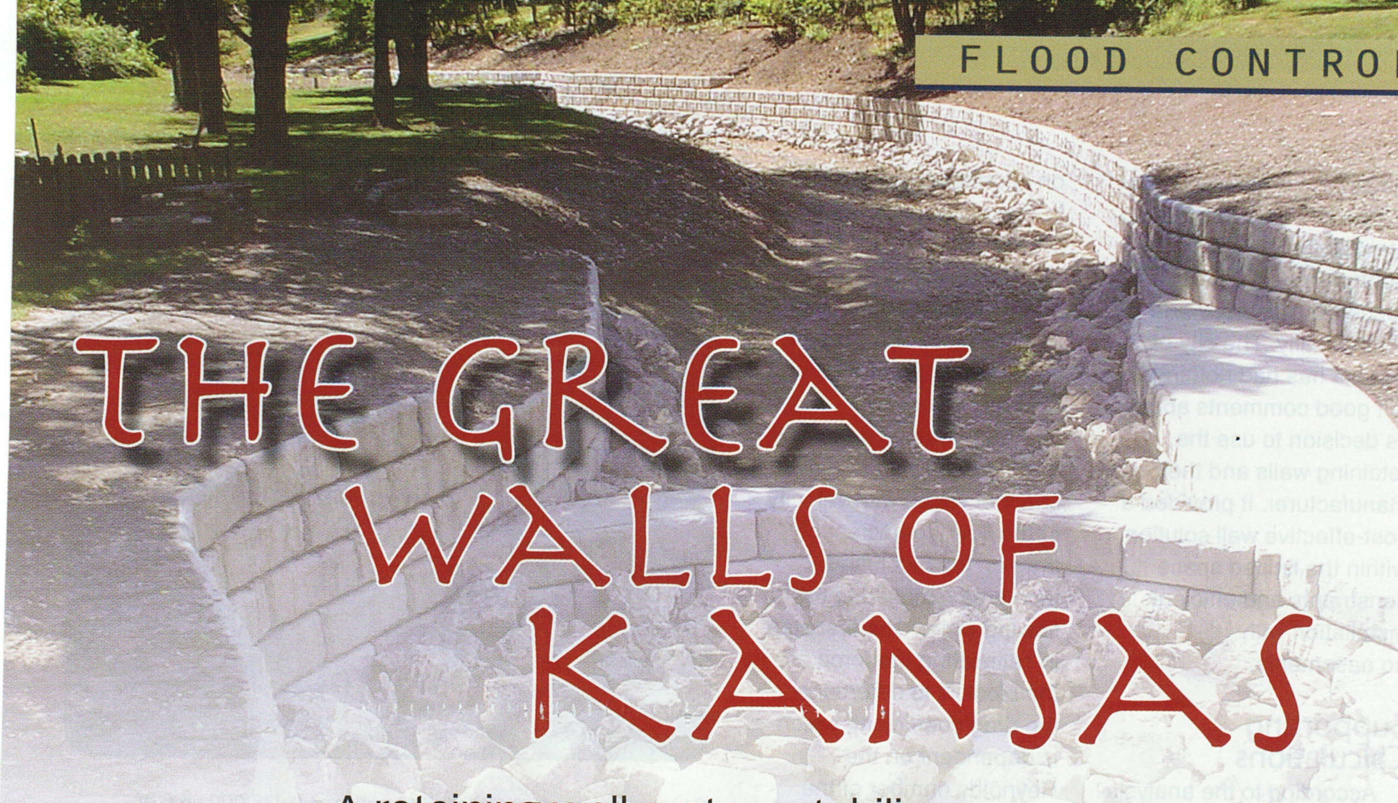

THE GREAT WALLS OF KANSAS

A retaining wall system stabilizes streambanks, keeps local properties dry

By Jacob Manthei

In order to successfully implement its Brentwood Stream Stabilization and Flood Control Project, the city of Lenexa, Kan., needed a system to help stabilize its streambanks, prevent erosion along residents' properties, provide flood control and prevent encroachment on the neighboring property line.

Engineers designed the walls to withstand sporadic water flows and keep off private property.

City officials looked to St. Joe Concrete Products, the local Redi-Rock Intl. manufacturer in St. Joseph, Mo., to provide a solution. Redi-Rock was the company of choice because of its ability to create tall gravity walls, as its systems utilize blocks that weigh more than one ton. The massive scale of the system allows walls to be built much higher than other wall systems without using geogrid or tiebacks. Additional benefits include the "essence of natural rock" look and easy-to-use design resources.

The Creal Clark and Seifert engineering firm designed the retaining wall on the job. The engineers faced several challenges—first and foremost, designing the wall to withstand sporadic flows of water, and secondly, making sure not to encroach on property lines.

Installation & Follow-Up

A particularly challenging section of the city of Lenexa project was very close to a property line where there was no room for soil reinforcement. A product called the 9-in. setback block was able to offer a gravity solution where no other product could. The 9-in. setback block creates walls with a batter angle at 2V:1H. The increased batter angle allowed the wall to achieve its height without geogrid. The balance of the project was designed with standard 41- and 28-in.-wide blocks.

The project, which totaled nearly 38,000 sq ft of retaining wall, was done in three phases; construction started in March 2007 and was completed in late 2007. CDM and Redford Construction worked to construct the project. On several occasions, 300 blocks (more than 1,700 sq ft) were installed in a nine-hour day.

The Brentwood Stream Stabilization and Flood Control Project was a success structurally and aesthetically. The city of Lenexa has had nothing but good comments about its decision to use the retaining walls and their manufacturer. It provided a cost-effective wall solution within the limited space constraints and efficient installation with no easements.

Supporting Calculations

According to the analysis of blocks subject to drag shear force from flowing water—prepared by LMNO Engineering, Research and Software Ltd. based on information contained in *Fundamentals of Fluid Mechanics*—the blocks are ideal products in channel applications such as the Brentwood Stream Stabilization and Flood Control Project.

Drag force on a block in a wall on the side of a river channel varies with velocity of the flow, coefficient of drag on the block and face area exposed to the flowing water. The first step in calculating the force on the block is to determine the drag coefficient, which is dependent on the Reynolds number of the flow. The Reynolds number is calculated by R_e=Vb/v, where R_e is the Reynolds number, V is water velocity (ft/second), b is length of block face parallel to flow (3.83 ft) and *v* is kinematic viscosity of water (1.25 x 10^{-5} sq ft/second at 60˚F).

The friction drag coefficient for a flat plate parallel to upstream flow can be determined from the Reynolds number and the ratio of roughness to plate length. For concrete, roughness varies from 0.001 to 0.01. Using the upper end of roughness values, e equals 0.01 and plate length, b equals 3.83 and e/b equals 2.6 x 10^{-3}.

The drag force shear force on the block is computed using the equation $F=\frac{1}{2}C_D AV^2\gamma/g$, where F is shear force (lb), C_D is the friction drag coefficient, A is shear area (5.75 sq ft), V is water velocity (ft/second), γ is the specific weight of water (62.4 lb/cu ft) and g is the acceleration of gravity (32.2 sq ft/second).

Resisting forces, which keep the retaining wall blocks in place, are provided by block-to-bloc[k] friction. The buoyant unit weight of a wall is $\gamma_{buoyant}=\gamma_{infilled}-\gamma_{water,}$ or 130 lb/cu ft – 62.4 lb/cu ft=67.6 lb/cu ft. The buoyant weight of a bloc[k] is $\gamma_{buoyant}$ x l_{block} x h_{block} x $w_{block,}$ or 67.6 lb/cu ft x 3. ft x 1.5 ft x 3.41 ft=1,324 lb. Using a coefficient of friction for concrete on concrete (0.2), the slidin[g] resistance of a block ca[n] be computed as μ x $W_{bu...}$ block, or 0.2 x 1,324 lb = 264 lb/block. SWS

Construction workers installed approximately 38,000 sq ft of retaining walls on site.

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