



EXPO - FORO 2023: ¡ALERTA!
¿Colapsan Condominios y Edificios?

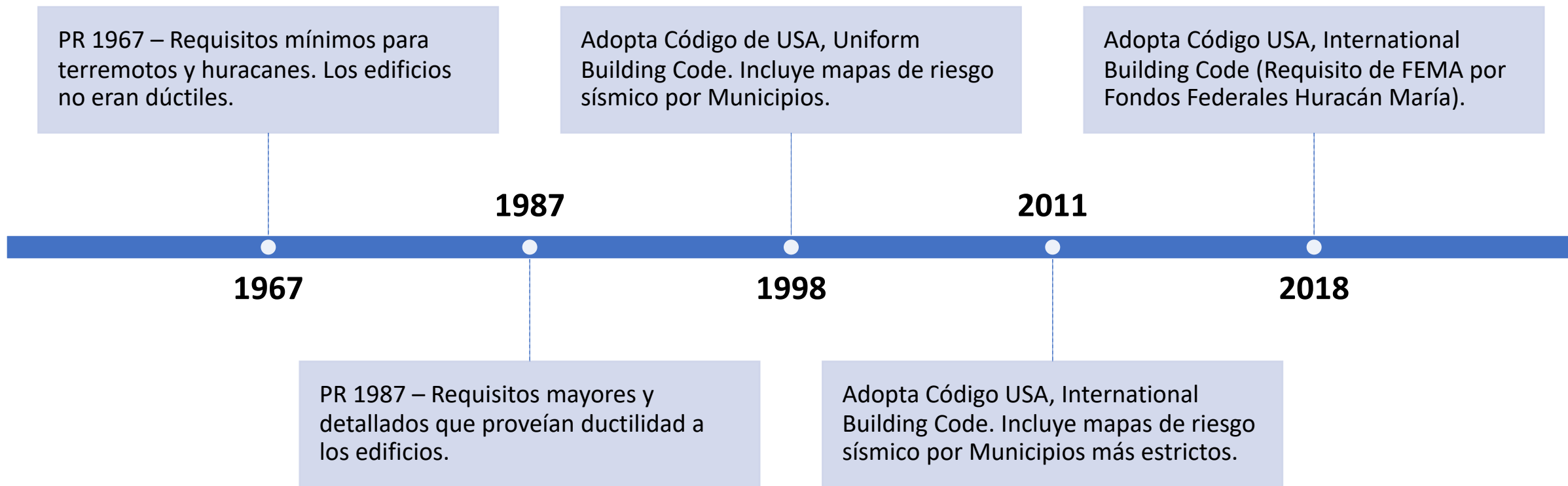
Resiliencia de Puerto Rico con Respecto a Desastres de Construcción

Ing. José (Pepe) Izquierdo-Encarnación
BSCE, MCE, PE, HonACI
PORTICUS CSP, President

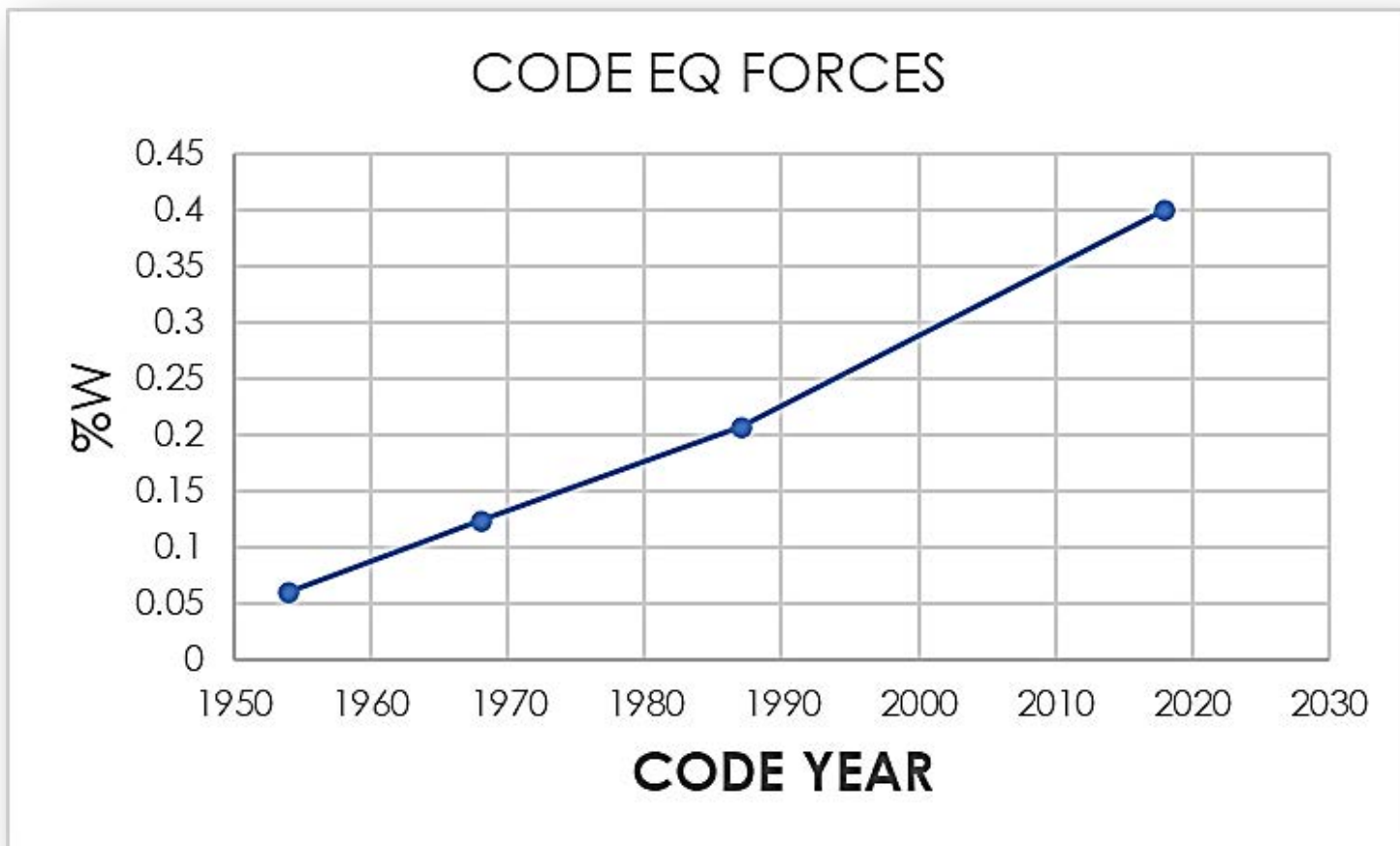
NATIONAL CONSTRUCTION SAFETY TEAM ADVISORY COMMITTEE OF NIST, Vicechair
AMERICAN CONCRETE INSTITUTE, President 2003-2004
COLEGIO DE INGENIEROS Y AGRIMENSORES DE PR, President 1994-1996
CAMARA DE COMERCIO DE PR, President 2005-2006



Reglamentos de Edificación



EQ LOADS COMPARISON



- LOADS APPLICABLE TO SCHOOLS ARE **8 TIMES LARGER** WHEN COMPARED TO 1954
- LOADS ARE **3.2 TIMES LARGER** WHEN COMPARED TO 1968.
- LOADS ARE **2 TIMES LARGER** WHEN COMPARED TO 1987.



Elastic vs. Inelastic Response

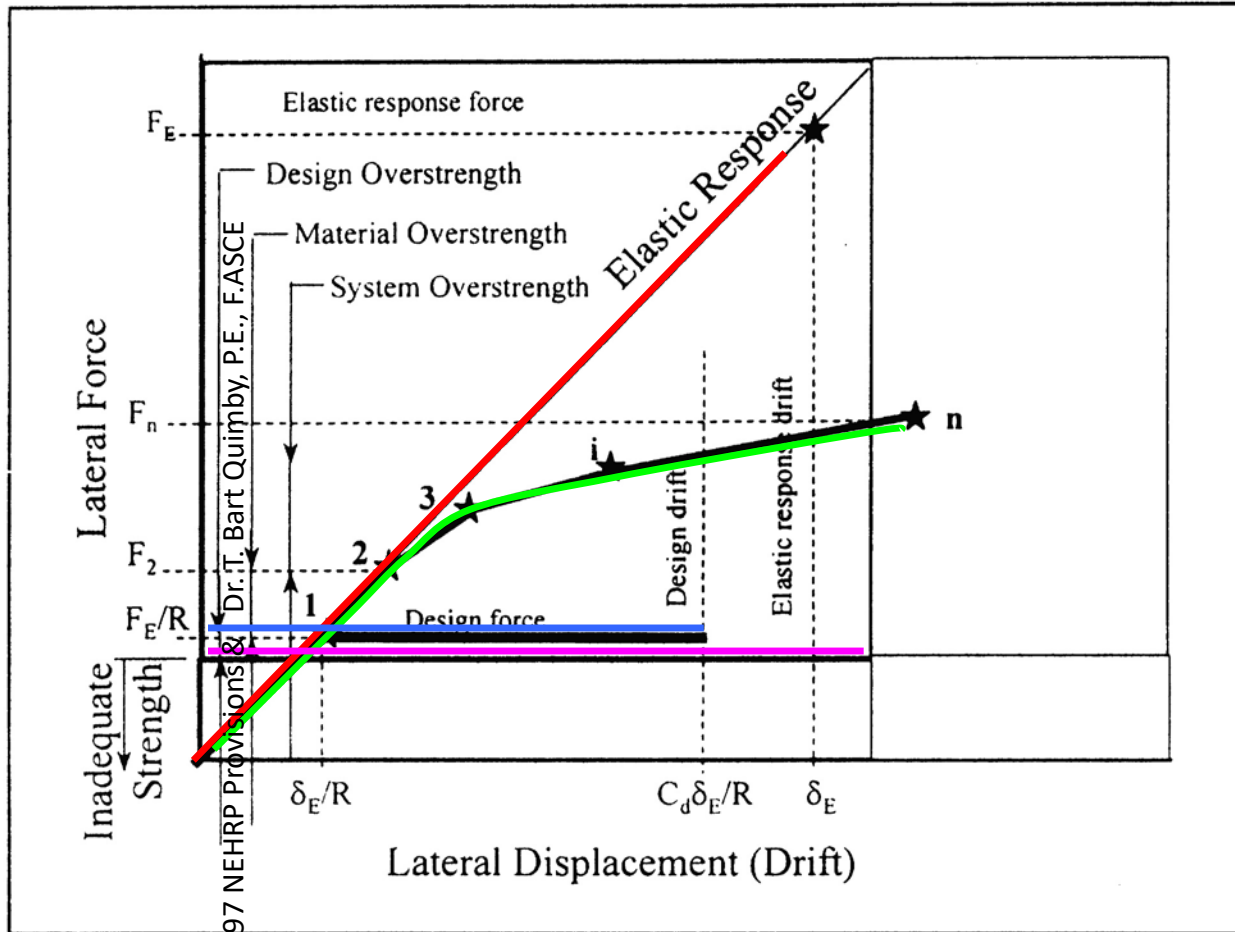


FIGURE C5.2.7 Factors affecting overstrength.

- The red line shows the force and displacement that would be reached if the structure responded elastically.
- The green line shows the actual force vs. displacement response of the structure
- The pink line indicates the minimum strength required to hold everything together during inelastic behavior
- The blue line is the force level that we design for.
- We rely on the ductility of the system to prevent collapse.

American Society of Civil Engineers REPORT CARD

2021

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There are 30,000 miles
of inventoried levees
across the U.S.,

and an additional 10,000 miles of levees
whose location and condition are
unknown.

There is a water main
break every two minutes

and an estimated 6 billion gallons of
treated water lost each day in the U.S.,
enough to fill over 9,000 swimming
pools.

Growing wear and tear
on our nation's roads

have left 43% of our public roadways in
poor or mediocre condition, a number
that has remained stagnant over the past
several years.

The average age of our
nation's dams

is 57 years.

Nearly 231,000 bridges,

in all 50 states,
still need repair and preservation work.

2021 REPORT CARD FOR
AMERICA'S INFRASTRUCTURE

G.P.A.



AVIATION	PUBLIC PARKS
BRIDGES	RAIL
DAMS	ROADS
DRINKING WATER	SCHOOLS
ENERGY	SOLID WASTE
HAZARDOUS WASTE	STORMWATER
INLAND WATERWAYS	TRANSIT
LEVEES	WASTEWATER
PORTS	

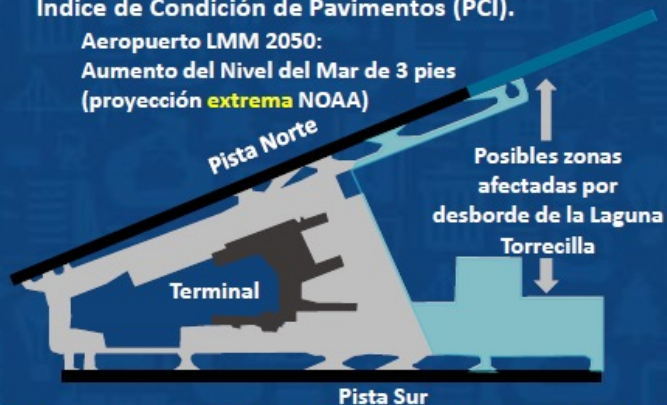
Puertos y Aeropuertos*

PROBLEMA:

- Plan Maestro para el Aeropuerto Internacional Luis Muñoz Marín (LMM) y la Autoridad de Puertos no incluye **medidas para mitigar el alza del nivel del mar**.
- La condición de los pavimentos de las pistas principales de los aeropuertos comerciales se encuentran en condición regular o mala a base del Índice de Condición de Pavimentos (PCI).

Aeropuerto LMM 2050:

Aumento del Nivel del Mar de 3 pies
(proyección **extrema** NOAA)



Aeropuertos no son parte del 2019 ASCE PR IRC, no fueron calificados

ACCIÓN NECESARIA:

- Implementar un Plan de Adaptación al Cambio Climático para los aeropuertos.
- Inversión total de \$1,136 millones, **\$879 millones provienen de fondos federales** para la rehabilitación de los puertos marítimos.
- Implementar el Plan de Mejoras Capitales de Aerostar (SJU) para los años 2019-2036 proyectado en **\$436.5 millones** de los cuales \$401 millones provienen de diversas fuentes **de fondos federales y cargos al pasajero**.

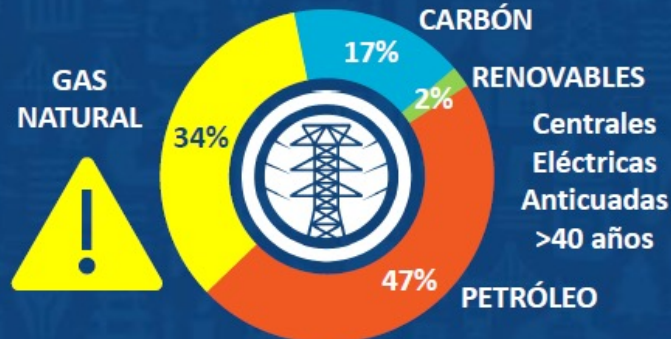
Muelle Panamericano y Aeropuerto Isla Grande en riesgo debido al cambio climático



Energía

PROBLEMA:

- Falta de resiliencia debido a una infraestructura eléctrica anticuada.
- El costo promedio de la electricidad supera los \$0.19 dólares/kWh, el doble de la tarifa de EE.UU. No obstante, la **red eléctrica de PR está entre las peores**.
- Dependencia a los combustibles fósiles:

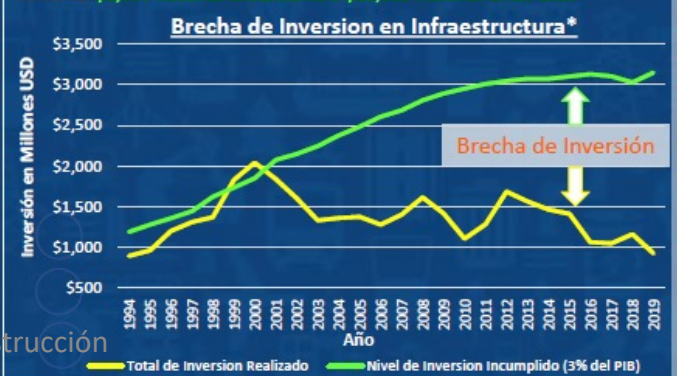


ACCIÓN NECESARIA:

- Rediseño y reconstrucción del sistema **para resistir vientos de 160 mph**, de acuerdo a los estándares de la ASCE. Se debe aumentar uso de **energía renovable**.

Inversión Total

Inversión **requerida**: ASCE recomienda invertir anualmente alrededor de 3% del Producto Interno Bruto (PIB) en infraestructura civil, pero **PR ha invertido anualmente alrededor de 1% promedio en los pasados 5 años**. El promedio de inversión debe aumentar **\$2,000 millones anualmente o \$20,000 millones en 10 años**.



Excluye planes de recuperación tras huracanes 2017



2019 REPORTE NOTAS INFRAESTRUCTURA PUERTO RICO

NOTA

PUENTES D+	PUERTOS D-	ENERGIA F
AGUA POTABLE D	DESPERDICIOS SÓLIDOS D-	CARRETERAS D-
REPRESAS D+	AGUAS USADAS D+	

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

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Resilience for Existing Construction?



Design and Construction Codes

The damage caused by Flooding, Hurricanes, Earthquakes and Tornadoes are address by the engineering communities by improving codes and regulations.

- For each catastrophe:
 - Funds are release (government and private) and extensive research is launched in the Universities to investigate the failures.
 - Papers and research are published.
 - Code committees evaluate the research and decide whether to incorporate the findings into the next Code cycle or governmental regulations.

As an example, due to the damage cause by the 2010 Chilean Earthquake, multiple research was launched, and the results were evaluated and incorporated in the American Concrete Institute **ACI 318-19 Building Code requirements for Concrete Buildings.**

National Construction Safety Team

- The National Construction Safety Team Act (H.R. 4687), signed into law October 1, 2002, authorizes the National Institute of Standards and Technology (NIST) to establish investigative teams to assess building performance and emergency response and evacuation procedures in the wake of any building failure that has resulted in substantial loss of life or that posed significant potential of substantial loss of life.
- The NCST Act gives NIST the responsibility to dispatch teams of experts, where appropriate and practical, within 48 hours after major building disasters. Under the law, the NIST Director, in consultation with the U.S. Fire Administration and other appropriate federal agencies, maintains a standing advisory committee of as many as 12 persons to advise him or her on carrying out the Act, and to review procedures and reports issued. The panel is known as the National Construction Safety Team (NCST) Advisory Committee.

Notorious Investigations

- Champlain Towers South Collapse (On going \$22 million cost)
- Hurricane Maria
- Joplin Missouri Tornado 2011
- World Trade Center

“Since 1969, NIST has investigated about 40 earthquakes, hurricanes, building and construction failures, tornadoes, and fires—all with the ultimate aim of identifying improvements in codes, standards, practices, and technologies.”

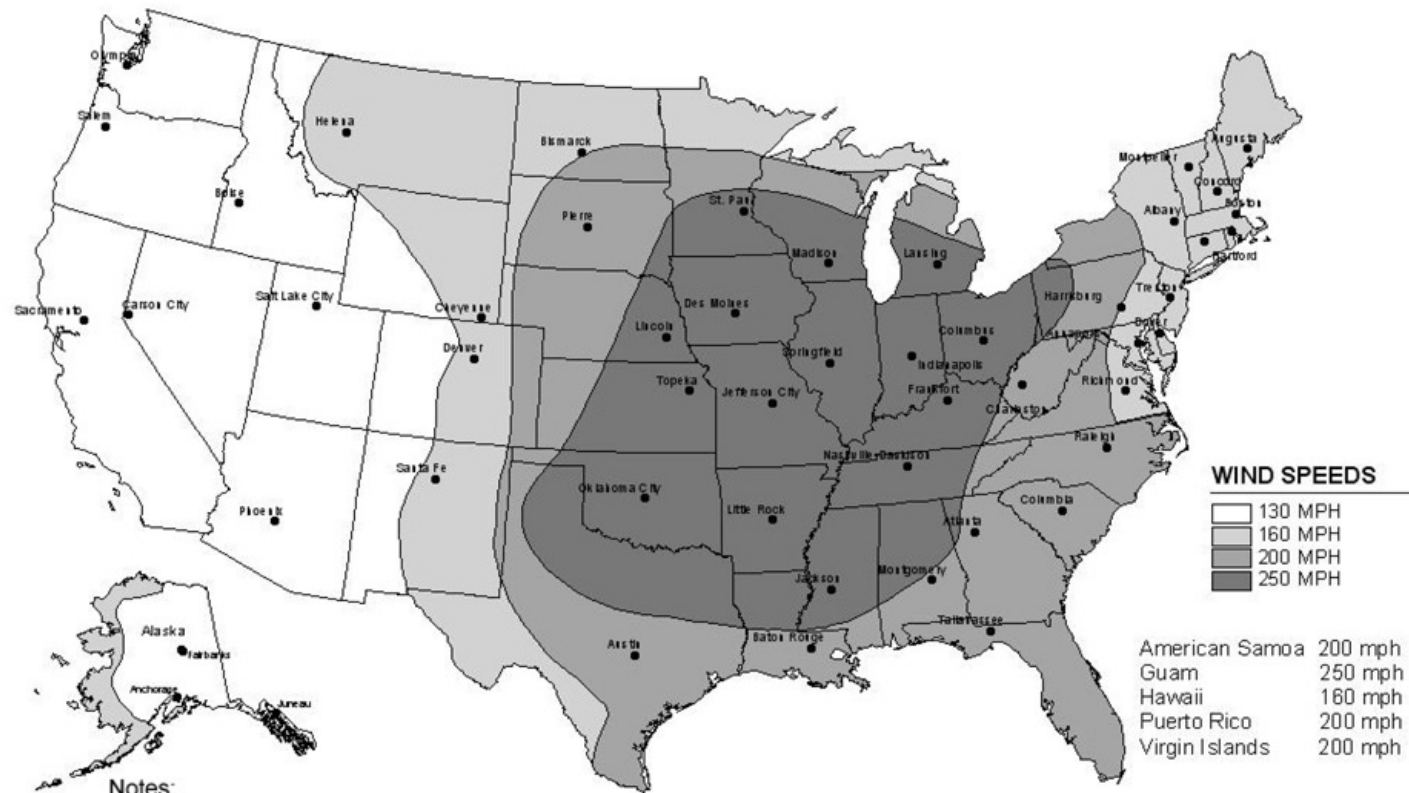
What about the existing
buildings and
infrastructure?

NOTHING!

Tornadoes, anyone?

According to the National Institute of Standards and Technology (NIST), roughly 1,200 tornadoes occur in the US each year! AND they occur in all 50 states, but primarily in the lower 48 and east of the Rocky Mountains. Given that tornadoes kill more people per year in the U.S. than hurricanes and earthquakes combined, ASCE's Structural Engineering Institute revised the ASCE 7 Standard for Minimum Design Loads and Associated Criteria for Buildings and Other Structures in hopes that it will be adopted into the 2024 International Building Code.

Millions of Americans live in tornado prone areas



Notes:

1. Values are nominal three-second gust wind speeds in miles per hour at 33 feet above ground for Exposure Category C.
2. Multiply miles per hour by 0.447 to obtain meters per second.

Millions of Americans live in tornado prone areas

2018 International Existing Building Code (IEBC)

- Require tornado shelters in additions to school bldgs. in 250 mph zone
- Requirements for shelter capacity and travel distance

2018 International Building Code (IBC)

- Require tornado shelters in new buildings at existing schools in 250 mph zone
- Requirements for shelter capacity and travel distance
- Require designated community storm shelters to be Risk Category I

Finally, some action...

- The new ASCE 7 created Chapter 32 to address the calculation of tornado loads. However, it is important to recognize that wind loads still must be calculated following the requirements in Chapter 30. **Chapter 32 is required for Risk Category III and IV buildings only!** This covers **essential facilities** — such as hospitals and emergency response facilities — that need to remain operational in the event of extreme environmental loading. These buildings are required to maintain functionality after a design-level tornado.
- Note that **functionality is not synonymous with a Safe Room or Storm Shelter**, which are intended to provide near absolute protection in extreme wind events. **FEMA developed a separate document for Safe Rooms and Storm Shelters**, which rise well above the level of requirements of ASCE 7-22.

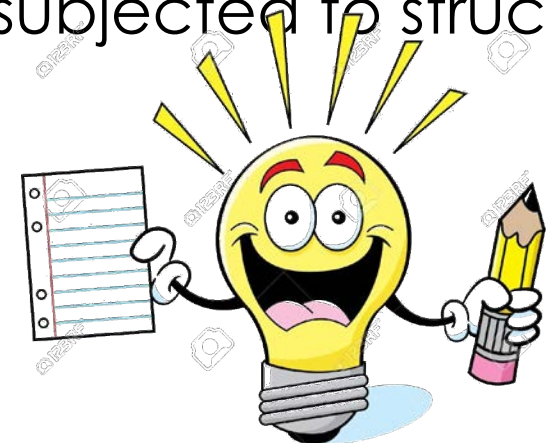
City of Los Angeles

Earthquake Retrofit ACTION!!!



LADBS (Department of Building & Safety) Mandatory Retrofit Programs

- The City of Los Angeles recently passed Ordinance 183893, which requires the retrofit of pre-1978 wood-frame **soft-story buildings and non-ductile concrete buildings**. The goal of the mandatory retrofit programs, under the ordinance, is to reduce these structural deficiencies and improve the performance of these buildings during earthquakes. Without proper strengthening, these vulnerable buildings may be subjected to structural failure during and/or after an earthquake



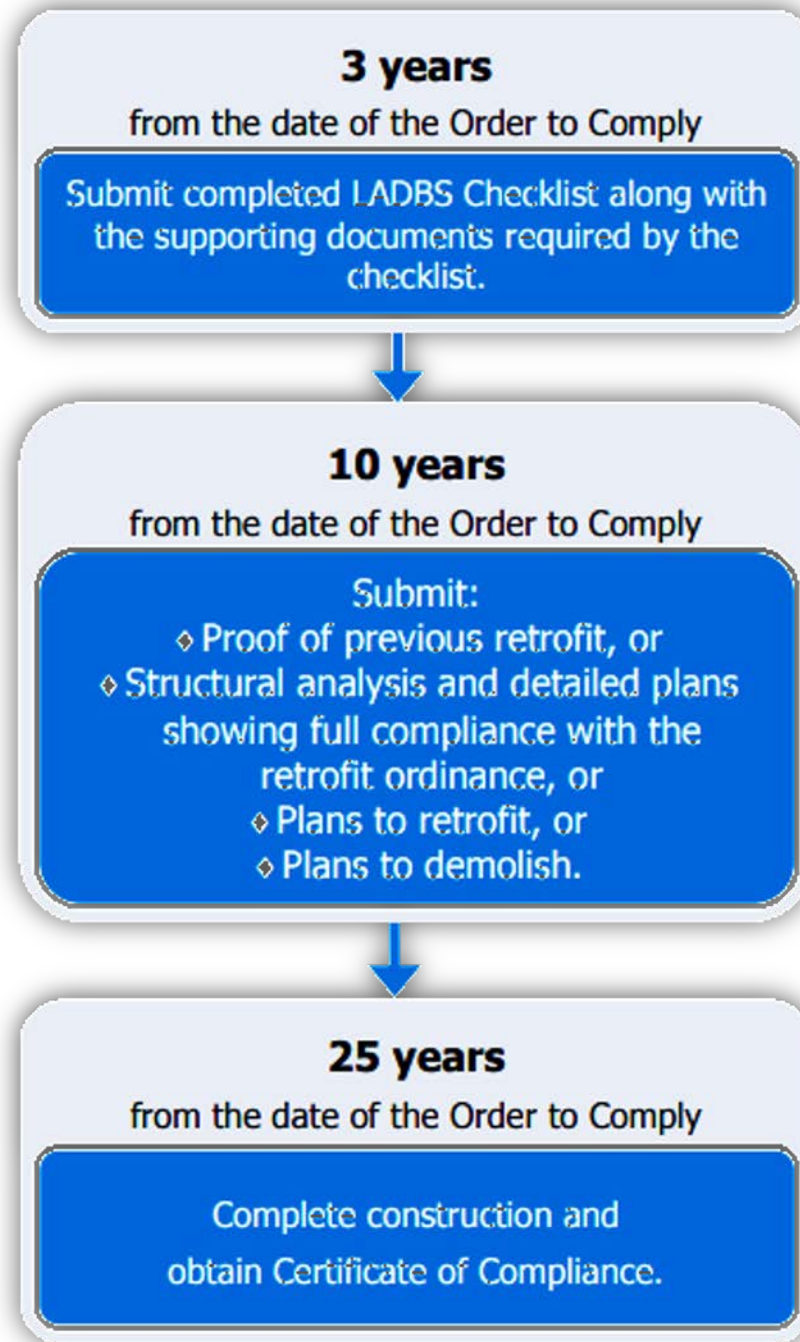
LADBS (Department of Building & Safety) Mandatory Retrofit Programs

The property owner must comply with the ordinance within the following time limits:
From the receipt of the Order to Comply:

- 3 years: Submit completed checklist for review to determine if building is a non-ductile concrete building
- 10 years: Submit proof of previous retrofit, or plans to retrofit or plans to demolish building
- 25 years: Complete construction

LADBS is currently in the process of identifying the concrete buildings subject to the retrofit ordinance.

Any concrete building, as defined in the retrofit ordinance, and built pursuant to a permit application for a new building that was submitted before January 13, 1977 is subject to the retrofit ordinance whether the building has been identified by LADBS or not.



What does retrofit look like?

- The Los Angeles Department of Building and Safety has identified **12,820 soft story buildings** and **1,218 concrete buildings that are in need of retrofit**.
- The retrofit process begins the same for both soft story and non-ductile concrete buildings.
 - Properties either have already received (between May 2016 and November 2017 for soft story) or will soon receive a notice from the city requiring a structural analysis. This must be conducted by a licensed civil or structural engineer or architect.
 - If the analysis indicates that seismic retrofit is required, the building must be structurally altered to meet LA's standards.

It is unlawful for any person, firm, or corporation to maintain, use, or occupy a building that has not completed its retrofit in the time designated.



University of Puerto Rico

Informal housing
construction
INITIATIVE



dificios?

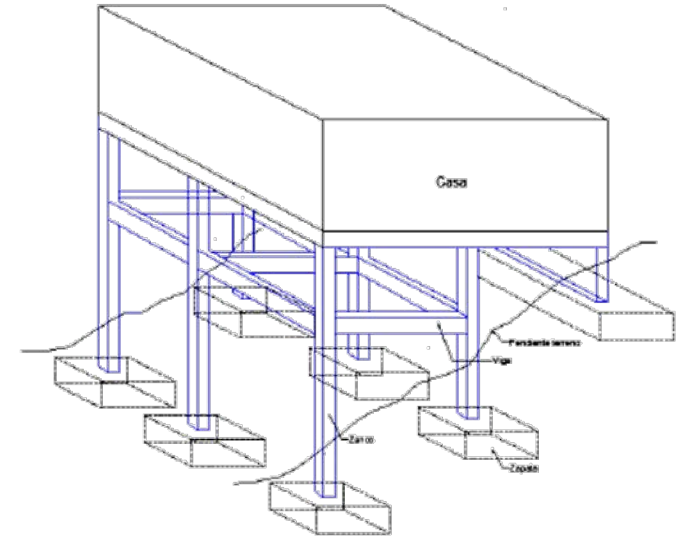
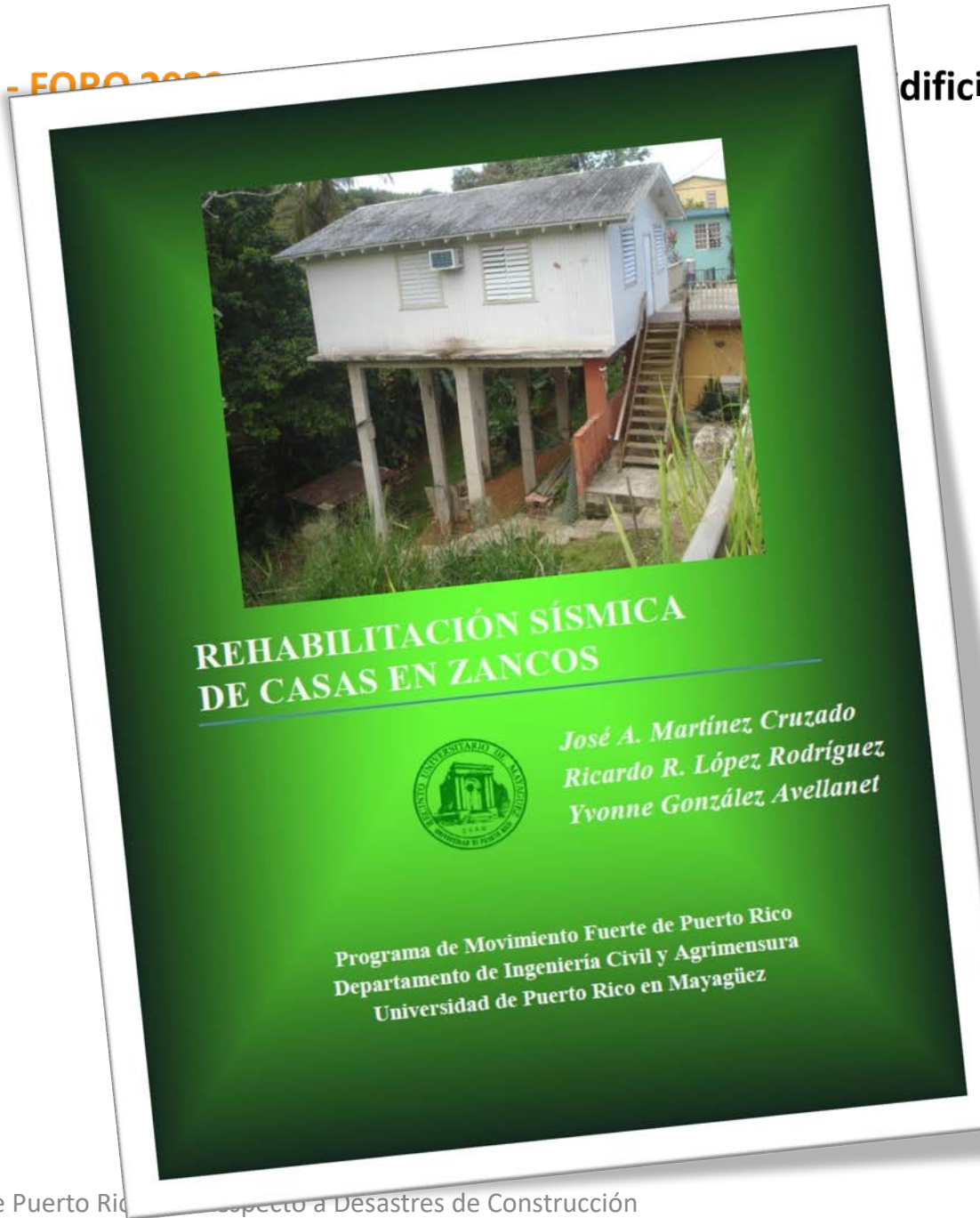


Figura 2. Casa en Zancos en una Jaldá

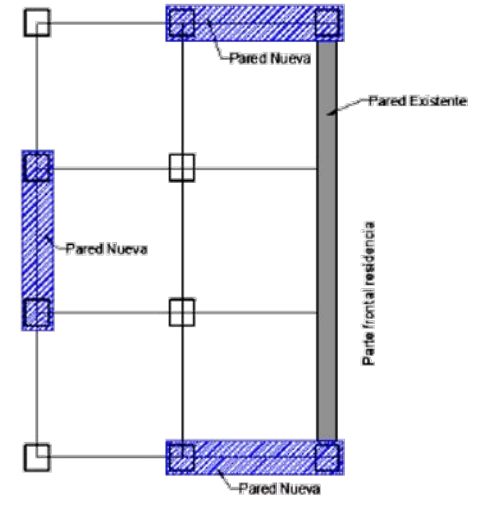


Figura 3. Vista en Planta de Casa en Zancos con Posible Localización de las Paredes Nuevas

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Casas en columnas



Reparación



Conclusions



Therefore,
We
need...

- **Greater commitment to DURABILITY in education, design and construction.**
- **Educate students, practitioners, Banking industry, Insurance Industry and owners on BUILDING RETROFIT AND PRESERVATION.**
- **Educate students, practitioners and government on INFRASTRUCTURE RETROFIT AND MAINTENANCE.**

Achieving RESILIENCE is a call to arms!!!

To achieve **RESILIENCE**, improve our quality of life and strengthen our international competitiveness, we need a strategic and holistic plan from our **architectural and engineering education, practice, owners** to **renew, modernize**, and **invest** in our existing buildings, housing and infrastructure. This plan **should make basic maintenance a centerpiece as we improve our legacy systems.**

Importantly, policymakers must understand **we are only as strong as our weakest link** — if we become homeless, if our essential facilities fail, if our roadways become too rough to travel, if our bridges close to heavier traffic, or if our levees protect one community at the expense of the one next door, our Country and economy grinds to a halt.

We all pay the price.

The road to **PUERTO RICO RESILIENCE**

is uphill,

hard,

and full of obstacles...

Let us be inspired by programs like the City of Los Angeles retrofit initiative....

LET US BEGIN!!!!

Thanks!



¿LES DIJE QUE SOMOS ABUELOS???

