Engineering
UPDATE©
MEA MARINO ENGINEERING ASSOCIATES, INC. • Issue 9

From Research to Practice

Engineering research should be directly connected to the practitioner. The engineer who works directly on the day-to-day problems of his industry—if he has sufficient foresight—will have the best grasp of where improvements in technology would have the most effective benefit. Not all practicing engineers, however, have insight into the most pertinent areas where improvement in the technology could have a vast impact as each person has different interests and different capabilities.

Pure engineering research which relates to sophisticated methods or to fundamental problems should be clearly thought out as to their future applications before adventuring into that direction. For example, developing technology which is less accurate than conventional procedures or methods or impractical for all but a very minute (yet important) percentage of problems should be weighted against potential technology with vast applicability.

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HARD EXCAVATION DISPUTE

MEA was selected by a Pennsylvania earth moving contractor and his attorney to investigate his dispute with the owner over the hard excavation quantity. The project involved installing the third phase of a major sewer line mainly in an open cut in soil and rock. Phase III was about 2 miles long (see Figure 1). Figure 2 shows the excavator attempting to rip rock in the bottom of the trench excavation. The hard excavation quantity measured and reported by the owner and the contractor were drastically different. The owner considered the contractor paid in full at about 3,700 cubic yards. The contractor reported about 12,000 cubic yards.

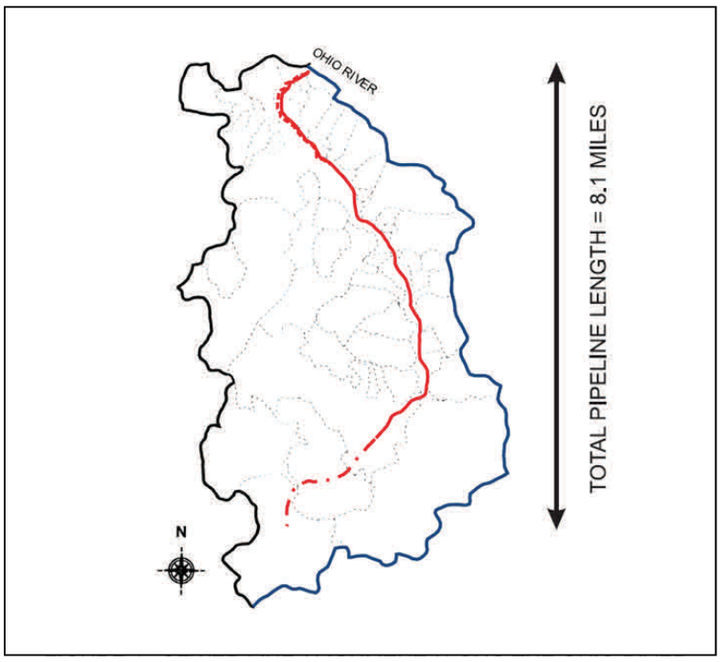

FIGURE 1 SEWER LINE ALIGNMENT ALONG THE OHIO RIVER

Under the contract specification, hard excavation was basically stated as:

"… "Hard" excavation shall include materials that cannot be effectively removed by a late model hydraulic excavator with greater than 160 flywheel horsepower, and equipped with a rock ripping bucket. Hard and compact material such as claystone or relatively soft or disintegrated rock will not be considered as such because of the intermittent use of hydraulic hammers to break up rock or concrete merely to increase production…"

MEA's forensic investigation of the above dispute included the review of project documents and depositions, data reduction, and evaluation of engineering design and field

FIGURE 2 PICTURE SHOWS CONTRACTOR USING A 300 HP EXCAVATOR FOR RIPPING ROCK. CONTRACT REQUIRED 160 HP EXCAVATOR TO DETERMINE HARD EXCAVATION QUANTITIES

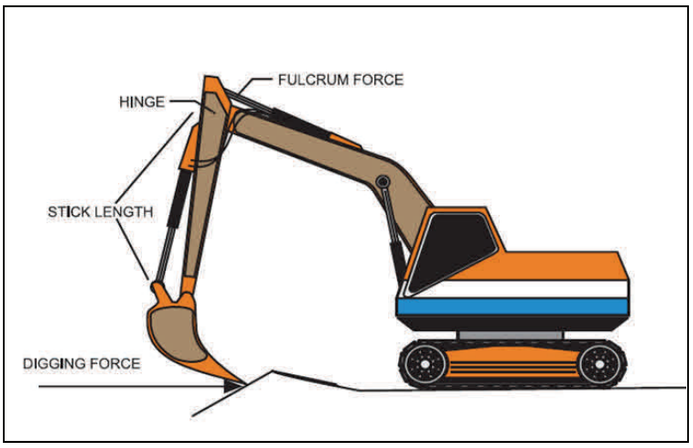

FIGURE 3 EXCAVATOR FULCRUM ACTION WHICH DETERMINES DIGGING FORCE

reports, as well as project discussions with construction personnel. Based on this investigation MEA found that the engineer neglected to count a significant quantity of material from the own records which amounted to approximately an additional 1,000 cubic yards. After this difference was brought to their attention the owner recognized the error; however, a significant difference in measured amount of hard excavation still existed between the contractor and owner.

MEA further determined that the main basis for the dispute in measuring hard excavation lay in the contract definition. MEA found:

- Based on their interpretation of hard excavation specification at the time of bid the contractor assumed that hard excavation was encountered whenever rock could not be excavated freely and required use of a hoe ram. A more stringent standard than expected was applied during construction by the Owner's Representative.
- As pointed out by MEA, variant field assessment of hard excavation by all parties (individually and as a group) involved in this project is symptomatic of an ill-defined and defective specification of hard excavation. Consequently, there are many valid interpretations of what hard excavation is. For example, the ripping force of an excavator can vary significantly even if it has the same horsepower. Analogous to a fulcrum, the stick length of the hoe excavator plays a critical role. In other words, the shorter the stick, the greater the digging force (see Figure 3).
- Further, the actual method of excavation used to remove rock was incompatible with the way hard excavation was to be measured per the specifications. For example, the contractor used a 300 hp excavator compared to the 160 hp machine required by the contract to determine hard excavation.

After depositions and trial, the court ruled in the favor of our findings and awarded the contractor his measured quantity with damages.

Other Engineering UPDATES of Interest:

UPDATE 7: Soil Provides Poor Road Construction Support

UPDATE 11: Frozen Fill Causes Building Damage

UPDATE 26: Construction Slide Causes Significant Delay and Added Costs

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.

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