

Application of Steel Fiber Reinforced Lightweight Aggregate Concrete in Underground Mining

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Abstract—Several devices are used to provide support in an underground space. Wooden prop is generally employed for the purpose of passive secondary or short-term support of the mine roadway roof and sides. The wooden prop has various known usage limitation, including low strength, deterioration of wood in humid environment, poor ductility, and generally low service life. Substitution of the wooden prop with a prop made with a more suitable material could thus yield important advantages. In this study, lightweight aggregate concrete (LWAC) is proposed to be used as a prop material. Since lightweight aggregate has a relatively low ductility, steel fibers are used in this investigation to achieve enhanced ductility levels. Five mixtures of fiber reinforced lightweight aggregate concrete were considered with different steel fiber percentages and pumice lightweight aggregates produced in Iran. The density, compressive, tensile and flexural strength as well as the toughness index of different fiber reinforced lightweight aggregate concrete materials were measured in order to assess their potential as replacement for wood in prop production. The experimental results indicated that the density of lightweight aggregate concrete is higher than wood. Since the strength and toughness of LWAC is significantly more than those of wood, the weight of a LWAC element with the same strength turns out to be 22 percent less than the wood element. Hence, wooden prop may be replaced with lightweight aggregate concrete prop to achieve improved service life and ductility while reducing the weight of the prop.

Keywords: lightweight aggregate concrete, steel fiber, prop, support, pumice, mining

INTRODUCTION

Background. Concrete has been used widely in underground mines for decades for various applications. Especially, concrete has initially been used in the coal mine while its fireproofing ability has been recognized. Much of the hazard in heavy working with heavy steel and timber supports, as well as the dangerous of repairing these support is omitted when concrete is used [1]. Using concrete with the high electrical resistance provides safer condition for underground use of electrical equipments. Concreted drifts supporting high voltage trolley wires are secured than equivalent timber or steel supports. Nonetheless, the lower cost of long term support maintenance is the most powerful reason for using concrete in mines. According to a research, 35-50 % of the total mine maintenance at a large coal mine spent on repair and cleanup of openings [2]. The high maintenance cost for underground support has been considered as an important threat for mine life time.

Nevertheless, the most application of concrete in mines is restricted to the structural lining. In these cases concrete is placed into the formworks tolerated the concrete weight. Regarding to high density of concrete no effort has been performed for using normal concrete in portable precast support elements such as wooden props. According to the wood usage limitations described later, few materials such as foam concrete were innovated to replace wooden prop. While weight deduction of these new elements has been only focused, decrease of prop weight is greatly achieved. However, ductility is a major problem of new elements forgotten in many cases. Since high deformation

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self-consolidating concrete (SCC) designated for repair applications.[PAPER] Complete List: Lightweight Aggregate Concrete Science Technology And Applications [FREEMIUM] Access. LIGHTWEIGHT.Lightweight aggregates concrete (LWAC) has been widely applied because . Lightweight aggregate concrete science, technology and applications, Standard.

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