

# CHASTAIN-SKILLMAN, INC.

ENGINEERS • ARCHITECTS • SCIENTISTS • SURVEYORS

## CONSULTANT'S UPDATE

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### HOW DO WE FIX THAT MANHOLE?

By H. Robin Losh



Water distribution systems and wastewater sewer systems are a critical component of urban development. Most people don't think about it, but they function as a key part of our public health system to minimize communicable disease and keep our communities clean and attractive. Unfortunately, the Cities and County utilities that operate these infrastructure systems are struggling. They have not received funding for several years, which is necessary to support adequate maintenance programs for their facilities. This is a fact that has been documented on numerous occasions by many industry and professional organizations.

Inadequate funding for upgrades or common maintenance has resulted in the overutilization of infrastructure systems. Many systems continue to be used well beyond the system service life. The

owner is then faced with the question of replacing or renewing the existing system. Today, much of our aging water and wastewater systems operate in highly developed areas, so the cost to dig them up and replace them can be very costly. This leaves the renewal of the existing system as the most frequently chosen option. As an example, Chastain-Skillman, working with the City of Bartow, has recently developed such a rehab project at the Bartow Municipal Airport.

The Bartow Municipal Airport was originally constructed during World War II as an aircraft pilot training base. When the training facility closed, the City of Bartow acquired the site and developed an airport and an industrial park. As industries located there, they utilized the existing street, drainage, water and wastewater systems. Over the past 70 years, the vitrified clay pipe and brick structures that make up the wastewater collection

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### THE WINDS OF CHANGE

By Suzanne S. Hunnicutt, AIA, LEED-AP



As required by Florida law, the Florida Building Commission updates the Florida Building Code (FBC) every three years. The update cycle is based on the code development cycle of the International Building Code (IBC) which serves as the model for the FBC. The process of incorporating Florida-specific requirements is normally a complicated one, but this time it seems even more so. This explains one of the ironies of the FBC in that the year

that is referenced in the name of the code bears no relationship to the time when it will become effective or the model code on which it is based. In this case the 2010 FBC is based on the 2009 IBC and will become effective in either late 2011 or early 2012.

This year brings an additional complication in that the Florida Building Commission chose to incorporate a newer reference document which has not yet been incorporated into the IBC. The ASCE 7-10 is the recently published update to the

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### EOHS NEWS

#### Proposed OSHA 300 Log Record-keeping Changes

- Restore Muscular Skeletal Disorders (MSDs) column to form 300 Log as originally included in the 2001 version
- Change Industry Generally Exempt List by changing from outdated SIC to NAICS codes
- Report workplace amputations within 24 hrs
- Report *all* in-patient hospitalizations within 8 hrs (Part 1904 currently requires reporting of 3 or more)

#### EPA Lead-based Paint Regulation Update

- EPA will not be able to enforce its Lead-based Paint Renovation, Repair and Painting (RRP) Rule until it approves a reliable lead test as mandated by its own regulations, according to an amendment adopted by the House Appropriations Committee
- In addition, EPA decided not to incorporate new lead dust-sampling and laboratory analysis requirements as part of the RRP Rule

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system have been subjected to the damaging effects of hydrogen sulfide, high groundwater and redevelopment construction activities. Manhole structures are a critical part of that system. They are necessary to provide access to the sewers, themselves, for hydraulic, operation and maintenance purposes. However, they are prone to deterioration over time and must be properly monitored and repaired to eliminate other - more serious - problems.

With many options to consider, it might be helpful to offer a quick review of some of the rehab systems available. Each rehabilitation system is tailored to address the specific structural damage and environment encountered. Depending on the data source referenced, it is estimated that 30% to 60% of all wastewater systems inflow/infiltrations (I/I) results from groundwater entering the system at manhole structures. Before implementation of any of the major manhole interior rehab systems, groundwater flowing into the structure should be stopped. If the exterior of the structure is exposed, breaches of the structure or chimney wall can be sealed with rubber or poly wraps and mastics. Waterproof grouts or bituminous sealants can also be used to repair and seal the exposed exterior chimney walls. If the chimney exterior can not be exposed, the injection of chemical grouts through the structure wall or surface application of hydraulic cement can be very effective.



Once the inflow of water is stopped, repair of the interior walls can begin. Again, there are numerous options to consider. These options fall into two primary installation categories: coatings and liners. These categories can be further separated by the material selected for the system and by the system's unique performance characteristics. Let's look at some of the options for coatings first.

One of the least expensive coating systems is Bitumastic, also known as coal tar, applied to a thickness of 32 mils over new mortar surface. This system is used mainly for new construction and where budget constraints are high. It has little or no structural value and limited performance characteristics. Also, this product is no longer approved for use in some areas of the country due to environmental and occupational health considerations.

Another coating system is the cementitious group made up of calcium aluminate mortar or polymer modified mortar. These systems can be applied via trowel, spray or pump to a thicknesses of 1/4" to 2"; some are fiber reinforced. These systems have good structural properties and perform well in an environment with low hydrogen sulfide and no infiltration. Environments that have high concentrations of hydrogen sulfide require coatings that are typically sealed or enhanced with additives.

The last of the coating systems in this discussion are the epoxy, polyurea, polyurethane or polymer resin systems. These systems can be applied via trowel or spray. They have good structural properties, but vary significantly in application thickness depending on the manufacturer. These systems also have excellent performance characteristics in high hydrogen sulfide and high groundwater environments. They are, however, the more expensive of the coating systems in initial cost.

Next we consider the liner systems. Liners are usually either inserts or cured-in-place liners. The insert family of liners are made from several different materials. Steel, fiberglass, polyethylene and ABS are among the more popular materials. These inserts are made to either remain in place or, acting as an internal form, be removed after filling the annular void between the insert and existing structure wall with concrete. These poured concrete liner systems are intended to add structure back to the manhole chimney wall. In cases where new concrete is exposed in the manhole interior, sealing or coating may be appropriate.

Cured-in-place liner (CIP) systems are similar in nature to the family of cured-in-place pipe (CIPP) rehab systems. They are comprised of a fabric liner material fabricated to fit the internal surfaces of the manhole. This fabric is then impregnated with a resin or epoxy that cures under pressure and/or with heat. The liner is installed using water, steam or a pneumatic bladder to hold the liner against the structure's surfaces. As with all liner and coating systems, CIP liners require cleaning of the interior surfaces prior to installation. However, once the interior surfaces are cleaned, CIP liners form and bond directly to the existing surface. They are structural and perform very well in environments with high hydrogen sulfide and high groundwater.



Rehab system manufacturers have responded to the needs of the utility industry with a large selection of options. Walking through this maze of options can be confusing. Before the final selection is made, the elements of structure condition, environment, anticipated service life and life cycle cost, just to name a few, must be considered. Also, there is the question of who manufactures the products in each of these categories and how to contact them for product information. Trenchless Technology Center at Louisiana Tech University has provided an extensive listing of manufacturers and products available for rehabilitation of manholes. A helpful summary entitled, Currently Available Products and Techniques for Manhole Rehabilitation, can be found on the Internet at <http://www.ttc.latech.edu/publications/other/manhole.availableproducts.pdf>.

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## IF NOT US, WHO? AND IF NOT NOW, WHEN? MASON'S RIDGE SUBDIVISION – SEBRING, FLORIDA HIGHLANDS COUNTY HABITAT FOR HUMANITY

By W.R. "Ron" Cauthan, PE



Following up on the article in the *Consultant's Update*, October–December 2009 issue, contributed by Mr. Mike Jacobson, President of Highlands County Habitat for Humanity (Habitat), this article is intended to convey an inspirational story of success resulting from the combined efforts of numerous individuals and governmental agencies. In the aforementioned article, Mike revealed the plans of Habitat to move away from building on in-fill lots and toward development of a 20-acre, 60-unit affordable single-family subdivision in Sebring, Florida. His question at that time was, *If not us, who? And if not now, when?*

Habitat had been approached by the Highlands County Housing Department and asked to rescue a 20-acre affordable housing development whose original building partners had withdrawn, leaving at risk a \$2.5 million grant from the Florida Housing

Finance Corporation. At risk also was \$500,000 in Hurricane Housing Relief Program (HHRP) Funds that the County had used to purchase the 20-acre site and would have to repay if a specific number of houses were not completed by June 30, 2011. The \$2.5 million grant was in fact lost due to the state's housing and budget crisis and funding for all but one state-supported project for homeownership through Florida Housing Finance Corporation was de-obligated. The harsh reality that the dream of home ownership is not available to families served by affordable housing developers would continue unless alternative and creative financing solutions were found. Habitat became the answer to the first part of the question, "who." The second part of the question, "when," now became prominent along with an additional third part – "how."



Mr. John Hawthorne became President of Highlands County Habitat for Humanity in 2010, with the same tireless devotion to the project and Chastain-Skillman was fortunate to join the team with Habitat. The "when" and "how" dilemma provided the opportunity for unprecedented collaborative partnership between the public and private sectors to be formed in order for

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document "Minimum Design Loads for Buildings and Other Structures" which is the basis for the code requirements for structural design. The 2009 IBC references ASCE 7-05 while the 2010 FBC will reference the new ASCE 7-10. Included in the new document are some fairly significant changes to the wind load design criteria.

ASCE 7-05 and older versions of the standard included a single map showing the design wind speed for any given area. The calculation for velocity pressure then included an "Importance Factor" multiplier to account for the type of occupancy housed by the structure, with more critical functions such as hospitals and fire stations having a higher value. The ASCE 7-10 standard has incorporated the multiplier (which is now referred to as a "Risk Category") into the wind speed map, resulting in three different maps.

Another major change to the wind design procedure is the change from an Allowable Strength Design method to an Ultimate Strength Design method. This requires a change in the factor that is applied to the wind loads in the load combination equations, but also requires an adjustment to the mapped wind speeds. The result will be that in most areas the basic wind speeds will be much higher than those in the previous editions of the code although the calculated design pressures will be somewhat lower.

For instance, in many areas in central Florida the wind speeds indicated on the maps will be 20 to 40 mph higher depending on the Risk Category, but the calculated design pressures will be 10% to 20% less.

The change to the wind speed maps will have one additional result for buildings in the central Florida area. The Wind-Borne Debris Region which was defined by the 120 mph wind speed line on previous maps, will now be tied to the 140 mph line on the new maps. The location of this line will bring Highlands, Hardee, Desoto, Okeechobee, Glades, and portions of Polk County into the Wind-Borne Debris Region which will require protection of openings from impacts. This will mean windows and doors will have to be impact-resistant or shutters will have to be provided.

The 2010 FBC will bring other "changes" related to energy conservation and accessibility requirements, but we will leave those topics for another day and another newsletter.

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## THE LAW OF UNINTENDED CONSEQUENCES IS ALIVE AND WELL

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



Many times, life observations and experiences are encapsulated in various pithy sayings or adages. For example, every engineering student is introduced early to “Murphy’s Law” which states that “if anything can go wrong, it will go wrong.” This is followed by “O’Toole’s Corollary” which asserts that “Murphy was an optimist.”

While these sayings are somewhat humorous, they seek to capture a very real truth about the perversity of nature and the need to look carefully at primary and secondary factors in a design. While Murphy’s Law does not take a mathematical form, it adds a degree of caution to the design professional’s approach to design and the variability of forces acting on the system.

A similar cautionary note founded in the social sciences is the “Law of Unintended Consequences,” otherwise known as “LUC” (isn’t that an interesting acronym?). In essence, this adage states that unilateral changes in complex, interrelated systems always create unanticipated and, often, undesirable outcomes. As with Murphy’s Law, LUC does not take a mathematical form to allow computation of its effects, but it should inject a degree of humility when tinkering with complex systems. Given the magnitude of the changes occurring in the political, economic and even the climatological realms, it might be worth examining the implications of this concept.

The concept has been around for a long time and probably dates back to 18th century Scottish Enlightenment and the social philosopher and father of capitalism, Adam Smith. In his book *The Wealth of Nations*, Smith describes the unintended consequence of “the invisible hand” creating a global benefit when individuals are free to work for their own self-interest. However, it was Robert Merton, a 20th century sociologist, who proposed the term and performed a systematic analysis of the factors that should be considered to minimize adverse impacts. Many of us are faced with making changes to adapt to a changing world and so it might be helpful to summarize some of the key points of his research to help in our considerations.

Although he spent much of his career developing and cataloging aspects of LUC, his 1936 paper entitled “The Unanticipated Consequences of Purposive Social Action” introduced the topic formally. In a subsequent book, Merton grouped unintended consequences into three general categories:

1. A positive, unexpected benefit.
2. A negative, unexpected detriment.
3. A perverse effect contrary to what was originally intended. (In other words, it had the opposite effect to what was intended.)

A few, quick examples of these categories are as follows. A positive, unexpected benefit of a modified social structure was mentioned previously in Adam Smith’s description of rudiments of capitalism and the societal benefit of self-interest. Another classic sociological description of this category is exhibited in Max Weber’s widely known work relating the Protestant work ethic and modern American capitalism. He noted that the Calvinist doctrines of predestination, orderliness and asceticism had the unintended consequence of creating an environment for capitalism by encouraging the accumulation of capital as a duty or end to itself. Thus, American society developed a base from which investment and efficient use of resources resulted.

Actions resulting in negative, unexpected detriments are ubiquitous. I recall when I began my public health training almost 25 years ago, some of the most depressing lectures that I ever heard had to do with well-intentioned efforts to improve a health outcome, but created other problems of equal or greater magnitude. Case after case was presented to caution against well-meaning, but poorly conceived, plans. One notable example was the creation of the Aswan Dam in Egypt. This large project had the laudable objective of reducing flooding potential of Egyptian farmland, and development of a low-cost hydroelectric power system. The project did meet these objectives; however, the rising, but stable, water level upstream of the dam created a perfect environment for the propagation of the parasite that causes Schistosomiasis. Incidence of Schistosomiasis rose to roughly 40% of the population at one time. Schistosomiasis is a chronic, debilitating disease that, on a global scale, is second only to malaria for adverse socioeconomic impact. Current

efforts have reduced that rate tremendously, but it caused significant harm to a generation of Egyptians. It also caused loss of soil nutrients and sediments for farming areas as well as coastal erosion issues which are still being addressed.

The last category - the worst type of unintended consequence - is taking an action to accomplish a specific goal that turns out to have exactly the opposite effect. Unfortunately, this happens more than we would like to admit. A fairly common example occurs in public relations situations where a strenuous effort is made to suppress or remove a piece of information (ex. photograph, document, etc.) from public view. This is especially common on the Internet. The result, though, is that the more strenuous the effort to block the information, the more notoriety and interest is generated. The result is that the information becomes much more widely disseminated than if it had just been left alone.

Dr. Merton studied many examples of the effects and tried to summarize the causes associated with them. Others who have written on the topic have delineated the causes in different ways, but Merton classified them as follows:

1. *Ignorance* (the world and its workings are too complex to know fully).
2. *Error* (incorrect analysis of the issue results in wrong or incomplete action).
3. *Immediate interest* (short-term goals and long-term goals may not be compatible).
4. *Basic values* (certain laws, morals, or beliefs may dictate a specific course of action even if the long-term effect is unfavorable...which may, in turn, force a change in the laws, morals or beliefs).
5. *Self-defeating prophecies* (the mere prediction or fear of a consequence may force an action that was unnecessary or erroneous because the non-occurrence of the situation was never considered).

Considering these causes highlights the fact that fears, beliefs, and limitations in knowledge and analysis play a major role in our decisions...and many times the unintended outcomes that result. Still, each of us face uncertainty and change in our daily lives. Decisions must be made. Even the choice not to make a change is a decision, which carries its own consequences. So, how do we use the LUC to make better decisions?

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this development to proceed. The primary partners included Highlands County government, providing the land and \$500,000 for infrastructure; Heartland National Bank, providing \$1,500,000 in construction financing; and the U.S. Department of Agriculture’s 502 Direct Loan Program, providing mortgage financing. Several regulatory agencies contributed greatly through expedited permitting. Among those agencies were the Southwest Florida Water Management District, the Florida Department of Environmental Protection, the City of Sebring and the Highlands County Board of County Commissioners and Engineering Department. Development planning began in the first quarter of 2010 and design was completed by mid-summer. All entitlements and permits were in hand before the end of that same year. Following an inspirational groundbreaking ceremony, construction began in the second week of September. In addition to the usual dignitaries from the State and Local governments, the family of Mason Smoak (namesake for Mason’s Ridge) and representatives from numerous churches were in attendance. This project was promoted as a “local stimulus” for at least 25 Highlands County contractors and suppliers with \$1.5 million of the \$2.3 million construction budget spent locally. Construction of the water, sanitary sewer, storm drainage and roadway infrastructure began with local site-work contractor, Excavation Point, Inc. of Sebring. The

Construction staff of Habitat simultaneously began construction of the first homes using energy efficient Structural Insulated Panels (SIP), manufactured by SIPS Team USA, with a host of volunteers. Models designed by South Florida Community College’s design class were among the first to be constructed.

The current economic slowdown has certainly had an impact on the pace of development but, as can be seen in the photograph below, 15 homes are either presently completed and occupied or are in some phase of construction. The grant funds lost were ultimately replaced by the partnership agencies, and the dream of home ownership is now a reality for 12 hardworking families. This story just goes to show what can be accomplished when public/private partnerships join forces to attain a common goal.

What’s next? The outlook is bright for completion of the remaining 45 homes within three years. The primary challenge for Habitat will be how to cultivate public / private partnerships to provide funding to offset the decrease in traditional donors who have supported housing construction in the past. Habitat affiliates across the country are being forced to develop alter-

native financing plans to sustain their operations with non-traditional programs and partnerships. Mason’s Ridge subdivision was presented at the State and National Habitat Conventions this past year as an innovative and creative sustainability solution. It has been said that necessity is the mother of invention. Through necessity, Habitat has found a way to turn renters into taxpaying homeowners who have achieved the American Dream.

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As with Murphy’s Law, the Law of Unintended Consequences should be used to create a mental framework that recognizes uncertainty and complexity in the world. Uncertainty and complexity in some fashion are part and parcel of all we do in human life, so it can’t be avoided. Change is an inherent part of life as well, so decisions must be made. Consideration of alternatives and mitigating factors should be considered if time allows. It is always important to understand that decisions we make can affect others as well. Certainly, this is the case as we look at some of the broad-sweeping social policy debates that are occurring (as with the Aswan Dam illustration). So, there actually can be an ethical component to be considered in this context as well.

In his excellent essay “The Unanticipated Consequences of Technology,” Professor Tim Healy of Santa Clara University explores some of the implications of burgeoning technology and its implications for societal good (or not). In the end, he presents six cautionary notes that are worth considering.

1. Life is complex, more so than we admit.
2. All of our actions have unanticipated consequences.

3. We bear a moral obligation to take our positions tentatively and with humility in light of our ignorance.
4. Short-term and long-term values are often different and often contradictory.
5. Uncertainty can be reduced, but there is always a cost.
6. It is desirable to reduce uncertainty, but not eliminate it. (Earlier in his essay he notes that each step in reduction of uncertainty results in a corresponding loss of some level of freedom.)

Thus, he notes that we have the right to act, but we also have an obligation to accept some level of responsibility for the unanticipated consequences of our actions. Perhaps the Wall Street financiers who developed and peddled the products that created the sub-prime mortgage crisis should have read his article. However, that assumes a moral and ethical constraint exists in that business...which has yet to be demonstrated.

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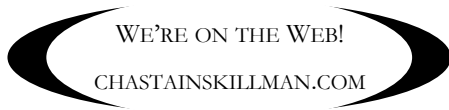
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