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Composite Macro-synthetic Fiber and Steel Reinforced Shotcrete for Final Lining

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ABSTRACT

Accelerated and cost effective construction methodologies for tunnel lining have attracted a growing attention in recent years. Sequential construction such as excavation, primary support, reinforcement, formwork, concreting and contact grouting has made limitations for decreasing the execution time. Available methodologies to accelerate the tunnel construction will require the elimination or merging of some of these steps. An innovative construction technology has been presented in this paper which reduces the reinforcements, omits the formwork and contact grouting and reduce the construction volumes by utilizing the appropriate properties of macro synthetic fibers, steel reinforcement and wet shotcrete. The design can also utilize the bearing capacities of primary support and create a composite single shell for load carrying. The procedure for analysis, design and construction of the support has been discussed in the paper. All materials including special distributed latticed panels, steels and fiber shotcrete were selected so as to satisfy the durability criteria. The lining can be used for different applications including metro tunnels, road tunnels and sewerage and waterways.

KEYWORDS

Fiber reinforced shotcrete, Lattice panel, Accelerated construction, Single shell lining, Final lining.

1. INTRODUCTION

Shotcrete is a robust design strategy. Several advantages such as ease of application, compatibility and quick application make this method a suitable procedure for tunnel works. Historically, this method has evolved a successful strategy out of 40 years of experience which may be adopted in supporting tunnels in widely different rock conditions. A tunneling revolution has occurred in the last 40 years with advent of wet-process shotcrete and structural fiber reinforced shotcrete (SFRS). Since steel fibers are not continuous, they do not experience corrosion like mesh and RCC. Synthetic polymer fibers such as Polyolephyne and Polypropylene totally remove the corrosion problem. As far as life of these "light" support systems is concerned, they are stable for last

40 years. Their cost is only a fraction of the concrete lining.

Shotcrete is mainly used as preliminary support in soft grounds or jointed rocks but there is a potential of being used as permanent lining as it has all the specifications of in-situ concrete lining. In this paper an improved method of using shotcrete in tunnel lining construction is proposed. This system is a combination of current technologies in this field and uses their advantages to obtain a quick, durable, effective, economic and reliable support.

Sprayed concrete lined tunnels are rapidly growing in popularity due to their versatility. The design and construction of both hard rock and soft ground tunnels has been revolutionized by the advent of this method and now the use of permanent sprayed concrete linings has unlocked the true potential of the method to minimize construction costs and