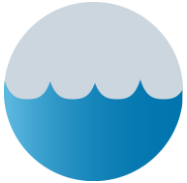
Global Program for Safer Schools

Peru Case Study

Peru

The Ring of Fire

Earthquakes



Floods

Landslides

Volcanoes

Earthquakes occur frequently

Year	1868	1970	1974	1979	1990	1991	1993	1996	2001	2005	2007
M	9.0	7.9	7.2	6.8	6.8	6.5	6.0	7.4	8.4	7.5	8.0

Schools Damaged by Earthquakes

PERÚ Ministerio de Educación


Unreinforced Masonry


Reinforced concrete frame


Short column effect


Reinforced Masonry


Collapse of non structural elements

School Seismic Rehabilitation

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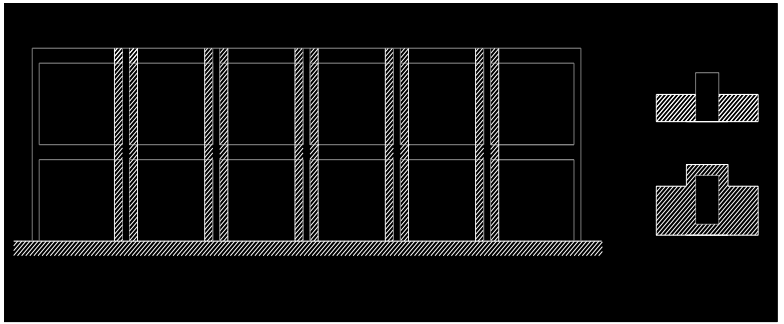
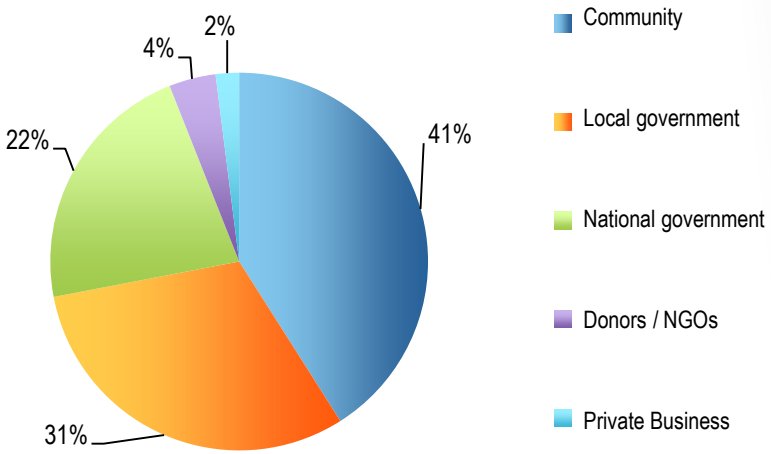


Public School Infrastructure in Numbers

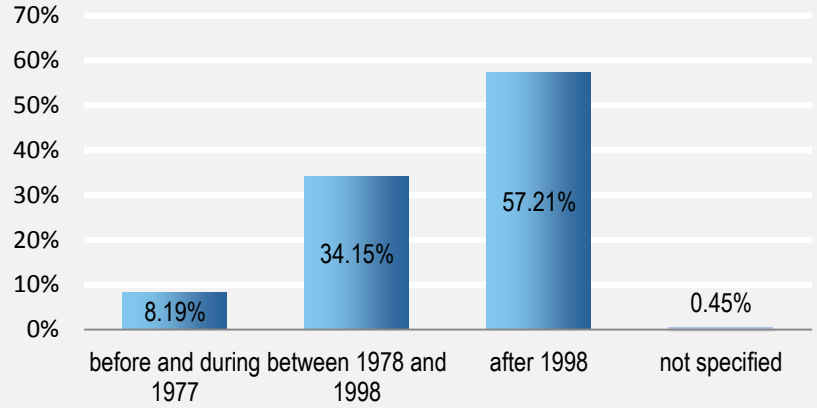
PERÚ Ministerio de Educación

Who builds schools in Peru?



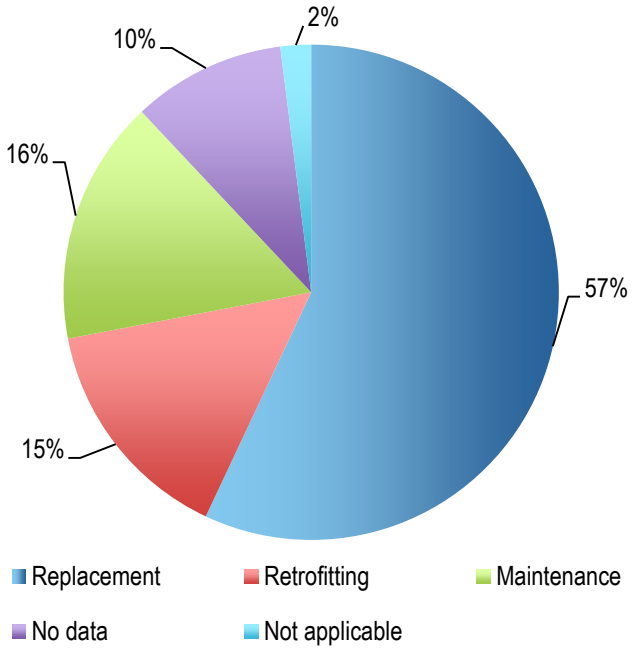
- **49,516** school facilities
- **187,685** school buildings
- School community: **6.5** million students
- Distribution: **35%** urban, **65%** rural

The age of school facilities



Public School Infrastructure in Numbers

Key question: What intervention is needed for the current school infrastructure?
A first answer: **OINFE's Algorithm**



Public School Infrastructure in Numbers

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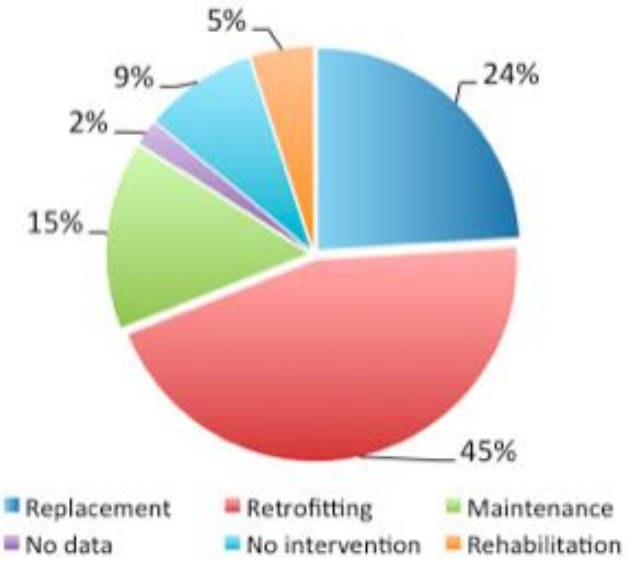
Analysis of Census Results

New Index by school building



Public School Infrastructure in Numbers

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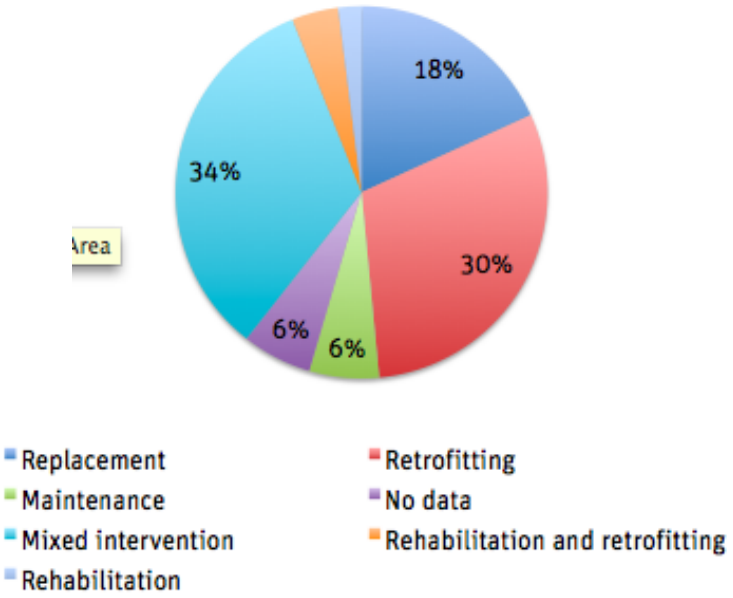
Analysis of Census Results

Aggregated structural index by school facility



Second set of key questions

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Where should the rehabilitation start?

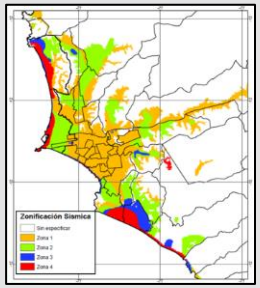
What group of schools are in critical condition?

What is the magnitude of the rehabilitation investments?

Can the impact of the investment be measured over time ?

How does the MoE communicate the results?

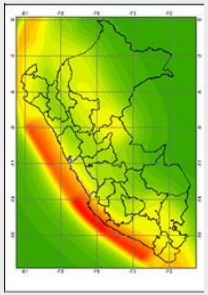
Measuring Seismic Risk (probabilistic approach)



Exposure

Vulnerability

Hazard



Annual Average Loss (AAL)

Measuring Seismic Risk (probabilistic approach)

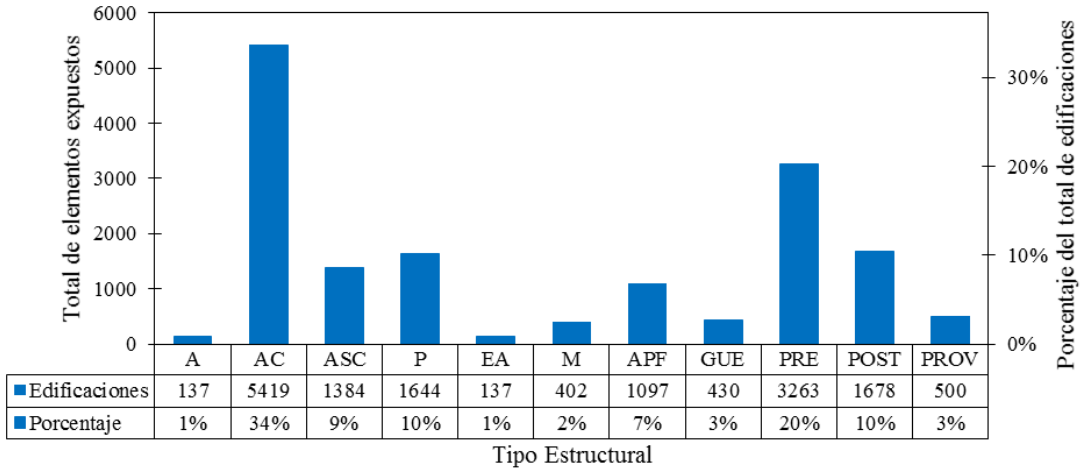
School Building

School Facility

AAL: Average Annual Loss

Lima’ s public school infrastructure portfolio

Summary	Un	
# of schools	[Un]	1,969
# of buildings	[Unidad]	16,091
Total area	[m2]	3,309,861
Portfolio replacement value	[US$ million]	1,426



	A	AC	ASC	P	EA	M	APF	GUE	PRE	POST	PROV
Edificaciones	137	5419	1384	1644	137	402	1097	430	3263	1678	500
Porcentaje	1%	34%	9%	10%	1%	2%	7%	3%	20%	10%	3%

Average Annual Loss (AAL) by Structural Typology

Structural Type	Exposed Value ($USD)	% of Exposed Value	AAL ($USD)	% of Total AAL	AAL(‰)
Adobe (A)	25,992,820	1.8%	1,800,318	6%	69.3
Reinforced Masonry (AC)	436,206,675	30.6%	7,170,827	25%	16.4
Unreinforced Masonry (ASC)	70,580,669	4.9%	3,628,838	13%	51.4
Non ingeneering (P)	41,193,727	2.9%	4,235,392	15%	102.8
Steel Frame (EA)	7,799,709	0.5%	33,839	0%	4.3
Wood Frame (M)	10,577,105	0.7%	37,614	0%	3.6
Concrete Frame "APAFA" (APF)	121,703,172	8.5%	3,255,316	11%	26.7
Gran Unidad Escolar (GUE)	76,620,591	5.4%	1,235,549	4%	16.1
Concrete Frame 780 (PRE)	406,874,983	28.5%	6,574,254	23%	16.2
Concrete Frame 780 post (POST)	213,277,441	14.9%	951,878	3%	4.5
Temporary Class Room (PROV)	15,940,828	1.1%	19,928	0%	1.3
Total	1,426,767,720	100%	28,943,754	100%	20.3

High potential of collapse

Structural Typology	# Buildings	Scenario M7.6			Scenario M8.2		
		# Potential collapses	% collapse	Buildings Replacement Value (USD)	# Potential collapses	% collapse	Valor de edificaciones en colapso (USD)
Adobe (A)	137	105	77%	23,186,585	137	100%	25,992,820
Unreinforced Masonry (ASC)	1,384	419	30%	21,832,655	1,379	100%	70,202,623
Non Engineering (P)	1,644	1,644	100%	41,193,727	1,644	100%	41,193,727
Total	3165	2168	68%	86,212,967	3160	100%	137,389,170

High potential of structural damage

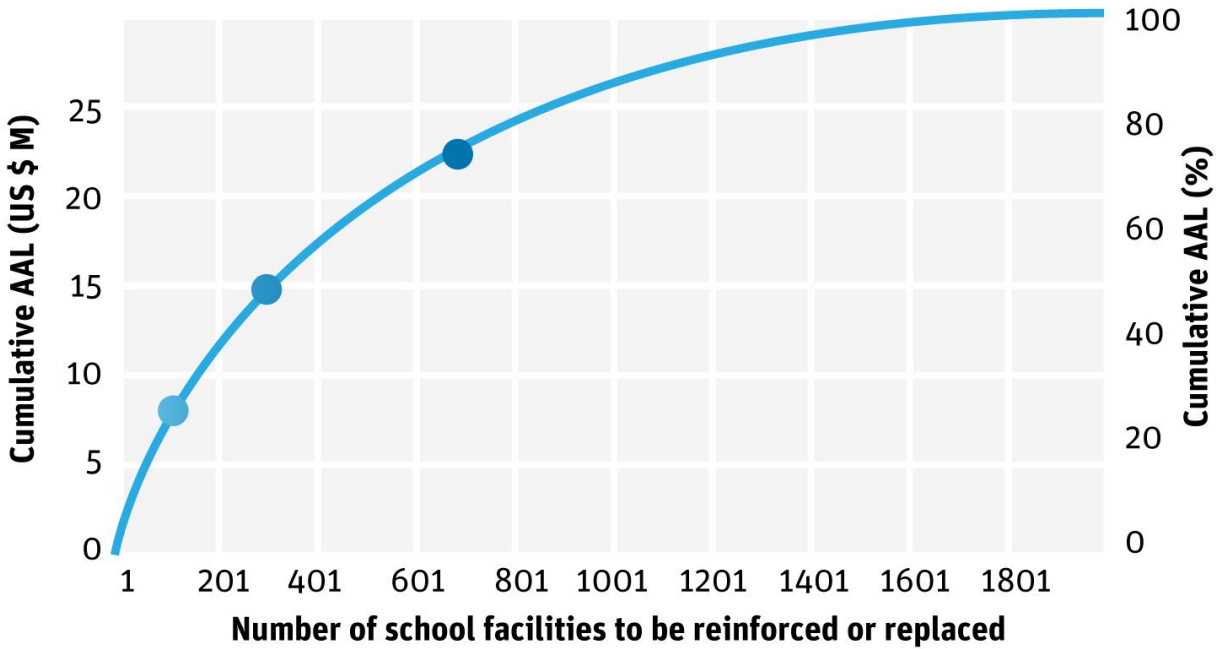
Structural Typology	# Buildings	Scenario M7.6		Scenario M8.2	
		High Potential Damage	%	High Potential Damage	%
Unreinforced Masonry (ASC)	1,384	965	70%	5	0%
Reinforced Masonry (AC)	5,419	654	12%	2768	51%
Cncrete Frame 780 (PRE)	3,263	324	10%	1543	47%
Concrete Frame "APAFA" (APF)	1,097	499	45%	1097	100%
Total	12,944	2,474	19%	5,413	42%

Ranking of most critical school facilities by AAL

ID_LOC	VALFIS (USD)	AAL (USD)		# of buidings by structural typology											
				A	AC	ASC	P	EA	M	APF	GUE	PRE	POST	PROV	TOTAL
315279	11,877,146	726,258	6%	26	8	2	2	0	7	0	0	0	1	0	46
296964	18,190,100	474,904	3%	0	14	3	0	0	0	0	0	0	0	0	17
320596	4,987,427	283,934	6%	0	5	1	5	0	0	0	6	11	0	0	28
340269	11,964,222	183,161	2%	0	15	1	0	0	0	0	9	1	0	0	26
309004	4,614,987	159,222	3%	14	27	12	1	1	0	0	0	4	0	0	59
288520	3,453,696	153,711	4%	0	2	5	0	0	0	3	0	0	0	0	10
144678	4,427,473	139,978	3%	0	10	9	8	0	0	21	0	0	0	2	50
299849	6,753,071	129,464	2%	0	5	3	1	1	0	0	0	24	0	0	34
343847	2,527,768	122,575	5%	0	7	3	1	0	0	0	0	4	1	2	18
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

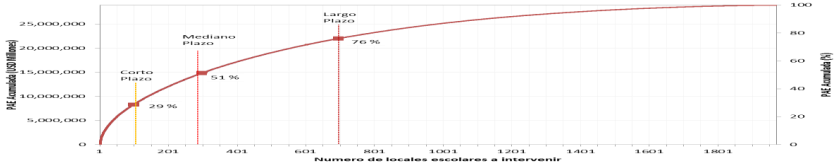
Measuring Seismic Risk

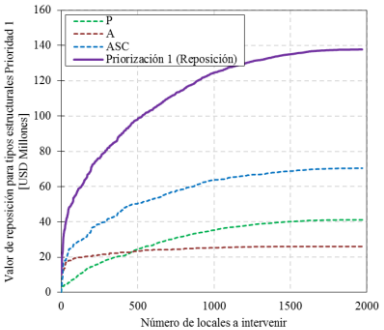
Concentration of seismic risk by school facility in Lima and Callao

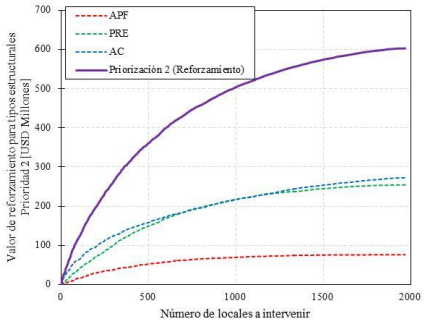


Scenario of school rehabilitation in Lima and Callao

Plan	Short	Medium	Long
	1-3 years	3-5 years	5-10 years
# ofsSchools to be rehabilitated	**99 (5%)**	**198 (10%)**	**396 (20%)**
% risk reduction by phase	29%	22%	25%
% risk reduction accumulated	29%	51%	76 %
# total of buildings by phase	1,894	2,893	4,206
Estimated Replacement (US$ million)	55.9	24.8	29.9
Estimated Retrofittin (US$ million)	120.2	142.9	166.5







Replacement (Potential of collapse)

Retrofitting (potential structural damage)

Challenges

- Updating standard design and construction code (functional & structural)
- Improving school infrastructure planning
- Functional and structural rehabilitation
- Increase local government capacity to manage school infrastructure
- Regulate community participation on new infrastructure development
- Improve maintenance protocols and financing

Areas of Action

1. **Diagnosis of Existing School Infrastructure**
2. **Design of National Plan for School Infrastructure (NPSI)**
3. **Design of Seismic Retrofitting Program**
4. **Building Capacity of MINEDU**

Areas of Action

1. **Diagnosis of Existing School Infrastructure**
2. Design of National Plan for School Infrastructure (NPSI)
3. Design of Seismic Retrofitting Program
4. Building Capacity of MINEDU

Activities

- Analyze Census results of MINEDU
- Assess seismic risk for school infrastructure nationwide

Areas of Action

1. Diagnosis of Existing School Infrastructure
2. **Design of National Plan for School Infrastructure (NPSI)**
3. Design of Seismic Retrofitting Program
4. Building Capacity of MINEDU

Activities

Enhance infrastructure design:

- Assess other sector initiatives linked to infrastructure
- Assess local/international practices and methods of construction technologies
- Update standards and codes for school infrastructure

Improve infrastructure planning:

- Assess local/international practices and methods for planning
- Develop integrated schools and urban corridors

Support the design of the investment component of NPSI:

- Develop methodologies to identify and prioritize infrastructure interventions
- Define strategic framework and methodology for the development of the investment component of the NPSI
- Deliver international workshop on school infrastructure planning

Areas of Action

1. Diagnosis of Existing School Infrastructure
2. Design of National Plan for School Infrastructure (NPSI)
3. Design of Seismic Retrofitting Program
4. Building Capacity of MINEDU

Activities

- Identify suitable retrofitting alternatives and conduct cost-benefit analysis
- Support definition of the strategic framework and methodology for the development of the Seismic Retrofitting Program

Areas of Action

1. Diagnosis of Existing School Infrastructure
2. Design of National Plan for School Infrastructure (NPSI)
3. Design of Seismic Retrofitting Program
4. **Building Capacity of MINEDU**

Activities

Deliver hands-on workshops to OINFE and the Secretariat for Strategic Planning in:

- Data analysis/management (incl. geospatial analysis)
- Disaster risk assessment