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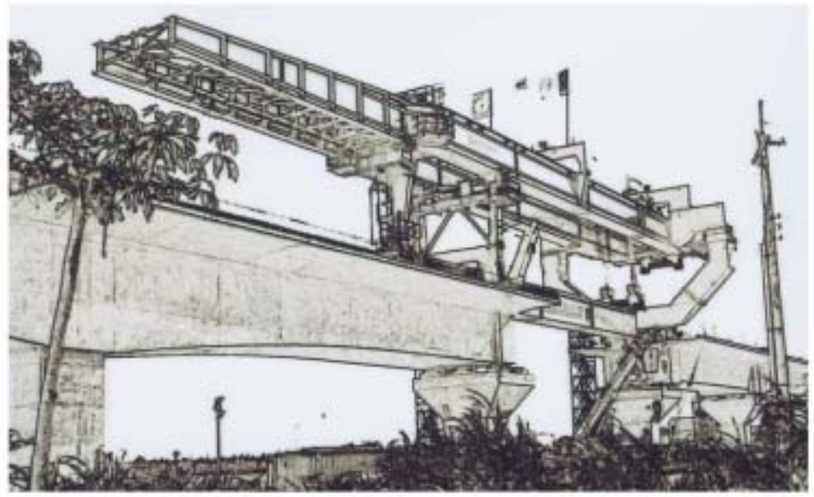
Joint Venture BB and CEC
Taiwan High Speed Rail Project C260 · C270

大陸工程股份有限公司和德商笛德營造股份有限公司之聯合承攬
台灣高速鐵路C260和C270標



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▲ Map of Taiwan indicating route of THSR Project and location of C260 & C270 Projects
台灣高速鐵路全線及C260標、C270標位置示意圖

THSR Contract C260 and C270

Taiwan High Speed Rail Corporation (THSRC) has awarded two contracts, C260 and C270, on a design and construct basis to the Joint Venture Bilfinger Berger AG and Continental Engineering Corporation. These two adjoining Contracts have a total length of approximately 80 kilometers and are located in the central section of the Island.

The northern most Contract, C260, starts just North of the city of Chang Hua, where the THSR enters the Paghuashan Mountain. The 14 kilometer route through the mountains region requires 7 tunnels, 13 bridges and numerous earthworks sections. The major element in this section of the works is the 7,359 meter long Paghuashan Tunnel - the longest tunnel in the THSR Project.

Progressing South from the mountain region the C260 project enters the western coastal plain of Taiwan and the structure changes to standard viaducts. The C260 viaducts run to the Cho Shue River where C270 starts and continues for a further 42 kilometers to the South.

The viaducts have been designed and are constructed using the full span pre-cast launching method with standard span lengths of 30 and 35 meters. Where this full-span method of viaduct construction is not suitable, different types of non standard bridges are required to be constructed by site shoring or balanced cantilever methods.

台灣高速鐵路工程C260和C270標

大陸工程股份有限公司和德商茵德營造股份有限公司聯合承攬承辦台灣高鐵公司的C260和C270兩標段工程之設計及施工。此兩標段座落於台灣本島的中部，縱貫彰化、雲林、嘉義三縣，總長約八十公里。

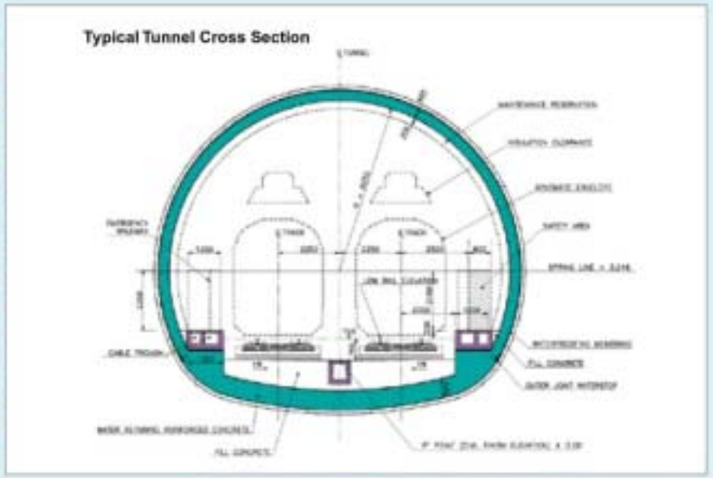
C260標自彰化市的北端進入八卦山區，在通過八卦山區的十四公里工程里程中，共有七個隧道、十三座橋樑及為數不少之土方工程。其中最主要的工程為長度七千三百五十九公尺的八卦山隧道，這個隧道也是高鐵全線最長的隧道。

在穿越八卦山區複雜的地形以後，工程進入台灣西海岸平原，同時結構型式也改變為標準的高架橋樑，C260標高架橋在濁水溪北岸銜接C270標，再向南延伸四十二公里至嘉義縣境。

這些高架橋採用跨距三十公尺及三十五公尺的全跨預鑄及吊裝方式施工，在不適用標準跨距的路段則採用場撐工法或是懸臂工法施工。

Project Characteristics	工程特點	C260	C270
Total Length	總長度	36,617 m	42,799 m
Pre-Cast Viaduct Length	預鑄橋樑長度	22,248 m	42,160 m
Number of Pre-Cast Spans	預鑄樑總數	678	1,264
Number of Non-Standard Bridges	非制式橋樑	21	11
Number of Tunnels	隧道	7	-
Tunnel Length	隧道總長度	9,141 m	-
Earthworks Length	路工總長度	3,168 m	-
Piling	基樁總長度	92,000 m	300,894 m
Concrete	混凝土	1,320,000 m^3	1,979,297 m^3
Reinforcing	鋼筋	185,000 t	344,393 t
Stressing	預力	6,700 t	10,209 t

The Tunnels



▲ Drilling works at Tunnel T3/6　T3/6 隧道鉆孔

▲ Bench and heading at Tunnel T3/2　T3/2 隧道頂拱及平台開挖

▲ Break through at Tunnel T1　T1 隧道貫通

The Tunnels

Contract C260 contains 7 tunnels with a total finished length of 9,141m. The longest tunnel - The Paghuashan Tunnel - at 7,359m long, is the longest tunnel on the whole of the THSR Project. All tunnels are constructed by the NATM method and have a full-face area of 132m^2. Three headings are used to excavate the tunnel face - top heading, bench and invert - with mesh reinforced shotcrete and lattice girders providing the temporary lining.

With over 1,000,000 m^3 of material already excavated, the tunnels are well ahead of program. The tunnel crews have continued to produce rates of advance that are above expectation and remarkable figures in excess of 10 meters per day on some drives has been achieved. The average rate of advance per drive through all ground - gravels, sands, silts and clays; with at times, high volumes of water inflow - is in excess of 5 meters per day.

After the final smoothing of the shotcrete surface, the water-proofing membrane is installed and the permanent concrete inner lining cast. The permanent lining involves placing over 300,000 m^3 of reinforced concrete into invert and vault forms. Five sets of formwork - each set 12m long - are to be used and it is expected that up to 60m of lining will be cast per day.

The permanent lining works are scheduled to commence in September 2002 and all tunnels are planned to be complete by the end of 2003.

隧道

C260標共有七座隧道，總長度為九千一百四十一公尺，其中最長的是七千三百五十九公尺的八卦山隧道，這也是整個高鐵工程中最長的隧道，隧道斷面積一百三十二平方公尺，採新奧工法施作。三個工作面同時展開，按頂拱、平台及仰拱依序施作，並以噴凝土搭配鋼絲網及輕型桁架作為臨時襯砌。

目前開挖土方數量已超過一百萬立方公尺，施工進度超過計劃進度。隧道工作團隊不只表現較預期進度好，某些工作面更曾達到每天前進十公尺的驚人速度，即使在湧水、多變化的惡劣地質情況下，仍能維持每天至少五公尺的進度。

開挖工作完成後，先在臨時襯砌的噴凝土面上鋪設防水膜，再澆置永久襯砌混凝土。永久襯砌混凝土數量共約三十萬立方公尺，預定使用五套活動鋼模，每套鋼模長十二公尺，以每天完成六十公尺為目標。

襯砌工作將於2002年9月開工，在2003年底前可完成全部襯砌工作。

The Viaducts

▲ Pre-cast span launching equipment　預鑄箱型樑吊裝設備

▲ Pre-cast span moulds in operation　內模及預組鋼筋籠吊運

▲ Standard bridge construction　完成吊裝的部份路段

The Viaducts

The J.V. has chosen the full span pre-cast launching method to construct the 64,400 meters of standard viaduct in C260 and C270. By using various combinations of the 2 standard span lengths - 30 and 35 meters - most site obstructions can be avoided. Where any obstruction requires a span length greater than 35 meters, a non standard bridge must be constructed.

The substructure of the viaduct consists of 2 meter diameter bored piles - 4 per pile cap, up to 60 meters long - a cast in situ reinforced concrete pile cap, rectangular reinforced concrete column and a reinforced concrete column head. In the north of C260 where the ground has no liquefaction potential, spread footings are used.

Each project has a pre-casting yard - C260 at Km 203 and C270 at Km 228 - where the standard spans are produced on a 2 day cycle from each mould. C260 has 3 moulds and 1 set of launching equipment, casting and erecting up to 9 spans per week and C270 has 5 moulds and 2 sets of launching equipment that can produce and erect up to 15 spans per week.

Both projects include the widened guideway work for a station. The stations themselves are to constructed by others, at a future date when there is sufficient passenger demand.

▲ C270 Pre-casting yard　C270 標預鑄場

橋樑

C260標和C270標合計有六萬四千四百公尺的路段，採用全跨預鑄吊裝工法施工，並以三十公尺及三十五公尺兩種跨距調整墩柱的位置，以避開既有道路、渠道或其他構造物。在跨距超過三十五公尺的地方，則以其他施工方法替代。

▲ C270 river crossing bridge　C270標跨越河川橋樑

高架橋之下部結構是由二公尺直徑的鉆掘樁組成，每個墩柱包含四支鉆掘樁，部分樁長超過六十公尺，在基樁上是一般鋼筋混凝土的樁帽，矩形墩柱及帽樑，C260標的北段因地質堅實，沒有土壤液化問題，直接採用擴腳基礎。

C260標在里程203K處以及C270標在里程228K處分別設置一座預鑄場，以每一外模生產週期為二天估算，C260標配置三套外模，一組運輸及吊裝設備，每週可以生產並吊裝九跨，而C270標則配置五套外模，二組運輸及吊裝設備，每週產能可達十五跨。

二個標段都包括一個車站的結構工程，車站本體不屬於本標段範圍，日後將由高鐵公司委由其他承商興建。

▲ C260 Incrementally launched bridge　C260標節塊推進橋樑

▲ C270 Balanced cantilever bridge　C270標平衡懸臂工法橋樑

▲ C260 non standard bridge, earthworks and tunnel portal　C260標非制式橋、路工及1號隧道南洞口

▲ C260 3 span continuous bridge　C260標三跨連續橋樑

Non Standard Bridges

Where obstructions are encountered that cannot be spanned by a standard span length a non standard bridge must be constructed. In the mountainous northern region of C260 non standard bridges are also used to cross the valleys to join the adjacent tunnels.

Generally for both projects, and depending on the situation, various types - simply supported constructed on site shoring, 3 span continuous constructed on site shoring, balanced cantilever, incrementally launched (C260 only) and composite steel deck structure (C270 only) - of non standard bridges are utilised. The longest non standard bridge is a 22 span incrementally launched structure and the longest single span is 85 meters constructed by the balanced cantilever method.

The non standard bridges adjoining the standard viaducts are constructed ahead of the erection of the standard spans and the bridges are designed to be passed over by the full span launching equipment.

非制式橋樑

由於地形阻礙或構造物影響，無法按標準跨距配置時，則用其他工法的非制式橋樑。在C260標北段非制式橋樑多跨越山谷，並連接兩端隧道。

根據現地不同的情況而使用各種不同工法的非制式橋樑一例如：場撐的簡支樑、場撐連續樑、平衡懸臂工法、節塊推進工法(C260)、鋼構合成樑(C270)等。最長的非制式橋樑有二十二跨，以節塊推進法施工。而最長的跨距達八十五公尺，以平衡懸臂工法建造。

在制式橋間的非制式橋，必須在預鑄樑吊裝前完成，以作為全跨吊裝設備通過之用。在設計非制式橋時所有制式橋節塊吊裝設備的重量對結構的影響都已仔細評估及計算，確保安全無虞。