**Liefkenshoek Rail Link advancement**

Liefkenshoek rail link, a 16.2km dual railway project under construction in Antwerp, includes 4.76 km of railway zone through excavation, 4.27 km of infrastructure in open and covered trenches, 1.2 km of Beveren tunnel, already constructed but never utilized (KW08) and a 5.9 km double bored tunnel (KW10).

Locorail consortium, consisting of CFE (25 percent), VINCI Concessions (25 percent) and BAM PPP (50 percent), has been selected in 2008 by Infrabel as concession-holder for the rail tunnel Liefkenshoek situated north-west of the Port of Antwerp. This tunnel creates an extra link between the left and the right bank of the Port of Antwerp. The DBFM (Design, Build, Finance and Maintain) contract has a duration of 42 years including the construction period. Total investment: EUR 765 M, from which EUR 75 M by Infrabel and EUR 690 M by PPP with Locorail NV (NV = SpA). Financing for Locorail: 50 percent EIB (European Investment Bank) and 50 percent JV of banks. Locorail has attributed construction works to the JV Locobouw, made of MBG (CFE group), VINCI Construction Grands Projets (Vinci group), CEI-De Meyer and Wayss & Freytag (both of BAM group).

The twin single-track tunnels (KW10): 5.979 m length for north tube, rail track A and 5.972 m length for south tube, rail track B have a 7.3m inner diameter and 8.1 m outer diameter. The full section tunnels were driven using two 8.4 m-diameter and 102 m length Herrenknecht Shield TBMs. The two Mixshields, S-532 and S-533, named Schanulleke and Wiske, started their advance in February 2010 (north tube) and March 2010 (south tube) respectively. Mixshield S-533 broke through into the target shaft on 16.05.2011 followed by S-532, which broke through on 23.07.2011 (click [here](http://www.herrenknecht.com/projects/projektsuche-detailansicht.html?tx_dbnhkprojects_pi1%5BresType%5D=detail&tx_dbnhkprojects_pi1%5Buid%5D=2557)). Due to works for crosspassages, mostly from tunnel North, the TBM in tunnel South surpassed tunnel North. The vehicles for TBM were supplied by Metalliance (FR).

For Liefkenshoek Rail Link, Engineering structure KW10, includes 13 crosspassages between tunnels and 8 evacuation/access shafts between tunnels with exit to the surface. Mucking by mixing excavated soil with bentonite slurry and booster pumps. Supply and return line 400 mm to a slurry treatment plant at the surface at a maximum distance of 7.2 km.

Max Boegl Fertigteilwerke GmbH & Co (D) lined the full section tunnels with 6,650 rings (length = 1,801 m) composed by 7 stones and 1 keystone each. Totally 53,100 reinforced concrete segments. Used polypropylene fibres for protection of structure in case of fire, designed according to RWS-curve fire. Additional fire protection: fireproofing with 26 mm of vermiculite sprayed mortar. For cross-passages, temporary lining of excavated opening with shotcrete and final lining with traditional reinforced concrete.

Waterproofing with rubber joints between segments in tunnels and with waterproof lining foil between shotcrete and reinforced concrete in cross-passages.

Shallow crossing of Canaldock: installation of 25.000 cu m of low strength mortar as a bad soil (sludge) replacement and 16.500 cu m of steel fibre reinforced concrete slab as protection against shield pressure blow-out. All performed underwater at 17 m depth.

Both tunnels were finished in December, 2011.

The ongoing civil works, after tunneling works, in KW10 twin bore tunnel are:

**Railslab:** installation of 2.6 km reinforced concrete track slab in the tunnels for direct installation of rails. 48,500 cu m of concrete C30/37 XF2 and 2,100 t of reinforcement. Production 48 m/day, total work front length about 400 m (chairs, reinforcement, concrete first stage, concrete second stage). Finishing of concrete of beams for rail installation: +-4mm. Equipment used: formwork 48 m per tunnel in 4.8 m modules (design of Locobouw in cooperation with manufacturer DOMS); concrete delivery system per tunnel: high pressure stationary pump CIFA HPC 1410/817 and stationary pump CIFA PC 907/612 with diversion valves for direction of concrete and water for cleaning and 1,500 m of high pressure delivery line (5 in/8 mm) with valves and supports suspended on tunnel wall. Supplier AHS-Alcomat (B).

The concrete is pumped from the top of the ES (Evacuation Shaft), 40 m approx high (like the ES07 visited), and is then channelled in a pipe, along the wall, inside each tube up to the point where the formwork realizes the slab. The power of the pump CIFA HPC 1410/817 allows to overcome distance without problems, even in the sections where it is greater, such as between the ES07 and ES08, under the Scheldt. A pump CIFA PC 907/612 is also used, at the end of each working day, for pumping water in the ducts, suitably plugged with sponges, in order to clean up them from concrete deposits. The operation is necessary for a better sliding of the concrete in the pipes in the following day (the deposits cause slowdowns).

**Fireproofing:** installation of 180.000 sq m of fire-protective coating (26 mm of vermiculite cement spray mortar Promat Cafco Fendolite MII). Subcontractor: JV Liereja (Renotec and Jansen (BE).
**Cable ducts:** prefabricated concrete culverts for cables for high tension and low tension lines: 24,000 m or 8,000 pcs. Installation by Locobouw, delivery of precast elements from EBEMA (BE).
**Other:** installation of anchor rails (supplier Halfen): +-7,000 pcs, for installation of E&M equipment on tunnel wall; installation of firedoors, handrail, etc.
**Geology:** mostly sand, partly clay in a certain zone.

**Equipment:** the major works for building management systems, electrification, rails, signs for KW08 (Beveren tunnel) and KW10 (twin bore tunnel) is not in the scope of JV Locobouw. Under the DB-contract of Locobouw will be installed the following E&M equipment:

* **AFFS (Active firefighting systems):** the JV Locofire, composed by Bam Techniek and Aquasecurity, supplied and installed water and foaming agent distribution system and foaming units: 100 systems of 60 m per tunnel in KW10 and 20 systems of 60 m in KW08. Click here.
* **OPI (Overpressure installations)**: the BAM Techniek – Keller supplied overpressure installation of 80 kPa to evacuation routes, crosspassages 4 cu m/s and evacuation shafts 2 cu m/s. One unit for every ES (evacuation shafts) and cross-passages (CP) between the tunnels.
* **RWA**: the JV CFE-Ansaldo supplied two 630 kW fans, one stand-by, at each end of the bored tunnels; two 300 kW fans, one stand-by, in the centre of the Beveren tunnel.
* **PP**:pumping installations for evacuation of water from leakage, run-off, etc were supplied by JV Bam Balteau. Five pump pits at tunnel level (one entry Beveren tunnel, one in Beveren tunnel, one ES03, one in bored tunnel, one ES12); 1 pump pit at ground level (receiving water from the pit in the bored tunnel); each pump pit has 2 - 4 pumps depending upon capacity.
* **Temporary lighting**: supplied by VMA.

Click here for the overview drawing of the rail line and the major engineering structures and be/20 for tunnelbuilder archive. Visit [www.bam.eu](http://www.bam.eu), [www.vinci.com](http://www.vinci.com), en.cfe.be/Homepage.aspx, [www.ahs.be/](http://www.ahs.be/), [www.cifa.com](http://www.cifa.com) and [www.ahs.be](http://www.ahs.be). 34/12.



Legend:

1-2 Zone along E34/N49 ; 2-3 Zone along R2 ; 3-4 Existing rail tunnel ; 5 Departure shaft drilled tunnel ; 5-6 Drilled rail tunnel ; 6 Arrival shaft drilled tunnel ; 7 Crossing R2