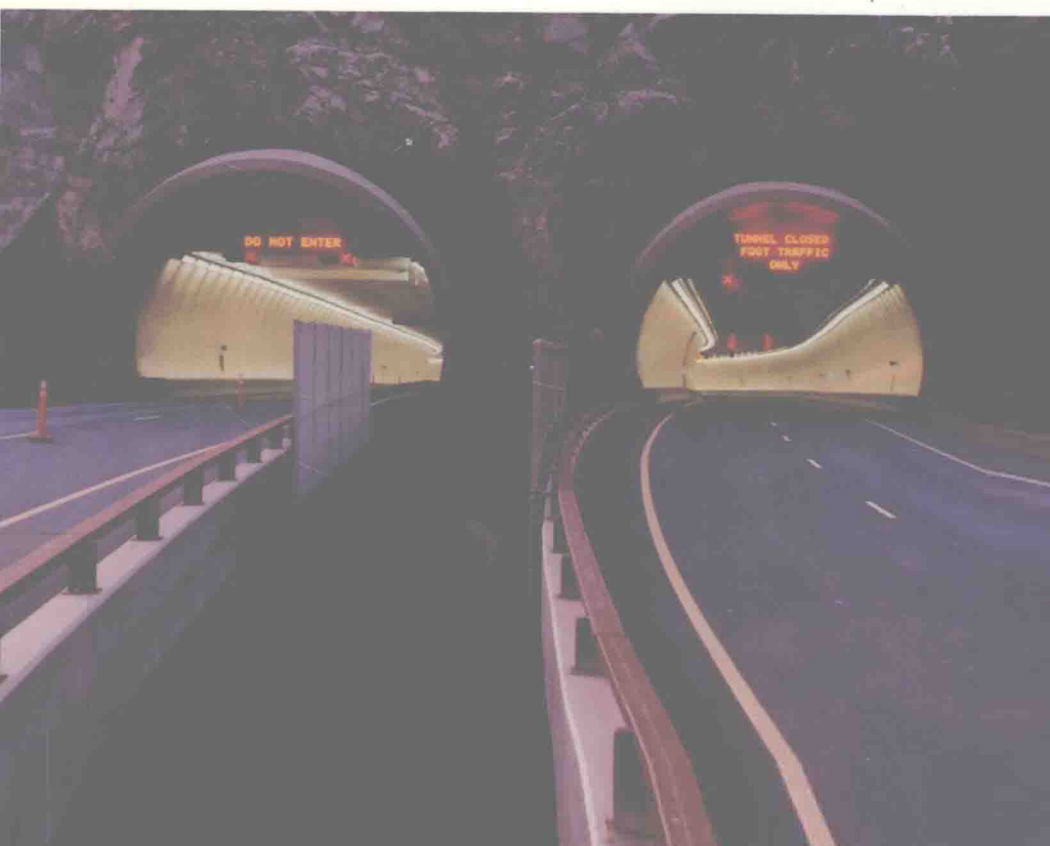




Proceedings

Rapid Excavation and Tunneling Conference
Boston, Massachusetts, June 13-17, 1993

Editors: **L.D. Bowerman, J.E. Monsees**





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L.D. Bowerman, AIME

J.E. Monsees, ASCE

Sponsored by

American Institute of Mining, Metallurgical, and Petroleum Engineers
American Society of Civil Engineers

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Preface

The Program Chairmen and Executive Committee of the 1993 Rapid Excavation and Tunneling Conference would like to welcome all participants and attendees to the eleventh RETC. From the inaugural 1972 conference held in Chicago, we have seen RETC develop into one of the premier gatherings of constructors, engineers, and owners in the contracting industry and the engineering profession. This year's meeting, held in the historic city of Boston, allows us not only to reflect on projects recently completed throughout the world, but also on current work and future projects in the Boston area.

Consistent with past meetings, this year's RETC includes three concurrent sessions, allowing the individual to participate in as many discussions as possible. We are confident that once again the variety and quality of the presentations, in addition to the briefs retained in this book, will encourage each attendee to recognize new ideas and different techniques, to learn points of interest on projects completed or current, and ultimately to promote an exchange of thoughts regarding our underground industry. This year, over 75 presentations will be given in 15 sessions ranging from favorites such as TBM and Soft Ground Case Histories, to Cavern and Shaft Excavation, to Geotechnical Aspects and Water Control. Current major programs such as the Superconducting Super Collider, as well as work on Europe's Trans Alpine tunnels are covered in detail. Always looking to the future and a better way, upcoming major programs are discussed, in addition to the ever-changing technology of mechanical equipment and underground construction methods.

As always, the Program Chairmen would like to thank each person who devoted their time and effort in the preparation and presentation of these briefs, as well as the Session Chairmen who ensured their timely submittal and inclusion in this book. The success of RETC is a result of direct input from all backgrounds of underground construction, and we would like to thank each Exhibitor, listed in the back of this book, for their contribution and involvement in the conference. Finally, a most special thanks to the SME-AIME staff and the ASCE for coordinating this event and providing the necessary patience and guidance throughout this RETC preparation.

L.D. Bowerman, AIME
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June 1993

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Design and Planning

Chairman
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Chapter 1

DESIGN OF THE PROPOSED SPEER/SIXTH/LINCOLN TUNNEL DENVER, COLORADO

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ABSTRACT

The future Speer/Sixth/Lincoln tunnel in Denver, Colorado, is built with the top down method of construction. The design of the three lane 573 m (1880 ft) depression with a 216 m (710 ft) tunnel required innovative solutions to difficult site constraints. The completed tunnel structure will have exterior load carrying diaphragm slurry walls acting as permanent load carrying structural elements which are integral with a post-tensioned concrete tunnel lid. Both the slurry walls and the tunnel lid will be completed in-place prior to excavation of the tunnel. This method allows rapid construction, minimum dewatering, minimum disturbance to adjacent structures, and reduced interference with traffic. The deeper part of the depression approaching the tunnel consists of cantilevered slurry walls with compression struts beneath the roadway. The completed project will have 8366 m² (90,000 ft²) of permanent structural diaphragm slurry walls.

INTRODUCTION

In November of 1989, the City and County of Denver announced a \$24 million construction project to rebuild one of the City's most congested intersections at Speer Boulevard, Sixth Avenue, and Lincoln Street. The project provides for the construction of a tunnel for southbound Speer Boulevard under Broadway, Lincoln Street, and Sixth Avenue.

The design of the three-lane, 573 m (1880 ft) depression with a 216 m (710 ft) tunnel and a 15 m (49 ft) width was a major undertaking requiring innovative solutions to difficult site constraints. These include maintenance of traffic flow on the cross streets during construction; protection of the structural integrity of large buildings and bridges next to the depression, and the restrictions of a narrow right-of-way. Also the tunnel will be built below the normal water elevation of adjacent Cherry Creek. Boring logs have identified soil contamination at the project site. The tunnel roadway is on a sag vertical curve to minimize vertical clearance at the portals and numerous existing utilities cross the site.

The completed design is a unique structure consisting of several structure types. The tunnel consists of exterior load carrying diaphragm slurry walls which are integral with the post-tensioned concrete tunnel lid. Both the slurry walls and the tunnel lid are completed in-place prior to excavation of the tunnel. This top down method of construction allows rapid construction, minimum dewatering during construction and in the final structure, reduced interference with traffic and minimum disturbance to adjacent structures. The deeper part of the depression approaching the tunnel consists of cantilevered slurry walls with compression struts beneath the roadway. The shallower part of the depression consists of a tie-down tub section and standard retaining walls.

PROJECT DESCRIPTION

The proposed project will depress southbound Speer Boulevard under Broadway, Lincoln and Sixth Avenue. Figure 1 is a site plan of the project which shows the location of the crossing streets, of Cherry Creek, and of the adjacent structures. The structure will begin with low retaining walls and a tie-down tub section for a length of 130 m (425 ft). Cantilevered slurry walls will extend 58 m (190 ft) to the north portal. The tunnel at this point will be 7.6 m (25 ft) deep. At Broadway there will be a southbound service road which will overhang the cantilevered walls on the south side of the depression. The tunnel will be 216 m (710 ft) in length. From the south portal cantilevered walls will extend 67 m (220 ft). A tie-down tub section and retaining walls will continue to grade for 78 m (255 ft). The overall length of the depression is 573 m (1880 ft). The maximum exposed retaining wall height is 4.9 m (16 ft) and the maximum exposed cantilevered slurry wall height is 7.3 m (24 ft). Figure 2 is a photograph of a model of the project looking toward the north tunnel portal.

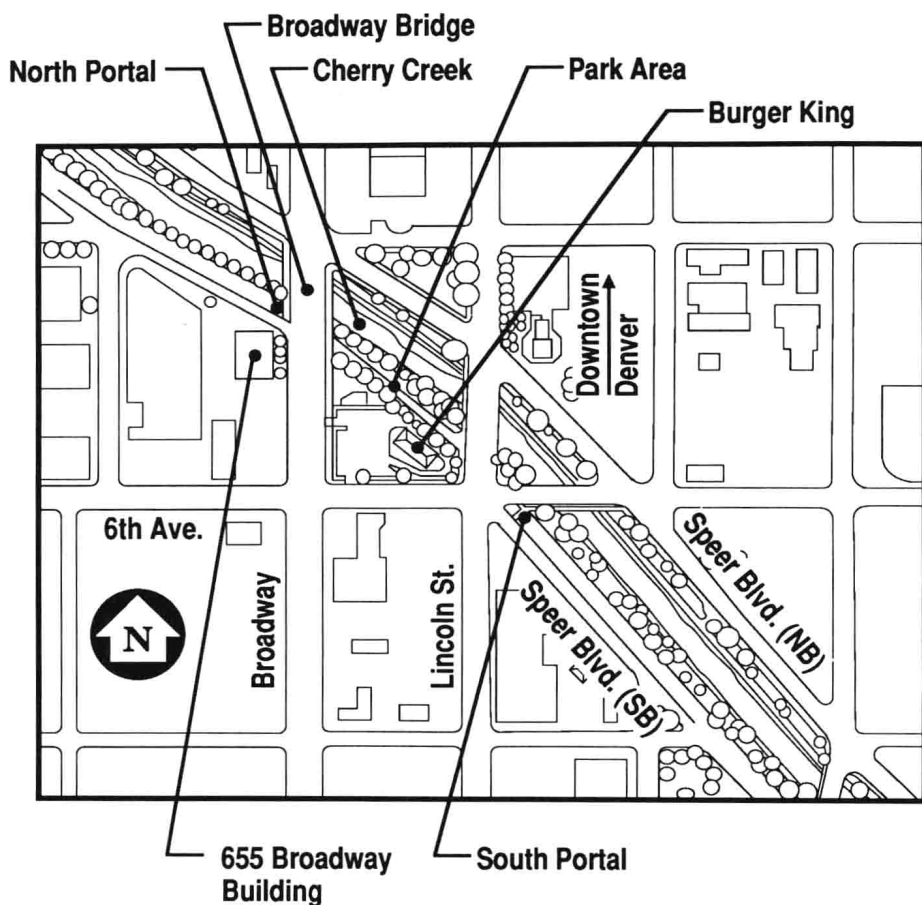


Figure 1. Tunnel Site Plan