APPENDIX AUS

Singleton, Australia (2002)

Rix's Creek Blasting

Richards & Moore_2002

Figure AUS-1 – Photograph of the residential structure in Singleton, Australia. (South-east view)

Background

This report aims to assuage the concerns about blasting vibrations near a residential structure in te township of Singleton, Australia by comparing crack responses caused by weather fronts to those caused by ground motions. The test house is of conventional brick veneer construction, with a timber frame, 10 mm plasterboard internal lining, tiled roof, timber floor boards and aluminium framed windows. Refer to Figure AUS-1 for a look at the structure and Figure AUS-2 for the floor plan.

Prior to the project, a number of cracks had developed over the life of the house generally consistent with loss of foundation support and settlement of footings, although some related directly to poor building practices. The growth pattern of all cracks was recorded between March 2000 and April 2001. The width of seven cracks in the house structure have been accurately monitored with DEMEC gauge measurements between installed targets.

The peak particle velocity measured on the ground near the house and the peak airblast measured during this investigation are listed in Table AUS-1.

The monitored cracks are described in Table AUS-2 together with the maximum movement during blasting and movement after blasting ceased. The peak air vibration exceeded 145 dBL, but no glass damage resulted in windows or sliding doors. Crack width movement diagrams are shown in Figures AUS-3 and AUS-4 and cumulative rainfall total, together with peak ground vibration measurements and daily rainfall totals. From these figures it can be seen that the rainfall pattern shows a strong correlation with the variation in width of some cracks. These cracks have responded to a high rainfall period after the cessation of blasting.

The horizontal strain gauge placed across the brickwork crack below the kitchen window in the test house enabled the changing width of the crack to be measured in response to ground vibration. Figure AUS-5 shows the plot of increased crack width versus PPV. There is a close correlation and it may be reasonably concluded that a ground PPV of 20 mm/s results in cracks temporarily opening between 0.05 mm and 0.08 mm. This further reinforces the observation that at vibration levels below 20 mm/s, the brick wall is behaving elastically and returns to its original position. At vibration levels above 70 mm/s, there is permanent widening.

At the locations where the crack width was monitored, the movement is complex and relates more closely to ground moisture variation than to blasting events. There was considerable movement of crack widths after the conclusion of blasting that is clearly related to high rainfall episodes.

Reference:
Richards, Alan B., and Adrian J. Moore. *Structure Response to Blast Vibration*. Rep. no. C9040. 2002.

Figure AUS-2 – House floor plan

Blast No.	Date	Charge Mass (kg)	Distance (m)	PPV (mm/s)	Air Vibration (dBL)
1	01/03/00	300	231	18.4	128
2	20/03/00	1300	450	16.1	140
3	22/03/00	300	268	14.2	127
4	27/03/00	200	363	4.5	125
5	11/04/00	85	395	4.5	129
6	13/04/00	150	306	7.3	124
7	13/04/00	150	306	6.3	127
8	04/05/00	1000	401	17.4	125
9	09/05/00	250	255	11.3	126
10	12/05/00	80	280	1.7	124
11	12/05/00	250	280	15.0	127
12	22/05/00	1000	260	20.5	128
13	31/05/00	300	380	9.3	120
14	31/05/00	50	408	3.0	117
15	14/06/00	50	425	1.5	124
16	14/07/00	50	247	4.7	136
17	18/07/00	150	418	6.9	133
18	25/07/00	-	-	8.0	130
19	28/07/00	30	-	4.9	135
20	07/08/00	200	214	16.6	124
21	07/08/00	50	447	2.9	120
22	08/08/00	1100	810	9.7	128
23	11/08/00	350	106	71.2	131
24	11/08/00	250	333	9.6	123
25	17/08/00	300	106	17.3	128
26	02/11/00	150	252	10.4	128
27	06/11/00	200	-	13.0	126
28	27/11/00	150	166	36.2	134
29	28/11/00	300	135	73.6	129
30	30/11/00	110	106	44.4	>145
31	07/12/00	350	55	190.0	136
32	20/12/00	330	50	222.0	145
33	21/12/00	1100	400	41.4	124
34	19/01/01	150	250	9.3	-

Figure AUS-2 – Blast Vibration measurement summary

No.	Location	Internal	External	Description	Movement during blasting (mm)	Movement without blasting (mm)
1	Living Room	✓		Stepped crack in non-structural brickwork.	0.3	1.3
2	Kitchen		✓	Stepped crack in veneer brickwork.	0.12	2.2
3	Kitchen	✓		Vertical crack in structural brickwork.	<0.1	0.5
3	Kitchen	✓		Horizontal crack in plaster.	<0.1	0.6
5	Laundry	✓		Sub-horizontal crack in plaster.	<0.1	0.5
6	Bedroom		✓	Horizontal crack in veneer brickwork.	<0.1	0.2
7	Bedroom		✓	Vertical crack in veneer brickwork.	<0.1	0.6

Table AUS-2 – Crack description and width movement summary

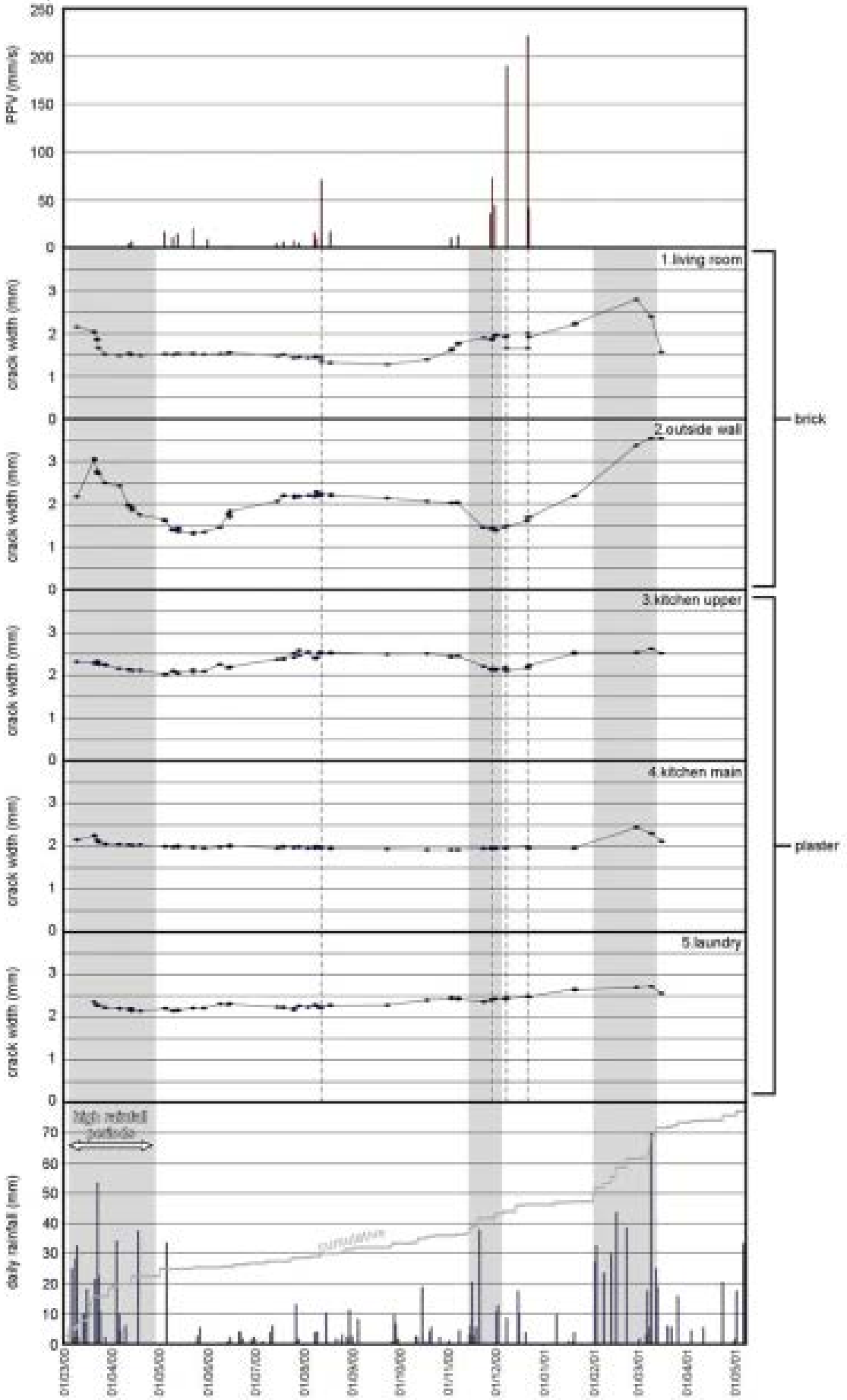

Figure AUS-3 – Crack width movement diagrams compared to PPV and rainfall

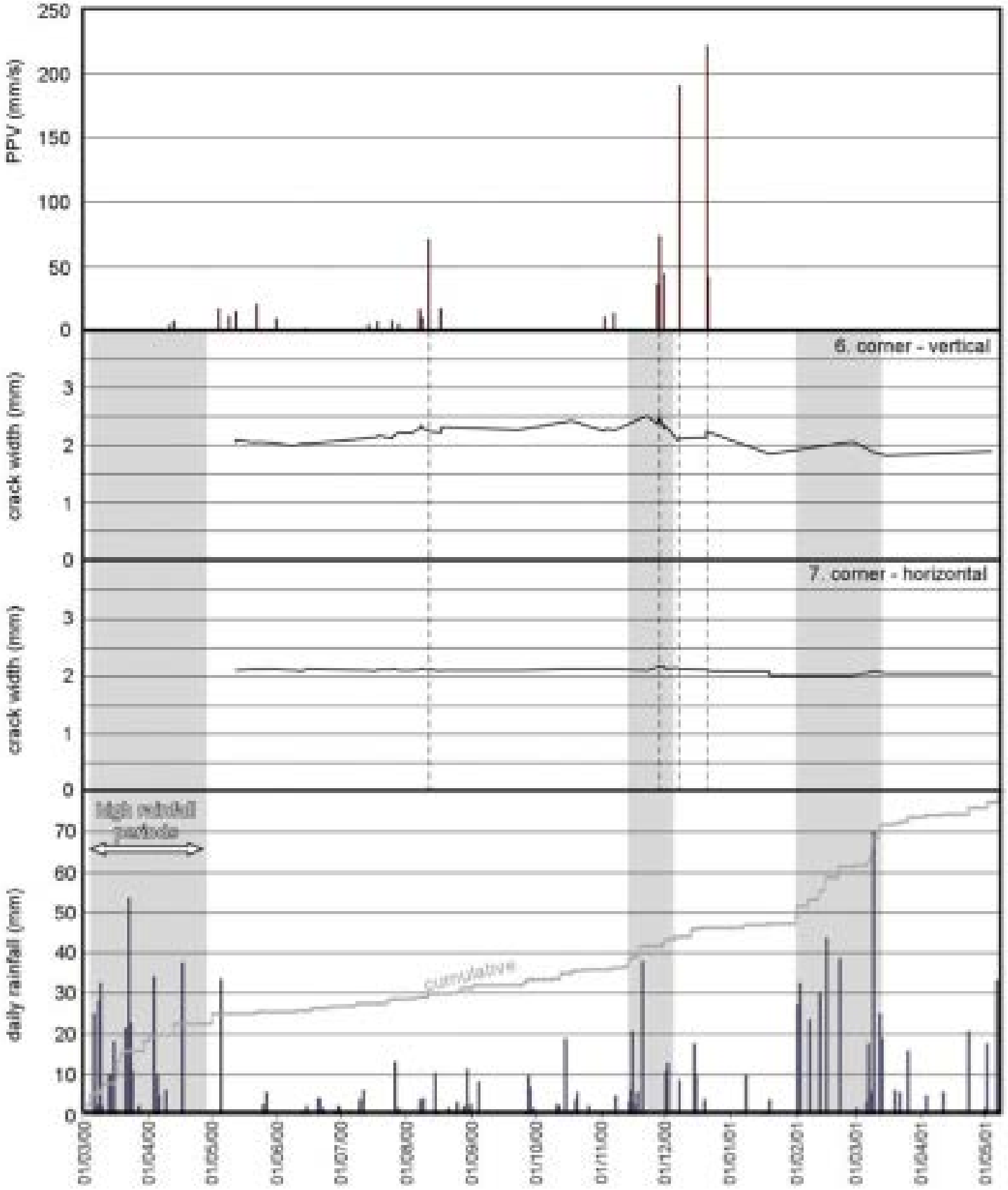

Figure AUS-4 – Crack width movement diagrams compared to PPV and rainfall (continued)

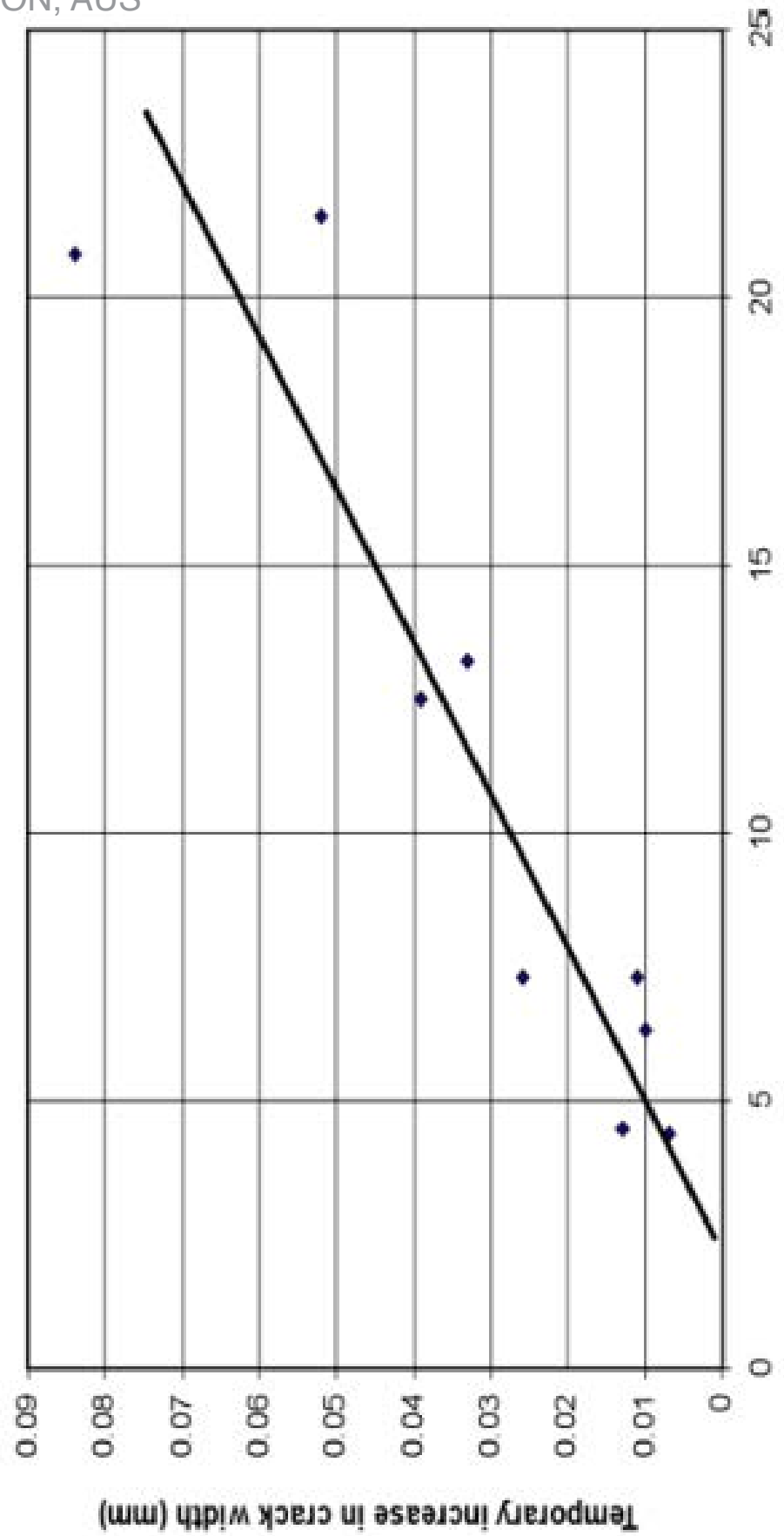

Figure AUS-5 – Cahnge of crack width versus PPV - crack no.4