Projects library of the specialized group for construction **PUBLIC BUILDINGS**

Domain	**Education**
Project name	**Earthquake resistant school models for the PARIS (Programme d'Appui à la Reconstruction des Infrastructures Scolaires)**
Country	**Haiti**
Region/town	**Varia**
Area	**Urban, rural, remote**
GIS data (WGS 84)	**-**
Project type	**Design of school models**
Typology	**Primary school**
Approach	**-**
Beneficiaries	**-**
Climate	**Hot, humid**
Special constraint	**Earthquake / hurricane**
start / end of project	**2011-2012**
Country GNP	**820 USD/cap**

Partners

Organization (donor)	SDC, UNICEF, IADB, Spanish Cooperation, World Bank
IO/NGO partners	-
GO partners	MoE, MPW (Public Works)

Context to project

Initial Situation	The massive earthquake of 12 January 2010 damaged or destroyed nearly the 80% of the schooling infrastructure in the affected departments, highlighting dramatically the poor construction quality in the country, the absence of norms and standards for public building and the incapacity of the authority to regulate the system. As a result, the MoE, froze, for more than 2 years, all permits for new permanent school construction mainly because they were not in position to guide and control the reconstruction process up to adequate standards. In the meantime, the MoE and the Ministry of Public Works, issued revised architectural and structural norms which set new and ambitious standards, especially for the seismic resistance, based on seismic maps taking into account an event with a return period of 2'500 years, meaning for Haiti a max. PGA of 8.4G. In order to meet these structural standards, a complete rethink of the usual construction technique was necessary, especially for 2 storey buildings largely needed in the urban and peri-urban affected areas.
Goals, Beneficiaries	Simplify, shorten and make less expensive the design phase of a school project by providing the sector with well documented school designs, adapted to the local context and integrating adequate architectural and structural norms and standards.
Implementations/Results	By may 2013, 3 different school models have been validated by the MoE and MoPW and are progressively integrated and used by various relevant actors (such as IADB, Worl bank, Spanish Cooperation) as well as by some Swiss NGO (HECKS).

Construction data

Model	Concrete	Confined Masonry	Wooden Frame
			
Materials			
Foundations	Concrete	Rubble stones	Rubble stones
Walls or columns	Concrete panels	Cement blocks	Wooden frame
Facade	Wood or metal (filling)	Cement blocks	Earth / rubble filling
Roof	Concrete	Insulated corr. sheet	Insulated corr. sheet
Earthquake protection	PGA 0.84G	PGA 0.84G	PGA 0.84G
Wind resistance	Over 150 km/h	Up to 150 km/h	Up to 150 km/h
Doors	Metal grids (or other)	Metal grids (or other)	Wood (or other)
Windows	Metal grids (or other)	Metal grids (or other)	Wood (or other)
Ceiling	Concrete	-	-
Reference data			
Number of unit (cl.)	6	3	1
Surface per unit	50 m2	50 m2	50 m2
Children / unit	40	40	40
Total beneficiary	240	120	40
Ground floor (incl. walls)	168 m2	235 m2	90 m2
Number of storey	2	1	1
Total floor (incl. walls)	465 m2	235 m2	90 m2
Surface / beneficiary	1.9 m2	1.9 m2	2.25 m2
Volume (outside dim.)	1300 m2	720 m3	220 m3
Volume / beneficiary	5.5 m3	6 m3	5.5 m2
Costs (indicative)			
Base	Haiti, 2013 Accessible area	Haiti, 2013 Accessible area	Haiti, 2013 Remote area
Cost of the block	255'000 USD	100'000 USD	20'000 USD (estimate)
Cost / beneficiary	1'000 USD	830 USD	400 USD
Cost / unit (classroom)	42'500 USD	33'000 USD	20'000 USD
Self help beneficiary	No	No	Partly

Evaluation	Concrete	Confined Masonry	Wooden Frame
Main advantages	Density / compact Durability (+ 60 years) Ration quality/cost Post-disaster shelter use Comfort	Well known technique Light construction Room for tolerance Adapted to all areas Comfort	Cost Light construction Economy of heavy material
Main disadvantages	Reserved to mid- to high level contractors	Combination of material Wide range of artisan needed	Limited durability Material resistance to climate and termite
Main conditions	Good accessibility to site Good contractors Good equipment Good supervision	Good materials Good size of plot Normal supervision	Beneficiary participation Training to technique Regular maintenance Good supervision

Approach to results

Initial Situation -

Approach -

Problems/Constraints -

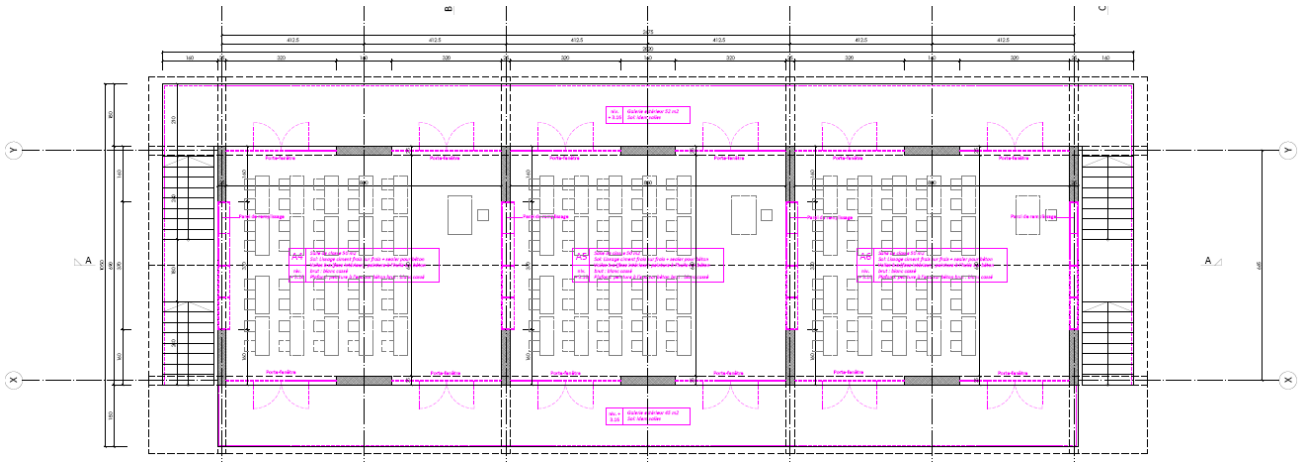
Lessons learned -

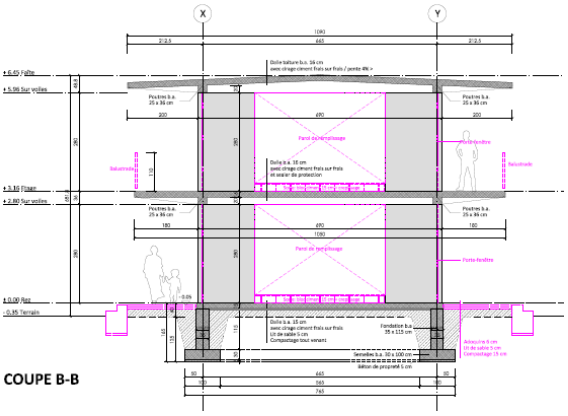
Evaluation

For further information

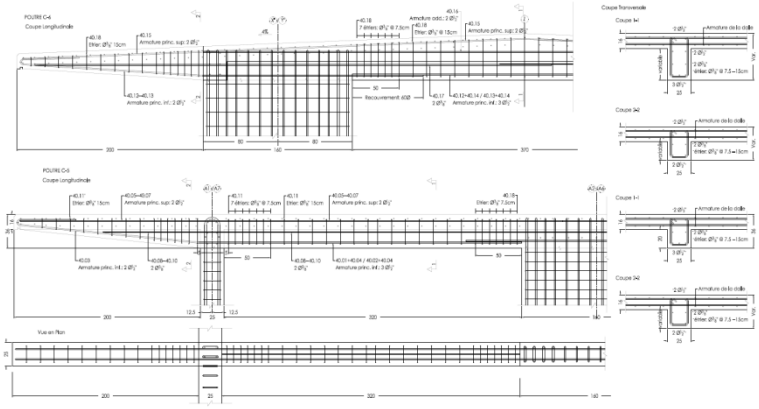
Involved SHA construction group collaborators:	Christian Ubertini, Jan Reifler, Sebastian Villiger, Oliver Ruefenacht, Guillaume Roux-Fouillet, Alexandre Wagnières
Other involved SHA consultants	-
Author / Contact:	Christian Ubertini / cubertini@bluewin.ch
Recommended Institutions:	-
Recommended partners:	-
Recommended books/reports:	Daniel Schwitter, SKAT, aug-sept. 2012 Marina Marinov, FG Bau, 10 july 2012. Werk, Bauen + Wohnen, November 2012 Christian Ubertini, "PARIS, Bilan fin de phase 1", may 2013. Christian Ubertini, "Des plans-types pour la construction d'écoles sûres, durables et confortables ", Observatoire de la reconstruction, revue no 8, 2013
Relevant other projects (links):	http://picasaweb.google.com/ddchaiti

HAITI : Earthquake resistant school models for the PARIS (Example of documentation)



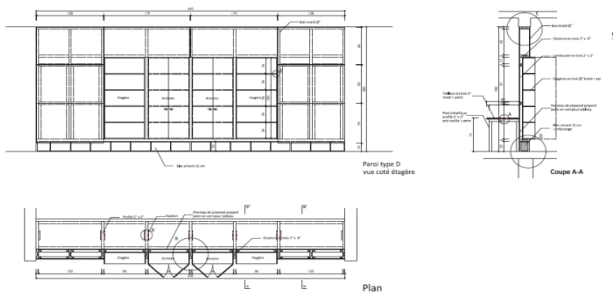


COUPE B-B



Bordereau Armature - Acier HA - Grade 60

Pos.	Description	#	Longueur m	Quantité	Longueur Total	Croquis	Poids/ml	Poids Total
			[m]	[-]	[m]		[kg/m]	[kg]
Escaliers								
60.01	Princ. 1	3	1.50	22	33.00	60.01 Ø30 85 65	0.561	18.51
60.02	Princ. 2	3	3.00	22	66.00	60.02 300	0.561	37.03
60.03	Princ. 3	3	2.00	22	44.00	60.03 140 60	0.561	24.68
60.04	Princ. 4	4	2.30	22	50.60	60.04 185 Ø8 21	0.996	50.40
60.05	Princ. 5	3	3.75	22	82.50	60.05 315 Ø3 60	0.561	46.28
60.06	Princ. 6	3	1.55	22	34.10	60.06 77 Ø6 78	0.561	19.13
60.07	Princ. 7	3	1.40	22	30.80	60.07 80 Ø6 60	0.561	17.28
60.08	Princ. 8	4	2.50	22	55.00	60.08 40 200	0.996	54.78



Paroi type D
vue coté étagère

Coupe A-A

Plan

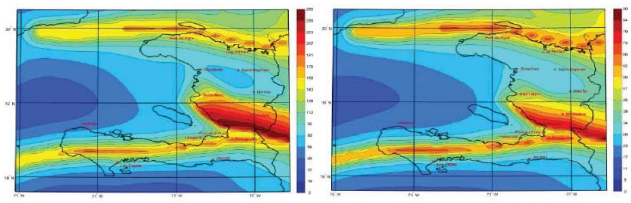


Figure 6- Spectre d'accélération pour une période de 0,2 s, pour 2 % de probabilité de dépassement en 50 ans. Valeurs de dimensionnement (données USGS)

Figure 7- Spectre d'accélération pour une période de 1,0 s, pour 2 % de probabilité de dépassement en 50 ans. Valeurs de dimensionnement (données USGS)

Figure 2 Cartes montrant les valeurs spectrales S_S et S_1 pour Haiti avec une probabilité de dépassement de 2% en 50 ans [MTPTC]

4. Actions sismiques selon SIA 261 et ASCE 7-05

Pour comparer deux normes pour calculer le séisme, il n'est pas possible de comparer directement les valeurs de l'accélération maximale du sol PGA (a_{gd}). Les résultats dépendent de plusieurs facteurs considérés différemment dans les normes. Par conséquent, il faut comparer les résultats des spectres de dimensionnement selon les différentes normes: dans les paragraphes ci-dessous, les normes [SIA 261] et [ASCE 7-05] sont appliquées pour calculer les spectres de dimensionnement pour les écoles en béton armé élaborées par le GTIS.

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Spezifikation: TragsicherheitNutzlast