RECO NEWS
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The Reinforced Earth Company

Reinforced Earth Supports CN Heavy Rail Mainline

Adjacent to CN's new structure is the CP main line and the Vancouver overhead rapid transit line with traffic on Front street.

An innovative construction technique was used by Canadian National Railway (CN) when an old wooden trestle structure at Yale Mile 118.93 in New Westminster, (Vancouver), British Columbia required replacement. The trestle had deteriorated at an accelerated rate due to fire damage. Using Reinforced Earth in a unique way, CN was able to meet their objective of minimizing down-time on a critical mainline section of track while ensuring minimal rail disruptions during replacement of this crucial section.

A number of challenges became apparent when considering the structure replacement.

The trestle replacement site forms part of CN's approach to the west end of the Fraser River Rail Swing Bridge and the trestle provides the necessary approach grade to the bridge. The site was challenged by constricted access. Immediately adjacent to the trestle (along the

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east / riverside) is the Canadian Pacific Railway (CP) mainline at grade. An elevated rapid transit line is located directly east of the CP line and to the west (landside) of the trestle is Front Street, a busy primary commercial traffic bypass route for the City of New Westminster that carries commercial truck traffic. CN could not have the rail removed from service for any significant length of time and road closures were severely limited and of short duration.

The nature and location of this project posed three primary constraints on the replacement design.

- -Rail traffic had to continue to use the track on an hourly basis.
- -The construction access was severely limited by the close proximity to the CP line and Front Street.
- -The timing of staged construction had to be carefully planned, executed, and achievable in the field.

Reinforced Earth Company Ltd. (RECo) was selected by CN as a viable option for structure replacement primarily because of extensive experience in similar rail and other heavy supporting applications for critical structures. The replacement structure selected consisted of narrow "back to back" MSE approach walls separated by only 5.380m (17ft-8in) leading up to a piled supported abutment wall. The completed approach walls fully support the Cooper E90 rail loading requirements.

CN opted to construct the 977m^2 (10,515ft^2) of TerraClass precast MSE wall system with it's own bridge and maintenance forces. RECo provided technical guidance to CN's work crews during the installation of the approach and abutment wall. CN and RECo carefully planned the precast panels and construction components so that the delivery sequence closely mirrored the construction schedule. This careful planning facilitated smooth erection production, while not excessively tying up the limited storage space at site.

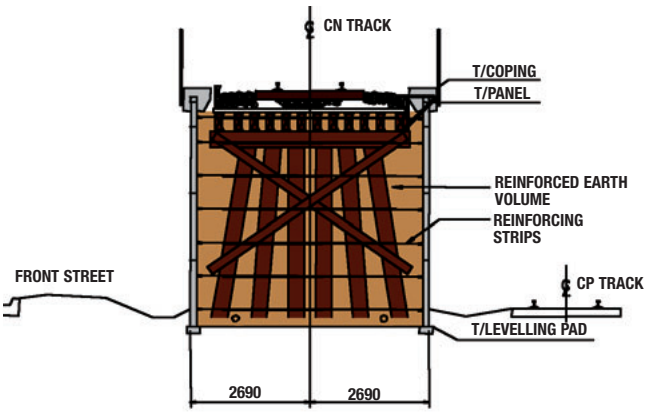
Precast concrete facing panels and soil reinforcement placement proceeded directly below the existing trestle deck as rail traffic continued immediately overhead. Construction successfully continued within the limited vertical clearance beneath the trestle deck for the majority of construction, to maintain movement of rail traffic at all times. Once the panel and reinforced backfill reached 1m (3ft) from the underside of the deck, CN opted to finish panel placement/backfill to the top of wall during two separate track closures of 12 and 18 hours. During the track closure the timber pile cap, deck and rail were removed allowing wall construction to be completed before the rails were re-instated. The mainline was back in service being fully supported atop the MSE wall.

A special Finite Element Design review was completed by RECo to determine the effects of the heavy dynamic rail loading to be considered in the design.

Numerous tests have been conducted on Reinforced Earth (RE) walls in the United States and Europe where heavy vibrating rollers have been placed directly on RE structures. The investigation revealed that under dynamic / seismic loading the importance of a strong connection is critical. High adherence steel reinforcing strips were employed due to the critical nature of these dynamic heavy rail loads and were connected to the back of the panels with structural bolts, connected in double-shear.

A bolted connection between the concrete panels and the soil reinforcing strips has the added benefit of allowing the strips to be rotated at the connection to the panel. Reinforcement skew angles of up 20 degrees to the perpendicular were considered in the design. Bolted soil reinforcement could be placed on a skew and permitted the strips to avoid interference with the piles supporting the bridge seat at the heavily loaded false abutment location and the existing wooden supports which remained in the RE volume.

RECo provided a successful staged construction solution while allowing CN to maintain safe rail traffic throughout the construction corridor during the entire course of existing timber structure replacement. Many parties were involved in the completion of this project and RECo would like to extend thanks to all CN's Design and Construction Forces, UMA Engineering, and panel precaster Con-Force Structures Limited.



Front Street Flyover, Castle Rock, Colorado

Prompted by growing congestion concerns located at the existing railroad crossing and the Front Street and Fifth Street intersections, the Town of Castle Rock, Colorado, determined that the best alternative solution would be a Front Street Flyover, or overpass, which would direct traffic over the railroad.

The Town of Castle Rock worked closely with the consulting engineer Felsburg-Holt & Ullevig to finalize the design of the project by incorporating the architectural ideas developed by both the Town and with extensive comments from the general public. During this time, many ideas were generated, one of which was an architectural scheme that would incorporate the native rock foundations of the area into the structures and retaining walls. The preservation of the view of the historical Castle Rock, locally known as "The Rock," was of paramount importance because it serves as the gateway into the Town.

Under a contract from SEMA Construction of Englewood, Colorado, Slaton Bros. Construction of Littleton, Colorado awarded the Mechanically Stabilized Earth (MSE) retaining wall design and supply contract to RECo in June of 2004.

RECo immediately began collaborating with the architectural form liner designer and fabricator Scott Systems Inc. of Denver, Colorado, who obtained impressions of the native Castle Rock conglomerate stone.

A unique feature of the project was the utilization of impressions of six distinct patterns of the native rock formations. Molds were then made of the individual patterns and utilized by RECo in the fabrication of the 5' X 5' square MSE wall precast facing panels that were then randomly located in the MSE wall by RECo's engineering team to replicate a natural, non-repetitive visual appearance.

The MSE walls were then erected by the SEMA Construction's subcontracted retaining wall contractor, Slaton Bros., and an integral stain was applied to the concrete facing panels to achieve the desired coloration. SEMA Construction was able to complete the approximately $6 Million project two months ahead of schedule and within budget.

The addition of the Front Street Flyover has achieved the intended goals of alleviating the congestion at the Fifth Street railroad crossing and increasing traffic flow in and out of the downtown area while preserving the natural architectural landscape that is part of the Castle Rock's identity.

The Front Street Flyover Project was named the "Project of the Year" by the American Public Works Association (APWA) and the award was presented to the Town of Castle Rock on March 8, 2005. The project was selected in the category of community involvement and overall design.

International Corner

North Kiama Bypass Road-Australia

Located two hours by car to the south of Sydney, North Kiama (New South Wales), with it's breath taking beaches, mountains with lush vegetation and a picturesque blow hole (cavity in the rocks on the seashore from which water spurts to heights of 60m (200ft) under pressure from the waves), is a choice destination for many Australians.

For many years the Princes Highway, a winding single lane road, with a rail grade crossing, was the only way to reach North Kiama. A new road was originally proposed in 1990, but it was not until 1997 that construction of a completely new, double-lane highway commenced.

Phase two of the project that began in November 2003, involved designing and supplying a covered railroad span 64m (210ft) long and 12m (40ft) wide composed of TechSpan arch elements and Reinforced Earth TerraClass panels supported access ramps to replace the previous Princes Highway grade crossing.

"The plans for the tunnel were drawn up using 3D-design software. This made it possible to optimize the design allowing for the complex geometry created by the horizontally and vertically curved rail track and the acute-angled retaining walls supporting the highly skewed bypass road. This was probably the main challenge of the project," states Michiel Knol, RECo Project Manager. These 3D simulations made it possible to validate tunnel height and to adjust the ends of the covered span that were turned towards the interior. It was necessary to build 86 TechSpan arch elements: 70 with classic width, 7 with reduced width and 9 specially tapered elements.

In the final configuration, the road will cross over the covered span. For this, 2400m^2 (25,800ft^2) of retaining walls are now under construction and will be used for the access ramps on each side. A technical solution was required to allow the General Contractor to build the walls without interrupting traffic on the Princes Highway running alongside the structure on the ocean side

The construction timeline called for the retaining walls on the land side to be built first. On the other side, temporary TerraTrel mesh walls 1270m^2 (13,670ft^2) were built to stabilize the backfill and avoid run over into the road. Once traffic is transferred to the new structure, construction of retaining walls on the ocean side will be completed.

Technically and architecturally this is an interesting project that uses three of RECo's systems to achieve a custom site solution.

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