STATE OF COLORADO

DEPARTMENT OF HIGHWAYS

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F A C T S H E E T

WESTBOUND BORE OF EISENHOWER MEMORIAL TUNNEL

BACKGROUND:

The first of what eventually will be twin tunnels was opened to traffic March 8, 1973. The first tunnel now carries two-way traffic on Interstate 70 under the Continental Divide. The Division of Highways in 1975 called for bids on the first two stages of the second bore, and when it is finished, it will become the eastbound tunnel, and the one-way system will go into effect. The eastbound tunnel will be mined along the location of the pilot bore, which was holed through Dec. 3, 1964, and was then used for a study of rock formations and related data. The two vehicular tunnels will be practically identical and run side by side.

SCOPE OF PROJECT:

For construction of the first vehicular tunnel, bids were opened Oct. 3, 1967. The project included driving the westbound tunnel complete; starting the eastbound bore a short distance into the mountain at each end; construction of combination portal and ventilating buildings for both tunnels at east and west entrances; installation of necessary facilities for use in the westbound tunnel, such as lighting, other utilities, and the electronic surveillance system.

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LOCATION:

The east entrance is in Clear Creek County, the west in Summit County. The east entrance is 1.7 airline miles northwest of the top of Loveland Pass, some 60 miles west of downtown Denver, and roughly 10 miles west of Silver Plume. From the west tunnel entrance it is about seven miles southwest to Dillon. The project lies entirely within Arapaho National Forest land, and no privately-owned right of way is involved. The west portal is in the valley of Straight Creek, while the east portal is in Loveland Basin and the valley of South Clear Creek.

LENGTH:

Outside face to outside face of ventilating buildings is 8,941 feet, or 1.693 miles. Of this distance, there are 7,789 feet of rock tunneling and a total of 1,152 feet of ventilating/portal structures and cut-and-cover sections at east and west ends. Saving in mileage as compared to the routing over Loveland Pass is 9.1 miles-- 10.6 instead of 19.7.

ELEVATION:

The elevation of the finished westbound roadway centerline at the outside face of the east ventilating building is 11,012; at the outside face of the west ventilating building, 11,158; under the Continental Divide, 11,112. The Clear Creek-Summit County Line runs along the Divide, and is at an elevation of 12,608 feet as it crosses over the tunnel, roughly at a right angle, or 1,496 feet above the tunnel roadway elevation at this point. The crossing is 2,821 feet east of the west entrance (outside face of the ventilating structure), and hence, that much of the tunnel is in

Summit County, the rest in Clear Creek County. It is the highest auto tunnel in the world.

GRADE:

The westbound tunnel climbs from east to west at an average grade of 1.64 percent (rising 1.64 feet for each 100 feet on the horizontal). There are slight vertical curves in the eastern half, and a vertical curve inside each portal is a transition from the tunnel grade to those of the approach roads.

DIMENSIONS:

At the circumference, the tunnel shape varies according to the type rock encountered, from a straight-leg horseshoe pattern to oval, the latter used where rock stress is greatest. Maximum planned height of the rough bore was about 48 feet, and maximum width was 40. There are several different types tunneling section. However, because of the lining, the motorist travels through a rectangle that is uniform in size and shape, once he gets inside the portals. Vertical clearance for vehicles is 16 feet-4 inches, and there are 26 feet of travel width (two lanes of 13 feet each). Above the ceiling, there are fresh air and exhaust ducts, and there is drainage provided beneath the roadways. Tunnel attendants have a walkway beside the vehicle travel lanes and access to the pilot bore (hence, later, to the eastbound tunnel) by three cross passageways. The ventilation/portal houses each measure 252 feet in width, 185 feet in depth, 50 feet high. Ventilating stacks stand an additional 30 feet above the buildings.

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ALIGNMENT:

The westbound tunnel runs generally east and west, and curves slightly about midway into the mountain. The second of the twin tunnels will be generally in a straight line. Centerline to centerline, the twin tunnels will be about 115 feet apart at the east ventilating building entrance, 120 feet at the west ventilating building entrance, and some 230 feet at the widest point of separation under the mountain.

FRESH AIR CAPACITY:

The ventilating system for the westbound tunnel has supply fans (six active, two standby), each providing 533,000 cubic feet of fresh air a minute. Exhaust fans (six active, two standby) each have a capacity of 542,000 cubic feet a minute. The design of the ventilating system followed two years of both field and laboratory studies of auto exhaust. The system will maintain conditions in the tunnel to meet Public Health Service standards. Maximum air input is about 1.6 million cubic feet per minute at each end. Detection equipment will monitor for any deviation from the normal level of carbon monoxide, and give a warning to the attendants.

OTHER EQUIPMENT:

There is a tram car suspended from the wall, a gasoline-powered facility that can travel the length of the tunnel, carrying an attendant. An emergency power system has been installed, in case of interruption of the commercial source of electricity. Closed circuit television allows attendants to monitor traffic flow from the control room in the east portal house.

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TRAFFIC:

Average daily traffic estimates:

1973	6,200	(8,184 actual)
1975	7,700	
1980	9,000	
1985	10,250	
1990	11,500	
1995	12,750	
2000	14,000	

Highest traffic volumes have been on Sundays, and it was estimated that 19,900 vehicles might use the tunnel on a Sunday in August, 1973, with the majority of them traveling eastbound (12,900). This high-day estimate was not quite realized.

ROCK FORMATIONS:

Geologic studies showed that bedrock in the tunnel area consists of 75 percent granite and 25 percent gneiss and schist. There are local dikes of augite diorite. There are faults and shear zones as well as solid bedrock. In the pilot bore, 26.5 percent of its length was in self-supporting rock; 73.5 percent required supports in varying degrees, and the total footage of what tunnelers call "bad" rock was 820. Because the location of the westbound bore lies between 115 and 230 feet to the north, rock conditions there did not exactly duplicate those of the pilot tunnel. Extrapolation from stresses measured in the pioneer bore to those expected in the vehicular tunnel did not prove to be absolutely exact in every case.

DESIGN:

Tippetts-Abbett-McCarthy-Stratton, New York City

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APPROXIMATE QUANTITIES OF SOME MAJOR ITEMS (Tunnel and Buildings):

Excavation (in tunnel):	524,000 cubic yards.
Portal excavation:	90,000 cubic yards.
Other excavation:	477,000 cubic yards.
Concrete tunnel lining:	190,000 cubic yards.
Concrete, buildings:	34,000 cubic yards.
Steel reinforcing bars in tunnel:	10,000 tons.
Structural steel in tunnel:	23,400 tons.
Structural steel, buildings:	2,600 tons.
Reinforcing steel, buildings:	2,100 tons.

KEY PERSONNEL:

For Straight Creek Constructors, the joint venture that held the contract, these men were in charge at the site at the opening date, March 8,1973.

Project Administrator--- Glen Nielson
Project Manager--------- W. K. McGlothlin
Project Engineer-------- Werner Ruemmele
General Superintendent-- R. A. Gillette

For the Division of Highways, key personnel at the construction site at opening date included:

District Engineer----------- R. C. Hopper
Tunnel Construction Engineer- P. R. McOllough
Tunnel Superintendent-------- John B. Cook

THE JOINT VENTURE:

Members of the contracting combine are Al Johnson Construction Co., Minneapolis; Gibbons and Reed Co., Salt Lake City; Kemper Construction Co., Los Angeles; and Western Paving Construction Co., Denver.

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HISTORY, IN BRIEF:

The call for bids opened Oct. 3, 1967 represented the fourth one for a highway tunnel under the Continental Divide. Following completion of a pioneer bore under Loveland Pass, in May, 1943, the Department of Highways advertised for bids on a vehicular tunnel at the site, and received only one offer Sept. 16, 1947: $ 10 million dollars, which was not formally considered since it was a sole bid and far in excess of the engineers' estimate. Upon readvertising, the department received no bids on opening day, Dec. 17 of the same year. In 1956, bids were opened Apr. 16 on two tunnel projects, one for Straight Creek and the other at Berthoud Pass. Only one valid bid was received on each, and no contract award was made.

Emphasis on a tunnel stemmed from Bureau of Public Roads designation in October of 1957, of a stretch of Interstate 70 between Denver and Cove Fort, Utah. (Other interstate designations in Colorado were made in 1956.) Federal money was not made available for construction on the Denver-Cove Fort leg until the 1962-63 budget. An engineering firm, E. Lionel Pavlo, New York City, picked Straight Creek as the best of eight possible interstate routes between Empire Junction and Dotsero, in a report made March, 1960, to the department, and pointed out the need for a tunnel because of the impossibility of getting over the Divide and maintaining interstate standards. In several contracts in 1962 and 63, the Department of Highways provided for approach roads to the site of a pioneer bore that would be driven on the Straight Creek route, then contracted for the pioneer tunnel in October, 1963. Mid-Valley, Inc., Houston, holed the tunnel through Dec. 3, 1964.

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FINANCE:

Federal aid on this interstate project is 91.32 percent. The contracting venture started the project on a basis of pay by bid items which, when totaled, amounted to the low bid. However, effective Dec. 16, 1970, pay procedure on mining items was changed to a cost basis because of difficulties encountered in mid-mountain. From the start of preliminary engineering to closeout of the current project, about $ 108 million will have been expended. The tunnel is Colorado's biggest highway venture and a record for a federal aid single project.

BIDDING:

Compared to a Division of Highways estimate of $ 42,479,000, the following bids were received Oct. 3, 1967

	Bid Price
Al Johnson Construction Co., Minneapolis Gibbons and Reed Co., Salt Lake City Western Paving Construction Co., Denver Kemper Construction Co., Los Angeles (later to operate as Straight Creek Constructors)	$ 54,140,486-LOW BID
Mid-Valley, Inc., Houston Morrison Knudsen Co., Inc., Boise Perini Corp., San Francisco	$ 55,113,270
Gordon H. Ball Enterprises, Danville, Calif. Granite Construction Co., Watsonville, Calif. Gates and Fox Co., Loomis, Calif.	$ 55,731,960
Peter Kiewit Sons' Co., Omaha J. F. Shea Co., Glendora, Calif. Colorado Constructors, Inc., Denver	$ 56,400,421
Dravo Corp., Burlingame, Calif S. J. Groves and Sons Co., Minneapolis C. H. Leavell and Co., El Paso	$ 59,531,179
Utah Construction and Mining Co., San Francisco Guy F. Atkinson Co., San Francisco	$ 63,613,895

BIDDING (Continued):

Enough items were deferred from the low bid to bring the contract price down to $ 49,576,412, and Straight Creek Constructors was awarded the contract Nov. 2, 1967. The deferred items were work-ordered back in late in the project.

CHRONOLOGY:

Oct. 3, 1967 - bids opened
Nov. 2, 1967 - contract awarded to Straight Creek Constructors
Jan. 22, 1968 - first steel delivered to job site
March 13, 1968 - mining for main bore, top heading, began west portal
March 15, 1968 - ceremony marking start of mining at west portal
June 14, 1968 - concrete pour began for west ventilation building footings
Oct. 24, 1968 - top heading mined from west to point halfway through the job
Dec. 1, 1968 - bench excavation began from west portal
Dec. 11, 1968 - top heading excavation began from east portal
May 27, 1969 - bench mining from west complete to midpoint of job
July 16, 1969 - structural steel erection began at west portal ventilation building
Aug. 3, 1969 - full-face excavation by mining shield started in mid-mountain near Loveland Fault zone
Sept. 5, 1969 - shield excavation stopped (method abandoned later)
Nov. 4, 1969 - structural steel erection for east ventilation building began
Dec. 6, 1969 - excavation of top heading from east suspended pending redesign of troublesome section
Jan. 27, 1970 - start of concrete pour for tunnel lining began in western half
July 19, 1970 - finish of concrete lining for western half
Oct. 6, 1970 - installation of ventilation fans at west portal building began
Dec. 16, 1970 - agreement effective to modify original contract (to pay mining items on cost basis)
Jan. 1, 1971 - Gibbons and Reed Co. assumed project management from Al Johnson Construction Co.
Jan. 7, 1971 - crown drift excavation began through mid-mountain sector (first of several drifts mined around tunnel periphery in 1,873 foot length)
March 11, 1971 - bench excavation began from east
April 5, 1971 - installation started for ventilation fans at east portal building

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CHRONOLOGY (Continued):

April 9, 1971 - crown drift excavation completed, first hole-through in main bore
Sept. 20, 1971 - mining began on remaining sector of top heading, 1,873 feet long
Feb. 29, 1972 - top heading holed through at 8:05 p.m.
July 21, 1972 - bench mining completed
Oct. 24, 1972 - concrete tunnel lining completed
Jan. 15, 1973 - ceiling paneling all placed
Feb. 10, 1973 - asphalt paving completed
Feb. 23, 1973 - light installation finished inside tunnel
March 7, 1973 - wall paneling all placed
March 8, 1973 - westbound bore opened to two-way traffic
April 1, 1973 - closed circuit television surveillance became operative
April 23 - May 11, 1973 - tunnel was closed 11 hours a day Mondays through Fridays to allow for installation of variable message signs.
May 10, 1973 - manual operation of variable message signs began
July 17, 1973 - one-millionth vehicle passed through at about 5:12 p.m.
Aug. 1, 1973 - computer operation of variable message signs began
Aug. 19, 1973 - (Sunday), busiest single day to that time, 18,350 vehicles
Oct. 21, 1973 - two-millionth vehicle passed through at about 5:08 p.m.
Oct. 29, 1973 - Division of Highways accepted project from Straight Creek Constructors
March 16, 1974 - three-millionth vehicle counted about 3:30 p.m.
July 2, 1974 - Work began to improve drainage above eastern half of tunnel.
July 16, 1974 - four-millionth vehicle counted about 6:30 p.m.
Sept. 28, 1974 - more than 800 visitors attended open house at east portal.
Jan. 26, 1975 to May 26, 1975 - Tunnel traffic routed in two lanes eastbound Sunday evenings from about 4 p.m. until ski rush was over, westbound diverted over Loveland Pass. Two hours was about average time.
June 16, 1975 - seven-millionth vehicle went through between 9 and 10 p.m.