

Lunardi method of tunnel excavation and support

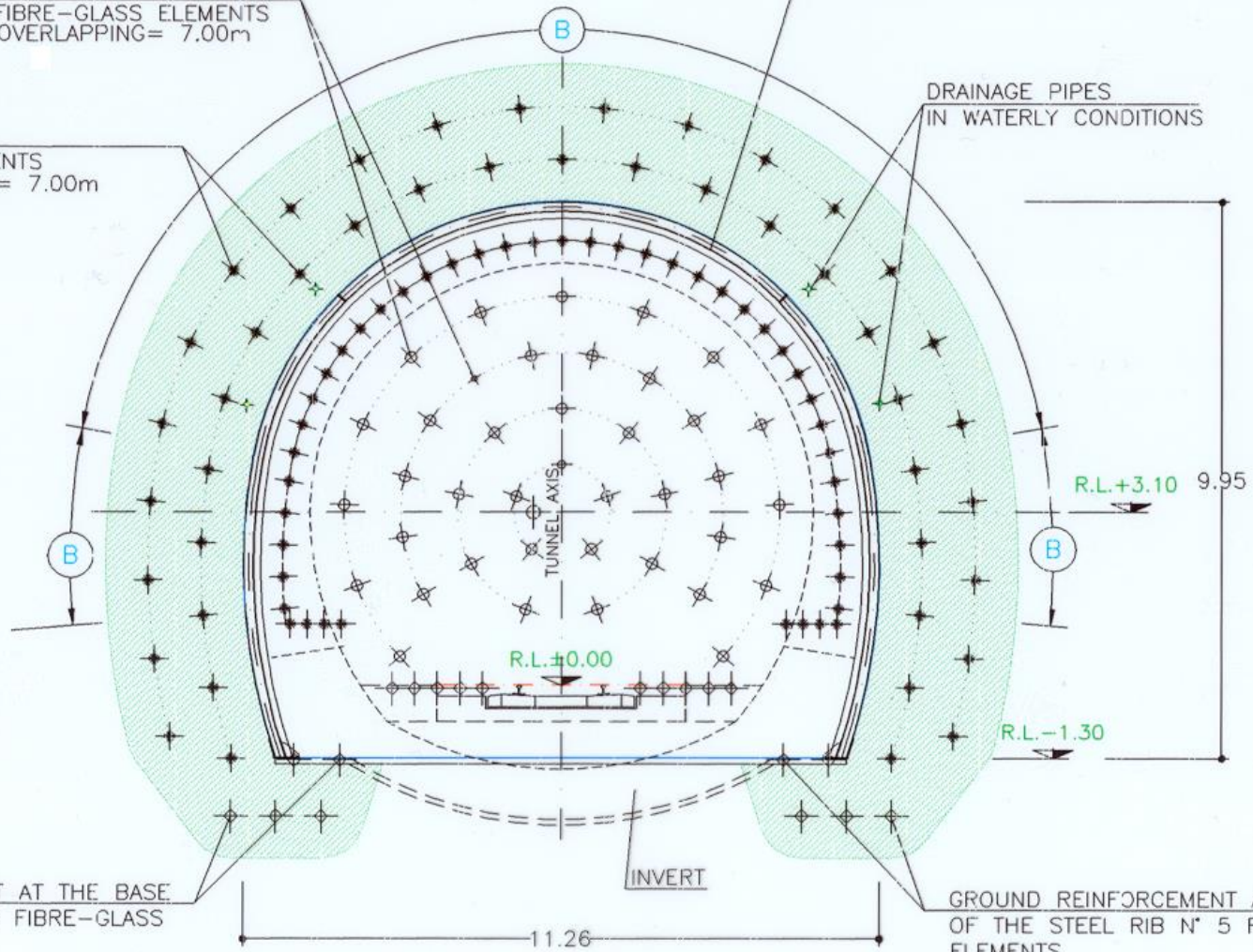
GROUND REINFORCEMENT CROSS SECTION TYPE C2A

CORE GROUND REINFORCEMENT
N°40 ± 10 FIBRE-GLASS ELEMENTS
L= 18.00m OVERLAPPING= 7.00m

SHOTCRETE PRELINING
THICKNESS 25±30 cm,
2 IPN180/1.00 m STEEL RIBS

DRAINAGE PIPES
IN WATERLY CONDITIONS

GROUND REINFORCEMENT
N°45 ± 5 FIBRE-GLASS ELEMENTS
L= 18.00m MIN. OVERLAPPING= 7.00m



GROUND REINFORCEMENT AT THE BASE
OF THE STEEL RIB N° 5 FIBRE-GLASS
ELEMENTS

GROUND REINFORCEMENT AT THE BASE
OF THE STEEL RIB N° 5 FIBRE-GLASS
ELEMENTS

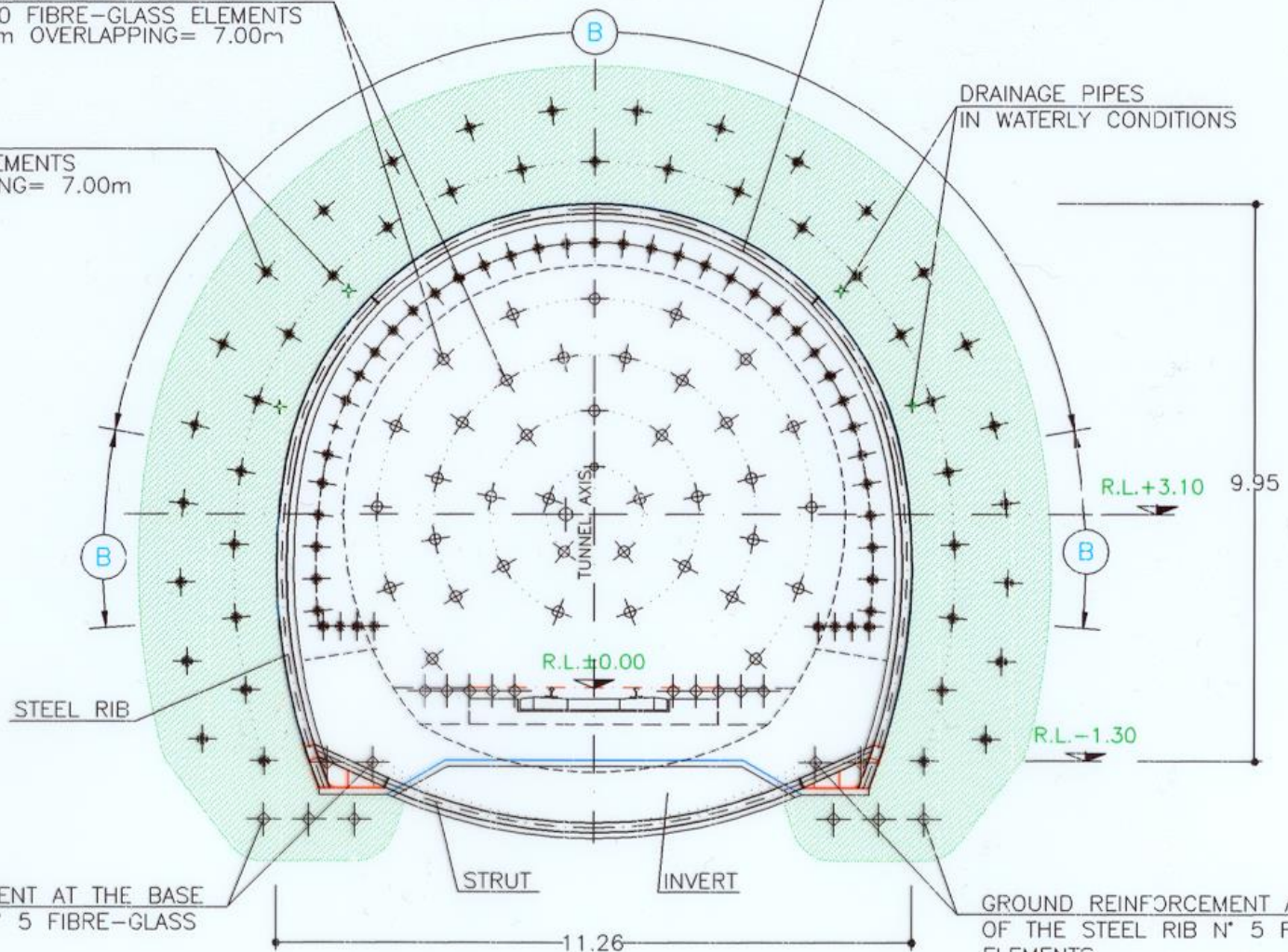
GROUND REINFORCEMENT CROSS SECTION TYPE C2A WITH STRUT

SHOTCRETE PRELINING
THICKNESS 25±30 cm,
2 IPN180/1.00 m STEEL RIBS

CORE GROUND REINFORCEMENT
N°40 ± 10 FIBRE-GLASS ELEMENTS
L= 18.00m OVERLAPPING= 7.00m

GROUND REINFORCEMENT
N°45 ± 5 FIBRE-GLASS ELEMENTS
L= 18.00m MIN. OVERLAPPING= 7.00m

DRAINAGE PIPES
IN WATERLY CONDITIONS

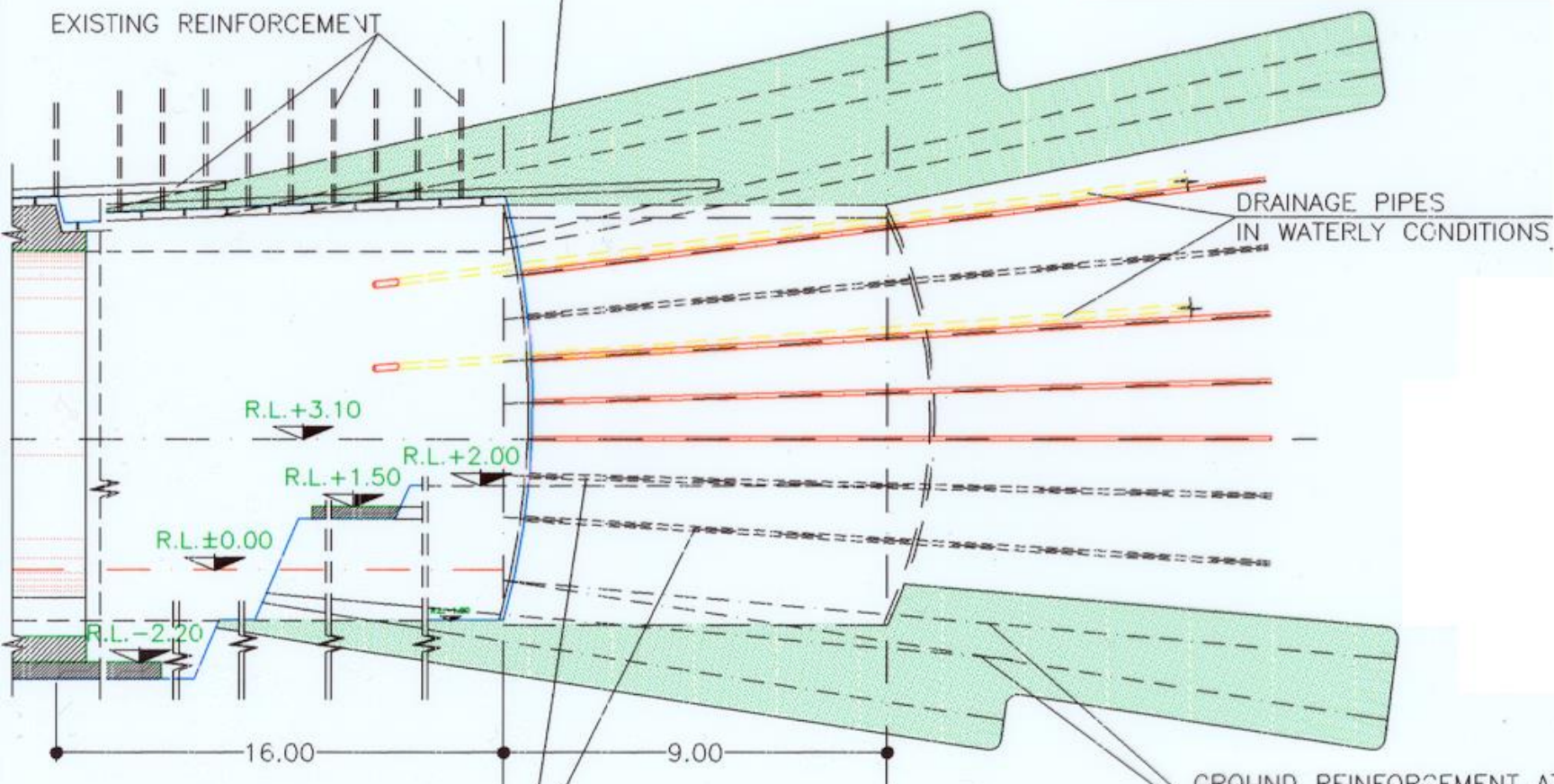


GROUND REINFORCEMENT AT THE BASE
OF THE STEEL RIB N° 5 FIBRE-GLASS
ELEMENTS

GROUND REINFORCEMENT AT THE BASE
OF THE STEEL RIB N° 5 FIBRE-GLASS
ELEMENTS

GROUND REINFORCEMENT
N°48 FIBRE-GLASS ELEMENTS
L= 21.00m MIN. OVERLAPPING= 12.00m

EXISTING REINFORCEMENT



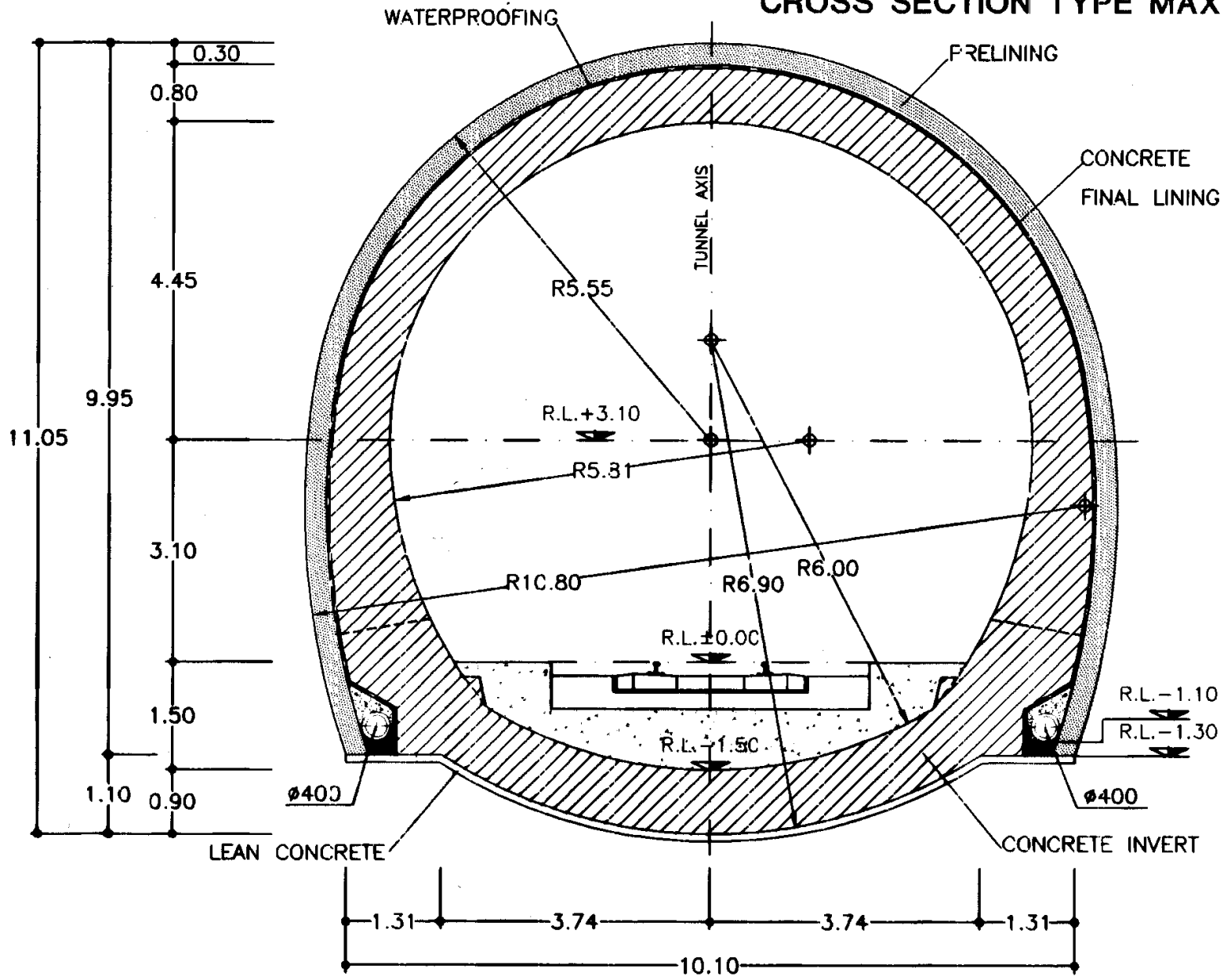
DRAINAGE PIPES
IN WATERLY CONDITIONS

CORE GROUND REINFORCEMENT
N°40 ± 10 FIBRE-GLASS ELEMENTS
L= 18.00m OVERLAPPING= 9.00m

GROUND REINFORCEMENT
LONGITUDINAL SECTION

GROUND REINFORCEMENT AT THE BASE
OF THE STEEL RIB N° 5 FIBRE-GLASS
ELEMENTS ALUMINATED GROUT

CURRENT FRAMING CROSS SECTION TYPE MAX

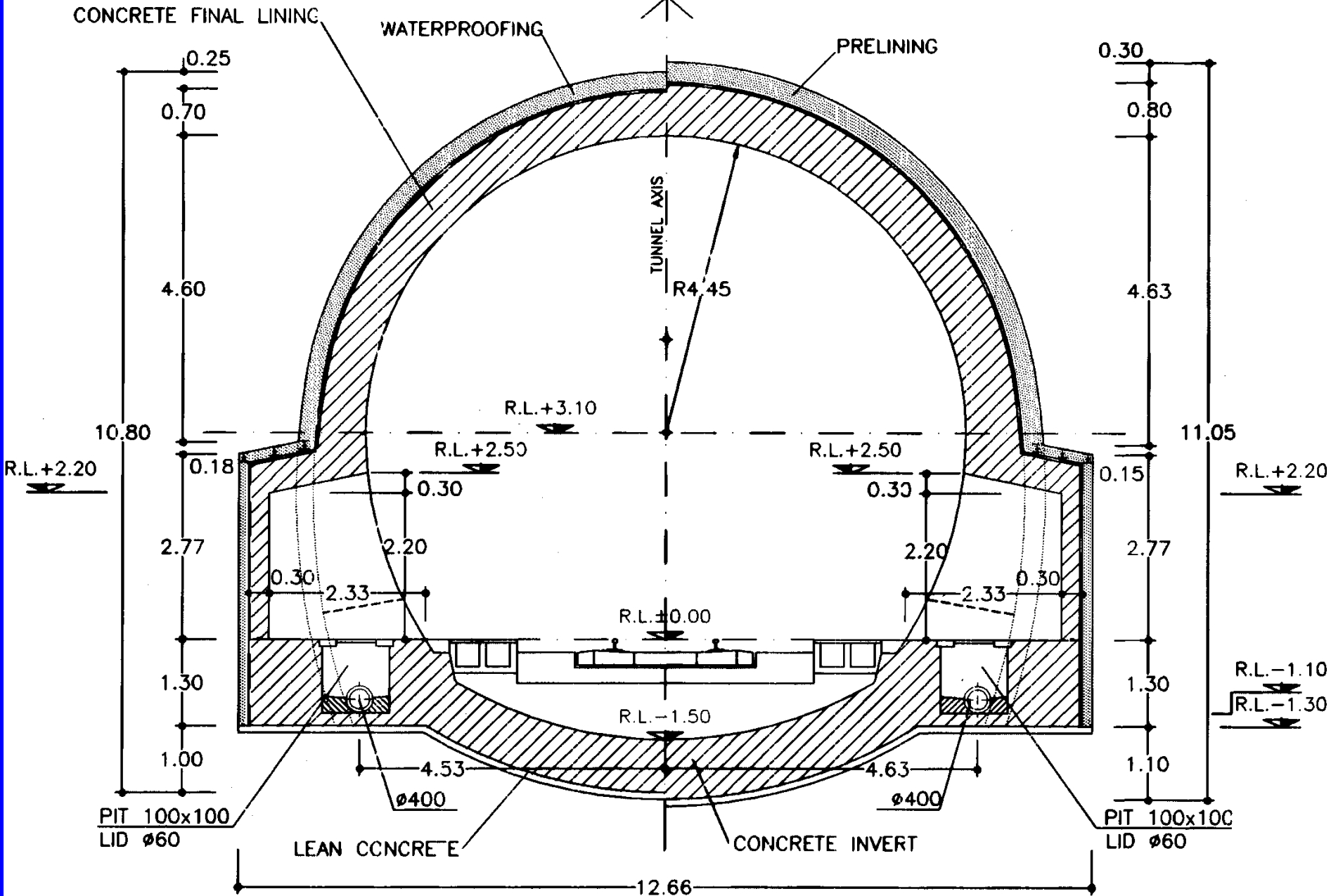


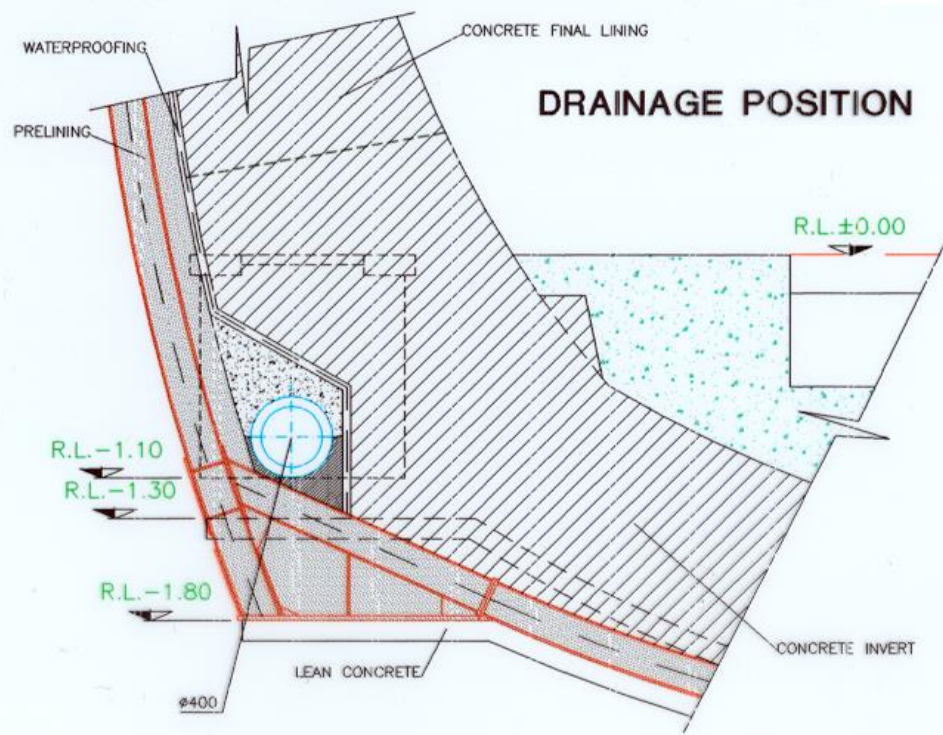
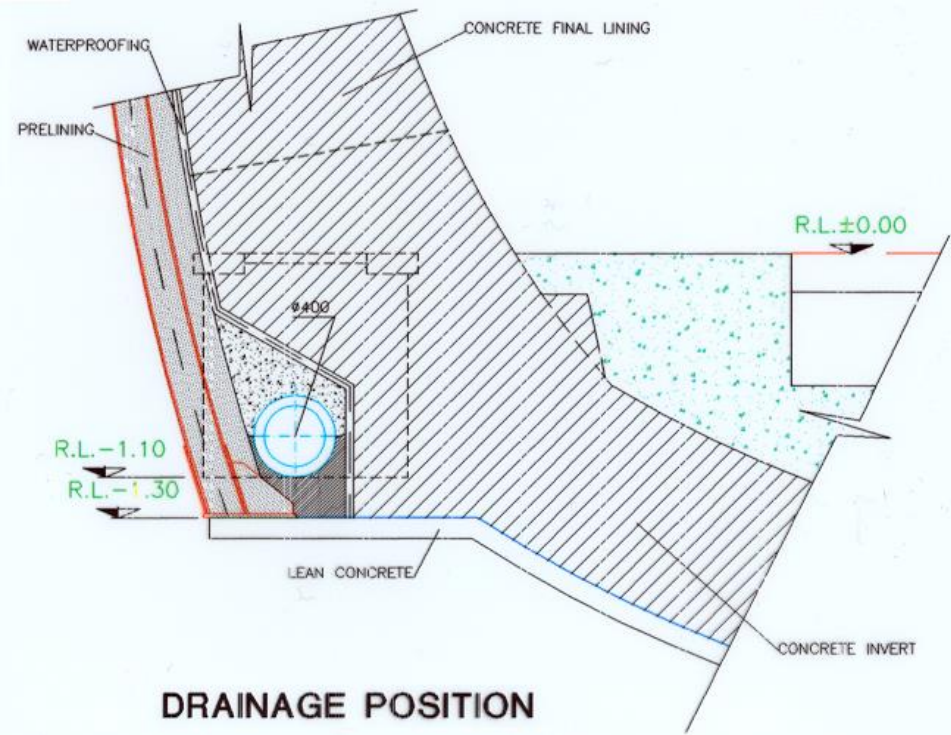
FRAMING WITH RESCUE BAYS

CROSS SECTION TYPE MIN

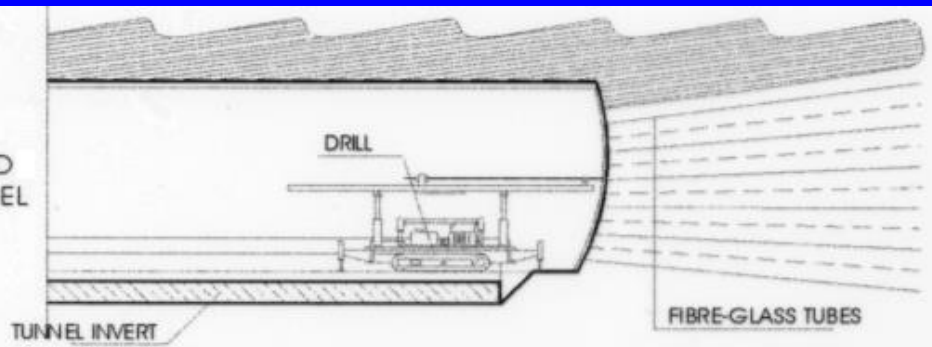


CROSS SECTION TYPE MAX

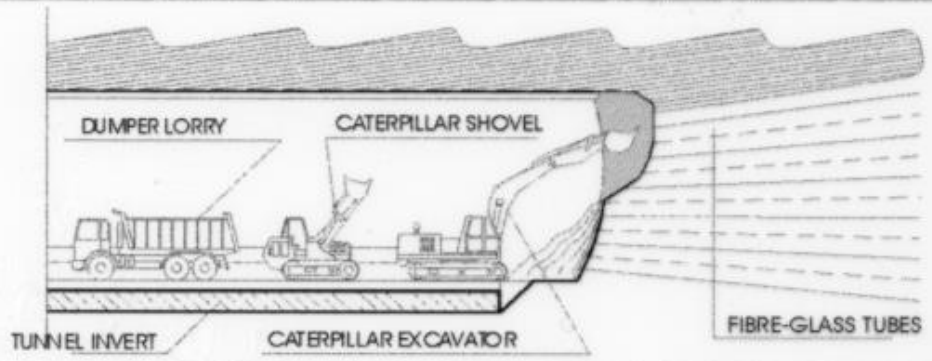




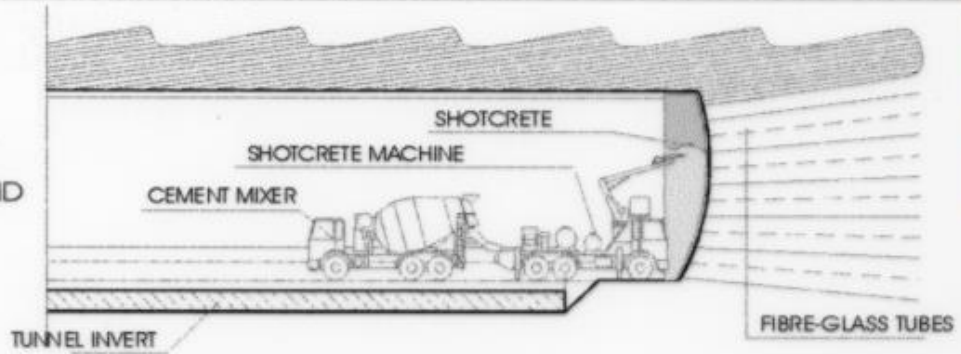
STAGE 1
 GROUND REINFORCEMENT AHEAD
 OF THE FACE AROUND THE TUNNEL
 AND IN THE CORE USING
 FIBRE-GLASS TUBES



STAGE 2
 FULL FACE
 EXCAVATION
 (mt 0.70 ÷ 1.00)

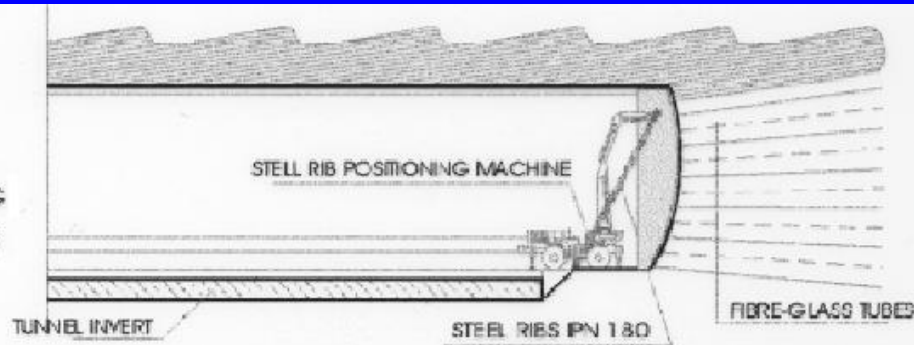


STAGE 3
 SPRAYING OF THE SHOTCRETE
 ONTO THE FACE AND AROUND
 THE TUNNEL (10cm)



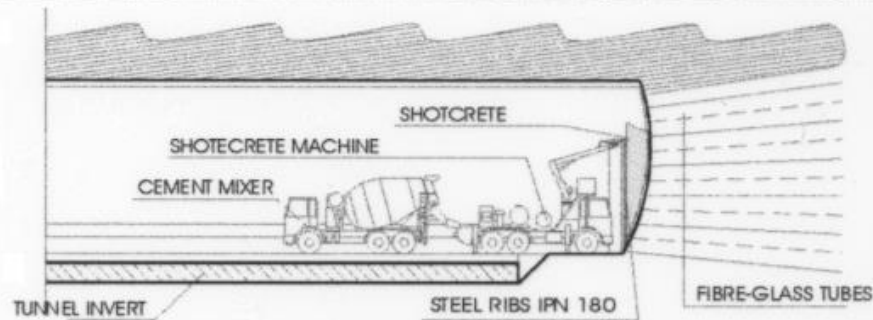
STAGE 4

POSITIONING
OF STEEL RIB



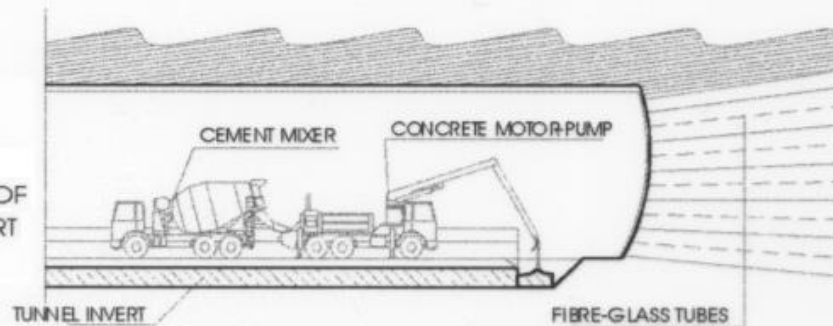
STAGE 5

COMPLETING
OF SHOTCRETE
REINFORCED
PRE-LINING
(25-30cm)



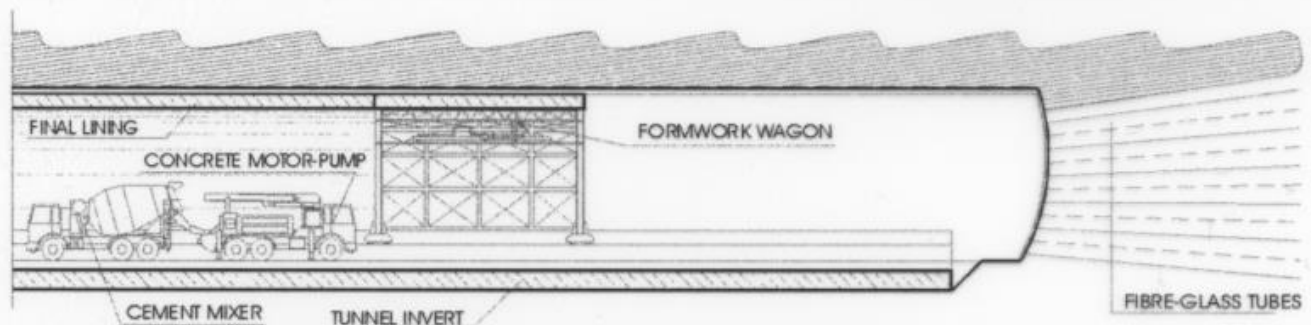
STAGE 6

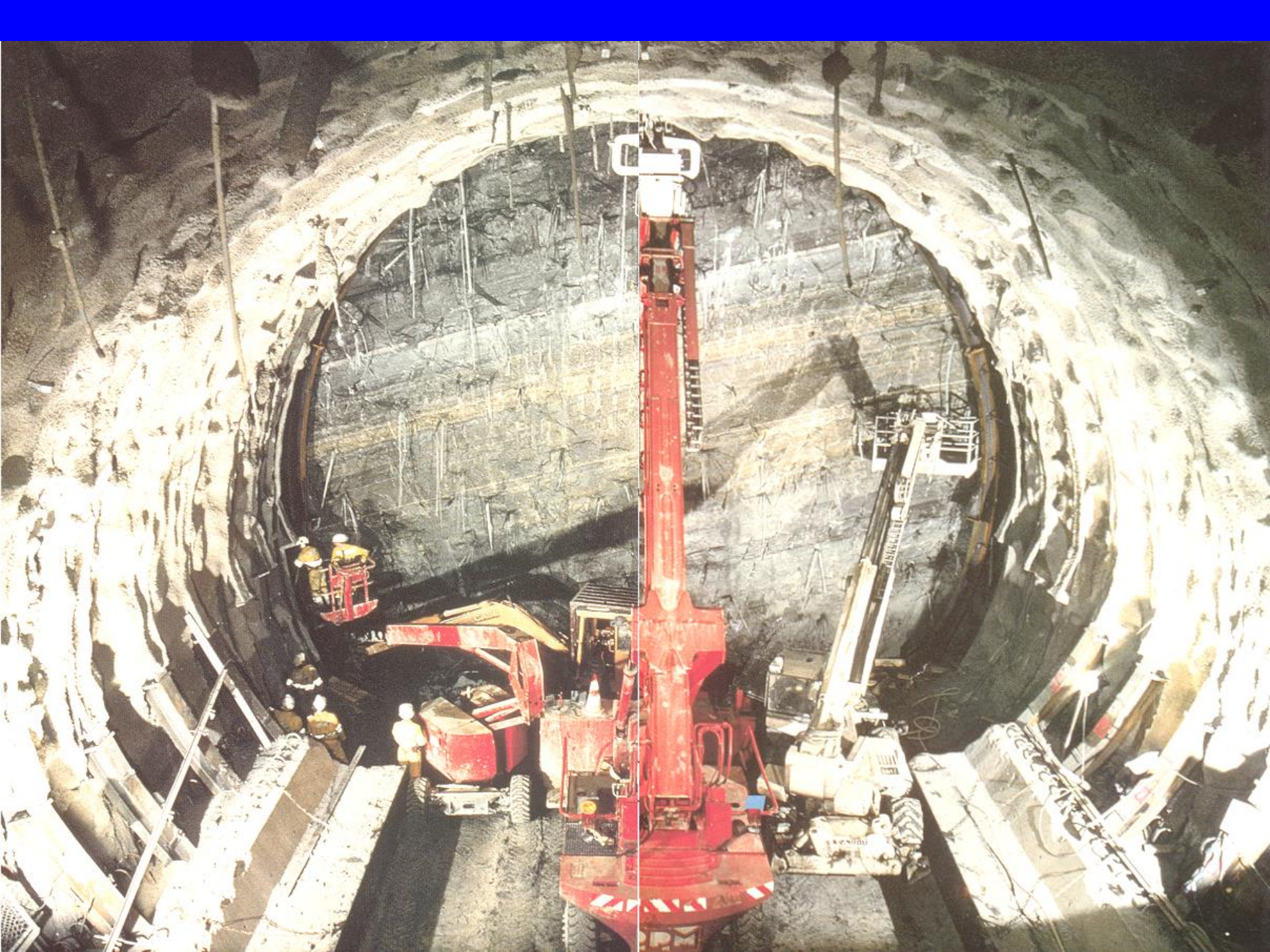
EXCAVATION
AND CASTING OF
THE TUNNEL INVERT
AND KICKERS



STAGE 7

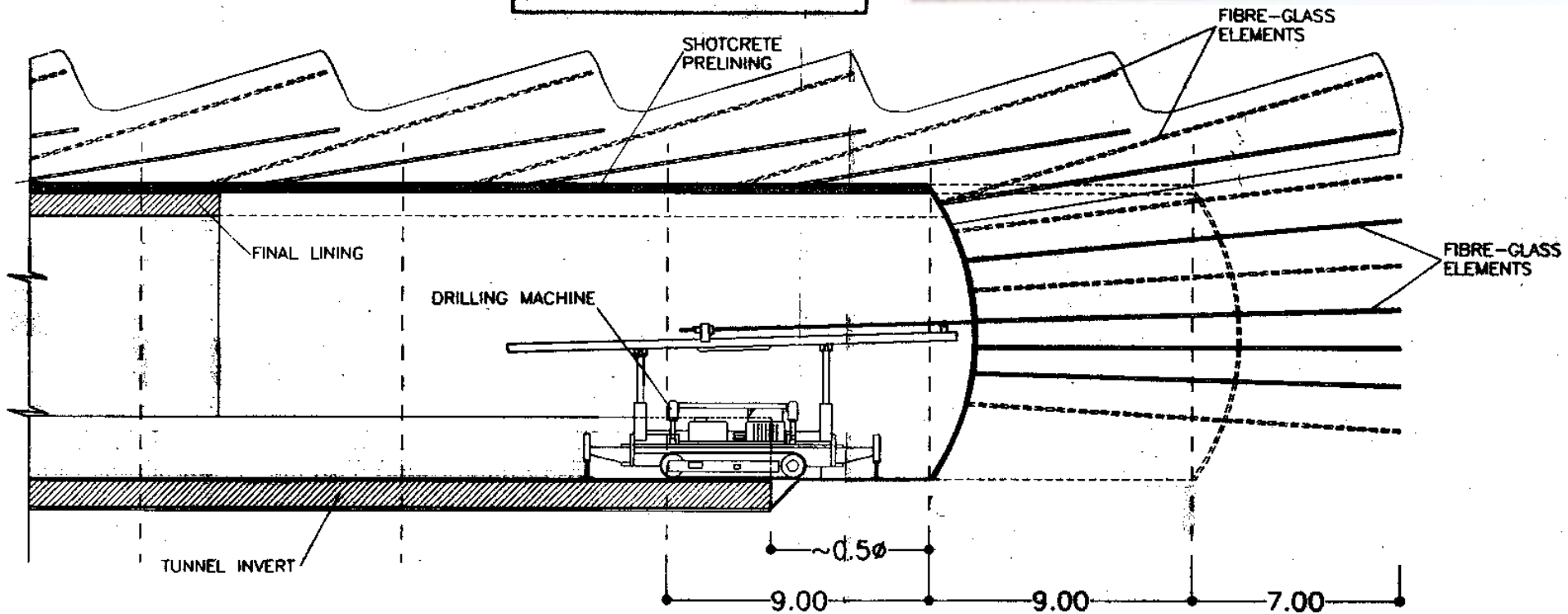
CASTING OF THE
FINAL LINING



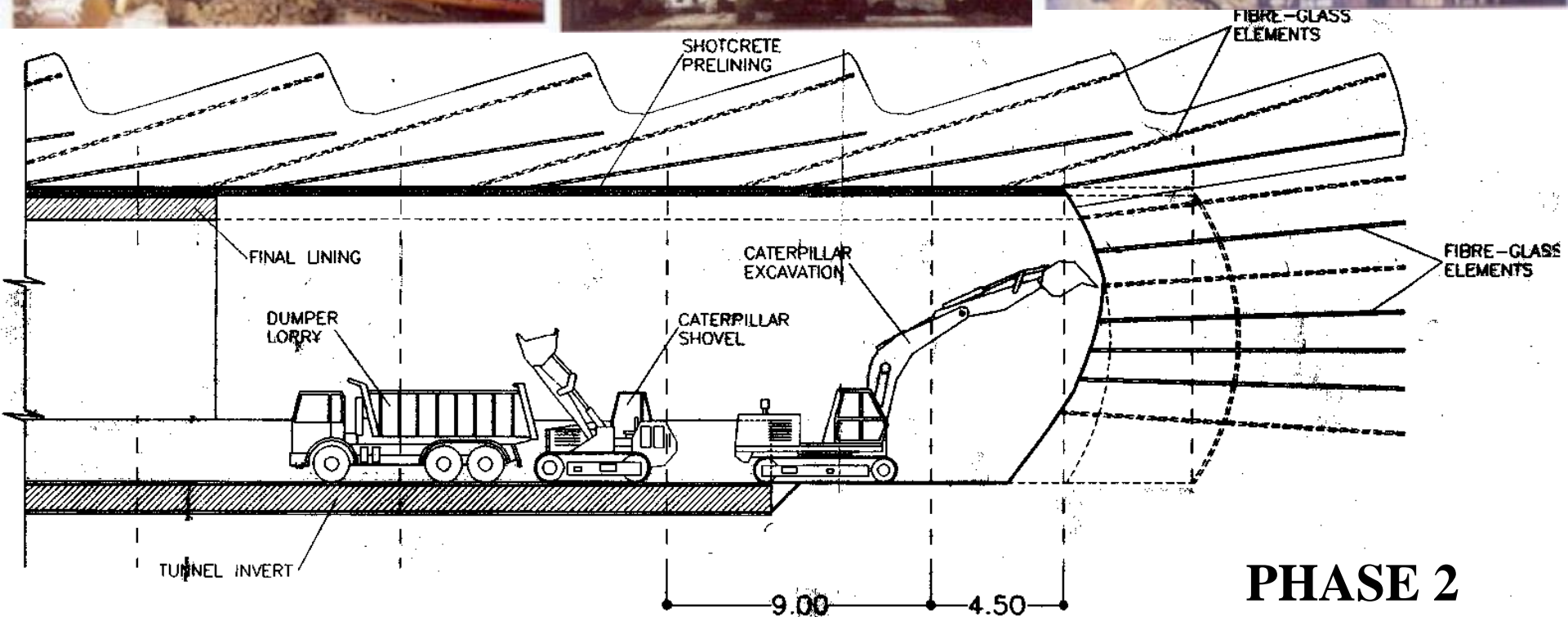




PHASE 1



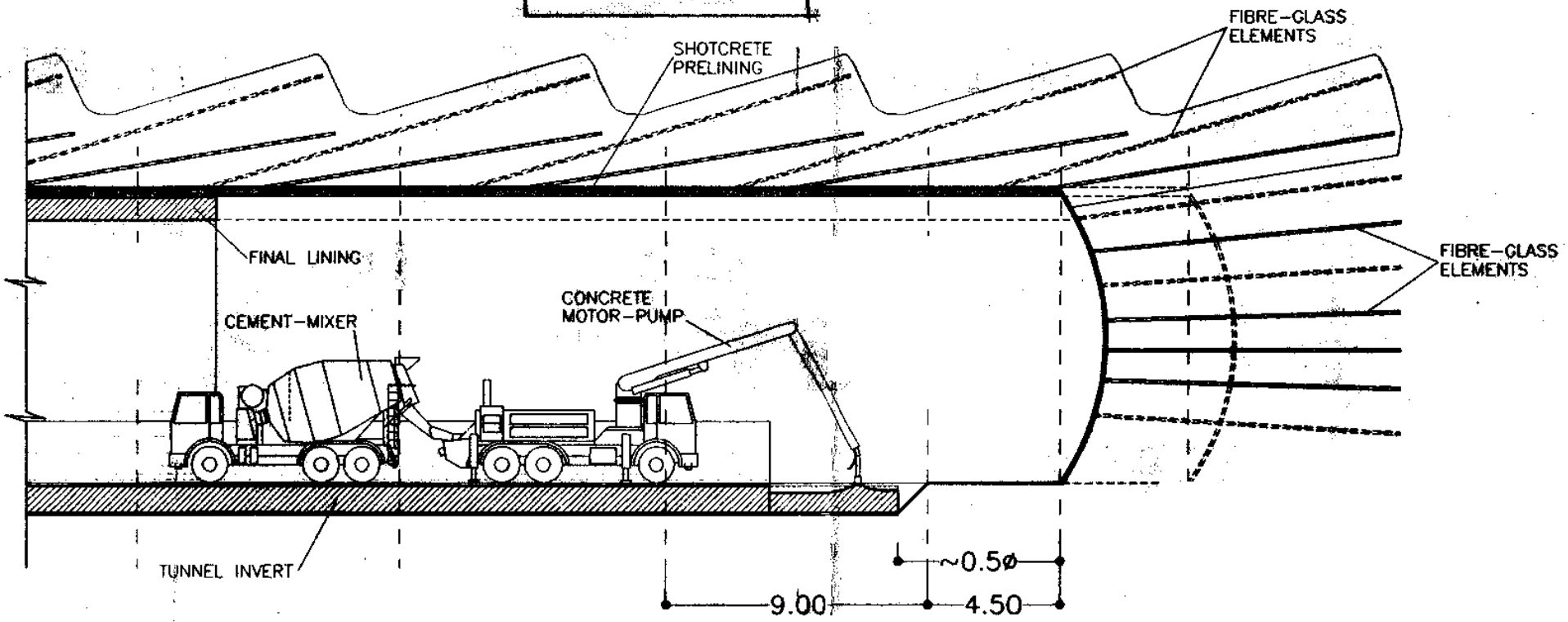
- GROUND REINFORCEMENT AROUND THE TUNNEL AND INTO THE CORE USING FIBRE-GLOSS ELEMENTS INJECTED BY EXPANSIVE ALUMINATED GROUT AHEAD OF THE FACE



- FULL SECTION EXCAVATION, BY 1.00m STAGES UP TO A MAXIMUM LENGTH OF 4.50m
- POSITIONING OF STEEL RIBS EACH 1.00m STAGE
- SPRAYING OF THE SHOTCRETE FIBRE REINFORCED PRE-LINING EACH 1.00m STAGE



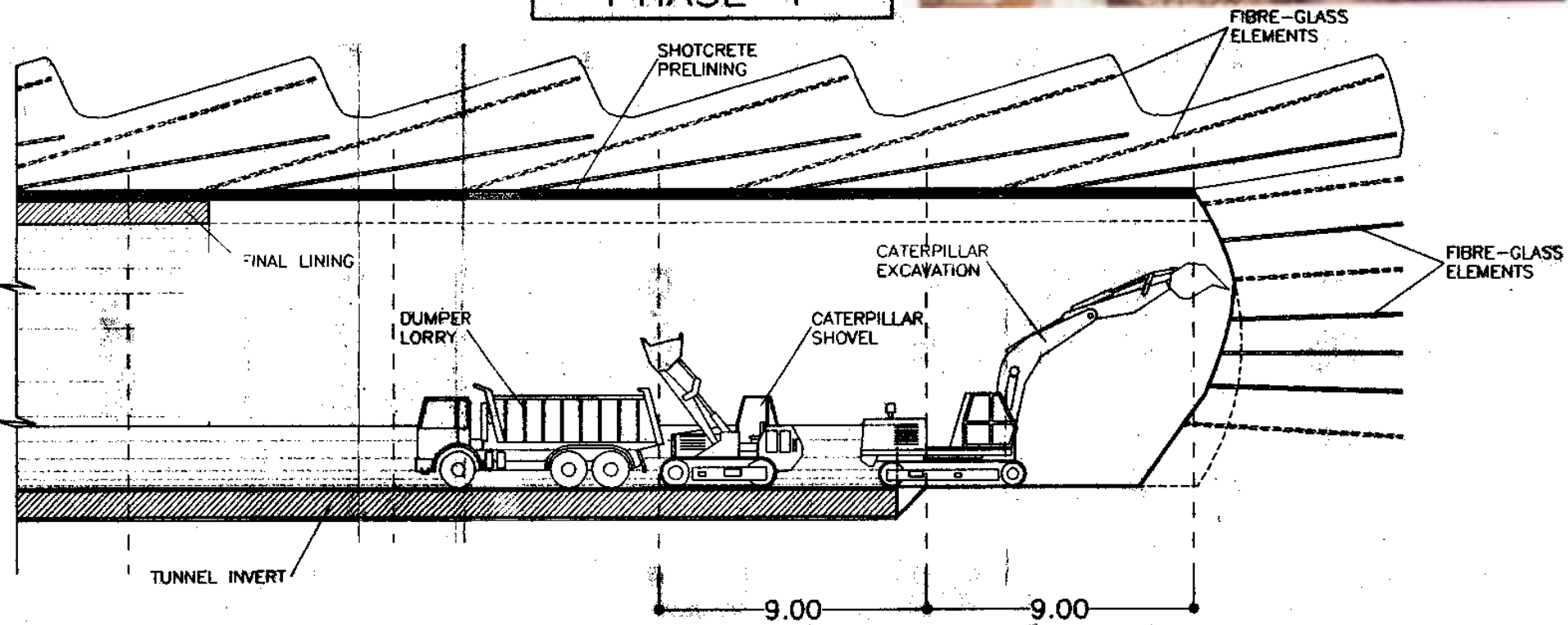
PHASE 3



- EXCAVATION AND CASTING OF THE TUNNEL INVERT AND KICKERS



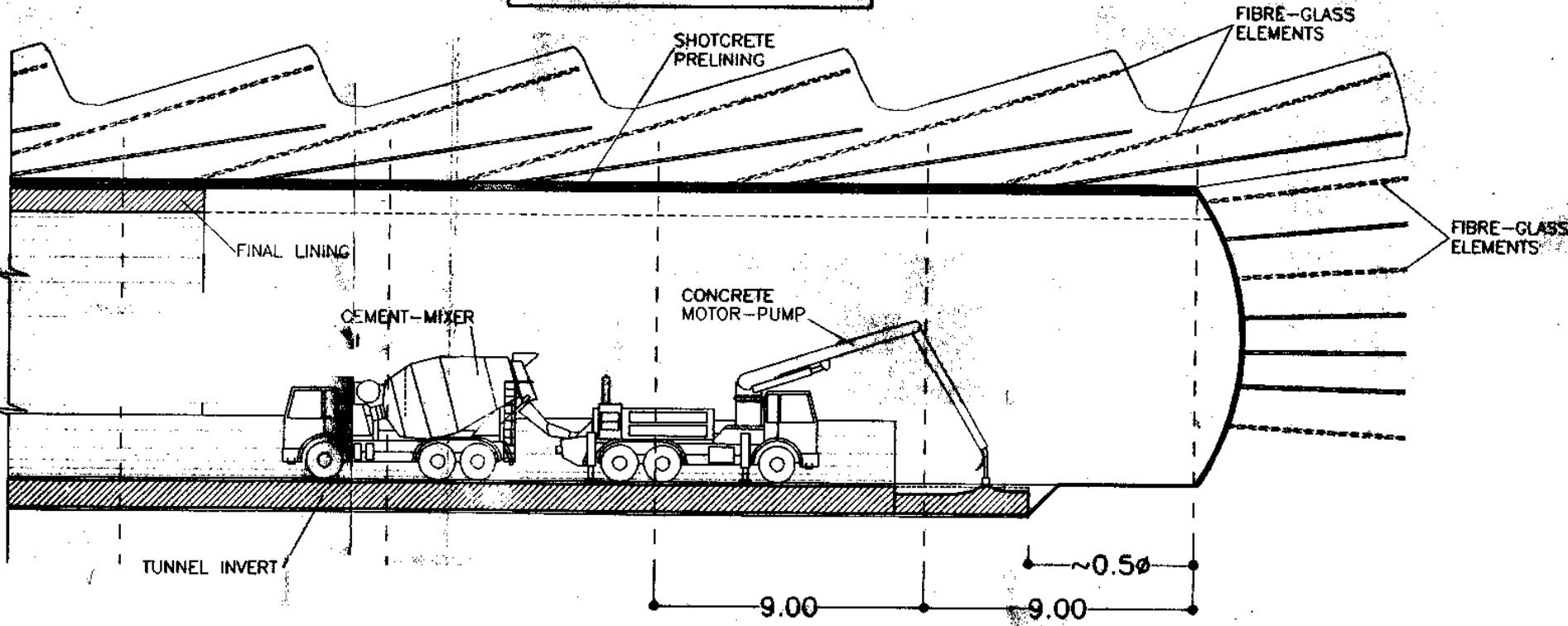
PHASE 4



- COMPLETING EXCAVATION BY 1.00m STAGES UP TO A MAXIMUM LENGTH OF 9.00m. ACCORDING TO PHASE 2 INDICATIONS.



PHASE 5



EXCAVATION AND CASTING OF THE INVERT AND KICKERS UP TO $\sim 0.5\phi$ FROM THE FACE

PHASE 6

