Underground stone or hard rock mines typically employ the room-and-pillar mining method. Room-and-pillar mines are designed in traditional patterns with square or rectangular shaped pillars. This method is favorable because the symmetric pattern aids in optimizing mining operations. In active mines, deviations from the mine plan often result in irregularly shaped pillars. In older mines, which were designed when pillar design methodology was less developed, irregularly shaped pillars are more common than in current operations. The performance of hard rock pillars is primarily based on the pillar’s stability factor and the width to height ratio, where the width is the smallest dimension of the rectangular base. The estimation of pillar strength in room-and-pillar stone mines has been studied by researchers and empirical relationships between traditional geometry (square and rectangular), and strength have been developed. Determining the strength of irregularly shaped pillars is integral to determining the pillar and regional stability. Laboratory experiments were conducted on laboratory specimens modeled after traditionally and irregularly shaped pillars. The laboratory specimens were modeled after slender pillars with a width to height ratio of 0.8. The objective of the laboratory experiments was to investigate the strength of the specimens and the core behavior and development. Numerical models were developed based on pillar systems with traditional and irregular pillar shapes. The analysis was performed in elasto-plastic constitutive models. The results of the laboratory experiments are compared to numerical models of irregular and traditional pillar shapes.