

**Use of containment walls as a  
liquefaction remediation method for  
existing buildings – Data report on  
centrifuge tests WA1P, WA1F and WA3**

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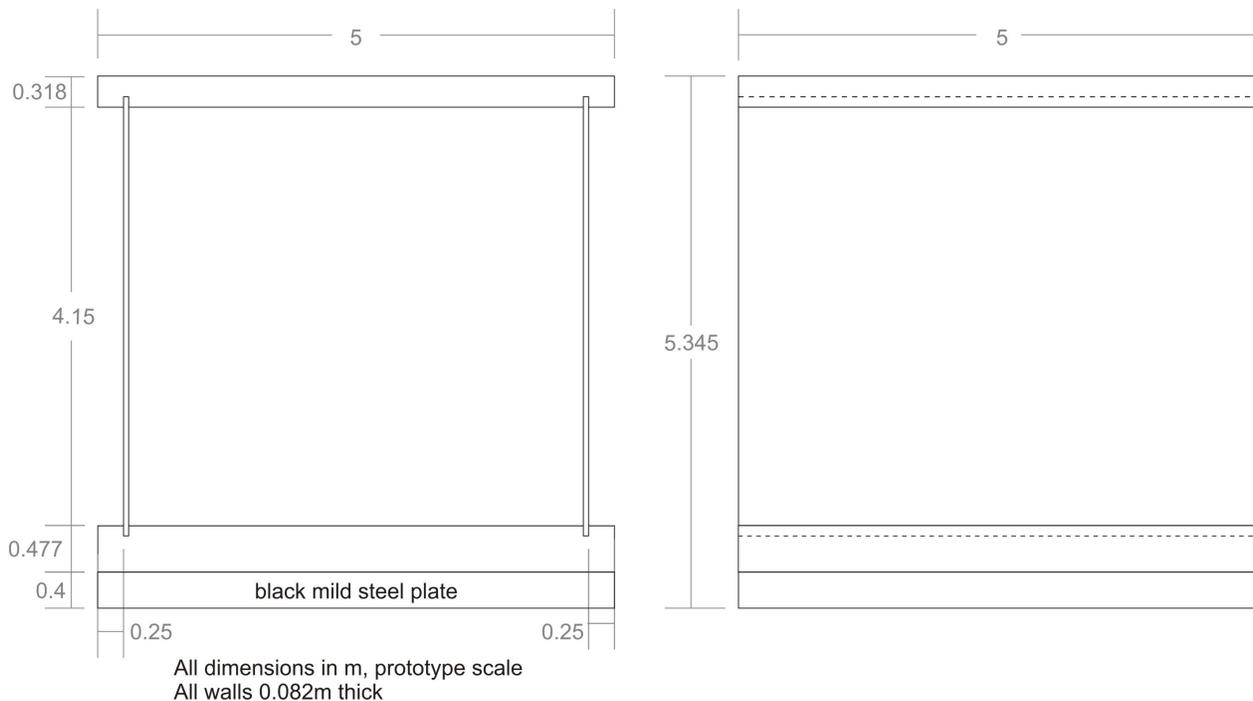
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## 1. Introduction

This report describes three centrifuge tests carried out as part of the NEMISREF project, at 50g, to investigate the behaviour of containment walls as a liquefaction remediation measure for existing buildings. The complete set of results is presented. Both rigid and flexible containment walls were used in the centrifuge tests to try and gain an insight into the factors affecting the performance of these walls. In order to assess the effectiveness of the containment walls tested, the results can be compared with those from centrifuge tests on similar unimproved soil profiles. These results can be found in technical report CUED/D-SOILS/TR.342 and full analysis, comparison and discussion of the results is given in Mitrani 2006, PhD thesis, University of Cambridge.

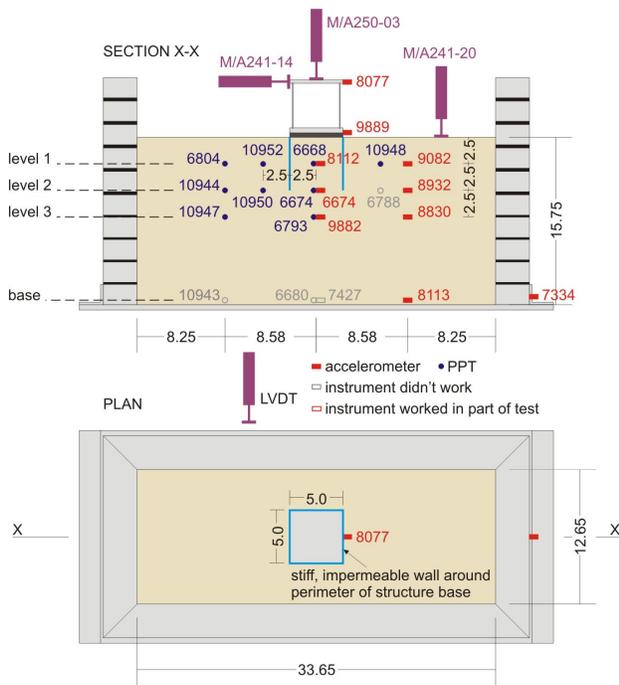
## 2. Description of centrifuge models

The model structure used in this series of centrifuge tests was a single degree of freedom (SDOF) frame structure with a natural frequency of 1.52Hz (prototype, 76Hz model scale) and a bearing pressure of 58kPa. This structure is shown in figure 1, at prototype scale.

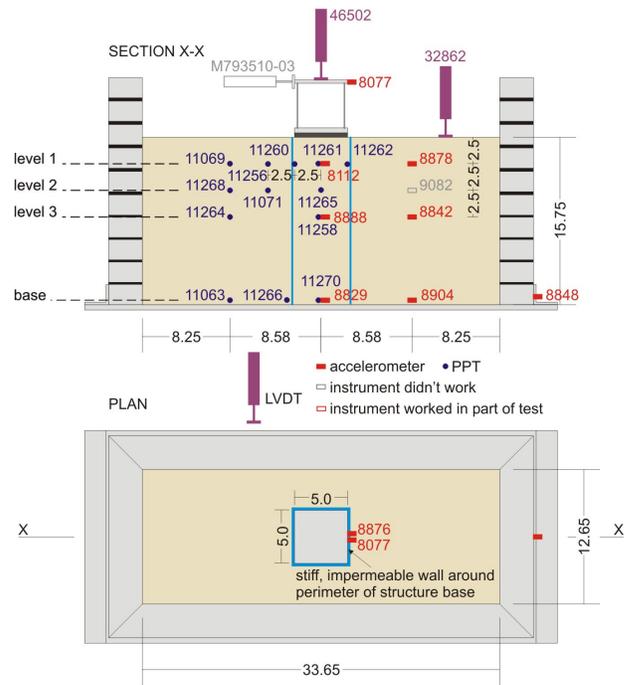


**Figure 1:** Diagram of SDOF structure

Centrifuge test WA1P was carried out on a model consisting of the SDOF structure founded on a deep (15.75m, 315mm) homogeneous bed of liquefiable sand. A partial-depth rigid containment wall around the base of the structure was used as a liquefaction remediation method. The containment wall was constructed from aluminium and was 5m (100mm) deep and 162.5mm (3.25mm) thick. This had an equivalent stiffness to a prototype concrete wall approximately 240mm thick. The instrument layout for centrifuge test WA1P is shown in figure 2, at prototype scale.



**Figure 2:** Instrument layout for centrifuge test WA1P



**Figure 3:** Instrument layout for centrifuge test WA1F

Figure 3 above shows the instrument layout for centrifuge test WA1F, at prototype scale. This centrifuge test was similar to WA1P, except a full-depth rigid containment wall, of the same properties as that used in centrifuge test WA1P, was adopted.

Centrifuge test WA3 was carried out on a model with a layered sand profile. This profile consisted of a loose layer of liquefiable sand 7m (140mm) deep, overlying a dense layer of the same sand, 5m (100m) deep. A flexible containment wall around the base of the structure was adopted, which extended through the full depth of the liquefiable layer. This wall was constructed from 0.1mm thick high density polyethylene (HDPE) sheet. The instrument layout for centrifuge test WA3 is shown in figure 4, at prototype scale.



### 3. Model Preparation

Each model was prepared in essentially the same way. Hostun S28 sand was air pluviated from an over-head hopper into the deep ESB box. A large orifice was used to produce the loose layers, and a small orifice, low flow rate and sieves were used to pour the dense layer in centrifuge test WA3. After completion of sand pouring and placement of the instruments and containment walls, the models were saturated under vacuum from the base, using 50cS methylcellulose. Following saturation, the structure was placed on the sand surface and connected to the containment walls. This was done after each model was loaded onto the centrifuge, to minimise structural settlement before testing. Placement of the containment walls and formation of this connection was slightly different for each model and full details of the preparation method for each can be found in Mitrani 2006.

It should be noted that the dimensions and instrument positions shown in figures 2 to 4 represent the geometry that was aimed for during construction of the models. However, due to the difficulties of making precise models by hand, the actual prototype dimensions were often different. The actual properties of the sand layers in centrifuge tests WA1P, WA1F and WA3 at prototype scale are shown in table 1.

**Table 1:** Properties of sand layers in models for centrifuge tests WA1P, WA1F and WA3

	WA1P	WA1F	WA3	
			loose	dense
layer thickness (m)	15.27	14.93	7.70	3.53
$\gamma_{drv}$ (kN/m <sup>3</sup> )	14.2	14.7	14.6	16.8
$\gamma_{sat}$ (kN/m <sup>3</sup> )	18.7	19.0	18.9	20.3
$D_r$ (%)	40	53	44	100

### 4. Centrifuge Test Procedure

All three centrifuge tests were carried out at 50g. Five earthquakes were fired in centrifuge tests WA1P and WA3 but only three in centrifuge test WA1F, due to a problem with the SAM actuator (see Mitrani 2006 for more details). The earthquakes were of difference size and frequency to investigate the behaviour of the structure thoroughly. The main details of the earthquakes fired in each test are shown in table 2, at prototype scale. It should be noted that in centrifuge tests WA1F and WA3, the order of the frequency sweep earthquake and earthquake 4

was reversed. The earthquakes were fired in order of increasing magnitude and frequency to try and minimise the effects of firing multiple earthquakes on a single model. Further details can be found in Mitrani 2006.

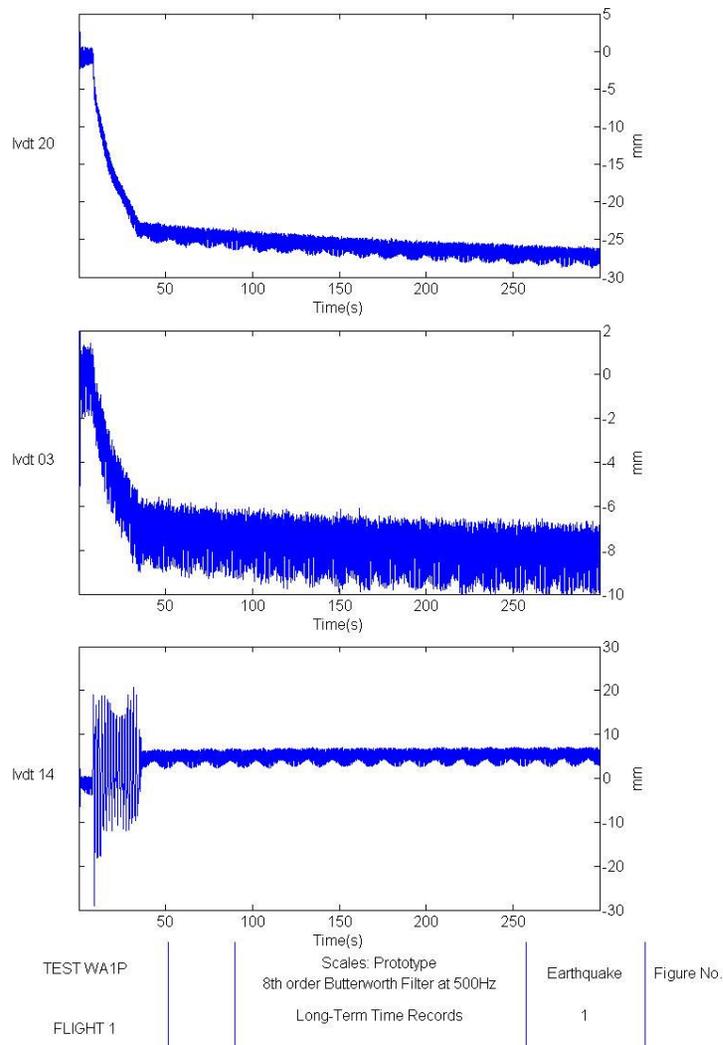
**Table 2:** Details of earthquakes fired in centrifuge tests WA1P, WA1F and WA3

	frequency (Hz)	duration (s)			max. base acc. (g)			no. of cycles		
		WA1P	WA1F	WA3	WA1P	WA1F	WA3	WA1P	WA1F	WA3
EQ1	0.6	28	40	29	0.08	0.07	0.04	17	24	17
EQ2	0.8	27	51	28	0.12	0.15	0.11	22	40	23
EQ3	1	27	54	28	0.23	0.27	0.17	28	52	28
sweep	1→0	≈193	-	≈181	0.31	-	0.26	≈113	-	≈107
EQ4	1	27	-	28	0.32	-	0.31	27	-	28

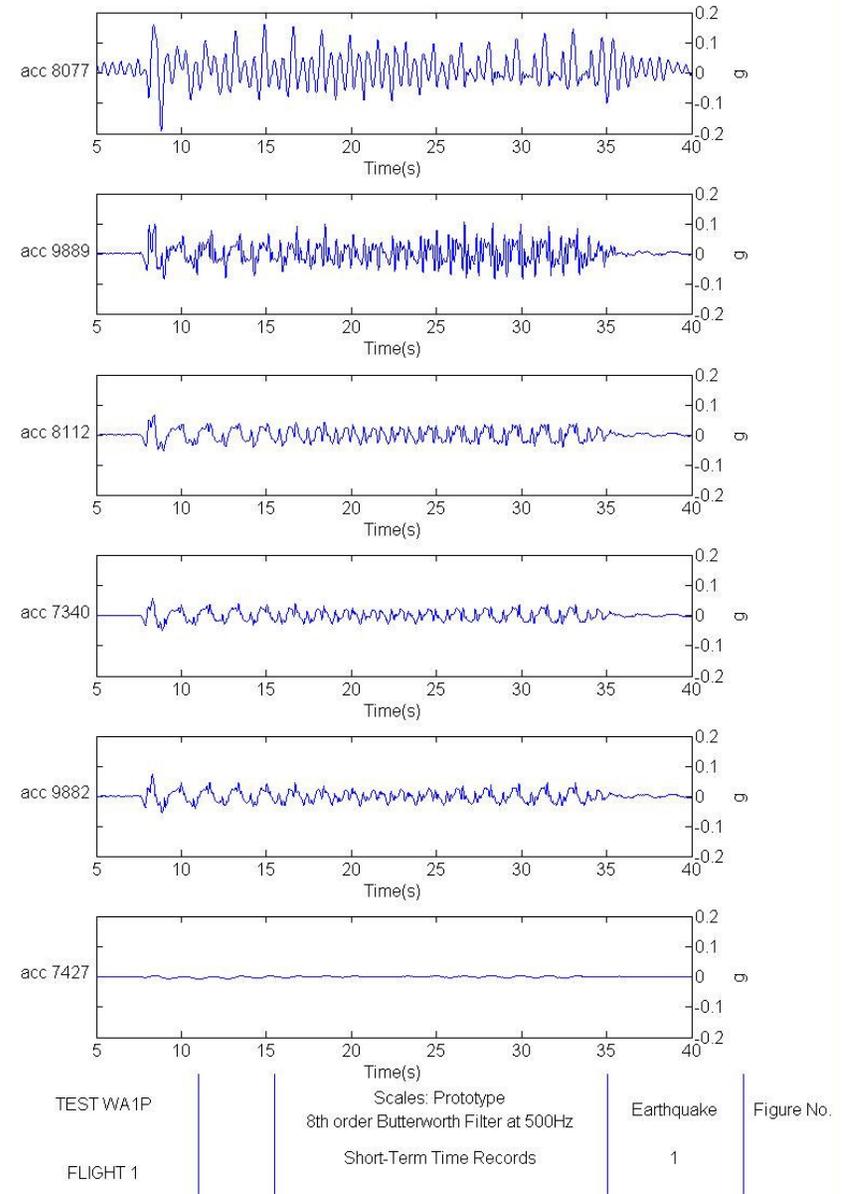
## 5. Results

### 5.1 Centrifuge test WA1P, earthquake 1

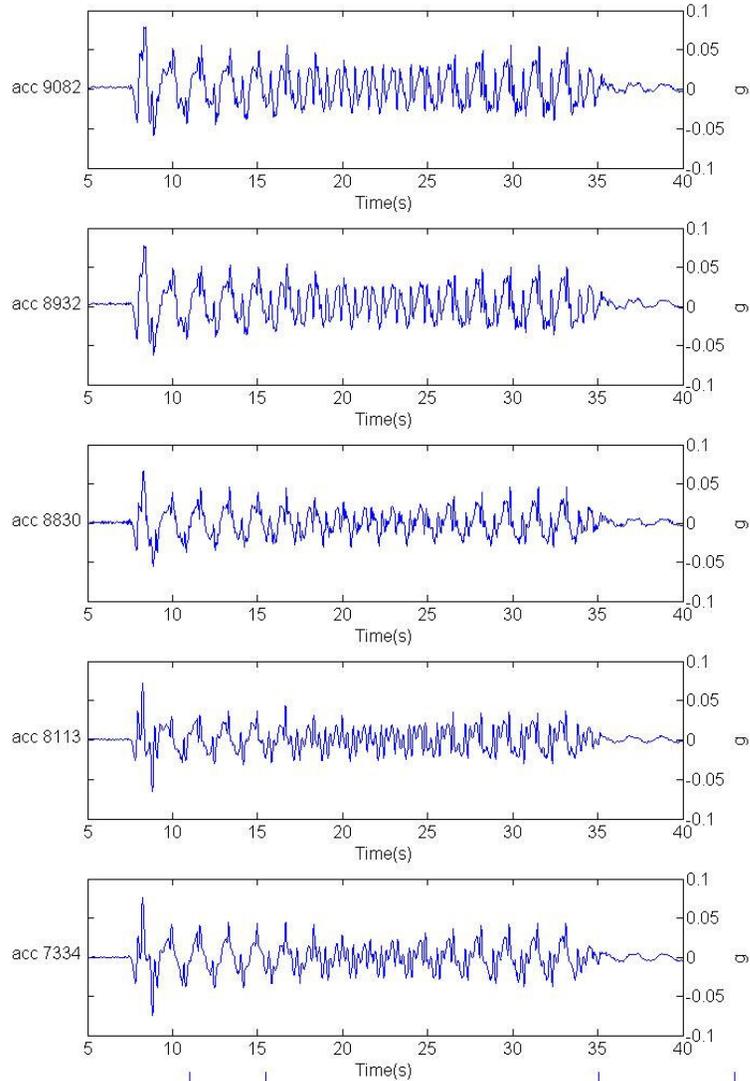
#### Soil and structural displacements



#### Accelerations on and under structure

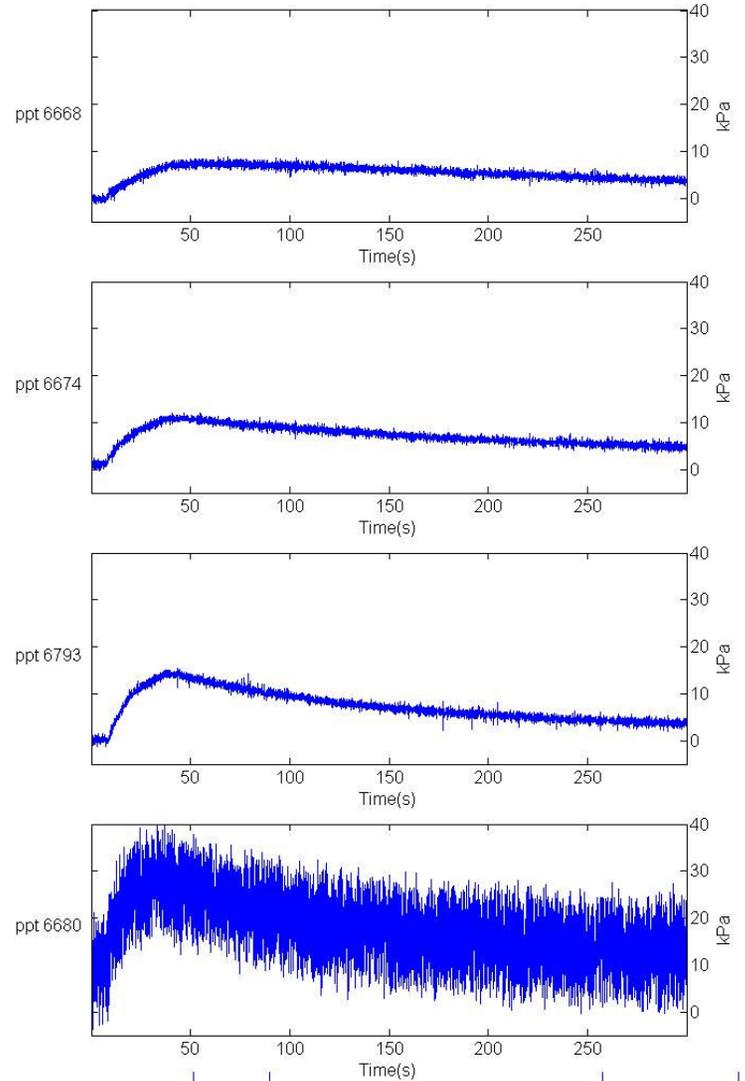


Free field soil accelerations and box (input) acceleration



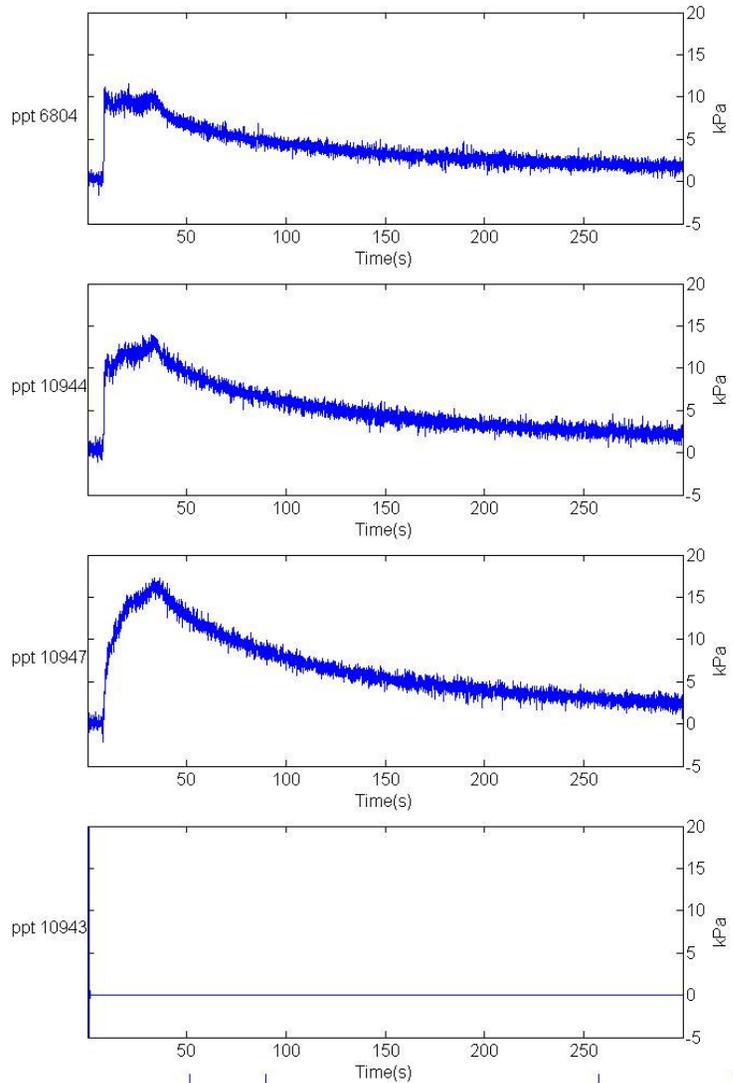
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
	8th order Butterworth Filter at 500Hz		
FLIGHT 1	Short-Term Time Records	1	

Excess pore pressures under centre of structure base



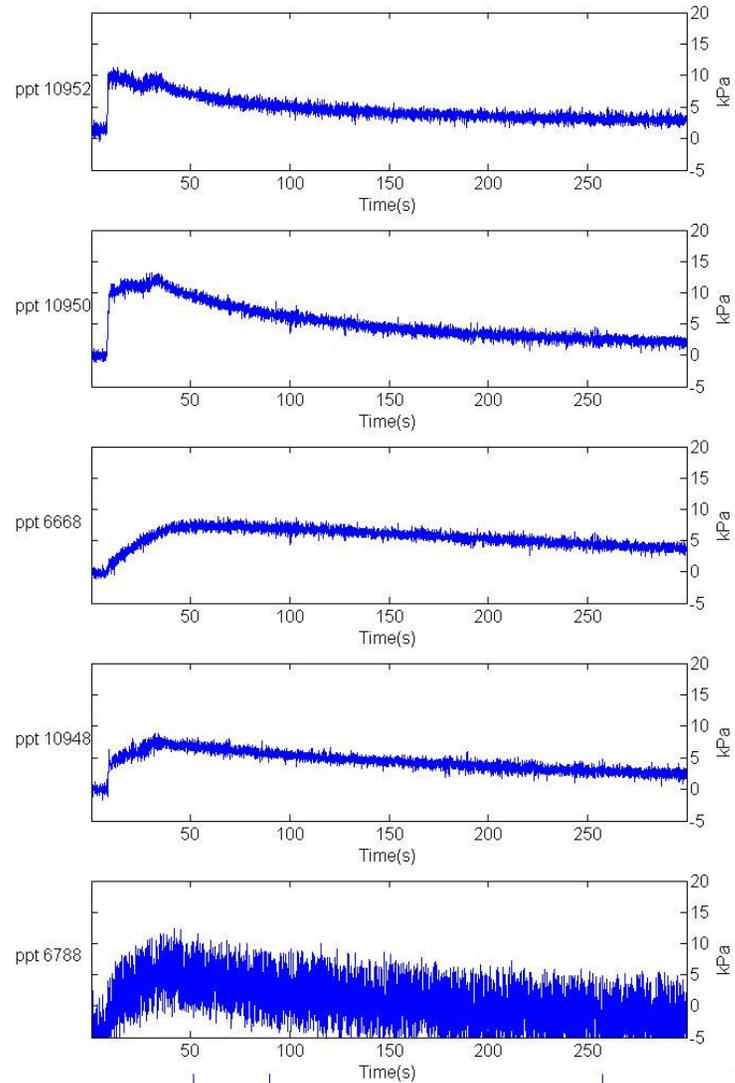
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
	8th order Butterworth Filter at 500Hz		
FLIGHT 1	Long-Term Time Records	1	

Free field excess pore pressures



TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	1	
	Long-Term Time Records		

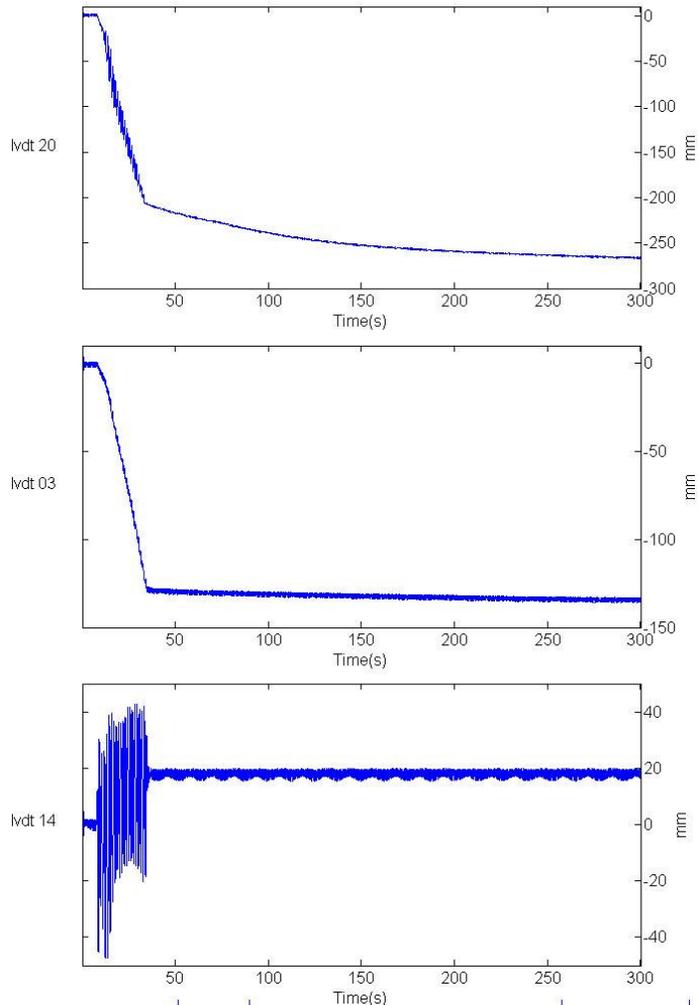
Excess pore pressures around structure base



TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	1	
	Long-Term Time Records		

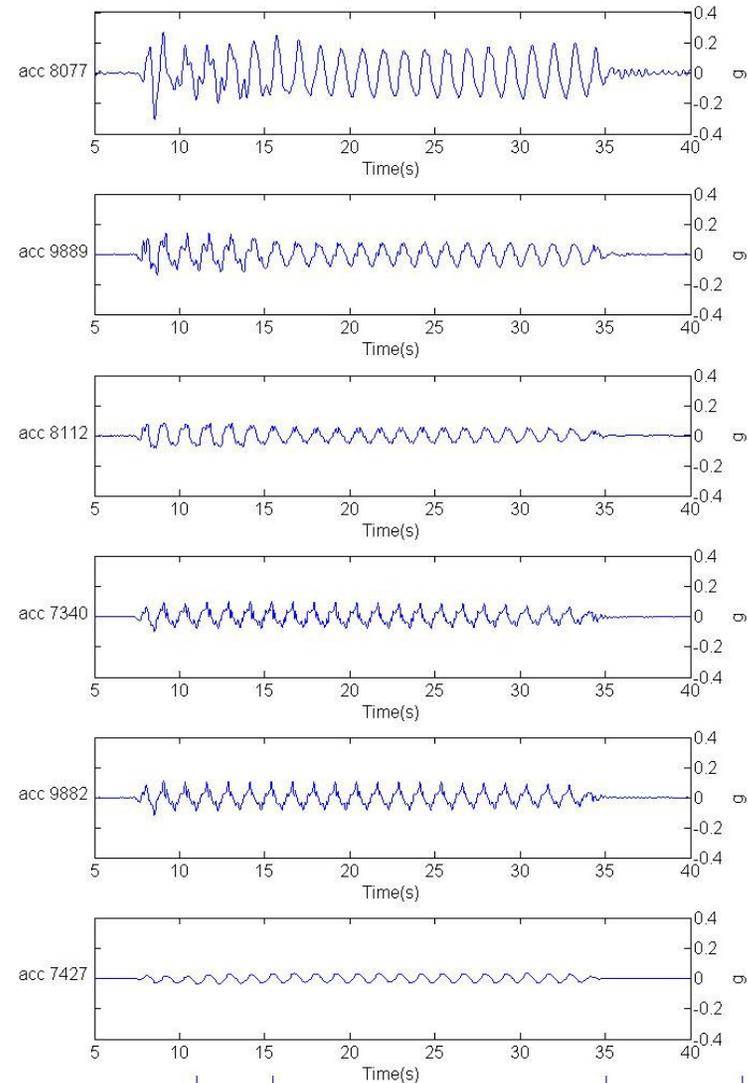
### 5.2 Centrifuge test WA1P, earthquake 2

#### Soil and structural displacements



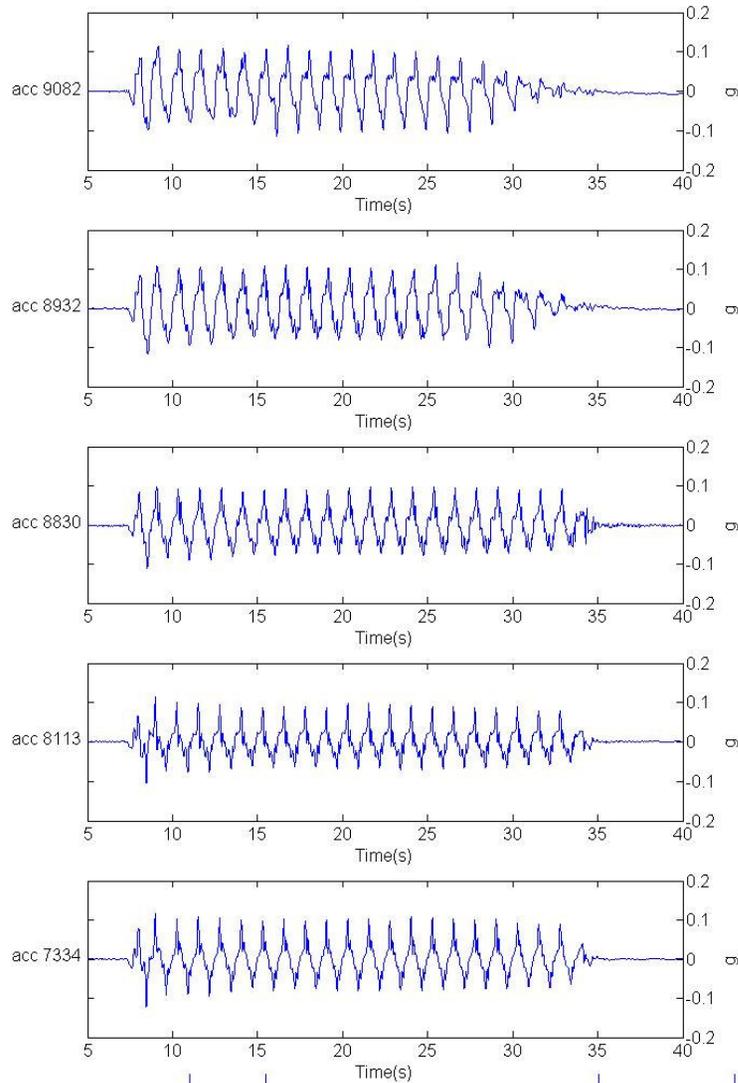
TEST WA1P	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Long-Term Time Records	2	

#### Accelerations on and under structure



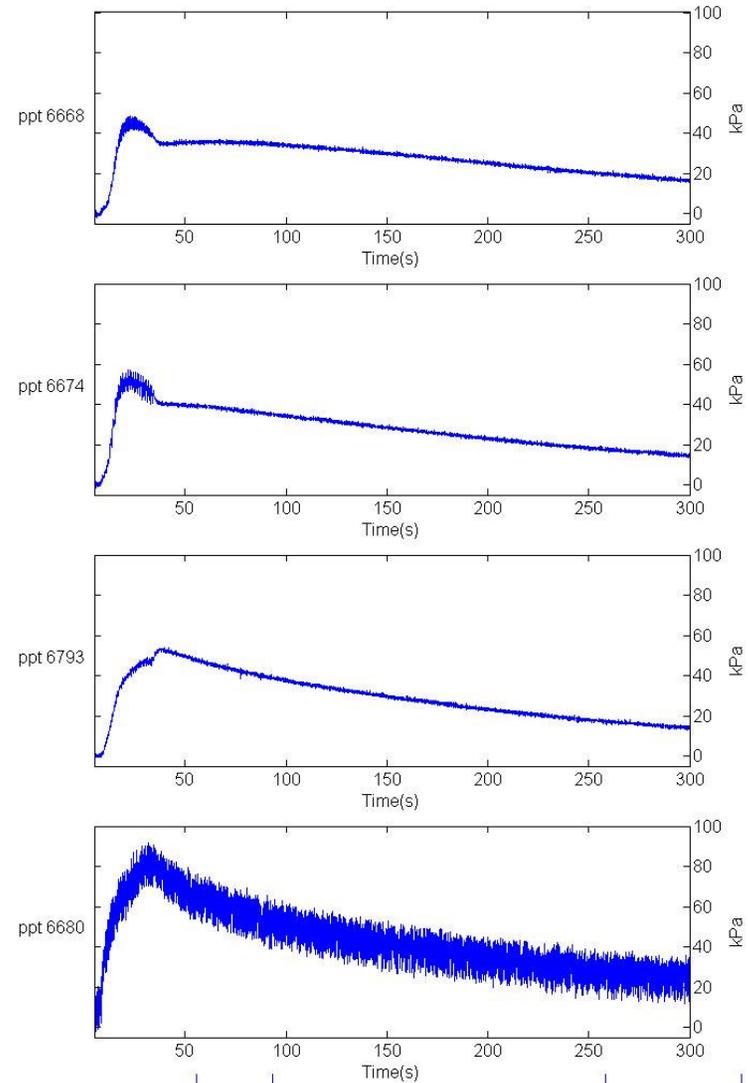
TEST WA1P	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Short-Term Time Records	2	

Free field soil accelerations and box (input) acceleration



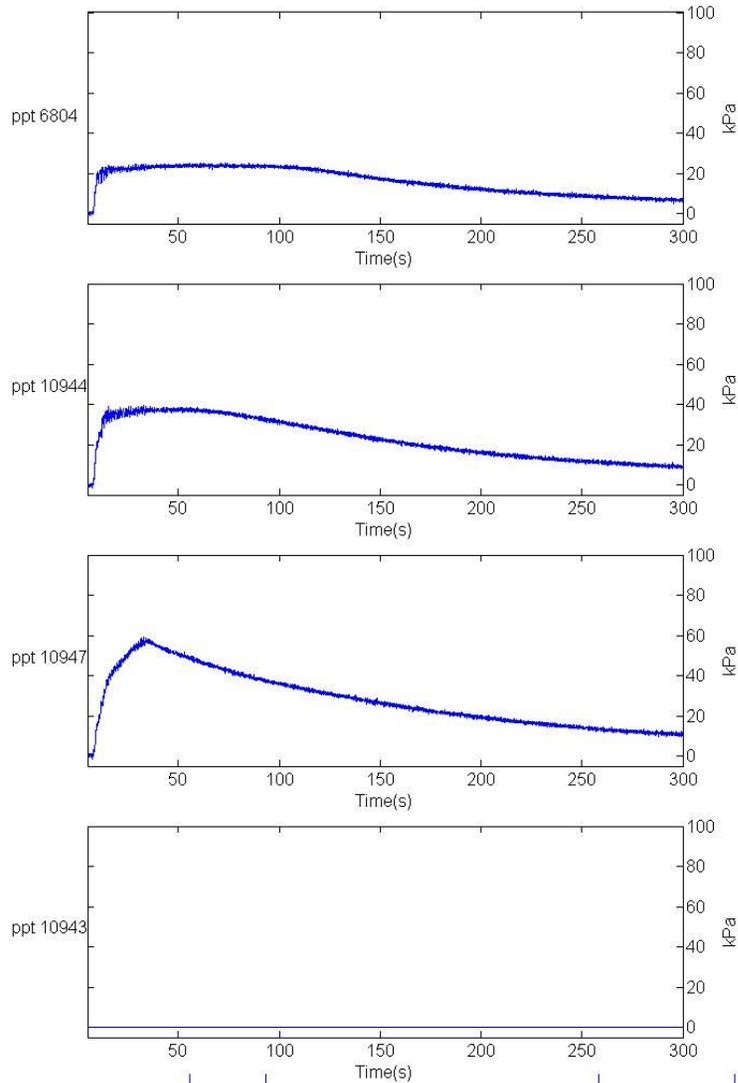
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Short-Term Time Records		

Excess pore pressures under centre of structure base



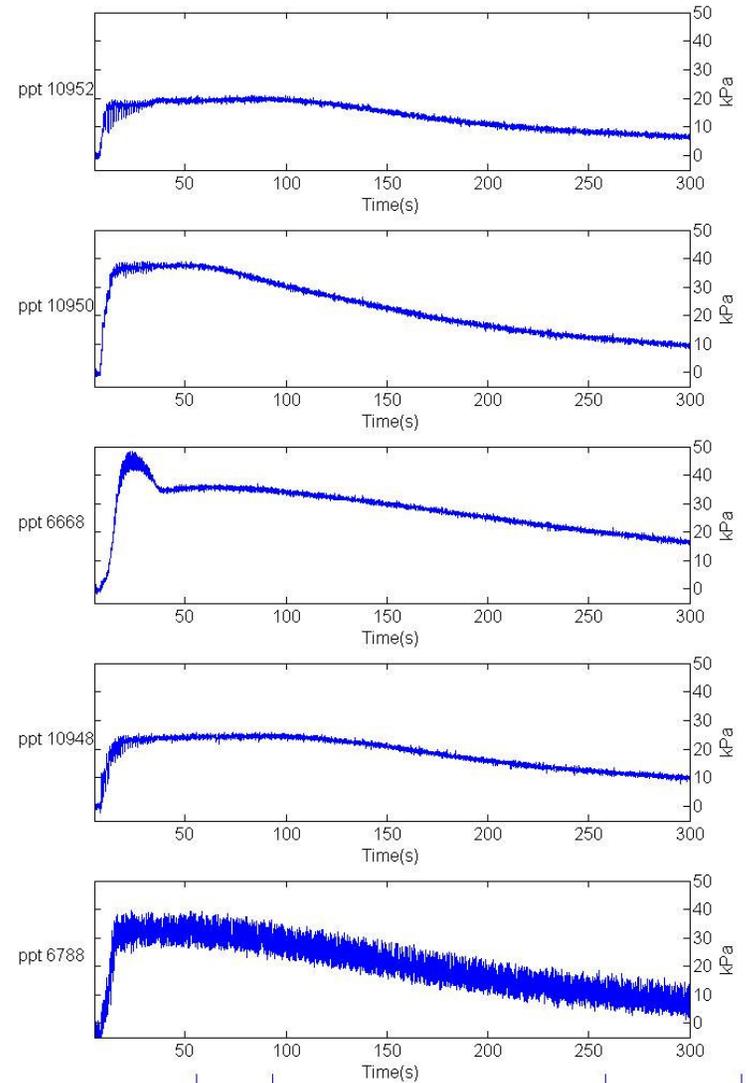
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Long-Term Time Records		

Free field excess pore pressures



TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Long-Term Time Records		

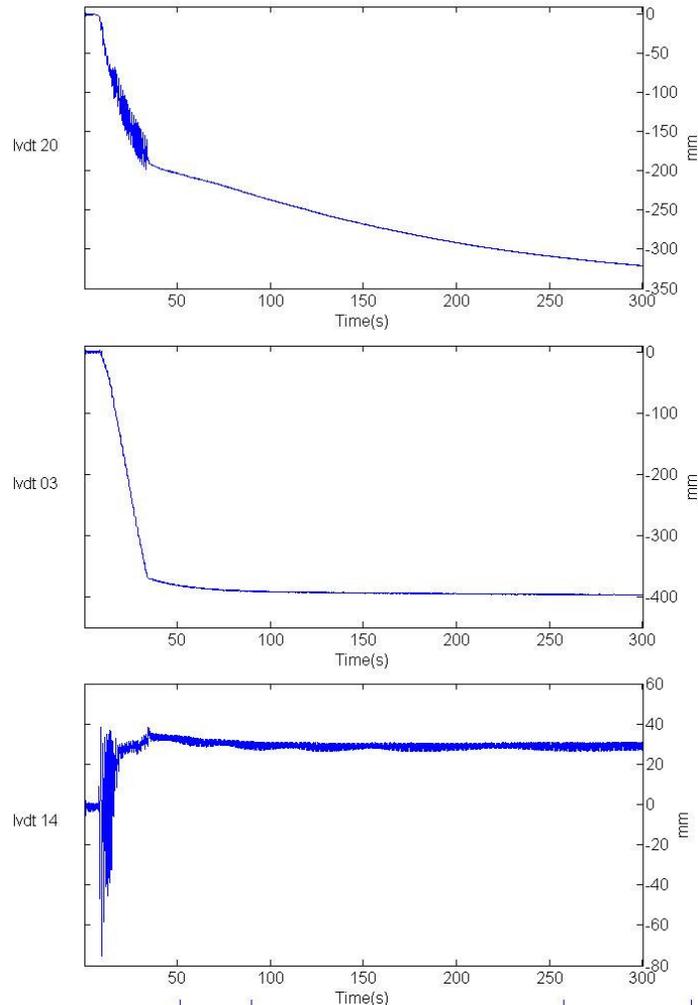
Excess pore pressures around structure base



TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Long-Term Time Records		

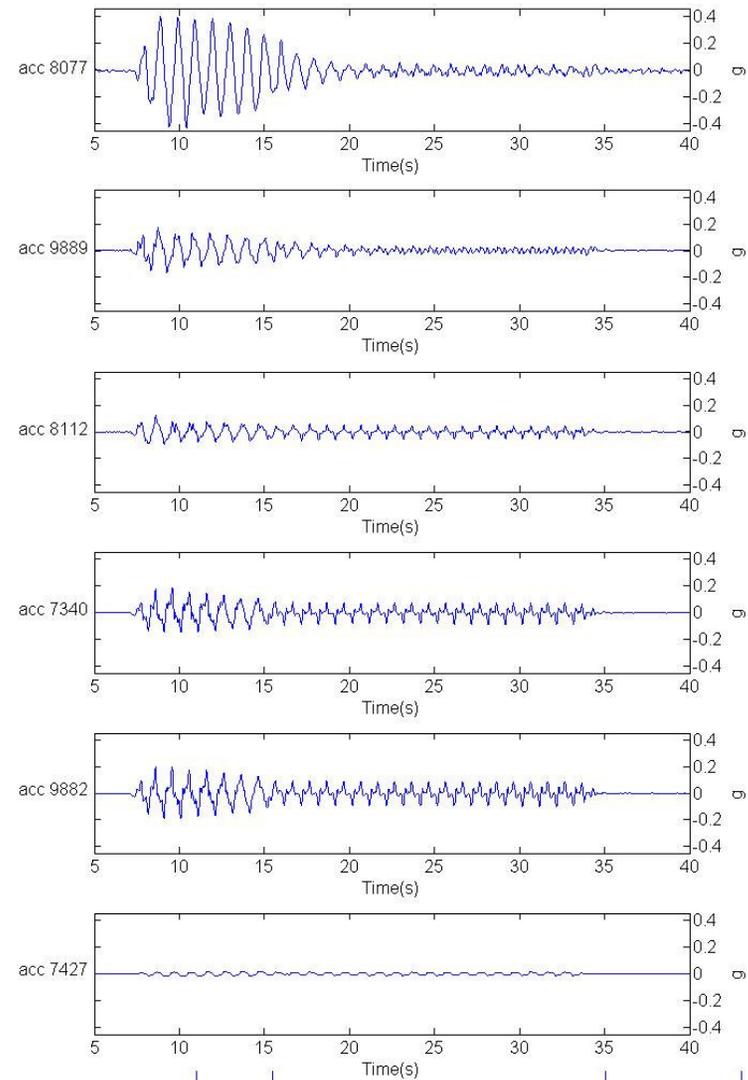
### 5.3 Centrifuge test WA1P, earthquake 3

#### Soil and structural displacements



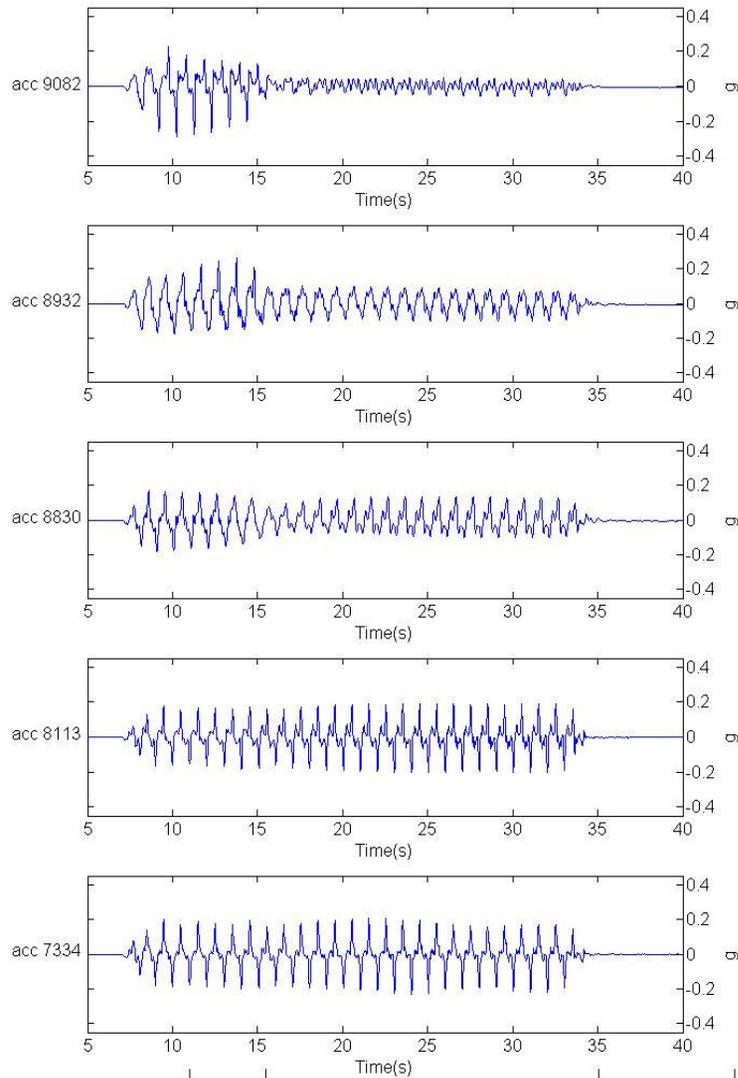
TEST WA1P	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Long-Term Time Records	3	

#### Accelerations on and under structure



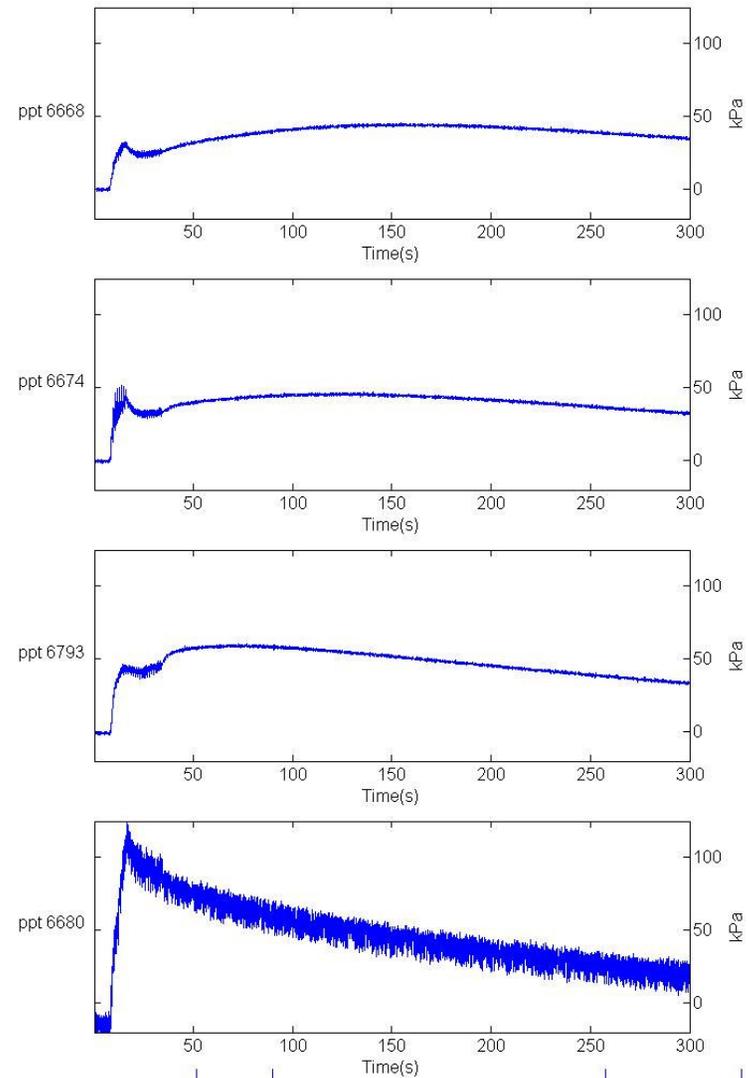
TEST WA1P	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Short-Term Time Records	3	

Free field soil accelerations and box (input) acceleration



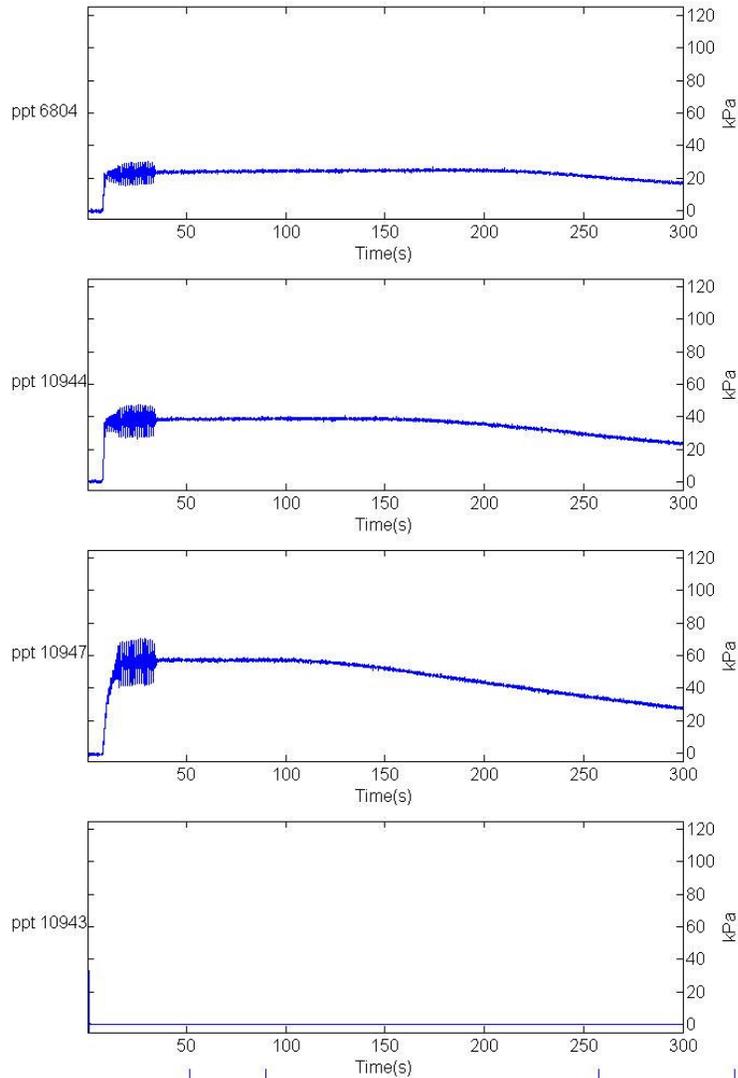
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Short-Term Time Records		

Excess pore pressures under centre of structure base



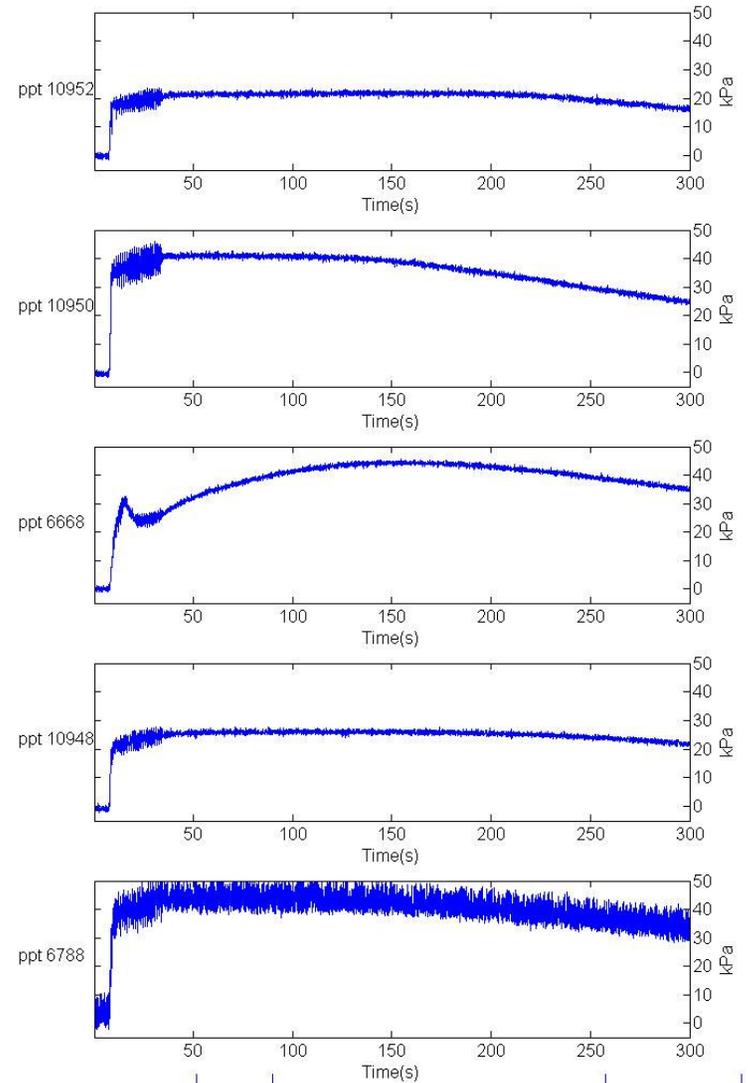
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Long-Term Time Records		

Free field excess pore pressures



TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Long-Term Time Records		

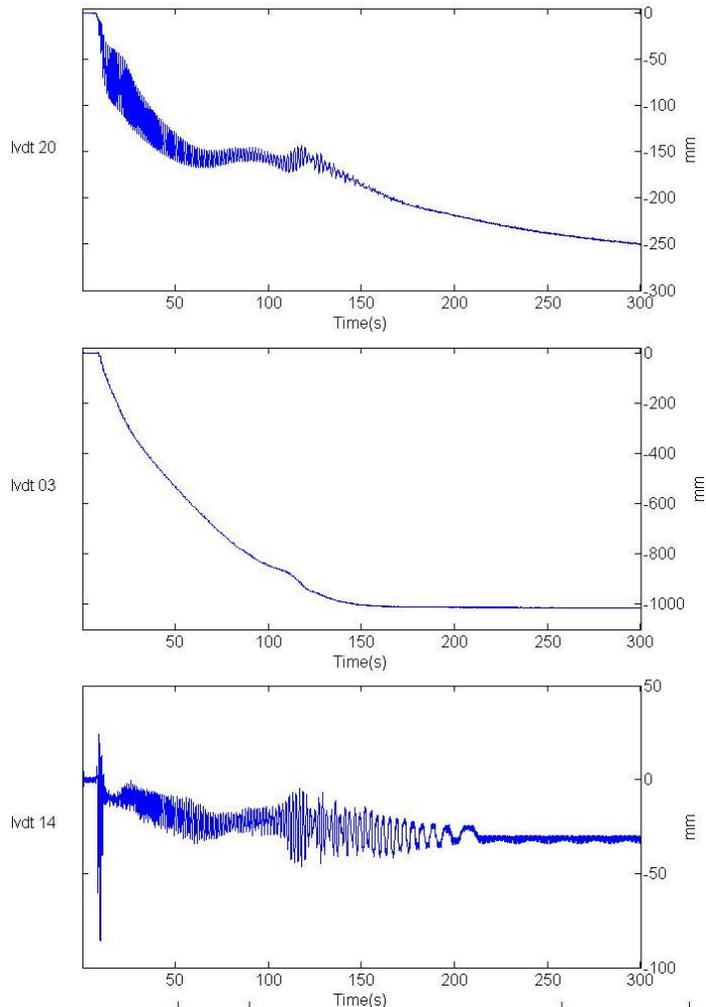
Excess pore pressures around structure base



TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Long-Term Time Records		

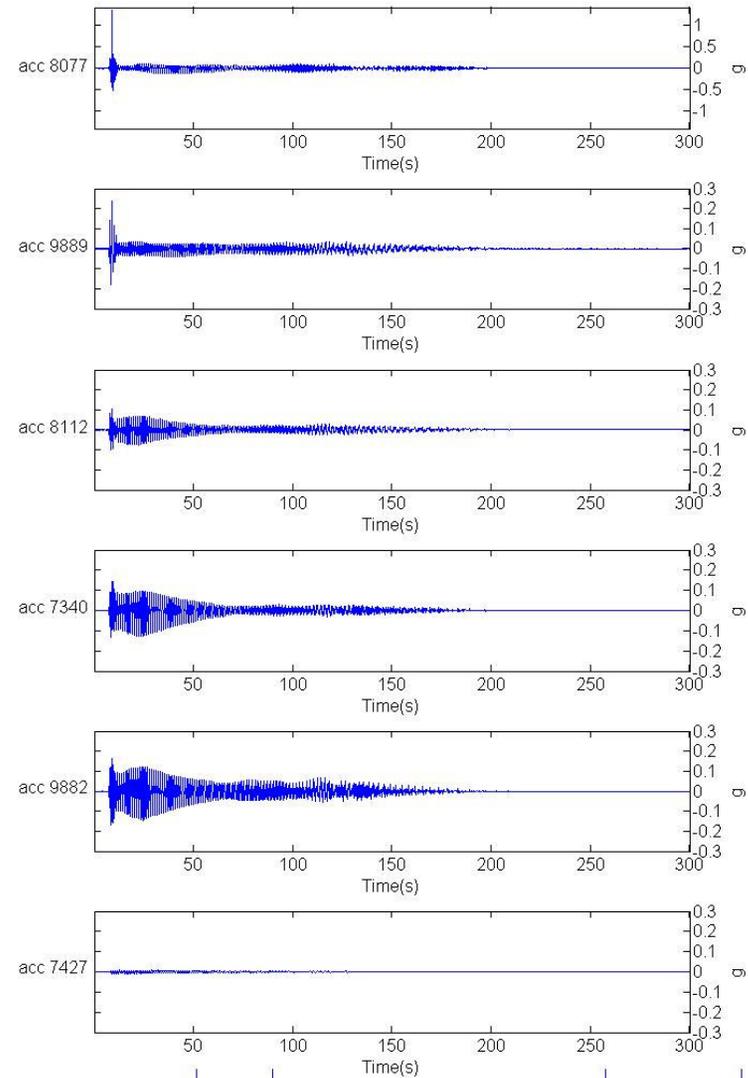
### 5.5 Centrifuge test WA1P, frequency sweep earthquake

#### Soil and structural displacements



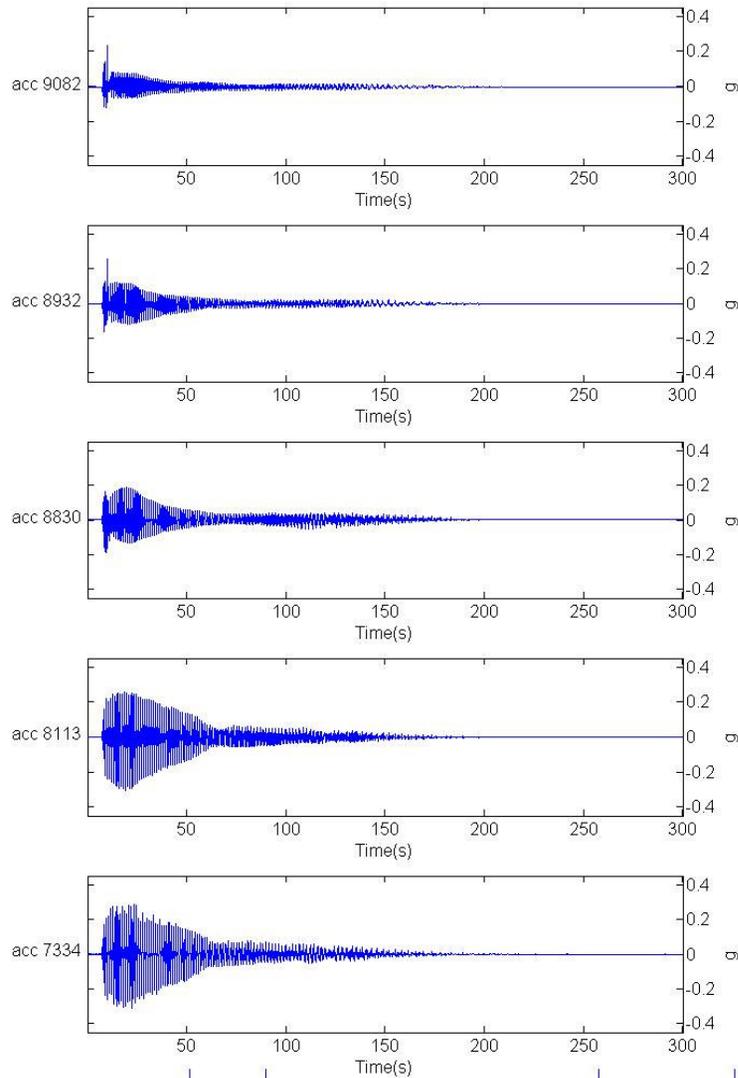
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
	8th order Butterworth Filter at 500Hz		
FLIGHT 1	Long-Term Time Records	sweep	

#### Accelerations on and under structure



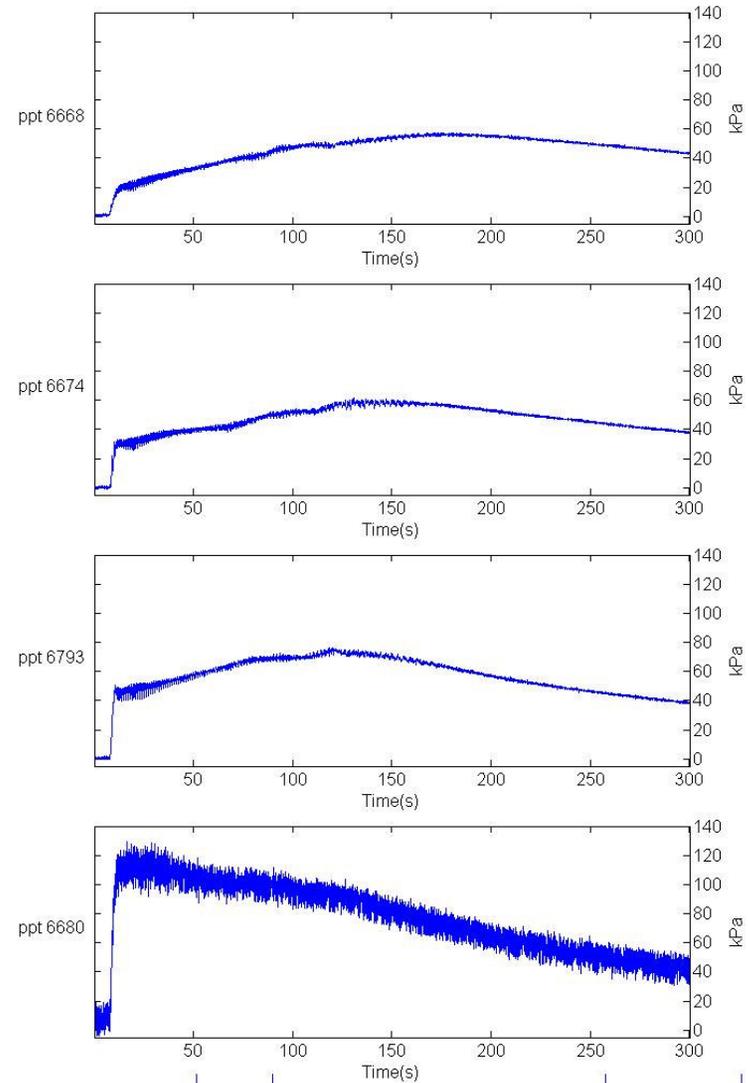
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
	8th order Butterworth Filter at 500Hz		
FLIGHT 1	Long-Term Time Records	sweep	

Free field soil accelerations and box (input) acceleration



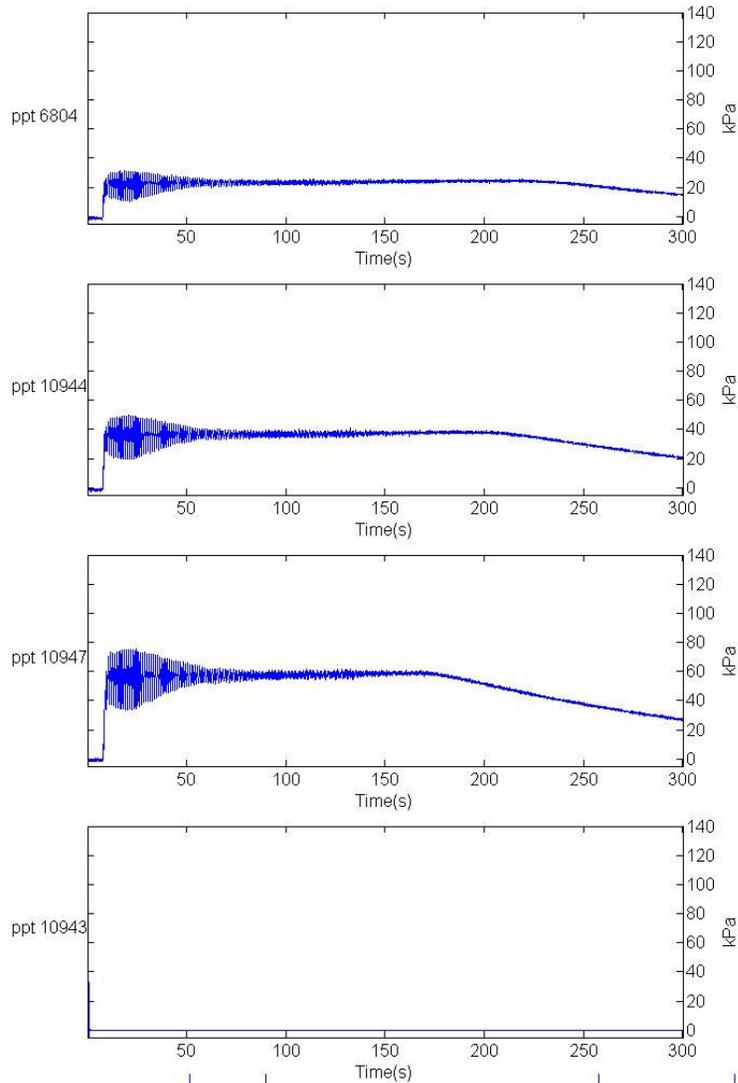
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	sweep	
	Long-Term Time Records		

Excess pore pressures under centre of structure base



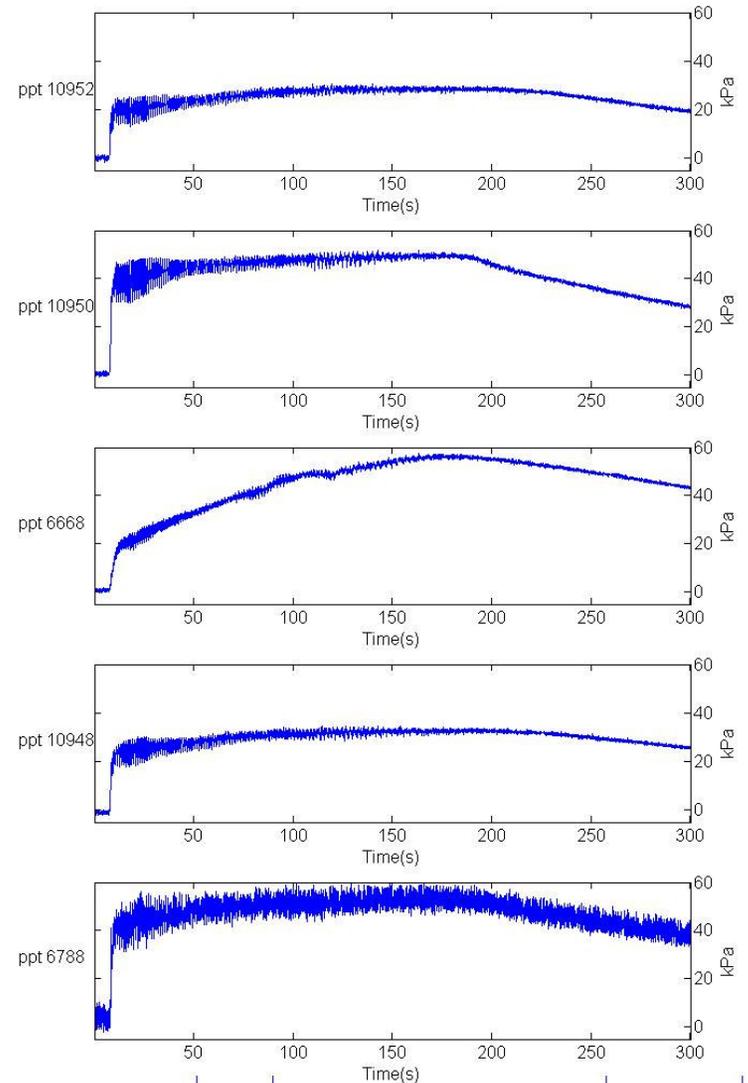
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	sweep	
	Long-Term Time Records		

Free field excess pore pressures



TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	sweep	
	Long-Term Time Records		

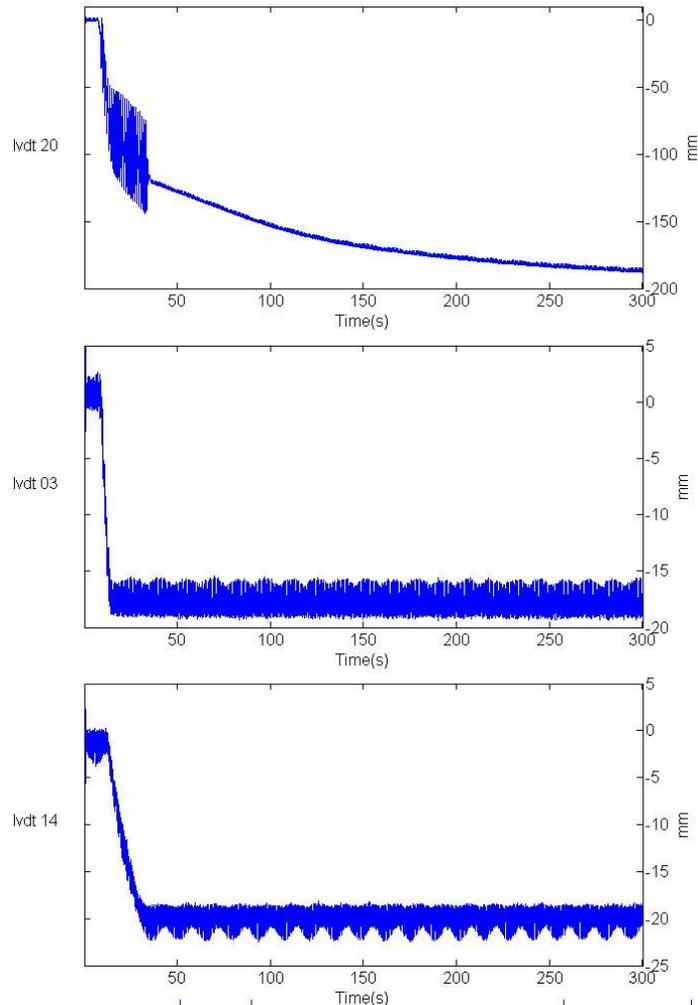
Excess pore pressures around structure base



TEST WA1P	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	sweep	
	Long-Term Time Records		

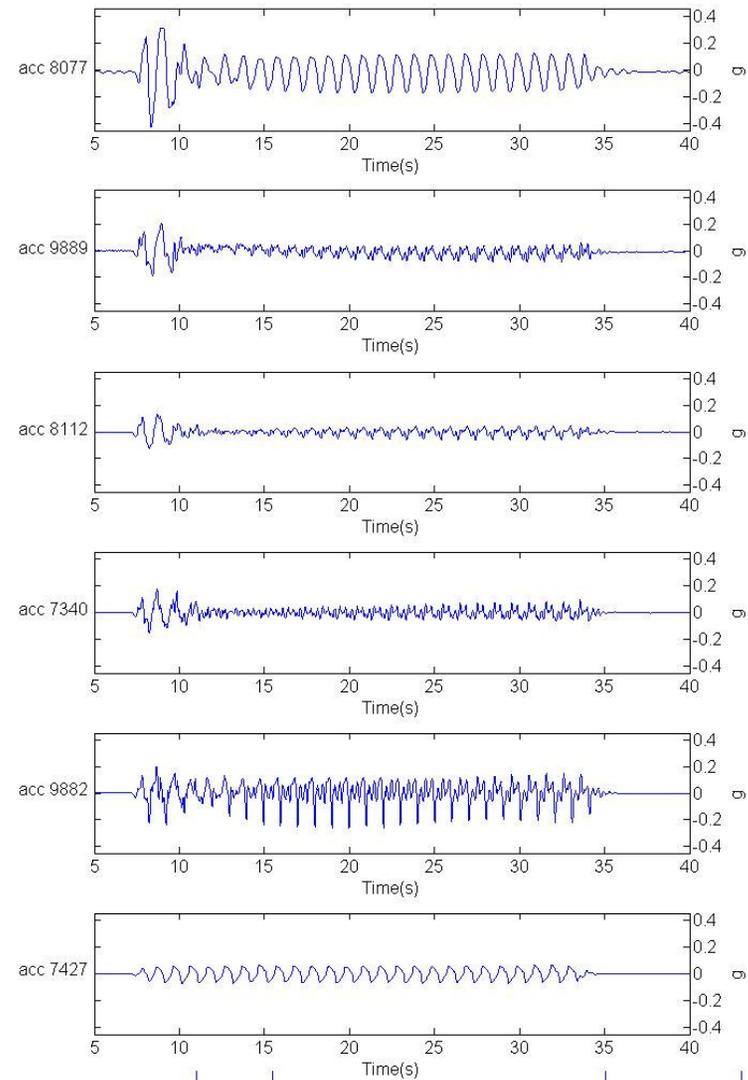
### 5.4 Centrifuge test WA1P, earthquake 4

#### Soil and structural displacements



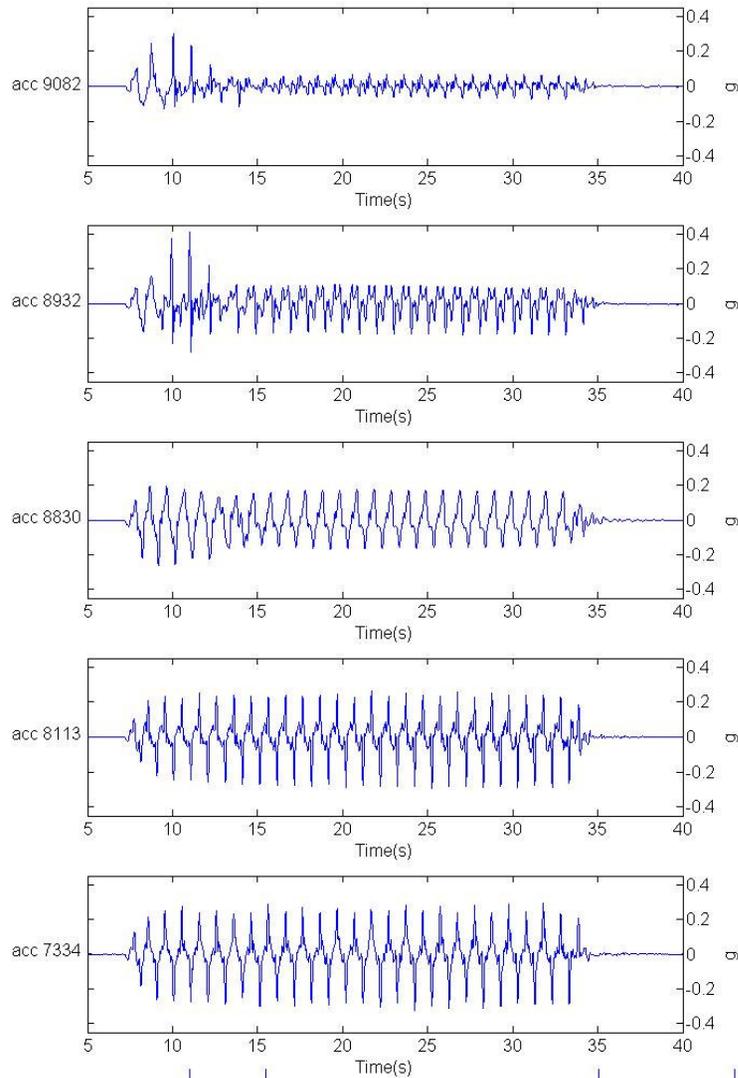
TEST WA1P	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Long-Term Time Records	4	

#### Accelerations on and under structure



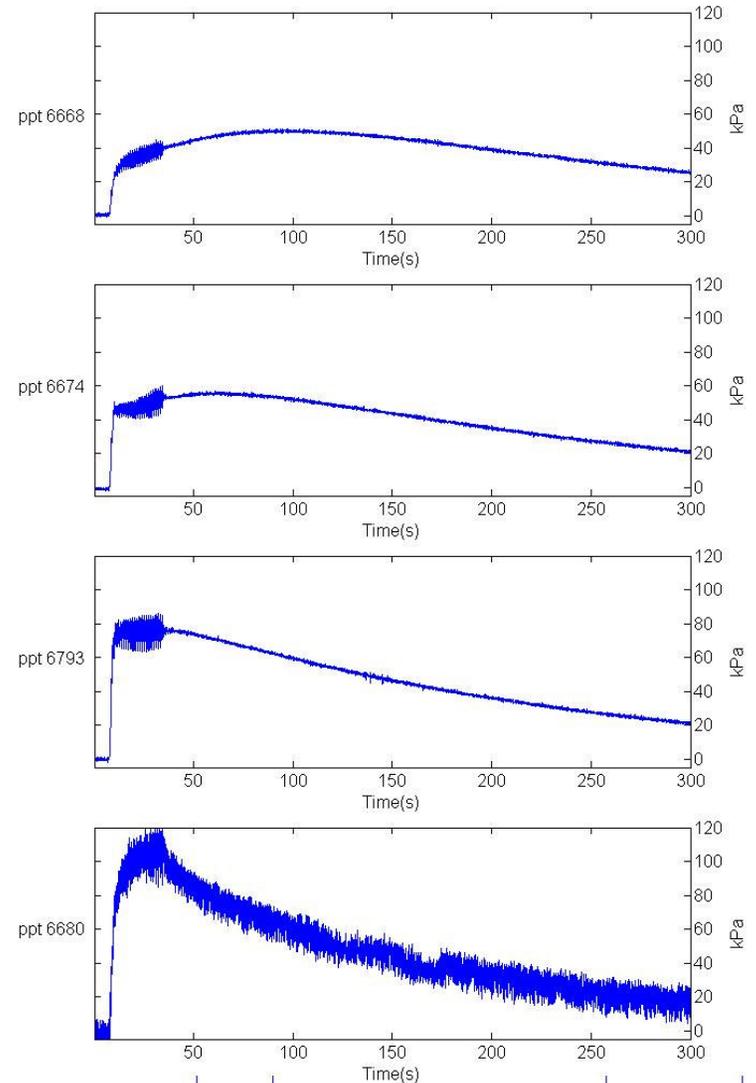
TEST WA1P	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Short-Term Time Records	4	

Free field soil accelerations and box (input) acceleration



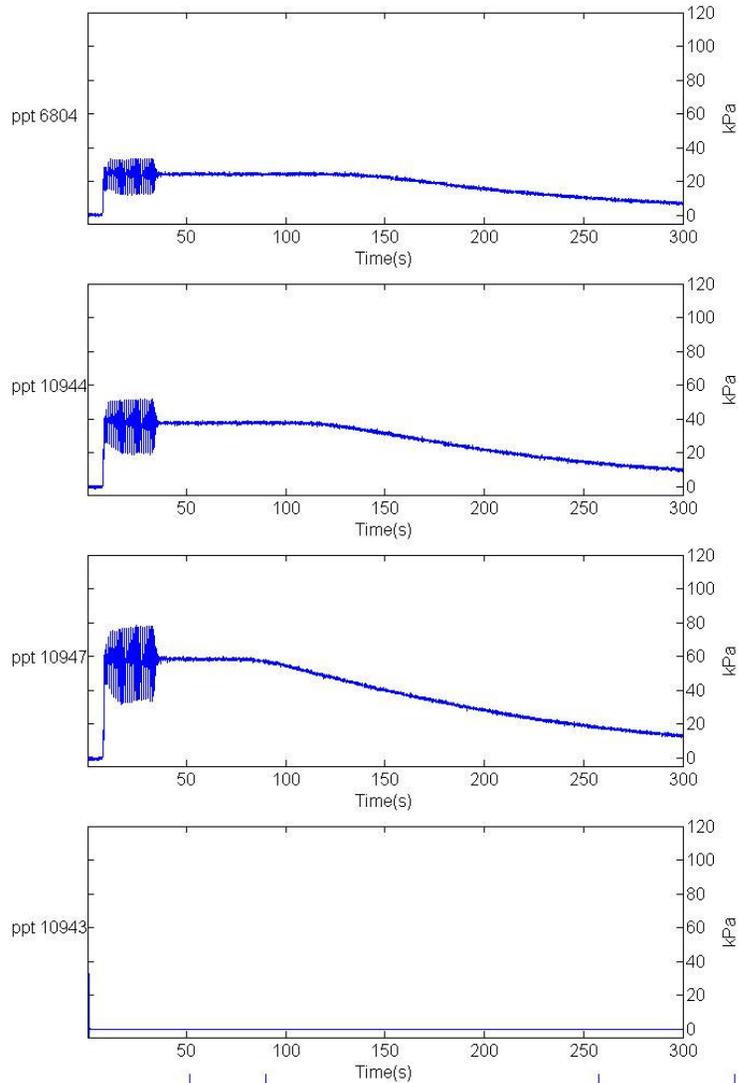
TEST WA1P	Scales: Prototype	Earthquake	Figure No.
	8th order Butterworth Filter at 500Hz		
FLIGHT 1	Short-Term Time Records	4	

Excess pore pressures under centre of structure base



TEST WA1P	Scales: Prototype	Earthquake	Figure No.
	8th order Butterworth Filter at 500Hz		
FLIGHT 1	Long-Term Time Records	4	

Free field excess pore pressures



TEST WA1P

Scales: Prototype  
8th order Butterworth Filter at 500Hz

Earthquake

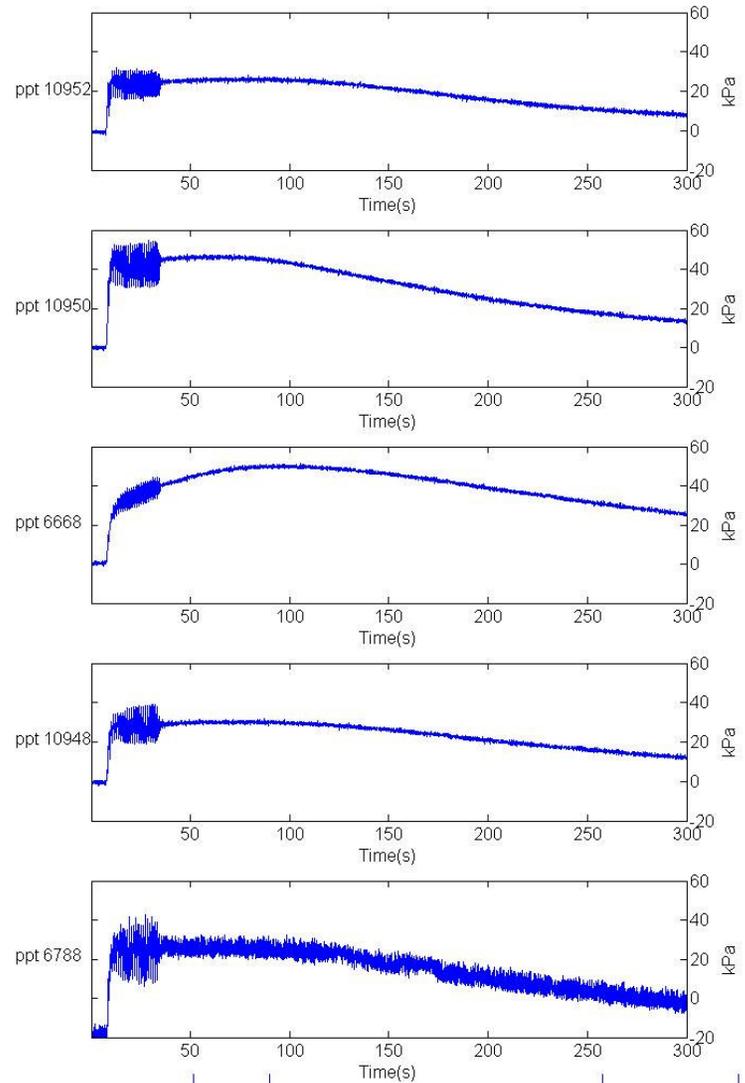
Figure No.

FLIGHT 1

Long-Term Time Records

4

Excess pore pressures around structure base



TEST WA1P

Scales: Prototype  
8th order Butterworth Filter at 500Hz

Earthquake

Figure No.

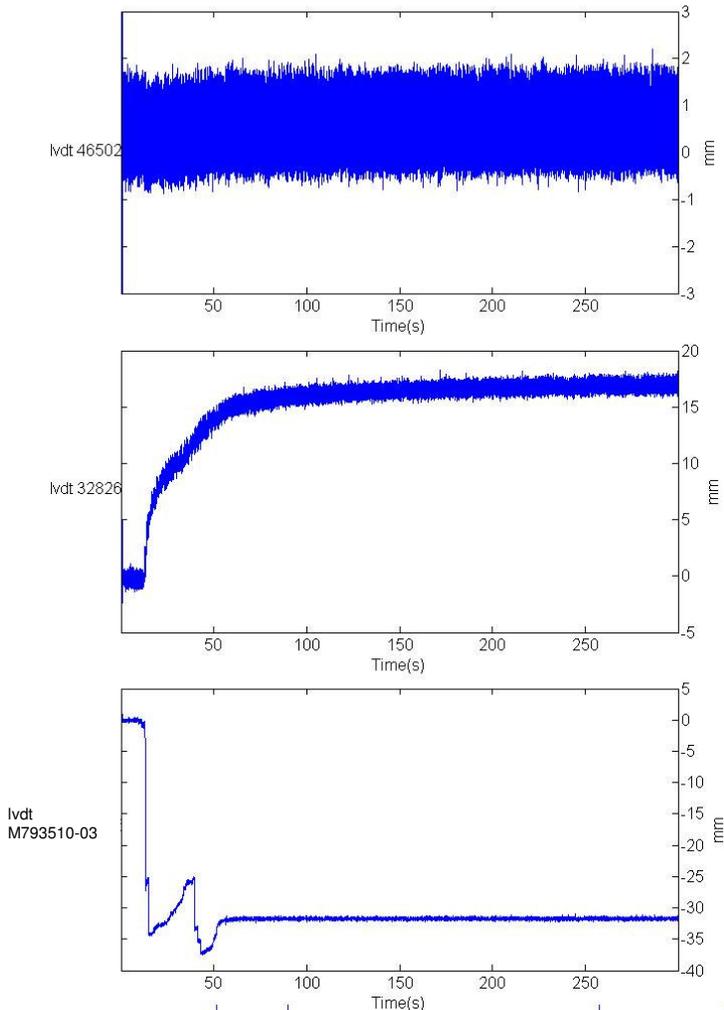
FLIGHT 1

Long-Term Time Records

4

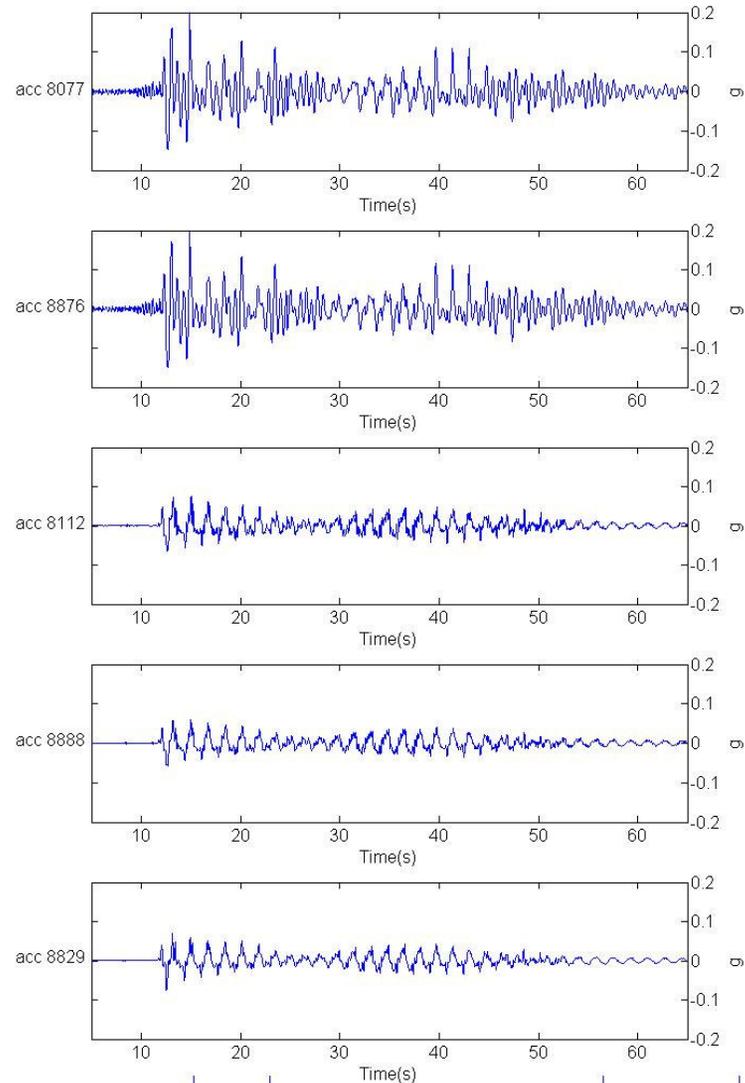
### 5.6 Centrifuge test WA1F, earthquake 1

#### Soil and structural displacements



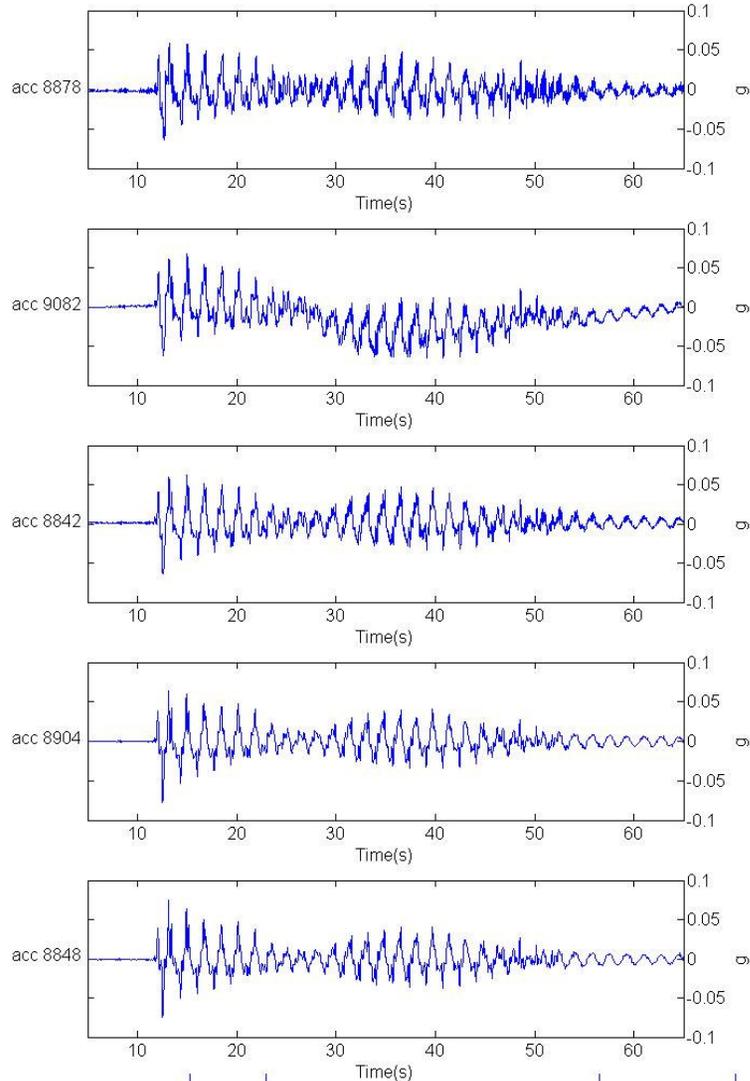
TEST WA1F	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Long-Term Time Records	1	

#### Accelerations on and under structure



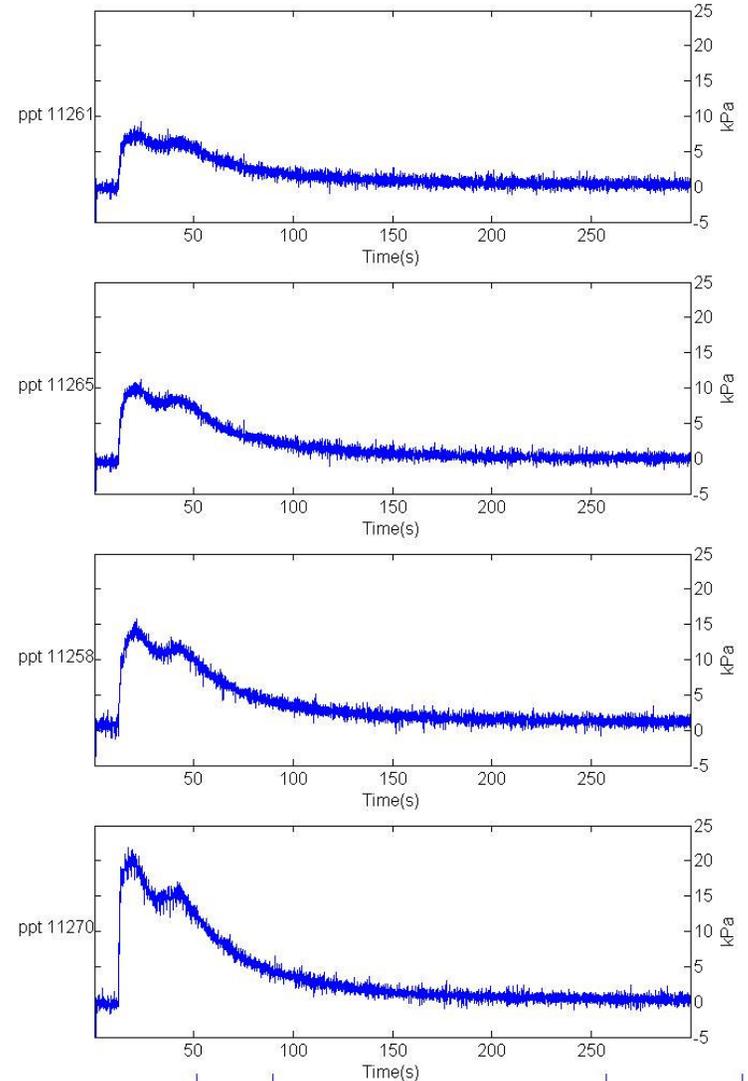
TEST WA1F	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Short-Term Time Records	1	

Free field soil accelerations and box (input) acceleration



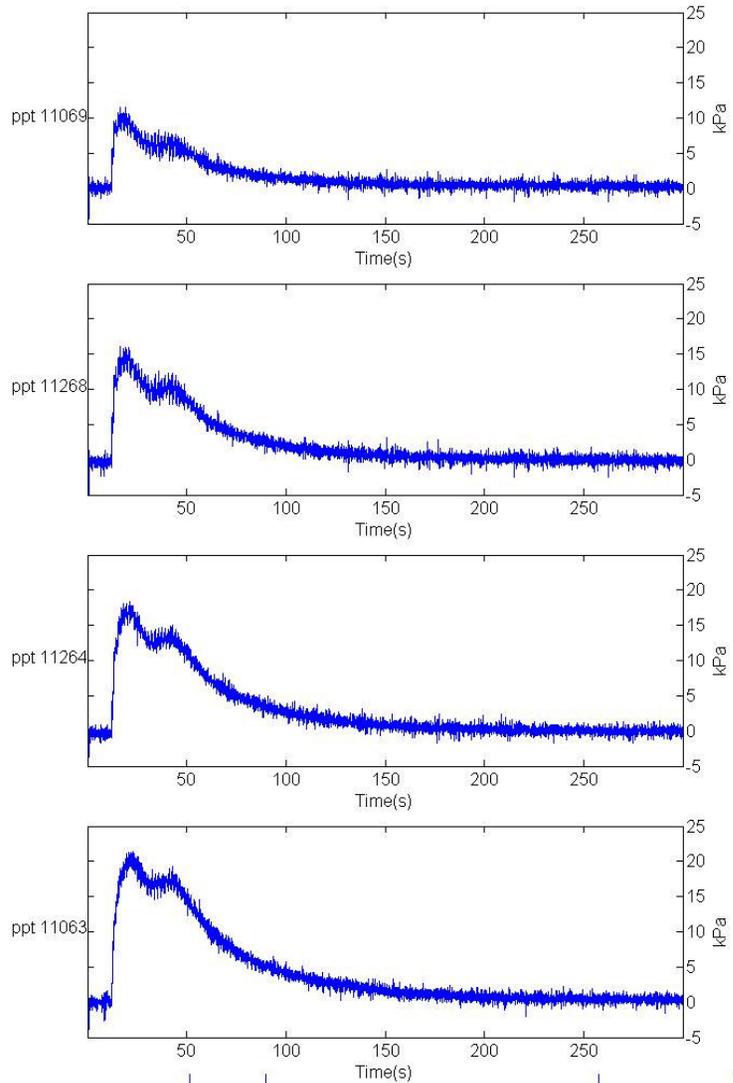
TEST WA1F	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	1	
	Short-Term Time Records		

Excess pore pressures under centre of structure base



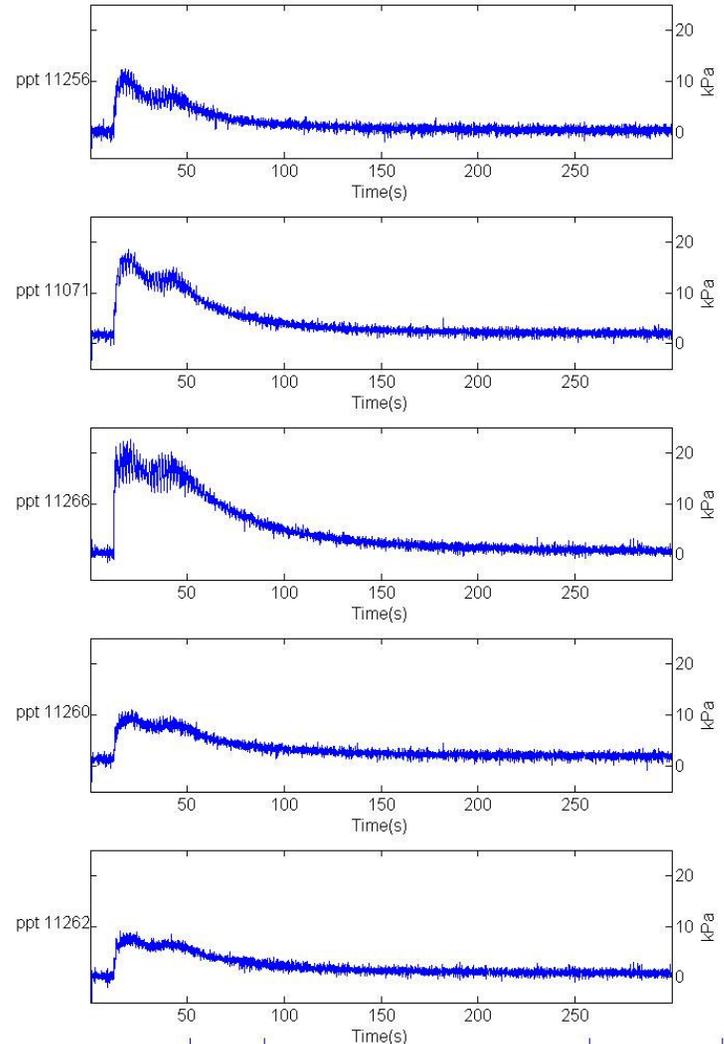
TEST WA1F	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	1	
	Long-Term Time Records		

Free field excess pore pressures



TEST WA1F	Scales: Prototype	Earthquake	Figure No.
	8th order Butterworth Filter at 500Hz		
FLIGHT 1	Long-Term Time Records	1	

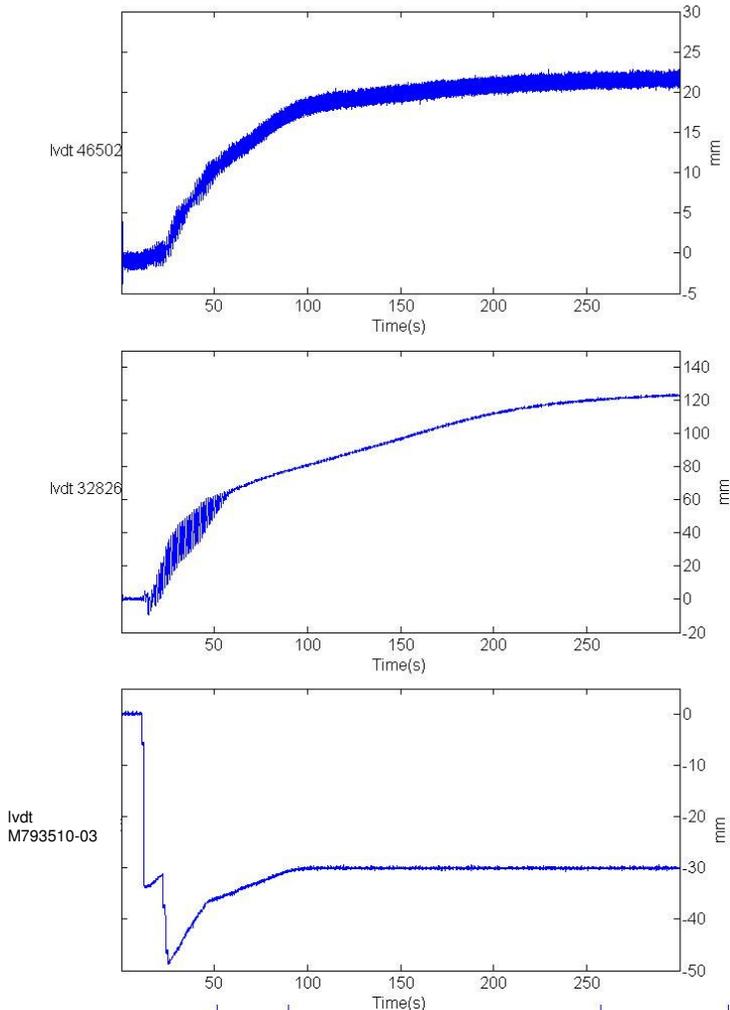
Excess pore pressures at sides of structure base and near containment walls



TEST WA1F	Scales: Prototype	Earthquake	Figure No.
	8th order Butterworth Filter at 500Hz		
FLIGHT 1	Long-Term Time Records	1	

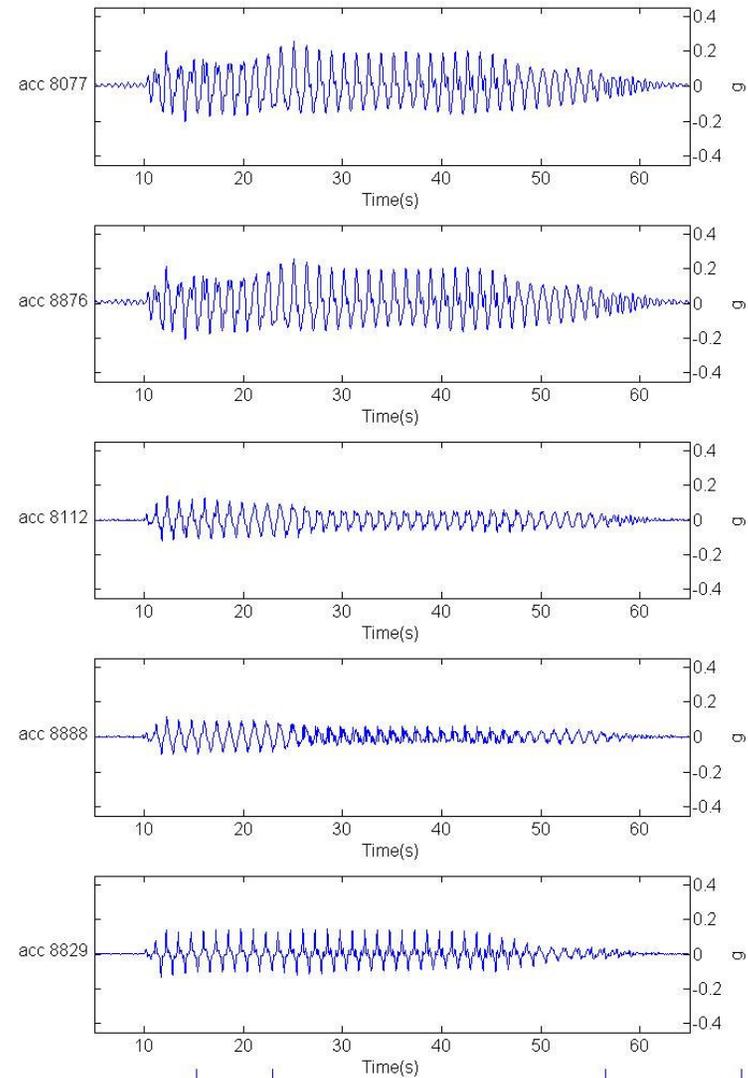
### 5.7 Centrifuge test WA1F, earthquake 2

#### Soil and structural displacements



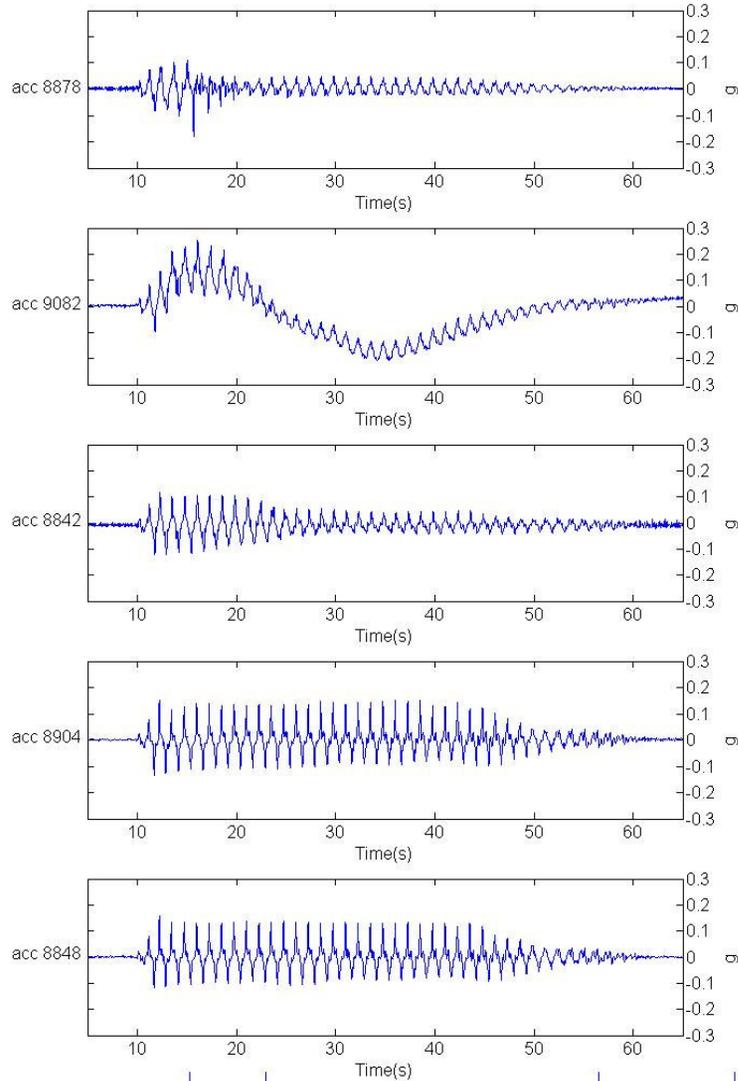
TEST WA1F	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Long-Term Time Records	2	

#### Accelerations on and under structure



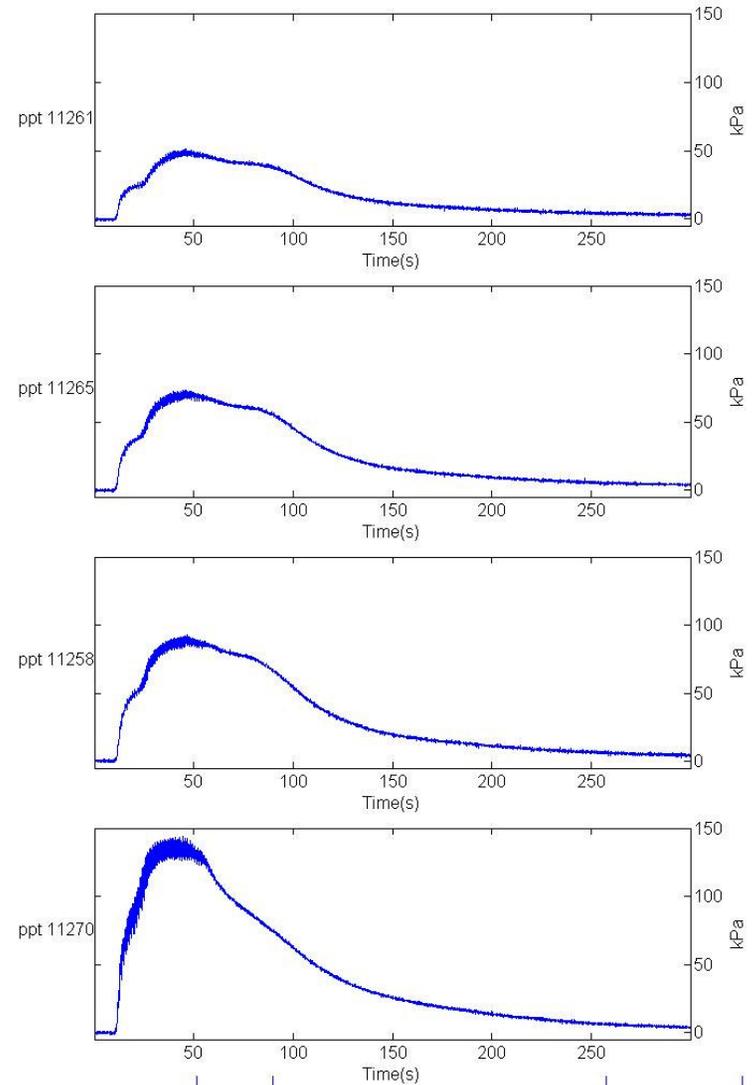
TEST WA1F	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Short-Term Time Records	2	

Free field soil accelerations and box (input) acceleration



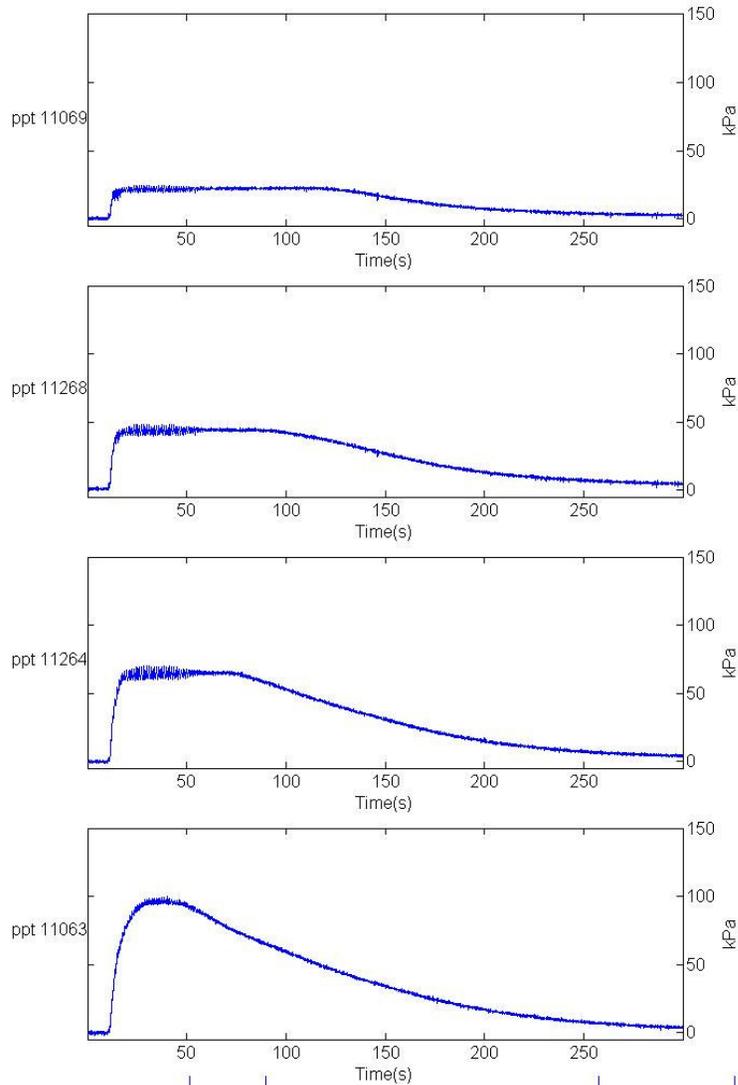
TEST WA1F	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Short-Term Time Records		

Excess pore pressures under centre of structure base



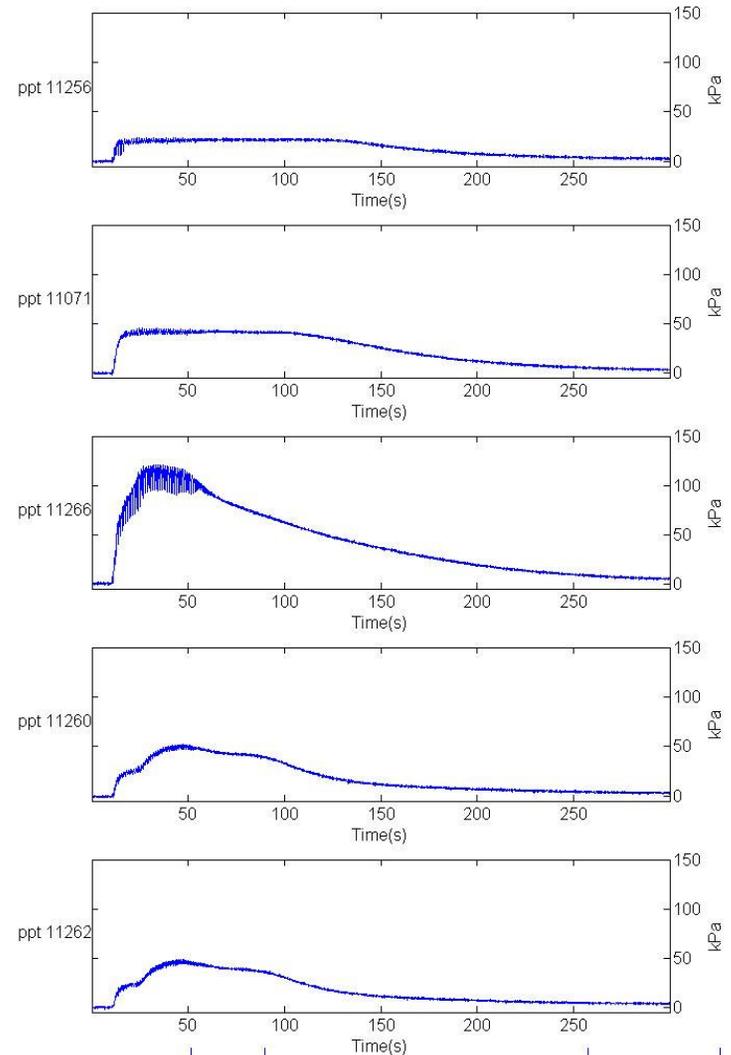
TEST WA1F	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Long-Term Time Records		

Free field excess pore pressures



TEST WA1F	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Long-Term Time Records		

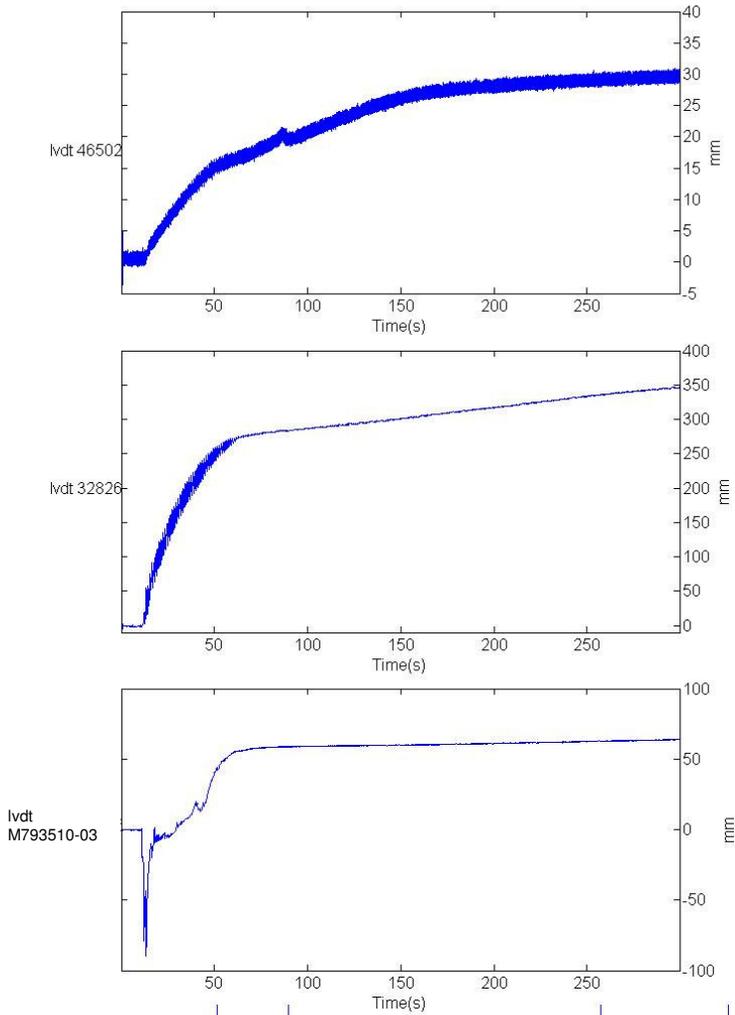
Excess pore pressures at sides of structure base and near containment walls



TEST WA1F	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Long-Term Time Records		

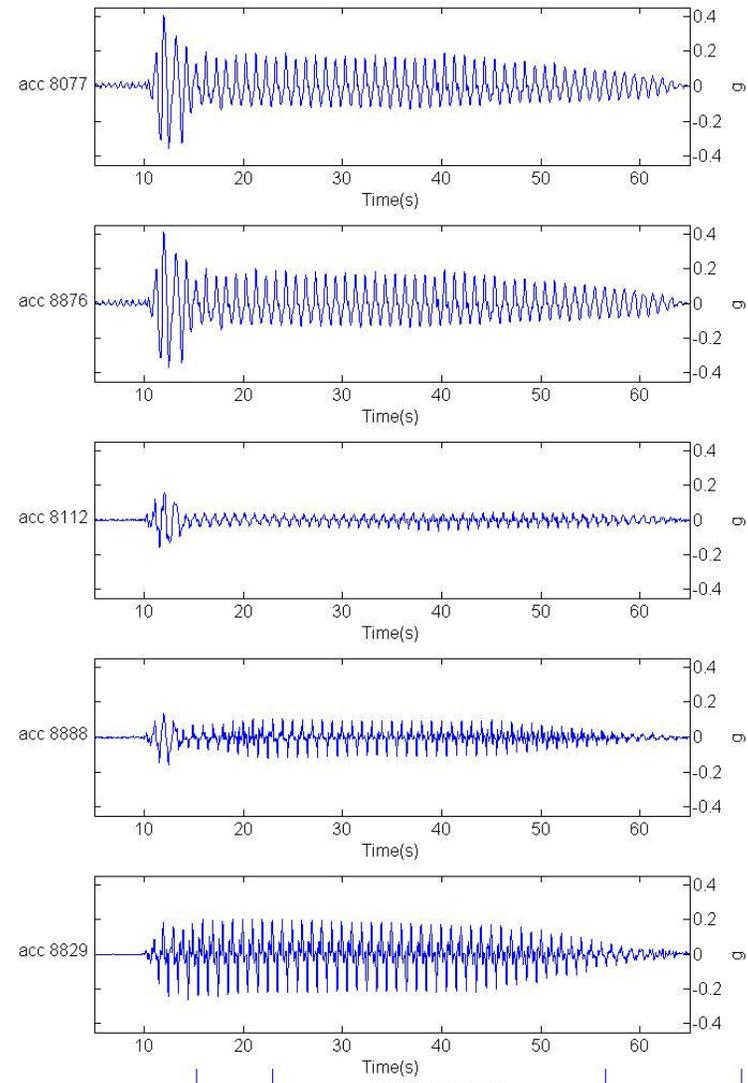
### 5.8 Centrifuge test WA1F, earthquake 3

#### Soil and structural displacements



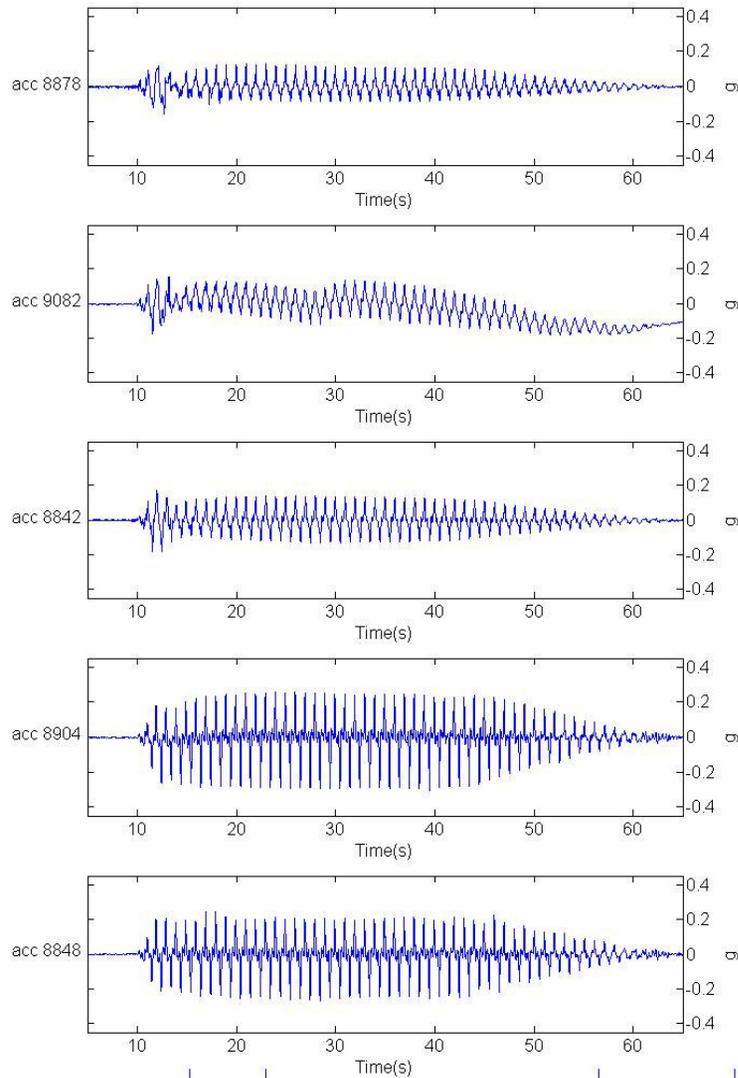
TEST WA1F	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Long-Term Time Records	3	

#### Accelerations on and under structure



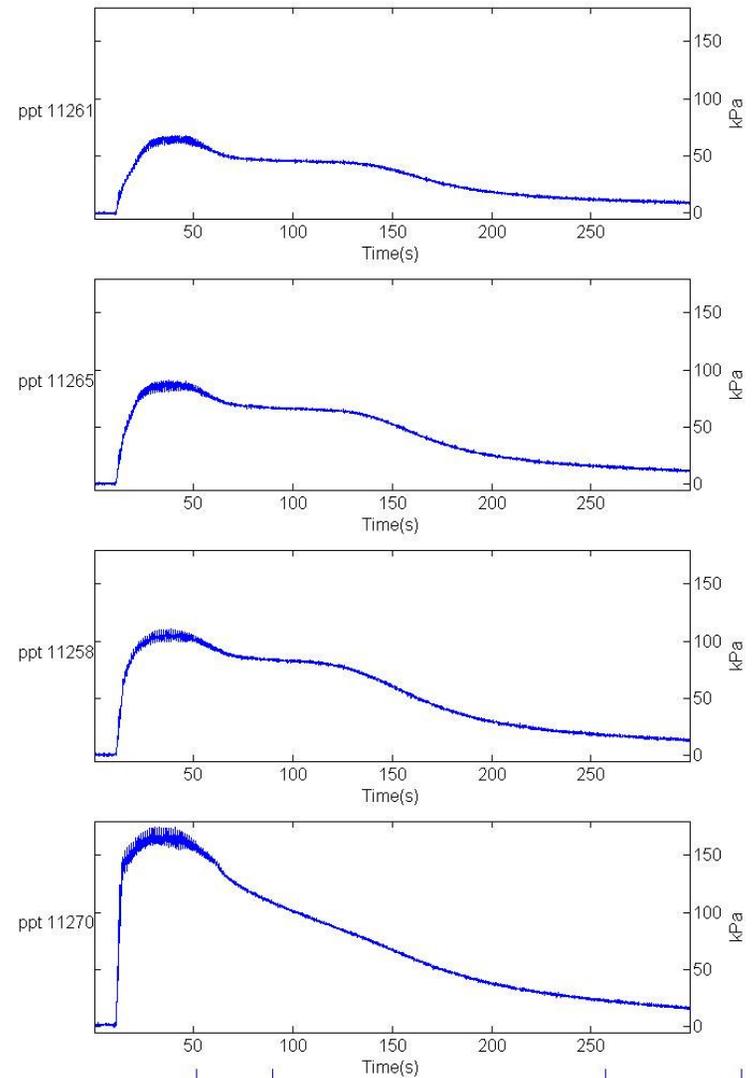
TEST WA1F	Scales: Prototype 8th order Butterworth Filter at 500Hz	Earthquake	Figure No.
FLIGHT 1	Short-Term Time Records	3	

Free field soil accelerations and box (input) acceleration



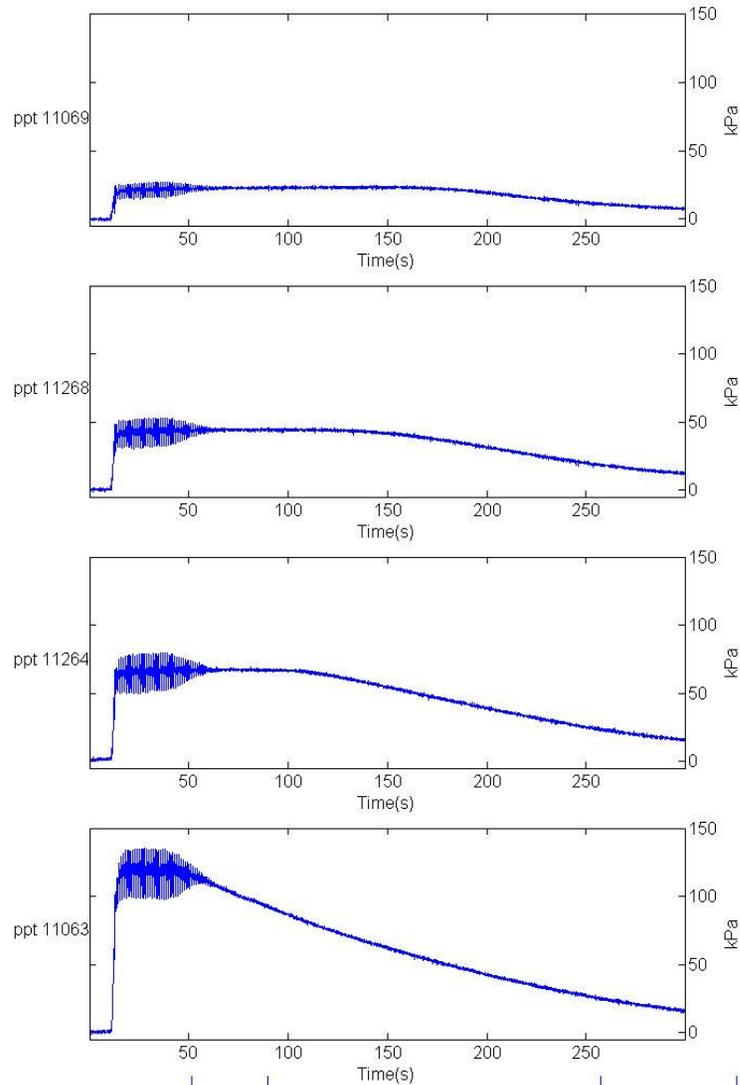
TEST WA1F	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Short-Term Time Records		

Excess pore pressures under centre of structure base



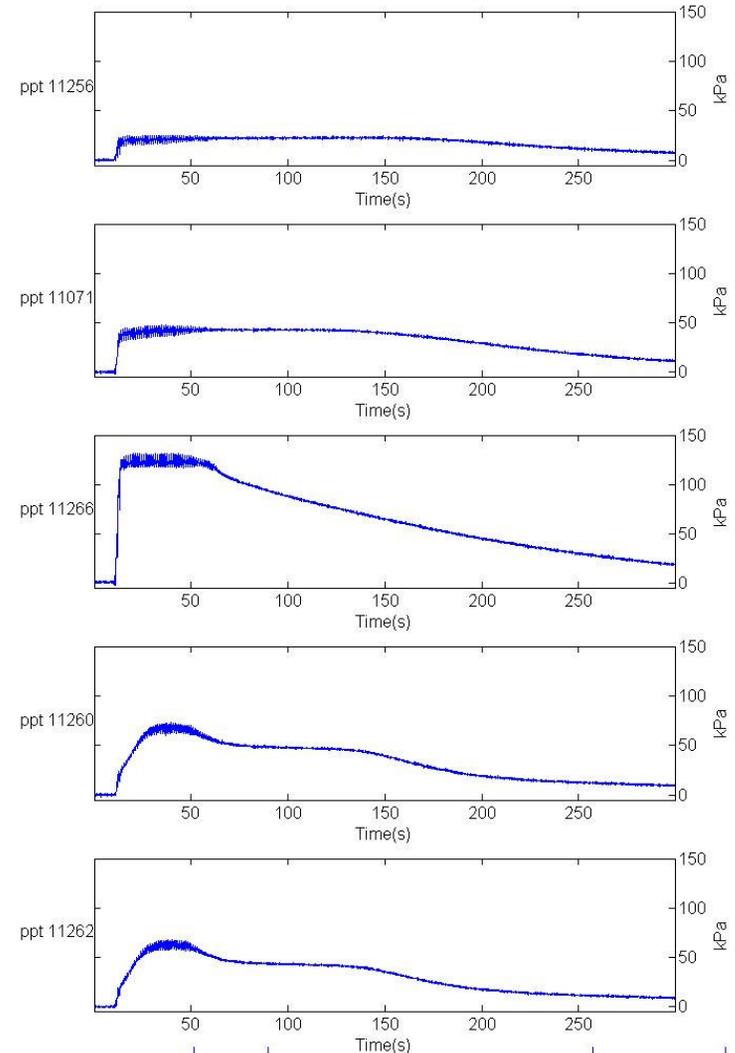
TEST WA1F	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Long-Term Time Records		

Free field excess pore pressures



TEST WA1F	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Long-Term Time Records		

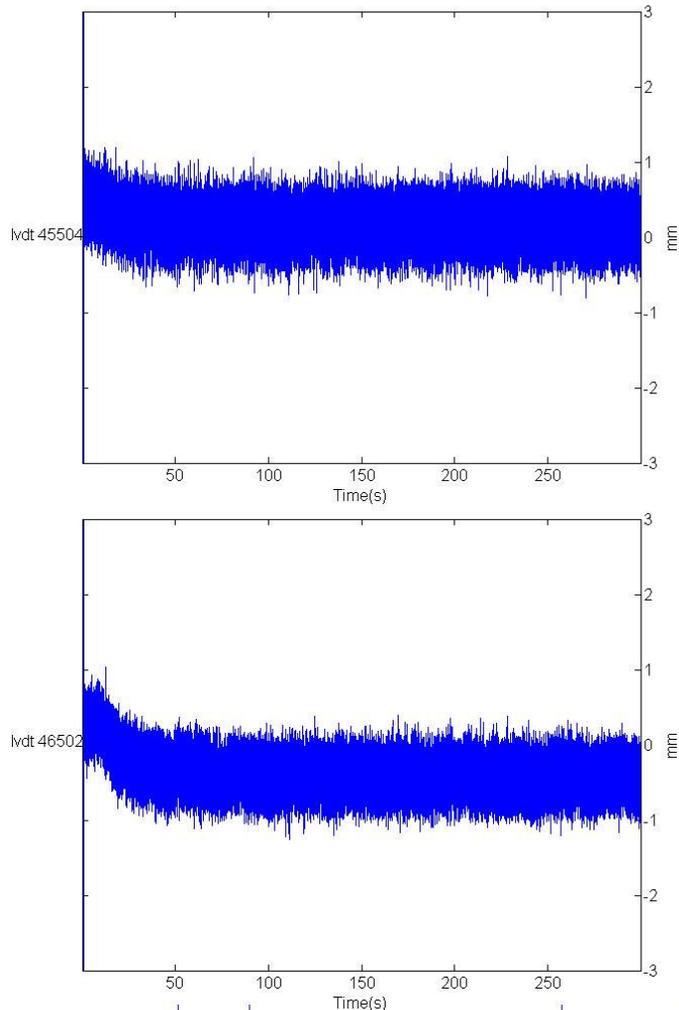
Excess pore pressures at sides of structure base and near containment walls



TEST WA1F	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Long-Term Time Records		

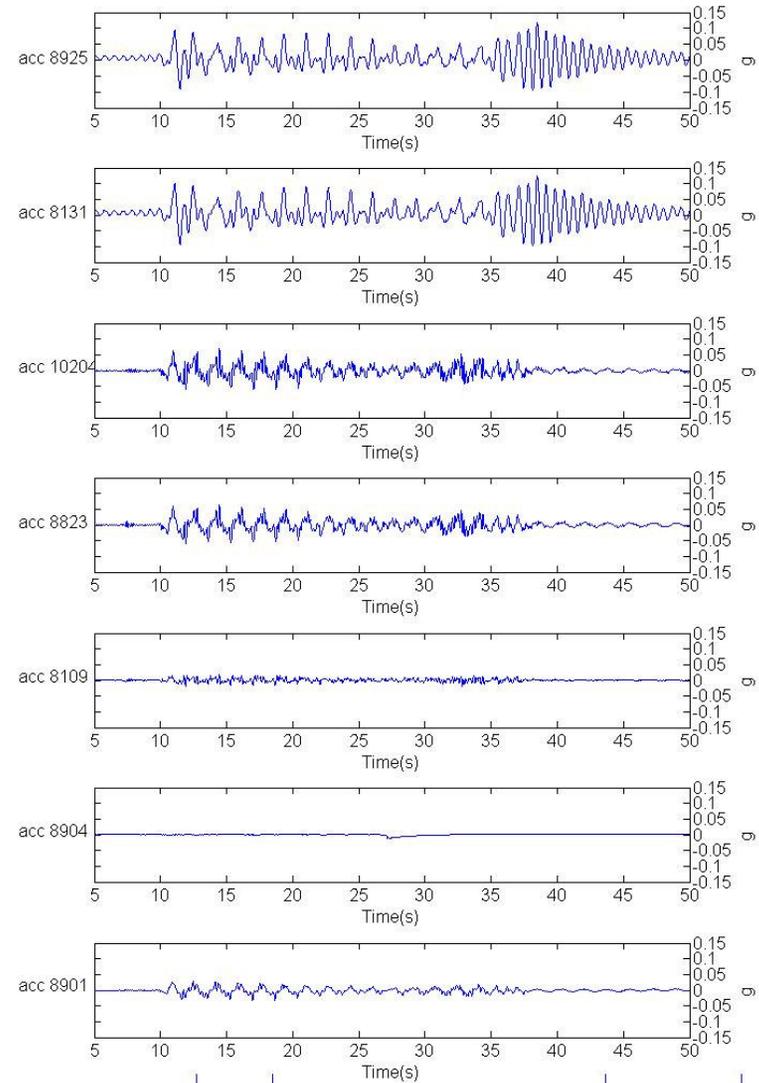
### 5.9 Centrifuge test WA3, earthquake 1

#### Soil and structural displacements



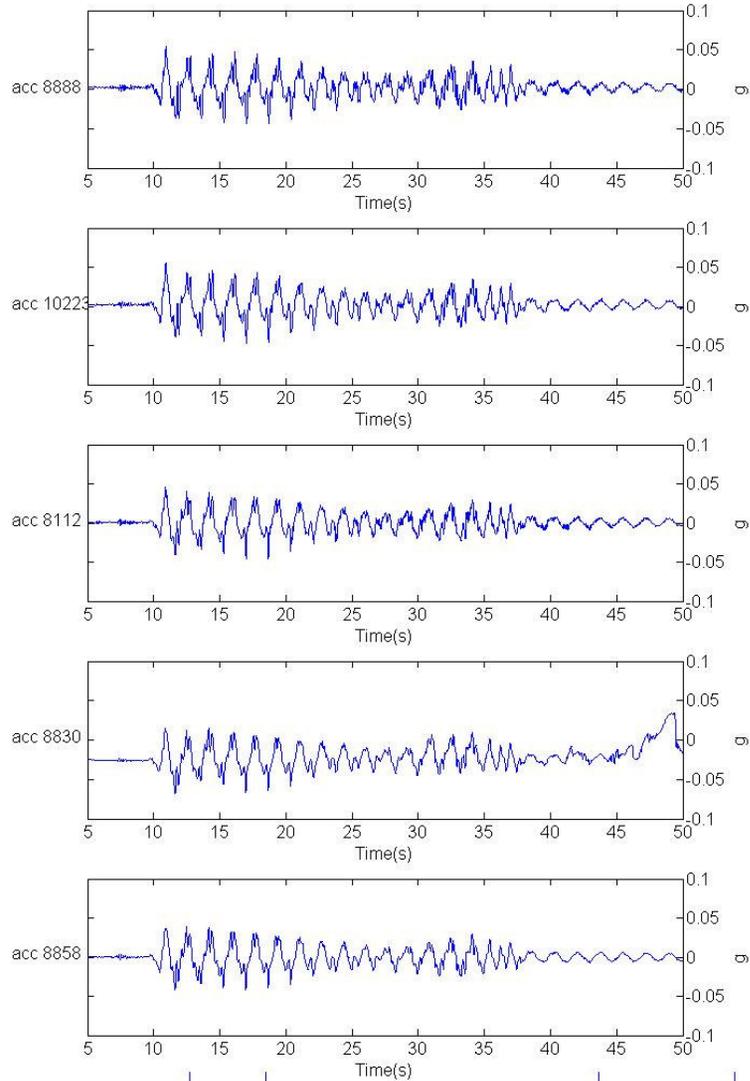
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	1	
	Long-Term Time Records		

#### Accelerations on and under structure



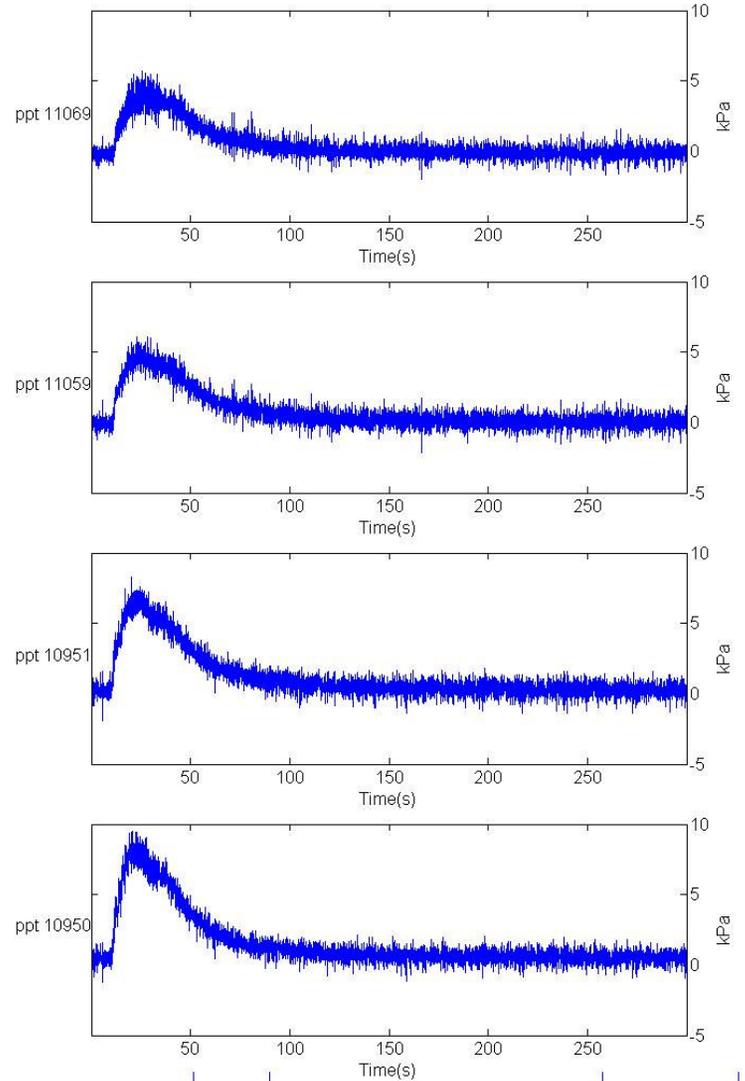
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	1	
	Short-Term Time Records		

Free field soil accelerations and box (input) acceleration



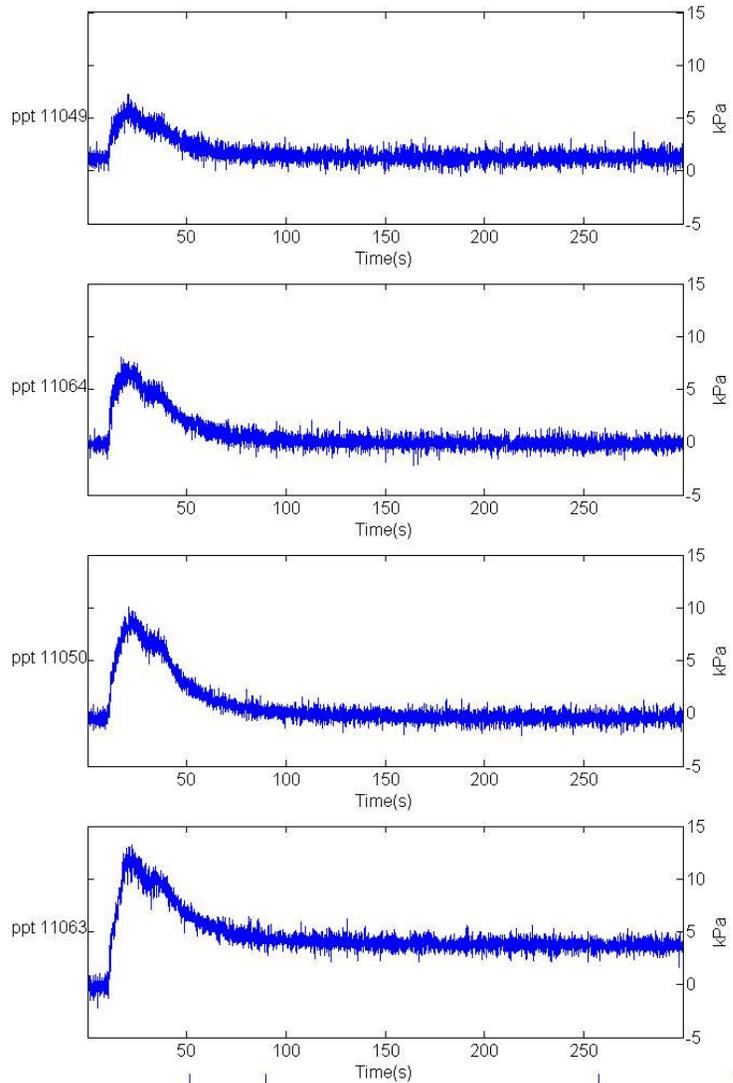
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	1	
	Short-Term Time Records		

Excess pore pressures under structure base



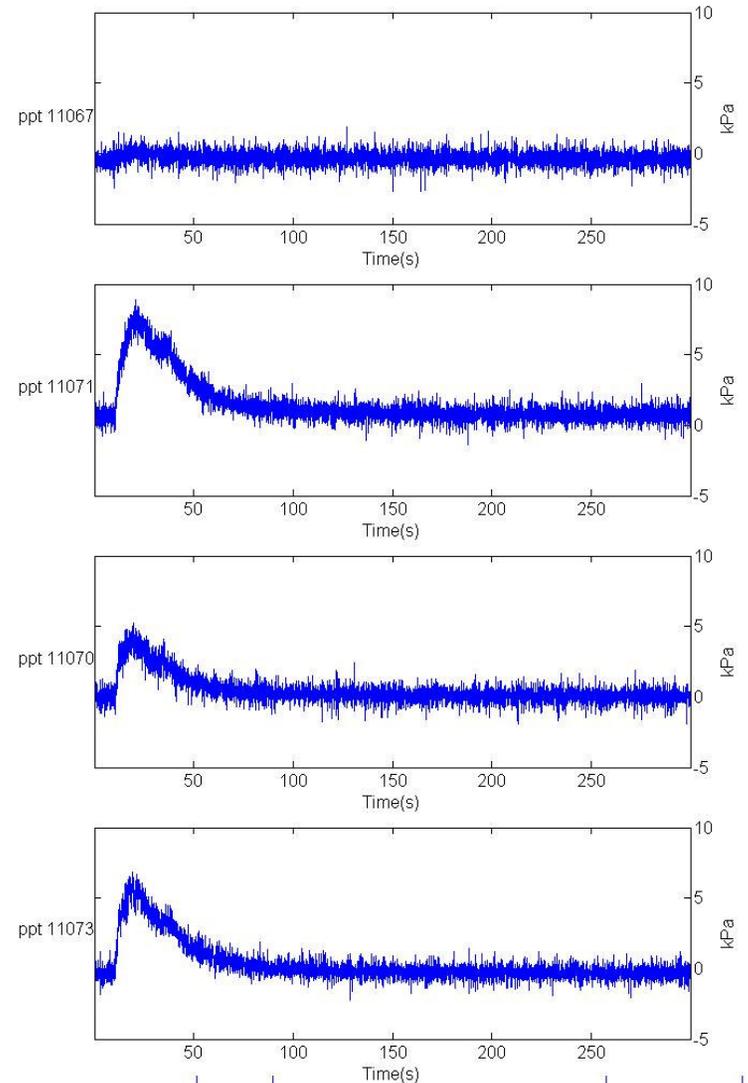
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	1	
	Long-Term Time Records		

Free field excess pore pressures



TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	1	
	Long-Term Time Records		

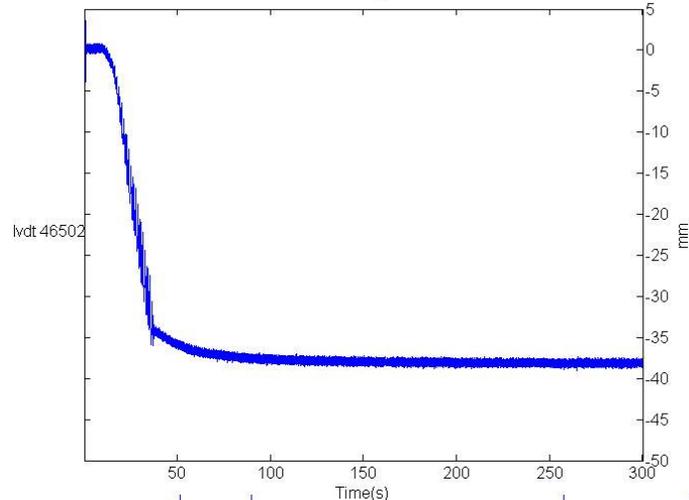
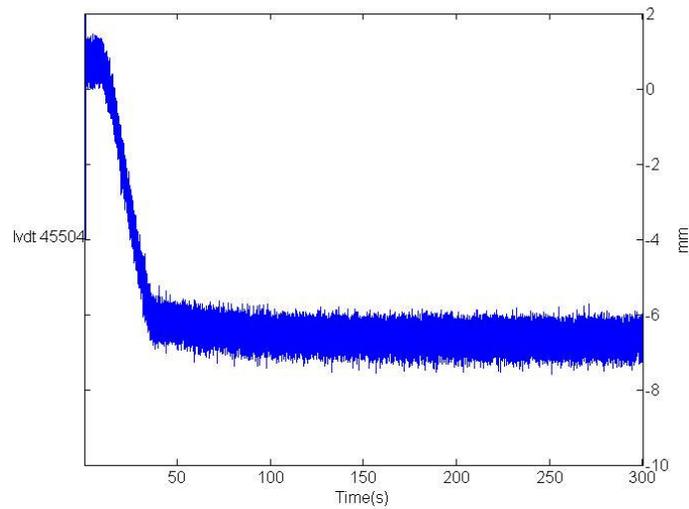
Excess pore pressures near containment walls



TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	1	
	Long-Term Time Records		

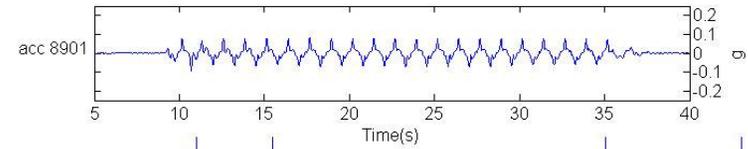
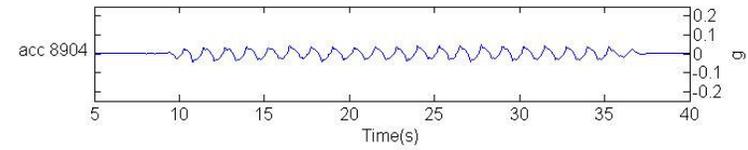
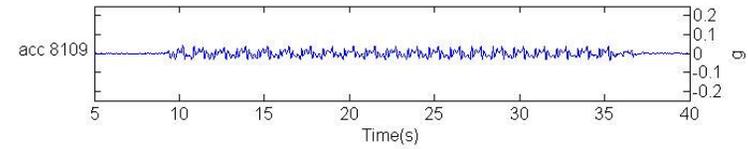
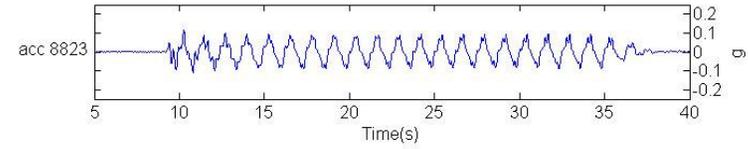
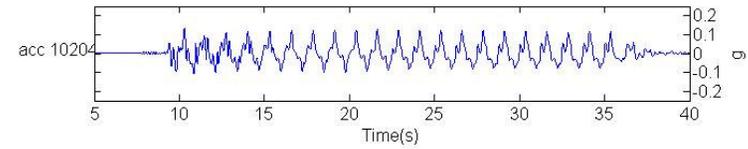
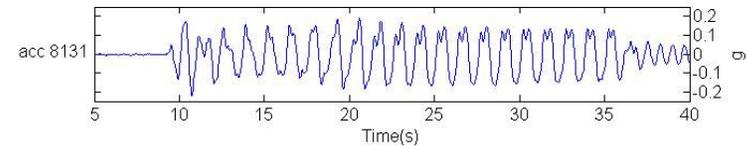
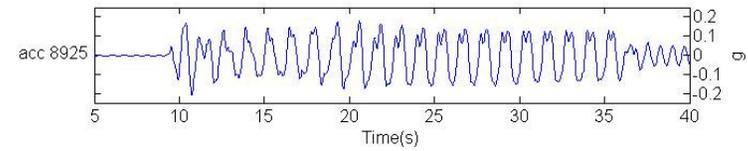
### 5.10 Centrifuge test WA3, earthquake 2

#### Soil and structural displacements



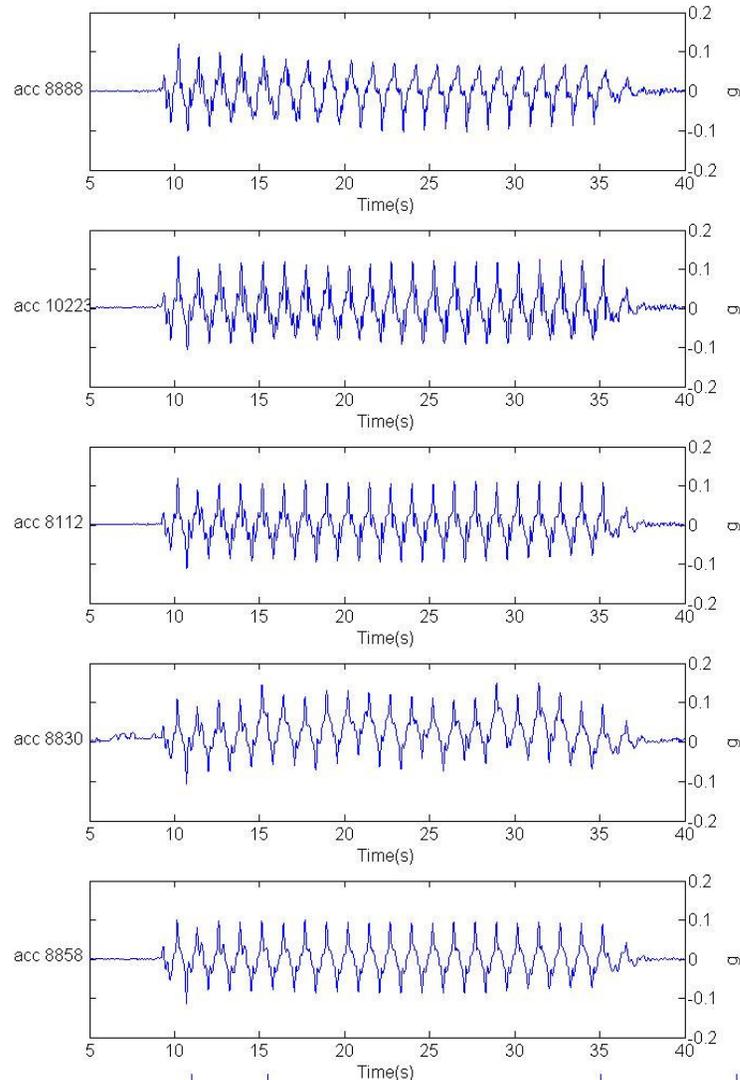
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Long-Term Time Records		

#### Accelerations on and under structure



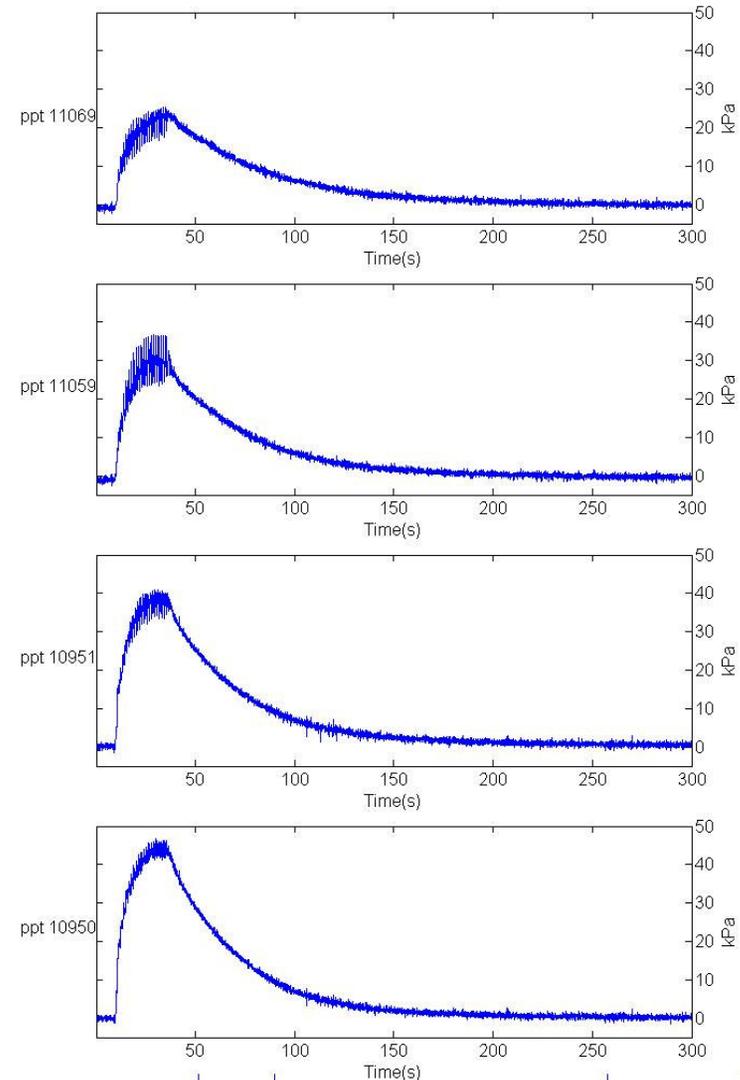
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Short-Term Time Records		

Free field soil accelerations and box (input) acceleration



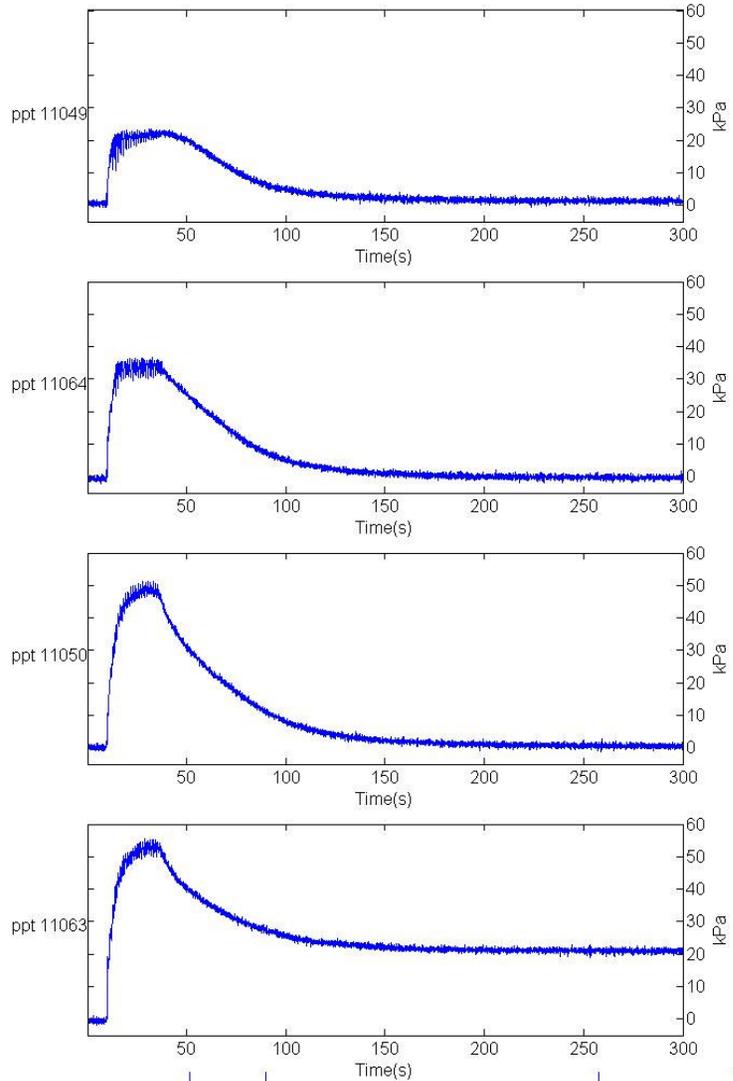
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Short-Term Time Records		

Excess pore pressures under structure base



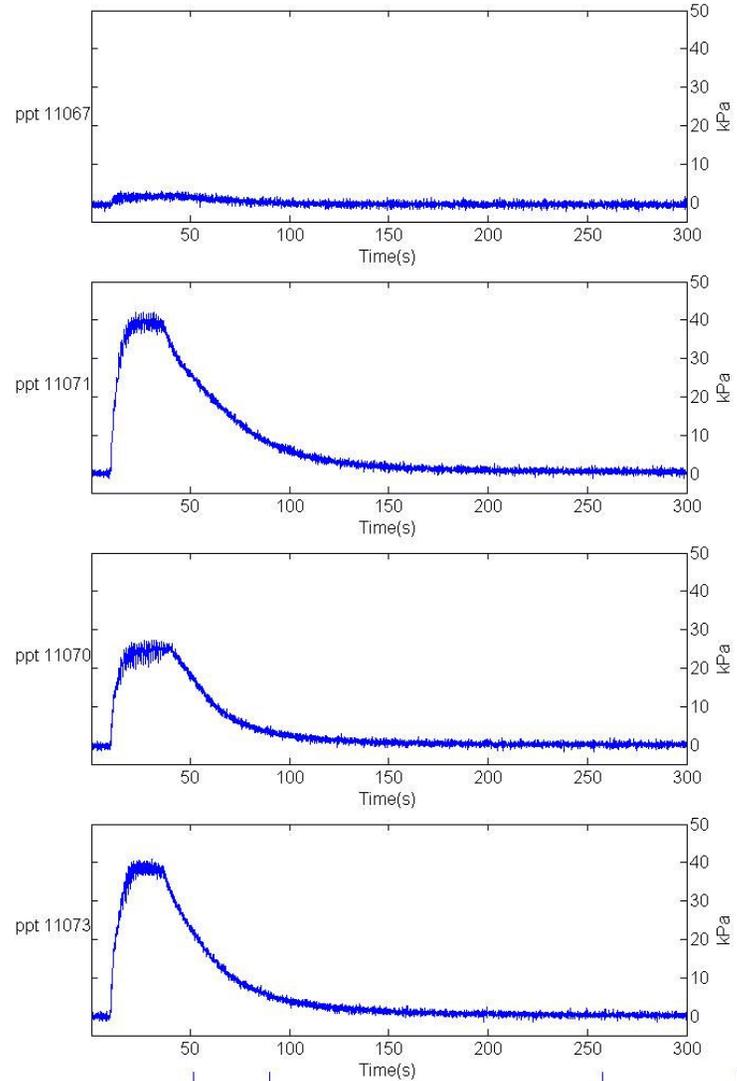
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Long-Term Time Records		

Free field excess pore pressures



TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Long-Term Time Records		

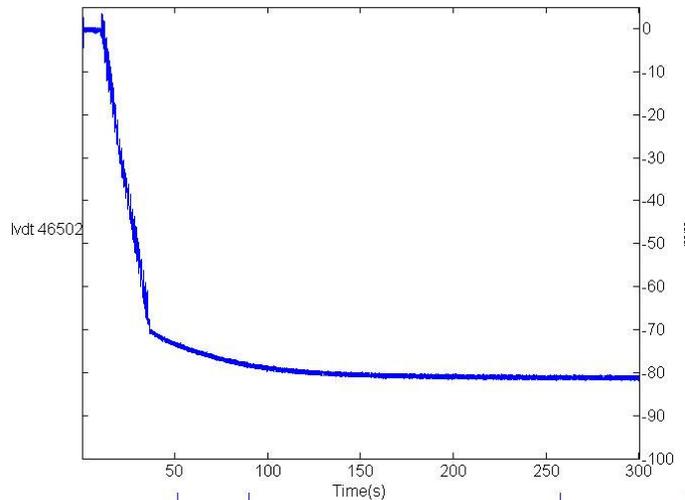
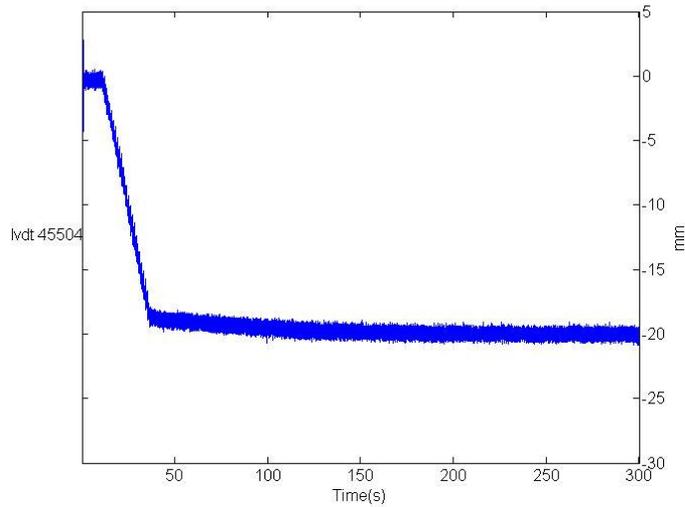
Excess pore pressures near containment walls



TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	2	
	Long-Term Time Records		

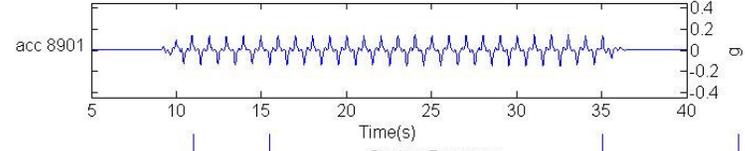
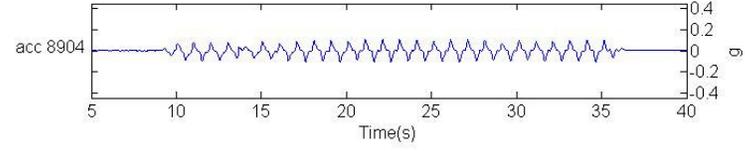
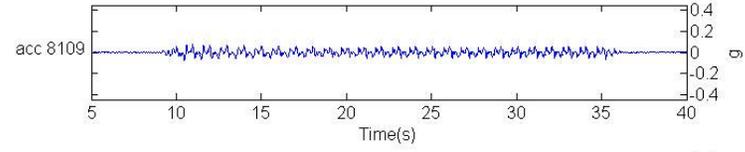
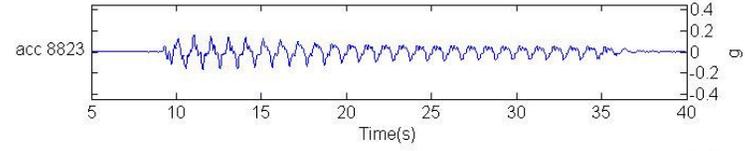
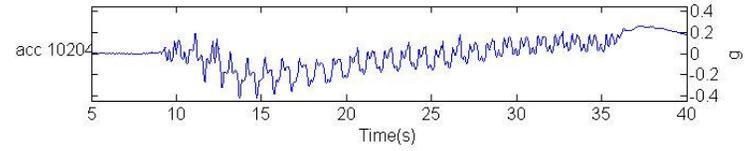
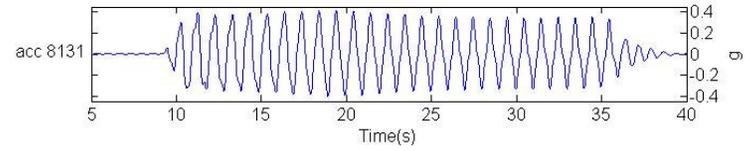
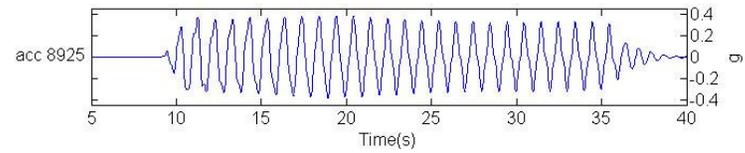
### 5.11 Centrifuge test WA3, earthquake 3

#### Soil and structural displacements



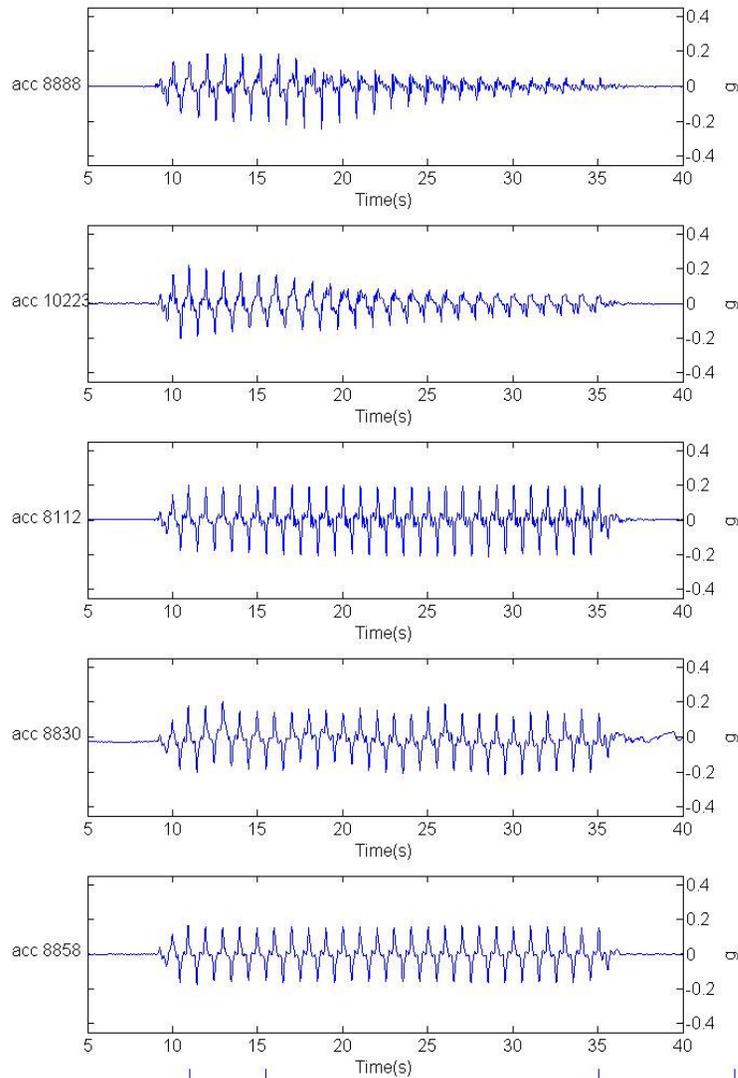
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Long-Term Time Records		

#### Accelerations on and under structure



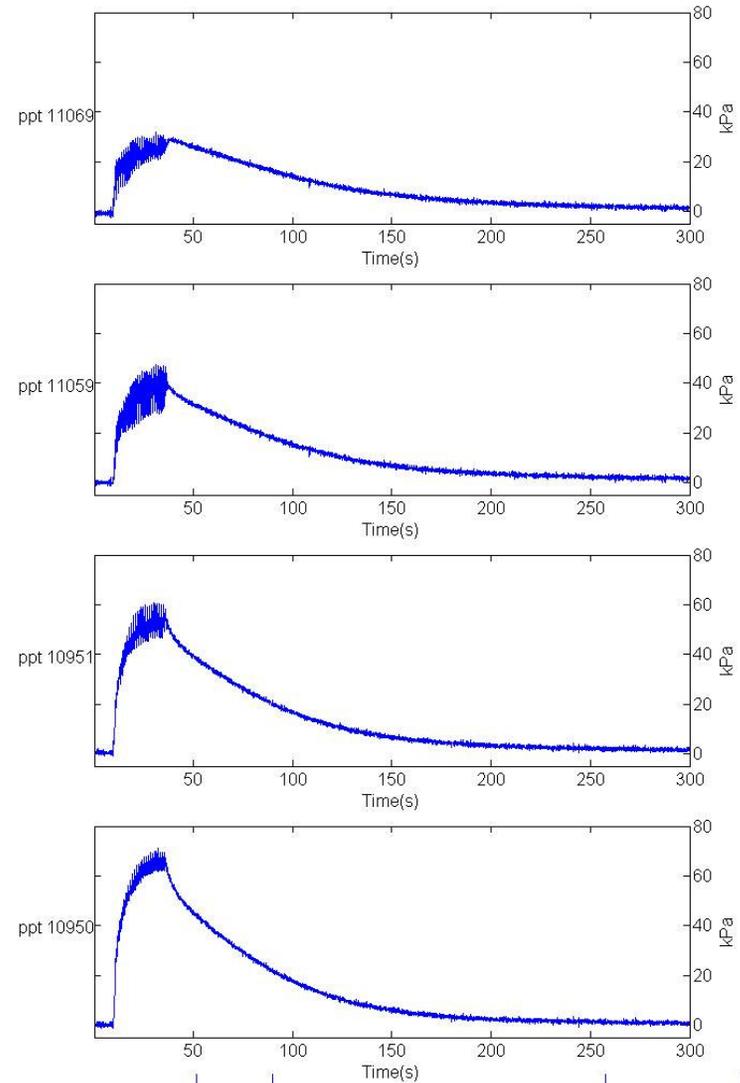
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Short-Term Time Records		

Free field soil accelerations and box (input) acceleration



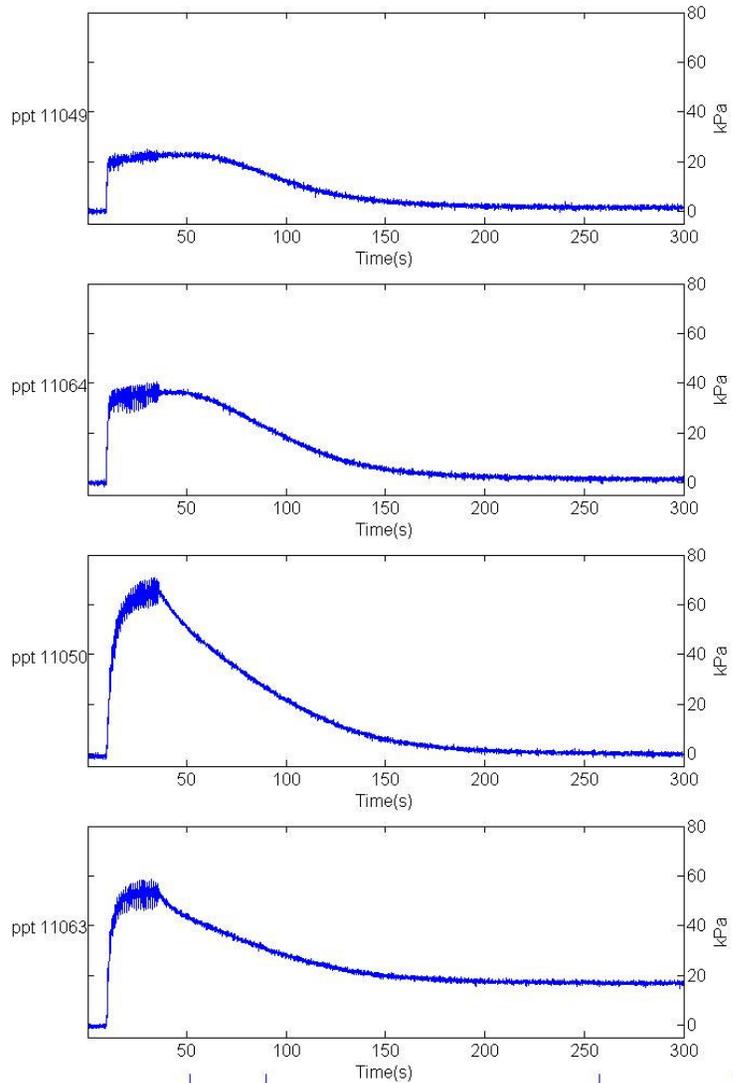
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Short-Term Time Records		

Excess pore pressures under structure base



TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	3	
	Long-Term Time Records		

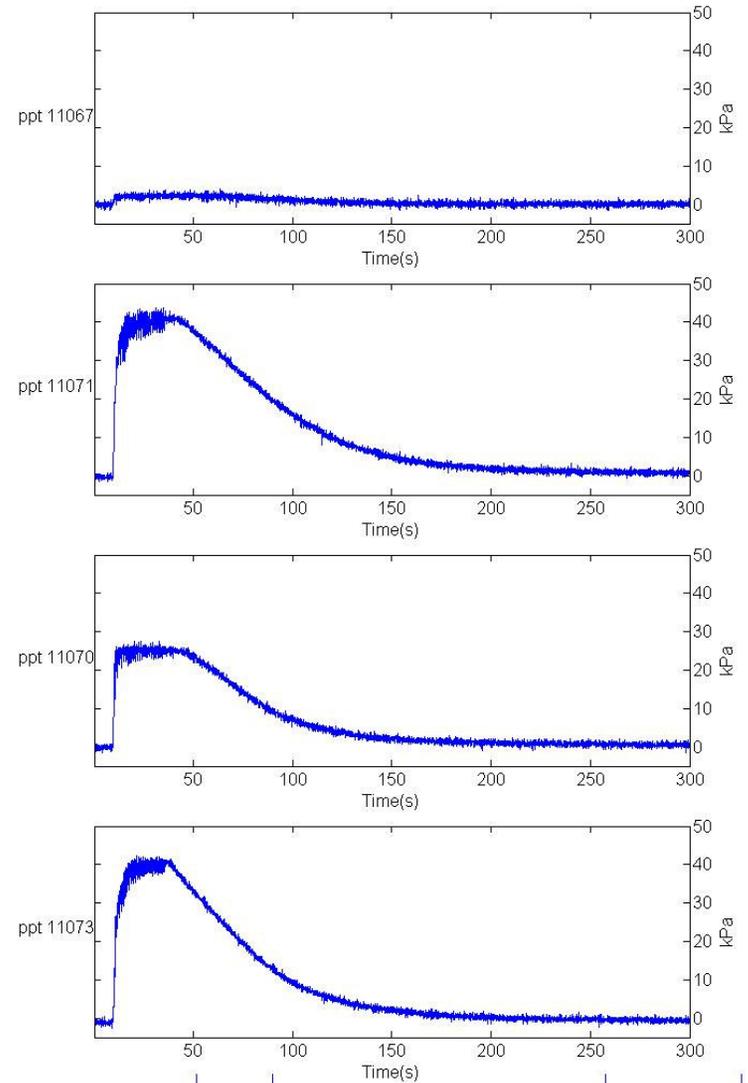
Free field excess pore pressures



TEST WA3	Scales: Prototype	Earthquake
FLIGHT 1	8th order Butterworth Filter at 500Hz	3
	Long-Term Time Records	

Figure No.

Excess pore pressures near containment walls

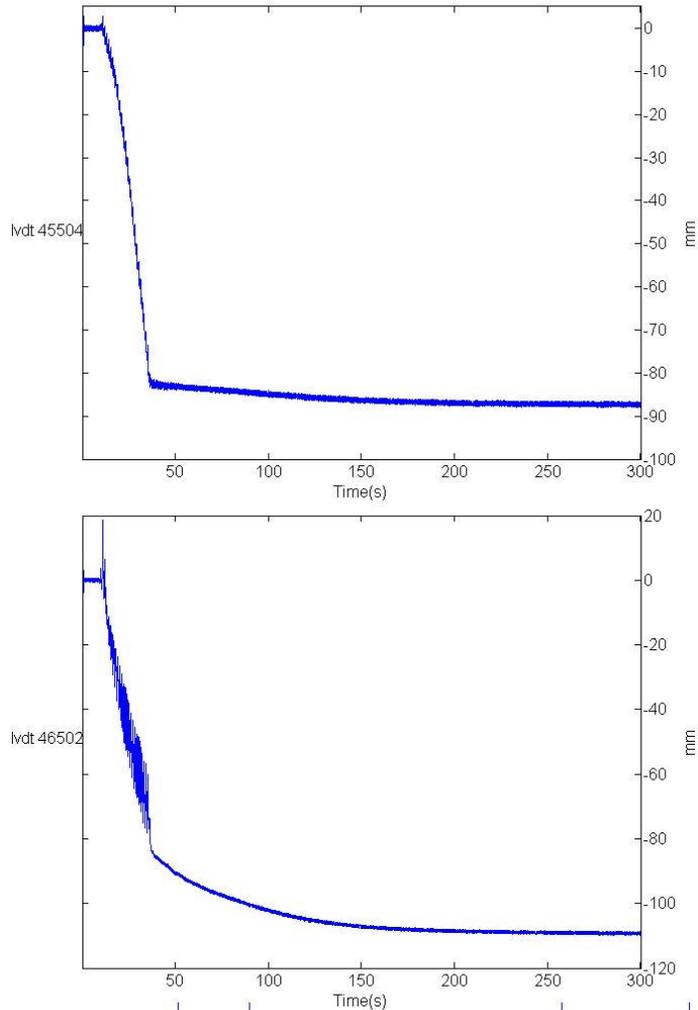


TEST WA3	Scales: Prototype	Earthquake
FLIGHT 1	8th order Butterworth Filter at 500Hz	3
	Long-Term Time Records	

Figure No.

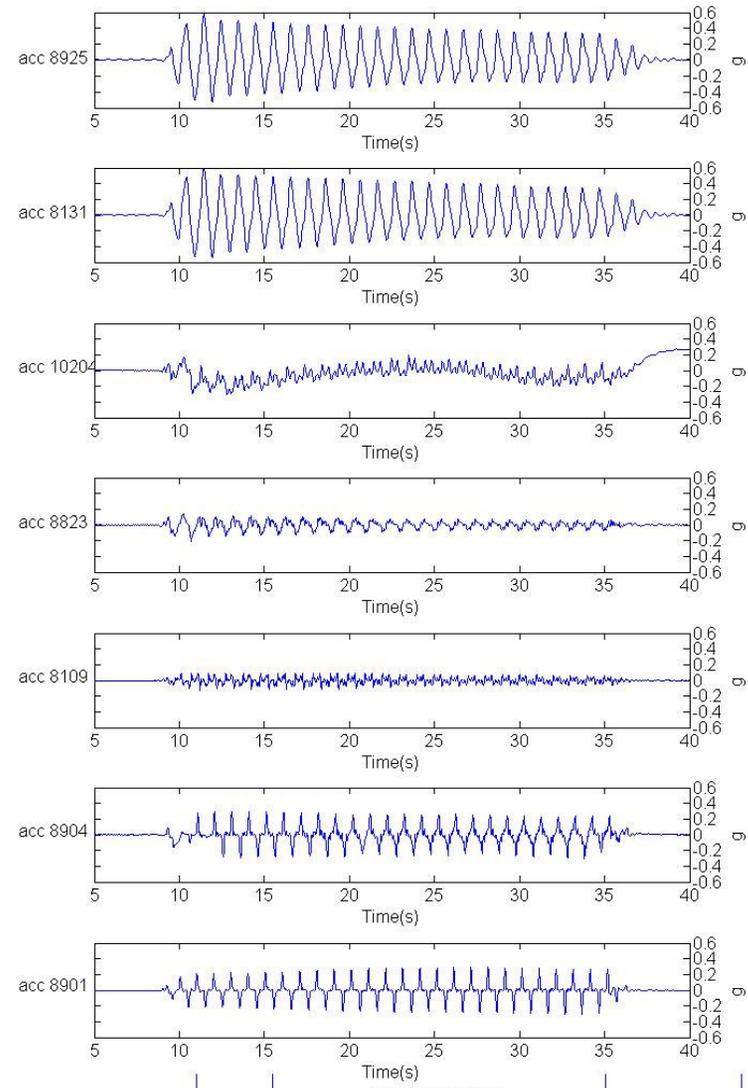
### 5.12 Centrifuge test WA3, earthquake 4

#### Soil and structural displacements



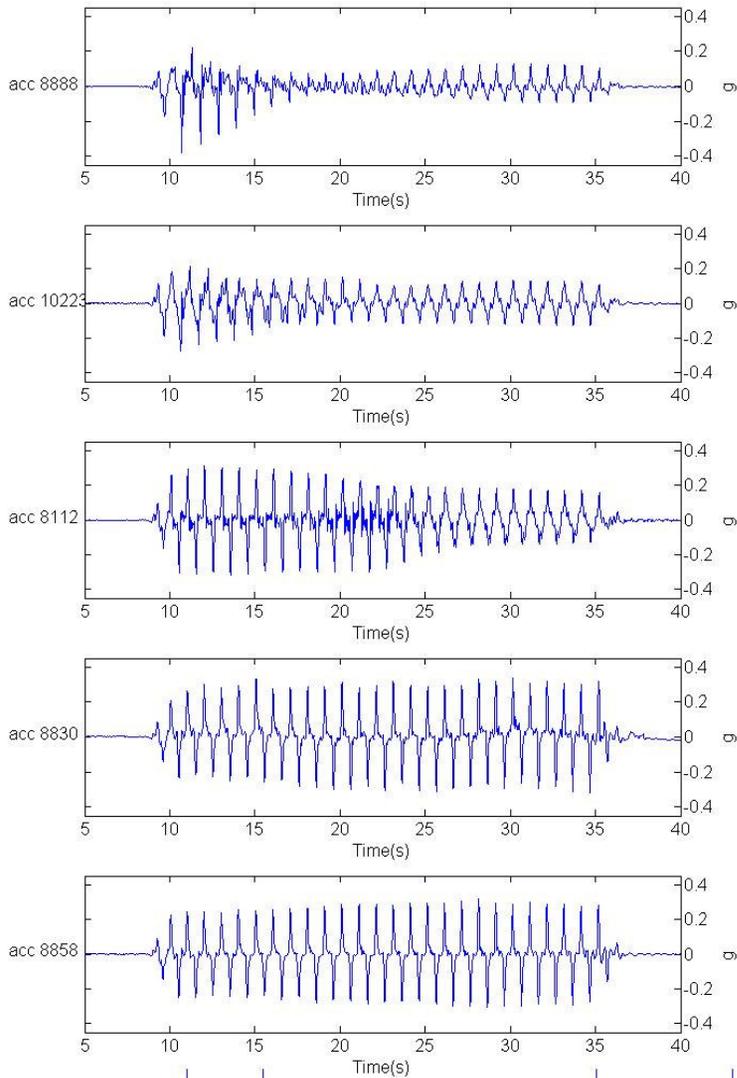
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	4	
	Long-Term Time Records		

#### Accelerations on and under structure



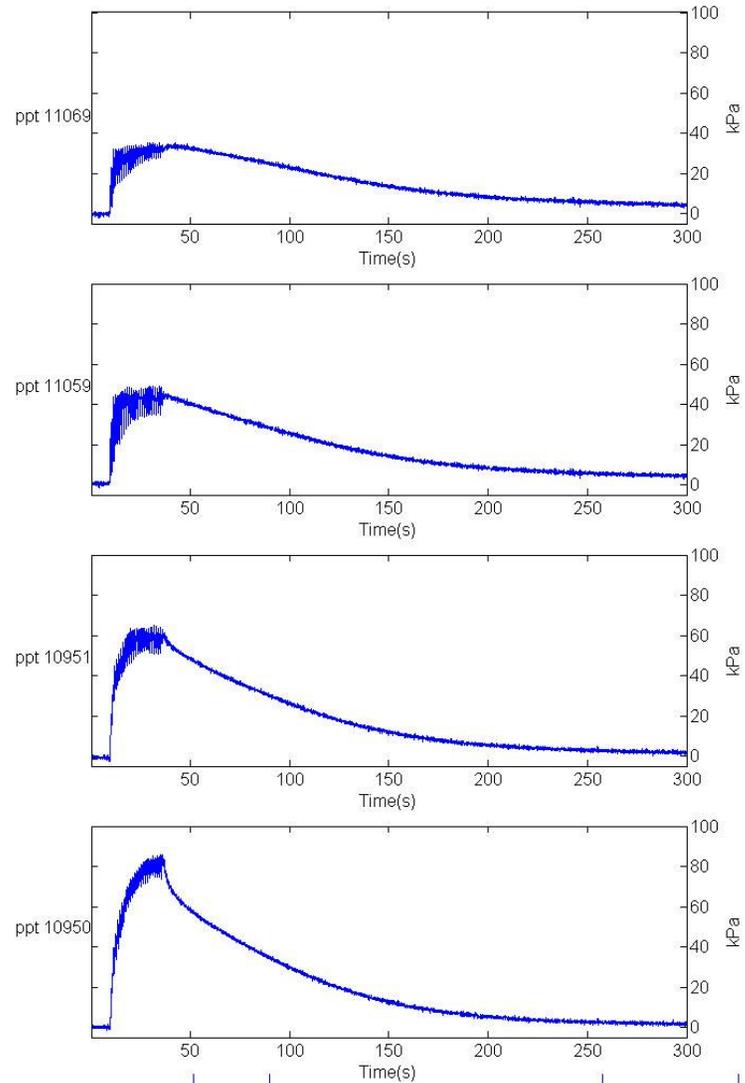
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	4	
	Short-Term Time Records		

Free field soil accelerations and box (input) acceleration



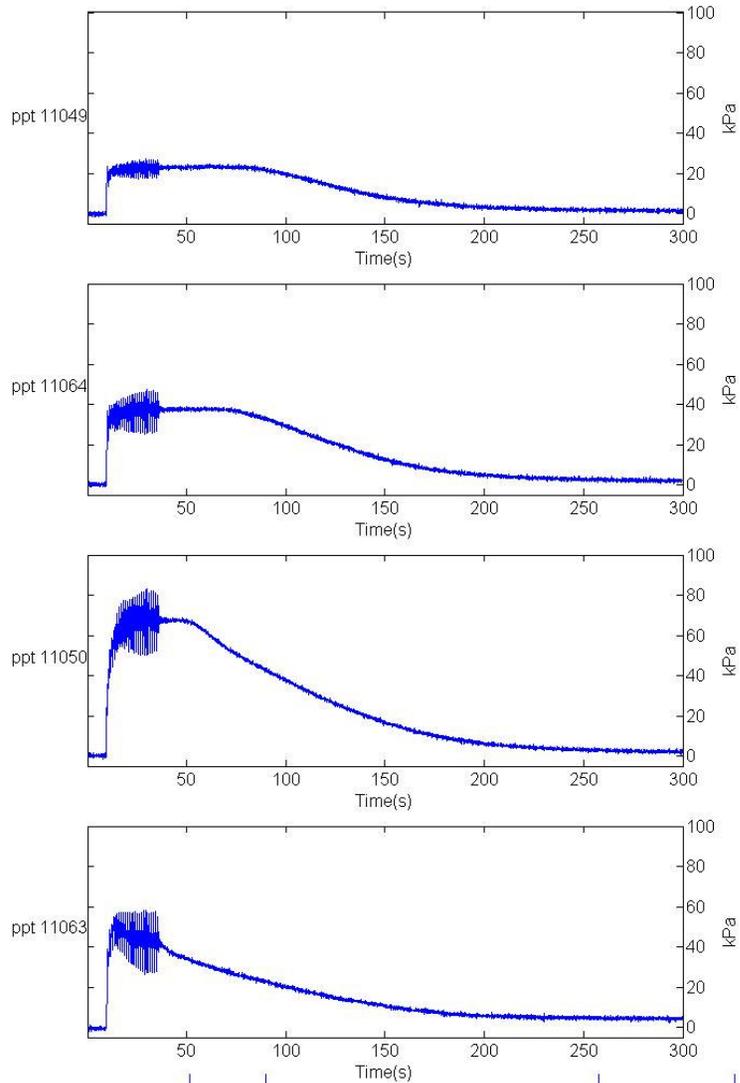
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	4	
	Short-Term Time Records		

Excess pore pressures under structure base



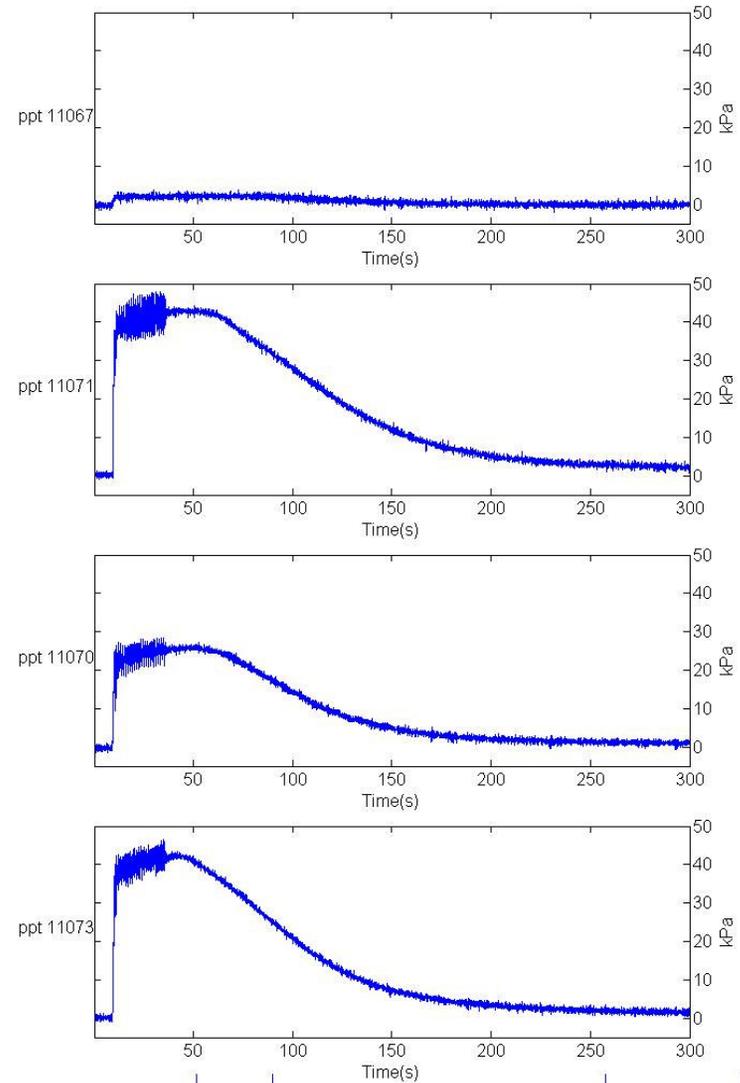
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	4	
	Long-Term Time Records		

Free field excess pore pressures



TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	4	
	Long-Term Time Records		

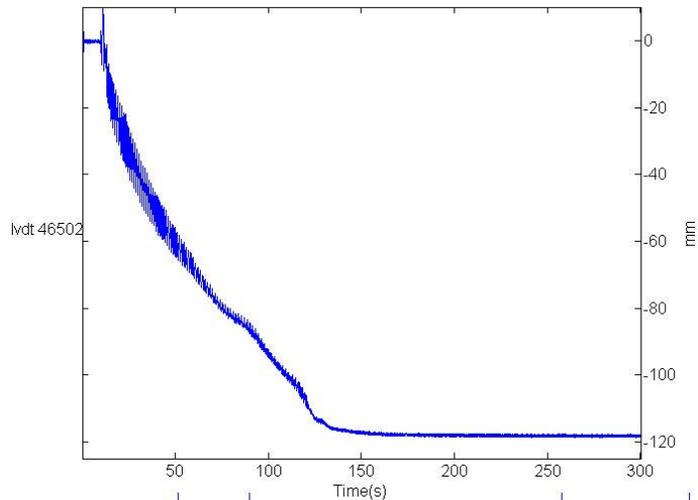
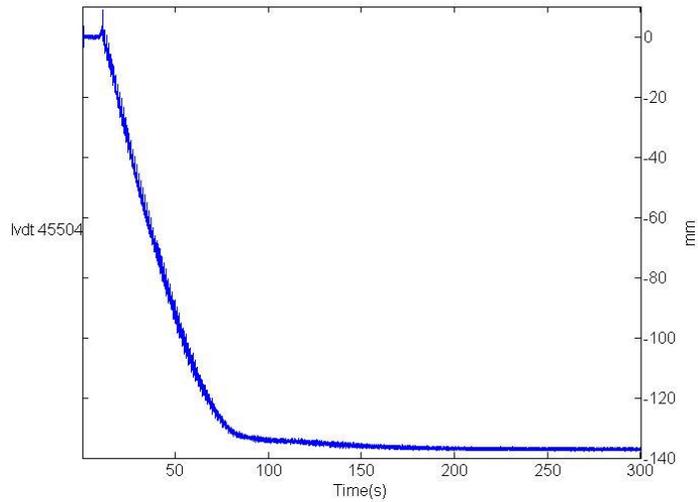
Excess pore pressures near containment walls



TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	4	
	Long-Term Time Records		

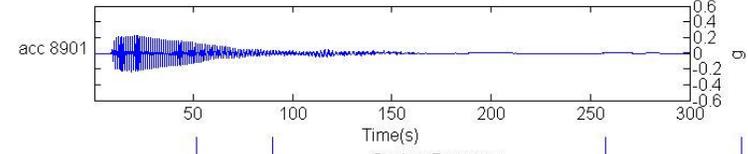
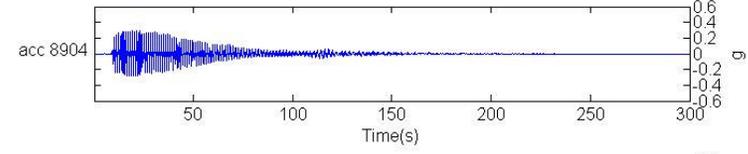
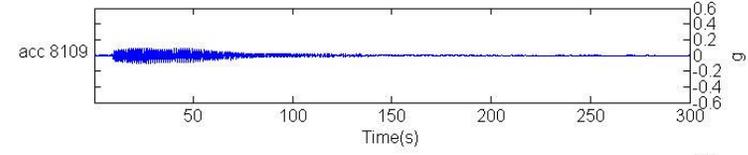
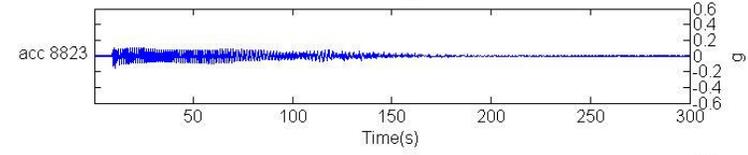
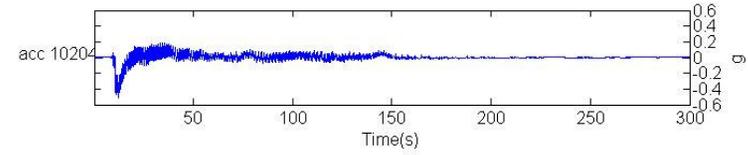
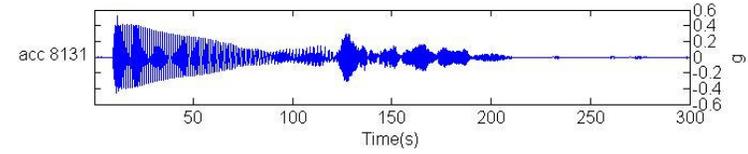
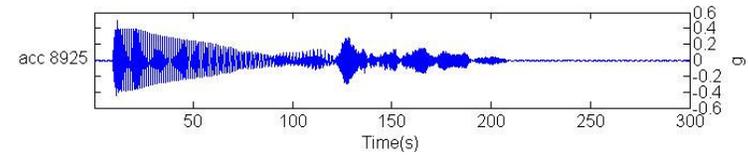
### 5.13 Centrifuge test WA3, frequency sweep earthquake

#### Soil and structural displacements



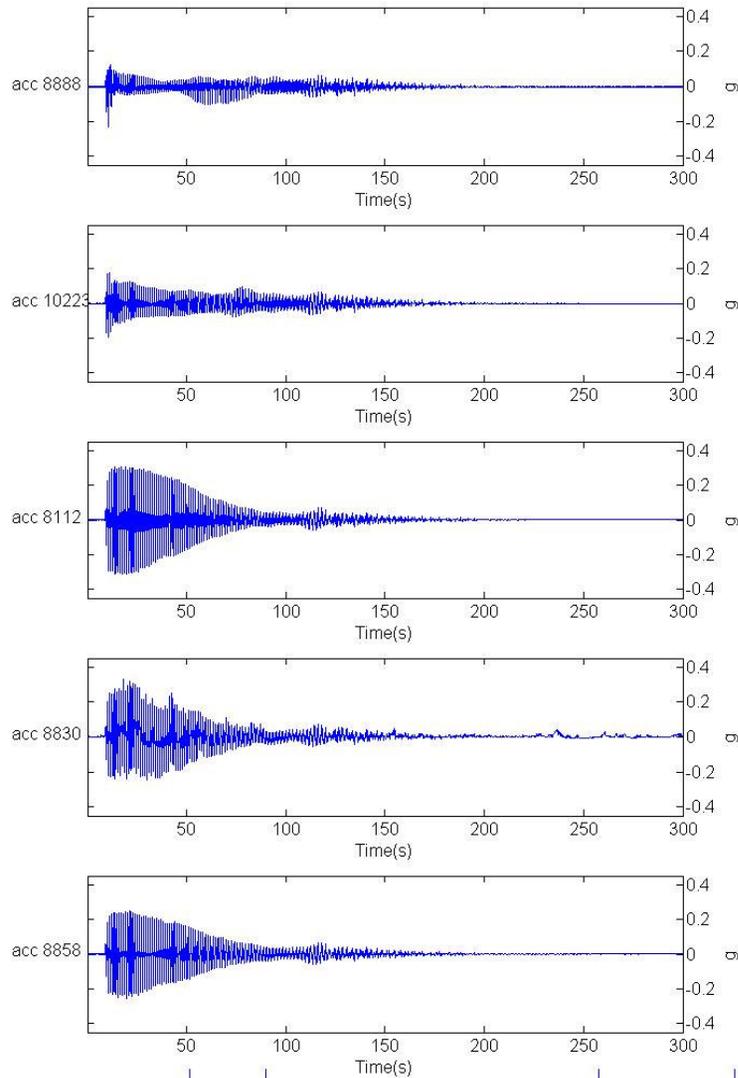
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	sweep	
	Long-Term Time Records		

#### Accelerations on and under structure



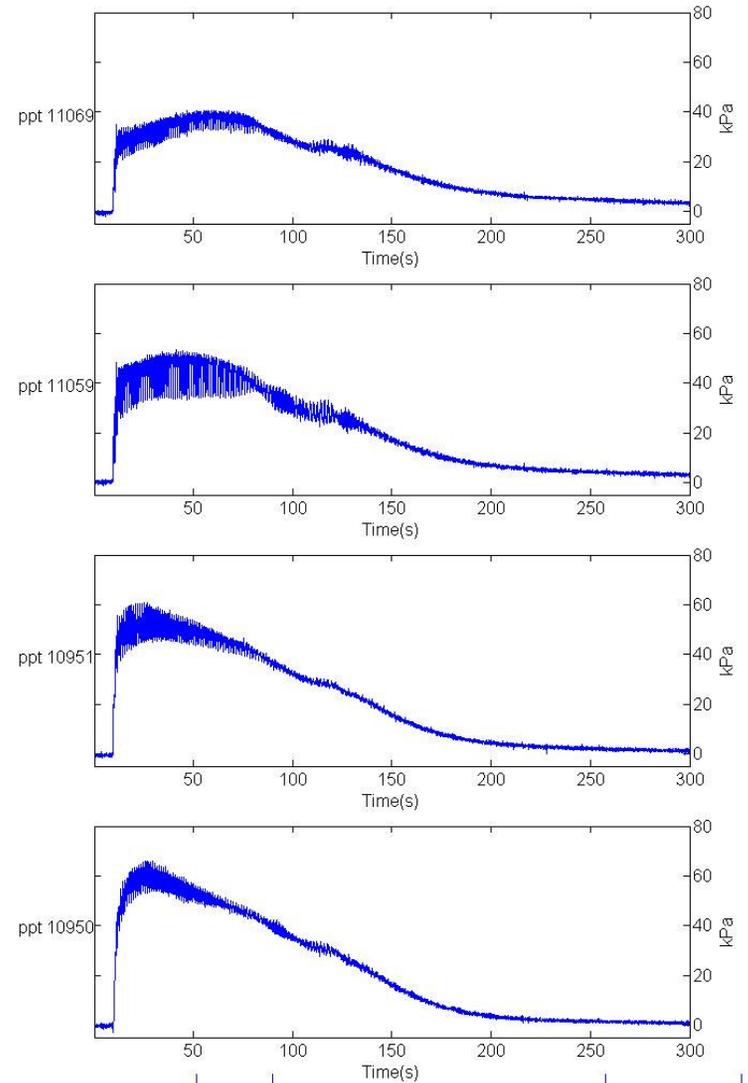
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	sweep	
	Long-Term Time Records		

Free field soil accelerations and box (input) acceleration



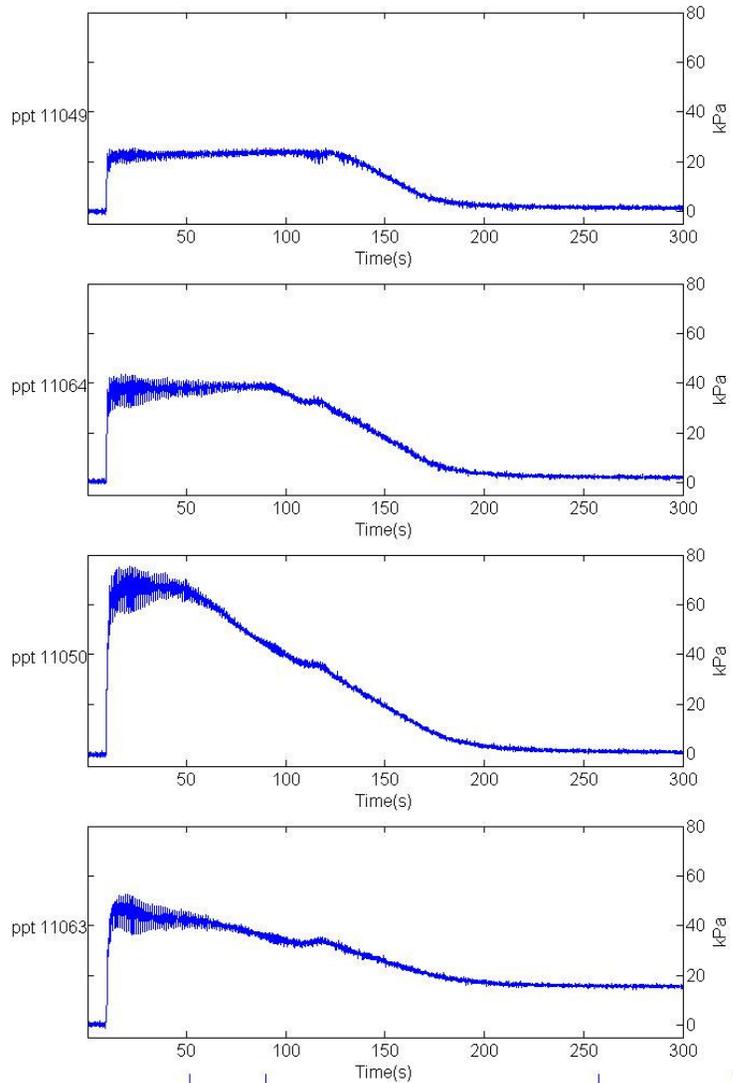
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	sweep	
	Long-Term Time Records		

Excess pore pressures under structure base



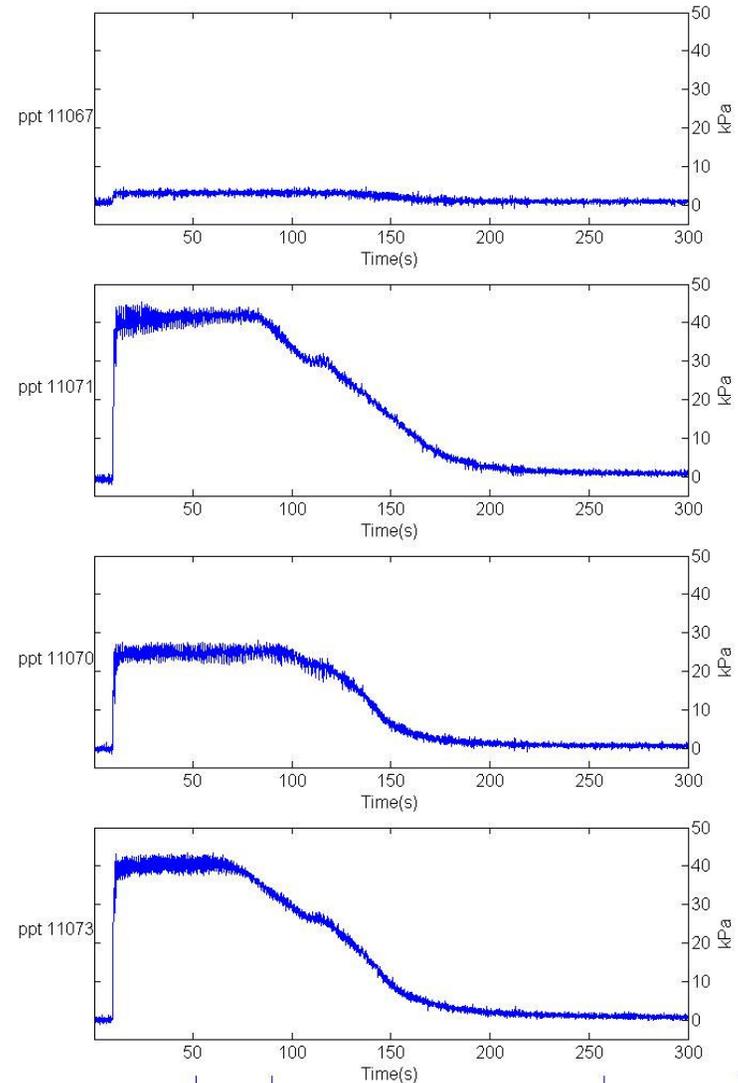
TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	sweep	
	Long-Term Time Records		

Free field excess pore pressures



TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	sweep	
	Long-Term Time Records		

Excess pore pressures near containment walls



TEST WA3	Scales: Prototype	Earthquake	Figure No.
FLIGHT 1	8th order Butterworth Filter at 500Hz	sweep	
	Long-Term Time Records		