

## ANALYSIS OF CONTRACT PROBLEMS AND SOLUTIONS FOR HSUEHSHAN TUNNEL

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### ABSTRACT

The 12.9 km long Hsuehshan Tunnel penetrating the precipitous Hsuehshan Mountain Range is the longest tunnel of the Taipei-Ilan Expressway. As a consequence of the special features, such as bad geology, complexity, enormous cost and so on, the construction time of the Hsuehshan Tunnel is about thirteen years. Since the construction procedure is tremendously difficult, certain part of the currently adopted contract is not well fit for the high-risk character of the tunnel project and therefore the original contract becomes an unreasonable and dissatisfied one. As a result, the contract problems usually cause dispute and affect the progress of the tunnel work.

The solutions of solving the contract problems for the Hsuehshan Tunnel are described in details in this paper. During the process of the tunnel construction works, the Project Office invites the contractor, the inspector, and the related engineering divisions to hold meetings for discussing and negotiating the contract problems from time to time. The most important part is that the Project Office has to discuss and negotiate with the contractor sincerely to settle the contract problems. Taiwan Area National Expressway Engineering Bureau (TANEEB) invites the famous specialist all over the world in tunneling to form the consulting board to examine the construction procedures and the contract management. The argument of the contract problems could be either referred to the Committee for Complaint and Mediation of the Public Construction Commission (PCC) or based on the arbitration regulations for the officially authorized procedure of adjudication. In this paper, the above mentioned solutions will be analyzed as an example of the studied case. The experience learned from the Hsuehshan Tunnel Project could be used to reduce the contract problems for the other tunnels. It is expected that the tunnel contract can improved to be fair and reasonable in the future based on this study.

**Keywords:** Contract problems, Hsuehshan Tunnel, Consulting board, Negotiation, Dispute, Arbitration

### FOREWORD

The Central Mountain Range, which is located middle through the Taiwan Island, makes transportation to be difficult between the Taipei City and the Ilan County. The Taipei-Ilan Expressway (TIE) Project is aimed at shortening the travel time between the two regions, thereby promoting economic development in the east Taiwan.

The 12.9 km long Hsuehshan Tunnel penetrating the precipitous Hsuehshan Mountain Range is the longest tunnel of the Taipei-Ilan Expressway. For the special features, such as bad geology, complexity, enormous cost and so on, the construction process, which started in July 1991, is extremely difficult. Since the actual construction time is much more than the contract construction time, certain part of the currently adopted contract is not well fit any more for the high-

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risk character of the Hsuehshan Tunnel Project and therefore the original contract becomes an unreasonable and dissatisfied one for the tunnel work. As a result, the contract problems always cause dispute and affect the construction progress of the Hsuehshan Tunnel Project. This paper studies the contract problems and makes brief statement for the solutions of the arguments. It is expected that the experience learned from the Hsuehshan Tunnel Project could be valuable for other tunnel projects in the future.

### GENERAL DESCRIPTION OF THE HSUEHSHAN TUNNEL

The Hsuehshan Tunnel of the Taipei-Ilan Expressway is situated between Pinglin, Taipei and Toucheng, Ilan. This tunnel cuts through the Hsuehshan Range in Northern Taiwan. The tunnel is located on a plate collision belt of the earth and therefore there are dense concentrations of faults and shear zones. The rock mass is fractured and contains an abundant amount of highly pressurized groundwater. The geological conditions around the Hsuehshan Tunnel are complicated and varied.

The construction contract was awarded in two separate Lots, Lot 4 and Lot 5. Lot 5 was the Pilot Tunnel Project. The Pilot Tunnel is a tunnel 4.8 m in diameter with the length of 12.9 km. The main purpose of the Pilot Tunnel is to provide geological investigation for the main Tunnels and also to serve as a working tunnel for conducting ground pre-treatments. After the completion of the Expressway, the Pilot Tunnel will serve as a passage for maintenance and emergency rescue access. The Pilot Tunnel Project was awarded to the Retired Soldiers Engineering Services Administration (RESA) in December 1990 following a price negotiation procedure. Construction work commenced in July, 1991. The construction period in the contract was 1,350 calendar days, and the Pilot Tunnel was anticipated to be completed on 25th March, 1995. The total cost of the contract was 2 billion NT dollars.

The project for the main Tunnels of the Taipei-Ilan Expressway constituted Lot 4 of the whole contract. This project was comprised of excavating two main Tunnels, each with diameters of 11.7 m and lengths of 12.9 km. The Hsuehshan Tunnel composes of two unidirectional tunnels, while each tunnel provides two driving lanes. The distance between the centers of the

two tunnels is 60 m. There are 28 connecting pedestrian passages, 8 traffic connecting passages, and 3 separate ventilation shafts equipped with machinery rooms and communicate stations. At the Toucheng End, there is a suspension bridge that connects the Toucheng Section of the Expressway with the Toucheng-Suao Section of the Expressway. The main Tunnels project was also awarded to the Retired Soldiers Engineering Services Administration (RESA) in May 1993 following a price negotiation process. Construction work commenced in July 1993. The construction period in the contract was 2,250 calendar days, and it was anticipated to be completed on 19th September, 1999. The total cost of the contract is 18.5 billion NT dollars.

The Hsuehshan Tunnel passes through a number of geological formations, which are quite different in their characteristics and overwhelmed with numerous shear fractures. About 10 km long of the tunnel is located within the protection area of the Taipei Water Resources Protection Area. The tunnel essentially deals with the problems of long-lasting construction period, too many working sites, shortage in experienced workers, pollution of the water resources, and severe obstruction to the traffics. Therefore, the conventional drill and blast method of tunneling would not be suitable for this project. In order to trim down the construction time, to minimize the environmental pollution, to shrink the labor demand, and to upgrade the domestic tunneling techniques, it was decided that a Tunnel Boring Machine (TBM) should be employed, for the first time in the history of construction technology in Taiwan. For a short section beginning at the east portals, the blast and drill method is employed to deal with poor ground conditions and to gain progress while the TBM are being purchased, designed, manufactured, and delivered. After the TBM are delivered to site, the rest of the tunnel would be excavated by TBM from Toucheng (east) portals and moving westward to Pinglin. Under this arrangement, the first 1000 m of the Eastern Portal Section, and the first 150 m stretch at the Western Portal of the Pilot Tunnel would be excavated through drill and blast method, while the rest of the tunnel would be excavated by the TBM. The Lot 4 construction planning philosophy was similar to that of the Pilot Tunnel philosophy. The first 800 m of the Eastern Portal and the first 150 m of the Western Portal would be excavated by the drill and blast method. Figure 1 presents the original construction plan for the tunnels. In addition, the Hsuehshan Tunnel would be excavated by TBM heading from the east towards the west.

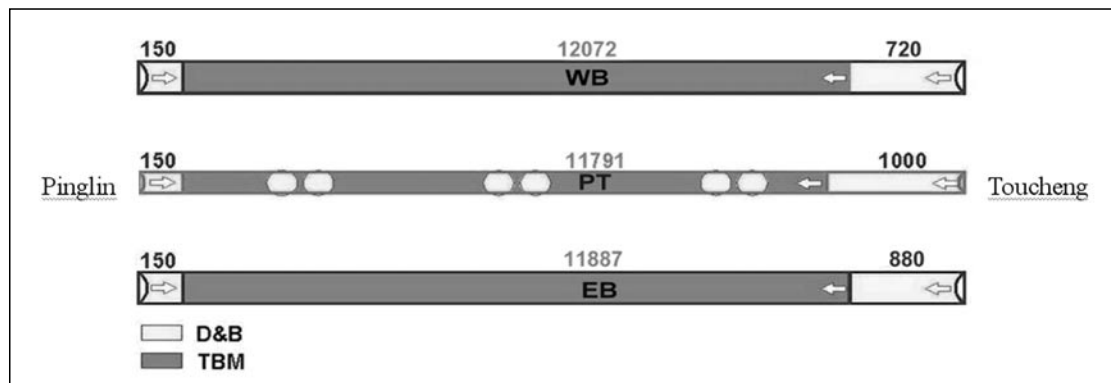


Figure 1 The Original Construction Plan

### THE CONTRACT PROBLEMS

The construction process of the Hsuehshan Tunnel started in July 1991 while the entire excavation operation of the Hsuehshan Tunnel was completed in September 2004. Because of the bad geology and highly pressurized groundwater, the process of construction work is extremely difficult. The actual construction period is about thirteen years. As a result, certain part of adopted contract is not well fit for the high-risk character of the Hsuehshan Tunnel and thus the original contract becomes an unreasonable and dissatisfied one to the tunnel work. According to the above mentioned situation, there are some contract problems encountered within the construction period described as follows.

#### The Execution of the Original Plan Being Dissatisfactory

From July 1991 to December 1998, the execution of the Hsuehshan Tunnel construction work followed the construction plan failed to meet the time table in the contract. Geological conditions at the Eastern Portal of the Hsuehshan Tunnel were quite poor. The excavation of the Tunnel, either by the drill and blast method or by the TBM had been overwhelmed with difficulty, and the excavation operation was drastically behind schedule.

Excavation commenced at the eastern portal of the eastbound in August 1991, and the drill and blast method was used in the beginning. Excavation of the Pilot Tunnel by the TBM began in December 1992. By September 1996, the total length excavated by TBM was 1,080 m only. During this period, the TBM was trapped or stalled ten times in total. Rescue operations

took about one to three months for each of the first eight trappings, whereas the last two incidences required more than 10 months. They were all accompanied by great quantities of instantaneous groundwater influxes up to a maximum of 185 l/sec. After the ten incidences of the TBM being trapped, the next 1,500 m extension within the Pilot Tunnel from where the TBM was stalled at the 10th trapping, which was at Sta. 39K+079, adopted the drill and blast excavation method, which the contractor was most familiar with. Consequently, a detour tunnel was excavated to gain access to the front of the TBM, and excavation of the tunnel reverted back to the conventional drill and blast method. The first half of the detour tunnel was the site of the trapped TBM. The geological conditions were quite undesirable. Furthermore, the rock mass at the site was severely disturbed as the result of numerous cave-ins and collapses during excavation of the Pilot Tunnel and excavation of the detour tunnel. There was also a threat from the large quantity of groundwater influx. Thus, the excavation of the tunnel was divided into three sections: the top-heading, the benches and the invert, and they were excavated in sequence. From March 1997 to December 1998, a total length of 223 m was excavated in the detour tunnel.

Excavation of the main Tunnel commenced at the eastern portal of the westbound in August 1993, and the drill and blast method was used initially. By April 1995, a total length of 732 m was excavated. The French firm Spie Batinolles entered the Tunnel site in May 1996. In September 1996, as the TBM was ready for launching, the Spie Batinolles claimed that excavation work in the Main Tunnel by the TBM might be ahead of the advances in the Pilot Tunnel. Hence there were risking geologic hazards which were not contained in

the contract, and then requested increase in payment. If their request were refused, the Spie Batinolles would cease to work. Following much negotiation process, RESA expelled the Spie Batinolles from the work site because of contract violations. Excavation by the TBM was taken over by the RESA. By July 1997, a total length of 653 m was excavated in the eastbound. During this period, the TBM was trapped down two times. Rescue operations took about five months for the two trappings. In view of the difficulty encountered in the Pilot Tunnel when excavating the site of the Shanghsin Fault, the Eastbound TBM stopped when it approached the Shanghsin Fault. The top-heading cut was constructed first, and the incompetent rock mass was removed. The top-heading cut was then supported while the lower half of the cross section was excavated by TBM. From July 1996 to July 1998, a total length of 469 m was excavated in the western portal of eastbound.

Excavation commenced at the east portal of the westbound in August 1993, and the drill and blast method was used first. By April 1995, a total length of 893 m was excavated. The westbound TBM excavation began in May 1996. By December 1999, the total length excavated by TBM was 456 m. The TBM was trapped ten times during this period of operation due to undesirable geological conditions. Rescue operations took about seven months for the first nine trappings. In December 1997, the TBM reached Sta. 38K+902.5 and it encountered an influx of great quantity of groundwater. The Tunnel was buried by rock debris that was brought into the tunnel by the vast quantity of water. The length of the section of the tunnel that was buried was 90 m, and the total volume of cave-in material was 7,000 m<sup>3</sup>, the maximum instantaneous water influx reached 750 l/sec. The TBM was crushed in the disaster. Technicians from the manufacturer of the TBM inspected the damaged TBM and estimated that it would take three years to repair the TBM at a cost of more than the cost buying a new unit. The contractor made a detailed evaluation, and made a recommendation proposing that the TBM be dismantled. The contractor also recommended conducting drill and blast excavation for the entire remaining length of the tunnel.

#### **High-Risk Character of the Hsuehshan Tunnel Causing the Difficulty to Insure**

According to the General Provisions 0715 specification,

the contractor shall, prior to commencement of the work, insure the Contractor's All Risks and The Third Party Liability for carrying out the work. The ceilings on the deductibles for the Contractor's All Risks insurance shall be as follows :

- (a) For roads, New Taiwan Dollars 20,000.
- (b) For bridges, New Taiwan Dollars 30,000.
- (c) For tunnels, New Taiwan Dollars 60,000.
- (d) For others, New Taiwan Dollars 30,000.

After signing the contract for the Pilot Tunnel, the contractor tried to buy insurance with three insurance companies, including the Taiwan, the Friendship, and the Central Products. The period for insurance expired on May 14, 1995. Because the accident risk of the TBM from danger was excessively high, the insurance companies were not willing to renew the insurance contracts even under many discussions and arrangements. The contractor discussed and made special arrangements again with the Taiwan Product Insurance Company with some adjustments on the insurance contract content. However, the contract stipulation is not conformed to the original one. Therefore, it is unable to completely renew the insurance contract after the adjustments on the content. The contractor also wanted to sign with the insurance company for the insurances of the Third Party Liability and the Employer Accidental Responsibility to reduce construction risk. After requesting by correspondence to the National Engineering Insurance Council for assistance, the contract content and the expense is still unable to reach an agreement with the insurance company. Hence, the contractor decided to insure the conventional drill and blast method of tunneling only. However, only the Min-Tai Product Insurance Company quoted price. Considering the insurance condition was not conformed to contract requirements and the insurance cost was way too high, the procedure for insurance was not completed at the end.

After signing the contract for the Hsuehshan Tunnel, the contractor offered 4 times of explanations and 6 times of price biddings, there was still no insurance company having the wish to provide insurance service. Even there were some willing insurance companies, they asked for high cost that made situation hard to reach the settlement. After requesting by correspondence to the National Engineering Insurance Council for assistance, the insurance procedure was still not completed. The contractor only reached the agreement with the insurance company for the Employer Accidental Responsibility,

the Third Party Liability, the All Risks on Roads and Bridges, and the TBM Installment Machinery to reduce as much risk as the insurance company would provided. The contractor raised the plan for dealing with the construction disasters, but it failed to achieve the mutual recognition with the owner.

#### **Currently Adopted Contract Unable to Fit or to Conform to the Tunnel Work**

- (1) In order to require the contractor to improve the progress of tunnel work, the General Provisions 0801(1)d specifies the penalty as follows : If, in the opinion of the engineer, progress of any work on a critical path has been delayed in sixty days in the aggregate for causes attributable to the contractor, the engineer shall so notify the contractor in writing. Any continuing delay in such work beyond ninety days will entitle TANEED to withholding of the monthly payment due to the contractor under the contract. But the specification usually causes the financial problem of the contractor.
- (2) The construction contract of Lot 5 did not have the maximum limit of liquidated damages for delay. the General Provisions 0728 ( 1 ) specifies the amount of liquidated damages for delay as follows: If the contractor fails to complete construction of the work within the time limit for completion stated in the agreement or on or before the day of expiry of any extended time, then the contractor shall pay to TANEED a sum as liquidated damage for delay, calculated at the rate stated in Appendix A to the tender form as liquidated damages for such default for every day which shall elapse between the time stated in the agreement ( or date of expiry of any extended time ) and the date of completion of construction of the work. In addition, the General Provisions 0728 ( 2 ) specifies the entitlement of liquidated damages for delay as follows: Any such sum or sums shall be payable by the contractor or deducted from any monies due or to become due to him, or disbursed from his performance bond, and shall be enforceable by the sole fact of the delay without legal or other formality and without proof of damage.
- (3) The Particular Provisions 0804(5) of Lot 4 specified the time control point. However, it is not conformed to the actual demanding since the construction techniques have been changed. The time control

table of Lot 4 is no longer effective since the actual construction progress is far behind of the progress expected by the original contract.

- (4) The Particular Provisions of Lots 4 and 5 specifies the qualifications for the foreign technicians. The qualifications are not agreed with the actual conditions and totally out of date. Based on the Special Provision T-3-06.3.b of Lot 5, it is specified that, "... The contractor can educate their workers to be familiar with the operation and maintenance of the drill machinery. However, the contractor has to consider the situation that for the first 3 km, they are supposed to hire the operating leader with 10 years hard rock cutting experiences on the operation and maintenance of the drill machine. In addition, for each group of operation and maintenance, they must hire some experienced technicians on operation and machinery." Furthermore, based on the Special Provision 04503.1.H, it is specified that, "... Ahead of the drill digging machine get into in the tunnel and during the excavation for the entire period, the contractor must hire a manager engineer who contains at least 8 years experience on the digging machine. This construction manager of the project should have solid service experience to take charge of the responsibility for the project preparation, the personnel arrangements, the construction technology information support, the construction technique improvement, the instruction abnormal circumstance and so on. ...The expense of the concerned engineer contains in the drill digging machine unit price, counts the price and not consider paying in addition."

Taking the Lot 5 as an example, the original contract time limit for the project only takes 45 months (1,350 days) to complete 12 kilometers. Therefore, the contract stated that the overseas operation group could not execute the drilling more than 3 km by taking the TBM. The purpose of the limitation is to train our own workers to be familiar with drill digging machine operation and the maintenance, as well as the transferring the operation technology into our country. Therefore, in the drill digging item of the tunnel project, the original design only consider overseas operation group to operate about 12 months calculating by proportional budgetary estimation. However, the cost of the drill digging machine, including the actual TBM operation, is incredibly over the original estimate. This is the result that the construction time far behind the

scheduled time of the original design plan because of the geological influence. The unexpected situation brings out the argument that the legibility consideration for paying the extra imbursement to the contractor. On the other hand, because the RESA has been operating the TBM for a long time, the employers should already be familiar with the TBM operation and maintenance. The contract that specifies the first 3 km for the overseas operation group appears to be out of time.

### SOLUTIONS

After the finalization of the bidding process for the Lots 4 and 5, the TANEEB assigned the Third Project Office and the Toucheng Site Office to charge the supervisory duty for the fulfillment of the contract and the investigation of the construction work. In order to ensure the smooth operation for the Hsuehshan Tunnel contract, The TANEEB picked the RESA to be the contractor with considering their plentiful tunnel construction experiences. Furthermore, The TANEEB assigned directly the Sinotech Engineering Consultants, which has accomplished the designing work for this project, for the first line supervisory duty. The construction period of the Hsuehshan Tunnel started from July 1991 of commencement for the Pilot Tunnel to September 2004 of the totally passing through the main Tunnels. During this period, the supervisory consultant, the Toucheng Site Office, and the Third Project Office always base on the contract documents (including General Provisions, Technical Provisions, Special Provisions, Design drawing, Unit price listing in the Tender, Construction drawing, Construction proposal and so on) to fulfill the contract management. Aiming at the problems encountered with the contract management, the solutions are described as follows.

(1) During the process of the works, the Third Project Office invites the contractor, the inspector, and the related engineering divisions to hold meetings for discussing the contract problems from time to time. The most important part is that the Project Office has to negotiate with the contractor sincerely to settle any contract problems. With mutual agreement from both sides, The Hsuehshan Tunnel Project can be executed smoothly. Furthermore, under mutual agreement, treatment of construction improvement, lengthening of the construction time, and adjustment of the contract content can be more easily achieved administratively. During the construction period of the Hsuehshan Tunnel,

which started from July 1991 of commencement for the Pilot Tunnel to July 2004 of finishing, there are totally 11 times of design changing, increasing the amount of contract for 1.1 billions NT dollars, and lengthening of the construction period for 3405 days. During the construction period of the Hsuehshan main Tunnels (Lot 4), which started from July 1993 of commencement to September 11, 2005 estimated at the moment, there are totally more 60 times of design changing, increasing the price of contract for 3.5 billions NT dollars, and lengthening of the construction time for 4434 days for now.

- (2) TANEEB invites the famous specialist in tunnel all over the world to form the consulting board to examine the construction procedure and the contract management. There are 8 meetings of the consulting board formed by overseas and national experts. According to the conclusions and suggestions of the meetings, the construction procedure and the construction plan have been adjusted and corrected.
- (3) After negotiating with the contractor sincerely, if there is still any disagreement unable to be settled, the argument of the contract problems could be either referred to the Committee for Complaint and Mediation of the Public Construction Commission or based on the arbitration regulations for the officially authorized procedure of adjudication. There are 17 arguments sent to the Committee for Complaint and Mediation or adjudication for the Lots 4 and 5 of the Taipei-Ilan Expressway. The total amount paid to the contractor based on the judgments is 3.4 billion NT dollars so far.

Relies on the above mentioned ways, the solutions of the previous stated contract problems are as follows:

#### Revised Construction Plan

Because of the serious delay of construction work and the bad damage of TBM in westbound of the Hsuehshan Tunnel, an advisory consulting board meeting was called again in January 1999. In accordance with conclusions and recommendations made at the board meeting, the contractor, based on past construction experience and with reference to the actual geological conditions revealed by tunnel excavation, formulated an "Overall Improvement Plan" for submission. The "Overall Improvement Plan" was reviewed by an ad hoc committee under the Public Infrastructure Construction Engineering Commission. The commission ruled that the construction would be increased by means of contract modification. The date of

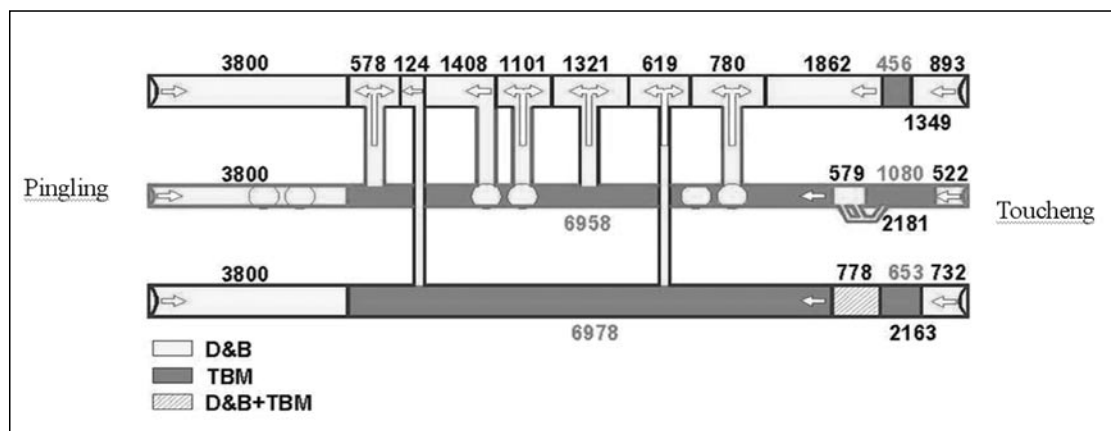


Figure 2 Overall Improvement Plan

completion for the Tunnel was set to be June 2003 when the Tunnel would be opened for traffic. This ruling was approved by the Executive Yuan. The contents of the "Overall Improvement Plan" (shown in Figure 2) are briefly presented as follows:

- (a) The East Portal of the Eastbound tube shall continue excavation through a top-heading adit to remove poor quality rock mass. The estimated length to be excavated is 628 m. Full face excavation by TBM will be resumed depending on the geological conditions of the ground.
- (b) The TBM at the East Portal of the Westbound tube will be dismantled. The entire alignment of the Westbound tube would be excavated by the drill and blast method. When condition is allowed, additional work faces, via access through the Eastbound tube and traffic cross-connections, will be added.
- (c) A detour tunnel will be excavated in the section at the site of the 10th time the TBM was trapped in the Pilot Tunnel to reach the front of the TBM to perform TBM rescue work. Excavation will be continued by the drill and blast method from this point onward. The TBM will resume excavation when fully repaired.
- (d) At the West Portals of the main Tunnel and the Pilot Tunnel, excavation through drill and blast will be continued and extended to 3.8 km.
- (e) Additional work faces going at both directions will be opened in the Westbound tube to perform 2.5 km of excavation.
- (f) Additional work faces, via access through the Pilot

Tunnel, ventilation shafts and ventilation relay stations, will be opened in the Westbound tube when conditions allow.

- (g) Additional work faces, via access through the Eastbound tube of the main Tunnel and traffic cross connections, would be opened in the Westbound tube.

In the Overall Improvement Plan, the Hsuehshan Tunnel was scheduled to be opened for traffic in June 2003. However, up to December 2001, excavation advances for the Pilot Tunnel and the Eastbound and the Westbound tubes of the main Tunnel were lagging way behind schedule. There were only 50% completed, respectively. It was ascertained following evaluation that the Tunnel would not be opened for traffic in June 2003. An advisory consulting board meeting on the Hsuehshan Tunnel of the Taipei-Ilan Expressway, comprised of experts and scholars, both domestic and foreign, was called again in December 2001. The recommendations and conclusions of the board meeting were that as many additional work faces as was feasible should be set up to speed up the overall progress of the construction. In early 2002, the Public Infrastructure Construction Engineering Commission of the Executive Yuan called a special meeting on the Hsuehshan Tunnel engineering plan. The meeting concluded that the client, contractor and the supervisor should jointly draft a plan for further execution of the project. A team composed of representatives from the client, the contractor and the supervisor then followed the conclusions obtained in the special meeting. Based on past construction experiences, this team then drafted a revised set with poor geological conditions for

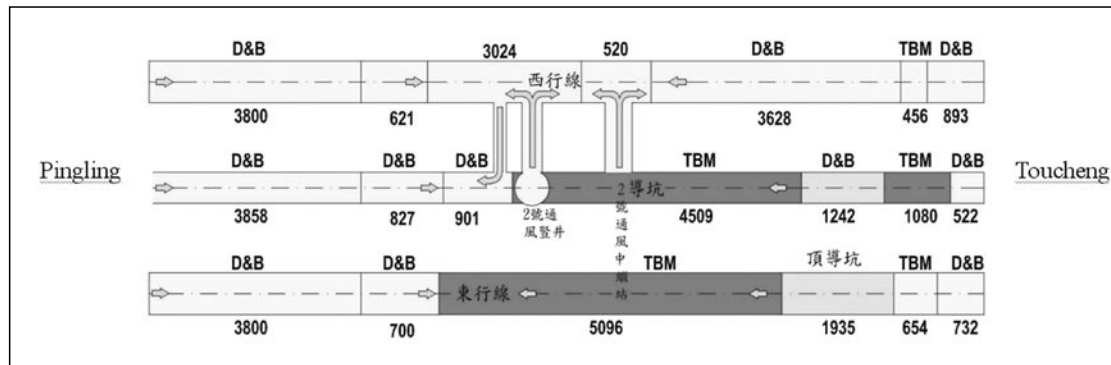


Figure 3 Revised Overall Improvement Plan

submission. A new completion date was projected for 2005. The submitted draft, as shown in Figure 3, was approved by the Executive Yuan, and contained the following points of importance:

- The TBM excavation rate was adjusted: the excavation rate in the Pilot Tunnel would be 300~450 m/month; in the main Tunnel, 150~200 m/month.
- By way of Vertical Shaft #2, in the Pilot Tunnel, a work face would be opened in the direction of Pingling. In the case of the East Portal, the TBM work was less than satisfactory, and a work face should be added in the direction of Toucheng.
- The excavation section at the West Portal of the Pilot Tunnel using drill and blast was to be extended 0.8 km more than the original length of 3.8 km.
- The drill and blast excavation operations at the West Portals of the Eastbound and Westbound tubes were to be extended 0.9 km and 0.5 km respectively on the original 3.8 km length.
- Perform supplementary excavation to 1.1 km in the Eastbound tube through access via the Westbound tube. Through the top-heading method, remove the 150 m length of poor ground to facilitate TBM excavation.
- Continue excavation through the top-heading method at the East Portal of the Eastbound tube. Resume TBM excavation when rock mass quality improved.
- Open an additional work face for drill and blast excavation in the Westbound tube via the Westbound tube and the relay station of the #2 Ventilation Shaft. Perform supplementary excavation for 528 m.

#### Adopting Tunnel Risk Sharing Mechanism

In view of not meeting the agreement for the All Risk insurance, the contractor referred to the Committee for Complaint and Mediation of the Public Construction Commission, Executive Yuan. The outcomes are described as follows:

- Increasing contractor's deductibles to the amount of 5 million NT dollars for each accident.
- Increasing the listing items not insured excluding the All Risk, the Finance Loss of Construction Engineering, and the Third Party Liability.
- Increasing the maintenance, tunneling, ongoing insurance, additional repair payment. Adding the additional items for using, connecting, and acceptance.

Subsequently, the contractor based on the mediation result to invite public bidding three times but still failed to get done with any insurance company. Furthermore, the contractor brought up only the drill and blast method, which is considered to be lower risk by the insurance company, for inviting tenders two times, but was unable to find any insurance company all the same. Therefore, the contractor requested to the Committee for Complaint and Mediation of the Public Construction Commission again for assistance to solve construction All Risk insurance matters. Following the agreement after the mediation, the tunnel disaster risk is shared by the mechanism described as follows:

- If the amount of disaster damages is lesser than 5 million NT dollars, the contract takes the responsibility. When the amount of disaster damages is higher than 5 million NT dollars, the owner and the contractor should gather to form the judgment committee to make the decision for sharing the



proportion according to individual case.

- (b) Judgment mechanism is established by a group with 5 members from the Ministry of Transportation and Communications, the TANEED, and the RESA. If any side contains disagreement on the result, it should be referred to the Committee for Complaint and Mediation of the Public Construction Commission.
- (c) Excluding the All Risk insurance for the construction, the insurance items specified on the original contract, such as the Third Party Liability, Maintenance Period Guarantee and so on, need to be insured as the same.

#### **Partially Modifying the Content of the Original Contract**

- (1) Signs the contract changing agreement under the mutual permission, deletes the original contract General Provisions 0801(7)d specified the penalty and adds the General Provisions 0801(7)e specified the imbursement as follows: "All the actions made to compensate the delay with increasing expense should be responsible by the contractor if the delay can be counted as the error of the contractor."
- (2) Signs the contract changing agreement under the mutual permission, adds General Provisions 0728(1)d into the original contract as follows: "If the contractor cannot finish the construction work by the deadline described in the contract or the lengthened date of the expired time for the project, then the contractor should pay the delay fine to the TANEED. The amount of the fine is calculated based on the bidding explanation in the contract's appendix A to compute the amount and the delay day. The amount of the delay days is the difference between the actual finishing date and the date assigned by the contract (or the postponed expiring date). Unless there is any special specification in the contract, the total fine amount should not more than 20% of the bidding price stated in the original contract." In addition, General Provisions 0728(2) was added into the original contract as follows: "This category of fine is compulsory and need not to be approved by the law or other procedures. Once the TANEED identifies the fact of delay after the final count for the finished construction, the contractor should pay the fine immediately. Otherwise, the TANEED can take off the amount from the payment to the contractor or get

it from the deposit."

- (3) The Particular Provisions 0804(5) of Lot 4 specified the time control point. However, it is not conformed to the actual demanding since the construction techniques have been changed. The time control table of Lot 4 is no longer effective since the actual construction progress is far behind of the progress expected by the original contract. Except a few time control points being retained because of completing already, the other time control points have been modified in the Overall Improvement Plan.
- (4) Signs the contract changing agreement under the mutual permission, deletes the Special Provision 04503.1.H in the original contract of Lot 4 and the Special Provision T-3-06.3.b in the original contract of Lots 5. Besides, adds the Special Provision 04503.1.H and the Special Provision T-3-06.3.b into the contract as follows:
  - a. Under the principle that the contractor takes the responsibility for construction risk and performance result, the contractor should arrange the supervisor for the TBM construction, the site representative of the TBM, and an adequate amount of operators and technicians during the whole period of the TBM operation.
  - b. The supervisor for the TBM takes charge of construction preparation, personnel arrangements, construction technology information support, construction technique improvement, instruction abnormal circumstance and so on.

#### **DISCUSSIONS AND RECOMMENDATIONS**

The difficulties such as geological conditions and highly pressurized groundwater, encounter with the new technique and the new machines, are unable to be handled completely well during the stages of planning and designing. The tunnel project should adjust the original construction plan during the construction stage for the actual situation at the right moment in order to obtain the maximum economic efficiency and fulfill the contract management smoothly.

Because of the high risk character for tunneling, the relative insurance correlation regulation (e.g., contractor's deductibles) and the insurance expense should take into consideration for adjustment during the planning and the designing stages.

During the process of execution contract management,

the owner, the inspector, and the contractor are considered to be a construction team. Whenever the unexpected problems come out during the construction stage, the whole team has to discuss and negotiate sincerely to find the solutions for construction improvement and administration treatment. Even though the mutual disagreement can not be achieved, the most important thing is still to execute the project smoothly. The arguments of the contract problems could be either referred to the Committee for Complaint and Mediation of the Public Construction Commission (PCC) or based on the arbitration regulations for the officially authorized procedure of adjudication.

#### REFERENCES

- \* Contract Agreement of the Taipei-Ilan Expressway Project Lot 4 and Lot 5.
- \* Standard Construction Specification-General Provisions (1987 and 1991 Editions).
- \* Special Provisions of the Taipei-Ilan Expressway Project Lot 4 and Lot 5.
- \* NIE Advisory Board (1999), Taipei-Ilan Expressway-Pinglin Tunnel Project, Record on Consulting Board Meeting NO.6.
- \* NIE Advisory Board (2001), Taipei-Ilan Expressway-Pinglin Tunnel Project, Record on Consulting Board Meeting NO.7.