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(54) IMPROVEMENTS IN OR RELATING TO TUNNEL LINING SEGMENTS

(71) We, WILLIAM F. REES LIMITED, a British Company, of Old Woking, Surrey, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to tunnel lining segments and is particularly, but not exclusively, concerned with lining segments for flexibly lined tunnels especially those with a bore of about 1220 mm or less.

The invention provides a 120° arcuate tunnel lining segment having a line of weakness extending between opposed arcuate edges of the segment so that if tensile stress occurs in the segment due to unequal pressure around the segment, cracking occurs along the line of weakness.

The line of weakness may extend parallel to the axis of segment.

Said line of weakness may be provided by at least one notch or rebate in the segment extending along the line.

A notch or rebate may be provided on both sides of the segment along said line.

A plurality of lines of weakness may be provided at spaced locations around the segment.

Three lines of weakness may be provided around the segment and may be equally spaced around the segment.

The notches or rebates may be V-shaped in cross-section.

The notches or rebates may be filled with an elastic waterproof substance.

The segment may be made of concrete.

The invention also provides a ring formed of arcuate tunnel lining segments according to the invention.

The invention further provides a tunnel comprising a plurality of rings as described in the last preceding paragraph jointed together end to end.

One embodiment of the invention will now be described with reference to the accompanying diagrammatic drawings in which:—

Figures 1 and 2 are end and side views of a ring made of tunnel lining segments embodying the invention, and

Figure 3 is a section on the line 3—3 in Figure 1 through a portion of a segment.

In Figures 1 and 2 of the drawings there is shown one ring of a tunnel lining which comprises three 120° arcuate segments 10. Each segment 10 is fabricated with two or more lines of weakness or dummy joints 11, which may consist of 'V' or similarly shaped notches or rebates formed in the axial direction of the ring at the inner and outer faces of the segment in corresponding positions, these being aproximately equi-spaced between the construction joints 12. The rebates are filled with suitable elastic adhesive waterproof compound to maintain watertightness.

Should tensile stresses occur in the unit after erection, due to unequal pressure of the surrounding strata, then cracking will occur at these dummy joints and small rotations will take place both at the dummy joints and at the construction joints and the segment ring will deform as a whole to equalise the external pressure thereon. The spacing of the dummy joints can be calculated such that direct stresses in the material of the segments, due to circumferential stresses and bending stresses caused by approximately uniformly distributed loading by the strata on each subsegment, are integrated to give resultant stresses within the working stress tolerances of the material, e.g. with concrete zero tensile stress, compressive stress as per the relevant Code of Practice or to other relevant specifications.

The ring or three segments may be erected by a method such as described in our copending Application No. 43907/69 (Serial No. 1288393). Alternatively where ground conditions permit the shield may be omitted from the oversize tunnel being excavated without support, a short length at a time, and the lining rings being erected within the tunnel. Hydraulic rams are of course still provided to drive the erected rings backward.

WHAT WE CLAIM IS:—

1. A 120° arcuate tunnel lining segment having a line of weakness extending between opposed arcuate edges of the segment so that if tensile stress occurs in the segment due to unequal pressure around the segment, cracking occurs along the line of weakness.

2. A segment as claimed in claim 1 wherein the line of weakness extends parallel to the axis of the segment.

3. A segment as claimed in claim 1 or claim 2 wherein said line of weakness is provided by at least one notch or rebate in the segment extending along the line.

4. A segment as claimed in any of claims 1 to 3 wherein a notch or rebate is provided on both sides of the segment along said line.

5. A segment as claimed in any of claims 1 to 4 wherein a plurality of lines of weakness are provided at spaced locations around the segment.

6. A segment as claimed in claim 5 wherein three lines of weakness are provided around the segment.

7. A segment as claimed in claim 6 wherein the lines are equally spaced around the segment.

8. A segment as claimed in claim 3 or claim 4 or any of claims 5 to 7 when dependent on claim 3 or claim 4 wherein the notches or rebates are V-shaped in cross-section.

9. A segment as claimed in claim 3 or claim 4 or claim 8 or any of claims 5 to 7 when dependent on claim 3 or claim 4 wherein the notches or rebates are filled with an elastic waterproof substance.

10. A segment as claimed in any of claims 1 to 9 which is made of concrete.

11. An arcuate tunnel lining segment substantially as hereinbefore described with reference to and as shown in Figures 1, 2 and 3 of the accompanying drawings.

12. A ring formed of arcuate tunnel lining segments as claimed in any of claims 1 to 11.

13. A tunnel comprising a plurality of rings as claimed in claim 12 jointed together end to end.

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