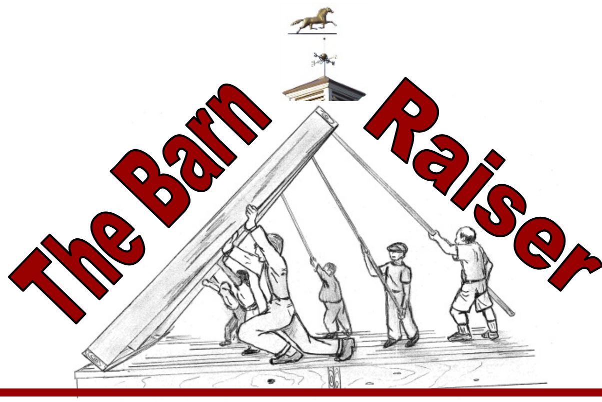

Mid-South Engineering Company

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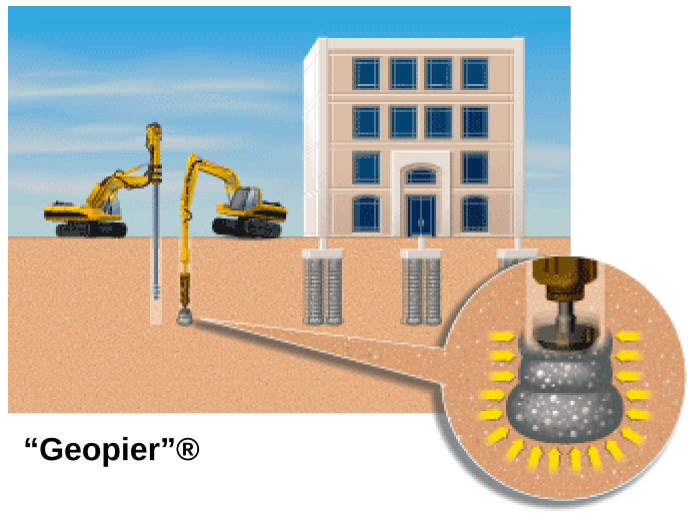
RAMMED AGGREGATE PIERS (R.A.P) ECONOMICAL SOLUTION?

By: Jeff Williams, P.E.

One available alternative foundation system that can be used when an "intermediate foundation system" is required [if soil conditions won't allow the use of shallow spread footings or continuous footings – even after significant over-excavation and replacement with compacted select fill] is the use of rammed aggregate piers.

Other types of "intermediate" systems include auger-cast piers, and helical anchors. Both of these foundation types offer some level of uplift resistance which rammed aggregate piers cannot. The advantage that rammed aggregate piers can offer is improvement of the adjacent soil conditions since they are most often placed in a closely spaced grid pattern and compress the adjacent soils when the aggregate is compacted. This whole class of "intermediate" systems can offer a cost-effective alternative that allows the designer to avoid the generally more expensive deep foundation systems such as driven piles or drilled piers (savings of up to 25% versus deep foundation options). Rammed Aggregate Piers are most cost-effective when a thin near-surface weak soil strata is encountered. Other solutions are most likely preferred if the depth to, or thickness of the weak strata are too great.

"Rampact"®



"Geopier"®

There are three (3) basic methods of placing the compacted rock in the pier column location. The most widely known (Geopier) requires a drilled shaft, and the rock is placed in multiple loose lifts and compacted to fill the shaft. Another method (Rampact) utilizes a driven, hollow shaft mandrill that is used to both place and compact the aggregate in the shaft. Other techniques (Vibro Stone Column; this is generally applicable to loose sand and/or gravel soil types) utilize a vibratory head that displaces soil to form the shaft.

In a narrow range of soil conditions these systems can provide an effective, less costly foundation system than deep foundations.

"Vibro Stone Column"

Fundamentals of Six Sigma and Control Charts

By: Jordan McInvale, EI, MA

One of the central problems in manufacturing is the ability to produce a uniform product consistently within specification. This problem seems simple enough until the question is asked: How do we know if a manufacturing process that just produced a product within specification will continue to produce a product within specification in the future? Manufacturing products uniformly with as little rework as possible means the difference between success and failure in manufacturing products and can lead to substantial economic gains. The purpose of this article is to attempt to answer this question by defining and explaining: variation, control charts, process capability, and Six Sigma.

The fact that there is variation and uncertainty in all activities studied is an undeniable fact. Fundamentally, there are three ways of describing the behavior of a system under study: as a deterministic model, as a model based on probability, and as a chaotic system. The outcome of a deterministic model is completely certain and knowable, while the outcome of a model based on probability is not knowable with certainty, but repeated past observations of a system provide data that indicate the boundaries within which the next observed value will fall—with a "level of certainty." Lastly, a chaotic system cannot be modeled or understood using scientific methods.

Unfortunately, it seems the **best that we can ever do to model and understand a process** is to check if it can be modeled using probability and make a statement about the probability of the next observation of the system falling within the established boundaries of the model. In a nutshell, this is exactly what a control chart allows us to do.

A control chart is a tool used to measure a characteristic of an outcome of a system in order to determine whether or not that characteristic is in statistical control. The most common control chart is the $\overline{X}$-bar control chart and consists of an "average of the averages" of a series of sample observations (less than 10 samples), an Upper Control Limit (UCL), and a Lower Control Limit (LCL) (refer to Figure 1)[1].

1 There are many different types of control charts used in science and industry. The $\overline{X}$-bar control chart was chosen because of its simplicity.

Plotting the sample average values on the chart along with the grand average, LCL, and UCL allows the user to determine if the process is in statistical control. The determination if a "run" is in statistical control is to apply screening standards rules, such as the Western Electric rules for control charts, and see if the past data points cross the UCL or LCL 3 times in a row or if 7 data points in a row are observed above or below the $\overline{X}$-bar line. Calculating the standard deviation (σ) of the sample averages, the Process Capability Ratio (PCR) is calculated using the formula: PCR = $[(UCL - LCL)/6\sigma]$. A process is considered a Six Sigma Process if the PCR $\geq$ 2.

The real power of control chart methods is, according to W. Edwards Deming, the ability to discern between common causes of variation and special causes of variation. By addressing the special causes of variation and ignoring the common causes of variation, in other words finding the times when the system deviates from statistical control and pinpointing the cause of the deviation, the system can be modified and the process variation reduced—leading to more uniform product and less rework.

In summary, applying Six Sigma to industrial problems in the wood products industry, or any industry, requires you to do the following: document the existing process and determine which process characteristics best describe the system, properly gather the data about the characteristics of the system, plot the runs on properly chosen control charts, look for evidence of statistical control, modify the existing system until statistical control is reached by finding and addressing the special causes of variation, and improve the existing system once it is in statistical control. Continue to improve the process until it is no longer economically justified.

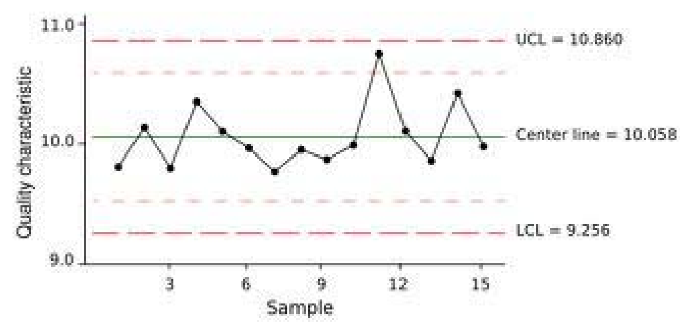


Figure 1 – Control Chart (Source: www.wikipedia.com)

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