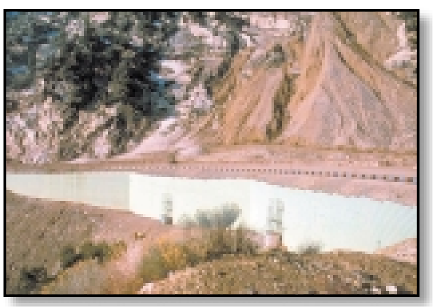
The Reinforced Earth Company

RECONEWS

SUMMER 2002

RECo USA CELEBRATES 30 YEARS

The first two Reinforced Earth structures built in the United States are now thirty years old. Located on Highway 39 in the Angeles National Forest northeast of Los Angeles and at the Anniston,



Highway 39: 2,000 m², 16 m max height, Los Angeles, California

Alabama, Kmart, these structures were the first of nearly thirty thousand structures, including more than 9 million m^2 of facing, built by The Reinforced Earth Company (RECo) since the company's founding in 1972. This thirty-year milestone is especially noteworthy considering the rather interesting way that Reinforced Earth came to being.

It all started more than ten years earlier, when French architect-engineer Henri Vidal, "experimenting" with sand and pine needles at the beach, noticed the sand's behavior changed when pine needles were mixed in. It took Vidal five years of research and testing before his theories were ready for their first practical test, the construction of a 23-m-tall, plus 26-m slope highway retaining wall in the French Alps! In an effort to educate and persuade potential users of Reinforced Earth, Vidal documented his work in a thesis comprising three hundred pages and one hundred drawings, about equally divided among theory, material technology and applications. What began so simply is now acclaimed by ENR Magazine as one of the world's major construction advances, an advance that truly revolutionized civil and transportation construction technology. Today, over three Reinforced Earth structures per day - more than one thousand per year - are completed and placed in service somewhere in the world.

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Kmart: 1,200 m², 9 m max height, Anniston, Alabama

Continued from page 1

The theory Vidal developed over thirty years ago continues to be proven on a daily basis. The pine needles of the beach were replaced first by smooth strips cut from galvanized steel sheets, then by hot-rolled, deformed, high adherence galvanized steel reinforcing strips. Of the many thousands of completed structures, there has not been a single failure or accident resulting from the theoretical basis of Reinforced Earth or its components. Extensive research, including both laboratory and full-scale testing, has thoroughly documented the behavior mechanisms of this technology, including predicting the excellent earthquake performance of Reinforced Earth walls. Structures designed both with and without consideration of seismic loads have demonstrated excellent performance during earthquakes in California (US), Kobe (Japan), Izmit (Turkey) and elsewhere around the world.

The first Reinforced Earth facing, like the first reinforcing strips, was fabricated from sheets of galvanized steel. Though lightweight, it was visually unappealing and was soon replaced by a nominally 1.5 m square precast concrete panel. Typical of the development process for Reinforced Earth components, the performance of the precast panels was proven by over 400 full-scale, extensively instrumented, load tests to failure conducted at our experimental research station in Madrid, Spain. Engineered to produce an interlocking as well as overlapping joint between adjacent panels, the precast facing offers cost effective fabrication, rapid construction and a wide variety of pleasing architectural finishes. Panels are produced in our manufacturing plants or by subcontracted precasters using our specially designed forms. Precast facings have also been developed to meet special requirements such as the inclined facing required for slot-type bulk material storage facilities and the larger rectangular shapes required for some highway projects.

Kenilworth Ave bridges: Ashlar Stone Finish, SE Freeway, Washington D.C.

Oil terminal: 12,000 m², combined length of 1,100 m, 17 m max height, Valdez, Alaska

The Reinforced Earth precast facing is used throughout the world for structures on both firm and soft foundations. Functioning as a thin, flexible skin, the facing helps structures adapt to settlement with minimal visible distortion while protecting the primary structural component of the system - the reinforced soil. For walls built on extremely soft foundations, where significant differential settlement and deformation cannot be avoided, a galvanized wire mesh facing serves temporarily until settlement is complete, and then is covered by a cast-in-place or precast aesthetic facing. For temporary walls, which do not require the permanence of concrete, an ungalvanized wire mesh facing is an extremely economical solution.

The most dramatic part of Reinforced Earth technology's success has been its worldwide acceptance. Initially used only in France, Reinforced Earth has become a standard construction technique in both developed and developing countries around the world. This success has been fueled by RECo's insistence on hiring only the most qualified, dedicated professionals to assure our clients the best service at all stages of a project - from engineering and design, through manufacturing, technical assistance during installation, through final project acceptance.

Three decades of Reinforced Earth construction in the United States and around the world have seen the development and maturation of a construction technology now considered standard practice by owners, architects, engineers and contractors everywhere. Nearly 30,000 structures have been completed in the United States, permanent and temporary, simple and complex, high and low, plain and beautiful. Yet, the future holds new opportunities for the creative application of this technology that revolutionized construction practice. The Reinforced Earth Company stands ready to help you realize your future ... where will your next Reinforced Earth structure be?

JOHN STREET

MARKHAM, ONTARIO

Project Details

This traditional False Bridge Abutment grade separation, in the Town of Markham carries vehicular traffic over a busy rail corridor. Now uninterrupted traffic movement occurs across this important link in the local road. The concrete panels were cast with RECo's Ashlar Stone finish to enhance the aesthetic qualities of this project located in a busy residential/commercial area. Reinforced Earth Company Ltd. worked closely with the Consultant and Contractor through two major project design revisions and an extended project construction period.

FEATURED PRODUCT: FALSE BRIDGE ABUTMENTS

The John Street project, shown in this Newsletter, is an example of a Reinforced Earth "False Abutment" application.

False bridge abutments are MSE walls that contain piles or columns within the reinforced soil to support the vertical bridge loads. False abutments differ from "True Abutments" which have no piles or columns and support bridge loads entirely with the Reinforced Earth mass. "True Abutments", were featured in RECONEWS Summer-Fall 2000".

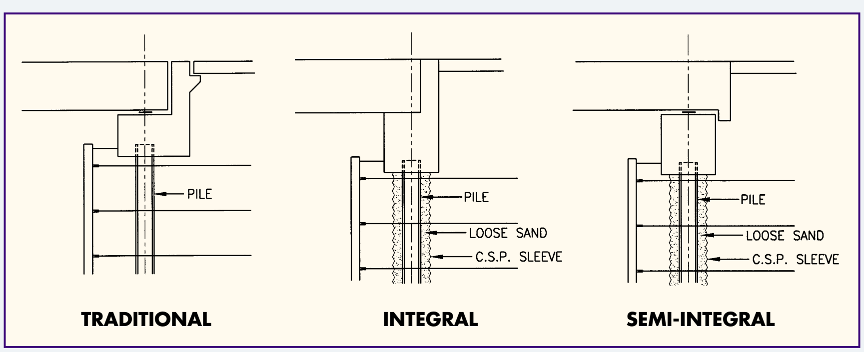
We discuss below three types of false abutments, which are referred to as Traditional, Integral, and Semi-Integral as illustrated in our figure.

A traditional false abutment consists of a bridge superstructure supported on bearings, typically elastomeric pads, with an expansion joint between the end of the bridge and the ballast wall. The piles or columns are surrounded directly by the compacted granular material of the MSE wall.

Integral abutments have become increasingly popular since bridge designers are keen to reduce maintenance costs associated with replacing bearing pads, and expansion joints. Semi-integral abutments include a bearing pad but no expansion joint. Both generally consist of a HP driven steel pile surrounded by loose sand inside a corrugated-steel-pipe.

The design of a MSE false abutment usually does not include any vertical bridge reactions since they are taken by the piles or columns. The MSE must however be designed to take the horizontal forces that get transferred into the MSE mass. The magnitude of the force depends on the type or false abutment, traditional, integral, or semi-integral and on the stiffness of the material surrounding the pile or column.

Designers at Reinforced Earth work with bridge consultants to select the best positioning of the piles to allow reinforcing strips to be skewed past.



INTERNATIONAL

CORNER

AUSTRALIAN TECHSPAN HANDLES THE CURVE

TECHSPAN CURVES OVER EDGAR CREEK

TechSpan is a versatile modular precast product that has been used for grade separations, rail tunnels, and various industrial and military applications. For this project, the challenge for Reinforced Earth was to build a TechSpan structure over a stream without interfering with the streams winding natural flow while providing a structure suitable for flood conditions.

The design required a structure that would meet the cross sectional area required for a 1 in 100-year flood while minimizing the change in grade for the proposed road over the stream.

OTHER IMPORTANT FACTORS INCLUDED MAINTAINING THE FLOW IN THE SENSITIVE STREAM DURING CONSTRUCTION AND MINIMIZING THE DISTURBANCE TO THE EXISTING STREAMBED AND BANKS.

TechSpan was selected for the Edgar Creek steam crossing on the South Eastern Freeway near Melbourne Australia. Reinforced Earth's in house finite element design program was used to custom design the structure. The span is 14.9 m with a height of 4.8 m and length of 54 m. The selected design shape minimized the moments due to loading conditions for the highway and hydraulic loading.

The TechSpan structure was built on a 150-m radius curve. This radius was selected to best match the route of the existing stream and to avoid encroaching on the streambed and banks. Individual elements were cast with tapers to provide a seemingly continuous, curve and a hydraulically smooth conduit. Reinforced Earth's custom TechSpan formwork was easily converted to produce the custom pieces.

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