TABLE OF CONTENTS

1. INTRODUCTION……... 1
1.1. BACKGROUND AND MOTIVATION…….. 1
1.2. OBJECTIVES……...5

2. LITERATURE REVIEW……... 6
2.1. STRESS-FLOW COUPLING IN FRACTURES: EXPERIMENTS AND MODELS…….. 6
2.2. PARTICLE TRANSPORT PROCESSES IN FRACTURES: EXPERIMENTS AND MODELS…… 10

3. METHODOLOGY…….. 14
3.1. SAMPLE PREPARATION AND APERTURE REPRESENTATION……... 14
3.2. CHARACTERIZATION OF SURFACE ROUGHNESS USING GEOSTATISTICAL APPROACH……...17
3.3. NUMERICAL METHODS…….. 18
3.3.1. FLOW CALCULATION USING FEM…….. 18
3.3.2. PARTICLE TRACKING ALGORITHM……22

4. RESULTS AND DISCUSSION…….. 30
4.1. CHARACTERIZATION OF ROUGHNESS, APERTURE AND TRANSMISSIVITY FIELDS USING SEMI-VARIOGRAMS……...30
4.1.1. APERTURE……30
4.1.1.1. TRANSLATIONAL SHEAR……30
4.1.1.2. ROTARY SHEAR……..37
4.1.2. TRANSMISSIVITY…… 41
4.1.2.1. TRANSLATIONAL SHEAR……41
4.1.2.2. ROTARY SHEAR……..45
4.2. COUPLED FLUID FLOW AND PARTICLE TRANSPORT DURING SHEAR.. 48
4.2.1. UNIDIRECTIONAL FLOW PATTERNS……..48
4.2.1.1. FLOW PARALLEL WITH SHEAR DIRECTION……48
4.2.1.2. FLOW PERPENDICULAR TO SHEAR DIRECTION…… 55
4.2.2. BI-DIRECTIONAL FLOW PATTERN……..66
4.2.3. RADIAL FLOW PATTERNS……72
4.2.3.1. TRANSLATIONAL SHEAR……73
4.2.3.2. ROTARY SHEAR……..80

5. CONCLUSIONS…….. 87

6. RECOMMENDATIONS FOR FUTURE RESEARCH…….. 88

7. ACKNOWLEDGEMENT……...89

8. REFERENCES……90

APPENDIX A……...95