Identification: Mark cables before installation so that sensors can be identified after installation.

Cable Strain Relief: Provide strain relief for signal cables. Cables can be stretched and damaged when the rebar cage is lifted and during placement and vibration of the concrete.

Typical Installation

In reinforced or pre-stressed concrete applications, the embedment strain gauge is usually tied to the rebar cage.



Other Installation Methods

Sometimes specifications require that the gauge be cast in a concrete briquette prior to installation.

In mass concrete applications, the gauge may be installed either before or immediately after placement of concrete. Gauges may also be installed in a rosette configuration.

Taking Readings

Introduction

These instructions tell how to read the strain gauge with Slope Indicator's portable readouts.

Instructions for reading VW sensors with a Campbell Scientific CR10 can be found at www.slopeindicator.com. Go to Support - Tech Notes and click on the link titled "CR10-VW Sensors."

Reading with the VW Data Recorder

1. Connect signal cable to the data recorder:

Binding Posts	Wire Colors	
VW	Orange	Red
VW	White & Orange	Black
TEMP	Blue	White
TEMP	White & Blue	Green
SHIELD	Shield	Shield

2. Choose Hz + RTD or Hz + Thermistor.
3. Select the 450-1200 Hz range.
4. The recorder displays sensor reading in Hz and a temperature reading in degrees C.

Reading with the VWP Indicator

1. Connect signal cable to the VWP indicator as shown in the tables below.
2. Select the 0.45-1.2 kHz range with the Sweep key.
3. Select Hz with the Data key. Do not use microstrain settings (these are for a different model of sensor).
4. Read the RTD: Select °C with the Data key.
Note that the VWP Indicator reads RTDs only and cannot read thermistors.

Standard Jumper 52611950

Connect alligator clips as shown below:

Clips	Wire Colors		Function
Red	Orange	Red	VW
Red	White & Orange	Black	VW
Black	Blue	White	TEMP
Black	White & Blue	Green	TEMP

Universal Jumper 52611957



This cable has a universal connector and is supplied with a bare-wire adapter:

BWA	Wire Colors		Function
5	Blue	White	TEMP
6	White & Orange	Black	VW
7	White & Blue	Green	TEMP
8	Orange	Red	VW
10	Shield	Shield	Shield

Reading with the DataMate MP

The DataMate MP allows you to choose engineering units for your readings. However, for ease of data reduction, we recommend that you record readings in Hz.

Manual Mode

1. Connect signal cable as shown in the table below.
2. Switch on. Press  (Manual Mode).
3. Scroll through the list to find “Vibrating Wire Hz.”
4. Press  to excite the sensor and display a reading in Hz and a temperature reading in degrees C.

Universal Jumper and Bare-Wire Adapter

The DataMate jumper cable has a universal connector that connects directly to a universal terminal box or to signal cables that are terminated with a universal connector. A bare-wire adapter (BWA) is also supplied with the DataMate. It allows connection to wires of the signal cable as shown below:

Terminals on BWA or Terminal Box	Wire Colors		Function
5	Blue	White	TEMP
6	White & Orange	Black	VW
7	White & Blue	Green	TEMP
8	Orange	Red	VW
10	Shield	Shield	Shield

Data Reduction

Converting from Hz to microstrain

Use the following equation to convert a reading in Hz to microstrain:

$$\mu\varepsilon = F^2 \times (3.304 \times 10^{-3}) \times K$$

Where:

F is a reading in Hz.

3.304×10^{-3} is the gauge factor.

K is the batch calibration factor listed on the calibration sheet supplied with the sensors

Calculating Change in Strain

Change in strain is calculated by subtracting the initial strain from the current strain.

$$\Delta\mu\varepsilon = \mu\varepsilon_{\text{current}} - \mu\varepsilon_{\text{initial}}$$

or

$$\Delta\mu\varepsilon = (F2_{\text{current}} - F2_{\text{initial}}) \times (3.304 \times 10^{-3}) \times K$$

Where:

F is a reading in Hz.

3.304×10^{-3} is the gauge factor.

K is the batch calibration factor listed on the calibration sheet supplied with the sensors.

Tension or Compression?

Using the equation above,

- a positive $\Delta\mu\varepsilon$ indicates tensile strain.
- a negative $\Delta\mu\varepsilon$ indicates compressive strain.

If you wish to use a different convention, reverse the sign of the $\Delta\mu\varepsilon$ value.

Temperature Effects

We recommend that you always record temperature along with strain. Temperature data can help you understand real changes in stress due to expansion and contraction caused by temperature changes.

Concrete and steel have different thermal coefficients of expansion. You can calculate a correction for this difference using the equation below:

$$\text{Temperature Correction} = (TC_C - TC_S) \times (T_{\text{current}} - T_{\text{initial}})$$

Where:

TC_C is the thermal coefficient of expansion for concrete. A typical value is 10 ppm per °C.

TC_S is the thermal coefficient of expansion for the steel wire. For the strain gauge, this is 12 ppm per °C.

T is the temperature in °C.

Applying a Temperature Correction

Apply the temperature correction according to the convention that you use:

- If you assume that compressive strain is negative, subtract the temperature correction: $\Delta\mu\varepsilon - \text{Temperature Correction}$
- If you assume that compressive strain is positive, add the temperature correction: $\Delta\mu\varepsilon + \text{Temperature Correction}$.