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Review of hydraulic behavior of faults and related models

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Abstract

- Joints, deformation bands, and faults are physical structures in rocks that have been developed as tabular zones of strain and fracture in response to tectonic and gravitational loading. The flow properties of faults are in general quite complex because they can act as conduits or barriers to fluid flow. Faults are complex hydraulic structures and determination of hydraulic behavior of these structures is one of the major problems during the site location of landfill tunneling, etc. the hydraulic behavior of faults is different in each case. These structures sometimes act as conduits and sometimes act as a barrier or both of them. There are not comprehensive researches about the permeability of fault zones in Iran. Due to the complexity and uncertainty of hydraulic behavior of fault, the main objective of this paper is to introduce the current models and equations related to the fault zone permeability. Several methods have been used to measure or estimate the permeability of faults. In this paper due to the importance of this subject, the main models include the Caine model (1996), Micarelli (2006), Smith (1995), Taylor (2000) have been introduced.

Keywords:*Model, hydraulic behaviour, fault, Permeability*

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Extended Abstract:

1. Introduction

Joints, deformation bands, and faults are physical structures in rocks that have been developed as tabular zones of strain and fracture in response to tectonic and gravitational loading. The flow properties of faults are in general quite complex because they can act as conduits or barriers to fluid flow. In most cases, a fault displays both aspects of this complex signature in time and space (Aydin, 2000).

2. Materials and methods

Thus, the accurate description of permeability in the fault zone is an important aspect of the overall characterization of the reservoir or aquifer. Fault zone components consist of sheared joints, deformation bands, fragmented rock, fault rock, and slip surfaces, while damage outside of the core is in the form of joints, sheared joints and deformation bands (Taylor,1999) (Fig. 1).

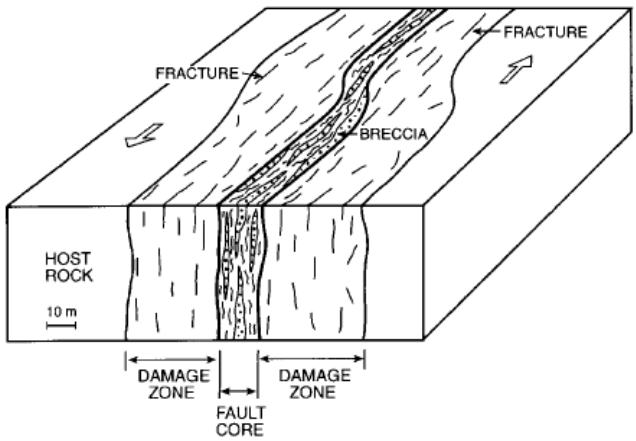

Fig. 1. Schematic infrastructure of a large-scale strike-slip fault zone (Taylor1999)

The distribution and orientation of these components may be variable within a fault zone, and each component has its hydraulic properties that vary as functions of geologic, mechanical and hydrologic conditions. Further, the influence of a given structural component on fluid flow within and around a fault zone depends strongly on the component's geometric relationship to other structural components and to the direction of fluid flow (Fig. 2).

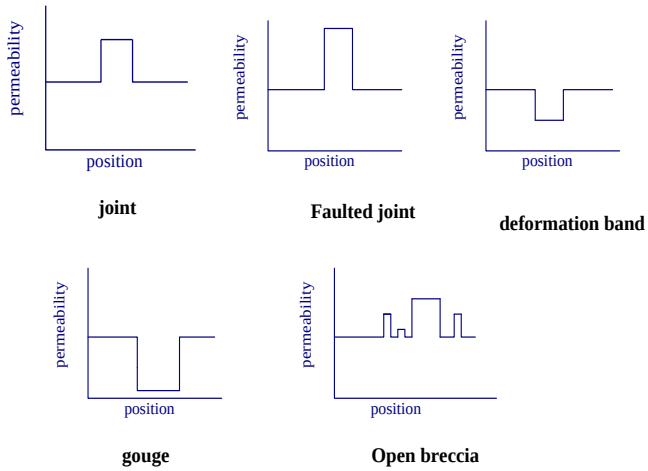

Fig. 2. Schematic permeability profiles across fundamental structural elements (Taylor1999)

Due to the complexity and uncertainty of hydraulic behaviour of fault, the main objective of this paper is to introduce the current models and equations related to the fault zone permeability. Several methods have been used to measure or estimate the permeability of faults. In this paper due to the importance of this subject, the main models include Caine model (1996), Micarelli (2006), Smith (1995), Taylor (2000) have been introduced.

3. Tests results

The obtained results indicated that the hydraulic properties of faults is depended on the fault components such as fault core, Slip band, joint aperture, filling material. The current models have been considered and reviewd.

4. Conclusion

The review of models have been sumurized in the table 1.

With increasing in the acidity or alkalinity of artificial rain and increasing the rainfall fluxes, the soil properties experience more serious changes, this phenomenon will lead to a decrease in the strength of the soil and increase in LL, PI and the coefficient of permeability.

Table1. the review of hydraulic behavuoir of faults models

method	Advantages	Disadvantages
Smith et al,1994	• Classification of hydraulic behaviour of faults to barrier and conduits • Considration to inner and outer hydraulic behaviour of faults	• Considration af limited permeability distribuition in fault zone • Model inefficiency in complex hydraulic conditions • Model is inefficient in paradoxical condition including low permeable gouge and high permeable fractures
Caine, 1996	• Improved the Smith model by classification of fault zone based on the fault core and disturebed zone • Considration of major properties of faults including gouge and berreciated zone • Isolation of the damaged area from the fault core, assuming high permeability for this zone	• Consideration of low permeable core for all fault zone is incorrect. • Inattention to the change in the fault permeability due to the filling material
Taylor, 2000	• Providing effective permeability ratio for fault zone in order to model hydraulic conditions in fault zone and fault cor • resolve the problem of the caine method, taking into account parameters such as secondary mineralization or filling materials, that change the fault zone permeability.	• The Small-scale items are not considered in the definition of effective permeability • Inattention to the physical connectivity of fault items and their effects on the fault zone permeability
Schipton e, 2002	• Classification of fault zone to the:core, slip band, disturbed zone, joints and deformation band • Attention to the permeability changes due to the weathering and filling material	• Considration of fixed aperture for faults • In the large scale, determination of faults item permeability is difficult
Micarly, 2004	• Considration of fluid properties in the fault zone • Attention to the fault length and width, flow path and fault dip • Attention to the flow turbulanty • Attention to the connectivity of faults and joints	• In attention to the aperture change during the loading • In attention to the changing in the slip band permeability

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