Concrete Coalition Phase II: Concrete Building Performance Record

Instructions: This form is for use in collecting data for phase two of the Concrete Coalition project: Developing a Global Database of Concrete Buildings Damaged in Earthquakes. For more information about how to use this form, see the sample form or view the demo at: http://concretecoalition.org.

Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 1: Basic Building Information

Exterior of school cafeteria.
(Federico, 2010)

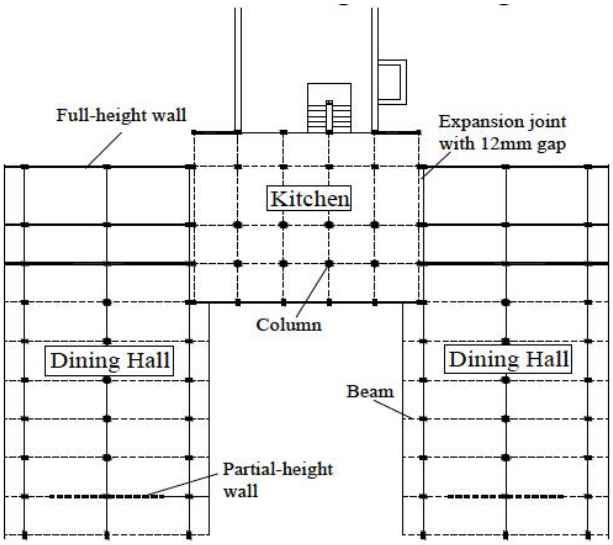
Country:	Haiti	
State/Province:		
City:	Port-au-Prince	
Latitude:	18.5540	
Longitude:	-72.3032	
Street Address:	Delmas 33, Port-au-Prince, Haiti	
Occupancy:	Education	
Height:		ft
Number of Stories:	1	
Number of Stories below ground:	0	
Size:	15000	gsf
Year Built:		
Original Code:		
Modification:	Unknown	
Year Modified:		
Code of Modification:		

Section 1: Basic Building Information-(Continued)

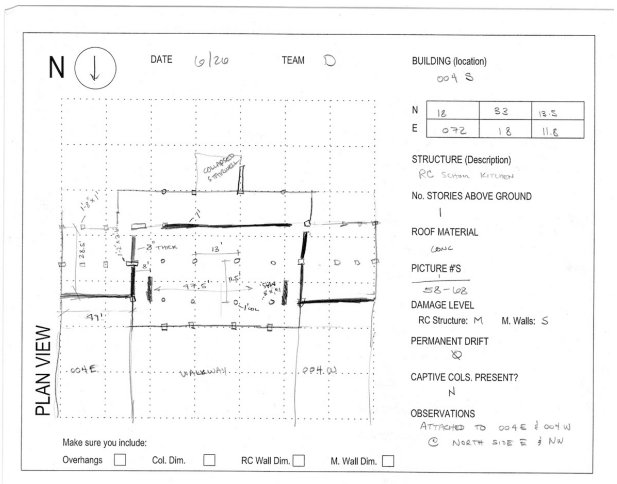
Lateral Load System:	Moment Frame
Other Lateral Load System:	
Vertical Load System:	Slab, beams, and columns
Other Vertical Load System:	
Foundation:	Unknown
Building Description:	The school cafeteria is a C-shaped one-story building that is made up of three wings separated by 12-mm expansion joints. The rear building is the kitchen while the two separate buildings on either side of the kitchen are used as dining halls or classrooms. The entire structure is covered by a vaulted concrete shell roof that is supported by gravity beams and columns. Full-height, nonstructural, unreinforced masonry walls were present along the rear of the structure while partial-height walls were located around the center columns at the front of both wings. The masonry walls have thicknesses ranging between 8 in and 12 in. The two dining hall wings are identical, with two bays in the transverse direction and eight bays in the longitudinal direction. Columns are spaced at approximately 23.5 ft in the transverse direction and 11.5 ft in the longitudinal direction. The interior columns are circular with a diameter of 12 inches while the perimeter columns are generally rectangular with dimensions of 13 in by 18 in. The columns at the front of both wings are larger, approximately 24 in by 11 in, with the exception of the corner columns which are 7 in by 9 in.

Supplemental Basic Information:

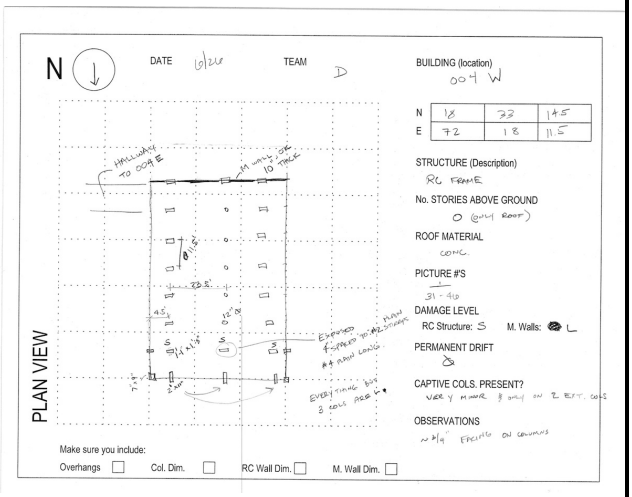
Paste in building plans, engineering drawings or sketches



Plan view schematic. (Zhang et al., 2011)



Sketch of plan view of kitchen wing as observed in field. (NEEShub, 2011)



Sketch of plan view of west dining wing as observed in field. (NEEShub, 2011)

Insert image here

Type image caption here:

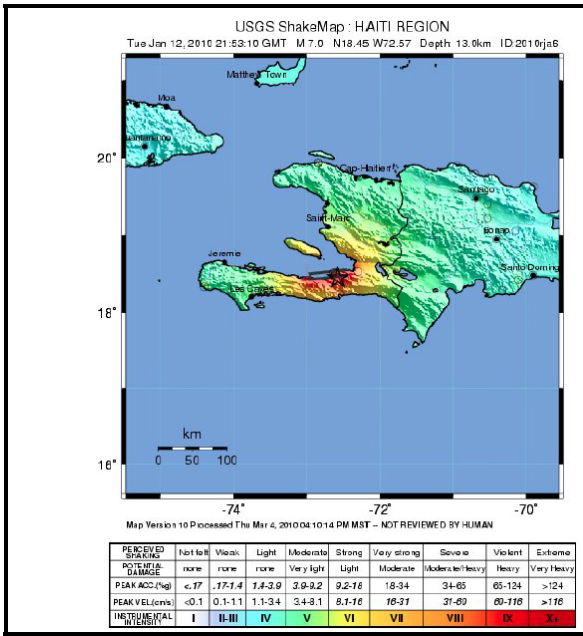
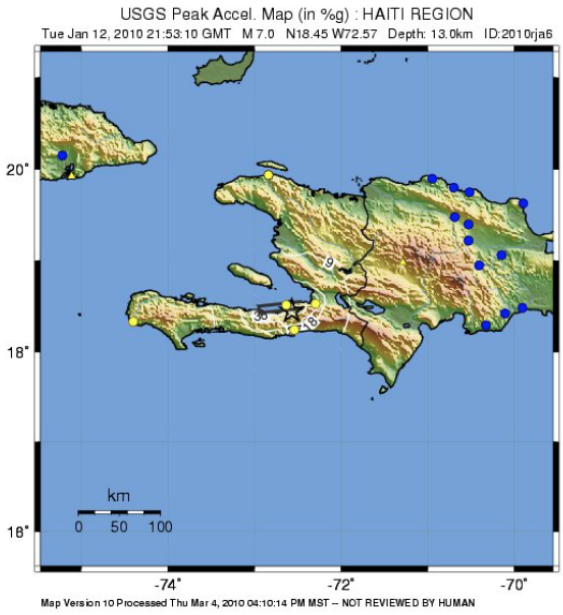
Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 2: Earthquake Information

Earthquake Date:	01/12/2010		
Moment Magnitude:	7.0		
Epicentral Distance (km):	27		
Local Intensity:	VIII	Intensity Scale:	MMI
Site Description:	Most of Port-au-Prince sits in the southwest corner of the Cul de Sac depression and is primarily underlain by Mio-Pliocene sedimentary deposits, relatively stiff soils with low impedance. It has been suggested that the low-lying Mio-Pliocene deposits in central Port-au-Prince may have amplified peak ground acceleration values by an approximate value of 1.8 . (Hough et al., 2011) A 2011 analysis of the site conditions throughout Port-au-Prince indicated that away from the foothills, the soil conditions largely coincide with NEHRP site class C. (Cox et al., 2011)		
PGA (max horizontal):			
PGA (vertical):			
SaT:			
Ground Motion Recording Stations:			
Distance to Station (km):			
Station Latitude:			
Station Longitude:			
Ground Motion Summary:	The main shock of the 2010 Haiti earthquake occurred along the Enriquillo Fault at a depth of approximately 13 km and a location of 18.457, -72.533. The focal mechanism indicates left-lateral oblique-slip motion on an east-west oriented fault with a fault rupture from east to west. The source zone had a down-dip dimension of approximately 15 km and an along-strike dimension of about 30 km - a source area about one third the size of a typical 7.0 magnitude earthquake. There were no active strong-motion instruments in Haiti so macroseismic observations offer the best estimation of shaking intensity during the main shock. Additionally, local geologic structure heavily influences the degree of ground motion amplification, further obscuring potential ground motion estimates.		

Additional Ground Motion Information:

Paste in earthquake maps, spectra, or figures involving the ground motion at the building site

	
Shaking intensity of Jan. 12, 2010 Haiti earthquake. (USGS, 2010a)	Estimation of peak ground aceleration (in %g). (USGS, 2010b)
Insert image here	Insert image here
Type image caption here:	Type image caption here:

Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 3: Damage Information

Performance Summary:	The structure sustained localized structural damage in two areas, likely a result of the building's irregular geometry and pounding of the two dining hall wings and the kitchen structure at the expansion joints. Other columns in the structure appeared to have performed well, suggesting that interaction with partial-height masonry infill walls was a cause of damage to columns. There was significant damage to nonstructural elements including the shattering of windows due to significant displacement demands.
Damage State Description:	The cafeteria sustained significant damage in two main areas of the building. Spalling and shear failures in the columns at the front of the dining hall wings were extensive and likely a result of the presence of partial-height infill walls and the significant displacement demands from the torsional response of the structure. Damage was also observed in the full-height masonry walls and columns where the two dining hall wings met the kitchen wing at the expansion joints.
Summary of Causes of Damage:	1. The irregular geometry of the building and the location of the full-height unreinforced masonry walls likely resulted in a torsional response concentrating displacement and damage at columns near the front of the building. 2. The effects of the significant displacement demands at the front of the structure were amplified by the presence of partial-height unreinforced masonry infill walls at the columns near the front of the building. The combination of large displacement demands and significantly limited clear-height resulted in severe shear damage in these columns. 3. The three structurally-independent wings separated by 12 mm expansion gaps pounded during the shaking, concentrating damage at the rear columns and full-height unreinforced masonry shear walls.

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Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 4: Observed Design and Construction Characteristics-Construction Quality

	Notes	Contribution to Observed Damage				
		Unlikely	Possible	Likely	Unknown	N/A
Materials						
Concrete		○	◉	○	○	○
Reinforcing steel	Corrosion observed in reinforcing steel, possible use of smooth reinforcing bars.	○	◉	○	○	○
Execution						
Conveyance/ placement of concrete		◉	○	○	○	○
Rebar		○	◉	○	○	○
Field variance with design documents		○	○	○	◉	○
Other Factors						
Please Specify:		○	○	○	◉	○

Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 4: Observed Design and Construction Characteristics-Configuration

	Notes	Contribution to Observed Damage				
		Unlikely	Possible	Likely	Unknown	N/A
Plan Irregularities						
Torsion		○	○	◉	○	○
Perimeter boundary		○	○	◉	○	○
Diaphragm		◉	○	○	○	○
Out-of-plane offsets in lateral resisting system		◉	○	○	○	○
Non-orthogonal systems		◉	○	○	○	○

Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 4: Observed Design and Construction Characteristics-Configuration-(Continued)

	Notes	Contribution to Observed Damage Unlikely	Possible	Likely	Unknown	N/A
Vertical Irregularities						
Soft Story		◉	○	○	○	○
Weak story		◉	○	○	○	○
Mass distribution		◉	○	○	○	○
Geometric variability of lateral resisting system		◉	○	○	○	○
In-plane discontinuity of lateral resisting system		◉	○	○	○	○
Setbacks		◉	○	○	○	○
Change in stiffness		◉	○	○	○	○
Other Factors						
Please Specify:		○	○	○	◉	○

Concrete Coalition Phase II: Concrete Building Performance Record

Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 4: Observed Design and Construction Characteristics-Lateral Load Resisting System-General

	Notes	Contribution to Observed Damage: Unlikely	Possible	Likely	Unknown	N/A
Strength						
Overall lack of strength		◉	○	○	○	○
Stiffness						
Extreme Flexibility		◉	○	○	○	○
Load Path						
Collectors/Struts		◉	○	○	○	○
Anchorage of nonstructural elements		◉	○	○	○	○
Out-of-plane capacity of walls		○	◉	○	○	○
Diaphragm chords		◉	○	○	○	○
Diaphragm openings		◉	○	○	○	○
Other Factors						
Please Specify:		○	○	○	◉	○

Concrete Coalition Phase II: Concrete Building Performance Record

Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 4: Observed Design and Construction Characteristics-Lateral Load Resisting System-Frames

	Notes	Contribution to Observed Damage				
		Unlikely	Possible	Likely	Unknown	N/A
Columns						
Shear strength	All observed shear failures were at locations where adjacent walls limited the columns' clear heights. Unobstructed columns appeared to have performed well.	◉	○	○	○	○
Flexural strength		◉	○	○	○	○
Axial load ratio (P/Ac/fc')		◉	○	○	○	○
"Vertical" load columns drift capacity		◉	○	○	○	○
Interference of frame action by infill		○	○	◉	○	○
Beams						
Strength relative to columns		◉	○	○	○	○
Shear controlled behavior		◉	○	○	○	○
Continuity of longitudinal reinforcing		◉	○	○	○	○
Loss of vertical capacity		◉	○	○	○	○

Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 4: Observed Design and Construction Characteristics-Lateral Load Resisting System-Frames-Continued

	Notes	Contribution to Observed Damage: Unlikely	Possible	Likely	Unknown	N/A
Beams –(continued)						
Interference of frame action by infill		◉	○	○	○	○
Joints						
Interior	Reinforcing within beam-column joints did not appear to have continuous reinforcing.	○	◉	○	○	○
Exterior	Reinforcing within beam-column joints did not appear to have continuous reinforcing.	○	◉	○	○	○
Corner	Reinforcing within beam-column joints did not appear to have continuous reinforcing.	○	◉	○	○	○
Other Factors						
Please Specify:		○	○	○	◉	○

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Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 4: Observed Design and Construction Characteristics-Lateral Load Resisting System-Shear Walls

	Notes	Contribution to Observed Damage				
		Unlikely	Possible	Likely	Unknown	N/A
Shear						
Diagonal tension/compression		○	○	○	○	◉
Sliding shear		○	○	○	○	◉
Flexure/shear		○	○	○	○	◉
Flexure						
Compression zone buckling capacity		○	○	○	○	◉
Boundary reinforcing fracture/buckling		○	○	○	○	◉
Discontinuity of wall		○	○	○	○	◉
Boundary Reinforcing at openings		○	○	○	○	◉
Other Factors						
Please Specify:		○	○	○	◉	○

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Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 4: Observed Design and Construction Characteristics-Lateral Load Resisting System-Infills

	Notes	Contribution to Observed Damage: Unlikely	Possible	Likely	Unknown	N/A
Unreinforced		○	○	◉	○	○
Interference with frame action		○	○	◉	○	○
Out-of-plane		○	○	◉	○	○
Attachment to framing		○	◉	○	○	○

Other Factors

Please Specify:		○	○	○	◉	○

Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 4: Observed Design and Construction Characteristics-Lateral Load Resisting System-Other

	Notes	Contribution to Observed Damage: Unlikely	Possible	Likely	Unknown	N/A
Foundations						
Liquefaction		○	○	○	◉	○
Pile/pier tension capacity		○	○	○	◉	○
Spread footing capacity		○	○	○	◉	○
Other:						
Please Specify:		○	○	○	◉	○
Miscellaneous						
Pounding		○	○	◉	○	○
Surface Rupture		◉	○	○	○	○
Other:						
Please Specify:		○	○	○	◉	○

Illustrations of damage:

Paste in drawings, sketches or photos of building damage

	
Shear damage to column and beam-column joint. (Federico, 2010)	Shear damage to framing and URM wall from pounding between wings. (Federico, 2010)
	
Severe shear failure in column adjacent to partial height URM infill wall. (Federico, 2010)	Severe shear failure in column adjacent to partial height URM infill wall. (Federico, 2010)

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Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Section 4: Repair and Retrofit Information

Type of retrofit or repair:	Unknown
Other:	
Performance Level:	Unknown
Hazard Level:	Unknown
Code:	Unknown
Other:	
Lateral Analysis:	Unknown
Other:	
Design Strategy:	
Retrofit Summary:	

Illustrations of Repair or Retrofit:

Paste in drawings, sketches or photos of building repair or retrofit

Insert image here	Insert image here
Type image caption here:	Type image caption here:
Insert image here	Insert image here
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Additional Notes:	
Section 1	
Section 2	
Section 3	
Section 4	

Record ID: 29 **Building Name:** School Cafeteria **Prepared By:** Quinn Peck

Appendix 1: Supplemental Basic Information

File Location	/static/data/2-supplemental-basic-information/HAIT003_Cover_Image.JPG
File Caption	Exterior of school cafeteria. (Federico, 2010)
File Location	/static/data/2-supplemental-basic-information/HAIT003_Plan_1.JPG
File Caption	Plan view schematic. (Zhang et al., 2011)
File Location	/static/data/2-supplemental-basic-information/HAIT003_Plan_2.JPG
File Caption	Sketch of plan view of kitchen wing as observed in field. (NEEShub, 2011)
File Location	/static/data/2-supplemental-basic-information/HAIT003_Plan_3.JPG
File Caption	Sketch of plan view of west dining wing as observed in field. (NEEShub, 2011)
File Location	
File Caption	
File Location	
File Caption	
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Appendix 2: Additional Ground Motion Location

File Location	/static/data/3-additional-ground-motion/HAIT001_Ground_M
File Caption	Shaking intensity of Jan. 12, 2010 Haiti earthquake. (USGS)
File Location	/static/data/3-additional-ground-motion/HAIT001_Ground_M
File Caption	Estimation of peak ground aceleration (in %g). (USGS, 2010b)
File Location	
File Caption	
File Location	
File Caption	
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Appendix 3: Illustrations of Damage

File Location	/static/data/4-illustration-of-damage/HAIT003_Damage_1.jpg
File Caption	Shear damage to column and beam-column joint. (Federico, 2010)
File Location	/static/data/4-illustration-of-damage/HAIT003_Damage_2.jpg
File Caption	Shear damage to framing and URM wall from pounding between buildings. (Federico, 2010)
File Location	/static/data/4-illustration-of-damage/HAIT003_Damage_3.jpg
File Caption	Severe shear failure in column adjacent to partial-height URM infill wall. (Federico, 2010)
File Location	/static/data/4-illustration-of-damage/HAIT003_Damage_4.jpg
File Caption	Severe shear failure in column adjacent to partial-height URM infill wall. (Federico, 2010)
File Location	/static/data/4-illustration-of-damage/HAIT003_Damage_5.jpg
File Caption	Out-of-plane failure of partial-height unreinforced masonry wall and shear damage to adjacent column. (Federico, 2010)
File Location	/static/data/4-illustration-of-damage/HAIT003_Damage_6.jpg
File Caption	Damage to full-height unreinforced masonry wall. (Federico, 2010)
File Location	/static/data/4-illustration-of-damage/HAIT003_Damage_7.jpg
File Caption	Observed corrosion of reinforcing bars. (Federico, 2010)
File Location	/static/data/4-illustration-of-damage/HAIT003_Damage_8.jpg
File Caption	Lack of transverse reinforcing in beam-column joint. (Federico, 2010)
File Location	
File Caption	
File Location	
File Caption	

Appendix 4: Illustrations of Repair/Retrofit

File Location	
File Caption	
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Appendix 5: References

Citation	Hough, S. E., Young, A., Altidor, J. R., Anglade, D., Given, D., Mildor, S., 2011. Site characterization and site response in Port-au-Prince, Haiti, *Earthquake Spectra*, **27**, S137–S155.
Link to Purchase	http://eqs.eeri.org/resource/1/easpef/v27/iS1/pS137_s1
File Location	
Citation	Cox, B. R., Bachhuber, J., Rathje, E., Wood, C. M., Kottke, A., Green, R., and Olson, S., 2011. Shear-wave-velocity and geology-based seismic microzonation of Port-au-Prince, Haiti, *Earthquake Spectra* **27**, S67–S92.
Link to Purchase	http://eqs.eeri.org/resource/1/easpef/v27/iS1/pS67_s1
File Location	
Citation	United States Geological Survey (USGS), 2010a. *USGS ShakeMap: Haiti Region,* http://earthquake.usgs.gov/earthquakes/shakemap/global/shake/2010rja6/ (16 July 2012).
Link to Purchase	
File Location	
Citation	United States Geological Survey (USGS), 2010b. *USGS Peak Ground Accel. Map (in %g): Haiti Region,* http://earthquake.usgs.gov/earthquakes/shakemap/global/shake/2010rja6/#Peak_Ground_Acceleration (16 July 2012).
Link to Purchase	
File Location	
Citation	Telleen, K., 2012. "January 12, 2010 Haiti Earthquake: Post-earthquake reconnaissance." Earthquake Engineering Research Institute. Oakland, California. 25 June 2012.
Link to Purchase	
File Location	

Appendix 5: References-(Continued)

Citation	Zhang, D., Federico, G., Telleen, K., Schellenberg, A., Fleishman, R., and Maffei, J., 2011. Structural analyses to replicate the observed damage to engineered buildings from the January 2010 Haiti Earthquake, in *Proceedings, Structures Concress 2011.*
Link to Purchase	http://ascelibrary.org/doi/abs/10.1061/41171(401)198
File Location	
Citation	National Science Foundation (NSF) RAPID Team, 2010. Photo collection.
Link to Purchase	
File Location	
Citation	Federico, G., 2010. Personal photo collection.
Link to Purchase	
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Citation	
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