Parking Ramp over Light Rail Station

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PROJECT DESCRIPTION

Minneapolis Saint Paul Metropolitan Airports Commission
St. Paul, Minnesota

3DEC™

The Minneapolis-St. Paul International Airport (MSP) serves about 36 million passengers annually, via about 405,000 flights. On-airport parking provides about 22,900 parking spaces and is frequently at or near capacity. A parking ramp expansion has been proposed at Terminal 1-Lindbergh. It will be constructed over the north end of the Metro Transit Light Rail (LRT) station. The station (55 ft wide, 40 ft high, and 540 ft long) is constructed in the St. Peter sandstone and Glenwood shale, with a flat roof of the Platteville limestone. In addition to horizontal bedding, three subvertical limestone joint sets were identified.

The parking ramp expansion involves two principal impacts on the LRT station:

- Column loads on the Platteville limestone above or nearby the station, and
- Excavation of the soil and some of the Platteville limestone above the station.

ITASCA'S ROLE

Itasca assessed the magnitude of the principal impacts by conducting three-dimensional geostructural analyses of the LRT station using *3DEC*. Models were calibrated based on surface settlement data (surface survey points, inclinometers, and extensometers) from the original construction. Two main construction options were evaluated:

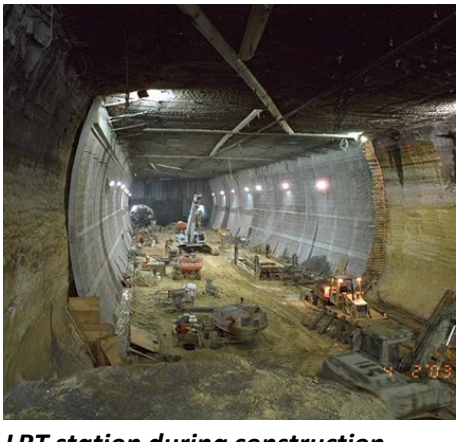
(1) Application of the ramp column loads to the upper limestone over the station footprint; and

(2) The use of transfer beams to carry all column loads outside the station footprint.

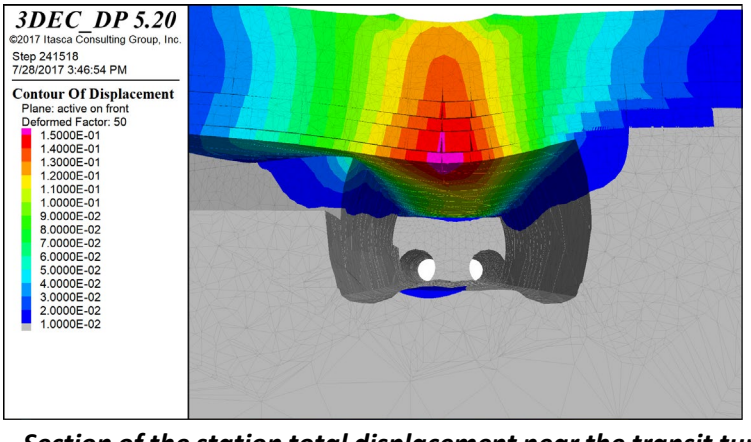
The base case included nearly 2,000 rock bolts. Four alternative options (including additional bolting, combination of methods, and the use of a center column) were also evaluated. The main stability evaluation criteria considered were surface settlement and factor of safety, of the limestone vertical joints and bedding planes, against slip.

PROJECT RESULTS

Of the six designs evaluated, all but Option (1) were predicted to be geostructurally feasible; ramp columns alone are predicted to perform worse than the current station with an increase in roof deflection of about 50%. Additional rock bolts or a combination of these methods are anticipated to perform as well as the current station. Improved station performance was found using additional rock bolts *with* a combination of (1) and (2), using Option (2), or using a center column *with* Option (1).



LRT station during construction.



Section of the station total displacement near the transit tunnel for Option (1) with model deformation magnified by 50 times.

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