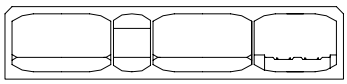
TUNNEL NAME/LOCATION/DATE COMPLETED: **J.F. Kennedy Tunnel (Scheldt E3); Antwerp, Belgium; 1969**	**T.33 - Scheldt E3** 

TUNNEL TYPE AND USE: Prestressed concrete box elements; Vehicular and railroad		LANES/TRACKS: Two roadway tubes with three lanes in each tube; one railroad tube with two tracks	
NO OF ELEMENTS: 5	LENGTH: 4 - 99 m 1 - 115 m	HEIGHT: 10.1 m	WIDTH: 47.85 m
TOTAL IMMERSED LENGTH: 510 m		DEPTH AT BOTTOM OF STRUCTURE: 25 m	
UNUSUAL FEATURES:	Extremely wide tunnel with combined rail and road usage. The project used the largest tunnel elements ever constructed at the time (47,000 tons). A quay wall, which was replaced over and supported on the tunnel, was constructed as hollow concrete caissons		
ENVIRONMENTAL CONDITIONS:	River currents of up to 3.0 m/s. Tides with a mean range of 4.8 m and a maximum range of 8.86 m		
FABRICATION METHOD: All five elements were cast in one cycle in a casting basin near the tunnel site.		JOINT TYPE: Gina gasket for temporary joining. Tunnel monolithic with ventilation buildings	
WATERPROOFING METHOD:	5 mm steel sheet on bottom painted with tar epoxy. Joints between the single sheets were sealed with bituminous strips. Walls and roofs were provided with a three ply membrane. On the walls, membrane was protected by timber sheeting supported on steel beams fixed to the concrete. The 3 cm space between the timber and the membrane was filled with mortar. Roof protection consisted of a 10 cm reinforced concrete slab. Bulkheads were constructed of 14 mm steel plate supported on horizontal and vertical beams (to save weight). The joints between the sheets were covered with bitumen mastic and the whole bulkhead was covered with a 2 mm butyl membrane.		
PLACEMENT METHOD:	Ten tugs (1200 HP) were required to place the first element. Four custom-built square pontoons on the element were used with control and survey towers in customary fashion.		
FOUNDATION METHOD:	Because of high water velocities, siltation was a serious problem. Skirts around the bottom of the elements were tried, but silt penetrated beneath them. A special patented sand jetting system, devised by Christiani & Nielsen, removed the silt and replaced it with sand.		
DREDGING METHOD:	River sediments, mainly loamy sand, were removed by cutterhead suction dredges. Stiff clay was removed by a chain bucket dredge which could dredge to 30 m. Because of current velocities at midstream, the dredge had to excavate the upstream slope and the downstream slope alternately. In addition, the trench was dredged wide enough to accommodate the elements moored in the direction of the current (floating in the event of an emergency)		
VENTILATION TYPE:	Longitudinal system with ventilators at entrance only		
COVER AND TYPE:	No cover over elements, other than 10 cm concrete		
CONCRETE CUBE STRESS: 450 kg/cm²		POST-TENSIONING: Partial: 235 ton transverse tendons at 0.5 m, roof and bottom	
ADDITIONAL INFORMATION:	OWNER: Intercommunale E3 DESIGNER/CONTRACTORS: Enterprises Ackermans & van Haaren, Compagnie d'Entreprises C.F.E., Compagnie International des Pieux Armes Frankignol, Société Belge des Betons and Christiani & Nielsen A/S		