

Kære Søren Hansen, Rambøll

I forbindelse med delrapporten fra workshoppen om linieføringsundersøgelsen, vedrørende en østlig ringvej om København, fremsender vi yderligere dokumentation for økonomien i vor brug af Jacked Tunnels (box-jacking technique) under bl.a. Banedanmarks jernbanespor (Kystbanen, Farumbanen og Frederiksbergbanen), på vores strækning mellem Nordhavn Vest og Helsingørmotorvejen.

Denne teknik som bl.a. er brugt og dokumenteret i England, og som teknisk/økonomisk er inkluderet i vort OPP-Pilotprojekt Motorring 2 Øst, bevirker at omlægninger af Banedanmarks spor undgås.

Banedanmark har i nedenstående kommunikation fremhævet at:

1. ” forudsætter Banedanmark, at der arbejdes videre på at finde alternative løsninger der kan minimere generne for de mange passagerer.”
2. ”vi er af den opfattelse, at alternative udførselsmetoder og midlertidige afværgeforanstaltninger ikke er undersøgt fuldt ud. Alternative udførselsmetoder forudsættes belyst både trafikalt og teknisk.”

Vi har gennemgået nedenstående dokumenter og kan konstatere at der kan spares op til ca. 248 mio. kr., (Notat side 5 nederst). Dog, anvendes tallene på side 10 og 11, synes det samlede driftstab at være ca. 33,4 mio. kr., som betyder at besparelsen i stedet vil blive ca. 157,2 mio. kr., hvis man anbefaler vores linieføring i stedet for Københavns Kommunes forslag til Nordhavnsvejen.

1. Banedanmark høringssvar vedr. Nordhavnsvej af 14.04.2009, 4 sider.

Side 1 nederste afsnit delcitater: ” forudsætter Banedanmark, at der arbejdes videre på at finde alternative løsninger der kan minimere generne for de mange passagerer.”

Side 2 tredje afsnit. Delcitater: ”vi er af den opfattelse, at alternative udførselsmetoder og midlertidige afværgeforanstaltninger ikke er undersøgt fuldt ud. Alternative udførselsmetoder forudsættes belyst både trafikalt og teknisk.”

Side 3 femte afsnit. Delcitater. ” De i notatet ”Togafvikling i anlægsfasen” foretagne beregninger bør i den kommende proces opdateres til nyeste oplysninger.”

”Tallet er formentlig 4 gange så højt i dag!”

2. DSB Nordhavnsvej forslag til lokalplan og VVM redegørelse af d.8 april 2009, 3 sider.

Side 1 syvende afsnit: ”Notatet er vedlagt som bilag til nærværende brev, og det redegør detaljeret for konsekvenserne af sporspærringerne og for de nødvendige sporomlægninger, som de meget lange spærringer af togtrafikken medfører. **Disse konsekvenser medfører en række meromkostninger og indtægtstab for DSB, der er oplyst i notatet, og som vi forventer at vejprojektet dækker.**”

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3. DSB Notat, Nordhavnsvejenens etablering, trafikale konsekvenser og ændringer af togtrafikken af 8. april 2009, 11 sider + 2 bilag

Bemærkning om økonomi:
Side 10-11 samt side 4

A: S-tog driftsøkonomi	ca. 21,6 mio. kr.
B: S-tog anlægsøkonomi	ca. 50-70 mio. kr.
C: Kystbanen	ca. 11,8 mio. kr.
S-tog i sydsystemet, (side 4 nederst) vendespor	ca. 20,0 mio. kr.

I alt ca. 123,8 mio. kr.

Passagertal på S-banen, side 5 nederst:

” Det vil endvidere være langtidsvirkning heraf. Således viser erfaringer fra tidligere sporarbejder at der er en tilbagefaldstid på 3 år. Dette indgår ikke i ovenstående tal, men kan samlet set give anledning til lige så stort et tab som under sporarbejdet.”

Det vil sige at ovennævnte ca. 123,8 mio. kr. ved rigoristisk tolkning, skal fordobles til ca. kr. 247,6 mio. kr.

Dog, anvendes driftstabene på side 10 og 11, synes det samlede driftstab at være ca. 33,4 mio. kr., som betyder at besparelsen i stedet vil blive 157,2 mio. kr., hvis man anbefaler vores linieføring i stedet for Københavns Kommunes forslag til Nordhavnsvejen.

Side 7 nederste afsnit. Tidspunktet for spærringen.

Delcitat: **”Det vil derfor ikke være hensigtsmæssigt at gennemføre arbejderne før tidligst i 2013.”**

Vi regner med at dette skrift vil indgå som bilag i Rambølls og Cowis evalueringsrapport pr. 1. september 2010 til Transportministeren.

Hilsen

Peter Wimmelmann Larsen
Leif Lind
Søren Christiansen

Bilag: PS! Uden fotos.

Vedhæftet dokumentationsmateriale (New Civil Engineer 2003 Boxed In.doc) vedrørende box-jacking technique.

PS! Link til høringssvar (4 MB) fra Banedanmark af 14.04.09 (4 sider), høringssvar fra DSB af 8. april 2009 (3 sider) samt Notat fra DSB af 8. april 2009 (11 sider + 2 bilag) med indstregninger som foruden New Civil Engineer 2003 Boxed In.doc, som danner grundlag for denne skrivelse, er:

http://www.kobenhavnertunnelen.dk/Nordhavnsvejen_Banedanmark_DSB_140409+080409.pdf

New Civil Engineer 2003 Boxed In.doc
July 28, 2010

BOXED IN: Main contractor Edmund Nuttall has successfully completed the UK's first box jack under a live motorway. Weighing 3,500t, the 45m long concrete box is 8.5m high by 14m wide and will carry a new £6M dual carriageway link between two roundabouts on the A43 under the M1 motorway (NCE 12 December 2002). Box jacking was chosen by the Highways Agency instead of the much cheaper cut and cover method of construction to minimise disruption on the busy motorway. Carriageway settlement is

Box jacking on the M1 - first for UK

By Deane, Christine

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The box-jacking technique to construct a tunnel under a motorway has been used for the first time in the UK by contractors Edmund Nuttall at junction 15A of the M1 in Northamptonshire (see Figure 1). **This £6M project** has resulted in a vast concrete box being pushed through the motorway embankment to form a tunnel which will provide a second carriageway for the A43 route between Towcester and Northampton. **The box-jacking system has been previously employed under railways and on smaller roads, but considerable challenges were presented to the contractors for its use beneath a major motorway, used by over 112,000 vehicles each day, without causing disruption or closure. Although a cut-and-cover method of tunnel construction would have been easier and more economical to build, delays caused by a diversion scheme on the M1 could have cost up to £30M.**

Cofferdam construction

Work began in January 2002 with the construction of a sheet-piled cofferdam, 5m deep, 14m wide and 45m long at the bottom of the east side of the embankment into which a jacking box was excavated through many levels of glacial deposits (see Figure 2). Amongst these was a layer of solid rock formation requiring the construction team to auger some holes before piling could begin, delaying the project by some three weeks. The piles used ranged in height from 8m at the back of the cofferdam to 17.5m at the front where the load pressure was enormous due to the ground profile and the movement of heavy vehicles moving overhead. The piles were supported by a temporary modular propping system, while the 1.2m thick concrete jacking base with steel soffit plates was constructed on the floor of the cofferdam to provide cantilevered support for the piles. The modular system was used as an alternative to welded steel bracing and proved to be more economical and easier to install and remove.

IMAGE PHOTOGRAPH 1

Københavnertunnelen ApS

Figure 2: The cofferdam in which the jacking box was built.

IMAGE PHOTOGRAPH 2

Figure 1: The M1 Junction 15a box-jacking project is the first to be constructed beneath an operational motorway. It forms part of a £6M Highways Agency project to provide a dual carriageway section between two roundabouts on the A43, either side of the motorway.

Jacking box forms tunnel

Once the base was prepared, a reinforced concrete jacking box, 8.5m high x 14m wide x 45m long, weighing 3500 tonnes was constructed with a threestorey concrete tunnelling shield attached to the front (see Figures 3 and 4). This sliced into the embankment during the jacking process and enabled miners to work at the higher reaches of the tunnel face while excavators operated below (see Figure 5). Anti-drag ropes and anchorages were added and finally the jacking equipment was attached to the back of the box. **The box was jacked forward at approximately 100mm per hour for 24 hours per day and seven days per week resulting in the process being completed in three weeks with no disruption to the live motorway (see Figure 6).**

IMAGE PHOTOGRAPH 3

Figure 3: Pouring the box took place in three week intervals.

Figure 4: The motorway overhead was completely unaffected by construction of the box.

Figure 6: The completed box awaiting jacking.

Figure 7: The jacked tunnel breaks through.

The anti-drag and jacking system, developed and patented by consulting engineer, John Ropkins, uses hundreds of greased wire ropes, similar to those used on cranes. As the box was pushed through the ground, each anti-drag rope was attached at one end to an anchor on the east end of the embankment, with the other end loose inside the box. As the jacking proceeded, the ropes unravelled forming a layer between the box and the ground immediately above and below it. In this way, drag on the concrete was reduced and the ground was prevented from moving with the box as it was dragged through. A bentonite lubricant was also used to help the box slide through the surrounding pulverised fuel ash, glacial deposits and stiff clay ground. The ropes were left in-situ once the box was in place.

IMAGE ILLUSTRATION 4

Figure 5: The box-jacking system:

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- a) The jacking pit is excavated and the base of the device constructed.
- b) The box is constructed and the tunnelling shield fitted.
- c) The top and bottom, of the anti-drag system, using various ropes and anchors, is added.
- d) The jack is attached, which pushes the box at 100mm an hour.

Geotechnical settlement

As the box advanced, spoil was excavated from the tunnel face, which was angled slightly inwards to provide greater stability during excavation work. A large amount of the spoil material was later used to remodel the roundabouts on either side of the motorway. Long-term ground movement was prevented by back-grouting the box roof, walls and floor to fill any voids left by the small over-cut. One of the concerns following the jacking process was settlement of the motorway surface, anticipated to be about 50mm.

Only 1.5m separated the top of the box from the traffic above. Thus, prior to beginning the jacking process, the road construction was gradually built up by a 25mm maximum hump of blacktop asphalt to permit possible settlement caused by advancing excavation. However, ground conditions were found to be suffer than anticipated, so there was less settlement than expected. The motorway surface was monitored throughout the jacking process and this continued for six months following completion. The final part of the project involved building wing walls on the western side of the embankment, once the jacking box had emerged, remodelling the roundabouts and associated roadworks in order to make the new tunnel fully operational (see Figure 7).

Concluding remarks

The new road opened for use in Spring 2003 and was launched by a charity ball held in the box beneath the motorway called the 'Ball in the Box'. The M1 site is being used as a test case by the Highways Agency and if it proves successful, the box jacking system could be used on many sites around the UK motorway system. This project has been nominated for the Prime Minister's Award for Better Public Building, the result of which is due to be announced in October.

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