Schnabel ENGINEERING

510 East Gay Street, West Chester, PA 19380

International RCC Dams Seminar, Study Tour & Training Session

Join us in Atlanta for RCC 2011 September 12-15th.

Schnabel is pleased to announce the date for RCC 2011, a 3-1/2 day seminar, training and tour program on the design, construction, performance and quality control on the use of RCC for the construction of new dams and the rehabilitation of existing dams. The program is sponsored by ASI, Fall Line Testing and Inspection, and Schnabel Engineering. This is the only such course offered anywhere in the world.

This is the sixth in a series of RCC seminar/study tours held in Denver and Atlanta starting in 1998. Previous programs have attracted attendees from 26 countries including Australia, Bolivia, Bulgaria, Canada, Chile, China, Costa Rica, Egypt, Germany, India, Indonesia, Jordan, Korea, Mexico, New Zealand, Nigeria, Norway, Panama, Peru, Portugal, Spain, Thailand, Switzerland, Turkey and Vietnam, as well as the United States.

For more information, or to register check the *News Section* of our website at www.schnabel-eng.com

The Schnabel Engineering Lecture Series

Schnabel presented its fifth seminar of the Schnabel Engineering Lecture Series to packed audiences at Virginia Tech, Villanova University, and Utah State University. Mr. Douglas Boyer, PE, PG, CEG, was the invited distinguished Lecturer for the series, which focused on lessons learned over the past 30 years and the future direction of dam and levee engineering and safety. Mr. Boyer discussed the importance of shifting our strategy to maintain civil infrastructure, particularly as it affects life safety in the face of limited financial resources. Mr. Boyer described how a "Risk Informed Approach" for decision making and planning has evolved within the USACE and other agencies seeking logical methods to optimally allocate resources. Mr. Boyer highlighted examples of how this paradigm shift has identified drawbacks to traditional engineering design and planning practices, and explained how its implementation across engineering practice will affect the future generation of engineers in attendance.

Mr. Boyer currently serves as the Western Division Chief for the US Army Corps of Engineers Risk Management Center in Denver, Colorado. A link to the recording of the Villanova lecture can be found at www.schnabel-eng.com/Resources/WaterWire.aspx

Schnabel ENGINEERING

Water Wire

Volume 3 SPRING 2011

From the Director's Chair

Floods and Droughts

Many dams are built to deal with floods or droughts. Flood control dams, including detention/retention ponds, are built to reduce flood peaks and slowly release flood waters to protect downstream properties. Water supply dams respond to drought conditions, providing water when streams cannot. Most dams need to be designed to operationally accommodate both. Our centerfold discussion presents an overview of a flood event that ravaged parts of Georgia in 2009. In some locations, it dropped more than 20 inches of rain (details inside). When focusing on dams, floods naturally translate to spillway flood passage issues.

Since we're covering floods within the fold, I'd like to touch on droughts. Dams designed for droughts are commonly water supply projects. When focusing on dams, droughts naturally translate to water supply and reservoir operations. [A link is provided for more information on droughts and floods.] Most reservoir water supply projects use a 50-year planning horizon – reasonable because it takes 15 to 20 years to get a reservoir planned, permitted, funded, designed, built and filled. Planning and permitting commonly recognize uncertainty only for demand projections. However, analyses also heavily rely on historical rainfall, runoff and temperature data. Weather is changeable, but climate is presumed fixed, so directly using historical data for supply availability is common practice. Stream flow and other records are implied to capture both typical and atypical weather. Additionally, while planning focuses on meeting demand for a specified period (up to 50 years), sponsors expect reservoirs to serve for much longer time frames.

Many values aren't fully defined - others are only generally estimated. Historically, contingencies covered data limitations and the uncertainties of future conditions, providing prudent protection from bad outcomes. Demand projections recognized uncertainty. Reservoir studies included added storage and/or diversion pumping capacity.

It was understood that analyses couldn't capture every consideration (and the future includes considerable uncertainty). Factors of safety provided a reasonable probability that the planned outcome would be met.

Over the decades, there has been a lot of change. Reservoir permitting now requires more analyses and more rigorous reviews. Values and analyses are carefully dissected and probed. Each consideration has to survive intense scrutiny; each is doubted and critiqued to minimize the project. Minimized criteria, lacking safety factors, are merged to size facilities. Unfortunately, a set of minimized elements provides a minimal solution unlikely to meet project needs.

Until recently, no one gave serious consideration to non-fixity of climate, nor would a project applicant have a chance of securing approval for such a proposition. Climate has been tacitly adopted as a predefined constant and arguments related to risk and factors of safety have been purged from the planning process. This translates into projects unlikely to meet needs over the planning period. Recognition of climate variability and unpredictability provides a prudent reminder regarding the need to reestablish both reason and caution to reservoir water supply planning.

Projections and execution of major capital investment programs planned to serve for 50 years or more merit contingencies to cover a multitude of unknowns and unknowables. In 1961, we had little idea of what our world would look like today. In turn, we have little idea of what 2061 will look like. Planning, permitting, funding and building a reservoir source of supply for a moderate sized water utility is overwhelming and complex, with layered regulatory requirements. It is imperative that all parties partner for thoughtful protection of both the environment and the needs of the sponsor, and the citizens and communities they represent. Water supply system failure presents unacceptable consequences to public health, fire safety and the local economy. A moderate over sizing merely defers the timing of need for an additional source.

The hoops are many, the maze is taxing,
year by year, the gauntlet waxing.
Earning a permit will gain your consent;
experienced counsel is fee well spent.

For more detailed discussion, go to:
http://www.schnabel-eng.com/Resources/WaterWire.aspx

GEORGIA FLOODS

A Few Words About Flooding . . .

Unfortunately, the seriousness of flooding is often not fully understood until communities are impacted by a major storm event. With on-going development in communities downstream of dams, it is critical to upgrade and maintain these structures to accommodate major storm events without failure. While many dams are designed for storms often considered unfathomable, events like that in Georgia in September 2009 remind us that these extreme storms are a reality. The rainfall during this event established new records for the area and in many locations, precipitation totals well exceeded estimates for the 100-year storm. Some might speculate that this provides some assurance that another event of this magnitude is less likely for the next century; however, like each spin of a roulette wheel, the probability of such a storm is an independent event.

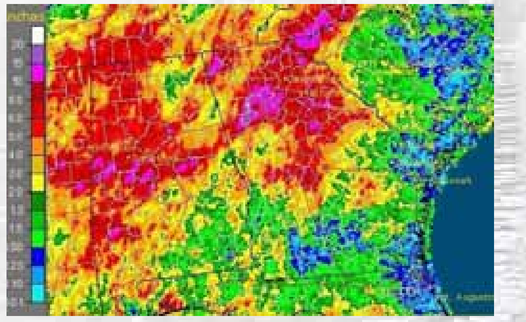
It is critical for planners, engineers, government officials, and dam owners to be diligent in the design and maintenance of dams and other infrastructure. When a flood occurs, our dams and levees must be equipped properly and ready to operate. We cannot be certain when a natural disaster will occur, but with proper preparation and vigilance we can manage nature's challenges to better protect our families and neighbors.

The Perfect Storm

In September 2009, portions of north and central Georgia experienced several days of steady rainfall resulting in a 24-hour event that exceeded 100-year amounts in many areas and approached, if not exceeded, 50% of the Probable Maximum Precipitation (PMP) in other areas.

24-hour Rainfall Amounts for North-Central Georgia

Event	Amount (inches)
100-year	7.9
1/3 PMP	13.8
½ PMP	20.7



Runoff from the intense rainfall resulted in damage to key infrastructure, including dams. Auxiliary spillways are designed to operate only under extreme rainfall events and when these floods occur, damages are acceptable as long as they don't cause an uncontrolled release from the dam causing increased downstream flooding. The auxiliary spillways of numerous dams in this region activated and many experienced damage. Several embankment dams overtopped. Following is discussion of three dams impacted by the September 2009 storm.

NRCS Pumpkinvine Creek Dam No. 3

- 35-ft earth embankment dam
- Located in Paulding County
- Approximately 22 inches of rain in a 40-hour period (nearly 1/2 PMP)
- Storm activated the dam's auxiliary spillway
- Maximum flow depth of three feet and flow duration of 20 hours

The spillways for the Pumpkinvine Creek Watershed Dam No. 3 consist of a pipe-and-riser principal spillway and an earth cut channel auxiliary spillway. The spillway system had capacity of 37% of the PMP compared to 50% of the PMP as required by Georgia Dam safety criteria. The auxiliary spillway eroded more than 20 ft deep; however, the erosion did not extend far enough upstream to cause a release of normal pool storage. The erosion was likely partially attributed to discontinuities in the spillway alignment and subsurface materials, including backfill for a sewer line constructed along the flow path of the spillway channel.

Snake Creek Dam

- 65-ft high earth embankment dam
- Located in Carroll County approximately 40 miles west of Atlanta
- Approximately 13 inches of rain in a 12- to 15-hour period (close to 1/3 PMP)
- Storm activated both of this dam's auxiliary spillways
- Maximum flow depth of about four feet

The spillway system for the Snake Creek Dam includes a pipe and riser principal spillway with two earthen auxiliary spillways. The right spillway experienced little damage and the left spillway experienced damage immediately downstream of the constructed outlet channel, largely the result of the natural outlet geometry, which conveyed flow at an angle to the alignment of the spillway. This abrupt change in flow direction along with the presence of trees that caused erosion generating eddies, instigated the damage. While repairs were necessary, the spillway performed as designed.

NRCS Yellow River Dam No. 16

- 34-ft high earth embankment dam
- Located in Gwinnett County
- Approximately seven inches of rain in a 24-hour period
- Storm activated the dam's RCC auxiliary spillway and portions of the grass and topsoil washed away

In 2007, the Yellow River Dam No. 16 (Y-16) was upgraded by closing/abandoning the existing earth-cut auxiliary spillway and constructing a roller compacted concrete (RCC) auxiliary spillway over the dam, increasing the project's spillway capacity to meet Georgia Dam Safety criteria. The principal spillway is the original pipe and riser. The auxiliary spillway consists of a two-stage sharp-crested weir that discharges onto a stepped RCC-protected slope over the embankment. For aesthetic purposes, the RCC was covered with topsoil and grassed. Damage to the spillway was limited to the erosion of grass and topsoil and the RCC spillway performed as designed.