



Numerical and Experimental Study of Mixed-Mode Crack Growth in a Brittle Asymmetrical SNEB Specimen Under Three-Points Bending Test

Seyed Benyamin Adibzadeh¹, Farzaneh Hamed²

1- Ph.D. Student, Dept. of Civil Engineering, Imam Khomeini International University, Qazvin, Iran

2- Assist. Prof., Dept. of Civil Engineering, Imam Khomeini International University, Qazvin, Iran

adibzadeh@edu.ikiu.ac.ir

Abstract

A mixed-mode crack (first and second modes of fracture) has been considered in an unsymmetrical single notched edge bending specimen and the crack growth path has been found through numerical simulations. The supposed rock is a kind of natural decorative and construction marble, namely, Gohareh. Then by testing eight symmetrical and five unsymmetrical SENB specimens under three-points bending test the fracture toughness of the first mode and the crack growth path were obtained. The result shows that the fracture toughness of the first mode in numerical analysis is almost 25% less than the experimental fracture toughness which was $1.1 \text{ MPa}\cdot\text{m}^{0.5}$.

Keywords: Fracture Toughness, Marble Rock, Mixed Mode, Crack Growth

1. INTRODUCTION

Rock as an initial material which has been used to build shelter by early humans, maintained its importance and is widely used in construction industry nowadays. For instance, 17 million tons of different types of rock is mined in Iran per year and the value of stone exports is around US\$ 180 million. [1]. Iran has only 1% of global decorative and constructional stone market and almost 85% of Iran exporting stones are unprocessed and raw. [2] So, making efforts in order to produce processed stones can increase Iran's share in this profitable market. The first step in this way is to identify the mechanical properties of indigenous rocks and one of the most important characteristics of rocks is fracture properties. Fracture mechanics is a type of engineering sciences which evaluate structures fracture failure under dynamic or static loading conditions. [3]

One of the most prevalent kinds of decorative and constructional stones in Iran is Gohareh Khorramabad marble which has the scientific name of "crystallized dolomite carbonate". This type of marble is almost homogenous, it has no cracks, and no veins. Regarding to these parameters Gohareh marble is extensively used in exterior buildings coverage, flooring and façade which is shown in figure 1.



Figure 1: Applying large pieces of marble stone in façade [4]