Data managing and archiving

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INTRODUCTION

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L.E.D.(ay)

- Ph.D. candidate in Structural engineering at UCSD
- Worked on the BNCS project
- In charge of instrumentation (analog sensors) and uploading data from analog sensors on NEEShub

HISTORY OF EXPERIMENTAL DATA

From the seed of the idea to the sharing of knowledge

PHASE 1: Brainstorming phase: determining the goals

PHASE 2: Developing instrumentation plans

PHASE 3:
Installation of the sensors

PHASE 4:
Testing i.e. Data collection

PHASE 5: Data sharing

HISTORY OF EXPERIMENTAL DATA

EXAMPLE: Precast concrete cladding panels installed on the BNCS building

Precast Concrete Cladding Panels

PHASE 1: BRAINSTORMING

WHAT WE DO: Determine what are our goals, what information we want to obtain from the test. Related to the open issues in the field

WHO DOES IT: Group of experts in the field [academia + industry]

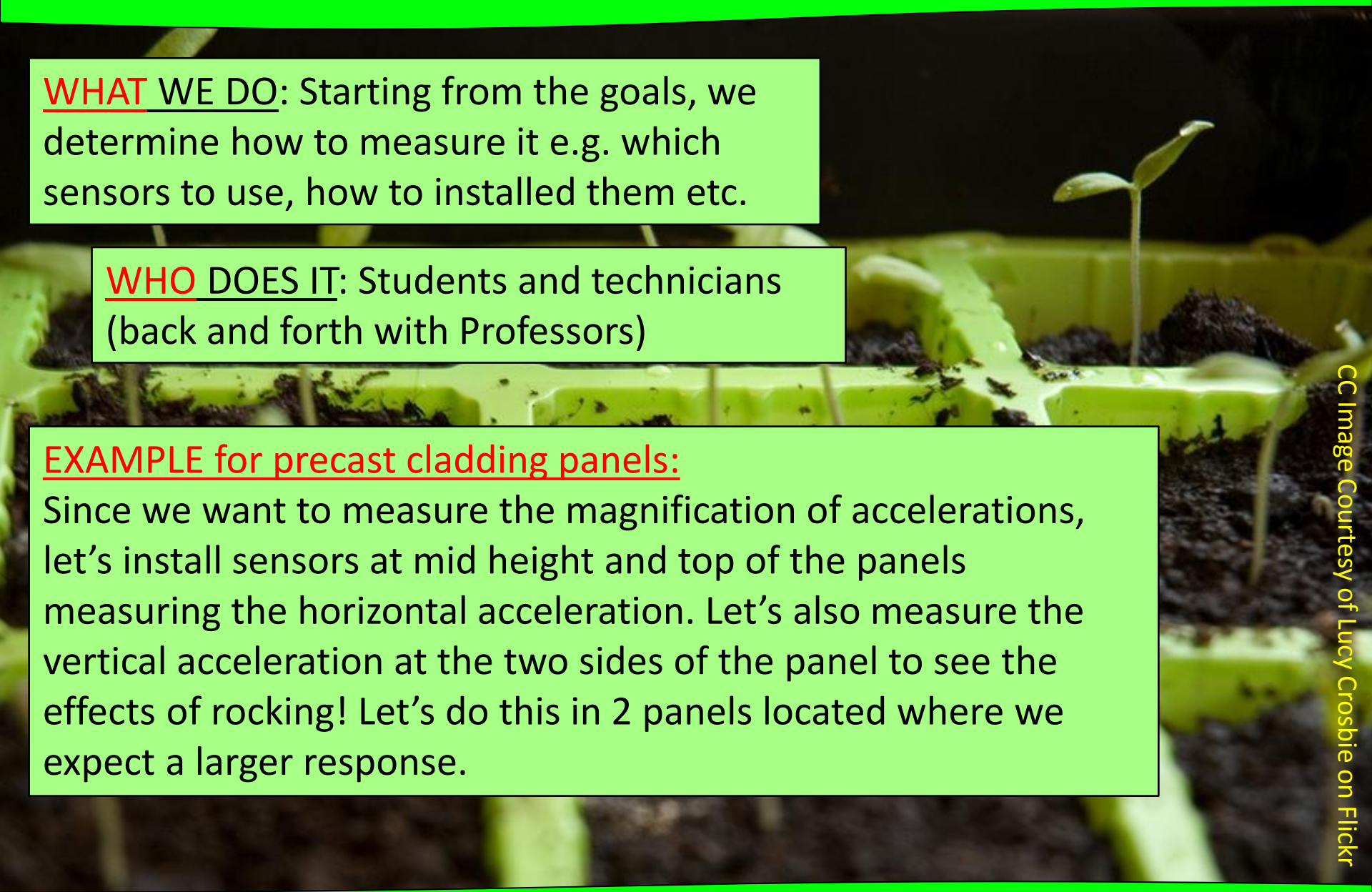
EXAMPLE for precast cladding panels:

Meeting between

- Professors (UCSD, SJSU)
- Industry representatives (Willis Construction, Clark Pacific)
- PCI advisor board

Determination of the goals: e.g. determination of the magnification of acceleration in the cladding panels, force in the connections, displacements relative to the building

PHASE 2: DEVELOPING OF INSTRUMENTATION PLANS



WHAT WE DO: Starting from the goals, we determine how to measure it e.g. which sensors to use, how to installed them etc.

WHO DOES IT: Students and technicians (back and forth with Professors)

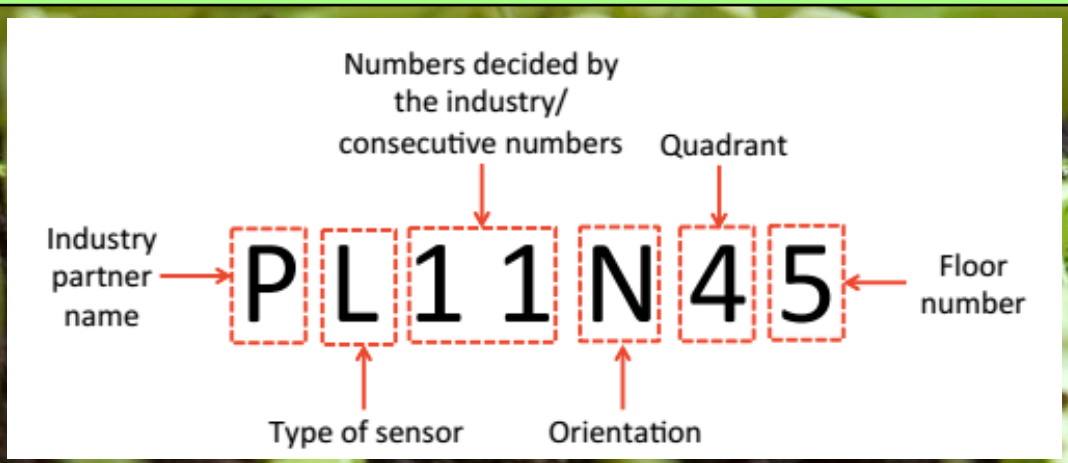
EXAMPLE for precast cladding panels:

Since we want to measure the magnification of accelerations, let's install sensors at mid height and top of the panels measuring the horizontal acceleration. Let's also measure the vertical acceleration at the two sides of the panel to see the effects of rocking! Let's do this in 2 panels located where we expect a larger response.

PHASE 2: DEVELOPING OF INSTRUMENTATION PLANS

NOTE: Why is the name of sensors SO IMPORTANT (especially if many sensors are used)?

- It helps us identify the sensor during testing (if there are problems)
- It helps researchers navigate through data during data analysis phase



CC Image Courtesy of Lucy Crosbie on Flickr

PHASE 2: DEVELOPING OF INSTRUMENTATION PLANS

CC Image Courtesy of Lucy Crosbie on Flickr

PHASE 2: DEVELOPING OF INSTRUMENTATION PLANS

ADVICE: Work in close collaboration with the staff!!!

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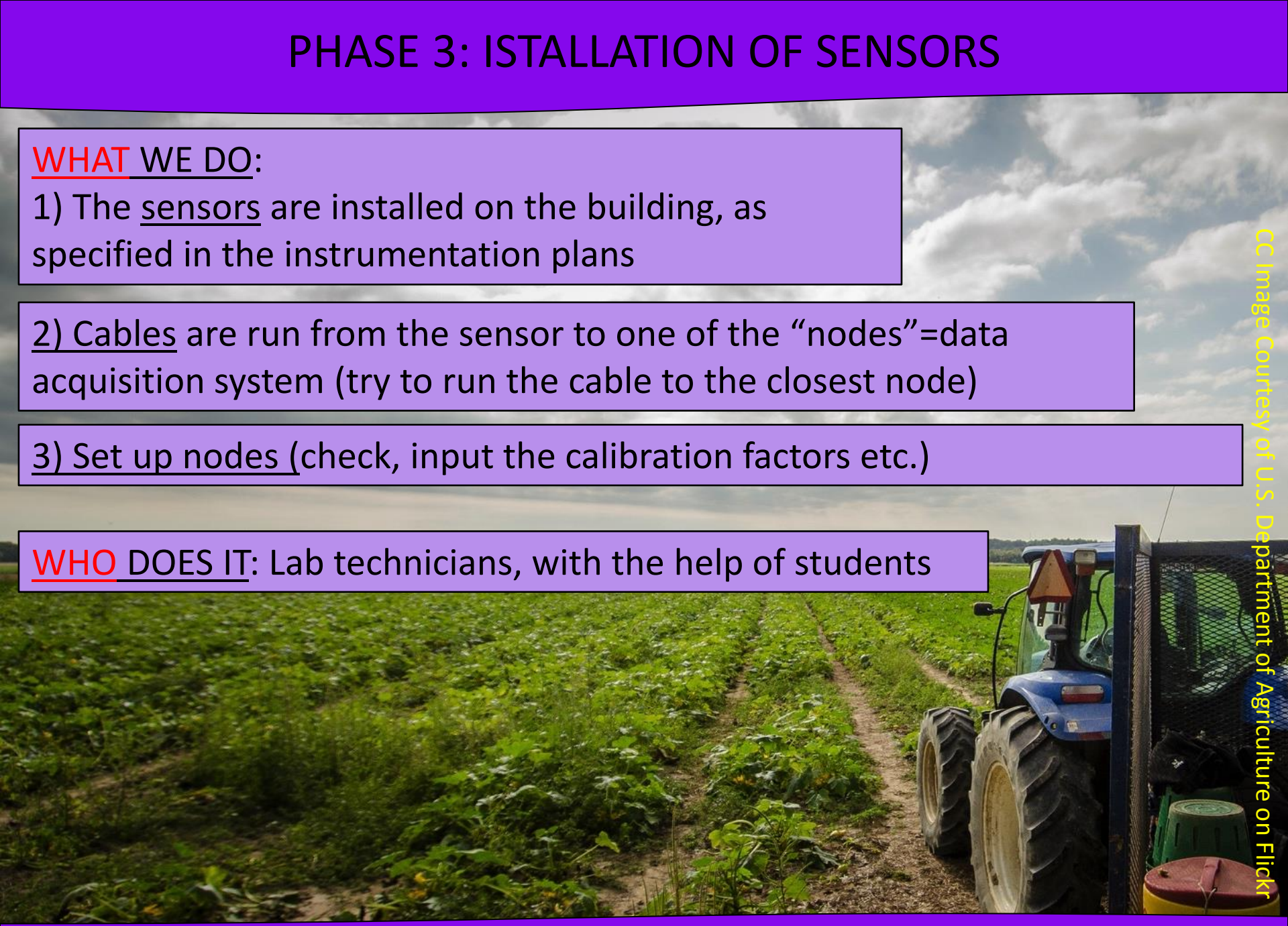
PHASE 3: ISTALLATION OF SENSORS

WHAT WE DO:
1) The sensors are installed on the building, as specified in the instrumentation plans

2) Cables are run from the sensor to one of the “nodes”=data acquisition system (try to run the cable to the closest node)

3) Set up nodes (check, input the calibration factors etc.)

WHO DOES IT: Lab technicians, with the help of students



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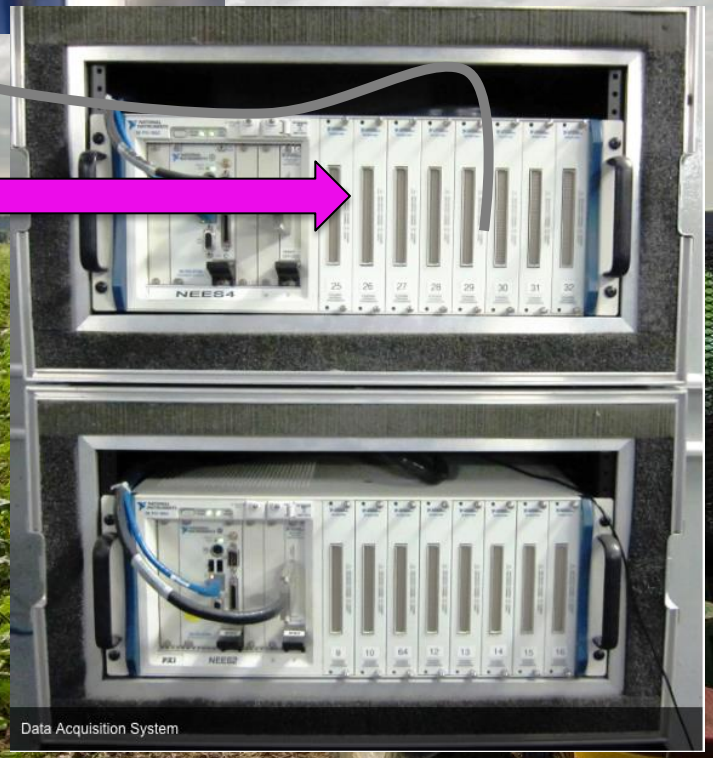
PHASE 3: ISTALLATION OF SENSORS

SENSOR

CABLES

Data acquisition system



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PHASE 3: ISTALLATION OF SENSORS

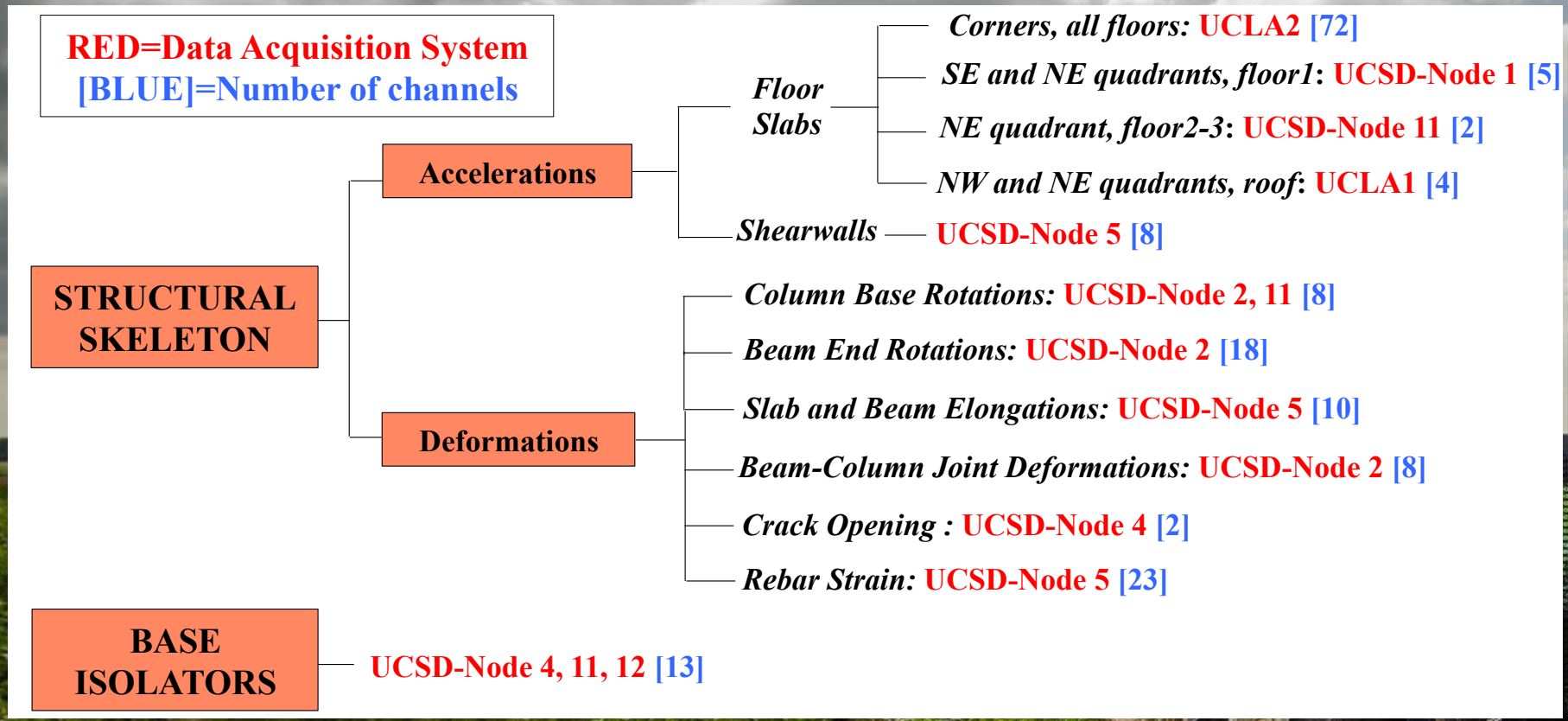
DAQs

Type of sensor

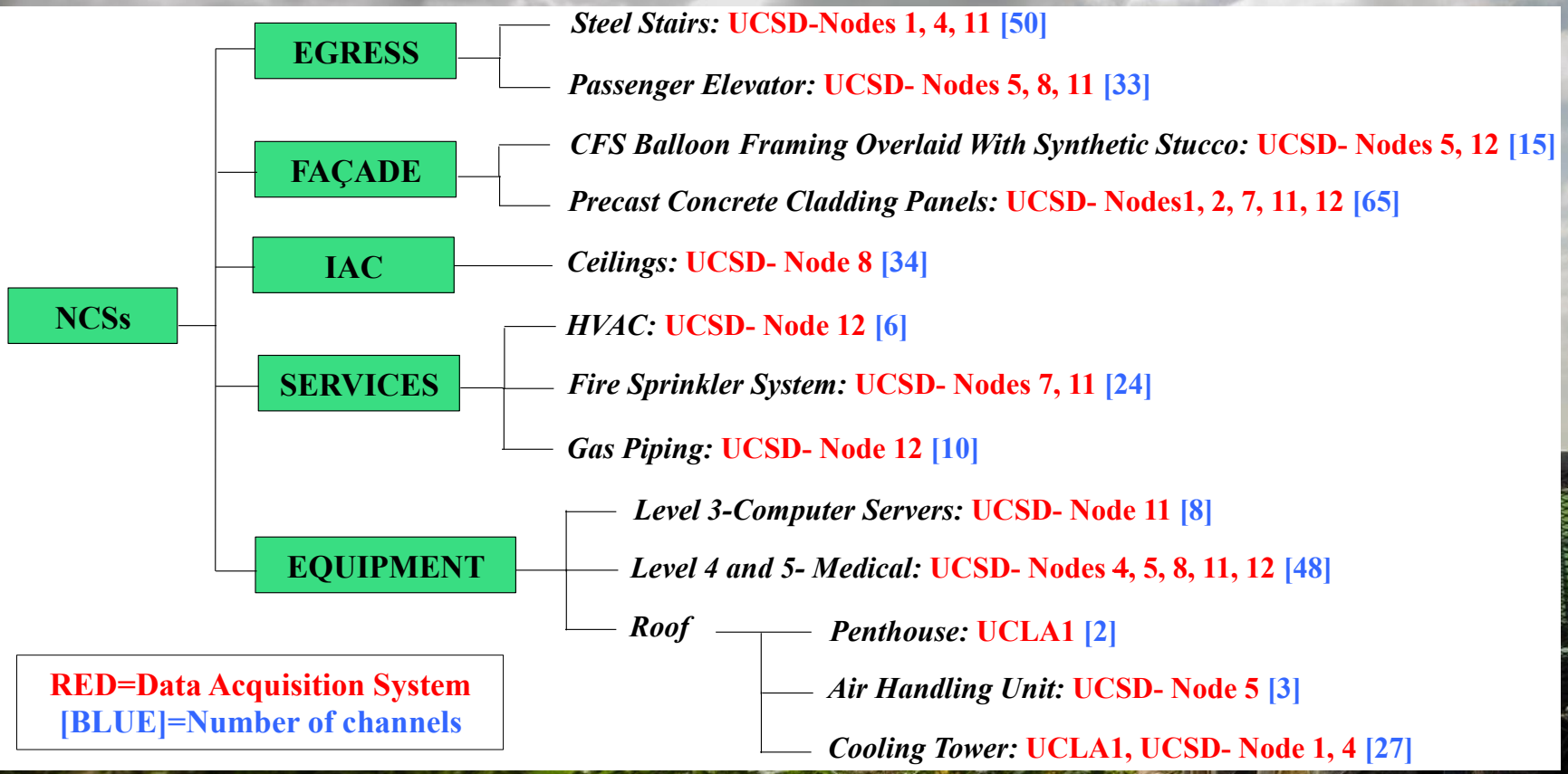
Component	Number of sensors						Sum
	UCLA1	UCLA2	UCSD				
	A	A	A	DT	SG	LC	
Structural skeleton and isolators	4	72	17	57	23	-	**173**
NCSs	8	-	124	108	23	62	**325**
Shake table and basement	-	9	9	-	-	-	**18**
Sum	**12**	**81**	**150**	**165**	**46**	**62**	**516**

Note: A=Accelerometers; DT=Displacement Transducers; SG=Strain Gauges; LC=Load Cells

PHASE 3: ISTALLATION OF SENSORS



PHASE 3: ISTALLATION OF SENSORS



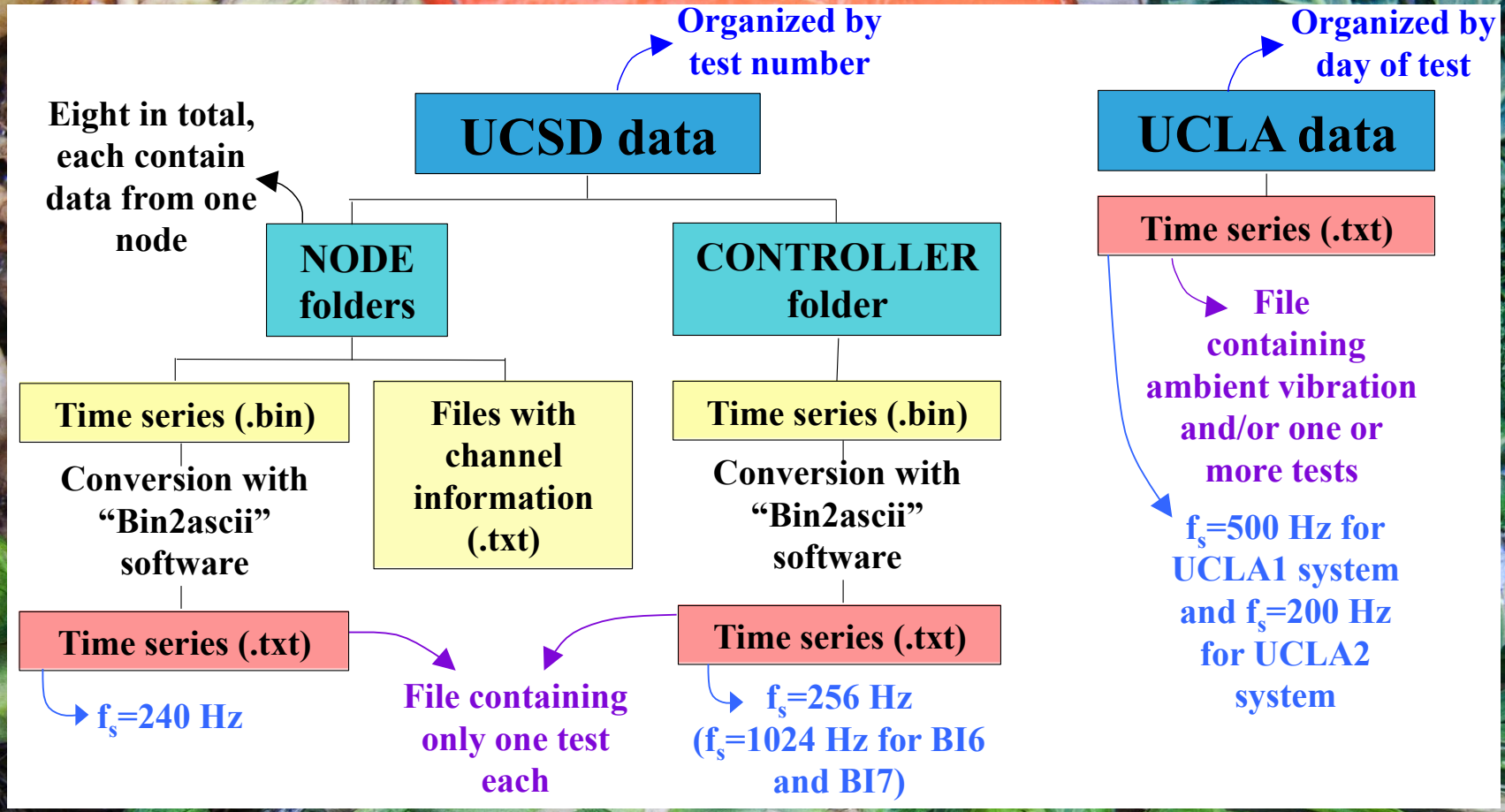
PHASE 4: TESTING a.k.a. DATA COLLECTION

WHAT WE DO:
Data are recorded during testing

WHO DOES IT: Whole team

- Data format: Students are generally provided with text files that can be opened in excel.
- Each column contains the time history of data recorded by a particular sensor
- Relevance of metadata: extra information that we need (example: units, sampling time etc.)
- Data from different DAQs can be formatted slightly differently (but key information must be present)

PHASE 4: TESTING a.k.a. DATA COLLECTION



Synchronization in time of the sensors → Manually

PHASE 4: TESTING a.k.a. DATA COLLECTION

NEES@UCSD Format:

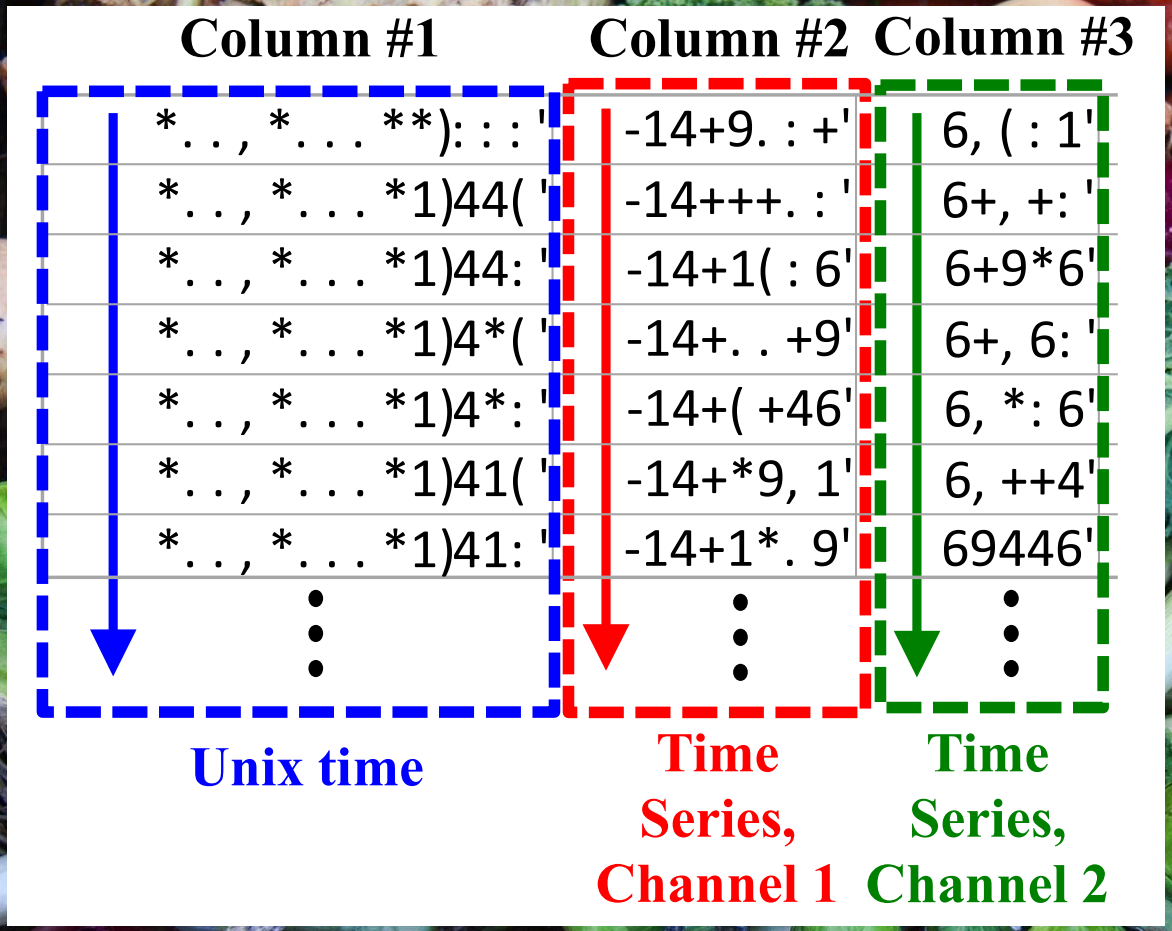
! "#$%&$''''''''''''''''''''''''''( )*++++++, "-. '		
/0*'	/01'	/0. '
2 34*". ('	2 3415 . 6'	2 3415 . . '
78'	78'	78'
4)19. 16*'	4)*. *+*+'	4): 1, +*, '
4)19. 16*'	4)*. *((6'	4): 1, +*, '
4)19. 16*'	4)*. *+*+'	4): 1, +*, '
⋮	⋮	⋮
Time Series	Time Series	Time Series

→ Sampling Period
→ Channel #
→ Channel Name
→ Output Units

NOTE: in this case the calibration factors were already applied/ Output given in engineering units!

PHASE 4: TESTING a.k.a. DATA COLLECTION

NEES@UCLA Format:



No headers in this case! Separate file telling us which channel was in each column

NOTE: in this case the calibration factors were NOT applied! Calibration factors provided in a separate file for each channel

CC Image Courtesy of Hans Splinter on Flickr

PHASE 4: TESTING a.k.a. DATA COLLECTION

BNCS NEESR Project
Sensor Table
Rev. 7, 3/17/2012 R. Nigbor/A. Salamanca

nees@UCLA
The George E. Brown, Jr. Network for Earthquake Engineering Simulation

KEY:
- Reversed polarity
- No Tilt Test
- Not installed yet
- Some electr. noise

System UCLA2: 84-channel Q330 Array

Start Date: 3/6/12 **Stop Date:** xxx

Notes:
1. 200sps per channel, linear phase filter
2. Rockhound system, triggered
3. ASCII data format w/time column

Data Channel	Rockhound DIG#	Q330	Q330 Channel	Measurement Type	Manufacturer	Model	S/N	Sensor Axis	Global Orientation (X-East)	Level	Quadrant	Channel Code	Coordinates,ft X	Y	Z	Cable No.	Data file units	Channel Sensitivity g/count	Calibration K (Volts/g)	
1			1	Acceleration	Kinemetrics	ES-U	543	k	Z	6	1	UA11U16	-17	-10	75	C4-1	counts	4.8068E-07	4.96	
2		273A	2	Acceleration	Kinemetrics	ES-U	539	j	Y	6	1	UA11N16	-17	-10	75	C4-2	counts	4.7779E-07	4.99	Long B
3	dig1		3	Acceleration	Kinemetrics	ES-U	532	i	X	6	1	UA11E16	-17	-10	75	C4-3	counts	4.7684E-07	5.00	
4			4	Acceleration	Kinemetrics		1446	k	Z	6	2	UA12U26	17	-10	75		counts	4.7779E-07	4.99	
5		273B	5	Acceleration	Kinemetrics	ES-T	1446	j	Y	6	2	UA12N26	17	-10	75	T17	counts	4.7827E-07	4.99	
6			6	Acceleration	Kinemetrics		1446	i	X	6	2	UA12E26	17	-10	75		counts	4.7875E-07	4.98	
7			1	Acceleration	Kinemetrics	ES-U	545	k	Z	6	3	UA13U36	-17	10	75	C7-1	counts	4.7684E-07	5.00	
8		274A	2	Acceleration	Kinemetrics	ES-U	541	j	Y	6	3	UA13N36	-17	10	75	C7-2	counts	4.7589E-07	5.01	Long B
9	dig2		3	Acceleration	Kinemetrics	ES-U	566	i	X	6	3	UA13E36	-17	10	75	C7-3	counts	4.7684E-07	5.00	
10			4	Acceleration	Kinemetrics		1702	k	Z	6	4	UA14U46	17	10	75		counts	4.7779E-07	4.99	
11		274B	5	Acceleration	Kinemetrics	ES-T	1702	j	Y	6	4	UA14N46	17	10	75	T18	counts	4.7827E-07	4.99	
12			6	Acceleration	Kinemetrics		1702	i	X	6	4	UA14E36	17	10	75		counts	4.7875E-07	4.98	

Column# in excel file

Sensor name

Calibration factor (from count to engineering units)

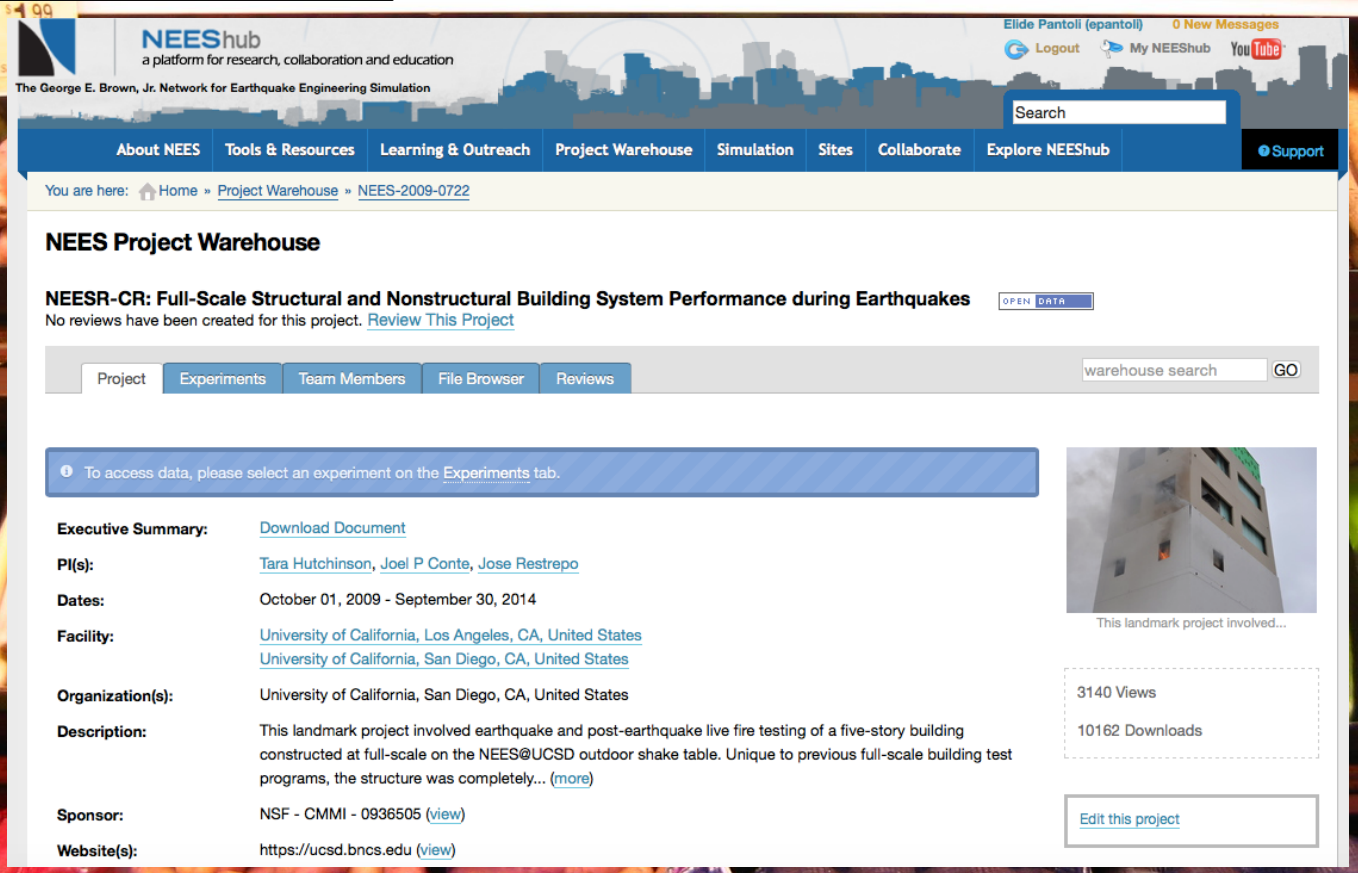
Some initial work to get the data ready for use, but once they are ready no need to deal with this anymore!

UCLA metadata file

PHASE 5: SHARING OF THE DATA

WHAT WE DO:
Data are uploaded on NEEShub and shared with the community

WHO DOES IT: Students



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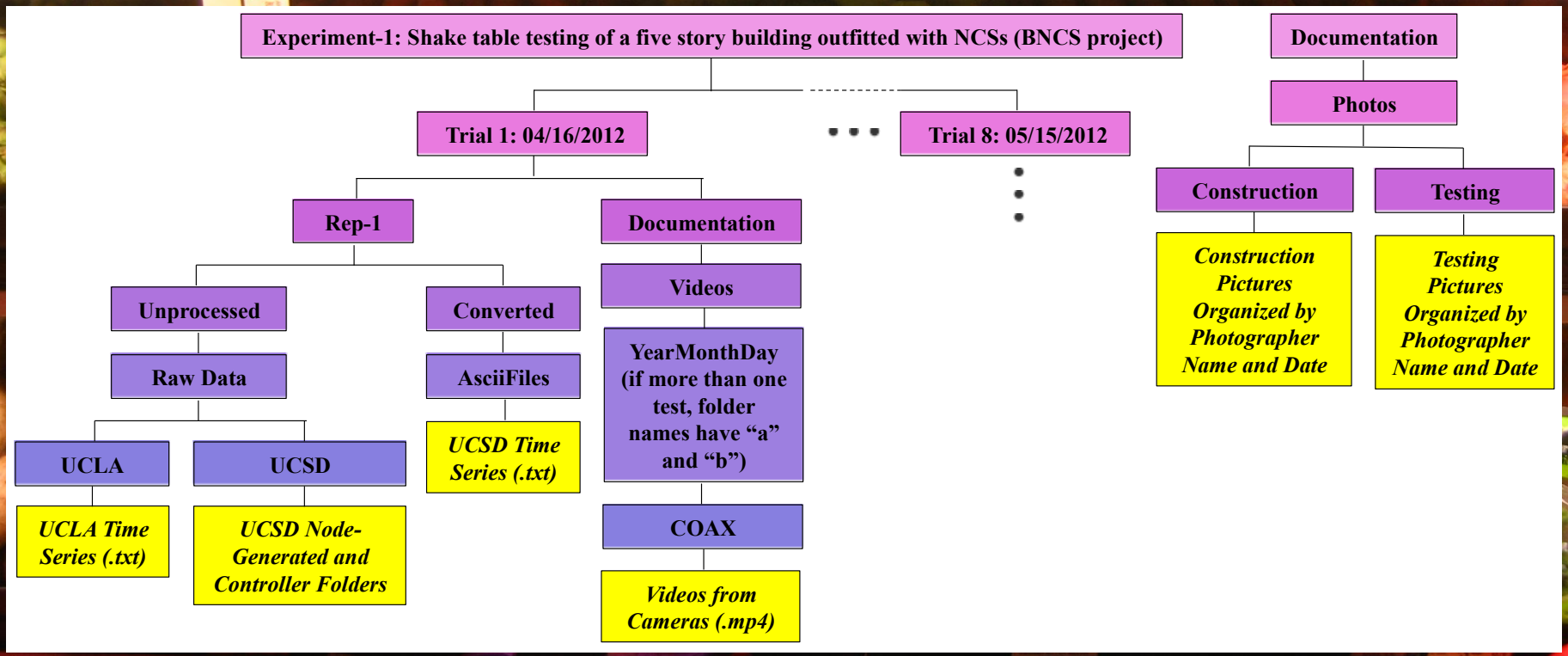

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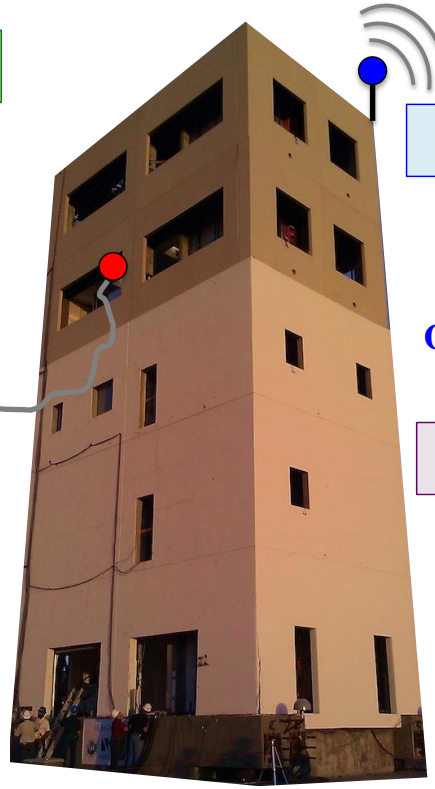
FINAL NOTE: it's not just about analog sensors!

VIDEO CAMERAS

Provided by industry partners and by NEES@UCSD

ANALOG SENSORS

Three DAQs provided by NEES@UCSD and NEES@UCLA (UCLA1 and UCLA2)



GPS

Provided by the Scripps Institute of Oceanography

STILL CAMERAS

High resolution digital images were taken during construction and testing by the research team and industry partners

VERY IMPORTANT to check the displacement obtained with double integration of accelerations

Follow general rules when taking pictures (makes sure you know where you are, you have a clean shot etc.)

CC Image Courtesy of Rick on Flickr

FINAL NOTE: video cameras

IP

Coax

High definition camcorder

GoPro

Typical Image of Camera	Number of Cameras	Approximate Uncut Data Collected (GB)	**General Purpose**	Sample Snapshot of Camera View
	56	~140	Capture visual data within the structure with input from industry partners – emphasis on NCSs	
	16	~43	Capture visual data within the structure – emphasis on NCSs	
	8	~215	Capture overall views and external visual data	
	7	~200	Capture visual data within the structure for fixed base testing emphasis on structural components	

CC Image Courtesy of Rick on Flickr

FINAL NOTE: video cameras

(a)

(b)

(c)

(d)

(e)

(f)

(g)

(h)

CC Image Courtesy of Rick on Flickr

FINAL NOTE: video cameras

CONSIDERATIONS

- GOPROS
  - BATTERY LIFE
  - SYNCHRONIZATION WITH EACH OTHER AND WITH DATA
  - DISTORTION
  - LARGE VIDEO FILES
  - VIBRATION (EASY TO STABILIZE BC OF LIGHT WEIGHT)
- IP/COAX CAMERAS
  - VIDEO QUALITY
  - DROPPED "PACKAGES" (DROPPED FRAMES)
    - SYNCHRONIZATION ISSUES FROM THIS
    - LIMITATIONS ON # OF CAMERAS
  - LONG CABLES
  - VIBRATION – MOUNTING BRACKET MUST BE STABLE
- CAMCORDERS
  - BATTERY LIFE
  - VIBRATION
  - SYNCHRONIZATION
  - LARGE FILES
  - MANUAL START/STOP