ANGLE and LINE

A Quarterly Newsletter by COWAN ASSOCIATES, INC.
Engineers • Designers • Surveyors
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BLEACHER SAFETY

by Nicole A. Schantz, EIT

Many of us attend our children's sporting events, a holiday parade, or a friend's graduation and utilize the bleachers provided for the guests and spectators. Many of these bleachers are old and some have not had any maintenance in many years. Have any of us stopped to think that we are at risk, or that children are at even greater risk, of serious, even fatal, injuries as a result of the hazards of these spectator seats?

The Consumer Product Safety Commission (CPSC) has developed "Guidelines for Retrofitting Bleachers" in response to the deaths and injuries that involved bleachers. In 1999 alone there were an estimated 22,100 bleacher-associated injuries treated in emergency rooms. Of those injuries, approximately 6,100 were the result of the person falling from, or through, bleachers onto the surface below. Approximately 4,910 of these falls involved children under the age of 15. The guidelines are intended to provide appropriate facility owners and operators as well as manufacturers with the suggested changes to avoid these injuries and tragedies associated with the four types of bleachers: permanent/stationary, portable/movable, telescopic/folding, and temporary. The guidelines are recommendations and not a standard or mandatory requirement. Beyond the guidelines, however, a licensed professional or qualified bleacher firm can help you learn more, and local building officials can determine the characteristics of these features that may be in the governing building code.

Photo from "Guidelines for Retrofitting Bleachers"
U.S. Consumer Product Safety Committee Pub. No. 330

Possible causes of injuries include missing guardrails from the back or open sides of the bleachers. Openings between components of the bleachers that are big enough to permit a person to pass through them also introduce potential hazards. If the bleachers are not operated properly, they could collapse. Missing or inadequate aisles, handrails, and non-stick surfaces, components all integral to the access and egress of bleachers, also contribute to hazards on bleachers. Bleachers installed prior to the enforcement of the current building codes may not have required guardrails and may have allowed openings big enough through which a child may fall.

It is difficult to formulate a standard recommendation for bleachers to be applied retroactively as one solution will not fit all bleacher situations. It is important to consider the current structure, condition, and environment when considering the materials and methods appropriate to correct the situation; otherwise, you risk introducing new hazards. Retrofitting may include the addition of supports or anchors to ensure stability. It is necessary to design the retrofit bleachers for all applicable dead load, live load, wind load, and sway load requirements of the governing building code. Loading is especially important when considering design of the guardrail and the loads created by spectators leaning on the components. CPSC recommends consulting a licensed professional or a qualified firm to help plan for the retrofit, and emphasizes that at times it may be required to replace the existing bleachers when retrofitting becomes too difficult or may create additional hazards. Prior to beginning retrofitting the bleachers, it should be determined with the local official if a permit is required to make the alterations.

The guidelines recommend that guardrails be installed on all bleachers that do not currently have them. Guardrails are defined as barriers that surround an elevated surface, specifically where the footboard, seatboard, or aisle is 30 inches or more above the floor or ground below. If the top row is nomi-

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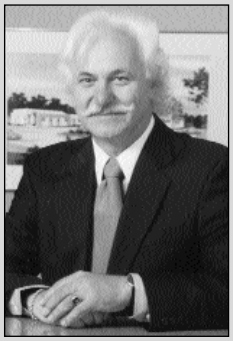
PRESIDENT'S CORNER



As Professional Engineers, we follow a formal creed established by the National Society of Professional Engineers. This statement of ethical and moral pledges requires us, among other guiding principles, to place public welfare among all other considerations.

When we fail to adhere to or rationalize a watered down version of this pledge, calamity is a likely outcome and our media-hungry and litigious society quickly and rightfully will demand for heads to roll, as the recent disastrous history of the big dig illustrates.

Looking back at my own educational experience, I must admit that regrettably I had no formal training in engineering ethics. However, having a solid background in the humanities and philosophy being one of my favorite subjects, I became well acquainted with moral concepts and theories; others may have achieved the same results through their faith-based education. Most of us learned to understand standards of "right" conduct and to judge particular actions as right or wrong by those standards. Yet I felt woefully underprepared to deal with the competing interests and value implications of the various project stakeholders during my "apprenticeship" for a Professional Engineering career.

Some colleges and universities now offer ethics-related undergraduate courses, often case studies which promise at least a rudimentary understanding of these professional challenges. Case studies typically lead to recognition of an engineer's legal liability, not necessarily his or her social responsibility. However, social responsibility goes beyond industry standards and legal requirements, which are typically reactionary following a disaster like the recent enactment of revised mine safety regulations in West Virginia. The fact that an action is legal, a building code-worthy, a land development approved, does not establish that it is ethically correct.

Continued emission of greenhouse gases, depletion of natural resources, development of environmentally vulnerable areas are all legal, often taxpayer-subsidized, and may make economic sense in the short run, but are they ethically correct? Whatever your views on this matter, it is clear that the mere fact that the constructed result of an engineering design is legal may not mean that it is ethically acceptable as well. But where do we draw the line?

It would be impossible to unite all of our individual moral thresholds into one postulate, formulating what an ethically acceptable engineering design is. So what should an engineer do?

The best he or she can, being mindful that our work is akin to the challenge of a high wire act, balancing legal liability and social responsibility.

What do you get when you cross an engineer with a woodwind player?
Someone with three piccolos, a flute, and two clarinets in his shirt pocket.

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nally 30 inches above the ground, the bleachers are exempt. The top surface of the guardrail should be a minimum of 42 inches above the leading edge of the footboard, seatboard or aisle. If the bleachers are adjacent to a wall at least as high as the minimum recommended height of the guardrail, guardrail is not necessary if a 4 inch sphere cannot pass between the bleachers and the wall. Additionally, any opening between components or under the guardrail should also prevent the passage of a 4 inch sphere in order to discourage climbing on the guardrails. All members used as in-fill between the top and bottom rails should be vertical members only. The maximum widest measurement of the opening where the foot could rest should be 1-3/4 inches as recommended in the guidelines. When possible, ladder patterns should be avoided or solid members should be used if visibility is not impaired.

The rationale behind the retrofit recommendation of the 30 inch surface height is based on the severity of injuries that can be sustained from a fall from that height. The 42 inch minimum rail height is intended to prevent inadvertent falls over railings. The 4 inch opening is based on data showing that 95% of all children 4 months of age and older would be prevented from passing through an opening of that size. The maximum 1-3/4 inch measurement for openings in guardrails is based on the width of a child's foot to reduce the potential of gaining a foothold for climbing.

In order to meet the recommendations in the standard, some retrofit suggestions include adding chain link fencing to the existing railing as in-fill or guardrail. If this is the method used to retrofit, the chain mesh should be 1-1/4 inch square or smaller to discourage climbing. When retrofitting the seating components, rigid materials such as aluminum extrusions or grating material should be used to close openings between seating components. It is not recommended to use chain link fencing in this application because it can introduce potential trip hazards, allow combustible and unsanitary debris to collect, is difficult to inspect for breaks in integrity, and it can encourage children to play and hang on it.

After the retrofit process is completed, it is recommended that trained personnel perform follow-up inspections and maintenance in a systematic manner. The frequency of the inspections is determined based on the amount of use, but a minimum of quarterly is recommended. At least once every two years, it is recommended that a licensed professional engineer, licensed architect, or bleacher company provide a written certification that the bleachers are fit for use after an inspection. The purpose of the inspections would be to identify any structural damage or degradation so that problems can be immediately resolved. It is recommended that all actions, whether inspections or repairs, be documented with a signature and date, and retained for files. There should also be well-documented records of all incidents and injuries relating to the bleachers to aid in identifying potential hazards or dangerous design features.

Information has been taken directly from "Guidelines for Retrofitting Bleachers" as published by the U.S. Consumer Product Safety Commission, Publication No. 330. Further information can be found on their website at http://www.cpsc.gov or by contacting Cowan Associates, Inc.

COWAN IS COMMITTED TO QUALITY

by Michael R. Smith, P.E.

This spring, the management of Cowan Associates, Inc. reinforced their commitment to providing the best quality services to their clients. Cowan has dedicated resources to achieving accreditation of its materials testing laboratory by the AASHTO Materials Reference Laboratory or AMRL. The voluntary process of accreditation involves multiple steps which include development of a company-wide Quality System (QS) evaluation, inspection by an outside agency, and participation in proficiency sample-testing programs.

Development of the QS establishes policies and procedures that ensure that all of Cowan's personnel, equipment, and standard operating procedures meet the minimum requirements set forth by industry and professional standards. The QS sets minimum standards for employee qualifications, training, and continuing education of our technical staff. Cowan's QS also sets the company's standards for verification and calibration of our data collection or testing equipment, better assuring accurate data recording which will be utilized for engineering evaluation and reporting. The most important part of the system is the requirement for the execution of bi-annual audits by management to monitor the performance of the system and to identify and correct any deficiencies identified by the audit.

The requirement of evaluation and inspection of our facilities by an outside agency helps to ensure that the minimum standards for accreditation are being fulfilled by Cowan. This "extra set of eyes" may identify any areas of improvement which may not be obvious to management operating on a daily basis. The outside auditor may also recommend corrective actions to improve the quality of our services.

Cowan's participation in proficiency sample testing programs allows our managers to evaluate both the accuracy of testing equipment being used as well as the performance of our personnel. The programs, conducted by CCRL and AASHTO, submit identical paired testing samples to numerous laboratories around the world. Each laboratory performs the applicable testing methods on the samples and submits the results for evaluation. The results of the sample testing are compiled by the agencies, and the laboratories are notified of their individual performance results. The laboratory evaluates its results and, if they are determined to be outside of the allowable standard deviation for the test method, the laboratory manager is required to identify the cause of the deficiency and implement corrective actions.

Cowan Associates is proud of our commitment to quality. With these new management tools, we will strive to better improve on our services and provide our clients with the quality products and services they expect.

MUNICIPAL ENGINEERING – The Big Picture

by Angelika B. Forndran, P.E.

It's a whole new world today in eastern Pennsylvania municipalities with burgeoning population growth. Sewers are overflowing with stormwater, open space is being lost, natural areas are decreasing and groundwater withdrawals are increasing, sewer plants need additional capacity, qualified manpower is in short supply, and tax free money is shrinking in a world with an aging infrastructure as old as the beginning of the last century.

Consulting municipal engineers for townships and boroughs need to be cognizant, versatile, and creative in recognizing and providing guidance in approaches to zoning and subdivision ordinances that consider incorporation of comprehensive plans, natural resource protection, open space design, and village streetscapes. Streets and roadways need full consideration of safety concerns to reduce municipal liability while making use of new specifications from Pennsylvania Department of Transportation that economize asphalt and extend the useful lives of pavement.

Increasing non-funded federal and state mandates in the typical services of drainage, water supply, and wastewater treatment require review and evaluation of alternate technologies, while regulations demand greater attention to the cross-referencing of agency jurisdiction and the real world interrelationships of water resources, all in a time of rising construction costs and almost every municipality facing budget concerns as infrastructure needs increase and funding sources from state and federal sources decrease.

All of this means that the municipal engineer providing the desired services to help insure a sustainable quality of life in the community needs to see the big picture on how the overall needs of the client can be met with the future in-hand with today's dollar. This is in addition to the traditional workload of engineering design and review. Engineers that are single-man firms are becoming very rare. Diverse work is accomplished more effectively when a firm has a full-service staff that includes scientists, engineers, planners, landscape architects, surveyors, technicians, and construction managers who, on occasion, may team and subcontract a specialty service to provide the best solution for the client. Single-man engineering firms cannot function efficiently in this environment. Cowan Associates, Inc., having been privileged to provide services to municipal clients over several decades, has watched and acted accordingly to this growing requirement of need diversification, and now has a staff that includes structural, civil, environmental, traffic, and mechanical engineers, supported by surveyors, geologists, construction inspectors, landscape architects, planners, and a construction materials testing lab.

Following is a description of a recent Cowan Associates project which incorporates almost all design disciplines in what, at first blush, appears a straight-forward task. Take $7.5 million construction dollars and replace/rehabilitate 8.8 miles of century-old water and sewer pipe in two municipalities with pipe located in state, borough, and township streets that require maintaining traffic, water and sewer service to industrial, commercial, and residential establishments on these same busy streets; and, of course, remembering that all have different needs and agendas.

Consider the tasks: research for existing maps of existing utilities; preparation of topographic surveys; find a location for main line pipe around, over and under existing waterlines, existing sanitary sewers, storm sewers, gas mains, and electric and telecommunication conduits; meetings with municipal government leaders; NPDES permits; erosion and sedimentation control; road opening permits; plan preparation and approval from these same government agencies; preparation of specifications; review of construction alternatives to determine which alternatives should be bid; pipeline sizing for both present and future needs; bidding of project; review of contractor qualifications;

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coordination of contractor work areas; material placement testing; traffic detouring scheduling; cost monitoring; and bill approval. Additional tasks include coordination of water, sewer and road restoration; cooperation among separate prime contractors, borough personnel, PennDOT, and adjacent township government officials. Cowan Associates designers and construction managers did all of this, enabling the project to move ahead on schedule resulting in greatly improved water service and fire protection, eliminating water leaks, and eliminating inflow and infiltration with the sliplining of the old sewers in a two-year phased construction.

Other Cowan Associates services to municipal clients have included preparation of watershed restoration protection plans, obtaining grant and loan funds, stream restoration projects, development of stormwater ordinances, installation and monitoring of flow in sewers using Cowan Associates flow meters, negotiation with Pennsylvania Department of Environmental Protection concerning discharge permits based upon watershed maximum daily load determinations, evaluation of arsenic removal from public water supply wells, upgrading water filtration plants and wastewater treatment, reconstruction of streets, bridge design, retaining wall construction and much more. These are examples of the variety of issues which municipal engineers need to address to help municipalities sustain livable and enjoyable communities.

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**ANGLE and LINE is published quarterly by Cowan Associates, Inc. For additional information on articles contained within contact:
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