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CONSULTANT'S UPDATE

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MUNICIPALITIES STILL RECOVERING FROM 2004 STORMS

By Suzanne S. Hunnicutt, AIA

When Hurricane Charley blew through central Florida in 2004, the Zolfo Springs Police and Fire Station building was damaged beyond repair. The two departments have operated out of temporary facilities while planning, designing, and constructing their new replacement facilities. They look forward to taking occupancy of the new building, which is scheduled for completion at the end of May.

Chastain-Skillman, Inc. (CSI) has provided architectural and engineering services for this project, working with both the Town of Zolfo Springs and the Hardee County Fire Rescue Department. CSI's role has been to design a facility to meet the current and future needs of the departments while working within the constraints of a Federal Emergency Management Agency (FEMA) grant that is a funding source for the project. The building is 5,200 square feet and is being constructed at a cost of approximately $120 per square foot including site work.

The police department area includes office space, records storage, evidence storage, and an armory for weapons storage. The fire department spaces include a bunk room, day room, three apparatus bays, and storage for turnout gear and medical supplies. The building design enables the departments to share a kitchen/dining area, training room, and locker areas, while maintaining their own security.

(Recovering—Continued on page 3)

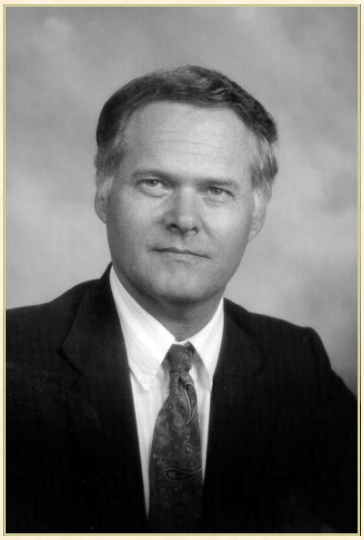
ROAD RIGHTS-OF-WAY

By Paul A. Bizier, PE, DEE

All across Florida, the Department of Transportation (DOT) and local entities are working every year to maintain and upgrade existing roadways. While we all benefit from the better driving conditions, have you ever thought about the underground utilities that have to be relocated in order to make these projects a reality? Road rights-of-way are a primary corridor for underground utilities. Often, an existing right-of-way in urban areas may have a half-dozen or more existing utility lines that include those for potable water, reuse water, sanitary sewers (gravity and pressure), electricity, telephone, and gas. As roads are widened and associated stormwater management systems are constructed, all of the organizations that own and manage these utilities have to scramble for a spot in the available right-of-way.

Typically, as a roadway agency begins design of a widening project, they will contact all the known utility owners in the area and request locations of existing utilities. In some cases, the utility owner will have up-to-date, and accurate, record drawings. This is the best case scenario, but certainly not the most common. Where record drawings are incomplete or non-existent, the utility owners have to field locate their utilities. This can be done in several different ways, depending upon the type of utility.

(Rights—Continued on page 2)



Paul Racette

July 4, 1945—
December 23, 2008

See our Tribute Inside

Inside this issue:

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The roadway agency will then incorporate this existing utility information into their design plans. As the plans reach partial completion, the design drawings and existing utility information are sent again to all the utilities. At this point, the utility owner has to review the design information and determine what is to be done with their utility. This leads to the creation of "Red/Green/Brown" drawings. The utility owner color codes their lines shown on the design drawings to show which existing lines are to be removed (red), which are existing and shall remain (green), and which are to be relocated/reconstructed (brown). In reviewing these locations, the utility owner has to consider not just their own utilities, but where new storm drains may be constructed. Where lines have to be removed or relocated, engineering design and permitting are typically required.

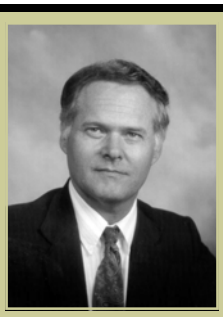
These color coded drawings are then returned to the roadway agency, which incorporates the information into the design plans. Often, there are several cycles to this review and compilation process, as there may be conflicts between two utilities, both seeking to occupy the same space in the final construction. Also during this process, the utility owner has to decide whether to relocate/reconstruct their utilities using a contractor, or to allow the roadway contractor to perform the work under a "Joint Project Agreement" or JPA.

After the roadway design is complete, and all utility work has been coordinated and incorporated into the drawings, construction begins. If a utility is going to relocate their facilities, this utility construction will usually occur well before any roadway construction. This is the reason that you often see electric companies relocating power poles two to three months before any roadway construction occurs. If the work is being done under a JPA, the roadway contractor takes the responsibility for utility relocation work, either directly, or through a subcontractor. In either event, utility relocation work will often continue throughout the construction project.

Chastain-Skillman has worked with a wide range of our municipal clients on utility relocation projects, ranging from local roads to interstate highways, and in locations that span from rural areas to downtown urban settings, such as the recent relocation of Main Street in downtown Lakeland, Florida.

Paul Bizier is a Principal/Director of Environmental Engineering for Chastain-Skillman's Environmental Engineering Department. He earned a Master's Degree in 1997 from Georgia Tech. He can be reached at (863) 646-1402 or pbizier@chastainskillman.com.

TRIBUTE TO PAUL RACETTE



All of us at Chastain-Skillman, Inc. (CSI) would like to pay special tribute to our long-time friend, colleague and co-worker, Paul Racette, PE, who passed away December 23, 2008 following a courageous battle with cancer.

Paul was born July 4, 1945 in Lowell, Massachusetts. He served in the United States Air Force, graduated from the University of Florida, and later earned a Structural Engineering degree from the University of South Florida. He was also a member of the American Society of Civil Engineers (ASCE).

With the exception of Jim Chastain, Jr., our company President, Paul was the longest tenured employee of the firm, having given over 30 years of service. He will be greatly missed by all of us at Chastain-Skillman.

Paul's area of expertise with the firm was in structural engineering, specializing in design using concrete, steel, wood, aluminum and fiberglass. The scope of his structural engineering work was broad, to say the least. He helped pioneer the use of pre-stressed concrete in the design and construction of the Lakeland Main Street Parking Garage. Other local projects that benefited from Paul's design expertise include the Lakeland Skateboard facility, Lakeland Maintenance and Construction Buildings, Stonewater Townhomes, Willowbrooke Apartments in the Oakbridge Development, and the expansion of Tiger Town Stadium bleachers. In fact, he even designed a stage for a Miss America Pageant.

In support of CSI's environmental engineering group, Paul provided structural engineering for Glendale Wastewater Treatment Plant (WWTP), Doug Allen WWTP (Bartow), Leesburg WWTP, and the Auburndale Regional WWTP, to name just a few. The list of schools for which Paul provided his services is almost endless, and includes: Bartow and Mulberry Senior High; Valleyview and Cleveland Court Elementary; Lake Gibson, Lakeland Highlands, Auburndale, Southwest and Denison Junior High Schools, to name only a few.

Paul also provided the structural design for a considerable number of projects for Publix Super Markets, including their Dairy Plant, Truck Re-fueling stations, several grocery stores, and distribution centers in Lakeland, Sarasota, Jacksonville and Orlando. Following our unusual hurricane seasons of a few years back, Paul was extremely busy providing professional analyses for insurance companies and claimants alike to facilitate the evaluation of countless damage claims!

Paul was very self sufficient, and would quietly and competently complete his work while most of the time even doing his own drafting. He was always pleasant to work with, and inspired confidence in his clients.

Immediate family survivors include his wife, Cindy Kalt Racette, Lakeland; mother, Lea Guay, Lakeland; son, Dr. Carlton John Racette, Indianapolis, Indiana; and daughter, Elizabeth Anne Racette, Lakeland. Paul will be remembered as a great family man. He rarely missed any of his children's activities, supporting them in cheerleading (Liz) and swimming (Carl). He served as President of the local swimming club for many years, even taking extra classes on his own time to learn how to be a judge at area swimming competitions. We will all truly miss Paul and are thankful for having had the opportunity to work by his side.

EOHS NEWS

The Consumer Product Safety Commission's (CPSC's) Consumer Product Safety Improvement Act (CPSIA), effective February 10, 2009, requires that consumer products intended for children age 12 and under cannot have more than 600 parts per million of lead in any accessible part.

The EOHS Task Force's primary recommendation to the State of Florida is for legislation to require all cities, counties, municipalities, school districts, state agencies and special districts to comply with OSHA 1910 (General Industry) and CFR 1926 (Construction) standards within three (3) years. Additional recommendations include the following:

- *All Florida public employers to collect and retain injury and illness data using the OSHA Reportable criteria and Form 300*
- *The Florida Division of Worker's Compensation (FDWC) should expand the annual report to include a "state-of-the-state" report covering all public entities*
- *A confidential toll-free telephone number should be provided to enable public employers and employees to ask questions, report perceived unsafe conditions, and request materials and assistance*
- *The FDWC should compile a list of professional safety resources to help public employers strengthen workplace safety programs*

New asbestos initiatives may impact the EOHS profession, as follows:

- *New asbestos-related legislation and regulations have been proposed*
- *There is new and proposed funding to develop a revised asbestos risk assessment protocol*
- *Health risk research has been expanded*
- *Attention is being directed at addressing naturally occurring asbestos*

More information is available on-line at the American Society of Safety Engineers (ASSE): http://www.asse.org/practicespecialties/docs/CoPSArticleoftheMonth10-08.pdf

PLANT WATCH

By Arthur "Art" D. Wade III, PWS


Slash Pine

Slash pine (Pinus elliottii) and gallberry (Ilex glabra) are currently considered upland species in the State of Florida's "Delineation of the Landward Extent of Wetlands and Surface Waters" (62-340 F.A.C.) Upland species are not used when identifying wetland boundaries. However, these two plant species are listed by the U.S. Army Corps of Engineers (ACOE) as being wetland species in the "1987 Wetlands Delineation Manual." The differences in the plant lists published by these two agencies oftentimes results in the identification of two different wetland boundaries on a project site, with the ACOE wetland boundaries generally being greater in size.

In 2005, the Florida Department of Environmental Protection (FDEP), proposed a rule change to Florida Statutes Chapter 62-340 to re-classify slash pine and gallberry as "facultative" (FAC) or "neutral" species, which would allow these species to be utilized during the delineation process. The effect of this rule change would be to bring the State and ACOE wetland boundaries closer together and assist in streamlining the two programs. For projects that do not have ACOE regulated wetlands, this change may also expand the wetland boundaries beyond the limits currently defined by the State.


Gallberry

The proposed changes require Legislative approval to become effective. Based on the FDEP website, ratification did not occur in 2007 or 2008 and is not currently scheduled for 2009. However, should the change be ratified, it may have an effect on the wetland delineation process for your project.

(Recovering—Continued from page 1)

The City of Davenport also lost their Police Station to the 2004 hurricanes, and has selected CSI to design the reconstruction of their facilities. Working within the remaining foundation and walls, the project will include office space, a briefing/training room, evidence and weapons storage, and holding cells. In the design phase, CSI also presented alternatives for the addition of a sallyport to transfer prisoners, and a community room.

The existing building shell is a simple rectangle with brick veneer, and is located near the center of town. The City asked CSI to develop a design that would not only meet the department's functional needs, but also weave the building into the historic fabric of the downtown area.

CSI is glad to be able to help these and other municipalities throughout central Florida meet the challenges of providing essential public services in a manner that is both effective and economical.

Suzanne Hunnicutt is Vice-President of Architecture, and works out of Chastain-Skillman's Sebring office. Her work focuses on the design of office, institutional and industrial buildings for both public and private clients. Suzanne received a Bachelor of Design degree in 1975 and a Master of Architecture degree in 1980 from the University of Florida. She can be reached at (863) 382-4160 or shunnicutt@chastainskillman.com.


Damage to Davenport Police Station


New Zolfo Springs Police Station, Exterior


New Zolfo Springs Police Station, Interior

IS THERE A TREND IN THAT DATA? (PART 2 OF 2)

By James R. Chastain, Jr., PhD, PE, MPH

The objective of this two-part essay is to provide a brief overview of the proper procedures to employ when using linear regression to summarize data and project trends. In the January issue of the Consultants Update, Part 1 of this article outlined the first three steps of a five-step process. In Part 2 of the article, the last two steps are described. As a reminder, the five-step process presented is:

1. Perform an exploratory data analysis (get to know your data)
2. Decide which regression model to use (in this article: linear regression)
3. Fit the model to the data
4. Check the model
5. Document and interpret the model

Check the model (Regression Diagnostics)

Once the tentative statistical model has been developed, it is necessary to test the model through regression diagnostics. The purpose of this step is to confirm that the assumptions that were made are within acceptable range. Note that until the regression diagnostics have been performed, the analysis has not been completed. Regression diagnostics generally include *Residuals Analysis*, *Outlier Assessment*, and *Collinearity Assessment and Remedial Methods*.

Residuals Analysis

This is the primary means of examining the acceptability of the regression model. The key concept is that, if the model is reasonably describing the relationship, the residuals should form a random pattern centered around 0. From Part 1, recall that a residual is the difference between the actual data point value and the value that is predicted by the linear regression equation (i.e. the fitted line). In order to properly perform this analysis, it is necessary to account for or correct scale dependencies and the magnitude of e_i changes throughout the dataset. The primary methods to examine and evaluate residual values are (1) Studentized Residuals, (2) Jackknife Residuals, (3) Normal Probability Plot of the residuals. Again, the purpose of these exercises is to look for non-random patterns in the residuals, which would indicate non-linear relationships or outliers among the variables. In a sense, these tests are analogous to performing a second linear regression analysis on the residuals of each predictor variable… only this time it is desirable that no trend is detected.

Most statistical programs will provide an option to compute and list these values. Plotting the studentized or jackknife residuals is a convenient way of viewing the computed values for trends that might be difficult to observe in tabular format. Likewise, preparing a Normal Probability plot of the raw residuals is always useful, although it may be a little more difficult to evaluate the existence of a trend than when using the first two methods.

Outlier Assessment

Outliers are points that have much larger absolute values (larger or smaller) than the others in the data set…in other words they don't appear to "fit." The issue of outliers should be dealt with cautiously so as not to omit valid data points. They should only be deleted from the analysis if the data points are determined to be collected inappropriately, measured erroneously or processed improperly (e.g., malfunctioning data collection equipment, erroneous data entry, etc.) If the data points are scientifically or methodologically valid, they should not be deleted because they may indicate other factors or variability at work that would be suppressed if the points were deleted.

Outliers can be roughly identified by data plots, but are more specifically identified by looking at the studentized or jackknife residuals. Any residual value that is seen to be more than three standard deviations from the mean of residuals should be examined as a potential outlier. This is especially true if the outlier is associated with one of the extreme values of X. This is a high leverage value and can significantly influence the regression model. In addition to the residual methods mentioned above, many computer packages compute *Cook's distance*. This is useful because it computes how much the regression coefficients are changed, by deleting the particular observation in question. A Cook's d>1.0 should be investigated.

Again, deleting an outlier will typically make the mathematical correlation of the variables look better, but will not improve the estimation of the actual underlying relationship if the outlier is a valid, but extreme point. Therefore, every outlier must be examined in detail, and a valid justification for eliminating it must be stated before it can be removed.

Collinearity Assessment and Remedial Methods

Typically, as the number of independent variables increases, the risk of collinearity (also know as multiple collinearity or multicollinearity) occurs. Collinearity effects arise when the independent variables are not truly independent of each other. In other words, being collinear, they are related to each other. If this issue is not recognized and resolved, the result tends to be large variations in the linear coefficients which means that resulting equation is unreliable. Also, the estimated standard deviations of the coefficients become quite large, so the confidence intervals of the coefficients are not helpful.

Statisticians have developed a number of ways of detecting this occurrence, but the most common test to identify it is by computing the Variance Inflation Factor (VIF). Without going into the mathematics of the test, when the VIF for a variable is greater than 10 it is generally considered a red flag warranting further investigation. The VIF is normally a computation option available on most statistical software packages. In most cases, by deleting or inserting predictor variables by trial and error and observing the VIF, the standard error and parameter confidence interval allows the analyst to arrive at the optimum combination of variables.

If problems persist after the regression diagnostics have been completed, several alternatives are available to recover. The following measures should be considered.

1. Examine outlier effects. Are data points valid? Should they be eliminated?
2. Abandon the regression model and develop a more appropriate model (e.g., Non-linear).
3. Transformation. This should be used with caution remembering that any regression coefficient has properties related to the transformed observations, not the original ones.

Document and interpret the model

As mentioned in Part 1 of this article, it is not uncommon for most of the attention in a statistical analysis to be focused on fitting the regression model to the data (Step 3). While this is without question an important step, hopefully, one of the take-away messages of this article is that the other four steps can be just as important. Typically, documentation and interpretation of the model (Step 5) tends to get the least amount of attention, and yet it ultimately can be the most important. No matter how suitably the math was performed in fitting the model, if an improper interpretation of the results follows, then the whole effort was unproductive. Also, if there is not proper documentation of the assumptions and trade-offs used in developing the fitted equation, future use of the results may be applied inappropriately.

First, when documenting the analysis, make sure that you note whether the data is classified as experimental (independent variables under the control of the experimenter) or observational (neither response nor predictor variables are controlled by the experimenter). A statistical test that leads to the conclusion that $\beta_1 \neq 0$ does not necessarily establish a cause and effect relationship between the predictor and response variables. With *non-experimental data* (observational), both the X and Y variables may be simultaneously influenced by other variables not in the regression model, which can lead to erroneous inferences. On the other hand, with *controlled experimental data* there is often good evidence for a cause-effect relationship. Recall also that in either case the response variable will always be continuous, while the predictor variables can be either continuous or categorical (discreet).

One of the attractive features of the linear regression model is that the interpretation of the results is straightforward and easy to understand. Once the fitted equation has been developed, each predictor variable will have a coefficient. This coefficient may be interpreted in the following way: "*by increasing the predictor (X) variable by 1 unit, the response variable (Y) will increase (or decrease if negative) by the value of the coefficient, when all other variables remain constant.*" This interpretation is applied to each predictor variable in turn, so it is possible to easily see which variables have the greatest effect on the response. This observation can be of great value when trying to prioritize actions based on the analysis.

Two general cautions should be noted with regard to using regression as a prediction tool. One is related to temporal extrapolations, and the other is related to data extrapolations. More specifically, regression analysis is frequently used to make inferences about the future. It is important to remember that the validity of the regression application depends upon whether basic causal conditions in the period ahead will be similar to those in existence during the period upon which the regression analysis is based. Secondly, caution is warranted when inferences are made involving predictor values that lie outside the range of observation. In this case, residual/error checking cannot be done to evaluate model validity. Thus, these extrapolations have an additional inherent error risk.

In sum, linear regression is a useful tool for organizing and developing linear relationships in a wide range of data types. Computer software makes the evaluation of even large volumes of data convenient and accurate. Most people find the results of this analysis easy to communicate and understand. However, this article and the previous one attempt to identify some of the major assumptions associated with the technique, along with some of the pitfalls to avoid when developing the model. Other subtleties and analytical features exist, but are beyond the scope of this article. The references below can be consulted for a more complete presentation of these issues.

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Kleinbaum, D.G., L.L. Kupper, K.E. Muller, and A. Nizam. (1998). **Applied Regression Analysis and Multivariate Methods** (3rd Ed.). Duxbury Press. Pacific Grove, CA.

Dr. Jim Chastain is the CEO and President of Chastain-Skillman, Inc. He has a Bachelor of Science in Civil Engineering (honors) and Master of Engineering from the University of Florida. He also has a Master of Public Health and Ph.D. from the University of South Florida. He is a registered Professional Engineer with over 30 years of experience and is a Diplomate of the American Academy of Environmental Engineers. He can be reached at (863) 646-1402 or jrchastain@chastainskillman.com.

ANNOUNCEMENT

Dr. George P. Anipsitakis, PE, our Orlando Regional Office Manager, was an invited judge at this year's Dr. Nelson Ying Orange County Science Exposition. Dr. Anipsitakis was assigned to the "Engineering" Category in the "Junior" Section. Twenty six outstanding engineering projects were presented under that category. Congratulations to all the students who participated in this year's science fairs across the State!

This newsletter is provided solely for informational purposes and presents only highly condensed summaries relating to the topics presented. Therefore, it should not be relied upon as a complete record for purposes of regulatory compliance, nor is it intended to furnish advice adequate to any particular circumstances. For additional information on any of the topics in this newsletter, please contact the author, or Allan Duhm, (863) 646-1402, or e-mail us.

General Information	Info@chastainskillman.com
Civil and Architectural	Civil@chastainskillman.com
Environmental and Structural	Environmental@chastainskillman.com
Environmental and Occupational Health/Industrial Hygiene	EOH@chastainskillman.com
Environmental Risk Management	ERM@chastainskillman.com
Survey	Survey@chastainskillman.com
Water Resources	Water@chastainskillman.com

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CHASTAINSKILLMAN.COM

Atlanta, Georgia
Phone (770) 980-9880
Fax (770) 980-9810

Lakeland, Florida
Phone (863) 646-1402
Fax (863) 647-3806

Orlando, Florida
Phone (407) 851-7177
Fax (407) 851-7123

Sebring, Florida
Phone (863) 382-4160
Fax (863) 382-3760

Tallahassee, Florida
Phone (850) 942-9883
Fax (850) 878-0945

Tampa, Florida
Phone (813) 621-9229
Fax (813) 626-9698

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Lakeland, FL 33813-2031

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