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CITE: (U) (b) (2)

SERIAL: (U) (b) (2)

COUNTRY: (U) NORTH KOREA (KN).

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SUBJ: (b) (2) NORTH KOREA PLANS TO DESIGN AND
BUILD UNDERGROUND STRUCTURES WITH LARGE CROSS SECTIONS (U)

WARNING: (U) THIS IS AN INFORMATION REPORT, NOT FINALLY EVALUATED
INTELLIGENCE. XXXX XXXXXX XX XXXXXXXXXXXX XXXXXXXXXXXXXX.

DEPARTMENT OF DEFENSE

DOI: (U) 20061104.

REQS:

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SUMMARY: (U) NORTH KOREA PROBABLY DEVELOPED NUMERICAL MODELS USED TO
DESIGN UNDERGROUND STRUCTURES WITH LARGE CROSS SECTIONS AND IMPROVED
METHODS TO CONSTRUCT UNDERGROUND FACILITIES. ENCLOSURES

TEXT:

1. (U) THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA (DPRK) RESEARCHERS
DEVELOPED NUMERICAL MODELS USED TO DESIGN UNDERGROUND STRUCTURES
WITH A LARGE CROSS SECTION. ANOTHER RESEARCHER DEVELOPED A METHOD
TO CONSTRUCT THE SIDE WALL OF UNDERGROUND FACILITIES WITH A LARGE
CROSS SECTION. A PANORAMIC SKETCH OF THE P'YONGYANG METRO
CONSTRUCTION DEMONSTRATED THESE TECHNIQUES.

2. (U) DESIGNING OF UNDERGROUND FACILITY (b)(7)(E)

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IN DECEMBER 2006 DPRK SOURCE PUBLISHED A RESEARCH PAPER ABOUT DESIGNING AN UNDERGROUND FACILITY.

- AUTHORS --

- ((CHO'NG)) PYO'NG-HO, P'YONGYANG RAILWAY COLLEGE
- ((KIM)) CHONG-WO'N, CHO'NGJU RAILWAY VOCATIONAL TECHNICAL SCHOOL

- TITLE -- METHOD FOR EVALUATION OF ROCK MASS STABILITY WHEN DESIGNING UNDERGROUND FACILITY WITH LARGE CROSS SECTION

- SUMMARY -- RESEARCHERS DEVELOPED NUMERICAL MODELS TO ANALYZE THE STABILITY OF ROCK MASS AROUND AN UNDERGROUND FACILITY WITH A LARGE CROSS SECTION. THEY USED PLASTIC MODELS TO ANALYZE ROCK MASS LOCATED A DISTANCE FROM THE LINING OF THE UNDERGROUND FACILITY. THE PLASTIC MODELS INCLUDED DRUCKER-PRAGER, VON-MISES, AND MOHR COULOMB NUMERICAL MODELS. THESE PLASTIC MODELS WERE MATHEMATICAL MODELS DESCRIBING THE RESPONSE OF ROCK MASS TO SHEARING STRESS AND COMPRESSIVE STRENGTH. THE RESEARCHERS USED THE MOHR-COULOMB NUMERICAL MODEL THAT THEY UPGRADED TO ANALYZE ROCK MASS NEAR THE LINING OF THE UNDERGROUND FACILITY. AS A RESULT, THEY PROVED THAT THE COMPRESSIVE STRENGTH OF ROCK MASS CONTINUITIES AND THE SHEARING STRESS OF THE DISCONTINUITIES AROUND THE UNDERGROUND FACILITY COULD BE VERIFIED BY THESE NUMERICAL MODELS.

3. (U) METHOD TO CONSTRUCT SIDE WALL OF UNDERGROUND FACILITY (b)(7)(E)

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IN DECEMBER 2006 DPRK SOURCE PUBLISHED A RESEARCH PAPER ON DEVELOPMENT OF A METHOD TO CONSTRUCT THE SIDE WALL OF AN UNDERGROUND FACILITY.

- AUTHOR -- ((O)) SO'NG-CH'O'L, P'YONGYANG UNIVERSITY OF CONSTRUCTION AND BUILDING MATERIALS, P'YONGYANG

- TITLE -- METHOD TO CONSTRUCT REINFORCED CONCRETE SIDE WALL OF UNDERGROUND FACILITY WITH LARGE CROSS SECTION

- MATERIALS --

- FORMS -- 2,000 MILLIMETERS (MM) LONG, 2,750 MM WIDE
- ANCHOR BOLTS -- 1,200 MM LONG, 30 MM IN DIAMETER
- REINFORCED CONCRETE -- VERTICAL REINFORCEMENTS, 16 MM IN DIAMETER, HORIZONTAL REINFORCEMENTS, 14 MM IN DIAMETER (b)(7)(E)

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- CONSTRUCTION PROCEDURES --

- O SO'NG-CH'O'L INSTALLED ANCHOR BOLTS IN ROCK MASS TO A DEPTH OF 900 MM AND FIXED THE ANCHOR BOLTS BY THE END TO THE FORM. THE FORM WAS LOCATED 300 MM FROM THE ROCK MASS. THE LENGTH OF THE ANCHOR BOLTS WAS 1,200 MM. NEXT, HE FASTENED THE REINFORCED GRID WITH ANCHOR BOLTS AND COLUMNS. THE GRID SPACE WAS 200 MM WIDE AND 300 MM LONG. NEXT, CONCRETE WAS CAST BETWEEN THE ROCK MASS AND FORMS. WHEN THE CONCRETE SPECIFIED DESIGN STRENGTH REACHED 50 PERCENT OR MORE, THE FORMS WERE REMOVED FROM THE SIDE WALL. THE

CONSTRUCTION LAYOUT (ENCLOSURE 1) SHOWS CONCRETE CAST BETWEEN THE ROCK MASS AND FORMS FIXED WITH ANCHOR BOLTS JUTTING HORIZONTALLY OUT FROM THE ROCK MASS.

- O SO'NG-CH'O'L MANUFACTURED A CRANE USED IN THE CONSTRUCTION. THE CRANE MOVED ON RAILS AND WAS EFFICIENT IN CONSTRUCTING A SIDE WALL OF 8 METERS (M) OR HIGHER. THE DATA OF THE CRANE ARE AS FOLLOWS.

- ARM LENGTH -- 17.8 M
- CRANE HEIGHT -- 2.6 M

4. (U) P'YONGYANG METRO (b)(7)(E)

A DPRK SOURCE PUBLISHED A PHOTO OF THE PANORAMIC SKETCH DISPLAYED AT P'YONGYANG METRO REVOLUTIONARY MUSEUM. THE SKETCH, ENTITLED "KIM IL SO'NG OBSERVING CONSTRUCTION OF UNDERGROUND PALACE," WAS PRODUCED IN 1980. THE PANORAMIC SKETCH (ENCLOSURE 2) SHOWS AN ARCHED UNDERGROUND FACILITY, A CROWN BEFORE LINING WAS CREATED, AND FORMS TO BUILD A TUNNEL WALL TO THE LEFT OF THE ARCHED FACILITY.

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ENCL: (U) AVAILABLE ON WEBSITES -- TWO ENCLOSURES.

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DISSEM: (U) FIELD -- NONE.

WARNING: (U) XXXX XXXXXX XX XXXXXXXXXXXX XXXXXXXXXXXXXXXX.

DRV FROM -- USAINSCOM SCG 380-2, PARA 3-3C, 5 AUGUST 1996, USAINSCOM
DECLASSIFY ON -- YYYYMMDD