Engineering
UPDATE©

MEA MARINO ENGINEERING ASSOCIATES, INC. • Issue 3

From Research to Practice

Structure dictates theory, which in turn dictates method of analysis and evaluation, i.e. one does not go out and just collect data, conduct lab or field experiments, or run computer analysis with only a cursory look at the structure and theory.

To the degree the evaluation of structure and theory are right will determine how efficient the latter verification is.

Within one program, gradient steps or cycles of structure, theory, and then verification are required in order to reach the overall goal of the program.

Gennaro G. Marino Ph.D., P.E., D.GE

SUCCESSFUL FIELD TEST OF STEEL STRAP REPAIR

The test site was a rural location just outside of West Frankfort, Illinois. The test foundation consisted of ordinary concrete block stem walls resting on 8” x 16” concrete strip footings. These walls were not grouted or reinforced in any fashion.

The walls were four courses high and 40 ft. long. The walls ran side by side and were paired with one another and supported soil-filled wooden bins which were used to stimulate the load of a house (see Figure 1).

The walls were erected above two future longwall mine panels. Figure 2 shows the location of the north-south test walls in relation to the relevant longwall panels. The walls were built before any subsidence took place. Significant damage in the walls was induced by the subsidence movement from the northern longwall panel that was beneath the test site. After extracting the first panel, the walls were repaired using the new strap technique. The southern panel which was adjacent to the test foundations then passed the test site. Consequently, the steel retrofitted test foundation experienced additional mine subsidence movements.

The strap retrofit system used in the field test is illustrated in Figure 3. There were five main steps taken in retrofitting the damaged test foundations. First, the steel required for the repair was determined.

Second, the first stage of repair was done and the walls were cleaned. This included filling open wall cracks in the expected wall of compression with mortar. By doing this, the large wall deflections due to crack closure were prevented. Shear strength was restored to the walls by grouting reinforcement into the cells of the concrete blocks in areas exhibiting diagonal shear cracks. Cleaning the walls was then completed, thus enabling the epoxy and fiber-cement to adhere to it. Third, the steel reinforcing straps were prepared for attachment. Fourth, the external reinforcing straps were attached to the walls to increase wall bending capacity. Finally a surface finish of fiber-cement was applied to the walls to improve retrofit appearance.

Based on the field measurements taken, the steel strapped walls experienced only about one-half the bending of the ground. At the most severe

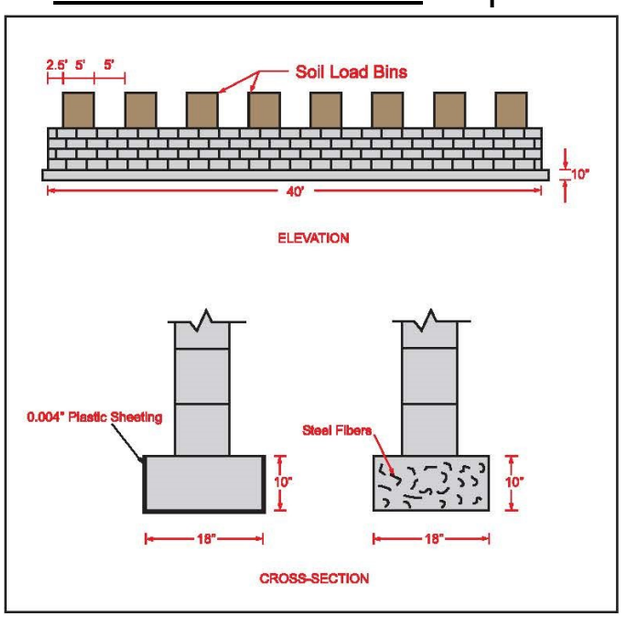

FIGURE 1 CONFIGURATION OF TEST WALLS

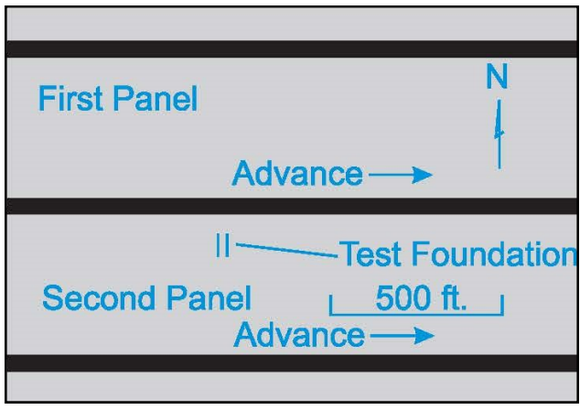

FIGURE 2 LOCATION OF TEST FOUNDATION OVER LONGWALL PANELS IN FRANKFORT, IL

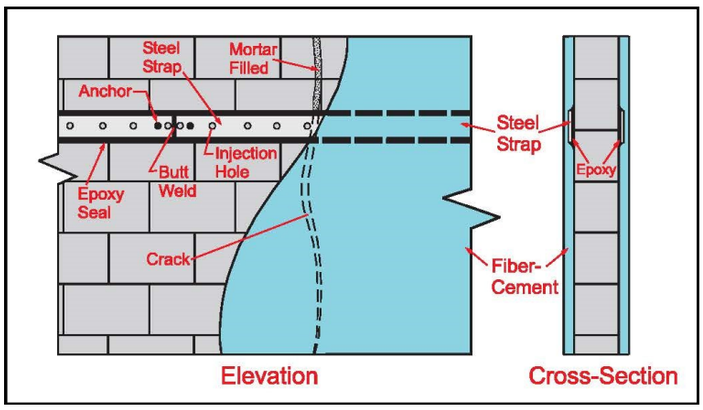

FIGURE 3 MAJOR COMPONENTS OF THE STEEL-STRAP RETROFIT TECHNIQUE

FIGURE 4 PHOTOGRAPH OF FACE OF FIBER-CEMENT COATING ONE YEAR AFTER APPLICATION

levels, the ground angular distortion was equal to 1/1200. Through straining and bending of the test wall, the surface coat of fiber-cement maintained their aesthetic quality (see Figure 4).

This method of foundation repair:

- Gives an aesthetically pleasing finish
- Costs less than equivalent alternatives
- Needs no special equipment or hard to find materials
- Can be easily performed by local contractors

Although the procedure was developed for mine subsidence, it could also be applied to other foundation damage scenarios.

This repair method and field test were funded by the Illinois Mine Subsidence Insurance Fund.

Other Engineering UPDATES of Interest:

UPDATE 2: Mitigation of Mine Subsidence Risk to a Prison Complex

UPDATE 6: Subsidence Mitigation by Combining Foundation Treatment with Deep Mine Grouting

UPDATE 8: Geotechnical Investigation of Building Damage

ABOUT MEA: Marino Engineering Associates, Inc. focuses on engineering research, practice and expert evaluations and is licensed in 24 states in the U.S. Our projects primarily have an emphasis on Geotechnical Engineering, however, we also have significant experience in projects involving transportation, subsidence engineering, laboratory testing, training, and geophysical exploration. Gennaro G. Marino, Ph.D., P.E., D.GE is president and principal engineer of Marino Engineering Associates, Inc., and has been a licensed professional engineer since 1984. To obtain additional information on MEA, one can also visit our website at www.meacorporation.com.

FOR MORE INFORMATION: There is a significant amount of additional information that is available on the above subject. For more information, please contact Dr. Marino at the address listed below.

MEA
MARINO ENGINEERING ASSOCIATES, INC.
1370 MCCAUSLAND AVENUE, ST. LOUIS, MISSOURI 63117
PH: 314.833.3189 FAX: 314.833.3448
http://www.meacorporation.com