CHAPTER V
TEST RESULTS

5.1 Introduction

Laboratory test results are presented in this chapter. The CERCHAR abrasivity index tests reveal the effects of number of joints and joint apertures. Scratching groove volume on the specimens, and energy required to produce groove volumes under different joint characteristics are also described.

5.2 CERCHAR abrasivity index

Table 5.1 summarizs the CAI values obtained from intact rocks and those with different characteristics of joints for all rock types. It can be clearly seen that intact Buriram basalt (strong rock) tends to show larger abrasiveness than those obtained from softer rocks (limestone and sandstone). This is also true when the rock contain joints. Appendix A shows the stylus tips measured from the three intact rocks.

5.2.1 Effect of number of joints

The CAI values are plotted as a function of number of joints (J_n) in Figures 5.1 through 5.3 for the three rock types. They are also compared with those of the intact rocks. For all tested rocks, CAI's steadily decrease as J_n increases. Each data point in the diagrams represents mean and standard deviation values. The existence of even one joint can signifyingly reduce the CAI values for each rock type. Appendixs B though E give stylus tips after scratching the specimen surfaces with one though four joints.

5.2.2 Effect of joint apertures

As shown in Figures 5.1 though 5.3, CAI's decrease notably when the joint apertures (e) increase. This is true for all tested rocks. Different joint apertures tend to show similar reduction trend of CAI's as the number of joints (J_n) increases. The reduction of CAI's with increasing joint apertures (e) is larger for basalt (strong rock) than those observed from limestone and sandstone (softer rocks).

Table 5.1 Results of CERCHAR testing of all rock types and joint characteristics.

Number of joints (J_n)	Aperture (e) (mm)	CAI		
		Rock type		
		Khao Khad limestone	Phu Phan sandstone	Buriram basalt
0 (Intact rock)	-	1.75	2.27	2.47
1	0	1.47	1.63	1.99
	0.3	1.37	1.56	1.51
	0.5	1.17	1.20	1.45
	0.8	0.96	1.04	1.09
2	0	1.36	1.41	1.74
	0.3	1.13	1.08	1.30
	0.5	1.02	0.96	1.26
	0.8	0.94	0.83	0.87
3	0	1.25	1.34	1.71
	0.3	1.10	0.95	1.06
	0.5	0.95	0.88	1.02
	0.8	0.75	0.73	0.87
4	0	0.87	1.23	1.70
	0.3	0.75	0.72	1.00
	0.5	0.60	0.69	0.77
	0.8	0.51	0.57	0.67

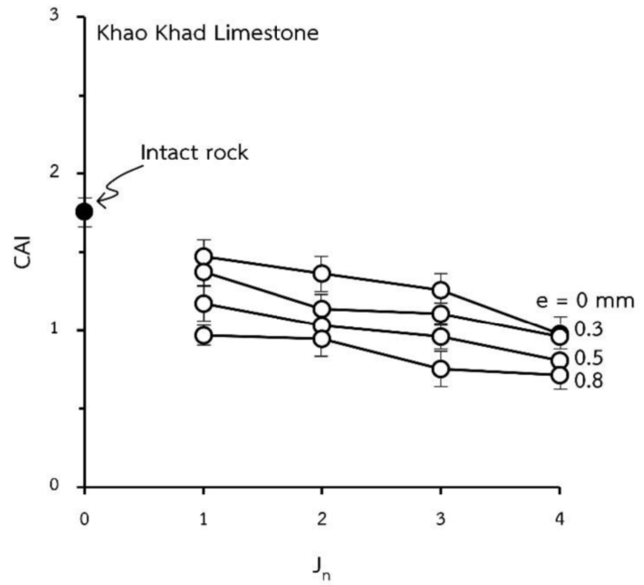

Figure 5.1 CAI as a function of joint numbers with different aperture for Khao Khad limestone.

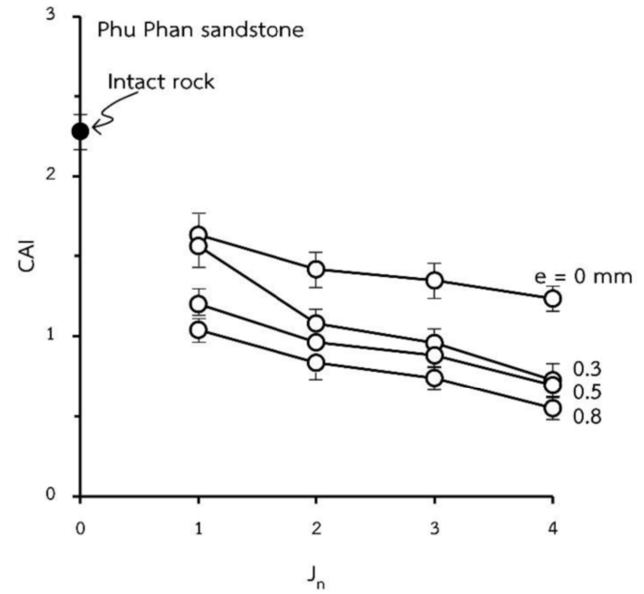

Figure 5.2 CAI as a function of joint numbers with different aperture for Phu Phan sandstone.

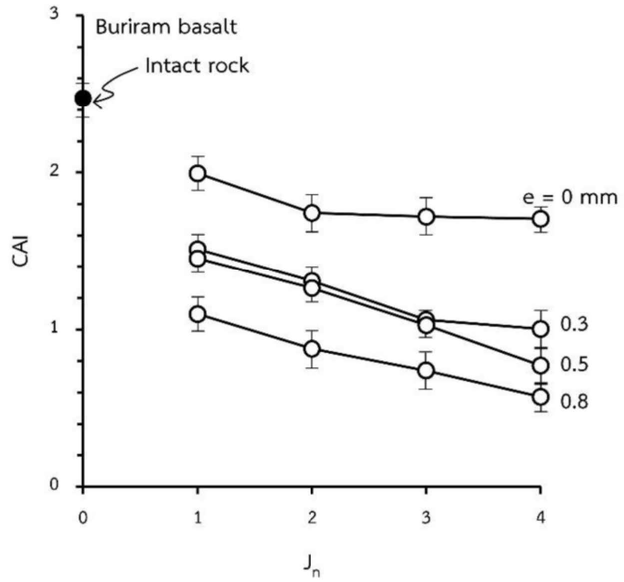

Figure 5.3 CAI as a function of joint numbers with different aperture for Buriram basalt.

5.3 Lateral force

Figures 5.4 through 5.6 show the lateral forces as a function of scratching distance for different numbers of joints and apertures. They are compared with those of the intact specimen (no joint). The curves shown here are the average of the five scratching tests. Individual scratching results for different joint characteristics are given in Appendix F, by the force at each contact point is determined based on the peak value recorded during each effect event between the rock surface and the stylus.

The method to obtain the representative curves from the five individual scratching is presented in the next chapter (Analysis of the results). Both joint apertures and their numbers strongly affect the scratching force, particularly for sandstone and basalt. For Khao Khad limestone the effects of joint aperture and joint number are small (Figure 5.4). Larger joint number and aperture induce larger scratching force on the rock surfaces for sandstone and basalt (Figures 5.5 and 5.6).

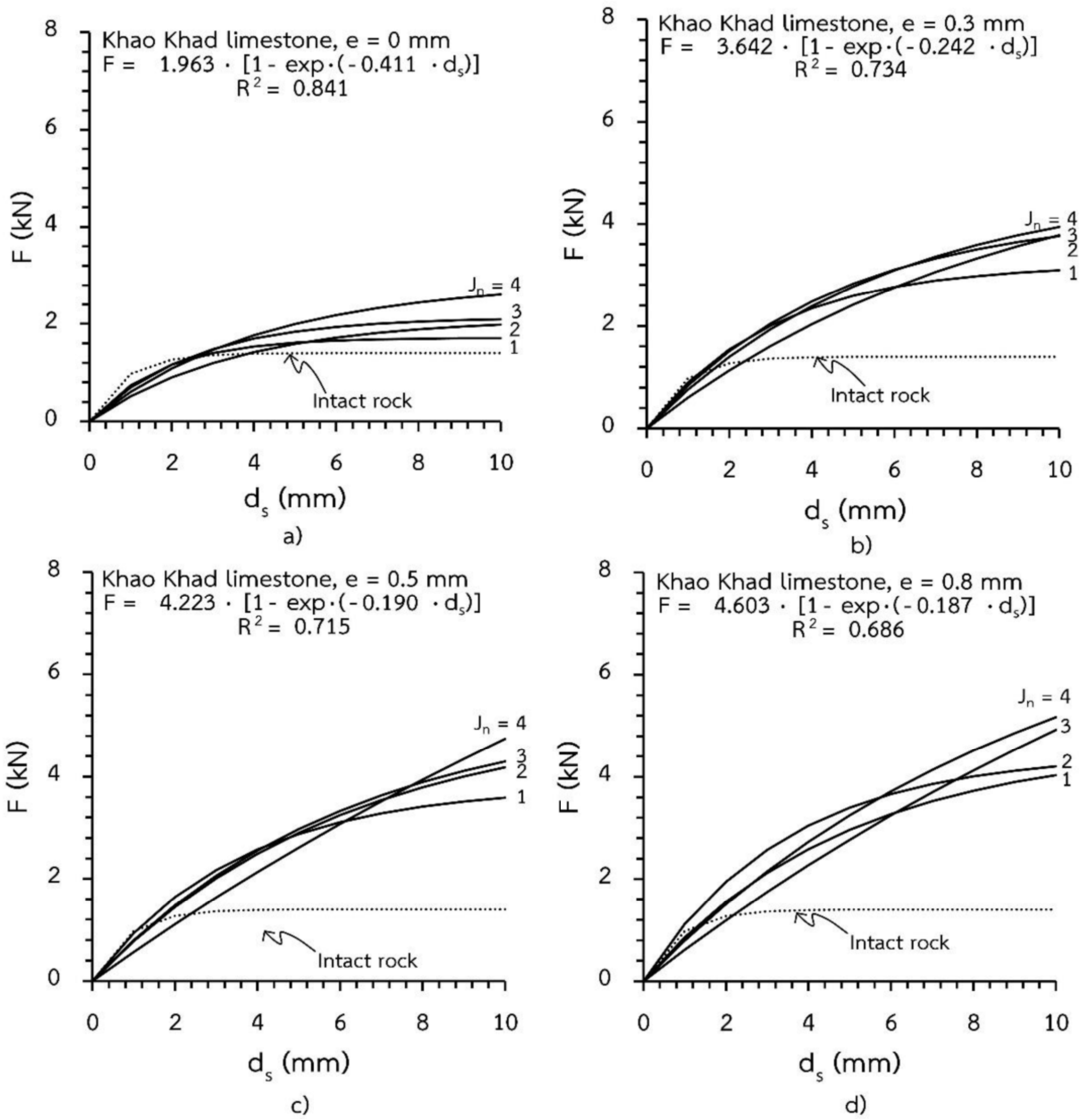

Figure 5.4 Lateral force as a function scratching displacement (d_s) for Khao Khad limestone for apertures of 0 (a), 0.3 (b), 0.5 (c) and 0.8 mm (d) with different number of joints (J_n).

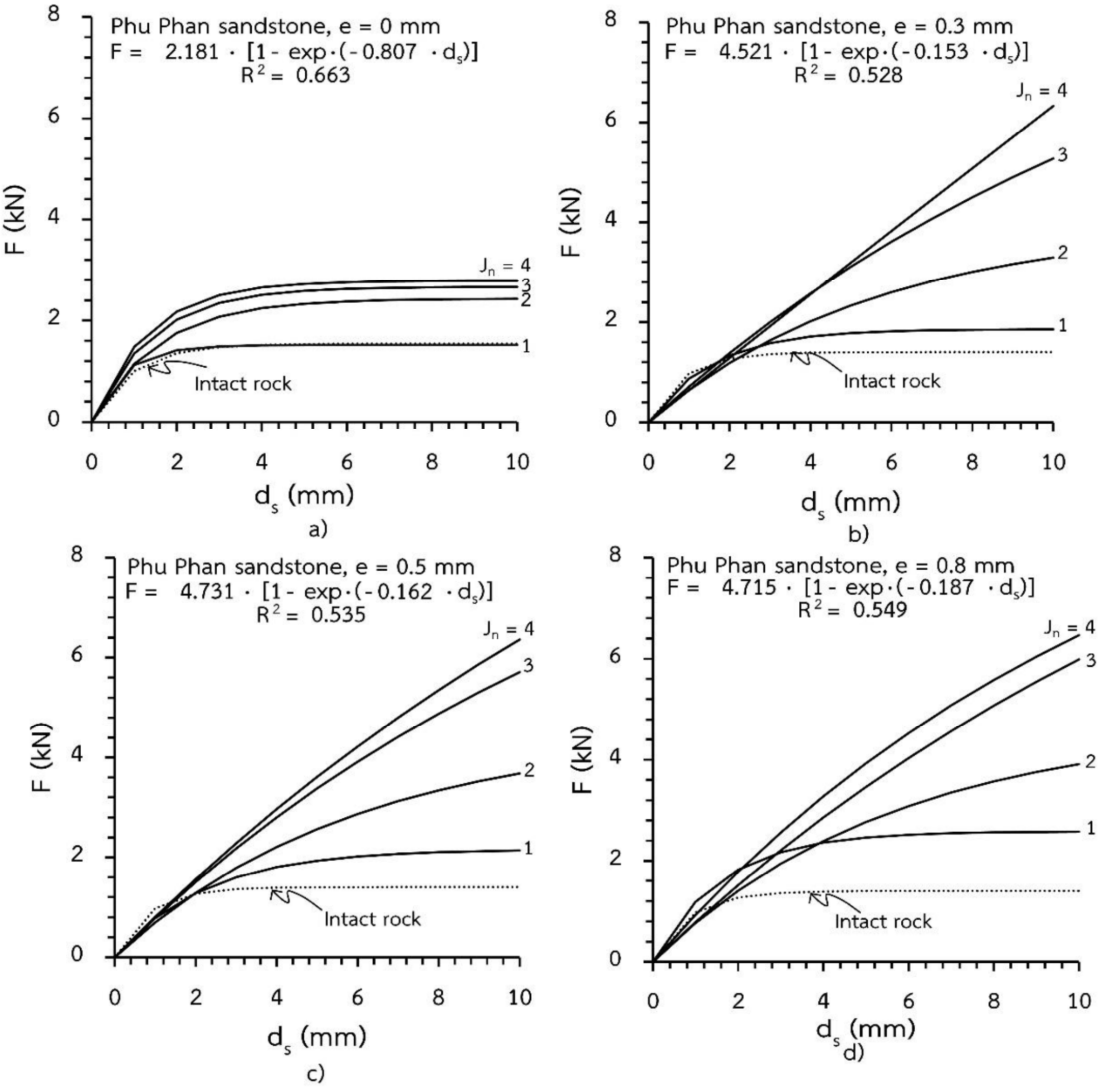

Figure 5.5 Lateral force as a function scratching displacement (d_s) for Phu Phan sandstone for apertures of 0 (a), 0.3 (b), 0.5 (c) and 0.8 mm (d) with different number of joints (J_n).

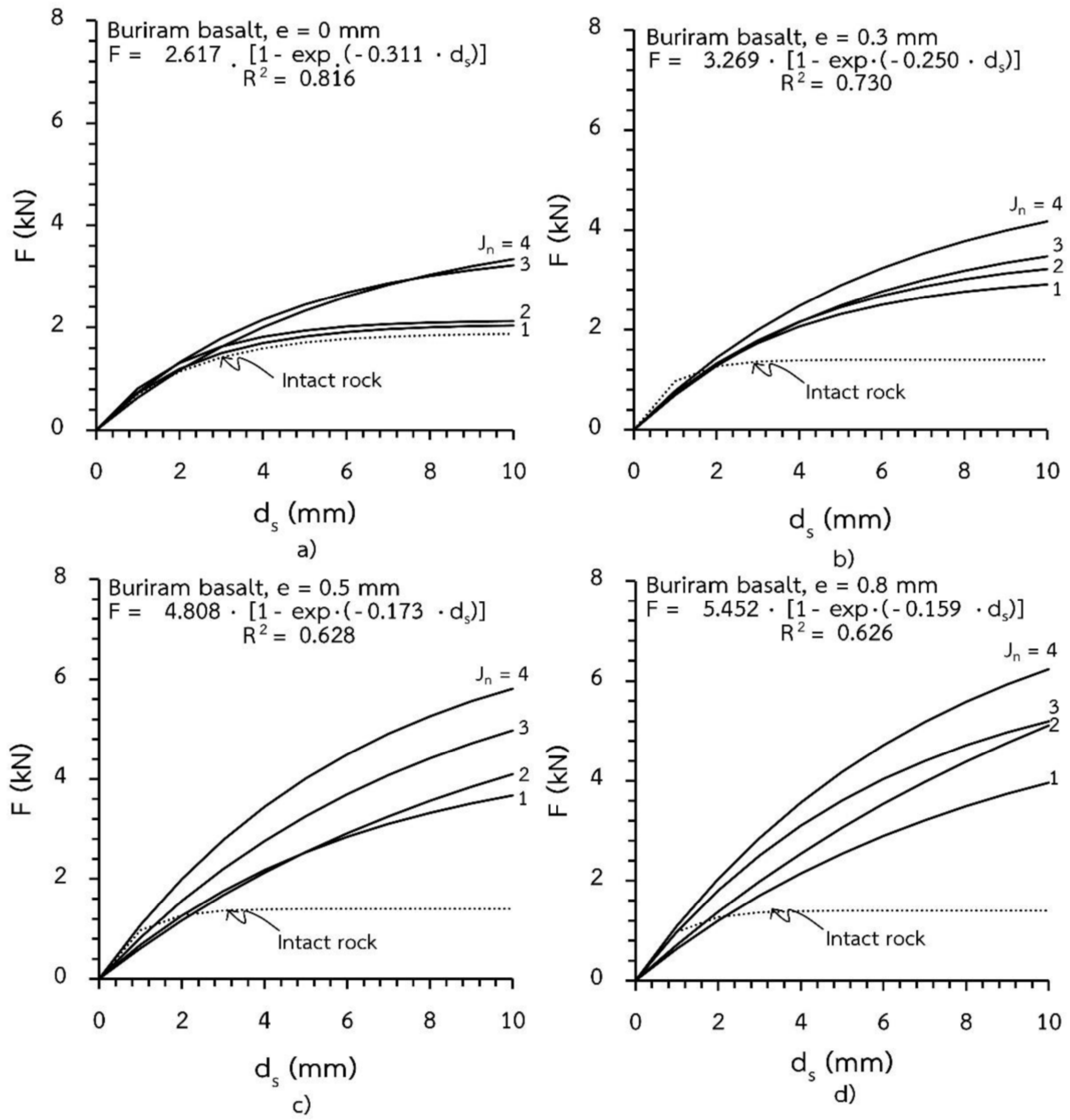

Figure 5.6 Lateral force as a function scratching displacement (d_s) for Buriram basalt for apertures of 0 (a), 0.3 (b), 0.5 (c) and 0.8 mm (d) with different number of joints (J_n).

5.4 Groove volume

Table 5.2 summarizes the average groove volumes measured from specimen surfaces under different joint characteristics for all tested rocks. The results from scratching intact rocks are also presented. Detailed images of individual scratching tests are given in Appendix G. For all tested rocks, the scratching volumes increase with joint numbers and apertures (Figure 5.7).

Table 5.2 Groove volumes for all rock types and joint characteristics.

Number of joints (J_n)	Aperture (e) (mm)	V (mm^3)		
		Rock type		
		Khao Khad limestone	Phu Phan sandstone	Buriram basalt
0 (Intact rock)	-	1.14	1.58	2.49
1	0	1.12	3.68	2.85
	0.3	3.01	5.89	3.87
	0.5	11.78	13.34	10.75
	0.8	16.05	21.61	13.78
2	0	1.92	9.09	3.08
	0.3	10.36	20.03	11.02
	0.5	21.05	39.21	29.16
	0.8	32.74	46.92	38.15
3	0	5.25	11.87	3.89
	0.3	16.90	25.95	14.87
	0.5	40.44	48.20	34.60
	0.8	50.99	59.19	47.72
4	0	14.71	20.67	13.85
	0.3	20.26	28.81	18.37
	0.5	47.65	52.99	42.57
	0.8	54.63	66.31	51.21

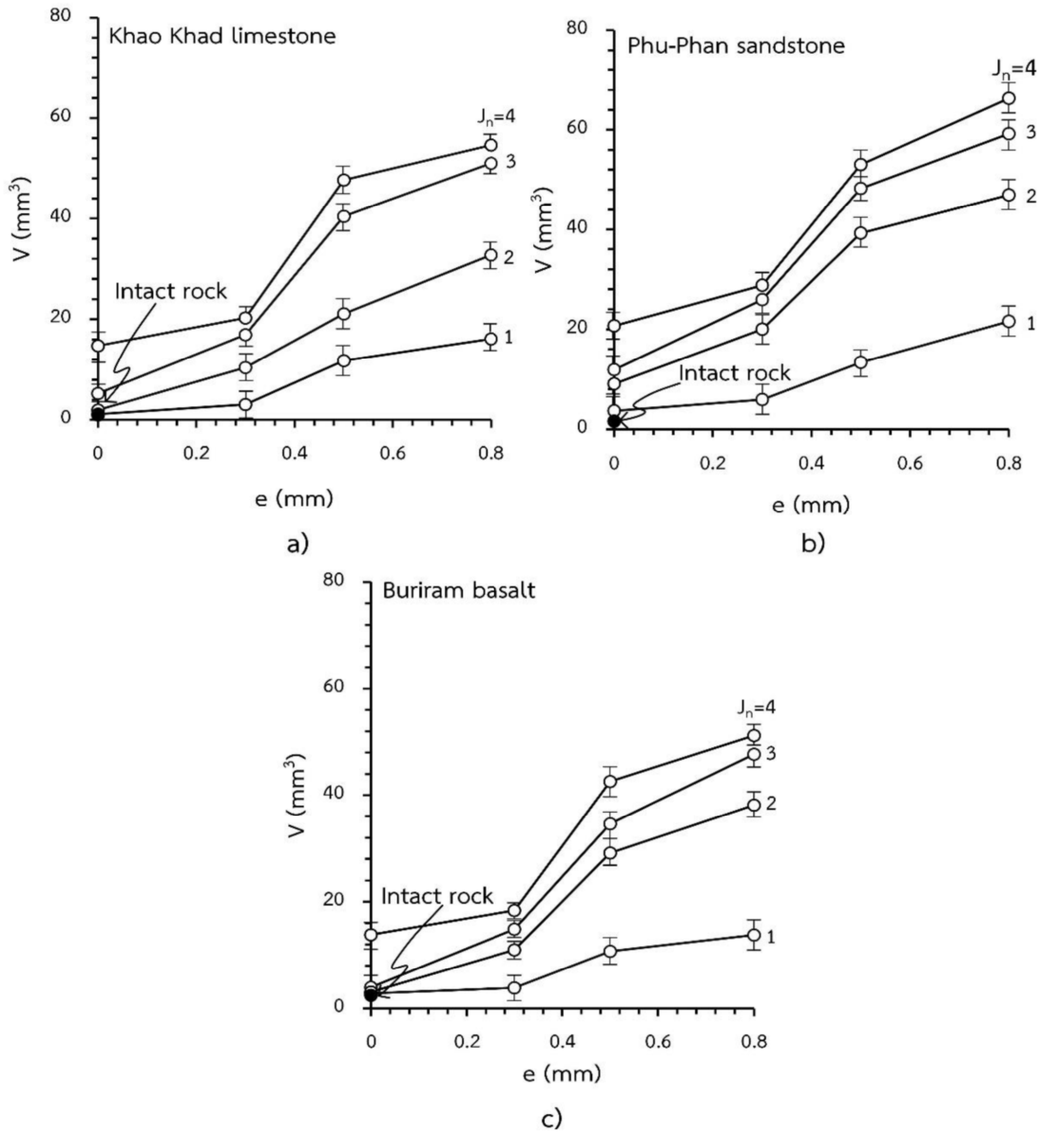

Figure 5.7 Groove volume as a function of joint aperture for different numbers of joints for Khao Khad limestone (a), Phu Phan sandstone (b) and Buriram basalt (c).